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The Near Future Impact of Smart Mobile Devices on Electronic-Commerce and the Growth of Mobile-Electronic-Commerce

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Abstract

This paper will examine the state of technology supporting electronic commerce, or e-Commerce, in the mobile mode.

Smart device adoption, in particular smart phones and touch-tablet computers, are prolific and will outpace desktops and laptops in the very near future. These devices have fast processors, adequate memory, and various sensors that augment their use, such as a microphone, speaker, camera(s), accelerometer, GPS, WiFi transceiver, and more. These devices will change the way we work and live. They already serve to communicate, control devices in our homes, and entertain. Soon they will help us shop in new ways as well.

Obviously, a mobile device can participate in normal e-Commerce; we contend that this is not in fact mobile electronic commerce, or m-Commerce, because the exact same actions can be done from home or work on a desktop, laptop, or even a server computer. Instead, the mobile parameter will drive new paradigms for sales and marketing, which we will differentiate as m-Commerce, and declare m-Commerce to be a new phase, as delineated by incremental innovation in technological exploiting the opportunity presented by location and context.

m-Commerce will take advantage of the location of the consumer, and use the smart device to persuade and inform the consumer in a contextual manner in order to convert the shopper into a buyer and close the purchase.

Introduction

Telephones have been used in commerce, to sample the population, since the 1950s. But even though mobile phones were introduced to the consumer market in the 1970s, and became popular to the mass market in the 1990s, the United States has been slow to pick up on the trend of mobile phone marketing. Short Messaging Service (SMS) was developed for billing purposes and later turned into a profit center as short text massaging. In 2004, Japan's NTT began selling its "mobile wallets" for contactless payment using cellphones. Mobile devices now stand to upend how we in the United States live, work, and shop. In order to be consistent across all marketing surfaces, companies will need to design campaigns for the mobile consumer. As they do, smart devices will transition m-commerce into the growth life stage. Some parts of the world have a head start (Kotler, Philip, & Keller, 2009).

In Kenya, rather than carrying money around physically, urban migrants send money and pay bills with their cell phones using the M-PESA money transfer service, operated by Safaricom. Used by 9.5 million people, or 23% of the Kenya's population, M-PESA transfers the equivalent of 11% of Kenya's GDP each year. M-PESA has inspired more than 60 similar mobile money schemes across the world in more than 40 countries (The Economist, 2010, 2011). Last year mPedigree launched a mobile service in Ghana and Nigeria for people buying medicine. A scratch-off a panel attached to the packaging reveals a code, which they can look up in a database to see whether the drug is genuine or not. The service is paid for by pharmaceutical companies that want to thwart the counterfeiters. Farmer's Friend in Uganda sends out market prices and other agricultural information in text messages. More than 6 million Nokia phone users in China, India, Indonesia and Nigeria use Ovi Life Tools, a set of information services from weather to sports. Esoko provides two-way communication for people and businesses in 15

African countries, allowing them to upload their own market or other data, which then become accessible via the internet and mobile phones. Dialog Tradenet in Sri Lanka lets farmers check market prices and text in offers. In India, Babajob.com lists low-skilled jobs. KenyaBUZZ in east Africa is selling tickets for cultural and sports events over the phone.

Other services include those that cut out the middleman, such as the Bhoomi project that helps Indians to obtain a loan or make cash transactions with "branchless microbanking systems" using the internet and mobile phones, and this disintermediation is made possible by mobile money. Other firms are extending the reach of mobile money. For example, software developed by French start-up Tagattitude, uses a handset's sound channel to transmit money, such as direct disbursements of welfare payments and pensions.

But m-Commerce can also be used to perform work. Txteagle, whose many "crowd sourced" users perform small jobs on a mobile phone, the sum of which complete job, such as translating words into a local dialect, and checking street signs for a satellite-navigation service. If mobile services such as these grow, they could transform lives and livelihoods, by allowing the world's poor to become digital producers and innovators. All the need is a smart device (The Economist, 2011).

Supporting Technologies

While there are many smart device manufacturers, there are few salient operating system (OS) vendors. The OS is a significant consideration because it is responsible for the operation, and look and feel, of the device. Google Android is now the No.1 mobile OS in the world, and shipments of Android phones rose by more than 600% from 2009 to 2010 (Reed, Brad, 2011).

The present OS choices are: Google Android, Nokia Symbian, Apple iOS (iPhone), RIM

Blackberry OS, Microsoft Windows Mobile, and soon Microsoft Windows 8. All of these OSs are proprietary, and available on a variety of smart devices. These devices are beginning to replace the laptop as a more portable, lightweight, and easy to use device (Laberis, Bill, 2011). The two most popular cell carrier technologies are Code Division Multiple Access (CDMA) and Global System for Mobile Communications (GSM). CDMA is a proprietary design by Qualcomm, and Evolution-Data Optimized or Evolution-Data only (EV-DO) is simply an extension of CDMA. CDMA is used by Verizon Wireless and Sprint. GSM is the world's most popular standard for mobile telephone systems and supports simultaneous multichannel communications (talk and browse at the same time). GSM is used by AT&T and T-Mobile.

The technological capabilities offered are referred to as generation. According to the FCC (http://www.fcc.gov/), 1G, or first generation (G), wireless was an analog voice format. 2G introduced the digital voice format and also allowed the use of short messaging service (SMS), otherwise known as text messaging. 3G, introduced in 2003, has the capability to support circuit and packet data at varying rates: 144 Kbps for high mobility traffic, 384 Kbps for pedestrian traffic, and 2 Mbps for stationary traffic. Please refer to Table 1 for an overview of 3G technology.

Table 1. An overview of 3G from http://en.wikipedia.org/wiki/3G

Overview of 3G/IMT-2000 standards[4]

ITU IMT-2000	common name(s)		bandwidth of data	pre-4G	duplex	channel	description	geographical areas
TDMA Single-Carrier (IMT-SC)	EDGE (UWC-136)		EDGE Evolution	*none*	FDD	TDMA	evolutionary upgrade to GSM/GPRS[nb 1]	worldwide, except Japan and South Korea
CDMA Multi-Carrier (IMT-MC)	CDMA2000		EV-DO	UMB [nb 2]		CDMA	evolutionary upgrade to cdmaOne (IS-95)	Americas, Asia, some others
CDMA Direct Spread (IMT-DS)	UMTS[nb 3]	W-CDMA[nb 4]	HSPA	LTE			family of revolutionary standards.	worldwide
CDMA TDD (IMT-TC)		TD-CDMA[nb 5]			TDD			Europe
		TD-SCDMA[nb 6]						China
FDMA/TDMA (IMT-FT)	DECT		*none*			FDMA/TDMA	short-range; standard for cordless phones	Europe, USA
IP-OFDMA			WiMAX (IEEE 802.16)			OFDMA		worldwide

4G is an all internet protocol (ip) packet switched network that supports mobile broadband and download speeds of more than 100Mbps. However, for cellular carriers, 4G is a myth, and won't be available any time in the near future (Goldman, David, 2010). Please refer to Table 2 for an overview of 3G technology.

Table 2. An overview of 4G from http://en.wikipedia.org/wiki/4G

Comparison of Mobile Internet Access methods (This box: view · talk · edit)

Standard	Family	Primary Use	Radio Tech	Downlink (Mbit/s)	Uplink (Mbit/s)	Notes
WiMAX	802.16	Mobile Internet	MIMO-SOFDMA	128 (in 20MHz bandwidth)	56 (in 20MHz bandwidth)	WiMAX update IEEE 802.16m expected to offer peak rates of at least 1 Gbit/s fixed speeds and 100Mbit/s to mobile users.
LTE	UMTS/4GSM	General 4G	OFDMA/MIMO/SC-FDMA	100 (in 20MHz bandwidth)	50 (in 20 MHz bandwidth)	LTE-Advanced update expected to offer peak rates up to 1 Gbit/s fixed speeds and 100 Mb/s to mobile users.
Flash-OFDM	Flash-OFDM	Mobile Internet mobility up to 200mph (350km/h)	Flash-OFDM	5.3 10.6 15.9	1.8 3.6 5.4	Mobile range 30km (18 miles) extended range 55 km (34 miles)
HIPERMAN	HIPERMAN	Mobile Internet	OFDM	56.9		
Wi-Fi	802.11 (11n)	Mobile Internet	OFDM/MIMO	300 (using 4x4 configuration in 20MHz bandwidth) or 600 (using 4x4 configuration in 40MHz bandwidth)		Antenna, RF front end enhancements and minor protocol timer tweaks have helped deploy long range P2P networks compromising on radial coverage, throughput and/or spectra efficiency (310km & 382km)
iBurst	802.20	Mobile Internet	HC-SDMA/TDD/MIMO	95	36	Cell Radius: 3–12 km Speed: 250km/h Spectral Efficiency: 13 bits/s/Hz/cell Spectrum Reuse Factor: "1"
EDGE Evolution	GSM	Mobile Internet	TDMA/FDD	1.6	0.5	3GPP Release 7
UMTS W-CDMA HSDPA+HSUPA HSPA+	UMTS/3GSM	General 3G	CDMA/FDD CDMA/FDD/MIMO	0.384 14.4 56	0.384 5.76 22	HSDPA widely deployed. Typical downlink rates today 2 Mbit/s, ~200 kbit/s uplink; HSPA+ downlink up to 56 Mbit/s.
UMTS-TDD	UMTS/3GSM	Mobile Internet	CDMA/TDD	16		Reported speeds according to IPWireless using 16QAM modulation similar to HSDPA+HSUPA
1xRTT	CDMA2000	Mobile phone	CDMA	0.144		Succeeded by EV-DO for data use, but still is used for voice and as a failover for EV-DO
EV-DO 1x Rev. 0 EV-DO 1x Rev.A EV-DO Rev.B	CDMA2000	Mobile Internet	CDMA/FDD	2.45 3.1 4.9xN	0.15 1.8 1.8xN	Rev B note: N is the number of 1.25 MHz chunks of spectrum used. EV-DO is not designed for voice, and requires a fallback to 1xRTT when a voice call is placed or received.

According to http://www.3gpp.org/, the cellular version of "4G" is really 3rd Generation Partnership Project (3GPP) and part of the Long Term Evolution (LTE) for mobile communications, and is capable of download speeds of 12 Mbps. True 4G is called WiMax (IEEE 802.16) and is similar to WiFi (IEEE 802.11). While WiFi is supported by most smart devices, WiMax is not yet supported. Popular cell phone network carriers include Verizon Wireless, Sprint, AT&T, and T-Mobile. WiMax is currently offered by: Antelecom, Carrier Services Groupholds, Clearwire (Clear), Towerstream, Promix, Rainbow Broadband, River

Canyon Wireless, Sprint, Xanadoo. Alvarian, Sprint, and Clearwire are the industry leaders circa 2011, and Clearwire has the advantage of the frequency spectrum it purchased from Worldcom.

Applications written specifically for the given OS will play a crucial role in the success of that OS, and in the future of m-Commerce, by providing a means and an enticement for participants. Special customer facing technology may be used to augment m-Commerce, such as the femtocell. A femtocell is a small cellular base station that connects to a broadband network. Femtocells could be used at strategic locations, such as store fronts, to retrieve data from and push data to smart devices. Major femtocell manufacturers include: Airvana, Alcatel-Lucent, ip.access, Motorola, Tatara, and Ubiquisys. Additional capabilities could be integrated with the femtocell for m-Commerce purposes, such as the addition of WiFi, bluetooth, and infrared ports. Transceivers such as this could be anywhere convenient to serve customers.

Current industry leaders Dell and Hewlett-Packard will still be relevant for the needed server hardware. Likewise, business intelligence will be needed on the back end to take incoming customer data, process it, and respond with the appropriate actions.

Factors Affecting m-Commerce

According to Stanford University professor Neil Daswani, m-Commerce is e-Commerce with mobile devices (PDAs, Cell Phones, Pagers, etc.) with additional challenges concerning security, usability, heterogeneous technologies, and business model issues (Daswani, Neil, 2001). Some factors affecting m-Commerce depend literally on where in the world it is performed. Signal coverage is one concern, although much of the world is covered by at least one terrestrial carrier. The problem areas, according to http://www.coveragemaps.com are in: western South America, northern and mid Africa, desert parts of the UAE, the Asia interior,

Indonesia and Papua New Guinea, the Australian interior, and unsurprisingly in the polar regions. Most of the world's population has coverage at home or in nearby metropolitan areas. The quality of coverage also matters, because it is instrumental in the user experience.

The quality and performance of the available devices is also an important factor in the success of m-commerce, however, the importance of look and feel decisions cannot be underestimated. Data plan limitations due to cost, or data transfer caps, also have an effect on the use of m-Commerce. A related topic is Net neutrality. Net neutrality says that the internet should be open and free of interference, and that internet service providers should not penalize competing services (Wu, 2008). The FCC (http://www.fcc.gov/) supports this position.

Another concern is political unrest, which can stifle any initiative. Government regulations, bureaucracy, and taxation are also obstacles. Similarly, in many African countries, providers of new mobile services cannot deal with network operators directly. Instead they must use intermediaries to get a short code for customers to dial first. (The Economist, 2011) Like regular e-Commerce, m-Commerce may come under scrutiny for state sales tax (Wall Street Journal, 2011), and the very nature of mobility will further complicate the issue.

Corruption is another concern. Governmental and other intermediaries can extract fees for approval and other forms of extortion for example. It is well known that India has an overabundance of this vexing problem, but it is safe to say that corruption exists in many parts of the developing world. These feckless activities block progress and are difficult at best to change.

Privacy and security are also important factors. Even with Opt-in/Op-out and Application Control, privacy cannot be guaranteed. There will always be a "Yield Manager" to collect too much personal data. Smart devices are uniquely qualified in one nefarious regard, the 'big brother in your pocket' complete with GPS, microphone, camera, and affinity (something you want with

you), makes this device the ultimate bugging/tracking device. This brings us to security. Most smart device users do not realize that they are vulnerability. For example, Google has recently come under fire for relying too heavily on user feedback and not pre-checking Android apps, and as a result, more than 150 malicious apps were downloaded to over 260,000 smart phones. Devices were infected with malware, and one malware in particular was able to compromise a significant amount of personal data on a user's phone and send it to remote servers (SecurityWeek, 2011). Smart devices are vulnerable to the same threats as any other computer, such as malware, clickjacking and social engineering, but they have a few more of their own, such as location and user tracking, local wireless threats, and bluesnarfing. Smart devices are easily lost or stolen, and business users in particular would be well advised to use on-device data encryption and support data-fading. Data-fading is the capability for an IT administrator to automatically lock, wipe, or reset a device that hasn't communicated with the management server after a predetermined amount of time (Oliver, Mike, 2010). Smart devices represent the most convenient use of technology to date, as well as the greatest electronic threat to date.

Another factor affecting m-Commerce could be called e-Government. In addition to web sites, applications, key services, and secure mobile payments for services (Proudfit, Elizabeth, 2011), and performing the duties of government while out of the office, the equivalent extension of m-Commerce to m-Government could provide needed assistance, real-time data during emergencies, and even a new easy and verifiable way to vote, and real time data for government use. This could also lead to more transparency in government.

Government also has a participative role in enabling, or restricting, e-Commerce and therefore m-Commerce. For example, in the United States, the federal government has acted to prohibit the burden of Internet-specific taxes (Internet Tax Freedom Act of 1998), copyright

infringement (Digital Millennium Copyright Act), and protect individual privacy (U.S. Gramm-Leach-Bliley Act of 1999; U.S. Children Online Privacy Protection Act of 1998; European Community Directive on Data Protection), and support net neutrality.

m-Commerce Attributes

One important concept of m-Commerce is mobile currency. Adding choices to the way purchases may be made should enhance sales. Smart devices will be able to use credit card and cash accounts, forms of mobile money, and execute transactions easily (The Economist, 2011). Starbucks recently said it will expand their mobile payment program to more than 6,800 company-owned stores (Henschen, Doug, 2011). For the vendor, the ability to read and process credit cards for mobile transactions using the smart device, for example selling goods at a fair or craft show, requires only software and a credit card reading dongle that connects to the audio jack. Such systems are available from squareup.com and intuit.com, and cost less than 3% for swiped transactions.

m-Commerce provides unparalleled convenience with the ability to access data and shop anywhere, any time. Worldwide mobile ad spending was estimated at $871 million in 2006, most of which went into text messages. New dual-mode phones and smart devices blend cell phones with wireless Internet service. The mobile nature of smart devices and marketers' ability to personalize messages based on demographics will soon converge (Kotler & Keller, 2009). Group Casino, a French grocery and convenience chain, allows customers use their smart phones to shop, call up their purchase histories, browse available products, and create new shopping lists. The service works from the company's e-commerce site and uses store-supplied handheld scanners (Henschen, Doug, 2011).

Another important technological leap that will drive m-Commerce, is Mobile Augmented Reality (AR), "Mobile AR," refers to the concept of overlaying media (graphics, pictures, video, and sounds) from the world around you onto a smart device. Point your smart device in one direction, and you see a video about an event happening down the street or right around the corner. Aim it at the museum, and learn about the exhibit featured that day. Point at a passersby, and see their social media status (Bogdanowicz, Anna, 2011).

m-Commerce Growth

We envision a near future system making use of all of these technologies to create an augmented shopping experience. For example, the "ShoppingList" concept where items to be bought are entered in a list, generated automatically by other smart devices, or entered manually by speech, photographing bar codes, typing, etc, and an application will provide directions, give suggestions, comparison shop, point to the store if nearby, provide special sales notification, and provide other marketing information on an opt in basis, selectable in real time. Mobile currency would be used to make the purchase, and coupons automatically applied. Wifi connectivity would provide customer identification, by the smart device and a personal "WiFi Tag", to the vendor, allowing the vendor to be aware of that particular customer for service of pickup or customized selling. The WiFi tag would identify the customer by their device, perhaps by the phone number, and target ads to them. Opt-in would be assumed by allowing the number to be given by the phone, or the presence of the WiFi Tag. Similar to the Group Casino system, but customer centric rather than vendor centric, the customers could use their smart device to shop, call up their purchase histories, browse available products, and create new shopping lists, using camera to read bar codes. In this case, reading the bar code would not only identify a product and

display current information, it would allow spot comparison shopping and even confirmation that the item is in fact needed. Quick Response bar codes are dedicated to this purpose.

Another example of an augmented shopping experience is the ability to use the smart device, and the location based on GPS and WiFi assisted location determination, to search for a nearby restaurant based on context and criteria. The diner could then click the phone to pay the bill for the meal. Another example is the ability to interact with "aware," or telematic, vending machines. Telematics places wireless internet connected computers inside other devices (Kotler & Keller, 2009).

By being clever and using data collected by other systems and stored as cookies, a plethora of marketing data can be harvested. Yahoo uses Yield Manager, "an open ad management platform where campaigns bid for ad space based upon website visitors' predicted responses**."** See http://rightmedia.com for additional details. By implementing Facebook 'like tracking' (note that when a user visits a webpage with the "Facebook Like" function, Facebook collects data on that user's visit whether they Like it, by clicking Like, or not), an enormous dataset for any user can be built.

But, the smart device will play an even bigger role as more attributes are added. The addition of a projector will allow for larger screen activity, the use of a virtual keyboard, and the display of projected images. While the first two are enablers, the third could be part of an m-Commerce solution application. Imagine contact lenses that are wirelessly connected to the smart device, that act as an overlay screen to augment real vision. With the advent of transparent electronics and atomic scale circuitry, this is not exactly science fiction.

Conclusion

Smart devices, enabled by m-Commerce, will continue to have a dramatic affect on how we live. Already ubiquitous, smart devices will continue to create new m-Commerce opportunities well into the future, and may become the dominant force, and an indispensable tool, in e-Commerce, and m-Commerce will grow to be the dominant form of e-Commerce.

References

Bogdanowicz, Anna (2011). *Augmenting Your Reality* [Electronic Version]. (2011, March 07). IEEE. http://www.theinstitute.ieee.org

The Economist (2011). *Not just talk* [Electronic Version]. (2011, January 27). The Economist. http://www.economist.com/node/18008202/print

The Economist (2010). *Out of thin air* [Electronic Version]. (2010, June 10). The Economist. http://www.economist.com/node/16319635/print

Daswani, Neil (2001). *Introduction to M-Commerce* [Electronic Version]. (2001, November 14-15). Stanford University. infolab.stanford.edu/~daswani/papers/IntrotoM-Commerce.ppt

Goldman, David (2010). *4G is a myth (and a confusing mess).* (2010, December 1). Money. http://money.cnn.com/2010/12/01/technology/4g_myth/index.htm#

Henschen, Doug (2011). *Mobilizing Enterprise Apps: The Next Big Leap* [Electronic Version]. (2011, February 12). InformationWeek. http://www.informationweek.com/shared/printableArticleSrc.jhtml

Kotler, Philip, & Keller, Kevin (2009). *Marketing Management* (13th Ed.). Upper Saddle River, New Jersey: Prentice Hall.

Laberis, Bill (2011). *Adopting Tablets in the Enterprise*. Retrieved February 26, 2011, from http://w.on24.com/r.htm?e=264685&s=1&k=8506A115D457C2069E87ED6470C85983

Oliver, Mike (2010). *Mobility Management For Dummies* [Electronic Version]. West Sussex, England: Sybase & John Wiley.

Proudfit, Elizabeth (2011). *eGovernment Mobile Applications*. Retrieved February 27, 2011, from http://www.nicusa.com/Solutions/Innovative/Pages/MobileGov.aspx

Reed, Brad (2011). *Android topples Symbian as world's No. 1 mobile OS***. (**January 31, 2011) Network World. http://www.networkworld.com/news/2011/013111-android-mobile-os.html

Schneider, Gary (2011). *Electronic Commerce* (9th Ed.). Boston, Massachusetts: Cengage.

SecurityWeek News (2011) *Multiple Variants of Android Virus 'Hong Tou Tou' Surface in China* [Electronic Version]. (2011, February 22). SecurityWeek. http://www.securityweek.com/multiple-variants-android-virus-hong-tou-tou-surface-china

The Wall Street Journal (2011). *E-Commerce Surge May Hit Tax Revenue*. [Electronic Version]. (2011, February 17). The Wall Street Journal. http://blogs.wsj.com/economics/2011/02/17/e-commerce-surge-hits-state-local-tax-revenue.

Wu, Tim (2008). *The Installation and Use of Filtering Software on Public Networks Contradicts U.S. Policy.* (2008, December, 15), Columbia University: FCC Testimony Draft. http://www.fcc.gov/broadband_network_management/022508/wu.pdf