WS-I Overview

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Notices

Executive Overview

The Web Services Interoperability Organization (WS-I) is dedicated to accelerating the adoption of Web services by assisting in the selection and interpretation of Web services specifications, and in the development of common best practices for their usage in the development, deployment, and integration of business applications.

Towards this end, the WS-I organization is producing a set of deliverables to assist developers in the creation and deployment of interoperable Web services. This paper introduces the reader to the WS-I deliverables: *interoperability Profiles*, *testing tools*, *sample applications*,

and other material useful to Web services practitioners. This paper also describes the WS-I Working Group development processes.

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1.0 Introduction

The WS-I organization is dedicated to meeting the needs of Web services developers, so as to enable them to develop and deploy interoperable Web services on the platform and development language of their choosing. The WS-I process reflects the reality of practical application of Web services technologies to solve real business needs.

Towards this end, the WS-I organization is producing a set of deliverables that is intended to assist developers in creating and deploying interoperable Web services. Among the key deliverables are the *testing tools,* which developers can use to test conformance of their Web services with the *test assertions* that represent the *interoperability guidelines* of established WS-I *Profiles*. The process used to develop these *Profiles*, *interoperability guidelines, test assertions*, and *testing tools* generates other related resources useful to developers. Figure 1 shows the deliverables that the WS-I organization is currently producing, the relationships between the deliverables, and the WS-I Working Groups responsible for producing each deliverable.

WS-I Deliverables & Relationships

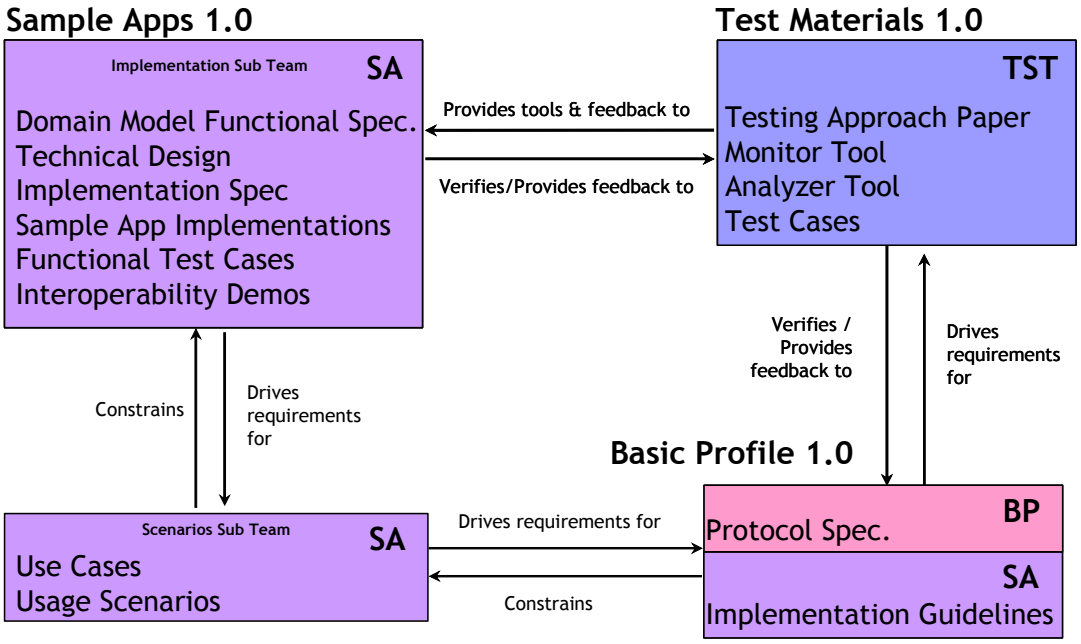

Figure 1. WS-I Working Group Deliverables and their Relationships

2.0 WS-I Deliverables

There are four types of deliverables produced by WS-I. This section provides an overview of each deliverable:

Profiles: Profiles contain a list of named and versioned Web services specifications together with a set of implementation and interoperability guidelines recommending how the specifications should be used to develop interoperable Web services.

More information on Profiles is provided in Section 4.0 Profiles on page 4.

Testing Tools: Testing Tools are used to monitor and analyze interactions with a Web service to determine whether or not the messages exchanged conform to WS-I Profile guidelines:

> **Monitor**: A tool used to intercept and log interactions with a Web service. This tool generates a log that is later processed by the Analyzer to verify that the monitored interactions conform to a Profile.
>
> **Analyzer**: A tool used to process the logs generated by the Monitor to verify that the intercepted Web service interactions conform to the given Profile.

More information on Testing Tools is provided in Section 5.0 Conformance Testing Web services on page 7.

Use Cases and Usage Scenarios: Use Cases and Usage Scenarios capture (respectively) business and technical requirements for the use of Web services. These requirements reflect the classes of real-world requirements supporting Web services solutions, and provide a framework to demonstrate the guidelines described in WS-I Profiles.

You can find more information on Use Cases and Usage Scenarios in Section 6.0 Scenarios and Sample Applications on page 8.

Sample Applications: Sample Applications demonstrate the implementation of applications that are built from Web services Usage Scenarios and Use Cases, and that conform to a given set of Profiles. Implementations of the same Sample Application on multiple platforms, using different languages and development tools allow WS-I to demonstrate interoperability in action, and to provide readily usable resources for the Web services practitioner.

You can find more information on Sample Applications in Section 6.0 Scenarios and Sample Applications" on page 8.

3.0 Process Overview

The WS-I process begins with the definition of *Use Cases* that describe how Web services can be applied to meet real-world business needs. These *Use Cases* are then decomposed into *Usage Scenarios* supporting various aspects of the Use Cases and design patterns. The *Usage Scenarios* describe the ways in which Web services are employed in the context of the collected *Use Cases*. This work aids in the demonstration of how Web services specifications are used individually, in concert with one another, or both.

Use Case analysis forms the foundation for *Profile* requirements to be defined. Each *Profile* is based on a specific set of Web services specifications, each at a particular version and revision level. Profiles provide a refined usage of these specifications and standards through *implementation and interoperability guidelines*, which, in many cases, are captured as a set of *test assertions* that can be used to verify the conformance of a given Web service implementation with the *Profile*.

WS-I then defines, and implements, S*ample Applications*. The supporting implementations are developed in multiple programming languages, such as C# (C sharp) and Java™, and are deployed on multiple platforms, including Java 2 Platform, Enterprise Edition (J2EE™) and .NET. This activity demonstrates *Profile* interoperability by implementing functional applications using the *Use Cases* and *Usage Scenarios* that the *Profiles* are intended to address.

Finally, to close the loop, WS-I develops *testing tools* for use by Web services practitioners, including those members of the WS-I Working Groups developing *sample applications*. These tools are used to verify that the interactions observed with the monitored Web service conform to the set of *guidelines and test assertions* that define the interoperability *Profiles*.

In the following sections, we discuss each of the WS-I deliverables and its relationship to the process outlined before in further detail.

4.0 Profiles

Since Simple Object Access Protocol (SOAP) 1.1 was released in April, 2000, there has been tremendous industry uptake in the basic specifications that constitute Web services as we know

them today. SOAP 1.1, Web Services Description Language (WSDL) 1.1, and Universal Description Discovery and Integration (UDDI) 2.0 are the core set of specifications used to describe, publish, enable discovery, and invoke Web services. Each of these specifications is based on XML and XML Schema. Given this core set of specifications, it would seem a manageable task to keep track of products and their degree of support for the specifications.

However as developers work to implement support of these specifications the number of additional efforts focused on expanding the library of Web services related specifications to support the full Web services vision expands. Viewing each of these new specifications in isolation is an oversimplification, as many of the areas have multiple interdependencies, sometimes with conflicting requirements. Over the past few months, additional specifications in many of these areas have begun to emerge.

Given the potential to have many necessarily interrelated specifications, at various versions and schedules of development and adoption, it becomes a very difficult task to determine which products support which levels of the specifications. Thus, even though the industry may have the best intentions of ensuring interoperability on a specification-by-specification basis, a CIO, purchaser or other user of a Web service product (be it a tool, runtime, or a Web service itself) would find it very difficult to match several pieces of software necessary to complete a task or build a solution.

WS-I addresses this need through the concept of *Profiles*.

4.1 What is a Profile?

A *Profile* consists of a list of Web services specifications at specific version levels, along with recommended guidelines for use, or exclusion, of any optional or loosely specified features of those specifications. WS-I is developing a collection of *Profiles* that support interoperability for general-purpose Web services functionality.

Profiles make it easier to discuss Web services interoperability at a level of granularity that makes sense for developers, users, and executives making investment decisions about Web services and Web services products. WS-I focuses on compatibility at the *Profile* level.

To be a useful concept and to avoid confusion, the number of *Profiles* will remain relatively small. Conversely, too few *Profiles* would force some Web services products to add unneeded features simply to conform and to assert interoperability. It is an ongoing task of WS-I to design and update *Profiles* that reflect real Web services usage.

There is already strong consensus on the underlying protocol standards which form the base for the most basic Web services *Profile*. As new standards and specifications emerge which address aspects of Web services technologies above the level of this most basic *Profile*, it is likely, but not required, that the *Profiles* developed for these will include this basic *Profile* as a foundation. Similarly, it is expected that vertical industries will build upon the WS-I *Profiles* by adding industry-specific specifications or standards.

WS-I does not consider it to be within its scope to do this industry-specific work directly, but rather intends to cooperate with industry groups to ensure that WS-I Profiles provide an adequate base for the work of these organizations, and that they are able to leverage WS-I *testing tools* and technologies. However, WS-I looks forward to working with these industry groups to develop industry-specific Use Cases and Usage Scenarios within WS-I.

4.2 Interoperability Guidelines

Previous experience with specifications has demonstrated that despite the best intentions of the authors, there are ambiguities or areas that are under-specified such that interoperability becomes difficult to achieve. A specification might also be of such a general nature that further conventions or recommended guidelines are necessary for interoperability. Or it might be that specifications that were developed independently do not fit together smoothly when they are used together.

Therefore, in addition to references to specifications or standards, a *Profile* might contain *interoperability guidelines* that resolve ambiguities or specify how to achieve consistent usage. These *guidelines* constrain some of the specifications or standard's MAYs and SHOULDs, which are often a source of interoperability issues, such that they become MUSTs or MUST NOTs, as deemed appropriate to satisfy the requirements of the Use Cases and Usage Scenarios. This in turn increases the potential for interoperability of the implementations of the specification. The guidelines may also contain information that supplements the standards and specifications upon which the *Profile* rests. These *guidelines* may apply to an individual Web service specification, or may pertain to how multiple specifications should work together.

These interoperability guidelines are available to the standards and other organizations that are working on the specifications included within the WS-I Profiles. WS-I will work closely with each of these organizations to ensure that an effective feedback process is established.

4.3 Producing Testable Assertions from Profiles

Interoperability aspects of the specifications that comprise a given Profile, along with the additional constraints imposed on them by the Profile, are also documented as a set of machine-readable test assertions that can be used by the testing tools to verify that the observed behavior of a given Web service conforms to the Profile. The test assertion development also endeavors to include applicable tests that have been developed by other organizations and efforts. These include, but are not limited to, ongoing related work within industry standards organizations such as OASIS, W3C, IETF, and others.

4.4 The First Profile— WSBasic

Through the first phase of Web services adoption, four specifications have risen to prominence as providing the basic functionality required. These specifications are XML Schema 1.0, SOAP 1.1, WSDL 1.1, and UDDI 2.0. The first Profile under development is WS-I Basic (WS-Basic) Web services (see Figure 2).

WS-Basic[1]	XML Schema 1.0 SOAP 1.1 WSDL 1.1 UDDI 2.0

Figure 2. Web Services Basic Profile: Referenced Specifications.

[1] Many of the specifications listed here make normative references to other related work. These additional specifications are included implicitly, and are equally important to the implementation of interoperable Web services.

4.5 Future Profiles

The development of additional or updated WS-I *Profiles* depends on the continued evolution and maturity of Web services usage and the development of the required specifications and standards. Each of the areas listed earlier in this document is a candidate for additional *Profile* work as Web services users document their requirements with *Use Cases* and *Usage Scenarios* and as the required specifications are developed. Additional work in areas such as message extensibility, binary attachments, routing, correlation, guaranteed message exchange, signatures, encryption, transactions, process flow, inspection, and discovery is expected and, in some cases, is underway. This work will help drive the evolution of these areas, support gap analysis for required functionality, and provide the context for an overall roadmap for vendors, users, analysts, and the media to understand the direction of Web services standardization and interoperability. WS-I works proactively with industry standards organizations to help in this evolution.

5.0 Conformance Testing Web services

WS-I also develops a set of testing resources. These testing tools, and the configuration data used with them will help Web services developers ensure that their Web services conform to the *Profile's interoperability guidelines*.

The tools developed monitor the interactions with a Web service, record those interactions, and analyze them to detect implementation errors. The Web service itself is treated as a "black box". The *testing tools* do not interact with the Web services, nor do they have any view of the supporting code or infrastructure.

This section provides an overview of the testing approach, and some of the thinking on both the WS-I testing process and the supporting technical resources to be developed by the WS-I Working Groups.

5.1 Test Tool Development

The Test Materials and Tools Working Group develop Monitor and Analyzer tools that support the testing of Web services for conformance with WS-I Profiles. These tools log interactions between or with Web services, and analyze these interactions in a manner that supports each of the test cases and interoperability guidelines. These tools are developed to gather and analyze Web service data pertinent to evaluation of conformance with WS-I *Profiles*.

These tools are configured using the *interoperability guidelines* established within WS-I *Profiles* and within referenced portions of the Web services standards these *Profiles* contain. As such, the tools focus on detecting instances where a Web service does not adhere to WS-I Profiles, and (explicitly) not on verification that every feature of every referenced *Profile* or specification is implemented.

5.2 Profiles, Test Tools, and Sample Applications

There is a rather handy relationship between *Profiles*, *Testing Tools*, and *Sample Applications*, which WS-I exploits. *Profiles* serve as the "rule set" that the *Testing Tools* use as they monitor Web services and analyze their behavior. They also give guidance to those implementing *Sample Applications*. When a *Test Tool* that is run against a *Sample Application* yields any result other than conformance, one of the following conditions is true: the *Sample Application* contains an error (the implementers missed a portion of the *Profile* they intended to follow),

the *Test Tools* contain an error (they're not testing for conformance properly), or the *Profile* is internally inconsistent. In order to exploit this "feedback loop," the *Sample Application* developers develop applications that exercise as much of the relevant *Profiles* as possible. This process is ongoing.

5.2.1 Observing Web Service Behavior

WS-I is developing, and will make publicly available, a set of Web services and other programs that record interactions between Web services in an as unobtrusive manner as possible. This "Monitor" tool treats the Web service and entities it communicates with as black boxes, recording the messages that are exchanged. This recording is then used to generate a log that includes rich details about all aspects of the interaction.

5.2.2 Analyzing Web Service Behavior

WS-I also develops a set of programs or Web services that analyzes the captured logs to determine if the interactions observed conform to WS-I *Profiles*. Any deviations from the *Profile's interoperability guidelines* are reported, and where possible, recommendations to assist in bringing the Web service implementation into conformance are provided. Input to the analysis tool consists of the *implementation guideline* assertions from the *Profile*, WSDL and/or UDDI descriptions of the Web service under test, and the logs gathered from observation of the deployed Web service.

6.0 Scenarios and Sample Applications

Within the context of a particular *Profile*, WS-I defines real-world *Use Cases* and accompanying *Usage Scenarios* that exercise salient features of the specifications referenced within the *Profile*. From these definitions a *Technical Design and Implementation Specification* for a *Sample Application* is produced that describes the Web services and supporting technical resources such as WSDL files, XML schema, and UDDI Web service registrations. The detail provided in the *Use Case*, *Usage Scenarios*, and *Technical Design and Implementation Specification* is sufficient for a developer to be able to code both sides of the interaction without additional clarification.

WS-I members provide real-world Web service *Use Cases* as part of the development process. Although the first *Use Cases* defined by the Work Groups are fairly simple, they are expected to become increasingly complex, driven from real customer needs. Real-world *Use Case* contributions act to improve the practical application of WS-I tests in a manner that is most useful to developers and implementers across the Web services community.

6.1 Sample Applications

WS-I participants use the *Use Cases* and their related documentation to develop implementations of Web services and the software that invokes them using their respective technologies. The intent is to ensure that there are implementations for each of the major platform environments available. Once development is near completion, members of the implementation Working Group will cross-test their implementations. As interoperability issues are identified, these issues are fed back to the *Profile* Working Group to update the respective *interoperability guidelines*, or make necessary changes to the extent appropriate. Identified issues and their resolution become the foundation for the set of test assertions that drive *Testing Tool* functionality.

In addition to the cross-testing of different application implementations, message traffic exchanged between the various Web services components is collected and analyzed using the *Testing Tools*. This creates a tight feedback loop that ensures the accuracy of the *Testing Tools* as well as the conformance of the *sample applications* that is constantly refined over time.

6.2 Supply Chain Sample Application

The WS-I Sample Applications Working Group has settled on a Supply Chain business application as the first *sample application* to be delivered. The Supply Chain application was chosen because it was felt that most people could relate to its intended purpose and design, which is an important attribute of any *sample application*. The functionality described in this *sample application* can be readily generalized for other types of applications.

The iterative design of the *sample application* is driven largely by the *Use Case* and *Usage Scenarios* developed so as to ensure that significant aspects of the WS-I Basic *Profile* are exercised.

7.0 More Information

All organizations are encouraged to join WS-I and actively participate in the design and development of Profiles, testing tools and other supporting resources. For more information on membership and activities, visit the WS-I Web site at http://www.ws-i.org. WS-I may be contacted by e-mail at membership@ws-i.org.

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