Broadening the Reach for Access to Advanced Cyberinfrastructure

Accelerating Research and Education

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ABSTRACT

Many smaller, mid-sized and under-resourced campuses, including MSIs, HSIs, HBCUs and EPSCoR institutions, have compelling science research and education activities along with an awareness of the benefits associated with better access to cyberinfrastructure (CI) resources. These schools can benefit greatly from resources and expertise to augment their in-house efforts. The Eastern Regional Network's (ERN) Broadening the Reach (BTR) working group is addressing this by focusing on learning directly from the under-resourced academic institutions in the region on how best to support them for research collaboration and advanced computing requirements. ERN BTR findings and recommendations will be shared based on engagement with the community, including workshop and survey results, as part of the NSF sponsored CC*CRIA: The Eastern Regional Network Award OAC-2018927.

CCS CONCEPTS

• **General and reference** → Cross-computing tools and techniques; • **Social and professional topics** → Professional topics; Computing education; Computing / technology policy.

KEYWORDS

Research computing, Eastern Regional Network, advanced cyberinfrastructure, data sharing, collaborative research, federated services

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1 INTRODUCTION

New models for research are emerging, driven by new technology capabilities, high performance networking and computing, and the availability of structured and unstructured data and analytics. The role of research computing and data in scientific discovery and scholarship across all disciplines presents challenges, as well as opportunities. The Eastern Regional Network (ERN) [2] was formed to simplify multi-campus collaborations and partnerships in the Northeast, in order to advance the frontiers of research, pedagogy, and innovation. The ERN is first and foremost a network of people interested in pursuing this goal, and who use and manage the campus and regional research computing, data, storage and network resources that can make it happen.

In June 2020 the ERN organized an All-Hands Meeting which included a session on Broadening the Reach (BTR). As an outcome of this session several working groups were established including the ERN Broadening the Reach (BTR) Working Group. Other working groups include, Structural Biology, Materials Discovery, Computer Science, Architecture and Federation, and Policies.

With close to 2000 public and private colleges and universities of all shapes and sizes within the Northeast, a majority being small to medium sized non-R1 colleges and universities, including MSIs, HSIs, and HBCUs, gaining a better understanding of the advanced computing needs, requirements, and outreach to best support researchers, educators, and upper administration from these communities are essential. The ERN Broadening the Reach working group is representative of the diverseness of these communities and focuses on how the ERN can be more inclusive, gaining a deeper understanding to enable the ERN to have the broadest impact across multiple research disciplines, pedagogical approaches, senior level college and university administrators, and other organizations within the region and beyond. Building & leveraging a highly skilled, diverse workforce to support advanced CI, and exploring the role of regionals as facilitator and user support for these smaller institutions within the ERN are additional important goals of the ERN Broadening the Reach working group.

The Broadening the Reach working group has met bi-weekly since August 2020 to discuss the needs of the community and how to best support them. A virtual workshop was organized December 2020 to a) identify the needs of the community, b) raise awareness to existing regional and national resources, and funding opportunities, c) identify existing best practices and models. A pre-workshop survey was administered to obtain a baseline of the issues most important to the community from the perspectives of researchers, faculty, research computing staff, central-IT, and campus leadership, including CIO's, vice presidents for research, and provosts. The survey confirmed and reinforced the areas of focus identified by the ERN BTR working group during the working group meetings. Based on the results, the workshop topics included:

- Leveraging Regional and National Resources
- Funding Opportunities
- Campus Cyberinfrastructure (CI)

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- Research Collaborations
- Expertise
- Trends in Research Computing and Data
- Diversity & Inclusion
- Resources for Education
- Leveraging the Cloud
- Democratizing Campus CI

This virtual workshop brought together representatives from smaller, mid-sized and under-resourced campuses, including MSIs, HSIs, HBCUs, and EPSCoR institutions, to identify, understand and quantify science drivers, the cyberinfrastructure needed to support the applications, and challenges and opportunities at participating institutions.

The next three sections of this paper focus on the ERN Broadening the Reach working group findings, recommendations, and plans for the future.

2 ACCESS TO ADVANCED CYBERINFRASTRUCTURE - CHALLENGES AND OPPORTUNITIES

Research is becoming increasingly collaborative. Multi-institutional, multi-investigator, interdisciplinary research, ranging from small private colleges to large research institutions, require access to high-performance networks, data repositories, advanced computing resources, and specialized instruments. Research competitiveness is strongly correlated to access to advanced cyberinfrastructure (CI) [1]. Therefore, requiring consistent investments in a cyberinfrastructure ecosystem that includes computing infrastructure resources and tools, as well as human and organizational resources needed to facilitate the services [3]. Access to advanced CI resources is important for recruiting and retaining faculty and preparing the next generation.

Campus advanced CI challenges are numerous at smaller, less resourced institutions. HPC-type services are typically offered in a distributed manner, with equipment located in departments, research labs, offices, and IT co-location facilities. It is unclear whose ultimate responsibility it is to provide support, communication, and service ownership. There is typically no CISO, no dedicated security team, and small support team overall, with limited to no centralized training and other opportunities for professional development. Faculty at smaller, less-resourced institutions reported they have limited access to support from leadership and central-IT. Leadership support for faculty research is necessary. Sustainability for existing environments is a big issue.

Access to a blueprint configuration for minimal standard infrastructure and systems is needed for getting started. In addition, devising CI architecture/allocation that simultaneously meets education and research needs would be very helpful for smaller, less resourced institutions.

The community needs best practices for getting started with the cloud. Challenges remain for navigating the cloud and the associated costs as institutions are evaluating using the cloud for research and education.

There is a need to bridge the coordination and communication gaps between central-IT and the research community. Challenges exist as IT organizations of institutions are striking the balance between the requirements for supporting the enterprise and those of the research community, especially areas such as security policies, identity access management, and using the cloud.

Access to expertise, and access to funding to support expertise is a challenge. Convincing administration and IT to support computational research is a significant hurdle. In addition, the required expertise with necessary skills that bridge scientific domains and computational skills are scarce.

Procuring NSF Campus Cyberinfrasturcture (CC*) funding will benefit participants in multiple ways, including providing access to expertise, regional and national research collaboration opportunities, as well as access to significant network, storage, and computational resources. Access to a strong HPC environment is important for attracting faculty and also preparing students to go on to graduate.

There is minimal awareness among the research community at smaller, under-resourced institutions of the CI resources available at local, regional, and national level. For those who become aware, assistance and training are needed for navigating the available resources.

Focused initiatives are necessary for spreading the word about available communities and resources, by leveraging existing programs that focus on people networks and communities, such as NSF-funded ACI-REF program, the Campus Research Computing Consortium (CaRCC), CaSC, Northeast Cyberteams, and CAREERS.

Collaborations with R1 institutions and the Regional Research and Education Network (REN) organizations provide numerous advantages to under-resourced institutions. The trusted relationship between these RENs can play an important role in user support and bridging new partnerships for these institutions.

In summary, the ERN BTR working group findings indicate the greatest impact for under-resourced institutions would be to lower the barrier for access to advanced CI ecosystem infrastructure; communities for information sharing and collaboration; knowledge of policy requirements; access to expertise; ease of use; education and outreach; and funding support. Building collaborative community connections will help provide opportunities to identify and leverage expertise in the CI ecosystem architecture and federation, raise awareness of regional and national resources, training support and funding opportunities. Access to funding is one of the top challenges for these institutions.

3 RECOMMENDATIONS

The Funding agencies play an important role in providing direction to the national CI community by identifying priorities. Organizations such as the Eastern Regional Network are well positioned to assist funding agencies in making CI infrastructure and services accessible to researchers, educators, and students at a broad range of institutions. Results of findings of the ERN Broadening the Reach working group indicate important recommendations to funding agencies and to the ERN for CI initiatives.

Recommendations to funding agencies include continuing to fund projects that support acquisition of regional CI resources that enable and foster regional collaborations and communities with a commitment to sharing resources, education, and outreach. In addition, investments are necessary in workforce development projects

that specifically address the gaps for creating an inclusive and diverse pipeline of Campus CI and research computing expertise with skills that bridge domain science and computational skills.

Recommendations to the ERN for initiatives focused on lowering barriers for access to advanced CI for under-resourced institutions include the following:

- **Design architecture and federation to simplify the collaborations** not just for the R1s but to enable multi-campus projects to easily share their resources, and extend to smaller, less-resourced institutions. Organizations such as the ERN are uniquely positioned to lower the barrier for access to advanced cyberinfrastructure resources for research collaboration in many respects, including: facilitating sharing computational and data resources across the region; identify operating models for effective and dynamic delivery of computational resources; support federated shared services model and infrastructure for smaller, less-resourced schools; design policies and guidelines for authentication, authorization, access, and data sharing; and design standard services for resource monitoring and performance management.
- **Promote CI awareness** and education through training (online and in-person) and educational material and community information sharing and professional development events.
- **Pursue funding opportunities for cyber-training to build a highly skilled diverse workforce to support advanced CI**. Training and professional development programs are essential for developing the necessary skills and creating a career path for research computing expertise and promoting diversity and inclusion. Partnership with community colleges can help advance the priority to increase diversity in research computing expertise.
- **Engage and expand community partnerships leveraging the ERN "People network"**, and coordinate efforts with regional and national activities and programs such XSEDE Champions, OSG, ACI-Ref, and Cyberteams, as well as the RENs and the national research and education networks such as Internet2, ESnet, & the Quilt, for sharing resources, expertise, and awareness campaigns.
- **Design standards and best practices for internal campus communities for research and research computing support**, enabling institutions to gain traction internally, including: strategies, communications, and justifications to garner leadership support regarding the needs of the research community; best practices for internal campus communication between the research community and central-IT; and proactive sharing of information about the available resources with the research community, for example at new faculty orientation events.

4 OPPORTUNITIES AHEAD AND NEXT STEPS

Lowering the barrier for access to advanced cyberinfrastructure ecosystem is complex and requires funding support; infrastructure; campus cultural transformation that promotes coordination, communication, and collaboration among multiple stakeholders; standards and policy requirements; ease of use; expertise; communities for information sharing and collaboration; and education and outreach, including awareness campaign and professional development.

The knowledge gained from the ERN Broadening the Reach working group's community engagement efforts, including workshop results, will be used to determine how the Eastern Regional Network can support the needs of the institutions, such as provide both the technical and application support associated with matching the applications to the infrastructure, particularly when the required resources are outside of their campus environment. Collaboration and partnership opportunities among the community for current and future ERN projects are in progress including the focus on strengthening and proving the feasibility and success of the ERN infrastructure design, and building the next generation workforce. In addition, workshops and webinars are being developed to gain further insights based on recommendations from the community. We welcome suggestions to explore opportunities to leverage the learnings and best practices identified to make research computing resources more widely available to researchers and educators.

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