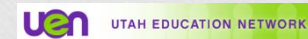


Cyberinfrastructure: An investment worth making

Joe Breen

University of Utah

Center for High Performance Computing



From CC-NIE/IIE/DNI to Building a Cohesive Platform for Collaboration Over Advanced Cyberinfrastructure

- THANKS to those who have listened and had vision!
- Investment by funding agencies in infrastructure IS MAKING A DIFFERENCE in development and support of multi-domain science.

From NTIA BTOP to NSF CC-NIE/IIE/DNI to EPSCoR to NSF MRI to ... to Building a Cohesive Platform for Collaboration Over Advanced Cyberinfrastructure

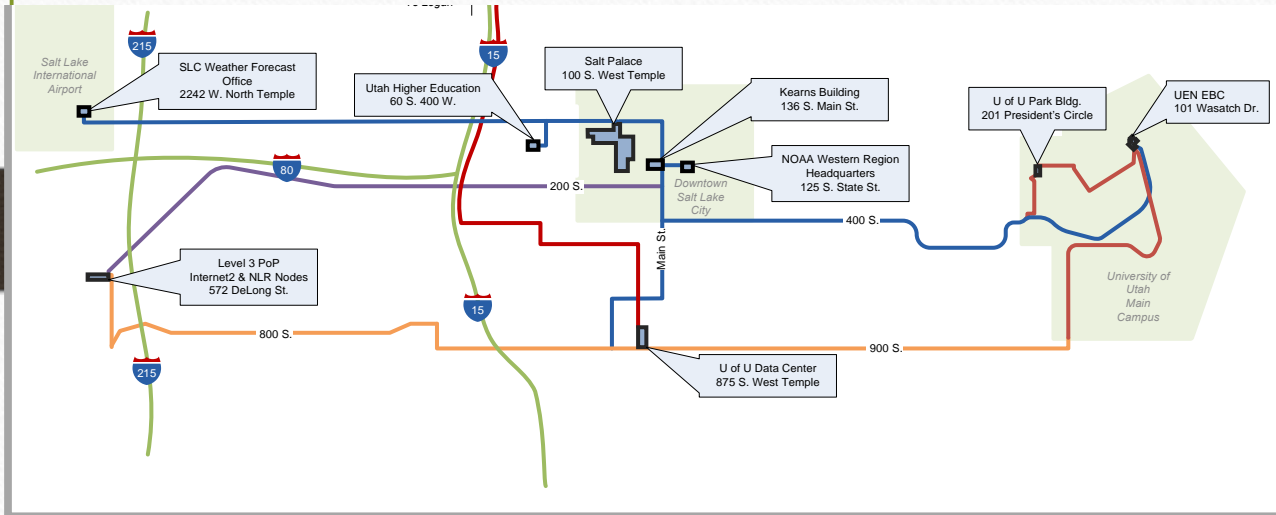
- Leveraging infrastructure grants at multiple levels creates an environment where:
 - students produce
 - researchers create
 - new opportunities arise.

From CC-NIE/IIE/DNI to Building a Cohesive Platform for Collaboration Over Advanced Cyberinfrastructure

- Key to success with the infrastructure: Collaboration, Collaboration, Collaboration!
 - Collaboration between multiple science domains, HPC/Research support staff, campus and regional network staff, campus and regional security staff, departmental IT staff and others.
- Collaborative mission: Enable the science!

NTIA BTOP: Infrastructure Investment in Regional Connectivity

BONFIRE Metro Optical



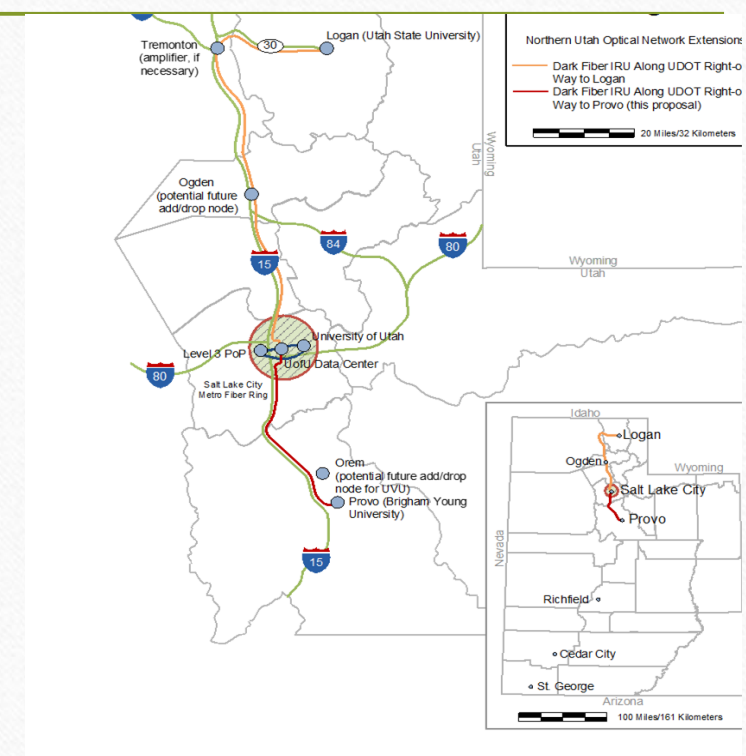
Research@UEN: Salt Lake City Metro Optical Network

- U of U Campus Fiber
- UTA Light Rail Routes (proposed)
- CENIC/LLC Fiber IRU (through AFS)
- AFS Fiber IRU (proposed)
- Northern Utah Extension (proposed)

1 Mile

Carrier proprietary information included

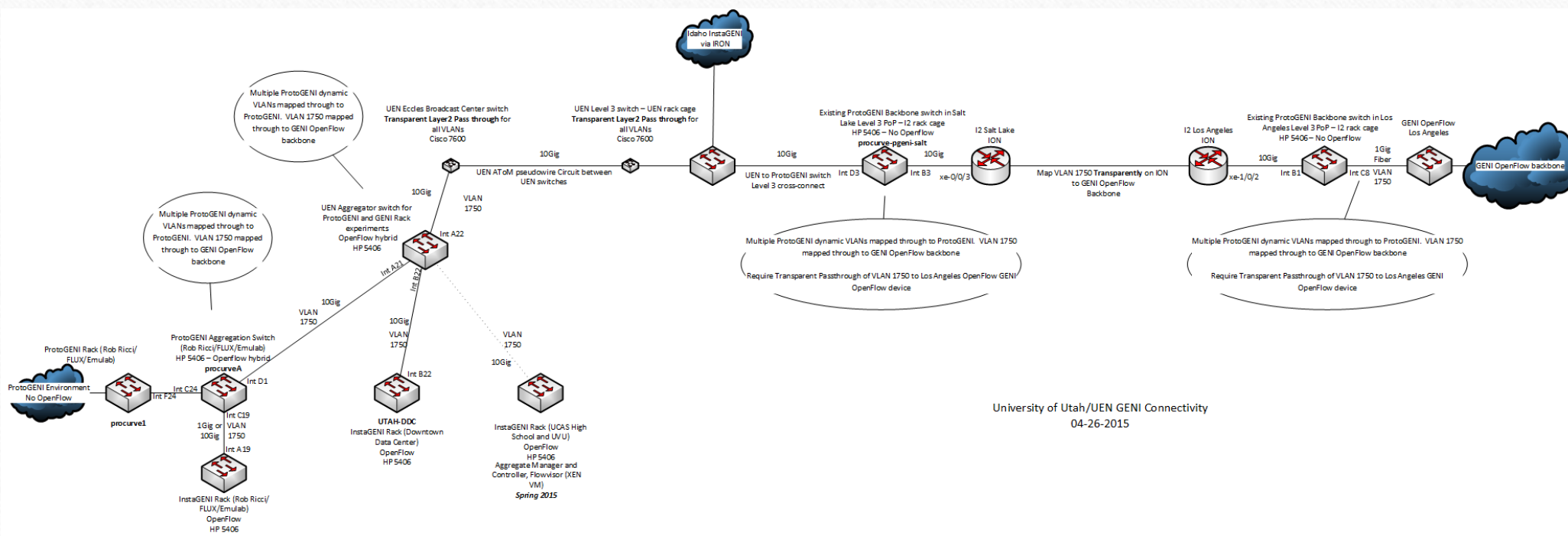
with extensions



Research Return on NTIA BTOP Infrastructure Investment: 100G capable Regional metro optical network (BONFIRE), 100G routers, perfSONAR measurement, etc.

- Enabled bandwidth increases for Utah K-20 and all libraries in state
- Enabled access to Internet2 and peer institutions through 100G aggregate point
- Enabled regional (UEN) to support large science data flows in a sustainable fashion

GENI Spiral 3 Infrastructure Investment: Software Defined Infrastructure for supporting InstaGENI rack infrastructure state-wide

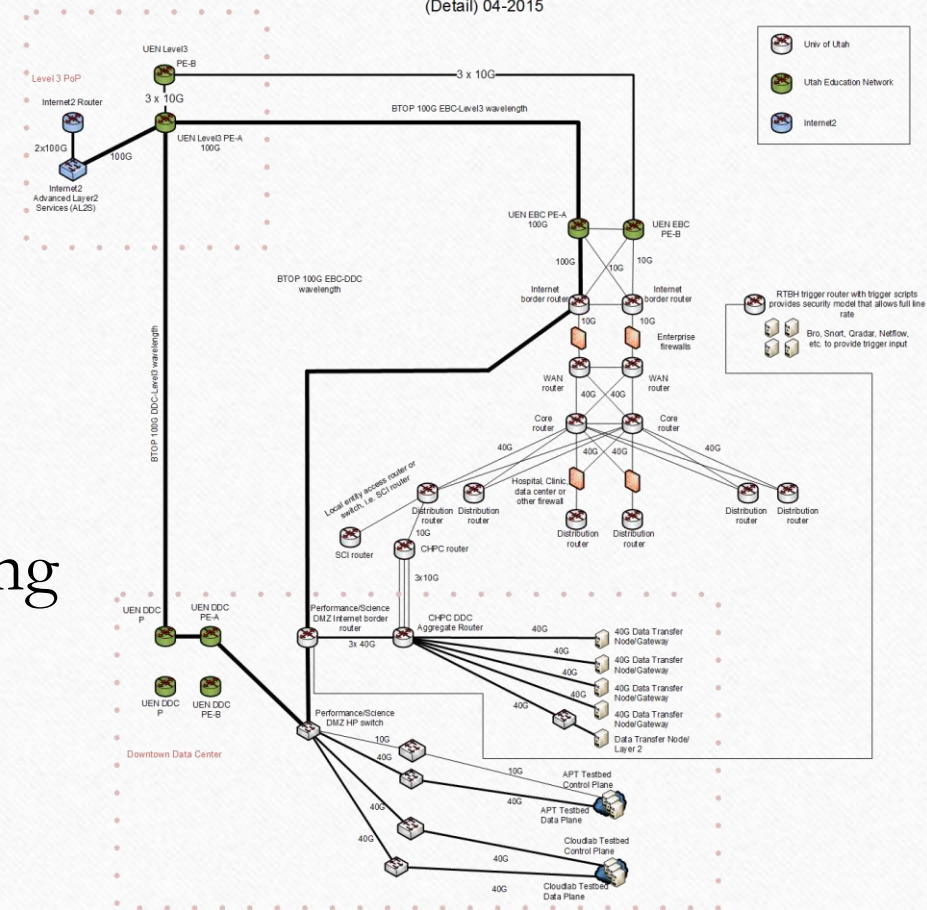


Research Return on GENI Spiral 3 Infrastructure Investment:

- Enabling experiments in software defined networking locally and regionally
- Supporting multiple testbeds throughout Utah and Idaho
- Providing InstaGENI testbed rack at Utah County Academy of Sciences high school and Utah Valley University
- Leveraging NTIA BTOP and CC-NIE infrastructure

CC-NIE Infrastructure Investment Part 1: Science slices: Converting Network Research Innovation into Enhanced Capability for Computational Science and Engineering

University of Utah/UEN
Performance/Science DMZ
Phase 1.5 Physical Implementation
(Detail) 04-2015

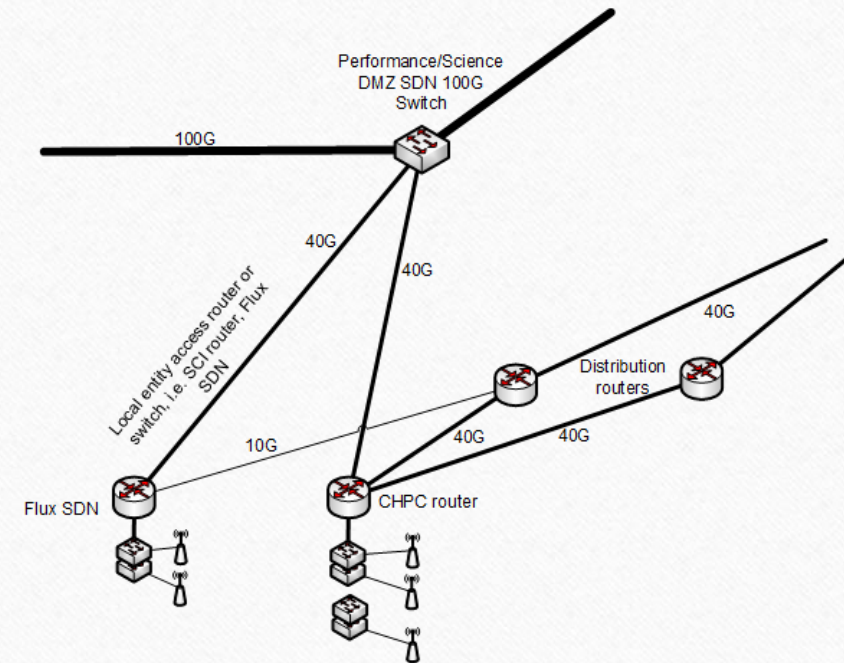


Research Return on CC-NIE Infrastructure Investment:

- 100G and 40G programmable switching infrastructure for science slices
- Support of 12+ dedicated Data Transfer Nodes at 40G and 10G
- Capability to extend Science DMZ as a slice to science instruments inside of campus (work happening now)
- Support of dynamic allocation of resources as part of on-demand pipelines

University of Utah/UEN
Performance/Science DMZ
Projected Phase 2 Summer Physical Implementation
(Opt-In Zoom Detail) 04-2015

CC-NIE Infrastructure Investment
Part 2:
Outreach Slices: Opt-in Services
based on Data or Service



Research Return on CC-NIE Infrastructure Investment:

- Creating programmable access layer switching for onboarding
- Enabling multiple student papers through work on programmable distribution and access layer switches
- Enabling prototype environment for existing Network Management research
- Enabling network security research on programmable backbone and programmable access layer

EPSCoR/RIIC2 CI-Water Investment: Utah-Wyoming Cyberinfrastructure Water Modeling Collaboration

CI-WATER: A Utah-Wyomi... x

ci-water.org

About the Grant | Partners | Contact Us | Team Workspace

CI-WATER

A Utah-Wyoming Cyberinfrastructure Water Modeling Collaboration

CI-WATER
An EPSCoR Project

Highlights

Cyberinfrastructure

Data & Modeling Services

Watershed Modeling

Education & Outreach

Modeling Apps & Tools

Reports & Results

CI-WATER Teacher Toolboxes
Students in Wyoming and Utah will get a first-hand view of water research through water science toolboxes developed as part of CI-Water, a Utah-Wyoming cyberinfrastructure water modeling collaboration.
[More Information...](#)

Project and Water News

[Tune in for Water Week 2015 on UEN-TV!](#)
As an education and outreach partner for CI-WATER, UEN-TV is proud to broadcast its 4th annual Water Week. Please check out and share the program...
[Read More...](#)

[New CI-WATER apps in development](#)
To improve access to high-performance computing for water resource managers and researchers, CI-WATER is developing a suite of resources that will be released over the coming months. The Tetlys App Development platform, released earlier...
[Read More...](#)

[Summer research for teachers, teens & undergrads](#)
iUTAH is now accepting applications for its 2015 Summer Institute, which will bring together teachers, high school students and undergraduates to conduct field research in Heber Valley and learn more about water science. Stipends are...
[Read More...](#)

[View All](#)

UTAH EPSCoR | BYU BRIGHAM YOUNG UNIVERSITY | Utah State University | THE UNIVERSITY OF UTAH | UNIVERSITY OF WYOMING | UEN | EPSCoR

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This project is funded through EPSCoR-1125482 and EPSCoR-1125483. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. Web services provided by the Utah Education Network in partnership with Utah EPSCoR and Wyoming EPSCoR.

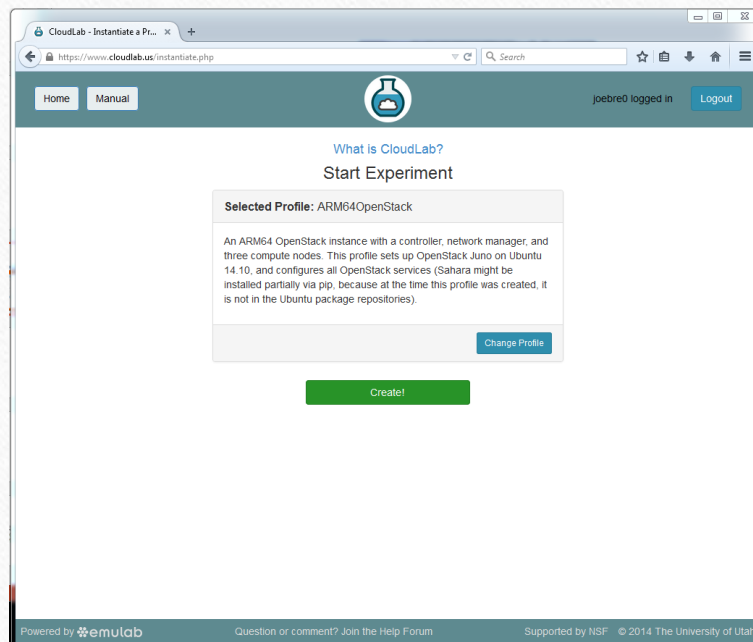
Research Return on EPSCoR Infrastructure Investment:

- Created environment for science workflow storage and archival which is now integral to multi-institution science
 - Leveraged CC-NIE and NTIA-BTOP infrastructure for moving data
- Enabled new science that helped professor with obtaining tenure
- Multiple domain science papers by multiple faculty at multiple institutions

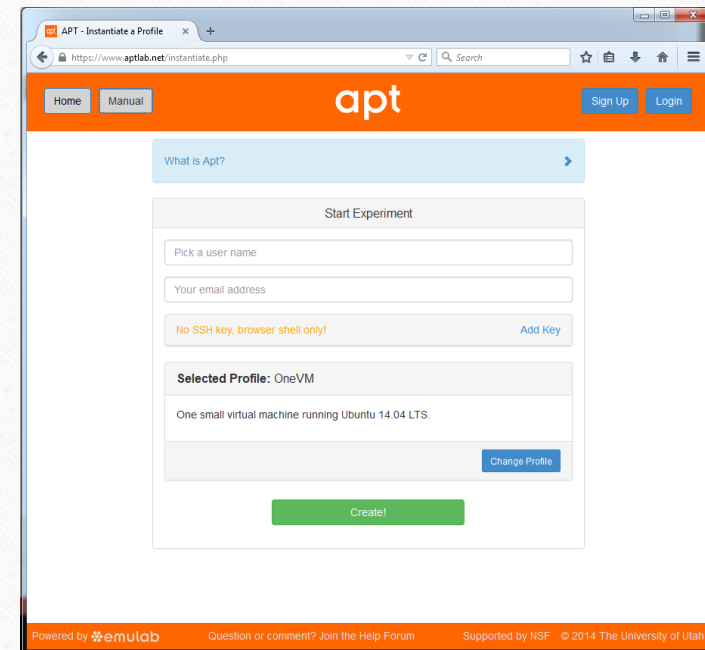
Information Technology Research
Investment: Cloudblab Scientific
Infrastructure for cloud research



Major Research Instrumentation
Investment: Advanced Profile-
driven Testbed (apt)



Flux Research Group



Research Return on Major Research Instrument Infrastructure Investment: Advanced Profile-driven Testbed (apt)

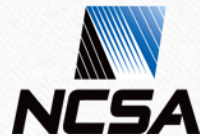
- Enabling prototypes of dynamic bare metal HPC images with ability to scale up/down
- Enabling packaging of whole experiments
- Enabling multiple papers for various network and security experiments
- Leveraging CC-NIE and NTIA-BTOP infrastructure

Research Return on Information Technology Research Investment: Cloudlab

- Enabling exploration of multiple hardware implementations for cloud research
- Enabling future prototype of dynamic HPC image in multiple locations
- Enabling power investigation of low power processors in a cloud
- Enabling multiple papers for various cloud experiments
- Leveraging CC-NIE and NTIA-BTOP infrastructure

CC-IIE – Identity Access Management Infrastructure Investment: FeduShare

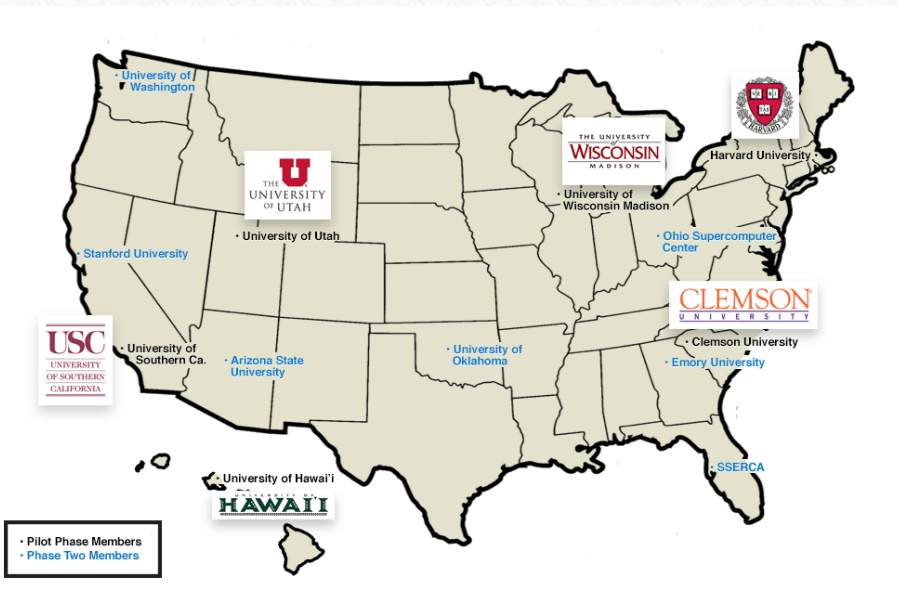
- Design a system architecture framework supporting self-managed collaborations
- Utilize existing Identity Management solutions and techniques such as InCommon, Shibboleth, GENI, CILogon, etc.



Research Return on CC-IIE Infrastructure Investment: FeduShare

- Exploring InCommon-based login for federated access models to campus clusters using a shell environment
- Leveraging GENI, CILogon, InCommon, Shibboleth, and other techniques
- Developing conceptual framework for access from the individual perspective

Strategic Technologies for Cyberinfrastructure Investment: Advanced Cyberinfrastructure Research and Education Facilitators



ACI-REF | Advanced CyberInfra... x

www.aciref.org

ACI-REF

Advanced CyberInfrastructure - Research and Education Facilitators

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Empowering The "Would-Be" Computational Researchers

The ACI-REF consortium includes six institutions that embrace the condominium computing model. We are dedicated to forging a nationwide alliance of educators to empower local campus researchers to be more effective users of advanced cyberinfrastructure (ACI). In particular, we seek to work with the "academic missing middle" of ACI users—those scholars and faculty members who traditionally have not benefited from the power of massively scaled cluster computing but who recognize that their research requires access to more compute power than can be provided by their desktop machines.

Click to Enlarge

Vision

Advancing scientific discovery through a national network of Advanced Cyberinfrastructure (ACI) Research and Education Facilitators (ACI-REFs).

News

- University of Utah Partners in Unique Multi-University Advanced Computation Project
- Clemson receives \$5.3M to broaden cyberinfrastructure education, outreach
- National Science Foundation grant to benefit computing resources
- Research Computing part of \$5.3M NSF award for Advanced Cyberinfrastructure
- UH partners on \$5.3 million cyberinfrastructure award

Patterns Of A Political Cartoonist This visualization, generated on Clemson University's Palmetto Cluster, is based on data collected for a study of 8,433 political cartoons by Herbert Lawrence Block (known as Herblock), published in the Washington Post between 1946 and 1976. The investigators are developing innovative ways of visualizing the different levels of context and meaning embedded within and across this collection as an insight to the cultural history of Cold War America. Each node (or point) represents a particular character depicted within the collection. Each line illustrates an instance where two characters appear in the same cartoon. Thicker lines reveal characters who are depicted together more frequently. Colors illustrate particular groupings of characters. In this case, blues indicate a close proximity to the Cold War and international relations, while reds indicate a more domestic/legislative focus.

Research Return on Strategic Technologies for Cyberinfrastructure
Investment: Advanced Cyberinfrastructure
Research and Education Facilitators (ACI-REFs)

- Leveraging expertise at different universities for better user support
- Creating more spin-off research collaborations between universities
- Leveraging CC-NIE, CC-IIE and NTIA-BTOP infrastructure

CC-IIE – Regional Infrastructure Investment: Rocky Mountain Cyberinfrastructure Mentoring and Outreach Alliance (RMCMOA)

- Show others how to use and leverage cyberinfrastructure by hosting regional workshops, site visits and sharing network engineering and knowledge

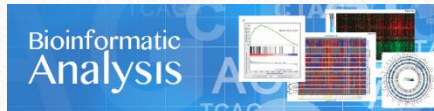
 Colorado State University NCAR | University Corporation
UCAR | for Atmospheric Research University of Colorado
Boulder

Research Return on CC-IIE Regional Outreach Infrastructure Investment:

- Enabling regional workshops and outreach to propagate successful models to smaller schools
- Leveraging CC-NIE infrastructure at multiple institutions for hardware support and for examples

Example Use cases: Enabling Multidisciplinary science

The train is coming, the track is still laying, we gotta' move!



Center for Clinical and Translational Science



Infrastructure Investment enables opportunistic domain science collaborations

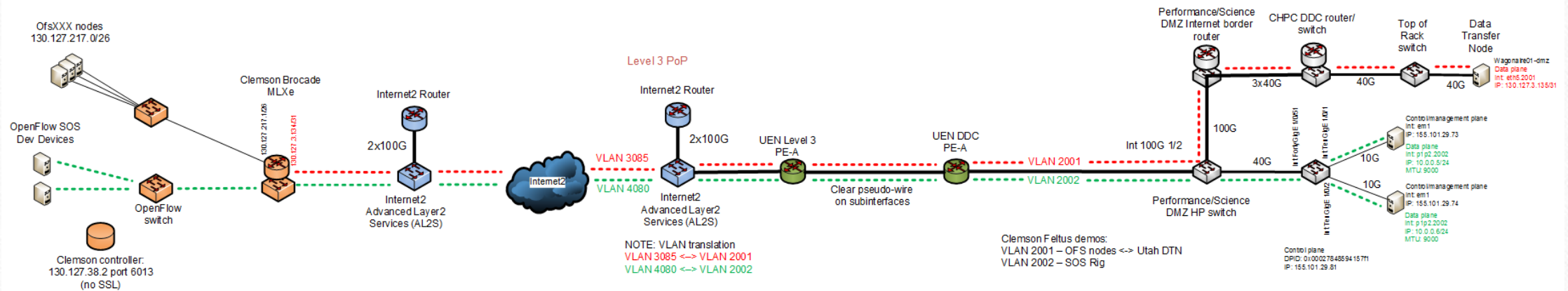
Example: Clemson plant genomics transfers

Clemson and Utah Genomic Transfer Test Environments

Environment 1: Dedicated circuit between production facilities

Environment 2: OpenFlow SOS Testbed

Apr 2015



Summary

- Build out of cyberinfrastructure enables science, student learning and researcher development – A LOT!
- Leverage as many cyberinfrastructure blocks as you can – be creative!
- Collaboration, Collaboration, Collaboration!
 - Start with internal collaborations – build on the strengths of those around you
 - Be opportunistic and willing to listen
 - Build the operational model so it can accept and sustain the opportunities
 - Be available and willing for unforeseen external collaborations
- Maintain patience, build in time for failures, and keep the focus on where you want to be – Enable the science!