Dissertation Summary

Towards Integration of Business Processes and Semantic Web Services

Business processes are modeled as syntax based compositions of multiple services to perform tasks that a single Web service alone can not perform. When these processes are exported as services they have same syntactical limitations as traditional WSDL services resulting in clampdown for their dynamic discovery, invocation and composition by other semantic enabled systems. Successfully translating existing business processes to semantic Web services can help to address syntactical limitations of business processes and enabling them for semantic based composition editing, modeling and for dynamic discovery, invocation and composition by other semantic enabled systems.

The aim of this thesis is to bridge the semantic gap between business processes and semantic Web services. Bridging the semantic gap between business processes and semantic Web services can help 1) to edit and model the compositions of Web services on the basis of matching semantics 2) to expose semantically enriched interfaces of business processes that can be used for dynamic and automated discovery, invocation and composition of business processes as semantic Web services.

The approach presented in this thesis describes solutions for bridging the semantic gap between syntax based and semantic based composition of Web services both at architectural as well as technical levels. To meet architectural requirements, a new 4-tier semantic Web service integration and composition architecture has been presented. The proposed 4-tier architecture addresses issues like developing domain ontologies, describing semantics of Web services, interfacing between different layers of integration architecture and semantic enhancements in Web service related machinery (e.g. UDDI). The approach presented in this thesis uses upcoming semantic Web service language (i.e. OWL-S) to address syntactical limitations of traditional business process modeling language (i.e. BPEL) by mapping BPEL processes to OWL-S services. The *Process Model* ontology of OWL-S suite is used to define the semantic based composition of services by translating BPEL process model (which is syntax based composition of Web services) to OWL-S *composite* process (which is semantic based composition of Web services). Each Web service operation with in a BPEL process model is translated to an OWL-S *atomic* process and the resulting OWL-S composite service is composition of these *atomic* processes with defined control and data flow. The *Profile* ontology of mapped OWL-S service can be used to expose semantically enriched interface of the BPEL process as OWL-S service. This semantically enriched interface can be used

for semantic based dynamic discovery, invocation and composition of BPEL process as OWL-S service. The *Grounding* ontology of mapped OWL-S service describes how to interact with the service. A tool has also been developed that can be used to map existing business processes to OWL-S services. An important feature of the implemented tool is that it supports the mapping of BPEL process to complete OWL-S suite of ontologies. Also, each Web service operation with in a BPEL process model is mapped to OWL-S *atomic* process with complete OWL-S suite of ontologies (i.e. *Profile, Process Model* and *Grounding*).

The main contributions of this thesis can be summarized as follows: First of all a new 4-tier architecture for semantic Web service composition and integration has been presented. On the basis of 4-tier architecture I proposed a semantic Web service composition and integration life cycle and a framework for semantic based composition of Web services. The framework consists of four components and each component is responsible to perform a specific task (e.g. discovery, selection, composition and execution) in the whole semantic Web service integration and composition life cycle. Second, I describe mapping constraints that can be used to establish the correspondence between syntax based and semantic based compositions of Web services. Third, on the basis of mapping constraints I present mapping specifications and algorithms that can be used to translate existing BPEL processes to OWL-S suite of ontologies. Fourth, a tool (BPEL4WS 2 OWL-S Mapping Tool) has also been developed that can be used to translate existing BPEL processes to OWL-S services. Mapping BPEL processes to OWL-S services overcomes syntactical limitations of BPEL processes and enables them for semantic based editing and modeling of Web services compositions. Also, the BPEL process mapped to an OWL-S service can be used for dynamic and automated discovery, invocation and composition by other semantic enabled systems. Finally evaluation of the proposed work has been provided by implementing it in a use case scenario.