A Knowledge Map based Composite Services Model and its Application in WSG-based Services Discovery

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Abstract

As the number of Web services grows exponentially, it is necessary to improve the efficiency of services discovery. The WSG-based service discovery method uses semantic relationships among Web services to discover a composite service as a whole. It has been shown from the existing simulated experiments that the method can largely improve Web service discovery efficiency. However, the encapsulation of multiple composite web services and transportation of it from UDDI center to a client as well as visualization of composite web services at client side for selection are still problems that should be solved to achieve a practical WSG-based service discovery. This paper proposes a knowledge-map-based method to solve these problems. It is a supplementary to WSG-based services discovery theory.

1. Introduction

As the Web services published on Internet increase exponentially, it will be extremely difficult for a service requestor to discover a suitable service. To enhance the efficiency of Web service discovery, Liu et al [1] proposed a new concept and framework for services discovery, i.e., Web Services Graph (hereafter this is abbreviated as WSG) which is a semantic index for Web services in a UDDI center. The simulated experiments show that the newly proposed framework works well for service discovery. The efficiency and response time of service discovery can be improved greatly without undermining other measurement indices. The WSG-based service discovery process is shown as Figure 1.

In actual WSG-based service discovery process, we need to provide an interactive selection mechanism for consumers to choose their preferences. Thus, we should first describe those composition flows in a way that makes consumer clearly and visually choose their preferences. And then we should define a protocol to transport web services composition flows on network. This paper attempts to solve those two problems through the methodology from knowledge map.

2. Knowledge map-based composite web service representation model

In order to transport composite services flow on network and visualize them on client end, we need a representation model. BPEL4WS can describe combined Web services flow. But it just describes when and where to call Web services and how to organize these invocation. It does not refer to services details [2]. So, it can not provide an evaluation standard to help client choose their preference. In our research, we consider a Web service as a node of knowledge. Then we use knowledge maps to describe web services and their relationships. As there are self-contained theory and tools to realize visual knowledge representation, we use these theory and tools to model composite web services flow, too.

2.1. Topic Maps and XTM (XML Topic Maps)

Knowledge map is a kind of Yellow Page that indexes all knowledge resources and their relations. It is the key component of a knowledge management system. At present, knowledge map and its system have been studied systematically both domestically and internationally [3, 4]. They have developed a XML-based Topic Map (XTM) to define the relationship between knowledge conceptions. And a set of interactive and visual operation tool have been
developed, too. When having a deep insight at knowledge map, we find them can be used to solve the problems faced by WSG as illustrated in Section 1.

The ISO standard ISO/IEC 13250 Topic map defines a model as the semantic structure of link networks (ISO). Topic maps provide a bridge between the domains of knowledge representation and information management and link them to existing information resources. The basic concepts are Topics, Occurrences and Association. And the details can be found in Reference [5, 6].

2.2. Representation of composite Web service using Knowledge map

Composite Web service is a kind of knowledge, which includes two things: one is Web services itself, such as service name, service provider, service address, service sort and so on; the other is relationships between Web services, e.g., publish assertion etc.. In order to represent this knowledge, a certain model is needed. There are many models to represent knowledge, such as Meta data, XML, predicate logic and etc.. As XML files can be transmitted effectively on network using Soap protocol, XTM (XML Topic Maps) is selected to store the knowledge of composite Web service flow.

```
<topic id=''1''>
  <base Name>
    <BaseNameString>booking hotel </BaseNameString>
  </base Name>
</topic>
```

Figure 2. Using <topic> to describe a service name

2.2.1. XTM based composite Web services representation.

In order to use XTM to describe service nodes and its associations in composite Web services flow, we should first abstract the Meta data of service nodes and its relations. In XTM, homologous elements are <topic> and <Association>.

WSDL document is a kind of XML document that contains the Meta information of Web services. The information are: service name, service provider, service position, service classification etc.. All of this Meta data can be represented by tag, <topic>. Figure 2 is an example of a service name represented by the <topic>.

There are many kinds of associations in a XTM document, which can be used to describe composite Web service. In this paper, we just consider two kinds of associations. One is Sequence association for describing sequence relation between one Web service and its successor. This association should have two roles: Start Point and End Point.

Another association is RelateTo, which is used to describe the association between Web services and their attributions. This Association also needs to define two roles: Parent and Children.

Up to now, the XTM-based composite Web service modeling is completed.

3. Conclusions

With the WSG-based service discovery method, we can reduce the returned results from UDDI center to a client, the final results will not be only one. Therefore, we should have a mechanism to effectively encapsulate the returned results and transport to the client. And a visualization tool for a client to choose his/her favorites is needed too. Based on the progress on knowledge maps research, we have proposed a XTM based model to represent, transport and visualize the composite services.

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