



Opportunity Analysis for Developing a Micropayment System in Local Area Networks

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ABSTRACT

Although transactions with small amounts of cash are simple and quick, they still present drawbacks. The main issue is to drastically reduce costs for very small electronic payments and solutions have already started to be identified. In this paper, the proposed solution implies aggregating payments into a privately owned local area network that operates at low costs and making only one transfer to the banking systems for each buyer. The equipment used has to be easy to operate and straightforward, security procedures have to be simple and based on the rapport between the cost of fraud and the expected value obtained through fraud and rappings with the bank have to be kept within profitability margins.

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1. Introduction

Many electronic based activities have imperceptibly become common practice due to their simplicity, low costs or simply due to being fashionable. Such examples are GPS navigation, mobile phones or iPods. We are no longer disturbed by the fact that certain areas are under video surveillance for our safety or that we need to register in order to access specific services provided by a website or to follow certain banking procedures for operations exceeding a preset limit.

Referring to the financial sector, we can see how the system protected itself against malicious implications through a simple system that is still rather difficult to implement: traceability. In the case of transactions involving large amounts of cash, there are legal banking regulations that deal with the maximum amount to be withdrawn, notification periods for transactions, justifying the costs and monitoring transactions that surpass certain values. These norms have as aim limiting the use of this type of transactions in major illegal activities with identifiable and immediate effects such as drug or weapons traffic or terrorist acts.

Transactions with small amounts have the advantage that cash is either free or the bearer of small withdrawal commissions and can also be divided or aggregated up to a level that is considered acceptable by the partners. Despite all these, this type of cash transactions still have some drawbacks: cash has a "friendly behavior" towards tax evasion and its usage is not traceable.

Products that carry major risks, like weapons, are processed through a personalized selling system. When pollution from a specific product will lead to the death of an identifiable quantity of people, like in the case of death caused by fire arms, the product in question will be treated following the same personalized selling system. This is the case for certain drugs and other hazardous substances.

When non-degradable plastic recipients will cause human deaths (this being the projected case unless avoided by a series of new regulations), then drinks might be sold in identifiable recipients in order to make each customer responsible.

The major problems of traceable selling processes are generated by the huge amount of data that consist of product and buyer identification. If you add tracing the packaging and the content simultaneously then this problem can prove to be absurd because of the high level of detail implied. As in many other issues, we can divide this problem by focusing solely on identifying the customer, with no regard to the product or package. One viable solution would be creating a system of electronic micropayments that allow identification of clients and maybe the path of the product within a set of determined and regulated situations.

The point is not to reiterate the advantages of electronic payments, but rather to identify problems, solutions and specific advantages that generalized electronic payments of small amounts have.

In order to be attractive to the buyer, electronic payments have to be commission free. On the other hand, the debtor faces large operating costs for electronic payments. These costs are generated primarily by the

infrastructure that is generally on loan from a bank. These costs cover the use of equipment, communication and security systems, while also including maintenance and intervention fees in the case of malfunction.

It is obvious that these costs are the same regardless of the amount being exchanged. This shows that large transactions have an advantage over small and medium ones (but not too large as to trigger a different set of issues as presented above).

Therefore, the present issue is to drastically reduce costs for very small payments - some solutions having already been identified. Equipment costs are reduced by using already existing mobile phones and communication costs, by using the cheapest service available: SMS. If we assume that a consumer has already covered all costs regarding their mobile phone for other purposes, the only remaining cost is that of an SMS.

As this cost is roughly around 0.1 Euro, it is a reasonable cost for payments exceeding 10 Euro. What about payments of 1 RON (approximately 0.25 Euro)? In this case, buyers should not pay any commissions because, as mentioned above, operating with this amount of cash has almost no cost attached.

Taking all these into account, the only costs that have to be dealt with are those of the merchant. As the merchant has no control over the costs imposed by their bank, one solution would be for the banks' policies to be adapted. They can choose to reduce costs by aggregating micropayments and using a limit point for transactions or even other solutions for the case of unprofitable thresholds.

The paper presents traditional systems for micropayments created around the concept of online payments in the chapter two and how to reduce costs by aggregating payments in chapter three. In chapter four we will present some considerations about transaction security, traceability and acceptability followed by legal aspects in chapter five.

2. Traditional systems for micropayments

A part of these traditional systems for micropayments are created around the concept of online payments, requiring buyers to connect to the Internet through their computer. Generally these electronic payments systems fall under the category of "subscription based selling". [2]

Thus, the MilliClient [7] system developed by the Research Center of Digital Equipment Corporation uses a "script" purchased by buyers from a broker, a financial institution or provider of Internet services that is managed through a piece of software installed on the buyers' computer.

The NetBill [1] system developed by Carnegie Mellon University is based on a registration process for both buyer and merchant. After registering, they receive a set of keys, a private and a public one, that are used by specific software installed on their computer.

PayPal have developed their own electronic payments system, built on the CyberCash [8] system. They offer commission free transactions only to clients registered on paypal.com. Launched in 1998 in the USA and purchased in 2002 by Ebay, this service has been activated for the Romanian market starting with May 2007.

Recently a number of online payments systems that use mobile phones or other intelligent mobile devices as equipment have become operational for the Romanian market. One of these systems is MOBILPAY [9], which allows payments through SMS, using your own mobile phone. This service is destined for legal persons or authorized natural persons.

The Fortumo [10] system, also available on the Romanian market, allows users to send an SMS with the merchant's keyword to a surcharge number. The system will then distribute payments to all merchants.

The closest concept to micropayments systems is the virtual, digital or electronic wallet. The architecture of a digital wallet [6] encompasses a series of components that are fundamental for defining a functional system of this type:

- The instrument manager controls all payment tools contained in the digital wallet. Banks or merchants can develop various financial instruments that the digital wallet is able to use in order to process payments.
- The protocol manager is in contact with the instrument manager to allow the establishment of communication on a physical level, as well as creating the data link with the bank's or merchants' systems. Also it implements encryption and security procedures.
- The manager of the client's profile controls their name, password and access rights for various payment instruments that are associated to the buyer or group of buyers.
- The communication manager allows asynchronous connection with the corresponding device used for connection using a question – answer format. It relies on the protocol manager and the security component establishing communication within the session.
- The wallet's controller generates interface between the user or a software agent and the other components by coordinating their interactions and hiding their complexity.

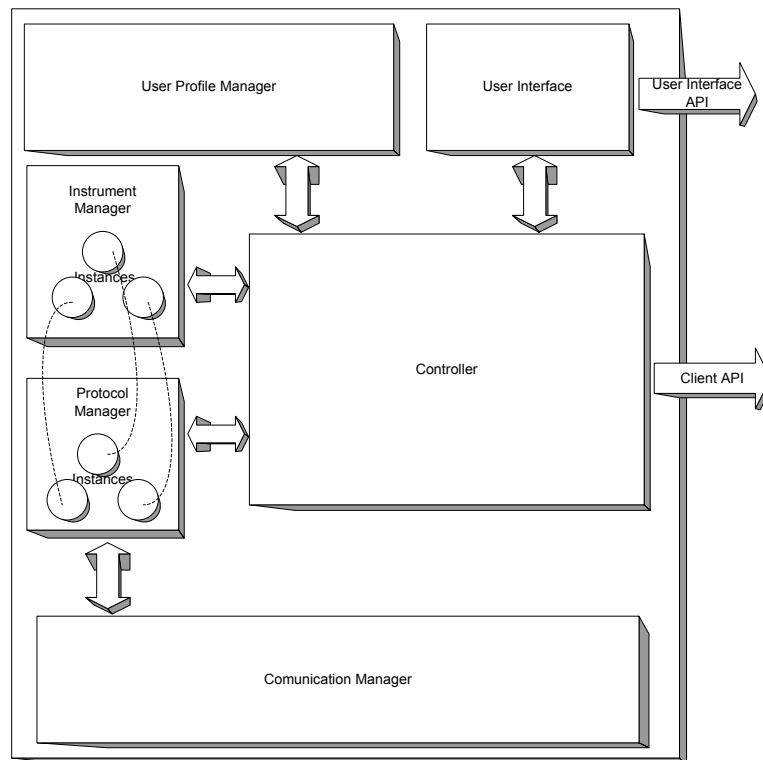


Figure 1. Architecture of digital wallet

- User interface is a component that allows easy access, in a graphical manner, to services provided by the controller. This is an optional component as some implementations cannot offer this function, as is the case with smart cards.
- The API Client is an interface offered by the controller that can be used by anonymous software agents that act for the benefit of human users.

The usual model for a digital wallet uses monetary units as payment instrument because it represents an open account to either a bank or a merchant. This account is credited with various amounts using traditional means and it is then used for online payments. Users are identified when making payments via password or personal details. The wallet retains a certain monetary value referred to as electronic money or e-money. As referenced in this article [11] and according to further regulations [13] electronic money represent any monetary value stored on an electronic device that is accepted as means of payment by other entities than the issuing ones and that is issued based on funds received for a sum of money that cannot be smaller than the monetary value issued. The deposited sum represents a debt for the issuing entity. Apart from storing a sum of money on an electronic device with the aim of realizing small payments, electronic money can also exist through prepaid instruments that do not necessarily imply a bank account. As opposed to cash, electronic money cannot be used instantly after receiving the payment, because they need to first be transferred to the account of the beneficiary.

Traditionally, digital wallets were stored on personal computers in the form of software that can transfer a certain form of electronic money obtained through crediting a bank account, in order to make payments via telecommunication networks. This service is charged a fee proportionate to the amount traded, whatever this amount is, thus making it appropriate for micropayments. The system does not limit the duration of use for the money and unused balance can be recovered by the owner.

The latest implementation method for digital wallets is the smartcard. This is a generic concept that includes: cards with integrated circuits or rechargeable cards that store monetary values on a support owned by the issuing party and that can be detached through bank accounts. Smartcards allow micropayments to be made directly between buyers and sellers, without any intervention from third parties by using devices (readers) installed at the selling points. Without feeling the need of an exhaustive presentation, we have identified some existing systems for micropayments that are available on a large scale in order to be able to pinpoint the location of the proposed solution.

3. Aggregating and dividing payments

From what was presented so far, we can guess what the solution for aggregating payments in a privately owned local area network is. This should operate with low costs that are conditioned by the very small value of each payment. The equipment has to be user friendly and straightforward, security procedures, not very complicated and based on the rapport between the cost of fraud and the estimated value obtained through fraud, while maintaining relations with banks within profitability margins. We will now focus on a series of fundamental components of this proposed system.

The concept of aggregating mechanisms is not a new one as they are already used in supermarkets. Upon finishing shopping, customers make a single payment towards the supermarket. This payment can be electronic by using the credit card and it is destined to cover the entire shopping cart. Even if the payments are electronic, it is obvious that it would be absurd to make separate payments for each product in the shopping cart towards each producer of the products. The store will make a single payment towards each producer at a preset date.

In order to be able to make correct payments toward producers for products that were actually sold, the store has to divide each payment received from customers so that each product is accounted for. Afterwards, the store proceeds to making the above mentioned operation of aggregating costs per producer. These are the basic mechanisms. The concrete ways in which stores manage their operations and their financial relations with producers can take different forms, depending on the parties' agreement.

The analogy with supermarkets stops here. How can we adapt this system for producers that want to sell their own products directly to customers using negotiable prices? In this case, the product must not be labeled with the producer's brand and preset price tags available for all buyers. We have to acknowledge that stores would be able to eliminate a difficult operation that even in the present system can be improved. Through the integration of this option we have passed from the supermarket model to the mall, bazaar or food market ones. This latter model is closer to our problem's hypothesis because products sold in these environments are bulk and unlabeled. They are also sold directly to the customer and have very small values (e.g. 0.50 RON for a bundle of parsley).

In the standard solution the buyer owns a digital wallet, similar to the one presented in figure 1. This wallet can be implemented through a mobile phone or a smartcard. Clients register on a server and deposit a certain amount of electronic money into an account on the server, or directly on the smartcard. The seller, which is also registered on the server, owns equipment similar to a mobile phone or a smartcard reader that allows them to record the execution of payments. This piece of equipment is already connected to the server and the payment is achieved by sending a message with the amount, the buyer and payment recipient. In order to adapt this system to small value payments, cost reduction is necessary and can be obtained through a simplified hardware solution and by cutting operating costs.

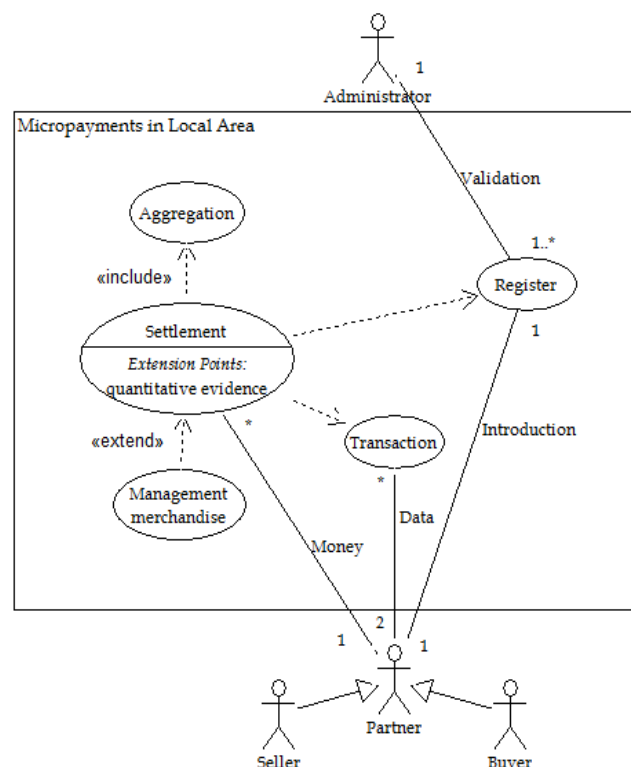


Figure 2. Use-case diagram for the proposed solution

At the level of the general scheme of the architecture of the digital wallet, presented in figure 1, will remain a single instance in the component of payment instruments and protocols and the user's profile will only contain a minimum of information resulted from diagrams that will describe in detail their functioning. The main change will consist of localizing the equipment that implements the digital wallet. This will not be kept by the buyer, as in the standard model, but will be held by the vendor. The authenticity component will be necessary for buyers and instead of repeated transfers of electronic money, there will only be a guarantee for the value of bought goods.

Through simplification, the proposed system transforms from a system of electronic payments into one, equivalent as goals that manages sales with settlement at the end of the period. In traditional commerce we

are familiar with this situation at the “neighborhood groceries” where customers from the area, known as loyal customers, may buy on credit and settle the purchases at the end of the month. In this case, the LAN is a neighborhood-wide system of information where authenticity and solvability problems are solved through knowing each other at the personal level and security and confirmation of transactions are replaced by mutual trust.

This proposed solution treats the functionality of more of these “neighborhood groceries” that serve not only their own customers and can introduce commercial crediting facilities while establishing a quantitative and value management of their own activity. The system, as presented in figure 2 through a use-case diagram [Georgescu, 2002], implies the existence of an administrator, as a trust factor, that ensures the registration of merchants and buyers, a network with a local server, a communication system and simple equipment, only for the vendors, for introducing the sum and the buyer’s confirmation. This software will identify the transaction, the partners and will aggregate data and manage the buyer’s warranty for the final settlement.

4. Transaction security, traceability and acceptability

In supermarkets, security for payments is ensured by the protection mechanisms associated with using a credit card and products’ security is ensured by unique access and exit points, by video surveillance, security agents and other types of detectors for security marks on the products. In bazaars and food markets (as we identify our problem with this example) the situation is reversed. Products’ security does not exist as they are passed directly from sellers to buyers by transferring property rights to them. We still have to tackle the issue of security for the electronic micropayments made by buyers towards vendors for the acquisitioned products.

Within this system we eliminate the potential problem of dividing the payment per buyer as each payment is made directly. Therefore, we need to focus on aggregating payments per vendor or producer for obtaining the financial settlement at each preset moment. Also, aggregating payments per buyer is necessary for operating a single electronic transaction with the buyer’s bank. If the value of the entire shopping cart is within preset limits, an alternate solution can be implemented: using the digital wallet model, the buyer “deposits into the wallet” a certain amount of cash that they will spend on the desired products. There are quite a number of examples on this model: prepaid cards for mobile phones, ski passes, the card for public means of transport etc.

Identically implementing cash operations in the electronic environment would mean that transactions need to be anonymous and untraceable but, as we have already mentioned, it is exactly these characteristics that generate inconveniences. The traceability problem of the bundle of parsley may be considered entirely not interesting, but if we discuss in broader terms of transactions’ fiscal registration then we need the log of all operations. The same data can be used within a system of fiscal deductions for buyers and establishing the income of vendors or producers. Moreover, rent (or any other form of taxation for using the designated space) will no longer be established in a flat manner, but based on sales. As for any initiative, the issue is who has to gain and how much out of using this system. To start with, let us focus on the complementary question: who will lose and how much? The first category would be those who do not pay taxes and have commercial activities on the black or grey markets. I do not think that diminishing these activities is a reason against the micropayments system but, at the most, a perturbing factor for implementing and functioning of the system.

For all the others, whether producers, vendors or buyers, who obey fiscal regulations we appreciate that the impact of this system would be maximum 0.2% which represents the current commission for withdrawing cash from the ATM. On the other hand, nobody currently uses coins of 0.01 RON and the difference between the price on the label of 4.99 RON and the one effectively paid of 5 RON is exactly 0.2%. With micropayments this commission becomes negligible and even in favor of buyers who never receive change when it comes to small change. Additionally, buyers also benefit from commodity aspects and improved ease of keeping account of all micropayments facts which can lead from an even spread of commission between buyers and vendors to the acceptance of the entire commission by the buyer.

After overcoming the possible reluctance of vendors, if the system is acceptable for both parties involved, the issue of who will manage this system occurs. One possible answer could come from the institutions that manage markets, bazaars, fairs or even the local public administration which would benefit from the correct fiscal tracking of these activities. We also have to add the direct income from commissions that are also an advantage at this stage. An estimated throughput for food markets determined by commissions would revolve around 50.000 euro annually. Knowing the required technical solutions will allow us to estimate the needed investment and then, an accurate cost-return analysis can be made based on market research and official statistical data. As the solution for micropayments in local area networks was foreseen, it can be easily demonstrated that this is a scalable solution that allows the creation of multiple local area networks that can be interconnected into a metropolitan area network. Such a configuration could generate an annual throughput between 250.000 and 500.000 euro by being capable of providing other directions of development. We will only mention the possibility that parents would allow their children to use such a traceable system as opposed to handing out pocket money.

5. Legislative aspects

Presently, electronic payments are made in Romania based on the National Bank Regulation [BNR, 2006]. There are no technologic restrictions that limit the development of systems that would prevent transactions through bank accounts to disappear. In this case, a considerable monetary flux that would escape registration

and thus control by monetary authorities can be generated. In 2009 a European directive was adopted referring to access to the activity and surveillance of the institutions that can issue electronic money [fortumo, 2010]. Applying this directive would need to be limited to providers of payment services that issue electronic money. The national legislation derived from this directive should not be applied to monetary values stocked on various prepaid instruments, designed to answer predetermined needs that can only be used in limited manners either because these allow the owner of electronic money to buy goods or services only in the locations of the issuer of electronic money or within limited networks of providers of services that have a direct commercial agreement with a professional issuer. It can also be the case that these instruments can only be used to buy limited arrays of goods or services. An instrument should be regarded as being used in a "limited network" if this can only be used for the purchase of goods or services within a single store or network of stores, or for the purchase of a limited array of goods or services, regardless of the geographic location of the selling point. This kind of instruments can include store cards, fuel cards, membership cards, public transportation cards, meal tickets or service tickets that are sometimes taxed and regulated by a special legislative system within the labor or fiscal law, designed to promote the use of this kind of instruments for the fulfillment of social legislation objectives. When these instruments with predetermined use transform into instruments of general use, the same exception to the European directive cannot be used. Instruments that can be used for acquisitions from merchants' stores should not be excepted from the application domain of the directive as these instruments are basically developed for a network of service providers that are continually developing.

Based on these European regulations, in Romania there is a legislative proposal referring to the activity of issuing electronic money [14]. The main modification of the regulation framework referring to issuing electronic money consists of excluding institutions that issue electronic money from the category of credit institutions and creating a special status that allows access to activities similar to payment institutions as defined by the Government Emergency Ordinance no. 113 from 2009 with ulterior modifications [15].

6. Conclusions

This proposal can be integrated in the European initiative "The union of innovation – ways in which in Europe ideas can become jobs, economic growth and social progress". This initiative was launched by the European Commission on 6th October 2010 with the view of creating national budgets for public acquisitions of innovative products and services, for achievements that improve public services [16].

The proposed system does not fall under the legislative limitations proposed by the European Union [JOUE, 2009] not only because it finds itself on the list of excepted activities, but also because it proposes a simplification and an approach from another perspective.

We appreciate that this type of system represents a possible solution for privately owned businesses that are involved in managing chains of neighborhood stores, malls, food markets, etc. Also it can prove useful for local public administrations that can follow the retail commercial activity from public spaces within their administration.

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