DESIGNING A GENERIC SYSTEM FOR PROCESS-ORIENTED SUPPORT OF BUSINESS TRANSACTIONS USING THE INTERNET

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ABSTRACT

We are presenting a project supported by the DFN Verein, a registered association, and the German government (BMBF) which is called "Confidential Business Transactions on the Internet". In this project we design and implement an open architecture for supporting business transactions using the Internet confidentially and in a process-oriented way. Furthermore we are developing a generic system which might be used in business to business, business to consumer as well as intra-plant cost allocation. Actually our system is designed for carrying out transactions within closed marketplaces independently of any third party. Financial transactions are accomplished by customer accounts. The open architecture guarantees that the system can easily be extended to cover open marketplaces, e.g. by including any payment systems.

INTRODUCTION

To our knowledge there is currently no information system which supports all of the following features:

- A business transaction consists of an information, an agreement and a settlement phase (Schmid, Lindemann 1997). Systems for supporting single or partial phases like electronic product catalogues, electronic auctions (Van Heck, Rivers 1997) or electronic payment systems (Wayner 1997) are developed and discussed in theory and practice. But only a system which supports all phases mentioned above in a process-oriented way can exploit the whole benefits of electronic commerce.
- There are many kinds of business processes an enterprise has to manage. Business transactions, though important, constitute only a part of business processes. Developing a system which supports only the business transaction process is not sufficient to carry out business processes efficiently throughout the whole enterprise. The system supporting business transactions has to be integrated into the information system infrastructure and vice versa i.e. it requires well-defined interfaces.
- The system should support a wide range of applications. Modern systems are merely designed to be applied to dedicated settings, for example business to business or business to consumer settings or intra-plant cost allocation. Therefore our goal was to design and implement a system which can be used in all three settings.

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In order to overcome the lacks mentioned above, Schmid suggests a reference model for electronic commerce (Schmid, Lindemann 1997). It consists of four vertically ordered views: A business view, a transaction view, a market services view and an infrastructures view. Horizontally he distinguishes between the information, agreement and the settlement phase. In accordance to this model we want to elaborate on the features of our system, which is called No3rd (speak: "NoThird") (Bremer, Minrath, Schmidt 1997).

NO3RD: BUSINESS VIEW

The business view defines conditions from an economic point of view. Our system should meet the following conditions:

- No3rd should be applicable for business to business, business to consumer and intra-plant cost allocation.
- No3rd should constitute an open architecture. In this context an open architecture constitutes a system, which consists of modules with well-defined interfaces. No3rd is flexible in the following way: From an economic point of view, components which support special transaction phases should be removed and replaced by more adequate components easily if required by the user's setting. From a technical point of view components, like cryptographic software for granting confidentiality should be easily exchangeable, because the lifecycle of underlying concepts (like cryptographic algorithms) might be short.
  Furthermore, if desired, each module can be accessed by other information systems, especially information which is collected during the agreement and the settlement phases. This feature is a necessary condition for business process integration.
- No3rd should be well-suited for small businesses. As far as business to business applications are concerned, short-term cooperations should be supported economically. Today most systems available on the market are still too expensive (e.g. EDI) or complex and imply high customizing costs (Peikert 1996).

- No3rd's main purpose is to support the trade and exchange of information goods which are distributed in form of files. Main applications might come from information brokering like selling news, software distribution, document management, e.g. concerning the cooperation between companies or the exchange of documents between public authorities and citizens.

No3rd: Transaction View

The transaction view describes the relevant business processes concerning the business transaction which should be supported. In our context a supplier delivers services and information goods as well as material goods.

The Open Trading Protocol Consortium is developing an Open Trading Protocol (OTP) (OTP 1998). Among other goals it tries to develop a standard for communication between trading partners, e.g. it tries to create a framework which contains standard business processes in certain contexts. The business processes supported by No3rd were developed independently of those contained in OTP, but No3rd's architecture allows that all concepts suggested by OTP can be easily adopted.

The current implementation assumes a closed marketplace, that means that a recipient has an account at the supplier's side. Actually closed marketplaces are of great importance, especially in business to business applications (e.g. cooperations in form of projects between companies) or intra-plant cost allocation. But also business to consumer applications are relevant. Consider for instance insurance companies and their customers, newspapers and their subscribers. Nevertheless No3rd is conceptionally not restricted to a closed marketplace. The open architecture allows registration and authentication systems to be easily included at the supplier's side. The project SEMPER (Secure Electronic Marketplace for Europe) (Lacoste 1997), supported by the European Union deals among other subjects with these questions.

The transaction process underlying No3rd is carried out using eleven steps which are related to the information, agreement and settlement phases as shown in Figure 1. Firstly, the recipient gets a market survey by searching electronic product catalogues. After he has finished the information phase, he starts the agreement phase. In Step 1 the recipient registers at the supplier's side. After presenting his user identification the authenticity is checked and confirmed by the supplier in Step 2. In the next step the recipient selects services and sends the order to the supplier. The supplier confirms in Step 4 the order if the services are available and the recipient has enough credit for payment. Once the confirmation of the supplier is given the recipient agrees with this part of the contract (Step 5) and the settlement phase starts. After this payment and delivery are carried out. The supplier prepares the data for the service, encrypts it, and sends the encrypted data to the recipient (Step 6). The encryption can be organized offline or online: Offline cryptography might be useful for applications like video on demand requiring huge amount of data which is difficult to encrypt online quickly. The correct transmission of the data is checked and confirmed by the recipient in Step 7. Now the supplier charges the recipient's account and sends the key for data decryption to the recipient (Step 8). Receiving the key, the recipient checks it for correctness, decrypts the data, and confirms the reception of the services to the supplier (Step 9). In the last step the recipient gets a receipt including information on purchased services and paid prices.

No3rd: Market Services and Infrastructure View

The requirements defined above have to be transformed by modern information technology. The open architecture can be achieved by dividing the entire system in independent modules which are responsible for certain well-defined tasks. These modules are:

- an electronic product catalogue for supporting the information phase,
- a communication system between recipient and supplier for supporting the agreement phase,
- a payment system for the handling of payments and a cryptography module for granting confidentiality during the entire communication process.

Broadly speaking No3rd implemented so far, consists of two main components, the software at recipients side and at suppliers side (compare Figure 2).

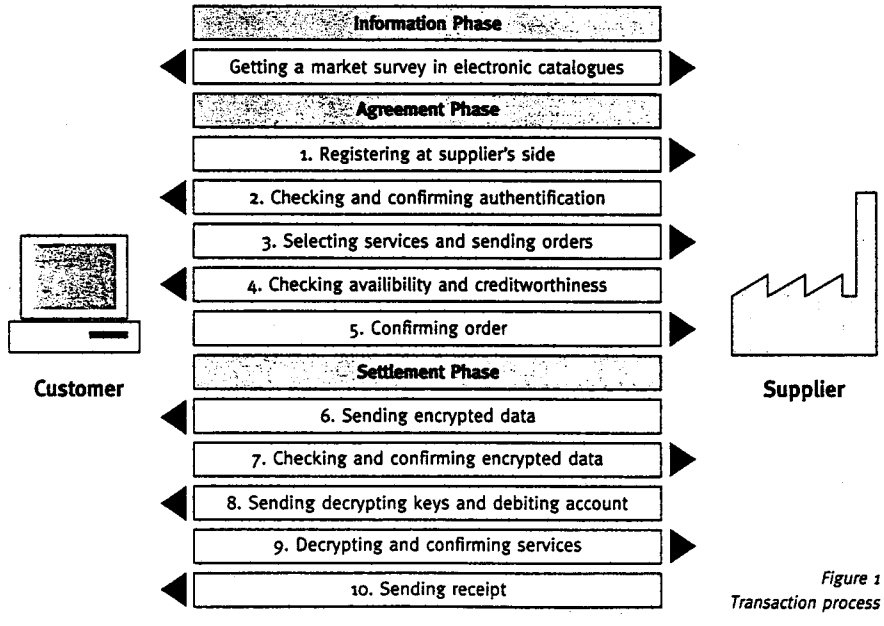

Figure 1
Transaction process

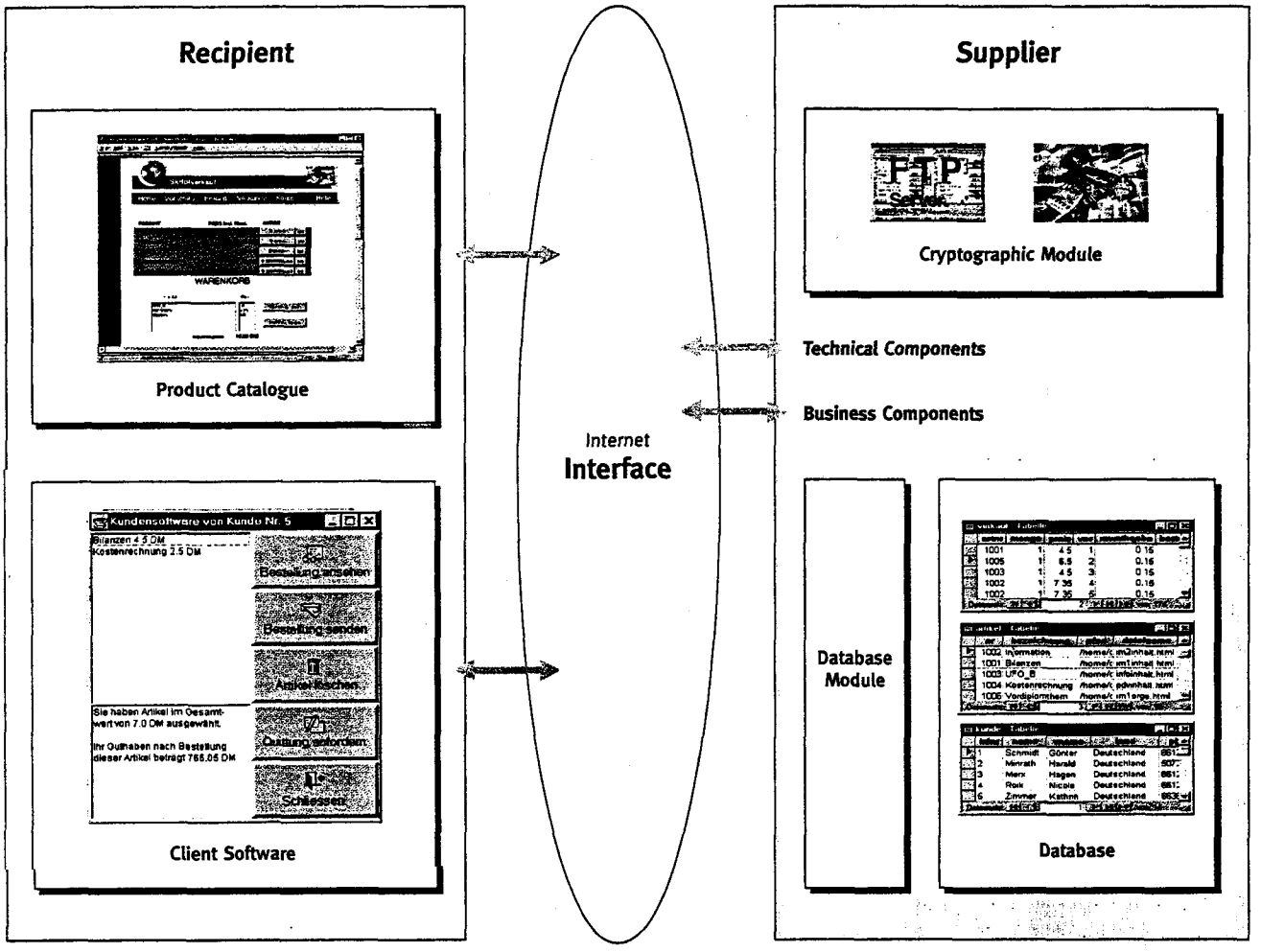

Figure 2
No3rd's modular structure

The software at the recipient's side uses the two components, the WWW-based product catalogue and the client software. The browser is used to register and navigate the WWW application at the supplier's side. It supports the complete information phase. The client software supports the agreement and settlement phase. In greater detail, it fulfils the following tasks:

- Providing the log-in procedure and communicating confidentially via Internet with the supplier.
- Displaying the current status of the recipients accounts, starting processes and confirming various steps in the agreement and settlement phase.
- Closing the session after the purchasing process has been finished or it has been cancelled for certain reasons.

The client software itself constitutes an open system. As far as business to business transactions and intra-plant cost allocation are concerned this feature allows to realize back-office integration. Information collected during the buying process have to be recorded in the recipient's information systems. No3rd has a well-defined interface to communicate with the recipient's information systems, too.

The server side uses three components which are the internal interface, the business components, and the technical components. The interface is the communication module of the tool; it has to manage the whole data transfer not only between server and client but also between the business and the technical components. The business components provide external interfaces to enterprise information systems in order to enable integrated data processing. The technical components are:

- File server storing the original electronic services,
- Random number generator for high quality encryption,
- Key manager to create and store symmetric keys for offline encryption of the electronic services, for storing public keys of the customers and the public/private key pair of the supplier,
- Offline cryptography for pre-encryption of the electronic services,
- Online cryptography,
- Client file server storing encrypted electronic services.

The business components merely constitute a complex database system based on a common data model. The information contained can be accessed by any information system for strategic decision making, like marketing information systems. This open interface guarantees that business processes which coincide to business transactions supported by our system, can be carried out effeciently, too. No3rd does not create new information islands.

The current implementation supports a closed marketplace. Each recipient has an account (credit or debit charging). The clearing of accounts can be done traditionally or might be accomplished in a hybrid way by a credit card system. This attempt provides an efficient way to handle micropayments. Settling micropayments efficiently provides a way to offer new services and is therefore from an economic point of view important for small businesses.

The different modules can be assigned to different hardware which should be selected in accordance with the required computing power. Distributing the server software on several physical computers requires security measures for sending messages between different devices. These measures are also provided by No3rd.

The whole communication process between recipient and supplier is realized by exchanging messages. Each message is built up in the same way. Messages consist of a head and a body. With the help of the header information a module detects the messages' origin and the kind of task it should perform. The information contained in the body is well-defined and depends on the messages' purpose. In this way our architecture is compatible to OTP. Each module is implemented in an object-oriented way. Each consists of three objects: One server, a distributor and a requester. The server constitutes a kind of daemon and is waiting for incoming messages. Incoming messages are accepted, the distributor checks the message's header and decides based on this information in which way the request can be fulfilled. More complex requests are passed to the requester which contacts the corresponding module by creating a new message. If the request is completed, the distributor generates a message containing the requested information and sends it back to the requesting module.

The software is implemented using the programming language Java and is therefore platform-independent. Java possesses a so-called "Java Electronic Commerce Framework" (Goldstein 1996). This is a library of routines which support cryptographic procedures and interfaces to standard software. The independence of the run time system and the availability of the library is a good basis for cheap and easy customizing.

In order to demonstrate the flexibility an object-oriented client-server architecture offers we consider the following process: A citizen wants to get a form from a public authority, to fill in special data and to send the form back. No3rd can be easily customized to support this process. Getting the form can be realized by No3rd by simply removing the payment process. At the citizen's side there must be a software module which encrypts the finished form. The necessary components can be taken from the cryptographic module at the server side. An additional function has to be added to the client software which starts the whole process.

FURTHER RESEARCH

Systems like No3rd enable the emergence of new business strategies and new services. Thereby new business processes have to be developed. Our further research focuses on developing information systems for integrating new business processes with existing ones.

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