SEMANTIC DESCRIPTION OF WEB SERVICES AND POSSIBILITIES OF BPEL4WS

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Abstract: The using of the upsurge of semantics web technologies gives a possibility for an increasing of the flexibility, extensibility and consistency of the existent industrial standards for modeling of web services. In the paper the types of semantic description of web services and the degree of their realization in BPEL4WS (Business Process Execution Language for Web Services) respectively on the abstract and executable level are treated. The methods for using of BPEL4WS for the purposes of semantic web services in the direction of their semi-automatic integration are suggested.

Keywords: Semantics, Web Services, BPEL4WS.

ACM Classification Keywords: H.3.4 Systems and Software: Information networks

Introduction

Technologies for creation, composition, description, publication, discovery, implementation and execution of web services are developing strenuously now for the fulfillment of exchanges and interactions of data and functions for dynamic integration of distributed computer systems in heterogeneous networks. Web services are software platform-independent, self-contained, modular business process applications. The main components of web services technology are: Web Service Description Language (WSDL) for interface description which details indicate how the web services to be called; Simple Object Access Protocol (SOAP) for messages exchange, that is XML-based protocol for communication between the web services and client applications; UDDI Universal Description, Discovery and Integration (UDDI) for registration, publication and location of web services and their characteristics.

The protocols and languages for business processes modelling are developed for the aims of the enterprise application integration, for creation and management of logic of connection between service and application during execution of business function. It was found that these basic components of web services are not enough for dealing with modern requirements – dynamic composition, flexible discovery, good initialization and selection of appropriate service.

In parallel with the elaboration of web services standards the investigations connected with application of semantic technologies in the web space are carrying out. There already exist semantic repositories of data, ontologies, rules of ontologies, and engines for data interpretation – taxonomies modeling, sets of tools and applications that are necessary base for the semantic web.

The use of the potential of the semantic web together with industrial standards for web services would help to resolve many present problems in business processes integration.

Business Process Execution Language for Web Services

A set of articles exists which compare and evaluate current languages for web services modeling and composing and show why Business Process Execution Language for Web Services (BPEL4WS or BPEL) [Andrews, 2003] is established as an industrial standard. It is made in co-authorship between IBM, Microsoft, BEA, SAP и Siebel Systems, combines IBM's Web Services Flow Language and Microsoft's XLANG specifications, superseding both these specifications. BPEL supports the constructions for presenting of complex models of web services compositions. The business process includes self-contained set of activities that are predetermined according given cases. There are two ways for specification of distributed business process – a global model specifies orchestration of the whole set of web services, on the other hand, each web service specifies the interaction between partners.

BPEL extends the possibilities of WSDL in direction of the integration of complex connections between web services on the base of the principles for modeling of business logic and the corresponding business processes [Farahbod, 2004]a.

The definition of business process in BPEL expresses business logic and describes process model elements in terms of business messages exchange and contains process partners to which web services are connected; variables, which define the state of the process; activities (basic and structural), which define the behaviour of business process. The basic activities define tasks, which are accomplished in business process. The structural activities define the control flow.

The figure 1 is a good illustration of the connections between the process model elements and the artifacts of BPEL4WS file and the relevant WSDL files [Beck, 2005].

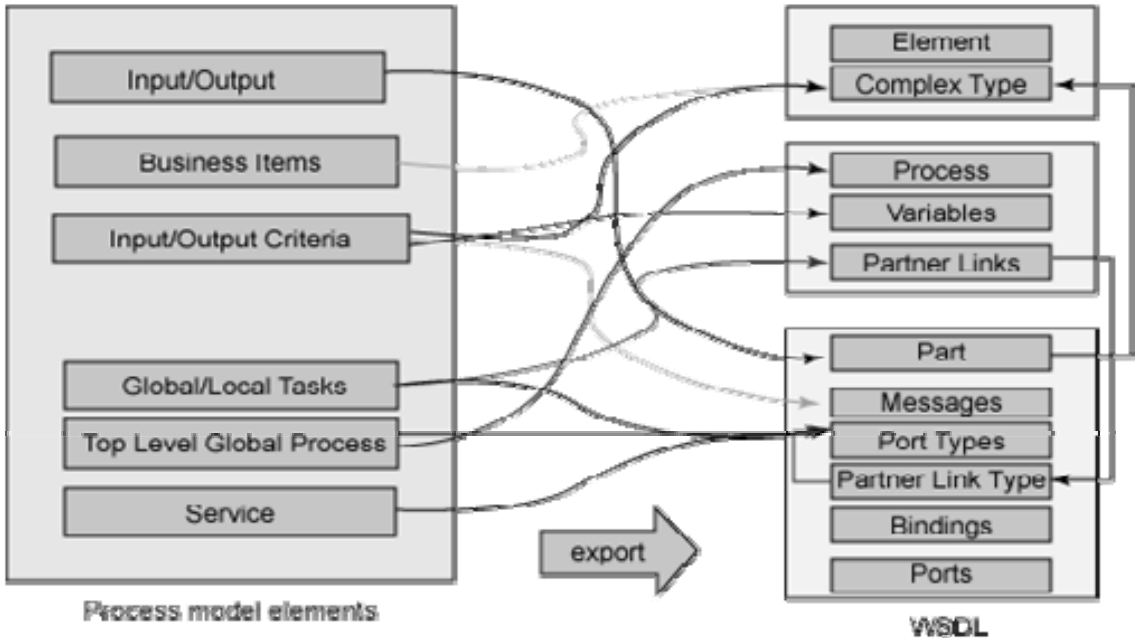

Figure 1

BPEL4WS is based on XML. A business process, described in BPEL4WS is executable by BP4WSJ engine, realized by IBM. It allows an automatic web services execution and is a precondition for automatic web services discovery [McIlraith, 2003]a.

Web services from partners that are not using BPEL can be included in the process. Mechanisms of dealing with errors and exceptions, events, compensations in long running transactions, dynamic process origination, and dynamic messages connection in different processes are supported.

The basic concepts of BPEL4WS are declared in two aspects: abstract and executable processes. The executable process reflects on the actual behavior of the process participants with all their specifications. The abstract process or the business protocol for interactions has a descriptive role with more than one aim – it can define openly the behavior of several or all services, as the operational details are skipped or opaque, or it can define a model, representative of the best domain specific practice.

Semantics

Semantic approaches give possibilities for unambiguous interpretation of the web services content, for description of their properties and potentialities in machine-understandable form. The higher layer on the base of traditional web is constructed, in which the information is given through its precise defined meaning.

The decisions that can be made on the base of web services by using their related semantics are illustrated by [IBM ® Corporation, 2004] in the figure 2.

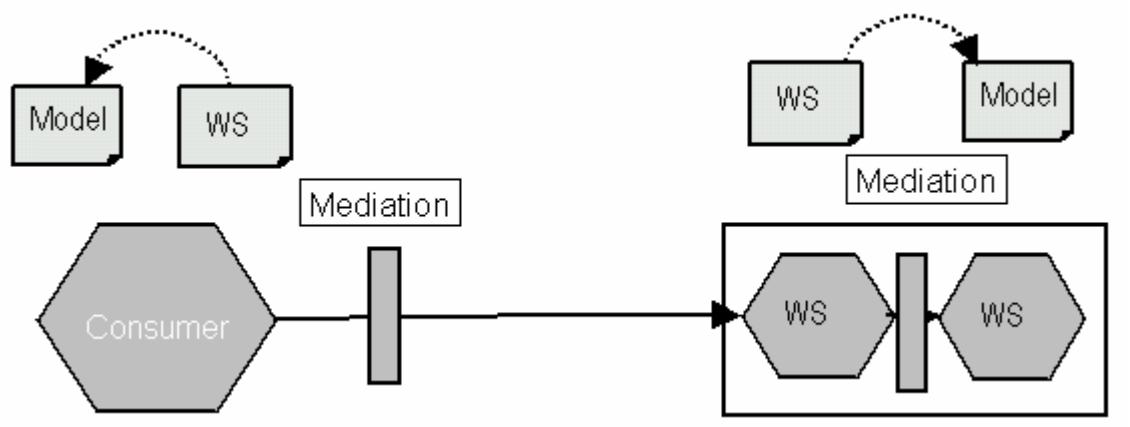

Figure 2

The semantics can be divided into different types on the base of different indications. For the purposes of this work, it is transformed as:

- functional, that expresses business logic and corresponds to web services capabilities;
- data semantics, semantics of inputs / outputs of Web Services;
- QoS semantics, that is connected with requirements and reflects on the results;
- Execution semantics that is connected to execution and dynamic service invocation.

[Patil, 2005] [Sivashanmugam, 2005] [Verma, 2005].

The functional semantics is connected with inputs/outputs as with functioning of web service, it is a collection of them. The functional ontologies are semantics of operation. The appropriate services are discovered on the base of their functional semantics.

The data semantics is the description of operation data. The ontology on their meaning is constructed.

QoS semantics is used during selection of the services. Different quality aspects (time, price, security, etc.) can be important for different composition of services in different range.

The execution semantics is precondition for realizing the dynamic discovery, binding and monitoring of process execution.

All of these kinds of semantics have to be recognized, marked and taken into consideration for establishing of the semantic web services.

Associating of Semantic Meanings with BPEL4WS Constructions

In [Mandell, 2003] it is mentioned the restrictions of XML schema, which is not able to be appropriate tool for expressing of the semantics of the exchanged data as to deal with problems of semantic interoperability, that reflects on the possibilities of BPEL [Mandell, 2003] [McIlraith, 2003]b.

XML is oriented to the document structure and does not propose data interpretation. BPEL is not a declarative language, which makes the task of its enriching with semantic technologies difficult.

However, it is necessary to exert efforts in this direction because there is no better industrial standard today than BPEL4WS, which envelops all life cycle of web services and is the essence of all similar languages. From the other side the semantics is proofed its necessity.

The semantic web services design from existing web services has to go through extracting and marking of all four kinds of semantics.

The data semantics can be described with using of corresponding WSDL files that belong to the BPEL-files, because WSDL is connected to the description of web services. On the base of input/output data, the ontology for the business process can be built.

By tracing the operation names in the corresponding constructions together with the names of partners and inputs/outputs, the collection of functionalities is formed that is connected to functional semantics. From other

side the possibility to represent the business process as directed graph helps for formal description of operational behaviour and extraction of abstract functional semantics [Farahbod, 2004]b.

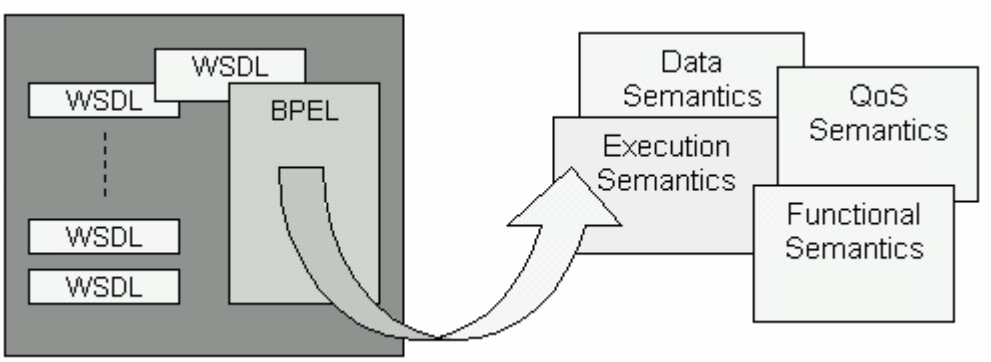

Figure 3

QoS may be referred to WS-Security, WS-Reliability, WS-Transactions, WS-Coordination, WS-Context and eventually can be extracted from them. In complex processes, they can be presented as compositional models, based on workflows models, and in such a way, it is possible to aggregate some numerical metrics of QoS [Cardoso, 2004] and corresponding semantic meanings. Another approach is in the extending of non-functional properties with Qos from the providers, receiving the certificate of quality and registering in UDDI with the corresponding description. [Al-Ali, 2003].

The execution semantics coordinates with the way of realizing in the process of the mechanisms for supporting of exceptions and error handling as with correct design of accordance between inputs and their outputs. Every activity is associated with the state of execution (completed, stopped, interrupted, unsuccessful, skipped, etc) which have to be defined for the process be executed and the semantics of alternative ways of execution can be extracted.

Deriving of different kinds of semantics not differs principally for abstract and executable BPEL process. But the results may be different because for the abstract process it is allowed to hide its behaviour, to use different levels of restrictions and transparency. Using templates can contribute to defining business processes from the application domain and to receiving the semantic knowledge more comprehensively.

Conclusion

Extant web services technologies for modeling, publishing, discovery and services connecting guarantee syntactic compatibility. That means that in the standard web services the discovery and the composition are syntactic based, and semantic compatibility does not exist. The using of the semantic description would help the dynamic composition of web services for concrete request. The dynamic composition of web services is necessary when the client request cannot be realized directly from extant web services.

For these purposes and in the same time to respond qualitative to the given request the existing web services should be described by their meanings, which would help the better comprehensions between computers and people in their work together.

The solution is in recognizing and marking-up of the web content with well-defined semantics.

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