

Chapter 45

Self-Adaptive QoS-Aware Web Service Discovery Using Ontology Approach

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ABSTRACT

In recent years, although semantic has been widely used in service discovery mechanisms, it still needs to exploit all semantic aspects included in service documents so that the discovered service can highly be relevant with user request. Moreover, it also needs to consider self-adaptability in discovering the services which can adapt to searching conditions or parameters in order to find other suitable and potential services if no feasible solution could exactly satisfy user QoS requirements. Therefore, this paper proposes a novel self-adaptive QoS-based service discovery mechanism which can adapt the discovery process with the help of semantically structured ontology trees if unexpected results are encountered. The discovery process matches the equivalences between service advertisement and requirement using three similarity evaluation criteria namely concept, attribute and constraint similarity. This discovery process is repeated until feasible solution is found and a set of most suitable services are returned to the users. The authors prototype their system called SQoSD to evaluate the efficiency and adaptability compared with OWLS-CPS and RQSS. The experimental results prove that our mechanism is superior to the other compared mechanisms.

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1. INTRODUCTION

Web Service (WS) has been considered as a major software paradigm with the abilities of self-description, self-management, self-adaptation and self-organization (Pastrana, Pimentel & Katrib, 2011). WSs are advertised, located, distributed and applied across the Internet through service oriented architecture (SOA). They enable to monitor and adapt themselves when the unexpected changes are encountered in their working environments.

Since very recent years, a large body of works has been done in the area of service management such as service discovery, selection and composition. Some applied category or syntactic approaches (Keller & Ludwig, 2002; Martin-Diaz et al, 2003; Rajendran & Balasubramanie, 2010; Lin, Sheu, Chang & Yuan, 2011; Li, Song & Zheng, 2014) while some utilized semantic approaches (Shu, Rana, Avis & Dingfang, 2007; Liu, Shen, Hao & Yan, 2009; Brandic et al., 2008; Ke & Haung, 2012; Zhao, Sun & Jin, 2015; Wang, Cao & Xiang, 2015) to partially address the SOA vision. Even though their mechanisms led to the semantic technology, they could not exploit well all semantic aspects of WSs. The reason is because they wholly depended on heuristic algorithms such as genetic algorithm (Su, Zhang & Chen, 2007), analytical hierarchy process (Tran, Tsuji & Masuda, 2009), artificial neural network (Cai, Hu, Lu & Cao, 2009), rough sets theory (Yahyaoui, Alumulla & Own, 2014) and collaborative filtering (Lin et al., 2014) based on some intuitive rules or guidelines to generate their expected solutions.

With the Web's growth, there have been many different QoS languages (Tosic, Pagurek & Patel, 2003; Keller & Ludwig, 2002) and models (Choi, Her & Kim, 2007; Toma, Foxvog & Jaeger, 2006) to express the meanings of QoS information offered by service providers and requested by users. However, remaining lack of semantic exploitation and self-adaptabilities in discovering the services creates the following two problems.

Firstly, the current approaches (Kritikos & Plexousakis, 2006; Cai, Hu, Lu & Cao, 2009; Tran, Tsuji & Masuda, 2009; Lin, Sheu, Chang & Yuan, 2011; Redl, Breskovic, Brandic & Dustdar, 2012; Yahyaoui, Alumulla & Own, 2014) consider only QoS constraint as a key factor of QoS metrics matchmaking. The sole consideration of QoS constraint without taking into account the other aspects of QoS metrics makes them inefficient to understand and reason the subtle QoS specification. In addition, the traditional exact match is no longer useful on today's sophisticated QoS descriptions because two syntactically different services might be similar by means of semantic (Redl, Breskovic, Brandic & Dustdar, 2012). Hence, it becomes insufficient to match the services without practically usage of semantic technology.

Secondly, the previous QoS-based service discovery approaches did not explore self-adaptable feature in discovery while some functional discovery ones (Ke & Haung, 2012; Wang, Cao & Xiang, 2015) presented adaptive methods. As lack of adaptive feature in QoS-based approaches, they remain difficult to solve the problem of non-feasible solution occurrences when unexpected QoS specifications are encountered. Besides, when incomplete or inconsistent user requests are obtained, they could not adjust the searching conditions to relax some rigid user QoS demands or to replace irrelevant QoS attributes that are unconsciously chosen by non-expert users with relevant ones. For example, the study (Redl, Breskovic, Brandic & Dustdar, 2012) faced no feasible solution occurrences under incomplete conditions like user's insufficient QoS demands, user's over-constrained QoS needs or unavailable status of suitable service offers which can exactly satisfy user QoS requests.

To address the above problems, this paper proposes a self-adaptive QoS-based web service discovery mechanism with the following contributions.

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