Acceptance and Adoption of e-Commerce Payments and Implications for International Trade

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ABSTRACT

When the internet first became freely available to the whole world in 1995, its usage was largely limited hence the need to explore various ways by which the platform can be used to support commerce. This initiative was pioneered by business managers and owners to know more about the potency of the internet including how it supports payments from one place to the other. Today there are many micropayment system used on various internet platforms but all of these developed from the ground breaking effort of the first generation of internet micropayment systems most of which have died a natural death. We examine in this paper, the development trend of e-commerce payment platforms; starting from the evolution of NetBill. Subsequently, we evaluate the competitive environment within which the first generation of micropayment systems operated and their eventual waterloo. After exploring the challenges and failures of the first generation of ecommerce payment systems, we aggregate and discuss some lessons for sustainable micropayment systems in the current market by drawing on the experiences of successful new neighbours.

Keywords: Micropayment, ecommerce, Netbill, software, international trade

INTRODUCTION

In general the point where traditional commerce and marketing methods evolved to an electronic modern one was facilitated directly by the advent of the internet. When the internet first became freely available to the whole world in 1995, its usage was largely limited hence the need to explore various ways by which the platform can be used to support commerce. This initiative was pioneered by business managers and owners to know more about the potency of the internet including how it supports payments from one place to the other. This is what led to the emergence of micro payments processing system. Today there are many micropayment system used on various internet platforms but all of these developed from the experiences of the first generation of internet micropayment systems most of which have died a natural death. One of the first generation of micropayment system which became operational in 1997 is the NetBill. In this report an analysis is made of the NetBill micropayment system in respect of three essential elements. The first section examines the development trend of the NetBill and then the second evaluates the competitive environment within which the company operated. The next section looks at the failure of the system to sustain itself and the interest of merchants and customers after which the paper is concluded.

Development of Micropayment System

Before the interest in how internet could facilitate payments systems, there has been many successful breakthroughs in application of the internet to other aspects of the business hence the booming of e-commerce, mobile commerce, mobile business and electronic business [1]. Some Professors and students of the computer science department of Carnegie Mellon University in Pittsburgh, in the United States were equally enthused about the advent of many electronic payments system online.
However they were of the view that these were not sufficient to meet the specific requirements of merchandising of software products or goods hence developed the NetBill as a special distributed transaction processing systems with peculiar payment protocols and software to support the payment for software goods and services that are sold over the internet [2]. The essential features of the NetBill programs were that it in the first place it served as a prepaid or an escrow account into which a customer makes payment for the requested/ordered goods such as the softwares that is being purchased from the service provider. When the product has been delivered to the customer in the manner that is acceptable to the customer (as in quality and standard), the funds in the merchant is then allowed access to the funds which can be withdrawn as final payment for the product they have sold minus any commission that would be charged by the server (NetBill Micropayment platform) [3].

In other words the NetBill’s design consist of a number of protocols and software rules designed specifically for the sale of images, text and software through the internet and could not facilitate the processing for the payment of tangible products. The client was only billed after he or she had taken delivery of the goods in its encrypted form and the content of its intact with the decryption key that will allow him an access to the information that has been sent to the customer. The NetBill system is connected automatically to the system such that the customer does not need to inform the company that he or she has successfully decrypt the information but as soon as that is done the sensor on the NetBill triggers the attention of the system which immediately invoices the customer and forwards the payment to the company. This security feature which was not available to other type of micro processing types was what set the NetBill apart from other forms of micropayments system. The NetBill Micro payments system was developed in 1997 but by the end of the year 2015, it had completely died out or no longer in use. [4] discussed some of the key protocols, security and transactional features of the NetBill Micropayments system by explaining that the NetBill micropayment was designed to apply an atomic certified delivery system in which the customer was secured of access to the product it its right form until he or she was subject to payment and in any instance where he or she could not access the facility, the payment made could automatically be returned to his or her card using the same procedure to see for refund. With the NetBill System, it was possible for the access control to be outsourced such that different person could use the access control service from remote locations in so far as they access the service on different occasions [5]. This made the system stronger as it could be used globally. However in order to allow for some degree of control member of the NetBill fraternity could only gain access if an only if they prove their membership or credential which could be used as a basis to give discounts and protect the identities of users or customers on the platform form.

The design of the NetBill is such that before a person can subscribe to use it the client sends his payment coordinates encrypted with a security module (MoneyTool) that is downloadable and then after receive from the NetBill service an identifier and a pair of public or private RSA Keys [6]. The merchant equally receives this same Product Server software and the RSA keys as client makes a prepayment from his bank account. The buying protocol uses the 8 HTTP messages to help the buyer and the merchant to complete the four main processes of the transaction which are negotiation, order delivery and payment. In this case the NetBill only serves as a payment intermediary (a third thrust party).

**How Micropayment Systems Work**

The latest technology advancements have brought about more exposure and inclusion into the digital world. Fintech, technology in finance, is an emergent sector that is focused on making financial products available to all consumers at a negligible price. These technological efforts are seeing consumers’ costs diminish to as low as a few cents [7]. The problem with such low fees is that they may not be feasible to be processed through credit card companies, hence, the emergence of micropayment systems. Micropayment platforms built for handling small transactions work in a number of ways. One way is that a seller or service provider may have an established account with a third-party micropayment provider who collects, stores, and distributes the payments made. A consumer is required to also set up an account with the same micropayment provider for easier facilitation of payments. Through a digital wallet managed by the provider, payments are stored until they accumulate to a larger amount and then paid out to the recipient [8].

For example, Upwork is a freelancing site that matches freelancers with companies that have temporary projects. For example, a company may hire a video editor from Upwork to edit a few of its commercial videos for a rate of $5/hr. If the freelancer completes the project in 4 hours, the company makes payment to Upwork who collects its fees and stores the remainder in a digital wallet for
the freelancer. As the freelancer gets more jobs, Upwork racks up IOUs until the wallet holds a large amount of say, $1,000. At this point, Upwork makes the payment to the freelancer’s account [9].

Another way that micropayment systems work is through the implementation of a prepaid system. A user sets up an account with a micropayment processor, and pays an average or large sum of money into the account. If the provider is also used by the e-commerce platform where the user makes small purchases, the user’s account with the provider is easily debited for the dollar amount of the purchase. In effect, the user makes payments through a micropayment processing account. For example, PayPal is a micropayment provider who defines micropayments as transactions that are less than $10. A user can open an account with PayPal and deposit say, $150. If s/he purchases a service for $7.99 from a digital store like iTunes, the funds would be debited from the PayPal account and used to pay for the purchase. The balance in the user's PayPal account will be $150 less $7.99 less PayPal's fees for micropayment transactions [10].

Micropayment is mostly limited to the realms of digital payment. Making a $0.99 purchase of a music CD with shipping and handling cost of $25.00 may not make sense to an average consumer. But paying $0.99 for digital content of the same music album could be a more rational transaction for the buyer as no physical delivery is necessary. Even still, many business owners and e-commerce sites have issues in finding a credit card processor as the fee for processing transactions may be more than the micropayment. Also, as different micropayment processors may handle micropayments differently, companies have to choose the system that works better for them and saves them the most in fees [11].

Types of Micropayments

Since the beginning of the World Wide Web there have been many attempts to implement micropayments. How the client responds to this challenge differs depending on which of the three 21 micropayments systems you use. With on-chain transactions, the client creates and broadcasts a new transaction for every challenge issued by the server. With off-chain transactions (BitTransfers), the client and server pay each other from their 21.co buffer, and then flush to the blockchain when done [12]. With micropayment channels, the customer temporarily locks up some of their satoshis on the blockchain and can then release them one satoshi at a time to a merchant by creating a special transaction the merchant can broadcast to the blockchain before the customer's lock expires. This allows the customer to make repeated payments as low as a single satoshi for the transaction fee cost of just two on-chain transactions.

<table>
<thead>
<tr>
<th>Micropayment Type</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Chain Payments</td>
<td>Very simple to understand</td>
<td>Up to 1 tx per API call</td>
</tr>
<tr>
<td></td>
<td>Works without any client/server setup or minimum deposit</td>
<td>Limited by Blockchain (absolute max of ~500k per day)</td>
</tr>
<tr>
<td></td>
<td>Only 2 tx on blockchain even for N API calls</td>
<td>Requires client to have sufficient BTC for deposit that is nontrivial multiple of API call cost</td>
</tr>
<tr>
<td>Micropayment Channels</td>
<td>Deposit and final tx are on blockchain</td>
<td>Deposit requires confirmation time</td>
</tr>
<tr>
<td></td>
<td>Fast: operates at speed of internet rather than speed of blockchain</td>
<td></td>
</tr>
<tr>
<td>BitTransfers</td>
<td>No rate limits</td>
<td>Buffer not recorded on blockchain until 21 flu</td>
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Competition

As indicated in the first part the NetBill platform became operational in 1997 at a time when the internet micropayments system were gathering momentum. There are many other companies that had begun developing other new micropayment systems with equal appeal and capabilities such as Millicent, iPin, IBM Micro Payments and others that had better capabilities [13].

According to [14] there were two main essential elements which affected the competitive position of the NetBill and these were condition in the market. For example the company was operating in a market where there was no limitation as to the number of new entrants that could enter the market. For this reason within a period of five months after the NetBill brand had been developed other related or similar brand such as Millicent, iPin, IBM Micro Payments also came into the market. The reason why there was ease of the entry into the market is because of the low protection of intellectual property at that time [14].

The internet platform had just began to develop hence very limited attempt had been made to guide the development of internet business which where the discovery of other people are protected. Further there were low security features of these products which made it very easy for other companies and competitors to copy the work or others [15]. Additionally, the cost of developing these programs were not very large and only took a small university team to develop a payment system that could be used by alloy of other people.
In essence the initial cost of set up was not a disincentive to those who wanted to go into the business hence were encouraged to come out with their own and this is what led to the presence of many new ones as already indicated. Another issue about the competition which NetBill faces was because of the existence of other substitute payments system which was considered to be more secured for customers than the online system [15]. It is important to note that by 1997, the internet had only been available for commercial business for a little over two years hence was just at the introductory stage of its developments. There had been several instance and reported case of internet fraud against many clients in other sectors or other usages of the internet and these had rippling effect on genuine products such as NetBill. Even if a person had an option to use NetBill and direct bank payment system, there was the tendency to use the direct bank transfer system as they considered it as safer [16].

In addition [17] claim that companies such as MoneyGram, Western Union and other instant money transfer system also posed greater threat to the online micropayment systems as they competed on the same degree of speed of access to funds and delivery with expressed delivery services. Because there were other existing companies that also had different micropayment system such as the IBM, they posed a greater degree of challenge to NetBill. For example a company such as IBM developed its IBM Micro Payments in 1999 but because of the credibility of the company, it was able to attract more customers to it than NetBill.

**Failure in the Market**

By the middle of the year 2015 NetBill as a micropayment system had died a natural death after many years of struggle under the weight economic pressure brought to bear by changes in the environmental condition [18]. It is not possible to argue that one single factor contributed to the failure of the NetBill but rather and orchestration of several factors led to the collapse. Firstly, as indicated earlier NetBill was restricted to the payment of software products and not good and services of any other form. This narrow scope of the operational purview of the company has had a negative effective to the extent that today most of the software that is available online is for free and very little of them are for sale [19].

Even those for sale the c merchants have established their own links with stronger companies that have the better security features and brand credibility than NetBill. Part of this credibility crisis m stem from the fact that Netbill was not developed by expert business organisation but by a university organisation whose focus was largely about the academic knowledge to be gained from developing such a product, for this reason there was little attempt to invest a lot of resources into the development of the NetBill micropayment system to make it stand up to the competition posed by the new micropayment system which were coming into the market [20].

Another major issue which contributed to the failure of NetBill is its technical nature of the system. It is accused by [21] as having an unnecessarily complex procedure for payment system in an environment where customers want to avoid making complicated process as has been done by more successful micropayment system like PayPal, Moneybookers and others.

According to [22] it appears even though the NetBill had great potential as a system to manage electronic order and payment system, the process of encryption and decryption of information occurs after payment is made warded off a lot of many merchants who would rather want to have access to funds as soon as delivery has been forwarded to the client. It involved an overly use of digital signatures and conglomerate of transaction taking place at the same time on the server [23]. This sometimes allowed the process of making and receiving payments and that is not attractive to merchant. In other words the attractiveness of a system is about the extent to which the customer and the merchant who are the main parties in the transaction finds the need to use the system and in this case both of them had challenges with the NetBill leading to its imminent death.

**General Challenges of Micropayment**

Electronic micropayments are stored and transported in digital form, which introduce a new host of problems for the development of secure electronic payment systems. Since digital payments are represented as simple byte arrays or sequences of bits, nothing in them prevents the copying of them. There are several technological challenges for micropayment systems whose fulfillment is a major issue of implementation [24].

1. **Security** of micropayment systems is a challenge of security in the technology being implemented. Failures of the underlying technology, software or hardware, can substantially decrease the trust on a micropayment system.
2. **Scalability** of a design is necessary to adapt to the changes that may emerge if a system cannot respond to the potentially rapid increase of the transaction traffic.

3. **Reliability** of a micropayment system is crucial, as it must serve customers 24 hours a day, seven days a week, with no point of failure at any time.

4. **Interoperability** of currencies like digital cheques and tokens should be able to be applied in different micropayment systems and be fully interexchangeable between systems and protocols.

5. **Anonymity** concerns relate to the amount of knowledge other parties have of others. Merchants or banks usually have no anonymity, while customers may have at least partial anonymity. Anonymity is a technical challenge that is defined on a fine line.

**Security**

Security prevents and detects attacks on a payment system and fraud attempts. A robust security system is also vital to authenticate appropriate payment information. Security is to a certain extent a subjective concept, and felt differently by each user. Users often interpret security as an equivalent for guarantee customers feel secure if they receive the paid products, while merchants feel secure if they get the money for the delivered products. The main security concerns are the non-repudiation, authentication and authorization, data integrity, and confidentiality [25]. The security of micropayment system depends on the underlying trust and security models applied. Several micropayment systems rely on the security of the underlying infrastructure, which is the lower network levels and physical devices that handle the connections and information storing. These systems are usually susceptible eavesdropping and data tampering and they cannot be trusted to provide adequate security services. No trivial assumptions about the security level of the underlying technology should be made in respect of the design of the micropayment system [26].

**Scalability**

The problem with most existing micropayment schemes is the heavy load on the trusted, centralized broker. A broker is required to handle accounts, distribute and cash coins, provide security and a host of other tasks [27]. Eventually the broker has to take some action for every transaction. As a result, the broker load is always O(n) in the number of transactions. Brokers therefore present scalability traffic jam for any system using micropayment schemes [5]. Token-based systems are generally those that have scalability problems, originating from the fact that they have a central administration for the issued or received e-coins/tokens. DigiCash's eCash is an example of such a payment system. In general, brokers have to register the issued tokens in a central database. In such schemes, the number of tokens to be issued was much higher than the number of accounts administered [28].

**Reliability**

Reliability has been a problem for many of micropayment systems. Many micropayment systems depend on cryptographic mechanisms to control credit transfers. The reliability of such systems is of considerable importance. Yet most commercial cryptographic systems are less reliable than one would wish. Attacks are continuously reported on systems such as satellite TV decoders, automatic teller machines, and utility meters [29]. Minimizing the risk of such failures is primarily a systems engineering issue, concerned with careful requirements engineering and thorough testing. The implementers of micropayment schemes often invent their own cryptography and operational practices from scratch, which often fail. There is a perceived need for design secrecy and operational secrecy. Rather than discussing the problems each micropayment companies have found, the motive to remain unique and individual has created large holes in the robustness of cryptography of their systems, inherently reducing the reliability of current micropayment systems [30].

**Interoperability**

Interoperability between micropayment systems is rarely provided let alone addressed. Interoperability is impossible because token-based systems create new currencies-eCoins, scrips, merchant-specific tokens, etc. These currencies do not define exchange rules or rates. Funds represented in one system can hardly be converted into funds of another systems [31]. Some systems need extensions to allow customers to withdraw their money and exchange them back to dollars. Many micropayment schemes require customers to buy specific scrips for each merchant they want to pay. eCash is supposedly a system that offers the possibility to pay anywhere on
the Internet. However, eCash licensees cover only the customers and merchants of a particular bank. Customers can only pay merchants that were affiliated to the same bank [32]. Of course limiting the interoperability of one system with another may be a business model, but it makes the concept and practice of micropayments too cumbersome and restrictive. The profit from allowing e-payments to be interchangeable will likely be more beneficial.

Anonymity

Anonymity is an especially interesting requirement in respect of both the user and the implementation of the micropayment systems. Contemporary micropayment schemes have compromised the security by giving full anonymity only to merchants, while the user has only partial anonymity [32]. The deprivation of anonymity eases the traceability of transactions. The possibility to trace one's own transactions can, however, also be seen as an advantage for the customers, since they are interested in a service that allows them to check what they bought using their account. However, even a single micropayment transaction, such as request of adult content, can be uncovered and cause the user inconveniences[33]. Though totally anonymous micropayment systems would be ideal from the viewpoints of many users, the contemporary payment systems offer only partial anonymity [34]. This may not be a problem in every system, since the users seem to accept the degradation of the security level to be able to purchase goods easily.

Partial anonymity usually necessitates the collecting of long-term logging data of the micropayments of the user [32], which could yield significant information of purchase patterns of single users when the protection is not adequate. CyberCash has very low anonymity. They record user identities, exchanged amounts and times of all transactions. Other schemes have similar low anonymity for the sake of traceability, where all actions are linkable by any observer. Privacy is rarely guaranteed and anonymity is not supported [35]. This is not necessarily desirable when the users identity and purchases are visible to merchants and banks that can use this data to manipulate prices and advertising.

Conclusions

In conclusion, the objective of this assignment was to evaluate and analyse the NetBill micropayment system. This was one of the first generation of micropayment system that was developed by some Professors and students of the computer science department of Carnegie Mellon University in Pittsburgh, in the United States and launched in 1997 . The focus of the analysis has been on the development trend of the NetBill and then the second evaluated the competitive environment within which the company operated. The next section has looked at the failure of the system to sustain itself and the interest of merchants and customers after which the paper is concluded. It has been indicated that the buying protocol of the NetBill used the 8 HTTP messages to help the buyer and the merchant to complete the four main processes of the transaction which are negotiation, order delivery and payment. In this case the NetBill only serves as a payment intermediary (a third thrust party). Two main elements affected the competitive strength of the product and these were the ease of entry by new entrants who posed a strong competitive threat to the company as well as the lack of protection of intellectual property. The next issue is the threat that was posed by substitute products.

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