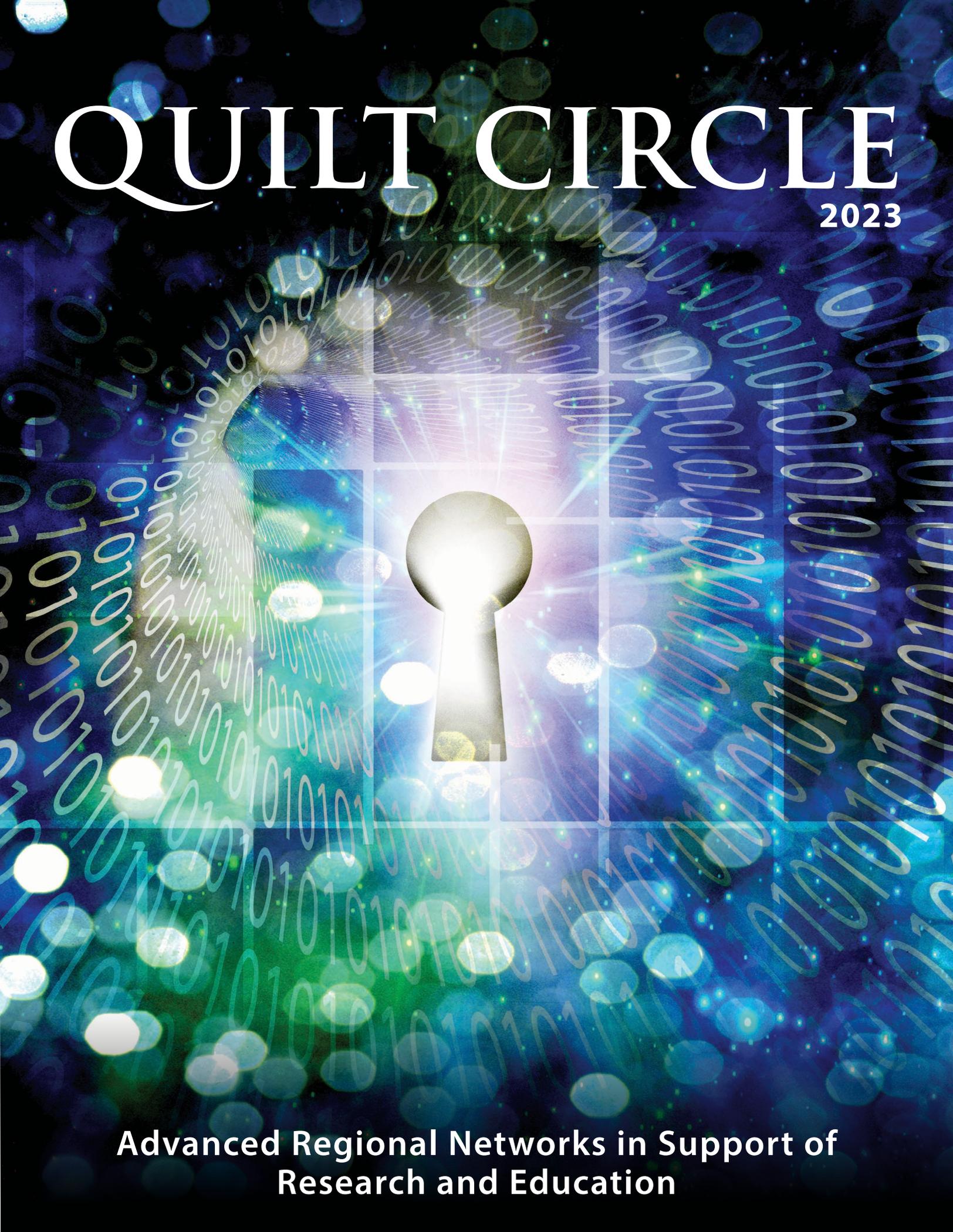


QUILT CIRCLE

2023



**Advanced Regional Networks in Support of
Research and Education**

About Us

The Quilt is a national coalition of non-profit U.S. regional research and education networks representing 43 networks across the country. Participants in The Quilt provide advanced network services and applications to over 900 universities and thousands of other educational and community anchor institutions. Our goal is to promote consistent, reliable, inter-operable and efficient advanced networking services that extend to the broadest possible community and to represent common interests in the development and delivery of advanced cyberinfrastructure that enables innovation through our education and research mission.

Our Mission

The Quilt: A collaboration of U.S. research and education networks committed to innovation and advancement of these purpose-built networks that empower our public service missions.

Our Name

Just like the various fabric patches of a quilt highlight different colors, patterns and textures, each regional network reflects the diversity and the unique qualities found in different parts of the country and the different institutions that particular network serves. Yet all regional patches must be stitched together seamlessly, coherently and interoperably to serve a larger purpose and community.

www.thequilt.net | [@TweetTheQuilt](https://twitter.com/TweetTheQuilt)

Acknowledgements

Layout and design of the 2023 Quilt Circle is by NGC Communications. Follow [@ThinkNGC](https://twitter.com/ThinkNGC)

A Letter From the President

Welcome to this year's edition of our Quilt Circle. Our 2023 edition presents highlights of our Quilt members' public-service missions in action supporting our nation's community anchor institutions. Our membership, comprised of the U.S. non-profit research and education (R&E) networks, provide community anchors with unique networking and IT service capabilities that are purpose-built for these institutions and their communities.

We are at an inflection point with the generational investments currently being made by the federal government in broadband access and adoption. Our R&E networking community has been focused on this type of work for decades with their community anchor partners and stakeholders. We are excited to be building the possibilities of tomorrow with our collaborators. The R&E networks are well poised to partner with state broadband offices, commercial partners, and community leaders for meaningful projects to achieve the goals of the current federal investment efforts. Read on to learn more about the middle-mile infrastructure and digital inclusion projects that our members are leading in their states.

Among these stories from the field of R&E networking are fascinating examples of how our members provide access to the advanced research IT ecosystem, enabling scientific discovery and educational pursuits by our country's higher education community. Naturally, the National Science Foundation (NSF) programs are referenced in these stories, as the NSF is a key partner with its investments in research IT infrastructure and programs. Our R&E networking community strongly holds a strategic vision for our country of digital equity for all higher education institutions. One aspect of this goal is to provide all types of higher education institutions--including historically black colleges and universities, tribal colleges and universities, minority serving institutions, and community colleges--not only advanced networking capabilities, but also access to the tools and resources within the advanced research IT ecosystem. We highlight examples of this focused work with these institutions in the following pages.

The success of our community over the past decades is based on our ability to forge meaningful partnerships and continually adapt to serve the unique IT needs of our community anchor partners. As we emerge from the global pandemic, evidence of this adaptation is captured in several of our member stories about building network capacity, strategic planning, and the deployment of wireless solutions.

These stories from the field underscore how our members thrive in environments of great challenges as well as opportunities. We are proud to share these stories of our public-service missions in action with you and how through working together, we continue to strengthen our national R&E networking community that we call "The Quilt".



Jen Leasure
President and CEO
The Quilt

The Quilt Members and Board of Directors

Albuquerque GigaPoP (NM)

Paul Chang

abqg.unm.edu

Arkansas Research and Education Optical Network (AR)

Elon Turner

www.aron.net

CENIC (CA)

Louis Fox

www.cenic.org

C-Light Network (South Carolina Research and Education Network) [SC]

Brian Miller

light.sites.clemson.edu

Connecticut Education Network (CT)

Ryan Koesondy

ctedunet.net

Florida LambdaRail

Jon Ellis

www.flrnet.org

Front Range GigaPoP (CO, WY)

Marla Meehl

www.frgp.net

Great Plains Network

(OK, SD, KS, MO, NE, AR, IA, MN)

James Deaton

www.greatplains.net

Idaho Regional Optical Network (ID)

Andy Binder

www.ironforidaho.net

Illinois Century Network (IL)

Robin Woodsome

www2.illinois.gov/icn

Indiana GigaPoP (IN)

Dave Jent

indiana.gigapop.net

KanREN (KS)

Bradley Hook

www.kanren.net

KINBER (PA)

Nathan Flood

www.kinber.org

KyRON (KY)

Cody Bumgardner

LEARN (TX)

Akbar Kara

www.tx-learn.net

Link Oregon (OR)

Steve Corbató

www.linkoregon.org

LONI (LA)

Lonnie Leger

www.loni.org

MARIA (VA)

Steve Lee

www.marialliance.net

MDREN (MD)

Jerry Waldron

www.mdren.net

Merit Network (MI)

Joe Sawasky

www.merit.edu

Mid-Atlantic Crossroads

(DC, VA, MD)

Tripti Sinha

www.maxgigapop.net

MOREnet (MO)

Chip Byers

www.more.net

MREN (IL)

Joe Mambretti

www.mren.org

NCREN (NC)

Tracy Doaks

www.mcnc.org

Networkmaine (ME)

Jeff Letourneau

www.networkmaine.net

NevadaNet

Scotty Strachen

www.scs.nevada.edu

New Jersey Research and Education Network (NJ)

Sam Conn

www.njedge.net

Northern Crossroads

(MA, CT, RI, ME, VT, NH)

Mark Sillis

www.nox.org

Northern Lights Gigapop (MN)

Louis Hammond

it.umn.edu/northern-lights-gigapop-introduction

NYSERNet

Jeanne Casares

www.nysernet.org

OARnet (OH)

Pankaj Shah

www.oar.net

OneNet (OK)

John Hennessey

www.onenet.net

OSHEAN (RI)

David Marble

www.oshean.org

Pacific Northwest GigaPoP

(AK, HI, WA, ID, MT)

Amy Philipson

www.pnwgp.net

Southern Crossroads/Southern LambdaRail

(GA, AL, FL, TN, SC, MS)

Cas D'Angelo

www.sox.net

Sun Corridor Network (AZ)

Derek Masseth

suncorridornet.org

Three Rivers Optical Exchange (PA, WV)

Ken Goodwin

www.3rox.net

Utah Education and Telehealth Network (UT)

Jim Stewart

www.uetn.org

WiscNet (WI)

Brian Remer

www.wiscnet.net

West Virginia Network (WV)

Steve White

www.wvnet.edu

Quilt Staff

Jen Leasure

President and CEO

Jennifer Griffin

Program Director

Somaliyah Al-Mahdi

Administrative Assistant

Table of Contents

MOREnet’s Missouri High School Cybersecurity Challenge..... 1

Link Oregon Supporting digital equity for all Oregon communities..... 2

Southern Crossroads (SoX) to help expand research at HBCUs 3

CENIC California Middle Mile Broadband Initiative: GoldenStateNet progress 4

SunCorridor (and SCN) Planting seeds across Arizona to harvest opportunity..... 5

NSHE Expanding the role of the REN in Nevada: kicking off research and education engineering 6

UCAR Navajo Tech University joins and enhances the broader research and education community 7

OneNet OFFN expands research computing to small campuses in Oklahoma 8

UETN strides forward in education and telehealth throughout Utah..... 9

The Great Plains Network (GPN) contributes to the National Research Platform 10

LEARN “The GPS for the journey: LEARN’s strategic planning initiative” 11

MCNC Big brains and weird infrastructure: MCNC’s innovation playbook bridges old IT
and new IT to bring next IT to NC 12

ARE-ON cuts costs for our members by leveraging national programs..... 13

OARnet celebrates 35 years of connecting Ohio communities through cutting-edge technology 14

NYSERNet’s participation in National Research Platform 15

LONI enables research powered by Artificial Intelligence and deep learning..... 16

I-Light (and Indiana GigaPop Emerging from the pandemic with a renewed commitment to
supporting members’ research and security needs 17

Merit Lighting the way forward: Merit Network and Michigan State University project could
mark a turning point in digital equity for Michigan..... 18

MREN Creating next generation networks for data intensive science 19

CEN supports transformative investments in Connecticut’s communities 20

“KINBER completes the Libraries Connect Communities (LCC) and Broadband Resources Program” 21

ESnet Evaluating and improving network performance to support high energy physics with ESnet 22

ICN Illinois K-12 consortium procurement promotes broadband competition 23

EPOC provides deep insights into ResearchCI use for institutions 24

MOREnet addresses the cybersecurity talent shortage with Missouri High School Cybersecurity Challenge



The cyber range and logistics of the competition are managed by [CYBER.org](https://www.cyber.org), who have partnered with this challenge for the last three years.

Over the past four years, over 500 Missouri high school students have participated in the challenge. Every student learns about the importance of cybersecurity as well as best practices for protecting data in our hyper-connected world. Many students realize during this event that they are a good fit for a career in cybersecurity.

To address the cybersecurity talent shortage, the Missouri Research and Education Network (MOREnet) created the Missouri High School Cybersecurity Challenge in 2019. The mission was to encourage students to learn about cybersecurity in the real world while developing skills needed for future careers in the field.

Four years later, the competition has become an annual event. According to MOREnet's executive director, Natasha Angell, "We hope that introducing Missouri students to cybersecurity through game-like exercises will spark interest in students to explore a career in the cybersecurity field. Through trial and error, students are learning techniques bad actors could use to gain access to sensitive information. With this knowledge, they can work toward keeping networks and valuable personal information safe."

In addition, by participating in the challenge, students gain a better understanding of all the

job opportunities related to cybersecurity. The challenge is designed with two rounds. The first round is an online, capture the flag (CTF) event that tests students' problem-solving skills, research abilities and understanding of cybersecurity concepts. The top ten teams advance to the in-person finals where students use real-world security tools in a virtual environment made up of Windows machines, Linux machines and servers. They are given challenges around exploitations, reconnaissance and network scanning, programming, password cracking and auditing, reverse engineering, cryptography, and trivia.

Once the final round begins, students are presented with a Jeopardy style board. Each category has multiple challenges with varying point levels. Students are free to choose which challenges they want to attempt, completing them in whatever order they prefer. Once a challenge is solved, points are awarded and tracked on the scoreboard.

Over the years, as a direct result of participating in the Missouri High School Cybersecurity Challenge, a handful of students have earned scholarships to Missouri colleges to major in cybersecurity. While participating in the event, these students were either awarded the scholarship as a prize or were connected to scholarship opportunities through university recruiters in attendance.

One participating student commented, "This competition was a lot of fun, and extremely challenging! I loved the opportunity to crack a Windows computer. Overall, this was an amazing competition."

"My students loved the challenges and got into it more than I have ever seen a group engage in something," shared David Biesenthal, the coach from Fort Zumwalt East High School.

The Missouri Research and Education Network (MOREnet) is both a data network as well as a human network. It provides Internet connectivity, access to Internet2, technical services, resources and support, as well as technical training to Missouri's public sector entities, including K-12 schools, colleges and universities, public libraries, health care, government and other affiliated organizations. www.more.net

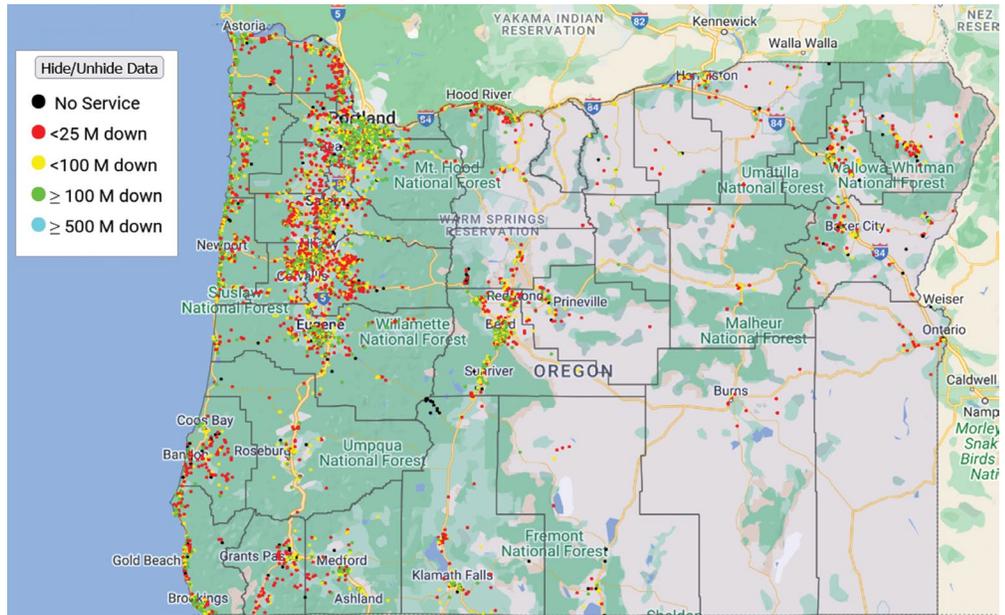
Supporting digital equity for all Oregon communities

Since broadband plays a central role in nearly every aspect of daily life, Link Oregon recognizes the challenge communities face when their residents cannot connect reliably due to cost or service availability. Having completed its fourth year of operation, Link Oregon is pursuing several programs to support digital equity and inclusion across Oregon to help address this challenge.

Faster Internet Oregon

Experts in Oregon are concerned that inaccurate data may distort how funds from the generational federal infrastructure investments are allocated. Oregon's Economic Development Districts and the Broadband Action Teams (BATs) recognized the need for better local data on the level of Internet service that Oregonians actually receive. They connected with Link Oregon, and together we formed a statewide coalition of nonprofit and public organizations—Education Service Districts, SpeedUpAmerica, Onward Eugene, and others—to deploy a Internet speed test and mapping initiative, Faster Internet Oregon (FIO).

Launched last May, FIO includes a home Internet speed test and availability survey (in [English](#) and [Spanish](#)), which also allows residents with no Internet service at home to report that information. To date, we've mapped nearly 10,000 responses from unique locations statewide; the long-term goal of 160,000 represents roughly 10% of Oregon households. A [public-facing version of the FIO map](#), offsetting household locations to protect respondent privacy, displays the aggregate data.



FIO has been endorsed by Oregon State University (OSU) Extension, the Oregon Public Utilities Commission, KGW Television, and a growing number of broadband savvy organizations across Oregon.

Oregon Tribal Broadband Summits & Oregon Tribal Broadband Boot Camp

To support Oregon's nine federally recognized Tribes as they pursue new forms of federal infrastructure funding, Link Oregon has co-hosted three Oregon Tribal Broadband Summits (OTBS) over the past 13 months and is planning another Summit in 2023. [OTBS I](#), held in December 2021, and [OTBS II](#) and [OTBS III](#), held in March and April of 2022, were co-sponsored with the Affiliated Tribes of Northwest Indians Economic Development Corporation, the Burns Paiute Tribe, the Confederated Tribes of Siletz Indians, the Confederated Tribes of the Umatilla Indian Reservation, the Klamath Tribes, the Network Startup Resource Center (NSRC), OSU Division of Extension and Engagement and University Information &

Technology, the University of Oregon (UO) Office of the President, and the Oregon Broadband Office. ([Click to view full poster.](#))

In addition, Link Oregon co-sponsored the first [Tribal Broadband Boot Camp](#) in Oregon, held in Eugene in August 2022. Event leaders Matt Rantanen (Southern California Tribal Chairman's Association and CENIC) and Chris Mitchell (Institute for Local Self-Reliance) previously hosted similar camps in California. Tribal participants came from across Oregon and neighboring states to learn networking fundamentals and to gain hands-on experience with broadband technologies. Support was provided by the NSRC and Jason Younker, Chief of the Coquille Tribe and the UO's Assistant Vice President and Presidential Advisor on Sovereignty and Government-to-Government Relations.

Link Oregon continues to build on its strong commitment to digital equity and inclusion by working in partnership with similarly focused public and non-profit organizations. Link Oregon is a federally tax-exempt 501(c)(3) Oregon non-profit organization, a consortium of the State of Oregon through its Enterprise Information Services and the state's four research universities: Oregon State University, OHSU, Portland State University, and the University of Oregon. We provide high-speed, resilient, middle-mile fiber broadband connectivity to our state's public and non-profit sectors. www.linkoregon.org

Southern Crossroads (SoX) to help expand research at HBCUs

Georgia Tech’s Office of Information Technology (OIT) was recently awarded a \$995,550 grant from the National Science Foundation (NSF) to enable network and research enhancements for nearby historically black colleges and universities (HBCUs). Southern Crossroads (SoX) is partnered with Georgia Tech to connect these universities, colleges, and a library to the national research and education (R&E) backbone.

The NSF grant will fund at 100 percent a two-year project titled *Promoting Research and Education at Small Colleges in the Atlanta University Center and at Tuskegee University Through Network Architecture Enhancements*. Through this project, Georgia Tech, in collaboration with Southern Crossroads (SoX), will extend advanced networking services and cyberinfrastructure

access to Clark Atlanta University, Morehouse School of Medicine, Spelman College, Morehouse College, and Tuskegee University. The project includes a robust training and support program to ensure proper adoption and success for researchers and educators at participating institutions. The Atlanta University Consortium (AUC) Woodruff Library will benefit from network upgrades through the grant as well.

Cas D’Angelo, Georgia Tech president of SoX and Georgia Tech OIT associate vice president and chief operating officer, serves as principal investigator for the project.

“We started preparing a compelling proposal package that would demonstrate the need and value to the research community in early 2021,” said D’Angelo. “For years,

we have been working to get institutions within the AUC — the oldest and largest contiguous consortium of African American higher education institutions in the U.S. — connected to the SoX regional network, given their proximity. This project provides us with that opportunity.”

This project will also lay the groundwork for expansion to other HBCUs.

The NSF has solicited proposals to support traditionally underserved institutions of higher education through partnerships with regional entities that have experience in high-performance research and education networking like Georgia Tech. Special emphasis has been placed on HBCUs, tribal colleges and universities, and other traditionally minority-serving institutions.



Robert W Woodruff Library, Atlanta University Center

Southern Crossroads (SoX), for over 25 years, has been serving non-profit education, research, and government entities in the Southeastern United States. SoX implements reliable cyberinfrastructure, high-performance global connectivity, and services within its region. SoX is committed to enabling collaboration and partnerships for its community, most recently with an emphasis on under-served and under-resourced institutions. www.sox.net

CENIC California Middle Mile Broadband Initiative: GoldenStateNet progress



When California’s Legislature and Governor launched the visionary initiative to provide “**Broadband for All**” in July of 2021, few fully appreciated the complexity and range of relationships that would be necessary to operationalize that vision. Among the few, was the engineering team responsible for building and expanding California’s high-performance research and education (R&E) network run by The Corporation for Education Network Initiatives in California (CENIC).

“We knew what was required to develop trust relationships based on our ever-expanding network from top higher ed institutions, to K-12 schools, libraries, health care institutions, tribal nations, scientific and cultural institutions,” said Louis Fox, CENIC ceo. “It presents a formidable challenge

based organizations, CENIC California Middle Mile Broadband Initiative—doing business as [GoldenStateNet \(GSN\)](#) – has driven significant progress in its first full year of operations.

“CENIC was founded in 1997 to serve California’s top R&E universities,” said Fox. “But always there was this idea that we could serve needs beyond those we imagined at the time. And today, the drive for greater equity in California is possible thanks to CENIC’s networks.”

Working with the California Department of Technology (CDT), California Department of Transportation (CalTrans), California Public Utilities Commission (CPUC), plus vendors and ISPs, GoldenStateNet has brought its network engineering and operational

to design, build, and operate a middle mile network of nearly 10,000 miles to support equitable access to previously underserved communities and households in California.”

It turns out that the human network of relationships CENIC built over 25 years was precisely what was needed to enable significant progress in the project’s first year. By leveraging key partnerships with private sector companies, broadband consortia, metropolitan and rural planning organizations, state, community, and tribal

knowledge to bear on developing key infrastructure and service architecture plans to support the middle mile project.

The first year of focused work has successfully determined how the network can reach the 20 percent of Californians who are un- or underserved. By November 2021, 18 projects were defined and within six months, the first fiber and materials contracts were signed with initial construction proposals received three months later. By the end of last year, CDT had more than 7,000 miles of construction contracts out to bid while convening and consulting with a broad range of stakeholder groups. CENIC and GSN have nearly completed the “System Level Design” for the network, including the backbone, regional routes, over 180 facilities for colocation and regeneration, and equipment specifications (see map).

GoldenStateNet is now developing the business model for ensuring the sustainability of the middle mile network, having completed its “Go-to-Market Plan” for the new network. The team is also developing the RFP for Fiber and Inventory Management systems.

CENIC has developed a range of [informational overviews](#) to educate and engage partners and communities in the progress and process of this initiative. “It has been remarkable to see how collaborative these diverse communities in California can be when we’re inspired by a visionary goal,” said Fox.

GoldenStateNet, funded through California State Legislature and Governor Gavin Newsom’s “Broadband For All” legislation, was selected by the California Department of Technology (CDT) as its Third Party Administrator (TPA) for the state’s 3.25 billion dollar project. GoldenStateNet is managing the development, acquisition, construction, maintenance, and operation of a statewide open-access, middle-mile, broadband network. GoldenStateNet is a Limited Liability Corporation managed by CENIC. GoldenStateNet leverages CENIC’s key partnerships including broadband consortia, metropolitan and rural planning organizations, community-based organizations, state, tribal, and private sector organizations. www.goldenstatenet.org

Planting seeds across Arizona to harvest opportunity

At Sun Corridor Network (SCN), we could measure a year in Gbps connections, but we prefer to do it in human connection. We spent 2022 engaged in long-range strategic planning for social impact in communities across Arizona. In our 10th anniversary year, our work has centered on expanding access to education and bolstering Arizona and the US's competitiveness in smart science and engineering. At SCN, we know that large-scale progress often happens over decades, not days.

Pilot program plants seeds for scalable growth

As many as 1 million Arizonans lack internet access, including [335,000+ K-12 students](#). At SCN, we are developing sustainable solutions to address this digital divide.

Along with Arizona State University, we partnered with Phoenix's Isaac School District on a pilot program in a neighboring mobile home park to extend the high-speed internet connection to the homes of some students. All participating households are able to successfully connect to broadband via rooftop antennas.

By developing a new 10 gigabit network, we're providing internet speeds ten times faster than their traditional ethernet connection -- more than enough for completing homework and other activities online. The pilot serves as a model for

providing reliable connectivity to under-connected households throughout Maricopa County and beyond.

Smarter agriculture, expanded access to education

With a climate that allows crop growth in winter months, Yuma, Arizona is lovingly known as "America's winter salad bowl." While we all depend on Yuma's food production, current and future water shortages in the region are concerning for crop yield and growth.

Precision agriculture, or the use of technology to improve crop yields, can help mitigate the effects of drought and climate change. To help enable this vital agricultural innovation, we led a planning effort in collaboration with Yuma's agricultural, research and academic communities.

The precision agriculture team hopes to implement a shared, local research cyberinfrastructure, benefiting K-12 and college STEM programs, industry and the surrounding community. With SCN's assistance in identifying fiber routes, Yuma County has already approved a plan to build county-owned, middle mile fiber infrastructure.

Engaging community colleges in vital science exploration

As the US struggles to innovate in STEM

fields at the community college and high school levels, we are investing in strategies to improve engagement in science and engineering curriculum.

Working with Northern Arizona University, we're providing local community colleges with high-quality, next-generation science curriculum that integrates smart agriculture knowledge and skills. As part of this work, SCN will connect participating community college programs to an internet fast lane that enables enhanced access and opportunities for science faculty and students.

A vibrant time ahead – \$34.6 million investment in transformation

The Maricopa County Board of Supervisors recently [voted unanimously](#) to provide Arizona State University (ASU), SCN and the Digital Equity Institute with \$34.6 million to advance local broadband access. The four-year program includes high-speed, reliable connectivity, community support and the distribution of internet-connected devices to those in need.

"With the research and technology expertise from Sun Corridor Network, we've been able to fast-track vital digital inclusion infrastructure across the region," shared ASU chief information officer Lev Gonick. "For 2023, we aim to empower more people across The Valley with equal opportunities to thrive."



Yuma, Arizona

Sun Corridor Network (SCN), established in 2013, is Arizona's Research and Education Network. It currently serves the three state universities and other educational institutions across the state of Arizona. SCN's mission is to connect every school, library, community anchor, healthcare organization, and public service agency in the state of Arizona with secure, high-capacity, responsive, available, and affordable broadband services. www.suncorridor.org

Expanding the role of the REN in Nevada: kicking off research and education engineering

As research and education technology practices evolve, the need for regional coordination, engineering, and engagement across institutions is changing rapidly. The Nevada System of Higher Education's (NSHE) NevadaNet established a new mission area in 2022-23 to respond to these changes: Research and Education Engineering.

"We repurposed two vacant positions associated with legacy systems management into the Research Engineering team," says NSHE CIO and NSHE System Computing Services (SCS) Executive Director Anne Milkovich. "This allowed us to pivot part of the organization towards serving advanced technology use for research and education in Nevada."

Modern challenges for higher education in the technology space are stacking up: remote computing access and hybrid/remote teaching are now necessary capabilities, set against the 'perfect storm' of high IT personnel turnover, cybersecurity threats, and volatile budgets.

"In order to facilitate research technology growth in the state, leverage and support existing infrastructures like the Nevada Seismology, Wildfire, and Climate Network, and pilot key services at scale, we really needed a dedicated team at the System level to start engaging," comments NSHE Director of Infrastructure Services and NevadaNet, Kirk Fitzgerald.

This new team is focusing on several objectives: (1) facilitate surveys and assessments of research computing and data (RCD) capabilities at Nevada institutions; (2) assist institutional leadership in planning and development of RCD programs and teams; (3) lead and contribute to statewide technology infrastructure development for



research, teaching, and science-based public service; (4) support and sustain key science-based natural hazards data networks; and (5) represent Nevada in regional and national RCD communities and initiatives.

"Engineering contributions made by this team to high-performance computing (HPC) and cybersecurity education projects in Nevada are already paying off," says Principal Research Engineer Scotty Strachan. "NSHE is actively enabling cybersecurity classes between the Universities and K-12 school districts in Reno and Las Vegas."

One of the early project efforts by the NevadaNet Research Engineering team is evolving the architecture for the Nevada Cyber Range, an NSF-funded cybersecurity training initiative led by faculty members at the University of Nevada, Reno.

"This work applies not just to the Cyber Range but also to any research computing

system in the state," states NSHE Senior Research Engineer Zachary Newell, who is the primary architect behind the Nevada Cyber Range, "Besides delivering interactive cybersecurity education, this project gives us the opportunity to pilot cutting-edge 'Teaching DMZ' zero-trust networks that integrate school-district-compliant content filtering for student development environments."

Infrastructure and services developed by the NSHE Research and Education Engineering team will remain in an ad-hoc, best-effort posture until project elements are viewed as stable solutions that can be deployed at scale. The long-term objective is to leverage this research and development work for future enterprise solutions for the state and higher education. This mission area is an exciting expansion of NSHE SCS and NevadaNet operations, and is providing immediate value for researchers and technology educators across the state's higher-ed System.

Nevada's System of Higher Education (NSHE) is a superpower. The connected higher education system in Nevada allows all institutions to benefit from each other. When one of our great eight institutions in Nevada succeeds, it translates into success for all of the institutions. NSHE's institutions are reflective of the state's population and are committed to supporting the state population to meet the current and future social, economic and workforce needs of a highly diverse state. Five of NSHE's colleges and universities are federally recognized Hispanic or Minority serving institutions. www.nshe.nevada.edu

Navajo Tech University joins and enhances the broader research and education community

In December 2022, Navajo Tech University (NTU), improved network access by connecting at 100 Gbps to the Front Range GigaPoP (FRGP) with the use of a Western Regional Network (WRN) connection. NTU is an active contributor to regional and tribal research and currently uses 1 Gbps of FRGP services. This is a great achievement by the NTU, FRGP, and WRN teams..

In 2018, NTU received a National Science Foundation (NSF) CC* award to both improve scientific research on campus and build new technology collaborations within the Navajo Nation (Arizona, Utah, and New Mexico) through the FRGP. The award includes expanding campus external connectivity to: other tribal colleges and universities, the FRGP, Internet2, ESnet, and the broader R&E community. Led by Jason Arviso (Principal Investigator), Jared Ribble (co-PI), Marla Meehl, FRGP (co-PI), and John Hernandez, FRGP (co-PI), the project aims to introduce performance measurement of networks on campus and to other tribal institutions. NTU will further expand their internet access to other tribal colleges, Navajo Nation organizations, and the Hogan (ITTH) project.

The impact of the pandemic on and off the Navajo Nation caused various delays, including in such areas as project implementation, supply chain delivery, personnel engagement, and equipment and services acquisition. NTU built a Phase I dedicated science network between the campus Advanced Manufacturing facility and the FRGP for a minimum of 1 Gbps of

science specific service. Additional locations on the NTU campus will be added later in the year..

In November 2022, NTU successfully coordinated a three-day technical planning and implementation event on campus to deploy the Science DMZ for the project. A Science DMZ is a portion of the network, usually built at or near a campus or laboratory's local network perimeter that creates a secure environment that is tailored to the needs of high performance science applications, including high-volume bulk data transfer, remote experiment control, and data visualization.

Led by Jared Ribble, the implementation team included engineering leadership from the FRGP, Northern Arizona University (NAU), and direct assistance from industry partner, CIENA. FRGP provided engineering assistance from John Hernandez, Carlos Rojas, and Scot Colburn with support from Kevin Adams and Devon Brookshire both from NAU, and from Brady Bell from CIENA. The engineering team completed upgrades to campus networking, added equipment to ensure large file transfer from NTU to FRGP/Internet2, added network performance nodes or systems, and they expanded NTU's external connection to the FRGP from 10 Gbps to up to 100 Gbps through WRN. Deployment of the new science-oriented network will enable faculty

to work with other faculty and researchers throughout the country.

NTU also received NSF funding to work with other tribal colleges in Arizona and New Mexico. The implementation workshop included representatives from Dine College (DC) in Tsaile, AZ and Tohono O'odham Community College (TOCC) in Sells, AZ. Tribal consortium engineering and technical assistance from Kevin Mitchell (DC) and Aaron Bates (TOCC) was part of the implementation workshop in alignment with NTU's second NSF Award, "CC* Regional: Tribal Consortium Research Network," Award #1925689. NTU will facilitate the deployment of science networks at TOCC, Dine College, and at Ashiwi College (Zuni, NM) later in the year.

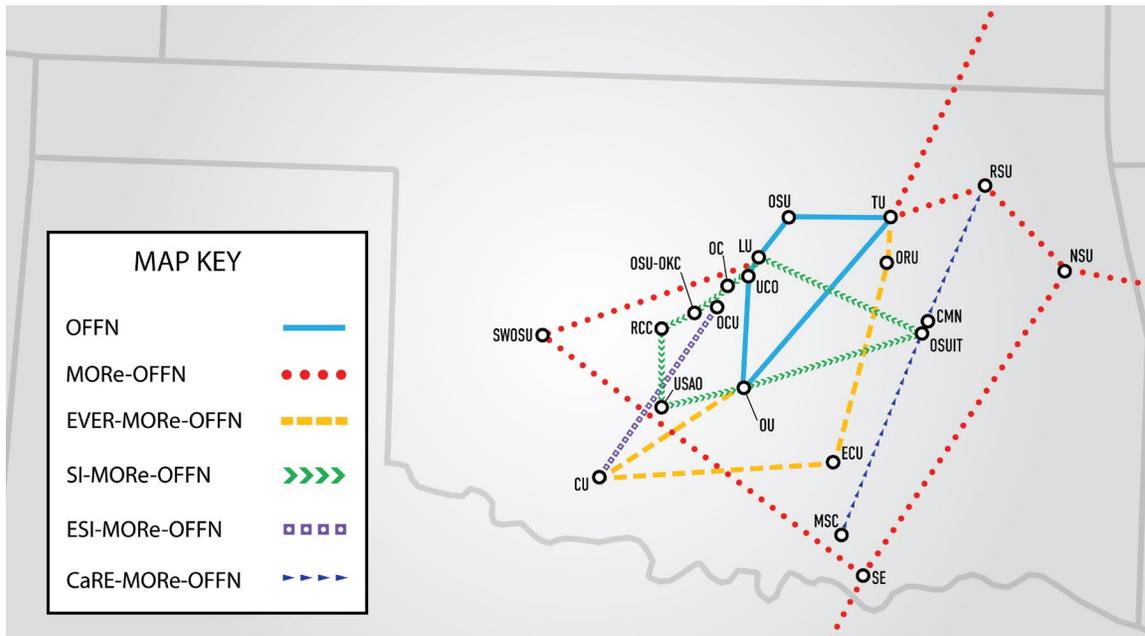
NTU is hosting an NSF-supported workshop in late January 2023. Presentations will be made by experts from across the country including the FRGP, NAU, Internet2, Globus, the University of South Carolina, and Sun Corridor Network.



Navajo Technical University (NTU), like all tribal colleges and universities, grew out of a prayer in the 1960s that envisioned all tribes moving toward self-determination by expressing their sovereignty and establishing their own institutions of higher education. It was as a result of this movement that NTU began as the Navajo Skill Center in 1979 to meet the immediate needs of an unemployed population on the Navajo Nation. Today, NTU is one of the premier institutions of higher education in the nation, providing a unique balance between science and technology and culture and tradition. Much of what guides NTU's success is our mission and our identity rooted in the Diné Philosophy of Education. www.navajotech.edu

Front Range GigaPOP (FRGP), since 1999, has advanced the research and educational goals of government, nonprofit, research, and educational participants in the region by establishing and maintaining a unique multi-state network infrastructure. The FRGP is owned and controlled by the FRGP participant research and education community. www.frgp.net

OFFN expands research computing to small campuses in Oklahoma



In May 2022, OneNet received a third award. The Campus Research & Education Multiple Organization Regional OneOklahoma Friction Free Network connects Murray State College and College of the Muscogee Nation to the network and upgrades connectivity for Oklahoma State University Institute of Technology and Rogers State University. The OneNet team is currently procuring fiber builds to three of these institutions and ordering the network equipment. These connections will bring the total number of institutions connected to OFFN to 21.

Through a series of National Science Foundation Campus Cyberinfrastructure (CC*) awards, OneNet is expanding research computing to small colleges and universities across the state of Oklahoma. Utilizing \$1.5 million in grant funding, OneNet is connecting nine campuses to Oklahoma’s dedicated research network, the OneOklahoma Friction Free Network (OFFN).

OFFN utilizes OneNet’s network infrastructure and provides 10 to 100 Gbps connectivity to give Oklahoma’s higher education institutions a dedicated alternative route to traditional internet pathways. Among other advantages, this allows researchers to access supercomputing resources across the state and allows for faster data transfer.

OneNet received its first CC* award in July 2020. The Small Institution Multiple Organization Regional OneOklahoma Friction Free Network award connected Oklahoma State University Institute of Technology, Oklahoma State University-Oklahoma City, Redlands Community

College, Oklahoma Christian University (OC) and the University of Science and Arts of Oklahoma to the network.

Researchers and students are utilizing OFFN for both science and learning. Students in OC’s big data management course put the new connection to work when they used the University of Oklahoma’s supercomputing cluster, Schooner, to perform a class assignment that gave them experience working with large data sets. Science & Arts utilized several universities’ supercomputers to conduct chemistry research by transferring research data on their OFFN connection. Students presented the results of their research at the 2022 Oklahoma Research Day Symposium.

NSF granted OneNet’s second award in September 2021. The Extended Small Institution Multiple Organization Regional OneOklahoma Friction Free Network connects Oklahoma City University and the Cameron University FISTA campus to the network. Fiber builds are currently underway to both of these campuses, so that OFFN can provide high-speed connectivity to both sites.

“As Oklahoma’s partner in research and education, OneNet is utilizing NSF CC* funding to increase research computing capabilities for our state’s higher education campuses,” said Brian Burkart, OneNet’s chief technology officer and the principal investigator for the grant awards. “Our goal is to engage faculty and students in scientific discovery and innovation through OFFN’s data transfer capabilities and high-speed connections to supercomputing resources, instruments and datasets. These investments not only foster new discoveries but enhance educational opportunities for students in our state.”

OneNet plans to continue applying to the NSF CC* program to expand OFFN’s reach. Burkart and the OneNet team are working on a new proposal to connect four additional colleges and universities to the network.

OneNet, as a division of the Oklahoma State Regents for Higher Education, has a mission to advance technology across Oklahoma. OneNet serves colleges and universities, research centers and laboratories, public and private schools, libraries, tribal organizations, hospitals and clinics, and local, state and federal governments. www.OneNet.net

UETN strides forward in education and telehealth throughout Utah

Leading innovation with eduroam2go

The Utah Education and Telehealth Network (UETN) is advancing an initiative that may give Utah students, faculty and staff even more places they can work while still being able to securely access their school network. Through eduroam, an Internet2 program, members of participating organizations can use their school credentials from any eduroam hotspot in the world. UETN is testing eduroam2go, a concept that transforms retired equipment into devices that make it easier for host sites like schools, libraries, athletic fields and museums to activate eduroam at their locations. The pilot project has garnered interest from eduroam service organizations across the nation. “Thanks to UETN’s leadership in bringing eduroam to our state, I can just show up at any of our 42 school districts, open my computer, and get to work confident that I’ll have connectivity,” said Ed Tech Specialist Brandon Harrison of Central Utah Educational Services.

Achieving 46 miles of fiber

Learners and patients in San Juan County – part of the remote Four-Corners Area – are now connected to the world via 46 miles of fiber optic cable. The milestone was reached through collaboration with Tribal Government officials, the Utah Department of Transportation, Emery Telcom and area stakeholders. Connecting rural area schools and healthcare clinics to the network fulfills a key objective of UETN’s mission and empowers local telecommunication providers to develop capacity that will benefit small businesses and homes in the area.

Expanding capacity

UETN is an innovation leader among state and regional broadband networks, with two fiber optic backbone circuits now upgraded to 400 gigabits per second, along with another 400 gigabits per second circuit connected to Internet2. The increased capacity helps the network continue to fulfill the state role providing education and telehealth infrastructure as demand rises.

Connecting for civic engagement

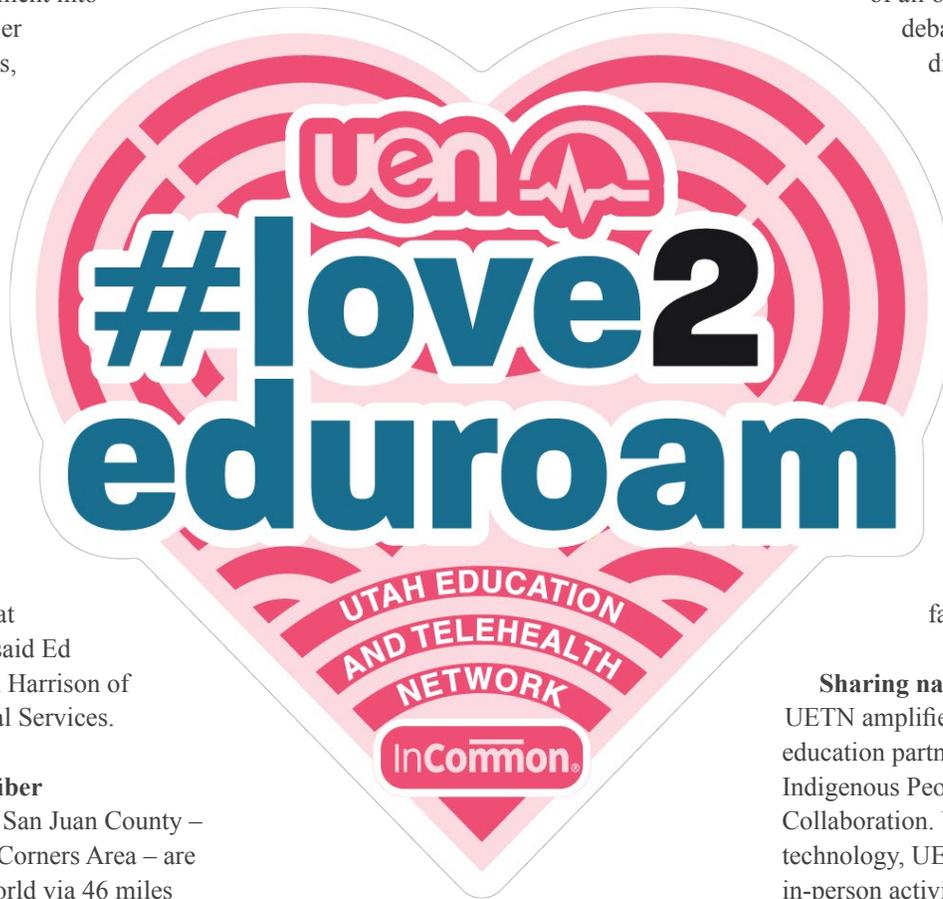
Audiences throughout the state watched candidates in the 2022 elections discuss key issues thanks to UETN’s collaboration with the non-partisan Utah Debate Commission and partners. UETN infrastructure and support carried the high-definition video of five debates from the college campuses hosting the events to the Eccles Broadcast Center for distribution to broadcast partners. “UETN was instrumental in the distribution of all of our 2022 general election debates,” according to executive director, Erik Nielsen, of the Utah Debate Commission.

Boosting telehealth speeds

More than 80% of UETN’s community-based telehealth sites now run on circuits of one gigabyte per second or greater with updates for security and efficiency. This means that large data applications such as radiology images can transfer for off-site evaluation up to 10 times faster.

Sharing native stories

UETN amplified the work of higher education partners through the 2022 Indigenous Peoples Day College Collaboration. Using distance education technology, UETN unified virtual, hybrid and in-person activities hosted by eight colleges into a statewide experience celebrating Native culture. More than 300 people participated. “UETN made it possible for us to share our panel discussions with a broader audience, increasing awareness of a vital public topic that seems to be forgotten by many,” said Fernando Montaña, chief diversity officer, Snow College.



The Utah Education and Telehealth Network (UETN) provides robust infrastructure, applications and support for education and healthcare, whether it’s for a teacher in Tooele or a physician in Fillmore, a patient in Parowan or a student in St. George, the Utah Education and Telehealth Network (UETN) provides robust infrastructure, applications and support for education and healthcare. UETN connects all Utah school districts, schools and higher education institutions and serves hospitals, clinics, and health departments in urban, suburban and rural areas of the state.

www.uetn.org

The Great Plains Network (GPN) contributes to the National Research Platform

The Great Plains Network Research Platform (GPN-RP) has made tremendous strides since its introduction in a 2019 Quilt Circle article, and this progress has also contributed to its participation within the National Research Platform (NRP). The NRP evolved from the Pacific Research Platform (PRP) (NSF award #1541349, CC*DNI DIBBs: The Pacific Research Platform).

The GPN-RP hardware started with just eleven compute nodes in 2018, but has grown through the generous donations of hardware through grants, vendors, and the purchase of additional resources by participating campuses. The GPN-RP community grew and is proud to contribute compute cycles to the NRP cluster, which advances research and education in the region.

The NRP cluster resources are used across the region for a variety of purposes: intense AI model development, teaching Software Carpentries workshops, and computer science education. The wide range of applications highlights the versatility of the platforms and their potential for further expansion as new use cases emerge.

Dr. Alex Hurt of the University of Missouri used the NRP compute nodes to perform overhead object detection on three different Remote Sensing datasets: RarePlanes, DOTA, and XView. DOTA and XView are general object detection datasets, while RarePlanes is specifically for aircraft detection. This analysis would have taken 76 days using local resources, but was completed in about 14 days on the NRP, demonstrating the power of the NRP to accelerate research.

The NRP hosts JupyterLab, which provides a programming environment through a website. This means that anyone learning to code can easily access and start practicing right away, without the need to install software on their local machine. Members of the Carpentries Foundation use them to teach programming in Python, R and other languages, making coding accessible for everyone. Each university can host their own branded space on the NRP, and when students connect, they can use a university identity.

Dr. Jeremy Everett of Southwestern Oklahoma State University said, “The web-based system greatly lowers the threshold

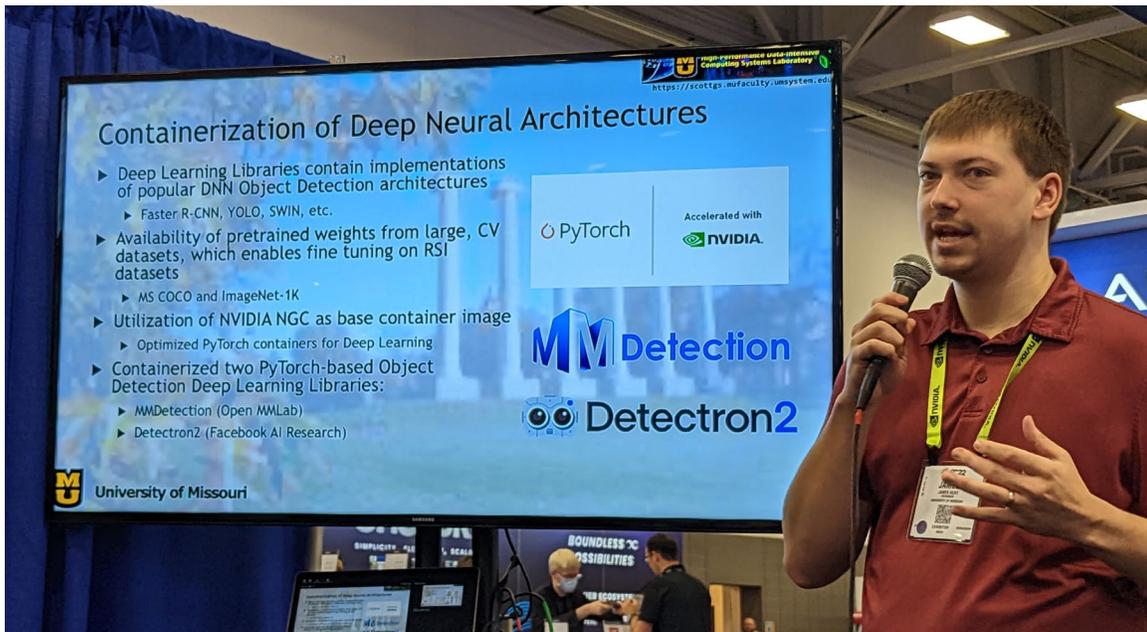
for getting started with programming, and it lets students with Chromebooks and iPads start...a Jupyter notebook means that even students with a Raspberry Pi can log in and run a bigger job in a short time, which is amazing.”

Installing Jupyter for universities is an ongoing process. The University of Oklahoma provided detailed instructions for installing it for their university and Kate Adams of GPN submitted updates to make these instructions more widely applicable. This demonstrates the collaborative and supportive nature of the GPN and NRP.

The NRP also provides an environment for computer science education, enabling smaller universities to teach concepts in high-performance computing without the need to install their own clusters. The cluster generally provides fantastic opportunities for students.

Three recent National Science Foundation grants across the Great Plains Network community highlight the continued support for the NRP: CCRI: ABR: Cognitive

Hardware and Software Ecosystem Community Infrastructure (CHASE-CI) (NSF award #2100237), Category II: A Prototype National Research Platform (NSF award #2112167), and CCRI: ENS: Cognitive Hardware and Software Ecosystem Community Infrastructure (CHASE-CI) (NSF award #2120019).



The Great Plains Network (GPN) is a non-profit consortium aggregating networks through GigaPoP connections while advocating research on behalf of universities and community innovators across the Midwest and Great Plains who seek collaboration, cyberinfrastructure, and support for big data and big ideas, at the speed of the modern Internet.
www.greatplains.net

The GPS for the journey: LEARN's strategic planning initiative



(strengths, weaknesses, opportunities, and threats) to identify key themes. Each participant used sticky notes to select their most important themes and ideas. As each sticky note was placed on the boards, common themes began to emerge that would make their way to the strategic plan. Dr. Hites reflects, “The level of engagement was spectacular. By the time we got to the point where we’re talking about priorities and goals and objectives, I think everybody in the room got to speak.”

Over the last two years of unprecedented change in the wake of the COVID-19 pandemic, and on the eve of the next generation network project, LEARN recognized a critical need to gather its stakeholders and determine a clear organizational strategy moving forward. LEARN’s president and chief executive officer, Akbar Kara, explains, “When the pandemic started to subside in the fall of 2021, we knew we needed to update our strategic plan. We’re the only organization in Texas that brings all higher education together at a statewide scale, and we want to sustain that. The strategic plan gives us guidance on keeping all of those things healthy.”

A key goal was to ensure that the strategic planning process was as inclusive as possible. To capture the unique perspectives of its diverse membership, LEARN chose regional in-person meetings as the primary way to gather feedback from stakeholders. This

allowed members to assemble closer to home in a more intimate setting as well as the opportunity to speak about more region or institution-specific concerns. Seventy-one participants, including board members, affiliates, and LEARN staff, attended four regional meetings throughout Texas in Dallas, Lubbock, Houston, and Austin.

LEARN looked to past board chair and chief information officer for Southern Methodist University, Dr. Michael Hites, to spearhead the strategic planning process. LEARN also engaged consultant and former Pennsylvania REN CEO Wendy Huntoon to develop a report outlining the current REN and higher education landscape at sister networks across the country. Dr. Hites brought a deep understanding of two integral concepts – strategic planning best practices and a comprehensive perspective of the higher education and research and education network landscape. Dr. Hites facilitated a guided discussion and SWOT analysis

As the staff and the board reviewed the feedback, they quickly found that the main themes fit organically within existing functional areas. “This process provided us a beacon with clear and concise guiding principles for the direction we’re headed moving forward,” reflects Kerry Mobley, LEARN’s treasurer & chief financial officer. At its second quarter board meeting in 2022, the board approved the strategic plan. Kara shares, “Now we have the GPS and they have given us coordinates and are saying, ‘You’ve gotta get there.’ Our road conditions might change and there may be detours or delays along the way. We will adjust as needed based on what’s in front of our windshield, but ultimately, we know we’re going North. That’s what I’m excited about – that we have clarity and a very focused direction for the journey ahead.”

Lonestar Education and Research Network (LEARN) is a consortium of 42 organizations throughout Texas that includes institutions of higher education, community colleges, and K-12 public schools. Organized as a 501(c)(3), LEARN connects its members and over 300 affiliated organizations to statewide resources through high-performance optical and IP network services. www.tx-learn.org

Big brains and weird infrastructure: MCNC's innovation playbook bridges old IT and new IT to bring next IT to NC

North Carolina has a rich history of innovation: First in Flight, Pepsi, and Vicks VapoRub, just to name a few. These embodiments of modern life helped form the foundation of an innovative state actively committed to developing new ideas, pushing boundaries, and solving problems.

MCNC is also an important NC innovation – a relatively unknown story of a niche organization maturing to a cornerstone of technology advancement that benefits so many each day. MCNC also was one of the first organizations in the country to create a statewide non-profit Research and Education Network, or REN.

About 10.5 million people call North Carolina home, living and working in communities ranging from large metros to rural towns stretching from the Atlantic Ocean to the Appalachian Mountains. Despite many geographic and cost barriers, MCNC has been able to expand its network over the past 40 years to more than 4,000 miles in virtually all 100 counties of the state – with plans to add more soon. But, MCNC is and has always been more than just a network provider, and herein is where their innovation truly exists.

MCNC aims to make North Carolina the most connected state in the nation by making secure, high-speed Internet and technology services more accessible to everyone. It supports North Carolina's entire technology ecosystem of high-functioning Internet in order to successfully drive digital equity to



the unserved and underserved. those who might get left behind and/or are simply forgotten.

Quantum computing and networking, application development and integration, and modern data fit neatly into MCNC's current innovation model. MCNC Senior Director of Innovation Phil Emer regularly ponders how MCNC can dive deeper. He explains that connecting the components of a modern IT infrastructure requires fast, efficient and customizable networking, which also requires experienced engineering and the wisdom of knowing the art of the possible.

“This is operational innovation, and this is where MCNC thrives,” adds Emer. This approach is a key pillar to the organization's clear mission for North Carolina. That mission sees the important emerging work of tomorrow, with projects such as NC Share, BEAD grants, Internet

for All, Vital Cyber, Modern Data, A.I., Quantum, and more. This fall, MCNC will host its annual MCNC Community Day celebration with its event theme: A New Wave of Innovation.

While MCNC is a trusted partner in North Carolina and nationwide, there is still room to bolster relationships, expand connectivity, increase innovation, and improve systems. Innovation requires big thinking, guts, passion, and know-how. MCNC is good at this, and RENs across the country are good at this. Let's continue to be there for each other, be that unique option, and help our clients continue to do great things.

MCNC is a non-profit, client-focused technology organization. Founded in 1980, MCNC owns and operates NCREN, one of America's longest-running regional research and education networks. With 40 years of innovation, MCNC continues to provide high-performance services for education, research, libraries, health care, public safety, and other community anchor institutions throughout North Carolina. www.mcnc.org

ARE-ON cuts costs for members by leveraging national programs

The Arkansas Research and Education Optical Network (ARE-ON) has been fulfilling its mission to deliver value to our members by leveraging national opportunities to control costs for our member's IT budgets. If that was too much marketing speak, here's what we actually did: in 2021, we began providing a new managed border router (MBR) service directly to our members. This service not only reduced the personnel time spent to connect to the ARE-ON Network, but also the costs of the equipment required.

When Internet2 (I2) completed its equipment transition to the Next Generation Infrastructure (NGI) routing platform, a pricing deal was established to allow a portfolio of networking products to be purchased by the state networks and other I2 partners. ARE-ON recognized the opportunity to leverage this equipment pricing for our members, not just as a purchasing vehicle, but also as the core of

a managed service business model. With resource-constrained community colleges facing talent shortages, we combined equipment leasing, technical installation, and expert support by ARE-ON engineers into a managed border router service package. ARE-ON pursued cutting-edge, yet cost-effective routing hardware to install for our member institutions. As of early 2023, there are more than 20 installed managed border routers across our member base.

On top of the equipment services, ARE-ON added the support of federal funding programs to round out the offering. There is a long-standing partnership between ARE-ON and the University of Arkansas for Medical Sciences (UAMS) Institute for Digital Health Initiatives to participate in the Universal Service Administrative Company (USAC) Rural Healthcare Fund Program. This partnership enables our members to receive reimbursements for the cost of

broadband and other network services that support their healthcare education and delivery programs. In 2022, USAC approved reimbursements for all our members participating in the MBR service, with up to 65% of the annual costs returned to the institutions.

Our members participating in this MBR service can now reduce their capital costs by outsourcing the service to ARE-ON as a trusted partner. Plus, our Arkansas members are receiving discounted service costs due to the pricing advantages received through the ARE-ON partnership with Internet2. By facilitating the reimbursement program with our UAMS partners on behalf of our member institutions, our members have realized reimbursements of most of the anticipated annual service expenses. It's a win-win scenario that's a beneficial model to repeat for the benefit of member institutions.



The Arkansas Research and Education Optical Network (ARE-ON) is a not-for-profit organization in Arkansas passionate about providing members with technical expertise, cost-effective network services, and personal connections with a high level of customer service. We create a collaborative community for local anchor institutions to leverage technology resources and knowledge to achieve their goals. www.areon.net

OARnet celebrates 35 years of connecting Ohio communities through cutting-edge technology

In 2022, the Ohio Academic Resources Network (OARnet) and its partners in the State of Ohio celebrated its 35th anniversary, reflected on the organization's evolution, growth, accomplishments and impact.

The Ohio Department of Higher Education (ODHE) founded OARnet in 1987 to provide Ohio researchers with their first online access to the high performance computing resources of the Ohio Supercomputer Center, established that same year. Since that time, OARnet has expanded to serve the K-12 education, state and local government, public broadcasting, health care, and Next Generation 911 emergency call center communities, delivering more than 5,500 miles of fiber-optic broadband connectivity and on-demand configuration to match each client's diverse needs.

In the last few years, OARnet also has worked closely with the state's new InnovateOhio and BroadbandOhio initiatives, joining public-private partnerships that seek to address the remaining unserved and underserved broadband regions of Ohio.

"OARnet is an important part of the State of Ohio's broadband infrastructure and access efforts," said Lt. Governor Jon Husted. "The team has done an excellent job of working closely with InnovateOhio and BroadbandOhio to determine how OARnet's expertise, resources and partnerships can

help the state bridge the digital divide for Ohioans."

The size and cohesion of OARnet's network enables it to rapidly adopt new technologies. Currently, OARnet is on track to be one of the first networks in the nation to upgrade its statewide fiber-optic backbone from 100 Gbps to 400 Gbps. OARnet was one of the first five networks to connect to Internet2 at

400 Gbps and continues to make technology changes that ensure the redundancy and reliability of its service.

OARnet's scale also provides savings to customers in the form of aggregate purchasing. One such solution is VMware, a technology that provides a platform for cloud computing and virtualization, which clients can access at a reduced cost through OARnet.

"Ohio's One Network, a long-time partnership with OARnet, has provided tremendous economies of scale for state agencies," said Katrina Flory, the State of Ohio's chief information officer and head of the Office of Information Technology within the Ohio Department of Administrative Services. "OARnet's strong understanding of the broadband needs of both the state and the research and education communities, as well as assistance with the aggregate purchases of bandwidth and other important services, has helped advance many initiatives beneficial to Ohio."

In addition to technology upgrades and aggregate purchasing arrangements, OARnet is adding value to the State of Ohio by expanding its cybersecurity efforts. OARnet recently hired its first cybersecurity architect to ensure the integrity of the network by monitoring security practices at the organization and evaluating relevant security services for OARnet members, including those with heightened cybersecurity requirements due to infrastructure-related vulnerabilities.

"OARnet's ability to develop strong partnerships with entities in the public and private sectors helps widen the organization's positive impact," said Randy Gardner, chancellor of the ODHE. "Because of OARnet's vision and planning, a core strength developed in service of higher education now touches the lives of all citizens in Ohio."



The Ohio Academic Resources Network (OARnet), a division of the Ohio Department of Higher Education's Ohio Technology Consortium (OH-TECH), serves the state's government, education, healthcare and public broadcasting communities. Through innovative public-private partnerships and a state-of-the-art fiber optic network, OARnet expands access to affordable broadband and delivers critical networking and technology services for academic and commercial R&D. www.oar.net

NYSERNet's participation in National Research Platform

NRP NATIONAL RESEARCH PLATFORM

The [National Research Platform](#) (NRP) is a high-performance computing collaboration led by a research team at the University of California San Diego (UCSD). The NRP has evolved from an interconnected set of computers linked by The Corporation for Education Network Initiatives in California (CENIC) across University of California campuses to a nationwide HPC cluster of almost 300 federated compute, storage and measurement nodes. Users of the cluster, Nautilus, consumed about one million CPU core hours per month and about 250 thousand GPUs per month in FY22. That number is expected to double for FY23, as its x86, GPU and FPA footprint continues to grow. Internet2, CENIC, the Great Plains Network, NYSERNet and many participating regional research and education (R&E) networks now collaborate to enable Nautilus at the national level.

“The Nautilus/NRP adopted DoE’s Science DMZ as a way to get data faster and has been propagating it to willing campuses,” said Tom DeFanti, research scientist, UCSD. “We are expanding Nautilus to also have well over 1,500 GPUs optimized as to cost/performance for use by machine learning and Artificial Intelligence researchers.”

The key underpinning of Nautilus’ design is that it operates on low-cost, high-performance systems (FIONAs) without the need for specialized, low-latency network interconnects. Nautilus operates on the R&E network, linking nodes across the nation connected to campus science DMZ networks

at 10Gbps and 100Gbps. Nautilus leverages the high bandwidth, jumbo framing and IPv6 connectivity uniquely available on the R&E network. It relies on established Transmission Control Protocol (TCP) tuning techniques to place research workloads proximate to regional storage pools. Leveraging open technologies such as Ceph storage, Docker containers, Kubernetes and JupyterLab, the NRP has enabled research at the national and international levels.

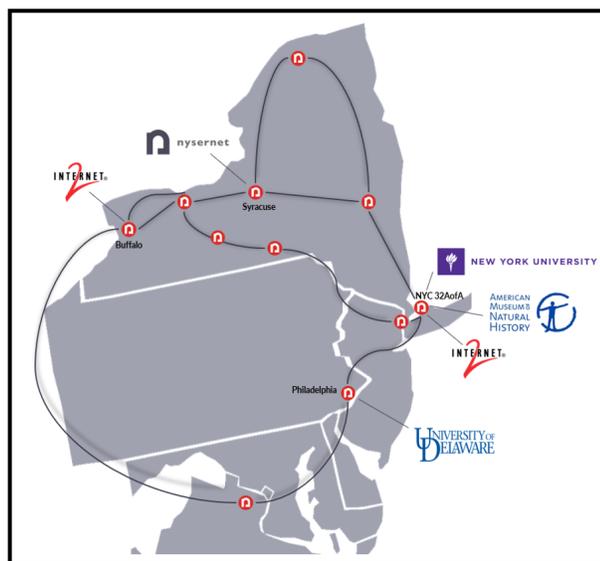
In 2019, NYSERNet had several Nautilus nodes active on its network and experienced first-hand that it was easy to set up a node, federate it and watch it become active seconds later. The NRP -- and its progenitor, the Pacific Research Platform -- began by installing nodes on campus networks. NYSERNet’s approach was to connect nodes to its regional high-speed backbone network, offering members high-speed access to a proximate pool of shared NRP resources, while also leveraging its network’s performance to integrate seamlessly with the national cluster and members’ host nodes. The development of NYSERNet’s environment has helped demonstrate the viability of coast-to-coast pools of regional storage and compute at scale over the R&E network.

“NYSERNet’s participation in NRP has afforded our researchers within the NSF EPSCoR-funded Project WiCCED...to test an operational implementation of machine

learning to decision support system,” said Tina Callahan, associate director, Delaware Environmental Monitoring and Analysis Center, University of Delaware (UD). “NYSERNet, especially Jim Kyriannis, has facilitated our entire experience.”

“Being involved in the NRP pilot provided resources [and]...the opportunity to expand our infrastructure with local NRP nodes at little or no cost,” said Anita Schwartz, IT research cyberinfrastructure, UD.

To date, participation in the NRP has assisted across various disciplines, including immersive visual and augmented reality, real-time computer vision and object recognition, atmospheric and oceanographic modeling, and environmental change and natural disaster prediction.



NYSERNet is New York State’s Research and Education advanced networking organization serving education, research, healthcare, and non-profit members. NYSERNet’s core mission is to advance science, research, and education missions of our members by delivering a full range of customized, progressive, and affordable end-to-end data and networking technology solutions. www.nysernet.org

LONI enables research powered by Artificial Intelligence and deep learning

Artificial intelligence, or AI, is an emerging technology transforming scientific research. However, one of the biggest challenges for researchers today is that high-quality, easy-to-access, production-ready, high-performance computing (HPC) resources with GPU acceleration (a key enabling technology for AI) are scarce.

In 2022, the Louisiana Optical Networking Infrastructure (LONI) HPC delivered nearly 100 million CPU-core-hours, an increase of 20 percent from 2021. LONI has been providing GPU capable HPC resources for more than 10 years. With its recent offering of NVIDIA V100 GPUs, the QB-3 cluster makes an ideal platform for researchers who are eager to harness the power of AI.

Dr. Gabriel Morra, an associate professor in the Department of Physics at the University of Louisiana at Lafayette, has been a LONI HPC user for several years. As a geophysicist, one of his research interests

is volcanology. To monitor live volcanoes that erupt continuously, scientists install infrared cameras in the crater to take pictures at a very high time resolution. The captured images, millions of them over a period of a few years, allow scientists to develop better understandings about these volcanoes.

There are two problems. First, the image analysis is traditionally performed manually. According to Dr. Morra, it can easily “take more than a year” for a graduate student to browse through ten million images. Second, not all events of interest are born the same. While the bigger ones are easy to detect, the micro ones—merely “a little dot”—may be elusive to the naked eye. “They look a bit like the sunspots, but the sunspots are always there and these come and go,” says Dr. Morra. To detect these events, the best one can do is to look very, very hard, but the intensity renders any long-term study impossible.

Here enters AI. With GPU-enabled deep learning algorithms, the same amount of work can be done in approximately 1,400 hours with one single GPU, which can be further reduced by analyzing the images on multiple GPUs simultaneously on the LONI QB-3 cluster. Talking about how essential LONI HPC is, Dr. Morra said, “You need this kind of GPU resources for the machine learning because without them the enormous speedup wouldn’t be realized.” Not only that, the deep learning algorithms allow Dr. Morra’s team to classify and analyze the micro events programmatically. They are able to detect eruption waves that no one else has seen before. The value of LONI does not stop there. When asked whether he considered running his workloads with commercial clouds, Dr. Morra said, “I used a fair bit of Amazon web services [in the past], but with LONI I receive more support. There are people who are ready to respond [when we have issues], which is very good [for my research].”



Recognizing the vital importance of AI-driven technologies for advancing scientific research as well as improving everyday lives, the State of Louisiana decided in June 2022 to invest \$12.5 million in a new LONI supercomputer with more AI capabilities. This new supercomputer, with more powerful NVIDIA A100 GPUs, will help researchers like Dr. Morra take AI research in Louisiana to an unprecedented level. Dr. Morra commented when talking about his AI-related work, “there is a big future with this [investment].”

The Louisiana Optical Networking Infrastructure (LONI) is the premier high-performance computing and high-capacity middle-mile fiber optic network provider for Louisiana higher education and research entities. The technology assets include a 1,674-mile-long system of fiber optics cables that provides subscribers with private and public cloud access at an improved level of service over a typical service provider and enhanced support for digital activities for teaching, learning, and administrative functions. The high-performance computing (HPC) service allows researchers to conduct and store highly complex experiments using compute powers specialized for highly intensive computational processing. This HPC service provided by LONI enables greater collaboration on research that produces results faster and more accurately. LONI is owned and operated under the authority of the Louisiana Board of Regents. www.loni.org

Emerging from the pandemic with a renewed commitment to supporting members' research and security needs

For I-Light and the Indiana GigaPOP, 2022 was a year of marked improvements from the previous two years.

We moved out of pandemic mode and back into face to face meetings and felt more like things were back to “normal.” The Indiana GigaPOP and I-Light networks held their annual members meeting at the Eiteljorg Museum, located in the cultural center of Indianapolis, White River State Park. It was the first in person meeting since 2019! The turnout was fantastic, and everyone was glad to be back in person for these meetings, making the pandemic seem even more of a memory. A highlight was hearing from our keynote speaker, Scott Shackelford, who spoke on “Cybersecurity and Cyber Peace in an Unstable World.” Shackelford serves as executive director of Indiana University’s (IU) Center for Applied Cybersecurity Research, among other duties.

The networking engineering team upgraded Indian a GigaPOP’s connectivity to the Internet2 network to 2 x 400G and increased resiliency with redundant network links from Indianapolis to Chicago at 400G. Our commodity internet usage continues to increase as does the demand for more bandwidth from our members, so we increased our commodity providers up to 60G between three diverse providers. We upgraded the Indiana Public Broadcasting Service (PBS) members with new Juniper SRX345 routers in our continued support of multicast for PBS.

Meanwhile, several members asked for redundant connectivity ensuring resiliency for their institutions. We added another PBS station to the network with WBAA out of Lafayette, Indiana.



I-Light and the Indiana GigaPOP continue to support the research mission of our members. For example, in June 2022, the University of Notre Dame Turbomachinery Laboratory (NDTL) completed new test cells for research, development, and testing of hypersonic propulsion systems. According to the news release, “National interest in hypersonic flight has intensified in recent years. Getting passenger planes to travel at Mach 6 speed – six times the speed of sound – would revolutionize air travel. Passengers would be able to fly from Washington, D.C., to Los Angeles in under an hour, New York to London in less than two hours and Los Angeles to Tokyo in under four hours.” We’re proud to support research like NDTL. They drive our networks’ demand for even more capacity.

To ensure the community has access to cutting-edge capabilities, the I-Light and Indiana Gigapop networks are also supporting the efforts to install, maintain,

and manage the IU FABRIC node that will connect from Bloomington, IN to Chicago, IL. The FABRIC network is funded by the National Science Foundation and supports experimental deployment, protocol testing, and evaluation.

Security is top of mind for our members, and we’re thrilled that the rollout of cybersecurity services via OmniSOC has been a tremendous success. Many members have taken advantage of OmniSOC’s tabletop exercises to examine the vulnerabilities on their campuses and learn how to mitigate weaknesses.

We look forward to another successful year helping our members reach their goals, establish new opportunities, and accelerate research and discovery.

I-Light is Indiana’s high-speed fiber optic research and education network, enabling high-quality lives through high-quality connections. Connecting every public university and private college in the state, we’re lighting up Indiana’s higher-education community. www.ilight.net

The Indiana GigaPOP, located in Indianapolis and established in 1998, serves as a foundation for Indiana’s research and education communities, providing an advanced high-speed, high-availability, feature-rich network that brings Indiana’s brightest to the world, and the world’s brightest to Indiana. www.indiana.gigapop.net

Lighting the way forward: Merit Network and Michigan State University project could mark a turning point in digital equity for Michigan

By the end of this year, Michigan’s digital divide may be on the verge of a rapid narrowing.

Merit Network has a history of trailblazing. The country’s first non-profit regional research and education network is continuing in the tradition of “firsts” with the rollout of Project MOON-Light (Michigan Open Optical Network – Leveraging Innovation to Get High-Speed Technology). A collaboration between Merit and Michigan State University, this upgrade to Merit’s 4,000-mile-long network heralds a new era in fiber optic telecommunications.

This project, supported by a \$10.5 million federal Broadband Infrastructure Program grant through the National Telecommunications and Information Administration (NTIA), is one of the first next-generation infrastructure projects of its kind in the country. It likely will be the first to rollout at a statewide scale, setting the strategic foundation for Michigan’s future last-mile projects. MOON-Light is an equipment-only upgrade and does not involve the buildout of any additional fiber infrastructure, but will impact Merit’s entire existing statewide footprint. Project MOON-Light will increase Merit’s capacity and enable the network to meet future needs across Michigan. Once completed, its coherent channels will be able to support up to 200G at deployment and up to 800G in the future. This will future-proof Merit’s middle-mile infrastructure, ensuring the upgrades prove worth the investment deep into the 21st century.

MOON-Light reflects a heightened emphasis on the open network and deployment needs of our existing members and rural broadband collaborators, including last-mile providers and new parties launching internet service in

Michigan. The new capabilities will enable Merit to optimize deployments of existing and future high-speed, coherent optical interfaces in a multi-vendor, multi-service environment.

As MOON-Light enables last-mile broadband service to tens of thousands of locations, Michigan could stand witness to one of the most impactful breakthroughs for robust, affordable connectivity in its history. The state ranked 32nd in the nation for broadband availability in a 2021 report from the Michigan High-Speed Internet Office, which used U.S. Census data. Some 1.24 million households (31.5%) lacked a permanent, fixed internet connection at home. Of these households, 13.8% of the total did not have any internet subscription at all as of 2019, according to U.S. Census estimates.

Project MOON-Light will improve those numbers by moving Merit’s optical access network to the leading edge of middle-mile

technology. This will remove traditional barriers of distance and geography for remote last-mile networks. With over 100 distributed exchange connectors (access points), the network will allow interconnecting local service providers to bring affordable and robust broadband to homes and businesses.

Partnerships with commercial and community last-mile operators will be key. The optical upgrade will create excess network capacity to serve local private Internet Service Providers (ISPs), cooperatives, and community networks that operate last-mile facilities. Operators stand to benefit from improved speeds, reduced expenses, and accelerated timelines for their last-mile deployments to unserved and underserved communities.

Services on MOON-Light are set to begin this fall, opening up a new chapter in broadband and digital equity in the state of Michigan.



Merit Network, Inc. is an independent non-profit corporation governed by Michigan’s public universities. Merit owns and operates America’s longest-running regional research and education network. In 1966, Michigan’s public universities created Merit as a shared resource to help meet their common need for networking assistance. Since its formation, Merit Network has remained at the forefront of research and education networking expertise and services. Merit provides high-performance networking and IT solutions to Michigan’s public universities, colleges, K-12 organizations, libraries, state government, health care, and other non-profit organizations. www.merit.edu

Creating next generation networks for data intensive science

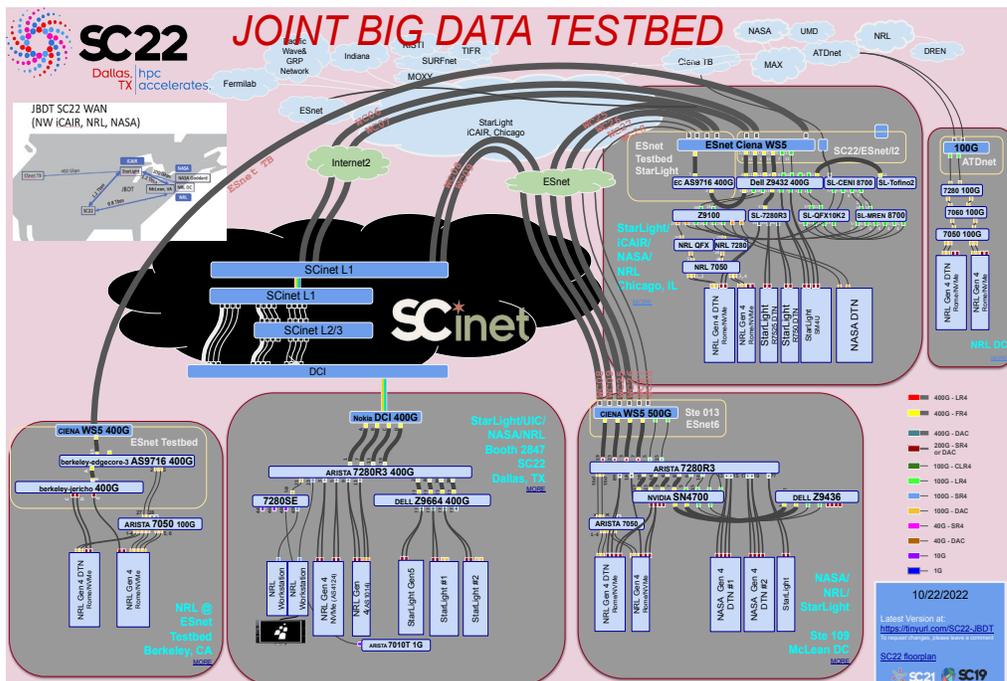
Every year, the Metropolitan Research and Education Network (MREN) collaborates with SCinet to create a national testbed with its international, national, and regional partners. This testbed, with international extensions, supports experiments and demonstrations for the annual “ACM/IEEE International Supercomputing Conference for High-Performing Computing (HPC), Networking, Storage, and Analysis.” SCinet, MREN, the Starlight International/National Communications Exchange Facility, and its research partners designed, implemented, and operated the 2022 versions of this testbed for the 2022 conference called SC22, which took place in Dallas, Texas. There, the collaborators showcased demonstrations and experiments related to data intensive science research applications, including: high energy physics, bioinformatics, synchrotron experiments, HPC based research, radio astronomy, astrophysics, atmospheric science, oceanography, and large scale modeling and simulation.

Global science research requires gathering, analyzing, and transporting extremely large volumes of data. One example includes using high capacity single end-to-end multi-100 Gbps data flows among sensor sites, instruments, analytic sites, HPC centers, and data repositories. A key theme was investigating and demonstrating WAN services beyond 100 Gbps – including 400 Gbps, 800 Gbps, and Tbps paths. The SCinet WAN testbed included 2*400 Gbps paths and two 100 Gbps paths (1 Tbps) between the Joint Big Data Testbed Facility (JBDT) in McLean VA and the StarLight International/National Communications Exchange in Chicago; 2*400 Gbps and two 100 Gbps paths (1 Tbps total) between the StarLight facility and the SC22 venue in Dallas; 2*400 Gbps between the JBDT and the SC22 venue, an extension of the national ESnet 400 Gbps testbed at the StarLight facility; and 2*100 Gbps from Pacific Wave to the StarLight facility. The testbed paths were provisioned in the SC22 SC22 StarLight booth (reference image below).

With its research partners, MREN used this testbed to successfully stage 25 large scale demonstrations, including a SCinet “Data Tsunami” that flooded the testbed with almost 5 Tbps at the end of the conference. Techniques demonstrated included: innovative multi-100 Gbps path services based on Software Defined Networking (SDN), Software Defined Exchanges (SDXs), Data Transfer Nodes (DTNs), Network Services Interface (NSI), transport protocols, measurements, P4 data plane programming, and dynamic L2 and L1 provisioning.

Demonstrations included: a) advanced services for Global Petascale science; b) dynamic capabilities of the NSF StarLight International Software Defined Exchange (SDX); c) programmable dynamic WAN networking; d) the Global Research Platform; e) advanced services based on AI/ML/DL optimization techniques for High Energy Physics, specifically, the Large Hadron Collider Open Network Environment; f) DTN-as-a-Service; g) 400 Gbps WAN Disk to Disk transfers across WANs; h) dynamic systems provisioning among open exchange points across WANs; i) Named Data Networking (NDN) for data intensive science; and j) packet marking for high fidelity visibility into science data flows, along with complementary analytics and automated responses.

Also in 2022, MREN supported planning for the design and implementation of an international testbed in 2023 for Data Mover Challenge, hosted by the Supercomputing Asia Conference. Those results will be announced in 2024.



The Metropolitan Research and Education Network (MREN) is an advanced, high-performance, regional network supporting organizations in seven states in the upper Midwest. MREN’s primary focus is on providing advanced digital communications for leading-edge research and educational applications, primarily communication services for data intensive science. MREN is a founding member of the NSF-supported Pacific Research Platform initiative (PRP), developing a regional Science DMZ that extends from the west coast to the StarLight facility. MREN is also creating a regional MREN Research Platform (MRP) and participating in developing a National Research Platform (NRP). www.mren.org

CEN supports transformative investments in Connecticut's communities

The Connecticut Education Network (CEN) is a unique asset for the State of Connecticut acting as a cornerstone for community growth and development across the state by providing the fundamental infrastructure for Internet connectivity. CEN utilizes its technical and human networks to expand and accelerate outcomes related to Connecticut's digital learning, research, and economic development goals and initiatives beginning with Internet circuits and extending through value-add services and support of fundamental projects.

2022 was a year of continued growth and expanded value for the CEN membership. Membership has grown by over 20% since 2018. In 2022, CEN welcomed 19 new members representing state and municipal organizations, police and fire departments, libraries, and open access businesses, bringing the CEN membership total to 679 community anchors. Despite extended inflationary pressures and supply chain disruptions, CEN created paths to grow the membership, increase value, expand services, maintain price stability, and to plan for the future with major project announcements.

Broadband infrastructure program

The American Rescue Plan Act of 2021 (ARPA) resulted in a planned investment of more than 6 billion dollars in Connecticut over the next three years. Governor Lamont's Plan defines five key areas of investment with a focus on equity. These areas of investment

include statewide infrastructure, access to high speed internet, education and health care programs, and economic development. CEN will play a significant role in meeting the Governor's objectives by executing five projects totaling over 70 million dollars funded through the American Rescue Plan Act (ARPA).

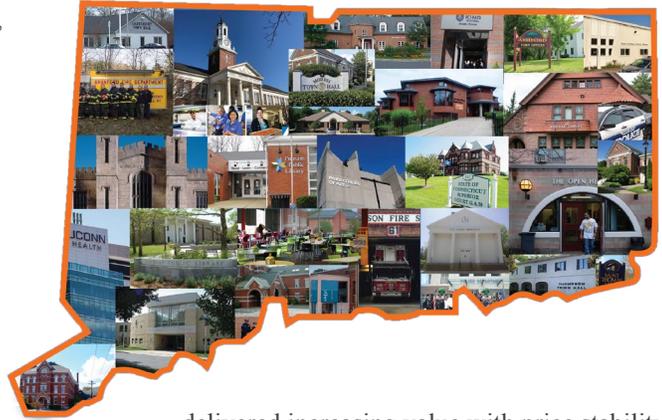
These projects include:

Community Wireless Expansion, Next Gen Infrastructure, and Fiber Internet Connectivity Expansions. They impact public libraries, municipalities, councils of governments, and public charter schools and provide a substantial opportunity for transformative investment in digital equity through expanded access to high speed internet.

The Next Gen Infrastructure project provides a comprehensive and critically necessary infrastructure upgrade to the CEN network to expand capacity, accommodate new members, and to serve as the backbone and attach points for high performance community wireless projects. This project will also bolster the capacity and resiliency of the network, ensuring equitable access to high-quality Internet for all connected.

Extending the value proposition

For over 22 years, CEN has consistently



delivered increasing value with price stability or price reductions for Internet access. In spite of significant inflation of underlying costs in 2022, CEN announced flat bandwidth tier pricing and certain long term agreement discounts. Collaborating with member IT directors, CEN also positioned its Internet access product as the CEN Dedicated Internet Access (DIA) Bundle to highlight our industry leading package of performance and quality attributes and security services, included at no additional cost to members.

Our members are our partners

CEN's vision is carried out through a member-focused lens. Fundamentally, CEN is a network of people and organizations extending into every corner of Connecticut, connecting community anchor institutions that serve all citizens. CEN and its member partners are proud to play a major role in serving the State of Connecticut and empowering our increasingly connected state.



The Connecticut Education Network (CEN), the nation's first all-optical research and education network, delivers reliable, high-speed Internet access, data transport, and value-added services to its members drawn from K-12, higher education, libraries, state government, and municipalities throughout Connecticut. CEN's statewide fiber-optic network connects more than 1.8 million citizens in support of Connecticut's workforce and economic development. www.ctedunet.net

KINBER completes the Libraries Connect Communities (LCC) and Broadband Resources Program



Over a two-year period, 80+ libraries in more than 25 Pennsylvania counties received support through the Libraries Connect Communities (LCC) and Broadband Resources Program (LCC), a project dedicated to improving the connections, technology, and broadband capabilities of participating libraries.

Through these funds, The Keystone Initiative for Network Based Education and Research (KINBER) was able to engage with 12 local and regional IT groups to provide support to libraries who lack access to technology services. More than \$750,000 in Library Resource Allocation (LRA) funds was invested in upgrades to participating library IT infrastructure, including emergency Wi-Fi access points, infrastructure and connectivity, and hardware and software.

“KINBER is proud of its partnership with the Office of Commonwealth Libraries on the Libraries Connect Communities grant,” said Nathan Flood, president and ceo of KINBER.

“Our team dedicated countless hours and hard work to understanding what Pennsylvania’s libraries needed to be successful now and for years to come. KINBER was able to provide better connectivity, fiber builds, upgraded equipment and an improved IT infrastructure in over 80 libraries across the Commonwealth.”

As an example of the project’s success, more than 200 desktops, laptops, Chromebooks and Chromeboxes were distributed for use by library staff and patrons. Additionally, three privacy booths were installed to give libraries without private meeting spaces an area for patrons to conduct job interviews, telehealth visits and much more.

“Speaking not only for myself, but also for the other Fayette County Libraries, we very much appreciate the help and support we’ve received from the KINBER Team and the Office of Commonwealth Libraries as recipients of the Libraries Connect Communities grant,” said Christy

Fusco, director of the Uniontown Public Library. “Our friends at KINBER dedicated themselves to understanding our situation. They made site visits, conducted in-depth virtual discussions and provided high quality community engagement trainings. The KINBER Team used their expertise to our benefit at every point.”

“They enabled the rebuilding and futureproofing of the technology infrastructure of our libraries – the impact of such an investment cannot be overstated. KINBER communicated frequently throughout the process and always welcomed our input and feedback,” continued Christy Fusco. “Small, underfunded libraries such as ours truly benefit from being able to offer the best in technology and not the worst. We thank both the KINBER Team and the Office of Commonwealth Libraries for helping Fayette County Libraries be recognized as broadband and technology hubs in our community.”

KINBER would like to acknowledge and thank the Office of Commonwealth Libraries (OCL) within the PA Department of Education for being a valuable partner and supporting KINBER through this program. KINBER is grateful to have been a part of such an incredible program and to be able to give back to the libraries in the Commonwealth that continue to give so much to our communities.

The Keystone Initiative for Network Based Education and Research (KINBER) is Pennsylvania’s statewide research, education, and community network. The non-profit organization is a trusted technology partner that provides a strategic and competitive advantage to 100+ Pennsylvania-based organizations through high-speed broadband connectivity, collaboration, and innovative use of digital technologies. KINBER is committed to delivering equitable, reliable, and affordable digital infrastructure and tools to inspire tomorrow’s scientific discoveries, enable the exchange of ideas and culture among diverse populations, educate the next generation of citizens, and revitalize Pennsylvania’s economy. www.kinber.org

Evaluating and improving network performance to support high energy physics with ESnet

The Energy Sciences Network (ESnet) is the high-performance network user facility for the US Department of Energy (DOE) Office of Science (SC). As a data circulatory system, ESnet connects all of the DOE's laboratories and facilities in the United States and abroad. In collaboration with the Office of High Energy Physics (HEP), ESnet routinely revisits requirements for scientific networking. Two major HEP experiments, ATLAS and CMS at the Large Hadron Collider (LHC), are a significant driver for the research and education (R&E) networking community within the United States.

ESnet and HEP are currently developing the High-Luminosity Large Hadron Collider (HL-LHC) project, which are upgrades to the LHC, with its first run set for 2029. This effort will improve the performance of the LHC by increasing the integrated luminosity, a value proportional to the number of particle collisions, by a factor of 10. Once implemented, this new operational mode will last a decade and large improvements in networking will be required to enable the ambitious physics goals of the HL-LHC. In each data-taking year during the HL-LHC, the ATLAS and CMS experiments combined are expected to accumulate roughly 1 exabyte (EB) of data.

Investment into network infrastructure at all layers (i.e. research computing facilities, campus networks, regional providers, national backbones, and international connectivity) must keep pace with these data demands. Today, a typical LHC Tier 2 facility may see 15 Gbps average network utilization over the course of a year, with peaks of 70 Gbps or more. Projections for the HL-LHC era are a 100 Gbps average over a year, with 400 Gbps bursts often lasting hours. It is projected that during the first 3 years of HL-LHC, the experiment will accumulate roughly the same amount of data that has been collected during the entirety of the LHC experiment. Network capacity must be provisioned to match the scale of the available resources for each participating site, which will exceed 1 Tbps for Tier 1s at National Labs, and at least 100 Gbps for Tier 2s facilities on university campuses. National network backbones such as ESnet will need to support multiple Tbps capacities.

ESnet is currently engaged with members of the LHC community, operators of regional networks, campus networks, and T2 centers to prepare for these coming requirements. A series of "data challenges" is planned between now and 2029 to prove the capability of the network infrastructure,

as well as the ability to process the end-to-end software workflows. The first of these challenges, conducted in Fall of 2021, exercised data volumes that were equal to 10% of the expected HL-LHC data volumes. Additional data challenges, set to run in 2024 through 2027, are expected to meet goals from 25% to 100% of the HL-LHC needs. Supporting the later tests will require 400 Gbps capabilities from ESnet, through regional and campus networks and into the T2 computing facilities.

ESnet and our LHC-affiliated partners will continue to expand outreach to the Quilt community, affiliated campus networks, and networking exchange points throughout 2023. For further information, contact engage@es.net or visit us at <http://fasterdata.es.net>.



ESnet

ENERGY SCIENCES NETWORK

The Energy Sciences Network (ESnet) is a high-performance, unclassified network built to support scientific research. Funded by the U.S. Department of Energy's Office of Science (SC) and managed by Lawrence Berkeley National Laboratory, ESnet provides services to more than 50 DOE research sites, including the entire National Laboratory system, its supercomputing facilities, and its major scientific instruments. ESnet also connects to 140+ research and commercial networks, enabling DOE-funded scientists to productively collaborate with partners around the world. www.es.net

Illinois K-12 consortium procurement promotes broadband competition

Following the launch of Connect Illinois by Illinois Governor J.B. Pritzker in August 2019, Illinois Century Network (ICN) and Illinois Department of Innovation and Technology (DoIT) have been providing free Internet access and broadband connectivity to Illinois public K-12 school districts. Costs are covered by state appropriation and the Universal Service Fund Schools and Libraries program (otherwise known as E-rate).

For Illinois K-12, the ICN provides free intranet and security services as well as access to the public Internet connecting 14 points of presence distributed throughout the state. The ICN is one component of the K-12 solution. Another key component is the The Department of Innovation & Technology (DoIT) E-rate consortium that manages the procurement of broadband circuits between school districts and the ICN. An example architecture is shown in Figure 1. The remainder of this article focuses on the consortium procurement process.

The DoIT E-rate consortium was established in August 2019 to manage the provision of free Internet and broadband connectivity to Illinois public K-12 school districts. The first step for the consortium was to issue an E-rate compliant procurement, requesting service

provider responses for hundreds of Last Mile and WAN circuits throughout Illinois. Each year, a new procurement is issued as more school districts join the consortium resulting in new circuits to bid. The procurement has 13 mandatory requirements that relate to service quality, interconnect and the ordering process with all procurement points being associated with bandwidth pricing. A responding service provider must agree to comply with all mandatory requirements or be disqualified. The awarded vendor is thus the vendor that receives the highest number of price points. Points are associated with bandwidth levels 20 Mbps, 50 Mbps, 100 Mbps, 250 Mbps, 500 Mbps, 1 Gbps, 2 Gbps, 4 Gbps and 10 Gbps, with the most common bandwidth levels—such as 1 Gbps and 10 Gbps—receiving the most points. The vendor with the lowest pricing for a bandwidth level receives the maximum points for that bandwidth level. Other vendors, with higher pricing, receive a proportionate share of the points.

This procurement approach, where service quality requirements are mandatory and all points are associated with pricing, results in an intensely competitive environment for service providers. For example, a vendor that responds with a slightly higher price than

another vendor could lose out on hundreds of circuits. When a vendor realizes this, they will typically adjust their pricing in a subsequent procurement round. The DoIT E-rate consortium is now in its 4th round and we have seen significant price reductions between Rounds 1 and 4.

This procurement approach results in a state master contract available to public K-12. For states that do not provide additional funding beyond E-rate, this approach is still very valuable since it allows schools to choose between their own procurement or the state procurement, and select the solution most cost effective to them. We believe the success seen in Illinois can be replicated throughout the US. For a copy of the Illinois Round 4 procurement, please visit this [bid solicitation](#).

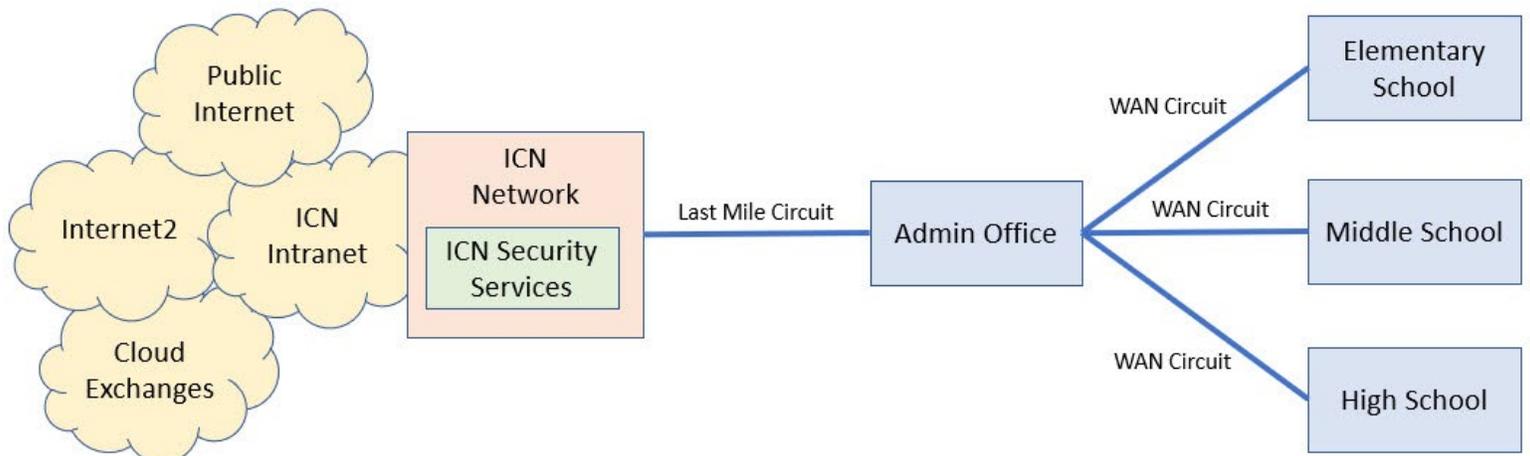


Figure 1. Public K-12 School District Circuit Architecture

The Illinois Century Network (ICN) began in 1997 with the recommendation from the Higher Education Technology Task Force to create a single, statewide educational network. The ICN became reality in May 1999 with the signing of the legislation called the Illinois Century Network Act. The ICN has evolved into a 2,100-mile, high-speed broadband network serving K-12 and higher education, public libraries and museums, state and local government, and commercial service providers. www.illinois.net

EPOC provides deep insights into ResearchCI use for institutions

Scientific progress is built on top of a complex system of hardware, software, networks, and well-defined processes to translate innovative ideas into research outcomes. It's important for regional networks to work with their members to keep all parts of this system current and able to meet the needs of researchers.

The Engagement and Performance Operations Center (EPOC) is a collaborative focal point for operational expertise and analysis that is jointly led by the Texas Advanced Computing Center at the University of Texas Austin (TACC / UT Austin) and the Energy Sciences Network (ESnet). EPOC provides academic researchers with a holistic set of tools and services needed to debug network performance issues and enable reliable and robust data transfers. By considering the full end-to-end data movement pipeline, EPOC is uniquely able to support collaborative science, allowing researchers to make the most effective use of shared data, computing, and storage resources to accelerate the discovery process.

One of the main activities of EPOC is performing Deep Dives with regional networks and member institutions. Deep Dives aim to understand the full research pipeline for collaborative teams and suggest alternative approaches for the scientists, local cyberinfrastructure (CI) support, and national networking partners. Deep Dives facilitate the achievement of long-term research goals via workflow analysis, storage and computational tuning, and identification of network bottlenecks.

The Deep Dive approach is based on an almost 10-year practice used by ESnet to understand the growth requirements of DOE facilities (<https://fasterdata.es.net/science-dmz/science-and-network-requirements-review/>) that was adapted for work with individual science groups. The structured conversations of the Deep Dive approach include information sharing not only about how the science fits in its field, but also a detailing of the process of the science; the latter of which includes explicitly explaining 'a day in the life' of the science group. This will tie together the people/collaborators, the use of resources, and the science goals for the team. Details are given about the use of resources across cyberinfrastructure and there is a discussion of any outstanding issues and pain points.

At the end of the interaction with the research team, EPOC staff can come away with a good understanding of the research, data movement, who's using what pieces, dependencies, and timeframes. This enables us to identify possible bottlenecks or areas that may not scale in the coming years, and to point the research team towards the use of existing resources so that they can reach their goals more effectively.

In the last three years, EPOC has worked with over a dozen Quilt members to better understand the science drivers and how they will impact future network needs. The majority of these engagements centered around data transfer performance issues between two institutions, handling secure data, Science DMZ deployment reviews, and data architecture planning advice. More information can be found in the reports available online at <https://epoc.global/materials/>.

Anyone in the Quilt community can contact EPOC for advice or consultations. Learn more at <https://epoc.global> or email us directly at epoc@tacc.utexas.edu.



EPOC

Engagement and Performance Operations Center

The Texas Advanced Computing Center (TACC) designs and operates some of the world's most powerful computing resources. The center's mission is to enable discoveries that advance science and society through the application of advanced computing technologies. TACC's environment includes a comprehensive cyberinfrastructure ecosystem of leading-edge resources in high performance computing (HPC), visualization, data analysis, storage, archive, cloud, data-driven computing, connectivity, tools, APIs, algorithms, consulting, and software. www.tacc.utexas.edu

The Energy Sciences Network (ESnet) is a high-performance, unclassified network built to support scientific research. Funded by the U.S. Department of Energy's Office of Science (SC) and managed by Lawrence Berkeley National Laboratory, ESnet provides services to more than 50 DOE research sites, including the entire National Laboratory system, its supercomputing facilities, and its major scientific instruments. ESnet also connects to 140+ research and commercial networks, enabling DOE-funded scientists to productively collaborate with partners around the world. www.es.net

THE QUILT

