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Chapter XIII

Service-Oriented Agents and Meta-Model Driven Implementation

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Abstract

Current efforts have not enforced Web services as loosely coupled and autonomous entities. Web services and software agents have gained different focuses and accomplishments due to their development and application backgrounds. This chapter proposes service-oriented agents (SOAs) to unify Web services and software agents. Web services features can be well realized through introducing software agents' sophisticated software modeling and interaction behaviors. We present a natural framework to integrate their related technologies into a cohesive body. Several critical challenges with SOAs have been addressed. The concepts, system and component structures, a meta-model driven semantic description, agent-oriented knowledge representation, and an implementation framework are proposed and investigated.

They contribute to the identified setbacks with Web services technologies, such as dynamic composition, semantic description, and implementation framework. A prototype of the proposed SOAs implementation framework has been implemented. Several economic services are working on it.

Introduction

Web services are featured with application, platform, and provider independence. They provide an appropriate paradigm for implementing open large-scale application environments. These environments can be viewed as collaborative integration environments with services. Services are not treated as isolated and one-time affairs but rather as elements in an interactive and dynamic collaboration structure. Service collaborations within or across environments are modeled in terms of supported transactions and processes. These collaborations are subject to norms and protocols specified for business domains. Services are thereby orchestrated vertically within one or horizontally across multiple environments. As a result, an individual environment streamlines services in terms of provided transactions while preserving its function scope to be highly specific to the targeted user group. Multiple environments collaborate to extend their business chains. Web services have been supported by major IT players through their commercial platforms such as Microsoft's .NET (Trowbridge et al., 2003) and SUN's J2EE/SUN One (Sun Microsystems). They are also underlying technologies behind the currently promoted business initiatives such as HP's Adaptive Enterprise (HP) and IBM's On-Demand e-Business (Wainewright, 2002).

Software agents have been developed with sophisticated interaction patterns. They are efficient in enforcing automatic and dynamic collaborations. Agent orientation is an appropriate design paradigm for e-business systems with complex and distributed transactions, especially for Web services. In services realization, software agents are very instrumental to provide a focused and cohesive set of active service capabilities. We therefore envision a Web service-based environment as a collection of economically motivated service-oriented agents (SOAs). SOAs cooperatively or competitively interact to provide common services in one specified environment, such as brokering, pricing, and negotiation in an e-marketplace, as well as cross-enterprise environment, such as integration and cooperation in an electronic supply chain. The fundamental elements of such environments are services, where transactions are behavioral aspects of the services. Software agents dynamically implement services as functionalities and roles.

The primary objective of our work is to integrate software agents and Web services into a cohesive body that attempts to avoid the weaknesses of each individual technology, while capitalizing on their individual strengths. There are two observations that set the stage for SOAs' comprehensive technical solution. On one side, Web services paradigm is fast evolving and has been provided with plentiful industry-oriented technologies. These technologies support Web services to be deployed, published, discovered, invoked, and composed in a standard and consistent way. It has therefore attained advantages, in that it is business and application driven. On the other side, software