

A large, light blue stylized letter 'Q' with a white square cutout in its top right corner, serving as a background graphic for the text.

# Overview: Web Services Standards and Specifications

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Service-oriented Architecture, or SOA, is an abstract architectural concept that can be implemented using a variety of different technologies, tools and products. An SOA can be built using *Web Services* technology, based on a set of standards and specifications that have been built for this purpose.

Or so it is claimed.

The goal of this presentation is to give an overview of the various specifications, recommendations and standards that are available in the Web services community.

- ❑ GM and Principal Consultant at innoQ, a consultancy founded in 1998 with offices in Duesseldorf and Zurich
- ❑ Customers include Deutsche Post, UBS, Nokia, Bank-Verlag
- ❑ innoQ focuses on software architecture, specifically
  - ❑ Rational Software Production using MDA and MDD approaches, including an MDA product called iQgen (since 2000)
  - ❑ Service-oriented Architecture/Web Services (since 2002)
- ❑ innoQ provides consulting and development services for
  - ❑ Strategic/Enterprise Architecture
  - ❑ Methods, Processes, Organizational Aspects
  - ❑ Technology such as J2EE and .NET
- ❑ innoQ is a Systinet Solution Provider

- ❑ Web Services Standards Process
- ❑ Authors of Web Services standards
  - ❑ Standards Bodies
  - ❑ Vendors
- ❑ Fundamental Technologies
  - ❑ XML
  - ❑ Messaging
  - ❑ Metadata

- ❑ Functional Areas and Related Standards
  - ❑ Attachments
  - ❑ Reliable Messaging
  - ❑ Notification
  - ❑ Transactions
  - ❑ Business Processes and Orchestration
  - ❑ Security
  - ❑ Resources
  - ❑ Management
- ❑ Interoperability
- ❑ Summary

# Web Services Standards Process

- ❑ There is no such thing!
- ❑ Some Web Services "standards" are only "specifications"
- ❑ Many Web Services "standards" are only in working draft or draft status
- ❑ Vendors and - to a lesser degree - standards bodies use standards for political purposes
- ❑ Some topics are covered by multiple competing specifications
- ❑ Only time will tell which will survive
  - ❑ General hint: If Microsoft and/or IBM are not involved, chances are slim
- ❑ Although many standards use the common prefix "WS-", that does not mean there's a "WS-Architecture"

# Authors of Web Services Standards



- ❑ Internet Engineering Task Force (IETF)
  - ❑ mainly for general, basic standards such as TCP, HTTP, TLS
- ❑ World Wide Web Consortium (W3C)
  - ❑ for XML, SOAP, WSDL and "The Web"
- ❑ Organization for the Advancement of Structured Information Standards (OASIS)
  - ❑ for UDDI, business vocabularies, ebXML
- ❑ Web Services Interoperability Organization (WS-I)
  - ❑ for real-world interoperability rules

**IETF (Internet Engineering Task Force)** is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet.

*<http://www.ietf.org/>*

**W3C (World Wide Web Consortium)** was created in October 1994 to lead the World Wide Web to its full potential by developing common protocols that promote its evolution and ensure its interoperability. W3C has over 350 Member organizations from all over the world and has earned international recognition for its contributions to the growth of the Web. W3C is designing the infrastructure, and defining the architecture and the core technologies for Web services. In September 2000, W3C started the XML Protocol Activity to address the need for an XML-based protocol for application-to-application messaging. In January 2002, the Web Services Activity was launched, subsuming the XML Protocol Activity and extending its scope.

*<http://www.w3.org/>*

**OASIS (Organization for the Advancement of Structured Information Standards)** is a not-for-profit, international consortium that drives the development, convergence, and adoption of e-business standards. The consortium produces more Web services standards than any other organization along with standards for security, e-business, and standardization efforts in the public sector and for application-specific markets. Founded in 1993, OASIS has more than 4,000 participants representing over 600 organizations and individual members in 100 countries.

*<http://www.oasis-open.org/>*

Most of the work in Web services standardization is driven by a few large vendors:

- ❑ Microsoft (.NET)
- ❑ IBM (WebSphere)
- ❑ BEA (Weblogic)
- ❑ Sun (Java)
- ❑ SAP
- ❑ HP (multiple, mainly management)
- ❑ Verisign (security)
- ❑ plus a multitude of other companies such as TIBCO, webMethods, CA, Systinet, ...



**Core Standards**

The only thing most Web services vendors, standard bodies and users agree on is that the data format should be XML. The core standards are:

- ❑ XML 1.0
- ❑ XML Namespaces
- ❑ Infoset
- ❑ XSD

XML is a pared-down version of SGML, designed especially for Web documents. It allows one to create own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

*W3C - Recommendation - 1.0*  
<http://www.w3.org/XML/>



**Namespaces in XML** provide a simple method for qualifying element and attribute names used in XML documents by associating them with namespaces identified by IRI references.

*W3C - Recommendation - -*  
<http://www.w3.org/TR/REC-xml-names/>

**Infoset (XML Information Set)** is an abstract data set to provide a consistent set of definitions for use in other specifications that need to refer to the information in a well-formed XML document.

*W3C - Recommendation - 1.0*  
<http://www.w3.org/TR/xml-infoset>

- ❑ The most noticeable effect of the Infoset is that W3C specs are now even harder to read than before

**XML Schema (XSD)** is an XML language for describing and constraining the content of XML documents.

*W3C - Recommendation - 1.0*  
<http://www.w3.org/TR/xmlschema-1/>

- ❑ XML Schema is large, complex, and a typical result of committee work
- ❑ Alternatives such as RELAX NG and complementary specs such as Schematron are worth investigating

Messaging (in the sense of "exchanging messages as part of some communication") is what standards such as SOAP layer on top of XML and different transport and transfer protocols.

Key standards are:

- ❑ SOAP (1.1 and 1.2)
- ❑ MTOM
- ❑ WS-Addressing



**SOAP** is a lightweight, xml-based protocol for exchange of information in a decentralized, distributed environment.

*W3C - Recommendation - 1.2*  
<http://www.w3.org/TR/soap>

*W3C - Note - 1.1*  
<http://www.w3.org/TR/soap12/>

- ❑ SOAP is more a protocol building toolkit than a protocol
- ❑ SOAP defines envelop, headers, body
- ❑ (Almost) all of the other specs leverage SOAP extensibility
- ❑

**SOAP Message Transmission Optimization Mechanism** describes an abstract feature for optimizing the transmission and/or wire format of a SOAP message.

*W3C - Proposed Recommendation -*  
<http://www.w3.org/TR/soap12-mtom/>

**WS-Addressing** provides transport-neutral mechanisms to address Web services and messages. This specification defines XML elements to identify Web service endpoints and to secure end-to-end endpoint identification in messages.

*W3C - Working Draft -  
<http://www.w3.org/TR/ws-addr-core>*

- ❑ With WS-Addressing, SOAP endpoints can be passed in SOAP messages
- ❑ Can be used for callback scenarios, asynchronous communication, fault "hospitals"

**Metadata**

Metadata is data about data, in this case data about Web services. Information that could be described includes logical (interface-related), physical, binding, addressing, quality of service and other non-functional information.

Standards and specs include:

- ❑ UDDI
- ❑ WSDL
- ❑ WS-Policy
- ❑ WS-Metadata Exchange
- ❑ WS-Discovery

**UDDI (Universal Description, Discovery and Integration)** defines a set of services supporting the description and discovery of businesses, organizations, and other Web services providers, the Web services they make available, and the technical interfaces which may be used to access those services.

*OASIS - Workin Draft - 3.0.2*  
*[http://uddi.org/pubs/uddi\\_v3.htm](http://uddi.org/pubs/uddi_v3.htm)*

**WSDL (Web Services Description Language)** is an XML-based language for describing Web services and how to access them. It specifies the location of the service and the operations (or methods) the service exposes.

*W3C - Note - 1.1*  
*<http://www.w3.org/TR/wsdl>*

**WS-Policy** describes the capabilities and constraints of the policies on intermediaries and endpoints (e.g. business rules, required security tokens, supported encryption algorithms, privacy rules).

*BEA Systems, IBM, Microsoft, SAP, Sonic Software, and VeriSign - Draft -  
<http://msdn.microsoft.com/library/en-us/dnglobspec/html/ws-policy.asp>*

**WS-PolicyAssertions** provides an initial set of assertions to address some common needs of Web services applications.

*BEA Systems, IBM, Microsoft, SAP - Draft -  
<http://msdn.microsoft.com/library/en-us/dnglobspec/html/ws-policyassertions.asp>*

**WS-PolicyAttachment** defines two general-purpose mechanisms for associating policies with the subjects to which they apply; the policies may be defined as part of existing metadata about the subject or the policies may be defined independently and associated through an external binding to the subject.

*BEA Systems, IBM, Microsoft, SAP, Sonic Software, and VeriSign - Draft -  
<http://msdn.microsoft.com/library/en-us/dnglobspec/html/ws-policyattachment.asp>*

**WS-MetadataExchange** enables a service to provide metadata to others through a Web services interface. Given only a reference to a Web service, an user can access a set of WSDL/SOAP operations to retrieve the metadata that describes the service.

*BEA Systems, Computer Associates, IBM, Microsoft, SAP, Sun Microsystems, and webMethods - Draft -  
<http://msdn.microsoft.com/library/en-us/dnglobspec/html/ws-metadataexchange.pdf>*

**WS-Discovery** defines a multicast discovery protocol for dynamic discovery of services on ad-hoc and managed networks.

*Microsoft, BEA Systems, Canon, Intel, and webMethods - Draft -  
<http://msdn.microsoft.com/ws/2004/10/ws-discovery/>*



# Attachments



Multiple specifications deal with the sending of arbitrary (binary) attachments as part of or associated with a SOAP message:

- ❑ SOAP with Attachments, MIME
- ❑ WS-Attachments, DIME

**SOAP 1.2 Attachment Feature** defines a SOAP feature that represents an abstract model for SOAP attachments. It provides the basis for the creation of SOAP bindings that transmit such attachments along with a SOAP envelope, and provides for reference of those attachments from the envelope.

*W3C - Note - No further work: superseded by MTOM*  
*<http://www.w3.org/TR/2004/NOTE-soap12-af-20040608/>*

**SwA (SOAP Messages with Attachments)** proposes a set of concrete idioms and conventions that build on SOAP (1.1 , 1.2) Messages with Attachments in order to integrate XML with pre-existing data formats

*AT&T, BEA Systems, Canon, Microsoft, SAP - Draft - 0.61*  
*<http://www.w3.org/TR/SOAP-attachments>*

**DIME (Direct Internet Message Encapsulation)** is a lightweight, binary message format that can be used to encapsulate one or more application-defined payloads of arbitrary type and size into a single message construct

*(IETF) Microsoft, IBM - Internet-Draft - dead  
<http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnglobspec/html/dimeindex.asp>*

**WS-Attachments** defines an abstract model for SOAP attachments and based on this model defines a mechanism for encapsulating a SOAP message and zero or more attachments in a DIME message

*Microsoft, IBM - Internet-Draft -  
<http://www-106.ibm.com/developerworks/webservices/library/ws-attach.html>*

Should you use SwA or DIME/WS-Attachments?

- ❑ None of them
- ❑ The future is XOP/MTOM
- ❑ In the meantime, pick one of SwA, DIME, or manual base64 encoding
- ❑ plan to change to MTOM later



## Reliable Messaging

Reliable Messaging provides guaranteed delivery of messages (with different QoS levels such as in-order, best-effort, exactly-one etc.) based on SOAP *regardless of the transport being used.*

Two specs compete:

- ❑ WS-ReliableMessaging
- ❑ WS-Reliability

**WS-ReliableMessaging** describes a protocol that allows Web services to communicate reliably in the presence of software component, system, or network failures. It defines a SOAP binding that is required for interoperability.

*BEA Systems, IBM, Microsoft, and Tibco - Draft -*

*<http://msdn.microsoft.com/webservices/default.aspx?pull=/library/en-us/dnglobspec/html/ws-reliablemessaging.asp>*

**WS-Reliability** is a SOAP-based protocol for exchanging SOAP messages with guaranteed delivery, no duplicates, and guaranteed message ordering. WS-Reliability is defined as SOAP header extensions and is independent of the underlying protocol.

*OASIS - OASIS-Standard - 1.1*

*<http://docs.oasis-open.org/wsrn/2004/06/WS-Reliability-CD1.086.pdf>*

- ❑ Which one should you pick?
  - ❑ WS-Reliability is an OASIS standard
  - ❑ WS-ReliableMessaging is backed by IBM, Microsoft and BEA
- ❑ Take a guess ...





**Notification**

Event notifications using SOAP enable advanced communication patterns, such as publish/subscribe and/or content-based routing, in a transport-independent way.

Again, specs compete:

- ❑ WS-Eventing
- ❑ WS-Notifications
- ❑ (WS-Events)

**WS-Eventing** defines a baseline set of operations that allow Web services to provide asynchronous notifications to interested parties.

*BEA Systems, Computer Associates, IBM, Microsoft, Sun Microsystems, and TIBCO Software - Public Draft -  
<http://ftpna2.bea.com/pub/downloads/WS-Eventing.pdf>*

**WS-Notification** is a family of related white papers and specifications that define a standard Web services approach to notification using a topic-based publish/subscribe pattern.

*OASIS - Working Draft - 1.2*

Is an umbrella spec that encompasses

- ❑ WS-BaseNotification
- ❑ Ws-Topics
- ❑ WS-BrokeredNotification

**WS-BaseNotification** standardizes the terminology, concepts, operations, WSDL and XML needed to express the basic roles involved in Web services publish and subscribe for notification message exchange.

*OASIS - Working Draft - 1.2*

*<http://docs.oasis-open.org/wsn/2004/06/wsn-WS-BaseNotification-1.2-draft-03.pdf>*

**WS-Topics** defines three topic expression dialects that can be used as subscription expressions in subscribe request messages and other parts of the WS-Notification system.

*OASIS - Working Draft - 1.2*

*<http://docs.oasis-open.org/wsn/2004/06/wsn-WS-Topics-1.2-draft-01.pdf>*

**WS-BrokeredNotification** defines the interface for the NotificationBroker. A NotificationBroker is an intermediary, which, among other things, allows publication of messages from entities that are not themselves service providers.

*OASIS - Working Draft - 1.2*

*<http://docs.oasis-open.org/wsn/2004/06/wsn-WS-BrokeredNotification-1.2-draft-01.pdf>*

There is hope in notification land:

- ❑ IBM has joined WS-Eventing
- ❑ It's likely that future versions of WS-Notification will use some common successor to WS-Eventing and WS-BaseNotification

# Business Processes & Transactions

**WS-Coordination** describes an extensible framework for providing protocols that coordinate the actions of distributed applications.

*Mircosoft, BEA Systems, IBM - Draft -  
[msdn.microsoft.com/library msdn.microsoft.com/ws-coordination.asp](http://msdn.microsoft.com/library/msdn.microsoft.com/ws-coordination.asp) <<http://msdn.microsoft.com/library/en-us/dnglobspec/html/ws-coordination.asp>>*

**WS-Business Activity** defines protocols that enable existing business process and work flow systems to wrap their proprietary mechanisms and interoperate across trust boundaries and different vendor implementations.

*Mircosoft, BEA Systems, IBM - Draft -  
<ftp://www6.software.ibm.com/software/developer/library/WS-BusinessActivity.pdf>*

**WS-Atomic Transaction** defines protocols that enable existing transaction processing systems to wrap their proprietary protocols and interoperate across different hardware and software vendors.

*Mircosoft, BEA Systems, IBM - Draft -  
<ftp://www6.software.ibm.com/software/developer/library/WS-AtomicTransaction.pdf>*

**WS-CAF (WS- Composite Application Framework)** is a collection of three specifications aimed at solving problems that arise when multiple Web services are used in combination. It proposes standard, interoperable mechanisms for managing shared context and ensuring business processes achieve predictable results and recovery from failure.

*Arjuna Technologies, Fujitsu, IONA, Oracle, and Sun Microsystems - Committee Draft - 1.0*  
*[developers.sun.com/techtopics/developers.sun.com/primer.pdf](http://developers.sun.com/techtopics/developers.sun.com/primer.pdf)*

**WS-CTX (WS-Context)** is intended as a lightweight mechanism for allowing multiple Web services to share a common context.

*OASIS - Committee Draft - 1.0*  
*[http://www.arjuna.com/library/specs/ws\\_caf\\_1-0/WS-CTX.pdf](http://www.arjuna.com/library/specs/ws_caf_1-0/WS-CTX.pdf)*



**WS-CF (WS-Coordination Framework)** allows the management and coordination in a Web services interaction of a number of activities related to an overall application.

*OASIS - Committee Draft - 1.0*

*[http://www.arjuna.com/library/specs/ws\\_caf\\_1-0/WS-CF.pdf](http://www.arjuna.com/library/specs/ws_caf_1-0/WS-CF.pdf)*

**WS-TXM (WS-Transaction Management)** defines a core infrastructure service consisting of a Transaction Service for Web services.

*OASIS - Committee Draft - 1.0*

*[http://www.arjuna.com/library/specs/ws\\_caf\\_1-0/WS-TXM.pdf](http://www.arjuna.com/library/specs/ws_caf_1-0/WS-TXM.pdf)*

**BPML (Business Process Management Language)** provides a meta-language for expressing business processes and supporting entities.

*BPML.org - Final Draft - 1.0*  
<http://www.bpmi.org/bpml-spec.htm>

**BPEL4WS (Business Process Execution Language for Web Services)** provides a language for the formal specification of business processes and business interaction protocols using Web services.

*BEA Systems, IBM, Microsoft, SAP, Siebel Systems - OASIS-Standard - 1.1*  
<http://www-106.ibm.com/developerworks/webservices/library/ws-bpel/>

**WS-Choreography Model Overview** defines the format and structure of the (SOAP) messages that are exchanged, and the sequence and conditions in which the messages are exchanged.

*W3C - Working Draft - 1.0*  
<http://www.w3.org/TR/ws-chor-model/>

**CDL4WS (Web Service Choreography Description Language)** specifies a declarative, XML-based language that defines from a global viewpoint the common and complementary observable behavior, where message exchanges occur, and when the jointly agreed ordering rules are satisfied.

*W3C - Working Draft - 1.0*  
*<http://www.w3.org/TR/ws-cdl-10/>*

**WSCI (Web Service Choreography Interface)** describes how Web service operations can be choreographed in the context of a message exchange in which the Web service participates.

*W3C ; Sun Microsystems, SAP, BEA Systems, and Intalio - Note - 1.0*  
*<http://www.w3.org/TR/wsci>*



Security

Web Services security standards define how to secure SOAP messages.

- ❑ In many cases, *transport-level security* (e.g. TLS/SSL for HTTP) is sufficient
- ❑ In many cases, it is not
- ❑ Based on XML standards such as XML Encryption and XML Digital Signature, *WS-Security* defines how to do *message-level security*
- ❑ Amazingly, vendors and standard bodies have agreed upon a single and consistent set of standards

**WS-Security** describes enhancements to SOAP messaging to provide quality of protection through message integrity, message confidentiality, and single message authentication.

*OASIS - - 1.0*

**WS-Security : SOAP Message Security** describes enhancements to SOAP messaging to provide message integrity and confidentiality. Specifically, this specification provides support for multiple security token formats, trust domains, signature formats, and encryption technologies. The token formats and semantics for using these are defined in the associated profile documents.

*OASIS - OASIS-Standard - 1.0*

*<http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-soap-message-security-1.0>*

**WS-Security : Kerberos Binding** defines how to encode Kerberos tickets and attach them to SOAP messages. As well, it specifies how to add signatures and encryption to the SOAP message, in accordance with WS-Security, which uses and references the Kerberos tokens.

*OASIS - Working Draft - 1.0*

*<http://docs.oasis-open.org/wss/2004/07/oasis-000000-wss-kerberos-token-profile-1.0>*

**WS-Security : SAML Token Profile** defines the use of Security Assertion Markup Language (SAML) v1.1 assertions in the context of WSS: SOAP Message Security including for the purpose of securing SOAP messages and SOAP message exchanges.

*OASIS - Working Draft - 1.0*

*<http://docs.oasis-open.org/wss/oasis-wss-saml-token-profile-1.0.pdf>*

**WS-Security : X.509 Certificate Token Profile** describes the use of the X.509 authentication framework with the WS-Security: SOAP Message Security specification.

*OASIS - OASIS-Standard - 1.0*

*<http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-x509-token-profile-1.0>*

**WS-Security : Username Token Profile** describes how a Web service consumer can supply a UsernameToken as a means of identifying the requestor by username, and optionally using a password (or shared secret, etc.) to authenticate that identity to the Web service producer.

*OASIS - OASIS-Standard - 1.0*

*<http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-username-token-profile-1.0>*



**WS-SecurityPolicy** defines how to describe policies related to various features defined in the WS-Security specification.

*IBM, Microsoft, RSA Security, VeriSign - Initial Draft - 1.0*  
<http://www-106.ibm.com/developerworks/library/ws-secpol/>

**WS-Trust** describes a framework for trust models that enables Web services to securely interoperate. It uses WS-Security base mechanisms and defines additional primitives and extensions for security token exchange to enable the issuance and dissemination of credentials within different trust domains.

*BEA Systems, Computer Associates, IBM, Layer 7 Technologies, Microsoft, Netegrity, Oblix, OpenNetwork, Ping Identity Corporation, Reactivity, RSA Security, VeriSign, and Westbridge Technology - Initial Draft - 1.1*  
<http://www-106.ibm.com/developerworks/library/ws-trust/>

**WS-Federation** describes how to manage and broker the trust relationships in a heterogeneous federated environment including support for federated identities.

*IBM, Microsoft, BEA Systems, RSA Security, VeriSign - Initial Draft - 1.0*  
*[www-106.ibm.com/developerworks](http://www-106.ibm.com/developerworks) [www-106.ibm.com/ws-fed](http://www-106.ibm.com/ws-fed)*

**WS-SecureConversation** specifies how to manage and authenticate message exchanges between parties including security context exchange and establishing and deriving session keys.

*BEA Systems, Computer Associates, IBM, Layer 7 Technologies, Microsoft, Netegrity, Oblix, OpenNetwork, Ping Identity Corporation, Reactivity, RSA Security, VeriSign, and Westbridge Technology - Initial Draft - 1.1*  
*<http://www-106.ibm.com/developerworks/library/ws-secon/>*



Resources

**WSRF (Web Services Resource Framework)** defines a family of specifications for accessing stateful resources using Web services.

**WSRF-BF (WS-BaseDefaults)** defines a base set of information that may appear in fault messages. **WS-BaseFaults** defines an XML Schema type for base faults, along with rules for how this base fault type is used and extended by Web services.

*OASIS - Working Draft - 1.2*

*[docs.oasis-open.org/wsrf-WS-BaseFaults-1.2-draft-03.pdf](http://docs.oasis-open.org/wsrf-WS-BaseFaults-1.2-draft-03.pdf)*

**WSRF-SG (WS-ServiceGroup)** defines a means by which Web services and WS-Resources can be aggregated or grouped together for a domain specific purpose.

*OASIS - Working Draft - 1.2*

*<http://docs.oasis-open.org/wsrf/2004/11/wsrf-WS-ServiceGroup-1.2-draft-03.pdf>*

**WS-ResourceProperties** specifies the means by which the definition of the properties of a WS-Resource may be declared as part of the Web service interface. The declaration of the WS-Resources properties represents a projection of or a view on the WS-Resources state.

*OASIS - Working Draft - 1.2*

*<http://docs.oasis-open.org/wsrf/2004/11/wsrf-WS-ResourceProperties-1.2-draft-05.pdf>*

**WS-ResourceLifetime** is to standardize the terminology, concepts, message exchanges, WSDL and XML needed to monitor the lifetime of, and destroy WS-Resources. Additionally, it defines resource properties that may be used to inspect and monitor the lifetime of a WS-Resource.

*OASIS - Working Draft - 1.2*

*<http://docs.oasis-open.org/wsrf/2004/11/wsrf-WS-ResourceLifetime-1.2-draft-04.pdf>*

**WS-Transfer** describes a general SOAP-based protocol for accessing XML representations of Web service-based resources.

*BEA Systems, Computer Associates, Microsoft, Sonic Software, and Systinet - Working Draft -*  
<http://msdn.microsoft.com/ws/2004/09/ws-transfer/>

**WS-Enumeration** describes a general SOAP-based protocol for enumerating a sequence of XML elements that is suitable for traversing logs, message queues, or other linear information models.

*BEA Systems, Computer Associates, Microsoft, Sonic Software, and Systinet - Public Draft -*  
<http://msdn.microsoft.com/ws/2004/09/ws-enumeration/>

**REST (Representational State Transfer)** is an abstraction of the architectural elements within a distributed hypermedia system. REST ignores the details of component implementation and protocol syntax in order to focus on the roles of components, the constraints upon their interaction with other components, and their interpretation of significant data elements. It encompasses the fundamental constraints upon components, connectors, and data that define the basis of the Web architecture, and thus the essence of its behavior as a network-based application.

*<http://www.ics.uci.edu/~fielding/pubs/dissertation/top.htm>*

- ❑ REST is the "architecture of the Web" - the largest distributed application of the world
- ❑ Leverages HTTP as an *application* protocol
- ❑ Generic interfaces (GET/POST/PUT/DELETE)
- ❑ Clearly defined semantics and standards
- ❑ Paired with XML, and possibly even SOAP, REST is an interesting alternative



**Management**



**WS-Events** defines the Web services based event notification mechanism. This mechanism is used by WSMF-Foundation.

*Hewlett-Packard - Working Draft - 2.0*

*<http://devresource.hp.com/drc/specifications/wsmf/WS-Events.jsp>*

**WSMF-Foundation (Web Services Management Foundation)** defines standard management interfaces for manageable resources as Web service operations, it describes how a manageable resource is discovered, how its management capabilities are described, how it is associated with other resources, and how to extend interfaces to address the management capabilities of resources in specific domains.

*Hewlett-Packard - Working Draft - 2.0*

*<http://devresource.hp.com/drc/specifications/wsmf/WSMF-Foundation.jsp>*

**WSMF-WSM (Web Services Management)** is an application of the WSMF-Foundation specification for the management of Web Services.

*Hewlett-Packard - Working Draft - 2.0*

*<http://devresource.hp.com/drc/specifications/wsmf/WSMF-WSM.jsp>*

### WSDM (Web Services Distributed Management)

- ❑ An OASIS TC creating a set of standards, including MUWS and MOWS
- ❑ Uses WS-ResourceFramework

MUWS (Management Using Web Services) defines how an IT resource connected to a network provides manageability interfaces such that the IT resource can be managed locally and from remote locations using Web services technologies.

*OASIS - Committee Draft - 1.0*

*<http://docs.oasis-open.org/wsdm/2004/12/cd-wsdm-muws-part1-1.0.pdf>*

MOWS (Management Of Web Services) The MOWS specification addresses management of the components that form the network, the Web services endpoints, using Web services protocols.

*OASIS - Committee Draft - 1.0*

*<http://docs.oasis-open.org/wsdm/2004/12/cd-wsdm-mows-1.0.pdf>*

**WS-Management** describes a general SOAP-based protocol for managing systems such as PCs, servers, devices, Web services and other applications, and other manageable entities.

*AMD, Dell, Intel, Microsoft, and Sun Microsystems - Published Specification - [http://www.intel.com/technology/manage/downloads/ws\\_management.pdf](http://www.intel.com/technology/manage/downloads/ws_management.pdf)*

- ❑ Overlap with WSDM MUWS
- ❑ Simpler and less powerful

**Interoperability**

**WS-I (Web Services Interoperability Organization)** is an open industry organization chartered to promote Web services interoperability across platforms, operating systems and programming languages. The organizations diverse community of Web services leaders helps customers to develop interoperable Web services by providing guidance, recommended practices and supporting resources. Specifically, WS-I creates, promotes and supports generic protocols for the interoperable exchange of messages between Web services.

*<http://www.ws-i.org/>*

- ❑ WS-I defines a set of profiles
- ❑ Profiles incorporate standards and specifications, disambiguate them
- ❑ WS-I also defines test criteria and provides testing tools

**Basic Profile** provides implementation guidelines for how related set of non-proprietary Web service specifications should be used together for best interoperability.

*WS-I - Final Specification - 1.1*

*<http://www.ws-i.org/Profiles/BasicProfile-1.1.html>*

**Simple SOAP Binding Profile** consists of those Basic Profile 1.0 requirements related to the serialization of the envelope and its representation in the message.

*WS-I - Final Specification - 1.0*

*<http://www.ws-i.org/Profiles/SimpleSoapBindingProfile-1.0.html>*

**Attachments Profile** complements the Basic Profile 1.1 to add support for interoperable SOAP Messages with attachments-based Web services.

*WS-I - Final Specification - 1.0*

*<http://www.ws-i.org/Profiles/AttachmentsProfile-1.0.html>*

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## Summary

- ❑ There is a huge number of specifications, standards and documents that aim to define Web services functionality
- ❑ Standards will evolve, merge, or become irrelevant
- ❑ Our take is:
  - ❑ 100% sure: XML, SOAP 1.2, WSDL (1.1 now, 2.0 later), MTOM, XML Schema, WS-Security, WS-Addressing, UDDI
  - ❑ Useful and usable today: WS-Policy, WS-ReliableMessaging, WS-Eventing, BPEL4WS, WS-Transfer, WS-Enumeration
  - ❑ Everything else should currently be taken with a grain of salt
- ❑ Before building your own conventions, check existing specs



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