Electronic Service Markets[1]

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Introduction

The term „Electronic Service Market“ (ESM) can be decomposed into the parts „market“, „service“ and „electronic“, i.e., the allocation mechanism of the market is used to co-ordinate service utilisation in a computer-supported way. This definition restricts that for *electronic markets* from [Schm93] to the provision and consumption of on-line available services. In an ESM, all transaction phases should be supported. This article motivates an ESM architecture and illustrates these design goals by taking pattern from the EU-funded Project *OSM* that Hamburg University participates in.

Markets

The definition of the market found in microeconomics textbooks is often restricted to the model of perfect competition where a sufficient number of suppliers and demanders, the lack of any preference of transaction partners, and full price transparency constitute the only required preconditions. However, in real life, aspects like transactions and set-up costs often hinder the free flow of market forces and innovative technologies, which lead to market evolution. As a result of the later factors, suppliers are constantly forced to adapt to changes in demand. In the case of sufficiently low transaction costs, this will be achieved through the combination, enrichment, or individualisation of existing goods - i.e. through the establishment of new levels of a value chain. The exchange between demanders and suppliers is carried out through business transactions, which in turn part into three phases: information, negotiation, and execution [Schm93].

Electronic Markets

Electronic markets map the abstract co-ordination mechanism of the microeconomic market model onto a distributed computing system - i.e., in real terms, to the Internet. Electronic markets support at least one of the three transaction phases and are open in the sense of interoperability, portability, user access, and in regard to the legal right to become a market participant. By reducing transaction costs, electronic markets usually raise the co-ordination efficiency of the market system. As an example, electronic stock market systems and also on-line-services - such as CompuServe or AOL - support their participant to find potential transactions partners, to agree on an accepted price, and finally to execute the contract. The stock exchange supports all of these phases, while the on-line service supports either the first one or the last. Also Internet services such as NetNews or WWW-based forums may be considered as on-line services in this sense.

However, what most electronic market systems lack is the support of market evolution, i.e. the possibility for suppliers to introduce a new product at low setup costs or to establish an additional stage of a value chain *in combination* with the support of all transaction phases. Most electronic market systems are either too far specialised so that they do not allow to co-ordinate markets for heterogeneous product specifications (the cost to convert a stock market system to a trading system for a different commercial sector is often prohibitive) or they are generic enough to allow the creation of an additional marketplace (e.g., a new NetNews group) - yet at the costs of supporting only the information phase. Today, electronic market systems pay off only when their expected turnover justifies the considerable investment to set them up.

Electronic Service Markets

The electronic service market (ESM) reduces the goods traded to on-line accessible services and extends the transaction support to all phases [Merz97]. The ESM should allow for market evolution

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by forming value chains at lowest possible costs and by providing innovative services without centralised registration or standardisation.

ESM infrastructures may differ regarding the functions that are standardised or left to competitive suppliers: an ESM may either only standardise the communication layer in order to allow third party providers to establish EMS software components or it may raise the borderline in order to include services such as directory, payment, accounting, non-repudiation as an integral part of the ESM. It is not important, how and by whom these supporting services are provided, however, if they are not available at all, full transaction support will not be feasible.

OSM - an Open Service Model for Electronic Service Markets

As a project funded by the EU ACTS programme, OSM (Open Service Model) strongly focuses on the support of ESMs [OSM96]. The OSM architecture is compliant with the OMG Electronic Commerce Reference Model that provides a framework for the integration of CORBA Common facilities for payment support, on-line catalogues, service brokerage, and the unified access to services that are offered commercially.

Components of the OSM (Open Service Model) development that have been developed at Hamburg University aim at integrating the following mechanisms that support business transactions in a flexible way:

- Generic user access to remote services is provided by a browsing tool, called the *generic client* [MeML94] It supports customers to establish sessions with suppliers, to integrate them visually at the desktop-level, and to store, transfer, and resume sessions on different network sites.
- The ad-hoc *configuration of support services* such as payment, authentication, or notary services. Each time a business transaction is to be established this configuration takes place using a unified description technique and a matching mechanism to specify the transaction partners' needs. In order to achieve this, a generic constraint unification facility is being developed.
- *Value chains* emerge in the following two ways: first, through the establishment of mediators, i.e. services that provide service references to their clients. Mediators may either supply a query interface (such as in the case of the trading service [MeML94]) or a browsing interface (on-line catalogues or directories). Secondly, value chains may emerge by enriching, combining, or co-ordinating existing services. A broker that hides the identities of the actual services involved is an example for such a value-added service.
- The *service profile* is established as a common vehicle for service offer description and as a persistent data store. Compared with the CORBA Interface Repository, the service profile allows applications to extend its data schema. Further, a profile may be transferred through the network as a light-weight object store. This allows all OSM components involved to dynamically provide or obtain specific information in a well-structured way: traders may process service type definitions, catalogues may extract icons and description texts, or the generic client may obtain information on the support service requirements of the transaction partner [MeTL96].
- Finally, the OSM architecture aims at supporting *service negotiation* between client and server by structuring conversations into a limited set of speech-acts [FFKE94]. This helps to reduce the complexity that is principally given when two parties agree step-by-step on a set of service attributes and it allows for a higher level of automation.

Transaction Support

The OSM ESM software supports all business transactions phases:

- *Service navigation.* Navigation and service matching support is facilitated through catalogue and trader services. Both allow providers to register service profiles. The catalogue service maintains a hierarchy of service offers, which are classified by provider, product, or the registration date. The trader allows to match requested and offered services. Since both trader and catalogue use the service profile, the customer may select an exemplary profile and order to catalogue server to

retrieve a list of matching offers from the trader (Fig. 1). As the result of using these services, a collection of profiles is obtained.

- *Service negotiation*. This transaction phase leads to the agreement on business terms with one of the possible suppliers. In order to achieve this agreement, a negotiation is required, which leads step-by-step to the identification of contract properties and their values. Therefore, the contract is sent forth and back between the transaction partners on the basis of a given conversation protocol. The contract template as a data object is standardised by the definition of a common superclass. However, for specific business contexts, this class may be arbitrarily extended through subclassing in order to cover individual contract conditions.
- *Service Execution*. This phase does not only involve both contract parties but also subordinated support service providers, which are required to carry through service utilisation securely and completely. Two examples for such support services are the notary and the bank. The first authenticates all parties and allows to archive the contract itself and the data exchanged in a non-repudiative way. The second supports payment between customer and supplier. The selection of the required set of support services takes place at run-time, i.e., when the generic client binds to the supplier's server.

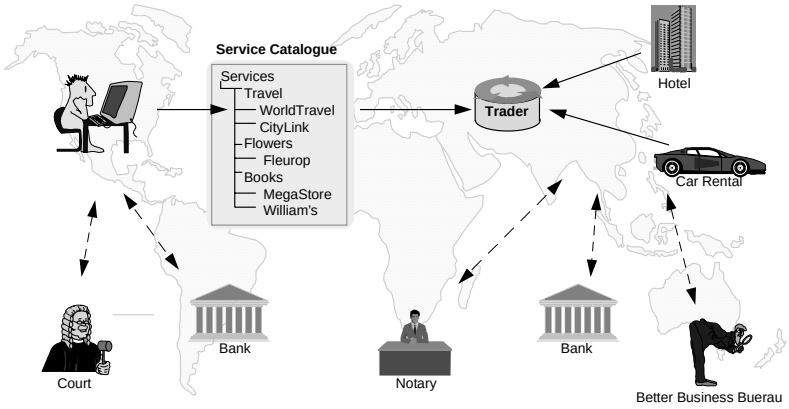

Fig. 1: Players on the electronic service market

Support Service Selection

Support services can be generally classified by the functions they supply. Some of these functions (payment and notary) have been involved in the scenario sketched by Fig. 1. Others may be distinguished as complementary functions such as *quality assertion services*, which certify a distinct quality of service property to the client, or *protocol validation services*, which allow to restrict both client and server to a calling sequence (or *lifecycle*), originally specified by the server as a part of an augmented service description.

Many more support services may emerge that cannot be covered at design time by the EMS architecture. Therefore, a flexible naming schema is required that allows the registration of newly introduced *support service classes* at run-time.

Within support service classes, several *support service protocols* may be selected alternatively to perform the required function. The payment example of the scenario illustrated the options for client and server to involve payment service like Ecash, SET, or NetBill. These protocols are standardised, i.e., an agreed protocol identifier will lead to a well-known behaviour of the respective service. Also in the case of notary services several notary protocols may be available and have thus to be identified by agreed protocol names.

Finally, for a single support service protocol, a large set of individual *support service providers* may exist. 'German Fed' may be one provider of the Ecash payment service besides of several more banks that support the same protocol. This leads to a 3-level hierarchy of support service classes, protocols, and providers.

Architecture

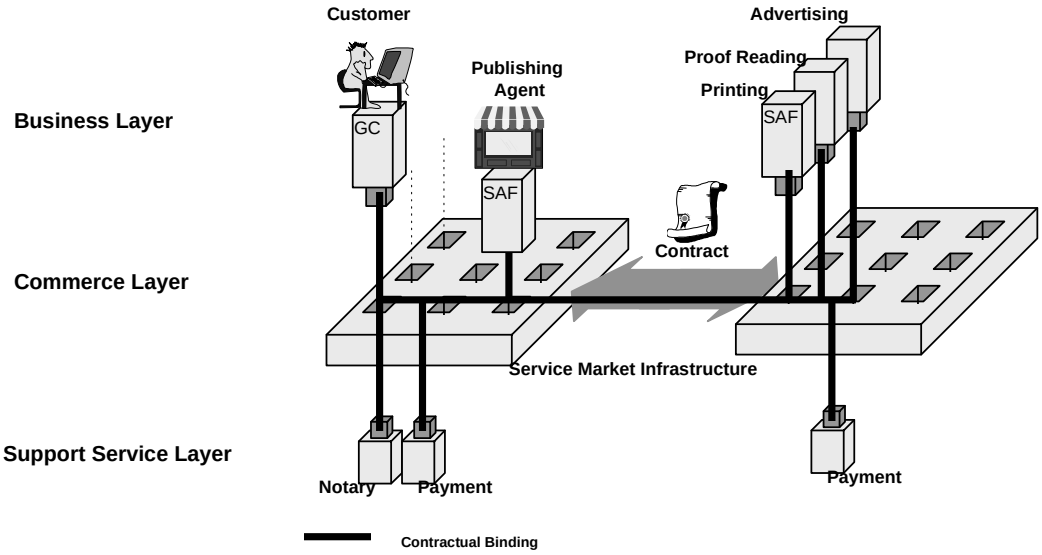

Fig. 2: A contract that binds customer, supplier, and support services

The overall architecture distinguishes three main layers:

- The business layer

The business layer consists of components that facilitate the access of customers and suppliers to the ESM platform. Human users may use the generic client for market access. Each user provides an individual *user profile* that characterises the specific requirements concerning the selection of support services.

On the other hand, suppliers need a *service access facility* (SAF) as a counterpart to the generic client. This manages the communication with support services, the generic client, and the actual commercial service offered. The supplier also provides a profile object to specify the service offer including initial contractual terms that may be negotiable.

- The electronic commerce layer

The actual commerce layer has been designed as thin as possible in order to factor out every possible functionality that can be provided by third parties. Thus the commerce layer plays a co-ordinating role that aims to create *sessions*, which bind all participants that are described by a contract. In particular, the profile matching function is located at the commerce layer.

- The support service layer

Support services are used to facilitate business transactions at low transaction costs. They are themselves deployed as commercial services and only play a supporting role. In a different context, a Bank may be accessed not as a support service (to carry out funds transfer) but as business layer application. Since business transactions may be carried out anonymously, additional services are required to enforce non-repudiation and a secure payment.

Implementation

The current implementation of the ESM system is based on plain Java. Certain components of the user interface, the communication system, and in particular support services will be migrated to industrial components such as CORBA-IIOP (Internet Inter-ORB Protocol), Java Beans, and the Java Electronic Commerce Framework.

Outlook

Further activities will focus on the automated support of negotiation protocols as well as automated support service integration. Here, a common standardisation for the representation of contracts is

required. Another extension of the OSM research platform leads to the integration of mobile agents as mediators between mobile users and commercial servers in the Internet. The current development uses the profile object as the agent representation. Since Java classes and objects can be embedded as profile content, agents may migrate through the network as self-contained objects.

In order to evaluate the ESM infrastructure, an application trial is planned for late 1997 by another project partner (ACS Systemberatung, Hamburg), which connects a digital press archive as a commercial service to the publicly available trial platform.

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