Software Agent-Supported Interorganizational Communication in the Settlement Phase

by Dominik Deschner, Oliver Hofmann, Stefan Reinheimer, and Freimut Bodendorf;
University of Erlangen-Nuremberg, Germany*

Abstract

Considering the way information is exchanged in the settlement phase for Tracking and Tracing tasks, it is obvious that there has merely been an electronification of existing ways to exchange information (EDIFACT messages instead of fax-messages or phone calls) [ADAM, ET AL. 1996]. In order for the sender to keep control over the forwarder's proper delivery process, status messages prove that certain milestones have been achieved. Taking into account that only a very small number of shipments face problems leading to a delay in delivery, this principle of pushed information causes a large amount of unnecessary EDIFACT-messages. Therefore, a pull principle for information exchange seems to be appropriate. In cooperation with a large company sending more than 10 million shipments per year, a software agent based concept was developed to cope with the problem described and to capitalize on the close relationship among the business entities.

The main idea of the concept is to leave data records of the transport process on the forwarders' computer systems and to access these remote systems when necessary. On demand, software agents collect status information from all forwarders involved in the transportation chain. Tracking requests are handed over to the system. Then, a software agent decides whether it can collect the information necessary exclusively by contacting the in-house database, or not. In the latter case the software agent retrieves information about which forwarders to contact and also about the forwarders' homepages through which their databases can be accessed. Retrieval agents then contact the forwarders' homepages, handing over the tracking request. The request is handled and answered by the forwarder's database using a common standard data structure automatically readable and interpretable by an agent.

Introduction

In recent years enterprises have started to improve their business processes by reengineering the existing ones. The focus lies mostly on intraorganizational improvements due to the problems arising when crossing the corporate boundaries. But especially for electronic commerce to be successful, interorganizational processes have to be considered. For comprehensive support through the different phases of electronic commerce (information phase, negotiation phase, settlement phase) business processes among organizations have to be improved.

Especially for physical goods, the task of Tracking and Tracing in the logistics chain can be supported. This broadens the electronic interorganizational interaction among buyer and seller to a three or more party interaction, since electronic communication will occur with the affected forwarders, too. Considering the way information is exchanged in the settlement phase for Tracking and Tracing tasks, it is obvious that there has merely been an electronification of existing ways to exchange information (e.g. EDIFACT messages instead of fax-messages or phone calls). In order for the sender to keep control over the forwarder's proper delivery process, status messages prove that certain milestones have been achieved. Taking into account that only a very small number of shipments face problems leading to a delay in delivery, this principle of pushed information causes a large amount of unnecessary EDIFACT-messages. Therefore, a pull principle for information exchange seems to be appropriate. In cooperation with a large company sending more than 10 million shipments per year, a software agent based concept was developed to cope with the problem described and to capitalize on the close relationship among the business entities.

*Dominik Deschner (Dominik.Deschner@wiso.uni-erlangen.de),

Oliver Hofmann (Oliver.Hofmann@wiso.uni-erlangen.de), and Stefan Reinheimer (Stefan.Reinheimer@wiso.uni-erlangen.de) are research assistants,

Freimut Bodendorf (Freimut.Bodendorf@wiso.uni-erlangen.de) is Professor for Information Systems at the University of Erlangen-Nuremberg, Germany. Their research focuses on electronic markets. In the project FAN/EFFEKT (see references) research is conducted about efficient coordination in the service sector.

Interorganizational partners in the system

Tracking (getting up to the minute information about the whereabouts of a certain load) and Tracing (evaluating the chain over a longer period) become more and more important in business, since companies see the opportunity to offer value added services to their customers. For example, if a load is damaged and information is available without delay, the sender can resend the product by express. The customer will not notice that there have been any problems. If resending is impossible, the customer can at least be informed on time and reassign his processes. Both actions result in more customer satisfaction, which in turn can increase the company's competitive advantage.

As depicted in figure 1 there are several overlapping physical flows from different senders to a lot of customers [IHDE 1991, p. 13]. Not only are there different senders but also several forwarders for a sin-

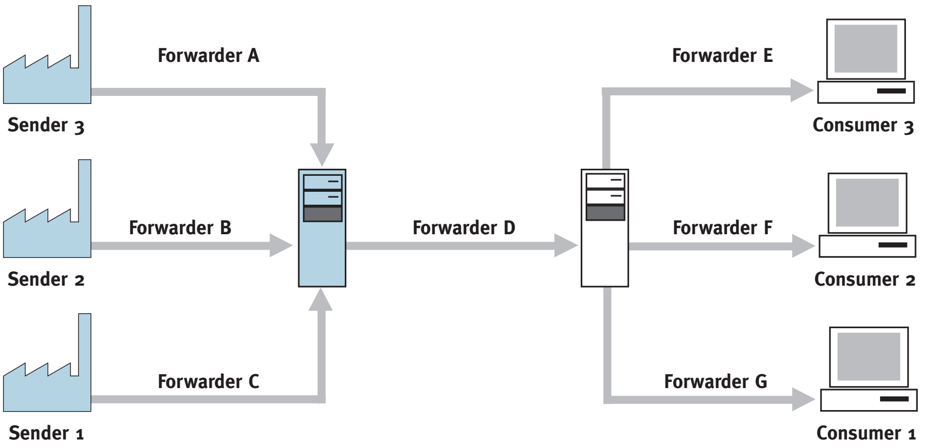

Figure 1: Logistics Chain

gle transport [DORDOWSKY, ET AL. 1997, pp. 113]. As a result, in order to get the relevant information various forwarders have to be asked about the status of a package, which leads to a complex inter-organizational scheme of interaction.

Every delivery note describes goods that have to be routed from a sender (e.g. factory) to a receiver (e.g. customer) resulting in several transportation orders for different forwarders. Generally, status information is relevant only if the package status is negative, e.g. the package is damaged or running late or a customer inquires about the scheduled arrival of his order. A negative status occurs about 3-5 times in a 100. Therefore, pulling the information on request seems to be adequate. Only in case of lost or damaged goods an exception message should be pushed to the sender.

SOFTWARE AGENT APPROACH

CONCEPT OF INFORMATION FLOW

Using the forwarders' databases for search activities requires on the one hand knowledge which forwarders to query and on the other hand the methodology to transform the request from the context of the questioner to the context of the specific forwarder. Furthermore, the ability to context switch must be reversable in order to provide an answer to the questioner.

Information retrieval in forwarders' databases must be based exclusively on specific forwarder keys. For example, a customer usually refers to a customer order number, whereas a forwarder refers to its own key. In the logistics chain (see figure 1) several forwarders' keys exist. As a result, each Tracking and Tracing request needs a context transformation from the sender's or customer's key to the forwarder's key supplied by a cross reference database.

EDIFACT messages are still the backbone of information interchange. Even in the near future forwarders will be put in charge by a DESADV message and accept the order by replying one or more IFCSUM messages. Within these messages different references are fixed. So, these message are used to fill the cross reference database assigning references of the forwarders to delivery notes, customer order numbers, etc.

Context transformation includes the risk of semantic inaccuracy. Especially the use of n:m relationships within the transformation path weakens the precision of the request and should be avoided (e.g. a retrieval based on a customer order number leading to several delivery notes which are compiled with other delivery notes to one shipment by a forwarder). While different transformation paths are possible sometimes, a suitable one must be identified. Because transformation paths must be chosen deliberately, a formal representation of the data model itself with all relationships is part of the cross reference database.

The widely available Tracking and Tracing applications via WWW meet the needs of pulling the information. Here, an easy to implement interface is specified based on already existing html-pages. So connecting even smaller forwarders is affordable.

Lost, damaged, or delayed goods trigger an exception leading to an email message to the sender. Since the forwarder is in charge of providing those exception messages, a proactive messaging system based on forwarders' databases is implemented.

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Software Agent Architecture

System Components

A system of cooperating agents [WEDEKIND 1994, p. 57] is designed to meet the requirements of distributed information retrieval. Three different types of agents (for an overview on the topic of software agents see [BRENNER, ET AL. 1998, CHEONG 1996]) can be identified which all “belong” to different organizations:

- A user agent (UA) is located on the PC of the questioner (either seller or buyer). The user agent processes the user input, validates the entered requests, and assigns each request to a retrieval agent. The results are transmitted back to the user agent to be displayed within an interactive graphical user interface. Because of the need for global acceptance, the user interface can be customized to the language of the user. Also the information itself will be translated to the user’s language.
- A retrieval agent (RA) is assigned to every request (run by the seller). Its lifetime is limited to the closure of the underlying request by the questioner. The RA is responsible for coordinating access to master files, interaction with the user agent, and assignment of decentralized retrieval tasks to service provider agents. The RAs are running on a dedicated server with fast access to the relevant master files and appropriate bandwidth to the Intranet/Internet.
- Each forwarder runs its own service provider agent (SA). A SA can be customized to the specific abilities of the forwarder with respect to both request and answer. In order to reduce communication load on the Internet, the service provider agent should run on the forwarder’s system. This would allow the SA to handle the messages based on exception statuses like lost or damaged goods. In some cases an exceptional situation arises at a forwarder (goods are lost, delayed or damaged). The service provider agent recognizes this particularity and informs the sender by e-mail.

System Interfaces

There are three major interfaces to consider. First, the user interface, which allows the user to send his inquiries to the system. Second, the data base interface which allows the retrieval agent to obtain necessary information about the forwarders of the logistics chain. Third, the interface to the forwarders, which allows the service provider agents to send a request to the forwarders’ database and to receive the answer. Considering that the difference between the second and third interface is based only on the transferred information from the database to the agent, the in-house interface will be treated as a forwarders interface.

- User Interface
  The user group of the Tracking and Tracing system consists of senders (e.g. staff), receivers (e.g. customers) and process controllers. This group is globally distributed and not willing to install and handle a dedicated software product. The ‘smartness’ of the user agent approach requires an active component on the retrieval client. So the usage of JAVA-applets within a web browser is almost compulsory.
- Forwarder Interface
  The forwarder interface is technically based on a http connection between service provider agent and a web server run by the forwarder. There are two services the forwarder’s web server has to provide: a mailbox for requests and answer pages in a specific format.

The mailbox for requests is realized as an CGI interface with URL encoded request information (GET method) [MCCOMB 1997]. Structure and syntax of the request string correspond to an Extended Backus Naur Form (EBNF) description given to the forwarders.

The answer pages delivered as a result to a CGI request are also described in EBNF. In order to achieve a page readable by agents, additional comments have to be inserted into the page tagging the information. Thus the effort of the forwarders can be reduced by reuse of existing web pages.

Conclusions

The focus of the system outlined above is to offer an easy and inexpensive way to get Tracking and Tracing information for one company. The use of the Internet and distributed databases of the forwarders offer the possibility to decentralize more business data which can be retrieved in the same way. Besides that, the system allows other senders to develop a system which can use the forwarder’s interface for automated information retrieval. Moreover, the system is adaptive to dynamic changes in the logistics chain, i. e. the sender does not know all partners in the chain. This in turn would require the RA to find the relevant SAs for a given transport, which means, even more intelligence on the RAs side [MARTIAL 1992].