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Towards a Reference Model for M-Commerce Applications

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Abstract

Not long ago m-commerce was proclaimed as the next technological revolution and opportunity for companies to provide a new distribution channel for customers. But, first examples of m-commerce applications show that only those applications are accepted by customers that provide clear added value compared to the on- and off-line channel. But how can the suitability for m-commerce be assessed by companies? Concepts, guidelines and methodologies for the development of strategies for m-commerce are not available yet. This paper tries to fill the gap and provides guidelines for the design and implementation of m-commerce applications based on the media reference model.

Keywords

M-commerce, Reference Model for M-Commerce

1. Introduction

Not long ago m-commerce was proclaimed as the next technological revolution and opportunity for companies to provide a new distribution channel for customers. But soon the initial euphoria transformed into greater rationalism. This disillusionment results from the cumulative effects of technological insecurity due to a lack of standards in the mobile market, the delay of the introduction of 3G networks, the overall uncertainty in the telecommunication industry, and the disappointing first experiences of users. For example, the Wireless Application Protocol (WAP), which was supposed to enable innovative and attractive applications, has instead proven difficult to use, too slow and too expensive (Baldi and Pyu-Pyu Thaung, 2001), (Boston Consulting Group, 2000)). In addition early commercial services of 3G systems in Japan and elsewhere have failed to generate as many new subscribers as expected (ITU 2002). The adoption of mobile technologies and m-commerce is much slower than predicted (Aarnio et al, 2002), (Ancar & D'Incau 2002).

As a result of the above developments – extreme ups and downs – now a period of realistic expectations has started. On the one hand we can already observe first movers on the market. In particular fast moving industries as the banking industry (see for example the bank Credit Suisse in Switzerland [http://www.credit-suisse.ch/de/direktzugriff/phonebank/wap/index.html#)](http://www.credit-suisse.ch/de/direktzugriff/phonebank/wap/index.html#) or successful Internet start-ups as Amazon.com have already launched a mobile extension of their e-commerce sites. On the other hand other industries with a slower pace of innovation are still reluctant to apply mobile technologies. Many of those companies still consider mobile technologies as relevant, but will only apply them if they can provide clear added value for their business in terms of strategic advantage, cost reduction or improved customer service (Aarnio et al. 2002), (Eklund & Pessi 2001), (Shim et al. 2002). But, how

can the suitability for m-commerce of the own products, services be assessed? What are the critical success factors for such applications? How do they differ and relate to already existing off- and online channels?

At present, concepts, guidelines and methodologies for the development of strategies for m-commerce applications are not available yet (Lehnert, 2002). This paper tries to close this gap and provides a first version of a reference model for m-commerce applications. The reference model for m-commerce was developed based on the media reference model (Schmid, 1997), (Schmid, 1999), and can be applied for assessment of the suitability for as well as the requirements upon m-commerce applications. It was developed based on experiences of using available mobile solutions, through desk research of published case studies in m-commerce (see for example (Thomet 2001) and (Lerner 2001)), as well as findings concerning the adoption of mobile technology in literature. In a next step it will be verified in practice through in depth case studies.

The content of the paper is organized as follows: In section two, basic concepts related to mobile technology and mobile business (m-business) are defined. In the third section, lessons learned from usage of mobile technologies and already available m-commerce applications published in literature are summarized. In section four, first the media reference model is explained. Section five describes the reference model for m-commerce applications. Section six closes the paper with a summary and an outlook to further research.

2. M-Commerce – Definitions

Even though m-commerce is a new phenomena, there are already many different definitions for the main terms related to this research area in the literature. In order to avoid misunderstandings the most important terms related to mobile technologies will be explained in this section.

In many cases the words "wireless" and "mobile" are used interchangeably to denote mobile applications. However, the adjective **"wireless"** denotes basically the way how the transmission of data is performed. Wireless means that data is delivered to an end user across airwaves (Mobilicity 2001), (Anckar & D'Incau 2002). The adjective **"mobile"** refers to applications, which are designed for users on the move, i.e. for applications that support the user independent of his location (Anckar & D'Incau 2002), (Lehnert, 2002). This means that a wireless application does not have to be a mobile application as well. For example, providing passengers with information about discounts and coupons that can be used for buying at the store through a Bluetooth interface when they pass near the store provides a wireless extension of marketing activities. It would be at the same time a mobile application, in case the customer could access the same information from any location through his mobile device and if interested can react on it. Therefore "mobile" is a term with wider meaning compared to "wireless" and subsumes "wireless". Providing added value for customers on the move is one of the key success factors of m-commerce.

Further terms that need to be defined are mobile business (m-business) and mobile commerce (m-commerce). They can be defined in analogy to e-business and e-commerce (Kemper & Wolf 2002). The prevailing definition for e-business is the following: **E-Business** is the integration of systems, processes, organizations, value chains, and entire markets using Internet-based and related technologies and concepts. **E-Commerce** is merely a part of e-business and is limited essentially to marketing and sales processes, i.e. to "...*buying and selling of information, products and services via computer networks*." as Kalakota and Whinston (1996) define it.

As an analogy to the above definition for e-business we define **m-business** as a collection of mobile technologies and applications used to support processes, value chains and entire markets using wireless technology (see also (Lehnert, 2001)). **M-Commerce** is a subset of m-business and *"...denotes the transaction oriented part of mobile business towards the end customer"* (Lehnert, 2002). M-Commerce is therefore *"...any transaction with a monetary value that is conducted via a mobile telecommunication network*" (Müller-Varese 2000).

In summary we can say that m-commerce can be viewed as an additional channel for e-business. However, this does not mean that approaches to the development of e-commerce applications can be applied to the development of m-commerce applications without adaptation (Shih & Shim 2002). Even though m-commerce can draw on experiences made in e-commerce it requires special treatment and guidelines due to its unique and differentiating features.

3. Basic Features of M-Commerce Applications and Lessons Learned up till now – A Literature Summary

The unique and differentiating features of m-commerce result from the specific features of the underlying technology. Compared to Internet technologies, mobile technologies have some disadvantages and some advantages (see also Kannan et al. 2001). The disadvantages can be summarized as follows:

- The small screens and keypads of mobile devices limit the size of information that can be displayed on the mobile screen and make data entry difficult and uncomfortable especially for longer messages and browsing of information. They furthermore require adaptation of existing content before it can be displayed.

- The limited memory and computing power of end devices does not allow for complicated processing on the client side.

- Until 2,5G and 3G transmission technology is widely introduced, mobile applications will have to cope with lower bandwidth as well.

The disadvantages of mobile technology described above are balanced by the following unique advantages compared to fixed-net Internet (see also (Müller-Varese, 1999), (Lehnert, 2002)):

- *Ubiquity* – The small size of end devices allows users to carry these with them always. This enables greater accessibility independent of the location of the user – the user can be accessed and can consume services anywhere and anytime.

- *Identification* - Mobile devices are personal devices and are not used interchangeably by several users. The owners are furthermore registered with mobile operators and can be uniquely identified. This feature provides favorable prerequisites for personalized services.

- *Localization* – Each mobile device can be located by mobile operators or by using other positioning technology. This feature offers unprecedented possibilities for innovative location-based services.

- *Immediacy* - The ubiquitous availability of services allows instant action and reaction to arising demand.

The above-described special features of mobile technology have resulted in different patterns of usage compared with those of the Internet. According to (Zobel, 2001) (Baldi and Pyu-Pyu Thaung, 2001), and (Boston Consulting Group, 2000)) the differences concerning Internet access and usage can be summarized as follows (c.f. 1):

Internet access		
Mobil		**PC**
Direct „One touch"	**Access**	Long winded
In between ≤ 5 Minutes	**Use**	Specific ≥1 Hour
Specific access	**Navigation**	Browse
Simple, added value (fun, local, time saving)	**Offer**	Diverse Rich
Real-time Specialised	**Content**	Deep and rich
Direct/immediate remuneration	**Utility**	Over a longer period

Figure 1: Comparison of Internet usage patterns of the wireless and wired Internet

The wired Internet comprises many divers offerings of information sources, entertainment and commerce possibilities with interesting content. Given that and the fact that the start-up time of a personal computer and the log in into Internet takes several minutes, users usually use the fixed-line Internet in longer sessions (in average more than 1 hour), like to browse through the content, follow links spontaneously and have dedicated time, when they use Internet. In comparison the mobile Internet still does not have the broad scope of offerings as the wired Internet. Users manly use mobile Internet during "niche times" in short sessions of less than 5 minutes. Examples of "niche times" are waiting time for public transportation. As the log in is much faster than compared to wired Internet, users see mobile devices as tools they can use whenever it suits them (Boston Consulting Group, 2001) for short sessions. This means that mobile application should provide support for transaction that can be finished in very short periods of time with several clicks. These features of mobile usage must be taken into account during the development of mobile applications.

Experiences with e-commerce show that successful services such as for example those of eBay and Amazon have been those that have offered added value through the new medium as compared to the physical channel. *"In the same way, the `winners` in m-commerce will be the industry sectors/products/services offering wireless users indisputable benefits in comparison*

to (a) the physical marketplace and (b) wired electronic channels. " (Mobilocity, 2001) (see also the empirical research in (Koivumäki, 2001) and (Bertelé et al., 2001)).

In the literature five different settings in which mobile application provide added value compared to the physical and the Internet channel have been identified (Acker and D'Incau, 2002):

- *Time critical situations* – The ubiquity of mobile applications enables the performance of urgent tasks in a very efficient manner, anywhere and anytime while the user is on the move. Examples of time critical tasks are – receiving information about changes of stock prices and immediate reaction in terms of selling or buying, sending of e-mails, replenishment of missing or broken spare parts on construction sites or in the field (see for example (Nachtmann, 2002)) and similar.

- *Spontaneous decisions and needs* – This are situations where the user can satisfy spontaneous needs while on the move. Examples of such situations are: buying and sending flowers to persons while travelling to them, spontaneous reservation of restaurants or hotels while on the move as a business traveler or tourist. In general spontaneous decisions are characterized by the purchasing decision being straightforward. They can be related to entertainment, efficiency-gains, and time-critical needs.

- *Entertainment needs* – are relevant from two perspectives: as means to kill time or to have fun. The first need is especially relevant in niche times, which cannot be used for other tasks, such as for example while waiting for public transport or waiting at the dentist. Entertainment needs are often also spontaneous needs and arise as soon as niche time periods appear.

- *Efficiency increase* – by performing tasks while on the move. For example members of mobile sales forces can check their mail, answer mails and update databases while travelling between two customer visits.

- *Exceptional mobile situations* – for example accidents, where immediate value can be created only through a mobile medium. Other examples of exceptional mobile situations are location-based services, which can also only be delivered through a mobile medium.

The special features of mobile devices and situations where mobile media can provide added value imply personalization as a necessary prerequisite for successful mobile applications (Acker and D'Incau, 2002). Given the small screen of end devices as well as the niche times where mobile applications are needed, personalization should enable users to get only information that is of interest to them, in order to be able to perform actions in short time.

4. Towards a Reference model for M-Commerce Applications

The reference model for m-commerce application was developed based on the media reference model. The media reference model has been developed by Beat Schmid (Schmid, 1999), (Schmid, 2000) and has been successfully applied for structuring the process of e-commerce application development (Lindemann & Schmid, 1998), (Stanoevska-Slabeva, 2002) as well as for the analysis of e-commerce sites (Lechner et al., 1999). Therefore it will on the one hand provide a structuring framework for the development process and on the other allow for comparison of concepts.

In order to provide a good foundation for understanding of the reference model for m-commerce application, first a definition of media and a short description of the media reference model will be provided in this section.

Under the term medium we understand platforms based on information and communication technologies, i.e. communication spaces of *"social interaction which allow the participant to meet and which embed them in a common physical, logical and socio-organizational structure"* (Schmid, 2002). Based on the underlying technologies we can distinguish two types of media: Business media, which provide platforms for the trading of goods and services, and knowledge media, which provide platforms for the storing, management and exchange of knowledge.

The media reference model provides guidelines for how to build a medium based on information and communication technology by guiding the process of requirements evaluation and by identifying the required services (c.f. 2).
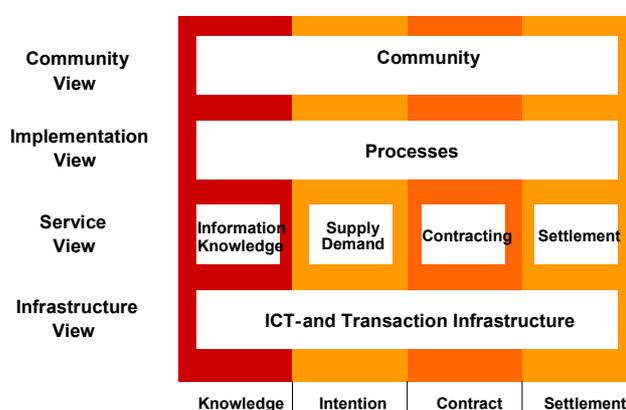

Figure 2. Media Reference Model (MRM)

The media reference model distinguishes four layers or views and four basic services (Schmid, 1999). The layers denote different stages in the design and implementation of a medium and the basic services refer to generic modes of interaction. Below, the views and services will be described briefly.

The ***community* view** represents the user-oriented part of the medium and is dedicated to the identification and modeling of the community and the target group, which will use the medium. In particular this means (see also (Stanoevska-Slabeva, 2002)):

- Identification of potential users, and

- Identification of their communication and transaction needs.

In a next step the ***implementation view*** identifies the necessary processes, i.e. the sequences of necessary tasks to perform market transactions through the medium.

The ***service view*** summarizes the fundamental communication and coordination services part of any market transactions (Schmid, 1999). In particular these are: 1) the sharing of information in the knowledge phase as a prerequisite for market transaction, 2) signaling of intentions in the intention phase as a prerequisite for negotiation, 3) negotiation of obligations in the contracting phase as part of coordination, and 4) settlement of obligations, i.e.

fulfillment of the market transaction in terms of payment and logistics. Below, each of the four services is briefly described.

- The ***Knowledge Services*** provide support for use and management of the knowledge that is available through the medium. Basic services necessary for the access to available knowledge are search engines, information catalogs, classification tools as well as content and document management tools.

  Two types of knowledge can be distinguished (Stanoevska-Slabeva, 2002): Knowledge created by the supplier including knowledge about offered products and services, and knowledge about the users in form of profiles. The second type of knowledge is usually created in a joint effort by the supplier and user and is mostly used by personalization tools to provide a more sophisticated service to users.

- The ***Intention Services*** support users in articulating their intentions and needs. Examples of such services are wish lists, shopping lists, shopping baskets, etc.

- The ***Contracting and Negotiation Services*** support negotiation of the market terms and comprise electronic contracting services as well as negotiation services as for example auctions.

- The ***Settlement Services*** enable and support both the shipment of goods supported by logistic services and payment enabled by electronic payment systems.

The ***infrastructure view*** refers to the applied software and communication systems used to build the medium. This includes, on the one hand, basic technologies and on the other, integrating middleware for the different modules within the medium and for integration with back-end systems.

5. Towards a Reference Model for M-Commerce Applications

Based on the media reference model and the findings concerning mobile Internet described in section 3 a first version of a reference model for m-commerce application was developed. Following each component of the model is described briefly (c.f. 3).
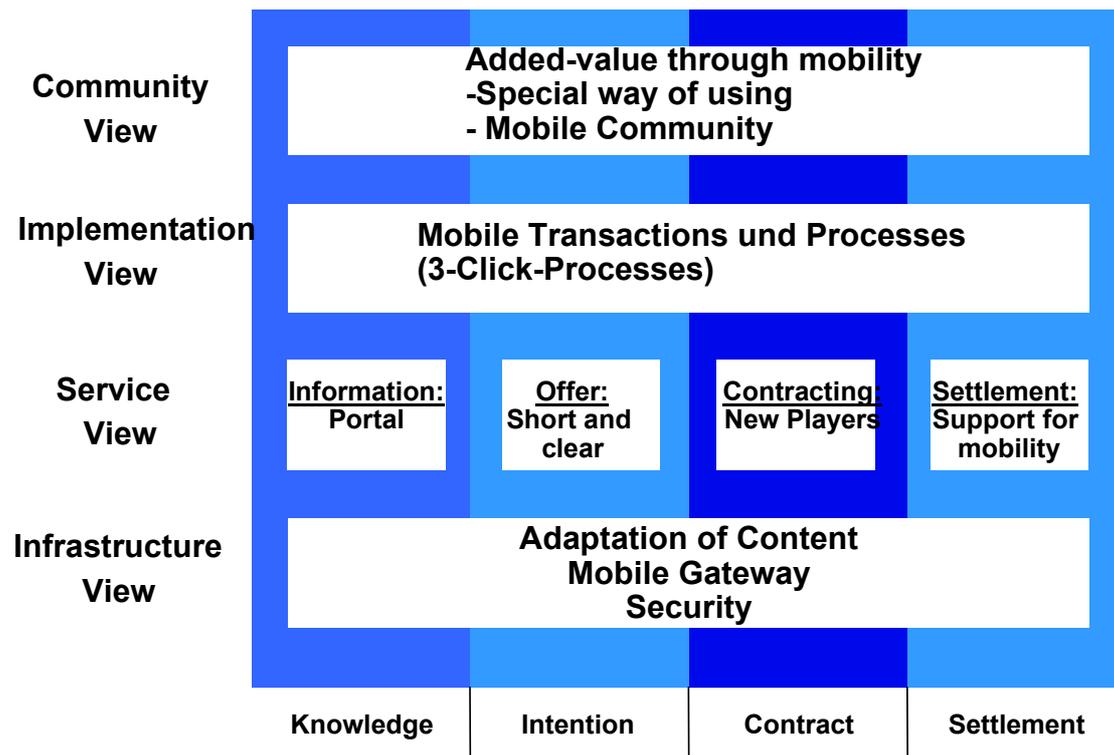
Figure 3: The reference model for m-commerce applications

5.1 The Community View

As already mentioned in section three, there are two critical success factors for mobile applications:

- There should be a broad potential user group, familiar with the technology and willing to use it for m-commerce.

- Mobile applications provide added value only in specific situations, so that the mobile application has to be carefully designed to meet the requirements of the special situations and of the potential users.

Therefore, the basic task in the community view is the assessment of the potential target user group and the identification of both user needs and mobile situations in which the offered services provide added value for the user. In order to achieve this a customer-oriented approach has to be chosen. According to (Pedersen et al., 2002), customer-orientation can be attained, if the potential customers are analyzed from three different points of view: as technology user, as potential customers and as network and community members.

- *Evaluation of potential customers as technology user* – a mobile application is only possible if in the target user group a significant number of users is already using the required mobile technology. For example, if the intended application requires a mobile phone with a Bluetooth interface and the target customers use manly older phones without such an interface, than the adoption of the new service will be much slower. In addition potential fears of users related to the technology as for example privacy concerns, security and trust should be assessed and addressed (Einwiller 2001).

- *Evaluation of potential users as customers* – As findings in section three show, mobile applications have a chance to be successful in specific mobile situations.

1. So the first important question would be: *Can such situations can be identified in the buying process of the target customers (Zobel, 2001)? Can the target application help the customer to save time, to be more efficient or to entertain him?* In many industries such suitable situations can be found. For example in the construction industry during work on a specific building far away from the fixed-net connection, or in the tourism industry by offering customers the possibility for spontaneous reservation of hotel rooms and restaurants.

   This first step of analysis results in a set of possible ideas about the features and scope of the intended application.

2. The first set of ideas might be too broad and conflicting with already available services in the physical and Internet channel. Thus, the next question that needs to be answered is the following: *What is the added value of the mobile application compared to the already available channels? Would the mobile offer be complementary to the offer of the physical and Internet channel?*

   For example a retailer of office appliances might offer its customers – purchasing managers of customer companies – to send them an alert, when specific goods are sold out per auction. Other examples are the mobile banking solutions, which provide a selection of services available through the physical and Internet channel suitable for users on the move. The analysis of the relationship with existing services will result in many cases in a narrowing of the set of target services defined in step 1.

3. The next question that needs clarification is: *How does the intended application support the different phases of the customer life cycle? Does it add mobility specific functionality to any of the phases?* (Pedersen et al., 2002).

   For example: One aspect of a mobile banking solution could be the notification of the user about changes in stock prices. But if the application stops here and does not offer additional support for taking immediate action in terms of selling or buying stocks, only one part of the potential added value is delivered to the user.

   This step might result in further clarification of the necessary scope of the target application.

- *Evaluation of customers as network and community members* – The final evaluation step has to be taken with respect to the customer as network and community member. Experiences from Internet have shown, that community building among online customers is a critical success factor (Stanoevska-Slabeva, 2002). The same can be transferred to mobile applications as well (see also (Zobel, 2001]). Important questions with this respect are:

  - Do the intended services provide enhanced life-style effects for the customer?

  - How does it relate to community building efforts in the physical and Internet channel?

  - Does the application improve social life of the potential users?

Through the triangulation of customer evaluation the possible and required features of the target application can be narrowed down to a concrete concept comprising a clear distinction of the target group, the added value of the target application, and a first idea of the required services and processes that need to be supported by the intended mobile medium.

5.2 The Transaction View

Based on the results of the community analysis, in the transaction view, the core processes are identified. According to the findings in section three, the processes of mobile application need to be adjusted to the features of mobile devices. This means they should be streamlined in a way to allow finishing of full transaction with several clicks. In addition process steps should be easy comprehensible and intuitive for the customer. One possibility to achieve processes of several clicks is by way of creating synergies with existing channels. For example Amazon.com provides m-commerce only for already registered customers that have also registered for the 1-click ordering and buying process (Lerner 2001). To be a 1-click-customer at Amazon.com means that the customer is a registered user and has already entered the preferred delivery method and address as well as payment procedure. Given these information in the background enables mobile ordering by 1 click, as all relevant information do not have to be entered again. Another possibility is by combination of different communication channels – for example more complicated steps of the process might be performed through the speech channel.

If the process consists of several steps, as for example auctioning, the user has to be informed at each stage of the process what the status is. In addition the transition from step to step should be possible in a smooth manner.

5.3 The Service View

In the service view specific services have to be defined for each step of the market transaction.

Knowledge Services:

In the context of mobile application available knowledge has to be adapted in two ways:

- The knowledge sources, as for example electronic product catalogs need to be summarized, so that they can be displayed on the small screens. The importance of the right wording is increasing as one word represents a whole process or great amount of information. In some cases replacing data sets with short codes summarizes complex data.

- Search should be supported in an efficient way, so that the user can find relevant information with view clicks. Amazon.com leverages existing customer profiles to achieve this. The customer gets as a first selection on the phone products matching his preferences.

Very important for the success of mobile applications is the availability of information about customers' preferences. This should allow for personalized offerings of information and services. Examples of relevant customer information are user profiles, shopping and wishing lists, and the purchasing history of the user. In the future it will also be necessary to combine location information with the available profile information.

Intention – Offer and Counteroffer:

While knowledge sources support the retrieval of broad information about products, the intention services provide support for providing structured and binding offers. Again, due to the small screen, with few words it should be clear for the user what the offer is and what additional actions are required from him to finish the market transaction.

Contracting- Negotiation

As in the case of e-commerce legally binding contracts in written form are only necessary, if the product is of high value. Given the usage patterns for m-commerce, we can expect that in most cases not very expensive products will be traded. This means that in m-commerce also the full form of contract will not be necessary. However, at least the essential confirmations should be send to the user. After the consumer has confirmed the purchase he should get a confirmation, that the transaction has been processed successfully. Combining the wired and wireless channel can again be of advantage, so that a short message is received per mobile device and a longer one per mail, where it can be printed and further administered by the user.

Negotiation processes require a higher level of coordination in mobile applications as less information can be displayed. One emerging form of negotiation in m-commerce are auctions.

Settlement:

Settlement comprises services that support fulfillment in m-commerce. Fulfillment means providing support for payment and delivery. M-commerce might in many cases require additional flexibility of existing fulfillment support in the Internet or physical channel. Given the time critical and mobile character of m-commerce, delivery might be requested to another place that the registered address of the user. For example, when ordering urgently needed spare parts for a construction side, the customer would wish to get the parts fast and on the construction site. That means, that the anywhere and anytime concept of m-commerce might be disturbed, if fulfillment is not possible anywhere and anytime as well. As this is in conflict with the limited possibilities of available devices, the customer could be offered the possibility to enter several delivery addresses and to choose from a simple menu.

To support m-commerce, logistics should in general allow for easy change of place of delivery depending on the current location of the customer. Logistics is a crucial aspect, as it has to be evaluated if such a service is possible with the existing Internet or physical logistic services in the company.

Another part of fulfillment is payment. In the last view years several concepts for mobile payment have been launched on the market (Kieser, 2001), but have up till now be mainly applied as additional possibilities of e-commerce applications. At present, it is not clear, which m-payment solution will be successful on the market. Existing m-commerce applications apply basically the conventional payment methods as credit card, payment per bill for registered customers or in cooperation with the mobile operator per monthly phone bill.

5.4 The infrastructure view

In the infrastructure view the requirements are matched to necessary software modules and applications that are available on the market or have to be developed. In general a mobile application will comprise the following specific modules:

- Support for content management capable of providing suitable content for different end devices.

- Mobile middleware, capable of automatical recognition of end device type and adoption of content. An overview of available middleware can be found at (Nösekabel, 2002), (Varshney & Vetter 2002).

- Security support in terms of policies for application access and encryption (see for example (Thome, 2000), (Bohn and Karjoth, 2001)).

- Middleware providing support for integration with legacy systems and services available in the Internet channel (Steimer et al., 2001), (Shih & Shim 2002).

6. Conclusion and Further Research

The aim of the paper is the provision of guidelines for development of m-commerce applications. In order to achieve this the main terms related to m-commerce were defined. Than based on an extensive desk research the main features of mobile technologies as well as of successful mobile application were extracted and summarized. Finally based on the findings and the media reference model guidelines for development of m-commerce applications were developed. In a next step the reference model for m-commerce will be validated through in depth case studies.

Acknowledgments

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