A Report on the EDUCAUSE Cyberinfrastructure Summit
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Background

EDUCAUSE, as part of its Grand Challenges Program, is hosting several summits on topics of particular importance to higher education. These summits are designed to bring together a small number of thought leaders and experts to capture the best ideas and strategies for advancing the community. The 2007 EDUCAUSE Cyberinfrastructure (CI) Summit, held July 10–11 in Denver, was attended by about 50 higher education leaders with particular expertise and responsibility in the support of IT for research. A professional facilitator guided the group through a rich discussion of the highest-priority topics they identified.

Context

The EDUCAUSE Campus Cyberinfrastructure working group (the CCI) was formed in 2005 in response to a dramatic increase in member interest in these issues. The group's Web (http://www.educause.edu/cci) states that:

> Cyberinfrastructure is a rapidly growing and expanding component of information technology focused on distributed computing, data, and communications technology. Hardware and software systems are rapidly being developed and implemented to build the virtual research communities along with the collaborative tools to knit these user communities together. Along with these rapid advances, a well educated and trained workforce needs to be in place to support these activities.
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> This overall process is changing whole disciplines, educational initiatives, and research methodologies. Cyberinfrastructure is being applied to such areas as supercomputing, large-scale data repositories, digitized scientific data management/high-capacity mass-storage systems, and scalable interactive visualization. State-of-the-art high performance networks deliver connectivity to an array of distributed software tools and services, including grids and middleware that hide the complexities and inhomogeneous components of large heterogeneous systems while seeking to provide users with ubiquitous access and enhanced usability. These activities are now a nationally important set of IT initiatives focused on these new types of opportunities with an emphasis on the education and workforce development to advance these technologies.

Speakers

Although the CI Summit was designed for productive discussion, several speakers helped set the stage. Peter Siegel, CIO and vice provost for information and educational technology at UC Davis, emphasized that CI is about not only the technology but also collaborative relationships among IT leaders and the research community—and how these communities need to bridge cultures and learn from each other. Between the common CI service components, often centralized, and the local applications of the

researchers lies a "demilitarized zone" of shared and standard IT applications. In this complex, ever-changing, dynamic system the most interesting challenges occur at these transitions. Higher education needs to define a process to best handle these changes as they occur over time, sometimes at different rates for different communities and faculty strategies. Higher education administrators must understand the importance of CI for their campuses and the need to fund it. In addition, the NSF's *Cyberinfrastructure Vision for the 21st Century Discovery* document (http://connect.educause.edu/library/abstract/CyberinfrastructureV/37146) could serve as the foundation of a new understanding or contract with the higher education community.

Patrick Dreher, cochair of the CCI and group/project director and research scientist at MIT, gave an update on the activities of the group. Among the CCI's motivations are the realization that the new technologies and methodologies driven by CI are generating new results that have profound implications for changing entire disciplines, educational initiatives, and research methods. The CCI's mission is to facilitate institutional strategies and suggested resource deployment for CI as well as to help researchers use the capabilities of these new, integrated IT tools and systems. The CCI is focusing on two goals: describing and selling cyberinfrastructure to campus leaders, and business models for data centers.

Representatives of several institutions gave an update of how their campuses are addressing their CI needs.

- Jim Bottum, vice provost for computing and IT and CIO at Clemson University, reported that Clemson's leadership believes that CI is the primary backbone to integrate innovation in research, instruction, and service. Grants to establish CI have been increasing over the past few years. Clemson is using a four-piece framework from the NSF vision document and is linking high-end research tools into everyday learning.

- Brad Wheeler, CIO, dean, and professor at Indiana University, described IU's highly leveraged, shared-infrastructure-focused model that enables a philosophy of abundance, and a discipline-oriented staff with domain and technical expertise. He described the funding model for the central Research Technologies group and the excellent partnering element resulting in external grants currently totaling $105M. He noted a solid IT governance environment in place at IU as well as strong support from the president.

- Bonnie Neas, associate vice president for cyberinfrastructure at the North Dakota University System, described CI being driven bottom-up from researchers. She also discussed NDU System's five-year plan for CI (begun in 2000–01), a regional consortium that was formed, and an NSF planning grant for the "northern tier" to

the four participating EPSCOR states. She noted that professional development and training are critical to success.

- David Walker, director of advanced technology at the University of California Office of the President, stated that academic cyberinfrastructure was a key component of the recommendations for research and scholarship of the system-wide IT Guidance Committee. Advanced network services for all campuses, compute and storage upgrades, and a common Web interface benefit all users. Access to services critical to research, scholarship, and instruction is ubiquitous.

DISCUSSION SUMMARY

The participants spent the remainder of the summit in structured discussions of six aspects of CI designed to gather their wisdom, creative ideas, and advice. They concluded with suggestions for what EDUCAUSE could do to help the community advance. The following sections are meant to reflect their major points.

Support for Research

While most definitions of CI are broad, implying applications beyond the research community, research will be the driving force and engine for investment. There is rapid expansion of demand for a robust CI on campus to support research. Key elements needed in planning for CI needs for research include the technology itself and the involvement of central IT. Also needed are workflow, policy and funding proposal development, and an effective IT governance structure. The human considerations include the need for early involvement and cooperation with research faculty, collaborations and partnership arrangements, support and consultation, and system ease-of-use, reliability, and interoperability. Critical facilities planning issues include space, power, and HVAC.

In addition, many adjunct CI services should be built and supported, including data curation, directories of services, communication structures for IT, support for the preparation of proposals for national and regional grants, workflow instrumentation, collaboration tools, vendor relationship management, professional development, and CI consulting services.

Because the definition of core CI services changes over time, an institution should implement a process to ensure it meets reasonable expectations and adjusts campus investments to shifting priorities. Recommendations include establishing a life-cycle replacement process; running development, test, and production systems simultaneously; continuously involving users, building a common vocabulary; balancing leading and bleeding edge; keeping abreast of international, national, regional, and campus developments; and understanding how CI must adapt to accommodate cross-disciplinary needs and domain-specific research. Researchers, IT leaders, and administration must engage in continuous dialogue and review of the CI environment,

including funding agency plans and commitments, to ensure the overall system's sustainability. And as always, the understanding and support of executive administration is a must, along with strong governance, measurement of outcomes, and an accepted prioritization methodology.

National and international services and collaborations are vital for the exchange of ideas and enable solutions that could not be achieved otherwise. CI can support the expectations and capabilities of global communities and facilitate "big science." Disciplinary collaborations (e.g., TeraGrid, LHC) support the research agenda and provide shared services with external resources.

Leadership

There was widespread agreement of the need for central IT organizations to play a leadership role in the strategic planning for a robust CI on campus. Although this is not only an IT issue, the CIO can facilitate partnerships across all campus sectors, lead from the side, and promote CI to researchers, development staff, finance officers, and other critical stakeholders. Leaders are needed across community disciplines to build consortial groups and mediate needs with actions and resources. Those who control the funding should be convinced that CI is a critical need. IT leaders must understand the local environment and culture and what researchers need, and should not be perceived as "pushing" CI onto the faculty. Faculty CI champions can demonstrate CI's benefits to other researchers. Interdisciplinary examples are particularly beneficial. In addition, the CIO should be the CI architect as well as the builder.

Priority and Funding

Many central IT organizations report that they did not accurately forecast the extent of new demand for CI and its impact on central IT services. Most institutions have neither anticipated nor planned for such a big shift. The granting of many small-to-large clusters for individual researchers accentuates the problem. Campuses should realize the need for a sustainable funding model, not a one-time cost, and share the burden of support among the campus and the funders. Common expectations and norms must be established for costs and benefits. NSF can act as a forcing function for higher education. A focus on the big ideas, which requires integration across scale, can establish competitive advantage. CI is now part of the cost of doing the "business" of research in higher education.

Long-Term Strategies

A significant social problem with CI is that it requires sharing, interoperability, coordination, and consolidation. New incentives and reward systems must be developed and encouraged, and discipline-unique drivers and close alignment with existing institutional incentives must be recognized. The scale of collaboration will increase greatly, with an emphasis on tools, relationships, data, and service. Virtual research parks will become more common, and CI will be leveraged in other areas than research.

Libraries and digital assets will become significant players. The entire nature of higher education could change based on the influence of CI.

Short-Term Strategies

Much of the short-term CI effort seeks consensus among the existing competing approaches. Short-term strategies can be designed to result in quick accomplishments, but can morph just as quickly to meet new requirements. Solutions and technologies that will facilitate interoperability across multiple implementations are advantageous. A small number of successes can be cultivated and supported to move the institution ahead. A common repository of materials including success and failure stories, articles, research examples, events, and meetings would be beneficial. Higher education must develop campus, regional, and national "buzz" around CI, and pilot projects can produce tangible results. Institutions can begin to develop technical CI-oriented staffing and expertise. Opportunities for mutual support between traditional IT and CI should be identified and leveraged.

EDUCAUSE Involvement

EDUCAUSE currently supports the CCI and has sponsored CI-related workshops and presentations at conferences and in ECAR material. EDUCAUSE could enhance these activities to support campus IT leaders and to help research CIOs address CI as a community.

At the conclusion of the CI Summit, participants made the following concrete recommendations for additional EDUCAUSE support of CI in the community:

- EDUCAUSE can take the lead in communications and can serve as an authoritative clearinghouse for best practices and case studies, including both successes and failures. The association should produce a publication for administrators (similar to *What Every College President Needs to Know About Cyberinfrastructure*); quickly generate a white paper on CI for CIOs to share with campus constituencies; create a CI wiki for interested institutions to post inventories of their campus CI resources and services; establish a speakers' bureau on CI to provide expert speakers for a variety of forums (including Congress); establish a CI award; help place CI issues on the agendas of other higher education professional associations (e.g., research libraries, presidents, NACUBO); post a regular CI column in *EQ* or *EDUCAUSE Review*; help publish CI articles in the press (e.g., the *Chronicle of Higher Education* and the *New York Times*); and create and maintain a resource list of CI experts, drawing from technical people, subject-matter experts, administrators, and so forth.

- EDUCAUSE can serve as the means to create various groups to discuss CI, including discipline-specific and international groups, as well as other higher education associations; a "research institutions" discussion group; and a forum for CIOs and senior institutional leaders (such as VPs for research) to address CI issues. EDUCAUSE should facilitate the formation of CCI teams; pursue integrating some of the CI-

related groups that have emerged recently (such as SCG and RUCC); facilitate a meeting with researchers to discuss CI (perhaps concurrent with the annual Supercomputing Conference); create a forum for EDUCAUSE corporate partners to engage with CIOs on research computing topics; and form a senior-level advisory council (to include presidents) for CI.

- EDUCAUSE can take the lead on funding strategies for CI, engaging funding agencies in discussions on how to more effectively fund CI, and foster the development of alternative funding models (e.g., central, taxation, SRAD).

- EDUCAUSE can help "sell" the idea that CI for physics, humanities, climatology, and the arts is largely "all the same stuff."

- EDUCAUSE should "digest" CI work done by others (e.g., the NSF report) into a CIO action plan, using "new language" to help facilitate the discussion among important contributing parties who may be put off by obscure terms like "cyberinfrastructure."

EDUCAUSE has not been viewed as an organization whose focus is academic research in higher education. Implementation of these recommendations can help change this perception.

Conclusion

Those attending the summit described it as a valuable experience that enabled them to focus exclusively on this topic in a meaningful way, contribute their thoughts and ideas to the group, and establish relationships with others challenged by the same issues. There was a pervasive sense of urgency that we now must move beyond discussions to concrete actions.