Web Service Discovery in Distributed and Heterogeneous Environment

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Abstract

In many business processes Web service composition is an integral part of service discovery. The mechanisms developed so far are based on the traditional Web technologies, which require human intervention to a larger extent. This paper presents current trends in this direction, discusses imminent problems and proposes new solutions.

1. Introduction

The area of Web usage has been drifted from a sole repository for text and images to a popular means of business progress integration giving birth to Web services. Thus, Web services is meant for tackling interoperability problems stemming from business process integration. However, current Web services centered around SOAP[1], WSDL[2] and UDDI[3] require human intervention to a larger extent for supporting interoperability between applications. Initiatives such as WSMO and OWL-S started aiming at resolving interoperability problems thereby facilitating seamless integration of applications. Therefore, the real problem that underlines the need of Semantic Web services is the machine level communication for Web service advertisement, discovery and invocation. The focus of this paper is centered around Web service discovery.

The complexity of the Web service discovery process depends directly on user requirements. In a practical situation, user requirements normally consists of multitude of services. Furthermore, the available services might satisfy only a part of the user requirements. These services may originate from heterogeneous sources and may have been represented in different data format. Therefore, the Web service discovery process should be able to effectively and efficiently integrate distributed and heterogeneous Web services in order to satisfy the user requirements.

The Web service discovery could only be effective if distributed Web serecices can be coordinated dynamically. It has been recognized in several research initiatives ([1], [6], and [5]) that an efficient resource sharing mechanism is required for a Web service discovery to work across dynamic, heterogeneous and multi-institutional virtual organisations. However, little care has been taken towards the need of execution environment for realising such systems. In this paper, we discuss some of the real problems pertaining to Web service discovery, and propose some potential solutions.

2. Current Trends in Web Service Discovery

Traditionally, the functionality of Web service discovery processes is mainly centered around manual intervention. A set of Web service descriptions are discovered according to user requirements. These service descriptions are manually scanned and those services that satisfy user requirements are selected and composed. In the context of distributed system integration, such manual intervention is unrealistic, cumbersome and time consuming. In [1] and [6], attempts have been made to bring Web service discovery mechanism on top of Peer-to-Peer network thereby reducing human intervention. Similarly, research initiatives such as [4], [2] are attempting at providing formal way of expressing service provider's capabilities and user's requirements. These initiatives are mainly focused on knowledge representation aspects. Despite knowledge representation, the Web service discovery is a complex task and need to consider the context of its availability and usability. In [7] different levels of service matches has been described. We acknowledge that service matches are mandatory but not sufficient for Web service discovery.

Current trends in Web service discovery is thus concerned on what service are available. We argue that the whole discovery process should be able to answer the fol-

[1] http://www.w3.org/TR/soap/
[2] http://www.w3.org/TR/wsdl/
[3] http://www.uddi.org

lowing two primary questions.

- Where the matching services are located, and

- How to get those services.

This aspect of web service discovery is not yet well addressed. In addition, the contextual information such as who processes the request, what resources are required to precess this information, etc are still not covered.

3. Potential Solutions

We believe that the effectiveness of the functionality of Web service discovery can be achievable by connecting resources. Semantic Web service technologies [4], [2] are aiming at connecting Web services through the use of Semantic Web technologies. However, for enabling dynamic and collaborative problem solving, in addition to resource connectivity, there is a need of connecting computing resources as well. Such connectivity should be described semantically such that it enables direct access to resources made available by different Web service providers. The 'semantic' connectivity of computing resources, in addition, allows load distribution and enhances scalability towards Web scale.

Though Semantic Web service technologies are aimed at resolving heterogeneity problems between source and target information; interoperability problem stemming from communication time, location space and access reference are still left untouched. In business environment such problems are immenent and need to be handled carefully. We strongly believe that a shared space where Web services under communication can write and read is required and essencial for enabling efficient and effective Web service discovery mechanism. Semantic augmentation of information as envisioned in Semantic Web technology and the usage of shared space for communication enables Web service applications more automated reducing the requirement of human intervention for Web service discovery and composition.

In distributed environment, Web service technologies to be successful, operations carried out at each individual applications need to be semantically described. The benefit of doing this is that precondition-postcondition relationship of individual operations can be predicted beforehand. Such a priori information will assist in load distribution. Furthermore, it motivates the use of Semantic Web technologies in Context-aware applications where only limited computing resources are available. The semantic augmentation of computing resources and application processes, we believe, enhances the Web services discovery mechanism.

The increasing number of Web services descriptions are difficult to manage in open environments such as in the Web. The main problem arises due to the fact that hundreds of different Web services exists providing hundreds of thousands of different services. They are built independant of each other at different locations by different people. Discovering a Web service that matches the user's requirement is time consuming, tidious and clumsy. In order for making discovery process efficient, scalable and resource effective, the structuring of Web service discription is enevitable. Some kind of information clustering, we believe, where related information are linked together, would facilitate easy access to the required information irrespective of their location.

4. Related Works

The problems pertaining to Web service discovery have long been taking attention of both academia and industry. In [1], a Peer-to-Peer Web service approach have been proposed. It is concerned with resource linking but nothing had been mentioned about the applications that process these resources. A scalable discovery mechanism has been presented in [6], [3]. However, they are unable to include resource limited devices into the Web service discovery picture.

5. Conclusion and Future Works

In this paper we discussed some of the higly ignored aspects of Web service discovery mechanisms and proposed some of the potential solutions. As the next step of our research, we incorporate Context-aware computing with Semantic Web services technologies and investigate its effect in Web service discovery process.

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