



A Framework and Protocols for Service Contract Agreements Based on International Contract Law

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ABSTRACT

Current protocols to agree to Web/Grid service usage do not have the capability to form negotiated agreements, nor do they take into account the legal requirements of the agreement process. This article presents a framework and a domain-independent negotiation protocol for creating legally binding contracts for service usage in a distributed, asynchronous service-oriented architecture. The negotiation protocol, which builds on a simple agreement protocol to form a multiround "symmetric" negotiation protocol, is based on an internationally recognized contract law convention. By basing our protocol on this convention and taking into account the limitations of an asynchronous messaging environment, we can form contracts between autonomous services across national and juridical boundaries, necessary in a loosely coupled, widely geographically distributed environment such as the Grid. [Article copies are available for purchase from InfoSci-on-Demand.com]

Keywords: Contracts; Distributed Computing; Grid; Negotiation; Protocol; Services

INTRODUCTION

An impediment in realizing a market of Web and Grid service consumers and providers trading resources is the lack of a standard mechanism by which formal, binding relationships can be made in a distributed, service-oriented architec-

ture (SOA). These formalized relationships are necessary as mutual guarantees of service quality and availability are required when services are hosted in separate administrative domains, or virtual organizations (Foster, Kesselman, & Tuecke, 2001) and where there may be little or no trust between the service consumer and provider.

In order to solve this problem, the obligations of each party, together with information regarding compensation if either party fails to carry out its commitments, can be gathered together in a legally binding contract.¹

A contract serves to build trust between the two parties in a service provider-consumer relationship as it provides binding guarantees for both sides: service consumers have a guarantee of service quality through a service-level agreement, whilst providers have a guarantee of recompense from consumers for the use of their service(s). If either side breaks (or “breaches”) their side of the contract, the other party has the legal right to receive or pursue compensation. Thus, trust is built around the contents of the agreed contract.

With the Grid community adopting SOA (Foster, Kesselman, Nick, & Tuecke, 2002; Foster et al., 2005) where the consumer/provider relationship will be based on well-defined contracts for service provision, a need exists for flexible, explicit, unambiguous, and standard protocols such as those presented here to establish trust through legally binding relationships that can be upheld in, and disputes resolved by, the courts of law if necessary.

Contract Law

This article is interested in the mechanisms and requirements for the negotiated formation of the contracts described. Contract law, which is “concerned with the transactions under which obligations are assumed” between two parties (Stone, 2000, p. 7), specifies these mechanisms and therefore the agreement and negotiation model we will use in this article follows the contract law model of a pair-wise process between a service provider and consumer. Later sections will present the rules of contract law in more detail, but it is enough to say here that these transactions effectively define a “protocol” for contract creation. We take the implicit protocol specified by an international contract law convention and make it explicit in order that it may be formally verified and, eventually, implemented between Web and Grid services

(though this article does not discuss any implementation of these protocols).

Basing a contract agreement mechanism on existing contract law has many advantages. These include the fact that contract law specifies the mechanism for general, domain-independent contract creation and semantics of the “messages” in the contract formation process—that is, the content of the messages is orthogonal to the process and we can, therefore, use contract law to negotiate for *any* service, provided through a Web service or otherwise. Furthermore, we feel that using contract law will have a greater chance of being accepted by the wider (i.e., non-Web services) community as a process whereby contracts are created, and are understandable and accessible to many people outside our immediate community—crucial if a Grid SOA is to create a working market economy. Finally, in using contract law as a model for contract creation it will avoid the unnecessary re-creation of existing processes.

However, basing a protocol on contract law is not enough; in a distributed asynchronous messaging environment as in an SOA we must take into account additional factors, such as “[the] network losing messages, networks retrying messages [and] those ... retries actually being delivered” (Helland, 2004) when developing our protocol. It is for this reason that we have investigated in detail cases where messages “overlap” in the conversation due to message delay, and checked each participant terminates in a consistent state by running the protocol through a model checker.

The creation of agreements like we have described is the premise of recent work within the Open Grid Forum’s² (OGF) Grid Resource Allocation Agreement Protocol Working Group³ that has resulted in the emerging WS-Agreement standard (Andrieux et al., 2006) that allows agreements to be formed between service consumers and service providers. However, for reasons discussed later in the Related Work section, WS-Agreement is not satisfactory since it has taken the approach of creating a new model to specify how these agreements should be created. This work takes the opposite

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