ECOSYSTEM for RESEARCH NETWORKING

The Ecosystem for Research Networking(ERN) : Exploring Democratized Access to Research Instruments

Barr von Oehsen – Pittsburgh Supercomputing Center
Forough Ghahramani – Edge
Maureen Dougherty - Ecosystem for Research Networking

Coalition for Networked Information Fall 23 Membership Meeting

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ERN Origins and Evolution

- **Germ of an idea:** at 2017 National Research Platform meetings
  - Can the regional research platform idea work in the Northeast?
  - Rutgers, OSHEAN, KINBER
- **Coalition of the Willing:** January 2018 gathering at Rutgers
  - Can we find something of common interest to work on?
  - KINBER, Rutgers, OSHEAN, MGHPCC, Internet2, NYSERnet
- **Resource Federation Proof of Concept:**
  - Can we work together to prototype a potentially beneficial resource federation idea?
  - Rutgers, MGHPCC, Syracuse, NJ Edge, U Maine, Google, Internet2
  - “Early if not elegant” approach; emphasis on getting people to work together

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ERN Origins and Evolution

- **Northeast perfSONAR Mesh:**
  - Can we work together toward a regional science DMZ?
  - Federation sites plus
    - BU, Brown, Colby, CEN, KINBER, Network Maine, OSHEAN, UNH
  - Less-specialized technology allows expanded participation
- **Growing interest:**
  - Maybe we really can do this?
  - Expanded steering committee; per-project working groups
  - All of the above plus
    - U Delaware, NJIT, U Buffalo, Bucknell, UMass Amherst, Yale, Princeton, BTAA, U Kentucky, Case Western Reserve

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ERN Vision and Mission

Vision:

Simplify, support, catalyze, and foster multi-campus collaborations and partnerships between academic institutions of all types and sizes across the U.S. that advance the frontiers of research, pedagogy, and innovation.

Mission:

To achieve the vision through a consortium of academic institutions, research facilities, core service providers, network providers, and industry partners, both public and private, **organized around a shared interest in supporting and enabling collaborative data and computation-enabled science by providing standards, blueprints, policies, and training associated with the design and implementation of an infrastructure to access data and research instruments,** a distributed federated environment designed to simplify, support, and encourage collaborative science, scholarship, and education.

To realize the vision and mission, the ERN will enable partnerships and collaborations **that support the democratization of science, research instruments, technical expertise, infrastructure, and services, aimed at lowering the barriers to participation** for scientists engaged in research that cross institutional and disciplinary boundaries.

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NSF CC* CRIA OAC-2018927

- Received notice of funding during 2020 AHM
- Project Team: Goodhue, Honavar, Pitt, Segee, and von Oehsen
- Funding period July 1, 2020, to June 30, 2024
- Working Groups
  - Materials Discovery (Shashank Priya, Chair)
  - Structural Biology (Stephen Burley, Chair)
  - Architecture/Federation/Computer Science (Maureen Dougherty, Michael Zink, Co-Chairs)
  - Policies (Ron Hutchins, Chair)
  - Broadening the Reach (Forough Ghahramani, John Hicks, Co-Chairs)
- Collect information to be used for future initiatives and funding opportunities

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Core Activities

- Organizing and/or supporting working groups focused on areas of interest to the community.
- Facilitating Workshops for deep dive explorations of cross working group areas of interest.
- Hosting yearly All Hands Meetings to bring the community together to give updates and discuss future initiatives.
- Offering recommendations on data standards, architectural blueprints, and policies.
- Project development targeting data management, standards and democratization of instruments
- Enabling delivery of training on topics related to new and emerging technologies and applications relevant to current areas of interest to ERN stakeholders.

Membership

Membership is open to any institution or organization that: (1) fully supports and acts in accordance with the ERN Vision and Mission; and (2) has higher education and/or open academic research as a primary mission, or have a formal affiliation with one or more organizations that do, encompassing academic institutions, industry, nonprofits, and government agencies in the U.S.

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Past Workshops and Events

- ERN Architecture and Federation Virtual Workshop, December 2-4, 2020
- ERN Broadening the Reach Virtual Workshop, December 10-11, 2020
- Structural Biology - The Voice of the Customer Online Workshop, February 11, 2021
- Broadening the Reach Working Group (BTR): Leveraging the Cloud for Research, December 2, 2021
- Enabling Protein Structure Prediction with Artificial Intelligence, December 9, 2021
- Data Science Seminar Series
- Several All Hands Meetings

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Participation

Academic Institutions:

Alabama State University, Arcadia University, Boston University, Brown University, Case Western Reserve, Clemson University, Columbia University, Cornell University, Delaware State University, Franklin and Marshall College, George Washington University, Georgetown University, Harvard University, Kentucky State University, Lafayette College, MIT, Montclair State University, New Jersey Institute of Technology, Northeastern University, Pace University, Penn State University, Princeton University, Ramapo University, Rutgers University, Southern Connecticut State University, Stevens Institute of Technology, Swarthmore University, Syracuse University, The College of New Jersey, Trinity College, Tufts University, USMA, University of Arkansas, University of Buffalo, UC Santa Barbara, University of Chicago, University of Delaware, University of Illinois, University of Kentucky, University of Maine-Orono, University of Massachusetts-Amherst, University of Michigan, University of New Hampshire, University of New Haven, University of Utah, University of Virginia, West Chester University of Pennsylvania, and Yale University.

Organizations/Industry/RENs/Funding Agencies:

Massachusetts Green High Performance Computing Center (MGHPCC), Northeast Big Data Innovation Hub, Ohio Supercomputer Center, SDSC, Internet2, CAAREN, CEN, KINBER, NetworkMaine, NJEdge, NYSERNET, Great Plains Network, Omnibond, OSHEAN, CILogon, CaRCC, Redhat, SHI, IBM, NSF, NIH, DOE

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ERN Broadening the Reach

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ERN Broadening the Reach (BTR)

Broaden Participation of Diverse Groups and Institutions

- **Missing Millions**: Lower the barrier of entry to science
- Build, strengthen, and expand strategic multi-sector partnerships
- Address research capacity for diverse disciplines and multidisciplinary collaborations

Workforce Development

- Build and leverage a diverse highly skilled workforce

Build Community

- Outreach and facilitation to the community
- Resource sharing and collaboration

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ERN BTR Activities and Outcomes

Topic Areas of Focus

- Trends in Research Computing and Data
- Campus Cyberinfrastructure Challenges and Opportunities
- Access to Resources (ex: funding, expertise, education, communities)
- Leveraging Regional and National Resources
- Democratizing Access to Cyberinfrastructure
- Research Collaboration Opportunities

Activities and Outcomes

- A series of workshops and educational seminars
  - Identify the needs of the community
  - Raise awareness to existing regional and national resources, and funding opportunities
  - Foster, coordinate, and facilitate sharing of current practices and models
- Share findings among the community at conferences and through publications
- Recommendations for Institutions, ERN, and Funding Agencies
- Partnerships and an engaged community of thought leaders focused on resource sharing and collabora

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A Work in Progress

Lowering the barrier for providing access to advanced cyberinfrastructure and for leveraging the cloud in research is complex and requires:

- Funding support
- Infrastructure
- Expertise
- Campus cultural transformation
- Standards
- Policy
- Ease of use
- Communities for information sharing and collaboration
- Education and Outreach
- Partnerships

Plans for Future

- ERN Annual Summit April 11-12
- Workshops and Educational Seminars
- ERN BTR Internship

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ERN Federated Cryo-EM Instrument Pilot Project

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ERN Cryo-EM Project

Facilitate and simplify multi-institutional collaboration at the interface of computing and electron microscopy, by removing many barriers and challenges, especially for the under-represented and non-R1 institutions.

Barriers/Challenges

- Infrastructure
- Security
- Policy
- Authentication, Authorization and Access
- Ease of Use
- Accounting
- Knowledge/ Expertise/ Education

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Objectives

- Easy to use, secure, web-based resource portal
- Simplified, federated authentication, authorization and access
- Real-time workflows
- Edge computing
- Access to additional analysis resources – private and/or public
- Portable, easily duplicated, flexible, managed and maintained
- Secure data management system
- Do not reinvent the wheel
- Share efforts with the research community

GitHub Repository – https://github.com/mghpcc/ERN-Remote-Scientific-Instrument

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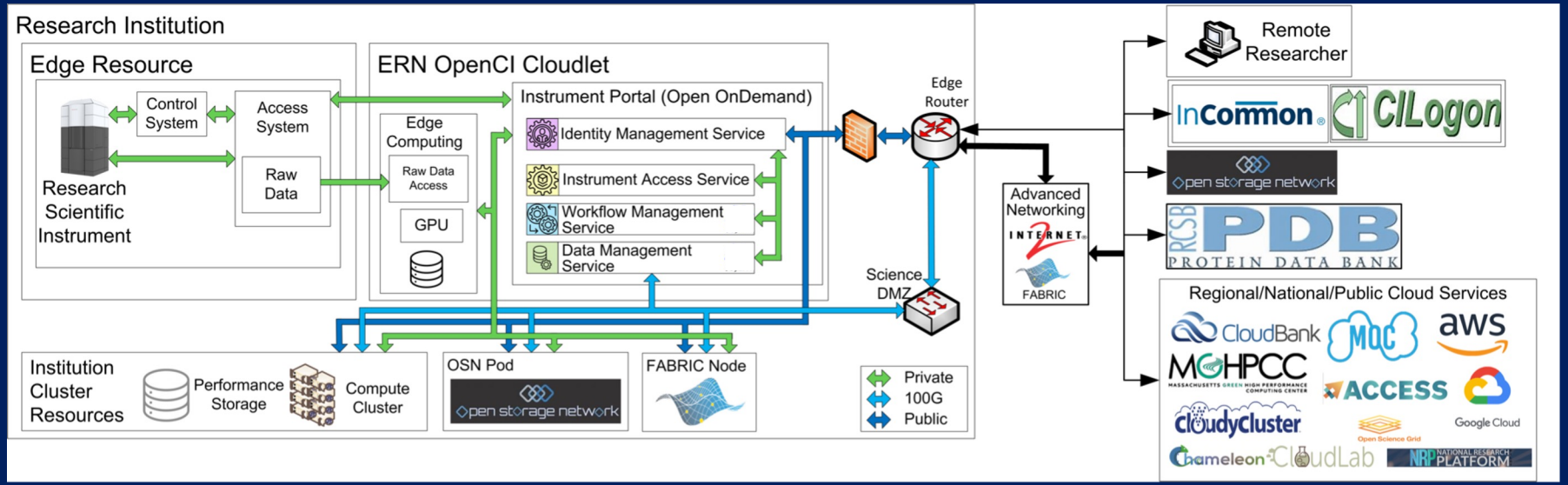
Project Design



- Secure environment across pathway/workflow
- Common framework for federated authorization, authentication, and access
- Reproducible, reliable, reproducible, portable, simplified support
- ERN OpenCI Cloudlet - Instrument Portal & Edge Computing using Open OnDemand
- Open source project - GITHUB: https://github.com/mghpcc/ERN-Remote-Scientific-Instrument

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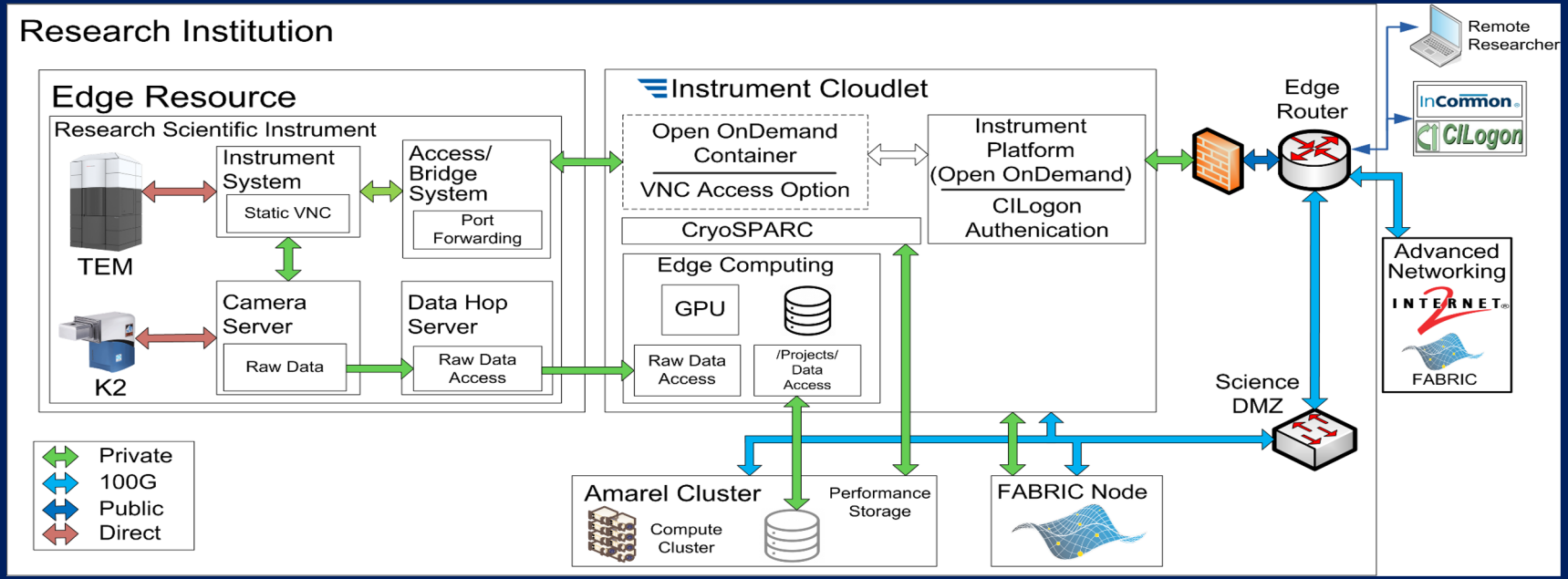
Phase 1 - Design



Collaborators

- Rutgers CryoEM & Nanoimaging Facility(RCNF)
- ERN Structural Biology and Architecture & Federation Working Group members

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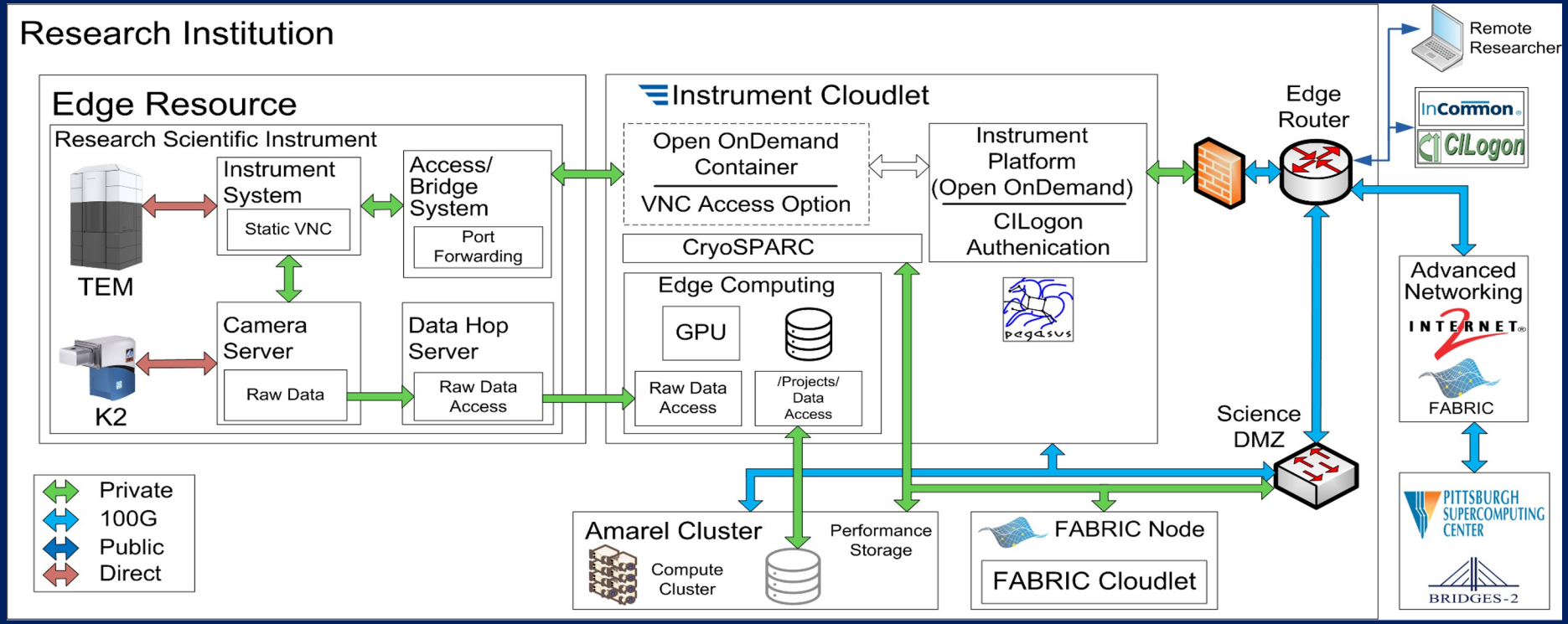
Phase 2 - Design



- FABRIC integration
- Bridges-2 - remote advanced analytics
- Pegasus - Data and Workflow Management Systems

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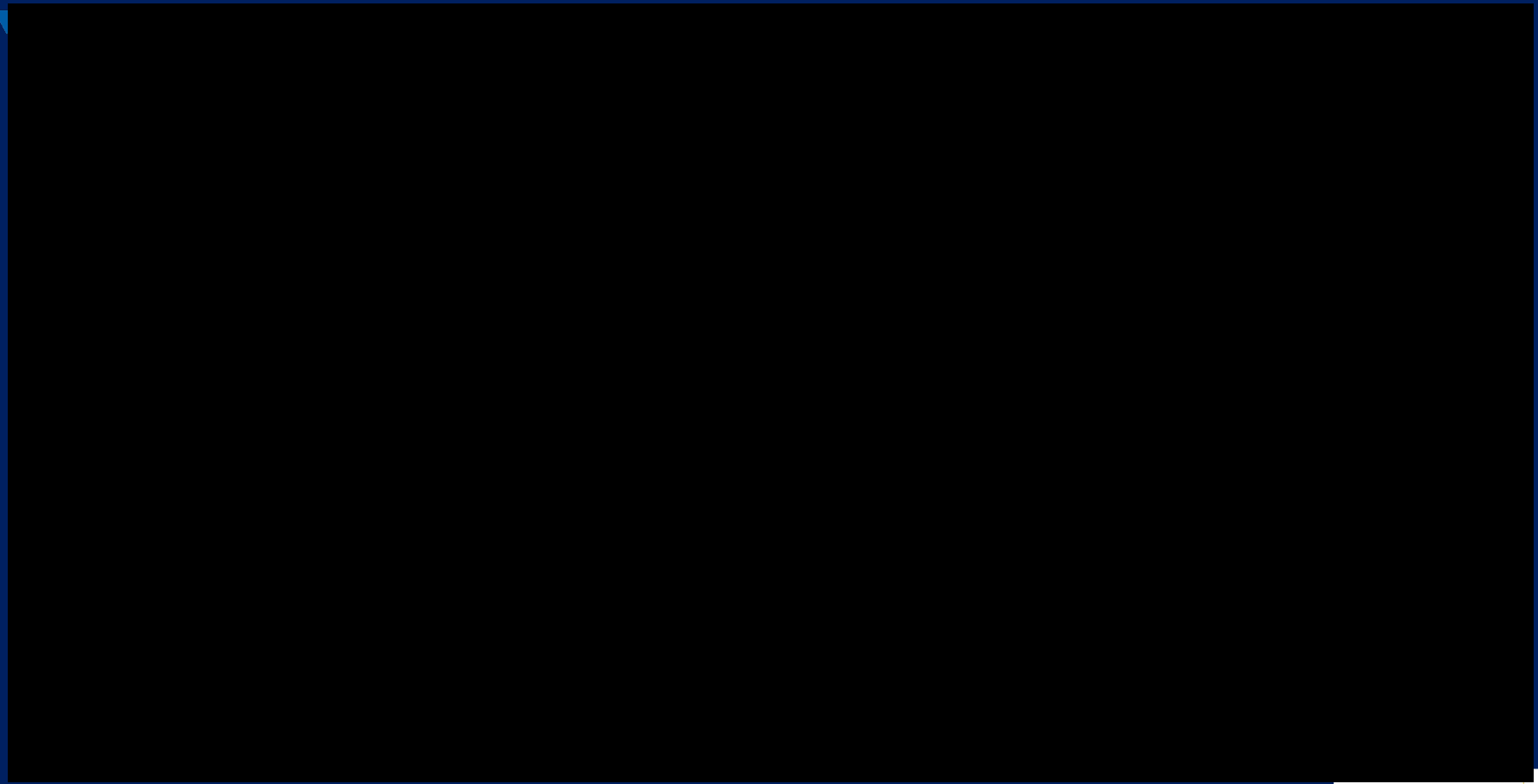

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Conclusion

Remote access to edge scientific instruments for real time analytical workflows using edge computing is both feasible and beneficial

Benefits

- **Remote access to scientific instrument in secure environment**
- **Real-time decision making and adjustment**
- **Edge computing**
- **Decreased network I/O** for pre-processed image data
- **Reliability, reproducibility, reusability, portability, ease of use/management/support**
- **GitHub repository** for community participation and contributions
- **Foster team science and democratization of scientific instruments with emphasis on under-represented and under-resourced colleges and institutions**
- Multiple institutions interested in project outcome

Lessons Learned

- security: traffic isolation, rootless container, per-user permissions
- expertise: subject matter experts, researcher and technical expertise important

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ERN Federated CryoEM Instrument Pilot Project Site Map

Participating Member Sites (alphabetical order)

- Massachusetts Green High Performance Computing Center
- Omnibond
- Pennsylvania State
- Rutgers University
- University of Massachusetts, Amherst
- University of Minnesota
- University of Southern California

Future Partnering Sites (alphabetical order)

- American Indian Higher Education Consortium
- Arizona State University
- Harvard University
- Kennesaw State University
- Purdue University
- Rowan University
- University of Alabama at Birmingham
- University of California, Santa Cruz
- University of Florida, Gainesville
- University of Utah

ACCESS Sites

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- James Barr von Oehsen, Pittsburgh Supercomputing Center
- Michael Zink, University of Massachusetts, Amherst
- Ewa Deelman, Mats Rynge, University of Southern California
- Maureen Dougherty, Ecosystem for Research Networking
- Forough Ghahramani, EDGE
- John Hicks, Internet2
- ERN Steering Committee
- ERN Working Groups – Structural Biology, Materials Discovery, Broadening the Reach, Architecture & Federation, Policy
- Pittsburgh Supercomputing Center/Bridges-2 Team
  - Ken Goodwin, Ed Hanna, Ken Hackworth, TJ Olesky
- The Fabric Team
  - Ilya Baldin, Paul Ruth - RENCI
  - Jim Griffioen - University of Kentucky
- The Open OnDemand team

NSF grant OAC-2018927

Interested in learning more or participating, please contact info@ernrp.org

GITHUB: https://github.com/mghpcc/ERN-Remote-Scientific-Instrument

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Open Discussion

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Publications

- Maureen Dougherty, Michael Zink, Barr von Oehsen, Kenneth Dalenberg, Bala Desinghu, Jason Kaelber, Jeremy Schafer, John Goodhue, Wolf Hey, Morgan Ludgwig, and Boyd Wilson. 2022. "***The ERN Cryo-EM Federated Instrument Pilot Project: Phase 1***," 2022 4th Annual Workshop on Extreme-scale Experiment-in-the-Loop Computing (XLOOP), Dallas, TX, USA, 2022, pp. 20-25, doi: 10.1109/XLOOP56614.2022.00009. BEST PAPER!
- Maureen Dougherty, Michael Zink, Barr von Oehsen, Kenneth Dalenberg, Bala Desinghu, Jason Kaelber, Jeremy Schafer, John Goodhue, Wolf Hey, Morgan Ludgwig, Boyd Wilson, and Cole McKnight. 2022. "***The ERN CryoEM Federated Instrument Pilot Project.***" In Practice and Experience in Advanced Research Computing (PEARC '22). Association for Computing Machinery, New York, NY, USA, Article 52, 1–4. https://doi.org/10.1145/3491418.3535141 BEST SHORT PAPER!
- Forough Ghahramani, John Hicks, and Barr von Oehsen. 2022. "***Broadening the Reach for Access to Advanced Computing: Leveraging the Cloud for Research***." In Practice and Experience in Advanced Research Computing (PEARC '22). Association for Computing Machinery, New York, NY, USA, Article 65, 1–5. https://doi.org/10.1145/3491418.3535143

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- Melissa Cragin, Ron Hutchins, Maureen Dougherty, James Barr von Oehsen, Michael Zink, D. Balamurugan, and John Goodhue. 2022. "***Federating CI Policy in Support of Multi-institutional Research: Lessons from the Ecosystem for Research Networking***." In Practice and Experience in Advanced Research Computing (PEARC '22). Association for Computing Machinery, New York, NY, USA, Article 49, 1–4. https://doi.org/10.1145/3491418.3535167 BEST SHORT PAPER RUNNER UP!
- Maureen Dougherty, Michael Zink, and James Barr von Oehsen. 2021. "***Identifying Research Collaboration Challenges for the Development of a Federated Infrastructure Response***." In Practice and Experience in Advanced Research Computing (PEARC '21). Association for Computing Machinery, New York, NY, USA, Article 40, 1–4. https://doi.org/10.1145/3437359.3465594
- Forough Ghahramani, John Hicks, and Barr von Oehsen. 2021. "***Broadening the Reach for Access to Advanced Cyberinfrastructure: Accelerating Research and Education***." In Practice and Experience in Advanced Research Computing (PEARC '21). Association for Computing Machinery, New York, NY, USA, Article 49, 1–3. https://doi.org/10.1145/3437359.3467026

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