Towards Cooperative Distributed Service Composition on the Semantic Web

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Abstract

Web services are the technology promising to become one of the future key enablers of the Semantic Web. There are strong prerequisites that, being self-described and self-contained modular active components, web services will appear to become the key elements in assembling intelligent infrastructures for e-Business in the near future.

There is the emerging consensus that the ultimate challenge to make web services automatically usable by artificial agents in their rational, pro-active interoperation on the next generation of the Web may be solved by creating effective frameworks, standards and software for automatized web service discovery, execution, composition and interoperation. Advanced tasks for the research and development in the domain comprise also the provision of the means for making services the subject of negotiation and trade among rational agents. The solutions will facilitate to the enhancement of dynamic character, flexibility, reconfigurability of the workflows, business processes for the Next Generation e-Enterprises (NGEs). It is also important for future service enabled web infrastructures to cope with business rules and logistics, notions and mechanisms of reputation and trust, legal and security issues with respect to services and service providing agents.

This is why the domain of Semantic Web Services is becoming increasingly hot. More and more attention is paid to the field of pro-active Web Service composition provided by intelligent software agents. Several communities are rather active in Web Service R&D. Among them are W3C, DARPA DAML, OntoWeb, Agentcities. A number of service related projects are currently performed under FP5 IST framework. The field has good opportunities to be funded in frame of FP6 as well.

Current industry landscape provides only initial and very partial solutions of the ultimate problem. Existing de-facto standards for web service description (WSDL), publication, registration and discovery (UDDI), binding, invocation, communication (SOAP) provide only syntactical capabilities and unfortunately do not really cope with service semantics. Known industrial implementations such as HP E-speak base on these standards and do not completely solve the challenge of semantic service interoperability. It should be mentioned that major industrial players realize the necessity of further targeted joint research and development in the field.

Most recent research and standardization activities of DARPA DAML community resulted in offering semantic service markup language DAML-S based on RDF platform. The constellation of XML based languages/ontologies for business process, logistics description is also expanding: WSFL, ebXML, BPML, RuleML, … Conceptual frameworks for Web Service modeling are also under development at the front-end of today's research activities. WSMF is one of the good examples. The principles of the WSMF philosophy are: maximal possible de-coupling complemented by scalable mediation service.

Our contribution to the research in Semantic Web services domain is the ongoing development of the framework of Agent-Mediated Cooperative Distributed Service Composition. The main idea of the approach is to apply the known results and the techniques from Cooperative Distributed Problem Solving area as well as our formal framework for Agent-Enabled Business Process Management and Performance to web services composition. From the architectural point of view a distributed multi-agent system acts as the mediator between service requestors (both humans and software agents) and service providing agents. Web services are treated as the capabilities of service providers. Service providing agents wrap respective services. The major role of the service mediating system is to guide the pro-active team work of service providing agents. Service providers form teams or coalitions for service provision task performance via the rounds of negotiations over the services they wrap. These negotiations are actually the kind of contracting in the process of assembling a compound service. The capabilities of the service providers are actually used as service breaks for the service composition.

The talk will overview the current state of the activities in the field of Semantic Web Services. The approach to web services composition will be presented with the help of the travel planning scenario. The proposal for the Agent-Based Service Mediation Architecture will be than presented. The final part of the talk will outline how the principles of CDSC are applied to our ongoing research project in the field of agent-enabled economically rational information retrieval (RACING project. http://www.zsu.zp.ua/racing/)/