

Chapter X

Model-Driven Semantic Web Services

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Abstract

The Semantic Web promises automated invocation, discovery, and composition of Web services by enhancing services with semantic descriptions. An upper ontology for Web services called OWL-S has been created to provide a mechanism for describing service semantics in a standard, well-defined manner. Unfortunately, the learning curve for semantically-rich description languages such as OWL-S can be steep, especially given the current state of tool support for the language. This chapter describes a suite of automated software tools that we have developed to facilitate the construction of OWL-S specifications. The tools operate in two stages. In the first stage, a Model Driven Architecture technique is used to generate an OWL-S description of a Web service from a UML model. This allows the developer to focus on creating a model of the Web service in a standard UML tool, leveraging existing knowledge. In the second stage, an interactive approach for generating groundings is used. This chapter describes both tools and demonstrates how the use of lightweight interactive tools facilitates creation of OWL-S specifications.

Introduction

A Web service is a loosely coupled component that exposes functionality to a client over the Internet (or an intranet) using Web standards such as HTTP, XML, SOAP, WSDL, and UDDI. Of the many challenges of using Web services are the problems of specification, search, discovery, selection, composition, and integration. The current state of practice in Web services is dominated by the use of the Web Service Description Language (WSDL) (Christensen, Curbera, Meredith, & Weerawarana, 2001) to specify access to services. This language lacks an ability to address the aforementioned challenges due to a lack of semantic constructs, although the proposal for WSDL-S addresses it in part (Akkiraju et al., 2005). A *Semantic Web service* extends the capabilities of a Web service by associating semantic concepts to the Web service in order to enable better search, discovery, selection, composition, and integration. Semantically rich languages such as OWL-S (Martin et al., 2005) have been created in order to provide a mechanism for describing domain concepts and the semantics of Web services as ontologies. Unfortunately, for the common developer, the learning curve for such languages can be steep, providing a barrier to widespread adoption.

Model Driven Architecture (MDA) (Miller & Mukerji, 2003) is an approach to software development that is centered on the creation of models rather than program code. The primary goals of MDA are portability, interoperability, and reusability through an architectural separation of concerns between the specification and implementation of software. In MDA-based approaches, the focus is on creation of software via the development of models specified using standard and widely adopted languages such as the Unified Modeling Language (UML) (OMG, 2005b).

We are developing an approach that allows a developer to focus on creation of Semantic Web services and associated OWL-S specifications via the development of a standard UML model. By using an MDA approach, the technique facilitates creation of descriptions of semantic concepts while hiding the syntactic details associated with creating OWL-S specifications. As such, difficulties caused by a steep learning curve for OWL-S can be mitigated with a language that has a wide user base, thus facilitating adoption of Semantic Web approaches.

One of the advantages of OWL-S is its flexibility in allowing the creation of many groundings or bindings for a single Semantic Web service. As part of our method, we have developed an interactive approach for generating OWL-S groundings. In this approach, the semantic and architectural concerns associated with specifying Semantic Web services can be performed by software and knowledge architects. The mapping of Web services described using WSDL to operations contained in the profile and process specifications are intended to be performed by developers of Web services as they are constructed or by architects as they identify existing services that meet the intended behaviors of the semantic services.

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