Chapter 10
Towards Aligning and Matchmaking QoS-Based Web Service Specifications

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ABSTRACT

QoS plays an important role in all service life-cycle activities, and consequently, has grabbed the researchers' attention. Concerning QoS-based service description, the various approaches proposed adopt different meta-models and propose different QoS models mostly covering domain-independent NFPs and metrics. This lack of a common QoS meta-model and model causes serious accuracy problems in QoS-based service matchmaking. While mapping between QSDs is not difficult as they rely on similar meta-models, mapping between equivalent metrics specified even with the same meta-model is challenging. For this reason, a novel QoS metric matching algorithm has been proposed for metrics specified in the OWL-Q language. In this chapter, this algorithm is exploited for aligning OWL-Q specifications. Moreover, two novel QSM algorithms are proposed that advance the state-of-the-art by solving the problems of non-coverage of QoS demand metrics by QoS offers, erroneous matchmaking metrics, limited service categorization, and non-useful result production for over-constrained QoS demands.

INTRODUCTION

Service-orientation (Georgakopoulos & Papazoglou, 2008; Allen, 2006) is a new design paradigm that promises to change the way software applications are built and business is conducted. This paradigm relies on exploiting services as application or business process building blocks. Services are modular and self-describing software or business entities exposing a particular functionality that can be discovered and invoked via the Internet. One key advantage of services is that they can be combined into new services offering an integrated functionality. As such, a

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whole application can be built from scratch or existing intra- or inter-organizational processes can be seamlessly integrated together in a loosely-coupled way.

Before services are combined and used, they first have to be discovered. To this end, the service-oriented paradigm relies on a particular architecture (Booth et al., 2002) in which three main entities play particular roles. The service provider offers the service and advertizes it to a service broker. The latter is responsible of storing the service advertisements and answering service queries issued by service requesters for a particular offered-as-a-service functionality. Finally, the list of advertisements fulfilling the requested functionality is returned to the service requester, who selects the best service and binds to it to invoke it. As can be seen, the service broker is the central role in this architecture and many research approaches have been proposed realizing it, thus being able to perform the process of service discovery.

Initially, most service discovery approaches (Stroulia & Wang, 2005) focused on answering user queries concerning only the service functionality. In particular, they used techniques from Information Retrieval (Baeza-Yates & Ribeiro-Neto, 1999) and Software Engineering (Zaremski & Wing, 1997) to match service advertisements and offers focusing on the structure and textual content of these service specifications. However, the accuracy of the service results returned was low as the service description terms semantics was not captured. To this end, the next series of approaches solved this problem first by either annotating the service terms with concepts from domain ontologies (Plebani & Pernici, 2009) or using purely ontological service descriptions (Klusch, Fries, & Sycara, 2009; Cliffe & Andreou, 2009) and then by exploiting Semantic Web (SW) (Berners-Lee, Hendler, & Lassila, 2001) techniques in order to reason about the similarity of the compared semantically-enhanced service specifications.

However, no matter how well the functional service discovery is solved, it is just one aspect of the service discovery problem. In particular, many functionally-equivalent services may exist in various domains and there should be a way to further filter them. Moreover, service requesters should be assisted in selecting the best service from those discovered. The solution to these problems comes with the description of the Quality-of-Service (QoS) of services, the service advertisements filtering (i.e. QoS-based service matchmaking (QSM)) based on the advertized QoS capabilities (i.e. QoS offers) and the requester's QoS requirements (i.e. QoS demand), and the best service selection according to the requester's preferences.

Inspired by the solution adopted in service discovery, the current trend (Kritikos et al., 2010) in QoS-based Service Description (QSD) is to use ontologies to provide rich, extensible, and formal service QoS models so as to increase the accuracy of QoS-based service discovery. To this end, many service QoS models have been proposed using different ontology languages and presenting different coverage of the various QoS aspects. However, the lack of a standard service QoS model increases the probability that different QoS specifications (i.e. QoS offers and QoS demands) may be described through different QoS models. Moreover, this probability is further increased as users may have a different conceptualization of the same QoS concept and measurements of equivalent QoS metrics may be produced by readings of a different abstraction level (high vs. low) in different service instrumentation systems (Kritikos & Plexousakis, 2006). Thus, aligning (Bach et al., 2004) QoS specifications is required.

In this chapter, we claim that QoS attribute models (QoS model parts) are more-or-less standardized as researchers tend to agree on their content so we focus on aligning QoS specifications based on their QoS metrics. To this end, we shortly analyze a metric matching algorithm (Kritikos & Plexousakis, 2006) used to infer the equivalence between QoS metrics of the same or different QoS