Semantic Web Processes

by

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1 Tutorial Description

The Web coupled with contemporary E-commerce and E-services is enabling a new networked economy [1]. The scope of activities that processes span has moved from intra-enterprise workflows coordinating multiple applications, predefined inter-enterprise and B2B processes, to dynamically defined Web processes among cooperating organizations. Components of technical aspect of the solutions involve the technologies for information exchange (from EDI to XML), software componentization (from CORBA to Web Services), and workflow coordination and collaboration.
Semantics is the new component to this mix, as observed at the Amicaola workshop [2], which could enable support both the scalability and increasingly more dynamic nature of these Web processes. To these Semantics-enabled and empowered Web processes we call Semantic Web Processes.
This tutorial presents what can be achieved by symbiotic synthesis of two of the hottest R&D and technology application areas: Web services and the Semantic Web. It presents some of the promises and challenges in applying semantics to each of the steps in the Semantic Web Process lifecycle. In particular we present the role of semantics in annotation (Semantic Annotation of Web Services), discovery (Semantic Web Service Discovery), composition (Semantic Process Composition), process execution/enactment (Semantic Web Process Orchestration), and quality of service of Semantic Web Processes. We also review ongoing frameworks and initiatives such as Semantic Web Service Initiative (SWSI) and DAML-S, as well as results from key projects such as the METEOR-S which build upon research, technology and current standards in workflow processes, Semantic Web, Web services and simulation [6].

1.1 Semantic Annotation of Web Services

In dynamic markets and environments, the selection of the most appropriate Web services to accomplish a pre-established goal becomes a challenge. Web services need to be dynamically identified, selected, and integrated to form a Web process that meets user?s objectives.
Today, Web service specifications are based on standards that only define syntactic characteristics. Examples include WSDL, SOAP, and UDDI. The syntactic approach to service description is relatively simple and commonly used in other areas. Unfortunately, it is

insufficient, since the interoperation of Web services is an important issue for Web processes and cannot be successfully achieved based only on syntactic descriptions.
Interoperability problems have lead to research which has involved a steady progress from syntax, to representation and structure, and to semantics [3]. One of the most recognized solutions to solve interoperability problems is to enable systems and applications to understand methods and data by adding meaning to them. Therefore, Web service can be enhanced semantically by annotating their descriptions.

1.2 Semantic Web Service Discovery

Emergent trading models, such as e-commerce, have evoked the development of systems and infrastructures to support the concept of Web services. An organization?s functionality is encapsulated with an appropriate interface and advertised as a Web service.
The search of Web services to model e-commerce applications ? such as business-to-business, business-to-customer, and customer-to-customer processes ? differs from the search of tasks to model traditional process.? One of the main differences is in terms of the number of activities (i. e., Web services) available to the composition process. In traditional processes, the number of available tasks to compose a process is relatively small. Usually only a few hundreds of tasks are available from repositories. On the other hand, potentially thousands of Web services are available during the composition of a Web process. Therefore, one of the problems that need to be solved is *how to efficiently discover Web services* [5]. One possible approach is to use semantic information to describe Web services. This additional information can then be use to enhance the discovery process.

1.3 Semantic Process Composition and Orchestration

While in some cases Web services may be utilized in an isolated form, it is normal to expect that Web services will be integrated as a part of Web processes. Compared to traditional process tasks, Web services are highly autonomous and heterogeneous.
As a result sophisticated methods are indispensable to *support, facilitate, and assist the composition and orchestration of Web process* [5] involving Web services. Here again, one possible solution is to explore the use of semantics to enhance interoperability among Web services.

1.4 Semantic Web process QoS

New trading models, such as e-commerce, bring a new set of challenges and requirements that need to be explored and answered. In such processes, trading agreements between suppliers and customers include the specification of QoS items such as products or services to be delivered, deadlines, quality of products, and cost of service. The correct management of such QoS requirements directly impacts the success of the organizations participating in e-commerce and also directly impacts the success and evolution of e-commerce itself. The composition of Web

services, and therefore of Web processes, cannot be undertaken while ignoring the importance of quality of service measurements.
The *good management of QoS directly impacts the success of organizations* [4] participating in e-commerce activities by better fulfilling customer expectations and achieving customer satisfaction. To enable adequate QoS management, research is required to develop mechanisms that semantically specify, compute, monitor, and control the QoS of the products or services to be delivered.

1.5 References

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[2] Amit Sheth and R. Meersman, ?Amicalola Report: Database and Information Systems Research Challenges and Opportunities in Semantic Web and Enterprises,? SIGMOD Record, 31 (4), December 2002, pp. 98-106.

[3] Amit Sheth. (1998). Changing Focus on Interoperability in Information Systems: From System, Syntax, Structure to Semantics. Interoperating Geographic Information Systems. Eds. M. F. Goodchild, M. J. Egenhofer, R. Fegeas and C. A. Kottman (eds.), Kluwer, Academic Publishers: 5-30.

[4] Jorge Cardoso, Amit Sheth and John A. Miller, "Workflow Quality of Service," Enterprise Inter- and Intra-Organizational Integration - Building International Consensus, K. Kosanke, R. Jochem, J. Nell and A. Bas, Editors (November 2002) pp. 303-312. Book Series: IFIP International Federation for Information Processing: Vol. 236, Kluwer Academic Publishers, Boston, MA.

[5] Jorge Cardoso, and Amit. Sheth, Semantic e-Workflow Composition. Journal of Intelligent Information Systems (JIIS), 2003 (to appear).

[6] METEOR-S: Semantic Web Services and Processes - Applying Semantics in Annotation, Quality of Service, Discovery, Composition, Execution, http://lsdis.cs.uga.edu/proj/meteor/SWP.htm ?

Note: The tutorial will build upon a broad variety of information, not only those authored by the tutorial presenters.? For this, a Web based resources will provide tutorial attendees with broad coverage of research, technologies and learning resources on related topics (example of such a resource appears at:
http://lsdis.cs.uga.edu/lib/presentations/SWSP-tutorial-resource.htm)

2 Background knowledge required and potential attendees

The intended audience of this tutorial is any person interested in business processes, Web processes and services, and semantics. This tutorial is of particular interest to e-service systems architects and Web process designers, as well as to researchers from the fields of business process re-engineering, e-commerce applications, and interoperability of Web services.? Exposure to Web Services is assumed.

3 Short CV of presenters

Jorge Cardoso (jcardoso@uma.pt) received a B.A. (1995) and a M.S. (1998) in Computer Science from the University of Coimbra (Portugal), and a Ph.D. also in Computer Science from the University of Georgia (2002).
His research work concentrated on workflow QoS management and semantic composition of workflows. Research results were implemented in the METEOR project at the LSDIS lab. METEOR system is a workflow process management system oriented to support mission-critical enterprise applications requiring high scalability and robustness. It is fully distributed, scalable and includes multilevel security mechanisms.
He published several papers on workflow systems, workflow QoS, and semantics composition of workflow. More information is at: http://dme.uma.pt/jcardoso

Amit Sheth (amit@cs.uga.edu) is a Professor of Computer Science and Director of the LSDIS lab at the University of Georgia. He is a co-founder and CTO of Semagix, Inc., a Semantic Web technology company based on the technology licensed from the LSDIS Lab. Earlier he worked at R&D in Honeywell, Unisys and Bellcore.? He is one of leading researchers and entrepreneur in the areas of Semantic Web (and more broadly semantic information integration and interoperability) and workflow process management. ?His research has led to over 150 publications, three significant commercial products, two start ups, and many deployed applications.? His recent invited talk on related topic includes Semantic Web Process Lifecycle: Role of Semantics in Annotation, Discovery, Composition and Orchestration (WWW 2003 Workshop on E-Services and the Semantic Web, Budapest, Hungary, May 20, 2003). More information is at: http://lsdis.cs.uga.edu/~amit and http://www.semagix.com/company/management_bios.shtml