



Cyberinfrastructure 101: What It Is, Why It Matters

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Role of Cyberinfrastructure

- Cyberinfrastructure is increasingly essential across all disciplines
- Supports collaborative, scalable, and reproducible research

Cyberinfrastructure is to research and education what roads and bridges are to commerce.

Cyberinfrastructure (CI) = IT for scholarship

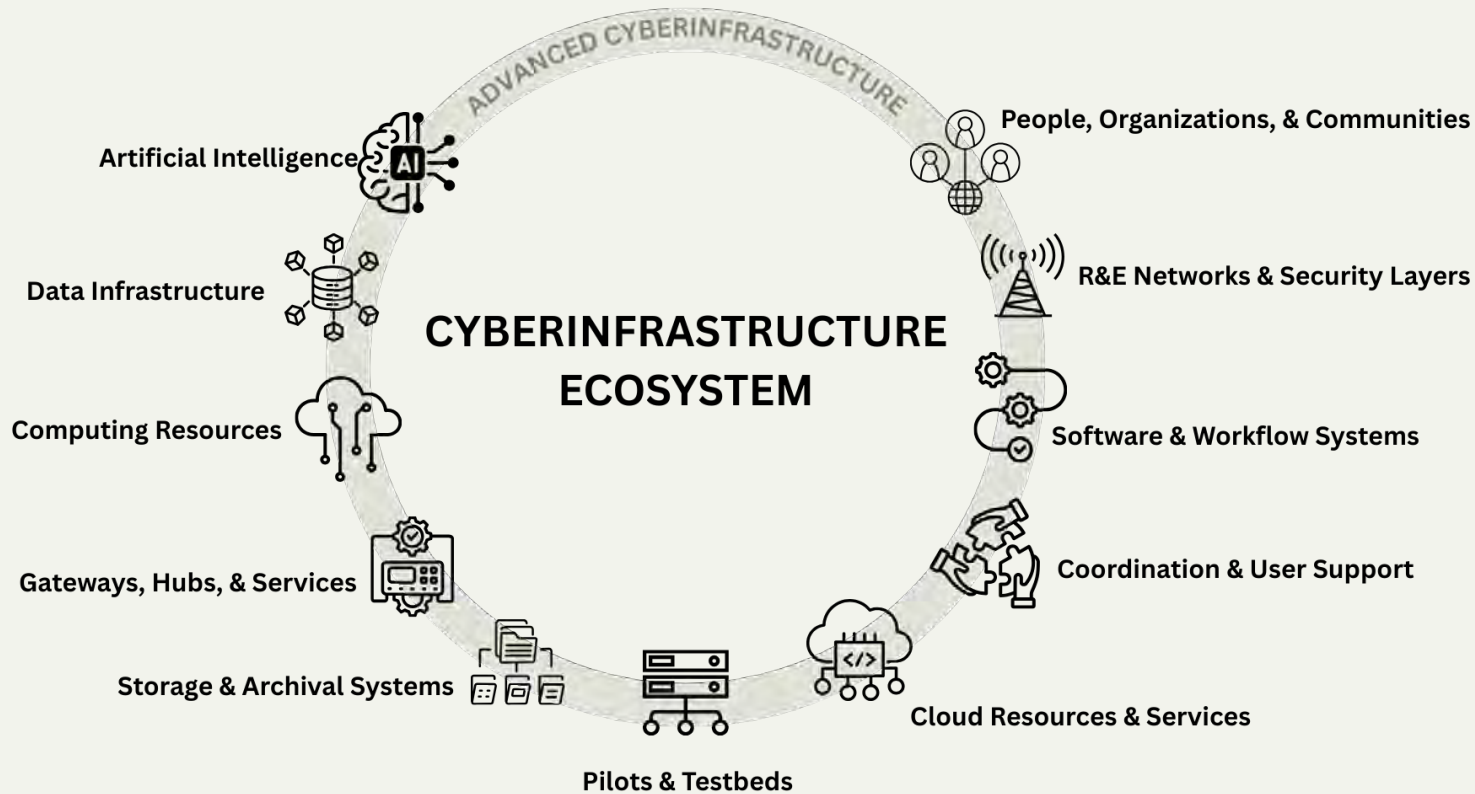
The systems (hardware, software, data, networks, people) that support and advance complex research and education in the digital age.



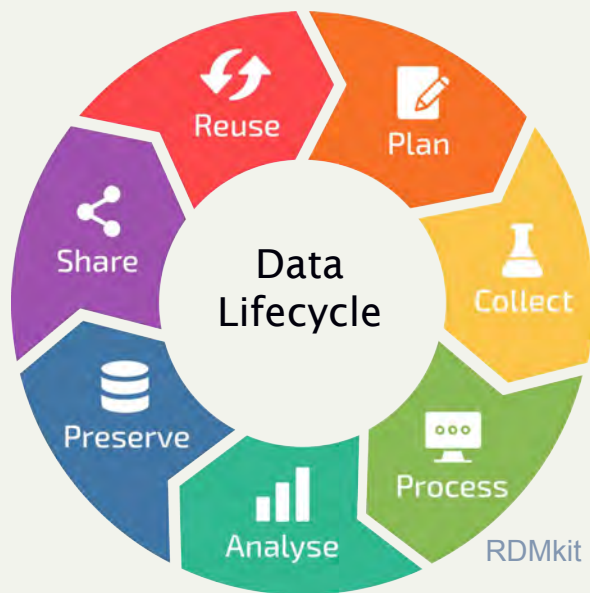
Cyberinfrastructure (CI) = IT for scholarship

- **People** to design, implement, and manage the infrastructure
- The Actual Network Hardware
 - Switches, routers, firewalls, fiber optic lines, copper lines
 - Software to monitor and protect the network
- Servers for various services (can be cloud based)
 - High performance computing (HPC)
 - High throughput computing (HTC)
 - Data storage node (DTN)
- Identity Access & Management (IAM)
 - How do you log in and access stuff?
- Policies & Procedures
- User Support
- CI Plan to help guide development
- Network Diagram

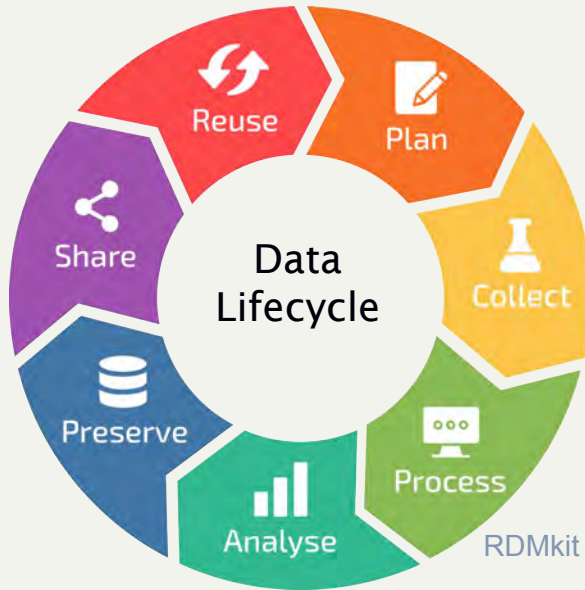




Cyberinfrastructure (CI) = IT for scholarship



Cyberinfrastructure (CI) = IT for scholarship



- network capacity
 - data storage, access, security
 - software, coding interfaces
 - computing capacity
 - data repositories, archives
 - teaching environments using the above
-
- **People/Learning to Apply and Deliver the Above**

Impacts to Data-Intensive Education

- Project-based learning
- Experience with real, full-scale datasets
- Modern tools for data science and collaboration
- Large-scale and cloud computing experience
- Increased enrollment, recognizing these strengths

Access to engaging research projects and experiences.



Impacts to Research Programs

- Expanded project scale and scope
- Accelerated outcomes
- Enhanced collaboration capabilities
- New lines of inquiry
- Greater research impact

*Transformative Research
Outcomes and Impact*



Workforce Development for Today's and Tomorrow's IT Professionals

- Research & Education Facilitation
- Network configuration for open science (Science DMZ) and data security
- Linux systems administration
- Data storage and computing systems

“ Access to technology is less [of] an issue compared to access to expertise.”



CI Funding Programs for Campuses

May include CI as

- the primary focus (CI-**centric**)
- an expected **component** of a research-/education-centric project
- a **potential** component of a research-/education-centric project

May Cover

- equipment (e.g. network, storage ...)
- effort, travel, training, etc.
- external services/products

Federal Entities with Campus-Relevant CI Funding

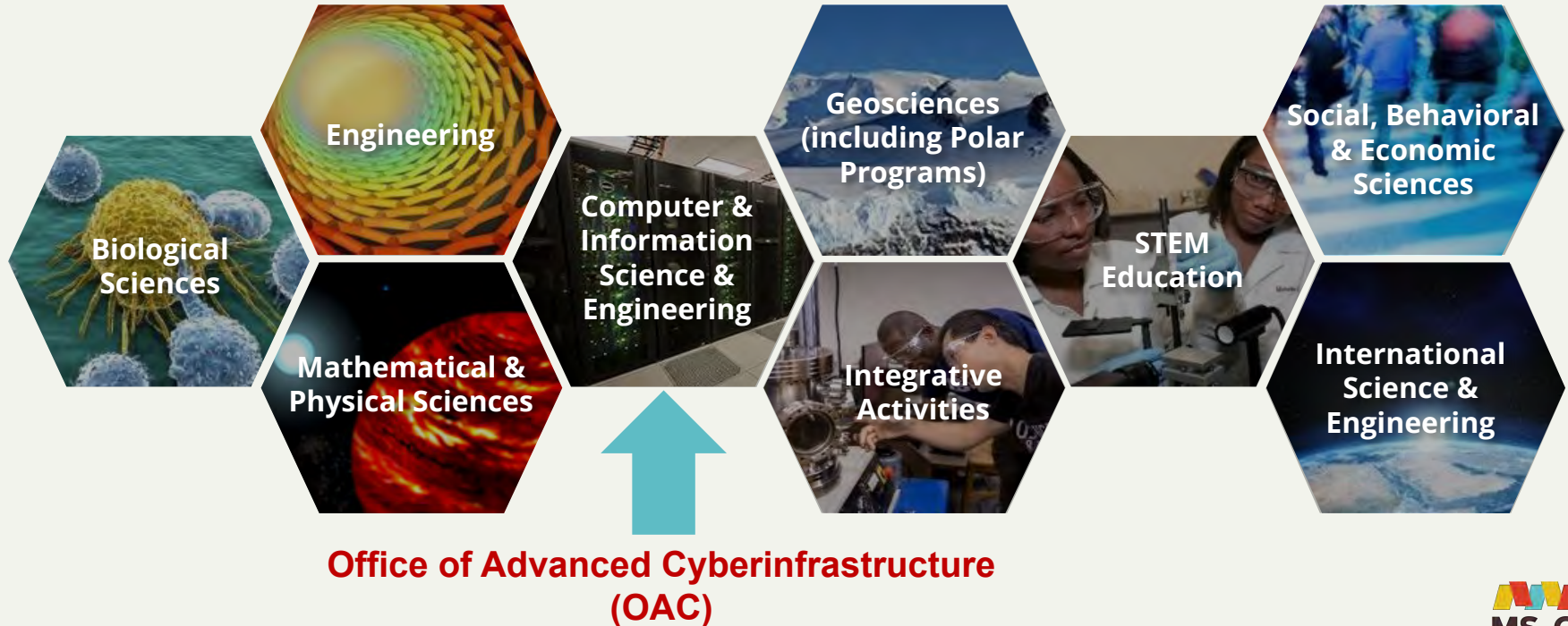


- **National Science Foundation** (*all CI facets*; potential-centric)
- **National Telecommunications and Information Administration** (*networks, devices, workforce*; centric, component)
- **Department of Homeland Security** (*cybersecurity research+inf*; potential-centric)
- Other entities funding research/education programs: (component, potential)
e.g. **NIH, DODefense, DOEducation, DOEnergy**, Title III, etc.
(*software, compute, storage, facilities, incl. cloud*)

NSF Directorates



NSF Directorates



NSF Directorates



Engineering



Geosciences
(including Polar
Programs)



Social, Behavioral
& Economic
Sciences

DIRECTORATE FOR TECHNOLOGY, INNOVATION AND PARTNERSHIPS (TIP)



Mathematical &
Physical Sciences



Engineering



Integrative
Activities



Education



International
Science &
Engineering

TIP Webinar: <https://www.youtube.com/watch?v=8CbogUbiTI8&list=PLGhBP1C7iCokQIS4xGK8GCjnxx02oSZIZ>

NSF CI Funding for Campuses

- Research & Education grants across directorates *potential-component*
- **CISE Office of Advanced Cyberinfrastructure (OAC)** *centric*
 - **Campus Cyberinfrastructure (CC*) Program**
 - Others, e.g. Cybertraining, SCIFE (CI users and professionals)
- Multi-track MSI-specific funding programs *potential*
 - HBCU-Undergraduates Program (EDU) *potential*
 - TCUP (EDU) *potential-centric*
- Office of Integrative Activities
 - Major Research Instrumentation (MRI) *component*
 - Mid-scale Research Infrastructure (Mid-scale RI) *component*

CC* Example: Texas College, Planning



2022 In-PERSON NSF CAMPUS CYBERINFRASTRUCTURE
PI WORKSHOP

September 19 – 21, 2022
Minneapolis, Minnesota

NSF Program Campus Cyberinfrastructure (CC or CICI): CC*

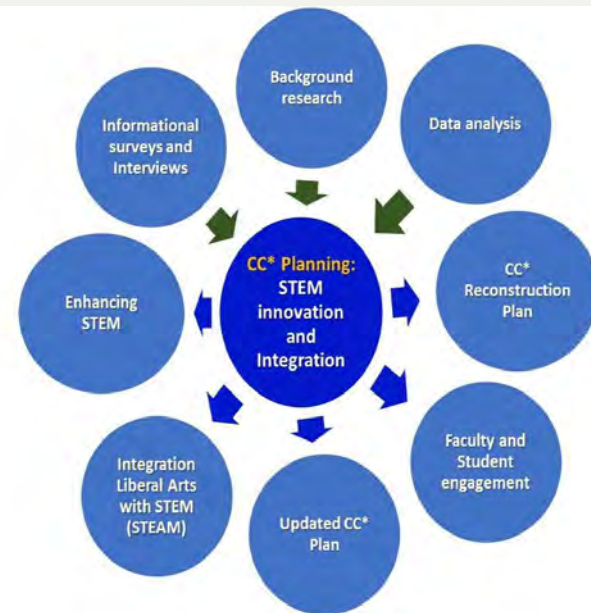
Program Area: Planning

Award Number: 2201474

PI: Dr. Sohel H. Quazi

**Project Title: CC* Planning: RE-CONSTRUCTING THE
CAMPUS CYBERINFRASTRUCTURE OF A SMALL, LIBERAL
ARTS HBCU IN ORDER TO MAXIMIZE STEM INNOVATION
AND INTEGRATION**

Dr. Sohel H. Quazi
Assistant Professor
Texas College
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CC* Example: Langston University, Compute



**NSF VIRTUAL CAMPUS CYBERINFRASTRUCTURE
PI WORKSHOP**
SEPTEMBER 19 – 21, 2022

NSF Program (CC): NSF 21-528 Campus Cyberinfrastructure

**Program Area: CC*
Compute**

**Award Number:
2201479**

PI: Franklin Fondjo Fotou

co-PIs: Horst Severini, Abebaw Tadesse

**Project Title: CC* Compute: Collaboration in Computing
Infrastructure for Research and Education (CO-InResE)**



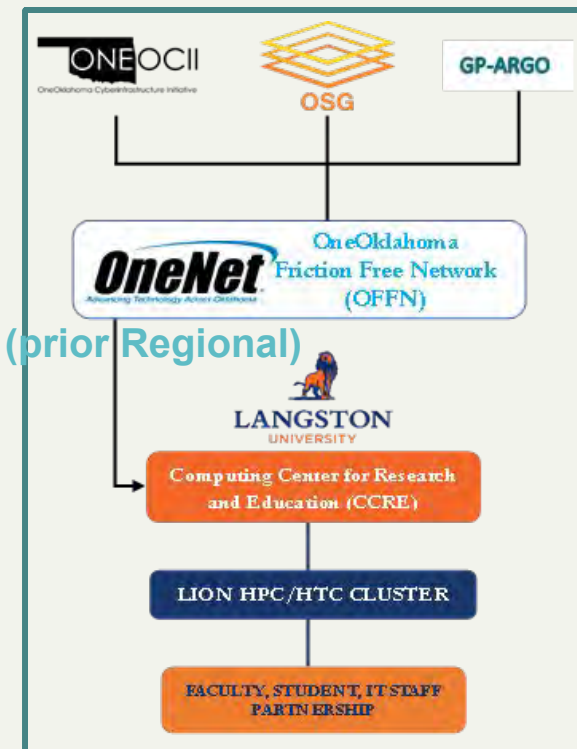
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CC* Example: Navajo Tech, Network Design (campus) + Regional



2019 NSF Campus Cyberinfrastructure and Cybersecurity Innovation for Cyberinfrastructure PI Workshop

September 24 – 25, 2019; University of Minnesota, Minneapolis, MN

NSF Program (either CC or CICI): CC

Program Area: CC* network Design Award Number: 1827199

PI: Jason Arviso Co-PIs: John Hernandez, Marla Meehl, Jared Ribble

Project Title: “Nilch’ bee naa alkaa go ohooa doo eidii t’jj. Translation: Using air (technology) to learn and understand new things.



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And later:

**CC* Regional: Tribal Consortium
Research Network**
connecting multiple TCUs
(NSF# 1925689)

CC* Major Proposal Components

- **Science Drivers** (education and research use cases)
- **Campus CI Plan** (document of existing CI and strategies)
 - not required for Planning (Strategy) or CIRA grants
- **Project Plan** that connects the above with technical resources and human effort.
 - **Budget and Justification**
 - **Letters of Collaboration** from stakeholders and partners.
- Standard for NSF proposals:
 - **Intellectual Merit** and **Broader Impacts** statements
 - **Data Management Plan** and **Facilities** docs
- See the [CC* solicitation](#) and [NSF proposal guidance](#)



Example Science Drivers

- *Network upgrade needed to migrate dated Cybersecurity computer lab hardware/OS to the cloud.*
- *Class using large GIS datasets from external repositories requires network upgrade for timely download during class.*
- *Network (and/or local data storage) to support multiple research groups that regularly move large datasets to/from collaborating institutions and/or off-campus computing resources (e.g. bioinformatics, health, weather forecasting).*

Find abstracts via “Browse projects funded by this program” on the CC* web page.



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CC* Networking Infrastructure: Bulldog Connectivity and Research (1827127)

The **Bulldog Connectivity and Research Network (BCR net) project at South Carolina State University (SCSU)** creates a network infrastructure to accommodate **increasing research activities in STEM and non-traditional areas such as the library, visual arts, museum and the planetarium**. The campus enterprise network ... supports only administrative and academic needs ... Disparate silos of unconnected computing resources have supported research computing in research labs with little scalability to the evolution of research needs...

... Transfers of large datasets and instructions will be enabled under projects such as the **Robotically Controlled Telescope Consortium, the NSF Partnership in Observational and Computational Astronomy (POCA), the NSF SCI-STEPS INCLUDES Project**. Other areas affected include; the **Physics and Chemistry computational labs for astrophysics and cancer research, the digital media lab, the historical collection and archiving Orangeburg massacre collection, applied radiation sciences lab, the Nuclear Engineering program reactor simulation lab, and the computer science security lab.**

https://www.nsf.gov/awardsearch/showAward?AWD_ID=1827127

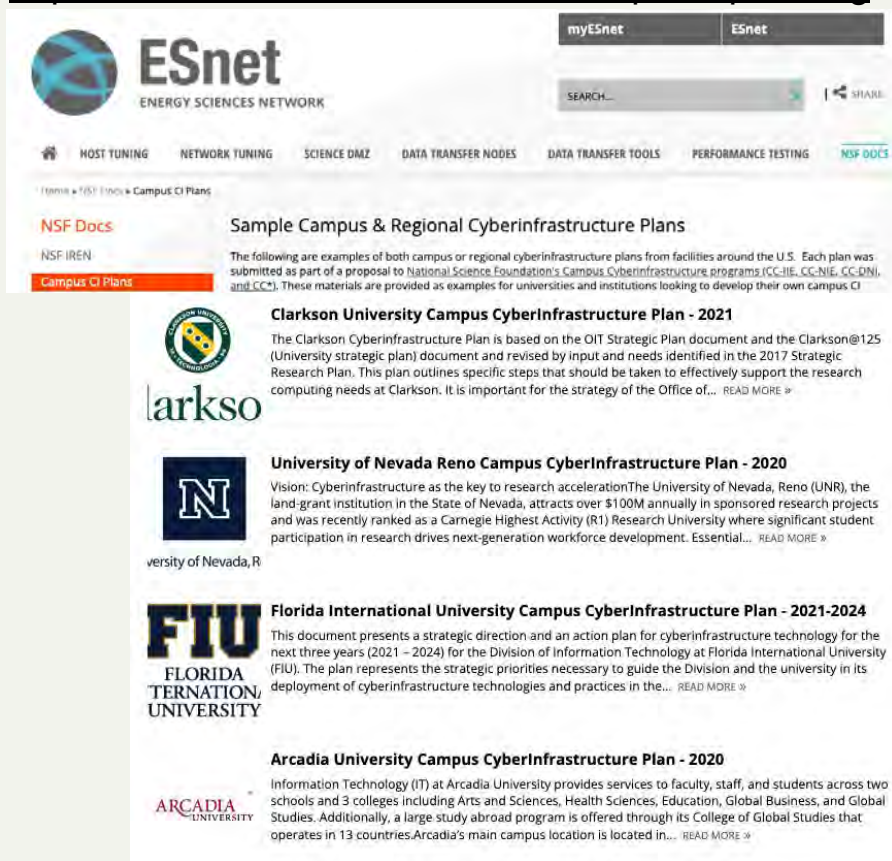
CI Plans

captures current CI capabilities and outlook, needed only for non-planning NSF CC proposals*

- **Examples from other campuses (Esnet)**
<https://fasterdata.es.net/nsf-docs/campusCIplanning/>
- **MS-CC [CI Plan Template](#)** (MS-CC, Google Doc)
- **MS-CC CI 101 Virtual Series introducing CI Plans**
<https://ms-cc.org/news/virtual-cyberinfrastructure-101-series/>
- **MS-CC CI Planning Community of Practice**
<https://ms-cc.org/community-resources/ci-plan-of-practice/>
 - 3rd Tuesdays (usually), Next: *Oct 21*
 - join the MS-CC email list for updates and invites:

<https://ms-cc.org/get-involved/participate-in-the-ms-cc>

<https://fasterdata.es.net/nsf-docs/campusCIplanning>



The screenshot shows the Esnet (Energy Sciences Network) website. The header includes the Esnet logo and navigation links like 'myESnet' and 'ESnet'. A search bar is present. The main content area is titled 'Sample Campus & Regional Cyberinfrastructure Plans' and lists several university plans:

- Clarkson University Campus Cyberinfrastructure Plan - 2021**
The Clarkson Cyberinfrastructure Plan is based on the OIT Strategic Plan document and the Clarkson@125 (University strategic plan) document and revised by input and needs identified in the 2017 Strategic Research Plan. This plan outlines specific steps that should be taken to effectively support the research computing needs at Clarkson. It is important for the strategy of the Office of... [READ MORE »](#)
- University of Nevada Reno Campus Cyberinfrastructure Plan - 2020**
Vision: Cyberinfrastructure as the key to research accelerationThe University of Nevada, Reno (UNR), the land-grant institution in the State of Nevada, attracts over \$100M annually in sponsored research projects and was recently ranked as a Carnegie Highest Activity (R1) Research University where significant student participation in research drives next-generation workforce development. Essential... [READ MORE »](#)
- Florida International University Campus Cyberinfrastructure Plan - 2021-2024**
This document presents a strategic direction and an action plan for cyberinfrastructure technology for the next three years (2021 – 2024) for the Division of Information Technology at Florida International University (FIU). The plan represents the strategic priorities necessary to guide the Division and the university in its deployment of cyberinfrastructure technologies and practices in the... [READ MORE »](#)
- Arcadia University Campus Cyberinfrastructure Plan - 2020**
Information Technology (IT) at Arcadia University provides services to faculty, staff, and students across two schools and 3 colleges including Arts and Sciences, Health Sciences, Education, Global Business, and Global Studies. Additionally, a large study abroad program is offered through its College of Global Studies that operates in 13 countries.Arcadia's main campus location is located in... [READ MORE »](#)

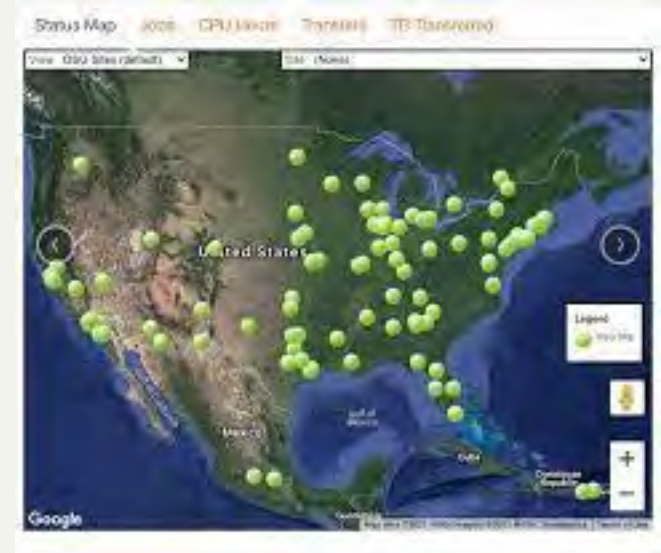
80,000 jobs, 40 billion base pairs, and 20 bats — all in 4 weeks

By: Josephine Watkins

October 26, 2021

An evolutionary biologist at the AMNH used HTC services provided by the OSG to unlock a genomic basis for convergent evolution in bats.

Ariadna Morales, a Gerstner postdoctoral fellow at the American Museum of Natural History (AMNH) from 2018 to 2020, used the fabric of services provided by the OSG consortium to single-handedly tackle her most computationally-intensive project yet. In only 4 weeks, she ran 80,000 jobs to analyze 20 bat genomes — a task that would have taken over 4 months to complete, even on the AMNH's significant local resources.



For more info:
<https://osg-htc.org/spotlights/bat-genomics.html>

Proposal-Development Resources from the MS-CC

CC* Proposal Consulting *no cost for HBCUs and TCUs*

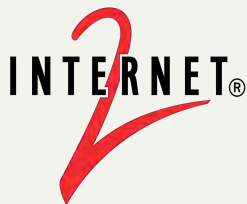
- virtual meetings, proposal checklists, templates, review
- expanding into other CI-related (and non-NSF) proposal support in the future

Letters of Collaboration

If you would like a Letter of Collaboration for your grant proposal, please complete [the appropriate form](#) and allow at least **6 weeks prior** to the date the letter is needed.

A National CI Ecosystem of Services to Support Researchers and Campuses

Networks, Data
Transfer, & Security



REGIONAL RESEARCH & EDUCATION NETWORKS IN THE UNITED STATES



QUILT MEMBERS & AFFILIATES



REGIONAL RESEARCH & EDUCATION NETWORKS IN THE UNITED STATES

SOUTHERN REGION



THE QUILT

QUILT MEMBERS

A National CI Ecosystem of Services to Support Researchers and Campuses

Software & Workflow
Systems



Science Gateways
Community Institute

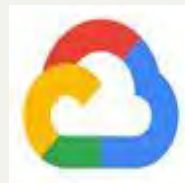
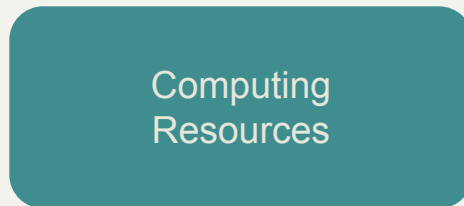


A National CI Ecosystem of Services to Support Researchers and Campuses

Data Repositories &
Storage



A National CI Ecosystem of Services to Support Researchers and Campuses



A National CI Ecosystem of Services to Support Researchers and Campuses

People, Organizations &
Communities



A National CI Ecosystem of Services to Support Researchers and Campuses

Networks,
Data Transfer,
& Security



InCommon®



Data
Repositories
& Storage



open storage network



Software &
Workflow
Systems



Computing
Resources

People,
Organizations &
Communities



THE
CARPENTRIES



CaRCC
Campus Research Computing Consortium



Red Hat
Training



Knowledge, Leadership, Service: A CI Strategy Sprint

07:00

A university is building a research initiative to study zoonotic diseases in livestock and how the weather affects outbreak patterns. Researchers need to gather data from rural farms, process it, and publish insights in both scientific and public platforms.

Knowledge

- How can CI improve what we know or teach?
- What new tools would empower faculty or students in this case?

Leadership – strategic vision, planning, partnerships

- What institutional action is needed?
- Who needs to be involved?
- What infrastructure or partnerships are missing?
- How do we fund or sustain this?

Service – support, community, student empowerment

- How can CI make this more impactful?
- How do we share results with the public?
- What about student access to tools?

Thank You! *Any questions?*



Business card

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Jennifer Kim

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(Anonymous)
Feedback Survey

<https://forms.gle/RW11Xs6azznwurRn7>

Pre-Workshop Survey:



<https://forms.gle/61xxZsEhrwYK6VLj6>

Workshop Materials:



<https://bit.ly/MSCCTuskegeeMaterials>