Multi-analyses electronic payment system

M. Madhoushi[1] & E. Mohebi[2]
[1]*Department of Management, University of Mazandaran, Iran*
[2]*Department of Industrial Engineering,*
Mazandaran University of Science and Technology, Iran

Abstract

This paper is an overview of electronic payment methods and analyses and compares some types of electronic payment systems which can be grouped into three broad classes: traditional money transactions, digital currency and credit–debit payments. Such payment systems have a number of requirements: e.g. security, acceptability, convenience, cost, anonymity, control, traceability and control of encryption methods. It also evaluates their advantages and disadvantages to the customer, the merchant, the e-payment service provider and the financial institution. These systems employ cryptography to provide security, however many consumers are still reluctant to purchase over the Internet because they are concerned about hackers accessing their financial information.
Keywords: electronic commerce, security, electronic payment system (EPS), digital currency, credit-debit payments.

1 Introduction

Electronic payment systems are an essential part of electronic commerce and electronic business and are greatly important for their further development. However, traditional ways of paying for goods and services do not work properly over the Internet. Existing payment systems for the offline world, such as credit cards, are widely accepted as a means of payment on the Internet; however users don't see in them enough of reliability, trust, security, etc [1].The existing payment systems are also far from ideal for merchants, because of the high transaction costs, fraudulent activity and the multiple parties involved in payment processing [2]. These systems need to strike a good balance between a numbers of deferent issues [3], [4]. The Internet was originally used by individual academics, universities and government agencies (particularly in the military) for research and development purposes. Since the commercialization of


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the Internet in 1993, this group has been joined by companies of all sizes, wishing to advertise and trade goods and services both locally and globally. Yet, despite this enthusiasm and rapid growth, the Internet has been recognized as a difficult place to do serious business (see, for example, Poon and Swatman [5]). A major problem, however, is the lack of an integrated financial transaction system suitable for an open electronic marketplace such as the Internet. How the consumer will pay for goods and services and how the provider will receive the payment securely over the Internet are issues which are being seen as some of the most important success factors for Internet commerce. To overcome these problems, many individuals and organizations have been developing financial transaction systems for the Internet which are becoming known as Internet payment systems (IPS).This paper describes the mode of operation of a broad range of e-payment systems available today in order to provide a comparative evaluation from viewpoint of the users [6, 7, 8, 9, 10].

2 Literature of the issue

2.1 Background

2.1.1 E-commerce

E-commerce is a general concept covering any business transaction executed electronically between parties such as companies (business-to-business - B2B), companies and consumers (business-to-consumer - B2C), consumers and consumers (C2C), business and the public sector, and between consumers and the public sector.

2.1.2 Electronic payment systems

The first C2C payment systems were developed in 1999 in USA. The biggest and the most popular e-payment system is Pay Pal. In autumn 2000 Pay Pal broadened its scope of business activity to some European countries. Currently it offers services worldwide. In June 2001 Pay Hound Limited launched the first European C2C payments system, developed specifically for the customers in UK [11]. The problems of electronic payment systems that we are facing at the present moment can be described as a failure to address user requirements and needs in the design and deployment of the systems. It can be suggested that in the design of electronic payment systems not only technological but also user-related factors should be taken into account. Even if there are good technical solutions, but they are not accepted by end users or vendors, the whole system would fail. The existing works that discuss the requirements for electronic payment systems don't provide rationalization for selection of the chosen requirements.

2.2 Types of Internet payment systems

2.2.1 Traditional money transactions

Currently, debit cards are spread widely and deposit transfer via the Internet appears to be coming soon [12]. On-line payment by credit card is already available at many commercial web sites today;

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- SET

IBM, Netscape, GTE, CyberCash, MasterCard, Microsoft and Visa have cooperatively developed the Secure Electronic Transactions Protocol (SET) for securing on-line transactions. This protocol will facilitate credit card transactions on the Internet.

- PCT

The Private Communication Technology (PCT) protocol, defined by Microsoft, provides privacy between two communicating applications, and authenticates at least one of the two to the other.

- iKP

iKP is an IBM proposal for a family of public key protocols supporting secure presentation of credit card information [13].

- First Virtual's InfoCommerce System

In this system the credit card information is given to First Virtual via phone only when the account is opened.

2.2.2 Credit-debit payments

In payment mechanisms that use the credit-debit model, including CMU's NetBill, First Virtual's InfoCommerce system, and USC-ISI's NetCheque System [14], customers are registered with accounts on payment servers and authorize charges against those accounts. This payment method is by definition not anonymous. An important advantage of the credit-debit model is its auditability. Once a payment has been deposited, the owner of the debited account can determine who authorized the payment.

- Millicent

Millicent [15] aims at small-scale commercial transactions over electronic networks.

- NetCheque

NetCheque is a distributed accounting service supporting the credit-debit model of payment.

- UEPS

UEPS, the Universal Electronic Payment System [16], is an electronic fund transfer product based on off-line operation.

Others

There are many systems in this category e.g. First Virtual Holdings, FSTC's Electronic Check project, Net-Bill.

2.2.3 Digital currency

Developments in cryptography have brought a new kind of money: the *digital currency* (e.g. the DigiCash system [17], the CAFE project [18]. The digital money, an encoded string of digits, can be carried on a smart-card, or stored on a computer disk. Like a traveler's check, a digital coin is a floating claim on a bank or other financial institution that is not linked to any particular account. One cardholder can make a payment to another without bank involvement, by

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placing both cards in a 'digital wallet' that moves coins from one card to the other.

– ***DigiCash***

The DigiCash system involves the creation of 'electronic coins' in the form of digitally signed numbers in exchange for real money from the user's bank account.

– ***NetCash***

NetCash is an electronic currency service that supports real-time electronic payments with some provision of anonymity across multiple administrative domains on an unsecured network.

– ***CAFE***

CAFE provides a high security of all parties concerned without being forced to trust other parties (so-called multi-party security).

– ***Mondex***

The Mondex system is based on a tamper-proof smart card that holds the cash (in multiple currencies) and the software to make and receive payments.

– ***Brands' off-line electronic cash system***

In this system a tamper-resistant smart card, issued by the bank and trusted by the user, controls a counter that represents the amount of electronic cash carried by the user [19].

– ***Others***

Other systems in this category are currently in test or actually in use (e.g. Chipknip and Chipper in the Netherlands)

3 Research methodology and design

The research which this paper describes was intended to identify common effectiveness criteria for Internet payment systems. But before these criteria could be identified, it was necessary to define two subsidiary objectives:

- What are the Criteria to compare, according to each party involved in an Internet payment system?

- Who are the main parties involved with Internet payment systems?

3.1 The identification of effectiveness indicators for IPS

The main reason given was that success factors for IPS primarily depend on customers' needs, so that some effectiveness indicators for IPS providers and financial institutions also depend on consumers' effectiveness indicators. The effectiveness indicators produced as a result of the research [20] include:

- **Ability to allow refunds:** merchants should be able to refund payments to clients if necessary.

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- **Ability to support both on-line and off-line activity**: allows more flexibility to operate the system even when the network breaks down.
- **Acceptability: IPS** must be accepted at a wide variety of stores and banks.
- **Accountability:** transactions must be accountable.
- **Anonymity:** the ability to conceal the identity of the payee.
- **Authentication:** the ability to authenticate the users of the system.
- **Customer support:** the IPS should be able to assist customers electronically at minimum cost and throughout the day.
- **Duration of transaction process:** the time it takes to approve the payment (transaction delay must be minimized as far as possible.
- **Ease of use (convenience**): the IPS must be as convenient as cash to use on any occasion. Its software must also be easy to use (user-friendly).
- **Exchangeability (also known as fungibility):** funds must be easily exchangeable between parties**.**
- **Flexibility:** the ability to allow different kinds of IPS.
- **Functionality:** the need to increase the functionality of systems to gain competitive advantage over competitors.
- **Irrefutability:** the ability to ensure that the payments cannot be refuted or disproved.
- **Legal certainty:** payments made using an IPS must be legally accepted.
- **Low fixed costs:** costs (including set-up cost, equipment cost and infrastructure cost) must be reasonably low for consumers and merchants.
- **Low transaction cost:** cost of the transaction itself must be as low as possible (zero transaction cost is desirable if possible (just like a cash transaction**)**.
- **Portability (remote access):** the ability to allow consumers to make payments from a variety of locations using a range of different interface devices.
- **Privacy:** the ability to maintain public confidence to ensure customer privacy.
- **Profitability (cost-effectiveness):** implementing the IPS must be profitable and cost-effective, especially from the merchant's perspective.
- **Regulatory framework:** the system must be able to operate in a regulatory framework that the regulators understand and can enforce.
- **Reliability (trustworthiness):** the IPS must be reliable, so that merchants and consumers will have confidence in using the system.
- **Responsibility:** the IPS must be responsible for any fraud, data security, or data privacy.
- **Scalability:** the ability to decentralize the system as much as possible to avoid bottlenecks.
- **Security:** the ability to protect the details of transactions and customers from internal and external fraud/criminal usage.
- **Traceability:** the ability to trace back the transaction, particularly in the case of illegal activities.
- **Transferability:** the ability to transfer value between customers.

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- **Universality:** a global standard interface (allow use anywhere around the world).
- **Unobtrusiveness:** the ability to integrate the system into the user's daily life.

According to the responses [21], some characteristics are perceived as more important than others. Characteristics of primary importance are**:** ***applicability, traceability, trust, security, convertibility, ease of use*** *and* ***reliability***. Lower level of importance was attributed to anonymity and efficiency. The survey illustrated that characteristics of anonymity and support for small payments are perceived by users as unimportant, in contrast to the numerous works that treat them as crucial issues and motivate building whole systems around these characteristics.

3.2 Main parties

According to viewpoint (*Tae-Hwan Shon*, *Paula M.C. Swatman*,), The first result of them survey had led to the identification of six principal roles for those directly involved with IPS [22]:

- Financial Institutions (including bank and non-bank financial institutions).
- IPS Providers (Manufacturers).
- Merchants (vendors).
- Consumers.
- Regulators.
- Network providers

This paper briefly describes the different types of main parties in at least two sets of parties (with broadly similar interests within each set) will need to participate: ***customers*** and ***merchants*** on the one hand, and ***financial institutions*** and ***regulators*** and **IPS Providers** and **Network providers** on the other hand. Arbitrators may be needed in case of a dispute.

At present, the consumer group is the key success factor for IPS success. Effectiveness indicators for IPS vary depending on a number of factors, such as what consumers are looking for and what kinds of payments are being made.

4 The criteria from the viewpoints of users

4.1 Concerns of customers and merchants

1. *Security*
   - Three Levels of Security:

   Digital Signatures- Server Authentication- Factor User Authentication

2. *Acceptability*
3. *Convenience*

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4. *Cost*
5. Privacy
6. *Durability*
7. *Immediate control*

4.2 From the viewpoints of *financial institutions* & *regulators* and IPS providers and network providers

8. Traceability
9. Control over the *spread of encryption* mechanisms
10. Transaction cost

Other Criteria:

11. Transaction Size
12. Ability to build up the customers purchasing pattern
13. Availability
14. Reliability
15. On-line and off-line
16. Use of dedicated tamper-resistance hardware versus software only

5 Multi analysis of the criteria

The possibility that a large share of the economy transactions will be carried on a new medium raises a lot of regulatory and public concerns described above. Many of those concerns appear contradictory and conflicting, not all the properties of an ideal system can be accomplished at the same time.

Privacy versus traceability

A conflict exists between the wish for privacy and anonymity and the possibility and desire of regulators and intermediaries to be able to trace any transaction in the economy. Traditional intermediaries (credit card companies, banks, etc.) emphasize the desire by consumers to be able to trace their own transactions themselves. Their systems have a low level of anonymity and serve more the objectives of the credit service bureau than those of consumers.

Hardware versus software

A dedicated hardware solution might look to be the ideal technical solution in many senses, but raises some economical and technical issues. On the one hand, the smart card, a tamper resistant piece of hardware with security functions, can help to solve the double spending problem in an off-line environment.

Transparency versus explicitness

On the one hand users may want transparent money transaction algorithms, the real money transactions are hidden from the user. But on the other hand the users

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want to be in the control-loop of all the money transactions. They want to be sure that they only pay what they have asked for and they do not want to spend any money without being notified. Monitoring Customer Purchasing Pattern Privacy advocates are concerned with the use of e-payment systems to assemble details of a customer's purchasing profile across many different merchants. In the case of electronic checks, access to the ACH is needed, so that the merchant cannot offer e-checks themselves. A service provider is required who, therefore, has access to the customer's account number.

Online versus offline

Offline payments involve no contact with a third party during payment the transaction involves only the payer and payee. The obvious problem with offline payments is that it is difficult to prevent payers from spending more money than they actually possess. Online payments involve an authorization server (usually as part of the issuer or acquirer) in each payment. Online systems obviously require more communication. In general, they are considered more secure than offline systems. Most proposed Internet payment systems are online. All proposed payment systems based on electronic hardware, including Mondex and CAFE (Conditional Access for Europe), are offline systems. Mondex is the only system that enables offline transferability: The payee can use the amount received to make a new payment himself, without having to go to the bank in between. CAFE is the only system that provides strong payer anonymity and untraceability. CAFE also provides loss tolerance, which allows the payer to recover from coin losses (but at the expense of some anonymity in case of loss). Mondex and CAFE are multicurrency purses capable of handling different currencies simultaneously. All these systems can be used for Internet payments, Instead of tamper-resistant hardware, offline authorization could be given via preauthorization.

6 Summary

To talk about importance of user-related factors of electronic payment systems we have to take into account that users' perception of payment systems is perception of a complex system with numerous parameters. From the way users perceive and feel about them they make difference in acceptance of the systems, provided that there is more than one system available. Thus, user acceptance of electronic payment systems on mass scale depends greatly on users' attitudes; feasible technological solutions are not the only important issues, but these systems will be perceived in a complex of facets. Issues of **Convertibility, Security, and Applicability** rise with seriousness not by themselves but also because they influence users and their subsequent decision to use payment systems. In relation to variable of anonymity, designers can face a choice: should they design a system that is not anonymous, provided that most of the users do not really feel need for anonymity and may never face consequences of misuse of their private information, or should they deliver a maximally anonymous

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solution, thinking that users do not really understand the problem and indeed should be protected in spite of incomprehension? There is also a trade-off: when aiming to provide full anonymity that is possible with the available technology, the resulting systems may fall short on other issues, e.g. being hard to operate or inefficient. Another result derived about small payments is that there might be a significant probability that users may not understand the real need of small payments that is emerging in the Internet industry, or they don't feel need for them simply because they are used getting things for free. However business models that are based on giving out free information and other commodities cannot stay for too long, now we are observing shifts from this direction. Small payments and micro payments will certainly find their place in various applications on the Internet.

7 Conclusion

First: there are a wide variety of electronic payment systems available and payment methods must offer requirements of the user's acceptance. an important conclusion can be made that it makes sense to be more specific in targeting payment systems for various context of use. This has implications that different systems should be designed for various applications and contexts, and there will not be one solution that covers all the requirements. For example, there may be cases when anonymity or convertibility is not highly important in relation to other characteristics. Thus user acceptance implies that people are willing to use a system for payments especially if there is more than one payment system available. Acceptance is dependent on:

-Perception of manifestation of characteristics of payment systems· -Specific applications for payment system for different contexts of use

Second: This survey was a necessary step needed to find out user needs and to guide further design of electronic payment systems with high user acceptance. These results are currently subject to a more detailed analysis. Although survey could identify some problems with defining important characteristics of payment systems, further research will have to employ other techniques for finding dimensions of user acceptance and its relations to characteristics, and validate them. This can be case studies or field research. The next step will be to develop guidelines and principles for design of user-accepted electronic payment systems.

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