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# Transaction management for m-commerce at a mobile terminal

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**Abstract**

Although there has been a lot of discussion of ''transactions'' in mobile e-commerce (m-commerce), little attention has been paid for distributed transactional properties of the computations facilitating m-commerce. In this paper we first present a requirement analysis for m-commerce transactions, a graph-based transaction model, and a Transaction Manager (TM) architecture for a wireless application that protects m-commerce workflows against communication link, application, or terminal crash. The application interface, modules and log structure, as well as a pilot implementation of this TM for the location-based application are presented. We further discuss other alternatives to design such a TM that together can be called ''Ontological Transaction Monitor'', which assumes also monitoring constraints related to security and privacy.


*Keywords:* M-commerce transactions; Terminal crashes; Mobile commerce; Workflows; Personal trusted devices

## 1. Introduction

The main driving force for the rapid acceptance of small mobile devices is the capability to get services and run applications at any time and at any place, especially while on the move [1]. The experience from Japanese market shows that the most important factor is that the terminals are permanently carried around, and thus people can use so-called ''niche-time'' to use the gadgets for various things [2,3]. The telecom industry estimates that there are now (winter 2005) 1.7 billion mobile users. According to some market analysis nearly half of the devices were internet-enabled in 2004 and the tendency is growing [4]. This means that at least 500 million, perhaps nearly one billion Internet-enabled mobile phones will be in use in the world in 2006. The number of these mobile Internet-enabled terminals, sometimes also called Personal Trusted Devices (PTDs), has exceeded the number of fixed-line Internet terminals around 2003 [5].

The term mobile commerce (m-commerce) is closely related with the term electronic commerce (e-commerce), both historically and conceptually. The definition of OECD for e-commerce is based on the concept of *electronic (commerce) transaction.* ''An electronic transaction is the sale or purchase of goods or services, whether between businesses, households, individuals, governments, and other public or private organisations, conducted over computer-mediated networks. The goods and services are ordered over those networks, but the payment and the ultimate delivery of the good or service may be conducted on or off-line'' [6]. E-commerce can be defined to consist of launching and performing electronic commerce transactions in the above sense.

M-commerce consist, correspondingly, of launching and performing *m-commerce transactions.* An m-commerce transaction is an electronic transaction that is conducted using a *mobile terminal* and a *wireless access network,* such as Wireless LAN, 2G or 3G telecom network, Bluetooth connection, or an Infrared connection. Notice, that this

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definition excludes those e-commerce transactions from m-commerce sphere, where the terminal is not mobile, albeit wirelessly connected, and the case where a portable terminal is connected with a fixed line to the network. On the other hand, laptops and even fixed terminals in cars, as well as all small portable telecom terminals and even Personal Area Networks (PAN) are included into the scope of the definition, if the conditions above are fulfilled.

In literature, also the term *mobile business* (or m-business) is used instead of m-commerce. We take the same view as the authors of [7,8] that m-commerce is a subset of m-business, i.e. it consists of those activities where economic value is transferred from some party to another one as a part of the transaction.

Based on the above definitions, one can speak about m-commerce market and of its size, measured as the sum of the values of the m-commerce transactions. In Japan, the market size was 24 billion US-dollars in 2003, of which $7 billion consisted of various mobile contents, including gambling, and 17 billions went into the wireless packet charges levied by the operators [9]. Global mobile commerce market – comprising concretely mobile entertainment downloads, ticket purchases and POS transactions – will grow to $88 billion by 2009, according to a Jupiter Research forecast [4]. About 50% of the market would be entertainment downloads and the rest ticket purchases. POS transactions would be worth of only $300 million in 2009. M-commerce transactions are an important class of applications on the PTD already now, and the above figures suggest that their importance will grow in the future. Thus, it is of high importance that the infrastructure offers proper security and transactional means to protect all actors in the environment against system crashes, but also against malicious actors and criminals.

In the above definition of m-commerce the notion of electronic transaction occurs. Looking at the context, the meaning of the term clearly points to a business transaction, as it is known in economics. Embedding the term into a particular technology is done from the perspective that information and communication technology mediates or facilitates these business transactions. The exact properties of the relevant technological artefacts are not at all addressed by the definition. Indeed, it is not very clear yet what kind of technical artefacts should correspond to the m-commerce transactions, as defined above. Taking a small step back into history, we can see a similar situation. The term ''transaction'' used to have almost ten closely related, but different meanings, already fifteen year ago, ranging from business transactions, over messages that mediate the contents needed in business transactions, to formal model of program execution within a database system [10,11]. A transaction with ACID properties, i.e. an execution of a set of commands generated by an application or user within a DBMS in a serializable and at least recoverable manner [12] is conceptually and practically certainly something else than buying a book using a mobile terminal. Still, they have the commonality, that with a rather high probability the e-commerce system recording the customer order and other steps in the book delivery process uses one or several DBMS and their transaction processing capabilities to guarantee unique view on the responsibilities towards the customer. Thus, m-commerce transactions should somehow subsume traditional DBMS transactions, but evidently, this is not yet enough, because there is the wireless tiny terminal, wireless access network and often a portion of Internet that are playing a role as facilitators of the m-commerce transactions.

During the late 1970's and early 1980's, it was already recognized that the transactional properties (or something very similar) are needed for distributed computations in general. The centralized transaction model was first extended to support distributed transactions in a distributed database context [12–14]. Soon it became evident that distributed transactions could not be reasonably used in autonomous environments or in such environments where the transactions last hours or even weeks. Many ''advanced'' transaction models were developed for these environments and many of them are published in [15]. More complicated models present individual transactional computations as trees with height larger than one. One modelling dimension is the selection of the correctness criteria that divide the computations, modelled as linear operation histories or trees, into acceptable and non-acceptable ones. A standard way of doing this is to set up an equivalence relation among histories or trees and classify those, which are equivalent to a serial history or serial forest as serializable, i.e. acceptable. Check e.g. [16,11] for a more complete analysis of diverse transaction modelling incentives.

Is m-commerce an area that would again need its own transaction model? Isn't the work of MeT already performed enough? Something called mobile e-commerce transactions have been indeed developed among others in an industry-led consortium called MeT-forum, later MeT Ltd [17]. This effort has produced public white papers [5] where the opportunities and risks of m-commerce are discussed. Scenarios (business models) for five subtypes of m-commerce have been developed. Protocols to support them are defined in technical documents of MeT. On June 12th, 2002, a larger consortium called Open Mobile Software Alliance (OMA) was announced [18]. Its goal is to create a truly global and interoperable m-commerce market. The key technical goal is end-to-end interoperability at the service level and thus end-to-end transactional properties of the services should also be considered. MeT Ltd will cooperate closely with OMA. They have a cooperation agreement [18].

In a closer look the need to go beyond individual messages and message exchanges, i.e. protocols, becomes more than evident, because the overall business transaction can consist of several interactions with different actors, such as merchants, financial institutions and logis-