E-Wallet. A New Technical Approach

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Abstract: The goal of this article is to propose a new technical approach regarding the "e-wallet" concept. Although the "e-wallet" concept has many implementations, we consider that we can improve the present level of knowledge by joining the Near Field Communication technology and the "classic" concepts about money. In order to develop a new architecture, we studied the present level of knowledge in the scientific literature and in the industry and we proposed new elements for e-transfers. Also, we made an experiment and the result consists in a prototype based on the Android platform emulators using the Near Field Communication technology. Our electronic prototype will be able to act as a wallet by using only a mobile smart phone because the proposed architecture embeds concepts like money, cards, payments and receipts in a single secured mobile application.

Keywords: E-payments architectures; e-money; e-transfers; mobile payments

JEL Classification: O33; O31; E42; L15

1. Introduction

Any modern economy develops based on the trade exchanges that involve the making of money payments. In fact, the payment represents a money transfer from a beneficiary to an assets or services seller. The origins of the payments can be found in the antique barter system, which represented a payment in kind, through direct interchange of goods. Due to the reduced flexibility of this modality, there have been developed payments systems based on the fiduciary currency and more and more advanced systems.

During the contemporary period, a payment system represents a set of procedures and computer networks used to make the financial transactions on the value certificates market, on the money market and that of the derived instruments, as well as for the transfer of funds among different institutions. Another issue that is to be taken into account is that of the payments made by the retail clients for the individual acquisitions of goods and services. Certain authors from the specialty literature (Patel, 2010) consider that in the contemporary world the payment systems represent in fact a very important element of the modern money systems.

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In the modern world the frequent forms of manifestation of the payments involve the money, the checks, and the bank transfers and in case of the business processes such payments are usually preceded by an invoice or followed by a form of the receipt.

At this moment, the industry of e-payments is focused on e-transfers based on card emulation and there are many successful implementations described in (Hun, 2008; Izhar, 2011; Tang, 2009). All of these systems are focused on card or bank account emulations and that means that the user has to connect with the bank to generate a money transfer (ISIS, 2012).

Our goal in this paper is to create a new architecture in which the users are able to instantaneous transfer their money from one to another by using a simple and secured e-wallet from their smart-phones. The research methodology consists in studying the literature and in developing a new prototype for a practical e-wallet whose goal is to allow the instant money transfers between two users.

In fact, we propose a new vision for managing money in an e-wallet, by using the Near Field Communication (NFC) technology and the network communications. NFC is a short distance wireless technology that normally requires a distance of 4-10 cm to initialize a connection between two mobile devices. It is a standard that extends RFID (Radio Frequency Identification) combining the interface between a smartcard and a reader in one device. We used NFC on the Android mobile platform and we developed a prototype for a practical e-wallet.

2. Characteristics, Risks and Needs for Electronic Payments

The electronic payment systems have to meet several minimal characteristics in order to be efficient (Lee, 2011):

- Atomicity: this characteristic takes into account the fact that during the transfer no existing money is lost and no new money is created;
- The impossibility of the non-repudiation: none of the actors involved in the transaction can decline his responsibility conferred by the electronic signature.

Also, the solutions of the electronic payments represent the central point of different requests, more or less economical (Tan, 2004):

- Security: the systems must restrain the possibility of the frauds within the electronic environment;
- Fiability: the systems must be accessible and available at any moment in time;

- Cost efficiency: the transaction cost must be reasonable even in case of the micro-payments;
- Integration and scalability: the systems must be inter-operable with all the other existing systems; also, they must be able to integrate themselves with the new payment methods from the on-line environment;
- The easiness of using: any system of electronic payments must be accessible through different types of hardware terminals and from different software platforms;
- Confidentiality: the data regarding the parties involved into the transactions must be available for the others only up to the confidentiality level established by the collaboration protocol.

According to the requests imposed to the solutions of electronic payments, the digital currency has to observe several defining restraints; thus, it has to be (Lee, 2011):

- Universally accepted;
- Electronically transferable;
- Divisible;
- Impossible to falsify or remove without authorization;
- Private (nobody, except those involved into the transaction, knows the value of the transaction);
- Anonymous (nobody can identify the payer);
- Able to also be operated off-line, without needing a previous on-line verification.

Up to this moment we appreciate that none of the known systems satisfies all these requests simultaneously. Nevertheless, there are several advantages of the digital currency in association with the electronic payment systems (Silver, 2012): potential for an increased flexibility, reduced costs for the transactions made within the digital environment, great rapidity regarding the speed of the transactions. At the same time, one may remark several dangers: in certain conditions, there is a possibility to realize a perfect copy of the electronic transaction, which leads to the appearance of the vulnerability in front of the informatics attacks. Also, "the tracking" of the transactions may determine the access to certain private data of the parties involved in the operations of the electronic payments.

Starting from 2007 there took place several notable initiatives in Europe regarding the payments from the mobile environments.

Table 1. Important initiatives of the payments from the mobile environments

Country	Initiatives
Belgium	• The operators launch the payment made via the SMS;
Great Britain	• Vodafone and Citigroup announce a collaboration protocol for the payments from the mobile environment; • Contactless type combined cards between Barclays and Oyster;
France	• NFC (Near Field Communication) type pilot systems in Caen, Strasbourg, Grenoble, Paris;
Italy	• The CartaSi cards processor launches the payment service for the ski paths;
Norway	• Telenor and several banks launch the BankID system;
Holland	• NFC type pilot systems that use credit and debit cards;
Germany	• NFC implementations within the transport public system from the Frankfurt area;
Austria	• The Paybox operator attains 300, 000 users;
Croatia	• 50% of the parking fees are paid via mobile phones.

Source: Adaptation after (Jong, 2007)

As we can notice, the European area tends to adopt the systems based on NFC technologies on a major scale.

From a technical point of view a transaction of electronic payment takes place under the basis of the participation of several actors to the transfer process of the digital money. The on-line payment systems based on the use of a bank card, possessing as security elements a PIN password or a specialized chip, are often used. The main entities involved into such a transaction are:

- The seller: he offers assets and services to the buyer and he sends to the brokers the payment solicitation on the account of his labour conscription to the client. At the end of the transaction, the seller receives the payment confirmation by the client.
- The buyer: he buys assets and services from the seller and he confirms to the brokers the payment request from the seller. At the end of the transaction, the buyer's account is discharged based on the request received from the brokers.
- The brokers: usually, they are the cards issuers, the digital certificates generators or the electronic wallets treasurers. They play a key-role in the

processing of the transaction as they assure the transparent connection between the seller, the buyer, the seller's bank and the client's bank. The brokers manage the flow of payment and confirmation requests, finalizing a transaction that observes the criteria of the atomicity. The brokers represent in fact the guarantee that the payment transaction is made correctly and that no "new money" is lost or generated during the process.

- The bank of the client and the bank of the seller play the role of depositories and they confirm the data requested by the brokers.

Because there are involved so many actors in a simple transaction, the payments are sometimes made with delays from one day to five days (especially during the international payments). In terms of electronic transfers of funds from one user to another by using smart phones, currently there are not specialized applications. In the following chapter we propose a new architecture which allows users to transfer e-money with no delays, using two smart phones devices that have NFC capabilities.

3. A New Architecture for E-Wallet

We intend to facilitate the e-money transfer between the users who have smart devices with Near Field Communication technology and we propose a new architecture in the following figure. In the literature we didn't find the feature we implemented in the prototype. All the sources and all the applications developed in practice implements the transfers based on debit/credit cards or on bank accounts. Our vision is based on secure transfers of the e-money that is stored just on the smart devices.

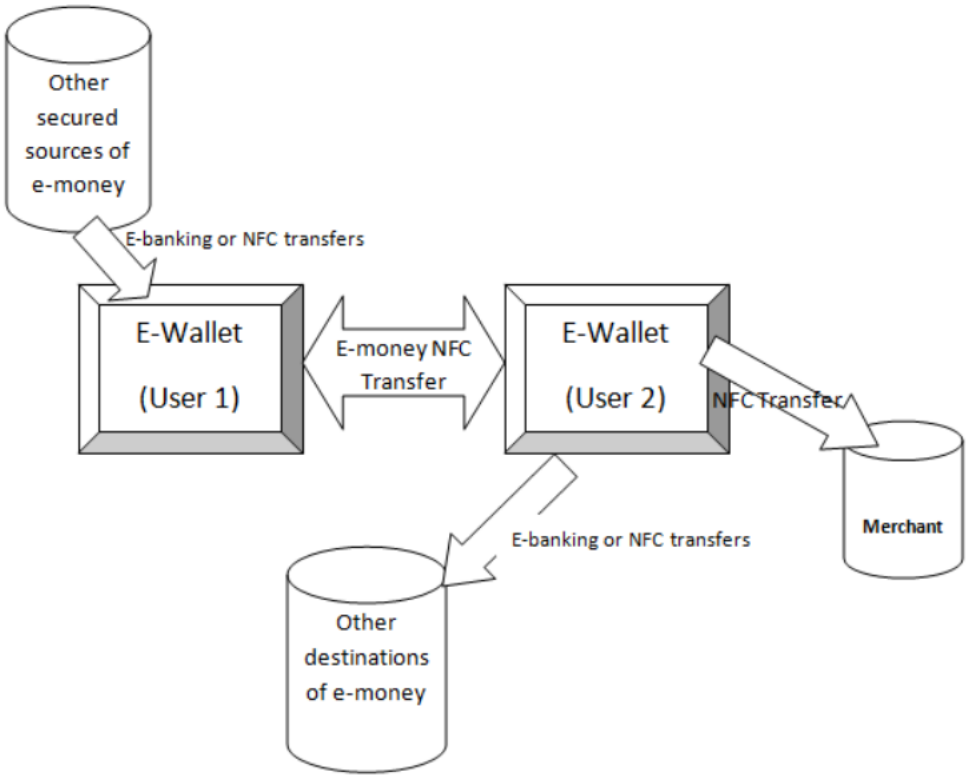

Figure 1. A proposed architecture for transferring e-money between two e-wallets

As it can be seen in the figure no. 1, we implement the e-money transfer between User1 and User2, supposing that both users have smart devices with NFC capabilities included. The money is stored in our secured application and it is transferred through the NFC tags. The application is developed on Android platform and uses NDF Data Exchange Format (NDEF) in order to transfer the messages between devices. Every message includes secured information about:

- The amount of transferred money;
- The security certificate of every monetary unit (because in our model, every monetary unit has its own security certificate);
- The payer;
- The receiver;
- The date of the transfer.

The application can run on Android 2.3.3 (API level 10) because it is necessary to be able to pass the NDEF message from one device to another (this is called *the beaming process*). The Android Beam allows passing messages between two devices only by touching them and it is not necessary a previous searching process

(like in the case of Bluetooth technology). At the implementation level, it is necessary to declare the specific permissions in AndroidManifest.xml.

```
<uses-permission android:name="android.permission.NFC"/>
<uses-sdk android:minSdkVersion="10"/>
<uses-feature android:name="android.hardware.nfc" android:required="true"/>
```

Also, our application uses some specific intent-filters.

```
<intent-filter>
<action android:name="android.intent.action.MAIN" />
<category android:name="android.intent.category.LAUNCHER" />
<
<intent-filter>
<action android:name="android.nfc.action.NDEF_DISCOVERED" />
<category android:name="android.intent.category. DEFAULT" />
<data android:mimeType="text/plain" />
</intent-filter>/intent-filter>
```

In order to implement the e-wallet features, we create a special record based on NDEF.

```
private NdefRecord newTextRecord(String text) {
        byte[] langBytes = Locale.ENGLISH.getLanguage().getBytes(Charset.
forName("US-ASCII"));
        byte[] textBytes = text. getBytes(Charset.forName("UTF-8"));
        char status = (char) (langBytes.length);
        byte[] data = new byte[1 + langBytes.length + textBytes.length];
        data[0] = (byte) status;
        System. arraycopy(langBytes, 0, data, 1, langBytes.length);
        System. arraycopy(textBytes, 0, data, 1 + langBytes.length, textBytes.length);
        return new NdefRecord(NdefRecord. TNF_WELL_KNOWN, NdefRecord.
RTD_TEXT, new byte[0],
data);
}
```

Every tag is transferred between the smart devices and it is intercepted by the "destination" e-wallet.

```
IntentFilter ndefDetected = new IntentFilter(NfcAdapter.
ACTION_NDEF_DISCOVERED);
try {
ndefDetected. addDataType("text/plain");
} catch (MalformedMimeTypeException e) { }
mNdefExchangeFilters = new IntentFilter[] { ndefDetected };
// Intent filters for writing a new tag.
IntentFilter tagDetected = new IntentFilter(NfcAdapter.
ACTION_TAG_DISCOVERED);
mWriteTagFilters = new IntentFilter[] { tagDetected };
```

Our application has been tested on an Android emulator and we obtained a rate of 100% successfully NDEF transfers between emulated e-wallets.

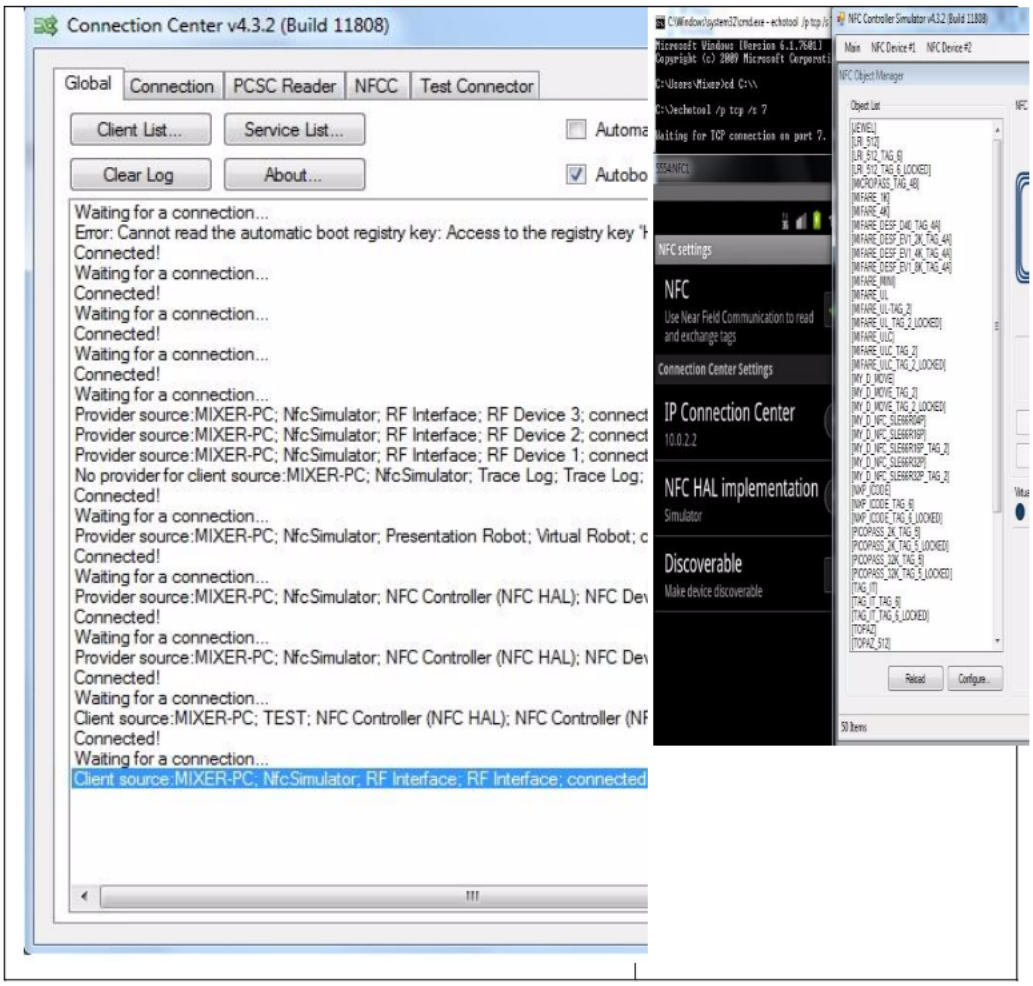

Figure 2. Transfers between emulated e-wallets

We identified some advantages for our proposed architecture:

- if the architecture is adopted on a large scale, the users will not have to use money, cards and the phone, but only the phone because the wallet is included in the device;
- the proposed e-wallet allows users to transfer e-money from one to another without any delay, because the transfer is made immediately;
- every monetary unit is marked with a security certification and the e-money cannot be multiplied.

Also, the architecture has some disadvantages:

- in case the user loses or destroy the phone, he will also lose the e-wallet and the money disappeared;
- by using the proposed application, the receiver of the e-money has to connect to internet in order to check the electronic certificate.

4. Conclusions

Taking into account the technological evolutions at a world-wide level and analyzing the investment intentions (PcWorld, 2012) of the companies, we may anticipate that the future of the electronic payments will have the mobile environments as a main infrastructure. The estimates (King, 2011) show that up to 2014, more than 50% of the "smart phone" type devices will contain interfaces that are able to communicate financial data without any physical contact with the payment terminal. The harsh competition (Paul, 2011) from the area of the contactless payments will probably determine the imposing of several strong standards meant to assure flexibility and security for the users in a global world.

Once with the proliferation of the "smart phone" type devices one may expect a reviving of the concept of electronic wallet that did not have any commercial success in the recent past because of the using difficulties.

Taking into account the foreseen technological evolutions, the strategies announced by the banks and by the great card issuer companies, as well as the increased needs of the buyers and merchandisers regarding the security and flexibility of the transactions, we consider that the future of the electronic payments systems will be based on the following defining elements: the mobile environments and devices, the electronic wallet and standards meant to increase the flexibility of the transactions.

5. Acknowledgment

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