

Developing Java[™] Web Services

Architecting and Developing Secure Web Services Using Java

Ramesh Nagappan Robert Skoczylas Rima Patel Sriganesh



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Foreword

In the last decade of computing, we have seen a growing realization that most of the cost of computing comes not from the initial purchase of the hardware, not even from the purchase of the software, but from the cost of responding to change throughout the life of the system. When one part changes, the degree of tight coupling between the elements of the system dictates the "brittleness" or probability that change will be forced elsewhere. When you have to retest the software because the operating system was "upgraded," that's brittleness. When you can't open your word processor documents because the software version is wrong, that's brittleness. When a policy change in the accounting department dictates a software rewrite in the sales department, that's brittleness.

In seeking to eliminate brittleness, there have been three significant steps taken:

- The first was the introduction of Java technology, which separated software from the platform and allowed the creation of business logic that wasn't greatly affected by changes to the underlying server.
- The second was the introduction of Extensible Markup Language (XML), which separated the data from the software and enabled different software systems to share data without being affected by changes to the data structures unless they needed to respond to them.
- The most recent is the introduction of Web services. Web services separate collaborating computer systems connected by networks, enabling them to delegate processing without becoming coupled in a brittle way.

All three of these steps need one another. The maximum protection against brittleness occurs when software written for the Java platform uses agreed XML data formats to supply or consume services, which are connected using Web services technologies such as SOAP and WSDL and perhaps UDDI, if the application calls for it. Systems built with Java technology, XML, and Web services are loosely coupled in all three dimensions and will be the most resilient and flexible in the uncertain future that faces us all.

The conjunction of Java for the software, XML for the data, and Web services for the collaborative processing makes this book especially timely and welcome. The majority of Web services development today is being conducted using products from the extraordinarily rich Java community, and the rapid integration of Web services into Java 2 Enterprise Edition (J2EE) by the Java Community Process (JCP) offers the software developer a comprehensive toolchest. In the pages that follow, you will find the following:

- Discussion of the evolving standards landscape for Web services, including the important developments at ebXML, the XML successor to EDI
- The Java APIs for XML (JAX) standards so skillfully evolved by the JCP to address everything connected to XML and Web services in a vendor-neutral way
- Information about the approaches being taken by all of the important Web services vendors, including a variety of tools
- Practical examples that will help you get started with your own Java Web services implementations
- A discussion of the essentials of Web services security that considers both the needs of identity management and of in-transit data protection
- A valuable case study of a real-world Web services deployment using Java

Web services are such a fundamental idea in the world of connected computing that they will rapidly become part of the everyday fabric of information systems, just as Java technology and XML have already. I commend this book to you as your springboard to the future of how to make the Internet work.

> –Simon Phipps (www.webmink.net) Chief Technology Evangelist at Sun Microsystems, Inc.

Introduction

"The big Web Services story is the end-to-end, side-to-side integration of technology." James Gosling, The father of Java Platform

In this age of Internet, the success of the Web-based applications played a vital role in moving our businesses from brick-and-mortar infrastructures to 24×7 online businesses running on different systems and locations. As a next evolutionary step, Web services are a new breed of Web-based applications that address the new phenomenon of building a general-purpose platform for creating efficient integration among business processes, applications, enterprises, partners, customers, and so on. Web services are the next evolution phase of distributed computing, based on XML standards and Internet protocols. Web services provide a promising mechanism for communication and collaboration among business applications, which were constructed using various resources, that enables them to work together regardless of their differences in their underlying implementation.

This book is a developer's guide for designing and developing Web services using a Java platform. It bundles together a wealth of knowledge and detailed study materials, focusing on concepts, technologies, and practical techniques for implementing and deploying Web services. It combines the Web services vision of the Java community by providing in-depth coverage of the Java Web Services Developer Pack (JWSDP). In addition, this book also addresses the fundamentals of Web services from the ground up.

Technologies Covered in This Book

The book covers the core Web services standards and technologies for designing and implementing Web services. In particular, it focuses in depth on the following subject areas:

- Web services standards, protocols, and technologies, including SOAP, WSDL, and UDDI
- Web services architecture and exposing J2EE applications as Web services.
- The development of Web services using Java APIs (JAXP, JAXB, JAX-RPC, JAXM, and JAXR) on JWSDP
- Web services security technologies: XML Encryption, XML Signature, Security Assertion Markup Language (SAML), XML Key Management Services (XKMS), and XML Access Control Markup Language (XACML)
- Interoperability with Microsoft .NET
- The real-world implementation of Web services on JWSDP, using a case study
- Introduction to Sun ONE

In addition, the book also provides example illustrations using tools such as Sun Microsystems JWSDP 1.0, BEA WebLogic 7.0, Systinet WASP 4.0, Apache Axis 1.0 Beta 3, IBM XML Security Suite, Exolab CASTOR, and Microsoft .NET framework.

Target Audience

This book is for all Web services enthusiasts, architects, and developers who perceive Java as their platform of choice for Web services development and deployment.

This book presumes that the reader has the basic conceptual and programming knowledge of implementing Web applications using Java and XML.

Organization of the Book

The content of this book is organized into following five parts, with exclusive chapters concentrating on the Web services technologies:

- **Part One, "Evolution and Emergence of Web Services."** Introduces the reader to Web services by taking a evolutionary journey of distributed computing and the emergence of Web services, and then it devotes an exclusive overview on Web services, addressing its motivation, characteristics, industry standards and technologies, strategies and solutions, and its benefits and limitations.
 - **Chapter 1, "Evolution of Distributed Computing."** The background of distributed computing and the evolution of Internet-enabled technologies is explored in the first chapter. Here, we will examine the definition and reasons for using distributed computing and the core distributed computing technologies.
 - **Chapter 2, "Introduction to Web Services."** This chapter presents an introduction to Web services, especially focusing on the definition of Web services, the standards and technologies that the services use, and the benefits of using these services.
- **Part Two, "Web Services Architecture and Technologies."** This section walks through the different Web services standards and technologies such as SOAP, WSDL, and UDDI with real-world examples. It features an in-depth coverage of the Web services architecture on a J2EE implementation model, with example illustrations showing how to expose enterprise applications to Web services. It also demonstrates an interoperability scenario with non-Java based Web services.
 - **Chapter 3, "Building the Web Services Architecture."** This chapter focuses on the Web services architecture, its core building blocks, implementation models, and deployment processes for building Web services-based application solutions. In addition, this chapter illustrates, using an example, the development of a complete Web services solution, exposing J2EE applications as services over the Internet.
 - **Chapter 4, "Developing Web services using SOAP."** This chapter provides an in-depth discussion on SOAP and its role in developing Web services. It covers the W3C definition of SOAP's standards, conventions, messages, communication models, and implementation of SOAP-based applications for Web services. In addition, the chapter also includes example illustrations of adopting different SOAP communication models in Web services.
 - **Chapter 5, "Description and Discovery of Web Services."** This chapter explains two important Web services specifications: WSDL and UDDI. It provides a detailed explanation on the important

aspects of a WSDL specification and examples of using WSDL tools within Web services development. UDDI specification also is covered in great detail, complete with practical examples on working with UDDI registries. This chapter also covers issues with the current WSDL and UDDI technologies.

Chapter 6, "Creating .NET Interoperability." This chapter discusses the Web services interoperability scenarios, challenges, and issues. It also illustrates a full-featured interoperability example that involves Java and Microsoft .NET environments.

Part Three, "Exploring Java Web Services Developer Pack (JWSDP)." This section exclusively focuses on Java APIs for Web services: JAXP, JAXB, JAXM, JAX-RPC, and JAX-R, and their reference implementation on JWSDP. This section provides complete example illustrations and developer essentials for implementing and deploying Java-based Web services on JWSDP. It also includes a special chapter that illustrates a case study demonstrating a real-world Web services implementation using JWSDP.

- **Chapter 7, "Introduction to the Java Web Services Developer Pack."** This chapter introduces the reader to the Java Web Services Developer Pack (JWSDP) 1.0. It covers the Java XML Pack APIs and provides an overview of the runtime environment and tools used for building, deploying, and testing Web services applications.
- **Chapter 8, "XML Processing and Data Binding with Java APIs."** This chapter discusses the Java API for XML Processing (JAXP) and Java Architecture for XML Binding (JAXB). It provides an overview of XML, DTD, and W3C XML Schema and then provides a walkthrough of the various techniques used for processing XML data. The chapter also covers the Simple API for XML (SAX), Document Object Model (DOM), and eXtensible Stylesheet transformations (XSLT). For completeness, it also dedicates a section on data binding using JAXB.
- **Chapter 9, "XML Messaging Using JAXM and SAAJ."** This chapter discusses the Java API for XML messaging (JAXM) and SOAP with Attachment API for Java (SAAJ). It covers the JAXM/SAAJ-based application architecture, an API programming model, and deployment. It also includes example illustrations of using JAXM and SAAJ APIs.
- **Chapter 10, "Building RPC Web Services with JAX-RPC."** This chapter discusses the Java API for XML RPC (Remote procedural call) for developing RPC-based Web services. It also covers the

JAX-RPC application architecture, an API programming model, deployment, and its different client Invocation models. It also includes example illustrations using JAX-RPC and demonstrates the different client invocations.

- **Chapter 11, "Java API for XML Registries."** This chapter provides detailed information on the Java API for XML Registry (JAXR) specification from the Java Community Process (JCP). It also discusses the various aspects of JAXR in terms of its classification support, association support, connection management, life cycle management, and querying capabilities. Also provided with this chapter is the discussion on the various JAXR examples about working with UDDI registries.
- Chapter 12, "Using the Java Web Services Developer Pack: CaseStudy." This chapter focuses on implementing a complete Web services solution using the Java Web Services Developer Pack(JWSDP) 1.0. It puts together all of the JWSDP-based APIs covered in this book to demonstrate a working Web services example.
- **Part Four, "Security in Web Services."** This section covers Web services security concepts and various security standards and technologies. In addition, it illustrates real-world Web services security implementation scenarios on XML Encryption, XML Signature, and SAML-based Single Sign-On.
 - **Chapter 13, "Web Services Security."** This chapter provides great details on the issues revolving around Web services security, which is followed by a discussion on each of the five major Web services security technologies: XML Encryption, XML Signature, XML Key Management Services (XKMS), Security Assertions Markup Language (SAML), and XML Access Control Markup Language (XACML). It also provides good examples of using tools for securing Web services through XML Encryption and XML Signature technologies. In addition, the chapter provides a hypothetical use case study of applying SAML for achieving Single Sign-On.
- **Part Five, "Web Services Strategies and Solutions."** This section introduces the reader to the Sun ONE initiative and provides information on Sun ONE tools and platform servers for implementing Web services.
 - Chapter 14, "Introduction to Sun ONE." This chapter aims at introducing the Sun ONE platform technologies and products. It also provides some brief information on the Sun ONE product stack, including its tools and platform servers. In addition, it also introduces ebXML technologies.

Companion Web Site

All the source code from the example illustrations found within this book is available for download from the companion Web site, www.wiley.com /compbooks/nagappan.

In addition, this site also includes the following material:

- Errata
- Further reading and references
- Changes and updates

Support and Feedback

The authors would like to receive the reader's feedback. You are encouraged to post questions and/or contact the authors at their prospective email addresses. Contact information can be found at the companion Web site to this book at www.wiley.com/compbooks/nagappan.

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After six months of hard work, it is an utter surprise for me to see the completion of the project, and it's a great feeling to see the quality of work the way we wanted.

It's quite fun to recall the genesis of this book: Two friends, Sada Rajagopalan and Sameer Tyagi, started gathering ideas for this mammoth project on September 19, 2001, at the John Harvard's Pub in Natick, Massachusetts. Around 10:45 P.M., after most of us had three pitchers of a seasonal flavor and all had shared rip-roaring hilarious talk, Sada, who didn't drink, came up with this idea of writing a book on Java Web services. In the next few days, we created the proposal for this book. Both Sameer and Sada helped us initiating this huge effort and in getting the proposal written; much thanks to them for all their efforts. It's always been great fun calling Sameer in the middle of the night, especially to discuss emerging technologies, as well as known bugs, changes, and issues.

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Robert Skoczylas

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Rima Patel Sriganesh

This book has been an exciting roller-coaster ride of my life. When I first started as a reviewer of this book, I never imagined that I would end up being a co-author. All of a sudden when that opportunity came up, I was overwhelmed with joy as well as work. It was during the course of this project that I realized how challenging this work was, not only for me, but also for my husband, who'd happily let go of all the fun moments for the sake of my venture.

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