



UML-Based Support for Designing and Validating Web Service Descriptions

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ABSTRACT

WSDL descriptions, often characterized as IDLs for Web services, are a key for Web service interoperability. Therefore, special care should be taken in designing WSDL descriptions. We present an approach that provides UML-based support to design and validate WSDL descriptions. To promote Web service interoperability, WS-I organization provides a Basic Profile that defines clarifications, refinements, interpretations, and amplifications of Web service specifications, including WSDL. We propose UML-based profiles to define structural rules of WSDL documents as well as Basic Profile recommendations for WSDL descriptions. These profiles can be used to guide the user in designing correct and Basic-Profile-compliant WSDL descriptions and to check the validity of existing WSDL descriptions. We propose a method and tools for such validity checking, and demonstrate the applicability of the approach with case studies.

Keywords: UML profile; Web services; WSDL

INTRODUCTION

Web services aim at making machine-to-machine interaction easy by providing a way to integrate systems loosely and independently from the platforms and programming languages used. They use and rely on well-known standards such as Web Service Description Language (WSDL) (W3C), Simple Object Access Protocol (SOAP) (W3C), and Universal Description, Discovery and Integration (UDDI); WSDL is the current standard way to describe Web

services, SOAP is used to handle cross-platform interactions, and UDDI provides a mechanism for client applications to dynamically find (other) Web services.

The vision of interoperable Web services is quite fascinating but also ambitious. Even though a general agreement on the high-level architecture of Web services and standards to be used exists (e.g., WSDL and SOAP), there are still many challenges and problems that are far from being solved. Experiences from Web

services clearly indicate that Web services often suffer from interoperability problems, insufficient support for security, and other limitations. These problems are partly due to the involvement of the standards, allowed freedom in using them, and the lack of usage guidelines. A lot of research is currently ongoing to overcome these problems.

Web Service Interoperability (WS-I) is a joint industrial organization that aims at improving interoperability across platforms, operating systems, and programming languages. It provides, for example, a Basic Profile (1.0 and 1.1) that defines clarifications, refinements, interpretations, and amplifications of Web service specifications, including WSDL, to promote Web service interoperability (WS-I). These Basic Profile recommendations consist of a set of rules given in a textual form. WS-I has recently gained wide support in industry and by tool vendors. Many of the currently available Web service toolkits already take the Basic Profile recommendations into account.

WSDL is an XML format for describing network services as collections of communication endpoints capable of exchanging messages (W3C). It has been often characterized as an Interface Definition Language (IDL) for Web services. Being a key for Web service interoperability, special care should be taken in designing WSDL descriptions to ensure the interoperability.

Many Web service toolkits allow automatic generation of WSDL descriptions from existing interface implementations to be exposed to Web service clients. However, these approaches indeed assume an existing service interface and do not support the design of Web service descriptions nor do they consider the point of view of clients of the Web service that well. Furthermore, automatically generated service descriptions may simply reflect the existing (e.g., Java) interfaces. Even though they are an easy way to develop the interface definition, the developer loses some control over WSDL construction. The easiness often comes with the cost of flexibility: the involvement of service interface often requires changes in

WSDL documents, which in turn may require changes at client ends. Another approach is to consider the construction of service descriptions as a starting point and allow the generation of, for example, parts of Java interfaces, from existing WSDL descriptions. These approaches require more from the service designer, like knowledge on WSDL grammar and Basic Profile recommendations.

In this paper we present an approach that provides UML-based support to design and validate WSDL descriptions. We:

1. Propose tool support for transforming WSDL documents to UML representations;
2. Introduce UML-based profiles capturing:
 - a. Structural rules of WSDL documents, including SOAP binding, and
 - b. WS-I Basic Profile rules and recommendations for WSDL;
3. Provide customizable tool support to combine and run different validity checks for either designed or reverse-engineered UML representations of WSDL descriptions;
4. Provide an extensible environment to modify existing profiles and add new ones, as well as to define new validity checks; and
5. Show the usefulness of the approach and tools in two case studies.

Using the visual UML class diagram notation, the service descriptions are easy to comprehend by the software designer. Our approach is thus useful both when considering the construction of Web service descriptions as the starting point of Web service design and when automatically generating the WSDL descriptions from existing implementations. In the former case, the profiles can be used to guide the design of service descriptions and to ensure that the rules, for example, WS-I Basic Profile recommendation, have been taken into account. In the latter case, existing WSDL documents can first be transformed into UML representations that can then be checked to find possible violations against the rules de-

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