

Trends in e-business technologies

by R. A. Smith

As e-business continues to develop, various technologies associated with computing underlie its evolution. Currently, the Java™ programming language and platform, the Extensible Markup Language, and transcoding are emerging as major technologies for performing e-business functions. In this overview essay, trends in these technologies are described, indicating how they will lead to future Web services.

In this overview, I would like to describe four major trends that I see coming along for the emerging e-business technologies of the Java** programming language, Extensible Markup Language (XML), and transcoding:

1. Continued integration of Java and XML into robust middleware such as the IBM WebSphere* software platform
2. Continued and accelerated standardization of Java and XML technologies for infrastructure and industries
3. Use of transcoding and XML technologies to support a much wider range of clients of every description, both synchronous and asynchronous
4. The move from tightly coupled applications to loosely coupled Web services

Let us take a look at each of these trends in turn.

Continued integration of Java and XML into robust middleware

I am amazed at the amount of progress we have made toward the goal of having robust Java and XML middleware running on all major platforms and op-

erating systems. We have come a long way since the move toward a server-side Java platform began only a few years ago. Although many companies today provide good application servers based on Java and XML standards, my experience with customers indicates that IBM's WebSphere software platform for e-business offers users the best one available. In the span of only a few years, WebSphere has grown from a simple Web server to a full-scale software platform supporting mission-critical e-business applications for thousands of IBM customers. WebSphere today provides powerful applications for development, presentation, and deployment of e-business applications. At its foundation WebSphere is based on some of the best Java and XML technology in the industry. These technologies include IBM's leading-edge implementations of the Java run-time environment and Java Development Kit, and the popular Java parser for XML (Apache Xerces) and the Apache Simple Object Access Protocol (SOAP).

Since Java and XML are at the foundation of IBM's e-business middleware, they are also very evident as you go up IBM's e-business software stack, as represented by the WebSphere software platform for e-business. At the base of the stack (the *foundation layer*) are the WebSphere application servers, which are based on Java and XML technologies. On top of the foundation layer are *foundation extensions*, including tools for developing, presenting, and deploy-

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ing e-business applications. All of these tools incorporate Java and XML. Examples are VisualAge* for Java, which continues to expand to provide a robust development environment for Java 2 Platform Enterprise Edition**, and the recently announced WebSphere Business Components that provide a set of building blocks for e-business applications.

Continuing up IBM's e-business software stack we have Java- and XML-based *application accelerators*, including WebSphere Commerce Suite for business-to-consumer applications, WebSphere Domino** for collaboration, MQ Series* Workflow for building business processes, and WebSphere BtoB Integrator for providing business-to-business applications based on trading-partner agreements.

Finally, at the top of the stack are customer and business partner applications for e-business. Because it is based on Java and XML standards, the WebSphere Application Server as the foundation of the WebSphere software platform for e-business is able to run across all major hardware and software server platforms, including the IBM platforms (Advanced Interactive Executive—AIX*, Operating System/390—OS/390*, Application System/400—AS/400*), as well as non-IBM platforms (Windows NT**, Windows 2000**, Solaris**, HP-UX**, Linux**, Novell Netware**).

With the WebSphere software platform for e-business, IBM has taken the lead in providing developers and customers with an integrated set of e-business enabling technologies for the beginning of the twenty-first century. You will see continued integration of our middleware based on Java and XML technologies.

This issue of the *IBM Systems Journal* contains papers focusing on many of the products included in the WebSphere software platform for e-business. For the latest information on the WebSphere software platform, see <http://www.ibm.com/websphere>.

Continued and accelerated standardization of Java and XML technologies

Open standards have driven the e-business revolution. Networking protocol standards, such as Transmission Control Protocol/Internet Protocol (TCP/IP) and HyperText Transfer Protocol (HTTP), and the HyperText Markup Language (HTML) Web standard have enabled universal communication via the Internet and the World Wide Web. Java programming standards have enabled portability of applications

and the reuse of application components. And now, XML standards for data are enabling the exchange and sharing of data across multiple systems connected by the Internet.

IBM has been and will continue to be a major driver of these standards efforts. What is good for standards activities also benefits IBM's customers and therefore IBM. Over the next few years, we see the standards community focusing on common *infrastructure standards* that will facilitate e-business and on common *industry standards* that will facilitate information interchange within and among industries.

For Java, we expect Sun Microsystems' Java Community Process to continue to be the basis for Java infrastructure and language standards. Sun Microsystems has recently made this process more open, and IBM will continue to work with the other members of the Java community in this body to refine the basic standards for Java. We expect to see the continued development of standardized industry-oriented Java components, such as the WebSphere Business Components package, and look to industry-specific standards groups to standardize these components.

For XML, we expect the bulk of the infrastructure standards work to be driven by the ebXML initiative (<http://www.ebxml.org>) and by the World Wide Web Consortium (W3C at <http://www.w3c.org>). The ebXML initiative is an international one established by UN/CEFACT and the Organization for the Advancement of Structured Information Standards (OASIS). This initiative is developing a comprehensive set of XML middleware standards for business process modeling, core components, registry and repository, and transport. W3C is developing basic transport standards. IBM has joined with Microsoft, UserLand, DevelopMentor, and others in submitting SOAP to W3C for consideration as a basic transport standard for XML. W3C has formed an XML protocol working group to standardize work in this area. This working group is being chaired by David Fallside from IBM.

We are seeing extensive industry-specific domain standards for XML. Many industry standards groups are working on domain-specific XML standards, including the Open Travel Alliance, the Automotive Industry Action Group, the Association for Retail Technology Standards, Health Level Seven, and the ACORD standards group for the insurance industry. IBM is encouraging these and other industry stan-

dards bodies to base their domain-specific XML standards on the ebXML set of infrastructure standards.

Use of XML and transcoding to support a wider range of clients

We have discussed above the trend toward a common Java and XML infrastructure for Internet servers. On the client side, the trend is to have a wide range of clients oriented toward specific purposes, such as smart cards, personal digital assistants, smart telephones, set-top boxes, and smart automobiles. The usefulness of these new clients increases greatly when they have a wide range of content available to them, and this content is often provided by Internet servers. Since many of these new clients are mobile, wireless connectivity and the ability to support disconnected operation are important to them.

These diverse clients have differing requirements for communicating and presenting data. When attached to Web servers, the best approach for working with these clients is to provide an easy means of translation and tailoring of data to meet specific client needs, a job that is easily handled by XML and transcoding technologies. To facilitate support of multiple clients, IBM provides a common infrastructure on top of its WebSphere software platform for e-business that supports many types of devices and networks. This common infrastructure, called the WebSphere Everyplace Suite, generates and delivers content for a wide variety of Java and non-Java clients. For more information, see <http://www.ibm.com/pvc>. In addition, products such as DB2* Everyplace and MQ Everyplace provide synchronized database and messaging access for clients that are sometimes disconnected.

The move from tightly coupled applications to loosely coupled Web services

The growth of open standards creates new opportunities for designers and developers of applications and services. By writing to Java application programming interfaces (APIs) rather than to operating system-specific APIs on the server, developers can greatly increase their potential customer lists. By making its legacy data available via XML-based Web services, a business can greatly extend its reach to customers. The network economy is driving the evolution of e-business from rigid to flexible application design, from static to dynamic interaction between partners, and from technology integration to business integration. The growth of a stack of XML standards from

the transport layer all the way up the programming stack to the business application layer has greatly accelerated this trend. The work going on in the World Wide Web Consortium with SOAP complements the XML infrastructure work being done by the ebXML consortium, which in turn supports industry domain standardization efforts being done by such industry standards groups as ACORD for the insurance indus-

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try and the Open Travel Alliance. We think that these trends will lead to the next generation of services available over the Internet, which we call *Web services*.

A Web service is an encapsulated “chunk” of behavior and data that is self-contained and modular, self-describing using XML standards, programmatically and dynamically accessible over networks using standardized mechanisms such as SOAP, and capable of being dynamically composed with other Web services. Web services will be available at many levels of granularity and will include such services as electronic payment, dynamic pricing, bill presentment and reconciliation, credit checking, freight forwarding, and inventory management.

The originator of a Web service registers it with a broker, using a standardized XML-based language to describe and index the service, and an XML-based interface definition language to describe how to access the service. The broker will store this information in a registry. Potential users of a service (whether humans using browsers or application programs) will query the broker to find the best match for their needs, and then dynamically bind to that provider. The broker will serve as a portal for registering and accessing such services.

We think that the direction toward Web services will particularly help “Net Generation” companies—companies that are born on the Web—to become successful by allowing their services to be easily discovered worldwide and easily integrated with other

services ranging in scale from other Net Generation services to enterprise-scale services.

Two recent developments have taken us a giant step closer to the world of Web services:

- In September 2000, IBM, Microsoft, Sun Microsystems, Ariba, and 32 other companies announced the Universal Description, Discovery, and Integration (UDDI) initiative. UDDI defines a set of specifications enabling Web services and includes shared operation of a globally distributed set of synchronized UDDI registries for such services. For more information, see the Web site <http://www.uddi.org>.
- Also in September, IBM and Microsoft announced the Web Services Description Language (WSDL), a jointly developed specification that offers a common way to describe the capabilities of Web services.

By lowering barriers to entry, Web services technologies such as UDDI and WSDL will enable Net Generation companies to quickly get to market with their offerings and generate sustainable profits and consistent growth.

IBM offers a Web Services Toolkit that works with UDDI and WSDL and includes tools to create and publish Web services, as well as a copy of the WSDL specification. The toolkit is available at no cost at the IBM alphaWorks Web site (<http://www.alphaworks.ibm.com/tech/webservicestoolkit>).

Many companies are working together to make the Web services vision happen, and IBM is proud to be a leader in this effort. As Daryl Plummer, Gartner Group Vice President of Internet and E-business Technologies, said in the UDDI announcement:¹

In the e-business world where multiple businesses and multiple marketplaces are trying to interact, a mechanism to locate software services and share those services must exist. The ability to find Web services is going to ease and speed e-business deployment, opening the door for the interoperability businesses desire.

Conclusion

These are exciting times for those of us writing applications for e-business. The growth of the Web and its associated Java and XML standards has been matched by a growth in the programming stack in

technologies and middleware applications. Because of the close coupling of standards and technologies that we have discussed in this overview, existing applications that have withstood the test of time can be readily coupled to new applications that reach new customers over the Web. Programmer productivity is greatly enhanced via opportunities for reuse, portability to new platforms, and ability to readily access existing services. The shift from tightly coupled applications to loosely coupled Web services will lead to another great increase in opportunity for those who develop and sell such services.

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Cited reference

1. "Industry Leaders Join to Accelerate Business Integration and Commerce on the Internet," News and Events, Universal Description, Discovery, and Integration (UDDI) of Business for the Web (September 6, 2000), <http://www.uddi.org/uddipr0906200.html>.

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Rodney (Rod) A. Smith *IBM Software Group, Solutions and Strategy, P.O. Box 12195, Research Triangle Park, North Carolina 27709 (electronic mail: rodneys@us.ibm.com).* Mr. Smith is the Vice President of Emerging Technology, Software Group. Prior to his appointment to this role, he held the position of Chief Technologist and Vice President of Internet Technology in the IBM Network Computing Software Division. He is a well-recognized technical leader both within IBM's software business and across the industry. He is responsible for leading technological innovation in the Internet software space and guiding it into industry standard specifications and into IBM's Internet products such as WebSphere. He is also responsible for setting both technical and business direction. He advises on investment and partnering opportunities and is the lead negotiator and technical strategist in negotiations with many outside companies. Mr. Smith has been recognized by IBM with numerous awards, including a Thomas J. Watson, Jr. Design Excellence Award in 1992, and was named a Distinguished Engineer in 1996. He earned both his B.A. degree in economics and a Master of Science degree from Western Michigan University. He is a member of the Software Advisory Council, the Investment Review Board, the Professional Review Board, the Institute of Electrical and Electronics Engineers, and the Java Design Council's Leadership Team, and is technical consultant to the IBM Academy of Technology. He has been a frequent keynote speaker at technical conferences and has been the author of numerous technical articles.