Issues in Wireless E-Commerce

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Mobile and wireless technologies continue to advance in terms of their capabilities and sophistication. There has been increasing emphasis on using these technologies as part of electronic commerce systems. But with this shift from wired to wireless e-commerce (also known as m-commerce) comes a new set of issues that needs to be evaluated. This paper explores some of the relevant technologies, applications, and issues in wireless e-commerce.

Additional Key Words and Phrases: Wireless E-commerce, m-commerce, WAP, WML

1. INTRODUCTION

Electronic commerce continues to have a profound impact on the global business environment. Recently, technologies have focused more on *mobile* computing and the *wireless* Web in addition to the traditional wired Web. With this change comes a new set of issues specifically related to wireless e-commerce (or mobile commerce). This paper summarizes some of the relevant technologies, applications, and issues in this field.

There are two visions for wireless computing [Waters 2000]. One says that the wireless Internet is something completely new and different. Mobile devices, by their nature, are more personalized and most aptly suited for bandwidth-limited applications such as text email and requesting stock quotes. Many organizations seem to be adopting this vision. We see a proliferation of text-only applications with limited communication and interaction capabilities. These applications are usually provided through specific service-providers, or through special servers that are not part of an organization's traditional (wired) Web presence. Another vision says

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that mobile devices are just another point of access to the existing WWW. Wireless technologies simply present an alternative way to interact with a traditional Web site, albeit in a different format or on a more limited basis.

2. TECHNOLOGIES

Wireless technologies can be roughly categorized into presentation devices and communications infrastructure. The devices currently most important to wireless e-commerce are phones, palm computers, laptops, and vehicle-mounted interfaces. Information viewing can be personalized for the user through many wireless devices. This is important because many users will want a consistent and familiar environment when going from one device to another. However, one issue that arises with personalization is whether or not organizations will want to control personalization, or at least want to limit it when their own content is involved.

Usability will become more critical with handheld and phone devices, which differ from PCs and laptops in terms of screen size and interfaces. Many hand-held devices have screens limited to a few lines of text, and do not have traditional keyboards. Organizations will need to determine how people can best use applications and access information through different devices. There is also the need to investigate how the current principals of interface design (e.g., [Shneiderman 1998]) can (or cannot) be transferred to newer devices.

The communications infrastructure necessary for the wireless environment complicates matters further. Wireless devices will always be at a disadvantage over their wired counterparts in terms of bandwidth. Limited bandwidth requires organizations to rethink how users interact through a wireless device with the information system at the other end. Developers are forced to create efficient applications that can realistically work with current technology. But developers may also be thinking more about users' needs in the process.

Wireless devices have also forced developers to revisit the software side of technology. Stripped-down operating systems such as Symbian's EPOC and Microsoft's Pocket PC have been created for phone and palm devices, respectively. Developers now work with Wireless Application Protocol (WAP) and Wireless Markup Language (WML) in addition to TCP/IP and HTML. Organizations are transcoding (converting the content of) their current Web sites to make them useable with wireless devices. Special mobile Web browsers (such as Pocket Internet Explorer) have been created. One significant issue here is how to store data so that it readily useable and accessible by multiple devices and applications. Extensible Markup Language (XML), which tags data and puts content into context, may be a solution to this problem. See [Manes 2000] for more details on these concepts.

Wireless communications standards continue to evolve. Bluetooth is an inexpensive short-range wireless standard that allows different devices to communicate with each other. With Bluetooth, a user might access a mobile phone, located in a briefcase across the room, using a headset for hands-free calling or a laptop computer for Web browsing. IEEE 802.11 is an established wireless standard. It is commonly used with laptops or personal computers to establish wireless local area networks. General Packet Radio Service (GPRS) is a continuous packet data service. Using this technology, network connections are "always-on", and mobile users do not have to dial into the Internet each time they need to access an application

(e.g., check email).

When moving from location to location and from device to device, seamless transfer will be necessary. Research with mobile software agents show that they can be used to facilitate the movement of users from one device to another (for example, see [Kotz et al. 1997]). The next big step for wireless communication will be third-generation (3G), which promises higher bandwidth, constant connectivity, and seamless global coverage. Europe and Asia, however, will probably benefit from 3G wireless before the United States does [Redman 2000].

Given the limitations of wireless devices over their wired counterparts, different payment models will need to be considered for mobile e-commerce application and data access [Molony 1999]. How will organizations charge for, or pay for, connections between their information systems and wireless devices? The advertising-based Web model may not work for the wireless Web due to small screen sizes with limited graphics capabilities. Basic monthly subscription models (like basic phone access, cable TV, and other services) may provide a simple solution, infrastructure firms may charge for usage, or a combination (subscription plus pay-per-use for premium services or higher bandwidth) may be the approach widely adopted. Currently, most users are charged for wireless access by the minute. But other approaches, such as email advertising or packet-based models, may prevail.

And how will users and organizations ensure that their wireless communications are not intercepted? Frequency hopping can make it more difficult to listen in on a data communication. Encryption technologies can also help ensure that even intercepted transmissions cannot be read easily, but will need to be made more efficient and more foolproof. Viruses are thought to be even more of an impending threat with wireless devices than their current threat to physical networks [Mullins 2000]. In fact, we have already seen the first large scale virus attacks on wireless phones. What makes this even scarier is that hackers could use stolen wireless devices to create and disseminate a virus. The equipment could then be physically destroyed, making it almost impossible to trace the origin of the virus or to identify its creator. The increased use of wireless devices for e-commerce makes the need for identity verification even more important yet more difficult to ensure, so with this the importance of biometrics continues to grow. Future wireless devices may include a thumbprint ID device.

Global positioning systems (GPS) will also play a large part in wireless e-commerce [Thibodeau 2000]. The President recently ordered the military to stop scrambling GPS satellite signals. This will allow for determination of user locations to within 10 feet. But there are privacy issues that must be addressed with this technology, such as who should have control over the data about our location at any given time.

3. APPLICATIONS

Some of the applications of wireless technologies to e-commerce activities that have started to appear across the globe are summarized here (see [Schwartz 2000] for even more examples). Many are currently constrained by the technology limitations and issues described above. Ultimately, researchers and developers must figure out what users really want to do anytime from anywhere, and determine how to make those tasks readily available and easily accessible.

Day-to-day activities have begun to appear as wireless applications. Many devices

and services allow access to email. Scandinavian Airlines and American Airlines are offering reservation services over the wireless Web, allowing schedule checking and flight changes. Services such Fidelity's InstantBroker allow wireless stock trading. Combining GPS with wireless devices allows out-of-town travelers to find a restaurant, make a reservation, and receive directions to its location. Wireless entertainment is also surfacing, with multi-player games that can be played from a phone or handheld device. Undergroundfilm.com (www.undergroundfilm.com) has even made short film clips available for wireless devices.

Shoppers are poised to benefit a great deal from wireless e-commerce. The first way they will do so is through easier product and price comparison. Applications such as E-compare (www.ecompare.com) will allow users to check the prices of a product at other locations through their mobile device while shopping in a brick-and-mortar store. BarPoint.com (www.barpoint.com) promises consumers the ability to actually scan in a bar code of an item for real-time product information and pricing.

E-commerce payment systems can also benefit a great deal from wireless technology. Imagine a scenario where a consumer does not have to stand in line to purchase a product, but simply has to pay for the item though a wireless device. Final payments can be made through a charge card, e-cash, or even billed to a telephone company or Internet service provider. Wal-mart is testing new wireless broadcaster UPC labels that will tell the Point of Sale terminal which items are in a cart during checkout without removing each item for optical scanning.

Even before most cell-phones become web-enabled and have screen displays, they can be used for e-commerce. With services like those from TellMe (www.tellme.com) and Quack (www.quack.com), anyone can make a free call and use simple voice commands to get information about restaurants, sports, movies, lotteries, traffic, weather, taxis, airlines, stock quotes, or horoscopes. This voice interface to the web makes valuable e-commerce information available to anyone from anywhere using wireless technology, even if they have no computer and no ISP!

Wireless technology is perfectly suited for bringing e-commerce to automobiles and other forms of transportation [Wilcox 2000]. Telematics such as the OnStar system (www.onstar.com) put distressed travelers in immediate contact with assistance and direct hungry travelers to the nearest appropriate restaurant. Traffic advisory systems can guide a driver to his or her destination or warn of impending traffic jams. An application developed in Great Britain helps drivers find an empty parking space. Newer car-mounted devices will eventually allow regular Internet access, although safety issues of "driving while browsing" must be addressed.

Without GPS, similar e-commerce applications may become possible. One proposed technology for bringing Enhanced 911 (or "E-911") service to cell phone users will use triangulation from surrounding towers to identify the location of the individual using a wireless phone or web device. This can not only direct emergency personnel to the scene, but could be used for e-commerce applications such as directions to services and merchants, pizza delivery, and appropriate traffic information.

Wireless technologies and e-commerce also facilitate the redesign of other organizational activities. Companies that use a just-in-time (JIT) manufacturing approach can track inventory through wireless transmitters and can also track the location of vehicles bringing materials to be processed. The medical indus-

try has begun to benefit from e-commerce through physician use of wireless prescription pads that feed orders directly into a pharmacy's information system (see www.pocketscript.com for an example). Vending machines can be wirelessly networked, and can automatically call for more supplies or maintenance. Sales people can go literally anywhere in the field and access product information and customer accounts. Students can become part of a virtual campus and maintain complete connectivity and interactivity with classroom activities and school resources.

4. FINAL THOUGHTS

The managerial and technical issues discussed in this paper must be addressed further by researchers and developers in order for wireless e-commerce to succeed. Organizations must also stay focused on the fact that wireless technology is simply an enabler, and that the real emphasis must be on people and processes to ensure the greatest effectiveness for all stakeholders. Wireless technology will provide the ability to communicate and interact over the Internet anytime from anywhere, but will always be limited in terms of screen size, interactivity, and communication speed relative to physically connected devices. Flexibility of information systems is needed to support the fast-paced dynamic global environment that we live in. Using wireless computing as an extension of the wired Internet will probably best meet the long-term needs of an organization, given the inherent flexibility that such an environment could provide.

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