

## Chapter XXII

# Web Services Management: Toward Efficient Web Data Access

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### ABSTRACT

The widespread use and expansion of the World Wide Web has revolutionized the discovery, access, and retrieval of information. The Internet has become the doorway to a vast information base and has leveraged the access to information through standard protocols and technologies like HyperText Markup Language (HTML), active server pages (ASP), Java server pages (JSP), Web databases, and Web services. Web services are software applications that are accessible over the World Wide Web through standard communication protocols. A Web service typically has a Web-accessible interface for its clients at the front end, and is connected to a database system and other related application suites at the back end. Thus, Web services can render efficient Web access to an information base in a secured and selective manner. The true success of this technology, however, largely depends on the efficient man-

agement of the various components forming the backbone of a Web service system. This chapter presents an overview and the state of the art of various management approaches, models, and architectures for Web services systems toward achieving quality of service (QoS) in Web data access. Finally, it discusses the importance of autonomic or self-managing systems and provides an outline of our current research on autonomic Web services.

### INTRODUCTION

The Internet and the World Wide Web have gradually become the main source of information with regard to extent, versatility, and accessibility. Products and services are being traded over the Internet more than ever before. Due to the cost of building and maintaining functionality in a service, outsourcing and acquiring services from

other service providers are becoming increasingly popular. Web services are a leading Internet-based technology and a perfect implementation of service-oriented computing (SOC; Casati, Shan, Dayal, & Shan, 2003; Curbera, Khalaf, Mukhi, Tai, & Weerawarana, 2003). It has great potential for being an effective gateway to information accessible on the Web. Web services follow specific standards to ensure interoperability and are accessible on the World Wide Web. In a service-based system, all applications are considered as services in a large distributed network. Web services, which have features like fine-grained functionality, interoperability, and Web accessibility, hold great potential for Web data access and business-to-business (B2B) communication (Hogg, Chilcott, Nolan, & Srinivasan, 2004; Seth, 2002) via cross-vendor service composition.

Efficient management is indispensable to provide good service quality, especially for complex Web service hosting systems that provide services around the clock over the Internet. Quality of service (QoS) is an increasingly important feature of Web data access. It is generally represented by a statistical metric of the system performance, such as the average response time for queries or the level of availability of a service that symbolizes a certain quality of system performance. In order to guarantee the QoS for business and legal aspects, the service provider and consumer should first agree upon a specific service level. This contractual agreement, which is called a service-level agreement (SLA), is a primary economic aspect of Web services management in a corporate environment.

Researchers are working on the architecture, policies, specifications, and enhancement of different standards to facilitate the development of Web services management systems (Farrell & Kreger, 2002). Some of the main management goals are ensuring QoS (Sheth, Cardoso, Miller, Kochut, & Kang, 2002), negotiating SLAs (Liu, Jha, & Ray, 2003), load balancing or resource provisioning (Chung & Hollingsworth, 2004),

dynamic reconfiguration (Anzböck, Dustdar, & Gall, 2002), error detection (Sahai, Machiraju, Ouyang, & Wurster, 2001), recovery from failure (Birman, Renesse, & Vogels, 2004), and security (Chou & Yurov, 2005). Most of the management-related research conducted by industry contributes to areas like the architecture and implementation of a management infrastructure for Web services (Catania, Kumar, Murray, Pourhedari, Vambenepe, & Wurster, 2003), the specification of event subscription and notification (*WS-Eventing*, 2004), security and trust relationships (*WS-Trust*, 2005) in a federated Web services architecture, and the automation of ensuring SLA negotiation (Dan et al., 2004) among coordinating Web services. There are yet many open problems in the area of Web services management that need to be addressed.

This chapter surveys the state of the art of Web services management to facilitate efficient Web data access. It specifically focuses on the importance of an effective management framework for providing reliable, efficient, and secure data access on the Web. The rest of the chapter is organized as follows. The next section provides background information about the architecture and basic standards of Web services. Then the chapter presents an overview and comparison of Web service management frameworks. It explains the criteria used to compare the frameworks, describes frameworks found in the research literature, and then gives a comparison of the frameworks. Finally, it discusses the open problems in Web service management, summarizes the chapter, and draws some conclusions.

## BACKGROUND

### Web Services

Web services are software applications that offer specific services to client applications and have Web-based interfaces to provide user access over

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