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## PREPAID-PAYMENT-SOLUTIONS FOR MICROPAYMENTS

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### ABSTRACT

*This paper describes aspects of the processing of micropayments. The customer payment procedure is considered with regard to the charge-back problem and a solution, based on a prepaid-card system, is introduced. Further on a concept that provides an easy implementation for the merchant and a simple but secure access for the customer is presented.*

### INTRODUCTION

During the last years the internet transformed from an information platform into a marketplace for virtual and real goods. This includes offers of hard- and software, access to sophisticated databases, complex services etc. The opportunity for online-payment-processing has become more and more crucial. Many payment-systems for online purposes have been created in the industrial and scientific area but yet no standard has emerged. Dr. Beck<sup>1</sup> from the department of communication sociology and psychology estimates that the development of the internet can be compared to the level of development of the radio in the year 1928. Higher stages can be reached by implementing new payment procedures. "If it were possible to directly account tiniest information bits this would change the medium strongly."

The technical and cryptographic means to realize internet-payment are available. The tough implementation has to do with psychology, standardization and convenience. Especially the payment of small amounts of money (micropayments) is solved in theory and commercially realized but still failed because of insufficient acceptance at all parties: the consumer, the merchant and the banks. To find the reasons you have to consider the history of the internet community and understand the transfer of the well-known payment-procedures (like credit and debit cards) from the real world into the virtual world.

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<sup>1</sup> <http://www.heise.de/newsticker/data/jk-30.12.00-000/>

The next chapter gives a short summary of classic payment-procedures and their transfer into the virtual online-world. Chapter three considers the special requirements of micropayments and describes historical and current approaches from a practical point of view.

## **CLASSICAL AND ONLINE PAYMENT-PROCEDURES**

A classical payment procedure is performed when customer and merchant are facing vis-a-vis. The best known of course is cash money but also credit and debit card transactions have become an inherent part of the payment procedure.

'*You can't teach an old dog new tricks*', the customer will not trust payment-procedures in the online world that he didn't know from the real world unless he can compare them to well known payment-procedures. Therefore the customer must be put in the center of all considerations. His confidence is based on comprehension and experience. Since classical procedures have a great acceptance in the real world it is no surprise that they also dominate the area of online payment systems. In the following a short summary of payment procedures and their transfer to the virtual world is given:

### **Payment on account**

The customer orders the goods and pays for them upon receipt of the invoice. This method requires a trusted relationship between customer and merchant because of the missing payment guarantee.

A survey<sup>2</sup> in Germany showed that this kind of payment is still the most popular internet payment procedure. The customer orders a good in the internet and pays for it after he has received it and is content with the quality.

The telephone companies who bring to account their services anyway use this as a base for timed micropayments. If the customer accesses content liable for costs a new telephone connection is established to a more expensive phone number. The costs are listed on the monthly invoice. This kind of payment-system is called dialer. The establishment of a new telephone connection is inconvenient especially for customers who still have analog modems (long time to reconnect) or even impossible for those who have a LAN-based connection to the internet. Furthermore the identification of the telephone number is only a weak authentication of the customer.

### **Credit cards**

While cashless payments in the USA are made almost exclusively by credit card, only each tenth adult possesses a credit card in Germany. The knowledge of the credit card number and the expiration date enables the merchant to authorize and capture a given amount of money. The authorization is done by the signature of the customer. If the cardholder denies the transaction (card abuse by third persons) the merchant has to prove the legality of the payment or must pay back the money (charge-back). He takes the risk of the payment.

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<sup>2</sup> <http://www.iww.uni-karlsruhe.de:8001/IZV3/>

Since there is no established possibility to worldwide authenticate the online-customer in a manner guaranteed by law, the problem of charge-backs has increased in the online-world. A significant problem is the fraudulent use of trashed slips from credit card imprinters. A protection against this misuse is given by using the 'Credit card Validation Code (CVC)' on the back of the card or to have a list of transaction numbers (TAN) for one-time online use. Standards like SET (Secure Electronic Transaction) are offering a solution by certifying the cardholder. But the distribution and administration of the certificates leads to inconvenience for the customer, who will not voluntarily agree to use this method. All mentioned methods to secure the payment procedure increase the complexity and reduce the acceptance.

### **Debit payment**

While the customer settles his account with credit cards at the end of the month, with debit payment an immediate deduction is transacted by the account. In Europe debit cards are very common. In Germany approx. 90% of the adult citizens possess a debit card e.g. the EC-card. Two kinds of authorization are performed. Firstly the customer signs the voucher. This procedure includes no payment guarantee. Secondly the customer types a secret personal identification number (PIN) which is checked online. This requires a certified pin-pad and a connection to the authorization-system.

Since there is no possibility to authenticate the online-customer via PIN in the internet (no certified environment), the missing payment guarantee is also the main problem of debit payment. A new idea is the authentication via mobile phone. The customer fills in his mobile number. He is called back and validates the transaction by typing a PIN at his phone. This method provides more security but again it does not result in a payment guarantee.

### **Cash**

Cash payment is the most popular means of payment. It has the following properties:

1. The delivery of the money has no incidental expenses.
2. The payment is guaranteed.
3. The payment is anonym.
4. The process is very simple.

Therefore cash is dedicated for the payment of small amounts of money. The most popular online-payment-procedure which is similar to cash is eCash. The customer receives virtual coins from a bank and stores them in a wallet on his computer. eCash coins worth real monetary value have been available on the Internet since October 1995, when the Mark Twain bank of St. Louis started issuing them in US dollars. Though other big international banks have supported eCash the system has still not succeeded. The Deutsche Bank for example stopped issuing eCash-coins in May 2001. The technical concept of eCash is very sophisticated and unique but the installation of special software contradicts the last point of simplicity. The user feels very uneasy to store coins on his

computer. The marketing experts have to spend long time to explain what happens when the customer computer crashes ('Get the stored coins lost?').

### Prepaid-cards

Since the debut of the telephone-cards prepaid-cards have become an inherent part of the assortment of cards in a purse. The customer pays a certain amount of money in advance and can spend it on various occasions. In contrast to debit- and credit-payment no fees have to be paid for the transaction. This makes prepaid-methods predestinated for the payment of small amounts of money. Prepaid mobile phones for example have become more popular than mobiles under contract. It is expected that this success of prepaid-cards can be repeated in the internet. They have the following advantages:

1. The transaction is anonym.
2. The risk is limited to the value of the prepaid-card.
3. Young people who are not qualified to own credit or debit cards can use them.
4. They are easy to use without any additional software.
5. They can be used for micropayments.

The government is the only issuer of cash in an economy and keeps a tight rein on the amount of cash in circulation. Operators of prepaid-cards could, in principle, affect this balance, decreasing the amount of control a government can exert. Therefore in Europe, a working group consisting of representatives of central banks from all countries in the EU convened in 1993 [EU] and distinguished between single purpose prepaid-cards (e.g. cards for pay phones or public transport) and multipurpose cards. In the case of the latter, they recommended that only credit institutions which are subject to central bank regulation should be allowed to issue such cards.

	Procedure in the real world	Transfer to the internet
Invoice	invoice and credit transfer	encashment procedures (NET900 <sup>3</sup> )
Credit	credit card	credit cards via SSL <sup>4</sup> , SET <sup>5</sup>
Debit	EC-card, debit transaction, maestro	account data encrypted via SSL or dual-channel (paybox <sup>6</sup> ) authentication
Cash	coins, bank notes	eCash <sup>7</sup>
Prepaid	telephone-card, prepaid-card (mobiles), Geldkarte	InternetCash <sup>8</sup> , paysafecard <sup>9</sup> , Geldkarte <sup>10</sup>

<sup>3</sup> <http://www.in-medias-res.com/products.htm>

<sup>4</sup> [http://www.weblogic.com/docs/classdocs/API\\_secure.html](http://www.weblogic.com/docs/classdocs/API_secure.html)

<sup>5</sup> <http://www.setco.org/>

<sup>6</sup> <http://www.paybox.de/>

<sup>7</sup> [http://info4.deutsche-bank.de/global/ui/nav\\_ec.nsf/frameset/DMEL-47ULWU?OpenDocument](http://info4.deutsche-bank.de/global/ui/nav_ec.nsf/frameset/DMEL-47ULWU?OpenDocument)

<sup>8</sup> <http://www.internetcash.com/>

<sup>9</sup> <http://www.paysafecard.com/>

<sup>10</sup> <http://www.fun.de/deutsch/produkte/internetpayment/default.htm>

### ***Who pays how and how much?***

That is the crucial question, especially for a payment service provider who wants to offer a wide range of payment methods. Because the number of transactions and the average transaction amount per payment type are confidential data of an online shop, it is a serious problem to answer this question - especially when all payment methods specific to a country are taken into account. A way out is to ask customers about their preferences<sup>2</sup> [SY01]. But still a leak between the customers answers and their real behavior remains. Common to all surveys is the estimation that classical payment methods are the customer's preference, as mentioned above. Payments by invoice or cash on delivery (C.O.D.) are about two/three times more popular than to pay online by credit or debit cards. The debit cards are especially used in Germany. The frequency of payments by credit card and payments by debit cards (if offered) are in balance.

Another insight is, that the larger is the amount to pay the more the customer prefers to use classical payment methods. At a certain point the customer even expects a written down contract. On this background the online-processing of small amounts of money will play a crucial role in the internet business.

### **MICROPAYMENTS**

The electronic payment methods mentioned above have involved systems that mirror the properties of conventional payment instruments already in existence. Micropayments, on the other hand, have not been available in conventional commerce. Their introduction opens up many new areas of business.

In the past valuable content was refinanced by online advertisements, there was no need to use micropayment systems. The price decline in this field more and more revives the discussion to make valuable contents liable for costs [EM1401]. The present state concerning micropayment systems can be described at best as follows: On the one hand content providers are awaiting a micropayment system that reaches the critical mass of users while on the other hand users are looking for a critical mass of content providers. That looks like a deadlock but the way out can be a micropayment system that sticks out by an impressive easy applicability and furthermore fulfills the criteria of a secure payment solution.

### ***Principles***

The main difference between macropayments and micropayments is that for the payment of a small amount of money it is not acceptable to pay the usual transaction fee. If you want to pay 10 cents it makes no sense to pay by credit or debit card because the costs for the payment process will be higher than the value of the goods. Likewise no merchant will send an invoice for this sum. The principle of micropayments therefore is to aggregate small amounts of money until the sum is worth to be transferred to the bank. This is shown in figure 1.

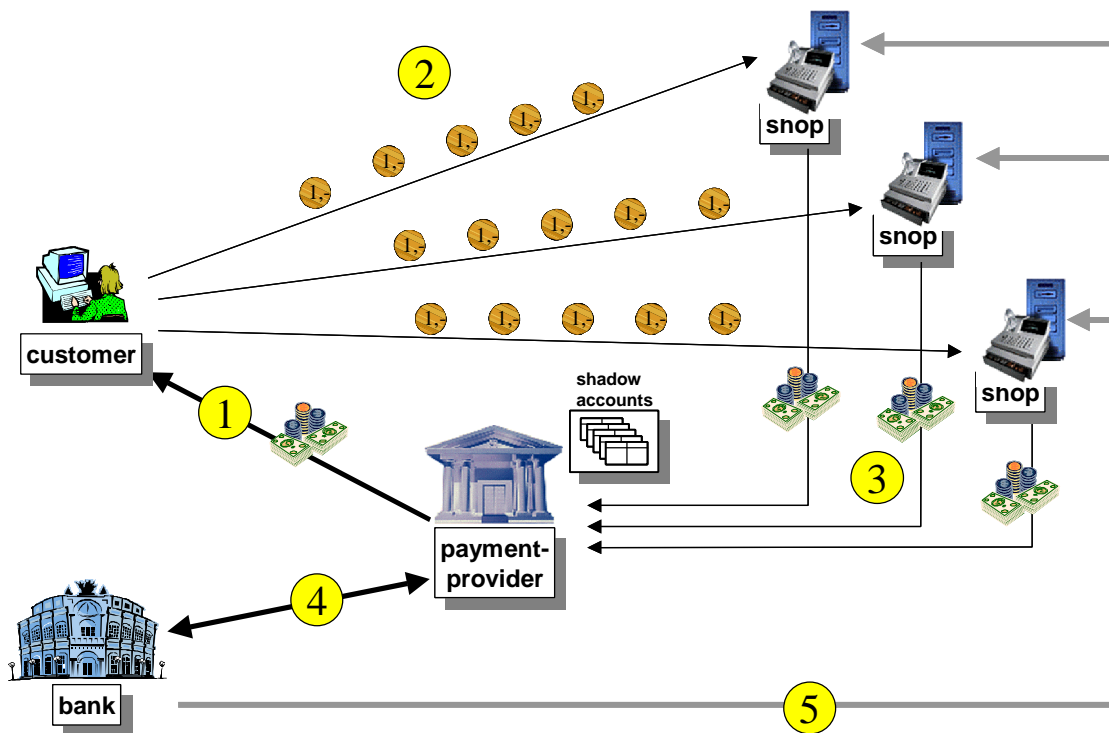


figure 1: principles of micropayments

1. The customer orders a dedicated amount of money from a payment-provider. The sum is entered on the credit side of a so called shadow account or some methods like eCash transfer virtual coins to the client computer and store the serial numbers in order to avoid double-spending.
2. The customer then spends this money in little bits for the virtual goods in the internet. The transactions are registered in the shadow accounts or inserted into a list of serial-numbers of the payment-provider. No real bank-transfer is initiated at this point of time. No costs incur for this transaction.
3. After the shops have aggregated a profitable amount of money, they initiate the transfer of this sum.
4. The payment-provider requests the bank to transfer the money on the real account of the merchant.

The weak point in this payment-procedure is the customer's request for a dedicated amount of money (no. 1 in the figure). Usually the customer pays for the available made money with a credit or debit transaction. As regarded in the chapter 'Classical and online payment-procedures' those methods have no payment guarantee. This is very critical especially for micropayments because in case of a charge-back there is no chance to return the micropayments spend for electronic goods. The bits of money are spread all over the internet.

Another problem is the complexity. The customer does not want to pass an expendable registration process where he has to enter personal data. This makes him feel queasy because the common message is to be careful with sensitive personal data in the internet. Or he refuses to install a special wallet software or plug-in for his browser where he does not really understand how it works and how secure it is built. The question remains whether the software is still secure when the computer crashes or whether a virus gets access to the data. The low-brow customer needs a procedure where he himself can estimate the worst-case risks and which he can handle very easily. The system design must follow the KISS-principle (Keep It Simple, Stupid).

### *State of the art*

Many solutions have been found to realize this mechanism. Examples are PayWord, MicroMint by Rivest and Shamir [RS96], Transactions Using Bets by Wheeler [Whe96], NetCash and NetCheque by Medvinsky and Neuman [MN93],[MN95], CyberCoin by CyberCash Inc. [Cyb99], No3rd by the DFN [DFN99], Millicent by Digital Inc. [Dig95], eCash by David Chaum [DS82], MiniPay by IBM [HY97], Jalda by Ericsson and EHPT [Jal00] or 'Click and Buy' by Firstgate [FG00].

Two main ideas shall be pointed out:

1. Of the conventional payment instruments mentioned above the one most suited is cash. Versatile as it is, it is limited in that no transactions can involve less than the value of the smallest coin. There are entire classes of goods and services where this poses a problem (e.g. single queries in a database, obtaining stock quotes). The main drawback is the low market-share on the internet-payment-market which is approximate 1%<sup>11</sup>.
2. For this reason encashment models have become popular. The customer has to subscribe, the pieces of money he has spent are aggregated and he pays for the sum afterwards. One disadvantage is that the user feels uneasy to run through a registration process where he has to enter personal data, another is the maintenance of the registration database at the online-shop. To avoid the subscription process other payment methods use the telephone bill. As explained in the chapter before the customer must dial into the internet from his private telephone-line. Internet-users from work, school or internet-cafe with dedicated lines are excluded.

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<sup>11</sup> Symposion Publishing: [http://www.symposion.de/studien\\_f.htm](http://www.symposion.de/studien_f.htm)

***Prepaid-solutions for micropayments***

A system which has had a great success in the mobile world could show a new way out. The combination of prepaid-cards and micropayments can meet the requirements above mentioned. Prepaid-cards are easy to handle. Everybody can go into a shop and buy them. Because of their anonymity they can be given as a birthday present or as an addendum to other delivered goods, e.g. journals. Once you have obtained a prepaid-card it is very easy to use. The registration process is similar to that of prepaid mobile phones and the maximum risk of misuse is limited to the value of the card. The market is opened for young people. The youth spend a lot of time for surfing in the internet. They know the ropes better than most of the adult people. But usually people who haven't reached full age do not own a credit or debit card.

Since prepaid-cards have no possibility for charge-backs they are also predestinated as a currency for micropayment-systems. Once a transaction has been finished the merchant can rely on receiving the money.

***Simple application***

The only thing the customer has to do to get ready to pay, is to buy a prepaid card. When requested he enters his prepaid-card number at the secure web-site of the payment provider to activate a desired amount of money to access content which is liable for costs. The content provider redirects the access to his site through a proxy server which is operated by the same payment provider. The communication between customer and shop is observed by the proxy. It automatically detects if content is liable for costs, authenticates the prepaid-card and transferred money from the prepaid shadow account to the shadow account of the shop. Except of the configuration of the proxy server (configure the price fixings for the contents) the shop's operator has nothing to do. The proxy server automatically displays the necessary payment information to the customer.

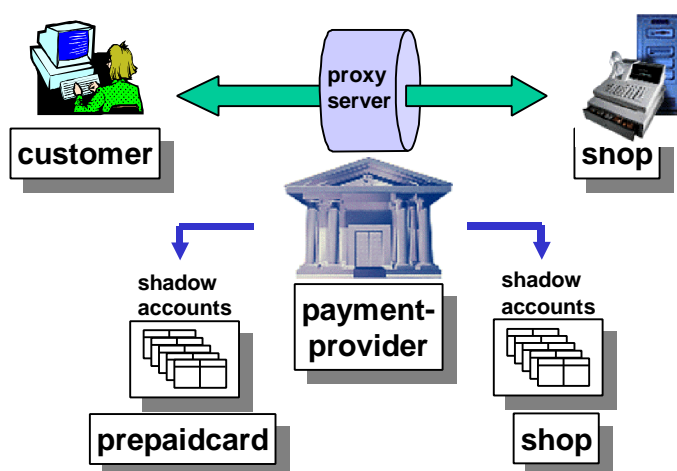


figure 2: proxy technology

### *Use-cases*

Prepaid card micropayments are an excellent customer loyalty system. This will be demonstrated by means of a scenario from the publishing industry. Most of the financial papers offer printed and online information. Of course the free accessible online information is not as complete as the printed version which is sold. Some people would not buy a paper if they could access the same information freely. On the other hand the online information should have a better quality than its competition.

A micropayment system can help offer sophisticated online information that is subject to cost. The prepaid-cards can be distributed with the financial paper. The purchaser of the paper can use this card, for example, to access a number of articles or special market information. For the consumer it would be an added value and for the publisher a means to acquire customers by his internet offering.

Automobile clubs or insurances can print a prepaid code onto the membership-card. This enables access to a number of online-services like determination of the value of a car, routing of the holiday trip or online-ordering of a member present.

### **CONCLUSIONS AND OUTLOOK**

The question is: Will "M" bring home the magic?

Prepaid cards have had a great success in the mobile world. If companies like ALLCASH GmbH<sup>12</sup> and paysafecard<sup>13</sup> manage to establish prepaid cards combined with a micropayment system this may repeat the success in the internet world.

A future extension could be to recharge a prepaid-card with non recallable payment methods, known from the real world, e.g. PIN-based methods like ec-cash, maestro or bank transfers via home-banking. It may also be possible to buy recharge codes via an ATM (Automatic Teller Machine).

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<sup>12</sup> [www.allcash.de](http://www.allcash.de)

<sup>13</sup> [www.paysafecard.com](http://www.paysafecard.com)

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