Service Selection Based on Non-functional Properties

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Abstract. Service-oriented Architecture supports software to be composed from services dynamically. Selecting and composing appropriate services according to business process, policies and non-functional constraints is an essential challenge. This paper proposes a method for automatic selection of the most relevant service for composition based on non-functional properties and the user’s context. In doing this we also propose a method of obtaining and evaluating non-functional aspects.

1 Introduction and Motivation

Service-oriented Architecture (SOA) is by now widely used in the industry for solving B2B problems due to their ability to deliver flexible software systems that support the changing nature of business co-operations. The predominant implementation of SOA is called Web Services (WS). Considering WS, the fundamental standards are SOAP, WSDL and UDDI – together they address the fundamental paradigm of SOA: publish-find-bind.

Services are made available via the internet by a service provider, and their description is published (using WSDL descriptor files with details stored in UDDI repositories); a service consumer will query the UDDI repository to find an appropriate service and then use SOAP to invoke that service (this involves very late binding, essentially taking place at execution time). Currently this process is largely based on a human user making the decisions as to which service is suitable for their purpose. Furthermore, currently the matching is mostly based on functional requirements while non-functional aspects are not formally considered. However, in order to decide which service is most suited for a particular user in their current situation clearly depends on the functionality, but also on non-functional properties such as cost or reliability. Of course a UDDI repository might contain information about the cost of using a service or the service level agreements provided, but again this mostly for human consideration and hence not suitably formalised for automatic selection. There has been some effort in the Semantic Web Services Community to address these issues, however adopting this requires much more fundamental changes than our suggestion and hence might not be as readily available in the short term.

The complexity of business processes and the dynamic nature of the co-operations make it difficult for the business modeller to select appropriate services, manage the compositions efficiently and understand requirements within a dynamic context.
correctly. In this paper we present the service management layer developed as part of the inContext project\(^1\) which is aimed at addressing the above issue, in particular considering that a service’s suitability depends largely on the user’s context. We will focus on a specific aspect of this management layer: namely the service lookup and relevance ranking. What is special about this lookup is that in addition to the functional aspects of a service non-functional aspects are considered both when looking up a service as well as when finding the most suitable service.

The remainder of this paper is structured as follows: section 2 introduces the reader to relevant background and related work, section 3 presents the service management layer of the inContext platform and its position in the wider platform. Section 4 discusses how data concerning the non-functional aspects is obtained, while section 5 discusses how it is quantified. Section 6 describes the ranking mechanism and section 7 shows an example. Finally we round the paper off with a summary and discussion of future work in section 8.

2 Background

Most of the related work on using non-functional properties for service selection concentrates on defining QoS (Quality of Service) ontology languages and vocabularies and identification of various QoS metrics and their measurements with respect to semantic services.

In [1] and [2], QoS ontology models are defined, which propose QoS ontology frameworks aimed at formally describing QoS attributes. To our understanding, these works have not considered non-functional property based service matching and neither how to quantify the attributes.

Ran [3] enumerates a large number of non-functional properties and organizes them into several categories, such as runtime-related, transaction support related, configuration management, cost-related QoS, and security-related QoS. However, the work fails to illustrate the quantifiable measurements as it simply assumes that all measured values are available somewhere.

The work in [4], [5], and [6] attempts to conduct a detailed evaluation and proposes QoS-based service selection. However, it does not explicit where the criteria come from. Additionally, all the current works does not consider the logic relations between criteria, using only the average of all individual values of the criteria as the final score.

Compared to the existing work, our selection approach has 5 major advantages. (1) Our process combines evaluation and selection activities in contrast to [4] and [7] which only address selection issues. (2) Our three measurement functions can deal with most types of criteria. This makes the measurement functions reusable and applicable to a wide range of non-functional attributes. Other work only focuses on criteria specific metrics and does not provide generic functions for all kinds of criteria. (3) Our method is more dynamic in that it automatically applies the correct metric while other work requires a manual association, or at least predefined maps, relating metrics

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\(^1\) Interaction and Context Based Technologies for Collaborative Teams; EU-IST-2006-034718; www.in-context.eu