TECHNOLOGICAL ASPECTS OF MOBILE PAYMENTS ORGANIZATION

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Abstract: article presents some technological aspects of the design of mobile payment system (MPS) as a preliminary phase in the life cycle of software development. Some models for m-payments are summarized and services for mobile communications are discussed. Generalized organization of communications in MPS is presented and formalization of two types of processes between participants in m-payments (client to client and client to business) processes in MPS is made.

Key words: mobile payments, mobile models and services, formalization, C2C and C2B communications.

1. INTRODUCTION

The development of commercial relations oriented to e-business and e-commerce permits to grow the role of mobile communications at different payments making. In this reason notions as “mobile wallet” and “mobile money transfer” have been established as a synonymous of mobile payment (money transfer by using mobile communications) [1]. This is a type of payment services, realized by using mobile devices “such as a cell phone or tablet computer” [2] and on the base of financial regulation that is engagement of international institution [3, 4]. For example Richard Kemp has written in [4] that the participants in mobile payments “need to carefully assess their and others' roles and regulatory aspects in determining their strategy and how to approach contractual discussions” but he notes also that “m-payments are giving rise to the development of a new ecosystem of market participants including card schemes”.

Cash payments exchange with mobile payments permits saving in time and cost. In other hand, this opportunity makes easier the banking [5] because the number of used mobile phones grows and there are many applications for online money transfers. The new technologies for mobile payments (using barcodes, QR-codes, cloud services, etc.) are opportunity for improving traditional payment methods (cash, cards, etc.) but authors of [6] put the question: “Will these new

technologies increase the overall value of mobile payments for end users, namely merchants and consumers, and motivate them to use mobile payments?". To answer this question the authors made comparative analysis of current payment environment (by cards) and mobile payment technologies and associated business models – Near Field Communication (NFC), Barcode and Quick Response (QR) and Cloud technology [6]. Some important key attributes of mobile payment for customers as experience, cost, customer's data control and security are discussed in the light of mobile commerce (m-commerce) perspectives.

The m-commerce is the logical continuer of e-commerce and e-business [7, 8] because it gives a wireless medium for communications and money transfer and could transform retailing [9, 10]. In this reason the mobile money transfer is a suitable and easier solution of the important side of e-commerce – the payment. The m-commerce technology is "similar and differs from e-commerce technically" [8]. An evaluation of mobile market advantages is made in this article and most important assessments are communication with customers by using mobile phone (92%), using different channels to reach customers (82%) and opportunity for targeted mobile marketing (50%).

Of course, very important problem of m-commerce and mobile payments is privacy of customers and protection of their personal data. The problems of customer's privacy are discussed in [11] on the base of the main epigram that "credit/debit card payment transactions do not protect the privacy of the customer". Authors propose an alternative mobile payment model called "Pre-Paid Mobile HTTPS-based Payment model.

The general goal of the paper is to define some architectural problems of designing mobile payments system (MPS – M-Payments System) and particular to discus some technological aspects of organization and formalization of system processes. In this reason the rest of the article is organized as follows. Section 2 discuses the main models of mobile payments (m-payments) and supported services for mobile interactions. Section 3 presents a generalized conceptual model of m-payments and formalization of two types of processes between participants in m-payments – client to client (C2C) and client to business (C2B). Simulation of MPS work and software development on the base of the formalization is planned as a future work. The idea for future work is discussed in the section 4.

2. MODELS AND TECHNOLOGIUCAL ASPECTS OF MOBILE PAYMENTS

The models for mobile payments could be defined as tree types presented below.

♦ ***Mobile payments based on bank accounts.*** In this model the bank accounts are directly connected to the phone numbers of all users and the mobile connections between participants are realized on software level. The process of payment (C2B type) starts after transaction via mobile device from the client (C) to

the tradesman (business – B) and the financial (bank) transfer will be made from the C-account to the B-account. The same model could be used for C2C and B2B transfers.

♦ ***Mobile payments based on credit cards.*** The credit card is connected to the user's phone number and the payment processes are identical with these in the previous model. In this model the transfer is made from customer's credit card to the tradesman credit card. This model could support the business models C2B, C2C and B2B. Payment system based on this model could be developed with an additional security level by using new technologies in this field (see the proposal of [11] presented in the Introduction).

♦ ***Mobile payments based on on-line invoicing trough telecommunication companies***. This model is based on adding all customer's payments to the phone charge for the current month. In this reason the customer will communicate with the telecommunication company only. This makes the payments easier for the customer. The processes of payment and could be defined as a two sub-processes named "prepaid airtime" and "postpaid subscription".

Each MPS refers to a system using mobile devices to make transactions for payments and bank transfers to any business participant in the process. This system should be designed on the base of selected model for m-payment realized traditionally through the network. All models determine the importance of banks and financial institutions in the process that have played a very important role for support financial transactions. Other important participants in the process are the mobile operators because they should support secure telecommunication services. In this reason an acceptable model for MPS organization should be developed before its realization. It will be good if the security issues in MPS from the customer's point of view are presented in this model. A similar model based on Unified Theory of Acceptance and Use of Technology (UTAUT) that modifies the Technology Acceptance Model (TAM) is proposed in [12]. The model describes by different constructs the concepts of security, trust, social influence, and computer efficacy and has been examined through an empirical study using structural equation modeling techniques. A conceptual framework of adoption enables, drivers, and barriers with propositions to guide future research in m-payments have been determined as a result from modeling.

A brief summary of technologies for mobile transfer of money is presented below. This will help to construct a life cycle model and to design a generalized architecture of mobile payment that could be used to make simulation of interaction between m-payment participants.

Two main parameters should be defined for the purpose of m-payment processes modeling: the channel for mobile data transfer and locality of client application. It is known that the mobile devices could send and receive mobile data by using 3 basic channels – SMS, USSD and WAP/GPRS. The client application could be installed in the mobile device (if it has an operation system), in the

subscriber identification module (SIM card), in the separate server accessed by mobile phone or to be integrated at the contactless smartcard used NFC technology.

♦ ***Short Message Service (SMS)***. This service permits to send text messages with a limited number of symbols (140-160) and it is supported by all types of mobile phones and mobile operators. SMS messages and phone calls are realized by same networks but the channels for access are different (this determines different workload of the channels). This permits to use SMS for giving information about client account status or for sending payment instruction (transaction messages). The SMS technology is based on saving and retranslation.

♦ ***Unstructured Supplementary Service Data (USSD)***. This is unstructured additional service for information transfer between mobile phone and server supported by the GSM communication protocol USSD. This technology is unique for GSM. It is built in the standards for mobile communications and secures session-based communication with different applications. The technology is oriented to the sessions and transactions and permits more quick processes.

♦ ***WAP/GPRS***. Another mobile service is General Packet for Radio Services (GPRS) that permits communication based on packet transfer of data via network. It gives opportunities as Wireless Access Protocol (WAP), MMS sending, Internet access, e-mail by using IMAP or POP3. WAP is created to secure open standard for mobile devices to access Internet/Intranet networks. WAP works well at the limited parameters (small screen, limited memory, narrow bandwidth).

♦ ***Phone based applications (J2ME/BREW)***. J2ME is a version of the standard platform J2SE and could be used for programming of small electronic devices with limited memory. This device must have implemented Java Virtual Machine (JVM) for realization program instructions. The client application requires preliminary configuration into mobile phone. This will permit the applications to be developed in binary regime for wireless (BREW) for CDMA mobile phones. The main advantage is that the user phone personalization could be made directly through the network.

♦ ***SIM-based applications***. The SIM cards in mobile phones are specialized processors because they have personal computational power and memory. The information into SIM cards could be protected by using cryptographic algorithms and keys. This determines higher security of applications for SIM cards. The advantage is that the SIM card could be used in different devices because it is the information medium.

♦ ***Near Field Communication (NFC)***. This technology permits to unite RFID and mobile phone. The devices with this technology could be used directly as wireless cards. NFC is a collection of standards for smart-phones. The platform Android support NFC and functions as Android Beam (data exchange between devices) and Google Wallet (for mobile payments) are realized. The main

advantages are that the payment could be made by contact with payment terminal and transactions protections by using Personal Identification Number (PIN).

♦ ***Dual Chip***. The technology is similar to SIM-based because uses pre-programmable cards but the device must have two slots for cards – for traditional SIM card and for the cord for mobile payments (the second card must be used for installation of additional application for payment only). This manner is preferable for financial institutions because they could make full control of mobile payments, but this imposes additional investments by the users.

♦ ***Applications for operating system***. This approach uses embedded operating systems (OS) as Android, Blackberry, iOS, Windows Mobile, etc. and the mobile wallet could be developed as a separate application installed as a software module in OS. This module could support many debit or credit cards for one account.

3. FORMALIZATION OF MOBILE PAYMENT PROCESSES

Generalized conceptual model for mobile payments organization is shown in figure 1. This formalization presents the main participants of a MPS.

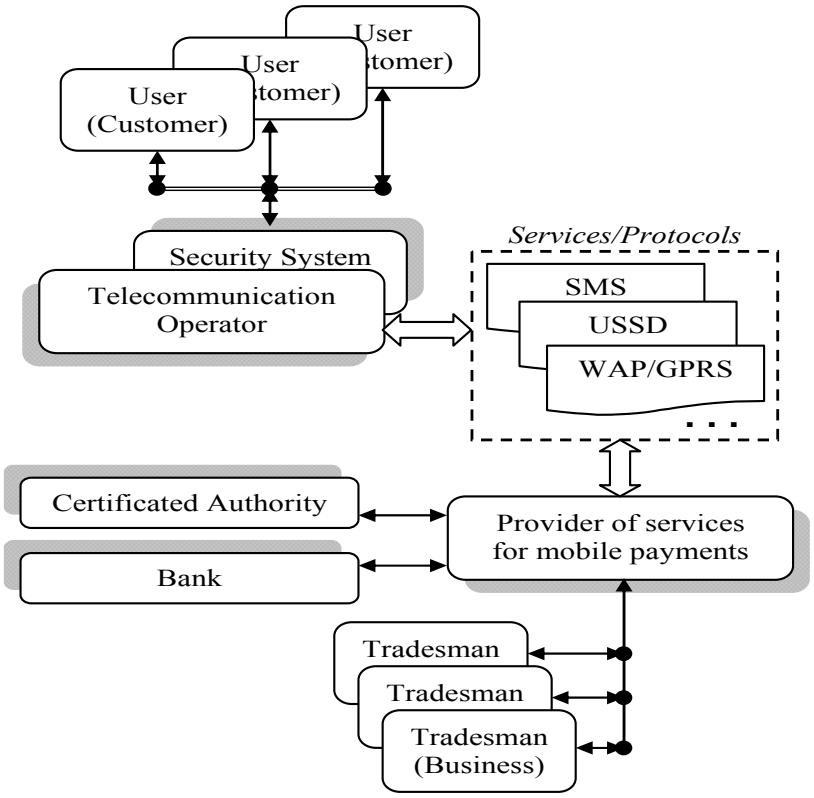

Figure 1. General organization of mobile payments

The end users of MPS are clients (C) and tradesmen (business – B). The provider of mobile payment services gives the technical infrastructure (software and hardware) for organization of financial transfers and makes the relation between financial institutions (banks) and operators of mobile networks.

The users must make registration in MPS before using of its opportunities. In more cases this registration is half-automatic – some additional activities made by user are needed (preliminary approbation, additional annex, etc.). The final step of registration is linking phone subscriber with bank account, excepting if the payment is made in the frame of month charge of the user.

Formalization of two processes in MPS between the participants in mobile payments is discussed below.

3.1. Formalization of communication process "Client to Client" (C2C)

Formal model of C2C communication process is shown in figure 2 and the main steps are presented below.

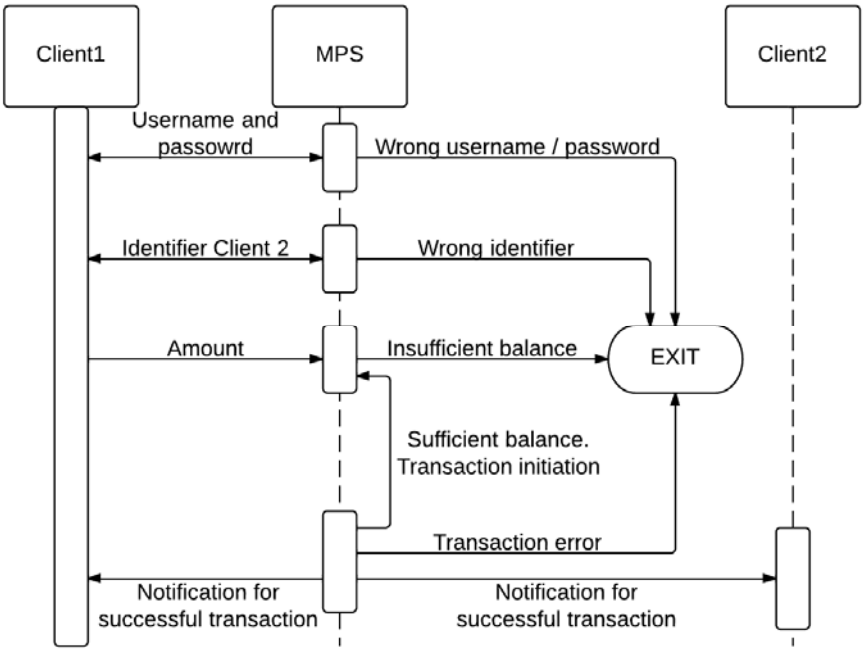

Figure 2. Formalization of the C2C communications

(1) Client1 enters username and password for logging on MPS

(2) MPS checks the correctness of the data and initiates a session (in case of correct data) or denies access (in case of incorrect data entered) and returns the respective response to Client1's device.

(3) Client1 navigates in the application and choses to perform an operation for sending money.

(4) Client1 enters a unique for the system identifier which is used to connect to the account of one singe other user (which in the case is Client2 – the recipient)

(5) MPS again checks the authenticity of the entered for processing data and reacts respectively (identically to how it does in step 2)

(6) Client 1 enters the desired amount which to be sent to Client2.

(7) MPS checks the sufficiency of the financial balance of Client1's account and respectively denies the operation(in case of insufficient balance) and replies with negative response or allows the operation and initiates the requested transaction.

(8) MPS applies the respective (debit / credit) recalculation to the balances of the accounts of both participants in the transaction.

(9) MPS notifies both parties (Client1 and Client2) about the successfulness of the transaction.

3.2. Formalization of communication process "Client to Business" (C2B)

Formal model of C2B communication process is shown in figure 3 and the main steps are presented below.

(1) Client1 enters username and password for logging on MPS.

(2) MPS checks the correctness of the data and initiates a session (in case of correct data) or denies access (in case of incorrect data entered) and returns the respective response to Client1's device.

(3) Client1 navigates in the application and choses to perform an operation for sending money.

(4) Client1 enters a unique for the system identifier which is used to connect to the account of one singe other user (which in the case is Merchant1 – the merchant)

(5) MPS again checks the authenticity of the entered for processing data and reacts respectively (identically to how it does in step 2)

(6) The returned positive response contains supplementary information regarding the services that Merchant1 provides.

(7) Client1 chooses a service which he/she wants to pay and sends a request to MPS.

(8) MPS communicates with an external server by sending a request containing information about the service that Client1 wants to pay along with additional information (names, national id or other identifiers). That external server is responsible for Merchant1's activities as a business participant.

(9) The server from (8) determines the feasibility of accomplishing the requested process and returns the respective response to MPS. In case of a positive response it is required that the external server also sends information about the necessary amount that has to be transferred in order the operation to be successfully performed.

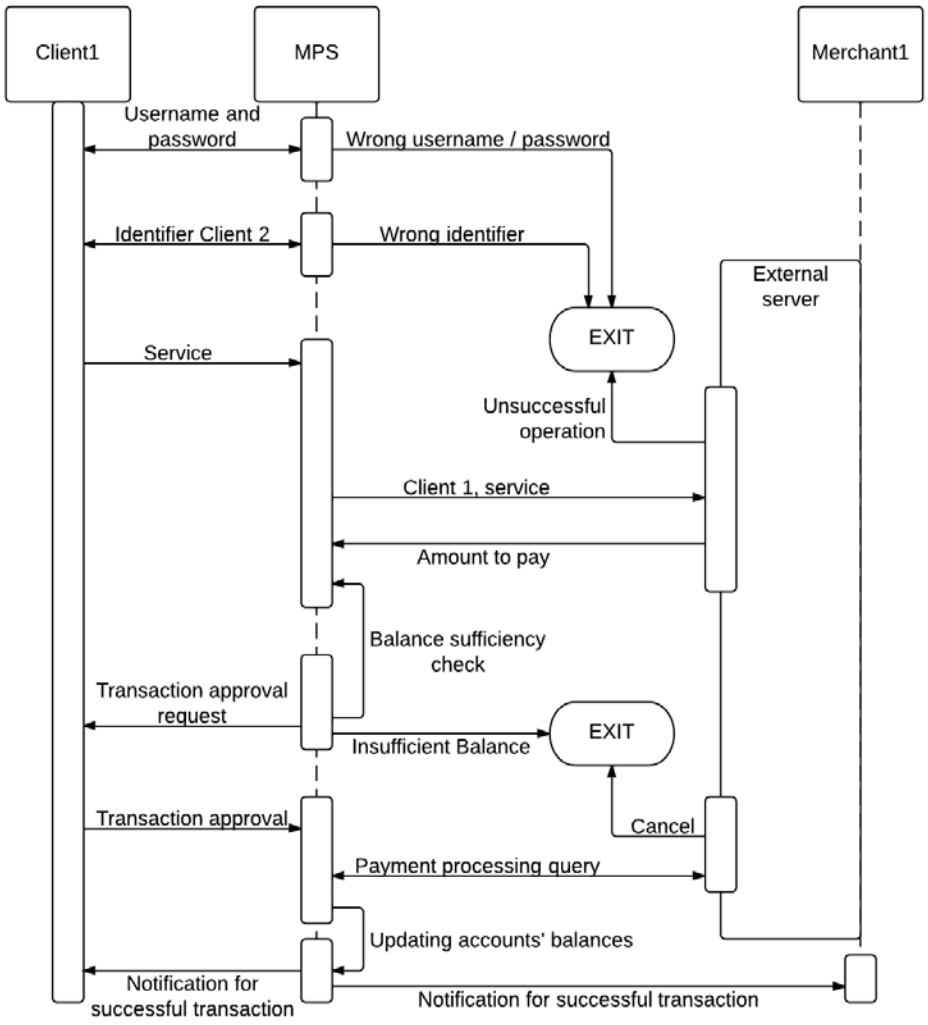

Figure 3. Formalization of C2B communications

(10) MPS sends a reply to Client1 containing information about the required amount that needs to be transferred.

(11) MPS checks the sufficiency of the financial balance of Client1's account and respectively denies the operation (in case of insufficient balance) and replies with negative response or allows the operation and ask Client1 if he/she wants to proceed with or cancel the operation.

(12) Client1 confirms or cancels the operation.

(13) In case of confirming MPS blocks the respective amount from the account of Client1.

(14) MPS again communicates with the external server to notify it about the possibility of performing the operation.

(15) The external server processes the request and returns a response notifying MPS about the successfulness of the requested operation's execution.

(16) In case of failure, the MPS cancels the transaction and unblocks the money from Client1's account. In case of success MPS applies the respective (debit / credit) recalculation to the balances of the accounts of both participants in the transaction.

(17) MPS notifies both parties (Client1 and Merchant1) about the successfulness of the transaction.

4. CONCLUSIONS AND FUTURE WORK

In the mobile payments landscape there is a lack of consolidated technology standards which to establish their universality. This can be viewed as both an advantage and a disadvantage. The absence of agreed standards provides scope for diversification and flexibility in the development of such systems, enabling technology companies to apply their insight on how the processes to be organized. This removes the restrictions on innovation and technology development in mobile commerce as a whole.

On the other hand, the development and implementation of standards for m-commerce can enhance security, control, and hence the confidence of the consumers. The standardization in the field depends on consensus among stakeholders in the m-payment processes but specific solutions are not only technological, but also largely political.

Nevertheless, the development of adequate MPS is the benefit of both consumers and businesses because it will allow the improvement of the investment policy and increase revenues. In this sense, the above formalization is an initial step for further development of a suitable MPS, which is consistent with the life cycle of software development. It will be used to create a simulation model for the preliminary study of planned processes in the system and its technological features and system parameters (volume, speed, adequate responses, etc.).

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