

# Mobile Commerce: An Overview

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Seminar "Mobile Services" ,  
Technische Universitaet Berlin

SS 2010 (Version vom July 11, 2010)

## Abstract

The evolution of Mobile Phones is making them an integral part of the life of their Users. Many tasks which were done manually or in a Personal computer setting are now being preferred to be done on Mobile Phones. The mobility, connectivity and increasing processing capabilities makes them powerful mediums of Commerce. This paper discusses some of the contemporary mCommerce solutions, in terms of their penetrations and application scopes. In the end these solutions are compared and respective advantages are discussed.

## 1 Introduction

Mobile Phones revolutionized the communication industry. With the number of subscriptions predicted to reach 5 billion (in a world of just under 7 billion people) in 2010, the penetration of the service into the populace is not only remarkable, but has also fueled the development of the service itself. The complexities in the design of hardware and the nature of services offered on them has increased many folds and has been welcomed by the users. Advancements in integrated electronics enable availability of many kinds of technologies, like broadband internet, in Handsets and the supporting service networks. All these developments open up the possibility of offering the user many services of unprecedented nature. Nonetheless, the goal of all the services in one way or the other has to be generation of revenues. This represents an ever increasing scope of Mobile Commerce or mCommerce as a subset of the more generic Electronic Commerce or eCommerce, which in general too has been booming with the increasing popularity of the Internet.

It has been argued that, till now mCommerce has employed on the transformation of the conventional Internet based business model of eCommerce on the mobile setting. And since mobile devices provide added values like ubiquity and context-sensitivity, it is vital to add these values into mCommerce for them to succeed to their true potential. Also the existence of standardized and widely acceptable mobile payment methods is crucial for the success of mCommerce[CMPP2002].

Aside from the technical challenges, the centre of mCommerce is the Customer/User. The acceptance of a particular payment procedure is critically defined by the convenience it offers the User. One of the reasons why mCommerce can be considered a subset of eCommerce is extraordinary relevance of Business-to-Customer (B2C) transactions.

Given the personalized nature of Mobile Phones in general it should be no surprise that the majority of expected transactions will be of the types B2C and Customer-to-Customer. Though revenues can be generated from both, the relevance of B2C is higher in terms of revenue generation for the industry and therefore more defining. The characteristics of these transactions also become more important for the User. Cost of these transactions will naturally be the most defining characteristic, it will determine the acceptability and shape the model of commerce that the payment procedure can target. Security, confidentiality, reliability and convenience are the other important characteristics that the user will concern himself with. These characteristics however, do not act as limitations, instead they proliferate the existence of several types of payment procedures that can target different levels of mCommerce. For example, a confidential (say a pre-paid method), less secure, small denomination payment method can come with lower costs; While a higher denomination payment method with more reliability and added security can be priced relatively higher. We will study the individual characteristics in detail in the subsequent chapters. But the fact remains that customer acceptance and choice remains the single most important factor in the success of a payment procedure for mCommerce.

## 2 Characteristics of Mobile Payment Procedures

Since mCommerce is a subset of eCommerce, it shares a considerable amount of characteristics with it. However, the mobile platform, has its own unique features, which can and should influence the design of mobile payment solutions. In this section, some of the most important ones of these characteristics and their relevance (in a mobile setup) are discussed briefly.

### 2.1 Participants

There can be several parties involved in a payment procedure. The nature and number of parties involved in the procedure will define a lot of other characteristics of the procedure. So, at this stage it is important to define these:

- **Merchants and Customers:** These are the end parties that are ultimately making the trade of good or services. Customers 'pay' the denomination to the Merchants. The customers might concern themselves with security and confidentiality in the transaction. The merchants on the other hand will be more concerned with the reliability. Both of them might concern themselves with the costs of the transactions depending on the business model of the payment procedure. Some models might impose a charge on both of them, while some make it more lucrative for the customers by requiring compensation only from the merchants.
- **Telecommunication Company:** These are the providers of the infrastructure of wireless communications. They can also be a part of the revenue cycle in case they provide specific gateways for the procedure. They can either assume the role of a Financial Service Provider (FSP) by paying the merchants and collecting the money from the user through their mobile phone bill. In this case they maintain the responsibility of the user's data and the risk of collection. Or they could facilitate other Financial Institutions like banks and credit card companies in making the transaction, for example by storing the credit card information in highly encrypted sim cards, which can then be used to settle the payment through dedicated telco servers. The involvement of telcos can lift the hardware dependence of the payment procedure.

- **Financial Institutions:** These are the financial institutions that are already maintaining the finances of the Users. They would normally be the final payment settling agency on the behalf of the user, either on debit or credit, depending on the nature of services subscribed by the Users. The involvement of Banks in the payment procedure can really simplify it, since they are already the 'trusted' partners of the users have dedicated systems for security, reliability, extensive facilities for settlement of the payment and they already possess the Users' data. Banks can make the payment procedure independent of Telco's and Hardware.
- **Other Intermediaries:** These are the companies that may provide or develop a payment procedure. Their roles include consolidation of all (or some) the above mentioned parties to provide the procedure as a complete solution, for example providing the same service in different regions where the involved parties (banks and telcos) may differ. They can play a significant role in adding to the convenience of a payment procedure but will add to the costs since they become an addition to the revenue sharers. The role of such companies might also become significant in security (in case they receive the User's data) and confidentiality (depending on the nature of service they offer to their subscribers).

## 2.2 Costs

All payment procedures require dedicated infrastructure. This infrastructure can be distributed amongst all the above mentioned parties. Users might need to possess specific hardware that facilitates them to use certain payment procedures. Telcos might need to issue special sim cards and maintain servers needed for the payment solution. In case the telco provides payment through their own bills they will require additional systems (or insurances) for bill collection or item repossession like the banks. Banks have their own well established costs. Intermediaries, depending of the nature of their involvement will also need to be compensated for their services. All these factors determine the final cost for the payment procedure. Costs though inevitable are undesirable by the Users.

## 2.3 Security

User's data and thereby the access to their finances and purchases histories are the single most important pieces of information in any transactions method. The access and storage of this information is not only a financial risk but a legal liability as well since this information is designated to be protected by the laws of many countries. Extra infrastructure is most certainly required to protect this information. In general, these concerns are well address in eCommerce, and transformation of eCommerce procedures to the mobile settings benefit from exploiting the deployment and development of this infrastructure, leading to lower costs. On the other hand, the systems that are dedicated for mCommerce face unexplored threats and even today require development and testing.

Security also encompasses the idea of anonymity altogether. Anonymity in most cases is provided through mWallets and other prepaid systems. In these systems the Users pay in advance for spending 'credits', which can later be exchanged for good and services. Since the payment is settled in advance, mostly through cash, there is no need to require or save the Users data. This way the Users gain total anonymity from merchants and potential legal and illegal data sniffers.

## 2.4 Convenience

Convenience, in general, is an undefinable term. Different payment procedures can provide their own creative conveniences that may be relevant for different users. But by

large, it can be seen as the number of steps that the user must perform to make a successful payment. Most commonly, the steps can be divided into the following categories. (i) Prerequisites: these are the initial steps that the user must perform to enable himself to use a procedure, it can involve registration, procurement of dedicated hardware, purchasing pre paid credits etc. (ii) Initiation: This is how the user initiates the payment by first selecting the mode, providing the identification information in the form of mWallet, login name, telephone number etc. (iii) Authorization: In this step the user must identify himself as the bonafide owner of an account. This can be done through a password or pin. The creativity in providing convenience depends on the methodology used by the payment procedure to integrate the steps involved and reduce it to a minimum. This obviously comes with certain tradeoffs. For example if authorization is as simple as a CVC code printed on the back of a credit card, then the just the theft of the credit card can enable the perpetrator to have unrestricted access to the payment account. These steps become more critical in the case of mCommerce compared to eCommerce, since the mobile systems in general have higher latency. Authorization whether done through SMS's or packet data takes longer to complete on mobiles in comparison.

Convenience can also involve added benefits that might result from the use of a procedure. Discounts, special offers or simply reward points are used by many payment procedures to attract customers.

### 3 Existing mCommerce Solutions

Since the conception of the idea of mCommerce, several payment solutions have been developed and tested. Unfortunately, most of them failed in terms of customer acceptance, and could never widely deployed. In this section we explore some mobile payment solutions that have enjoyed customer acceptance and have been deployed globally.

The study of the characteristics of Mobile Payment solutions in the previous sections, help in developing a classification in terms of the FSP. The participant who holds the financial liability of the commercial transactions, determines a unique set of services and range of deployment of the payment solution. Obviously the final settlement agency in all cases are banks or credit card companies (except for in the case of cash-down prepaid services), but in most cases, as we will see in the following sections, that for the merchants and customers the final settlement agency is abstracted by the presence of a intermediary. The role of the FSP in Mobile Payment solutions cannot be understated. It determines the nature of good and services being traded, the type of infrastructure, costs and finally even the magnitude of the values of the transactions.

We begin with payment by SMS, one of the oldest mobile payment solutions and of the first methods to bill mobile media content. In the case of this solution the role of the FSP is played by the Telco, the transaction amounts are added to the users monthly billing cycle or deducted from the prepaid credit. Even in the case of mWallets accessed by SMS, we will see that the Telco maintains the role of the FSP since they have direct access to the mobile infrastructure. Next we have a look at Near Field Communications, RFID technology though not only limited to mobile payment solutions, which has undergone several successful trials all across the globe. In the case of this technology, the FSP cannot be defined. The role could be adopted by a intermediary company that provides the infrastructure at several merchant locations. Or in the case of larger merchants, especially in the transportation sector, could be taken up by the merchant itself. This would obviously lead to different costs at different merchant locations, even for the same customer and the nature of service could differ too. For example, in the future we might see banks providing Customer-to-Customer transactions by assuming the role of the FSP. Lastly we have a look at Web-based Wallets which made a successful migration from eCommerce setting to mCommerce. In this payment solution, the role of the FSP lies cer-

tainly with various intermediaries offering competitive services. These intermediaries must assume financial liability to provide their services across the regional restrictions of the Banks, Merchants and Customers.

### **3.1 Payment by SMS**

The Short Message Service (SMS) was originally developed as a communication tool. Its use was never intended for mobile payments, however, this had stopped its use in creative mobile payment methods. The most common method is the use of Premium SMS rates. Others include the use of standard SMS as an access to a prepaid mWallet. SMS technology is the simplest of its kind and needs no introduction. It is being used by billions daily for day to day communication with their friends and families. The ease of use is only eclipsed by the costs. Hardware requirements for the use of SMS is extremely low, the service itself is incredibly cheap all across the world. It is not a surprise that it has been turned into a mobile payment method all over the globe.

Premium SMS has been fueled by the evolution in Mobile Media. To procure these media items, like ringtones, wallpapers, the user sends a SMS message with a keyword pertaining to the media item, to a preregistered number. The user receives a WAP push information in a premium SMS, which can be used to download the media item. Receiving this premium SMS costs the price of the media item purchased plus a small overhead cost of the service. The media items are then delivered by WAP and GPRS over the phones browser. There is also a variation of this service where the costs of sending the SMS message to a preregistered premium number are elevated and used to collect payment. The use of premium messages has also been seen for collecting donations or funds from a target group. This is a very simple and specific payment method. Nonetheless is very lucrative for both the Telco's and mobile content vendors. Depending on their cooperation agreements, the revenues can be shared as high as by 50% [MTSMSB2006].

SMS has recently been deployed in many countries as an access to mWallets too. mWallets initially require registration at the providing company and then funds are pre-paid into these accounts. The User can then use SMS to transfer the money around, pay bills or make donations. In some cases the mWallets can be associated with telco billing, thus foregoing the requirement of initial registration and pre payment of funds.

SMS payment methods are in most cases targeted at micro-payments. It would be nearly impossible use them for higher denominations because of the lack of reliability and security. SMS was never intended to be used as a payment method. It was not even intended to be reliable method of communication. There is no guarantee of delivery of an SMS message, the contents cannot be natively encrypted. There is no method of authentication, until unless the phone itself is locked with a pass code [MTSMSB2006].

#### **3.1.1 SMS Payments Business Model**

The maximum scope of revenue generation from SMS payment methods is for the Telco's. They provide access for merchants to their entire cliental and operate and maintain the entire infrastructure. As mentioned before, the Merchants can agree to as much as half of the revenue generated from the user with the Telco. As per the industry trend we also see that very specific merchants dealing in mobile media content can benefit from this payment method. There has not been widespread adoption of this payment method by other kinds of merchants.

Users benefit from the convenience of mobile media delivered to them in a single easy step, sending an SMS message. The micropayment nature of this method minimizes the risk for the user. However, subscription models have known to be notorious for users. In such cases the users are subscribed to subscriptions of mobile media, accidentally or maliciously, but cannot detect this until the Telco bill is reviewed.

Even with limited scope and inherent security issues, this payment method and the industry around it has been hugely successful. Just the revenues from music delivered to mobile phones is projected to reach US\$ 32.2 billion globally by 2010[GPR2007]. And these trends show no decline even with other dedicated channels (for mobile media distribution) developed by hardware manufactures like Nokia and Apple for their smart phones.

The specific use case of SMS messages providing access to mWallets have recently enjoyed a lot of success in developing nations where banking infrastructure is not as developed as in the West. In this case the Mobile operator acts as the financial institution and earn all the revenue. Users are charged small fees for making deposits into their mWallets and also must pay per transactions. This way the users can transfer money to registered or unregistered users and can also pay bills to Merchant companies. Agents are hired by the service provider to reach a wider audience. One such successful service is m-Pesa offered by Safaricom in Kenya. More such services are running in South-east Asia, Middle east and Africa[DQI2009]

### **3.2 Near Field Communication**

Near Field Communication (NFC) is an extension of RFID to integrate the smart card interface and the reader into one single device. So like RFID it uses short range high frequency waves (13.56 Mhz) for data transfer between two ISO/IEC 14443 devices. In addition to ISO/IEC 14443, NFC is also compatible with ISO/IEC 18092 and ISO/IEC 15693 standards. The selection between the three compatible standards is done with an algorithm called NFCIP-2 defined in ISO/IEC 21481. It provides contactless communication for a range of upto 10 centimeters. In mobile phones, a dedicated NFC chip must be preinstalled to enable it to use this technology. But increasing standardization of the technology and the selection algorithm are facilitating inter-compatibility between a large range of devices.

NFC is being heralded as the future of mobile payments by many experts, and several trials are being conducted in many different countries to evaluate its performance and customer acceptance. The contactless nature of NFC, means that neither the reader or the smart card suffer any damage or wear and tear from extended use. NFC also adds the advantage of very high data transfer rates which give it an added advantage of speed over other mobile payment methods.

The integrated reader and card functionality of NFC coupled with Mobile Connectivity adds an enormous amount of potential applications to the traditional RFID. The Smart card interface can alongside an internet connected reader can be used to make payments over credit cards, bank accounts and mWallets. Payment solutions could deploy User data in SIM cards or they can maintain Over-The-Air Data distribution systems. This way the normal latencies of SMS and packet data transfer can be avoided. The additional reading capabilities built in the technology can be incredibly beneficial for Customer-To-Customer transactions, where essentially users can make financial transactions by simply bringing their phones with close proximity. This way error prone exchange of User data such as bank account numbers can be circumvented entirely.

The increasing popularity of NFC technology lies mostly in its potential to be a content delivery system alongside a mobile payment method. The bidirectional communication channel can be used to deliver digital products like mobile applications, e-tickets, ringtones, media etc. almost instantaneously after payment information is relayed by the users device in the first half of the communication session. The data rates of NFC coupled with high speed physical link capabilities, that can be very easily bundled in the access points, together form an incredibly fast and reliable communication channel that can even alleviate the loads from the mobile wireless networks.

### 3.2.1 NFC Business Model

The promotion and standardization of NFC was initiated by the formation of the NFC forum in 2004 by namely hardware manufacturers. Today the forum consists of over 120 members from various industry sectors, non profit organizations and educational institutions. All the industry sector members also stand to generate revenues from this technology.

Most apparent segments that can hope to generate a lot of revenues from NFC are the financial institutions. Credit card companies can reduce costs by shifting away from plastic cards which need to be shipped to the users periodically. They could migrate to over-the-air or SIM embedded information distribution systems, opening up possibilities for the Telco's to earn revenue alongside as well. Credit card companies can aim at increasing their revenues by allowing PIN less small transactions, which in many scenarios might work faster than cash payments as well. Thereby, increasing the User convenience as well. Similarly banks can promote debit card transactions through NFC while cutting down the costs of plastic cards PIN and TAN management. Banks can also provide value added Customer-To-Customer transactions, which can be extremely convenient for the transacting parties.

Merchants can use NFC to enhance the customers's shopping experience. Vendors of digital content can look forward to a new distribution channel. Vendors of physical items can make check out processes more efficient and can use NFC for providing users additional product information over the air. Studies conducted by Visa and American express conclude that NFC can speed up the check out process by upto 63% [CMPTIT2007]. In addition, smaller retailers (like tobacconists and magazine sellers), which nearly completely operate on cash transactions could include debit payment method for the benefit of their customers. The integration of NFC into mobile phones would reduce the costs of procuring and maintaining hardware from banks. These small retailers could benefit financial institutions by providing penetration into cashless micro-payments. A specific type of merchants that have been heavily involved in NFC trials are the Public Transport companies. The abilities to issue e-tickets and automated fare deductions over NFC is enabling them to reduce waiting queues of their customers and increasing the efficiency of their throughput.

For the Customers, NFC provides a faster and much more convenient method of making payments and receiving digital content, than any other mode. Customers might even look forward to subsidies on hardware from financial institutions for adopting NFC technology based mobile handsets. As the many trials across the world are making it evident, that customers and industry alike, are accepting the use of NFC as a mobile payment method[ANFCFMPS2007].

Widespread deployment of NFC as a payment technology is only hindered by the lack of infrastructure. The increasing and growing trials are slowly enhancing the infrastructure. But still a lot of costs are involved in migrating from contact based payment methods (credit and debit cards) to contactless ones. The investment required for the modification of the infrastructure could become critical to the cost of NFC as a payment method. Essentially the different segments of the industry need to align themselves to establish a well defined value chain. The work and growth of the NFC Forum is evidence of the progress being made.

### 3.3 Web-based Wallets

Web Based Wallets constitute all the eCommerce solutions that are being developed for the Mobile Context. These payment solutions benefit from the existing infrastructure, penetration, research and development that has been done in the context of eCommerce over the years. Applying these methods for Mobile systems usually just involves the

development of a native system or Web protocol API for access to the service servers.

These solutions require the User to register themselves with the service in advance and provide Credit card or bank account details. These systems are very secure because they inherit from the legacy of eCommerce. The costs associated with such services is also generally very low, some times none at all. They are able to provide familiarity and seamless integration from PC to Mobile for the users. However they suffer from the latencies in the mobile wireless network. But with growing Mobile Broadband Speeds, those issues are projected to be resolved soon. And unlike NFC, in these cases the Mobile device can only interact with the service servers. Thus two mobile devices cannot exchange user information reliably and quickly.

These systems have however developed and gained importance in mobile media content distribution. With the relatively recent concept of Online media stores, like Apple's iTunes, Google's Marketplace, Nokia's Ovi Store and Amazon, hardware manufacturers and Internet Media Giants have entered into the mobile domain in a big way. Mobile hardware is no longer being sold as devices but as 'Multimedia Experiences'. The growth of these online stores, threatens the traditional media distribution scheme operated by the Telco's. Currently the penetration of these 'Experience' devices is very less but is gaining fast. These devices have not only increased media consumption in its users but have also consolidated the distribution of Mobile Media in the hands of a few companies. And the chosen method of payment in all of these stores without exception is Web based wallets.

While some of these stores deal exclusively in digital media content (iTunes store and Ovi store), others also provide comprehensive wallet solutions for purchase of other physical goods in an eCommerce scenario (Google checkout and Amazon Payments). Thus, conceptually they can be coupled with mobile ticketing solutions (like two dimensional matrix bar codes) and be used even for more on-location transactions, like in the NFC setting. However, these wallets could also develop to integrate NFC technology in their solutions and enhance their services, like automated billing etc.

### **3.3.1 Web Wallet Business Model**

Web Wallets have the advantage of simplicity. They have the simplest hierarchy in terms of value chain. Financial Institutions have not involved directly. The service provider mediates all payment details on its own end. The service provider has the responsibility of the security of User's data. And if desired, the service provider can provide complete anonymity to the Users. Telco's are also not explicitly involved in the procedure, but could find a role in providing infrastructural support in accelerating the procedure.

The only party that can claim revenues is the payment service provider. Companies with business models built on top of these services can also generate revenues by providing additional services. Usually all these services requires both merchants and users to pre register with them. Merchants are then informed about the transaction fee that the provider expects. The merchant must then price his products and services taking the fee into account.

## **4 Conclusions**

mCommerce, even though is a subset of eCommerce, requires development of specialized payment solutions. Many such solutions failed, mostly because of lack of user acceptance. An ideal Mobile Payment Solution should be easy to use, secure and cheap. Payment by SMS has some of these benefits but lacks security. Nonetheless, the SMS solution has been greatly successful all across the world, and has promoted the mobile media content industry. SMS however unreliable, is revolutionizing the way people do

banking in the developing nations of the world. This shows us that familiarity and ease of use are key factors to the success of a payment solutions.

We are also seeing development in NFC technology. Customer response to it as a payment method has been staggering. However the modifications required in the infrastructure for widespread deployment of NFC, are extensive. In addition, the short range of NFC could turn out to be a limitation. Advancements in the the WiFi standard, are allowing hosts to connect to each other without the need for a router. WiFi has exceptional security, range and data transfer rates in comparison to NFC. Web wallets are simple transformations of eCommerce and in need of a device intercommunication system to be regarded as a complete mCommerce solution. But their increasing role in mobile media distribution will be a threat to SMS payment based media distribution.

Thus there is a lot of scope still in the development of a comprehensive Mobile Payment Solution. While no solution can call itself complete, many standardized technologies are present (and being further developed) for the specific setting of mCommerce. More effort is required from the different sectors of the industry to come together for the widespread deployment of mCommerce.

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