Semantic Networks – Based Approach for Web Services Management

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Abstract: As commonly assumed in literature, Web services are software components of distributed applications which provide services to other applications by using standard Internet technologies (XML, SOAP, WSDL, UDDI). In this paper, we propose a novel semantic network-based approach for Web services management in order to facilitate the Web services composition. For answering complex needs of users, the creation of a composite Web service is required. The Web services composition is one of the big challenge problems of recent years in a distributed and a dynamic environment. The proposed approach uses an inter-connected network of semantic Web services describing in OWL-S, using the similarity measure (Outputs-Inputs similarity) between concepts based on ontologies of domain, built before any submitted request. Experimental results confirm that the proposed management approach reduces the complexity of the composition task.

1 INTRODUCTION

Web services are more than distributed systems, they provide the software foundation for next generation organisations. To make Web services accessible to users, service producers use Web services registries to publish them. Among the exponentially growing plethora of Web services, the development of an infrastructure of Web services is expected to change the business paradigm in the Web because the current infrastructure of registries is poor and the mechanism of Web services composition is inefficient. The Web services composition is a highly complex task. The proposed standard (XML, WSDL, UDDI, SOAP) of Web services technology do not answer the problems of Web services composition by a software agent. Furthermore, the semantic annotations for Web services and requests are not yet mature. According to (Nacer et al., 2009), the Web services composition is useful as soon as a client's request cannot be satisfied by a single existing service but by a composite Web service. This later is obtained from a correct combination of several existing Web services.

The purpose of this work is to propose an approach of Web services management in order to facilitate the Web service composition. This work uses an ontology-based approach to organize the UDDI into domains. We suggest, a semantic network to publish the Web services in UDDI.

This paper is organized as follows. The section 2 covers research issues about Web services management and composition. In section 3, we introduce a semantic network as a knowledge representation of several Web services. In the section 4, Web services management is discussed as an application of several semantic networks merging, and a simple implementation is shown. Finally in (section 5), we end with concluding remarks and future works.

2 LITERATURE REVIEW

The Web services technology was concretized around the specification of the W3C. It is divided into three areas: *(1)* Communication Protocols (SOAP: Simple Object Access Protocol)[1], *(2)* Service Description (WSDL: Web Services Description Language)[2], and *(3)* Service Discovery (UDDI: Universal Description, Discovery and Integration)[3]. These current standard revolve around XML to achieve platform independence features. Few researches have been done in the area of Web

[1] Is a protocol to exchange structured information in a decentralized and distributed environment
[2] It describes only the syntactic interface of Web services
[3] Is a virtual registry that exposes information about Web services

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services management. According to (Yu et al., 2008), Web services management refers to the control and monitoring of Web services qualities and usage. Web services management mechanisms are coupled with the QoS[4]. The authors identify two types of management: control[5] and monitoring[6].

OASIS proposed the Web services distributed management specification that addresses the management of IT resources by defining Web services interfaces and the management of Web services by defining messages. A Web service description can be published to multiple service registries using a variety of mechanisms. These various mechanisms provide different capabilities depending on how dynamic the publications using the service is intended to be. Like all Internet based computer applications, composition Web services is one of the most common concerns for interoperability (Nacer and Aissani, 2014). There have been several research efforts on Web services composition. We surveyed Web services composition development literature from these last years. Many industry standards have been developed. Furthermore, many academic research activities have also been resolved by various models; Petri Nets (Chemaa et al., 2015), Logical Programming (Zhai et al., 2015), Markov Process (Cetina et al., 2015) Matching Algorithm or Chaining (Ara et al., 2014), AI Planning (Remli et al., 2015), Graphs (Chao, 2010), Semantic Network (Nacer et al., 2009), States Machine or Finite States Automaton (Nagamouttou et al., 2015), Workflow techniques (Zou et al., 2014), Genetic Algorithms (Michael and Gero, 2007) (Canfora et al, 2005), and KP (Tao and Jay, 2005) (Mallayya et al., 2015), etc.

3 USING SEMANTIC NETWORK AS KNOWLEDGE REPRESENTATION

3.1 A Semantic Network

Semantic networks are widely used to represent knowledge, they are a specific class of graphs, characterized by a huge number of nodes. They are used in many different fields to model real-word systems. Semantic networks are consist of nodes and and arcs. A node *Ni* represents the semantic Web service and a relation defines an arc from the node *Ni* to the other node *Nj* with a label L. This later indicates the similarity measure between the two nodes. Furthermore, a set of nodes, labels, and arcs represents a knowledge as a semantic network. A knowledge K_1 is given by the following equation:

$$k_1 = \{\{N_1, N_2, \ldots N_k\}, \{L_1, L_2, \ldots L_l\} \cup R_i \rightarrow j\} \quad (1)$$

Where k_1 is the number of nodes, l is a number of labels. A tuple with a set of nodes, a set of labels, and a set of edges makes knowledge in semantic network.

3.2 Merging Several Semantic Networks

It is possible to link sets of knowledge represented in several semantic networks by using a sharing operation. As in (Kuwata and Yatsu, 1997), we use the merging operation. Given n knowledge sets k_1, k_2, $\ldots k_n$, we can built a global knowledge by adding labels and edges. This is represented by the following equations :

$$k_1 = \{\{N_1, N_2, \ldots N_{k1}\}, \{L_1, L_2, \ldots L_{l1}\} \cup R_i \rightarrow j\} \quad (2.1)$$

$$k_2 = \{\{N_1, N_2, \ldots N_{k2}\}, \{L_1, L_2, \ldots L_{l2}\} \cup R_i \rightarrow j\} \quad (2.2)$$

$$k_n = \{\{N_1, N_2, \ldots N_{kn}\}, \{L_1, L_2, \ldots L_{ln}\} \cup R_i \rightarrow j\} \quad (2.n)$$

Produce the following new knowledge set as $k_1 \cup k_2 \cup \ldots \cup k_n$

$k_1 \cup k_2 \cup k_n = \{\{\{N_1, N_2, ..., N_{k1}\} \cup \{N_1, N_2, ..., N_{k2}\} \cup \{N_1, N_2, ..., N_{kn}\}\} \cup \{\{L_1, L_2, ..., L_{l1}\} \cup \{L_1, L_2, ..., L_{l2}\} \cup \{L_1, L_2, ..., L_{ln}\}\} \cup \{R_i \rightarrow j\}\}$

The Figure 1 is an example of merging tree knowledge.

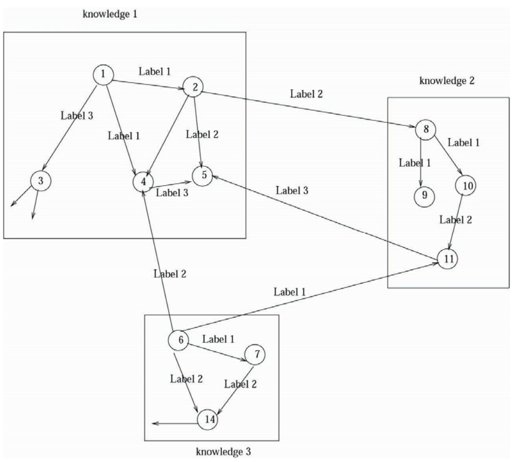

Figure 1: An example of merging semantic network as a new knowledge.

[4] Quality of a Service
[5] It aims to improve the service quality through a set of control mechanisms
[6] It rates the behavior of Web services in delivering its functionalities in terms of quality

4 WEB SERVICES PUBLICATION AND MANAGEMENT

Two dimensions are required for publishing and managing Web services in order to facilitate the Web services composition. The two dimensions are defined as following:

- **Space:** This dimension refers to the space memory reserved for Web services' publication in UDDI:
  1. Construction of sub registers of Web services description.
  2. Criteria of classification: Domain's Web service application.
  3. Storage of sub registers in UDDI.
  4. Exploitation of sub registers in Web services composition.
- **Structure:** This dimension refers to the organization of Web services in UDDI by using semantic networks:
  1. Semantic network:
     - Node: Name of service
     - Arc: Semantic relation between two services (It means the similarity between the Output of a service and the Input of the following service)
     - Label: Similarity Measure between two services
  2. Measurements of similarity:
     - Match: The two concepts are equivalent.
     - Subsume: A concept is more general than another.
     - PlugIn: A concept is included in another.

The semantic Web services in UDDI have to be recorded in a registry in the form of a semantic network before any submitted request. Each node represents a semantic Web service and an arc is labeled by a value which represents a similarity measure between the output of the service and the input of the following service. The space's criterion provides the first hierarchical classification of Web services on the basis of work's activity related to an ontology of domain. In addition, to refine this classification, and to reduce the complexity of Web services composition, it is necessary to refine sub registers of Web services by specifying the structure. Furthermore, we can define interconnections between different Web services of each sub registry by using concepts and relations based on the model of a semantic network. Thus, it is very important to organize semantic Web services in groups, each group represents a knowledge. We applied the merging operation on the set of groups. To validate our proposed approach, we implemented a prototype in Java.

Let 16 real semantic Web services be in a local registry without the QoS criteria, the following Table 1 shows the local registry. The URIs of services used in the example begin with: www.mindswap.org/2004/owls/1.1/ (Site, 2009b).

Example: For the service which sid=0, the URI is www.mindswap.org/2004/owls/1.1/ZipCodeDistance.owl

Table 1: UDDI: Directory of Services.

Sid	Sname	Inputs	Out-puts	Link to ontology
0	zipCode-Distance	zipcode1 zipcode2	Dist-ance	ZipCode-Distance.owl
1	FindZip-Code	City, state	Zip-code	ZipCode-Finder.owl
2	zipCode-Forecasts	lat/long, temp	forcast	ZipCodeFor-ecasts.owl
3	EnglishDic-tion nary	string, string	string	Dictiona-ry.owl
4	BabelFish	string, string	Lan-guage	BabelFishTranslator.owl
5	GetTemperature	Zipcode	temp	GetTempe-rature.owl
6	Google Business	what, addres	url	GoogleBusi-nesses.owl
7	ZipCode-info	Zipcode	info	ZipCode-info.owl
8	Google Direction	addres1 addres2	url	GoogleDirection.owl
9	Currency-Converter	price, currency	price	Currency-Converter.owl
10	Bn Price Check	Book-info	Book-price	BNPrice.owl
11	GetPres-sure	lat/long, coast	geo	GetPressurE.owl
12	Book Price	Bookname, currency	Book-price	BookPrice.owl
13	Book Finder	Bookname	Bookinfo	BookFinder.owl
14	FindLat-Long	zipcode	lat/ long	FindlatLong.owl
15	Display-Url	url	info	Display-URL.ow

- **Step 1: Classification based on domain of activity**

An example of a sub registry is illustrated in the Table 2, which is extracted from the previous Table 1.

- **Step 2: Refinement**

An example of a semantic network built from the information of the previous Table 2 is shown in the Figure 2.

Table 2: Example 1: Sub registry.

Sid	Sname	Inputs	Out-puts	Link to ontology
0	zipCode-Distance	zipcode1 zipcode2	Dis-tance	ZipCode-Distance.owl
1	FindZip-Code	City, state	Zip-code	ZipCode-Finder.owl
2	zipCode-Forecasts	lat/long, temp	forcast	ZipCode-Forecasts. owl
5	GetTem-perature	Zipcode	temp	GetTempe-rature.owl
7	ZipCo-deinfo	Zipcode	info	ZipCode-info.owl
11	GetPres-sure	lat/long, coast	geo	GetPres-surE.owl
14	FindLat Long	Zipcode	lat/ long	Findlat-Long.owl

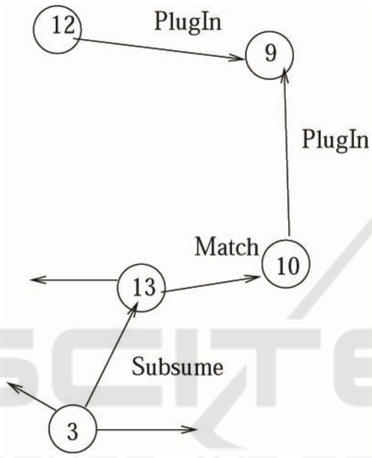

Figure 2: Knowledge 1: An example of a sub semantic network of Web services.

- **Step 3: Merging**

All semantic networks in UDDI is regarded as a group knowledge coming from the merging of the several knowledge. $Knowledge_1$, $Knowledge_2$, ... $Knowledge_n$.

5 CONCLUSIONS

Despite the importance of Web service composition, management and publication of Web services have not been extensively investigated. In this paper we have discussed the management requirements of semantic Web services. As a contribution to this important concern, we have proposed an approach to managing Web services according to the semantic requirements of Web services and the concepts of semantic network and the merging operation. However, we are also planning to do other experiments I order to find the best knowledge representation for publishing and managing semantic Web services in UDDI.

REFERENCES

Nacer, H. Aissani, D. Boudjlida, N. (2009) 'Semantic annotations for web services discovery and composition', *Computer, Standards and Interfaces Journal (CSI),* 31 (6), pp.1108–1117.

Yu, Q. Liu, X. Bouguettaya, A. et al. (2008) 'Deploying and Managing Web Services: Issues, Solutions and Directions', *The VLDB Journal*, Vol. 17, Num. 3, pp. 537-372.

Nacer, H. Aissani, D. (2014) 'Semantic Web services: standards, applications, challenges and solutions', *Journal of Network and Computer Applications,* Vol. 44, pp. 134-151.

Chemaa, S. Bouarioua, M. Chaoui, A. (2015) 'A High-level Petri Net based Model for Web services Composition and verification', *International Journal of Computer Application in Technology*, Vol. 51, Num. 4, pp. 306-323.

Zhai, S. Xin, Z. Song, A. (2015) 'A Reliable Automatic Service Composition Method Based on Type Theory, *International Journal of u and e Service, Science and Technology,* Vol, 8, Num. 2, pp. 277-290.

Cetina, V. Mena, F. M. Ucan, R. H. (2015) 'Composition of Web Services Using Markov Decision Processes and Dynamic Programming, *The Scientific World Journal*, doi: http://dx.doi.org/10.1155/2015/545308.

Ara, S. Shamszaman, Z. Chong, I. (2014) 'Web of Objects Based User Centric Semantic Service Composition Methodology in the Internet of Things', *International Journal of Distributed Networks*, doi: http://dx.doi.org/10.1155/2014/482873.

Remli, M. Deris, S. Jamous, M. et al. (2015) 'Web Services Composition for Concurrent Plan Using Artificial Intelligence Planning', *Journal of Theoretical and Applied Information Technology*, Vol. 78, Num. 2, pp. 228-235.

Chao, Y. (2010) 'Web Service Composition Using Graph Model', *In proceedings of 2nd IEEE International Conference on Information Management and Engineering (ICIME),* Chengdu, China, pp. 656-660.

Nagamouttou, D. Egambaram, I. Krishnan, M. et al. (2015) 'A Verification Strategy for Web Services Composition Using Enhanced Stacked Automata Model', *SpringerPlus Journal,* doi: 10.1186/s40064-015-0805-1.

Zou, G. Lu, Q. Chen, Y. et al. (2014) 'QoS-aware Dynamic Composition of Web Services Using Numerical Temporal Planning', *IEEE Transactions on Services Computing*, Vol. 7, Num. 1, pp. 537-372.

Michael, C. Gero, M. (2007) 'Qos-based selection of services: The implementation of a genetic algorithm', *in Proceeding of the International Conference on Service Oriented Architectures and Service Oriented Computing (SOA/SOC)*, Bern, Switzerland, 2007, pp.

1–12.
Canfora, G. Di-Penta, M. Esposito, R. al. (2005) 'An approach for qos-aware service composition based on genetic algorithms', *in: Proceedings of the International Conference on Genetic and Evolutionary Computation (GECCO),* Washington, USA, pp. 1069–1075.
Tao, Y. Jay, L.K. (2005) 'Service selection algorithms for composing complex services with multiple qos constraints'*, in: Proceedings of the 3rd International Conference on Service Oriented Computing (ICSOC),* Berlin, Heidelberg, pp. 130–143.
Mallayya, D. Ramachandran, B. Viswanathan, S. (2015) 'An Automatic Web Service Composition Framework Using QoS Based Web Service Ranking Algorithm', *The Scientific World Journal,* doi: http://dx.doi.org/10.1155/2015/207174.
Kuwata, Y. Yatsu, M. (1997) 'Managing knowledge using a semantic network', *Laboratory for Information Technology*. AAAI Num. ss-97-01.
Site, (2009b) Maryland Information and Network Dynamics lab Semantic Web Agents Project, access year: 2009. URL du document http://www.mindswap.org/.