

CC Program BRICCS Workshop*



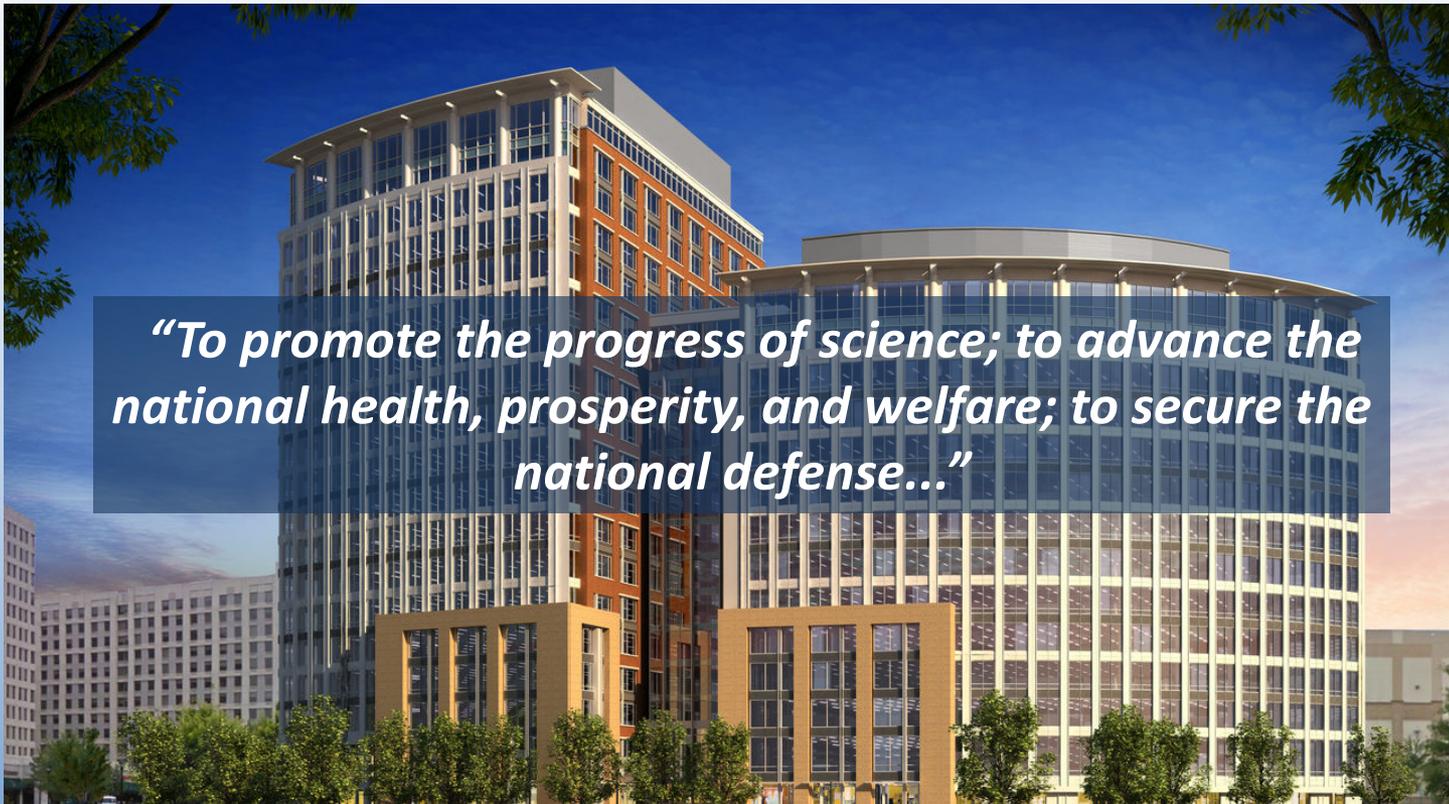
**Kevin Thompson
Program Director**

**Office of Advanced Cyberinfrastructure
Computer & Information Science & Engineering**

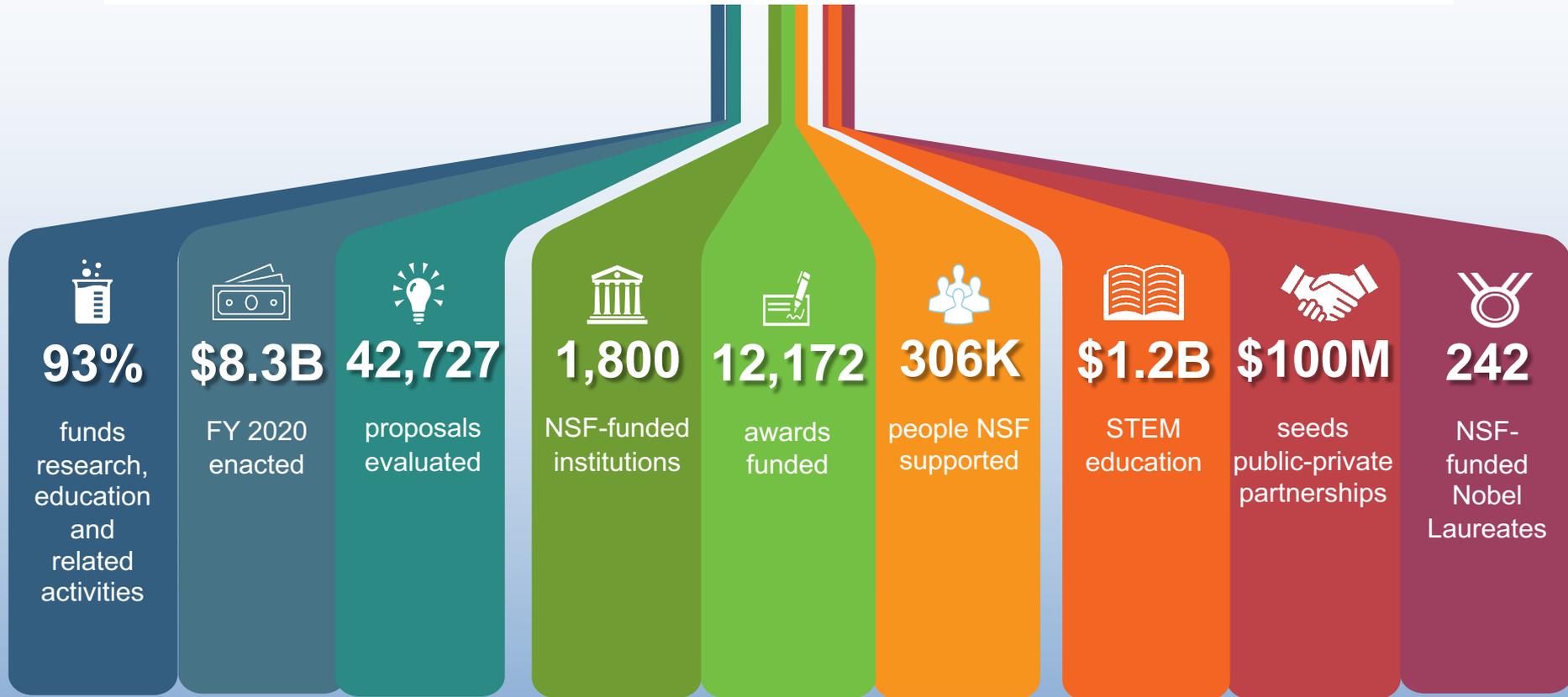
October 2021



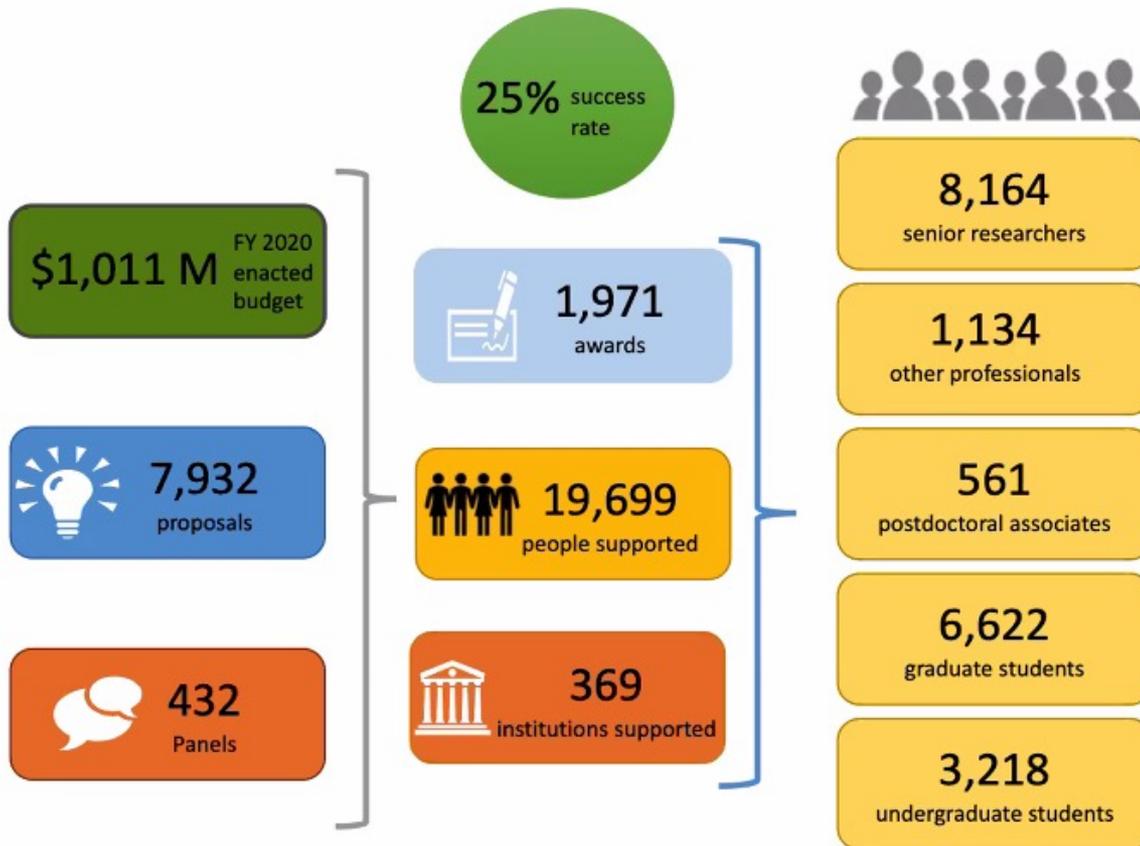
National Science Foundation's Mission



NSF by the Numbers (2021)



NSF CISE by the numbers, FY 2020

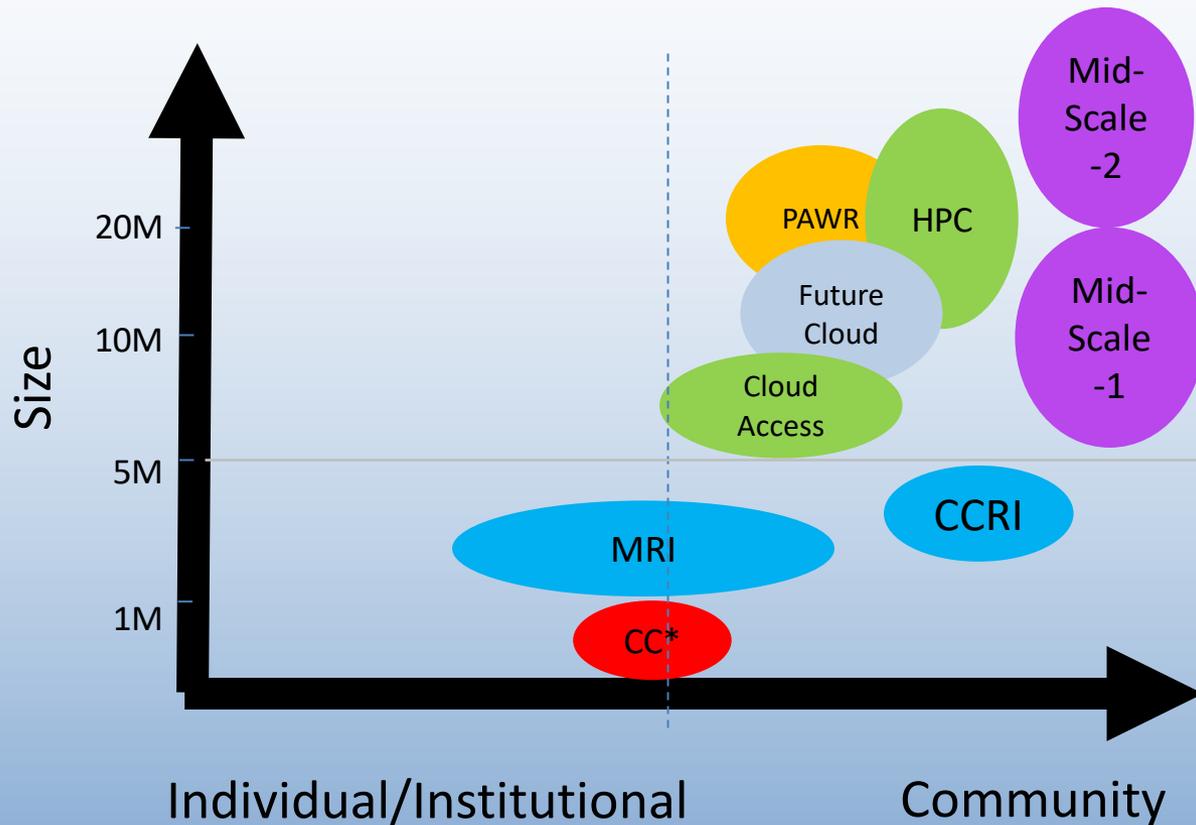


NSF funds > 85% of federally-funded academic CS research in the US.

(Source: NCSES)



A Sketch of CISE Infrastructure Programs



Infrastructure is not just Hardware!
Think broadly about Infrastructure to include software, data and people!

Cyberinfrastructure for Sustained Scientific Innovation (CSSI)

<https://www.nsf.gov/pubs/2021/nsf21617/nsf21617.htm>

- Supports the **development and deployment** of robust, reliable and sustainable **data and software cyberinfrastructure**.
- Brings innovative capabilities towards sustained scientific innovation and discovery.
- Provides opportunity to advance common approaches to sustain and innovate research cyberinfrastructures.
- Follows accepted data management and software development practices.

Proposals Due: December 8, 2021

Guiding Principles

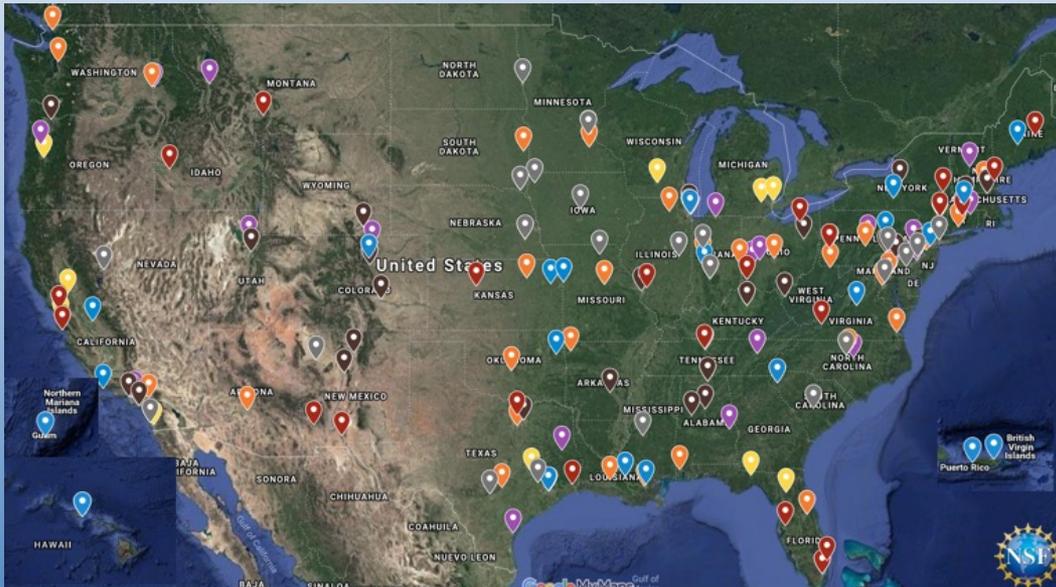
<i>Project Motivation and Impact</i>	<ul style="list-style-type: none"> • Science-driven • Innovation
<i>Cyberinfrastructure Plans</i>	<ul style="list-style-type: none"> • Close collaborations among stakeholders • Building on existing, recognized capabilities • Project plans, and system and process architecture.
<i>Measurable Outcomes</i>	<ul style="list-style-type: none"> • Clear deliverables • Sustained and sustainable impacts • Metrics

Project Types	
Elements	Small groups that will create and deploy robust capabilities for which there is a demonstrated need that will advance one or more significant areas of S&E. (Awards <= \$600K, up to 3 years)
Framework Implementations	Larger, interdisciplinary teams organized around the development and application of common infrastructure aimed at solving common research problems faced by NSF researchers in one or more areas of S&E, resulting in a sustainable community framework serving a diverse community or communities. (Awards between \$600K - \$5 Million, up to 5 years)
Transition to Sustainability	Groups who will execute a well-defined sustainability plan for existing CI with demonstrated impact in one or more areas of S&E supported by NSF. The sustainability plan should enable new avenues of support for the long-term sustained impact of the CI. (Awards <= \$1 Million, up to 2 years)



The Campus Cyberinfrastructure (CC*) Program

- Networking as a fundamental layer and underpinning of Cyberinfrastructure, driven by scientific R&E needs
- Most awards go to 10/100 Gbps Campus networking upgrades, external connectivity to the national R&E fabric, and campus border redesign prioritizing science traffic.
- ~CC* emphasizes strong campus level partnerships between researchers/teachers and campus IT leadership



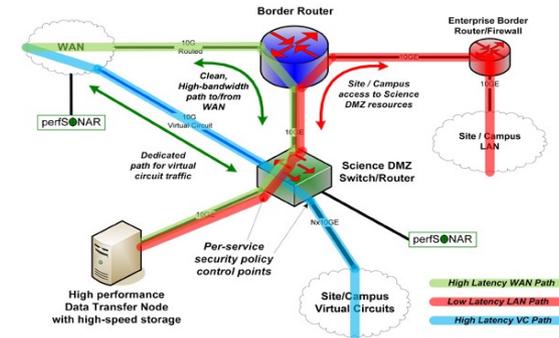
Its not all about bigger pipes

- re-architecting the campus border [longer term ~ re-engineering trust relationships]
- How your campus networking plans fit into the broader cyberinfrastructure strategy for your campus – campus CI Plan (required in CC*)
- driving partnerships between scientists and campus IT – **enabling science and education**

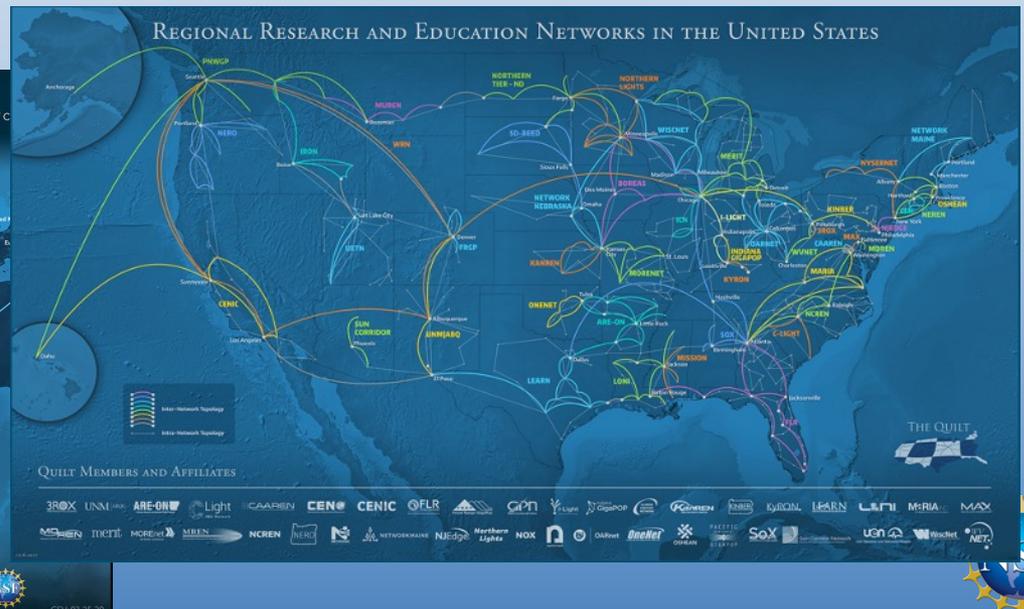
* end-to-end perspective on networking and performance

Simple Science DMZ Diagram

A simple Science DMZ has several essential components. These include dedicated access to high-performance wide area networks and advanced services infrastructures, high-performance network equipment, and dedicated science resources such as Data Transfer Nodes. A notional diagram of a simple Science DMZ showing these components, along with data paths, is shown below:



The essential components and a simple architecture for a Science DMZ are shown in the Figure above. The Data Transfer Node (DTN) is connected directly to a high-performance Science DMZ switch or router, which is connected directly to the border router. The DTN's job is to efficiently and effectively move science data to and from remote sites and facilities, and everything in the Science DMZ is aimed at this goal. The security policy enforcement for the DTN is done using access control lists on the Science DMZ switch or router, not on a separate firewall.



Summary #s for NSF's Campus CI Program 2012-2021

- ~370 awards
- \$100M+ invested over 10 years
- 49 states and jurisdictions represented on award map
- Award categories [aggregate (FY21)]:
 - Campus Networking Upgrades: 145 (2)
 - Network Integration/Innovation: 66 (6)
 - Regional/Network Design (small institutions): 40 (3)
 - CyberTeam / CI Engineer: 33 (n/a)
 - Compute: 38 (5)
 - Other: 41 (6 planning grants)



CC* 21-528 - Campus Cyberinfrastructure

- <https://www.nsf.gov/pubs/2021/nsf21528/nsf21528.htm>
- \$13M-\$15M in expected award funding
- **Proposals due ~~March 1 and October 11, 2021~~**
- **Area #1 – Campus Network upgrades**
 - 10/100Gbps+ inter- and intra-campus networking
 - Re-design of campus border to prioritize science flows
 - Awards up to \$500,000
- **Area #2 – Regional coordination for Small Institutions**
 - Establishing r&e network connectivity for multiple under-resourced institutions
 - Awards up to \$1,000,000
- **Area #3 – Networking Integration and Applied Innovation**
 - Applied R&D in networking motivated by science use cases
 - Awards up to \$500,000 (small) and \$1,000,000 (large)
- **Area #4 – Campus Computing**
 - Shared cluster cycles for campus-wide science
 - Awards up to \$400,000
- **Area #5 – Planning Grants and CI-Research Alignment**
 - Awards up to \$100,000 (planning) and \$200,000



Program-wide Criteria for CC* proposals

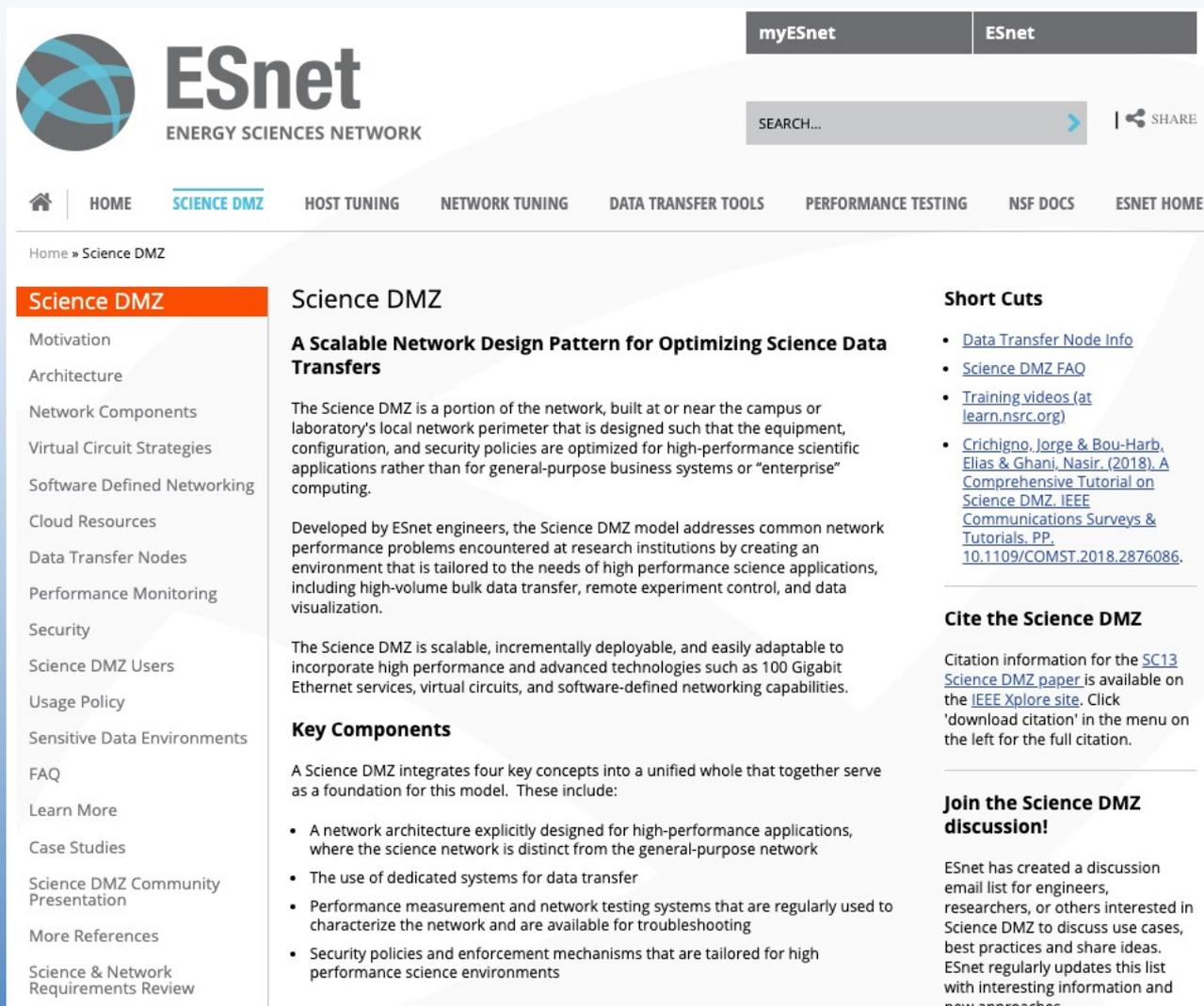
- **Science-driven requirements** are the primary motivation for any proposed activity. Proposals will be evaluated on the strength of the science enabled (including research and education) as drivers for investment and innovation in data networking infrastructure, innovation, and engineering.
- **A partnership among researchers/educators and campus IT leadership**
- All proposals submitted to the CC* program, with the exception of area (5), must include a **Campus CI plan** within which the proposed CI improvements are conceived, designed, and implemented in the context of a coherent campus-wide strategy and approach to CI that is integrated horizontally intra- campus and vertically with regional and national CI investments and best practices. This Campus CI plan must be included as a Supplementary Document and is limited to no more than 5 pages.
- <https://fasterdata.es.net/campusCIplanning/>



CC* Area#1 - Data Driven Networking Infrastructure for the Campus and Researcher

- network infrastructure improvements at the campus level
- network improvements include:
 - Network upgrades within a campus network to support a wide range of science data flows...
 - re-architecting a campus network to support large science data flows, for example by designing and building a "science DMZ" (see <http://fasterdata.es.net/science-dmz/> for more information on the "science DMZ" approach)
 - Network connection upgrade for the campus connection to a regional optical exchange or point-of-presence that connects to a state/regional/national network aggregation point prioritizing support for research and education
- In addressing networking equipment choices and configurations matched for high-performance R&E networking environments, proposals are encouraged to leverage objective community expertise and experience available from the NSF-funded EPOC project at: <https://epoc.global/cc/>.





The screenshot shows the ESnet website's Science DMZ page. The header includes the ESnet logo (ENERGY SCIENCES NETWORK), navigation links (HOME, SCIENCE DMZ, HOST TUNING, NETWORK TUNING, DATA TRANSFER TOOLS, PERFORMANCE TESTING, NSF DOCS, ESNET HOME), and a search bar. The main content area is divided into three columns: a left sidebar with a navigation menu, a central main content area, and a right sidebar with 'Short Cuts', 'Cite the Science DMZ', and 'Join the Science DMZ discussion!' sections.

ESnet
ENERGY SCIENCES NETWORK

myESnet | ESnet

SEARCH... | SHARE

HOME | SCIENCE DMZ | HOST TUNING | NETWORK TUNING | DATA TRANSFER TOOLS | PERFORMANCE TESTING | NSF DOCS | ESNET HOME

Home » Science DMZ

Science DMZ

- Motivation
- Architecture
- Network Components
- Virtual Circuit Strategies
- Software Defined Networking
- Cloud Resources
- Data Transfer Nodes
- Performance Monitoring
- Security
- Science DMZ Users
- Usage Policy
- Sensitive Data Environments
- FAQ
- Learn More
- Case Studies
- Science DMZ Community Presentation
- More References
- Science & Network Requirements Review

Science DMZ

A Scalable Network Design Pattern for Optimizing Science Data Transfers

The Science DMZ is a portion of the network, built at or near the campus or laboratory's local network perimeter that is designed such that the equipment, configuration, and security policies are optimized for high-performance scientific applications rather than for general-purpose business systems or "enterprise" computing.

Developed by ESnet engineers, the Science DMZ model addresses common network performance problems encountered at research institutions by creating an environment that is tailored to the needs of high performance science applications, including high-volume bulk data transfer, remote experiment control, and data visualization.

The Science DMZ is scalable, incrementally deployable, and easily adaptable to incorporate high performance and advanced technologies such as 100 Gigabit Ethernet services, virtual circuits, and software-defined networking capabilities.

Key Components

A Science DMZ integrates four key concepts into a unified whole that together serve as a foundation for this model. These include:

- A network architecture explicitly designed for high-performance applications, where the science network is distinct from the general-purpose network
- The use of dedicated systems for data transfer
- Performance measurement and network testing systems that are regularly used to characterize the network and are available for troubleshooting
- Security policies and enforcement mechanisms that are tailored for high performance science environments

Short Cuts

- [Data Transfer Node Info](#)
- [Science DMZ FAQ](#)
- [Training videos \(at learn.nsrc.org\)](#)
- [Crichigno, Jorge & Bou-Harb, Elias & Ghani, Nasir. \(2018\). A Comprehensive Tutorial on Science DMZ. IEEE Communications Surveys & Tutorials. PP. 10.1109/COMST.2018.2876086.](#)

Cite the Science DMZ

Citation information for the [SC13 Science DMZ paper](#) is available on the [IEEE Xplore site](#). Click 'download citation' in the menu on the left for the full citation.

Join the Science DMZ discussion!

ESnet has created a discussion email list for engineers, researchers, or others interested in Science DMZ to discuss use cases, best practices and share ideas. ESnet regularly updates this list with interesting information and new approaches.



CC* Area#2 – Regional Connectivity for Small Institutions

- This area supports broadening participation and significantly widening the set of institutions connected to the regional and national research and education network fabric. **This area specifically targets groups of smaller institutions with fundamental challenges in networking infrastructure and resources.** This area supports increased research and education (R&E) network connectivity across smaller institutions **coordinated and led by a Regional Optical Network (RON) or a leadership institution in R&E networking in the region.**



CC* Area#2 — Regional Connectivity for Small Institutions of Higher Education

- This area solicits proposals led by established regional and state R&E data networks and data network-based consortia. Example entities are listed as members of the national regional network consortium called the Quilt (see <https://www.thequilt.net/about-us/the-quilt-participants/>).
- For areas of the US without a state or regional level coordinating entity and associated structure and network infrastructure, proposals will be accepted from self-declared leadership universities. An institution may also lead a proposal in regions with an established RON with documented coordination with the RON.
- **Proposals are required to address campus networking needs spanning multiple under-resourced institutions.** Proposals addressing a single institution are not allowed to submit to this area and will be returned without review. Proposals may choose to apply an alternative design framework to the conventional single institution context in Area (1) and consider an aggregation model where some or all associated resources and services (e.g., Science DMZ) are centralized at a regional level.



CC* Area#3 - Network Integration and Applied Innovation

- Goal - take advantage of research results, prototypes, and emerging innovations to use them to enable specified researchers in a networking context.
- Proposals in this area are expected to reflect innovation in advanced networking. As a result, this area is not appropriate for projects whose costs are dominated by equipment purchases.
- **Proposals in this area support the development and integration of innovative networking capabilities and network-related software development, and deployment activities resulting in an operational environment prototype are expected to be part of the proposed activities.**
- **Proposals are encouraged to perform experimental deployment, protocol prototyping and testing, and evaluation using FABRIC (<https://www.fabric-testbed.net>).**



CC* Area#4 – Campus Computing and the Computing Continuum

- This program area promotes coordinated approaches in scientific computing at the campus level. This area invests in the seeding of new and shared computing resources at the campus level through investments in capacity computing in campus clusters. The program promotes a coordinated approach incentivizing multi-campus and national resource sharing.
- All proposals into this area must address:
 - Scientific and engineering projects and their research computing needs, describing project-specific scenarios for scientific computing tied to the proposed computing resources;
 - Features, capabilities, and software platforms representing the proposed computing resources; and
 - Scientific computing codes expected to run on the resources.
- NSF encourages proposals in this program area from under-resourced institutions and strong preference will be given to proposals demonstrating a compelling need for access to campus/cloud resources, including institutions lacking necessary computing and storage resources on campus.
- Proposals are required to commit to a minimum of 20% shared time on the cluster and describe their approach to making the cluster available as a shared resource external to the campus,



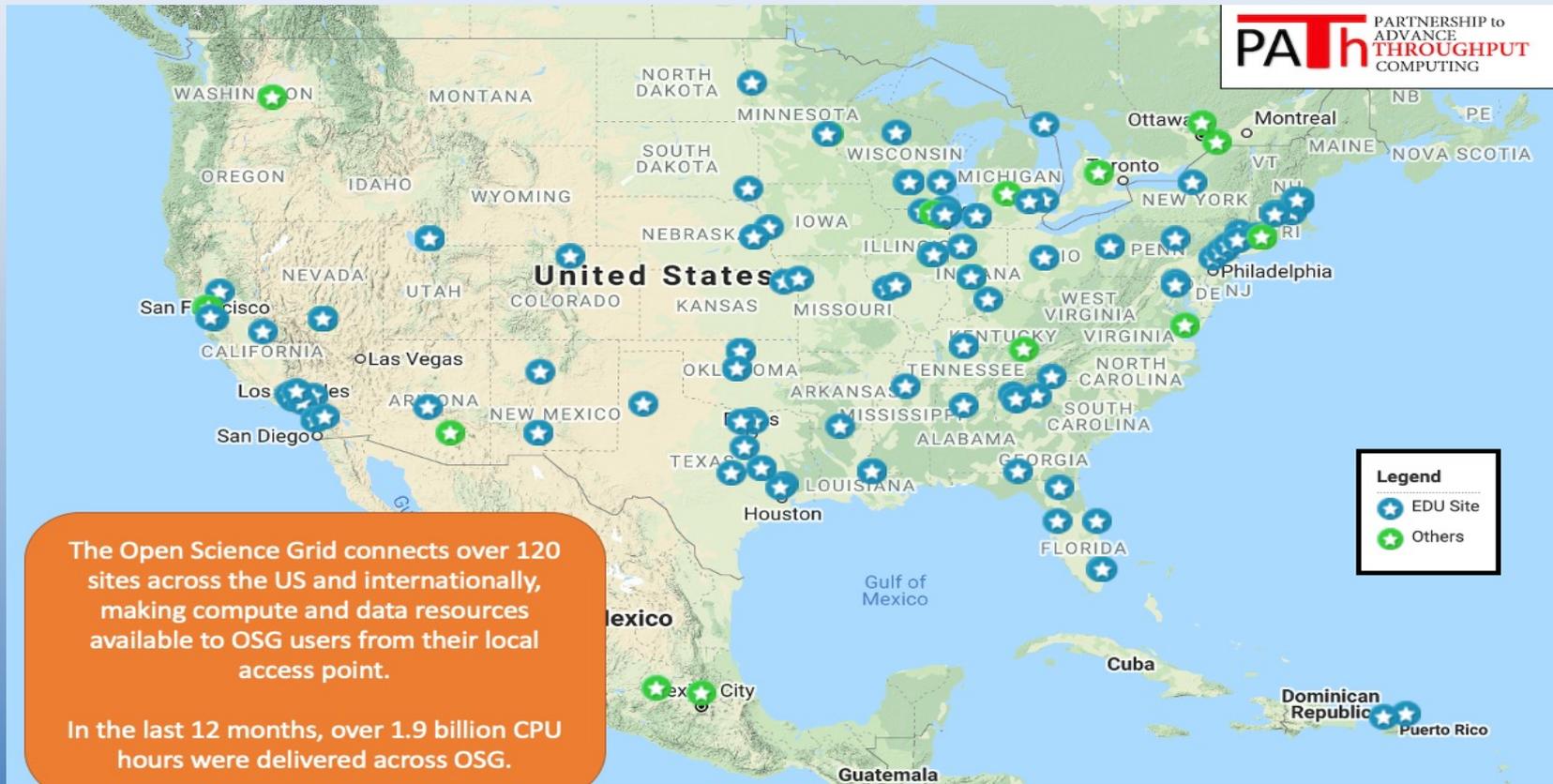
Open Science Grid as a National Distributed Compute Fabric



About ▾ CC* News Events Contact Docs ▾

349 Million Core Hours Contributed by CC* Campuses

In the last year, these campuses contributed over 349 million core hours to researchers using distributed high throughput computing (dHTC). (August 2020 - July 2021) These core hours supported over 236 projects in fields of study ranging from the medical sciences to the evolutionary sciences, and from biostatistics to physics. This campus support throughout the United States contributed to the advancement of science and to researchers both on and off their campuses. The campuses currently contributing CC*-funded resources are shown in the map below. Every month, the OSG is working to help additional campuses to join this effort to support open science by sharing their resources:



CC* Area#5 – Planning Grants and CI-Research Alignment (CIRA)

- This program area supports planning and coordination activities.
- Planning Grants:
 - Planning proposals should define a clear set of goals and a set of coordination and planning activities to meet those goals. Equipment costs are not allowed as part of a Planning Grant, and proposed costs are expected to include support for community coordination and planning activities
 - Planning proposals are welcome for areas (1) through (4) in CC*
- CI-Research Alignment (CIRA) proposals:
 - A CIRA award provides opportunities to foster new collaborations, including international partnerships, and address interdisciplinary topics.
 - A CIRA proposal is expected to develop a comprehensive CI strategy encompassing a campus, multiple campuses, or a state or regional research and education network entity.
 - The CIRA activity may encompass planning for a future CC* proposal, but goes beyond a specific campus network design, assessment of campus computing needs, or compilation of demanding science drivers to address integrated CI planning and scoping across the relevant scientific communities on campus, across multiple campuses, state-wide, or regionally.



CC* Status in Oct. 2021

- CC* 21-528 deadlines have passed
- NSF targets a 6-month dwell time for proposals
- More solicitations are planned
- Note the CC* solicitation changes year over year
- CC* community is highly collaborative
 - See EPOC next talk
 - Other resources and activities to tap include:
PaTH/OSG, PRP/NRP, Internet2, LEARN, MS-CC



#2137123: NSF Cyberinfrastructure (CI) Center of Excellence Pilot

Minority Serving Cyberinfrastructure Consortium (MS-CC)

Internet2 Principal Investigator: Ana Hunsinger [ana@internet2.edu]

Objectives

- Create a connective and collaborative organization that serves as a centralized hub for HBCUs, TCUs, and other MSIs to utilize for CI advocacy, guidance and expertise
- Increase awareness, availability, and financial support for professional development opportunities for faculty, staff, and students at HBCUs, TCUs, and other MSIs
- Enhance communication among researchers, university leadership, and CI professionals
- Increase access to shared CI resources at MS-CC organizations

Anticipated Deliverables

- MS-CC dedicated staff
- Development and deployment of CI shared resources, including a CI cyberteam
- Specialized campus workshops and community webinars
- NSF Big Data Hub Collaborations
- Presidents' workshops
- Travel stipends for faculty, students, and staff
- Mentorships and Internships for MS-CC member organizations
- Stakeholder alignment mini-surveys as feedback
- Advancing opportunities that amplify successful NSF proposals from MS-CC members



Scientific Impact

- Increase diversity in the STEM talent pool and workforce
- Advance understanding of why CI collaboration among institutions is beneficial
- Advance CI capabilities at minority serving campuses

Keywords

- HBCU
- TCU
- HSI
- MSI
- STEM
- Broadening participation
- Cyberinfrastructure
- Professional Development
- Digital divide
- Diversity
- Inclusion
- Equity

See: <https://internet2.edu/solutions/minority-serving-institutions/>



Active CC* Awards in Texas

Award#	PI Name	Institution	Title	Award
#1827139 networking	League, Brent	University of Texas at San Antonio	CC* Networking Infrastructure: The Roadrunner High-Performance Science, Engineering, and Business DMZ	\$500,000
#1827243 networking	Cui, Suxia	Prairie View A&M University	CC* Network Design: Improve Network on Campus for Research and Education in Agriculture, Science, and Engineering at Prairie View A&M University	\$499,964
#1925553 Regional net	Kara, Akbar	LEARN	CC* Regional: Accelerating Research and Education at Small Colleges in Texas via an Advanced Networking Ecosystem Using a Virtual LEARN Science DMZ	\$799,649
#1925764 Cyber team	Chakravorty, Dhruva	Texas A&M University	CC* Team: SWEETER -- SouthWest Expertise in Expanding, Training, Education and Research	\$1,400,000
#1943948 planning	Buckley, Merdis	Texas Association of Developing Colleges	Campus Cyber-infrastructure Planning Grant	\$94,738
#2018472 Net innovation	Gurkan, Deniz	University of Houston	CC* Integration-Small: Integrating Application Agnostic Learning with FABRIC for Enabling Realistic High-Fidelity Traffic Generation and Modeling	\$299,956
#2018841 Compute	Pal, Anirban	West Texas A&M University	CC* Compute: GROWTH - Gateway for Increased Research Output at a West Texas Higher-education Campus	\$297,538
#2019007 Compute	Jelinkova, Klara	Rice University	Compute: Interactive Data Analysis Platform	\$397,600
#2019135 Cyber team	Simmons, Christopher	University of Texas at Dallas	CC* Team: Texas Education and Research Cybertraining Center (TERCC)	\$1,399,502
#2019136 planning	Chakravorty, Dhruva	Texas A&M University	CC* CIRA: Building Research Innovation at Community Colleges	\$250,000
#2126248 Regional net	Kara, Akbar	LEARN	CC* Regional: LEARN Extending & Accelerating Participation in Science (Texas LEAPS)	\$890,486



Thanks!

