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University of Augsburg

2002

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Abstract. Companies are not going to invest into the development of innovative applications or services unless these can be charged for appropriately. Thus, the existence of standardized and widely accepted mobile payment procedures is crucial for successful business-to-customer mobile commerce. The acceptance of mobile payment procedures depends on costs, security and convenience issues. For the latter, it is important that a procedure can be used over the different payment scenarios *mobile commerce*, *electronic commerce*, *stationary merchant* and *customer-to-customer*. Current payment procedures can be categorized with *strategic*, *participation* and *operational* criteria, using the morphological method. The proposed scheme allows to unambiguously identify and characterize any given mobile payment procedure. The design of today's mobile payment procedures should less try to optimize on the future mobile commerce problems but focus on the ease of spreading in the electronic commerce setting as lead-in scenario.

1 Introduction

The ever growing number of mobile phone users as target group represents an enormous potential for mobile commerce (MC) as a new level of electronic commerce (EC). So far, mobile applications are mostly still the transformation of conventional Internet applications or EC business models on mobile devices. But in order to be successful (and thus gain profits) in an MC setting, this is not sufficient. Added values are necessary.

For purposes of this paper, we define EC as any kind of business transaction, in the course of which transaction partners employ electronic means of communication, may it be for initiation, arrangement or realization of performance (cf. [2]). We define MC as a subset of these, on condition that at least one side uses mobile communication techniques.

Typical mobile added values originate from ubiquity, context-sensitivity, identifying functions or command and control functions of MC applications (cf. [6] and the extension in [7]). In addition to technical issues such as packet-oriented data transmission, adequate payment procedures are most important to realize their potential. Since companies are not going to invest into the development of innovative applications or services unless these can be charged for appropriately, the existence of

standardized and widely accepted mobile payment (MP) procedures is crucial.

This is especially true for business-to-customer (B2C) MC, for which reason we focus on B2C MP in this paper. The customer-to-customer (C2C) variant itself may perhaps not be a good deal for the payment provider. But as it provides an added value for the customer and thus, an incentive for usage and spreading of an MP procedure, C2C MP is to be examined along with B2C MP.

For our purposes, we define mobile payment as a subset of MC, which deals with the completion of payment. We focus therein not on technical issues or the clearing process, but on the payment interface to the customer. As is shown later, MP is crucial for, but not limited to MC scenarios. On the contrary, usability of an MP procedure in scenarios other than MC is relevant for its acceptance.

After a reflection on the issue of acceptance, characteristics of MP procedures are identified, classified and aggregated within a morphological box (cf. [12]). This allows us to distinguish actual and foreseeable types of MP procedures precisely. Based on these results, major shortcomings of existing procedures are explained and opportunities for their improvement are shown.

Please note that whenever we talk in this paper about a general payment method such as credit card usage, electronic payment or MP, we refer to the term *payment systems*. Whenever we talk about concrete solutions such as Paybox or Mobilix, we refer to the term *payment procedures*.

2 Acceptance of MP

2.1 General acceptance

The examination of the development of payment procedures in the past shows that the key to acceptance is in the hands of customers. Well-known examples are the spreading of the US credit card system in Europe (although merchants weren't enthusiastic about handing over 3 to 5 per cent of their revenue to credit card issuers) and the simple debit procedure in Germany (although banks tried hard to prevent this in favor of selling their point-of-sale terminals to merchants). These systems finally superseded the Eurocheque, who dominated the market for many years, because of the market power of customers who wanted to use them regardless of the preferences of banks or merchants.

In the course of a study on mobile banking, more than 16.000 Internet users have been interviewed about their payment preferences if away. On the issue of general acceptance, about two third stated that they will surely or can imagine paying with their mobile phone. The most significant acceptance was ascertained with persons already using electronic banking (cf. [9]). On the issue of preferred payment methods if away, the mobile phone would already be preferred by about a quarter of the interviewees for micropayments (less than 2.50 €), a third for macropayments from 2.50 € up to 50 €, a fifth for macropayments up to 250 € and anyhow by 13% for amounts over 250 €. In the segment between 12.50 € and 50 € paying by mobile phone would be the most preferred method (cf. Fig. 1).
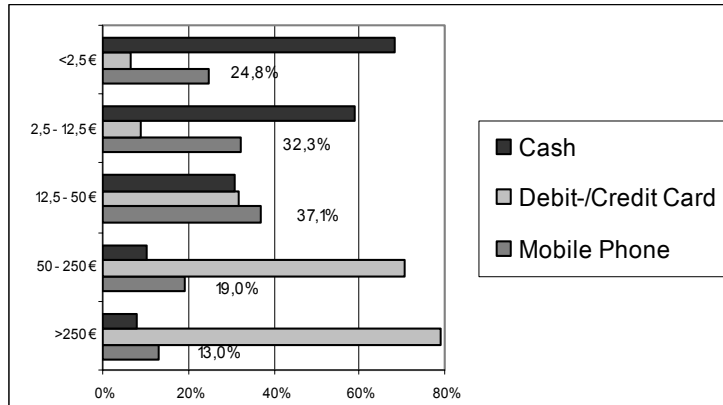
Fig. 1. Preferred payment method of Internet users if away (cf. [9])

These results show that general preconditions for an acceptance of MP by the customer are good. But the decisive factor for a market breakthrough is the acceptance and actual usage of concrete MP procedures.

This consideration allows us to identify a major failure risk in the transformation of general MP acceptance into this concrete acceptance and usage.

2.2 Acceptance of individual payment procedures

If, as we concluded in Chapter 2.1, the key is in the hands of customers and a general acceptance of MP can be stated at least in a significant part of the target group, this leads us to the question on determinants influencing the acceptance of a single MP procedure by the customer. Furthermore, other participants (above all, merchants) will only be able to follow customer preferences up to a defined point, where disadvantages overweigh significantly the advantages.

It is already much said about this issue of acceptance (cf. e.g. [8], [5], [1]). In our point of view most of the arguments can be subsumed to the categories

- *cost* (which includes direct transaction cost and fixed cost of usage as well as cost for technical infrastructure on the part of the customer, e.g. a new mobile phone perhaps necessary, and the merchant, e.g. the integration of the payment solution in his existing IT infrastructure),

- *security* (which includes not only integrity, authorization, authentication, confidentiality and non-repudiation of transactions, but also the issue of subjective security from the viewpoint of the customer),

- *convenience* (which includes e.g. ease and comfort of use as well as the attainment of concrete benefits through the use).

For the latter, it is important that a procedure is not limited on MC scenarios, but can be used in other settings, too. Briefly: It should be possible to use the procedure whenever, wherever and for whatever kind of payment the user wants to do this.

2.3 Relevant M-Payment scenarios

Brokat called the different payment settings "r-world", "e-world" and "m-world" (cf. [5]). We will distinguish them a little more precisely and, for the reasons mentioned in chapter 1, add the C2C scenario.

This leads us to four general scenarios for the usage of MP: the *mobile commerce scenario*, the *electronic commerce scenario*, the *stationary merchant scenario* and the *customer-to-customer scenario* (cf. Fig. 2). We also note that in different settings MP also is competing to different other payment systems. In this connection, we already saw a comparison with competing systems for the stationary merchant scenario in Fig. 1 and furthermore noted the high influence of the amount level on this competition.

Table 1. Relevant MP scenarios

Scenario	Description/Example	Competing payment
MC scenario	New applications and services, e.g. context-sensitive information	- - -
EC scenario	All kinds of B2C EC excluding MC, e.g. purchase of goods or content via the Internet	Offline Debit-/Credit Card e-payment
Stationary Merchant scenario	Classical "face-to-face" commerce, e.g. purchase in a supermarket, usage of a ticket machine	Cash Debit-/Credit Card
C2C scenario	Money transfers between individuals, e.g. pocket-money for children, settling debts for small amounts	(Cash) (Offline)

The distinction of these scenarios is not only important for the examination of the different payment procedures in chapter 4, but also for a brief look at the strategy of market entry and its conclusions on construction of payment procedures in chapter 5.

3 Typical Characteristics of MP Procedures

3.1 Strategic Questions

First we have to analyze, *how suitable a given payment method is for different payment scenarios*. The relevance of the different scenarios has already been discussed in Chapter 2.3. It is now necessary to examine whether the different payment procedures will actually work within the described scenarios of *MC, EC, stationary merchants* and *C2C*.

Another crucial question is, *whether the selected payment model is suitable for various invoice amounts*. In the US, 40% of online merchants want to offer items for under $10, but transaction fees of most payment procedures do not allow this in a

cost-effective way (cf. [10]). Payment categories are usually differentiated in *picopayments* (which we define as amounts of 5 ct or less down to fractions of a cent, cf.[4]), *micropayments* (amounts from 0.01 € up to 2.50 €, cf. chapter 2 and [4]) and *macropayments* (from 2.50€ on, cf. chapter 2 and [4]). While within macropayments transactional costs can usually be neglected, they are critical when it comes to pico- or micropayments since they may be greater than the total revenue made with the service. An MP procedure may therefore be considered a reasonable mean of payment, as long as its total transactional costs are smaller than the total payment amount.

3.2 Participants

3.2.1 General Participants
Since many different parties can be involved within a payment process, their roles and objectives have to be discussed. It is therefore now focused on the question of *who is involved in the payment process*. The integration of a large number of different stakeholders leads to a high complexity and difficult negotiations, e.g. concerning the sharing of revenues or payment risks. First, there are of course the *customers* and *merchants* who trade (electronic or physical) goods or services and use an MP procedure for settlement. *Telecommunication providers (telco)* operate the technical infrastructure and can be involved in the payment process as well (e.g. when they offer billing services for third parties). They may also operate an MP procedure themselves and provide payment services for customers and merchants. *Banks* or *financial service providers (FSP)* (e.g. credit card companies) may be involved as a clearing/settlement instance or they may offer own MP procedures for their customers. Since they have usually a high reputation they may also be involved as a trusted third party. Both – the telcos as well as banks or FSP – already have access to their customers and are used to dealing with financial issues. Another group of stakeholders within MP procedures are newly founded, *specialized intermediaries*, such as payment or content providers. Those companies are focused on the development and dissemination of MP procedures. Finally there is a group which can be characterized as *old economy companies* who develop efficient payment procedures integrated into their own business. One example is the Austrian Railway Company which offers a SMS-based payment procedure for their train-ticketing.

The question of *who receives the Customers data* is crucial. On the one hand, customers are rarely willing to spread their personal data among various institutions or intermediaries. On the other hand gaining information about customers is one of the most relevant issues for merchants and/or providers in today's business. Parties, who receive customer data, may be the same ones as mentioned above: *merchants, telcos, banks or FSP, specialized intermediaries* or *old economy companies*. However, within MP procedures it is also possible that within a payment procedure *nobody* receives the customer's data, e.g. when paying with a prepaid card for a certain service or buying goods with digital cash anonymously.

3.2.2 Customers

Discussing the relevant stakeholders and their interests, we now take a closer look on the customers since they are the key for MP acceptance (cf. chapter 2.1). We can distinguish MP procedures according to their *need for a customer pre-registration.* Besides a difference in convenience, the need for anonymity can be decisive for or against a certain offered solution. If customers have to register they have to transfer personal data to some other institution and may feel monitored. They may therefore favor solutions such as prepaid cards which allow them to remain anonymous.

Another important topic influencing both convenience and the establishment of MP procedures is the *technical infrastructure needed on the customer side* in order to participate within a certain payment procedure. A high-sophisticated technology may be very secure and advanced but it will probably fail, if it can not be operated comfortably by the customer. Current payment procedures are often based on simple message exchange via *short-messaging-services (SMS)* or use the *wireless application protocol (WAP).* Some MP services use *dual-slot or dual-chip-phones.* Dual-slot-phone-technologies use the regular SIM-card (secure identification module-card) to identify the mobile device and also provide a second card-slot for a credit-/debit card integrated within the mobile phone. When paying for a service or good, the user is asked to insert his credit or debit card into this second slot and to enter the card's PIN (Personal Identification Number). The phone then serves as a regular payment terminal, similar to the ones already used with stationary merchants. Dual-SIM-technologies operate similar to the first described method, only is the second card (a credit or debit card, the size of a SIM-card) already integrated in the mobile device – an extra slot is not needed and therefore some of the shortcomings of the dual-slot technology (e.g. usually heavier devices) are overcome. Another application used within some payment models are special software tools needed on the customer side, e.g. to generate digital cash or upload a digital wallet.

3.3 Operational Issues

Any given MP procedure can be distinguished according to *the basis of payment.* The payment procedure can either be *token- or account based* (cf. [1]). Token-based payment procedures use tokens to represent monetary value. The tokens are exchanged during the financial transaction. The customer usually has to create virtual money (e.g. with a certain software) and store it on his mobile device. Token-based MP procedures usually allow the user to stay anonymous when paying and are also usually capable to conduct pico- or micropayments, since the tokens can be created in any given fraction of "real" money. Most MP procedures so far are however account-based. The user has to register with the payment provider and his payments are settled via his account.

The *suitability of an MP procedure for various payment frequencies* is another important factor concerning the establishment of MP procedures. When *paying per (used) time unit* the customer is charged for the time he has used a certain service (e.g. playing an online game). *Payments per product unit* are probably the most frequent payment methods. Goods or services are charged for a flat price (e.g. download of an

MP3 file, purchase of a book) regardless of the time used. A third payment method can be the *subscription* of goods or services. The subscription of services may be limited to a certain number of usages (e.g. the use of a certain information service twice a month) or one may use the service without any limitations.

We are now going to take focus on the *time of account settlement*. There are different methods how a service or good can be charged to the customer. They can be differentiated according to the time the payment is actually initiated. First of there are *prepaid* methods. The customer either buys a smart-card, where the money-value is stored and then pays off of this credit for goods or services desired, or he can upload a digital wallet with electronic coins on a prepaid basis. Subscription of special services is another prepaid method. One pays for something first and receives the service later on a special point of time. All of these prepaid services usually allow anonymity on the customer's side and are already used for EC payments. Another way of account settlements are *instant-paid* methods. Those payments are triggered as soon as the customer accepts the offer. An example for this payment method is direct debiting systems such as the German "EC-Card" or the "Carte Bancaire" in France. Debit cards have a high penetration rate among the population and are widely accepted within traditional shops as well as in EC payment scenarios. They are easy to use and all that is needed for the customer is a giro account at the card issuing bank. A third method of charging for goods or services are so called *post-paid* services. The customer purchases a product or service and is charged for it later. Typical examples are so called "offline-methods" such as "collect on delivery", invoices, credit-card payments or payments via the phone bill. They are typically used in traditional payment scenarios such as stationary merchants or for catalogue-shopping. They are also widely spread and accepted. Phone companies are used to billing via the phone bill and have offered their services for a number of years to third parties. When paying for a good or service, the customer usually dials a premium rate number and will be charged the telephone costs plus an extra fee equivalent to the product price.

Besides the actual settlement time the *number of offered payment methods* that can be used for the settlement is relevant. Since the customer is already used to having different choices of how to pay for a purchased good and is likely to chose a new payment method only if it allows him to use his accustomed payment practices, the number of different payment methods offered by the provider to settle payments will contribute to the acceptance of the payment method itself. The different payment methods have already been described above. They are: *smart* and *prepaid cards*, *electronic cash/digital wallets*, *direct debiting*, *offline-procedures*, *credit cards* and *payments via the phone bill*.

3.4 Morphological Box of MP Characteristics and Instances

According to the results of chapter 3.1 to 3.3 the main characteristics of MP procedures and their instances can be combined. In fig. 3 we do this following the morphological method (cf. [12]).

Table 2. Morphological box of MP characteristics and instances

characteristic		Instances					
strategic	payment scenarios	MC		EC		Stationary merchant	C2C
strategic	payment heights	picopayments		micropayments		macropayments	
participants	involved parties	customer	merchant	telco	bank/FSP	spec. intermediary	old economy
participants	receiver of customer data	merchant	telco		bank/FSP	spec. intermediary	none
participants	pre-registration needed?	yes			no		
operational	technology required	SMS		WAP	dual-slot/dual-card phone	special payment software	
operational	basis of payment	account-based			token-based		
operational	payment frequency	pay per time unit		pay per product unit		subscription	
operational	deduction time	prepaid		instant-paid		post-paid	
operational	method for settlement	smart cards/ prepaid cards	electronic cash/ digital wallet	direct debitting	offline payment	credit card	telephone bill

# 4 Categorization of Typical MP Procedures

In the following chapter we portray typical, current MP procedures and examine them according to the scheme developed in chapter 3.4.[1] Paybox and PayPal are examples for SMS-based procedures whereas Iti Achat and EMPS use dual card technologies. Furthermore, Mobilix and the i-mode-payment procedure, which are unique in their functioning, will be described.

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[1] For further information about existing MP procedures cf. www.jrc.es/cfapp/invent/list.cfm.

Paybox[2]

One of the most important payment procedures in Germany is offered by the Paybox AG. So far Paybox is also offering its services in Austria, Sweden, Spain and the United Kingdom. This service works throughout all of the described payment scenarios and can be used for any payments higher than 0.01 €. After registration the customer can send and receive money to other participants and pay for goods or services using his mobile device. All that is needed within the payment process is a SMS-capable mobile device and a special "paybox-PIN" which can be chosen by the customer. Paybox – who owns the customers individual data – is then responsible for the settlement and does not give the personal data to any other parties involved in the process (e.g. the merchant). It therefore acts as a trusted third party for the merchant as well as the customer. Since the payment process is settled via the customers' current account only, the customer can – until now – not chose between different payment options but he may use paybox for various payment frequencies.

The other introduced SMS-based payment methods vary only little from the process described above and therefore only their special differences are mentioned.
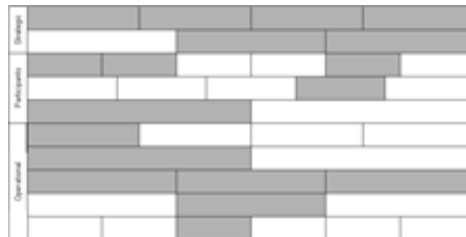
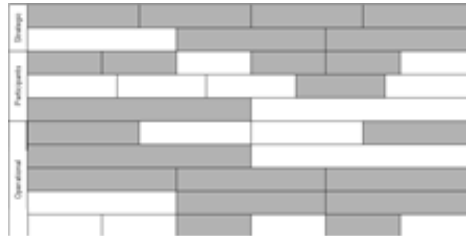**Fig. 2.** Paybox within the morphological box

PayPal[3]

Payments via PayPal are settled via a Credit Card (in countries other than the US, users have to pay to the conditions of abroad credit card usage). All of the described payment scenarios are supported. In order to use this service the customer has to pre-register with the PayPal Company, reveal his credit-card details and – if used on a PDA - install specific software.

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[2] Cf. www.paybox.de
[3] Cf. www.paypal.com

Fig. 3. PayPal within the morphological box

Iti Achat[4]

This MP procedure initiated by France Telecom and the Groupement des Cartes Bancaires is one of the few existing dual-slot payment systems. The 'bank-centric' payment management of Carte Bancaire makes this service an 'inter-operator' system, which means that no single telecom operator has control and explains why all french mobile operators offer or will offer this service. The user needs a dual-slot phone and a Carte Bancaire credit or debit card (including a card PIN). Payments may then be conducted in EC and MC scenarios as well as with stationary merchants.
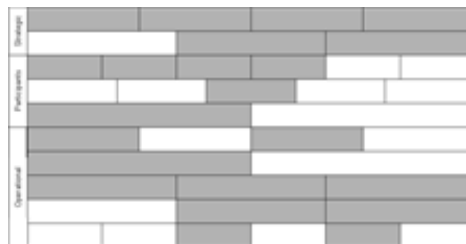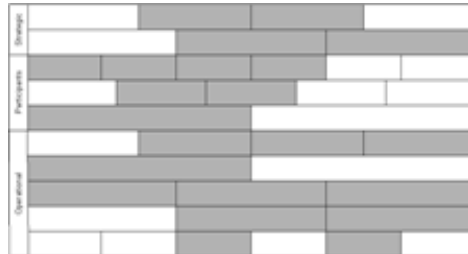

Fig. 4. Iti Achat within the morphological box

EMPS (Electronic Mobile Payment Services)[5]
Unlike the It Achat system the EMPS – a joint venture of Nordea bank, Nokia and Visa International – payment procedure requires a dual-chip WAP-handy with a WIM (wireless identity module) application. The second, semi-permanent chip-card can either be a debit or credit card and is used for settlement. The Payment procedure is actually in its pilot-phase and payments can either be made in an EC scenario (www.ruoka.net) or with a stationary merchant (kinopalatsi, a movie theatre).

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[4] Cf. the ePSO database-entry of www.jrc.es/cfapp/invent/list.cfm
[5] Cf. the ePSO database-entry of www.jrc.es/cfapp/invent/list.cfm

19

Fig. 5. EMPS within the morphological box

Mobilix[6]

The Mobilix payment procedure (developed by the telco orange, the Danish IT-company PBS and the SIM-card producer Gemplus) allows users to purchase airtime in advance via his credit card. This prepaid account can be used to perform payments in MC and EC scenarios as well as with stationary merchants. In order to use this service the customer has to pre-register with the telco. Besides this registration a special SIM-card (plus a new SIM-Toolkit 2+), which can be purchased at the telco's outlets, is necessary to participate.

Fig. 6. Mobilix within the morphological box

i-mode[7]

Within the i-mode payment scenario, developed by NTT DoCoMo in Japan, the user may pay for online services via his mobile phone. He dials a premium-rate number and the accounts are then settled via his phone bill. NTT DoCoMo serves as a telco as well as a payment provider and settles the accounts with the merchants. The i-mode payment procedure works within MC and EC payment scenarios.
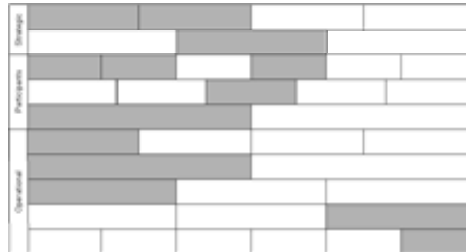
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[6] Cf. [3]
[7] Cf. [3]

20

Fig. 7. i-mode within the morphological box

5 Reflections on the structure of MP procedures

After identifying and classifying existing MP procedures, we will now try to identify some recommendations for the design of MP procedures suitable for the attainment of wide acceptance, since without a wide spreading and usage any given payment procedure will not survive at all, regardless of its possibly brilliant features. The disappearance of some innovative electronic payment procedures (e.g. eCash) as well as the incessant failure of the German GeldKarte[8] may serve as examples for this fact.

In chapter 1 we claimed that MP is crucial for, but not limited to MC scenarios. The latter we proved in chapter 3, showing that in any payment scenario there is at least some MP procedure that makes sense and that there are several MP procedures usable in more than one payment scenario. In order to reflect on a recommended structure for an MP procedure, it will be useful to put the scenarios in an order of relevance. The decisive factor is the impact of the scenario on the diffusion process of the procedure.

Since the *mobile commerce scenario* represents only low revenue rates up to now, it is questionable if customers accept an MP procedure just to possibly use it sometimes in an MC setting. Opposing to this, the *electronic commerce scenario* already represents a good revenue potential today. Because of the so far unsolved EC payment problem (most transactions are paid through offline methods (cf. e.g. [8])) and the high acceptance potential for MP among Internet users, EC users could be very interesting as a target group for MC.

The revenue potential of the *stationary merchant scenario* is definitely the highest of the four described scenarios. But this potential is so far hard to realize because neither the average merchant nor the average customer within this scenario is likely to adopt innovative MP procedures easily. The *customer-to-customer scenario* typically represents only an incentive for usage and spreading of an MP procedure.

Our reflections above coincidence with Weitzel/König who state that MP is going to play an important role in the EC setting (cf. [11]) and lead to the conclusion that a strategy of market entry for an MP procedure should focus on the electronic

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[8] The GeldKarte is a smart card with electronic purse functionality (cf. e.g. www.gdm.de).

commerce scenario. This would allow a significant, interested and interesting target group to get familiar with the system. The other way round, this implicates the electronic commerce scenario nowadays being the most relevant scenario to the design of MP procedures. According to the results of chapter 4 we may state that most of current MP procedures are not optimized for, but at least suitable for the electronic commerce scenario.

On the issue of payment heights (cf. chapter 3.2), it may well be an important factor for the usage of an MP procedure in an MC setting, that it is suitable for micro- and picopayments. But with the assumption of the paragraph above and the numbers we saw in chapter 2.1, we see that this is not the main point for today's spreading. This leads us to the conclusion, that an MP procedure today should above all be optimized for low to medium macropayments (2.50 € to 50 €), but include at least the potential for further development in the direction of cost-effective micro- and picopayments. The latter is not the case for most of current MP procedures, which remains to be solved.

6 Conclusions

The penetration rate with mobile devices - especially phones - is already high. The image of the devices is positive; they are accepted and associated with modernity. But above all, they accompany their users anytime, anywhere and furthermore, tend to be more personal than any other device and to become more and more an integral part of their users' lives. Thus, the mobile device tends to resemble more a purse, than a Personal Computer (cf. [3]).

The MP properties stated in the first paragraph of this chapter as well as the acceptance numbers we stated at the beginning of our paper represent good starting conditions for MP. The decisive point is the transformation of a general interest of users into their everyday usage of concrete MP procedures. We did not find an "ideal type" and do not believe that we will see one in the future. A possibility would be MP procedures which aggregate the properties of two or more types, making it possible for the customer to use their advantages without giving up too much convenience.

MP usage may start in the EC scenario, open the door for the MC scenario and ideally lead to the acceptance as an additional mean of payment in the stationary merchant scenario, the so-called "real world".

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