

Secure Mobile Payment - Architecture and Business Model of SEMOPS

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Abstract

Mobile payment is considered by many experts as the next “big thing”, that will kick-off existing e- and m-commerce efforts and unleash the true potential of mobile business. Different approaches come to the market and try to address existing needs, but up to now no global solution exists. In this paper we present the approach followed by the EU IST SEMOPS [3] project, its architecture and the innovative business model that it is based on. Finally we make an initial evaluation and examine possible benefits arising from this model for different actors e.g. banks, network operators and users.

1. Introduction

The mobile payment is considered by many people as the new killer-application that will boost e-/m-commerce. According to Wireless World Forum report [1], the total value of mobile payments will rise from 5.5 billion Euro in 2002 to 55.3 billion in 2006. Forty four percent of 5,600 mobile phone users on four continents surveyed in February 2002 in the global Mobinet study [2] would like to use their mobile phones for small cash transactions. It is obvious that the need for a universal payment system exists and current efforts have not yet addressed the area at an adequate level. The EU IST Secure Mobile Payment Service (SEMOPS) [3] project depicted in this paper aims at designing, developing, testing and deploying such a solution that has the potential to be a global payment service.

2. The SEMOPS Architecture

The SEMOPS (Secure Mobile Payment Service) project is a two-year European Union funded project that was initiated at the end of 2002 with the aim to address effectively most of the challenges bundled with a mobile payment service, and develop an open, cross-border secure approach. SEMOPS has 15 participants from 4 countries and is based on the cooperation of banks and international mobile network operators (MNOs). The service concept is built on the credit push concept. Based on this model and combined with state of the art mobile technology, the SEMOPS project aims to develop a real time, user friendly mobile payment service, for virtual and real points of sale (POS) as well as for person-to-person (P2P) transactions on pan-European scale. The solution establishes new ways of interaction as it was required in [5] between the actors, thereby relying on the already established traditional trust relationships between customers and his home bank or home MNO, supported by a unique business model that allows revenue sharing between the banks and MNOs.

The availability of a general purpose mobile payment service, will be a driving force for the development of new mobile applications, will accelerate the growth of mobile commerce, will generate new business opportunities for the mobile operators and as such will contribute to the overall economic growth.

The project's aim is to combine the new payment solution with various forms of proven and state of the art mobile and wireless technology (e.g. 3G, SIM Toolkit, WAP, IrDA, Bluetooth and WLAN will be considered) to achieve a high level of security, availability, user friendliness and interoperability. In order

to establish general purpose mobile payment service on a European scale, the project heavily relies on existing standards and also develops the necessary new technical, operational initiatives and regulations, with customer protection, liability, anti fraud measures, privacy and data protection being of highest importance.

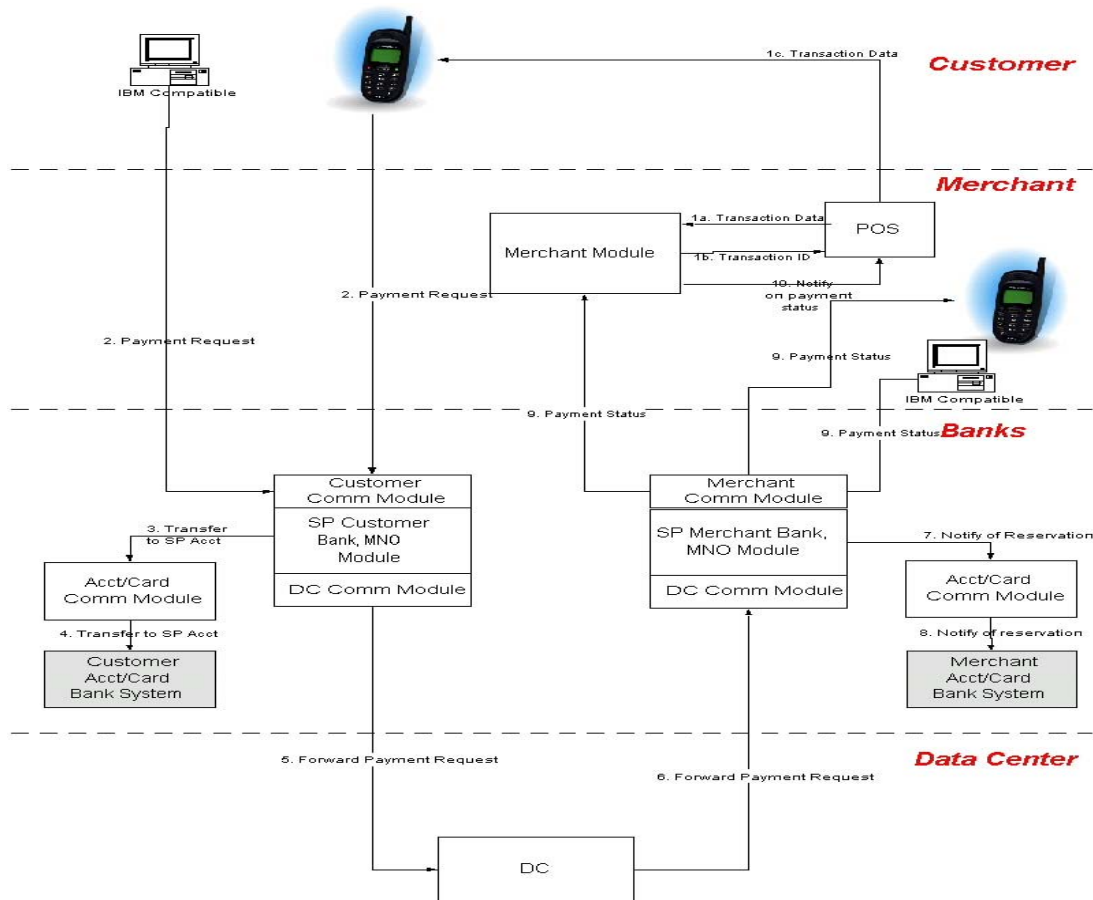


Figure 1 – General architecture of SEMOPS

In Figure 1 one can distinguish the main players and components in a mobile payment scenario. Each user (customer or merchant) connects with his home bank/MNO only. The banks can exchange messages between them via the Data Center (DC). We should mention that the legacy systems of the bank and the merchant are integrated in the SEMOPS infrastructure and are used as usual. In order to give an idea of the interworking of the approach we describe a possible scenario:

- The merchant (in general any POS/VirtualPOS) provides to the customer the necessary transaction details. This data includes certain static and dynamic elements that identify the merchant and the individual transaction. During the whole payment process, the customer does not identify itself to the merchant, nor provides any information about itself, its bank, or any other sensitive data.
- The customer receives the transaction data from the merchant and combines it with information that identifies himself. A standard format payment request is prepared. Then he selects the account manager, where the payment request is to be processed. This payment processor is the trusted partner of the customer – either his bank or his mobile network operator. When the payment request is ready for transfer, the customer checks its content, authorizes it (e.g. via PIN, PKI) and sends the payment request to its account manager.
- The customer’s account manager receives the payment request, identifies the customer and processes the payment request. Processing includes the verification of the availability of the necessary funds, and reservation of the required amount. When the processing is completed a payment notice is prepared by the account manager and is forwarded to the Data Center of the payment service. The Data Center identifies the addressee bank of the payment notice and forwards the message to the merchant’s trusted payment processor, who again can be either its bank or mobile operator. The data

center handles the message delivery. In case of an international transaction however a second data center is also involved, namely the local data center of the foreign merchant's country. In general one Data Center per country is envisaged, but more than one may also exist.

- The merchant's payment processor receives the payment notice and identifies the merchant. The payment processor advises the merchant in real time about the payment by forwarding the payment notice. The merchant has the chance to control the content of the payment notice and can decide, whether to approve or reject the transaction. By confirming the transaction to its payment processor, a confirmation through the data center to customer's trusted partner is forwarded.
- When customer's payment processor receives the positive confirmation it initiates a regular bank transfer to merchant's bank. This transfer is based on the regular well-established interbank procedures, however with the involvement of a clearing house the process could be optimized. In case of successful money transfer, the merchant's bank sends a notification to the merchant, and the customer's account manager sends a notification to the customer. If for whatever reason the merchant rejects the transaction, the customer's payment processor releases the funds it has reserved for the purchase.

3. Business Model

The new payment solution only has a chance to be accepted on the market if it is profitable for the key players to support and promote the service. All the features, offered to the end users, the security, the comfort, the wide reach may be in vain if there is no economic incentive for the service providers. However it is obvious also that the service providers alone cannot gain success if the users are dissatisfied with either the service or the terms of usage.

3.1. Actor Requirements

Key actors of the payment service are: Banks, Mobile operators, Customers, Merchants, Developers, Initiators, License holders, Service providers and Suppliers.

The business model takes into account the following aspects:

- The banks involved in the new service have already existing payment services, and while the new service may offer increased market presence and new transaction channels it may also encroach into present business lines – the new service has to be more profitable than existing solutions.
- MNOs are already involved in a number of payment initiatives, or are completely disinterested in this line of business. The business model has to offer increased potential for the mobile operators either in terms of customer reach, product scope, but most importantly value added new revenue channels.
- It is a key task to integrate the special conditions of micro payment services into a combined payment scheme.
- Customers want a comprehensive spectrum of services and products to buy with the new payment service in a number of purchase situations. This allroundness, comfort and security has tangible value for the shoppers, but the level of this value differs according at each transaction type. Consequently in some cases the customers may also be charged for making payments, but in most cases purchase fees have to be low or are not acceptable.
- Many of the merchants are already active in electronic commerce, but for others the associated expenses are purely prohibitive. The simple consequence is that the business model has to support low overall transaction costs (including set up expenses).
- For the mobile operators the service provides a number of different revenue channels. Besides the mobile communication revenues, direct revenue channels are associated with the service.
- The mobile operators receive revenue from all sales transactions via their own merchant modules. If these transactions are also processed using e.g. prepaid accounts that leads to an additional income. Being the owner of the SIM Toolkit card in the customer's handset the operators are allowed to charge a fee for any transaction initiated from the card. This fee will be associated even with those transactions that have nothing to do with digital content and micro payment (the traditional mobile transaction types) i.e. with high value purchases, like POS transactions, P2P payments, etc.
- Another revenue stream might be realized by co-owning the local data centers. This ownership fee allows a participation also in revenues that are not even related to mobile communication but are realized via alternative channels e.g. Internet.
- Initiators are those entities that introduce the service in new countries. This assumption of risks has to be associated with adequate returns. The financial return can either take the form of ownership rights

in the local operations or preferred commercial conditions if the initiators are also involved in the service provisioning.

- The SEMOPS approach is based on decentralization. In each country where the service is introduced there is a local entity, the license holder, who organizes the service contracts with the banks and mobile operators, contracts with the local service providers, ensures that local regulations are complied with, makes sure that the general service requirements are followed. This license holder has substantial initial investment and running expenses. The revenue streams have to be designed with the goal to provide adequate returns for this actor.
- It is clear that in a global payment service, the local organization will require the participation of external suppliers and service providers as well. The overall revenue streams will have to provide adequate coverage for these expenses as well.

3.2. Business Concept

Basic principle of the business model is that it is based on the cooperation of banks and MNOs. This situation has two consequences:

- Actors' resources can be combined
- Revenue has to be shared

Based on the complexity of the service and the market strength of the two key partners (group of banks, group of MNOs) the service will follow a revenue maximization strategy and it is not heading for niche markets. This statement does not mean that every solution, in every payment situation will be introduced simultaneously, but the full service will comprise the whole potential scope. Introduction of each service component will be individually designed and elaborated based on prevailing market situations and the state of technology development. There is no uniform international business strategy, but each national market has to adapt to its individual peculiarities that best fit the local circumstances [4], or the strategies of the key players involved.

The revenue maximization policy is based on the following factors:

- combination of customer base of the banks and mobile operators (customers, merchants)
- combination of transaction potential of different transaction channels (mobile, internet, traditional POS/ P2M)
- combination of transaction potential of different transaction types (B2C, B2B, P2P)
- combination of transaction potential of different monetary value levels (micro, mini, macro)
- combination of transaction potential of large geographical coverage (domestic, cross border)

Regarding costs the business model utilizes all the potential that the complexity of the service provides in terms of scale and efficiency. The new service has a relatively low cost structure due to the following factors:

- The service is fully automated and covers end-to-end electronic processing. As a result the variable expenses are minimal and introductory expenses can be kept low due to the modular and scalable infrastructure solutions.
- Much of the facilities and equipment used are not dedicated to the service but are already used by existing services and applications. Extensions to the functionality of legacy systems is only done if required in order to accommodate the SEMOPS requirements.
- SEMOPS uses open and when possible standard interfaces in order to ease future 3rd party product integration and cooperation with other modules (software/hardware) with the aim to provide an extensible but also cost effective system.
- Installation of the new service modules is based on middleware technology, i.e. a number of different platforms are supported and the introduction should be relatively simple and cost efficient.

The operation of the service optimizes available resources: The payment processing is allocated to those organizations that can perform this activity within their existing operating framework with marginal extra expenses. Furthermore allocation of micro payment to mobile operators and larger values to banks provides a revenue distribution optimum (Note: SEMOPS does not prohibit banks handling micropayments or MNOs handling macropayments). Similar conditions apply to the data centers: their operation, at least at the launch of the local services will be performed by existing service providers.

Much of the operational costs could be incurred through communication, the settlement process or through security related requirements. However all of these cost items are controlled well:

- The communication between the service partners is optimized by the channels used. Much of the communication is either based on local connections (IrDA, Bluetooth) or on the Internet and an optimal technology is envisaged, i.e. 2.5G and beyond (e.g. GPRS, UMTS).
- The settlement process is based on distinct (batch based) large value transactions thereby minimizing related expenses.

To understand the basic philosophy behind the operation one has to see, that all transactions irrespective of the channel, value, commercial situation and terms are using the very same infrastructure, the same solution and processes, and are settled and protected under a common umbrella.

3.3. Revenue Streams

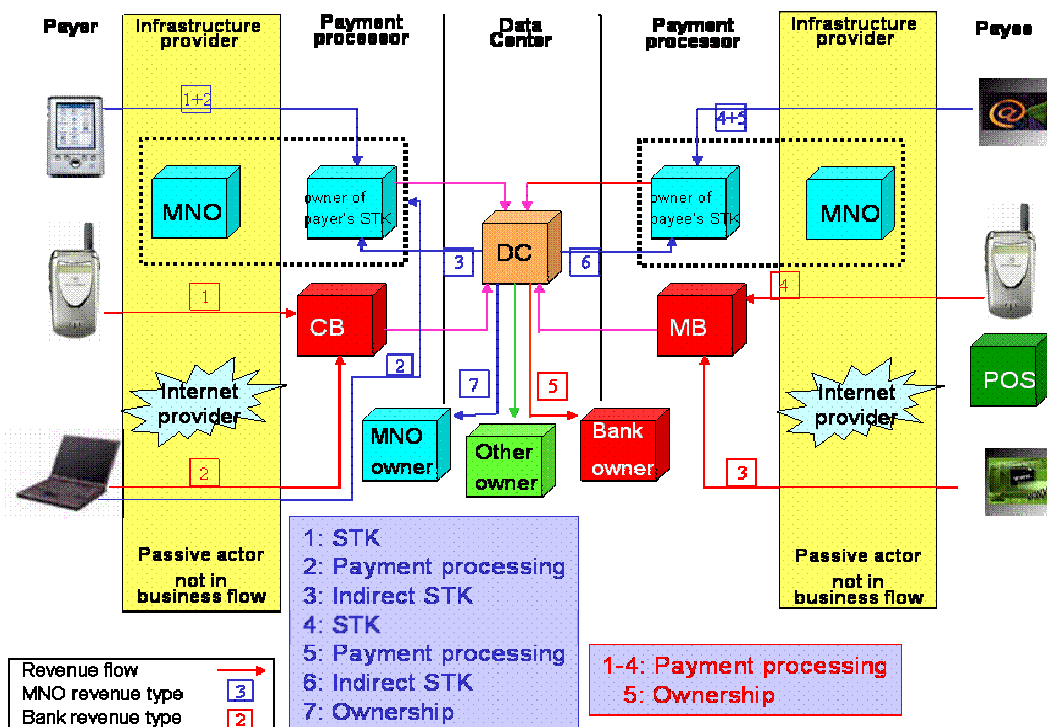


Figure 2 - Revenue streams

Figure 2 depicts the major revenue streams for the key partners, i.e. the mobile operators and the banks. It contains only the service related revenue sources and does not include revenue streams for the associated parties. Those revenues will have to be derived from these channels. Figure 2 contains also those potential revenue streams that are uniquely associated with the new service. For this reason the normal communication revenues that are associated with the use of the telecommunication infrastructure are not shown.

3.3.1. MNO revenues

MNOs may individually decide, which of the potential sources will be tapped by them based on market situation or other preferences. The model allows individual variations and does not require a unified approach not even on a national level.

- The MNO is charging a fee for using the SIM card to initiate a payment transaction. This fee is paid directly by the customer to the MNO if the transactions are also charged by the MNO. This fee is paid indirectly by the customer to its MNO if the transaction is processed by the customer's bank. The actual transaction cost includes this fee, which is collected by the banks from the customers. The Data Center collects this fee from the banks and forwards it to the MNO. The customer's mobile operator is processing the payment transaction for a fee. Processing in this sense means debiting a prepaid account, or levying a charge on a post paid account (if regulation permits this). In the new service the MNOs can potentially be also involved in micropayment Internet transactions by also debiting those charges onto their customers' accounts.

- The MNO is charging a fee from its merchants or the beneficiaries, if they are using a device containing the MNO SIM card. This direct flow is only possible if the MNO is performing a direct service for the beneficiary. An indirect flow applies if the banks are collecting a fee for the payment transaction. Part of this fee belongs to the MNO, and is forwarded by the Data Center to the MNO.
- The MNO is charging its merchants for enabling them to sell products and services using the MNO infrastructure.
- Ownership revenue can be gained if the MNO acquires interests in the local Data Center. Based on transaction volume, it is expected that Internet based transactions make a big share in the Data Center revenues. MNOs can only participate in these revenues by ownership shares of the Data Center.

3.3.2. Bank revenues

In the SEMOPS, banks are involved in various payment processing activities (cases 1 to 4). They are processing mobile and Internet transactions both for customers and merchants. The activity is practically the same however the fee level may vary based on transaction type, transaction channel and whether the service is provided for the customer or the merchant. Banks, if wished, can also acquire ownership shares of the local data centers (case 5). This ownership would result in additional revenue sources independent of the banks' payment processing activities.

4. Evaluation of the payment model

The payment solution to be developed by SEMOPS is unique from a number of perspectives.

The service embraces one overall principle - *Independence*

- *from banks*: If a customer or merchant changes his bank, this does not result in loosing access to the service. Potentially all banks should be able to offer the service
- *from MNOs*: If a customer changes his MNO, this does not result in loosing access to the service or to certain merchants
- *from handset technology*: All traditional handsets are well suited to provide access to the service. This independence does not mean however that all optional features are also available in all phones. Some designs and types will provide more functionality than others.
- *from STK*: All different kinds of SIMToolkit cards are able to store and run the customer modules. Certain minimum criteria apply as memory capacity and RSA functionality.
- *from network technology*: The service is available on different mobile technologies such as GSM, GPRS, and 3G technology.
- *from IT platform and connecting infrastructure*: Modules communicating with external systems are to be built on various IT platforms, and are to be based on middleware and interface technology.

The payment service is based on the cooperation of banks and MNOs. In this model competition is replaced by synergy and cooperation between the two key actors – both parties can contribute with their added values thereby realizing a vision outlined in [6]. The banks are processing the macro transactions, which is their core business, while the mobile operators are involved in the micro payment transactions, which has been targeted by them for a long time, and where banks are usually not efficient enough. MNOs can define their level of involvement based on business strategy or other considerations. With this division of work the solution can offer a full scale of payment possibilities. It does not only cover Internet and mobile transactions but can also handle all monetary values from micro to macro payments. The variety of service potential is further increased by the fact that not only 'real-time' payments are processed, but value date and deferred transactions are also possible. The service will offer refund features, cross border and escrow payments will be possible as well.

By involving the key participants of the mobile and financial services industries and offering a universal payment solution to the public, the potential clientele of the service is huge. All customers of all the banks and mobile operators are potential users of the service. This market potential is further increased by the openness of the transaction flow. The customers and merchants transacting with each other do not have to know each other in advance, do not have to authenticate each other, do not have to belong to one common service provider. Any client of any of the member banks or mobile operators can perform a transaction with a client of any other member bank or MNO. This decentralized structure allows quick market penetration and the strong growth of transaction volumes. By adding one new bank or MNO to the partner list the number of potential transactions increases, as the customers of the newcomer can carry out transactions with the clientele of all other existing partner companies.

The new payment service opens new dimensions for a large segment of the population. So far electronic transactions were the privileges of those customers, who possessed bankcards, credit cards, etc. The

SEMOPS payment concept is based on bank accounts or accounts maintained by mobile operators. Key feature of the service is its inverse transaction flow. As a result, all users (customers and merchants) are in a direct relationship with their own trusted partners i.e. banks and MNOs. Sensitive information is not provided to anyone else except to the customer's trusted partner, while payment guarantee is provided by the merchant's trusted partner – its bank. This social-trust based model provides a very high, but at the same time a very flexible security solution. The lack of publicly available traceable information in the system allows the customers to control and retain their anonymity if they wish. Except their trusted partner no one else knows their identity during the payment process (however it is possible that during the purchase transaction some personal information has to be provided to the merchant, e.g. a delivery address). In order to comply with money laundering directives the solution allows lawful interception if necessary.

Customers individually approve each transaction (with a PIN, electronic signature), according to the bank's or MNO's policy. Trust in the service is also supported on the merchant side. For each transaction the merchant receives a payment notice from its own trusted partner. The payment notice in most cases (except at value date and deferred transaction) serves as a bank guarantee issued by the merchant's bank. With this solution monetary risk for the merchant is minimized, performance is sped up, expenses are reduced.

The new payment solution is end-to-end automated. All payment notices and acknowledgements are sent and processed in real time supporting time sensitive purchases, like POS payments and payments for digital contents. In addition the payment settlement can be sped up and the merchants can also be credited practically in real time. This extra feature depends on the participating banks, i.e. if they offer this feature to their customers. The introduction of the real time settlement function does not require any modification in the present interbank clearing processes.

The service is designed with the goal to allow an easy, quick and cheap implementation for all partners involved. The new software interfaces to the traditional systems and will be available on various platforms. The same holds true for the merchants. The merchants are further assisted with the added comfort features of the service and the merchant module that provides access and online information to the merchant's back office systems.

5. Transaction Types in SEMOPS

Among the mobile transactions types that SEMOPS will support are:

- Mobile content – (mobile applications, information, services - buy it and use it on the mobile).
Key specific of these transactions is their low value. Potentially the number of the transactions can be very high, and one order can also comprise a larger number of individual transactions. Time might be a key issue for these types of purchases.
- Out of band C2B – (purchase by browsing – buy it via the mobile, use it traditionally)
These types of transactions are the mobile equivalent to e-commerce. In certain cases (with some high-end PDAs already in the GPRS environment, but especially in 3G) convergence between “m” and “e” commerce will be completed. Consumers are browsing the merchant's WAP or WEB site and buy products from the web-store. Time is of no importance to these transactions (considering that the whole payment process should not take longer than 10-15 seconds). Payments can range from mini to macro.
- P2P – (money transfer between two individuals, payment for purchases made in the non-electronic environment, like catalogue sales)
These payment types are very similar to traditional fund wire. One person the payer is initiating payment through its own bank to the payee. In case of the SEMOPS solution the key difference is the time needed to inform the beneficiary about the completion of the payment. Today such a notification via traditional bank systems can take a few days, while in case of the SEMOPS service this will be just a few seconds.
- POS – (proximity payment in brick and mortar stores)
Using mobile devices to perform payment transactions at regular stores can be achieved by establishing interaction between the phone (PDA) and the POS terminals. The most cost effective way is the installation of multi-function terminals that are able to process both the credit card payments and the new SEMOPS transactions. Key criteria of these transactions are convenience and speed. The payment process has to be simple, and from start to finish (including interaction with the cashier) should not take longer than a credit card transaction (preferably it should even be faster). Transaction values cover everything from micro to macro payment.
- P2M – (payment to vending machines)

Presently it is not clear yet whether these transactions should be treated as a separate category or should be included under the POS chapter. Basic difference is that the interaction with the seller is fully automated (unmanned POS), time is of lower importance, and most possibly average value of transactions will be lower than that of the POS purchases. A subversion of this functionality is the communication with ATM machines. Practically there is no technical difference regarding the interaction between the devices however transaction volume in this scenario will be substantially higher.

- It was also considered by the project whether a real wallet like solution needs to be integrated into our own concept or if it is not necessary at all. The project was looking at payment scenarios where time is of such importance that even the 10-15 seconds targeted by the development is too excessive. Research did not discover any commercial situation, that could not be handled by the new service or non-performance could not be backed up by legal solutions.

The Internet transactions follow a more unified patent, the process and technology – as far as we know it today - are the same, unrelated to the type of the transaction.

- **B2B, B2C** – (browsing in a web-store and selecting any kind of goods or services)
The payment process is independent from the fact, who the parties of the transactions are. The same basic solution covers B2C, B2B payments, monetary value and time sensitivity is not a factor either in the payment process.
- **Escrow service** – (auction payment)
While the payment process is practically the same, there are additional integration requirements between the payment functionality and the core systems of the auction houses. The back office procedure is also different as instead of the usual four parties, five are participating in the transaction (practically there are two merchants).

6. Conclusions

We have presented ongoing work within the EU SEMOPS project. SEMOPS aims at developing a global mobile payment system. Its innovative business model is based on two key concepts a) that of cooperation of Banks and MNOs and b) that of social trust relationships since each actor transacts only with his trusted bank or MNO. It is worth noting that SEMOPS features a distributed approach where banks/MNOs can dynamically join the system with their customer base and users do not have to register alone, something which will allow SEMOPS to grow fast and reach a the critical mass that may establish it as a global payment service. The SEMOPS business model is general and flexible enough to integrate future needs. We aim the development of a prototype according to the approach described and intend to demonstrate it in a cross-border trial at the project's end in 2004.

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