Chapter 23
Brokering Web Services via a Hybrid Ontology Mediation Approach Using Multi Agent Systems (MAS)

Saravanan Muthaiyah
Multimedia University, Malaysia

Larry Kerschberg
George Mason University, USA

ABSTRACT

This chapter introduces a hybrid ontology mediation approach for deploying Semantic Web Services (SWS) using Multi-agent systems (MAS). The methodology that the authors have applied combines both syntactic and semantic matching techniques for mapping ontological schemas so as to 1) eliminate heterogeneity; 2)provide higher precision and relevance in matched results; 3) produce better reliability and 4) achieve schema homogeneity. The authors introduce a hybrid matching algorithm i.e. SRS (Semantic Relatedness Score) which is a composite matcher that comprises thirteen well established semantic and syntactic algorithms which have been widely used in linguistic analysis. This chapter provides empirical evidence via several hypothesis tests for validating our approach. A detailed mapping algorithm as well as a Multi-agent based system (MAS) prototype has been developed for brokering Web services as proof-of-concept and to further validate the presented approach. Agent systems today provide brokering services that heavily rely on matching algorithms that at present focus mainly only on syntactic matching techniques. The authors provide empirical evidence that their hybrid approach is a better solution to this problem.

INTRODUCTION

The concept of Semantic Web was introduced by Tim Berners-Lee who is also the founder of the World Wide Web (WWW). He defines the Semantic Web as "a web of data that is directly or indirectly processed by machines" (Gruber, 1993). The **Semantic Web** is envisaged as more powerful web than the current web as it is able to process contextual information. It is a futuristic web platform where agent systems

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would winnow and sift through metadata on the Semantic Web to provide services to users. In other words, just like how human beings play the role of a travel agent to find the best travel package or deals for their clients, similarly **web agents** would be deployed in the Semantic Web as brokers to search, find and secure the best deals for their customer's. Agents would process customer requests by sifting through all types of metadata that involves data on pricing, travel packages, last-minute promotions, etc. In order for this to happen, agent systems must be provided with the ability to process, convert and reason data in useful and meaningful ways. For example if a user had to look for "accommodation" then, the agent must be able to winnow and sift for data that is related to "accommodation". This would include hotel, motel, lodging, etc. Thus the agents must be able to process contextual information as well. Currently, Web agents cannot process contextual data accurately. This is because; they have to acquire, match, reason and interpret contextual data from the Web and semantically as well as syntactically match them for achieving precise results.

Unfortunately, the status of the Semantic Web today is far from what Tim Berners-Lee had envisioned and this is because it hasn't really begun including **semantic** processing within its search methods(Resnik, 1998). In a semantically Web-enabled environment, agent systems would search the Web for "accommodation" where it is defined as "a type of lodging" or "a place to stay". In other words it would understand the contextual meaning of accommodation to locate all the relevant results pertaining to the search of "a place to stay". Agent systems would also accurately present to the user the best deals for those accommodations based on the criteria set by the user as a result of contextual analysis of search over heterogeneous sources. Such a search is also referred to as semantic search. Current search techniques used in information retrieval processes today, are mostly based on data label matching algorithms that use **syntactic** matching schema that does not perform semantic search(Ram, 1999).

Since various semantically associated meanings can be associated with the concept "accomodation", applying purely syntactic matching will only produce unfavorable results. In considering the Semantic Web vision, such a technology would rely on searching over all structured, semi-structured as well as unstructured heterogeneous data sources (Muthaiyah & Kerschberg, 2006). Therefore, **agent systems** or softbots must be enabled to access other agents to process readily available semantic information. In order to achieve these goals, semantics must be included in existing search algorithms(Silva & Rocha, 2003).

THE PROBLEM

This section highlights the interoperability problem. The main reasons for **data heterogeneity** amongst ontologies are: 1) structural heterogeneity (difference taxonomy structures); 2) semantic data heterogeneity (scale and representation conflict); 3) subjective mapping (conflicting data instances) and 4) atomic stored data (conflicting data type value) (Stuckenschmidt, Wache, & Visser). Sources for semantic heterogeneity also include differences in data-definition constructs, differences in object representations, and system-level differences in the way that atomic data (e.g., byte order for multibyte data, such as an integer) is stored in the two systems (Maedche, Motik, & Stojanovic, 2002).

Structural Heterogeneity Problem

Structural heterogeneity is a problem that is caused by different data structures (Stuckenschmidt, Wache, & Viss)(Stuckenschmidt, et al.). The differences in the lattice structures are common problems that exist in most structured data sources (Muthaiyah & Kerschberg). Figure