A Conceptual Framework for Semantic Web Services Development and Deployment

Claus Pahl

Dublin City University, School of Computing
Dublin 9, Ireland
Claus.Pahl@dcu.ie

Abstract. Several extensions of the Web Services Framework have been proposed. The combination with Semantic Web technologies introduces a notion of semantics, which can enhance scalability through automation of service development and deployment. Ontology technology – the core of the Semantic Web – can be the central building block of this endeavour. We present a conceptual framework for ontology-based Web service development and deployment. We show how ontologies can integrate models, languages, infrastructure, and activities within this framework to support reuse and composition of semantic Web services.

Keywords: Web Services, Semantic Web, ontology technology, conceptual development and deployment framework.

1 Introduction

Opening the Web for software applications is the objective of the Web Services Framework WSF [1]. Services are self-contained computational entities, used as is by service requesters, and made available through the infrastructure provided by a provider. The focus is on the boundaries of systems and on the interaction between systems.

A number of shortcomings of the Web Services Framework WSF can be identified [2,3,4,1]. On the structural level, composing services is not part of the WSF. The description of services is limited to syntactical and type aspects; no support is provided for functional and non-functional semantical properties. The combination with the Semantic Web [5], in particular ontology technology [6,7], can provide an essential step forward that introduces meaning to Web services and that provides the foundations to enable a software component-style composition of services [8,9].

Previous work on the combination of the Semantic Web and Web Services has often focussed on modelling and language aspects [2,3]. More architecture-oriented treatments have neglected the semantical aspects [1]. Here, our aim is to identify the central aspects of a conceptual framework for semantic Web services architectures [10]. We address models, languages, infrastructure, and stakeholder activities – and illustrate the integrating role that ontology technology can play in this endeavour. Such a framework can form the underlying
foundation of a methodology for semantic Web services development and deployment. It provides a taxonomy for a Web services development and deployment platform. A major aim of the framework is to link models, languages, infrastructure, and activities. The conceptual framework results from an analysis of our own language-oriented work \[11,12\], but also related work on semantic Web services and Web services infrastructures such as \[13,14,15,16,17,18,19,20,3,21,22,23,10\]. We aim to capture these in a generic conceptual framework.

In our framework, particular models for services are essential and need to be prescribed. This is a clear deviation from the WSF focus on interfaces and interactions. Our notion of a Web services architecture is connected to a different style of service development and deployment than anticipated by the WSF – based on principles such as composition and reuse and a notion of services as processes.

Automation of stakeholder activities in a shared and distributed environment, such as the discovery and selection of suitable services for a requester, requires a new distributed type of development and deployment methodology in the Web services environment based on joint activities, sharing knowledge and artefacts, and reuse – supported by a distributed architecture geared towards this purpose.

In Section 2, we outline the basics of Web services and introduce the rationale behind our conceptual framework. In Section 3, we investigate model and language aspects of a conceptual framework for Web services. Infrastructure and activity aspects of the framework are subject of Section 4. We end with some conclusions.

2 Web Services

Our objective is to introduce a conceptual Web services framework supporting semantic service reuse and composition. We propose ontology technology as a means to integrate successful techniques used in WSF extensions – domain modelling [3] or design-by-contract [2] – into a coherent framework.

2.1 A Conceptual Framework for Service-Oriented Architectures

The Web Services Architecture WSA [1] defines ”a Web service [as] a software system identified by a URI, whose public interfaces are defined and described using XML. Other systems may interact with the Web service in a manner prescribed by its definition, using XML based messages conveyed by Internet protocols.” A wider scope of the service notion includes distributed object – or Web-mediated – services, i.e. software agents providing the service functionality that are not necessarily part of the Web environment themselves.

Services in service-oriented architectures (SOA) are coherent collections of operations described in an interface and provided to a user. Often a service is

\[1\] This would allow us to see the WSF as a meta- or interoperability framework between middleware platforms.