

# Web Services

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## INTRODUCTION

Web services are changing the way in which the World Wide Web is currently being used. The Web was created originally to support human-to-computer interactions with textual and graphical data. Today, people use the Web to read the latest news, buy consumer goods, search for information, and obtain stock quotes. However, the Web does not yet support effective computer-to-computer interactions between software applications of different enterprises.

Web services can enable Internet-based software applications of different enterprises to interact with each other directly by providing application programs with the ability to invoke operations that otherwise would be invoked manually by a human through a browser. Web services can run not only on mainframe computers and server computers, but also on desktop computers and client handsets. Web services allow individuals and organizations to publish links to their software applications, just as they publish links to their Web pages.

Web services solve the enterprise application integration (EAI) problem by enabling interaction among different applications within the same organization. They can also enable computer-to-computer applications of different organizations to interact without human intervention. For example, Web services can be used for reservation systems, order-tracking systems, and business supply chains. In the example shown in Figure 1, Company A (a customer) orders goods from Company B (a distributor). Company B checks the availability of the

goods from Company C (a supplier), and then arranges for payment and shipping of the goods to Company A without human intervention.

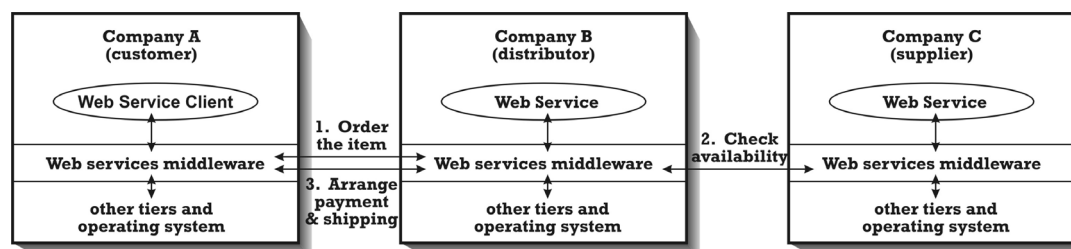
Performance, security, and reliability are factors that will limit the use of Web services unless those issues can be properly addressed. Nonetheless, the potential widespread use and benefits of Web services are very compelling. Web services allow disparate computing systems and applications to be coupled together, and they enable enterprises to streamline and automate their business processes.

## BACKGROUND

The term Web services is used today with alternative meanings. Sometimes a Web service is considered to be any application that is accessible over the Web. This usage is very general and is not what we mean here by a Web service, nor is it a Web service as defined by the standards organizations.

The Universal Description, Discovery and Integration (UDDI) Consortium (2001) has described Web services as “self-contained, modular business applications that have open, Internet-oriented, standards-based interfaces.” This definition emphasizes the need to be compliant with Internet standards. It also requires a Web service to be open, which means that it has a published interface that can be invoked by another computer program over the Internet.

*Figure 1. Use of Web services in business-to-business interactions*



The World Wide Web Consortium (W3C, 2002) has gone further to define a Web service as “a software application identified by a URI [Uniform Resource Identifier], whose interfaces and bindings are capable of being defined, described, and discovered as XML [eXtensible Markup Language] artifacts. A Web service supports direct interactions with other software agents using XML-based messages exchanged via Internet-based protocols.” This definition emphasizes that a Web service must be capable of being defined, described, and discovered so that it is possible to create client software that binds to and interacts with it using the defined interfaces. It also states explicitly that Web services are based on XML.

*Webopedia* (Jupitermedia Corporation, 2004), an online technical dictionary, has given an even more specific definition of a Web service as “a standardized way of integrating Web-based applications using the XML, SOAP [Simple Object Access Protocol], WSDL [Web Services Description Language] and UDDI [Universal Description, Discovery, and Integration] open standards over an Internet protocol backbone. XML is used to tag the data, SOAP is used to transfer the data, WSDL is used for describing the services available, and UDDI is used for listing what services are available.” In addition to XML, this definition requires the use of SOAP, WSDL, and UDDI.

Other useful Web-services references include Alonso, Casati, Kuno, and Machiraju (2004), Fisher (2002), Newcomer (2002), and Zimmermann, Tomlinson, and Peuser (2003).

## WEB SERVICES TECHNOLOGY

### Web Services Architecture

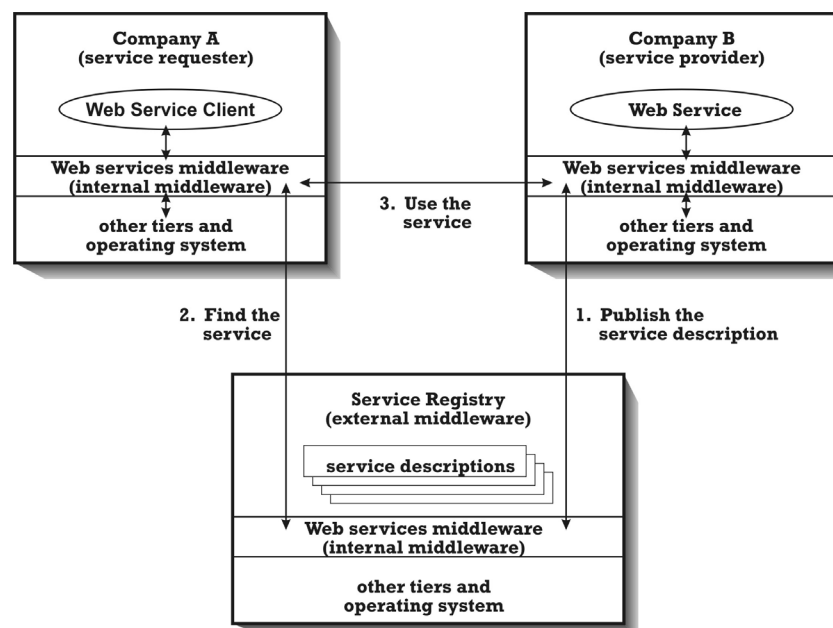
The Web services architecture, developed by the World Wide Web Consortium (W3C: ARCH, 2004), is described briefly below and is illustrated in Figure 2.

Viewed externally, a service provider creates a Web service and defines an interface for invoking that service. The service provider also provides a service description for the Web service and makes the service known to the world by publishing the service description in a service registry. The service registry uses the information in the service description to catalog the service and to search for the service when it receives a request for information about the service from a service requester.

When a service requester tries to find a service, it queries the service registry. The service registry replies with a service description that indicates where to find the service and how to invoke it. The service requester can then bind to the service provider by invoking the service. The service registry is itself a Web service, the address and interface of which are known a priori to the service requester.

Internally, Web services can be viewed as a tier on top of the other tiers of an enterprise architecture. The internal middleware for Web services packs and unpacks messages exchanged between Web services and converts

Figure 2. Web services architecture



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