Web Service Interoperability (WS-I) Standardization Activities

Yusuke Shigyo[†]

Abstract

As an innovative means of facilitating system interaction between enterprises and organizations, Web services are attracting widespread attention and gradually evolving. However, before they are fully accepted, it will be necessary to overcome the lack of interoperability between Web service products. To address this issue, the Web Services Interoperability Organization (WS-I) was created.

1. What is WS-I?

"Web services" is a generic name for technology based on the data description language XML (extensible markup language) that allows systems using Web protocols, such as SOAP (simple object access protocol), to interact. One example would be a travel agent providing one-stop shopping for flight and hotel reservations and travel insurance. The provision of these services requires interoperability between the various Web services used for connecting the travel agent and flight reservation system, etc. and for interacting between them.

WS-I [1] was founded on February 6, 2002 to encourage the adoption and accelerate the deployment of common and standard forms of Web service usage (called profiles) that facilitate Web service interoperability across different platforms, programming languages, and applications. The founding members were Accenture, BEA Systems, Inc., Fujitsu Limited, Hewlett-Packard Company, Intel Corporation, IBM, Microsoft, Oracle Corporation, and SAP AG. Note that WS-I is not a standards body for Web services specifications. Rather, it focuses on formulating uses for Web services specifications and developing sample applications and test materials designed to promote the interoperability of Web services. Its outputs are expected to be utilized by: end-user companies and developers; IT vendors who provide Web services tools, platforms, and products; and designers and project managers for enterprise system applications.

2. Organizational structure

The organizational structure of WS-I is shown in **Fig. 1**. The Board of Directors (the Board) is responsible for overall management and decision-making including establishing working groups and approving draft specifications. There are eleven board members. Each of the Founding Members has one permanent seat and the other two seats are representatives of the Contributing Members elected by voting for a two-year tenure. Working Groups (WGs) develop draft specifications and perform tasks assigned by the Board. Special Interest Groups (SIGs) study specific issues not addressed by any WG. WS-I has three types of members: Founding Members, Contributing Members, and Associate Members. The Founding Members are the nine companies mentioned above. Contributing Members have voting rights and can participate in the development of specifications. They include a wide range of companies, from carriers to vendors such as Nortel Networks and Sun Microsystems. Japanese Contributing Members include NTT, Hitachi, NEC, and Nomura Research Institute. Each of the Founding and Contributing Members can assign a representative to each WG. Associate Members make up a new category added in June 2003. They include non-profit corporations, government entities, educational institutes, standards bodies, and organizations of a similar nature, all of which have

† NTT Information Sharing Platform Laboratories
   Musashino-shi, 180-8585 Japan
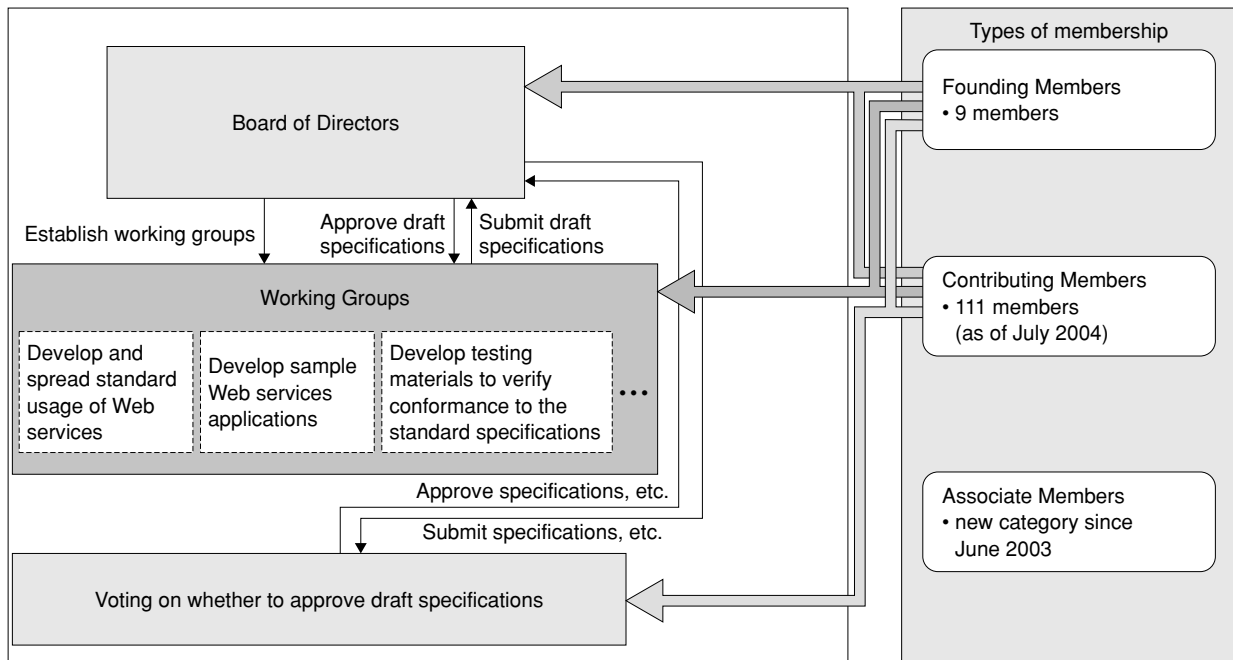   E-mail: shigyo.yusuke@lab.ntt.co.jp

Fig. 1. Organizational structure of WS-I.

been invited by the Board. They do not have voting rights. This category reinforces collaboration with W3C (World Wide Web Consortium), OASIS (Organization for the Advancement of Structured Information Standards) and other standards bodies. When WS-I was founded, the Board consisted of only Founding Members, but an election in April 2003 resulted in two Contributing Members (Sun Microsystems and WebMethods) joining the Board. Initially, there were three WGs, but now there are six. The primary ones are Basic Profile WG, Sample Applications WG, Testing WG, and Basic Security

Profile WG. One of the SIGs is Japan SIG, which promotes and markets WS-I specifications in Japan.

3. Process of specifications development

The process of developing specifications is shown in **Fig. 2**. WS-I activities start with an analysis of businesses that may utilize Web services. This analysis yields a set of business requirements called "use cases". Technical requirements in use cases are identified and are compiled as "usage scenarios". Then a profile is developed containing conventions that must
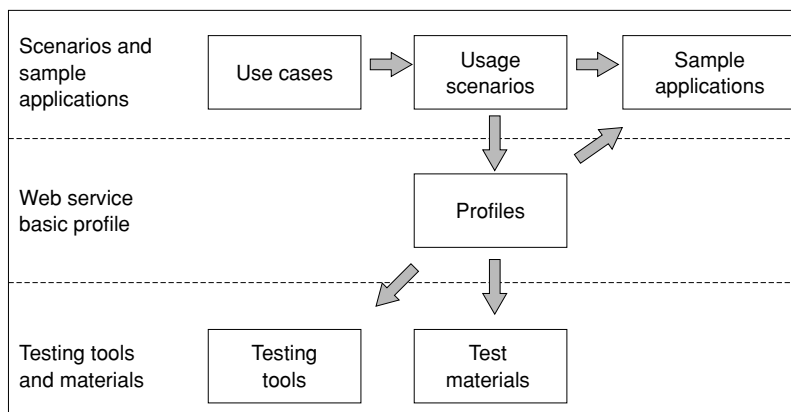
Fig. 2. Process of developing specifications.

Table 1.   Current status of primary Working Groups.

Working Group	Final deliverable versions (approval dates)	Future deliverables (release dates)
Basic Profile WG	• Basic Profile 1.0 (Aug. 2003) • Basic Profile 1.1 (June 2004) • Simple SOAP Binding Profile 1.0 (Aug. 2004) • Attachments Profile 1.0 (Aug. 2004)	
Sample Applications WG	• SCM Use Cases 1.0 (Dec. 2003) • Usage Scenarios 1.0 (Dec. 2003) • SCM Architecture 1.0 (Dec. 2003) • Sample Application Package (Dec. 2003)	• Study on sample applications supporting a set of Basic Profile 1.1 specifications and Basic Security Profile 1.0 (a set of sample applications and documents)
Testing WG	• Testing Tools Specifications (Jan. 2004) • Test Tool 1.0 Packages (Mar. 2004)	• Study on testing tools supporting a set of Basic Profile 1.1 specifications and Basic Security Profile 1.0 (a set of testing tools and documents)
Basic Security Profile WG		• Basic Security Profile 1.0 (May 2004 (WGD)) • Security Scenario (Jan. 2004 (WGD))

WGD: Working Group Draft

be satisfied by the standard specifications for Web services. Finally, in order to verify conformance of Web services products to the profile, testing tools and materials are developed. WS-I also develops sample applications and performs conformance tests using the testing tools it has developed. Any deliverables generated by a WG are subject to approval by the WG, then by the Board, and finally by WS-I voting members.

4.   Current status of deliverables

The current status of deliverables from each of the primary WGs is described below. The current status of Working Groups is shown in **Table 1**.

4.1 Basic Profile WG

The Basic Profile is a set of requirements designed to improve Web service interoperability. It describes the required extent of implementation of the standard specifications needed for Web services, clarifies any ambiguous points and errata, and describes items that identify inconsistencies or ensure compatibility between different specifications. This is the central document of WS-I. Current work on the Basic Profile includes clarification of how to use XML Schema 1.0, SOAP 1.1, WSDL (Web services description language) 1.1, and UDDI (universal description, discovery, and integration) 2.0, including indicating which options in these specifications are mandatory. The requirements can be classified into (1) clarifying ambiguities in each specification (unifying interpretation) and (2) ensuring compatibility between different specifications (e.g., eliminating inconsistencies

Table 2.   Examples of requirements in Basic Profile.

(1) Clarifying ambiguities in different specifications
Example: R2007 A DESCRIPTION MUST specify a non-empty location attribute on the wsdl:import element. Explanation: WSDL 1.1 is not clear about whether the location attribute of the wsdl: import statement is required or what its content is required to be.
(2) Ensuring compatibility between different specifications
Example: R2701 The wsdl:binding element in a DESCRIPTION MUST be constructed so that its soapbind: binding child element specifies the transport attribute. Explanation: There is an inconsistency between the WSDL 1.1 specification and the WSDL 1.1 schema regarding the transport attribute. This could impair interoperability.

and unifying implementation). Examples of the requirements are shown in **Table 2**. The final edition of the first version (Version 1.0) of Basic Profile was released in August 2003.

Currently, the WG is working on a set of Basic Profile 1.1 specifications. This consists of Basic Profile 1.1 (the foundation) and Simple SOAP Binding 1.0 and Attachments Profile 1.0, which are both extension profiles. Basic Profile 1.1 has been created by incorporating errata in Basic Profile 1.0 and removing the requirements related to SOAP binding.

Simple SOAP Binding Profile 1.0 was an integral part of Basic Profile 1.0. However, it was separated from Basic Profile 1.1 into an extension profile to make WS-I applicable to Web services that utilize MIME (multipurpose Internet mail extensions) binding based on SOAP with attachments instead of using SOAP binding. If Simple SOAP Binding 1.0 and Basic Profile 1.1 were combined, they would become

equivalent to the requirements in Basic Profile 1.0.

Attachments Profile 1.0 is a profile derived from the requirements for attached documents (SOAP with attachments and MIME binding). Its scope includes explicitly bound attachments (a communication method in which a SOAP message contains attached files) and referenced attachments (a communication method in which a SOAP message contains links to attached files). This specification is intended to be used with Basic Profile 1.1. Since not all Web services that are supposed to conform to WS-I implement SOAP with attachments, it was considered unreasonable to include this format in the Basic Profile, so it was defined separately as an extension profile.

The standard specifications and conventions referred to by a set of Basic Profile 1.1 specifications are the same as those of Basic Profile 1.0.

Basic Profile 1.1, Simple SOAP Biding Profile 1.0, and Attachments Profile 1.0 were approved by WS-I members in August 2004 and became the final edition.

4.2 Sample Applications WG

The Sample Applications WG defines scenarios that support the Basic Profile and develops sample applications that are designed to demonstrate interoperability. As its first output, the WG has released use cases, usage scenarios, an architecture, and a sample application package modeling a supply chain management (SCM).

SCM Use Cases describe, for each use case (e.g., purchasing goods), the actions of each actor (e.g., a retailer sending a delivery request to a warehouse), and related business requirements.

Usage Scenarios state technical requirements for the use of Web services based on use cases. They define SOAP message processing, constraints, messages, and the sequence for each scenario for three types of message exchange (one-way scenario, synchronous request/response scenario, basic callback scenario). This document is intended to enable users to obtain necessary information when they develop Web services applications conforming to WS-I using these scenarios.

SCM Architecture details the technical design and implementation of sample applications. Specifically, it describes the relationships between actors in SCM Use Cases (retail service, warehouse, and manufacturer) in the form of functional specifications (e.g., operations, messages, sequence, and class diagram).

The Sample Applications WG has declared that it

will develop use cases, scenarios, architecture and sample applications that support Basic Profile 1.1. The deliverables supporting Basic Profile 1.0 were released in December 2003. The WG is currently working on use cases, scenarios and architecture for the set of Basic Profile 1.1 specifications, and the specifications of sample applications for Basic Security Profile 1.0. The new versions will be based on current SCM applications and will incorporate newly added functions and requirements. Specifically, they will be those for Basic Profile 1.0 plus amendments related to (1) increased Web service security using SSL (secure sockets layer), and (2) exchange of attached documents.

4.3 Testing WG

The Testing WG provides testing tools and documents used to test the conformance of Web services to the Basic Profile.

Testing tools consist of a *monitor* that captures messages exchanged between Web services and creates a log and an *analyzer* that analyzes the messages recorded in the log and produces a conformance report. There are both Java and C# versions of these tools. A Test Tool Package is a set of these testing tools.

A set of documents called "Testing Tools Document Package" consists of four documents. (1) Test Assertion Document (TAD): To test conformance to the requirements in the Basic Profile, those requirements are converted to a form that can be understood by the analyzer. This converted form is called an Assertion and is written in XML. (2) Tools User's Guide: This provides a general description of testing tools, their usage, TAD, test processing, and test results. (3) Monitor Tool Functional specification and Analyzer Tool Functional specification: These provide functional specifications of the monitor and the analyzer. (4) TAD Helper Document: This describes how to display TAD, defines terms used in TAD, and explains how to interpret test results.

The Testing WG has declared that it will develop testing tools and documents that support Basic Profile 1.1. The WG released deliverables supporting Basic Profile 1.0 in March 2004. As with the Sample Applications WG, this group is working on new versions that support the set of Basic Profile 1.1 specifications and new versions that support Basic Security Profile 1.0. The new versions that support the set of Basic Profile 1.1 specifications will be those for Basic Profile 1.0 plus amendments related to the exchange of attached documents.

4.4 Basic Security Profile WG

The Basic Security Profile WG was established in April 2003 with the aim of creating a profile related to Web service security. One of the base specifications for Basic Security Profile 1.0 is "WS-Security 1.0", developed by the OASIS Web Service Security Technical Committee. The WS-Security documents currently subject to review are: (1) SOAP Message Security, (2) Username Token Profile, and (3) X.509 Certificate Token Profile. They address security in message transfer, security of SOAP messages, and other security issues involved in Basic Profile 1.0. The Working Group Draft of the Basic Security Profile 1.0 was released in May 2004.

Security scenarios are derived from the foundational part of Sample Application 1.0. They document security requirements that must be met by Web services, show how to identify security threats, and provide countermeasures. Specifically, they address issues, threats, countermeasures, and usage scenarios. The security scenarios deal with three types of message exchange (one-way, synchronous request/response, and basic callback). The Working Group Drafts of these specifications were released in January 2004.

5. Future prospects

Basic Profile 1.0 and various supporting deliverables were all completed by March 2004, so WS-I is now working on Basic Profile 1.1. Since April 2003, work has intensified on security issues, and related specifications have been developed. Sun Microsystems' election to the Board is particularly noteworthy. This implies that the non-IBM/non-Microsoft camp is now in a position to give approval to WS-I documents. There have already been some positive results. JDK1.4 conforms to Basic Profile 1.0, and WS-I specifications are widely recognized for the lower layers of Web-service-related standards (XML, SOAP, WS-I, and UDDI). The work of WS-I, which enhances interoperability which is crucial for the spread of Web services, is expected to find even more widespread acceptance in the future.

Reference

[1]   http://ws-i.org/

Yusuke Shigyo
  Senior Research Engineer, Web Service Project, Application Platform SE Project, NTT Information Sharing Platform Laboratories.
  He received the B.E. degree in electronics and communication engineering from Waseda University, Tokyo in 1989. He joined NTT the same year. His current research involves service integration methods, mainly for web services. He is a member of the Institute of Electronics, Information and Communication Engineers of Japan.