Towards a coherent US National Cyberinfrastructure:

Opportunities for Coordinated Contributions

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Overview

The United States agencies support the nation's cyber-infrastructure (CI) to ensure that it is second to none in serving the computational needs of scientists, university faculty, educators, students and the US workforce. This leadership needs to be expanded and sustained to support the rapid increase in CI scale and complexity by these communities. The most effective outcomes require a coordinated approach across agencies and programs. The members of the Open Science Grid Consortium are scientific and research communities that mainly span two of these agencies - NSF and DOE – and have some smaller sponsorship from others, e.g. NIH.

There is a window of opportunity during the overlap of the current phase of the Open Science Grid project, the final year of TeraGrid as it exists today and preparations for the eXtreme Data (XD) program where contributions can leverage all three programs of work and make maximal contribution to the future. TeraGrid serves the high performance users at Track-1 and Track-2 facilities and Open Science Grid provides high throughput computing on generic clusters. The advance of multi-core capabilities in commodity computing and the inclusion of high throughput services within HPC allow more opportunity for collaboration across the projects. XD broadens the scope and comprehensiveness of the NSF shared cyber-infrastructure towards an open architecture for all CI services including shared archives, visualization, digital libraries, high performance and high throughput resources, software sustainability, and the next generation workforce.

In this paper we describe areas where short-term targeted contributions can effectively increase the cohesiveness and interoperation within the current set of US national cyber-infrastructures. The goal is to make some specific small steps by leveraging the existing projects (and future successful proposals) in collaborative tasks that move the vision of "coherent" "usable" "comprehensive" forward. There is no attempt at this stage to be complete.

Extension of Campus Infrastructures

The number of universities engaging in shared cyber-infrastructure is rapidly increasing. In OSG alone there are currently more than 25 participating US LHC Tier-3 institutions, with up to 70 more likely to join once LHC data taking commences. Many universities, including MSI institutions, need considerable support just to socialize and design the right solution for their local needs and organization. Distribution and support for usable, robust underlying software is a challenge. Faculty computing administration and support teams are small, temporary and rely on external experts. The TG Campus Champions program provides support for local campus contacts, similar to that of the OSG Engagement effort. A collaborative approach across OSG, TG, and XD will ensure that individuals and groups are presented with easy to understand, robust and diagnosable services and software, with no barriers to the use of local and a diverse set of remote computing and data resources.

Easy to install and administer software, toolkits to help in system administration, external support for security vulnerability and incident response are among those activities in which the OSG and other projects are currently engaged. Some targeted activities to increase attention to collaboration between OSG and TG, as well as on-site visits and local engagement with the technical administrators and scientific users can have a productive impact.

Common and Virtual Machine Technologies

Common technologies for job and data management and access and, especially, common client software distributions, will increase the usability and effectiveness for the user communities. Extended multi-core hardware and MPI configuration support will improve effectiveness across the full range of applications. The integration and deployment of Virtual Machine (VM) technologies in "scientific clouds" will hide the heterogeneity of the underlying operating systems and services from the application and user developers. Specific contributions that can provide value include: deployment and use of VMs on existing resource provider infrastructures; integration in OSG of the global file system solutions in development in TG; deployment across OSG and TG of just-in-time workload management solutions; evaluation of workflow tools that manage jobs and data across infrastructures.

The groundwork for all these advances exists today. Specific activities to address each one that leverage the previous and ongoing work in OSG, TG and other projects can make creditable contributions to the usability and robustness of the solutions.

Networks and Identity Management

The network providers to the broader US scientific community include ESNET, Internet2 and NLR. These projects work together to provide a seamless fabric as well as advanced services to the end-user communities. Work continues on identity management system (e.g. Shibboleth, PKI, Open-ID) to support "one time login" for users across the US national cyberinfrastructure. OSG and TG provide operations and management that support monitoring, diagnosis and use of the suite of middleware, application and scientific software and services depending on the network and identity (security) fabrics.

Activities that would give short to medium term benefit are: integration and use of Shibboleth based identity systems and authorities in the production grid infrastructures; integration of network monitoring and alert tools into the grid operations center monitoring and alarm systems; integrated support for mixed IPV6/PV4 environments.

Incorporate Commercial Cloud Resources

Commercial cloud computing offers a possible cost effective solution for some scientific computing and storage applications. Provisioning these resources as part of the integrated national cyberinfrastructure further strengthens the totality of the capacities and capabilities available to the research communities and users. The purchase of an infrastructure allocation and integration of the operations and applications support into the existing national resource provider infrastructures reduces the risk of "vendor lock-in", provides an integrated approach to "the right resource for the job", and offers a mechanism to quickly add short-term resources if existing ones are oversubscribed.

Deploy and Operate Inter-Infrastructure Gateways

A sustainable architecture for cyber-infrastructure includes the bridging between administrative, technology, and scientific domains. The EGEE and OSG have infrastructure gateways that translate accounting, information and resource data between the infrastructures for joint publishing the science communities in the World Wide LHC Computing Grid Collaboration (WLCG). OSG and TG have prototype gateways in place for the automatic scheduling of jobs from clients on one infrastructure to resources on the other. Production deployment, operation and adoption by the community of these gateways will significantly lower the barrier towards the use of the best available resource across the infrastructures.

Expand Participation in the Allocation Processes

The TeraGrid allocation committee reviews the computing and data storage requests of all communities and users who request to use TG resources. Currently there is no allocation process within the Open Science Grid Consortium. OSG participation in the resource allocation process would allow a common view across all our national CI resources and enable more coherent prioritization and policies.

Cross-program Training

A common training program across the infrastructures would help ensure usability across the resources and services, and enable the workforce and research community to use those capabilities and capacities best suited to their needs. A joint paper on "Sustaining the Workforce" has recently been submitted[1]. This needs an ongoing program of support for: undergraduate and graduate students; developing an infrastructure for the delivery and, most crucially, ongoing updates of online training material; mentors and logistical organizers.

International Activities

The physics communities together with OSG have a long history and increasingly productive collaboration with their peer European communities. In the next few years EGEE will transition to a pattern of independent national infrastructures collaborating in a federation under the EGI and separate software consortia. TG and the European DEISA and PRACE projects are increasingly collaborating. Now is the time to build on and expand work in areas such as policy (e.g. the Infrastructure Policy Group[2]), security incident response (point-to-point collaborations already exist), and determining if US participation in the Open Grid Forum is useful.

Expanded Planning within the XD Planning Phase

The XD proponents have initiated a year of planning. OSG has started requirements gathering from their stakeholders towards the next five years. This gives an opportunity to encourage coherence by ongoing monitoring between and communication across the management of these programs. We recommend regular meetings[3] towards bringing OSG, TG and the future XD, into a more collaborative approach to move forward our vision of a coherent US national cyberinfrastructure.

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[1] http://tinyurl.com/md2u33

[2] https://forge.ggf.org/sf/wiki/do/viewPage/projects.ipg/wiki/HomePage

[3] Like the US LHC Joint Oversight Group or OSG Joint Oversight Team