

WEB SERVICES: THE THIRD WAVE OF INTERNET DEVELOPMENT

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ABSTRACT

Web services promise to make it simpler and cheaper than ever before for different software applications to work together. Simple and ubiquitous standards are in place, and with the backing of major hardware and software players, Web services may become the new foundation for enterprise computing and the most dynamic technology since the original web. Web services promise to change the way companies do business and people use the Internet and are poised to be an important block for business integration.

Keywords: web services, XML, UML, SOAP.

INTRODUCTION

A customer visits an airline Web site and makes requests to buy an airline ticket, rent a car and reserve a hotel room. The airline Web site server, linked via XML-based Web services to the servers of the car rentals and hotel sites sends requests. After the customer has been authenticated, a confirmation is sent via XML to the airline Web site server. The customer trip is planned after one visit to only one web site. If the return flight is delayed, the customer's calendar is automatically adjusted, e-mails are sent to reschedule meetings, and a car rental office or relatives are notified of a change in pickup time. This is an example of what we expect to experience as we enter the third wave of Internet development. The first wave was characterized by widespread use of emails to connect people to people, the second wave connected people to information in web sites, and the era of Web services connects applications and processes to one another for business to business interoperability. (15)

In the last 3 years the concept of Web services has created a stir among companies in the Internet and electronic commerce fields. A standard definition does not exist quite yet; however of the several that has been advanced the following stands out as being the easiest to understand from a non-technical perspective:

“A new technology that makes it easier for different business software applications to talk with each other. Where the traditional web allows any person with a browser to visualize data published by an Internet site, Web services allow any computer program equipped with the right interface to connect to any other program on the Internet that has been set up as a web service. The client program can then get data from the program providing the Web services or ask it to perform some useful task or transaction” (12)

Other more technical definitions describe Web services are self-contained, modular, loosely coupled web applications, which perform many functions from simple requests to complicated business processes via a set of standards based on XML data description language. Web services can be invoked from any platform and devices and once it is deployed, other

applications including other Web services can invoke the deployed application. They can run on a server, a PC, an embedded system or a mobile device. (14) (15) (12).

Exactly what makes Web services such a great technology that major vendors of the caliber of IBM, Microsoft, Oracle, Sun, HP invest billions of dollars on it? Let us now concentrate on the characteristics of this technology that distinguishes it from previous one such as EDI or CORBA, which also promised seamless business integration.

Flexibility: Web services represent an evolution of the Web to allow applications to interact in a dynamic, open and reconfigurable execution environment. It connects private or public networks, can work with existing programs written in different languages, developed by different vendors or in-house IT departments.

XML (Extensible Markup Language) is at the core of the technology and is used to encode all communications to a Web service. For example, a client invokes a Web service by sending an XML message, and then waits for a corresponding XML response. Because all communication is in XML, Web services are not tied to any one operating system or programming language--Java can talk with Perl; Windows applications can talk with Unix applications. Programs can talk to one another regardless of how the companies build their own internal systems.

Many Web services are wrappers for existing applications so that these applications can be accessible on the Internet or an intranet. As such, many are very simple and can be generated automatically by tools (1). As a result they work with heterogeneous operating environments rather than homogeneous, totally controlled environments. Web services could be shared or rented rather than installed and owned. All these features make them independent of the interactions from the platform, programming language or application. This new ease of communications will make enterprise software as we know it obsolete, inciting companies to dump expensive in-house packages in favor of the new breed of mix-and-match software functions piped in from outside providers in the form of web applications or components.

Scalability: A company can invest modestly at first and scale up as Web services mature, starting perhaps by web service enabling existing applications. With most Web services of moderate complexity little restructuring and fewer skills are needed, and an installation can be completed in days or weeks rather than months or years. This gradual approach is not only less invasive but minimizes migration costs.

Exposing existing applications as XML Web services, will allow users to build new, more powerful applications that use XML Web services as building blocks. For example, a user might develop a purchasing application to automatically obtain price information from a variety of vendors, allow the user to select a vendor, submit the order and then track the shipment until it is received. The vendor application, in addition to exposing its services on the Web, might in turn use XML Web services to check the customer's credit, charge the customer's account and set up the shipment with a shipping company.

Integration: Rather than replace or restructure existing systems to achieve uniformity across facilities, companies can now create a common front end using Web services standards. At GM parties inside and outside the company require access to the VIN number that GM assigns to

each car it makes. Until now GM had to build hundreds of custom interfaces to link user applications to the VIN database. With Web services, all those applications are interfaced effortlessly in a more simplified manner.

Dell computers was able to connect its assembly plants (each with its own manufacturing and database management systems) to share the data vastly improving utilization and cutting logistics costs throughout the production network. It also served as the basis for automated communication with the company's supply chain partners (4). Dollar Rent A Car Systems built a Web service to connect its reservation system with Southwest Airlines, allowing passengers to reserve a car through the airline's Web site. The operation, which can be duplicated for other airline partners, took only two months--well short of the estimated eight months it would have taken before today's Web service technologies were available. (17) It costs the company just \$1 per online transaction routing customer reservations through airline sites compared to the travel-agent networks that charge as much as \$5 per online transaction. (8)

This interoperability also works well in outsourcing situations. Thus, Web services ensure seamless transfer of data from the outsourcer to the outsourced company and vice versa. Integrating disparate systems after a merger or acquisition for instance, can be done fairly cheaply and quickly with Web services. Rather than forcing companies to throw out old technology, Web services tie together old software systems, including mainframes, that hadn't been able to talk before, and that way it solves the industry's biggest problem, which is that systems built over 30 years using different technologies now have to be integrated and delivered in ways that nobody intended. (9).

Standard Based: Just 15 years ago the Internet consisted of many disparate network technologies. Since then, the widespread standardization of TCP/IP as the core Internet transport has greatly simplified global communications for both businesses and consumers. A similar widespread agreement on the use of standard web protocols, namely XML, SOAP, UDDI and WSDL has sparked the same revolutionary simplification for business-to-business collaboration. Because Web services are based on standards, it keeps companies from having to cope with pricey, proprietary software that can cost 10 times as much as Web service software (6).

A significant number of companies already have a Web infrastructure, and people with knowledge and experience in maintaining it, so the cost of entry for XML Web services is significantly less than for previous technologies. Software and hardware manufactures have learned a lesson from past rivalry among competing technologies and they now know that anything proprietary, no matter how big it is, can't dominate. That is why in an unprecedented display of cooperation has characterized the early stages of Web services standard development. Hewlett-Packard, IBM, Microsoft, Oracle, and Sun Microsystems among others, in a historic show of unity, have collectively blessed the core set of Web services protocols by creating the Web services Interoperability (WS-I) consortium. The nonprofit group's aim is to ensure that software by rival technology makers is compatible, and to promote harmony in the Web services sector so that customer information can freely move across platforms, applications and programming languages.

The potential rewards of universal connectivity are untold savings in time and money, increase of software sales, and a major boost in productivity. A catalog company for instance, that needs to communicate with FedEx and UPS could rely on a single Web service to dispatch

orders to both shippers, instead of having to separately integrate its applications with each company (10).

Cooperation and efficiency: Web services provide better connection among trading partners not only streamlining their activities but also collaborating to deliver more value to customer. Companies like Dell Computers, General Motors, and Merrill Lynch are using Web services protocols to connect selected activities to suppliers, dealers, or customers (4). What it means is that a company with a broad range of partners for example, will be able to connect its own technology to that of its suppliers more efficiency reducing the need for manual data reentering. Data exchanges could be expanded transforming the development and distribution of products and forging business alliances. Coordination efforts obviate the need for expensive enterprise application integration software or high-priced integration talent. Furthermore, Web services boosts customer relationship by building more effective websites (8).

Current Status of Web services

In a recent survey to discern the level of usage and type of Web services applications, 64 percent of 403 U.S. information technology professionals said that their organizations use the technology to integrate internal applications beyond the firewall; 46 percent claim to use Web services to integrate with known suppliers, customers, or partners; 28 percent to provide services to new customers; 19 percent to discover/interact with third parties; and 18 percent don't deploy any Web services technology at all (3).

In another survey prepared jointly by the Software & Information Industry Association (SIIA) and Systinet it was found that companies are not taking a "wait-and-see" approach to the technology. Just about 30 percent claimed their companies already have live deployments of Web services. More than 40 percent claimed pilot deployments, about 60 percent said their companies were experimenting with them, and nearly 70 percent said their companies were or had investigated the technology. Over 30 percent of those currently working with Web services said they are spending their time SOAP-enabling existing applications, over 25 percent are integrating existing internal applications and about 25 percent are creating new Web services applications. It was detected as well an increase in the diversity and sophistication of new projects in favor of critical, outside-the-firewall applications. About 25 percent of respondents said they will be using Web services to create new applications, while less than 25 percent will deploy them to coordinate public Web services, and yet another 25 percent to create new service architectures (11).

With the advent of Web services will see an influx of companies rushing to offer services and products in all areas of electronic commerce. Some believe Web services have become the newest Internet business model where services can be valuable enough to charge a fee for it. A real possibility is a calendar service. If your dentist and mechanic exposed their calendars through Web services, you could schedule appointments with them on line or they could schedule appointments for cleaning and routine maintenance directly in your calendar if you like. Another scheme is to sell software as a subscription-based service over the Web instead of through traditional methods such as boxed copies at retail stores. By running software on central Web servers, as opposed to on individual PCs, people can theoretically have access to all manner of applications and services from any computer, cell phone, handheld device or anything else connected to the Internet, with updates made automatically, in real time.

The proliferation of Web services will incite further interaction, integration and presentation of data binding to XML, which in turn will require a multitude of companies offering portals, development and integration tools, content management, identity management, directory services, and Web services hosting and brokering. A case in point, Life Time Fitness already gives members access to its applications through a portal built on Web-services technologies. Registered users are able to create their own interactive schedule, plan workouts and chart their fitness progress. The company partnered with Xtime who developed the scheduling tools. When a member initiates the Xtime application on the Life Time portal it triggers a hyperlink to an Xtime web service based secure page. Such as been the success of Life Time's own membership service that it now markets it to other companies as well (8). A salesperson for an investment bank sends research reports to clients using Web services that match the topic of the report with information about the client's interests that is drawn from yet another web service. The report are routed automatically via email, saving the company \$500,000 a year on printing and mail cost (6). The state of New Mexico for example, is creating a web service portal that allows employees to see and tailor their personal information on a single web page –everything from paychecks to retirement plans (8).

Web services Standards

It is widely accepted and recognized the fact that Web services are based on four platform-neutral standards: XML, SOAP, UDDI and WSDL. The whole process is likened to an ordinary phone call. XML represents the conversation, SOAP describes the rule for how to call someone, and UDDI is the phone book. WSDL describes what the phone call is about and how you can participate (5). From a standards point of view, Web services is defined an XML Web service as a software service exposed on the Web through SOAP, described with a WSDL file and registered in UDDI (7).

The lingua franca of Web services is XML (Extensible Markup Language), classified as a page description language. XML allows companies to more easily exchange data online by defining the element of the document that describe its various pieces, the names you call the data, and the relationship of all data to one another.

SOAP (Simple Object Access Protocol) describes how Web services communicate over the Internet. It is a specification that defines the XML format for messages and acts as a wrapper around it.

WSDL (Web Services Description Language) describes Web services and how to access them while UDDI (Universal Description, Discovery, and Integration) lets businesses register, advertise and find Web services in a directory. UDDI is the yellow pages of Web services. As with traditional yellow pages, you can search for a company that offers the services you need, read about the service offered and contact someone for more information. You can, of course, offer a Web service without registering it in UDDI, just as you can open a business in your basement and rely on word-of-mouth advertising but if you want to reach a significant market, you need UDDI so your customers can find you (16). There are three parts to an entry in the UDDI directory. The "white pages" describe the company offering the service: name, address, contacts, etc. The "yellow pages" include industrial categories based on standard taxonomies such as the North American Industry Classification System and the Standard Industrial Classification. The "green pages" describe the interface to the service in enough detail for someone to write an application to use the Web service. The UDDI directory also includes

several ways to search for the services you need to build your applications. For example, you can search for providers of a service in a specified geographic location or for business of a specified type. The UDDI directory will then supply information, contacts, links, and technical data to allow you to evaluate which services meet your requirements.

Challenges ahead for Web services

As much as there is a tremendous interest and support behind Web services, and companies are deploying them, there are a few challenges that need to be overcome before the technology moves into the next phase of development. Forrester Research Inc. predicts that traditional application integration technologies will prevail until 2004, because Web services standard for security, auditing, and transactions won't stabilize until then. It will not be until 2006 that business will apply more complex technologies as their confidence increases (18). In survey on utilization of Web services, respondents said that their biggest stumbling blocks to Web services were lack of security and authentication (13). Part of the concern is the current lack of universal online identification system. Without it is difficult for machines to know whom they are dealing with and to protect people's privacy. Furthermore, external transactions must be authenticated and remain confidential and intact, and the transactions have to be verifiable, so they can't be disavowed if there is a dispute.

A key benefit of the emerging Web services architecture is the ability to deliver integrated, interoperable solutions. Ensuring the integrity, confidentiality and security of Web services through the application of a comprehensive security model is critical, both for organizations and their customers. Security standards in particular are of primary importance, since connecting to expose Web services interfaces over the Internet will require new levels of trust between business partners. Before we see a rush of companies web service enabling their mission critical applications, the technology needs to operate as reliable as the telephone system, always on – no breakdowns of servers computers and networks and it has to be difficult for hackers to break in.

This concern is not lost in the ears of the industry's movers and shakers. The World Wide Web Consortium which has given full support to the technology from its inception, recently approved two XML encryption specifications that enables web pages using XML to encrypt parts of a document –for instance, a credit card number entered in an XML form – being exchanged between web sites. In addition, six new Web service specifications aimed at advancing security capabilities and streamlining business policy for organizations implementing Web services have been outlined by IBM and Microsoft. They are part of second wave of proposed Web services security capabilities, which is crucial to making Web services fly on a global scale (2).

CONCLUSION

Web services await a bright future as electronic marketplaces, inter-company collaboration and E-commerce grow. The potential is there to save money and even find new ways to generate revenue. For companies that have not yet implemented Web services applications, it is recommended to start with a pilot program and get educated on the intricacies of the technology. Until this is done it may be difficult to do a proper risk assessment. Gradually wrapping one application after another will soon form a base of components that it could connect together to build new services.

In summary, Web services have a profound implication for business. The promise of business interoperability, with the ease with which Web pages flow over the Internet, is what will fuel the demand for Web services. The speed with which Web services are deployed will be determined by a combination of how quickly additional standards are finalized, how strong customer demand is, how fast the market rolls out support tools, and how encompassing is the synergy that is produced as more Web services are created and interfaced.

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