

# Surveying Mobile Commerce Environments

**Jari Veijalainen**

*University of Jyväskylä, Finland*

**Mathias Weske**

*University of Potsdam, Germany*

## THE EMERGENCE OF MOBILE COMMERCE

During the last five years, the term mobile commerce (m-commerce) has appeared in the vocabulary of business people and researchers. Historically and conceptually, m-commerce can be regarded a new phase in electronic commerce (e-commerce). Although the term was introduced without a clear meaning and it is still lacking a single widely accepted definition, most people would say that the term m-commerce refers to e-commerce activities performed by people while on the move. Thus, m-commerce involves e-commerce transactions where a mobile terminal and a wireless network are used to conduct them. Therefore, m-commerce takes advantage of the e-commerce infrastructure developed for Internet e-commerce. Although in some cases an m-commerce transaction might be an alternative to a regular e-commerce transaction (such as buying a book) performed using a workstation and wired network, in many cases this is not the situation. The limitations of the mobile device - for instance, user interface limitations - are such that it is not attractive to perform typical Internet e-commerce transactions on them. Wireless technologies, combined with so-called 'Internet-enabled' terminals, constitute an ideal platform to realize new types of e-commerce transactions that are not possible or reasonable for wired terminals. The small and light, yet powerful, mobile terminals are almost always carried by their owners, just like wallets or watches. They can indeed also store electronic cash, credit card information, tickets, certificates of the Public Key Infrastructure (PKI), and so forth. Thus, they can assume the role of an e-wallet, as well as function as authentication and authorization devices in various contexts.

The wireless mobile terminals can be *positioned* either by using satellite technologies, terrestrial network facilities, or indoor mechanisms. Recent developments in these technology areas seamlessly extend the positioning of wireless devices into several environments. Thus, services based on the current position of the terminals, and their past or future movement patterns on earth, have become widely possible. These so-called location-based

services (LBSs) are a new service class for mobile networks and make new kinds of location-related transactions viable. Thus, LBSs represent a new business area in e-commerce that is typical of m-commerce. For the above reasons, the telecom industry has begun to call portable wireless terminals with the above functionalities Personal Trusted Devices (PTDs).

It is worth noticing that a user can do many things with a PTD that are not m-commerce in the above, rather restricted, sense. Some of these activities can still be closely related with business, such as browsing catalogs, or receiving offers and discount coupons (see Funk, 2004). Those activities that precede or follow the actual m-commerce transactions belong rather to m-business activities (Kalakota & Robinson, 2002). We confine ourselves in the sequel mostly on the m-commerce aspects, although the network infrastructure and many other aspects we are modeling below support m-business and activities that fall outside of both. This is natural, because the wireless infrastructure is indeed common to m-commerce and many other activities.

All in all, there are hundreds of papers written on various aspects of m-commerce so far, and published in journals and conference proceedings. Regarding other approaches to model the entire m-commerce environment, it seems that there are only a few so far. One was presented in Varshney and Vetter (2001) and refined in Varshney and Vetter (2002), but the emphasis was on technical aspects. Another characterization is presented in the preface of Mennecke and Strader (2003) in order to differentiate between general e-commerce and m-commerce. The book (Sadeh, 2002) contains a balanced snapshot of m-commerce applications and business models, but does not present a clear overall model of the m-commerce environment. The E-Factors network in Europe (E-Factors, 2003) has addressed a wide variety of issues in e-commerce and m-commerce, but has not presented a succinct model for the environment. Mobile Internet Technical Architecture (Nokia, 2002) models the entire wireless Internet environment primarily from the network architecture perspective, and m-commerce is an activity supported by certain applications. An application-centric view is also adopted in Varshney (2003). Camponovo and Pigneur (2003) present

a rather good overview of the pertinent issues, published literature, and also a description of their view of the m-business environment.

### MODELING GLOBAL MOBILE COMMERCE ENVIRONMENT

A model in general is an artificially produced object that reflects the structure and other properties of an object of interest (e.g., a part of reality) in a simplified manner and thus makes it easier to gain knowledge of it or produce the actual object of interest. Creating a model (i.e., *modeling*) is always performed from a certain perspective and with certain goals in mind. These determine what kind of a model is created (physical, conceptual, computer simulation, etc.) and what kind of questions it is expected to answer. The original questions in our modeling attempt were: Are there any entities, structures, or phenomena that are *persistent* in the m-commerce environment? If there are, what could they be and what are the *persistent relationships* between those entities and phenomena? What we have in mind are concepts and relationships with a lifetime of, say, tens of years, instead of a couple of years. Should we be able to identify those, we could write down a framework that could be used in further research and practice for several years to come. This framework should make it possible to distinguish between entities, structures, and phenomena that are persistent and at the same time also inherent in m-commerce, and those that are not. We show below that there are persistent and inherent properties in the environment that are desirable, but others that are not desirable.

### Wireless Terminals: Personal Trusted Devices

The first evident thing that is rather persistent and is embedded into the very definition of m-commerce is the terminal. It is indeed immediately clear and trivial as such that m-commerce cannot be performed without a terminal, where terminal is meant in an abstract sense. What forms the concrete terminals adopt in their development over time have of course much influence on the concrete m-commerce transactions that can be performed. But always a terminal is needed in m-commerce, be it a powerful one mounted into a car, be it a personal area network with many wirelessly connected nodes, or a telecom terminal or a PDA as we know them now. As indicated above, the current top-end terminals are called Personal Trusted Devices or PTDs.

### Wireless Access Networks, Core Networks, and the Internet

A wireless access network and a larger e-commerce infrastructure including m-commerce servers and authentication servers is needed. Again, the concrete forms these take vary over time, but they are needed in some form.

The main components of the infrastructure are mobile telecom networks - access networks and core networks (Kaarainen et al., 2001) - Internet, and various servers providing the contents and services for e-commerce. The important additional persistent property of the infrastructure is that it consists of pieces that are controlled by different autonomous organizations. There are hundreds of separately controlled 2G telecom networks in the world and roughly the same number of mobile telecom operators that control the networks. Further, there are millions of servers providing for e-commerce services.

### Persistent Organizational Structures

Autonomous organizations make autonomous decisions. This leads to heterogeneity of the infrastructure, as concerns the services, protocols, and so forth. A further consequence is that the development speed and stage of the network infrastructure in different parts of the world vary considerably. This situation will prevail because there is no one external force in the world that could stop this development. Only if the organizations themselves decide on a voluntary basis to provide interoperability of their systems can the problems arising from the different stages and development speeds be solved or at least mitigated.

Concerning the regional development, there are currently three large regions in the world, namely the EU, Japan, and the USA, that have reached the m-commerce phase. The rules are more or less homogeneous inside a region, but not necessarily between the regions. Other large regions, like China, might develop their own rules, or they might adopt those of the leading regions. We expect the three most advanced regions to be the dominant ones also in the foreseeable future, although new regions with new rules might emerge. We call such a region *regulatory area*.

Japan and the USA (as well as China, Korea, and Australia) are homogeneous in natural language, whereas Europe is divided into tens of smaller and larger language areas. Thus, although the rules applied would be the same, as is roughly the case in the European Union, the concrete m-commerce services could still be obtainable in different language. Thus there is no guarantee of m-commerce in Europe in a strong sense.

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