

# Requirements for Mobile E-Commerce

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**Abstract.** Mobile Electronic Commerce (MEC) can be defined as Internet e-commerce conducted by a mobile hand-held terminal and thus using the wireless telecommunications network. MEC operates in a different context than Internet E-Commerce due to the special characteristics and constraints of hand held devices and wireless networks and the different usage of the hand held devices than desktop or laptop PCs. The Wireless Application Protocol (WAP) bridges the gap between the mobile world and the Internet by optimizing the Internet standards for the constraints of the wireless environment and hand held devices. A number of companies started offering products to satisfy the continuously evolving user requirements by exploiting the technical advances in wireless network technology. This paper gives an outline of the dynamically evolving functional and non-functional requirements and of solutions currently offered in this area.

## 1. Introduction

Internet has made available a wide range of applications and services over the World Wide Web at a low cost. At the same time, the number of users of mobile terminals (phones, personal digital assistants (PDAs), and communicators) is continuously increasing. The miniature size of mobile terminals, their cheap price and the fact that they can easily fit in a pocket and carried everywhere makes them an ideal channel for offering personalized and localized services to the continuously increasing number of mobile users. This creates a new era, the era of the Mobile Electronic Commerce (MEC). As MEC can be defined any type of transaction of an economic value having at least at one end a mobile hand-held terminal and thus using the mobile telecommunications network.

MEC operates in an environment which is different from Internet E-Commerce in many respects due to the special characteristics of mobile terminals, the unique constraints of the wireless network and the different context, situations and circumstances that people use their hand-held terminals in relation with desktop or laptop personal computers. This situation has a number of business, technical and legal implications. There is a need for new business models, new applications and new technology that satisfy the requirements accrued by the aforementioned situation. The Wireless Application Protocol (WAP) plays an important role in MEC as it bridges the gap between the mobile world and the Internet by optimizing Internet standards for the unique constraints of the wireless environment.

The area of MEC is dynamic and so are the requirements. Companies continuously announce new products and applications to catch up with the constant and dynamic evolution of user requirements. In this paper, we try to give an outline of the current situation in MEC in terms of needs for new applications and services, functional and non-

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functional requirements and partly in terms of already existing solutions. In this context the paper is organized as follows. In section 2 we briefly examine the Wireless Application Protocol (WAP) [1] and Wireless Network Technology. The requirements for MEC applications are analysed in section 3 followed by a discussion on the emerging issues and conclusions.

## 2. Wireless Network Technology and the Wireless Application Protocol (WAP)

The Wireless Application Protocol (WAP) plays a major role in MEC: Internet standards such as HTML, HTTP, TLS and TCP are inefficient over mobile networks as they require large amounts of mainly text-based data to be sent. WAP optimizes these standards for the unique constraints of the wireless environment, i.e. low bandwidth and not stable connection. The WAP Specifications define a lightweight protocol to minimize bandwidth requirements and to guarantee that a variety of wireless networks can run WAP applications. In this way, the mobile terminals together with WAP are the new access technology to Internet-based E-commerce world. Figure 1 depicts the WAP protocol stack and compares it with Internet standards.

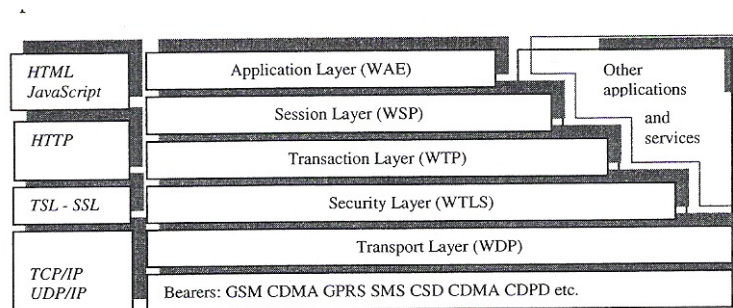


Figure 1. The WAP Protocol Stack and its relation with Internet Standards [1]

We would like to mention here the importance of the Bluetooth new emerging technology [2] and its expected impact on MEC. Using this technology it would be possible to conduct e-commerce transactions without a heavy network infrastructure. Thus, handheld devices could talk directly e.g. with cash registers. Currently integration of Bluetooth and WAP are under way [1]. GPRS (General Packet Radio Service), a packet-based wireless communication service, when available (in late 2000), will give a further push to MEC, as it will offer data rates up to 100 Kbits/s and continuous connection to the Internet for mobile phone and computer users. GPRS is based on Global System for Mobile (GSM) communication and will complement existing services such circuit-switched cellular phone connections and the Short Message Service (SMS). GPRS will also complement Bluetooth. Furthermore, the increased bandwidth to be offered with the Universal Mobile Telephone Service (UMTS), is also expected to have a great impact in MEC, but it is not easy to make any estimations at the moment, as UMTS will not be available earlier than 2003.

## 3. Requirements for MEC

Applications and services in MEC require a lot of effort in order to be successful. On one hand, they have to take into account the constraints imposed by the current network infrastructure and handheld terminals and, on the other, they have to satisfy the requirements from the user point of view, which are continuously evolving. Advances in network infrastructure and hand-held terminals have an impact on user/application requirements and vice-versa and application developers should follow in a similar pace. Thus, services successfully being offered over Internet (e.g. financial services, travel services), in order to

have similar success in MEC, they need take into account the different needs of mobile users, the different usage of hand held devices and the peculiarities of the wireless environment and hand held devices. The following list includes some of the main issues that have to be taken into account for the success of MEC:

- **The characteristics of hand held terminals:** small size, restricted input/output devices, limited memory capacity and storage, limited computing power, not always reachable.
- **The peculiarities of the wireless environment:** low bandwidth and less connection stability in relation with the fixed network environment.
- **Vulnerability of mobile hand-held devices and enhanced hostility** of the open mobile environment: hand held devices can be easily stolen or misused.
- **Different usage of hand-held devices with respect to desktop or laptop PCs:**
  - **Conditions of usage:** the mobile user may be engaged into another activity, like traveling, meeting people etc. rather than sitting in front of his desktop terminal.
  - **Locality:** the user needs to get location-dependent information, like maps, restaurants, etc.
  - **Personalisation:** the user wants access to personal information and time management services and to various sites in a familiar way.
  - **Instantaneous delivery:** immediate delivery of the ordered product/service, e.g. the chocolate should pop up from the automatic machine or the sms with the code for cinema tickets be received as soon as the user clicks his mobile for payment.
  - **Micro Payment:** MEC customers buy also little things at a very low cost, e.g. news. Such payments shouldn't have high fees.

These characteristics result in a number of requirements for MEC applications classified into Usability requirements, Requirements for new applications and services, Security requirements, Quality of service and other non-functional requirements, Transactional Requirements and Legal Issues which are briefly described in the following.

### 3.1 Usability requirements

The characteristics of the mobile terminals and the different usage mentioned above dictate that respective applications must be easy to use without requiring too much effort from the user's side, i.e. extensive navigation and many clicks in order to get what s/he wants. Furthermore, users of mobile terminals are usually non I.T. experts and thus the user interface must be as friendly and simple as possible. According to a survey by Dulracher any additional click required reduces the possibility of the user committing a transaction by 50% [3]. When it comes to payment, this should be made as easy as possible, preferably with just a click, especially with micropayments. However, this should not compromise security, so, for high value transactions additional clicks and checkings are necessary. Further usability requirements can be accounted into:

- Advanced security mechanisms requiring as little as possible from the user. For example, now the user of mobile banking has to carry around a piece of paper with the various combinations of codes, but this is not at all practical
- Real time information - the users want to always receive the latest version of news for example or time sensitive information e.g. stock rates
- Ubiquity - users want to be able to receive information and perform transactions from virtually any location
- Unified messaging and intelligent notification, e.g. user may be able to receive/send email or faxes in any presentation form s/he likes, i.e. written, voice, etc.
- Optimized service settings - e.g. for the time being offered services are dependent on operator, gateways, type of terminal, etc. The user has to invest a lot of time and effort to set up his terminal before s/he can receive corresponding services.

In a way, the mentality of a mobile user holding a hand held device is similar to a Zen monk, as they both focus on 'here and now'. This is the basis of many user requirements on the first case while on the second case it is a philosophy of life.

### *3.2 Requirements for new applications and services*

The mobility and continuous reachability of the user, the possibility of continuous access in data and information, services and applications and the fact that hand held terminals are personal and can be used for the locating the user's position, introduce a number of requirements for new applications and services. Typical location-based services are: personal navigation, mobile yellow pages, find 'the nearest' restaurant, petrol station, etc. service. The user should be able to easily locate him/herself as well as to control the transmission of this information. However, in some cases, e.g. emergency services, the transmission of user's location should be independent of his control. A number of interesting applications and devices are under way. For example, Benefon's new phone Benefon ESC! [4] is equipped with a Global Positioning System (GPS) receiver and maps.

Locality can be viewed also from another aspect: the user's cultural location and the effective presentation of the information. This type of location services can include familiar access to services, language, monetary and measurement units etc. In other words, the user should be able to access services in a familiar way and independently of the geographical location. Thus, the user's profile, past behavior, situation and cultural background could be combined with information about his/her geographical location and used as a filter for the provision of not only localized but also personalized services.

Another type of personalized services is "personal information management" including many of the functions of current PDAs or communicators. These can include maintenance of personal address book, writing and reading notes and memos, personal calendar functionality, alert notifications etc. and communication facilities like sending and receiving email, voice mail forwarding or faxing. Current mobile portals have already started providing such services, e.g. [5]. This personal information should also be accessed and changed from anywhere, any time and via a variety of devices. The industry initiative SyncML is along these lines of requirements [6].

The continuous reachability of mobility and the knowledge about their location make them an ideal channel for broadcasting (supported by latest WAP specifications) location related information (e.g. local traffic information and weather forecast) and other services. Presently, the mobile location-based services are at the development stage. They depend on the terminal device, network type operator, access gateway, portal, service provider, continent, country, city, etc. [7].

### *3.3 Security requirements*

Together with additional functionality, more trust is needed so that a hand held terminal can become a personal trusted device. In general, security and trust in e-commerce transactions can be achieved with the following security functions:

- Authentication and non-repudiation: each party needs to be able to authenticate its counterpart, i.e. to make sure that the counterpart is the one s/he claims to be and that s/he doesn't deny later on agreements s/he has approved earlier
- Integrity: each party needs to make sure that received messages are not altered or fabricated by other than their counterpart
- Confidentiality: each party wants to keep the content of their communication secret
- Message Authentication: each party wants to make sure that the received messages do really come from his counterpart

Techniques like the asymmetric cryptographic algorithm (also called Public Key algorithm) are used to achieve these results, with a Certification Authority (CA) which

issues certificates and a Public Key Infrastructure (PKI) for generating, revoking, updating, recovering etc. certificates and keys.

Three different security techniques are currently used for hand-held devices: 1) Smart trust type solution card (offered by Sonera [8]), where the PKI private key is on the SIM card and it is used for authentication and non-repudiation, 2) the solution offered by Nokia, Merita, Visa where authentication and other security mechanisms incorporated into the software and hardware of the terminal in such a way that the terminal has a credit card capability and 3) the solution provided by Motorola and MasterCard which offer terminals equipped with a credit card reader. There is still on going work in security, e.g. the Mobile Transactions (MET) Initiative recently announced by Ericsson, Nokia and Motorola or the Wap Identity Model (Wim) to be included in WAP 1.2 specifications that enables a WAP server to validate a mobile phone before allowing payment.

### *3.4 Quality of service and other non-functional requirements*

Quality of service (QoS) can be expressed in terms of response time, bandwidth, latency, loss rates etc. Especially response time should be minimal, because of the expensive wireless connection and of the increased possibility of losing the connection. Reliability is another important requirement and this can be expressed in terms of robustness in the sense that crashes are not so easily 'absorbed' by the system, since this would add on the already existing 'dangers' coming from the peculiarity of mobile environment. A further set of requirements is related with billing. Since users have different requirements, a variety of pricing models should be available:

- Event based billing: the user is billed for each transaction/event s/he activates
- Service based billing: the user pays a certain amount for having a service for a certain period of time, and then uses this service as many times as s/he wants
- Area and time based billing: e.g. the user can have different tariffs depending on where s/he is and when s/he is using the service
- QoS based billing determined in relation to QoS parameters, eg. since location services are more accurate in cities, they can be more expensive than in the country side.
- Fixed price per month: the user can pay a fixed price per month to use certain services and then be charged on top of this depending on how much he is using these services
- Low monthly rate for basic services and extra billing for every additional transaction
- Partly billing of some services in case for example the user accepts to receive advertisements or 'sell' his/her personal data
- A combination of the above

The user should be free to choose the billing model that best suits his/her needs and lifestyle.

### *3.5 Transactional Requirements*

From transactional point of view, the hostility of the MEC environment and the vulnerability of hand-held devices imply that the transactional mechanism should not rely on the device identity (such as phone number or IP number) and it should not deduce user's identity based on the device identity. On the other hand, there are great opportunities for useful applications that are based on the device/user identity assumption or anonymous payments based on E-cash carried within the device. Therefore, the transactional mechanisms should not be either or but rather both end. The user could specify the security level s/he wants. Furthermore, from transactional point of view, the autonomy characteristic of hand-held devices means that transactional mechanisms should not assume continuous capability of the terminals to communicate, nor should expect that the terminal is continuously able and willing to communicate with other components. Thus, while ordering a service through a C-autonomous and error-prone mobile device,

the probability that the process at the customer side stops and the status information is lost (cf. running out of battery or coverage while paying) should not be underestimated. For these kind of situations the terminal should have failure resiliency and capacity to recover the process into a consistent state. In practice, this would require that the data obtained from the merchant that contains the transaction identifier and the details of the payment etc. should be stored persistently along the process state indication "transfer in progress". The application at the bank should also accept a new connection attempt after the crash with the same transaction id. These are typical transactional requirements for the implementation of the service. Further transactional requirements related mainly to the fact that e-commerce transactions require the process at the merchant to run several days or weeks instead of a few minutes, as the customer may return the product he has bought in a month for example (the time period depends on national legislation), also apply to mobile e-commerce transactions and these have been analysed in [9].

### *3.6 Legal Issues*

The situation in Europe is characterised by a 'push' legislation on E-Commerce and a great emphasis on consumer protection. A large number of initiatives have already been launched by the European Commission and address various issues like taxation, electronic signatures, contracting, payments, intellectual property rights, etc. [10]. These initiatives lay down principles in the form of directives and regulations to be included in National Legislation of Member States and aim at establishing a clear framework in order to stimulate investments in electronic commerce services with ensuing benefits for EU in terms of growth, competitiveness and employment. It is worth to mention that in the USA there is a different approach oriented toward a self-regulatory market, while in Japan the approach is similar to the one in European Union (EU).

However, there are still some open issues that need to be solved for the further success of MEC. These open issues are related to the role and liability of intermediaries and cancellation of contracts. Also some taxation issues are still open. For example, the fact that VAT is not paid for products purchased from merchants outside EU creates a competitive advantage for non-EU merchants. In order to alleviate this fact, new EU directives dictate that taxation of goods depends on the place the goods are consumed. However, it is not clearly defined how the place of consumption is defined. A mobile user can be anywhere when s/he purchases a good and also crossing country borders. What is the place of consumption in such cases? Furthermore, it is still open how non-EU services providers can charge, collect and remit VAT when selling in EU. These are some of the open legal issues which need to be resolved.

An interesting issue related with MEC is what are the rights of the operator regarding location related information of a user. In some countries, operators are not allowed to give this information to other content providers, which may create some problems in the offering of location services. Naturally the operator can send the location of a user without revealing the identity of the user, but this means that it has to act as a portal or intermediary between the user and the service provider.

## **4. Conclusions**

The area of MEC is dynamically evolving from technology and applications point of view and so are the user requirements. New MEC services and applications are announced daily which try to go along with the advances in network technology. Mobile e-commerce platform and service providers are trying to develop dynamically evolving products that exploit the latest advances in network technology and enable users to have ubiquitous access to advanced mobile services and applications. A synergy between application platform vendors that offer middleware and standards, application developers who offer

mobile platform applications, content providers and aggregators, mobile portal providers for application aggregation, mobile network operators and mobile service operators that offer added value services is essential for the provision of useful and effective applications and services to mobile users. The alliances announced daily between the industry players in the field of MEC are along these lines. It is expected that GPRS (IO appear at the end of 2000) and especially the increased bandwidth to be offered by UMTS (IO be in use not earlier than 2003) will give a further push to Mobile E-Commerce.

However, some issues still remain open and require special attention in the area of MEC. Some of them are the following:

- Lack of applications and services with pertinent content and functionality.
- Easier accessibility of applications and services - at the moment, services are heavily dependent on operator, gateway and terminal type, so a user needs a lot of effort to set up the different configurations needed to access various services; also, when abroad, s/he needs to reconfigure his terminal to access the locally provided services and so on.
- Legal issues and privacy protection - especially regarding the user's current position.

It is the authors' belief that further research is needed in the area of user needs and requirements in order to provide applications and services that take into account the different usage of handheld terminals, the different lifestyle and needs of mobile users and provide innovative applications and services that exploit the latest technological advances in the network and software technology.

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