# Chapter 16
# A Semantically Enabled Service Delivery Platform:
## An Architectural Overview

**Ioan Toma**
*Semantic Technology Institute, University of Innsbruck, Austria*

**Iker Larizgoitia**
*Semantic Technology Institute, University of Innsbruck, Austria*

**José María García**
*Semantic Technology Institute, University of Innsbruck, Austria*

**Dieter Fensel**
*Semantic Technology Institute, University of Innsbruck, Austria*

## ABSTRACT

*It is expected that virtual factories and enterprises of the future will be able to self-organize in distributed, autonomous, interoperable, non-hierarchical, innovation ecosystems and be dynamically delivered as services, end-to-end along the global value chain. In this scenario, services and service ecosystems become central artifacts, and it is necessary to model and manage them appropriately for automation and scalability. Two main popular architectural approaches for realizing service orientation are WSDL-based SOA and the RESTful style. The level of automation offered by these approaches is limited, and human intervention is required in order to achieve most of the service-related tasks such as discovery, ranking, invocation, and monitoring. In order for service-oriented technologies to scale, they need to offer a significant degree of automation. To address the scalability issues in service composition, this chapter proposes a semantically enabled service-oriented architectural approach (SESA) and its implementation in the form of a platform. The authors detail the principles, models, architecture, and implementation underlying the approach in which lightweight semantics play a central role.*

## INTRODUCTION

Web services are at the core of many established solutions for realizing distributed enterprise applications and Enterprise Integration. They are modular, self-describing, and self-contained applications that are accessible over a network (Curbera, Nagy, & Weerawarana, 2001). Services can be seen as an effort to build a distributed platform on top of the current Web, hiding the technical realization in terms of hardware and software. Two main architectural approaches for

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realizing service orientation has gained momentum over the past years, namely WSDL based SOA (Booth et al., 2004) and the RESTful style (Fielding, 2000). The level of automation offered by these approaches is, however, limited and human intervention is required in order to achieve most of the service related tasks such as discovery, ranking, invocation, or monitoring. In order for service-oriented technologies to scale they need to offer a significant degree of automation.

Manual integration is not feasible when aiming at service-driven systems that are dynamically composed of numerous services. To address the scalability issues in service composition, our approach makes use of semantic technologies, in particular Semantic Web services. Semantic Web services build on top of Web service technology by describing the various aspects of services using explicit, machine-understandable semantics that enables a certain degree of automation for various service related tasks, allowing keeping the intervention of the human user to a minimum.

In this chapter, we introduce a Semantically Enabled Service Oriented Architectural approach (SESA) and its implementation (SESA, 2012) in the form of a platform. SESA[1] provides automatic support for overall service delivery, including various service related tasks such as discovery, ranking, invocation, and monitoring, for both WSDL-based and RESTful services. First, we motivate the need for a semantically enabled service-oriented architectural approach, and then introduce the principles and models underlying our approach in which lightweight semantics play a central role.

The implementation of the proposed approach, namely, the SESA platform, is described in detail in terms of functionalities and their interplay. To exemplify the real world relevance of our solution, we have chosen the manufacturing domain. We focus on the drilling machinery manufacturing services ecosystem scenario involving one of the largest European manufacturers and distributors of drilling machines to illustrate how heterogeneous manufacturing services can be discovered, ranked, monitored, and invoked in a semi-automatic fashion enabling the realization of dynamic manufacturing ecosystems (MSEE, n.d.).

## BACKGROUND

The *Web service* technology stack allows for exchanging messages between Web services (SOAP) (Box et al., 2000), describing the technical interface for consuming a Web service (WSDL) (Box et al., 2000), and advertising Web services in registries (UDDI) (Fernandez, Gomez-Perez, & Juristo, 1997). However, in traditional Web service implementations, the lack of information to express the meaning of the data and of the vocabulary referenced by the interface, as well as the lack of formalization of the Web service behavior implies the requirement of human intervention in tasks such as Web service discovery, composition, and ranking and selection, thus severely hindering the automation of the envisioned tasks. The emergence of the Semantic Web (W3C, 2011) envisions an extension of the current Web in which information is given well defined meaning, thus better enabling computers and people to work in cooperation (Berners-Lee et al., 2001). This meaning is represented by the structured collections of information and sets of inference rules that can be used by machines to conduct automated reasoning. The same formalization techniques can form a foundation to introduce semantics to Web service architectures.

*Semantic Web Services* (SWS) aim at providing more sophisticated Web service technologies along with support for the Semantic Web. SWS utilizes ontologies as the underlying data model in order to support semantic interoperability between Web services and clients, and apply semantically enabled automated mechanisms that span the whole SWS usage lifecycle comprising discovery, selection, composition, mediation, negotiation, and execution of Web services. More generally,