

Advances in the MSI Community and the MSI CyberInfrastructure Empowerment Coalition (MSI-CIEC)

Richard A. Aló, Member, IEEE, Karl Barnes, Diane Baxter, Geoffrey Fox, Al Kuslikis, and Alex Ramirez

Abstract Building on a very successful NSF CI-TEAM Demonstration project, MSI-CI² [1, 2, and 11] and the earlier Advanced Networking for Minority Serving Institutions [3], The Minority-Serving Institutions CyberInfrastructure Empowerment Coalition (MSI-CIEC) is laying the foundation for a sustainable and scalable initiative to meaningfully engage MSIs into CyberInfrastructure and the TeraGrid. We discuss some of the challenges and opportunities for MSIs with the emergence of CI for science and engineering. We will briefly illustrate the potential of MSI-CIEC by presenting two prominent success stories within the context of the overall MSI community. We then discuss the approach and current activities of MSI-CIEC including those with the TeraGrid.

Index Terms— Minority Serving Institution, CyberInfrastructure, Grid Computing, TeraGrid.

1 Introduction

CyberInfrastructure (CI) is enormously promising for the nation's science and engineering enterprise and offers the opportunity of democratically benefiting all participants [1, 2, 4, 5, 10, 12, 13, and 22].

2 MSI-CIEC VISION

The Minority-Serving Institution CyberInfrastructure Empowerment Coalition, MSI-CIEC, is established to accelerate the advancement of e-science and CI, the development of a diverse CI-related science and engineering workforce, and to broaden access, participation, and appreciation for CI and e-science, particularly among traditionally underrepresented minority populations. The vision of MSI-CIEC is to advance science, technology, engineering and mathematics (STEM) and the participation of the nation's underrepresented minorities in STEM, particularly e-science and in the global STEM workforce through our MSI's and the emerging CI. This defines a mission to build and enhance the social and technological mechanisms for meaningful engagement of MSI's in CI. That is, to develop the CI "middleware" resource to encourage, broker, enable and manage meaningful CI initiative and MSI collaborations of mutual benefit for the use, support, deployment, development, and design of CI to enable the advancement of e-science research and education unlike ever before, and the development of the nation's diverse science, technology, engineering and mathematics (STEM) workforce, including the current and next generation of the STEM professoriate in an increasingly diverse society. MSI-CIEC exploits the virtualization and global integration features of CI as a democratizing force that can offer

leading edge STEM involvement to all.

3 MSI-CIEC- A VIRTUAL ORGANIZATION

MSI-CIEC is a virtual organization (using Grid terminology) shown in the figure above and organized under the Alliance for Equity in Higher Education. This ensures its work will have systemic impact on at least 335 Minority Serving Institutions covered by the Hispanic Association of Colleges and Universities, the National Association for Equal Opportunity in Higher Education, and the American Indian Higher Education Consortium). MSI-CIEC is envisaged as largely aimed at supporting the community interested in CI-involvement of MSI's and that it will lead just a few projects but also provide a scalable implementation of its mission by leveraging and advising many relevant projects led by others. The MSI-CIEC initial project is the Minority-Serving Institutions CyberInfrastructure Institute (MSI CI²) funded by the NSF CI-Team program as an initial planning and information dissemination activity. This has worked with MSI and CI leaders to identify challenges, opportunities and success stories so as to prepare a pathway forward. We have identified some critical features of our future work including:

- Institutional activities: executive presentations and campus visits to plan CI
- Funding of faculty release time and students
- Linkage of MSI and National CI research projects
- Curriculum enhancement
- Education and Training of faculty, students and CI support staff
- CI installation at MSI sites for both local capability and access to International CI. We

- Richard A. Aló, University of Houston Downtown, Center for Computational Science, www.uhd.edu/ccsds, ralo@uh.edu
- Karl Barnes, National Association for Equal Opportunity in Education, www.nafeo.org, karl.barnes@gmail.com
- Diane Baxter, San Diego Supercomputer Center, dbaxter@sdsc.edu
- Geoffrey Fox, Indiana University, gcf@indiana.edu
- Al Kuslikis, American Indian Higher Education Consortium, AKuslikis@aihec.org
- Alex Ramirez, Hispanic Association of Colleges and Universities, aramirez@hacu.net

suggest the formation of a MSI CI Operations Center to support this.

We will present details of our current and

4 WHAT WE MEAN BY "MEANINGFUL ENGAGEMENT", TWO CASE STUDIES

The mainstay of CI and the TeraGrid is collaboration; just like it is for much of science research and the technology industry today. MSI-CIEC provides a point of collaboration or engagement to CI for MSIs and to MSIs for CI projects and resources, as a scalable, equitable mechanism for developing a CI-enabled science and engineering workforce inclusive of MSIs as full-partners. Two exemplary MSIs are well on their way to being full-partners in meaningful collaboration, collaboration meeting the needs of the MSI and meeting the needs of their non-MSI partner.

4.1 NAVAJO TECHNICAL COLLEGE

Navajo Technical College (NTC)- being encouraged by their participation in the MSI-CIEC planning meeting and MSI-CI Institute, both held at MSI-CIEC partner San Diego Supercomputer Center (SDSC), as well as the MSI Resource Provider workshop done with the National Center for Supercomputer Applications (NCSA) (also a partner) and building on a relationship with the TeraGrid (another partner)-commenced their building of high-performance networking and cluster and grid computing for NTC and the Navajo nation with the "Internet to the Hogan" celebration. Under the strong leadership of Tom Davis, Dean of Instruction, NTC, and highly regarded national leader in technology for TCUs, NTC will work with the University of New Mexico (UNM), a leading HSI, and the SDSC High Performance Wireless Research and Education Network (HPWREN) [16] to connect to the National Lambda Rail (NLR) [20] and Internet2 [17] at OC-3 (155 Mbps) speeds. HPWREN has trained NTC staff and a talented NTC student who in turn is teaching other NTC staff and students to do the actual building and maintenance of the wireless towers and network connections. Additionally, through Scott Lathrop, TeraGrid Education Director and current chair of the Supercomputer '07 Education Committee, a "Little Fe" supercomputing computer cluster was donated to NTC which is among the first to establish the Diné Grid, part of the Navajo nation's local CI. NTC will expand their educational degree offerings through the Ph.D. and strengthen the Navajo STEM education pipeline through partnerships with Navajo K-12 schools and other colleges and universities. Jared Ribble the NTC student who with other NTC staff attended all the MSI-CIEC meet-

planned activities and how they interact with TeraGrid.

ings is the talented student who will train the other NTC students and together build the Navajo CI. Jared also hopes to pursue his masters and Ph.D. through NTC. Jared and Navajo Tech are illustrative examples of the vision and mission of MSI-CIEC. MSI-CIEC including the University of New Mexico and MSI-CIEC CI partners, especially SDSC and TeraGrid, will continue to work with Navajo Tech to bring about its CI vision, and broaden the participation of Native Americans and Hispanics into the CI enabled workforce.

4.2 ELIZABETH CITY STATE UNIVERSITY.

Elizabeth City State University (ECSU), an HBCU in North Carolina, attended our two meetings hosted at SDSC that described how CI enabled new science. ECSU recognized the value of CI for the collaboration they had with the Center for Remote Sensing of Ice Sheets (CReSIS) [8] which is an NSF Science and Technology center developing new sensors and new models to understand ice sheets. This critical project is motivated by recent polar satellite observations that show disintegration of ice shelves in West Antarctica and speed-up of several glaciers in southern Greenland. The great ice sheets in Antarctica and Greenland interact with the global climate in a complex manner, and the impact on global sea level of their retreat would be profound. Most of the existing ice-sheet models, including those used by the Intergovernmental Panel on Climate Change (IPCC), cannot explain the rapid changes being observed. CReSIS work will enable a new-generation of high resolution ice-sheet models with realistic boundary conditions, but it will require distributed CyberInfrastructure to gather and process data and assimilate them with large simulations.

ECSU along with CReSIS and MSI-CIEC collaborators have already taken several steps to develop the Polar Grid CI. A follow up CI-Team proposal has been approved and will develop the PolarGrid Science Gateway linking TeraGrid with CReSIS research. ECSU will offer a CI track in their master's program and their undergraduate and graduate students will be offered CI internships this summer. An ECSU graduate student took the first step with a week at the OGF19 Open Grid Forum meeting during January 29-February 2 of this year [21]. Existing collaborations of ECSU with the Association of Computer/Information Sciences and Engineering Departments at Minority Institutions (ADMI)

and MSI-CIEC will bring these opportunities to other MSIs. As a next step, ECSU and Indiana University have proposed an innovative infrastructure that will link intermittently disconnected field and base grids in the polar regions to “lower 48” data and computing resources. This has important hardware and software challenges that will advance CI research and enable new science discoveries. After little more than a year, NSF’s MSI-CIEC has brought a relatively small HBCU with less than 3000 students to the leadership position in development of CI for an internationally critical science project.

4.3 OTHER EXAMPLES WE HAVE FOUND: UT BROWNSVILLE, FIU, UTEP, UNIVERSITY OF NEW MEXICO, HOWARD UNIVERSITY, , AND SOUTHERN UNIVERSITY.

There have been a few other notable examples of meaningful engagement of MSIs in CI which MSI-CIEC will use as models for emulation. The University of Texas at Brownsville, a small four-year institution just yards away from the Mexican border and which shares a campus with a two-year institution, Texas Southmost College, has been significantly advancing scientific discoveries in the science of gravitational wave astronomy through their collaboration with the Open Science Grid [14] and the TeraGrid through the Texas Advanced Computing Center. Florida International University is meaningfully engaging in CI partnerships through its now international Cyberbridges project [9] and its grid enabled Center for High-Energy Physics Research and Education Outreach (CHEPREO) [7]. The University of Texas at El Paso is the lead institution in the Computing Alliance of Hispanic-Serving Institutions (CAHSI) [6] with whom MSI-CIEC very closely collaborates, and is a partner in the GEON project [15] and has developed a formable research and education program in grid computing and the semantic web. The University of New Mexico, as mentioned above, is helping provide high performance networking connectivity to Navajo Tech and will soon be acquiring a high performance computing cluster which will place it as the only MSI on the Top 500 Supercomputer list [23]. Howard University researchers have been meaningfully partnering in the LEAD project [18] with the University of Oklahoma and the TeraGrid. Southern University is a part of the LONI grid computing project [24] with several other universities in the hurricane- Katrina-damaged gulf coast regions in Louisiana. These leaders have participated in MSI-CIEC activities and provide model examples for possible adoption at other MSIs.

5. LAYING A SUSTAINABLE FOUNDATION

In order to have a scalable implementation of its mission, MSI-CIEC recognizes the need to undertake several measures that will lay the foundation for the promotion, development and enhancement of activities similar to the two described above. Being a catalyst for advancement in CI research and education for our MSIs is an important starting point for the work that needs to be done. To this end we need to understand the capacities and capabilities of our MSIs to enter into the world of CI.

5.1 SURVEYING MSIS AND BUILDING PARTICIPATION. Many approach working with MSIs as an “outreach” effort where they reach out to MSIs and work with just a small set of institutions. This approach is not scalable or sustainable because the MSIs are then dependent upon the sponsoring institution and such sponsorship can only be extended to a few. Our approach is to be concerned with the whole community of institutions of MSIs for then you can approach the highest potential efficiency of impact on the underrepresented minority college students and the minority community. This scale is also the domain and scale of membership of the three base organizations of the Alliance for Equity in Higher Education, namely: the American Indian Higher Education Consortium (AIHEC), the National Association for Equal Opportunity in higher education (NAFEO) and the Hispanic Association of Colleges and Universities. In this vein, a broad survey of MSI faculty, IT staff and administrators is under development to begin to systematically tap into the collaborative research and education potential of the MSI community of institutions.

The survey is a simple, very brief survey of contact information and research, education and administrative interests as well as basic campus CyberInfrastructure information. This can help to build the knowledgebase about the more permanent people at our institutions from which we may build collaborations either directly lead by MSI-CIEC or indirectly with our CI partners or, as in the case of ESCU and NTC, MSI campus lead initiatives, collaborations or projects fostered by the collaborative environment designed by MSI-CIEC. The latter would be considered the most meaningful and sustainable developments. We expect these to be manifested through research or education proposals or self-funded projects with the support and assistance of MSI-CIEC and the relevant CI partners that MSI-CIEC can bring to bear. The survey and follow-on projects would not be a one-

time snapshot of the MSI community, but an ongoing continuous effort to build increased participation of MSI faculty, IT staff and administrators and the students they can bring in appropriately.

5.2 MSI-CIEC AS MANIFESTED IN A COLLABORATIVE PORTAL. Also under development is a social networking collaboration portal as a technological manifestation of the MSI-CIEC collaborative environment. With information gathered from the above survey combined with information about and from CI partners, the MSI-CIEC portal will provide the technological mechanism to encourage, enable and broker research and curricular collaborations for conducting research or developing CI curriculum, or developing research or education proposals.

5.3 MSI CAMPUS VISITS AND CYBERINFRASTRUCTURE DAYS.

Building upon the NSF funded Advanced Networking with Minority-Serving Institutions (AN-MSI) [3] campus visits program, MSI-CIEC will use information gathered from the above survey to identify potentially fruitful MSI campuses to help develop into model campuses for engaging in CI for research or education. Recognizing that successful CI engagement is a complex confluence of administrative leadership, faculty and IT staff ability, interest and knowledge, and the right technology, MSI-CIEC will work with a small set of MSI campuses to raise the awareness of campus executive leadership, assess campus strengths and weaknesses in technology and in research, education and technical interests and capacities while assisting in development of strategic goals, objectives and plans along with the initial implementation. Working with TeraGrid, Internet2, Open Science Grid and Educause, the campus awareness of CI and its potential will be raised through a series of presentations by and discussions with these partners, MSI-CIEC and local campus leaders (all within the larger context of this broader campus visit).

In follow-up to the above campus technical assistance visits, MSI-CIEC will help participating MSIs strengthen their capacity to build and manage CI-enabled collaborative environments and services and more effectively use technology to deliver and manage services, information, and resources to community members using open-source tools and services. The Access Empowerment Team will provide technical recommendations and support in the acquisition and maintenance by MSIs of the infrastructure necessary to both access and contribute to

the national CI, e.g. clusters, AG nodes, and connectivity. The project will assist participating MSIs in identifying opportunities to contribute computational, data and other services and resources to the national grid, and possible funding models and opportunities.

5.4 TERAGRID CAMPUS PARTNERSHIPS.

Members of the MSI-CIEC team helped in the development of TeraGrid Campus Partnership program, which includes CyberInfrastructure Days- seeing it as a vehicle for some MSIs to join in the TeraGrid community and the larger CyberInfrastructure community strengthening the MSI and the TeraGrid.

5.5 PARTNERING WITH TERAGRID EDUCATION AND TRAINING.

Whereas last year we developed our own summer institute to educate and develop MSIs with the considerable support and participation of our CI partners, most noticeably SDSC, NCSA and the TeraGrid, this year we intend to work with our partners and incorporate MSIs into the CI education and training opportunities of the TeraGrid, such as TeraGrid '07, and others, SC '07, and the SDSC, NCSA and TACC summer institutes looking for one specifically for MSIs at NCSA and possibly TACC. This decision was based upon the quality of the programs and willingness of the partners to attempt to accommodate MSI needs. We will continue to assess the appropriateness of this approach, and make adjustments as needed.

6 CONCLUSIONS

Being a focal point for MSIs to enter the world of CI research and education is underscored in the discussion above. The activities described are designed to initiate and then to accelerate the advancement of e-science and CI in conjunction with promoting the development of a diverse CI-related science and engineering workforce. At the same time activities are included to assist in broadening access, participation, and appreciation for CI and e-science. The MSI-CIEC under the leadership of the main, national MSI organizations and with the active partnership of an illustrious and growing advisory board of CI leaders, aims toward our commonly held desire for meaningful and mutually beneficial engagement of MSIs into the emerging CyberInfrastructure, including the TeraGrid. Taking a community of MSI institutions approach, this can be an efficient and scalable vehicle for broadening the participation of underrepresented minorities in CI and e-Science which is much needed for the vitality of the national participation in the global, knowledge-based society. By the collaborative efforts of MSIs and CI projects, resources and

services we can more effectively shape an appropriate strategy for working with individual campuses within the broader context of the MSI and national higher education community

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REFERENCES

- [1] Alo, R. et al. (2006). MSI-CIEC: MSI CyberInfrastructure Empowerment Coalition and the TeraGrid <http://grids.ucs.indiana.edu/ptliupages/publications/MSI-CIECPaperMay06.pdf>
- [2] Alo, R. et al. MSI-CIEC: MSI CyberInfrastructure Empowerment Coalition and the TeraGrid presentation June 12-15, 2006 TeraGrid Annual Conference 2006 <http://grids.ucs.indiana.edu/ptliupages/presentations/CITEA-MTG06June13-06.ppt>.
- [3] AN-MSI Advanced Networking with Minority-Serving Institutions <http://www.anmsi.org/>
- [4] Atkins, D. et al. Revolutionizing Science and Engineering through CyberInfrastructure: Report of the National Science Foundation Advisory Panel on CyberInfrastructure. Arlington, VA, 2003
- [5] "Grid Computing: Making the Global Infrastructure a Reality" edited by Fran Berman, Geoffrey Fox and Tony Hey, John Wiley & Sons, Chicester, England, ISBN 0-470-85319-0, February 2003
- [6] Computing Alliance of Hispanic-Serving Institutions (CAHSI) <http://cahsi.fiu.edu>
- [7] CHEPREO <http://www.chepreo.org/>
- [8] CReSIS Center for Remote Sensing of Ice Sheets <http://www.cresis.ku.edu>
- [9] Cyberbridges demonstration project at Florida International university <http://www.cyberbridges.net/>
- [10] Cummings, J., & Kiesler, S. (2005). Collaborative research across disciplinary and organizational boundaries. *Social Studies of Science*, 35, 703-722
- [11] Educause <http://www.educause.edu/>
- [12] EPIC Engaging People in CyberInfrastructure <http://www.eotepic.org/>
- [13] Foster I, Kesselman C (eds.). *The Grid 2: Blueprint for a New Computing Infrastructure*. Morgan Kaufmann: San Francisco, CA, 2003
- [14] Grid Operations Center of Open Science Grid <http://www.grid.iu.edu/meetings/scmeeting06.php>
- [15] GEON <http://www.geongrid.org/>
- [16] High Performance Wireless Research and Education Network (HPWREN) <http://hpwren.ucsd.edu/>
- [17] Internet2 <http://www.internet2.edu/>
- [18] Linked Environments for Atmospheric Discovery (LEAD) <https://portal.leadproject.org/gridsphere/gridsphere>
- [19] MSI-CI² Minority-Serving Institutions CyberInfrastruc-

- ture Institute <http://www.educationgrid.org>
- [20] National Lambda Rail <http://www.nlr.net/>
- [21] Open Grid Forum – OGF19 http://www.ogf.org/OGF19/events_ogf19.php
- [22] SACNAS (Society for Advancement of Chicanos and Native Americans in Science) <http://www.sacnas.org/>
- [23] Top 500 Supercomputers <http://www.top500.org/>
- [24] LONI (Louisiana Optical Network Initiative) <http://www.loni.org/>