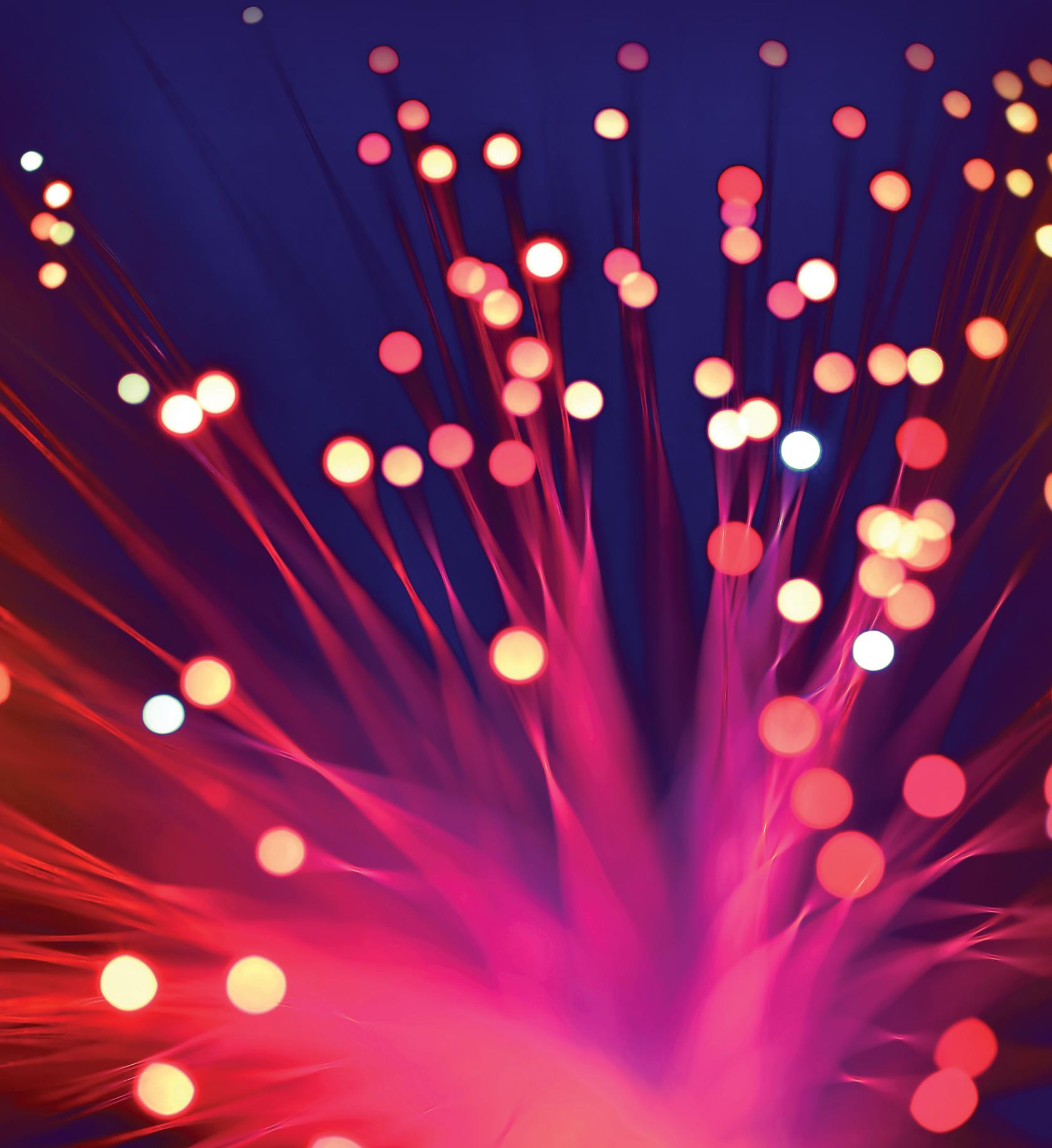


THE QUILT CIRCLE

2020



A Letter From the President

This 2020 *Quilt Circle* edition commemorates the 20th Anniversary of The Quilt. The fabric of our research and education (R&E) networking community has never been stronger. While our Quilt community has evolved in new and exciting ways in the past two decades, we have also been faced with a number of challenges which we take head-on and always with the spirit of collaboration. As we address the unprecedented challenges presented by the current global public health crisis due to the COVID-19 pandemic, the work of our members is more important than ever to the missions of their member communities. U.S. higher education institutions rely on R&E networks to give them a competitive edge in the most impactful scientific research initiatives which is essential in this crisis. We connect the educational institutions that support university medical centers and their associated hospitals. R&E networks also connect tens of thousands of other community anchor institutions, including K-12 schools, public libraries, local/state government, research sites, cultural institutions, public safety, and tribal lands. Being responsive and providing vital networking infrastructure and resources right now to address immediate needs is who we are and what we do. R&E networks are part of our nation's critical infrastructure.

This year's edition of *The Quilt Circle* showcases several examples of the key role of R&E network members in both providing and facilitating the use-network infrastructure to further scientific discovery and collaborations at higher education institutions of all sizes. Our members are key partners in supporting investments that the National Science Foundation is making in campus research infrastructure through its campus cyberinfrastructure program. These articles also demonstrate the unique leadership positions R&E networks play in their respective broadband landscapes to create solutions to bridge the digital divide for rural communities as well as tribal lands. By bundling new and innovative networking solutions with IT applications, our members are transforming classrooms and K-12 education. Lastly, you will enjoy learning about the direct impact these organizations have on their member communities by providing support for presidential primaries, public libraries, collegiate e-sports programs, and so much more.

The collaborative spirit that is exemplified by our member networks in the work they do with their community institutions has also fueled the success of The Quilt for the last 20 years. It is the energy that will propel our work for decades to come. These stories about our members compiled within *The Quilt Circle* are a reminder of the valuable roles our members play in the success of one another's organizations and in building the national fabric of the R&E networking community that we call "The Quilt".



Jen Leasure
President and CEO

National Regional Networks Consortium
Advanced regional networking in support of research and education



About Us

The Quilt is the national coalition of non-profit U.S. regional research and education networks representing 40 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. With the goal of promoting 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

Through The Quilt, non-profit regional research and education networks collaborate to develop, deploy and operate advanced cyberinfrastructure that enables innovation in research and education.

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.

Acknowledgements

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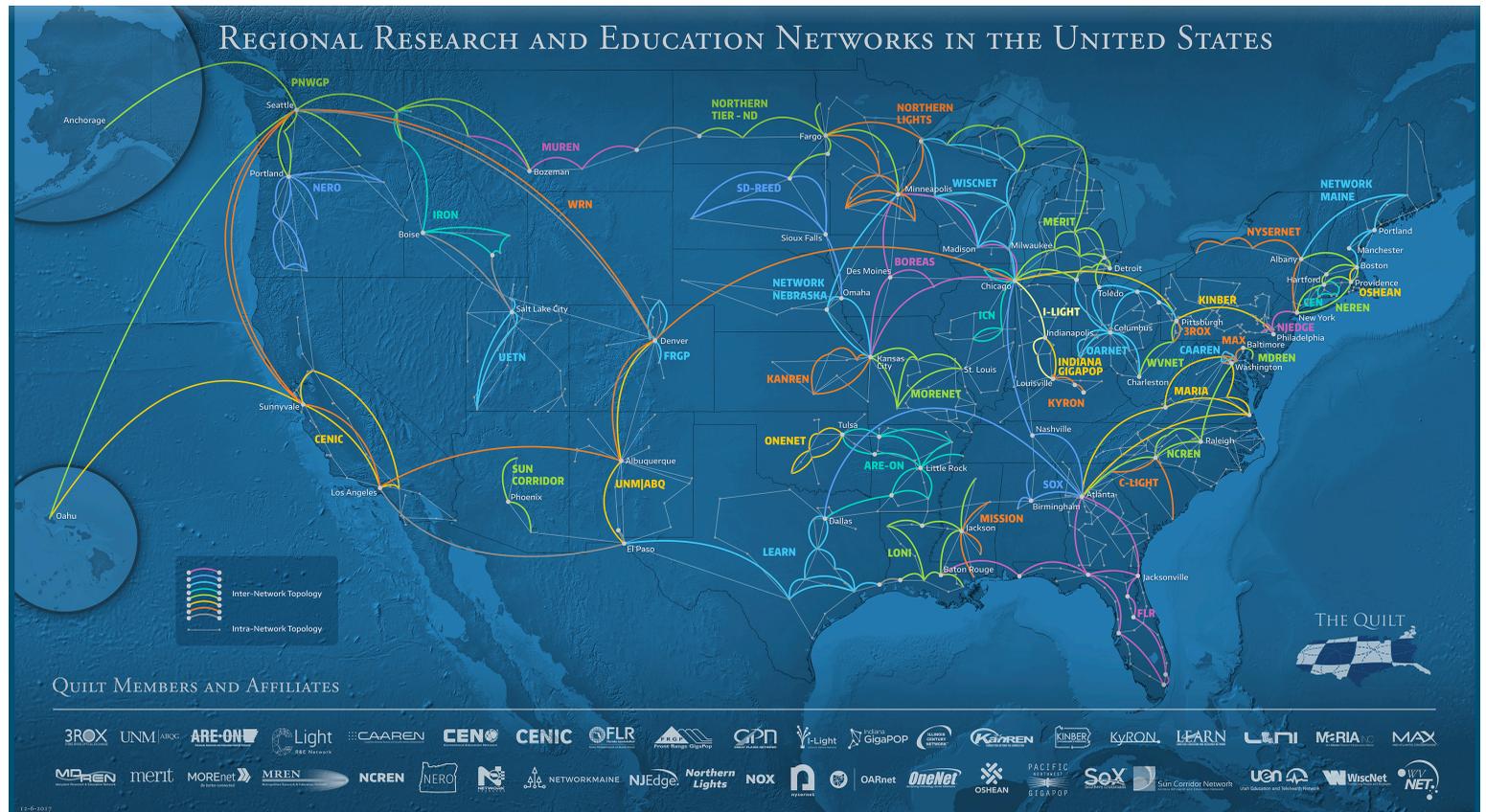


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Members and Board of Directors

Albuquerque GigaPoP (NM)

Paul Chang
abqg.unm.edu

Arkansas Research and Education Optical Network (AR)

Robert Nordmark
www.areon.net

CENIC (CA)

Louis Fox
www.cenic.org

C-Light (SC)

Daniel Schmiedt
clight.sites.clemson.edu

Connecticut Education Network (CT)

Ryan Kocsondy
ctedunet.net

Florida LambdaRail (FL)

Joseph Lazor
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

Illinois Century Network (IL)

Robin Woodsome
www2.illinois.gov/icn

Indiana GigaPoP (IN)

Dave Jent
indiana.gigapop.net

KanREN (KS)

Cort Buffington
www.kanren.net

KINBER (PA)

Nathan Flood
www.kinber.org

KyRON (KY)

Doyle Friskney

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)

Ron Hutchins
www.marialliance.net

MDREN (MD)

Ray Barghi
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)

Jean Davis
www.mcnc.org

Networkmaine (MA)

Jeff Letourneau
www.networkmaine.net

New Jersey Research and Education Network (NJ)

Sam Conn
www.njedge.net

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

Mark Silis
www.nox.org

Northern Lights (MN)

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

NYSERNet

Steve Kankus
www.nysernet.org

OARnet (OH)

Pankaj Shah
www.oar.net

OneNet (OK)

Von Royal
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 (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

WVNET (WV)

Carl Powell
www.wvnet.edu

Quilt Staff

Jen Leasure
President and CEO

Jennifer Griffin
Program Director

Tracey Norris
Administrative Assistant

FRGP-NTUstar: Using Air (Technology) to Learn and Understand New Things

National Science Foundation Campus Cyberinfrastructure (CC*) award grants improve scientific research by supporting improvements in campus and regional networking on large and small higher education campuses. Navajo Technical University (NTU) in Crownpoint, N.M., received a CC* in 2019, with the University Corporation of Atmospheric Research (UCAR) serving as the leadership organization.

For hundreds of years, information-sharing in the American Southwest depended on foot traffic. Messengers needed to understand the terrain, its perils and shortcuts, and the intricate relationships between destinations. It makes sense, then, that the NTUstar team of collaborating institutions chose a fact-finding approach toward existing cyberinfrastructure conditions to lay the groundwork for a more efficient and effective build.

Through workshops, site visits and communications, the team set about understanding unique regional challenges and building trust among stakeholders, including educational institutions, tribal entities, vendors, local governments and community members. Subsequently, the NTUstar team was able to unearth potential issues, from geography and resource limitations to a lack of competition among vendors, and begin collective brainstorming. The team also provided technical training to stakeholders.

Marla Meehl, manager of Front Range GigaPoP (FRGP) at UCAR, notes that perhaps the biggest benefit of the grant has been a platform establishing common ground among tribal entities. The common focus on networking provides a vehicle for new discussions.



Stakeholders recognize a shared opportunity to realize benefits, such as helping to close the homework gap or negotiate with vendors. “We have provided guidance, but I’ve learned just as much from this collaboration,” says Meehl. “It has allowed us to work with passionate people in creative problem-solving and addressing challenges that are different from what we’ve handled.”

Perhaps the most important outcome is the shared trust-building that will act as ballast long-term. Meehl says, “The grant and subsequent grants are commitments. It takes time and conversations to plan, build and implement. We know that each of us will follow through and be back.”

Steve Burrell, CIO and vice president for information technology at Northern Arizona University, one of many valuable partners, reflects on greater implications: “We can extend resources not otherwise accessible to faculty, students and researchers, and participate in the discovery of new knowledge that serves to improve the

quality of life of native citizens, raises the prosperity of our communities, and contributes to the wellness of our mother earth.”

Jason Arviso, principal investigator and NTU vice president for operations, foresees the collaboration will benefit all tribal colleges and universities. “R1 institutions have provided expertise, but have also had to adapt their solutions to our problems. We’ve relied on high-cost solutions offered by “outsiders” with difficult-to-support network designs, but now we’re able to plan and build solutions ourselves and better negotiate our agreements. Just think about what we will be able to do to help others. There’s no way to put a number on it or imagine how we can change the world.”

The Front Range GigaPop (FRGP) is a consortium of universities, non-profit corporations, government agencies, and secondary members (such as the UCAR Point of Presence) behind primary FRGP members who cooperate as part of a Regional Optical Network (RON) in Colorado and Wyoming in order to share wide area networking services including the commodity Internet, Internet2 and peering connectivity. www.frgp.net

OneNet's Next Generation Classroom Initiative Transforms Learning

Today's education system is in the midst of a digital transformation. As classrooms become increasingly dependent on technology, tablets are beginning to replace textbooks and educational apps are transforming the way students interact with learning material. The adoption of technology has made information widely available, changing the way students think and learn. It is important to recognize that what students need from a classroom is also changing.

To help schools in Oklahoma address these changing needs, OneNet has launched the Next Generation Classroom initiative to educate teachers about emerging technologies and provide digital learning tools for the classroom. Digital technologies such as virtual reality, augmented reality, 3-D printing and "gamification" create an immersive, stimulated environment that advances learning for today's students.

Emerging technologies also expand science, technology, engineering and mathematics (STEM) learning opportunities. One of OneNet's goals is to ensure that Internet access and bandwidth are available to support STEM education at all grade levels. Through the classroom initiative, OneNet is extending its support beyond Internet and network services by equipping teachers with resources that enable them to incorporate new technologies in their classroom and engage students in STEM learning.

One way OneNet is creating new STEM learning tools is through augmented reality (AR). AR utilizes audio, graphics, text and other visual elements in a real-world environment, displayed in real time. AR teleports students to

far-off places and encourages more creative freedom in their learning environments.

Through a collaboration with MetroTech's Bioscience Academy, OneNet is working with a career technology instructor to create an AR app that makes biology lessons more interactive and engaging for students. OneNet has developed an AR experience that demonstrates the structure of DNA molecules. Students can interact with the app to transform a DNA helix and learn how the parts of a DNA molecule work.

OneNet is developing additional AR experiences to provide teachers lessons on atoms and the periodic table. These experiences will provide no-cost STEM activities that enable teachers to incorporate AR technology in their lesson plans.

OneNet's partnership with the University of Oklahoma's K20 Center also combines STEM lessons with digital learning. The K20 Center focuses on educational research and development to promote innovative learning. OneNet is helping distribute

the center's digital, game-based, learning tools. The center's learning games teach students important STEM concepts from inferential logics to hypothesis testing to calculus concepts. Thanks to the partnership, the learning games are available to all Oklahoma schools at no cost.

In addition to these partnerships, OneNet plans to expand the Next Generation Classroom initiative in the coming year to promote other emerging educational technologies.

"The current education system is undergoing a digital transformation," said Vonley Royal, OneNet's executive director. "Technologies such as augmented reality and game-based learning create new avenues for learning in which students thrive. OneNet wants to be a part of that transformation."

By providing educators with the tools they need to teach in the digital learning age, OneNet is furthering its mission to advance technology across Oklahoma.



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

MOREnet KIDS: The K-20 Interoperable Data Solution



As key stakeholders in educational institutions make decisions to mold the best learning environment for today's students, accurate and comprehensive data is crucial. Many struggle with downloading, uploading and merging data from multiple systems to provide information for education leadership, parents, teachers, and counselors as well as required reporting for state and federal purposes.

When the Missouri Research and Education Network (MOREnet) began developing a solution to integrate data from different systems across an educational institution, the primary goal was to help members merge and gather data from a host of existing applications automatically, without the cost of hiring third-party development resources several times per year.

In 2019, MOREnet launched a technology integration solution to K-12 members, the K-20 Interoperable Data Solution (KIDS). With KIDS, information about students currently in a Student Information System (SIS) can be automatically shared into other applications such as a

learning management system (LMS), Active Directory, Google Directory and more. Data is delivered in a single direction or bi-directionally in a safe, comprehensive environment using Kimono as a platform. As an extension of a member's educational and technical staff, MOREnet staff are equipped to help set up and customize KIDS to meet specific needs. MOREnet provides updates, assists as information or applications change and troubleshoots when challenges arise.

With nearly 4,000 students, Camdenton School District was one of the first members to subscribe to KIDS. They are currently using it to integrate data between Active Directory account creation and suspension, Google groups management, SpedTrack data message and Project Lead the Way (PLTW) class rostering. KIDS can be expanded to a variety of other systems as Camdenton is ready.

Adam Johns, system administrator at Camdenton Schools, said, "KIDS has definitely saved us time and made certain aspects easier. We can spend more time on other work processes

while we know that we only have to worry about the KIDS systems if there is an issue."

Although KIDS began as a way to solve data challenges for K-12 schools, MOREnet quickly learned that higher education institutions have similar needs. And, because their primary member groups work closely with one another, MOREnet established a statewide forum for an open exchange on interoperability ideas and needs. The Missouri Data Interoperability Vision Exchange (MoDIVE) started as a day of discussions to learn and interweave an information exchange between K-12, higher education and public libraries.

According to Nathan Eatherton, deputy CIO at Columbia College, "There are dozens of integrations from point-to-point, each traditionally done manually. A data integration tool would mean less coding and configuring and more overall visibility and easy access to real-time data. Using a systematic approach could in most cases shave weeks of work."

Two years into their interoperability journey, MOREnet has barely scratched the surface with this solution to their members' needs. However, excitement remains about the integration and streamlining opportunities they can offer their members - saving them time, building efficiencies, improving data quality and enhancing the user experience along the way.

The Missouri Research and Education Network (MOREnet) is a member-driven consortium providing 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. MOREnet serves more than 700 members across Missouri. www.more.net

OARnet Partnership Supplies Network to Boost Ohio Drone Research

For more than 30 years, OARnet has provided statewide connectivity for a wide variety of innovative projects across Ohio. These projects include a booming esports industry, a growing number of next-generation 911 systems, an ever-widening network of telehealth services, K-12 distance learning and online testing efforts, and a national presidential debate held on a small college campus.

“Since its inception, OARnet has been at the center of hundreds of complex partnerships where disparate communities accomplish amazing things together,” said Denis Walsh, interim executive director of OARnet. “The Ohio UAS Center project is a wonderful example of the power of such collaboration.”

Recently, OARnet engineers connected the Ohio Unmanned Aircraft System (UAS) Center in Springfield, Ohio, to the network’s 5,000-plus-mile, 100-gigabit-per-second fiber-optic backbone. Achieved through a local, state and federal governmental partnership, this “big-pipe” connectivity boosts

the ability of UAS Center engineers to develop a ground-based “sense-and-avoid system” for unmanned aircraft, also known as drones.

The OARnet connection supports SkyVision, which enables drones to be flown in the beyond-visual-line-of-sight (BVLOS) mode. Developed as a cooperative effort between the U.S. Air Force Research Lab and the State of Ohio, the system monitors radar data from several locations via OARnet, allowing experimental drones to see and avoid other aircraft while they are in flight.

“New technology connectivity is a crucial piece to deploy unmanned aircraft across the state, and OARnet facilitates that vision,” said Richard C. Fox, airspace manager at the Ohio UAS Center. “Bandwidth is a crucial driver in the continued growth of autonomous vehicles -both in the air and on the ground - and Ohio had the vision to develop a network that supports current and future advancements.”

The OARnet connection links the center at the Springfield-Beckley Municipal Airport to Ohio UAS offices at a tactical training site, as well as to FAA radar feeds from airports in Dayton and Columbus and long-range radar in London, Ohio. Network links were added between the center and nearby Wright-Patterson Air Force Base and the NASA Glenn Research Center in Cleveland, another test site for drone technologies.

This project additionally included robust network connections to the city of Springfield, along with added resiliency, better redundancy and greatly increased bandwidth to nearby OARnet member schools Wright State and Miami universities. Clark State Community College leverages drones for its precision agriculture program, and Sinclair Community College developed a UAS training and certification center to teach students to fly drones.

“The OARnet connection further strengthens the UAS flight activities,” said Tom Franzen, assistant city manager for Springfield. “Building on the assets of the 1,800-acre airport complex and the SkyVison UAS range, the high-speed OARnet network enables the research and development of state-of-the-art autonomous technologies advancing Ohio’s leadership role in aerospace.”

The work of the UAS Center, carried out through the Ohio Department of Transportation’s DriveOhio initiative, gives Ohio a major advantage in economic development as drones become the basis for new industries such as precision agriculture, infrastructure inspection, environmental survey and first-responder support.



The Ohio Academic Resources Network (OARnet) is a division of the Ohio Board of Regents’ Ohio Technology Consortium. Since 1987, OARnet has identified and deployed shared services that reduce costs, deliver quality programs, increase productivity, and improve customer service. Ultimately, OARnet promotes community and economic development by expanding access to affordable technology. www.oar.net

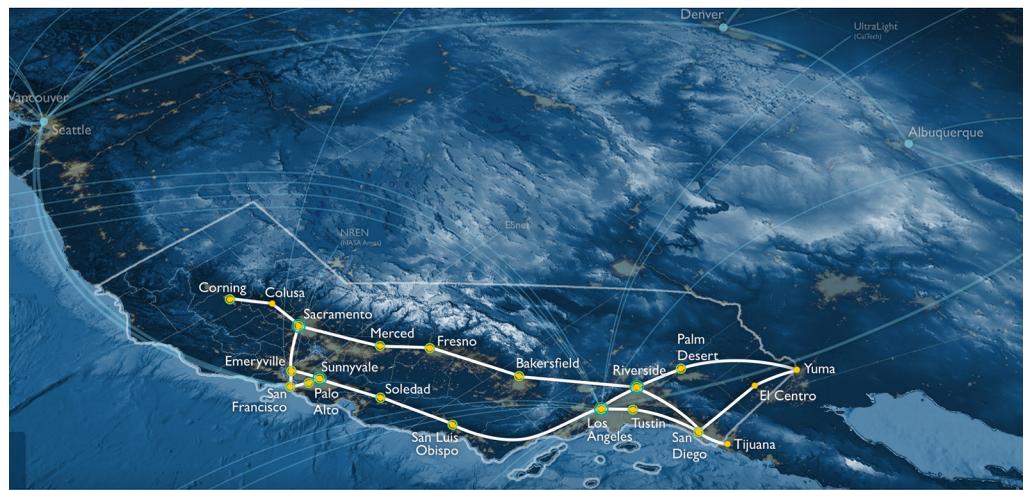
CENIC Builds 400G Super-Channel Between Los Angeles and Riverside

CENIC has built a 400 gigabit-per-second (Gbps) single-carrier optical circuit between Los Angeles and Riverside in California, one of the first-ever production 400G super-channels to be deployed by a US regional research and education network. Construction included upgrading nodes in Los Angeles, Tustin, Oceanside, San Diego (home to the San Diego Supercomputer Center), Escondido, Sun City, and Riverside to 400G capabilities.

This next-generation super-channel ensures CENIC can meet today's networking demands while remaining future-proof and flexible to meet the needs of tomorrow. CENIC members conduct scientific research in astronomy, genomics, climatology and more, and they need to be able to collect, transfer, process, and store huge data sets as they collaborate with colleagues across the world. Each year, CENIC's network traffic grows by roughly 60 percent; in 2019, the network moved an exabyte of data.

To develop the 400G connection, CENIC upgraded network infrastructure to flex spectrum Reconfigurable Optical Add-Drop Multiplexers (ROADMs) and the NCS 1004 transponder platform. The new 400G wavelengths support network operational benefits to deliver 100G services.

"This is an important networking milestone for CENIC," said President and CEO Louis Fox. "With increasing demands for 100G services among our community, from research scientists working with big data sets to educators leveraging technology to transform the classroom, network capacity should not limit the work or ambitions of our researchers, teachers or students."



"This achievement is part of CENIC's ongoing plan to upgrade to the latest 400G technology," added Sana Bellamine, senior optical engineer. "CENIC plans to expand 400G capabilities along its coastal fiber path from Los Angeles to Sunnyvale in 2020. Emerging 400G-plus technologies are space and power-optimized, and have a lower cost per bit, enabling CENIC to scale efficiently."

The new capacity will support the Pacific Research Platform (PRP), a partnership of more than 50 institutions, led by scientists at UC San Diego and UC Berkeley, with funding from the National Science Foundation. PRP builds on the optical backbone of Pacific Wave, a project of CENIC and Pacific Northwest Gigapop, to create a high-speed freeway for large scientific data sets by connecting campus networks and supercomputing centers on a regional scale, with Science DMZs at each site. Developed by the U.S. Department of Energy's Energy Science Network (ESnet) engineers, Science DMZs address common network performance problems by tailoring the environment to the needs of high-performance science applications, including high-volume bulk data

transfer, remote experiment control, and data visualization. PRP supports projects such as the Large Hadron Collider (LHC) and the Large Synoptic Survey Telescope (LSST).

Nationally, CENIC's new 400G connections will support FABRIC, an NSF-funded testbed for scientists to build the Internet of the future. FABRIC anticipates a 1 terabit-per-second (Tbps) network, interconnecting nodes at major research and supercomputing centers, including connections along the West Coast.

"This new 400G circuit is an important step forward in evolving an optimal, highly flexible architecture for high-performance interconnection of research and education networks, and most importantly, researchers and their crucial instruments, data and applications," said Tom DeFanti, PRP co-principal investigator.

CENIC connects California to the world — advancing education and research statewide by providing the world-class network essential for innovation, collaboration, and economic growth. This nonprofit organization operates the California Research & Education Network (CalREN), a high-capacity network designed to meet the unique requirements of over 20 million users, including the vast majority of K-20 students together with educators, researchers, and others at vital public-serving institutions. www.cenic.org

Networkmaine Cultivates Collaboration to Expand Research Capabilities

When faced with a computational biology student who needed to analyze a data set over 11 terabytes in size, Colby College in Waterville, Maine, realized it had a challenge. The data set required for the student's research took over 11 hours to process on its current network. With a commitment to providing students access to outstanding research opportunities, Colby found a solution in partnership.

With National Science Foundation (NSF) funding, a research collaboration between Colby, the University of Maine System, and the Jackson Laboratory worked with Networkmaine to build a dedicated research network. The new network expands classroom and lab capabilities and supports projects in computational biology, computational physics and astrophysics, computational chemistry, and machine learning. That same data set that took 11 hours to process now takes under

30 minutes. Soon that data will be able to be processed in less than 8 minutes.

The new research network provides 10G network connectivity to all academic buildings at Colby and creates a secure, dedicated 10G research network connecting the Advanced Computing Group resources at the University of Maine to the large genomic databases at the Jackson Laboratory. This new technical capacity allows faculty access to state-of-the-art computing and data facilities and enables researchers to obtain fast access to gigabyte- and terabyte-scale data sets. Using this infrastructure, researchers are able to execute analyses and simulations that simply were not possible before.

Beyond the technological advances and impacts though, both Downer and Jeff Letourneau, executive director at Networkmaine, agreed that the biggest

win of the grant was the relationships that were built in the process and the future collaboration it inspired. "The most important thing about this grant is the community that we've built," Downer emphasized. "It's all about the people, not just about the tech. The community built between Jackson, the University of Maine, and Colby and connection to campus champions has been huge and the relationships we have developed between the institutions are still massively paying benefits."

As a result of the strong relationships that now exist, several opportunities for new collaborations have surfaced. Colby and the University of Maine System now are co-locating each other's infrastructure, making the network more resilient. "Because of our connection to Networkmaine, I was able to connect Bigelow Labs personally and now they're connected to the Maine Research and Education Network," Downer shared. "We have dramatically improved the connection between the two institutions."

Moving forward, the new research network not only creates the technical capacity for future innovation in research and instruction at Colby, it opens the door for future collaborations across the state. "It's our hope that this thing that we built between us gets picked up by other institutions in Maine," Downer said. "Hopefully we've laid the groundwork and done enough of the basic tubes and wires kinds of stuff that they can join up with us really easily."

Article reprinted courtesy of Therese Perlowski, Internet2 Community Anchor Program Manager. Image owned by and courtesy of Colby College.



Networkmaine is a unit of the University of Maine System providing Maine's Research & Education (R&E) community with access to high-bandwidth, low-latency connectivity and complimentary services that enhance their ability to successfully deliver on their missions. In addition to servicing higher-education and research, Networkmaine provides K-12 schools and public libraries in the state with Internet connectivity at little or no cost through the MSLN project.

www.networkmaine.net

KyRON Connects Rural Kentucky - One Parking Lot at a Time

What do you do when the neighborhood gas station has a better wireless connection than the local community college? In parts of Kentucky, you turn your car into a personal computing center.

The Kentucky Community & Technical College System (KCTCS), the Kentucky Post-Secondary Education Network, and the Kentucky Regional Optical Network (KyRON) have banded together to provide a unique way for their communities to access the Internet through their “parking lot initiative.”

Many parts of rural Kentucky do not have access to high-speed Internet. In most of these areas, there isn't a Starbucks nearby, and even libraries may have a poor connection. Commercial providers often don't reach these areas, leaving entire communities without access. Dr. Jay Box, KCTCS president, immediately saw the need for quality wireless Internet after he embarked on a “roadshow” tour to gather community and student feedback.

The scope of KCTCS and its focus on rural communities make it uniquely positioned to provide a solution to the lack of high-quality access in its communities. KCTCS serves more than 75,000 students through 16 colleges and more than 70 other locations throughout Kentucky. Campus buildings span as far east in the state as Ashland and as far west as Paducah. With a mission to improve the quality of life and employability of Kentucky's citizens, KCTCS took the issue of expanding wireless services head on.



KCTCS invested over half a million dollars in refreshing and building out wireless infrastructure. As a result, there are now over 2,000 wireless access points available via KyRON throughout the community college system. KCTCS focused on providing expanded Internet access by creating an open-guest, wireless network that extends out into the parking lots of each of its locations.

The parking lot initiative has been a huge success for KCTCS, allowing it to expand capacity to serve its students and the local communities. Most students are working adults ages 25-36. Without home Internet access, they need a place to study and interact with curriculum tools. The parking lots were a perfect solution. Students and other community members come in after work or in the evenings to connect to the network to study, share music, apply for jobs, and enroll in

healthcare. Several campuses also started a specific program designed to increase law enforcement presence on campus, reserving parking spaces for local police officers so they can use the wireless access to complete and access reports from their vehicles.

A true part of the community, KCTCS offers its often-underserved communities the incredibly valuable resource of connection. Kenneth Burdine, associate CIO for KCTCS emphasizes, “In everything we do, our mission is to improve the quality of life and employability of the citizens of the commonwealth.”

In a world where Internet access is no longer just a want but truly a need, KCTCS provides a creative and effective solution by connecting rural Kentucky communities one parking lot at a time.

Article reprinted courtesy of Therese Perowski, Internet2 Community Anchor Program Manager.

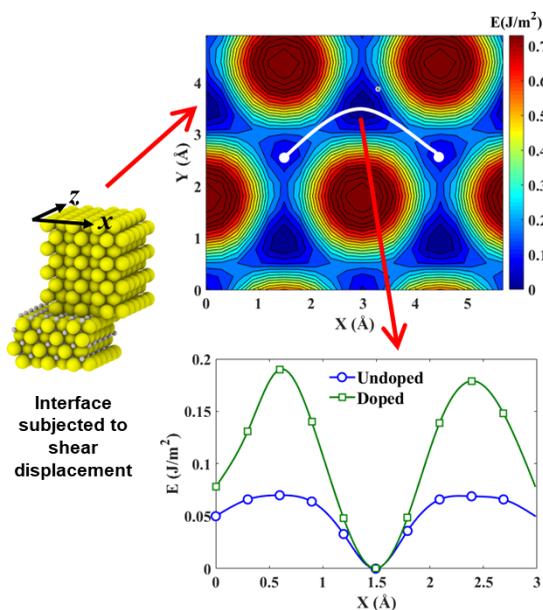
KyRON is a statewide, higher education network serving 8 public universities and 16 community and technical colleges in Kentucky. KyRON provides Internet2 services to the state's entire post-secondary education community and extends services to local libraries and agricultural extension offices. As a member of Internet2 and The Quilt, the KyRON community provides members the opportunity to utilize nationwide technology services in support of their academic programs.

LONI Speeds Up Research to Improve Machine Parts

A few decades ago, it was common for automobile transmissions to wear out despite having an engine in relatively good condition. Engineers soon discovered that the life of machine components operating at high temperature, pressure, and speed can be significantly extended by adding a thin layer of ceramic, provided the interface between the metal and the ceramic was strong and durable. Although this discovery has allowed automobile manufacturers to offer powertrain warranties of up to 10 years or 100,000 miles, the principles involved in choosing the materials for an appropriate interface are unclear. The current approach in material selection consists of trial and error in the laboratory – an endeavor which is expensive, time-consuming, and prone to accidents.

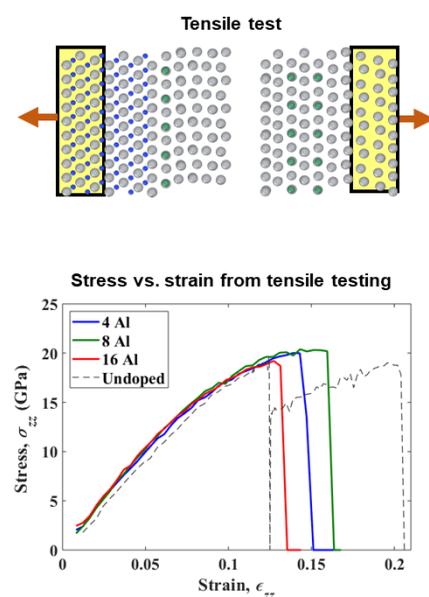
A solution is currently being developed by a team of Louisiana Tech University-based researchers through the Consortium for Innovations in Manufacturing and Materials (CIMM) in Louisiana and funded by the National Science Foundation. This team is led by Professor Collin Wick and has developed a computational simulation protocol that helps predict metal/ceramic interface properties based on large-scale computations on the QB2 supercomputer of the Louisiana Optical Network Infrastructure (LONI).

The computationally demanding part of the research is based on a framework known as density functional theory (DFT). These computations enable researchers to gain atomic scale insights into the metal/ceramic interfaces. Using this approach, the team that includes doctoral students



Abu Shama Mohammad Miraz and Nisha Dhariwal, undergraduate student Eboni Williams, and faculty collaborator Professor Ramu Ramachandran, predicted that adding aluminum to the interface between titanium and titanium nitride will significantly increase its wear resistance whereas some other doping agents will have no effect or a negative one.

Predictions of interfacial properties were also made for copper/titanium nitride interfaces doped with zinc and nickel. These results have allowed the researchers to increase awareness of factors that determine interfacial strength in these cases. Equally important is that these results were obtained in a matter of several wall-clock hours of computations running on several compute nodes of QB2. Preparing the corresponding metal/ceramic systems in the lab and testing their properties would have taken many months of painstaking effort, but without the atomic scale insights provided by computations.



The computational demands of DFT are so high that only systems of a few hundred atoms can be studied. Simulations make it possible to understand the effect of phenomena that only emerge at larger scales, such as crystal domain boundaries, defects, and misfit dislocation networks, on interfacial properties.

The team is now collaborating with experimentalists to validate their results and models against sophisticated measurements made possible by the research infrastructure investments through the CIMM project. Once the computational models are refined and validated against experiments, the protocol can be used to rapidly screen additives to coatings that optimize wear resistance and to rule out the less effective ones, thus saving significant time and money for the manufacturing industry.

The Louisiana Optical Network Infrastructure (LONI) is the premier high-performance computing and high capacity middle-mile fiber optic network provider for higher education and research entities in Louisiana. 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 provided by LONI enables greater collaboration on research that produces results faster and with greater accuracy. www.loni.org

UETN Provides Leadership for High Performance Networking at International Event

The Utah Education and Telehealth Network (UETN) provided a leadership role in planning, building and operating SCinet - the lightning fast network at the heart of SC19, the International Conference for High-Speed Computing, Networking, Storage and Analysis, held in Denver last year.

Jim Stewart, UETN CTO, chaired the SCinet team. It took them more than a year to plan and a month to build, but just a week to operate, and 24 hours to dismantle. Under Stewart's direction, 33 organizations contributed \$80-million in hardware, software and services to build the network. That's up from \$52 million contributed at SC18 in Atlanta the year prior.

UETN was among 88 organizations that sent employees to volunteer in planning, building and operating the network.

"It's a one-of-a-kind opportunity to work with this international team in a multi-vendor environment and thus provides unparalleled professional development," said Stewart. "We are able to integrate different technologies. We learn and share technical skills. We learn and practice organizational, management and communication skills. We develop important interpersonal skills."

Participants also learn how to face the pressure of building real-world infrastructure that has to work on a global scale. "This is a project with a final exam," exclaimed Stewart. "The exam starts on the opening night of the conference. International participants start using the network to showcase their research. Cutting-



SC19 Chair Michela Taufer, SCinet Chair Jim Stewart, and SCinet Deputy Chair Marc Lyonnais (center front) with 140 of the 200 women and men who planned, built and operated SCinet (background). Photo by Susan Cohen. Visit <https://www.facebook.com/watch/?v=779767119151747> to view volunteers explaining why the experience is a one-of-a-kind professional learning opportunity.

edge experiments are deployed. VIP tours are conducted. It is a fishbowl! If you stumble, you stumble on an international stage, but if you succeed, you succeed on an international stage."

By all accounts Stewart and his team succeeded. SCinet delivered a stunning 4.22 terabits per second of wide-area network bandwidth, enough speed to download the entire iTunes music library in less than 10 minutes. It deployed the first-ever 400 Gbps connection between Denver and Chicago.

"What we do always comes back to making the UETN network better," added Stewart. "It's all of these configurations; it's all of these details that we're learning, that we're working out how to make a network perform better and be more reliable."

Stewart sees that outcome when he visits schools in the isolated communities of Utah, where

broadband is a necessity for education and healthcare. The network is nearing completion of fiber paths to remote San Juan and Daggett Counties, which have had to rely on much slower digital microwaves.

Ray Timothy, UETN CEO, attended the Denver event and hopes future SC conferences will again be held in Salt Lake City. He said SC12 and SC16 provided immediate and long-term benefits to Utah. "Visitors want to come back and bring their families, which in turn contributes to our economy. Some attendees return as valued members of Utah's workforce."

UETN also benefits in recruiting and in reputation. "Because we are part of SC, we're acknowledged as an industry leader in high-performance networking," adds Timothy. "Our ongoing involvement shines the spotlight on UETN and the University of Utah, where we're based, and on the state at large."

Whether it's 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

LEARN Uses \$800K Grant to Accelerate Connectivity at Small Texas Colleges



Accelerating Research and Education at Small Colleges in Texas via an Advanced Networking Ecosystem Using a Virtual LEARN Science DMZ

Award # 19-25553

Objectives



1. Establish a small college collaborative environment within the LEARN community



2. Improve network connectivity/services at each college campus for research and education



3. Establish a network performance monitoring infrastructure



4. Establish a means to facilitate the transfer of large data sets



5. Deliver technical training to personnel at each campus



6. Develop and implement an outreach program for informing/educating faculty, staff, and students at each college, and develop and disseminate project results.

Participating Colleges

- McLennan Community College
- Trinity University
- South Plains College
- Texas Wesleyan University
- South Texas College

Collaborators

- EPOC & Esnet
- Internet2
- The Quilt
- TACC



In September 2019, LEARN was awarded its first National Science Foundation (NSF) grant as a lead organization – a two-year, \$800,000 CC* Regional award titled: Accelerating Research and Education at Small Colleges in Texas via an Advanced Networking Ecosystem Using a Virtual LEARN Science DMZ (award number: 19-25553). The grant helps LEARN develop a program for regional network connectivity for smaller colleges and universities in Texas.

The initial set of five diverse colleges – McLennan Community College, South Plains College, South Texas College, Texas Wesleyan University, and Trinity University - have unique needs and programmatic foci, but many shared goals that can be addressed by faster, more advanced network infrastructure and access to high-performance

computing. Through partnerships with the Texas Advanced Computing Center (TACC) at the University of Texas at Austin, Internet2, The Quilt, and the Engagement and Performance Operations Center (EPOC), LEARN hopes the project can be extended more broadly to other R&E networks across the United States and to the smaller campuses in their regions.

“We wholeheartedly embrace the theme of this project,” said Dan Stanzione, associate vice president for research at the University of Texas at Austin and executive director of TACC. “LEARN, as a regional cyberinfrastructure (CI) organization in the southern U.S., can and should play a substantial role in expanding utilization and access to research and education CI to less resourced colleges and universities.”

“This is a big technological leap forward for South Plains College – aside from this being our first NSF grant, we will now have access to resources and training that has not been available in the past,” said Ryan Fitzgerald, co-principal investigator for this grant and dean of Dual Enrollment and Distance Education at South Plains College. “As a large, rural community college, this grant will allow our institution to provide the same network connectivity that large universities provide their students and staff.”

A primary objective of this project is to develop a CI-enabled community of small colleges to foster the growth of research and research-related education and training in institutions where there have been historical limitations. The outcomes of this collaboration will be faster, more efficient uptake of technologies, deployment of services needed to support excellence in teaching and research in the classroom, professional development of faculty and IT staff.

“Being able to partner with LEARN and have access to their expertise is a force multiplier for us,” said Jim Bradley, co-principal investigator for this grant and CIO at Trinity University. “This program will allow our researchers to access advanced computational services at scale without requiring us and many other smaller universities to replicate expensive local infrastructure. This serves everyone in Texas well and creates a great model for the country.”

The Lonestar Education and Research Network (LEARN) is a consortium of 41 organizations throughout Texas that includes public and private institutions of higher education, community colleges, the National Weather Service, and K-12 public schools. The consortium, organized as a 501(c)(3) non-profit organization, connects its members and over 500 affiliated organizations through high performance optical and IP network services to support their research, education, healthcare and public service missions. LEARN is also a leading member of a national community of advanced research networks, providing Texas connectivity to national and international research and education networks, enabling cutting-edge research that is increasingly dependent upon sharing large volumes of electronic data. www.tx-learn.net

Indiana's I-Light to Build, Manage Network for First 2020 Presidential Debate

When the spotlight falls on the University of Notre Dame as host of the first presidential debate of the 2020 election season, I-Light will be there. As Indiana's research and education network, I-Light has a starring role in this high-profile democratic tradition by providing all the connectivity for the event. The debate at Notre Dame will be the first in the 2020 election series. It will take place on Sept. 29th in the Purcell Pavilion of the Joyce Center in South Bend.

"The heart of democracy is addressing significant questions in open, reasoned discussion that will inform voters as they prepare to cast their votes," said Notre Dame president, Rev. John I. Jenkins, in a university-issued news release. "Standing apart from the glitz and spin of modern campaigns, the presidential debates are that solemn moment in our national life when candidates are invited to discuss seriously the central issues before us."

In order to present such discussion to the American electorate, whether via television, the Internet or radio, Notre Dame needs a reliable, secure network to transmit information. In fact, the Commission on Presidential Debates takes this so seriously that they require debate-hosting institutions to provision a new network completely separate from the current campus network. This practice helps prevent connectivity disruptions and cyberattacks that could thwart the debate.

Since 2001, the I-Light network has provided reliable, high-speed network connectivity to nearly every college and university in Indiana. Powered by the



Global Research Network Operations Center (GlobalNOC) at Indiana University, I-Light is a collaboration of higher education, government, and private-sector broadband providers working together to accelerate teaching, learning, and research across the Hoosier State.

I-Light was a natural fit for Notre Dame based on its years of membership within I-Light. Today, I-Light provides two diverse 100G links to Notre Dame for their campus academic and administrative needs as well as to support the research needs of the campus. For the new debate network, I-Light will provide engineering expertise to install the network as well as on-site engineering during the debate to handle any potential issues.

Tom Johnson, I-Light network architect, will manage the team of engineers

building the network. "This kind of project is our bread and butter, so to speak," he said. "My team has the tools and expertise to work around problems, and we're providing fully redundant connectivity - provisioning the network to redundant routers and paths - as an added measure of protection."

"It is an honor to be seen as a trusted partner to Notre Dame," said Marianne Chitwood, I-Light director. "It is what we strive to be to all our members, and building the debate network is a perfect example of being called upon to provide this support."

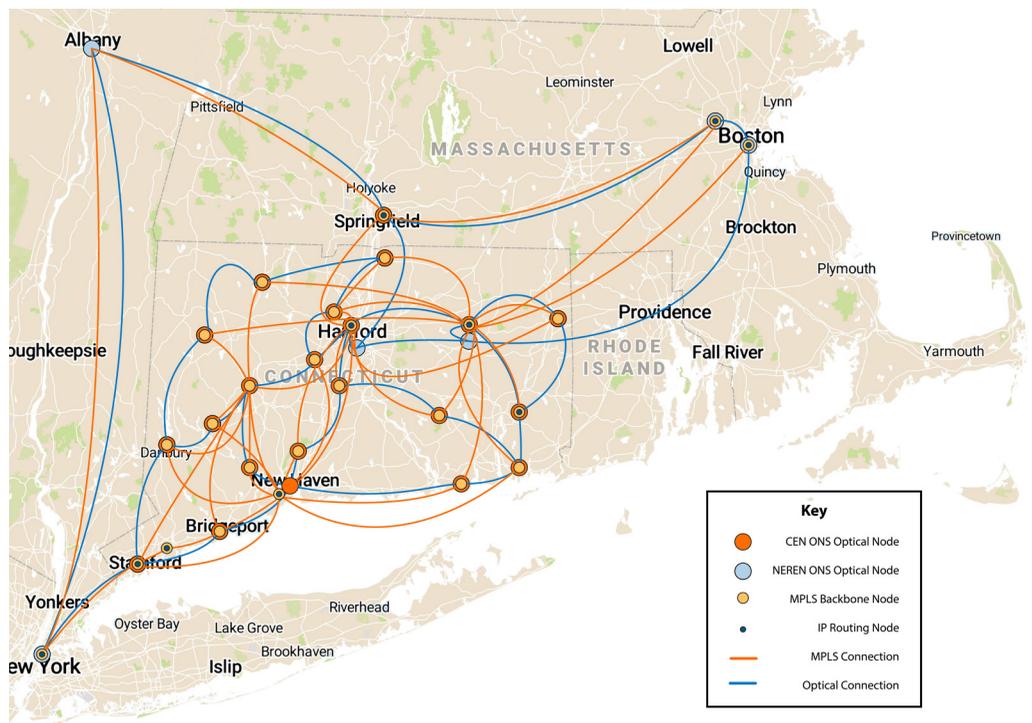
I-Light, a unique collaboration among Indiana colleges and universities, state government, and private sector broadband providers, is a high-speed fiber optic network that connects Indiana member sites to state, national, and international research and education communities. www.ilight.net

CEN Celebrates 20 Years of Growth with Strategic Plan for the Future

In 2020, CEN celebrates connecting Connecticut's communities and citizens for 20 years! CEN provides end-to-end, Gigabit-plus connectivity to community anchor institutions in every Connecticut community serving more than 1.8 million students, educators, researchers, state and municipal employees. Developed with the participation of members from across the community, CEN released its five-year, strategic plan in 2019. The plan offers direction and initiatives to provide increased value, ignite innovation, foster collaboration, promote advocacy, and enhance core resources.

While well established in K-12 and higher education for over a decade, connecting Connecticut's libraries has been a major initiative for enhancing their community value and reducing the state's digital divide, especially in rural areas. Over the past five years, CEN has connected 158 libraries representing 66 percent of all libraries statewide. Many locations help underserved communities where connectivity options have remained unchanged for decades. With the financial benefits of E-Rate and matching state bond funds, eligible libraries transition from copper-based asymmetric 25/3 Mbps service to CEN's fiber-optic network with symmetric 1 Gbps speed and capacity for growth to 40 Gbps.

CEN's DDoS Threat Management service provides tremendous value to the education community by ensuring smooth operations at no additional cost to member organizations. CEN's DDoS solution mitigated 988 attacks in 2019, representing a significant increase in frequency, size and duration from prior years. The return on investment on DDoS mitigation is well over 1,000



percent since its introduction four years ago. This service is a prime example of an aggregated service delivered at scale, helping members avoid millions in direct costs if purchased individually and/or commercially.

Providing enhanced security is the primary service need for CEN members. Along with the DDoS service, CEN members of all sizes can now benefit from the CEN Firewall service. Offering enterprise class technology with a high availability, geo-diverse architecture, and a fully-managed support option, CEN's Enterprise Firewall service helps members improve their security posture, reduce burdens on staff, and save money over time.

The CEN Engagement and Development Advisory Council launched a series of community trainings to foster collaboration and deliver additional value at no additional cost. Topics have included: Student Data Privacy (K-12), Toward Gigabit Library Tool Kit,

Digital Accessibility (higher education), Ransomware Forum (K-12 and municipal), Cyber Defense Clinic (all), E-Rate Category 2 Enhancements (K-12 and library). CEN also introduced a series of Member Town Hall Meetings in various locations across the state discussing member concerns, needs, and future CEN service offerings.

The CEN Member Conference expanded into a two-day event. Alongside the traditional Member Conference experience, which included keynote speakers, parallel sessions, affinity group meetings, vendor exhibits, and the ever-valuable colleague networking, members joined in-depth technical or educational workshops at the pre-conference.

CEN will continue to be the trusted partner through which Connecticut's digital and human networks can connect, collaborate, and share resources to realize the full potential of a robust statewide network.

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 and municipalities throughout Connecticut. CEN's statewide fiber-optic network connects more than 1.8 million students, educators, researchers, state and municipal employees, and citizens in support of Connecticut's workforce and economic development. www.ctedunet.net

WVNET Powering Teaching and Learning Commons in West Virginia



The West Virginia Network (WVNET) is one of the longest-running, research and education networks in the United States - celebrating 45 years of operation this year. Their customers include higher education, K-12 education, state government, and non-profit organizations. WVNET has gone through several changes in almost five decades of service and is currently on the precipice of another evolutionary shift.

Beginning in August 2020, WVNET will offer a Teaching and Learning Commons (TLC) to the state of West Virginia. The TLC is a new service model built on the foundation of WVNET's current PEAK service offering.

PEAK (Portal for Education, Achievement and Knowledge) is an online portal utilizing Blackboard. This portal allows WVNET to host and administer its own Learning Management System (LMS) for professional development and online courses. PEAK provides online, on-demand faculty and staff training. It is a shared resource that provides cost savings to WVNET and

their clients through reduced travel and lower personnel costs. PEAK is an ever-growing knowledge base of information. The course and training library continues to expand and will provide the backbone for the TLC.

In 2012, WVNET began providing managed hosting services for Ellucian Banner and DegreeWorks as well as the Blackboard LMS. These services include both front- and back-end support. The front-end support encompasses training and professional development, a 24x7 help desk, on-site and online training. Both services have a well-established customer base and will seamlessly roll into the TLC model. WVNET has recently acquired licenses for the SoftChalk Content Authoring Solution and the Medial Video and Audio Streaming service. These tools provide additional support to customers in a managed hosting environment. Application specialists, instructional designers, GUI administrators, along with database and systems administrators, work together to round out the team and service providers.

The TLC will include a variety of instructional modalities and utilize faculty experts throughout the state to design and deliver topics. Needs assessments will be conducted among constituents to provide a shared vision for development and implementation.

WVNET will also offer a service model for on-demand expertise. Universities will be able to contract for IT professionals to fill any gaps on their campuses. Services include Blackboard and Banner experts, database administrators, software developers, telecommunications support, web developers, and systems administrators. Contract terms will vary from short-term engagements to long-term projects.

WVNET continues to provide the educational technology services and professional development needed in West Virginia.

West Virginia Network for Educational Telecomputing (WVNET) is a dynamic service organization providing telecommunications and computing services within West Virginia. Administered by the Higher Education Policy Commission (HEPC) and focused on state colleges and universities, WVNET also provides significant services to state and county governments, K-12 schools, public libraries and non-profit organizations. www.wvnet.edu

MAX Supporting Research in Turbulent Hypersonic Flows



Cyberinfrastructure is critical to the advancement of research and Mid-Atlantic Crossroads (MAX) has a critical role in this complex ecosystem. MAX supports the University of Maryland's Department of Aerospace Engineering by providing computing resources and research support for the Cluster for Research on Complex Computations (CRoCCo) Laboratory.

The CRoCCo Laboratory was founded in 2002 by Dr. Pino Martin who currently serves as its director. The focus of the lab's research is to create the engineering foundation for the accurate prediction of turbulent hypersonic flows, develop theory and numerical methods, perform space and time-accurate simulations, design new experiments to validate the numerical data, and collaborate with experimentalists. This research has many applications of interest to the U.S. Department of Defense and the

space program, including problems of current interest in fields related to atmospheric hypersonic flight, supersonic combustion and access to space.

One of the goals of the CRoCCo Laboratory is to create an open database of traceable, standardized wall-bounded turbulent flows. The database is to include experimental and computational data, with the experiments and computations being performed under the exact same conditions for a 1:1 comparison, which will provide a major boon to future research of turbulent flows.

The CRoCCo Laboratory's research has benefited immensely from the computing resources on MAX's high-performance computing (HPC) cluster, Juggernaut, particularly the compute and file storage resources. The nascent database of turbulent

flows will require significant amounts of storage, on the order of 1 petabyte, as well as a significant amount of computational resources to compare to the experimental results. Additionally, the database will need to be well connected to facilitate access by other researchers. To this end, this growing cluster is part of the ScienceDMZ on the MAX research infrastructure, which rides on the MAX production network and includes a 100 Gbps connection and other network-rich compute and storage resources. In addition, MAX modernized the CRoCCo Lab's equipment hardware and networking components to allow for ongoing remote visualization and other capabilities. In particular, MAX worked with campus IT security at the university to create a process through which CRoCCo workstations could access the file system in the ScienceDMZ directly, bypassing normal campus firewalls. MAX also assists the CRoCCo Lab by providing system administration support, user support, and general cluster support.

As the prediction of turbulent flows continues to be of paramount importance, the availability of sophisticated computational resources will play an increasingly significant role. "MAX is well-positioned to support this kind of research, and we see this as our core mission," says Tripti Sinha, MAX executive director.

Mid-Atlantic Crossroads (MAX) is a center at the University of Maryland that operates a multi-state advanced cyberinfrastructure platform. MAX's all-optical, Layer 1 core network is the foundation for a high-performance infrastructure providing state-of-the-art 100-Gbps network technology and services. MAX participants include universities, federal research labs, and other research-focused organizations in the Washington and Baltimore metropolitan areas. MAX serves as a connector and traffic aggregator to the Internet2 national backbone and peers with other major networks. Its mission is to provide cutting-edge network connectivity for its participants, tailored and generic data-transport solutions, and advanced services to accommodate and optimize large data flows and to facilitate network and application research. www.maxgigapop.net

FLR Engages Members to Identify Future Needs

Florida LambdaRail (FLR) takes pride in customer service; knowing it's both an obligation and a privilege to serve the needs of Florida's research and education community. Meeting that obligation, FLR recently surveyed members about their technology needs over the next five-to-ten years and is utilizing this information to grow their network in a purposeful way as well as fully understand what types of services their members will want and need.

The responses, which were in broad alignment with the results of the Educause Top 10 IT issues for 2019, indicated that the next five-to-ten years will require a focus on Security (highest priority), Data, Funding, Student Success Issues, Cloud Services migration, Research Computing, and Big Data capabilities.

FLR is already taking steps to help members meet these new demands. Working with Internet2, they have incorporated a system-wide distributed denial-of-service (DDoS) solution that covers every FLR participant at no additional cost to members. They have created a Science DMZ, following the ESnet Science DMZ model, that has been established across their entire network backbone. A Science DMZ is a portion of the network, built at or near the network perimeter, designed so equipment, configurations, and security policies are optimized for high-performance scientific applications rather than for general-purpose business systems or "enterprise" computing. To date, four FLR campuses have connected to the FLR Regional Science DMZ with several others in progress.



FLR

Florida LambdaRail

Florida's 100 Gigabit Research and Education Network

FLR will soon bring the Sunshine State Educational and Research Computing Alliance (SSERCA) into operation. SSERCA is a collaboration of Florida's public and private universities that promotes the development of a state-wide, computational science infrastructure of advanced scientific computing, communication and education resources. Incorporating SSERCA into FLR will provide researchers with the assets they need to better manage their efforts while freeing their members to focus on core research computing initiatives.

FLR members are planning to upgrade their Enterprise Resource Planning (ERP) systems soon. To assist them, FLR is developing a plan to help them navigate new ERP procurements and implementations. Meetings will take place over the next several months to identify areas of common need from human resources and fiscal to student support systems. As a convening agent, FLR's strength is in the diversity of their membership. Not every school will need the same solution, but there are enough commonalities that having FLR involved in the early stages provides benefits to all.

Routinely surveying their membership is an important part of how FLR provides good service and at their core, that is what all research and education networks do. The feedback gained from routine engagement keeps FLR fresh and is essential to identifying and negotiating important services for the community. FLR members expect the best tools and solutions to remain at the cutting edge of technology and FLR provides them with exactly that.

Florida LambdaRail (FLR) is Florida's Research and Education Network. With its 100 Gbps 1,540 mile dark fiber network, FLR provides a cost-effective, ultra-high speed, inter-connected, broadband service delivery network that enables Florida's higher education institutions and partners to collaborate, connect, utilize, and develop new innovative broadband applications and services in support of their scientific research, education, and 21st century economy initiatives. www.flrnet.org

OSHEAN Celebrates 20 Years of Innovation and Growth

As we celebrate two decades of collaborating with community anchor institutions (CAIs) across Rhode Island and Massachusetts, we have an opportunity to pause and reflect upon our early roots and just how far we've come since OSHEAN's founding in 1999.

What began as a germ of an idea during discussions among the University of Rhode Island (URI), Brown University, and the state of Rhode Island about internet access, has developed into an advanced fiber-optic network extending more than 600 miles and innovative, layered technology services to a community of more than 160 member organizations.

In 2009, the effort accelerated and expanded as the group explored ways to utilize a National Telecommunications and Information Administration (NTIA) administered grant program called BTOP, or Broadband Technology Opportunities Program. The OSHEAN-led grant

proposal called for building a communications fabric that would bring CAIs together to benefit further from advanced network connectivity. This included the merging of the local K-12 and library networks (RINET) into OSHEAN, extending services to these communities.

In the early days of the Internet, there was much energy and excitement around what a research and education network could do for Rhode Island and beyond. OSHEAN started with a single router in Providence that connected to a router in Boston belonging to the Northern Crossroads, a consortium of higher education institutions including Harvard and MIT. A cross-institutional collaboration among an impressive group of organizations including URI, Brown, the Rhode Island School of Design, Johnson & Wales University, Rhode Island College, Bryant University and more, helped propel our network forward.

It's this spirit of collaboration that still guides us today. Our progress can, in the simplest terms, be measured by our membership growth. In 2009, OSHEAN's membership numbered 28. Today, OSHEAN provides connections that drive innovation for more than 160 organizations across the region. OSHEAN is dedicated to continuing to expand access to global networks and content providers, and to deliver innovative services such as cost-saving programs for members, embedded security applications, shared research platforms, virtual private cloud services and much more.

It's evident now more than ever that we truly are stronger together. As we forge into the future, OSHEAN will continue to foster collaboration among and with its members to help manage the rapid pace of change in technology.

OSHEAN is dedicated to continuing to expand access to global networks and content providers, and to deliver innovative services such as cost-saving programs for members, embedded security applications, shared research platforms, virtual private cloud services and much more.



WE'RE PROUD TO ANNOUNCE

We're Celebrating 20 Years of
Connections That Pioneer Progress

OSHEAN Inc., is a 501c3 non-profit consortium of member organizations that was formed to foster the development of a communications infrastructure for Rhode Island's research, educational, health care, and public service community. OSHEAN is committed to developing network expertise among its member organizations and to creating an environment that encourages collaboration through shared resources, information and expertise. www.oshean.org

Link Oregon Boosts Marine Research and Aims to Close State's Digital Divide

In 2019, the University of Oregon transitioned the long-standing Network for Education and Research in Oregon to Link Oregon. With this shift, the organization acquired a ready-made research and education network as well as a committed community and experienced engineering staff. Since last summer's launch, Link Oregon made good progress in honing their business and operations model, refining their technology and networking strategy, aligning with leading vendors, and strengthening relationships with other organizations including Internet2, CENIC, telecoms, and broadband agencies.

Link Oregon is currently operating a pilot network segment connecting the Oregon State University (OSU) main campus in Corvallis and OSU's Hatfield Marine Science Center (HMSC) in coastal Newport. OSU and Link Oregon partnered with Oregon-based carrier, PEAK Internet, to light more than 60 miles of dark fiber crossing the Coast Range. This initial connection has important implications.

Newport is fast becoming a key science hub in Oregon. Link Oregon's commitment to supporting the networking needs for marine science research at HMSC also extends to assisting the growing number of federal and state researchers based in the city. Adjacent to HMSC is the base for the western fleet of the National Oceanic and Atmospheric Administration (NOAA). Link Oregon supports Newport connectivity for N-Wave - NOAA's enterprise network leveraging alliances with the research network community and connecting researchers to data and resources needed to advance environmental science.

In contrast, other state regions suffer from broadband deficits inhibiting education, healthcare, Tribal services and economic development. Over the last year, Link Oregon leaders have traversed the state to meet with community broadband champions and have seen first-hand the positive impact a coordinated, state-wide educational networking platform could have for smaller school districts and rural students. Yet many areas do not yet have these capabilities. Link Oregon's mission includes an effort to level the broadband playing field for all Oregon communities.

Governor Kate Brown has recognized that the lack of high-speed Internet poses a key barrier to economic development for rural communities. Link Oregon was among the partners that assisted city manager, Nick Green, in the remote, mountainous community

of John Day, to submit a successful \$6 million USDA ReConnect proposal last year. Link Oregon will continue to support the city of John Day's leadership to develop new broadband infrastructure.

Newport and John Day are just two examples of the state's connectivity opportunities and challenges. Link Oregon will continue their outreach to community partners statewide as they finalize the implementation of the initial network and plan for expansion into southern and eastern Oregon. Link Oregon is dedicated to making statewide connectivity a reality and ensuring a bright (and speedy) networked future for every Oregonian.



Anne Keane, business manager for NOAA's N-Wave Network (R), provided Link Oregon Network Engineer Stephen Fromm with a tour of the NOAA research ship Hi'ialakai. (Dec 2019)

Link Oregon launched in 2019 as the state's non-profit organization representing the consortium of Oregon's four public research universities (OHSU, Oregon State University, Portland State University, and University of Oregon) and state government through enterprise information services. Our mission is to develop and operate a statewide, facilities-based optical network for our members as well as for other public and non-profit entities across Oregon. www.linkoregon.org

KINBER Gets in the Game with E-Sports



The Keystone Initiative for Network Based Education and Research (KINBER) is making big moves in e-sports - competitive, team-based online video gaming - which has steadily grown over the past two years. KINBER recognized the potential growth in infrastructure needed to support e-sports early on and has developed the KINBER E-Sports Direct Connect (KESDX) service, allowing KINBER to carve its way as a leader in Pennsylvania's e-sports community.

In April 2019, KINBER debuted the KESDX pilot at its annual conference and quickly launched e-sports services to its first pilot participant. In response to the tremendous interest in Pennsylvania, KINBER also launched an E-Sports Working Group to provide a way to share information and get feedback from the community. In

addition to forming the first E-Sports Community of Practice in the state, KINBER also worked with fellow Quilt member, Merit Network in Michigan, to co-sponsor an E-Sports Community Discussion in November, that ultimately evolved into a multi-state, distributed e-sports event where KINBER and Merit engaged their members in e-sports conversations, shared best practices, and discussed the exciting and dynamic growth of e-sports all over the world.

KINBER's exclusive KESDX service allows colleges and universities, as well as K-12 schools and libraries, to have direct peering with the most popular game network servers. This keeps latency down by decreasing hops to game servers and keeps network paths optimized, which is essential for competitive game play. Through

KESDX, participants get direct access to Twitch, Riot, Blizzard and Valve through a connection in Ashburn, Va., at the Equinix peering facility. The KESDX service is provided through a Rapid Private Interconnect (RPI) connection provided through Internet2 from Ashburn to KINBER's major POP facility in Philadelphia.

As of 2020, KINBER has moved from piloting e-sports to rolling it out as a new service available to all KINBER customers. The success experienced during its e-sports pilot and through its working group has allowed KINBER to bring more universities and public schools into the game with new opportunities for students.

KINBER is optimistic about the future of e-sports and the opportunities for partnership and the tremendous growth for its members. KINBER will continue to convene its E-Sports Working Group meetings on the first Thursday of each month and has opened participation to many other research and education networks and their members across the United States.

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

KanREN Stabilizes Region by Expanding Fiber Footprint

For 28 years, the Kansas Research and Education Network (KanREN) has worked with community anchor institutions to connect, collaborate, and share resources to realize the full potential of a robust statewide network. KanREN's core membership is anchored by public universities in Kansas that operate as a consortium working collaboratively to function as their own ISP.

KanREN is "connecting beyond the connection" in multi-faceted ways. The network provides powerful connectivity to research and education resources not available through commercial providers. KanREN's backbone is a set of overlapping rings which includes a 100 Gbps ring connecting the research universities and a 10 Gbps ring interconnecting other public universities.

The first phase of a new multi-year plan is to create a fiber ring backbone connecting all the state's public universities. Today there is a single lit 100 Gbps wave between downtown Kansas City and Wichita State University (WSU). The dark fiber KanREN recently acquired through a

20-year agreement with Zayo, will run from downtown Kansas City, through to Johnson County Community College (JCCC), Emporia State University (ESU) and on to WSU. That new 240-mile route is hitting two core institutions along the way, and strategically puts JCCC, the largest undergraduate institution in the state, on its backbone. WSU is considered a strategic location because it also serves as an exit point from the state. It is about 20 miles from the Oklahoma border, where KanREN is working on the next phase: an interconnect with OneNet. Once completed, KanREN and OneNet will provide a shared connection to Great Plains Network (GPN), a regional consortium of state networks with POPs in Kansas City and Tulsa – providing all GPN participants diverse access to Internet2 in both locations.

The plan is to start bringing the fiber online late this summer into early fall. In the long term, engineers are looking to wrap dark fiber around the backside from KSU to WSU, completing a dark fiber ring around all the state's research universities, and to then obtain dark fiber to the other public universities.

KanREN board chair, and JCCC executive director of Business Continuity Management, Sandra K. Warner, said, "The investment this year serves as a centerpiece for KanREN's financial, technology infrastructure, membership, and mission continuity strategy." She added, "Kudos to the KanREN staff and board of directors for their fortitude and commitment to ensure the Kansas Research and Education Network will not only survive, but thrive in the future."

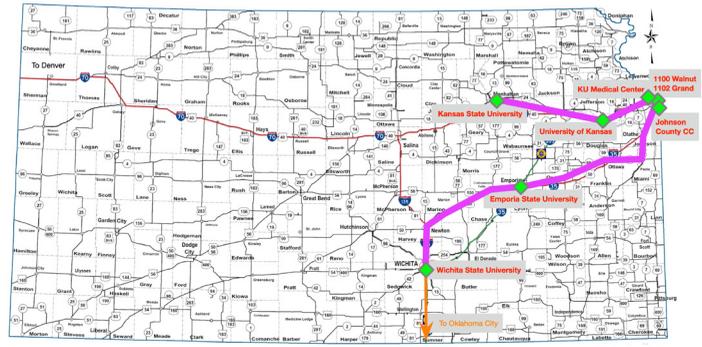
KanREN's multi-year network expansion in collaboration with OneNet and GPN to directly interconnect states in the region will have a long-term stabilizing effect. "It's not only about capacity. Sure, having essentially unlimited bandwidth is great, but our operating paradigm is very much a consortium," confirmed KanREN executive director, Cort Buffington. "This expansion will contribute to the long-term financial and technical stability of KanREN members, and contribute to economic and workforce development in our state; so in that sense, it's about so much more than just bandwidth."

Before



- Intrastate Fiber and DWDM Network
- Lit / Leased Circuit (10G or 100G)
- ◆ DWDM Add / Drop Site
- Lit / Leased Circuit Endpoint

After



- Intrastate Fiber and DWDM Network
- (Future) Interstate Fiber to Regional Partners
- ◆ DWDM Add / Drop Site

KanREN brought "The Internet to Kansas" and continues to provide critical, world-class broadband services, innovations, and support to the Kansas research and education community. As a member-driven, not-for-profit organization, the Kansas Research and Education Network has and continues to focus on advanced network services for all its members.

www.kanren.net

ICN Steps into the Future with High-Speed Digital Learning

Illinois Gov. J.B. Pritzker recently launched Connect Illinois, a statewide initiative to expand broadband access across the entire state. Connect Illinois includes \$20 million for the Illinois Century Network (ICN), to upgrade and expand the broadband network for schools, refresh aged components and expand the existing network, with a focus on the K-12 community. This investment together with the creation of a new state consortium will provide all Illinois public K-12 students access to high-speed broadband at no charge.

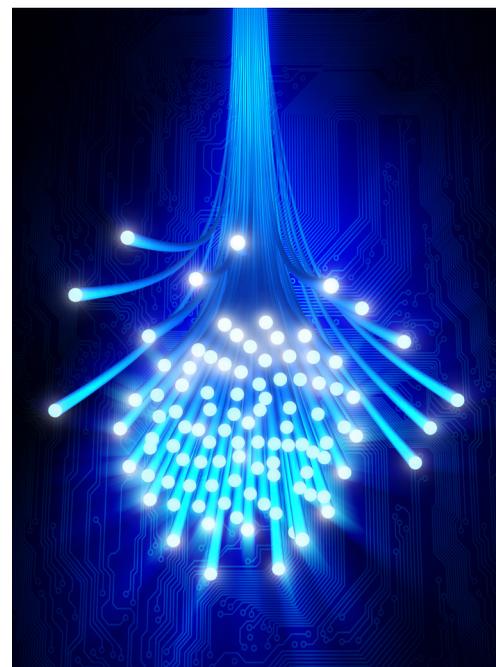
Providing Illinois K-12 students with a world-class education requires unlimited and timely access to information and data. Access to the Internet with no bandwidth restrictions allows students to fully develop their creativity and imagination and provides students a foundation to implement applications using the latest technologies, such as virtual and augmented reality, holographics and new applications using the most advanced computer technologies, such as quantum computing. We should expect continued growth in bandwidth requirements due to exponential growth in processing power and storage, together with innovative new applications.

“At Taylorville Community School District, we are committed to providing students with access to tools such as: virtual reality machines, chrome books, interactive white boards, 3D printers and anatomy visualization systems to name but a few. ICN and consortium infrastructure supporting our ever-growing broadband needs is foundational for these tools and supports our focus on STEM and technology education from primary to high school.”

Anita Brown, Curriculum Director
Taylorville Community Unit School District #3

To prepare for this, the Illinois Department of Innovation & Technology (DoIT), established a state consortium in July 2019 to purchase Internet access and broadband circuits for public school districts, providing as much Internet and broadband connectivity as required, at no charge to public school districts. ICN provides the fiber backbone for the consortium as well as security and Intranet services to the schools. Funding for the consortium is provided through Connect Illinois and the Universal Service Schools and Libraries Fund, commonly known as E-Rate.

Broadband circuits purchased by the consortium are from one of 14 ICN points of presence to the school head end site (Last Mile Circuit) and between schools in a school district (WAN Circuit). Thus, the consortium will cover the cost of both Last Mile and WAN Circuits. Security services include Distributed Denial of Service (DDOS) mitigation, intrusion detection, content filtering, firewall and Security Operations Center (SOC) monitoring. The ICN also provides access to K-12 services and private, secure access to cloud services. These services are provided at no charge to the school district.



The ICN plays a key role in the consortium as the middle-mile backbone network, enabling connectivity to the public Internet and providing access to security, cloud and K-12 services.

The future of the DoIT consortium is strengthened through collaborations with Illinois higher education institutions. With ICN currently serving all Illinois public universities, the partnership between K-12 and Illinois higher education institutions is expected to grow and flourish. By removing bandwidth limitations, K-12 schools can access university applications, instruments and data, such as electron microscopes or space telescopes or even data related to research projects. Both universities and public school districts benefit from these partnerships. The strength of ICN facilitated links between K-12 and higher education will help ensure all Illinois students are best in class on the world stage.

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 2,000-mile, high-speed broadband network serving K-12 and higher education, public libraries and museums, state and local government and commercial service providers. www2.illinois.gov/icn

GPN CyberTeam Uses Mentoring Program to Grow Their Network

The Great Plains region was settled by pioneers. Spread out homesteads fostered a feeling of community and camaraderie that persists to this day. This heritage continued when Great Plains Network (GPN) members submitted a grant proposal for and were awarded the Campus Cyberinfrastructure Team: Great Plains Regional CyberTeam (NSF award #1925681) in 2019.

The CyberTeam leverages expertise and a willingness to help others. Many universities have only a few research computing staff. There are few well-developed training programs, and new staff often learn on the job. Experienced system administrators, network engineers and educators, learn a wide variety of software and skills over the years. One CyberTeam goal is to collect this expertise and create a best practice guide to share with new staff. The CyberTeam does this by connecting experienced Mentor Institutions with newer Mentee Institutions and then growing a network of institutions who share expertise and support.

The CyberTeam operates via one-on-one engagements. Each engagement is tailored to the Mentee university to serve their unique needs. A future Mentee contacts one of the CyberTeam members and answers a few questions. Then the CyberTeam sends more detailed questions to match expertise with desire. The Mentors and Mentees meet online for a few weeks and then determine a site visit and long-term goals which may include activities such as the hosted Software Carpentries Workshop, which teaches researchers basic programming skills.



The team's initial engagement was at the University of South Dakota. The tangible outcomes from the weekly, on-line meeting and site visit included streamlined workflows for two research labs and a Software Carpentry Workshop held two weeks later. The most important outcome was intangible; the quick development of personal relationships. The team's activities created connections that allowed Mentees to feel comfortable asking Mentors questions at any time.

What does the CyberTeam do for regional research and education networks? It provides opportunities to develop relationships at universities beyond the CIOs. It also provides insight into the research occurring on the campuses and a better understanding of the significance of the bits that flow over their networks. As R&E networks facilitate more use of both commercial and research cloud resources, these relationships and understandings are invaluable.

When and where do bits go? What new projects may begin? What new interconnects should be explored? All these can be answered with CyberTeam interaction.

If you would like more information about the Great Plains Regional CyberTeam or are interested in applying for an engagement, feel free to contact one of the leadership team: Timothy Middelkoop (PI) (middelkoopt@missouri.edu), University of Missouri; Daniel Andresen (Co-PI) (dan@ksu.edu), Kansas State University; Carrie Brown (Co-PI) (carrie.brown@unl.edu), University of Nebraska-Lincoln; James Deaton (Co-PI) (jed@greatplains.net), Great Plains Network; George R Louthan IV (Co-PI), University of Oklahoma; Kevin Brandt (SP) (kevin.brandt@sdstate.edu), South Dakota State University; Ryan Johnson (SP) (ryan.johnson@usd.edu), University of South Dakota.

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

ESnet: Deep Science Understanding Leads to Enhanced CI Capabilities

Research and Education (R&E) networks form the “circulatory system” for science. These critical technology components serve as the linkage of the global data architecture and are the mechanisms that allow collaborations to move, store, and analyze the output of sophisticated, experimental instruments capable of creating massive datasets. Understanding the scientific workflow and creating technical solutions adaptive to the changing needs of science, remains a critical gap that must be addressed.

The Engagement and Performance Operations Center (EPOC) is a production platform for consulting, applied training, monitoring, and R&E support, jointly led by Indiana University (IU) and the Energy Sciences Network (ESnet). EPOC provides researchers and cyberinfrastructure engineers with a holistic set of tools and services needed to address the growing demands of scientific innovation by helping to assist with expectations related to performance issues, reliable and robust data transfers, and understanding scientific workflow. 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.

A major component of the EPOC strategy is to work closely with the regional networking community. EPOC has partnered with Quilt members - Front Range GigaPop, Great Plains Network, iLight, KINBER, LEARN, and OARnet - to sponsor Application Deep Dives for campus environments. The outcome of these activities is a better understanding of the scientific drivers, growth areas and points of friction that exist today, and how they are likely to change over time. Campuses, regional partners, EPOC, and science communities receive a set of actionable items that can be addressed to better support the use cases.

Every Deep Dive finds and addresses problems, both technical and socio political. KINBER member school, Arcadia University, found that a lack of available computation and storage was limiting a major science driver (Bioinformatics) from creating a research program to investigate genomics. EPOC and KINBER are working with regional partners

to investigate sharing of analysis infrastructure to meet these needs. LEARN member school, Trinity University, found that a lack of locally available storage resources were impacting the ability of several research groups to adopt new technology.

LEARN and EPOC, in collaboration with Trinity, are working on an upgraded network and data architecture to address this challenge.

OARnet member school, University of Cincinnati, found that some use cases were not fully integrated to the campus Science DMZ. A policy and process for onboarding new use cases is being defined.



EPOC

Engagement and Performance Operations Center

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

Founded in 1820, Indiana University is one of the world's foremost public institutions. With nearly 100,000 students and more than 20,000 employees statewide, IU continues to pursue its core missions of education and research while building a foundation for the university's enduring strengths in teaching and learning, world-class scholarship, innovation, creative activity, community engagement and academic freedom. Bloomington is the flagship campus of the university, and each one of IU's seven campuses is an accredited, four-year degree-granting institution. www.iu.edu

Edge Delivers Business Systems Modernization Success

Institutions are realizing the need to modernize their business processes and technologies, including Enterprise Resource Planning (ERP), Student Information Systems and Constituent Relationship Management software, to improve performance and results in the digital economy. In service to its members, Edge has created a Business Modernization Success Program to unpack the process of digital transformation and business systems modernization, and meet institutions' strategic goals at an affordable price. By bringing together best practices, the Edge team's experience, expertise and industry leading vendors, this program aims to increase the likelihood of success in transformative business systems modernization projects.

ERP and related systems have evolved to be the heart of an institution's enterprise information systems architecture. Modern business systems rely on data centrality to deliver a suite of applications to serve accounting, student information, constituent

relationship management, human resources, student recruitment and enrollment, career placement, and alumni management. Mass amounts of data can now present trends, patterns, and behaviors that are of strategic value in solving problems of recruitment, attrition, and graduation rates.

The use of legacy business systems through the years has resulted in a reality where functional areas rely on siloed data, with reports generated within silos telling different stories and creating confusion about the actual state of the business. A change is needed - but when facing a reality where 55 to 75 percent of system upgrades fail because of a combination of delays and cost overruns - how can institutions successfully execute complex projects to move from legacy applications to modern systems? The Edge Business Systems Modernization Program aims to answer this question with a three-phased approach.

Research indicates many ERP implementation programs fail on their first attempt, mainly as a result of lack of preparation. Phase 1 helps institutions overcome that challenge by executing a thorough assessment combined with a reengineering of business processes to reorient the institution towards successful business practices.

Armed with deliverables from Phase 1 - a properly defined scope, vetted data model, data mapping and migration plan, transformation ready workforce, detailed project plan and redefined business processes - the transition to new ERP software can commence. In Phase 2, Edge-approved vendors will work in concert to manage the project plan as well as support the institution's project governance committee to affect an efficient implementation, with built-in checkpoints to ensure expected progress is maintained throughout the project lifecycle.

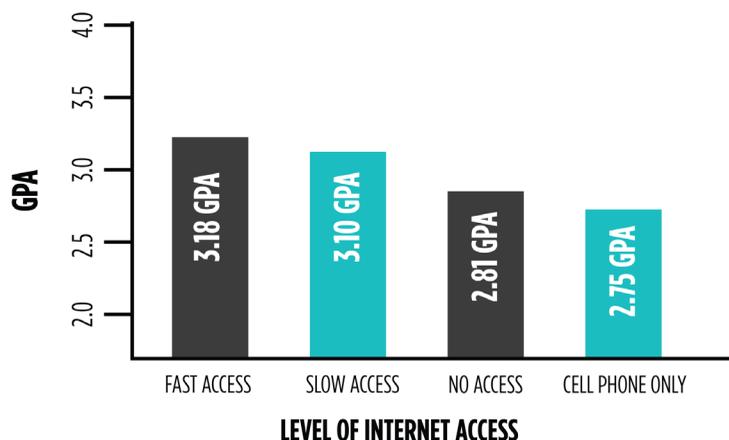
With business systems implementations, the end-user community will inevitably have an adjustment period, and rollouts are often derailed by failure to contemplate the needs of the faculty, staff, and other end-users who are accessing these systems for the first time. In Phase 3, this risk can be mitigated by providing dedicated customer care for the new system, with highly available and well-trained professionals who can problem solve, assist in orientation and training, provide assistance to end users, and otherwise ensure a successful "go-live" period for the critical first 90- to 120-day, post-implementation period.



NJEdge is a non-profit provider of high-performance optical networking, Internet, digital asset management solutions and IT products and services. NJEdge provides these solutions to colleges and universities, K-12 school districts, government entities, hospital networks and businesses as part of a membership-based consortium. NJEdge's membership spans Maryland, Michigan, New Jersey, New York, Pennsylvania and Virginia. The company's mission is to empower members with affordable, reliable and leading Internet-based technologies and services. www.njedge.net

What Are the Current Implications?

Students without home Internet access have lower overall GPAs - on average half a letter grade lower.



When it comes to K-12 students, disparities in broadband Internet access have often been referred to as the “homework gap.” This lack of access diminishes the capacity of students to succeed in the knowledge and information-based economy of the 21st century. Research and education (R&E) networks are ideal catalysts to convene collaborations surrounding the innovative technologies required for expanding broadband accessibility. Many R&E networks have decades of experience in network operations and have built long-standing relationships with a broad landscape of community anchor institutions. In addition, these networks play a critical role in spreading awareness of the education digital divide to state and federal policy makers, support strong relationships with vendors in a centralized capacity, and foster public/private partnerships through the lens of a nonprofit.

The Quello Center at Michigan State University, in partnership with Merit

Network and M-Lab, studied the consequences of poor and absent home broadband access for the academic achievement of students in rural Michigan school districts. Many students in rural areas do not have Internet or depend on cell phones for Internet access because they live in small towns, rural areas, and on farms that do not have an infrastructure for broadband. The aim of this study, which began in 2019, was to understand how home Internet access is related to students’ homework completion, digital skills, grades, standardized test scores, interest in postsecondary education, and career goals. This groundbreaking study reveals that the “homework gap” is part of a much broader “performance gap” with repercussions not only for school achievement but lifelong opportunities.

Findings show that a lack of broadband and dependence on cell phones for home Internet is leaving rural Michigan students behind. Students who do not

have home Internet access perform lower on a range of metrics. These differences exist regardless of gender, race and ethnicity, parental income and education, and whether the student has an individualized education plan (IEP). Middle and high school students with access to high-speed Internet at home have more digital skills, higher grades, and perform better on standardized tests like the SAT.

Students who rely on a cell phone for Internet access outside of school experience gaps in performance that are as large or larger than those with no home Internet access. Unlike their peers, students who are dependent on a cell phone for Internet access outside of school, rely on smaller screens with slower devices, have access to content with fewer features, and need to monitor data caps and recharge prepaid phone plans.

This research substantiates that a lack of Internet access impedes the development of critical skills needed to competently participate in the digital economy. Consequently, entire regions that lack Internet access, either as a result of unaffordability, not knowing the benefits of connectivity or missing infrastructure, may be lastingly disadvantaged.

To learn more about the study or to access broadband-related resources, visit Merit.edu/Moonshot. For the complete Quello Center K-12 Findings Report, visit <http://quello.msu.edu/broadbandgap/>.

Hampton, K.N., Fernandez, L., Robertson, C.T., & Bauer, J.M. (2020). Broadband and Students Performance Gaps. Quello Center, Michigan State University, East Lansing, MI. Available at <http://quello.msu.edu/research-reports/broadband+student-performance-gaps.pdf>.

Merit Network is the nation’s longest-running research and education network. Merit owns and operates 4,000 miles of fiber-optic infrastructure throughout Michigan. We offer networking, security and community services to nonprofits. www.merit.edu

MREN Continues to Push Networking Boundaries for Data Intensive Science

The Metropolitan Research and Education Network (MREN) was established specifically to meet the requirements of data-intensive science. Increasingly, science research requires gathering, analyzing, and transporting extremely large volumes of data. Frequently, this transport requires support for high-capacity single end-to-end data flows (e.g. 10-100 Gbps individual flows). With its science community and network research partners, MREN is developing and implementing new techniques to provide such services.

These techniques include methods based on Software Defined Networking (SDN), Software Defined Exchanges (SDXs), Data Transfer Nodes (DTNs), Network Services Interface (NSI), the P4 programming language, and dynamic L2 and L1 provisioning. MREN currently also faces issues related to multi-100 Gbps, 400 Gbps and Tbps paths, including using bonded lightpaths provisioned over superchannels.

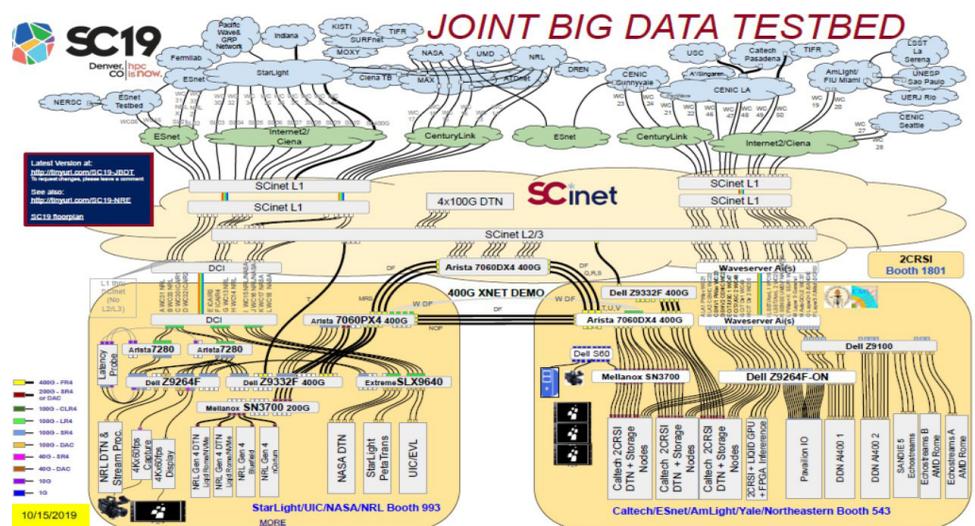
To showcase these innovative services and technologies, MREN collaborates with its community partners to stage demonstrations at major international and national technology workshops, conferences, and special forums. One major venue for these demonstrations is the Supercomputing Conference (SC). In 2019, the 31st annual ACM international Supercomputing Conference for High-Performing Computing, Networking, Storage, and Analysis International Conference (SC19) took place in Denver, Colo. For this conference, MREN, the SCinet Wide Area Network (WAN) team, the StarLight consortium, and multiple national and international research partners,

designed and successfully staged over 30 large scale demonstrations. With SCinet, MREN, the StarLight consortium and other partners creating 11*100 Gbps network paths and one 400 Gbps path from the StarLight Facility in Chicago to the conference venue in Denver, 6*100 Gbps path from Washington, D.C. to the venue, and also 2*100 Gbps from Washington, D.C., to the StarLight Facility.

SC19 demonstrations included a showcase of capabilities for supporting Petascale science with the StarLight International Software-Defined Exchange (SDX); programmable WAN networking with the NSF Global Environment for Network Innovations SDX; the Global Research Platform; advanced services for the High Energy Physics, with a focus on the Large Hadron Collider Open Network Environment; astrophysics; geophysics; and dynamic systems provisioning. MREN also participated in an extensive collaboration led by Argonne that

won the Inaugural SCinet Technology Challenge at SC19 by demonstrating real-time analysis of light source data from Argonne National Laboratories Advanced Photon Source to its ALCF supercomputer. Accelerator-based light sources, which are large-scale instruments used to investigate the fundamental properties of matter, generate large amounts of data that require computational analysis. This demonstration showcased capabilities for real-time streaming and analysis at 100 Gbps.

Earlier in 2019, MREN supported international meshed DTN demonstrations as part of a global data mover challenge competition at the Supercomputing Asia Conference, which resulted in an innovation award presented to the StarLight consortium and the International Center for Advanced Internet Research (iCAIR) at Northwestern University.



The SC19 topology used to stage the demonstrations at SC19, along with the StarLight and CalTech booths.

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 Pacific Research Platform initiative (PRP), which is an NSF support project, developing a regional Science DMZ that extends from the west coast to the StarLight facility. Recently, MREN has been involved in the PRP efforts to support a National Research Platform (NRP) pilot project. www.mren.org

MCNC Creates Value by Putting Clients First

The Microelectronics Center of North Carolina (MCNC) is more than just the operator of the North Carolina Research and Education Network (NCREN). It is a valuable technology resource and partner benefiting North Carolina.

MCNC believes reliable, fast, and affordable Internet is a basic requirement for being a productive citizen in the 21st century. After 40 years of success, MCNC has established an integrated marketing and communications model that focuses on providing excellent and expanding technology solutions along with managed services to clients. This demonstrates that NCREN, and the expertise of the staff that operates it, is what differentiates MCNC and brings its clients the greatest return on their investment.

Integrated marketing and communications break down barriers between departments and create a unified and seamless experience for clients to interact with the organization. All aspects of marketing and communications such as advertising, public relations, direct marketing and social media, work together as one cohesive force. While this approach is not new, it still is relevant today; there are more marketing channels now than ever before, attention spans are short, and information comes constantly from a variety of sources.

MCNC understands the necessary harmony needed between marketing and communications as a holistic strategy to grow and message all the great things they do and offer across all channels. Their integrated communication plan creates mutually-positive relationships between clients

and staff. The overall result is a powerful bridge and client engagement that MCNC and other Research and Education Networks (RENS) find to be genuine and especially valuable.

With their customer-first approach, MCNC has helped to improve local economies by leveraging advanced technology, sizable expertise, and a vast 4,000-mile fiber network to develop and implement managed services so each and every community can successfully address their modern technology challenges. MCNC considers the client in everything they do.

Aligning with what's important to clients, ensures the consistent production of excellent and expanding technology solutions and services available through MCNC. Carefully and strategically linking messaging

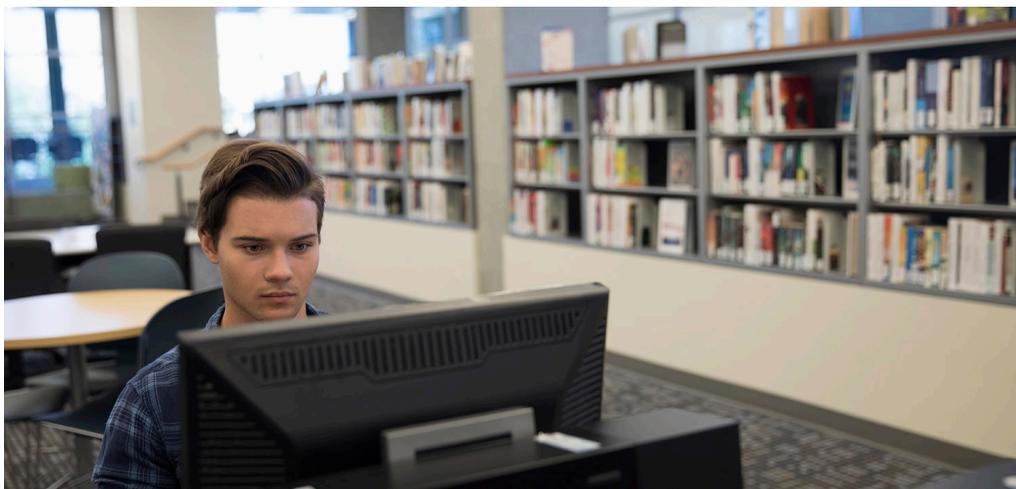
together, MCNC is properly defining the fully-integrated roles of marketing and communications as it relates to several key and strategic areas of the organization.

Smart broadband for North Carolina starts with MCNC, and MCNC continues to make great strides to making North Carolina the most connected state in the country. Putting clients first has successfully led to the development and maintenance of good company-client relationships.



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

Cybera Helps Citizens Get Online by Connecting Via Alberta Libraries



When you look at the total geographic region that the Peace Library System covers, you get a good sense of some of the challenges faced by its IT services manager, Janet Ayles. Peace Library basically serves the entire top-left corner of Alberta, Canada. With 46 libraries spread over 238,000 square kilometers, Ayles sees a broad range of needs from communities both large, small, accessible and remote.

Since 2016, the Peace Library System has been buying a 100 Mbps connection through the Internet Buying Group. At first glance, this seems like a fairly large connection for just a simple group of libraries. However, that connection doesn't seem so large when you consider that 38 different libraries are sharing it, and many of those libraries are, themselves, filling a surprisingly large connectivity need.

"The reality is we serve several communities where local residents have poor - or no - Internet connection, so we have a lot of people coming into the library just to access the Internet," said Ayles. "You can actually see the usage spike after school ends, when all the kids come straight to the library to get on our Wi-Fi."

Many of these students use the library's Internet to do homework and access online learning resources as well as play video games or download movies to later watch at home. Ayles said they also see many adults (including former oil patch workers) coming in to do online coursework or certification tests. Many are also forced to come in just to fill in government forms, since so many public services have now moved online.

"In some communities, there are people who only become members to access the Internet," noted Ayles. "And since the recent economic downturn began, the library's membership numbers have gone up."

According to Ayles, the largest demand for Internet and Wi-Fi comes from libraries located near First Nations communities. "There's one region that doesn't even have cell phone service," added Ayles. "Their library is literally the hub of the community and has become a gathering place for local youth."

One of the biggest challenges for Ayles and her team is to ensure that the Internet is running at all times (even after hours, as some people will gather near libraries just to access the Wi-Fi hotspot.) The Peace Library System also offers learning programs and free online resources - such as Homework Help, and access to tutorial sites such as Lynda.com - to help residents retrain or develop new skills.

Their work is a great demonstration of the evolving role of libraries in a digitized world, and how many continue to be a central hub for information and learning; however, it is also an example of how important the Internet is to people of all ages and locations, and, sadly, how there are still many areas across Alberta - and Canada - that are desperately in need of improved access to digital communications. We still have a long way to go to meet this need!

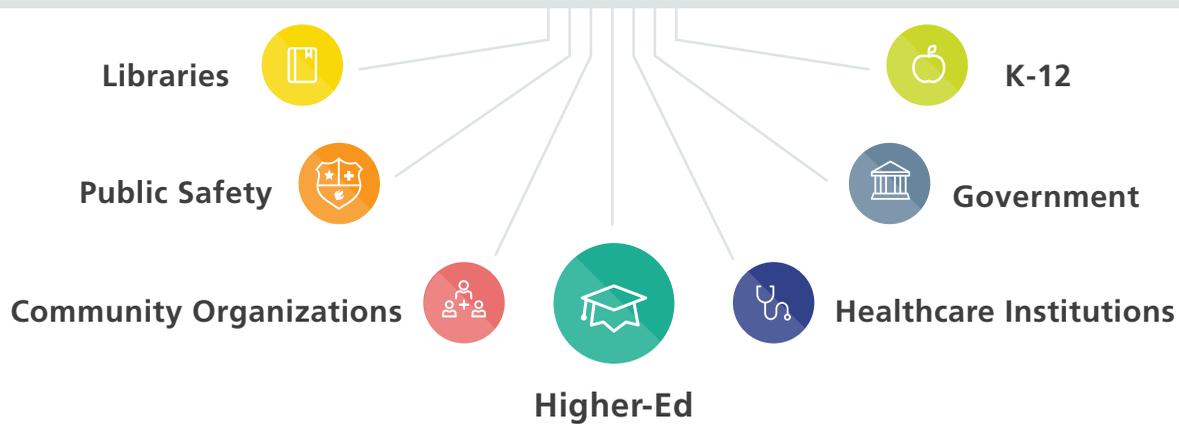
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Cybera is a not-for-profit, technology-neutral organization responsible for driving Alberta's economic growth through the use of digital technology. Its core role is to oversee the development and operations of Alberta's cyberinfrastructure - the advanced system of networks and computers that keeps government, educational institutions, nonprofits, business incubators and entrepreneurs at the forefront of technological change. We work with our members to ensure a connected future for all Albertans. www.cybera.ca

Research and Education Networks:

Enabling Breakthrough Innovations that Power the Greater Good

Non-Profit Research and Education Networks provide secure, high-capacity, high-performance network infrastructure and related technical and operational support for:



Fastest, Most Advanced Technical Infrastructure	Trusted Network-to-Network Collaboration	Resource Sharing and Cost Reduction
<p>Purpose built and dedicated to meeting the needs of our communities.</p> <p>Unparalleled levels of performance, reliability and security.</p> <p>Redundant connectivity to other regional, national and international research and education networks.</p> <p>Separate experimental networks, which foster networking or application research or very large point to point data transfers.</p> <p>Multiple colocation facilities providing participants with geographically separate locations to land different connections.</p> <p>Networks offer Netflix and Akamai caching to offset commercial traffic draws, as well as direct peering with entities such as Google, which all result in better end use experience with better network performance.</p>	<p>Secure and lightning-fast networks connect schools to hospitals to research centers and beyond – enabling exciting new research and education opportunities.</p> <p>Networks are often part of multi-state regional partnerships that provide shared network services across communities as well as diverse backup and connectivity options.</p> <p>Nationwide research and education communities regularly share technical and operational information and expertise for the betterment of all.</p> <p>Networks create a trust fabric between research and educational communities.</p> <p>Member driven collaboration – not a vendor / customer relationship.</p>	<p>Participants enjoy reduced costs for the entirety of services provided due to the shared expertise and services, increased buying power and economies of scale participants obtain from being part of the larger R&E networking group.</p> <p>As non-profit entities, equitable and shared cost recovery models minimize costs and maximize benefits across the membership by offering participants a way to be a part of regional or national buying aggregation efforts.</p> <p>R&E networks can offer another avenue for participant advocacy, outreach and education around common topics or areas that may benefit from a larger, aggregated voice.</p>

Research & Education Networks are the Ultimate Facilitators of Innovation, including:

- Access Control
- Big Data Solutions
- Climate Modeling
- Cloud Computing
- Cybersecurity
- Disaster Recovery
- Genomic Research
- Global Research
- Healthcare
- Museum Science Centers
- Supercomputing
- Telemedicine
- Transportation
- University Research
- Video Collaboration
- Video Streaming

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National Regional Networks Consortium

Advanced regional networking in support of research and education

