

# From BPEL4WS Process Model to Full OWL-S Ontology

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## ABSTRACT

BPEL4WS is one of the most well known business process development languages. It can be used to develop executable business processes as a combination of Web Services interactions in a specific sequence called process flow. But still BPEL4WS does not present sufficient semantics of a business process so that business processes can be automated in a machine understandable way. On the other hand OWL-S (OWL for web services) is designed to present such kind of semantic information. There exists similarity in the conceptual model of OWL-S and BPEL4WS that can be used to overcome this lack of semantics in BPEL4WS by mapping BPEL4WS process model to OWL-S ontology. The mapped OWL-S service can be dynamically discovered, composed and invoked on the basis of matching semantics. BPEL4WS2OWL-S is a prototype mapping tool that can be used to map BPEL processes to OWL-S ontology (Service, Profile, Process Model and Grounding) to overcome semantic limitation of BPEL4WS.

## 1. INTRODUCTION

Different workflow languages specially Business Process Execution Language for Web Services (BPEL4WS) [1] uses Web Services in a more meaningful way by combining Web Services functionality in a specific sequence to perform some specific business task. Even though BPEL has good process modeling capabilities, but semantic limitations of BPEL are a big hurdle in business process automation. OWL-S [2], OWL ontology for web services, aims to make Web Services computer-interpretable, described with sufficient information to enable automation of variety of tasks including Web Service discovery, invocation, and composition [3]. Therefore mapping and presenting BPEL processes as OWL-S services can be helpful in automation of business processes on the basis of semantic information presented in the form of OWL-S ontology.

Our work (improvement and extension to [4]) presents a mapping strategy and a prototype <sup>1</sup>mapping tool (BPEL4WS 2 OWL-S mapping tool) that can be used to map BPEL4WS processes to complete OWL-S suite of ontologies.

<sup>1</sup><http://bpel4ws2owls.sourceforge.net/>

## 2. Mapping Specifications

BPEL has two kinds of activities “Primitive Activities” and “Structured Activities”. BPEL primitive activities are mapped to OWL-S “Perform” statement to perform the relevant Atomic Process. Also if a primitive activity is an input/output (I/O) activity (working as BPEL process interface) then this activity is used to create the “Profile” of the resulting OWL-S service. BPEL structured activities are mapped to relevant OWL-S control constructs as shown in figure 1.

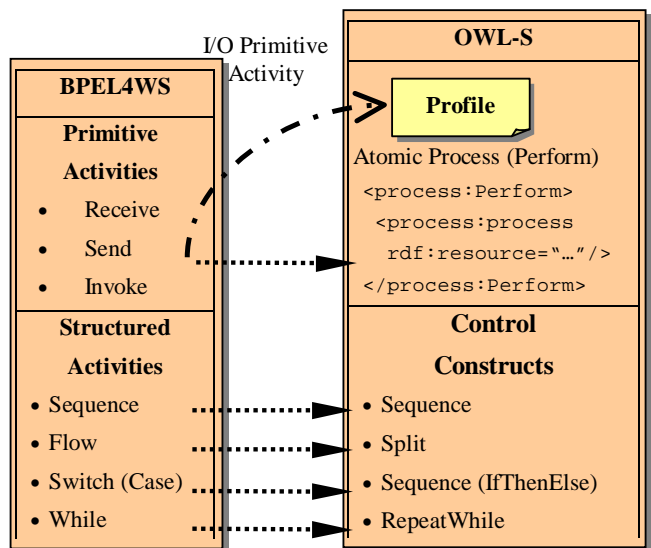


Fig.1. Overview of mapping specifications.

• **Process Mapping:** BPEL “Executable Processes” are mapped to OWL-S “Atomic and Composite Processes”. Also to keep the mapping complexities within limitations synchronization between process components is not supported in this version.

• **Atomic Processes:** “Operations” supported by partner services (WSDL services) can be used to perform some specific task in a single step. Like an operation supported by a web service, an “Atomic Process” in OWL-S is a process that can perform some action in a single step. Therefore partner web services (WSDL Services) are parsed and corresponding Atomic Processes (with Profile, Process Model and Grounding) are created for each supported operation.

- **Primitive Activities and Atomic Processes:** As a logical equivalent of the OWL-S “Perform” statement used to perform an Atomic Process, BPEL has Primitive Activities e.g. Receive, Invoke and Reply activities that can be used to perform some specific operation by sending and receiving appropriate messages. BPEL primitive activities can be used to perform some specific operation in a single step and they have no sub activity to be performed. We can map these BPEL primitive activities to OWL-S “Perform” statement to perform the relevant Atomic Process.

- **Structured Activities:** BPEL4WS structured activities are mapped to OWL-S control constructs within an OWL-S composite process. Fig.1 shows the mapping of BPEL structure activities to OWL-S control constructs.

- **Data Flow:** Mapping of Assignment activity that is used between two primitive activities, results in the creation of data flow between the corresponding atomic processes.

- **Profile:** A BPEL process can have one or more primitive activities, which behave as an interface to communicate with BPEL process. Therefore among these primitive activities options, input message of the first Receive primitive activity receiving a message from the outer world is defined as input for the OWL-S Composite Process. If a Receive activity has corresponding Reply activity then message variable of this Reply activity is used to set the output of the OWL-S Composite Process. In other case first primitive activity e.g. any “Invoke” activity sending some message to the outer world is taken as an output activity to define the output of the OWL-S Composite Process. Also a primitive activity is declared as an Input/Output (I/O) activity if the BPEL’s corresponding WSDL file supports its port type and operation. These input and output messages are used to create the profile of the resulting OWL-S service. This profile is used to present the semantically enriched service capabilities by annotating input and output parameters of profile with ontological concepts.

- **Grounding:** Grounding of the mapped OWL-S service specifies the location of the grounding of each Atomic Process (created during mapping as discussed above). Off course mapping is not able to define the xsltTransformation [5] for complex messages. Web Services Description Language (WSDL) service, being XML format for describing network services is referred in grounding of each Atomic Process to have access to the original implementation of WSDL service.

### 3. User Interface

BPEL4WS2OWL-S mapping tool provides a very easy to use interface (fig.2). User interface provides with menus and buttons to perform mapping process. Mapping process includes creating new project, adding input BPEL and WSDL files, validating the input files, building the project and finally mapping the project. Resulting OWL-S ontology files can be viewed in project explorer (upper right window) and contents of these files can be seen in upper left window of the tool. The left lower window acts as an output window to show output of different mapping actions. The left lower window is object explorer, which gives object view of input files.

### 4. Conclusion and Future Work

Since OWL-S is not as much mature as BPEL e.g. equivalent of BPEL activities like *Assignment*, *Fault Handler*, *terminate* etc. are not available in OWL-S for direct mapping from BPEL to OWL-S. Issues like “process: produce” Control Construct (used to create data flow) are under discussion on W3C. Therefore in these areas where mapping is partially supported or needs information to be added by the user, manually changing is also a time consuming and complex task and requires a user to be an expert of OWL-S. So at this stage our BPEL4WS2OWL-S tool needs constant updates with the upcoming versions of the related technologies. Secondly a tool is needed that can be used to develop required ontologies and an editor which can help in editing resulting OWL-S ontology with these ontological concepts more easily and ideally in a visual environment. Protégé with its plugin, OWL-S Editor, is an ideal environment to proceed. We are also working to improve our tool, and to make it available as a BPEL4WS2OWL-S import plug-in for “Protégé” and “OWL-S Editor”, so that mapped OWL-S services can be directly imported in “OWL-S Editor” and can be edited in a visual environment.

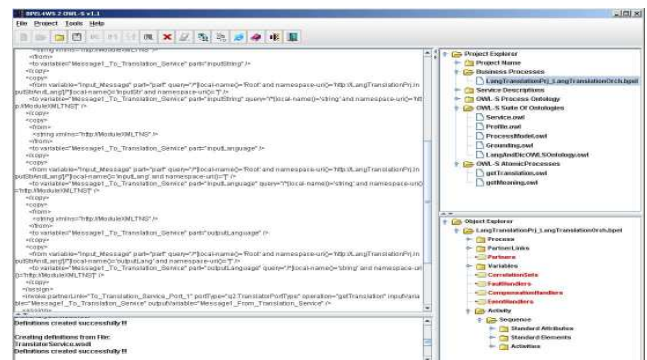


Fig.2. Overview of BPEL4WS2OWL-S mapping tool interface.

### 5. REFERNECES

- [1] Business Process Execution Language for Web Services Version 1.1. 5<sup>th</sup> May 2003. [online] Available <ftp://www6.software.ibm.com/software/developer/library/ws-bpel.pdf>.
- [2] OWL-S: Semantic Markup for Web Services. [online] Available <http://www.daml.org/services/owl-s/1.1/overview/>.
- [3] OWL-S’ Relationship to Selected Other Technologies [online] Available <http://www.daml.org/services/owl-s/1.1/related.html>.
- [4] J. Shen, Y. Yang, C. Zhu and C. Wan. “From BPEL4WS to OWL-S: Integrating E-Business Process Descriptions”, *Proc. of 2<sup>nd</sup> IEEE International Conference on Services Computing (SCC 2005)*, pp.181-188, Orlando, USA, July 2005.
- [5] XSL Transformations (XSLT): [online] Available <http://www.w3.org/TR/xslt>.