Grid TALK GridBriefings
Grid computing in five minutes

Grid computing and standardization: thinking inside the box

"Standard" can often be equated with "average" or "boring": how can you innovate or invent when you're bound by standards and regulations? How can you push the boundaries when you're stuck inside a box? Yet how can you create something on a grand scale—something that can slot together with other grand things—unless you create something interoperable. Something standard.

Why do we need grid standards?

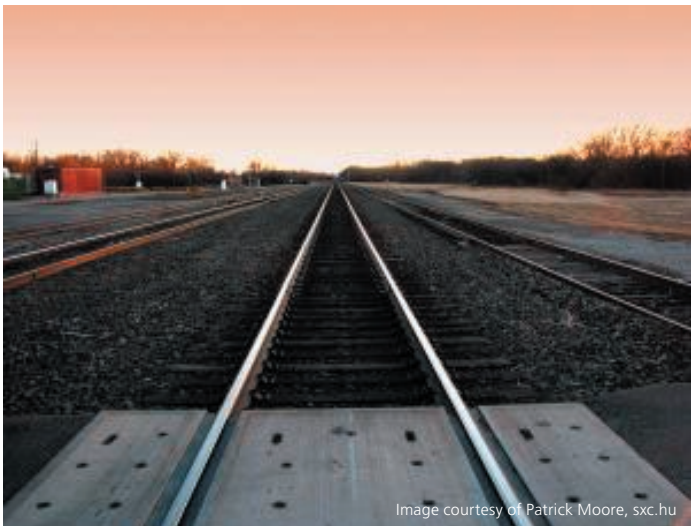

Image courtesy of Patrick Moore, sxc.hu

A classic example is the rail system: in 1850s Australia, for example, engineers began building train lines across the continent. Each team adopted their preferred system. The result? Australia developed horribly incompatible train lines. By 1917, you needed to change trains six(!) times to get from Brisbane to Perth. After much time, money and effort, these systems were finally standardized: you can now cross Australia on a single train. But can the same be said of data on a computing grid?

In early June, two important meetings of the grid community were held in Barcelona: the 23rd Open Grid Forum and the 5th e-Infrastructure Concertation Meeting. Both meetings were dedicated to discussion of standardization in grid computing. Debate was rife, but a strong message emerged; Europe, and the ICT world, cannot afford to repeat the Australian train situation ■

Standardizing grids: the current landscape

While "the Grid" in its idealized form is a single interconnected, interoperating computer farm, the reality of grid computing is very different. Instead of a single all-powerful "Grid", there are many smaller grids, each customized to the specific needs of a user group. These different needs have led to different technical solutions: just as a toaster from the U.S. won't automatically work in a kitchen in the UK, grid solutions developed for one grid don't always work for another. Further, just as a multi-way plug or an electrical transformer allows interoperation between electrical equipment, appropriate grid technology can enable interoperation between computing grids.

The challenge is clear: if grids are to be widely adopted—if they are to offer real solutions with acceptable risks for industry and e-science—then they must be interoperable, which means the development of standardized, transferable technologies. Such technologies usually develop in one of two ways: de facto standards, like using Google for web searches, seem to develop themselves; and formal standards, like the meter or the kilogram, require consensus within a user community.

In the grid world, the Open Grid Forum is the largest group working towards standards adoption. The OGF provides a global opportunity for volunteers from all walks of grid computing life to contribute to the development of new standards. The development process usually happens in one of two ways: A group can work to develop best practices in a particular area, and can then approach OGF for endorsement of that work as a particular standard. Or, in reverse, an area of interest is first identified, and then a group forms to work on a standards solution in that area. These processes may sound simple, but in practice, the path to achieving an accepted, implemented standard is long and dotted with potholes ■

Image courtesy of NorduGrid and OSG

Challenges for the future

In addition to technical challenges, standardization can introduce issues such as different user requirements, incompatible policies and poor market timing. A classic case in which these factors combined is that of videocassette standards, where Sony's earlier and arguably superior technology, Betamax, was outdone by VHS, a cheaper option that better serviced the rental movie market. (Both standards are now obsolete due to the rise of digital technologies. This fact highlights another difficulty facing grid computing: a rapidly changing marketplace makes it hard to pin down a strict standard.)

Despite these challenges, the benefits of standardization are all too tangible. Standardization translates to interoperability, which encourages collaboration, competition and sustainability. The implementation of a popular, functioning standard leads to smooth technology transfer, reliability and ease of use. In the medical industry, for example, adoption of the DICOM digital imaging standard has enabled radiologists anywhere in the world to interchangeably send, receive and store medical images. The use of Latin when naming biological species means all scientists speak the same taxonomical language. And the advent of HTTP as a communications protocol has helped fuel the massive growth of the World Wide Web. In the same way, the success of network standards such as Ethernet has aided healthy commercial competition in the network equipment market ■

A "de facto" standard: VOMS

"Virtual organizations" are the human backbone of grid computing: groups of researchers from around the world who collaborate on common challenges, using grids to share and integrate their data and resources.

The Virtual Organization Management System, or VOMS, is a system that allows distributed VOs to centrally manage the roles and authorizations of their members. Using VOMS, site administrators can generate local credentials for specific VO members, providing them with a single login and access to VO grid resources for a set time. VOMS was developed by the DataGrid and EGEE projects. Although not an official standard, it is used by many VOs around the world.

Image courtesy of The DataGrid Project

The way forward

In grid computing, standardization is voluntary. No one can force a community to build middleware to a particular specification, or to adopt a particular security policy. Standardization relies on grid users and builders choosing to implement a solution that works most of the time, for most of the people.

At both OGF23 and the 5th e-Infrastructure Concertation Meeting, when the floor was opened for discussion, there were many questions yet to be answered: Who will pay to test for standards compliance? If we're not testing these standards, why bother to create them? And how can we ensure that we create standards that enforce best practice, when we're still learning what those best practices are?

Discussion is ongoing, but several things are certain: Grid computing requires standards at the industry level, with a validation framework that reinforces continued efforts towards software quality. Standards developers need to think long-term—beyond the lifespan of a typical project—to allow the time and energy required for a standard to mature. And standards developers need open corridors for communication, with different projects, different standards bodies and different user groups.

What are members of the grid community saying about standardization?

"The European Union is leading the way on effective grid adoption and sustainability through its policy of comprehensively supporting the entire adoption process. Projects such as the European Grid Initiative will also drive the development of policy on many levels, such as data access, resource consumption, and energy efficiency or green IT. Such usage policies will have to be monitored and enforced through standardized tooling, which OGF working groups are already pursuing. OGF looks forward to partnering with the EU at all levels—from the development of commission policies to technical implementations—to make this vision a reality." *Craig Lee, OGF President*

"The e-infrastructures initiative of the European Commission delivers cutting-edge ICT-based infrastructures and services to solve real-world problems. Already today, there are more than 300 different organizations participating in the e-infrastructures initiative, including more than 80 scientific projects. Through their work, these researchers are helping to shape the necessary common network and service standards that will

be the key to European competitiveness in the ICT domain. Such common standards are very important. They make sure that these new infrastructures and services will be broadly adopted in the future. Although the e-infrastructures initiative targets the scientific community initially, common standards will ensure that eventually this technology spreads to areas with very high societal impact, such as education, health-care and environmental monitoring." *Mario Campolargo, European Commission*

A standard in action: GridFTP

Grid computing provides the IT power needed to drive data-intensive scientific applications, such as drug discovery or high energy physics. As part of this, massive amounts of data must be shunted around the world at high-speed. Although there are many different ways of storing and partitioning such data, the grid community have agreed on just one way of transferring it: GridFTP.

Also known as the "grid file transfer protocol", GridFTP is the accepted method for securely and reliably transferring large volumes of data across distributed computing grids. It is based upon standard Internet FTP protocol, but is tailored to support the special needs of grid computing, including authentication and confidentiality features, reliability and fault tolerance, and third party and partial file transfer, GridFTP was developed by the Globus project. The GridFTP Working Group, organized by the Open Grid Forum, continues to coordinate updates to its protocol.

Image courtesy of the Jade Colley, sxc.hu

"Standards are the basis for innovation and progress in grid and are essential for grid technology take-up and exploitation. Over the last few years, NorduGrid have been involved in a large number of interoperability-related efforts. Condor, gLite, UNICORE, a number of lesser-known solutions—you name it, we tried it. The only way for users of other middlewares to use our services, and for us to reach out to such users, is to make sure our ARC middleware is interoperable with other major solutions." *Oxana Smirnova, NorduGrid*

"For all of us, standards are a means to an end: interoperability that enables integration, collaboration, choice of vendor products/components and reduced costs. As scientists, government bodies or businesses, all of us have slightly differing priorities, but ultimately we all need the benefits that standards bring. The real challenge is how to deliver relevant standards in a timely fashion. My belief is that community-driven standards are the way forward and that standards driven through implementation are the most likely to be successful for those of us driven by quarterly and yearly results. We need interoperability and we need it fast!" *Paul Strong, eBay*

"It is clear that EGI on the one hand and OGF on the other hand need to collaborate on shaping the future European Grid infrastructure. Mastering the landscape of standardization is a key element in the future sustainable European grid infrastructure. In fact, standardization is essential to the further distribution of grids as well as to interoperability between different grids, such as National Grid Infrastructures." *Dieter Kranzlmueller, European Grid Initiative Design Study*

Standards in space


Image courtesy GridTalk

A thrilling example of the need for communications and standards to go hand-in-hand is the 1999 Mars Climate Orbiter. Now "lost in space," the orbiter completed a 286-day journey to Mars by firing its engine in the wrong direction.

The mishap was caused by confusion between members of a distributed team, leading to use of both Metric and non-Metric units in crucial calculations.

"The OMII-Europe experience has shown that the adoption of standards can potentially enable scientists and other grid users to do new things that would not have been possible with resources tied to single infrastructures. The benefit of the project-based approach is that it brings together demanding users, standards-savvy developers and competing providers focused on achievable medium-term goals. There are no simple answers as business and research communities want different degrees of security and stability." *Steve Brewer, OMII-Europe*

"ETSI has a long history of partnership with the grid standards community, working with OGF to develop grid test cases and interoperability events in collaboration with all stakeholders. This year we will hold our 5th Grid Plugtests interoperability event, providing new opportunities for companies to test their prototypes against a standard with their partners and competitors. ETSI's mission is to succeed in involving the telecom operators and manufacturers in grid standardization. This is what is happening now in the ETSI Technical Committee GRID and we should soon have some echo of success from this committee's collaboration with OGF." *Gaby Lenhart, European Telecommunications Standards Institute (ETSI)*

"To build a seamless European and even worldwide grid infrastructure, common standards are key. While today's users have to adopt to the specific services offered by different grid infrastructure providers, common standards will soon help offering by them a seamless infrastructure. EGEE works closely with standardization bodies such OGF and other grid infrastructure projects to ensure standards are developed according to best practices originating from operational experiences." *Erwin Laure, EGEE Technical Director*

"As I see it, when common interfaces and best practices are adopted and begin to demonstrate value, standards follow. In the Open Science Grid, we work with many different end-user communities to provide easy access to resources across local campus, national and international distributed infrastructures. Standards emerge from the agreed-upon services to meet the needs of these communities. Agreeing on and documenting standards across a diverse set of projects is a painstaking process. I much appreciate the efforts within and facilitated by the OGF and similar standards bodies to which we contribute." Ruth Pordes, *Open Science Grid Director*

European investment in grid standardization

In her presentation at the e-Infrastructure Concertation Meeting, Gabi Lenhart from ETSI, the European Telecommunications Standards Institute, said that the current landscape of European research initiatives is extremely favorable. Her figures indicated that from 2007 to 2014 (FP7), the European Commission is investing 50.5 billion Euros in R&D projects. In the years prior to this (FP6), 1449 R&D projects were funded. The technical solutions these hundreds of projects produce need to interoperate not only with each other, but with other solutions adopted around the globe. Lenhart suggested some 32.4 billion Euros of FP7 money will fund projects that include measures to address standardization issues in their scope.

For more information:

5th e-Infrastructure Concertation Meeting
http://www.beliefproject.org/e-infrastructures-as-standardisation-drivers

OGF23
http://www.ogf.org/OGF23/

GridFTP
http://www.globus.org/grid_software/data/gridftp.php

VOMS
http://www.globus.org/grid_software/security/voms.php

ETSI grid activities
http://www.etsi.org/WebSite/Technologies/GRID.aspx

OGF
http://www.gridforum.org/

GridTalk
http://www.gridtalk-project.eu

EGI
http://web.eu-egi.eu/

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