

# Appendix to DoD Grid Opportunities and Technology Overview

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## A. WS-\* and Related Basic Specifications

This gives the technical detail underlying table 2 of [Fox05D] (table 1 of [Fox05H]) and is organized around the rows of this table. Each subsection of this appendix (corresponding to each row) lists key specifications and finishes with a short summary. [MSWSSite] is a good summary of Web Service specifications with a Microsoft perspective. The excellent book [Weerawarana05A] summarizes some of the core specifications including SOAP, WSDL, WS-Policy, WS-Addressing, UDDI, WS-Metadata Exchange, BPEL, WS-RM and transaction and security areas.

### A.1 Core Service Architecture

#### A.1.1 Specification

XSD XML Schema (W3C Recommendation) V1.0 February 1998, V1.1 February 2004  
<http://www.w3.org/XML/Schema>.

**WSDL 1.1** Web Services Description Language Version 1.1, (W3C note) March 2001  
<http://www.w3.org/TR/wsdl>) endorsed in WS-I Basic Profile 1.0 April 2004  
<http://www.ws-i.org/Profiles/BasicProfile-1.0-2004-04-16.html>  
**WSDL 2.0** Web Services Description Language Version 2.0, (W3C under development  
) March 2004 <http://www.w3.org/2002/ws/desc/>  
**SOAP 1.1** (W3C Note) V1.1 Note May 2000, V1.2 Recommendation June 2003  
<http://www.w3.org/TR/soap/>, V1.1 endorsed in WS-I Basic Profile 1.0  
**SOAP 1.2** (W3C Recommendation) June 24 2003 <http://www.w3.org/TR/soap/>

## **A.1.2 Summary**

XML Schema describes the powerful XML syntax; WSDL describes the specification of service interfaces in XML; SOAP describes the structure of messages exchanged between services. See also [Weerawarana05A] and  
<http://msdn.microsoft.com/webservices/webservices/understanding/default.aspx> for general discussions of core service architecture

## **A.2 Service Internet and Messaging**

### **A.2.1 Active Specifications**

**WS-Addressing** Web Services Addressing (BEA, IBM, Microsoft, SAP, Sun) 10 August 2004 <http://www-106.ibm.com/developerworks/library/specification/ws-addr/> and now under consideration at W3C at <http://www.w3.org/2002/ws/addr/>. See also [Weerawarana05A]

**WS-RM** Web Services Reliable Messaging (BEA, IBM, Microsoft, Tibco) February 2005 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/WS-ReliableMessaging.pdf>. See also [Weerawarana05A]

**WS-RM Policy** Web Services Reliable Messaging Policy Assertion (BEA, IBM, Microsoft, Tibco) February 2005 <http://msdn.microsoft.com/ws/2005/02/ws-rmpolicy/>. WS-RM and this specification are being standardized by the OASIS Web Services Reliable Exchange Technical Committee (WS-RX) [http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=ws-rx](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=ws-rx)

**WS-Reliability** Web Services Reliable Messaging (OASIS Web Services Reliable Messaging TC) Version 1.1 OASIS Standard 15 November 2004

[http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=wsm](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsm)

**SOAP MOTM** SOAP Message Transmission Optimization Mechanism (W3C Recommendation) 25 January 2005 <http://www.w3.org/TR/soap12-mtom/>.

**SOAP-over-UDP** Binding of SOAP to UDP (Microsoft, BEA ...) September 2004  
<http://msdn.microsoft.com/library/en-us/dnglobspec/html/soap-over-udp.pdf>

### **A.2.2 Inactive Specifications**

**SOAP MOTM** Supersedes:

- **DIME** Direct Internet Message Encapsulation  
<http://msdn.microsoft.com/library/en-us/dnglobspec/html/draft-nielsen-dime-02.txt> and

- **SwA** SOAP Messages with Attachments W3C Note 11 December 2000  
<http://www.w3.org/TR/SOAP-attachments> and
- **PASwA** Proposed Infoset Addendum to SOAP Messages with Attachments  
<http://www.gotdotnet.com/team/jeffsch/paswa/paswa61.html>

**WS-MessageDelivery** Web Services Message Delivery (W3C Submission by Oracle, Sun ..) April 2004 <http://www.w3.org/Submission/ws-messagedelivery/>

**WS-Referral** Web Services Referral Protocol (Microsoft) October 2001  
<http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnglobspec/html/ws-referral.asp>

**WS-Routing** Web Services Routing Protocol (Microsoft) October 2001  
<http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnglobspec/html/ws-routing.asp>

### A.2.3 Summary

WS-Transfer, WS-Enumeration (See A.8) and the specifications in A.3 could be placed in this category. WS-MessageDelivery appears inactive (and its role taken by the simpler WS-Addressing). WS-Routing and WS-Referral are early Microsoft specifications superseded by WS-Addressing. WS-Reliability and WS-RM are similar with the former an official OASIS standard but the clout of IBM and Microsoft appears to make WS-RM the major reliable messaging specification.

## A.3 Notification

### A.3.1 Specifications

**WS-Eventing** Web Services Eventing (BEA, CA, IBM, Microsoft, Sun, TIBCO) 1 August 2004 <http://www-128.ibm.com/developerworks/webservices/library/specification/ws-eventing/>.

**WS-Notification** Framework for Web Services Notification with **WS-Topics** (V1.2 22 July 2004), **WS-BaseNotification** (V1.2 21 June 2004), and **WS-BrokeredNotification** (V1.2 21 July 2004) OASIS Web Services Notification TC  
[http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=wsn](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsn) and <http://www-106.ibm.com/developerworks/library/specification/ws-notification/>

**JMS** Java Message Service V1.1 March 2002 <http://java.sun.com/products/jms/docs.html>

### A.3.2 Summary

These specifications provide publish-subscribe style notification capability with WS-Eventing and WS-BaseNotification offering similar features. WS-BrokeredNotification specifies the use of intermediate brokers in a fashion familiar from JMS and MQSeries [JMS] [MQSeries]. The web service notification events are specified by XPath while WS-Topics defines the common topic style event labelling used in JMS.

## A.4 Coordination and Workflow, Transactions and Contextualization

### A.4.1 Workflow Specifications

**BPEL** Business Process Execution Language for Web Services (OASIS) V1.1 May 2003 with V2.0 in OASIS discussion <http://www.oasis->

[open.org/committees/tc\\_home.php?wg\\_abbrev=wsbpel](http://open.org/committees/tc_home.php?wg_abbrev=wsbpel) and <http://www-106.ibm.com/developerworks/library/ws-bpel/> (latter updated to 1 February 2005). See also [Weerawarana05A]

**WS-CDL** Web Services Choreography Language (W3C) V1.0 Working Draft 17  
December 2004 <http://www.w3.org/TR/ws-cdl-10/>

**WSCI** (W3C) Web Service Choreography Interface V1.0 (W3C Note from BEA, Intalio, SAP, Sun, Yahoo) <http://www.w3.org/TR/wsci/>

**WSCL** Web Services Conversation Language (W3C Note) Submission from HP March 2002 <http://www.w3.org/TR/wscl10/>

#### **A.4.2 Transaction Specifications**

**WS-CAF** Web Services Composite Application Framework including **WS-CTX**, **WS-CF** and **WS-TXM** below (OASIS Web Services Composite Application Framework TC) [http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=ws-caf](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=ws-caf) . This includes three specifications **WS-CTX** (Web Services Context ), **WS-CF** (Web Services Coordination Framework) and **WS-TXM** (Web Services Transaction Management)

**WS-Coordination** Web Services Coordination (BEA, IBM, Microsoft) November 2004  
<http://www-128.ibm.com/developerworks/library/specification/ws-tx/>,  
<ftp://www6.software.ibm.com/software/developer/library/WS-Coordination.pdf>,  
<http://msdn.microsoft.com/webservices/webservices/understanding/specs/default.aspx?puhl=/library/en-us/dnglobspec/html/wsatspecindex.asp>. See also [Weerawarana05A] and [MSTXS].

**WS-AtomicTransaction** Web Services Atomic Transaction (BEA, IBM, Microsoft) November 2004 <ftp://www6.software.ibm.com/software/developer/library/WS-AtomicTransaction.pdf> or <http://msdn.microsoft.com/library/en-us/dnglobspec/html/WS-AtomicTransaction.pdf>

**WS-BusinessActivity** Web Services Business Activity Framework (BEA, IBM, Microsoft) November 2004  
<ftp://www6.software.ibm.com/software/developer/library/WS-BusinessActivity.pdf> or <http://msdn.microsoft.com/library/en-us/dnglobspec/html/WS-BusinessActivity.pdf>

**BTP** Business Transaction Protocol (OASIS) May 2002 with V1.1 November 2004  
[http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=business-transaction](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=business-transaction)  
**ebXML BPSS** Business Process (OASIS) with V2.0.1 pre-Committee Draft review 17 July 2005 [http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=ebxml-bp](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=ebxml-bp)

#### **A.4.3 Summary**

This area contains a rich set of specifications addressing the linkage of services at two levels. The highest application level is commonly called workflow and BPEL (sometimes called WS-BPEL) from IBM, Microsoft and OASIS is dominant. An alternative Web Services Choreography Language from W3C does not have much traction. There are a suite of specifications for transactions (which are roughly “small workflows” expressing key features such as ACID interactions [MSTXS]) and context (which is roughly the distributed equivalent of environment variables in UNIX). The WS-CAF and WS-

Coordination represent competing approaches but there is not enough experience to evaluate them yet. These specifications and the BTP and BPSS activities also intend to define a suite of common templates for service interactions.

## **A.5 Security**

### **A.5.1 Core Specifications**

**WS-Security 2004** Web Services Security: SOAP Message Security (OASIS) Standard March 2004 <http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-soap-message-security-1.0.pdf>.

**WS-I Basic Security Profile V1.0** Web Services Interoperability Organization Working Group Draft May 15 2005 <http://www.ws-i.org/Profiles/BasicSecurityProfile-1.0.html>

**WS-Security Username Token Profile** Web Services Security Username Token Profile V1.0 OASIS Standard, March 2004 <http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-username-token-profile-1.0.pdf>

**WS-Security X.509 Certificate Token Profile** Web Services Security X.509 Certificate Token Profile OASIS Standard, March 2004 <http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-x509-token-profile-1.0.pdf>

**WS-Security REL Profile** Web Services Security Rights Expression Language (REL) Token Profile OASIS Standard: 19 December 2004 <http://docs.oasis-open.org/wss/oasis-wss-rel-token-profile-1.0.pdf>

**WS-I REL Token Profile V1.0** Web Services Interoperability Organization Working Group Draft 13 May 2005 <http://www.ws-i.org/Profiles/RELTokenProfile-1.0.html>

**WS-Security Kerberos** Web Services Security Kerberos Binding (Microsoft) December 2003 <http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnglobspec/html/ws-security-kerberos.asp>

**Web-SSO** Web Single Sign-On Metadata Exchange Protocol (Microsoft, Sun) April 2005 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/webssso.pdf>

**Web-SSO-Mex** Web Single Sign-On Interoperability Profile (Microsoft, Sun) April 2005 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/webssso-mex.pdf>

**WS-SecurityPolicy** Web Services Security Policy Language (IBM, Microsoft, RSA, Verisign) V1.1 July 2005 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/ws-securitypolicy.pdf>

### **A.5.2 Major Capabilities**

**WS-Trust** Web Services Trust Language (BEA, IBM, Microsoft, RSA, Verisign ...) February 2005 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/WS-trust.pdf>

**WS-SecureConversation** Web Services Secure Conversation Language (BEA, IBM, Microsoft, RSA, Verisign ...) February 2005 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/WS-secureconversation.pdf>

**WS-Federation** Web Services Federation Language (BEA, IBM, Microsoft, RSA, Verisign) July 2003 <http://www-106.ibm.com/developerworks/webservices/library/ws-fed/>

**WS-Federation: Active Requestor Profile** Web Services Federation Language Active Requestor Profile V 1.0 (BEA, IBM, Microsoft, RSA, Verisign) July 8, 2003

<http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnglobspec/html/grfWS-FederationActiveRequestorProfile.asp>

**WS-Federation: Passive Requestor Profile** Web Services Federation Language Passive Requestor Profile V 1.0 (BEA, IBM, Microsoft, RSA, Verisign) July 8, 2003

<http://msdn.microsoft.com/library/default.asp?url=/library/en-us/dnglobspec/html/passive-client-profile.asp>

**WS-Authorization** is being developed by IBM and Microsoft [Weerawarana05A] and will build on WS-Trust to describe how access to particular web services is specified and managed.

**WS-Privacy** is being developed by IBM and Microsoft [Weerawarana05A] and will build on WS-Policy to describe the binding of privacy policies to Web services and their exchanged data.

### A.5.3 Languages

**SAML Assertions and Protocols for the OASIS Security Assertion Markup Language (SAML) V2.0** OASIS Standard, 15 March 2005 [http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=security#samlv20](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=security#samlv20)

**WS-Security SAML Token Profile** Web Services Security SAML Token Profile OASIS Standard, 1 December 2004 <http://docs.oasis-open.org/wss/oasis-wss-saml-token-profile-1.0.pdf>

**WS-I SAML Token Profile V1.0** Web Services Interoperability Organization Working Group Draft 13 May 2005 <http://www.ws-i.org/Profiles/SAMLSecurityTokenProfile-1.0.html>

**XACML** eXtensible Access Control Markup Language (OASIS) V2.0 1 February 2005 [http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=xacml](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=xacml)

### A.5.4 Summary

The Security arena is very active with major activity in OASIS with independent and precursor work by the vendors especially IBM and Microsoft [MSSecurity]. [Weerawarana05A] has an excellent discussion of most of the core specifications. Linkage to other security models such as the Liberty Alliance, and Shibboleth [Liberty] [Shibboleth] are important as are many profiles explaining how best to use languages and technologies. WS-Security is a core architecture while further standards go into detail. WS-Trust defines extensions that build on WS-Security to request and issue security tokens and to manage trust relationships. WS-SecureConversation defines extensions that build on WS-Security to provide secure communication for streams of messages. Specifically, it defines mechanisms for establishing and sharing security contexts, and deriving session keys from security contexts. WS-Federation defines mechanisms that are used to enable identity, attribute, authentication, and authorization federation across different trust realms. This is a very active area with new and updated documents appearing regularly. However there is still uncertainty both as to approach and implementation.



## A.6 Service Discovery

### A.6.1 Specifications

**UDDI** (Broadly Supported OASIS Standard) V3 August 2005 <http://www.uddi.org/>. See also [Weerawarana05A]

**WS-Discovery** Web services Dynamic Discovery (Microsoft, BEA, Intel ...) April 2005 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/WS-Discovery.pdf>

**WS-IL** Web Services Inspection Language, (IBM, Microsoft) November 2001 <http://www-106.ibm.com/developerworks/webservices/library/ws-wsilspec.html>

### A.6.2 Summary

Here we find technologies to register and discover Web Services with closely associated metadata either aiding search or part of discovery. In this sense, this area is very important part of the general metadata area A.7. Many projects build extensions of UDDI as this has a limited model for associated metadata.

## A.7 System Metadata and State

### A.7.1 General Specifications

**RDF** Resource Description Framework (W3C) Set of recommendations expanded from original February 1999 standard <http://www.w3.org/RDF/> and the heart of the Semantic Web and Grid <http://www.semanticgrid.org>

**DAML+OIL** combining DAML (Darpa Agent Markup Language) and OIL (Ontology Inference Layer) (W3C) Note December 2001 <http://www.w3.org/TR/daml+oil-reference>

**OWL** Web Ontology Language (W3C) Recommendation 10 February 2004 <http://www.w3.org/TR/owl-features/>

**WS-MetadataExchange** Web Services Metadata Exchange (BEA, IBM, Microsoft, SAP, Sun ...) September 2004 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/ws-metadataexchange.pdf>. See also [Weerawarana05A]

**ASAP** Asynchronous Service Access Protocol (OASIS) [http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=asap](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=asap) with V1.0 working draft 2B December 11 2004 <http://www.oasis-open.org/committees/download.php/10857/wd-asap-spec-02b.doc>

**WS-GAF** Web Service Grid Application Framework (Arjuna, Newcastle University) August 2003 <http://www.neresc.ac.uk/ws-gaf/>

### A.7.2 Web Services Resource Framework

**WS-RF** Web Services Resource Framework (OASIS) [http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=wsrf](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsrf) (see also <http://www-106.ibm.com/developerworks/library/ws-resource/ws-modelingresources.pdf>) including

- **WS-Resource** Web Services Resource 1.2 (OASIS) Public Review Draft 01, 10 June 2005 [http://docs.oasis-open.org/wsrf/wsrf-ws\\_resource-1.2-spec-pr-01.pdf](http://docs.oasis-open.org/wsrf/wsrf-ws_resource-1.2-spec-pr-01.pdf)
- **WS-ResourceProperties** Web Services Resource Properties V1.2 Public Review Draft 01, 10 June 2005 [http://docs.oasis-open.org/wsrf/wsrf-ws\\_resource\\_properties-1.2-spec-pr-01.pdf](http://docs.oasis-open.org/wsrf/wsrf-ws_resource_properties-1.2-spec-pr-01.pdf)



- **WS-ResourceLifetime** Web Services Resource Lifetime V1.2 Public Review Draft 01, 13 June 2005 [http://docs.oasis-open.org/wsrp/wsrp-ws\\_resource\\_lifetime-1.2-spec-pr-01.pdf](http://docs.oasis-open.org/wsrp/wsrp-ws_resource_lifetime-1.2-spec-pr-01.pdf)
- **WS-ServiceGroup** Web Services Service Group V1.2 Public Review Draft 01, 10 June 2005 [http://docs.oasis-open.org/wsrp/wsrp-ws\\_service\\_group-1.2-spec-pr-01.pdf](http://docs.oasis-open.org/wsrp/wsrp-ws_service_group-1.2-spec-pr-01.pdf)
- **WS-BaseFaults** Web Services Base Faults V1.2 Public Review Draft 01, June 13, 2005 [http://docs.oasis-open.org/wsrp/wsrp-ws\\_base\\_faults-1.2-spec-pr-01.pdf](http://docs.oasis-open.org/wsrp/wsrp-ws_base_faults-1.2-spec-pr-01.pdf)

### A.7.3 Summary

WS-Resource defines relationship between resources and services and there are further specification of Resource Properties and Lifetime. WS-RF developed from the OGSi activity in GGF [OGSiV1]. WS-GAF typifies approaches that prefer not to explicitly associate resources with services. WS-Metadata exchange covers the important scenario where metadata is discovered and accessed via exchange of messages between services rather than looked up in a catalog or registry like UDDI. ASAP appears rather quiescent and represents another approach like WSRF with a clear state model. RDF, DAML, OIL and OWL are critical technologies for expressing metadata and semantic knowledge using ontologies.

## A.8 Management by and for Web Services

### A.8.1 WSDM Suite

**WS-DistributedManagement** Web Services Distributed Management Framework with MUWS and MOWS below (OASIS) [http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=wsdm](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsdm) with all documents available at <http://docs.oasis-open.org/wsdm/2004/12/wsdm-1.0.zip>

**WSDM-MUWS** Web Services Distributed Management: Management Using Web Services (OASIS) OASIS Standard March 9 2005

**WSDM-MOWS** Web Services Distributed Management: Management of Web Services (OASIS) OASIS Standard March 9 2005

### A.8.2 WS-Management Suite

**WS-Management** Web Services for Management (Microsoft, Intel, Sun ...) February 2005 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/WS-Management.Feb.2005.pdf>

**WS-Management Catalog** The WS-Management Catalog (Microsoft, Intel, Sun ...) February 2005 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/WS-ManagementCatalog.Feb.2005.pdf>

**WS-Transfer** Web Service Transfer (Microsoft, BEA, Sonic Software etc.) September 2004 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/ws-transfer.pdf>

**WS-Enumeration** Web Service Enumeration (Microsoft, BEA, Sonic Software etc.) September 2004 <http://msdn.microsoft.com/library/en-us/dnglobspec/html/ws-enumeration.pdf>

### **A.8.3 Summary**

There are two overlapping specification sets here with WSDM led by the major Enterprise system companies (IBM HP etc.) and the WS-Management suite by Microsoft and Intel. WSDM was designed especially for enterprise applications and Ws-Management to enable plug-and-play for small devices. However both approaches are broadly applicable. WS-Management describes an interaction protocol between two Web services (one being a proxy for a device perhaps) and the catalog specification describes the metadata areas that will be used in the management process. WS-Transfer gives the interaction protocol with WS-Enumeration being used where multiple items need to be exchanged sensitive to practical constraints such as maximum amount of information that can be sent at once to the managed service. WS-Transfer and WS-Enumeration can be considered as part of messaging in A.2.

## **A.9 General Service Characteristics: Policy and Agreements**

### **A.9.1 WS-Policy Specifications**

**WS-PolicyFramework** Web Services Policy Framework (BEA, IBM, Microsoft, SAP ...) September 2004 <http://www-106.ibm.com/developerworks/library/ws-polfram/> and <http://msdn.microsoft.com/webservices/default.aspx?pull=/library/en-us/dnglobspec/html/ws-policy.asp>

**WS-PolicyAttachment** Web Services Policy Attachment (BEA, IBM, Microsoft, SAP ...) September 2004

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

**WS-PolicyAssertions** Web Services Policy Assertions Language (BEA, IBM, Microsoft, SAP) 18 December 2002 <http://www-106.ibm.com/developerworks/library/ws-polas/> (Superseded by WS-PolicyFramework)

### **A.9.2 Global Grid Forum Activity**

**WS-Agreement** Web Services Agreement Specification (GGF under development) 9 August 2004 <http://www.ggf.org/Meetings/GGF12/Documents/WS-AgreementSpecification.pdf>

### **A.9.3 Summary**

These specifications describe how metadata is to be specified with the key application to defining how the many detailed specifications are to be implemented and so build a coherent system rather than just a sea of SOAP messages flying around. As well as the general frameworks and formats given here see A.2 for WS-RM Policy and A.4 for WS-SecurityPolicy which apply the A.9 technologies to other service areas. WS-Agreement specifies service level agreements.

## **A.10 User Interfaces**

### **A.10.1 Specifications**

**WSRP** Web Services for Remote Portlets (OASIS) OASIS Standard August 2003 [http://www.oasis-open.org/committees/tc\\_home.php?wg\\_abbrev=wsrp](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsrp) and

<http://www.oasis-open.org/committees/download.php/3343/oasis-200304-wsrp-specification-1.0.pdf>

**JSR168:** JSR-000168 Portlet Specification for Java binding (Java Community Process) October 2003 <http://www.jcp.org/aboutJava/communityprocess/final/jsr168/>

### **A.10.2 Summary**

These specifications describe how Web Services interact with user clients. WSRP specifies the protocol while JSR168 specifies how portlets are implemented for each supported service user-facing Web service ports inside aggregating portals like [uPortal] [GridSphere] and [Jetspeed]. Note that the GGF Grid Computing Environment research group made substantial contributions to the understanding of the use of portals and WSRP/JSR168 [OGCE] [GCE].

## **B. Global Grid Forum (GGF) Activities**

This gives the technical detail underlying table 3 of [Fox05D] (table 2 of [Fox05H]) and is organized around the rows of this table. The material is taken from the GGF web site [GGF-A] and is expected to change as a set of OGSA roadmap activities (Sec. B.1) produce better summaries. Note that we choose to organize around GGF areas and not the OGSA architecture as we could not find a stable definition of it. Note we only highlight those GGF projects that are producing specifications and either ignore or mention briefly those engaged in studies. We use bold in text to denote activities in the projects summarized that are expected to produce specifications for Grid services.

### **B.1 Architecture Area**

This area includes an activity defining a High Level Resource/Service Naming (level 2 of fig. 1 of [Fox05D]) but the major effort is the OGSA Working Group (OGSA-WG). This aims to achieve an integrated approach to future OGSA service development via the documentation of requirements, functionality, priorities, and interrelationships for OGSA services. [OGSA] [OGSAGloss] [OGSA-Globus]. Much of the GGF standards will be re-aligned under the OGSA banner.

#### **B.1.1 OGSA Naming (OGSA-Naming-WG)**

The objective of this working group is to work on two specifications (RNS and WSNR) to realize a three level name space for OGSA and to produce a **WS-Naming** naming specification based on WS-Addressing (See A.2.1).

### **B.2 Applications Area**

This area has one interesting group defining Grid Information Retrieval standards which we consider a particular application. The other activities are rather differently developing tools, programming models and specifications to support applications. Software Interfaces to Grid, Grid Remote Procedure Call, Checkpointing and Recovery, Interoperability to Job Submittal services, Information Retrieval

#### **B.2.1 Grid Remote Procedure Call (GridRPC-WG)**

The GridRPC Working Group has defined a **Grid Remote Procedure Call Model** and API. Projects such as Ninf and NetSolve have exploited this standard [Ninf] [NetSolve].

### **B.2.2 Distributed Resource Management Application API (DRMAA-WG)**

This group has developed general API for the **submission and control of jobs to Distributed Resource Management (DRM)** systems. The scope of this specification is the high level functionality which is necessary for an application to consign a job to a DRM system including common operations on jobs like termination or suspension.

### **B.2.3 Simple API for Grid Applications (SAGA-RG)**

The **Simple API for Grid Applications (SAGA)** is a set of programmatic (Perl, Python, Java, Matlab etc.) interfaces to Grid services especially in the job submission and file manipulation areas.

### **B.2.4 Grid Checkpoint Recovery (GridCPR-WG)**

The **Grid Checkpoint Recovery Working Group** is defining a user-level API and associated layer of services that will permit checkpointed jobs to be recovered and continued on the same or on remote Grid resources.

## **B.3 Compute Area**

The Compute Area is focused on the description and execution of computational tasks, and the scheduling and negotiation of grid resources. Its activities include Job Submission, Basic Execution Services, and Service Level Agreements for Resource use and reservation, discussed in the following sub-groups below. There is a research group on Grid Scheduling Architecture (GSA-RG) studying Distributed Scheduling that supports cooperation between different scheduling instances for arbitrary Grid resources. Considered resources include network, software, data, storage and processing units.

### **B.3.1 Grid Resource Allocation Agreement Protocol (GRAAP-WG)**

This working group has the goal to produce a set of documents describing a common resource management protocol for Grid environments, which allows the advance reservation of those resources. A core activity is **WS-Agreement** in A.9.2 which defines a language and a protocol for advertising the capabilities of providers and creating agreements based on creational offers, and or monitoring agreement compliance at runtime. A follow-up **Grid Resource Allocation Agreement Protocol** is planned.

### **B.3.2 Job Submission Description Language (JSDL-WG)**

The JSDL-WG will provide a specification for an abstract standard **Job Submission Description Language (JSDL)** that is independent of language bindings. It will also provide a normative XML Schema corresponding to the JSDL specification and a document of translation tables to and from the scheduling languages of a set of popular batch systems for both the job requirements and resource description attributes of those languages, which are relevant to the JSDL..

### **B.3.3 OGSA Basic Execution Services (OGSA-BES-WG)**

The objective of the OGSA-BES working group is to focus on a minimal sub-set of the **Execution Management Services** and develop specifications for them.

## **B.4 Data Area**

This is a very important and active area and its products have broad applicability with the integration with OGSA an important goal. GridFTP is well known for its high performance secure data transfer and major efforts are Grid interfaces to Databases and Files. There is a sophisticated publish-subscribe information model and new activities focussing on communicating (ByteIO group has just started) and specifying (DFDL) binary data. Storage Management and Data replication efforts are currently not active. A transaction management research group is examining the role of transactions (See A.4) in a Grid.

### **B.4.1 Data Access and Integration Services (DAIS-WG)**

This group is developing grid database services, focusing principally on providing consistent access to existing, autonomously managed databases. It is highly successful and provides specifications used by the UK e-Science OGSA-DAI activity [OGSA-DAI]

### **B.4.2 Grid File Systems (GFS-WG)**

The Grid File System Working Group (GFS-WG) will provide specifications of **Grid File System Directory Services** and Architecture of **Grid File System Services**.

### **B.4.3 Data Format Description Language (DFDL-WG)**

This group is defining an XML-based language, the **Data Format Description Language** (DFDL), for describing the structure of binary and character encoded (ASCII/Unicode) files and data streams so that their format, structure, and metadata can be exposed.

### **B.4.4 GridFTP-WG**

This group focuses on improvements of FTP and has developed the well used **GridFTP** v1.0 protocol with the goal to produce bulk file transfer protocol suitable for grid applications. This is backward compatible with traditional FTP as much as possible with new features added as (negotiable) extensions. Some important extensions are parallel transfers, GSI authentication, and striped transfers.

### **B.4.5 Information Dissemination (INFOD-WG)**

This group is developing a **high-level publish-subscribe** mechanism for Information Dissemination (ID) that supports data replication and third-party data delivery in real-time environments.

## **B.5 Infrastructure Area**

There is a significant standards specification activity in network measurements and research groups studying the role of IPv6, high performance networking, and mechanisms supporting secure, robust, high speed transport of data in the wide area.

### **B.5.1 Network Measurement (NM-WG)**

The performance of most grid applications is dependent on the performance of the networks forming the grid. This Group identifies network metrics (aka characteristics)

useful to grid applications and middleware, and develops standard mechanisms to support the **request for and reporting of network characteristics**.

## **B.6 Management Area**

The Management Area covers the management of essential grid operating components, such as policies, processes, equipment, and data, for overall effectiveness of grid systems, storage, applications, and services. Its activities include Resource/Service configuration, deployment and lifetime, Usage records and access, and a Grid economy model which is not active at present.

### **B.6.1 Application Contents Service (ACS-WG)**

The Application Contents Service (ACS) provides central management of diverse sets of application information bundled into a single unit. It is developing a) **Application Repository Interface (ARI)**, specifying repository service and its interface to Application Contents; and b) **Application Archive Format (AAF)**. It is not clear how this activity relates to metadata services.

### **B.6.2 Configuration Description, Deployment, and Lifecycle Management (CDDLW-WG)**

The CDDLW-WG addresses how to: describe configuration of services; deploy them on the Grid; and manage their deployment lifecycle (instantiate, initiate, start, stop, restart, etc.). This builds a higher level framework on top of WSDM (A.8.1). It has defined an XML and SmartFrog [SmartFrog] based language for **Configuration Description, Deployment, and Lifecycle Management**.

### **B.6.3 OGSA Resource Usage Service (RUS-WG)**

This specification will define a **Resource Usage Service (RUS)** for deployment within an OGSA hosting environment that will track resource usage (accounting in the traditional UNIX sense) and will not concern itself with payment for the use of the resource. It will build on the Usage record specification defined below.

### **B.6.4 Usage Record (UR-WG)**

This is defining a common **usage record** based on those in current practice. In order for resources to be shared, sites must be able to exchange basic accounting and usage data in a common format.

## **B.7 Security Area**

The Security Area is concerned with technical and operational security issues in Grid environments, including authentication, authorization, privacy, confidentiality, auditing, firewalls, trust establishment, policy establishment, and dynamics, scalability and management aspects of all of the above. There are research groups in the areas of P2P, Firewall, and Trusted Computing issues.



### **B.7.1 Open Grid Service Architecture Authorization (OGSA AUTHZ-WG)**

The objective of the **OGSA Authorization** WG is to define the specifications needed to allow for basic interoperability and plug-ability of authorization components in the OGSA framework.

### **B.7.2 GridShib**

The GridShib project aims at integration of **Shibboleth** Internet2 Security framework [GridShib] [Shibboleth] with the Grid but is conducted outside the GGF.