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Requirements for Electronic Commerce Protocols in Business-to-Business Markets

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Abstract

This paper describes the requirements for electronic commerce protocols in business-to-business markets. A protocol comprises rules for communication between communication partners. In the world of electronic commerce such protocols need to be designed for the support of automated communication between information systems of different participants. We want to set a focus on protocols for negotiation processes in electronic procurement. These processes are not supported appropriately in traditional standard protocols like ANSI X.12. We outline the requirements for an open and extensible protocol that comprises electronic negotiation on multiple attributes of a deal.

Introduction

Business-to-business electronic commerce has the potential to make the traditional procurement process much more efficient. Electronic markets consist of three main components: i. the expression of buyers' interests, ii. the definition of the suppliers' capabilities and iii. a match-making mechanism (see Figure 1). We want to focus on the requirements for protocols that support the exchange of suppliers' capabilities and buyers' interests in order to enable automated negotiation.



Figure 1: Components of an electronic marketplace

Current protocol standards do not appropriately support electronic negotiating. In the following section we show the main characteristics of the traditional negotiation processes in business-to-business markets. Thereafter we discuss the particularities of automated negotiation in electronic procurement and analyze the capability of the protocol standard ANSI X.12 to support the negotiation phase of a business transaction. After describing the advantages of XML-based protocols we introduce example protocols defined for a prototypical implementation of an Internet-based market that supports negotiation on multiple attributes of a deal. Our study focuses on the food industry where the presence

of complex products justify the need for automated negotiation.

Particularities of negotiation processes in business-to-business markets

A characteristic of the supply chain in the food industry is the existence of a few big retailers and a lot of small and medium sized enterprises (SMEs) that act as suppliers such as breweries and bakeries. During a conventional procurement transaction the purchasing manager of the retailer collects offers from different suppliers and compares them manually. Typically some bilateral face-to-face negotiations are taking place before the deal can be closed. For the purchasing manager of the retailer the comparison of the different offers is intricate as the products are very heterogeneous. Accordingly the number of possible suppliers as well as the number of the negotiated attributes is typically restricted (Bichler et al. 1999). Long-term business relationships and a constant base of trading partners are dominant.

In the following section we outline the potential of automated negotiation and the limitations of according support by the existing standard ANSI X.12 for electronic data interchange.

Limitations of negotiation support by EDI ANSI X.12

Automated negotiation takes place when the negotiation function is performed by (networked) computers (Beam et al. 1997). Real-world negotiation is an extremely complex and time-consuming process especially if the traded products are complex like food or cars. To support automated negotiation on heterogeneous goods we propose multi-attribute auctions (see Bichler et al. 1999 for a more detailed description of multi-attribute auction mechanisms). During this process the buyer has to define his preferences and trade-offs for the different attributes of a deal, like color, taste or terms of payment and delivery. These preferences are communicated to the potential suppliers in form of a request for bids. Suppliers have to react to the preference function of the buyer in defining appropriate bids. A central brokerage facility is responsible for the match-making. Using an auction mechanism the bids are evaluated and

the supplier(s) that best satisfies the preferences of the buyer are determined.

One important precondition for the implementation of such an electronic procurement market system is the definition of suitable protocols to enable automated communication between the market participants. Furthermore a common understanding about the traded products must be provided. In order to prevent the separate definition of protocols for each trading partner and to support open marketplaces, several standardization initiatives started. The first step was the announcement of EDI (Electronic Data Interchange) standards, which were designed to replace paper documents and define the standardized structure of a machine-readable business document. EDI has been used since the 70ies and was standardized by ANSI (X.12) amongst other consortias. It is a document-oriented standard as business-transactions are conducted through the exchange of electronic counterparts of business documents. ANSI X.12 is a generic superset intended to satisfy a broad spectrum of data requirements. Therefore, many industries and individual organizations have defined their own subsets and designed guidelines that prescribe their permissible data. Most EDI messages are sent over proprietary networks. The standard is complex and expensive to implement requiring a custom integration solution between each pair of trading partners.

The main purpose of traditional EDI is to support the settlement phase of a business transaction. The document definitions are not well adjusted for support in the pre-contract phases where negotiation plays an important role especially if complex goods are traded. Currently defined ANSI X.12 documents do not support a rich enough set of possible business interactions for the support of the negotiation processes described in section 2. What is provided is a Request for Quotation (X.12 840) and a Response to Request for Quotation (X.12 843). The request for quotation is mainly used to provide potential buyers with the ability to ask for price information of specified products but is not appropriately applicable for the specification of complex product requirements and does not assist the definition of preferences and tradeoffs for multiple attributes of a deal.

Thus the determination of the optimal offer that best satisfies the needs of the retailer must be conducted furthermore in a time-consuming manual search process.

Another important issue for automated negotiation is the support of more spontaneous business possibilities. With the advent of Web-based electronic commerce there is a demand for more ad-hoc business-relationships. In order to enable arbitrary business relationships standard definitions are getting more important. X.12 is best suitable for long-term and stable business relationships between organizations and therefore needs to be complemented in order to

support the full potential of open and extensible automated negotiation.

The implementation of traditional EDI meant heavy investment in EDI software and VAN (Value Added Network) access which was a big venture especially for small and medium sized enterprises. The cheap access to the Internet seemed to solve the problem, but also specific software had to be developed and the interoperability problem could not be solved. With the upcoming of the XML-technology an affordable open access to Web-based EDI solutions can be provided.

In the following section we present the possibilities of XML-based protocol definitions and the emerging standardization efforts.

XML-based Protocols for Internet Marketplaces

A promising base for standardization of Internet trade is the emerging XML (Extensible Markup Language, www.w3.org/XML/) standard for information exchange on the Internet. XML makes it possible for business document forms and messages to be interoperable and comprehensible. It suggests a way to make business transactions easier to define and provides self-describing messages. A XML Document Type Definition (DTD) defines the sets of elements and their attributes as well as element relationships of a document and assigns the names that are used as element tags. XML combines the simplicity of HTML with the computability of EDI standards. The main benefits of XML-based standards are:

- The leading Web browsers support the display of XML-documents by the use of style sheets.
- The documents are machine as well as human readable.
- There is a wide range of free XML-software available.
- XML has wide industry support and is used by many Web-based languages like RDF, PICS, CDF and OFX.

In order to assure interoperability and openness of electronic commerce the XML tags need to be semantically consistent across merchant boundaries. Therefore standard DTDs need to be defined on a global or industry basis.

One joint initiative comprised of CommerceNet Consortium, XML/EDI Group and ANSI ASC X12 investigates how to translate ANSI X.12 data elements, segments and transactions into XML. Another approach is the creation of a Common Business Library (CBL) of XML documents by Veo Systems (www.veosystems.com). CBL is an extensible, public collection of pre-built XML documents and document components that can be customized. Veo Systems also offers software tools that facilitate the work with

CBL and maps today's major Internet commerce standards like OBI (Open Buying on the Internet) into CBL.

In order to enable consistent behavior amongst the participants of an electronic marketplace and to allow complex interactions such as negotiation and mediation, greater levels of semantic content need to be made explicit and represented. Therefore it's not enough to define standardized XML-DTDs. Participants in a network relationship need assurance that transactions will be negotiated meaningfully and correctly because all participants mean the same thing. XML itself has to be complemented in order to provide semantic transparency. Because of the complexity of how to describe organizations, their products and services a single common domain-specific standard for content and transactions is difficult to achieve. One possibility is the development of product-taxonomies. The alternative is to develop shared foundational ontologies which include richer relationships between terms. Ontology.org (www.ontology.org) is developing reusable standard ontologies and associated XML schemas.

In the following section we highlight the protocols used in our prototypical implementation of an electronic negotiation system.

An example Negotiation Protocol

Auctions are one of the oldest negotiation mechanisms but traditionally only support price negotiation and therefore must be expanded for automated negotiation in markets where heterogeneous products like food are traded. The supporting automated auction mechanism must be able to support bidding on multiple attributes of a deal.

We implemented an example procurement market for a big food retailer where matchmaking is based on an auction mechanism. For each product category traded a product taxonomy is centrally provided. Based on this taxonomy the buyer can define his attribute preferences in form of a request for bids. We use MAUT (Clemen R. T. 1996) as decision analysis technique to determine the utility function. This function is sent to the brokerage facility in form of a Request for Bids (RFB). The brokerage facility determines the suitable sellers, and let them collect the RFB-document. Before consideration sellers have to register their general capabilities. Based on the RFB they define their Response to Request for Bids (RRFB) document. There is also a document definition available that allows the participants to determine the bid status during an auction period. All the documents are exchanged as XML formatted messages over HTTP (HyperText Transfer Protocol) and the DTDs are centrally provided by the brokerage facility. Bidders and Buyer are supported by the use of Java applets.

Conclusions

There is a need for negotiation support in electronic commerce systems, especially for the trading of complex goods like food or cars. Therefore communication protocols have to be defined that provide open and extensible support for negotiation on multiple attributes of a deal. Traditional EDI messages do not include appropriate message types and are expensive to implement. Internet-based solutions promise a wider acceptance of the EDI potential but did not provide the technologies for interoperable solutions so far. The newly emerging XML-technology is a very promising base for the definition of appropriate negotiation protocols.

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