Survey on semantic service discovery using semantic web technologies

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Abstract- **The number of available Internet services increases every day at rapid speed. This demands distributed models and architectures to support scalability as well as semantics to enable efficient publication and retrieval of services. Semantic web services focusses on providing automation and dynamics to existing web services. One of the main challenges facing the current web is the efficient use of all the available information. Traditional web service discovery approach is keyword based search using UDDI. Linked data are helping to build the Semantic Web, in which a set of standards are proposed for the exchange of data among heterogeneous systems. A study conducted on various approaches for semantic service discovery.**

Index Terms- **Web services, service oriented architecture, semantic web**

I. INTRODUCTION

In the past three decades, advancements in microelectronic technology, communication technology have been resulted in the availability of the fast, cost-effective and efficient computer systems and networks. Web is 25 years now which is the great invention of Timothy John Berners-Lee in the computer science history. Web is powerful and easy now then it was and still evolving more powerful and easy. The ultimate result of these advancements have been multiple interconnected computer systems by a high-speed network in a local network or over the web or hybrid network. Today, almost everything is distributed. Web services are application component which are based on XML. Web services can be used by any application irrespective of platform in which it is developed. Web service description is provided in WSDL document. It can be accessed from internet using SOAP protocol or REST architectural style.

Semantic Web Service (SWS) evolved due to rapid development of Web service technologies and the advent of Semantic Web. Automatic web service discovery still remains a complex task. This complexity is mainly due to rapid increase in the number of web services available on the Web and the various concept models available to expose services like Web Service Description Language (WSDL), Web Ontology Language for Services (OWL-S), Web Service Description Language Semantics (WSDL-S), Web Service Modelling Language (WSML), etc. With the advent of ontology and various semantic service matching algorithms, web services can be automatically discovered.

Basic process of web service discovery is demonstrated in section 2. Various approaches in the literature for semantic service discovery are reviewed in the section 3. Section 4 discusses the conclusion.

II. SERVICE DISCOVERY

Service discovery is the process of finding appropriate services from a set of services which could be provided in a central or distributed service repository. After a set of appropriate services has been discovered, it is possible to select the most suitable service and bind/invoke it [1]. Figure 1 shows the main components of the service discovery process.

The factors affect the discovery process are:
- The ability of service providers to describe their services.
- The ability of service requestors to describe their requirements.
- The effectiveness of the service matchmaking algorithm.

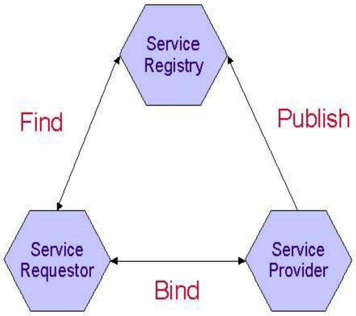

Figure 1: Discovery of Web Service

The following concepts are essential in service discovery:

Service Advertisements describe a service offer with respect to different aspects, for example functional capabilities, non-functional aspects etc. Depending on the type of the service registry adopted and the expressiveness of the Web service standard used, the service description may be more or less formal and detailed.

Service Requests declare the requirements of a service requestor regarding functional, non-functional and technical service capabilities. Service requests are formulated in concrete queries, which can have different forms.

Matching Engines (or matchmakers) match service advertisements and requests and calculate a DoM between them. The actual matching is a (pairwise) comparison of a service advertisement and a service request. A matchmaker can be syntax- or semantic-based or be hybrid.

The DoM “can be formally defined as a value from an ordered set of values that express how similar two entities are with respect to some similarity metric(s)”. In service matchmaking based on semantic information, logic-based subsumption relations between semantic concepts from an ontology are often employed as DoMs

III. SURVEY ON SEMANTIC WEB SERVICE DISCOVERY

1. Self-Organized Semi-Structured P2P with Super-Peer Paradigm

This approach supports scalable and efficient service discovery for cross-enterprise collaboration by forming and maintaining autonomous enterprise peer groups. [2]Known similarity among different enterprise peers and the predetermined number of peer groups, k-medoid clustering algorithm [3] is used for self-organized grouping of enterprise peers which organize the similar enterprise peers in the same group. The similarity values and reputation values of peers are evaluated periodically. Thus, the overlay network connections among peers are rearranged autonomously as the network evolves.

Super Peer (SP)-based P2P overlay network is self-organized which realizes both advantages of centralized search and decentralized search. It addresses the drawbacks of both unstructured and structured P2P architectures, by minimizing the overhead either incurred by the random peer communication or maintenance of peer overlay structure. Manufacturing Service (MS) request (SR) is first routed to the suitable SP and further to its leaf peer in a systematic way.

2 Reactive Multiagent based distributed SOA middleware

In this approach, Services and users’ queries are modelled as agents. The middleware is distributed into a system of federated registries, each of which is managed by a pair of middleware agents [4]. Reactive model of multiagent system (MAS) [5], [6] capable for implementing large-scale parallel and concurrent SOA based systems. The use of multiple agents can improve load balancing significantly and also improve the overall performance of service discovery. Agent modelling makes the platform resilient to unexpected bottlenecks or sudden crash of nodes due to the mobility feature of the agents.

3 Goal-Oriented Agent in the RESTful Architecture

In this approach, Agent intelligently crawl and use services for retrieving contents in the web that correspond to some top goals, generally stated by the user. The agent searches the web and combines different information resources to carry out effective reasoning that determines its decisions and behaviour during the crawling. [7]

The agent architecture follows the belief-desire-intention (BDI) pattern. Both belief and goals are set of Resource Description framework (RDF) triples extracted from web pages, while intentions are stacks of plans that are fired upon the creation of deletion of triples in the beliefs and goals triples sets. Ultimately it has been naïve adaption of Agent Speak’s agent model [8] to RDF which becomes the approach that integrate RDF and Semantic Web standards with BDI agents [9]. Agent has the basic discovery capabilities: 1) Focused Crawling Plan and 2) Deep Web Crawling Plan. Service description is modelled as feature-oriented. Service description allow the reuse of feature descriptions in which features, aspects and abstract classes are reused respectively in feature oriented programming (FOP), aspect oriented programming (AOP) or mixins paradigms [10] [11] [12].

4 Quality-based Semantic Service Broker using Reachability Indexes

In this Approach, Service Broker is modelled as service information, including inputs, outputs and descriptions is translated to semantic concepts by comparing semantic terms. The services are modelled as vertices in a conceptual aggregation graph and connected to other vertices based on the translated semantic concepts. The reachability indexes are calculated and assigned to each vertex. Searching for the composition between two service done by finding a path between two vertices in the conceptual aggregation graph. The reachability between two vertices checked immediately and the path searching been accelerated. When all the paths between two vertices have been found, all the possible composition solutions for the two services could been found also. The qualities of these solutions could be evaluated and ranked. Even if there is no solution that fits the specified quality requirements, a suggested solution from the similarity distance relaxation could be provided. The concept of reachability indexes used to speed up the service discovery and to allow users to be informed at the start if there are no feasible composition solutions. [13]

5 Distributed Hash Table (DHT) based Semantic Overlay Network

In this approach, Semantic-driven query answering be done in Distributed Hash Table (DHT) based systems by building a Semantic Overlay Network (SON) over a DHT. [14]

DHT is prominent network paradigm for data distribution and indexing due to their scalability properties and efficiency in retrieving content. SON is a paradigm in which clustering the peers according to the semantic similarity of content they share, the clusters can then be exploited to speed up query routing while providing good recall. A measure of semantic similarity between service descriptions combines the feature-based and information content-based similarity models.

The construction of a SON benefits in terms of service discovery, since it allows query forwarding more efficiently. The construction of SON occurs by piggybacking on the service publishing mechanism provided by the DHT with almost no additional cost. Due to its based on DHT, there exists a stabilization protocol to reorganize keys when peers join or leave the network. Therefore, semantic link maintenance in the SON seems similar process to the stabilization protocol. Indeed, a semantic link maintenance protocol can be run at the same time of the stabilization protocol by exchanging information between peers to check the value of a link or whether it is still valid.

Table 1 gives summary of the various semantic web service discovery approaches discussed above along with their pros and cons.

IV. CONCLUSION

Traditional web service discovery approaches involve manual selection of required web services, by users, from an extensive textual list, etc. This process is time-consuming and exhaustive. This paper has summarised some of the approaches available for Semantic Web Service discovery.

Various web service discovery approaches and their pros and cons have been discussed.

Semantic web service discovery approaches reduces cost and time, enhances precision and recall by moving from manual service discovery to reusable functionality of search results.

Table 1: Approaches of Semantic Service Discovery

Sr. No	Approach	Pros	Cons
1	Self-Organized Semi-Structured P2P with Super-peer Paradigm	forming and maintaining autonomous enterprise peer groups, Dynamic reputation-based trust model	Lack of working for Large-scale Enterprise Peers >500
2	Reactive Multiagent based distributed SOA middleware	improved load balancing, distributed Semantic Taxonomic Cluster	Restricted to 3000 services and
3	Goal-Oriented Agent in the RESTful Architecture	Used for discovery of services and content over the entire web using agent architecture	Could take infinite time to crawl the whole web for finding particular service
4	Quality-based Semantic Service Broker using Reachability Indexes	Reachability indexes speed up path finding, At the beginning check for possible finding, Suggest similar solution if finding not found	Requires additional computation resources to maintain the conceptual aggregation graph and reachability indexes
5	Distributed Hash Table (DHT) based Semantic Overlay Network	Semantic-driven query answering, Better performance than Chord and Gnutella-like network scenario	Duplicate message rate needs to be accepted, Quality-based similarity matchmaking not included

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