



Akkermans and his colleagues present the business perspective of services, described in a formal semantic framework. Unlike research on other contemporary services, this article focuses on describing real-world services while emphasizing description frameworks (such as higher-fidelity models of resources) and the customer-provider service mismatch. An important contribution of this article is the description of relations that might exist between services (such as supporting and enhancing) that facilitates the formation and configuration of service bundles.

The power of a service-based approach for achieving tasks is realized by combining different services from different providers. However, because these services might assume different ontologies, agents and service requesters must translate the service descriptions into a familiar ontology to formulate valid requests. In "Dynamic Invocation of Semantic Web Services That Use Unfamiliar Ontologies," Mark Burstein proposes a model of service invocation that includes this translation by employing a set of articulations, or bridging axioms. He also argues that this translation process should be integral to planning and composition.

The Grid is a service-oriented environment that the scientific community uses heavily to carry out complex experiments and analyses across several organizations. Typically, this involves manually constructing workflows that combine various services with available data. Users can then employ existing grid-based middleware to schedule and execute these workflows. In "Automatically Composed Workflows for Grid Environments," Jim Blythe, Ewa Deelman, and Yolanda Gil explore the benefits of AI-based scheduling and planning for such services, given semantic characterizations of the processes and data used. Their approach uses the types of knowledge available in current grid services to construct executable workflows from high-level descriptions of a user's desired data products and from any intermediate data-staging requirements.

In "Filtering and Selecting Semantic Web Services with Interactive Composition Techniques," Evren Sirin, Bijan Parsia, and James Hendler take an alternative approach to generating service compositions that satisfy user requirements, through an interactive metaphor. Their composition tool uses contextual information to locate semantically interoperable services that it can present to the user at each stage of the composition framework. Sitting atop the OWL-S service framework, it employs semantic discovery and filtering to deter-

mine a meaningful set of candidate services based on advertised Semantic Web Service descriptions.

In "ODE SWS: A Framework for Designing and Composing Semantic Web Services," Asunción Gómez-Pérez, Rafael González-Cabero, and Manuel Lama present a framework for the design and composition of Semantic Web Services at a knowledge- and language-independent level. Their work is based on a set of different ontologies and associated axioms, each describing a different aspect of Semantic Web Services. They model services as problem-solving methods that describe the service decomposition, and show how to use this representation to control the reasoning process for executing the service.

Two important aspects of any service-oriented environment are security and privacy. Services may be available only to requesters that have authority to use those services—likewise, there might be mechanisms that preserve specified access rights or prevent malicious or unauthorized invocations of restricted services. In "KAoS Policy Management for Semantic Web Services," Andrzej Uszok and his colleagues present justification for defining policies and contracts that are applied to service-oriented architectures. They briefly introduce the KAoS (Knowledgeable Agent-Oriented System) policy language and explain how it relates to OWL. They describe three service deployments, each presenting a different aspect of Semantic Web Services that's addressed by using KAoS:

- Fine-grain management of service use in a grid environment
- Policy compliance for service discovery
- Verification and local policy satisfaction during service composition and planning

In "Authorization and Privacy for Semantic Web Services," Lalana Kagal and her colleagues also review policies. They present a framework for incorporating security annotations in OWL-S service descriptions (based on a security ontology). The authors illustrate how to use the Rei policy language to augment the OWL-S process model, and they offer a framework for enforcing defined policies in an OWL-S execution environment.

**T**hese articles represent only a sample of the increasing body of Semantic Web Services research. Representing the fusion of research areas as diverse as agent-based sys-

tems, description logics, computational grids, and Web Services, Semantic Web Services will be essential to the realization of ubiquitous services in the Semantic Web. ■

## References

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