Development and Deployment of Web Services

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INTRODUCTION

A Web service is an interface that describes a collection of operations that are network accessible through standardized XML (extensible markup language) messaging specifications such as SOAP, WSDL (Web service description language), and UDDI to provide open, XML-based mechanisms for application interoperability, service description, and service discovery (Kim & Jain, 2005). They are self-contained, modular units of application logic that provide business functionality to other applications via an Internet connection (Srivastava & Koehler, 2003). Although Web services are a relatively new concept, they provide a solution to the set of serious problems that have plagued enterprise systems using a service-oriented architecture (SOA). Web services address a similar set of problems that middleware technologies such as CORBA, RPC, COM, and RMI address by providing a tightly coupled and vendor-driven proprietary environment for implementing SOA.

BACKGROUND

Web services are based on open standards and are designed to promote loosely coupled interactions between service providers and consumers to provide an interoperable environment (Gisolfi, 2001b). Loosely coupled Web services provide modularity and flexibility in complex, distributed IT environments (Kreger, 2003), emerging as a catalyst for SOA. A service is a unit of work such as a business function, a business transaction, or a system service (Channabasavaiah, Holley, & Tuggle, 2003) completed by a service provider to achieve desired end results for a service consumer. A well-designed SOA is therefore likely to be comprised of a relatively large number of modular, focused Web services that can be swapped in and out as needed to respond to changing needs.

Organizations can exploit Web services to enhance their ability to (a) respond quickly and reliably to special requests from customers and suppliers, (b) improve the agility of business processes to respond to various situations and changes in the marketplace, and (c) automate and integrate business processes across organizational boundaries (Seybold, 2002). As various standards related to Web services become mature, Web services are becoming basic building blocks of the service-oriented architecture from which new applications can be composed. For this vision to realize its full potential, several issues need to be addressed. The range of these issues includes quality of service (QoS; performance, availability, security, etc.), semantic matchmaking, and the development of services-based applications.

This article is organized as follows. In the next section, we discuss in depth these various issues. We categorize them in three groups: Web services matchmaking, Web services quality of service, and the development of services-based applications. In the final section, we present the implications of these issues for dynamic e-businesses and provide concluding remarks.

ISSUES IN THE DEVELOPMENT AND DEPLOYMENT OF WEB SERVICES

In this section, we present a discussion on a diverse set of technical, social, and regulatory issues faced by organizations that intend to deploy Web services. Figure 1 depicts these various issues in service-based application development efforts.

Matchmaking of Web Services Capabilities

The huge number of Web services already available on the Internet makes it almost impractical, if not impossible, for a human being to analyze and combine them efficiently (Matskin & Rao, 2002). One of the major tasks when using Web services for today's service-oriented business application development is their discovery and the degree of match between the tasks that a service can accomplish and the requirements of the consumer. This requires the capability to match Web service descriptions with the service requirements.

Figure 1. Issues in Web services-based application development for dynamic e-business
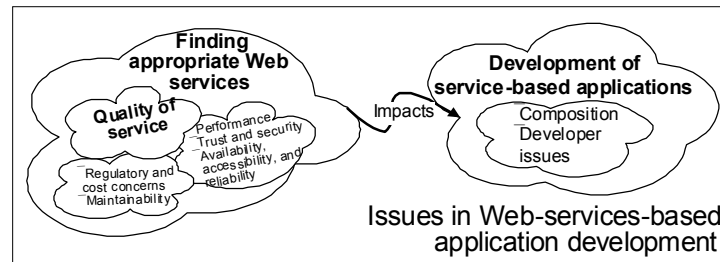
Matchmaking is a process by which parties that are interested in having an exchange of economic value are put in contact with potential counterparts. It is carried out by matching together the features required by one party with those provided by another. A common problem in this process is that different Web services may use the same name or term with different meanings. The challenge is then to mediate between these different contexts (Hansen, Madnick, & Siegel, 2002) and to select a Web service that provides accurate, complete, consistent, and correct functionality. Since Web services exist in an open environment, semantic matching is more natural (Matskin & Rao, 2002). By semantically enhancing the functional description of the Web service, more accuracy in service discovery can be achieved. This matchmaking process should ideally support the following: (a) functional matching, (b) input and output interface matching, and (c) matching the order of the subtasks' execution as it can potentially affect the QoS expectations such as compliance with requirements to follow a specific process.

Quality-of-Service Issues for Web Services

As businesses continue to assess the viability of Web services for enterprise-strength applications with their growing recognition and proliferation, a major issue is maintaining adequate levels of QoS. QoS, an important complement to the operational description of work flows supported by Web services, describes nonfunctional properties of a work flow (Cardoso, Sheth, & Miller, 2002). Delivering QoS on the Internet is a critical and significant challenge because it is dynamic and unpredictable in nature while applications with very different characteristics and requirements compete for scarce network resources. Changes in traffic patterns, denial-of-service attacks, infrastructure failures, low performance of Web protocols, and security issues over the Internet create a need for Internet QoS standards (Mani & Nagarajan, 2002) for Web services. The management of QoS directly impacts the success of organizations participating in e-

commerce activities enabled by Web services. QoS issues should be assessed from the perspective of the providers as well the users of Web services. It is important to have some mechanisms for monitoring Web services and their deployment environment in real time to ensure their auditability (Seybold, 2002).

Performance

The performance of Web services is measured in terms of throughput and latency. Higher throughput and lower latency values represent good performance of a Web service (Mani & Nagarajan, 2002). One component affecting performance is the task time or the time taken to transform inputs into outputs. Other factors affecting performance include accessibility, availability, and reliability. When composing applications from Web services, care must be taken regarding the possibility that a Web service may time out (Myerson, 2002). In other words, the response time of a Web service will affect the performance of an application. This will involve making careful choices about when to use asynchronous vs. synchronous processing.

Maintainability

Sheth, Cardoso, Miller, and Kochut (2002) highlight the importance of taking into consideration the time taken to maintain a Web service when failures or changes take place (also known as the time taken to repair ;Mani & Nagarajan, 2002). A related concern is versioning (Myerson, 2002), that is, how new builds will affect the functionality of the existing Web services and applications that rely on them. Also, another issue is the ability to consistently serve the service consumers' requests despite variations in the volume of requests.

Trust and Security

Organizations that consume and provide Web services need to be in a relationship strong enough to warrant

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