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Semantic Web support for the business-to-business e-commerce pre-contractual lifecycle

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Abstract

If an e-services approach to electronic commerce is to become widespread, standardisation of ontologies, message content and message protocols will be necessary. In this paper, we present a lifecycle of a business-to-business (B2B) e-commerce interaction, and show how the Semantic Web can support a service description language that can be used throughout this lifecycle. DAML+OIL is a sufficiently expressive and flexible service description language to be used not only in advertisements, but also in matchmaking queries, negotiation proposals and agreements. We also identify which operations must be carried out on this description language if the B2B lifecycle is to be fully supported. We do not propose specific standard protocols, but instead argue that our operators are able to support a wide variety of interaction protocols, and so will be fundamental irrespective of which protocols are finally adopted.

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1. Introduction

Electronic commerce is having a revolutionary effect on business. It is changing the way businesses interact with consumers, as well as the way they interact with each other. Electronic interactions are increasing the efficiency of purchasing, and are allowing increased reach across a global market.

With the increasing availability of the Web, a more open e-commerce environment is developing, allowing businesses to trade more flexibly with each other. Some of this openness is achieved by competition between Web portals, while some compe-

tion occurs within a single Web portal, acting as a marketplace for buyers and sellers to meet.

The e-commerce community is creating new infrastructures to support high-level business-to-business (B2B) and business-to-consumer interactions on the Web. The effort is concentrated on defining a new generation of electronic data interchange protocols, mostly based on XML (like OASIS, BizTalk and RosettaNet) and on creating new kinds of e-business services such as agent-mediated B2B e-commerce, and knowledge-driven customer relationship management.

On the other hand, with the Semantic Web initiative, the World Wide Web Consortium (W3C) is developing a range of proposals aimed at supporting intelligent information intensive operations over the Web. The emphasis is on enriching the Web's data markup languages with knowledge

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representation features, to permit inference over the content of Web pages (prominent initiatives include DAML+OIL, and RDF). Its goals include the production of Internet-scale inference mechanisms, knowledge markup languages, and active information-seeking services.

The goal of this paper is to explore how Semantic Web technology can provide support to the B2B e-commerce lifecycle. In particular, we study the early (pre-contractual) phases of the lifecycle. We present a conceptual framework for modelling B2B interactions. Within it, we experiment with Semantic Web technology (in particular DAML + OIL) as a means to express semantically rich descriptions of services and goods. It is important to note that the environment here presented can be used both for automated interactions, but also to provide structured interactions between humans.

This paper is structured as follows. In Section 2 we introduce our conceptual framework. In Section 3 we explore the phases of matchmaking and negotiation in detail, with particular attention to the operations that are carried out on the messages that participants exchange. In Section 4, we identify the need for a declarative language for service descriptions, derive requirements for it and show that DAML+OIL satisfies them. We also present a set of example service descriptions used at various stages in the B2B e-commerce interaction lifecycle. In Section 5, we specify the operations that are required during the B2B lifecycle, and demonstrate that they can be straightforwardly be implemented on a description logics reasoner (Section 6). We then discuss related work (Section 7) and we conclude presenting our future work intentions (Section 8).

2. E-services framework

We have developed a lifecycle model to help us understand the interactions which take place between businesses engaged in e-commerce. This model (based on that in [1]) follows the lifecycle of an interaction between two (or more) parties and has the following stages:

Matchmaking: A trader locates other traders that it could potentially do business with. This is

done by some traders placing *advertisements*, and others making queries over these advertisements.

Negotiation: The trader enters into negotiation with one or more of these potential business partners, to see if they can agree mutually acceptable terms of business. This is done through an interchange of *negotiation proposals* describing constraints on an acceptable deal. The outcome of this is an *agreement*, specifying the terms that both parties consider acceptable. These terms could include a definition of the good or service being traded, price, delivery date, etc.

Contract formation: The *agreement* is transformed into a legally binding *contract*.

Contract fulfillment: The parties carry out the agreed transaction, within the parameters specified in the contract. The transaction may be automatically monitored, and parties would be warned if any behaviour outside the agreed terms of the contract takes place.

If this open e-commerce environment is to become pervasive, interactions throughout this lifecycle must be standardised by the industries using it. Standardisation must take place at three levels:

1. Standards for business-specific ontologies which describe goods, services and contracts being traded. These ensure that when one trader uses a set of terms to describe a given good, another trader will be able to interpret them accurately.
2. Standards for specifying the format of advertisements, proposals, contracts and other constructs which are used during B2B interactions. These standards would specify the syntax of these constructs, with the semantics being defined by the ontologies. Hence, these standards need not be business-specific.
3. Standards that specify the protocols which traders use to interact with each other during different phases of the B2B lifecycle. These determine the messages that are sent back and forth containing the standard constructs described above.

The ARPA knowledge-sharing project [2] was the first to tackle these standardisation issues, albeit in the domain of information exchange rather than e-commerce. Ontolingua [3] provides a tool

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