Grid and Web Services STANDARDS

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Grid is a type of parallel and distributed system that enables the sharing, selection, and aggregation of resources distributed across "multiple" administrative domains based on their (resources) availability, capability, performance, cost, and users' quality-of-service requirements. Service orientation of the Grid makes it a promising platform for seamless and dynamic development, integration and deployment of service-oriented applications. Flexibility are essential characteristics of Web services technologies such as WSDL (Web Services Description Language), SOAP (Simple Object Access Protocol), and UDDI (Universal Description, Discovery, and Integration).
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Web services & grid computing

Web services are Internet-based, modular applications that perform a specific business task and conform to a particular technical format. The technical format ensures each of these self-contained business services is an application that will easily integrate with other services to create a complete business process. This interoperability allows businesses to dynamically publish, discover, and aggregate a range of Web services through the Internet to more easily create innovative products, business processes and value chains.

Grid computing joins together many individual computers, creating a large system with massive computational power that far surpasses the power of a handful of supercomputers. Because the work is split into small pieces that can be processed simultaneously, research time is reduced from years to months. The technology is also more cost-effective, enabling better use of critical funds.

Grid computing is not a futuristic technology. World Community Grid is at work right now applying this technology to exciting research projects that can benefit us all. By many accounts, average system utilization across organizations is 15% to 20% today, while obviously the ideal would be around 80%. What's more, some 20% of IS budgets go to operations, marginally less than the 25% earmarked for capital investments. We've created large, underutilized, complex environments that are costly to maintain. So there is a huge need to do this better, and the prevailing thinking at this point seems to be that grid is the answer.

The technology behind grid isn't new. Its roots lie in early distributed computing projects that date back to the 1980s, where scientists would connect multiple workstations to let complex math problems or software compilations take advantage of idle CPUs, dramatically shortening processing times. For years, vendors and IT departments eyed this opportunity to dramatically increase processing power by employing existing resources. But only recently have the tools arrived to put general business applications to work on a grid.

Standards, pricing and other grid hurdles

Creating tools that work in distributed, heterogeneous environments is a field ripe for standards, something both grid vendors and customers realize.

Understanding that concern, vendors and researchers are involved in several standards bodies.

- *Global Grid Forum (GGF)* - whose members include Ascential, DataSynapse, Hewlett-Packard, IBM, Microsoft, Oracle, Platform Computing and Sun -works to develop standards intended to create a wide range of

interoperable grid-computing environments and applications.

- *Enterprise Grid Alliance (EGA)* - formally announced by Oracle, HP, Sun and others (though notably not Microsoft, IBM or Platform Computing) - has set goals of providing standards aimed at grid-enabled enterprise applications, what it claims will be a subset of the GGF's work.

- *Globus Alliance* - was formed by a group of research organizations, including Argonne National Laboratory and the University of Chicago and sponsored by the Defense Advanced Research Projects Agency and the National Science Foundation. The group implements standards through its Globus Toolkit, an open-source development suite that lets software makers jump-start their grid development. Current standards include:

- the Open Grid Services Architecture (*OGSA*),
- the Open Grid Services Infrastructure (*OGSI*)
- the *Web Services Resource Framework*, which will supplant OGSI later this year, according to GGF, and allow grid software makers to use common Web services standards to identify and utilize grid-computing resources.

Other issues arise around licensing and pricing. Vendors who move their products to grid must figure out ways to price their software. Per-CPU or per-seat pricing often makes sense in a world where those numbers stay relatively static, but with grid, an application could run on 500 processors one minute and none the next. Being charged for every one of those processors could drive much of the cost benefit out of grid for customers, but adopting a "buy it once, use it everywhere" model could push vendors out of the grid business. Ultimately, per-use price models—likely based on specifications supplied in the OGSA—could dominate, but the tools for tracking such usage have yet to be fully developed.

Grid and web services standards to converge

New specifications will ease development and deployment of Web Services. In 2004, GLOBUSWORLD - Akamai, The Globus Alliance, HP, IBM, Sonic Software and TIBCO today proposed new Web services specifications that will integrate Grid and Web services standards.

The new WS-Notification and WS-Resource Framework represent the first time a common, standards-based infrastructure will be available for business applications, Grid resources and systems management. These new specifications will help customers lower costs, speed deployment and enable integration across and outside of the enterprise.

These new Web services specifications will significantly extend the types of enterprise solutions customers can easily deploy. These new specifications are important for key business applications and provide customers with the ability to utilize a common Web services based infrastructure that support of Grid and management based solutions.

The WS-Notification specification and the WS-Resource Framework will provide a scalable pub/sub messaging model and the ability to model stateful resources using Web services. Stateful resources are elements that can be modeled including physical entities (such as servers) to logical constructs (such as business agreements and contracts). Access to these stateful resources enables customers to realize business efficiencies including just in time procurement with multiple suppliers, systems outage detection and recovery and Grid-based workload balancing.

The WS-Resource Framework includes:

- *Modeling Stateful Resources with Web service*s - describing how to utilize the related specifications to model the resources in the context of Web services.
- *WS-Resource Propertie*s - defines how data associated with a stateful resource can be queried and changed using Web services technologies. This allows lients to build applications to efficiently read and update data associated with resources, such as contracts, servers or purchase orders.
- *WS-Resource Lifetime*- which allows the

user to specify the period during which a resource definition is valid. For example, WS Resource Lifetime can automatically update suppliers from all systems once contracts or service level agreements expire, or deleting products from inventory systems that are no longer being manufactured.

OGSA

The Open Grid Services Architecture (OGSA) combines technologies to unlock and exploit grid-attached resources. OGSA defines mechanisms to create, manage, and exchange information between Grid Services, a special type of Web service. The architecture uses WSDL extensively to describe the structure and behavior of a service. Service descriptions are located and discovered using Web Services Inspection Language (WSIL). By combining elements from grid computing and Web services technologies, OGSA establishes an extensible and interoperable design and development framework for Grid Services that includes details for service definition, discovery, and life-cycle management.

OGSA defines and standardizes a set of (mostly) orthogonal multipurpose communication primitives that can be combined and customized by specific clients and services to yield powerful behavior. OGSA defines standard interfaces (portTypes in WSDL terminology) for basic Grid services.

Grid applications use grid tools and middleware components to interact with the fabric.

OGSA introduces several service concepts that need to be adopted in order to qualify as Grid services. Necessary components are *factories, registries, and handle maps*. Additional mechanisms that can be used to build our data grid are *notification* and *lifetime management*.

From a software-design perspective, a grid can be viewed as a collection of self-contained computing services that can be described, published, located, and invoked over any type of network. Services are location-independent and dynamic, span multiple computing architectures, and reach across administrative domains. The design principles of OGSA reflect a combination of elements from Web services and grid computing:

- *Resource virtualization:* each grid component is considered a service.
- *Standard interface definition mechanisms:* enabling multiple protocol bindings and transparency between local or remote services.
- *Standard foundation services:* defining service semantics, reliability and security models, and core functions such as life-cycle management, or discovery.
- *Implementation independence:* support for multiple development languages and hosting environments including Java, COBOL, C, J2EE, CICS, and .NET.

Since a grid consists of both existing and new hardware and software, multiple variations of communication protocols, security schemes, and transaction management systems exist and cooperate at the same time. Today's grids tend to be a patchwork of protocols and noninteroperable "standards" and difficult-to-reuse "implementations." The OGSA uses Web services technologies like WSDL, SOAP, and WSIL to abstract platform and implementation differences, giving transparent access to grid services.

Fundamental to OGSA are WSDL and interfaces for dynamic discovery and life-cycle management for a specific type of Web service - a Grid Service. WSDL conventions and extensions are used to describe and structure services, while core service activities are expressed using WSDL interfaces and behaviors. Every Grid Service instance has a unique and immutable name called the Grid Service Handle. Lifetime management is provided by mandatory support for the operations Destroy and SetTerminationTime.

Grid application and companies

The most important grid players and they application, in the alphabetical order, are:

- **Ascential** (*ascential.com*): Enterprise Integration Platform that supports data integration grids.
- **Avaki** (*avaki.com*): Avaki Data Grid creates a unified catalog of data across a network.

- **DataSynapse** (*datasynapse.com*): GridServer lets customers move existing applications to grid environment
- **Dell** (*dell.com*): Partnered with Platform Computing (see below) to provide grid-enabled systems for CPU-intensive computing purposes.
- **Enterprise Grid Alliance** (*gridalliance.org*): Group formed by Oracle, HP and others to create enterprise-oriented grid standards.
- **Global Grid Forum** (*ggf.org*): Standards body that creates and publishes grid computing standards.
- **The Globus Alliance** (*globus.org*): Group offers open-source development kits based on Global Grid Forum and Oasis. Will likely include other standards.
- **Hewlett-Packard** (*hp.com*): Utility Data Center provides rapid reallocation of computing resources. Works on a variety of corporate grid products and services.
- **IBM** (*ibm.com/grid*): Grid is a central part of IBM's autonomic computing model. Numerous products and partnerships in place.
- **Oracle** (*oracle.com/grid*): Released Oracle 10g database early this year. Built-in support for grid computing resources.
- **Platform Computing** (*platform.com*): Software that consolidates computing resources and provides an architecture for grid-enabled applications.
- **SAP** (*sap.com*): Currently piloting a project to grid-enable SAP applications.
- **Sun Microsystems** (*sun.com*): N1 Grid engine combines grid and clustering.
- **United Devices** (*ud.com*): Offers enterprise grid software and hosting service for grid-on-demand.

Conclusion

The combination of the confluence of developments:

- The maturation of grid technology
- General consensus that the future of computing is about networked, low-cost components
- And the emergence of service oriented architectures, or a Web service seems to add up to a potent force, a sensible image of the future.

We have new applications on the horizon that will give us further impetus, one being efforts to instrument anything and everything of value - sensors in/on everything in every field, from medicine to military and manufacturing. This will create a flood of raw, real-time streaming data.

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