Chapter 4

Semantic Web Service Coordination

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4.1 Introduction

Semantic service coordination aims at the coherent and efficient discovery, composition, negotiation, and execution of Semantic Web Services in a given environment and application context. What makes coordination of services in the Semantic Web different from its counterpart in the Web is its far more advanced degree of automation through means of logic-based reasoning on heterogeneous service and data semantics.

In this chapter, we only focus on approaches to semantic discovery and composition planning of Semantic Web services, and briefly comment on their interrelationships and selected open problems of both fields. For reasons of space limitations, the set of presented examples is representative but not exhaustive.

4.2 Semantic Service Discovery

Service discovery is the process of locating existing Web services based on the description of their functional and non-functional semantics. Discovery scenarios typically occur when one is trying to reuse an existing piece of functionality (represented as a Web service) in building new or enhanced business processes. A Semantic Web service, or in short semantic service, is a Web service which functionality is described by use of logic-based semantic annotation over a well-defined ontology (cf. Chapter 3). In the following, we focus on the discovery of semantic services. Both service-oriented computing and the Semantic Web envision intelligent agents to proactively pursue this task on behalf of their clients.

Semantic service discovery can be performed in different ways depending on the considered service description language, means of service selection and
coordination through assisted mediation or performed in a peer-to-peer fashion. In general, any service discovery framework needs to have the following components ([37]).

- Service description language: A service description language (more precisely top-level ontologies, also called service description formats) is used to represent the functional and non-functional semantics of Web services. Examples of structured and logic-based semantic service description language are OWL-S and WSML. The standard Semantic Web service description language SAWSDL allows for a structured representation of service semantics in XML(S) with references to any kind of non-logic-based or logic-based ontology for semantic annotation.1. Alternatively, in so-called monolithic logic-based service descriptions the functionality of a service is represented by means of a single logical expression of an appropriate logic, usually a description logic like OWL-DL or WSML-DL.

- Service selection means: Service selection encompasses semantic matching and ranking of services to select a single most relevant service to be invoked, starting from a given set of available services. This set can be collected and maintained, for example, by front-end search engine, or given by providers advertising their services at registries or middle-agents like matchmakers and brokers. Semantic service matching, or in short: service matching, is the pairwise comparison of an advertised service with a desired service (query) to determine the degree of their semantic correspondence (semantic match). This process can be non-logic-based, logic-based or hybrid depending on the nature of reasoning means used.

  Non-logic-based matching can be performed by means of, for example, graph matching, data mining, linguistics, or content-based information retrieval to exploit semantics that are either commonly shared (in XML namespaces), or implicit in patterns or relative frequencies of terms in service descriptions. Logic-based semantic matching of services like those written in the prominent service description languages OWL-S (Ontology Web Language for Services), WSML (Web Service Modeling Language) and the standard SAWSDL (Semantically Annotated WSDL) exploit standard logic inferences. Hybrid matching refers to the combined use of both types of matching.

- Discovery architecture: The conceptual service discovery architecture concerns the environment in which the discovery is assumed to be performed. This includes assumptions about the (centralized or decentralized P2P) physical or semantic overlay of the network, the kind of service information storage (e.g., service distribution, registries, and ontologies) and location mechanisms such as query routing, as well as the agent society in the network (e.g., service consumers, providers, middle-agents).

\[1\] In this sense, SAWSDL services can be seen as a weaker form of semantic services while WSDL services are no semantic services.