COMPOSITION OF WEB SERVICES IN THE ICS ARCHITECTURE

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Abstract: This paper proposes the use of the Web Services Composition to enhance the matchmaking process acctually in use within the ICS (Intelligent Commerce System), a Business-to-Business e-commerce system. The actual matchmaking process used in the ICS considers only single services and may return a high number of false-negative results. The new approach aims to reduce the number of false-negative results through the composition of existing single services to obtain new functionality.

1 INTRODUCTION

Web Services are transforming the web from a collection of static pages to a web of dynamic service providers that automatically discover information that we seek, negotiate on our behalf for goods we intend to purchase, gather information from different sources, and fuse it into coherent forms. Nowadays, Web Services are discovered and invoked manually by human users (hard code approuch), limiting their ability to take advantage of opportunities that may exist. This investigation represents an effort to overcome these limitations.

In this paper, we show the Web Services composition process in the ICS context as an alternative to reduce the number of negative results, returned by the Matchmaker agent, responsible for the matching of negotiating agents in the ICS. Actually the Matchmaker agent ignores the possibility of the salers agents combine theirs capacities to attend a solicitation from a purchaser. As a result of this limitation, even if there is the possibility of attending the service by the agents present in the negotiation environment, the Matchmaker agent returns a denial of service (false negative) to the requesting user.

The main contribution of our work is to improve the matching process of agents within the ICS, increasing the number of matching results returned by the Matchmaker agent.

In the next section, we present an overview of the ICS architecture. Section 3 describes three motivating scenarios for our work. Section 4 shows the actual matchmaking procedure used in the ICS and emphasizes our contribution to enrich the matchmaking process. Finally, section 5 presents our conclusion.

2 OVERVIEW OF THE ICS ARCHITECTURE

Aiming to describe the context of our work, we present a brief high level vision of the ICS project.

The ICS is a Agent-Oriented implementation of a Business-to-Business e-commerce system, where the trading agents, representing purchasers and salers, work in an open environment as the Internet, moving through the network to meet at common

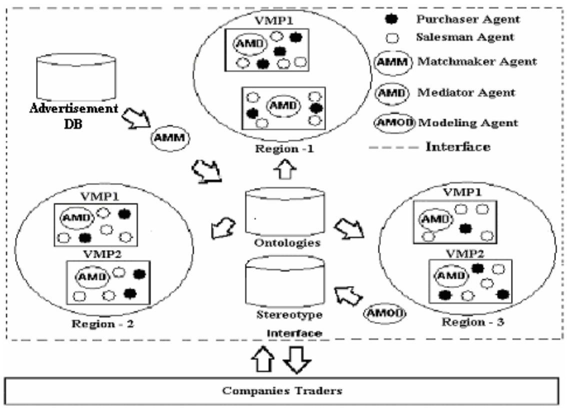

Figure 1: The ICS Enviroment

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negotiation areas. (Labidi et al., 2003)(Tomaz, 2003)

The main ICS components are: Virtual Marketplaces (VMP), Regions, Matchmaker Agent, Mediator Agent, Modeling Agent, Ontologies Repository and Stereotype and Advertisement databases as it showed figure 1.

The Virtual Marketplace (VMP) is the place where the agents carry through the negotiation and the closing of the contract. A Region is an abstraction of higher level than the VMP that provides a vision of grouping of virtual markets that are operating on the same domain ontology, that is, acting in the same area of business (vehicles, remedies, books etc).

An Ontologies Repository is a semi-structured database that allows the storing of the domain's ontologies. The ICS is not limited to operate in a specific business domain. The stereotype database is a semi-structured database that allows the storing of the users profile. It is used by the traders agents to deliberate on the preferences of the companies they are representing. The advertisement database is a semi-structured database that allows the storing of the salers' advertisements.

The Matchmaker Agent objectives to approach trader agents with complementary objectives, that is, it is the responsible for the composition of the VMP.

The Mediator Agent operates as an arbitrator inside of a VMP, it follows each carried through transaction and intervenes when necessary trying to decide problems of negotiation, formation and execution of contracts. For each Virtual Market there is an instance of the Mediator Agent.

A Traders Agents can be a purchaser or a salesman. These agents are triggered for the using companies of the ICS from its WEB interface.

The Modeling Agent objectives to inform the Mediator Agent of the preferences of each Trader Agent so that the Mediator Agent can interact in a particular way with each Trader Agent.

This section presented a high level vision of the ICS architecture. In the next section we present two motivating scenarios for the development of our work.

3 MOTIVATING SCENARIOS

With the objective to give a better understanding of our investigation, we present here two scenarios that show how the composition of services can enrich the actual matchmaking procedure used in ICS.

Suppose three services represented by Web Services: (i) an airplane tickets agency; (ii) a hotel chain and (iii) a transportation firm, all operating globally. Consider that all the services are descripted in a services description language like DAML-S (DAML-S,2003) and published in a UDDI directory service (Daum, 2002), as (Paolucci, 2002) proposes. If a client wishes to buy a full travel package, a matching service that doesn't use the services composition techniques will return that there isn't a service that satisfies the client's request. However, a matching engine that is capable to use the services composition will promote the sum of the individual capacities of each service to satisfy the client's needs.

Another example of Web Services composition is presented by (Sirin, 2003). The example deals with the composition of the capacities of an on-line language translator and a dictionary service. The language translation service translates texts between various pairs of languages, the dictionary, however, returns the meaning of words in english. If the user needs the service of a french dictionary, neither of the services alone will satisfy this demand. But together the services are capable to attend the request – the french text is passed as input to the language translation service, who returns as output the text in english. This output is passed as input to the english dictionary service to obtain synonyms and then translated back to french.

To provide the semantic concepts as "language", "english", "french", etc. we can use ontologies, (Guarino,1998) now used in the construction of the Semantic Web.

In the next section, we'll give a brief description of the matching procedure actually used in ICS, concentrating on how the Web Services composition could enrich it.

4 ENHACED MATCHMAKING PROCESS

The Matchmaker agent in the ICS restricts itself to compute the degree of similarity (distance) among purchasers' requests and salers' advertisements. As result, it returns a *binary match-pairs list* (or *record-match lis*t), which contains the possible matching among customers and suppliers (a set of clusters).

When the Matchmaker agent is asked to make a search for a purchaser agent, this will be done inside an advertisements database. The matchmaker looks for possible single saler agents that satisfy the searches requests and returns the possible partners salers agents.

An important requirement for the Matchmaker agent is the search flexibility. The search for partners should not be restricted to the syntax aspect only. This is because equivalent terms incorporated in more generic concepts *(subsumptio*n), as well as terms having some relationships (such as *aggregatio*n, *synonym*y, *antinom*y, etc.), must be considered in the matchmaking process. The figure 2 displays the ICS Matchmaking process.

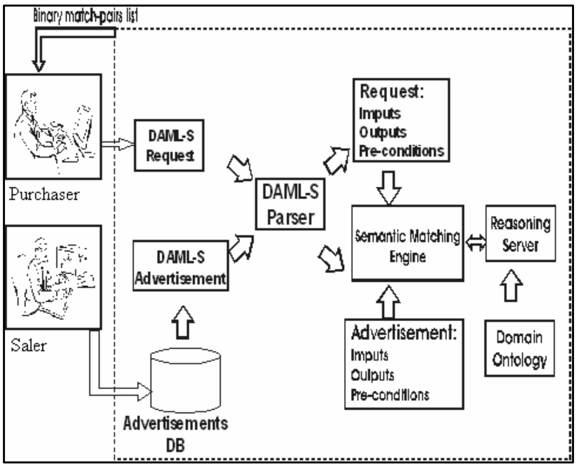

Figure 2: The ICS Architecture (Tomaz, 2003)

Purchasers and salers use DAML-S to express requests and advertisements respectively. The DAML-S parser extracts inputs, outputs and pre-conditions from DAML-S requests and Advertisements.

The Matchmaker Agent, made by the semantic matching engine and DAML-S Parser, classifies and crosses the requests inputs, outputs and pre-conditions to the advertisements inputs, outputs and pre-conditions. The ICS reasoning server, implemented by a *Description Logic reasone*r (Tomaz,2003), supports the classification of taxonomy of the terms found in the inputs, outputs and pre-conditions based on the application domain ontology.

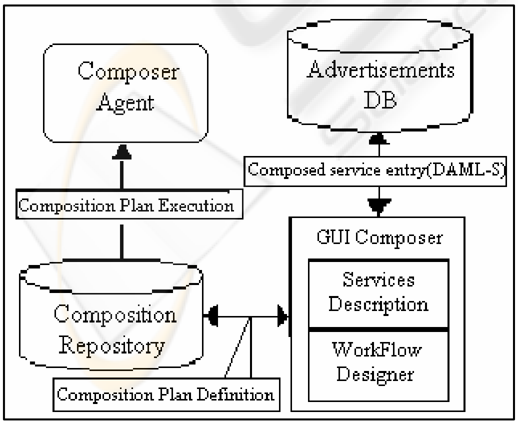

Figure 3: Web Composition on the ICS matching process.

To maintain compatibility with the advertisements repository structure, and the parser capabitlity, a composed service must also use DAML-S. In fact, a composed service entry is exactly the same as the entry of a single service. The composition plan – a description of wich ones and in what order the single services will be grouped to form the composed service - is stored in other repository, the Composition Repository. With this compatibility, no alteration is needed in this part of the matchmaking process to make it use composed services also.

When a composed service is chosen by the Matchmaker Agent is that the first difference in the actual process appear, but now under the control of other agent, the Composer Agent. Instead of the salers agent that form the composed service, it is the Composer Agent that is warned when a composed service is found adequate. The Composer Agent then warns the salers agents, as the Matchmaker Agent does, and then passes the composition plan to the Mediator Agent, wich will be responsible for realizing the business.

There are several approaches for the development of the matchmaking algorithms. Nevertheless, DAML-OIL is greatly influenced by the description logics languages. That's why, we proposed, in our work, the use of algorithms based on ***description logics*** (DL) languages.

A limitation of the actual matching procedure used in ICS is that the matchmaker agent, which is responsible to gather the negotiating agents, ignores the possibility to compose the capacities of the salers agents to satisfy the requests of the buyers that are passed as parameters to it. The matchmaker simply compares the buy requests of each one of the advertisements published in the advertisements repository, so that if none of them presents some degree of similarity with the buying parameters, the matchmaker returns an empty list (a void binary match-pairs list).

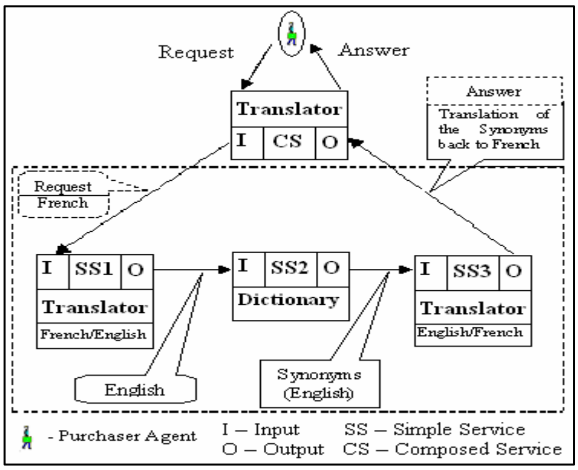

Figure 4. Composition Plan

We propose the use of the Temporal Workflow technology (Labidi et al., 2000) to model a semi-automatic service composition tool within ICS. This tool has a GUI (Graphical User Interface) that allows the user to compose a new service from the available services in the advertisement repository. To illustrate this, let's take the second example presented in section 3 – Motivating scenarios.

The advantage of the use of the ICS Composer is that, from a restrict set of services published in the advertisement repository, a user can create a vast number of new services that enriches the environment and increases the possibility of satisfaction of the requisites given by the buyers, what increases also the number of accomplished business in the ICS. As it is shown in figure 4, to make the service composition it is necessary that there is communication between them. We propose the use of the SOAP protocol to allow each service to pass its output as an input parameter to other services.

After the composition of the new service from the previously stored services of the advertisement repository, the user must also describe its capacities. We propose the use of the DAML-S as the description language of the services capacities. Each new service represents a new entry in the advertisement repository and also a new entry in the composition plans repository. When a composed service satisfy the requisites of a buyer, the Composer Agent consults the composition plan in the composition plans repository and executes it, receiving and sending the parameters of each one of the simple services that constitutes the composed service until it fulfills its objective described in the capacities of the composed service. As figure 3 shows.

As we can observe, the main use of the composer agent is to guarantee the execution of the composition plan. It is the composer agent that communicates with the buyer, giving him the necessary details to fulfill the business (price, payment form, delivery date, etc.)

5 CONCLUSIONS

In this paper, we presented how the technologies that come from the development of the Semantic Web allied to the technologies of the Web Services can enrich the actual tools of e-commerce. The composition of web services enhances the negotiation possibilities inside the ICS, increasing the number of possible traders partners.

The coupling of the composition service to the ICS architecture will be an easy task, once it uses the same standards and technologies used in the ICS prototipation. Today, we are studying the tools and standards used in the Semantic Web and soon we will begin the prototipation work to validate our propositions.

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