LEE LIMING, TOM GARRITANO, AND STEVE TUECKE

Standardizing the Grid

A proposed new set of specifications, the Web Services Resource Framework (WSRF), will permit use of stateful Grid resources via Web service-based environments. WSRF addresses a number of key capabilities missing in existent standards and promises a true convergence of Grid and Web services. Stemming from many months of discussion among Grid and Web services leaders, it heralds a new era of interoperability across heterogeneous systems based on emerging standards and protocols. Numerous WSRF documents are posted at *www.globus.org/wsrf.*

The Grid is a set of technologies that, when deployed across an enterprise's resources, ease the creation of applications and infrastructure that facilitate *collaborative* and *adaptive* systems. Grid functionality is integral to a rapidly growing number of commercial and open source implementations that benefit from the community's emphasis on standardization.

In January at the GlobusWORLD 2004 conference (*www.globusworld.org*), the Globus Alliance and IBM — with partners including Hewlett-Packard, Akamai, Sonic Software and TIBCO — announced WSRF. Why are these open standards important to the Grid community, and what exactly does WSRF mean for the Grid?

Standards are Critically Important

Grid functionality is integral to a rapidly growing number of commercial and open source implementations that benefit from the community's emphasis on standardization. The Internet, the World Wide Web, and Web-based applications have much in common with the Grid in that each of these technologies is fundamentally motivated by the desire to facilitate collaboration. Current and proposed standards in these areas (formalized by the Internet Engineering Task Force and the World Wide Web Consortium) have provided several important building blocks, but they do not yet provide a complete solution for facilitating the collaborative use of resources.

The Globus Alliance is an international collaboration of researchers, system architects, and software developers whose goal is to enable widespread, Grid-enabled collaboration. Its three primary activities are conducting fundamental IT research; creating and supporting production Grid deployments and applications based on its open source Globus Toolkit(tm), the de facto standard Grid middleware; and working through the community and established standards bodies to develop open Grid standards such as WSRF.

WSRF and its predecessor, the Open Grid Services Infrastructure (OGSI), are aimed squarely at the field of system monitoring and management, which — because it has not seen the broad adoption of standard solutions enjoyed by the Internet and the World Wide Web communities — is an area where the Grid can have a major impact.

While Web Services standards meet many needs in industry, prior to OGSI and WSRF there were no established standards to define the basic interfaces for managing, monitoring, and interacting with resources and services that maintain persistent state. These are precisely the areas addressed by Grid computing and by the Globus Alliance's efforts to help ensure the establishment of Web Services-based standards in these areas. In the absence of diligent efforts by researchers and industry to set open Grid standards, an over-abundance of proprietary systems and specifications would prevent any particular set of solutions from becoming ubiquitous

Grid users need standards in order to develop interoperable applications that can discover, inspect, and interact with resources and their associated states. WSRF addresses these needs by building on emerging standards work in both Web services (e.g., WS-Addressing) and Grid services (e.g., OGSI). At GlobusWORLD, IBM vice president of software development, strategy and architecture Daniel Sabbah described the convergence of Grid and Web services as "the best of both worlds."

With a closer alignment through WSRF, both communities will have a common framework that lets users share, access and manage resources and applications.

WSRF: What It's All About

WSRF specifies how XML can be used to describe and access a resource's properties, clarifies how stateful resources are addressed, and defines how resources may be created and destroyed, individually or collectively. The new set of specifications also adds a fault-tolerance capability to WS-Addressing.

Although similar work had recently been completed by the Globus Alliance and the Global Grid Forum in the form of the OGSI v1.0 specification, the Web servic-

es community's adoption of OGSI was hindered by concerns about its breadth ("too much in one specification"), its incomplete compatibility with emerging Web services standards and tooling, and its object orientation.

OGSI defined a set of conventions and extensions for using the Web Service Definition Language (WSDL) and XML Schema to enable stateful Web services.

It introduced the idea of a stateful Web service and defined approaches for creating, naming, and managing the lifetime of instances of services; for declaring and inspecting service state data; for asynchronous notification of service state change; for representing and managing collections of service instances; and for common handling of service invocation faults.

WSRF re-factors OGSI to exploit new Web services standards such as WS-Addressing and to respond to the concerns of the Web services community. WSRF also represents an evolution of OGSI based on lessons learned from early implementation and application experiences.

WSRF retains essentially all of OGSI's functional capabilities, with changes in syntax and terminology to establish five distinct, composable specifications (plus the related WS-Notification specification) in a unified approach to modeling and managing state in a Web services context. The specifications' functions are as follows:

- WS-ResourceProperties describes associating stateful resources using Web services, and how elements of publicly visible properties of a resource are, retrieved, changed, and deleted.

- WS-ResourceLifetime allows a requestor to destroy a WS-Resource either immediately or at a scheduled future point in time.

- WS-RenewableReferences annotates a WS-Addressing endpoint reference with information needed to retrieve a new endpoint reference when the current reference becomes invalid.

- WS-ServiceGroup creates and uses heterogeneous by-reference collections of Web services.

- WS-BaseFault describes a base fault type used for reporting errors.

- WS-Notification uses standard approaches to notification using a topic-based publish and subscribe pattern.

Work is already under way to incorporate WSRF into release 4.0 of the Globus Toolkit. In the meantime, March 2004 will see the release of an interim GT v3.2 with

TABLE ONE

Mapping from OGSI to WSRF Lifetime Constructs

FUNCTION	OSGI	WSRF
Create New Entry	Factory portType operation "createService"	Factory pattern definition
Address the entity	Grid Service Reference and Grid Service Handle properties	WS-Addressing Endpoint Reference with reference
Immediate destruction	GridService portType operation "destroy"	ResourceLifetime portType operation "Destroy." However, this operation is synchronous in WSRF
Scheduled destruction	GridService portType operations: "requestTerminationAfter" "requestTerminationBefore"	ResourceLifetime portType operation "SetTerminationTime" is equivalent to "after." "Before" was determined to be superfluous in absence of real-time scheduling
determine current time	GridService portType service data element "CurrentTime"	Resource property "CurrentTime"
Determine lifetime	GridService portType service data element "terminationTime"	Resource property "TerminationTime"
Notify of destruction	Not Available	Subscribe to topic "ResourceDestruction"

improved robustness, scalability, performance and usability. The first WSRF-based release, GT v4.0, will appear in the third quarter of 2004, with some new functionality and further enhancements to usability and performance. GT v4.2 in the first quarter of 2005 will have additional WSRF-based services. After a brief period of feedback and interoperability testing among several early implementations, the specifications' authors will propose WSRF and WS-Notification formally to an appropriate standards body such as the Organization for the Advancement of Structured Information Standards (OASIS) or the Global Grid Forum (GGF).

A substantial portion of the Grid community continues to use pre-Web-services (pre-WS) components, which will be included and supported in v3.2 and v4.x. A discussion forum has been established at *www.ggf.org/ogsi-wg*.

For users who had begun using OGSI components, the Globus Alliance is striving to ease the transition to WSRF, which is expected to be straightforward — not as tricky, for example, as the jump from GT2 to GT3. As shown in Table One, the differences between WSRF and OGSI are in many ways syntactic, reflecting changes in terminology that bring tighter integration with the Web services lexicon.

The e-Science and e-Business communities have important investments in Grid technology, and they stand to benefit significantly from the intermediate-term opportunities presented by WSRF, in part because a new generation of commercial software is expected to emerge from the convergence of Grid and Web services. Worth noting is that, in his GlobusWORLD keynote, Sabbah committed to implementing WSRF and WS-Notification in IBM's Websphere and Rational offerings. To date, users particularly in e-Science have had application needs that were not traditionally met by the private sector. The Globus Alliance has met some of that demand, but must balance its role in delivering and supporting production-quality code for Grid deployment projects against its computer science research role. With WSRF, companies may become more active in developing customized, interoperable Grid applications, which should be cheaper and faster to produce due to reliance on familiar, existing Web service tools.

> The Globus Alliance is an international collaboration of researchers, system architects, and software developers

The overall effect of WSRF should be to accelerate the pace of technical innovation while improving the quality of code, support and documentation. Among other benefits will be the availability of a variety of solid Web service platforms on which the Globus Toolkit will be able to build its higher level services. This emphasis on standardization is meant to deliver Grid technology that becomes at least as accessible as current Web Services technology.

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Lee Liming is manager of the Distributed Systems Laboratory (DSL) at Argonne National Laboratory, part of the Globus Alliance.

Tom Garritano is project director for the GRIDS Center (part of the NSF Middleware Initiative) at the University of Chicago.

Steve Tuecke is the lead software architect of the DSL at Argonne and chief architect of the Globus Toolkit.

Resources

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