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# Role of Semantics in Autonomic & Adaptive Web Services and Processes

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The emergence of Service Oriented Architectures (SOA) has created a new paradigm of loosely coupled distributed systems. In the METEOR-S project, we have studied the comprehensive role of semantics in all stages of the life cycle of service and process--including annotation, publication, discovery, interoperability/ data mediation, and composition.

Among the concrete contributions, we offered a broad framework of semantics consisting of four types [1]:

1) Data semantics: Modeling of the inputs and the outputs of a service,
2) Functional semantics: Modeling of the functional capabilities of a service,
3) Non-Functional semantics: Modeling the non-functional requirements and capabilities including policy and/or agreement between services and
4) Execution semantics: Modeling service execution including interaction pattern and adaptation to failure.

The data semantics is essential towards addressing issues related to data heterogeneities, which are common in service compositions and service interactions [2]. Modeling functional semantics allows for better service discovery [3] and also helps in addressing issues in process composition. Non-functional semantics plays a very important role in partner selection based on requirements and guarantees. In a distributed ecosystem like SOA, it is very likely that services in different domains often want to communicate with each other. It is in this context, modeling of non-functional semantics, via mechanisms like WS_Agreement [4] or WS-Policy [5], allows for better matching and selection of partners. The SAWSDL candidate recommendation, which originally started as WSDL-S, enhances the current WSDL standard to model the data and functional semantics using WSDL.

We recognized the need for an incremental and evolutionary approach to add semantics to SOA that is consistent with W3C recommendations and industry's investment in tools and skills in Web Services related technologies. This led to our proposal for WSDL-S, which was refined in collaboration with IBM and submitted to W3C [6]. W3 Working group (of which we are a member) adopted key aspects of WSDL-S and has defined the Semantic Annotation of WSDL (SAWSDL) specification, which is now a W3C candidate recommendation. Significant tools and use cases for SAWSDL already exist [7].

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Lately we have focused on the using semantics to add dynamism and adaptability to services and processes in SOA-based systems. This led to the proposal of Autonomic Web processes presented as a vision talk at ICSOC [8]. Here we propose a self-healing, self-optimizing
framework for SOA. Modeling execution semantics is critical towards realizing that vision. Execution semantics can be used to specify, what a system should do in the event of failure doing execution. In the METEOR-S project, this led to extending the notion of task skeleton, first proposed in [9], towards creating an adaptation framework
for Web processes.

This talk would expand on the short motivation towards the need for the four types of semantics, its standards-based support through WSDL-S/SAWSDL, and the efforts towards realizing dynamic and adaptive SOA.

References/Additional Reading:

[1] Amit P. Sheth, Semantic Web Process Lifecycle: Role of Semantics in Annotation, Discovery, Composition and Orchestration, Invited Talk, WWW 2003 Workshop on E-Services and the Semantic Web, Budapest, Hungary, May 20, 2003. description presentation

[2] Meenakshi Nagarajan, Kunal Verma, Amit P. Sheth, John A. Miller, Jonathan Lathem, Semantic Interoperability of Web Services - Challenges and Experiences, Proc. of the 4th IEEE Intl. Conference on Web Services, Chicago, IL, September 2006, pp. 373-382.

[3] Kunal Verma, Kaarthik Sivashanmugam, Amit P. Sheth, Abhijit Patil, Swapna Oundhakar, John A. Miller, METEOR-S WSDI: A Scalable Infrastructure of Registries for Semantic Publication and Discovery of Web Services, Journal of Information Technology and Management, Special Issue on Universal Global Integration, 6 (1), 2005, pp. 17-39.

4. Nicole Oldham, Kunal Verma, Amit P. Sheth, Farshad Hakimpour, Semantic WS-Agreement Partner Selection, Proc. of the 15th Int. World Wide Web Conference (WWW2006), May 2006, Edinburg, UK.

5.Kunal Verma, Rama Akkiraju, Richard Goodwin, Semantic Matching of Web Service Policies, Second International Workshop on Semantic and Dynamic Web Processes (SDWP 2005), July, 2005, Orlando, Florida, pp. 79-90

6. http://www.w3.org/TR/sawsdl/

7. Radiant: http://lsdis.cs.uga.edu/projects/meteor-s/downloads/index.php?page=1

8. Kunal Verma, Amit Sheth. Autonomic Web Processes. In Proceedings of the Third International Conference on Service-oriented Computing (ICSOC), - Vision Paper, Lecture Notes in Computer Science (LNCS 3826), 2005. pp. 1-11

9. N. Krishnakumar, Amit P. Sheth, Managing Heterogeneous Multi-system Tasks to Support Enterprise-wide Operations, Journal of Distributed and Parallel Database Systems, 3 (2), 1995.