The Role of Regional Cyberinfrastructure in Sustaining Campus High Performance Computing Centers

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Abstract – Regional cyberinfrastructure (CI), consisting of networks, computing and data grids, shared services and expertise held in common across multiple institutions in a region is an enabler for multi-institutional research collaborations to access university-based HPC centers. We discuss the role of regional CI in supporting access to and use of university HPC centers and the need to consider the relationship between regional CI and the effectiveness of investments made by Federal agencies and universities in HPC resources and services on a regional basis.

I. What is regional CI and why is it important?

Regional cyberinfrastructure (CI) consists of networks, computing and data grids, shared computational and data services, infrastructure to support virtual organizations spanning regional institutions, and expertise in diverse areas such as high performance computing, grid computing, data management, and collaboration technologies held in common across multiple institutions in a region. Regional CI organizations address several important problems including maintaining networks that connect institutions in a region, providing a collaborative context in which researchers can address problems of regional interest and importance, and working to bridge the cyberinfrastructure divide between users at resource poor institutions and regional and national resources.

A critical emerging problem is the Cyberinfrastructure Divide between computing environments researchers find themselves working in on their home campuses and those found at HPC centers at other universities and national CI resources such as the TeraGrid Centers, Track 1 and 2 machines, the OSG and national data repositories. It is often difficult or impossible for researchers to leap this divide because they lack appropriate local support that understands both departmental/campus computing environments and those provided by regional or national facilities. This CI divide is caused by structural mismatches between national and campus CI and related services, and in many cases altogether missing campus CI components. Programs such as CI Days and EMERGE at RENCI are very useful for building awareness and meeting specific researchers’ needs through provisioning of off-campus computing resources but do not directly address the long-term commitment needed to nurture and build campus CI so that it both meets local needs and articulates seamlessly with national CI.

Regional entities that span many campuses and have close service provider relationships with them are in a unique position to bridge the CI Divide. Regional optical network organizations, for example, have many attributes that make them good candidates for providing a context in which regional CI can emerge as a synthesis of local needs, capabilities, development goals and funding. In addition to providing a technically sophisticated engineering capability and a 24x7 operational support structure
(e.g. operations centers) RONs typically have the social infrastructure (social networks and administrative and technical support) needed to develop and implement technical goals across multiple institutions.

Regional cyberinfrastructure organizations such as the Great Plains Network and SURAGrid have the following goals:

- Supporting the development of CI at the campus level in a regionally coherent way at primary research institutions with the possibility of outreach to four year and two year institutions and to industry
- Aggregating regional CI resources and making them available through a common set of policies and procedures
- Providing a seamless path for researchers to scale their research from campus work environments to regional HPC and national capability computing centers
- Building knowledge management structures and training programs that will allow the efficient sharing of CI and computational science expertise across the region
- Supporting the integration of CI into educational programs at institutions of higher education primarily through the cooperative development and delivery of computational science curricula.

II. How does regional CI support university and national HPC centers?

Regional CI supports university HPC centers in several important ways. First, they are able to bridge campus users at one institution to resources at nearby institutions. As a corollary they also establish processes and standards to make local resources available outside their home institution. Regional CI organizations advance state and regional economic development goals using the combined resources of the member institutions. They also provide a context for outreach from campus HPC centers to nearby two and four year colleges that may also participate in the region’s R&E network. Finally, they increase university HPC centers’ reach and potential impact on state economic development priorities and responsiveness to national needs.

As an example of how regional CI organizations support campus-based research CI, the Great Plains Network (GPN) provides Federated Identity Management across GPN member institutions making campus-level services broadly available outside the home institution; sharing of data, computation and storage resources among GPN members; direct support to researchers to access shared resources and to move applications to HPC or HTC centers; training and support to campuses on emerging technologies such as CONDOR and Shibboleth and perhaps most important, ongoing development and refinement of middleware and end-user services for integration of local computing, storage and computational services into a regional pool.

Regional CI organizations increase the effectiveness and reach of a campus HPC center by providing end-user training, research training and inter-institutional graduate research fellowship programs. They can also be springboards for the formation of new collaborations, directly supporting regional multi-institutional projects and serving as a focal point for development and specialization of multiple regional HPC centers with different but interlocking areas of expertise.
Regional CI centers may also serve as focal points for provisioning CI to be held in common by multiple institutions but co-located at a particular HPC center. Examples of this include infrastructure for federated identity management across several institutions in the region and providing a point of aggregation of services provided by several HPC centers so that all institutions in a region (or from outside the region) have a consistent view and method to access these services.

III. How can regional CI be used to sustain university HPC centers?

A key issue in sustaining HPC centers is in nurturing and growing a varied user base working on important problems. This can be done by seeking out individual researchers working on large scale problems. As an alternative to active recruitment of key users, regional CI organizations provide a context outside the HPC center in which collaborations can be developed and brought in to the center. The HPC center then becomes a regional resource that such collaborations naturally turn to as their problems grow to need these capabilities.

A second issue in sustaining HPC centers is differentiation and specialization for competitive advantage. Regional CI groups can support differentiation and specialization strategies at HPC centers by providing channels for reaching researchers within a region who may be interested in a particular center’s expertise or facilities. Regional CI groups can also serve as aggregators and filters to help researchers in their region find centers with competencies and expertise that meet specific requirements needed to achieve their research goals.

IV. Discussion questions
A. How can regional CI groups like the Great Plains Network and SURAGrid contribute to the sustainment of HPC centers?
B. How can HPC centers contribute to the development and continued improvement of regional CI?