

# Standards and protocols in Service oriented Software Development

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## Abstract

*The emergence of the service oriented architecture(SOA) has created many new windows of opportunities to the software developers to develop and conceive new concepts, models, technologies and methods based on the need of the evolving and dynamic field of service oriented environment. Thus to procure these things, we need certain standards and protocols that can be universally accepted and followed so that we can apply the concepts to develop service oriented applications. The standards and protocols are being developed and refined in a continuous facilitative manner by the joint co-ordination of the industry people and the researchers. This paper will attempt to provide an detailed overview of these standards and protocols in service oriented software development.*

**Keywords:** Service-oriented computing, software development, standards, protocols, web services.

## 1. Introduction

Service oriented architecture(SOA) has been the most talked about software paradigm in the recent years. Service oriented computing, especially web services, has received a significant amount of attention in the recent years from both the academia and industry. With the onset of the web services, major industries are trying to incorporate them into their technology domains. It has certain benefits like now the computer applications can be deployed through remote servers also rather than only on the local server as standalone applications. This has benefitted the software development rapidly by promoting component based development, thus integrating the business requirements much faster than before. [2]

Thus due to all these reasons we need a proper standard and guidelines to understand these concepts and able to apply them to meet our business requirements.

## 2. Service-oriented architecture and web services-need for standards and protocols:

Service oriented architecture(SOA) functions based on the platform independency and interoperability which allows consuming and publishing services over the internet as web services. The standards set for the web services are based on the readily and openly available internet protocols making easier to adopt.[2] Current researches are being done on how to standardize and converge upon the best way of implementation of the web services. However the architecture of the web services can be broadly classified into three parties - service requestor, service broker and service provider which are independent of each other and their communication pattern is shown via the following diagram.

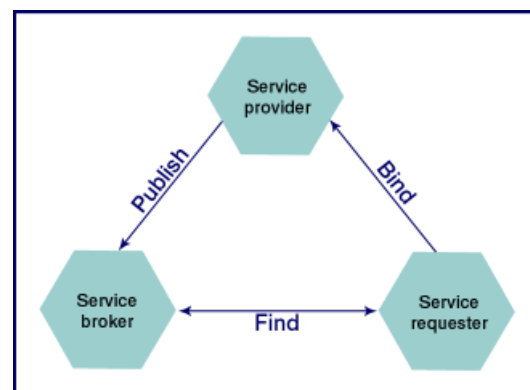


Figure 1 taken from Reference [2]

## 3. Standards of Web services:

The web services architecture is built on standards relating to connection, communication, description and discovery of the services to promote better communication between organizations. The service

requestor and the service provider requires a common standard language to interact among each other which is provided by XML. The Simple Object Access Protocol(SOAP) has been the standard protocol for communication between the systems. Another important standard that is being used is the Web Service Description Language(WSDL) which acts as a programming interface for describing the web services. The service brokers provides a set of standard service interfaces for the dynamic discovery of services using Universal Description, Discovery and Integration(UDDI) which contains a registry for holding the services to be discovered by the consumers.[1][3]

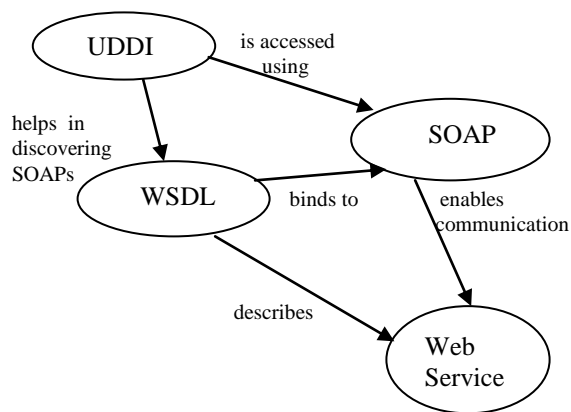


Figure 2 showing the relationship among the standards

### 3.1 SOAP :

Simple Object Access Protocol(SOAP) can be generally used for exchanging structured information in a distributed environment. It is a stateless and one way message exchange protocol which relies on HTTP to relate the return message to the requesting message. HTTP implicitly correlates the SOAP request message with its response message.[1][8] The HTTP binding makes use of the SOAP Web Method feature to allow application in choosing web method - either GET or POST - to use over HTTP message exchange. The messaging pattern is mainly through Remote Procedure Call(RPC) in which a client sends a request message to the server and the server immediately sends a response message back to the client. SOAP message can take longer time to process due to their lengthy XML format. An example of the SOAP message sent by a client to the server requesting the information about a hotel is given below:

```

<soap:Envelope
xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
<soap:Body>
<getHotelDetails
xmlns="http://www.hotels.example.com/ws">
<hotelID>827631</hotelID>
</getHotelDetails>
</soap:Body>
</soap:Envelope>
  
```

Figure 3 showing a SOAP example code

### 3.2 XML :

XML is an extensible markup Language and is one of the important standards in service oriented software development. It is a meta language that can be used to define other languages. Most protocols in service oriented computing paradigm such as SOAP and WSDL are based on XML. It uses original markup tags surrounding sentences, statements, paragraphs and even complete documents. It uses elements and attributes to provide both logical structure and physical structure to the document.[1][9] An example of an XML code showing the information about hotels is given below:

```

<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="Hotel.xslt"?>
<Hotels>
  <Hotel Stars="*****">
    <Name>Mandarin Oriental</Name>
    <Contact>
      <Phone>7025908888</Phone>
      <Email>hotels@mandarinoriental.com</Email>
    </Contact>
    <Address BusLines="482,987,994">
      <Number>3752</Number>
      <Street>Boulevard South</Street>
      <City>Las Vegas</City>
      <Zip>89109</Zip>
    </Address>
  </Hotel>
  ...
</Hotels>
  
```

Figure 4 showing a sample XML code snippet

### 3.3 WSDL :

Web Service Description Language(WSDL) is a language that can be used to describe Web Services in the common XML syntax. It demonstrates four aspects of web services :

- a) functionality of the web service
- b) Data types for parameter values and return types of the function(service) calls.
- c) Binding information about the transport protocol that is used.
- d) Address for locating the specified service. [1]

A WSDL document defines one or more services and each service is a collection of endpoints called ports. The WSDL document uses certain elements in the definition of the web services.[7]

They can be classified as :

- a) **definition** - root element that defines the name of the web service, declares namespaces used in the document and contains all the service elements.
- b) **service** - collection of related endpoints. It defines the address of the invoked service.
- c) **port** - single endpoint defined as a combination of binding and a network address.
- d) **binding** - concrete protocol and data format specification for a particular port type.
- e) **message** - name of the message, contains zero or more message parts, which can refer to message parameter or return values.
- f) **operation** - abstract description of an action supported by the service.
- g) **types** - Container for data types using a certain type system(such as DTD or XSD). Describes all the data types between a client and a server.[1]

An example of a WSDL document is given below:

```
<definitions name="HelloService"
targetNamespace="http://www.examples.com/wsdl/HelloService.wsdl"
xmlns="http://schemas.xmlsoap.org/wsdl/"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
xmlns:tns="http://www.examples.com/wsdl/HelloService.wsdl"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
<message name="SayHelloRequest">
<part name="firstName" type="xsd:string"/>
</message>
<message name="SayHelloResponse">
<part name="greeting" type="xsd:string"/>
</message>
<portType name="Hello_PortType">
<operation name="sayHello">
<input message="tns:SayHelloRequest"/>
<output
message="tns:SayHelloResponse"/>
</operation>
</portType>
<binding name="Hello_Binding"
type="tns:Hello_PortType">
<soap:binding style="rpc"
transport="http://schemas.xmlsoap.org/soap/http"
/>
<operation name="sayHello">
<soap:operation soapAction="sayHello"/>
<input>
<soap:body
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:examples:helloservice"
use="encoded"/>
</input>
<output>
<soap:body
encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"
namespace="urn:examples:helloservice"
use="encoded"/>
</output>
</operation>
</binding>
<service name="Hello_Service">
<documentation>WSDL File for
HelloService</documentation>
<port binding="tns:Hello_Binding"
name="Hello_Port">
<soap:address
location="http://www.examples.com/SayHello/">
</port>
</service>
</definitions>
```

Figure 5 showing a sample WSDL document [7]

### 3.4 UDDI :

The Universal Description, Discovery and Integration(UDDI) is an OASIS standard that is used to represent, to model and to publish Web services. UDDI was first initiated by IBM, Ariba and Microsoft. Now more than 300 companies are part of this organization including HP, Intel, Novell. It is platform-independent and based on existing standards including XML, SOAP and WSDL. UDDI contains a central directory that hosts service descriptions that stores standardized profile records called registry. The registry information is roughly organized into three groups:[1]

- **White pages:** It includes service provider's name, identity and contact information.
- **Yellow pages:** It includes the industry type, product type, service type and geographical location.
- **Green pages:** It includes the binding information of the services, references to the technical models that those services implement and pointers to various files and URL based discovery mechanisms. [1][4]

The data in an UDDI is conceptually divided into five different categories or models, each of which can be represented into an entity. Each of the entity is assigned a UUID, Universally Unique Identifier such as:  
a)businessEntity      b)      businessService      c)  
bindingTemplate d) tModel e) publisherAssertion.

(a) and (b) refers to the white pages and yellow pages respectively and (c) and (d) refers to the green page.[1]

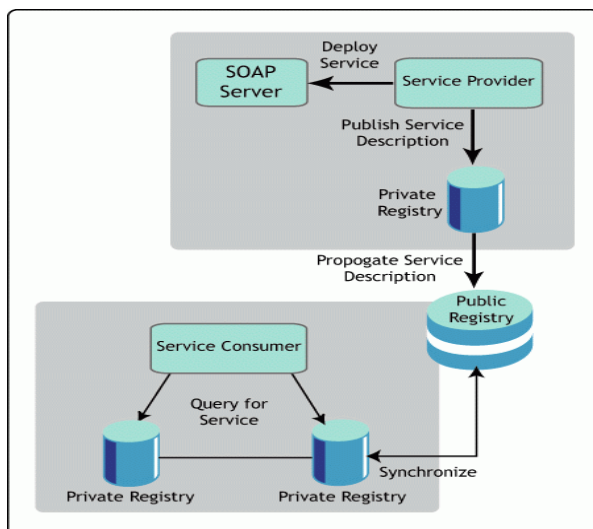


Figure 6 showing interaction between service providers and consumers in a typical UDDI scenario.[13]

### 3.5 ebXML:

ebXML (electronic business XML) describes the electronic trading relationships and standard business processes between business organizations. ebXML provides a global standard for governmental and commercial organizations for interacting with business partners. ebXML provides a flexible platform for supporting simple service descriptions as well as complex document exchange in the heterogeneous eBusiness transactions. ebXML provides the same directory service (registry/repository) as UDDI and builds a complex global e-business infrastructure that allows small companies and start-ups to participate. In addition to the central business processes, ebXML also leverages messaging service and CPP (Collaboration Protocol Profile) which is the description of the processes and interface published by the participating company.[2][6]

### 4. Standards Organizations:

Many of the SOA standards and protocols are open source and are independent of the vendor. For example IBM has its own SOA built in for its WebSphere platform , on the other hand Microsoft has its SOA for its Visual Studio in supporting the ASP.NET framework. Thus it is important to standardize the technologies based on the services. The three most important standards organization for implementing these are W3C, OASIS and WS-I.[4][5]

#### 4.1 W3C :

The World-Wide Web Consortium is an organization promoting the standards for web technologies. The goal of the W3C is to improve online business and sharing of resources. W3C's main standards for services are based on XML, XML schema, WSDL and SOAP.

#### 4.2 OASIS :

The Organization for the Advancement of Structured Information Standards is the largest standards group for SOA and web services. It supports over 60 technical committees. Most standards are from OASIS which includes UDDI, BPEL4WS and ebXML.

#### 4.3 WS-I :

The Web Services Interoperability Organization is an open industry organization which promotes the interoperability of web services across different platforms and languages using Basic Profile Version.

	<b>W3C</b>	<b>OASIS</b>	<b>WS-I</b>
Established	1994	1993 as SGML open, 1998 as OASIS 600.	2002
Approximate membership	400	600	200
Objective	To provide fundamental standard that promote online business and resource sharing.	To provide online trade and commerce via specialized web standards	To provide standard interoperability using web standards.
Prominent deliverables	XML, XML schema, XQuery, Xpath, SOAP, WS Addressing.	UDDI, ebXML, SAML, WS-BPEL, WS Security	Basic Profile, Basic Security Profile

Table 1 showing the comparative study among the web services standards organization[10]

Among them the WS-I supports generic protocols for the interoperable exchange of messages. Its main part is the Basic Profile Version 1.0 which consists of services like SOAP, HTTP, XML, XML Schema, UDDI and WSDL.

These standards organizations have also outlined certain security and reliability features of the web services. There are certain standards and protocols that portrays and standardizes the security and reliability issues of the web services. Now I will discuss the security and reliability standards of the web service.

## 5. Security of Web Services:

To ensure confidentiality and integrity of the web service documents the organizations have set up standards and protocols that help in maintaining that.

### 5.1 WS Federation:

The Web Service Federation Language defines ways to allow different security procedures to federate, such that it allows the authorized access in one security

domain can lead to management of the identities and attributes of that access in other security domains also using the same principle.[13][14][12]

### 5.2 WS Security:

The Web Service Security is a mechanism that converts security information into SOAP messages. It uses certain kinds of binary tokens for authentication, digital signatures for integrity and content level encryption for confidentiality. Microsoft .NET Passport uses WS Security as a standard.[13][14][12]

### 5.3 WS Trust:

The Web Service Trust Language is basically the extension of the WS-Security which has all the functions of WS-Security and also provides further additional methods for validating, securing and renewing security tokens.[13][14][12]

### 5.4 SAML:

Security Assertion Markup Language is a framework for exchanging information regarding authorization and authentication. It uses an XML format to represent the security credentials and terms them as assertions and uses HTTPS protocol to ensure confidentiality of the web services. The Liberty Alliances' authentication solution is based on SAML for security.[11]

These are the major security standards used by the web services. However there are other security standards also like the WS-Security Kerberos Binding, Web Services Security Policy, WS-Federation: Passive Requestor Profile, Web Services Provisioning, Web Services Secure Conversation Language.

## 6. Reliability of Web Services:

Reliability in Web Services is maintained in a way which allows messages which are reliable to be delivered between distributed applications in service oriented software components. There are a number of standards which ensures completion of message exchanges.[13]

### 6.1 WS-Reliable Messaging:

Web services reliable messaging describes a protocol to transfer messages in between distributed applications

in presence of service oriented software components. This type of messaging system works in case of system and network failure.[14]

## 6.2 WS-Policy Assertions:

Web Service Policy Assertions Language specifies a common set of policies of message that are asserted within a specified message policy. The specifications of these messages defines general messaging related assertions for use with Web service Policy for reliable messaging.[14]

## 7. Conclusion :

Thus in this paper you can get an overview of the most important and commonly used standards and protocols in service oriented software development and also their security and reliability measuring standards. There are other standards also. The use of a particular standard on a web service depends on the need and the business requirement. The unified objective of all these standards is to promote rapid software development and thereby helping reusability of services. The end users can deploy the applications in any platform at any time thus benefitting them immensely being cost effective. Thus service oriented computing paradigm and its standards will be of more value in the future with further research and development in this field.

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