

A Framework for Providing Electronic Payment Services

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As from the beginning of the late 70's an impressive number of innovative electronic payment systems have been developed and tested commercially. However, the resulting variety and complexity of the systems have turned out to be one of the obstacles for the broad acceptance of electronic payment. In this paper we propose a process and service oriented framework, which offers a structural and conceptual orientation in the field of electronic payment. It renders possible an integral view on electronic payment that goes beyond the frame of an individual system. To do this, we have generalized the systems-oriented approaches to a phase-oriented payment model. Using this model, requirements and supporting services for electronic payment can be sorted systematically and described from both the customers' and the merchants' viewpoint. Providing integrated payment processes and services is proving to be a difficult task. With this paper we would like to outline the necessity for a Payment Service Provider to act as a mediator for suppliers and users of electronic payment systems.

1 Introduction

The slogan "It's no e-commerce, if you can't get paid!" led to the rapid development of electronic payment methods in the late seventies. Thus, solely for the Internet, more than a 100 payment methods are available, part of which are still being used commercially. Link collections can be found in [Pei02] and [IPT02]. Despite the intensive efforts made by the economy, in particular banks and in recent times also mobile telephone operators, so far none of the innovative electronic payment systems have become generally accepted in the market.

Many of the experimental prototypes and practical field tests concentrated too much on the technical issues of electronic payment and on sophisticated security features. Because of this, a heterogeneous landscape of systems has arisen. These individual systems are comparable in their characteristics, such as in the handling, security mechanisms, cost structure or range of application.

If a merchant wishes to offer several payment methods to his customers, he is confronted with a complex and multilayered problem, because of the variety of isolated and proprietary solutions:

- **Requirements**

The features of the offered payment systems have to be adjusted to the requirements for the payment process. If, for example, a foreign customer wants to purchase and pay in an on-line shop, this transaction must be supported by the available payment systems.

- **Processes**

The intended payment systems have to be integrated into business processes. This is no simple task, because every payment system (in particular a sophisticated one) has a very specific control logic. Furthermore, it may be that a payment system only supports a part of the entire payment process. For example, if a payment system does not support a partial cancellation of a payment or a credit note, then a merchant has a problem in the case of part delivery. As a consequence the missing parts of the process have to be supplemented separately by the payment provider.

- **Services**

The individual services provided by each of the payment systems have to be integrated in an overall concept. An example of this would be a report on all in-coming payments. This report should uniformly represent all payments and not reflect the specific payment system used for the payment.

Furthermore, data provided by the payment systems have to be integrated via interfaces into existing systems, like ERP, billing or CRM systems. However, despite the huge number of payment protocols (an overview can be found in [Lel01, 4.1.2]) no generally accepted standards for interoperability exist, as yet.

This paper introduces a framework that permits an integral treatment of all essential aspects of electronic payment. It offers a scheme

- by which user demands and payment services can be put together and described systematically,
- which contributes to clarify the role of a payment service provider as service supplier, process manager and systems integrator.

Initially, we started in chapter 2 by compiling the customers' and merchants' requirements for electronic payment found in the literature. Then, by abstracting from the control logics of individual payment systems we derived in chapter 3 a more abstract phase model for electronic payment. In chapter 4, using this model, services for electronic payment are specified system-neutral and assigned to the phases of the payment process. This leads on to the task of providing payment services. In chapter 5, a Payment Service Provider (PSP) is introduced as an intermediary between payment system providers and users. He is in the position to make an integrated payment solution available for the market and the customers.

2 Requirements for Electronic Payment

The requirements for electronic payment systems have been compiled and analyzed in a vast amount of studies. Initial attempts, as shown in the papers [NM95], [FW96], [HSH96] and [AJSW97], are constitutive. In particular during the 90s many studies concentrated on the development of new payment protocols. In lieu of this, the requirements for electronic payment were primarily developed out of one system with the emphasis on technical security and thus formulated. Recent studies have moved more towards user requirements, with its main focus on the system. cf. [Rei99], [BGH+00] and [Abr01].

The requirements specified in the above mentioned literature can be summarized in five categories: Security, confidentiality, fungibility, user friendliness and efficiency. Due to its selective description, the explanation of requirements is compatible for both the trader and the consumer. Individual requirements for consumers, traders or bankers will only be examined if necessary.

Security

The question of security is stated as an essential requirement for electronic payment systems in almost all of the studies carried out on customers and merchants and supported by numerous surveys. For the German speaking region, please see the extensive research undergone by the Institute for Economic Policy and Economic Research, University of Karlsruhe, Germany [IWW02].

Security regarding electronic payment can be broken down into three areas:

The *systems security* takes into account the technical and organizational IT infrastructure security for customers and merchants during the electronic payment process.

The transaction security means the secure and reliable payment in the handling of electronic media according to defined rules. In addition, this entails the availability of payment functions, the complete and correct execution of payment, mechanisms for payment data integrity as well as protection against the unauthorized outflow of funds.

Legal Security is maintained within a legal frame for electronic payment, effecting that one participant is not subject to the arbitrariness of another, for example with regard to payment and delivery dependability. This entails the requirements such as payment denial, the ability to assign the payment to someone else and the conclusion of the transaction, i.e. the legally binding closing conditions.

The security requirements for all participating parties must be adequately considered. Therefore, electronic payment should be realized in accordance with the principles of multilateral security, which are focused on an equilibrium between different security interests [Ran00].

Trust

Electronic payment is confidential when all phases of the procedure are designed to satisfy the participants and their security expectations. Therefore, credibility and authenticity are especially important. As an initial prerequisite, all participants should have absolute trust in the system. This fundamental attitude must be underlined during each payment process again and again. Recent surveys have shown that the question of trust is essential for the acceptance of electronic payment [IWW02]. Therefore requirements in this category should be given adequate consideration in the future.

To build up trust in the electronic payment system, three areas can be taken into consideration: data, identities and role behaviour.

Data should include the protection of personal and business related data in each phase of the electronic payment procedure, especially contract data, systems and configuration data, revenues, bank data and also archived data. In handling this data, the respective national laws and regulations of data protection are decisive. In Germany this means for example that each user must be able to decide for himself, which of his personal data are available and to whom.

The question of identity deals with the participant and the information the latter brings to the system. For this purpose, a differentiated reflection with regard to the roles and the situation of the participants is required: the user may wish to hide his identity by paying anonymously. At the same time the merchant names and proves his identity as a matter of trust. In addition, he is interested in as much information as possible from his customers. The questions arising can be handled systematically within the frame of identity management, where demands such as pseudo anonymity, inability to connect chain links, inability to identify locations or inability of observation can be considered and precisely formulated [CK01], [Cha85].

Within the context of role behaviour the dynamic aspect of trust is captured. With every role there are certain activity sequences connected during the payment process. The execution of these activities, relies on the responsibility of each of the role participants. Among the responsibilities of the customers and merchants, are the acceptance of license regulations, the correct declaration of data, the payment of amounts corresponding to the negotiated conditions and to effect delivery. Essential for the question of confidence in electronic payment, is that all participants behave according to their role and in harmony with the entitled expectations of their interaction partners.

Fungibility

An electronic payment is fungible if it can be used comprehensively, i.e. in as many possible payment situations as possible. This presupposes that

- the electronic payment is available over a wide area and broadly accepted. This must be independent of the chosen distribution channels (internet, kiosk, mobile phone, POS), the point of payment, the paid product (digital, atomic), the utilized currency and the price (micro or macro payment),
- no user will be kept out of the utilization of electronic payment, regardless of his social or economical position, his age, his role (consumer, trader, payee, payment recipient) or his nationality.

The extent of these requirements can be illustrated by two everyday cash payment situations:

- A child gives some money to a beggar – as an example of independence regardless of age and position.
- In a restaurant, a bartender gets a tip. This is an example of more than one payment recipient, and the distribution of payment.

Surveys show that the customer is willing to pay via electronic channels such as the internet [IWW02]. But in fact, electronic payment usually does not take place because of a lack of fungibility in the general sense of universality, acceptance, flexibility or internationality.

User friendliness

The handling of electronic payments should be so simple that even children, older people and disabled people are able to operate a payment transaction without difficulties. For this, cash is a suitable example. In addition to the basic principles of user ergonomics such as being clear and self explanatory, there are further demands such as failure tolerance, integrated IT devices, marginal lags as well as transparency and control for the user.

Some important user demands can only be formulated within a spanned and superior view of the different systems. For example, a payment cancellation should take place in one and the same manner, independent of the fact that the transaction can be initiated by a credit card procedure via internet or by a payment system based on mobile phones.

Efficiency

Electronic payment is said to be efficient when the best possible performance is obtained in every phase of the payment process and taking cost into consideration.. Thereby it is essential that efficiency is granted to all participants. Otherwise there will be no continual willingness to use the system of electronic payment. The

results from I. Pippow and D. Schoder show this by exploiting the example of a quantified economic feasibility study in electronic wallets [PS01].

A complete and systematic registration of individual cost factors includes overhead costs such as investments, license and implementation fees, costs of installation, integration and maintenance as well as variable costs, for example costs of transaction, cancellation and collection.

On the other hand, electronic payment offers a variety of starting points for additional benefits, for example when

- new business ranges in mobile business provide higher revenues for the merchant
- payments can be processed more efficiently
- the users searching for a suitable payment solution can be supported
- payments are linked with a lower risk
- interest can be made on the amount of money when fixed for a while or paid in advance.

Vendors of integrated payment solutions (Service Providers) have the opportunity of using new business models by offering a balance of price and conditions as well as additional services. For the economic success of these business models, an optimized procedure of electronic payment and additional services will be crucial.

3 A Phase Model for Electronic Payment

Since the beginning of the 90's the concepts of Business Process Reengineering (BPR) have placed demands, starting with smooth and optimized business processes. Based on this idea the concepts for customer services and the supporting IT infrastructure have to be developed [HC93].

The high number of online purchases aborts proves that smooth business processes in electronic commerce have not been realized sufficiently so far [Viv01]. In particular, this applies to the field of electronic payment. Only recent articles on this topic have made business processes their starting point. For example, S. Lelieveldt has defined a generic on-line transaction process that covers the entire B2C purchase process [Lel01]. He models the electronic payment as a subprocess with the phases *billing* (the company produces the invoice), *paying* (the buyer pays the seller) and *matching* (seller matches the payment information with the orders). This elementary structuring corresponds to the intuitive understanding, and supports the task to integrate electronic payment into the whole transaction process. But this basic structuring of the payment process does not suffice if different payment solutions have to be integrated into an overall architecture. This demands a more differentiated modelling and structuring of the payment process.

With our paper we intend to start with real payment processes for various existing payment systems. These processes are various and often complex as shown in [KL01]. Therefore, for a homogeneous view of payment we will generalize in two directions:

- **Extension**
The extension broadens the horizon of the payment process by preceding and succeeding processes which are directly connected with the payment. Examples are the conclusion of a contract between the user (merchant or customer) and the supplier of a payment solution, or the cancellation of a payment transaction already performed. The inclusion of all of these processes leads to a wider understanding of the payment process and allows a more comprehensive use of services.
- **Abstraction**
Abstraction describes the transition from real system-specific processes to more general structures of the payment process. It takes place in three steps (see figure 1):

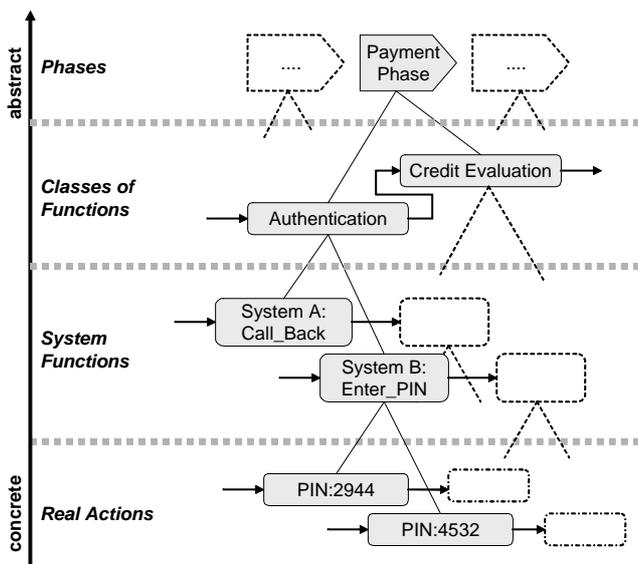


Figure 1: Abstracting the payment process

1. In the first abstraction step, the individual characteristics of the real payment processes are detached. This results in a process which is typical for this system. It consists of a concatenation of system-specific functions.
2. In the second abstraction step, system-specific functions of different payment systems which comprise the same task are combined in more abstract function classes. For example the functions *Call-back Customer on Mobile Phone*, *Input Customer PIN* and *Verifying Public Key* can be combined into the function class *Authentication of the Customer*.
3. In a third abstraction step, function classes belonging to the same temporal context are combined into a phase of the payment process. So for instance the function classes: *System Installation*, *Workflow Design*, and *Interface Integration* can be assigned to the *Deployment phase*.

In this way, we come up with a phase model with five phases *Initialization*, *Deployment*, *Negotiation*, *Payment*, *Post Payment*, shown in the figure 2

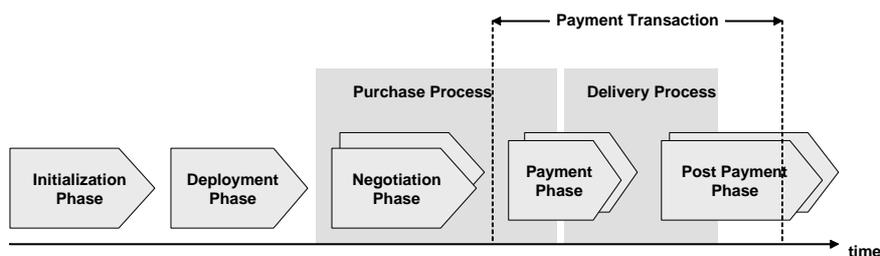


Figure 2: Process oriented phase model for electronic payment

The phase model describes the fundamental structure of the payment flow. While the functions belonging to the initialization and the deployment phase of payment have to be executed generally only once, functions from the other phases have to be activated with each payment transaction.

A concise description of the five payment phases follows:

- **Initialization Phase:**
In the initialization phase customers and merchants select payment methods according to their requirements and conclude contracts, which make them participants of the payment method in the legal sense.
- **Deployment Phase:**
Customers and merchants integrate the payment methods into their existing environment technically and organizationally, so that these are ready for use.

- **Negotiation Phase:**
Before paying, in an online purchase process customers and merchants negotiate – if possible - type and modalities of payment (e.g. credit period).
- **Payment Phase:**
Based on the negotiated parameters the payment transaction is authorized. The successful authorization represents the actual payment for the customer (system message: “Payment carried out!”). Therefore, in this paper, all processes taking place after this time are assigned to the Post Payment Phase.
- **Post Payment Phase:**
In the Post Payment Phase an assigned payment is processed and completed. If relevant circumstances for the payment change, for instance if the merchant can not deliver, then the Post Payment Phase should provide adequate means to influence the regular completion of the payment transaction (e.g. by a cancellation).

The introduced phase model is used for structuring the payment services in the following chapter.

4 Services for Electronic Payment

A service describes an operation which is adapted to the individual needs of the customer.

In grouping the relevant electronic payment services, system specific functions are drawn on from various payment services in just the same way as offered by payment service providers in Germany such as [Bib], [Ges], [iso], [Tel], [Wir]. In addition we have to consider the user requirements, which will be described in chapter 2.

The identified services can be classified in seven categories and outlined according to the phase model (see figure 3).

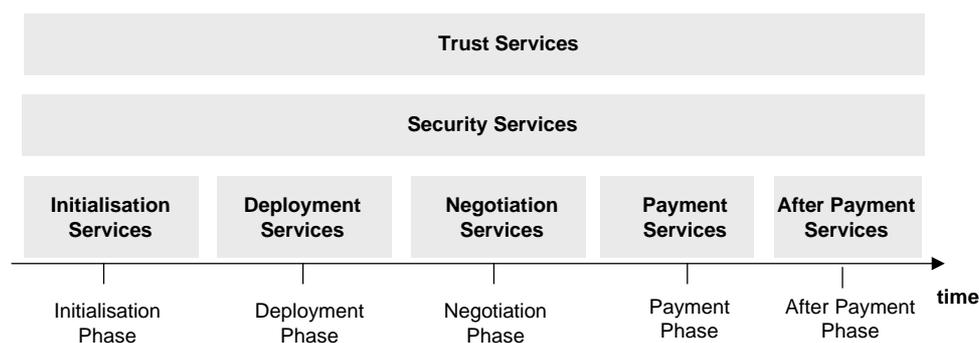


Figure 3: Classification of the service categories in the phase model

In addition to the five service categories for the electronic payment process, there are two service categories comprising the payment phases, namely the category of trust services and the category of security services.

Initialisation services

The category of the initialisation services comprises services, which aid the customers and merchants to participate in a desirable payment form. Individually, it is a question of

- the provision of information for the various payment operations,
- individual consultation for its employment or
- the undertaking of the contract agreement for both the customer and the merchant together with all parties involved in the payment process. Examples of this are, the contract agreement to obtain a credit card, the choice of a payment scale for billing, or the settlement of a mail order agreement.

Deployment services

The category of the deployment services comprises services such as the organisational and technical integration of the payment operations in the customer’s and merchant’s infrastructure. These include the following services:

- the provision of the technical requirements, such as software or a smart card reader,

- assistance in the system configuration for example via a phone hotline or configuration on location,
- system and application hosting for outsourcing the installation and administration tasks,
- the technical contact to the other participants of the payment process, for example, to a credit card processor,
- advanced training for the employees,
- the integration of the payment process in the work and service flow of the merchant,
- the integration of important payment data with standardized interfaces in the merchant's existing IT infrastructure (for example shop system, cash management, call centre, ERP and the CRM system),
- the design and realization of the payment interfaces for each electronic distribution channel, which the merchant offers to his customers.

Negotiation services

Negotiation services assist the customer and merchant in the negotiation of the parameter for a precise payment transaction. The issue of a successful negotiation determines the nature of the subsequent payment transaction.

The negotiation services are also added to services, which the customer can select in the negotiation phase. In practise a lot of these services and their parameters, are part of a fixed agreement in the preliminary transaction stages thus securing a widely uninterrupted transaction. Examples of negotiation services are:

- the selection of payment methods in the context of the payment amount (micro/ macro), the nationality or the products,
- the negotiation of the payment amount taking cash discount into consideration,
- the negotiation of the payment date in respect of the actual debit entry of the amount payable,
- the negotiation of part payment options (e.g. deposit and outstanding payment after a faultless supply),
- the selection of the desirable currency,
- the integration of bonus systems, e.g. by direct rebates,
- the provision of finance possibilities,
- the possibility of splitting the amount between various payees.

Payment services

Payment services undertake the settlement of the payment according to the agreements in the negotiating phase. This entails

- the authorization of the payment transaction by the participants,
- the confirmation of the payment transaction,
- the transfer of the payment data to the particular payment participants (e.g. merchant/retailer or credit card company).

After payment services

The category of the after payment services includes all services, which are necessary and preferable for the further settlement of payment transactions. For this purpose we consider e.g.

- the clearing of the payment transaction,
- the recording of the payment transaction, which can be seen and tracked by the user (transaction monitoring),
- the currency reconciliation of the merchant,
- the clearing of the bookkeeping entry by the merchant,
- the accounting for the different clients (client ability) and accounts (money routing), by the merchant,
- the billing,
- the possibility to modify consisting payment transactions by mutual agreement,

- the cancellation of consisting payment transactions by the user,
- the control and the punctuality of incoming payment transactions by the merchant,
- the documentation of all transactions in terms of payment receipts, daily, monthly and annual sheets, statistics, log files, histories or account receipts,
- the archiving of the payment transaction according to legal storage terms.

Security services

Security Services realise the security requirements of the participants in the whole payment process. So that they belong to the comprehensive services. Examples are

- the security of technical components, which are used during the payment process, such as networks, servers and browsers by firewall architectures as well as intrusion detection systems, backups, recoveries and redundant component constructions.
- the security of communication and data against unauthorised reading or changing,
- the verification of authorisation on accessing data in the payment process (authorised access),
- the mandatory, probative as well and non-repudiable security of documents, agreements and receipts.
- the verification of data incurred in the payment process (e.g. via address checks, plausibility controls),
- the provision of security infrastructure such as key- or certification management.

Trust services

Trust services provide services for the trustworthiness of the payment. Just like the security services they belong to the comprehensive services. Examples of trust services are

- the realisation of the data protection act (e.g. training of the employees who are entrusted with the processing of personal data or itemisation of inventoried files with personal data),
- comprehensive control possibilities regarding his or her stored personal data,
- the identification or authentication of the participants,
- the possibility for absolute or partial anonymity, e.g. in the provision and administration of pseudonyms,
- the credit assessment of the participants,
- the provision of scoring methods, which facilitate users in assessing their own risks during the payment process,
- the settlement of an (payment) insurance, that gives the merchant a payment guarantee or the customer a money back guarantee,
- the mediation of payment disagreements,
- the handling of claims,
- the collection process in the case of non payment or breach of payment,

The examples show that in the environment of electronic payment a very wide palette of services are available, which far transcend beyond the functionality of the “real” payment. This constitutes high demands on the market- and on customer-driven payment-proposal services and their technical and organisational realisation.

5 Provision of Payment Services

Provision of Payment Services is offered by a service company which is specialized in electronic payment. A Payment Service Provider (PSP) offers payment procedures and accompanying services to customers and merchants.

As a characteristic, a PSP is located as a mediator between the participants of a payment process, cf. figure 4.

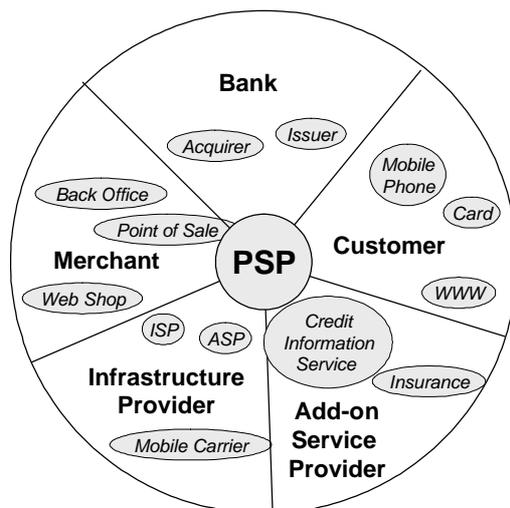


Figure 4: A Payment Service Provider (PSP) as mediator between the participants of electronic payment

In this position, the PSP produces a valuable service which can be paid:

- The PSP develops or purchases the required preliminary products for electronic payment. These might be technical systems (e.g. servers, data bases, communication systems or payment systems) as well as service functions which are integrated by interfaces, for example authenticity services and credit evaluation.
- Preliminary products are transferred into technical and organizational payment services and supporting customer services. Therefore the requirements for the payment participants (customers, merchants and banks) are important.
- Payment and supporting services are offered to the customers, i.e. merchants and clients, via agreements based on a self developed concept of pricing and conditions. Corresponding to these requirement of efficiency mentioned above, the configuration of the so called Service Level Agreements (SLA) have to accomplish a balance between several economic interests between the payment participants.

A PSP does not have to be realized necessarily as an independent instance. One of the payment participants can take over the role of providing payment services - typically a bank, a mobile phone carrier or an internet service provider.

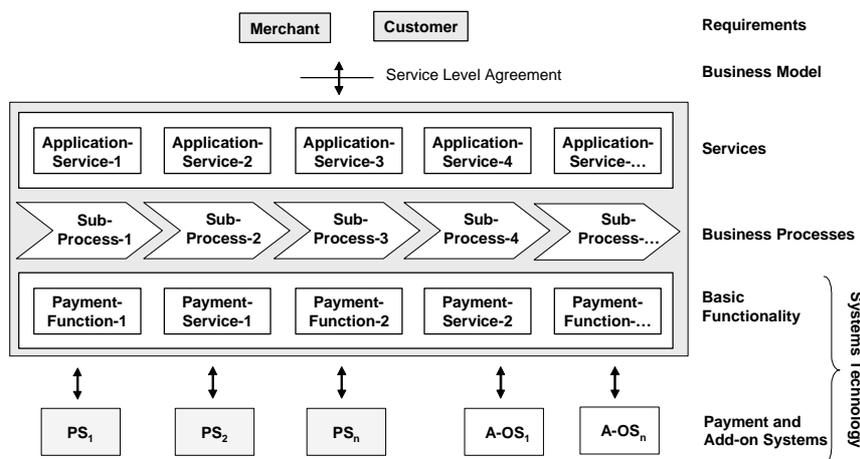


Figure 5: The tasks for providing payment services

As a result of the mediator role the PSP has a complex task which can be structured in different layers (cf. figure 5). The following model of a development process traces, from the business and service model, to the technical aspects and the individual systems.

- **Step 1: Defining services.**

Within the frame of a marketable business model the PSP develops a comprehensive offer of services which are aligned to the requirements of merchants and customers.

- **Step 2: Defining processes**

The success of payment service as a complete product depends on the ability to offer the customer individual services adjusted and linked to each other [KW00]. Therefore the PSP should have the opportunity to influence the design of the process at every phase of the payment. By this means only, the PSP can insure that the supplied services for customers and merchants are connected as a full service offer comprising all phases of payment.

- **Step 3: Procurement of basic functions.**

The selected services for electronic payment are based on fundamental payment functions and services. These should be completely provided by the PSP when possible. In this case the PSP has to make a decision as to how the basic functions can be provided. The possibilities are:

1. Using software components and systems available on the market, e.g. a special payment system or a system for credit evaluation,
2. Developing proprietary software, for example a scoring method for risk estimation,
3. Using services from other carriers via interfaces, such as credit evaluation.

- **Step 4: Adjustment and integration of basic functions.**

The basic functions must be integrated into the business processes so that they can be made available as services for the customers.

This can lead to extensive functional adaptations. For example, the payment functions of a specific system must be extended and adapted in order to make it compatible with the payment process. If a function is not needed it must be by-passed. Absent services, e.g. a possibility for cancellation, can be realized by corresponding service functions of another system. If more than one payment system provides the respective basic function, the PSP makes a choice taking into account the customers' requirements as well as the specific situation.

To avoid different user environments, it is necessary to

- map all payment and service functions of the same type (for example all cancellation functions) in a homogenous user interface which integrates the contents as well as the functions (horizontal integration),
- bring a series of service functions, e.g. cancellation and receipt functions, into a logical and process oriented order (vertical integration).

Ideally the provision of payment services appears to the user as an independent and homogeneous product with one and the same user interface

A PSP is challenged to adopt its technical infrastructure towards the respective requirements, in a fast and flexible manner. A set of modular payment and service functions are desirable so that the PSP can combine them in order to build user services without huge efforts. This leads to the ideas and concepts of XML, and the technology of web services which promise a flexible technical infrastructure by means of 'loosely coupled' systems. The importance of web services in the area of financial services has already been indicated by [TW02]. Further contributions must verify whether the technology of web services can be used for the challenges and tasks of providing payment services.

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