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# WIRELESS/MOBILE E-COMMERCE: TECHNOLOGIES, APPLICATIONS, AND ISSUES

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## Abstract

*Many technologies and applications have appeared recently which are directed at mobile computing and the wireless Web. Wireless (or mobile) e-commerce is concerned with conducting transactions and other business activity with these new technologies and applications. This research looks at some of the relevant technologies, applications, and issues in wireless e-commerce.*

## Introduction

While electronic commerce (e-commerce) continues to have a profound impact on the global business environment, technologies and applications have begun to focus more on mobile computing and the wireless Web. With this trend comes a new set of issues and problems specifically related to *wireless* e-commerce. Ultimately, researchers and developers must determine what tasks users really want to perform anytime from anywhere and decide how to ensure that information and functionality to support those tasks are readily available and easily accessible. This paper provides an overview of some of the relevant technologies, applications, and issues in the relatively new field of wireless e-commerce.

Wireless e-commerce (also called mobile commerce or m-commerce) is the promotion, buying, and selling of goods and services through electronic data communication networks that interface with wireless (or mobile) devices. Wireless e-commerce is a subset of wireless computing, which is the accessing of information systems by wireless means. Many of the issues that affect wireless computing in general also affect wireless e-commerce.

Mobile e-commerce also includes the use of devices such as handheld and laptop computers that interface with computing resources through wired synchronization. We do not consider this wired form of mobile e-commerce in this paper principally because it is likely to be replaced by wireless devices in the future. Our focus here is on the wireless forms of mobile commerce.

## Technologies

Wireless technologies for mobile commerce can be roughly categorized into mobile client devices for interactivity (or m-commerce terminals) and communications infrastructure.

### *Mobile Client Device Technologies and Issues*

The interactivity devices or mobile client devices currently most important to wireless e-commerce are mobile telephones, handheld computers, laptop computers, and vehicle-mounted interfaces. Hybrid devices are now appearing, such as the crosses between mobile phones and handheld devices (sometimes called smartphones), but the question remains as to what form the devices will ultimately take, which is an important issue for mobile system developers.

Usability will become more critical with handheld and phone devices, which differ from desktop and laptop computers in terms of their smaller screen sizes, less available memory, and limited input devices. Many handheld devices are limited to a few lines of text, and do not have traditional keyboards. One usability issue is the need for organizations to determine how people can best use applications and access information through different devices.

Wireless devices have forced developers to carefully revisit both operating systems and applications software on a variety of platforms. Operating systems such as Microsoft's Pocket PC and Palm's PalmOS have been developed for handheld devices. Although this software meets some of the current needs, it has limited functionality. The creation of system software with increased functionality for devices with limited capabilities will be an ongoing challenge.

Another important building block for this emerging infrastructure landscape may be the Wireless Application Protocol (WAP), which enables wireless devices such as mobile phones to access the Internet. Many WAP-enabled devices have already appeared, although there is doubt as to whether WAP will become a globally accepted standard, especially with the popularity of Japan's i-mode. Developers ultimately face the issue of deciding which set of protocols to accept, or risk the potential problems of working with multiple standards and/or choosing to ignore some.

### ***Communications Infrastructure Technologies and Issues***

The communications infrastructure necessary for the wireless Internet environment is quite complex. Wireless devices are likely to remain at a disadvantage over their wired counterparts in terms of bandwidth. Limited bandwidth is a significant problem that requires organizations to rethink how users interact through a wireless device with an information system. An important issue is how to create efficient applications that can realistically work with current technology.

#### **Local Area Network Technologies**

IEEE 802.11 and IEEE 802.11b are established wireless standards commonly used with laptops or personal computers for wireless local area networks. This technology provides speeds of 1 to 11 megabits per second (Mbps). Bluetooth is a relatively new, inexpensive short-range wireless standard that allows different devices (such as laptops and mobile phones) to communicate with each other. The maximum distance between devices is about 100 meters, and data exchange rates are 1 to 2 Mbps. HiperLAN is a set of wireless LAN standards, primarily used in Europe, which provides speeds up to 20 Mbps.

Issues that must be addressed concerning local area network technologies include a lack of compatibility between the different standards and the related difficulties involved with devices trying to interface with more than one communications environment. Frequencies used for wireless LANs are expected to become very crowded very fast. There has also been recent concern about possible interference problems between different signals of different standards.

#### **Telecommunications Technology**

There are three basic "second-generation" (2G) digital wireless telephone technologies – time division multiple access, Global System for Mobile communication (GSM), and code-division multiple access. All these are circuit-switched services, where a user must dial-in and maintain a connection when data communications are desired. GSM is the most widely used of the three technologies, especially in Europe; its current speed is only 9.6 kilobits per second (Kbps).

General Packet Radio Service (GPRS), based on GSM, is a continuous packet data service. Using this technology, network connections are "always-on", and mobile users need not dial into the Internet each time they need to access an application. GPRS promises data rates from 56 to 114 Kbps. GPRS communication channels are used on a shared basis, only sending or receiving packets as needed, rather than maintaining a continuous dedicated line as with circuit-switched services.

UMTS (Universal Mobile Telecommunications System) is a so-called "third-generation" (3G) technology. It offers broadband, packet-based transmission at rates that will exceed 2 Mbps. Based on GSM, UMTS is the planned global standard for mobile users. Once UMTS is fully implemented, computer and phone users can be constantly attached to the Internet and have access to a consistent set of services worldwide.

Many of the issues with telecommunications technologies are similar to those found with LANs. There are distinct bandwidth limitations with the older generation technologies, which make it difficult to develop efficient applications for all technologies.

Standards vary from country to country, making it difficult for devices to interface to networks in different locations. An additional issue is the high initial cost of establishing a wireless network that uses these technologies.

### **Other Wireless Technology Issues**

Security of wireless information is another important technical issue in m-commerce. Users and organizations will want assurance that their wireless communications and transactions are not intercepted. Organizations that set up wireless LANs must realize that there are no physical boundaries limiting their networks, and that people and devices outside the organization may have (inadvertent) access to their systems. Frequency hopping can make it more difficult to intercept data communications. Encryption technologies can also help, but will need to be made more efficient and more foolproof. The increased use of wireless devices for e-commerce makes the issue of positive identity verification even more important yet more difficult to ensure. One consequence of this need is the increasing importance of biometrics. Location technologies, especially the Global Positioning System (GPS), will also play a large part in wireless communications. However, privacy issues must be addressed, such as how personally-identifiable data and location data should be used.

### **Applications**

Some of the applications of wireless technologies to e-commerce activities that have started to appear across the globe are summarized here. Many of these are currently constrained by technology limitations and issues described previously. Two fundamental application issues that researchers and developers must address are what tasks do users want to do without regard for temporal or spatial constraints and how to provide support for these tasks through wireless applications.

E-commerce payment systems can also benefit from wireless technology. One scenario involves a consumer not having to stand in line to make a purchase, but simply paying for an item through a wireless device. Final payments might even be billed to a telephone company. Bluetooth technology may enable a list of available services to be generated automatically on a device when a user walks close to a Bluetooth-equipped cash register.

Wireless technology is well suited for bringing e-commerce to automobiles and other forms of transportation. Traffic advisory systems can warn of impending traffic jams. Cars will eventually be able to report potential problems to service centers themselves. The service center might even make minor adjustments to the car online. Car-mounted devices will eventually allow regular Internet access, although safety issues of "browsing while driving" must be addressed.

While most initial mobile commerce applications seem to be aimed at the business-to-consumer market, business-to-business and intranet applications are also appearing. Service technicians can be dynamically assigned new tasks and sent problem information while they are traveling. Sales people can go literally anywhere in the field and access product information and customer accounts, although the applications right now are still subject to the constraints of current wireless devices. Organizations must address the issue of designing complex, robust applications that work well within these current (and any foreseeable) device limitations. Flexibility can be integrated into designs to enable future functionality.

### **Global M-Commerce**

The global use of wireless technologies and applications adds another layer to the problems and issues in m-commerce. One important issue is the current lack of standardization throughout the world. Mobile phone standards vary from country to country and even within a country. A global initiative for universal standards would foster greater growth in m-commerce.

A significant issue is the disparity in the adoption of wireless technologies and applications in different regions of the world. Japan will probably be the first to implement 3G technologies, followed by Europe and the United States. The primary reason for the U.S. lag is that the United States has not had the same demand for increased mobile capacity as Europe and Japan. Fewer Americans use wireless devices than individuals living in Asia or Europe, and current American users exhibit lower usage rates than Asians and Europeans. Therefore, the overall demand for 3G will be slower to reach critical levels.

## **Conclusion**

Wireless devices continue to change rapidly. While no one is quite sure what the ultimate wireless device(s) will be, there is definitely a need to ensure that devices can function with one another. There is also the need for a truly global wireless communication infrastructure with sufficiently high bandwidth to satisfy the needs of wireless and m-commerce applications. The establishment of a wireless infrastructure costs a great deal, and there will be many difficulties ahead for the companies paving the way for m-commerce, but the long-term prospects look good for the companies that survive.