0. Introduction

This article discusses how to incorporate the technology of web services into a human’s interaction of behavior: negotiation. Before digging into the detail of implementing the technology, we would like to know why we need the negotiation integrate into the world of computer.

1. Negotiation

Internet and web technologies have dramatically changed the way enterprises conduct business and how they compete. So companies of all size are necessary to increase the speed of communication with their customers. More abstractly, they are forced to speed up the treatment of information, if we consider a company as a control center of information. That is, to automate interactions with their business partners, including suppliers and manufacturers as well as their customers, leaving the computer doing all the repeated things that no need human being’s intervention. Companies may receive purchase orders from individual consumers or business partners, deliver goods and services, and accept payments, etc. All of these actions need NEGOTIATION.

Negotiation is an important business activity of an enterprise. Traditionally, negotiations are conducted by people involved in business transactions. However, in the context of e-commerce, in both B2B and B2C transactions, it is often desirable to carry out these interventions only when necessary. But how to automate the process of negotiation? There are two tasks we have to do in advance: 1. formalize the process of negotiation, 2. incorporate necessary negotiation knowledge and intelligence into the computer system.

But, negotiation in the real world is a very complex process, which involves participants to make individual decisions and to interact with each other. More troublesome problem, negotiation may involve issues of culture, ego and prejudice. Thus, a more sophisticated business model with negotiation feature is required for this challenging research field.

2. Web Services

A web service is defined as an autonomous unit of application logic that provides either some business functionality or information to other applications through an internet connection. Web services are based on a set of XML standards such as Simple object Access Protocol (SOAP), Web Services Description Language (WSDL), and Universal Description, Discovery and
Integration (UDDI).

According to author, there are three important tasks to automate the negotiation process between web services providers and requestors: (1) formalize the process of negotiation (2) develop an XML negotiation language for defining negotiation message, negotiation protocol and negotiation decision making, and (3) incorporate negotiation support technologies into the web services architecture.

3. Negotiation Model

The author proposes a list of entities in the process of negotiation and their relationships, as shown in the figure 1:

![Diagram](image)

Figure 1. Relationships of Negotiation Entities

And the process of negotiation should be like this:
Figure one shows all the entities that might involve in the negotiation process, and figure two is the negotiation template for considering and designing the role of WS-negotiation in the context of web services negotiation scenario.

Then the author defines negotiation message, negotiation protocol and negotiation decision making in the process of negotiation. A figure is enough to show the function of these three process in the negotiation:

Figure 2. Coordination Plan of Negotiation Process

4. Negotiation Message
Negotiation message is used to the communication between two parties, just like the hand-shake process in a B2B business to establish confidence with each other. It is used to describe the format for messages exchanged among negotiation parties.

Here is the example of Negotiation Message:

```xml
<negotiationMessage id="1854" ref="None" type="Offer">
  <sender>user.example.com</sender>
  <receiver>car-rental.example.com</receiver>
  <content>
    <issue>types-of-car</issue>
    <alternative preference = "1">compact</alternative>
    <alternative preference = "2">full size</alternative>
  </content>
  <expiry>07/01/2003</expiry>
</negotiationMessage>
```

5. Negotiation Protocol

It is used to describe the mechanism and rules that negotiation parties should follow. Referring to figure 4, the negotiation protocol consists of exchanges of negotiation messages that contain the details of offers, counter-offers and etc.

The negotiation primitives are used to define the process of negotiation. And the negotiation protocol use it for the services requestor and provider to facilitate the negotiation and to effectively communicate with each other. So the negotiation primitive is something like the formula who constraints the behavior of two parties while negotiating. Here is some possible negotiation primitives: Call for proposal, Propose, Accept, Terminate, Reject, Acknowledge, Modify, Withdraw.

6. Negotiation Decision Making

The negotiation decision-making process is the private process at the web services requestor and provider side. The negotiation decision making is just a decision making support solution, it can use the agreement template with its own negotiation strategies to arrive an offer or counter-offer.
Figure 8 shows the architecture of the WS-negotiation and negotiation entities. This paper introduces the concept of domain specific vocabularies for different types of business negotiations into WS-negotiation framework. Then those negotiation primitives are used to coordinate and execute the negotiation tasks and to handle the negotiation events. Then the negotiation decision-making part uses the negotiation strategies with criteria to determine the preferences for each issue during the negotiation process.

A service-level agreement is a formal contract between the requestor and provider which guarantees quantifiable issues at defined levels only through mutual concessions.

Figure 9. The SLA Template Model

The negotiation issues are described as SLA parameters, and SLA parameters are based on the domain specific vocabularies. After a sequence of negotiation messages exchange via WS-negotiation, a SLA document is created. So the SLA document is used to specify the service level parameters that
describe the negotiation parties’ guarantees and obligations

7. Conclusions and future work

The author discusses the problems when integrate the negotiation into the web services. He defines the negotiation message, negotiation protocol and negotiation decision making which base on XML in order to formalize the process of negotiation. There are different predetermined problems in different domain, so the author defines the domain specific vocabularies for different type of business negotiation. Further more, he defines a Service Level Agreement template that describes the negotiation parties’ guarantees and obligation.

Next step, the author is going to try to finding the feasibility and applicability of WS-negotiation into the context of Agreement-based Grid Service Management(OGSI-Agreement).