

2017 Edition

THE QUILT CIRCLE

National Regional Networks Consortium

Advanced regional networking in support of research and education

A Letter From the President

Welcome to our best edition yet of *The Quilt Circle*. Our 2017 edition is bursting with stories from our Quilt members about the impact their networks and their networking organizations have on the research and education missions of the institutions they serve.

The theme of this year's *Quilt Circle* is "collaboration". Through The Quilt, our members come together to ensure our country's scientific community and academic institutions have access to the most advanced technology capabilities available. Underlying these successful collaborations is an impressive set of advanced networking infrastructure capabilities, tools, and services delivered to our communities of connected institutions when and how they need it and with the best possible performance so that the network is not an impediment to new and innovative research and learning collaborations.

Collaboration also defines the work of each of our Quilt members. For those of you already familiar with the work of the R&E network in your area and for those who are just learning about them for the first time in this edition of *The Quilt Circle*, you will learn quickly how these R&E networks are exceptional in their ability to collaborate in so many innovative ways and with a variety of partners in order to fulfill their missions to further the research and education goals of their member institutions.

Within the pages of this year's publication, we showcase how our research and education network members work with partners at the highest level to advance individuals, local communities, scientific discovery, educational outcomes, and so much more. The 2017 edition of *The Quilt Circle* brings to light several examples of the key role of regional networks providing advanced networking infrastructure for scientific research, discovery, and innovation. This edition also showcases how other member communities benefit from the advanced capacity, tools, access and support that research and education networks provide. Finally, you will enjoy learning about the tools and support our Quilt members are providing to their communities in an area of critical importance which is network security. All of these articles contain compelling examples of collaboration to achieve a common good. Like The Quilt itself, we believe that this single collection of examples of our Quilt member missions in action, is more powerful than the sum of its parts.

Because of the rich collaborations of our members, The Quilt continues to be a vibrant community where our regional R&E networking organization members gather to engage with one another. The collaborative spirit that is the foundation for each of our member networks and the creation of The Quilt over 15 years ago is also the same driving force behind the success of the organization today in accomplishing our program objectives. Our work together this year is a valuable reminder of the key roles all of our members play in the success of one another's organizations and in building the national fabric of regional network community that we call "The Quilt".

Jen Leasure

Jen Leasure
President and CEO

Acknowledgements

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MCNC: Broadband Gave Him Strength



Derrin Mallory is a 16-year-old boy who loves to fish, hang out with friends, swim, and play football. As a sophomore at Roanoke Rapids High School in eastern North Carolina, he demonstrates leadership as class president, is active in Science Olympiads, and excels on the gridiron as a wide receiver for his Yellow Jackets.

His life was rather impeccable until June 27, 2016.

That was the day Derrin was diagnosed with acute lymphoblastic leukemia (ALL), a form of cancer affecting white blood cells. His symptoms included enlarged lymph nodes, bruising, fever, bone pain, bleeding, and frequent infections. While undergoing chemotherapy, there were many times he couldn't attend school because his white blood cell count was too low to be around others and he was prone to illness.

Every Friday since diagnosis, this exceptional young man and his mother, Angela Mallory, would make an hour drive to Vidant Medical Center in Greenville for chemo treatments. He had to be hospitalized on several occasions, causing him to miss a lot of school, and was feeling pretty down about his situation and chances in life.

“I am a kid who genuinely loves school, and up until this year I had never missed a day – ever,” Derrin explained, citing History as one of his favorite subjects. “However, when I couldn't attend classes at my high school campus, I was able to participate in a cyber class. And, on the days when I receive chemo treatments, I still can log into the recorded sessions of the class and honestly feel like I hadn't missed a beat.”

Derrin had enrolled in Honors African American Studies, offered as a distance-education class at the North Carolina School of Science and Mathematics (NCSSM) in Durham. MCNC, through the operation of the North Carolina Research and Education Network, or NCREN, provides the fundamental broadband infrastructure for connecting NCSSM and more than 500 institutions like it – including all K-20 education – in North Carolina.

“Broadband gave him some fight and real sense of normal,” his mother said with emphasis. “He's a real inspiration for me and many others in our community. Connectivity has been therapeutic in so many ways to help in the healing process.”

At NCREN Community Day in November, Derrin shared his story and explained that having high-speed Internet to him means reaching out and connecting with others as well as being able to communicate with them. “During some of the most difficult days of my life,” he exalted, “I have found refuge, if only for 70 minutes, when I logged into this class.”

Derrin now feels he is learning more and in different ways, developing new friendships both on and offline, and has come up with a plan to pursue a career as a pharmacist. He also plans to apply for both residential and online classes at NCSSM next school year, at which time he hopes to be in complete remission. Watch the video of Derrin's story: <http://bit.ly/DMallory>.

MCNC, a technology nonprofit that builds, owns and operates the North Carolina Research and Education Network (NCREN), has served research, education, non-profit health care and other community institutions with Internet connectivity in the state for more than 30 years.

www.mcnc.org

OneNet's 100G Network Supports Big Data Movement for Bioinformatics Research

In the last decade, human genome research has produced exponential growth in the understanding of DNA, genetics, and disease. With the increase in research data, there is an equal demand for technology to maintain and move the data.

At Oklahoma State University (OSU), scientists are using supercomputers to analyze massive amounts of data to draw large-scale conclusions. This practice of using technology to process scientific data is called bioinformatics. Bioinformatics allows scientists to make assumptions about datasets without having to individually track each data point. This saves significant time and has enormous possibilities for the future.

OSU researcher Brian Couger uses supercomputers regularly for his work in bioinformatics. He said researchers at OSU have been able to evaluate the use of fungi in biofuels, study pathogens that damage poultry populations, analyze the human genome for diseases and conduct numerous other experiments with real-life implications. In addition to tracking datasets, these supercomputers enable researchers like Couger to collaborate with fellow scientists located thousands of miles away.

"Datasets must often be moved across the country for analysis or sent to collaborators so further specialized examination can take place," Couger said.

Sending high-volume data across conventional networks is not easy, however. Typical internet connections are not capable of handling the capacity bioinformatic experiments generate. This is why OneNet's 100 gigabit-per-second (Gbps) network is essential to support innovation at Oklahoma's research institutions.

OneNet's 100 Gbps optical network connects OSU campuses in Stillwater and Tulsa, the University of Oklahoma (OU) in Norman and OneNet in Oklahoma City. This ring then connects to Internet2's 100 Gbps nationwide network for research and education. The 100 Gbps ring allows OSU and OU to perform groundbreaking studies and move big data to numerous cities around the globe without burdening each university's internet connection.

Couger said that high-speed networks aren't just beneficial for scientific research, but essential.

"Today many experiments outright require high performance computing to complete analysis," he said. "There is also a large influx of new groups making use of high-performance computing, which traditionally may not have in the past."



Couger went on to say supercomputers and high-speed networks like OneNet's are allowing scientists to more efficiently study genetics than ever before, which in turn has significant value for the future of science. Currently, anyone can map their genome for little more than \$1,000. Genome mapping allows individuals to scan for genetic risks like cancer. Couger says the use of supercomputers is quickly changing the accessibility of a once expensive assessment and expects genome mapping to become as routine as a blood draw.

"Technology is one of the best tools we can put in the hands of our brightest minds," said Vonley Royal, OneNet's executive director. "At OneNet, we are committed to empowering as many citizens, students and researchers as possible with the services and support they need to succeed."

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

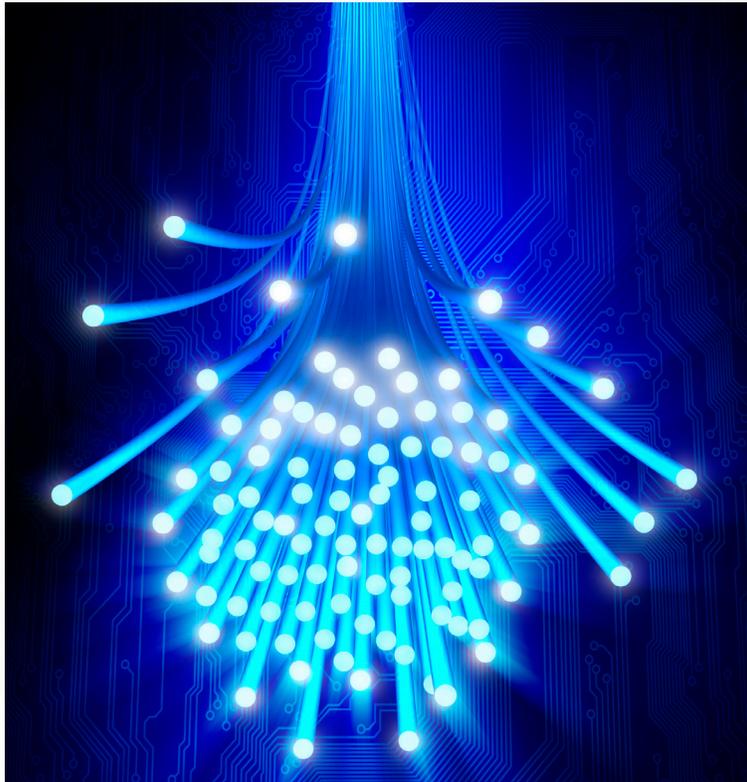
www.onenet.net

OSHEAN Enables School District to Fully Utilize the Power of their Network

East Greenwich School Department (EGSD) had previously laid private fiber between numerous locations within the school district. They initially self-lit this fiber but were not seeing optimal performance and as a result, they were missing opportunities to best leverage this valuable asset. The organization turned to OSHEAN to improve its wide-area network (WAN) throughput with a focus on serving the needs of faculty, staff, and students.

The OSHEAN team began by conducting an analysis of the network to understand what the district was experiencing at a wide-area network level, and help identify areas for improvement. Then OSHEAN utilized EGSD's existing fiber plant and Cisco's Carrier Packet Transport (CPT) platform to offer advanced layer-2 services that provided the foundation for inter-school communications. Engineers were able to optimize traffic flow, provide redundancies, and offer a self-healing network foundation. This resulted in seamless, reliable high-speed connectivity between the school district's locations – which ultimately enhances the user experience by lowering latency and providing for greater throughput.

East Greenwich schools now enjoy 10 GB intra-district connectivity with strategically placed connections to the OSHEAN network for access to external resources such as the internet. An example of the benefit of this is that while EGSD could utilize video before, the network can now support much more video, at better quality, with virtually no delay.



The platform on which the solution is built enables EGSD to have virtual circuits (point-to-point, point-to-multipoint, and multipoint to multi-point) between locations and to other OSHEAN members on the Beacon 2.0 network. Beacon 2.0 is OSHEAN's 450+ mile fiber optic backbone that connects many of the region's Community Anchor Institutions (CAI), and is currently one of the most advanced optical networks in the country.

Furthermore, EGSD no longer needs to worry about the WAN platform as it's entirely managed by OSHEAN. EGSD has the benefit of 24/7/365 monitoring and alerting through OSHEAN's Network Operation Center (NOC) that proactively monitors the transport platform and can address issues, potentially even before users know an issue exists. This gives EGSD IT staff peace of mind that the network is running optimally while minimizing operational costs and freeing up the IT department to work more closely with their constituents.

“OSHEAN has allowed us to redirect our focus on teaching, learning, and the classroom with confidence that OSHEAN will handle the management of the network,” said Victor Babson, Director of Technology, East Greenwich Public Schools.

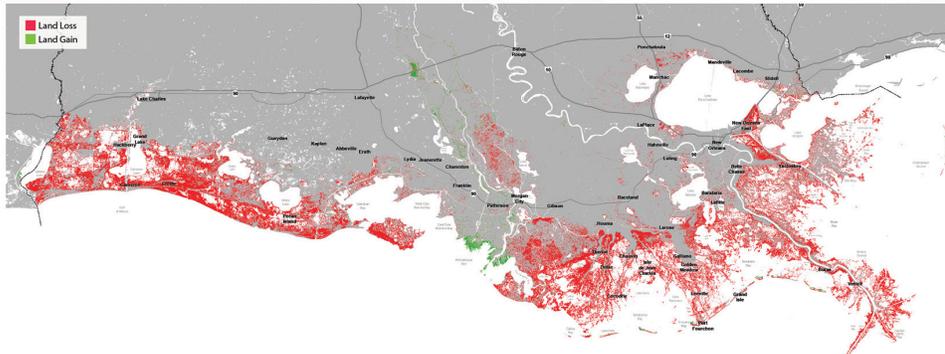
The end result of this combination of advanced hardware, software, and talented engineering resources is a 'hands-off' solution that will meet EGSD's transport needs for years to come. East Greenwich School Department IT isn't in the business of managing infrastructure, they're there to support education and provide technical assistance to users, demonstrate best practices, and more -- and with OSHEAN's support, they are able to focus their efforts on doing just that.

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

LONI Helps to Fight Coastal Wetland Loss in Louisiana

Predicted Land Change over the Next 50 Years



Picture courtesy of Louisiana Coastal Protection and Restoration Authority

Wetlands are a vital component of our natural environment for a number of reasons. They support agricultural activities by providing water for irrigation and consumption. Wetlands also help reduce the damages from storm and flooding, improve water quality and stabilize climatic conditions. They play an important role in maintaining biodiversity, providing habitat for many animals and plants that are found nowhere else.

In the United States, over half of the coastal wetlands are in the Gulf of Mexico region, with Louisiana alone accounting for 12 percent of the national total. Proportionally, Louisiana reports the highest coastal wetland loss rate among all states in the US, losing 25 to 35 square miles every year, not least because of the flood control projects on the Mississippi River, which reduced sediment discharge, the main source material of coastal wetland and marsh.

Supported by funding from state and federal agencies, Dr. Zuo “George” Xue, assistant professor of the Department of Oceanography and Coastal Sciences at Louisiana State University, is leading an unprecedented effort of developing a fully coupled atmospheric-hydrological model for the three local coastal rivers in southwestern Louisiana. By simulating and projecting the water cycle of these rivers, Dr. Xue hopes to answer key questions such as how long-term climate, land use and land cover affect their hydrological regime and, with the weakening influence of the Mississippi River, how much the water and sediment from them contribute to the sustainability of the coastal wetlands of Louisiana. Dr. Xue’s research will provide a solid scientific basis for coastal sustainability management in Louisiana as well as other mega delta around the world.

In order to accomplish this goal, Dr. Xue needs to perform a series of multi-physics simulations of terrestrial water cycle processes, coupling surface runoff, channel flow, sub-surface flow and land-atmosphere exchanges, on a wide range of spatial and temporal scales. For simulations of such complexity and size, the use of desktop computers even workstations is unimaginable. Instead, Dr. Xue’s team deploys WRF-Hydro, a state-of-the-science software framework, and runs their simulations on LONI’s Queen Bee 2 supercomputer, one of the fastest in the world. Equipped with more than 10,000 CPU cores and more than 1,000 General Purpose

Graphic Processing Units (GPGPUs), Queen Bee 2 provides an ideal platform for Dr. Xue’s team to address the computational challenge they are facing.

Dr. Xue’s research team is among many around the State of Louisiana who harness the power of LONI cyberinfrastructure towards important scientific discoveries. In 2016, the Queen Bee 2 supercomputer supported a total of 154 research projects of a wide variety, whose focuses ranged from the origin of cosmos to the network of proteins. The researchers working on these projects consumed more than 65 million CPU-hours, which is equivalent to approximately 7,400 years of compute time on a single, 16-core workstation. In this sense, LONI network and computing resources constitute one of the cornerstones of scientific endeavors in the State of Louisiana.

LONI is a state-of-the-art, fiber optics network that runs throughout Louisiana, and connects Louisiana research universities to one another as well as Internet2. LONI offers its participants a world-class network and high performance computing environment with the strategic integration of highly available and scalable bandwidth, computational, storage and personnel resources.

www.loni.org

OARnet & BEMC Enables Distance Learning Opportunities

Professor Chris Stellato waits patiently for his middle school student to answer the question he's just asked her in fluent Mandarin Chinese. She fidgets meekly with the sleeves on her hooded sweatshirt as she struggles to come up with the right word. Even over the webcam image, Stellato can tell she's tired today. He nudges her on with a verbal clue and eventually she answers his question quietly, but correctly, in near-perfect Chinese.

A few short months ago, neither this student nor her classmate could speak a word of the language. However, thanks to opportunities provided through the Ohio Broadcast Educational Media Commission (BEMC), school districts across Ohio can offer distance learning classes with live instruction at a low cost. The seamless real-time video conferencing is made possible through OARnet's high-speed statewide network. Through connections on OARnet's 100 Gbps backbone, live video streaming is not only possible, but very accessible to rural districts in even the most remote parts of the state.



“The OARnet backbone allows for hundreds of schools and classes across the state to be able to connect to high-speed internet,” said Jarrod Weiss, chief of operations at BEMC. “It’s an incredible thing to see. It’s a large, fast internet capability and without it, those schools wouldn’t be able to connect to us and we wouldn’t be able to help them to provide these educational opportunities.”

Since 2006, the BEMC Video Conference Network Operations Center (VNOC) has operated and maintained a statewide video conference network that provides reliable, multi-point video conference services to more than 1,200 customers in Ohio. The video conference service is offered at no cost to Ohio K-12 school districts, Ohio educational service providers and Ohio content providers. And if equipment cost presents a burden, Weiss said there are grants available to offset or even cover equipment purchases.

“With a program like this, there may be 10 to 15 kids in the whole school that want to take Chinese. So to bring on a Chinese teacher who may not be able to teach any other classes would be incredibly expensive,” Stellato said. “But with this, you’re probably looking at a third of the cost. And I think actually it’s just as, if not more, effective.”

The Chinese language classes are taught through the Confucius Institute at the East Central Ohio Educational Service Center. Director Michele Carlisle said the institute uses six instructors, including Stellato, to provide instruction to nearly 825 students. BEMC provides the bridging service that allows a daily class recording so that students are able to access their class content after class in the manner of a recorded session, while also achieving live instruction daily. The operations center at BEMC provides help desk support to distance learning instructors, as well as post-conference technical support to diagnose any issues that may come up during a class or conference call.

The Ohio Academic Resources Network (OARnet) is a member 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's Community Approach for Bringing Increased Security to Its Network and Constituent Institutions

Numerous recent headlines have drawn our attention to successful hacking, with breaches of information believed to be secure and systems believed to be safe. In the last year, hospitals have paid ransom to regain access to their own records, and political parties have been publicly embarrassed. Headlines like these raise security concerns for any organization.

At the center of CENIC's work is its commitment to supporting the research, education, and government missions of its members in an open and transparent way. The 20 million people who rely on CENIC's network to connect with each other and the world want to know that their network is reliable.

A central precept of CENIC's approach to security is "community." One part of CENIC's approach is awareness of and respect for community needs. CENIC's constituents have different needs from those of many businesses. CENIC's constituents, for example, expect CENIC to do whatever it can to keep the network running so they can communicate with each other and the outside world. There is also an emphasis on "openness" that would make most businesses uncomfortable. Any security solutions need to accommodate these distinctive needs, not impede them.

Likewise, there is the impact of being a community. The 1988 Internet Worm, introduced in the Internet's early days, was the first event to inform computer operators that being connected to the Internet carried security downsides along with the advantages of being able to communicate across the globe. Nearly 30 years later, we are not only still fighting Internet malware, but are fighting 1.2-Terabit per second denial-of-service attacks generated by Internet-connected baby monitors. Much as with public health, we're all in this together, and therefore we all have a responsibility to help address security problems as a community. This requires awareness, communication, and coordination.

In 2016, CENIC began its security initiative by hiring a Chief Cybersecurity Strategist. This strategist, together with CENIC's Chief Technology Officer, other CENIC staff, and a working group of leaders from CENIC's community, defined a broad strategy for addressing security, and began a risk assessment of all CENIC assets. They also created a "virtual security team," including representatives from every department, to obtain broad input on security issues and create a "community" of security awareness within CENIC itself.

In 2017, CENIC will give particular focus to facilitating a dialogue and coordinating actions among its constituents to bring its collective abilities to bear on security. This may include implementing a mechanism for mitigating certain attack classes

within the network, as well as collective action by multiple institutions connected by CENIC. In some cases, security may be relatively straightforward "cybersecurity hygiene" but other mitigations may require leveraging the R&D capabilities of CENIC's constituents, including all of the University of California, Caltech, Stanford, and USC—institutions with many of the most distinguished security researchers in the world.



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 other vital public-serving institutions.

www.cenic.org

Partnership between MAX and ARL Harnesses the Power of Defense Supercomputing to Create Opportunities for Scientific Discovery

In the summer of 2016, Mid-Atlantic Crossroads (MAX) announced a strategic partnership with the U.S. Army Research Laboratory (ARL), the central laboratory that provides world-class research for the Army, to provide high-performance computing (HPC) resources for use in the higher education and research communities. As a result of this synergistic partnership, students, professors, engineers, and researchers will have unprecedented access to technologies that enable scientific discovery and innovation.

The partnership was formed under ARL's "Open Campus" initiative, which aims to build a science and technology ecosystem. MAX operates a multi-state advanced cyberinfrastructure platform and will connect ARL's high-performance computer "Harold" to this ecosystem on its 100-Gbps optical network. Collaborators from the University of Maryland (UMD), MAX, and ARL communities will be able to build research networks, explore complex problems, engage in competitive research opportunities, and encounter realistic research applications.

Harold will become available once the machine is scrubbed, declassified, and brought into ARL's demilitarized zone, or perimeter network. Under ARL and UMD/MAX's collaborative research development agreement (CRADA), the HPC resource will be accessible to the collective communities of UMD, MAX, and ARL's Open Campus. As a result, researchers will have at their fingertips supercomputing-caliber computational capability and leading-edge advanced networking research that is designed for application development and networking experiments.

"The MAX-ARL partnership provides a unique opportunity for both organizations to create a national model of collaboration in the HPC field," said Tripti Sinha, MAX Executive Director and UMD Assistant Vice President and Chief Technology Officer. "Collaborative partnerships are key to maximizing our technological potential and ensuring our nation's strength and competitiveness in the critical fields of science and research."

MAX and ARL's combined effort not only benefits the mid-Atlantic region, but also aligns with the federal government's strategic initiative to maximize the benefits of supercomputing for economic competitiveness, scientific discovery, and national security. An executive order announced in July 2015 established the National Strategic Computing Initiative (NSCI) to support the United States in its efforts to remain a leader in the development and deployment of HPC systems. The MAX-ARL partnership also lays the foundation for the organizations to expand their reach and make additional HPC resources accessible to the communities they serve.

"Regional networks are well positioned to be the focal point for integration of high-end compute, storage, networking, and data resources from a variety of resource owners and providers," said Tom Lehman, MAX Director of Research. "We hope this activity will demonstrate the power of direct regional network connections as a mechanism to facilitate access to high-end cyberinfrastructure."



Mid-Atlantic Crossroads (MAX) is a center at the University of Maryland that operates a multi-state advanced cyberinfrastructure platform. 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. MAX participants include universities, federal research labs, and other research-focused organizations in the Washington and Baltimore metropolitan areas.

www.maxgigapop.net

Florida LambdaRail: Science DMZ Establishes Framework for the Atlantic Research Platform

Florida LambdaRail (FLR) is leveraging its recent 100 Gbps core network upgrade to deploy the FLR Regional Science DMZ and the Atlantic Research Platform. FLR has joined with Florida International University/AMPATH and the Sunshine State Educational and Research Computing Alliance (SSERCA) to create the Global Reach Consortium who's main purpose is to lead and guide the globalization of Florida LambdaRail and to operationalize the Atlantic Research Platform. FIU/AMPATH serves as the premiere interconnection point for network-enabled U.S.- Latin America and Caribbean science research and education. In collaboration with FIU/AMPATH, FLR's network topology along the east coast of Florida directly supports the existing 10G AtlanticWave and the 100G FIU/AMPATH Open wave from Jacksonville to Miami, extending FLRnet to Sao Paulo, Brazil. Beginning in the 2017 – 2018 timeframe, FIU/AMPATH will ask FLR to support traffic from the Large Synoptic Survey Telescope in Chile. SSERCA brings together Florida's geographically distributed universities and their HPC resources to further the development of a statewide computational science infrastructure consisting of advanced scientific computing, communication and education resources.

Together, the Global Reach Consortium partner institutions are working to connect their respective campus science DMZs and campus research networks to the FLR Regional Science DMZ, then build the Atlantic Research Platform upon that foundation to extend and interconnect campus research, high-performance computing, and instructional technology environments to the global research and education networking fabric. The primary goal of the FLR Regional Science DMZ is to enable intensive science and High Performance Computing (HPC) applications with a secondary goal being to highlight the increased need of Science DMZs on FLR member campuses to support research. Currently, Science DMZs are in production or under construction at seven (7) FLR member university campuses, including: FAU, FIU, FSU, UCF, UF, UM, and USE. Some of these are aligned to support campus research computing or HPC clusters in partnership with SSERCA while others have been designed to support Software Defined Networking, Open Flow research experiments.

The Atlantic Research Platform (ARP) will be a science driven, high capacity data exchange and transport facility that links campuses to other regional, national and global science DMZ's, AtlanticWave, Internet2's Innovation Platform, Energy Sciences Network as well as the Global Lambda Integrated Facility. The ARP will integrate campus Science DMZs (following a model developed by ESnet) and link together many of the Campus Cyberinfrastructure initiatives (e.g., CC-NIE, CC-IIE, CC-DNI) that have been funded by the National Science Foundation in recent years. With the ARP, FLR foresees extensive benefits for research within and around Florida and the East Coast by extending and interconnecting campus research, HPC and instructional technology environments beyond campus borders to the global research and education networking fabric with integration of campus Science DMZs as secure enclaves for data intensive science and high speed data transport.



FLR

Florida LambdaRail

Florida's 100 Gigabit Research and Education Network

The Florida LambdaRail, LLC (FLR) is an independent research and education network owned and operated on behalf of the FLR partner institutions and affiliates. Created to facilitate advanced research, education, and 21st century economy initiatives in the State of Florida, utilizing next generation network technologies, protocols, and services, FLR provides opportunities for Florida university faculty members, researchers, and students to collaborate with colleagues in-state, across the country, and around the world.

www.flrnet.org

WVNET Provides “COAL” for West Virginia Schools



There is no doubt that coal is abundant in West Virginia. Aside from the mineral, the West Virginia Network (WVNET) has a different take on coal and has been offering COAL (Custom On-Line Application Library) to West Virginia Schools for over a decade. A talented team of programmers at WVNET custom-build web and mobile applications based on specifications from institutions in both K-12 and higher education. Most of these applications are offered as services to schools running on WVNET servers and sold for a modest monthly maintenance fee. By choosing COAL, West Virginia institutions receive exactly the application they want with the option to request changes or get first-hand assistance from developers at a more affordable price than most commercial products.

WVNET began producing on-line applications more than 20 years ago when they created a Conference Registration and Management System (CRAMS) to provide services for annual statewide technology conferences. Later, a work order system called OZ was developed to track problems and tasks. After years of use at WVNET, numerous educational institutions began using OZ. By their request, WVNET added inventory and asset management, supply requests, information management and interfaces to other systems. OZ currently tracks work orders that touch nearly every K-12 school in West Virginia.

Hiring a programming team to create and maintain a custom application can be costly and education budgets are very tight in West Virginia. So as schools became aware of WVNET's application development service they began to request other

custom programs. The programming team created applications to track inventory, track student arrivals and departures, manage training and certifications, request and authorize travel, facilitate on-line requests and bids, schedule nursing experiences at West Virginia hospitals, help chronic heart disease patients interact with their doctors, monitor electronic door swipe access to a building, send SMS emergency alerts, and more. WVNET has worked hard to give schools this valuable service of application development while keeping costs very low.

WVNET found that in many cases schools were managing information strictly on paper, using a spreadsheet, database system that was confined to a single computer, or a legacy in-house application. Sharing of such data was limited, and there was a high risk of data loss. Moving to a custom application running in WVNET's cloud provided access to the service from any computer with internet access. Data recorded in the application is backed up locally and in a disaster recovery location.

The WVNET team has found that the connection they build with schools in developing applications fosters communications to identify and fulfill other needs. For example, a school may decide to move some of its computers to virtual machines or schedule automated nightly backups -- other services that WVNET provides at a cost savings to schools.

WVNET's goal continues to be providing the best services at low prices through consolidation of resources and personnel. They are planning additions to their COAL as West Virginia schools look for newer and better ways to manage students and learning.

The West Virginia Network for Educational Telecomputing (WVNET) is a state agency that provides a diverse suite of technology services to West Virginia Higher Education, K-12, libraries, government and nonprofits. Through consolidation of equipment, software, licenses and personnel, WVNET is able to offer top-quality technology at a great savings to customers.

www.wvnet.edu

NJEdge: Lighting the Way with illumira

With the emergence of streaming video over a decade ago, NJEdge realized that its members in education, healthcare, government, and the non-profit sectors would soon find themselves faced with a digital tsunami. This deluge of information came down to one seemingly simple concept: the inability to manage content.

Ten years ago, few truly understood the herculean effort involved with managing content; fewer still realized that managing content was only one aspect of the digital tsunami. The ripple effect of the rising digital tide also demanded the need to: (1) render content searchable, (2) enable discoverable content, and (3) make content re-usable in the learning and teaching environments (both traditional class and virtual classroom) as well as in the research arena.

The first generation of the **illumira** service, formerly known as NJVID, was developed from a \$1 million federal grant in 2005 to solve commercial media licensing and streaming challenges for the libraries. The service was developed in conjunction with library systems to enable traditional libraries to transition to a digital streaming platform while keeping the cataloging, metadata, and integration with library systems intact.

“Having **illumira** act as a major streaming video resource makes sense in terms of economies of scale and access,” stated Dr. Sandra Miller, Deputy CIO, William Paterson University. “I applaud NJEdge as it launches our educational institutions deeper into 21st century teaching and learning.”

illumira is now a comprehensive platform for institutions across the country to upload and manage digital content and securely share it with intended students, staff and faculty members.

While solving the digital content management problem for the library client, NJEdge realized they were a short walk away from solving another problem that was being faced by faculty members in educational institutions – adding rich digital media to traditional course content while providing an easy yet secure access mechanism.

illumira's library-centric roots helped in the evolution to meet the demand from faculty and instructional technologists looking to integrate video to create effective and compelling learning experiences enriched with digital media.

“**illumira** is a powerful and private video management solution – built by education for education,” said Joseph Sawasky, President and CEO, Merit Network. “Its unique feature set is very compelling to educators, libraries, and other non-profits.”

According to [Credence Research](#), the enterprise video management and reuse industry is projected to grow to nearly \$39 billion by 2020. This projected growth drives NJEdge to further innovate on behalf of their constituencies – as well as those organizations that might be in the initial phases of their own digital content tsunami.

Mobility, push technology and personalization will drive the next wave of digital content management innovation. Armed with individualized information requirements profiles, content mining agents will actively crawl media repositories and deliver content in accord with individualized curation standards and inquiry profiles. NJEdge, the proud parent of **illumira**, will work side-by-side with members and peers to further harness the potential of digital content to advance teaching and learning in the years ahead.

¹[CredenceResearch.com](#), Report code 57941-06-16; June 2016



NJEdge is a non-profit consortium created to support New Jersey's institutions of higher education in their pursuit of excellence in teaching, learning and research. NJEdge built a state-of-the-art technology network that is purpose built with standards-based digital education infrastructure.

www.njedge.net

Collaboration between FRGP, ABQG, PNWGP, and CENIC Enables Data-Intensive Collaborative Science

The Western Region Network (WRN) represents a highly successful and innovative collaboration among the leading regional network providers in the western United States: Albuquerque GigaPop (ABQG), Corporation for Education Network Initiatives in California (CENIC), Front Range GigaPop (FRGP), Pacific NorthWest Gigapop (PNWGP), and University of Hawaii (UH).

WRN members have seven years of experience in leveraging a high speed layer two network constructed on I2, CENIC, PNWGP and Pacific Wave fiber and lambda infrastructure. WRN directly enables research and scientific projects, supports the sharing of scientific and network resources, and provides access to instruments and services, which are key to the researchers within their respective organizations. In the past, WRN has utilized Layer 2 networking but is transitioning to a Layer 3 network to provide greater flexibility and interconnectivity.

WRN partners facilitate and directly participate in the Pacific Research Platform (PRP), which is exploring the future of research and education networks and, on a broader scale, trust and identity. PRP investigates the opportunities and challenges for data-intensive collaborative science. The goal is to build a science-driven high-capacity data-centric “freeway system” on a large regional scale.

National Oceanic and Atmospheric Administration (NOAA) leverages WRN to optimize interconnectivity of its multiple distributed offices across the WRN region to the NOAA Trusted Internet Connection access points in Denver, Colorado, and Seattle, Washington. WRN provides the high-speed interconnect, which provides resiliency and efficiency.

The Albuquerque GigaPop (ABQG) provides the on-ramp to WRN and other research networks for the University of New Mexico (UNM) Long Wavelength Array Consolidated Information Site (LWA) program. The LWA is a project to advance astronomy by using low cost antenna stations, which together produce a large aperture to probe the depths of space. This low frequency radio “telescope” can produce very high resolution images in the frequency range of 10-88 MHz. The ABQG and WRN have been instrumental in transporting datasets from the UNM Long Wavelength Array Consolidated Information Site to research partners across the country. The LWA is a project of a large group of universities working in partnership with the National Radio Astronomy Observatory, Los Alamos National Labs, Naval Research Laboratory, and the Air Force Research Labs, among others.

The NOAA Mauna Loa Observatory (MLO) is a premier atmospheric research facility that has been continuously monitoring and collecting data related to atmospheric change since the 1950s. The undisturbed air, remote location, and minimal influences of vegetation and human activity at MLO are ideal for monitoring constituents in the atmosphere that can cause climate change. The observatory is part of the NOAA - Earth System Research Laboratory - Global Monitoring Division.

WRN provides the wide area connectivity from the Mauna Loa Research Facility on the Big Island of Hawaii. NOAA-Boulder and the National Center for Atmospheric Research and University of Hawaii scientists benefit from the data from the instruments on the summit of Mauna Loa, which enable their scientific research and dissemination of data to the public.



LWA-1 Site – New Mexico

Mauna Loa Solar Observatory



The Mauna Loa Solar Observatory is an NSF-owned facility operated by the High Altitude Observatory (HAO), NCAR located in Boulder, Colorado. HAO conducts research and provides community support and facilities in the following areas: Atmosphere, Ionosphere and Magnetosphere, Long-term Solar Variability, and Solar Transients and Space Weather. HAO currently operates three solar telescopes on Mauna Loa that provide unique observations designed to understand the Sun's release of magnetized plasma and energy and the impacts these variations have at Earth and throughout interplanetary space. The current suite includes: 1) the Coronal Multi-channel Polarimeter to determine conditions of the coronal magnetic field and plasma; 2) the COSMO KCoronagraph (KCor) to observe the formation and initial acceleration of coronal mass ejections; and 3) the Precision Solar Photometric Telescope to track the variability of solar irradiance from magnetic structures in the photosphere and chromosphere.

WRN facilitates the distribution of this data which are fully available to the community from the Mauna Loa website. HAO currently provides Global Oscillation Network Group and KCor observations in real-time for space weather forecasting by the community. The increase in bandwidth provided in part by WRN for Mauna Loa allows HAO to provide real-time data products to the Space Weather Prediction Center in Boulder, the University of Michigan for use by scientists and students using the Michigan space weather forecasting models, and for community use worldwide.

The 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

The Albuquerque GigaPoP (ABQG) is an aggregation point of networks to provide high-bandwidth network accessibility to the State of New Mexico. ABQG is the on-ramp for high speed National Networks. These high speed networks are the Western Regional Network (WRN) and Internet2 (I2). ABQG is operated by The University of New Mexico's Information Technologies.

abqg.unm.edu

The Pacific Northwest Gigapop (PNWGP) is a nonprofit corporation serving research and education organizations throughout the Pacific Rim. Providing cost-effective, robust, reliable, high-bandwidth, and high-capacity networking, PNWGP supports the missions of these organizations and the needs of researchers, faculty, students, and staff. PNWGP designs, implements, and manages a multi-state high-bandwidth and high-capacity network specifically designed to meet the unique requirements of research and education communities.

www.pnwgp.net

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 other vital public-serving institutions.

www.cenic.org

UETN Supports Global Super Computing Events in Utah, Colorado and Texas

The Utah Education and Telehealth Network (UETN) provided wide area network and communications support to SC16, the 28th annual international conference of high performance computing, networking, storage and analysis held at the Salt Palace in Salt Lake City November 13-18, 2016. The conference includes a globally attended technical program, workshops, tutorials, a world-class exhibit area and demonstrations.

The world's fastest computer network, SCinet, empowered thousands of conference participants to engage in research and hands-on innovation. Multiple sectors benefit including education, business and science. Before and after the event UETN assisted in designing and implementing SCinet so it could deliver a bandwidth with the staggering speed of 3.15 terabits per second—necessary to support the cutting edge work of the conference.

In addition to providing 56 miles of fiber on the convention center floor and \$32 million in loaned equipment for SCinet, UETN was part of the team of 200 volunteers representing global organizations spanning higher education, commerce and government. Previously UETN provided leadership and volunteers for SC15 in San Antonio and SC12 in Salt Lake City and will again provide assistance at the SC17 conference this fall in Denver.

UETN also assisted the SCinet communications committee to provide marketing and public relations support before and during the show. The committee developed online and social media content, wrote and edited the monthly SCinet Newsletter, contributed SCinet content for the conference program guide, edited SCinet vendor communications, wrote press releases and produced event videos.

In one of those videos, Utah Lieutenant Governor Spencer Cox, a former telecom executive, shared his enthusiasm after visiting the exhibition floor.

“It’s an amazing opportunity. The benefit to humankind that is happening here today is just mind-boggling. Technology is a way to increase educational attainment,” Cox said, “I come from a rural part of the state. Rural Utah will never be like the Wasatch Front, but we can have those same opportunities through technological advancement, not just for children in Utah but across the globe.”

“As Utah’s network for education and healthcare, UETN is a strong supporter of the conference which provides unprecedented opportunities for technology professionals and students to engage

in advanced, hands-on learning,” said Ray Timothy, UEN CEO and Executive Director, “This year also brought Utah about \$100-million donated equipment, business-to-business commerce and tourism.”

Twenty-one student volunteers traveled from six states and seven countries to volunteer at the conference. Erik Kooistra, a student at the Universiteit van Amsterdam, marveled at the efficiency with which SCinet was implemented.

“It’s almost a dance how the whole set up goes, and it’s really impressive how everything [...] fit together,” Kooistra remarked, “It is amazing how quick everything is put together.”



Utah Lieutenant Governor Spencer Cox visits the exhibit hall at SC16.

The Utah Education and Telehealth Network is one of the nation’s premier education and telehealth networks. UETN connects public schools, colleges, universities, hospitals, clinics and health departments throughout the state. As a public private partnership the network collaborates with technology and telecom providers to develop and maintain broadband infrastructure and support services.

www.uetn.org

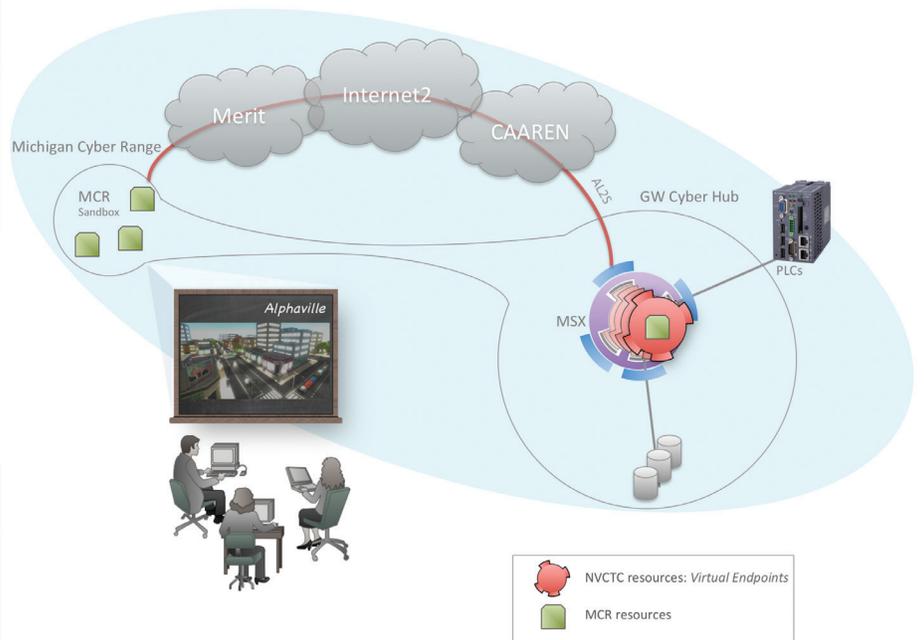
CAAREN Receives Grant to Boost Cybersecurity Education in Virginia

The Capital Area Advanced Research and Education Network (CAAREN) is teaming up with the Michigan Cyber Range (MCR) to bring a cutting-edge cybersecurity training environment to the George Washington University's (GW) Virginia Science and Technology Campus (VSTC). Made possible by a half-million dollar grant from the National Science Foundation (NSF), the SCEPTRE project will create a platform for training, research and experimentation.

Awarded in 2016, the two-year grant provides the GW Cyber Academy's students and faculty with access to an advanced cybersecurity training facility through the new GW Cyber Hub – an expansion of Michigan's Cyber Range. This new facility will become a regional hub for cybersecurity training by extending its offerings to other universities and businesses in the region and Commonwealth. GW will also develop and share educational and research resources.

The Michigan Cyber Range (MCR) provides a real-world environment to help train future cybersecurity professionals, with a virtual environment for cybersecurity research. The Cyber Range runs on the Merit Network, a regional research and education network infrastructure providing high-performance services for education, government, health care, libraries and nonprofit organizations. As soon as the GW Cyber Hub is up and running, the existing robust training resources on the Merit Network will be available, including a secure sandbox with a virtual city. CAAREN will operate the GW Cyber Range, the test bed and research platform, and the new training facility, a hub on the MCR. GW's Cyber Academy will develop and deliver courses and certificates. The grant will fund a cybersecurity engineer who acts as a liaison between the education community and cybersecurity professionals.

According to Jaroslav Flidr, principal investigator on the grant, "The Michigan Cyber Range's virtual city of Alphaville is a critical resource for students because from the cybersecurity perspective, it is real. Its virtual municipal and organizational components - the hospital, the power plant and its schools - are configured the same way their real-world counterparts would be. In fact, it is so real that when someone successfully hacks Alphaville's power plant, the city goes dark in its 3D visualization engine presentation!"



Community partners, including universities and businesses in the region and Commonwealth, will also be able to create content and use CAAREN's high-speed network to access the training environment. GW professors will develop new cybersecurity curriculum using these resources, which will be available to the larger community as adult education classes through the Northern Virginia Community College system. GW researchers will also have access to the Cyber Range to test studies in a repeatable environment with advanced networking on an open science platform.

The Capital Area Advanced Research and Education Network (CAAREN), is an initiative of George Washington University designed to build a high-performance research and education infrastructure to serve the Washington, DC, and Northern Virginia areas. CAAREN offers research network services to government, education and research organizations, as well as some private-sector organizations within the District of Columbia and Northern Virginia.

Virginia Cyber Range to Enhance Cybersecurity Education



Governor McAuliffe during the Commonwealth Cyber Physical Systems Summit in Newport News, VA

Proposed by Governor McAuliffe in the spring of 2016 to boost Virginia's cybersecurity industry through strategic educational investments, the Virginia Cyber Range is a Commonwealth of Virginia initiative with a mission to enhance cybersecurity education in Virginia high schools, colleges, and universities. The Cyber Range is being built by a consortium of Virginia public institutions with the goals of providing a courseware repository for educators and a cloud-hosted environment for hands-on cybersecurity labs and exercises for students, and building a cybersecurity education community among Virginia institutions.

The effort is led by an executive committee representing public institutions that are nationally recognized centers of academic excellence in cybersecurity education within the Commonwealth. These schools include George Mason University, James Madison University, Lord Fairfax Community College, Longwood University, Norfolk State University, Northern Virginia Community College, Radford University, Tidewater Community College and Virginia Tech.

Mid-Atlantic Research Infrastructure Alliance (MARIA) helped to conceive and develop the Cyber Range concept. While the Virginia Cyber Range represents a unique mission and architecture, the project benefited from the considerable expertise of colleagues at other institutions including Quilt member Merit Network. MARIA provides shared cyberinfrastructure

for its members and for research, education, and community anchors in the region including access to Internet2. MARIA is facilitating high performance network connectivity for the institutions who are members of the Cyber Range executive committee and will help to convene broad participation throughout the communities we serve.

The unique, cloud-based architecture will be hosted virtually by one or more cloud service providers, making it easily accessible by participating schools and agencies state-wide and beyond. Cloud hosting requires the least amount of administrative overhead, labor, and equipment investment. This approach also provides for maximum customization, scalability, responsiveness, and sustainability. To ensure universal accessibility, all content will be delivered using standard web browsers, so no special software is required to access labs and exercises hosted in the range. The Virginia Cyber Range will be housed at Virginia Tech (VT), and VT leadership will, in consultation with the Executive Committee, provide day-to-day oversight of cyber

range personnel. Content for the range is being solicited from participating institutions through a grant process.

University students began using the cyber range for cybersecurity coursework beginning in January 2017 and the range will support high school cyber education starting in summer 2017. The range will support the Virginia Cyber Cup Competition, a cybersecurity contest among Virginia colleges at the Virginia Military Institute in February 2017.

The Mid-Atlantic Research Infrastructure Alliance (MARIA), Inc., is dedicated to facilitating access to advanced information, instruction, and research infrastructure technology and advancing research and education in the United States. MARIA is managed and operated by the Virginia Tech Division of Information Technology.

www.marialliance.net

NYSENet Extends the Shape, Scope of Its R&E Network



For most of the last 20 years, NYSENet has often been defined by the inverted-L of its R&E network, which bisects New York state from Buffalo to New York City along a path that parallels the Thruway. In 2017, NYSENet is taking a large step toward expanding its network, in both shape and scope.

Beginning in late 2016, NYSENet set out to add a new, 400-mile path that will extend the network south of Syracuse to Binghamton to New York City. By adding this path, NYSENet will establish a redundant route between Syracuse and Manhattan and place dozens of important colleges, universities, schools and other institutions within affordable reach of the R&E network.

Until now, the institutions scattered across what's known as New York's Southern Tier – an area covering about 10,000 square miles from Middletown in the east to Jamestown in the west – have suffered from a critical lack of network options. Many of the institutions find themselves cut off by geography (including the Finger Lakes) and the steep costs of laying their own fiber to extend their networks to limited commercial providers.

Those networking challenges are happening at a time when colleges, K-12 schools, libraries and other institutions are finding it difficult to compete for faculty, students and funding without modern, high-capacity networks and all they can provide. As the cloud becomes predominate, it is essential to provide reliable, affordable, high-speed connectivity.

By establishing a point of presence in Binghamton, acquiring rights to dark fiber, and lighting up a new southern path, NYSENet is aiming to ease those challenges. In later phases, NYSENet aims to bring new PoPs to other underserved areas of western and northern New York.

“There’s never been a more urgent need to extend our network’s reach and redundancy,” said NYSENet President and CEO Christopher M. Sedore. “The capabilities of a 100 Gbps network go beyond mere speed and capacity; it’s changing how institutions serve students, engage researchers and do business.”

The new route through Binghamton will provide a redundant path for all NYSENet traffic between Syracuse and New York City, which is important for network reliability and for members who take advantage of NYSENet’s 4,000-square-foot Central New York data center. NYSENet expects to have the Southern Tier path completed by summer 2017, with the first connectors taking service shortly thereafter.

In addition to extending its network, NYSENet is simultaneously building out its peering service by adding content delivery network connections to several cloud providers, including Apple, Akamai, Facebook, Google and Netflix. By providing access to a select set of busy commercial destinations, NYSENet’s 10 Gbps members can reclaim capacity on their commercial connections and increase use of the R&E network, which has enormous capacity. Several large institutions already have begun offloading Netflix and other service traffic to NYSENet’s R&E network, reducing their combined commercial traffic by 3 Gb as a result.

NYSENet is a private not-for-profit corporation created to foster science and education across New York state. Our mission is to advance network technology so New York’s research and education community can thrive and find solutions to our generation’s greatest scientific challenges.

www.nysernet.org

KanREN Accelerates into the Future



Reflecting on KanREN's upcoming 25th anniversary, Executive Director Cort Buffington stated, "It's not about where we've been or what we've done. It's always been about building a next generation network; looking to the future in order to build a stable and innovative connection that will be the greatest benefit to our members at the lowest cost possible."

Building on its 25-year history of providing next generation networking for its members, KanREN has deployed two innovative networks, HyperCore and ResilientRing, designed to support the data sharing needs of modern research and education in the state of Kansas.

HyperCore is a dual-redundant, geographically diverse backbone with multiple 100 Gigabit connections shared by University of Kansas (KU), Kansas State University (KSU), Wichita State University, and the University of Kansas Medical Center (KUMC). ResilientRing is a dual-redundant, geographically diverse network of multiple 10 Gigabit connections at Fort Hays State University, Emporia State University, Pittsburg State University and Washburn University.

HyperCore and ResilientRing are interconnected at exit points in Wichita and Kansas City, providing 100 Gbps upstream speeds to Internet2. The networks are deployed utilizing a combination of fiber owned and operated by KanREN, KSU, KU, and KUMC and lit fiber from telecommunications partner Kansas Fiber Network. HyperCore and ResilientRing represent two years of planning and collaboration with the forward-thinking Kansas universities and was launched within budget and ahead of schedule. The next generation network will attract not only high-end research, but innovative businesses as well.

Speed and efficiency of the network have not been KanREN's only area of focus. The integrity of the network has been fortified as well. KanREN has been preemptively protecting its members from the fall out of DDoS cyber-attacks; i.e., overwhelming burst rates and resulting increased charges from ISPs for excessive use.

KanREN has built a comprehensive solution to mitigate attacks and their impact. It includes training, education, consulting, and technical services combined with an entire suite of tools and response protocols. There are multiple methodologies to mitigate attacks in addition to actively working with members to best defend their networks. All of this is included in KanREN's basic service offering while still lowering service costs for all members.

Finally, students across Kansas soon will benefit from unprecedented access to information and opportunity through the Prairie Line Express, a new initiative from KanREN. The Prairie Line Express initiative will extend the effort recently announced by Kansas Governor Sam Brownback, the Kansas State Board of Education and Education Superhighway to ensure every classroom in Kansas has access to fiber and high-speed internet.

The Prairie Line Express will connect schools across Kansas to its existing backbone infrastructure, delivering high-speed gigabit fiber connectivity to schools at an affordable price. A request for proposal issued January 23rd invites providers across the state to partner with the Prairie Line Express in meeting the State Board of Education's vision that, "Kansas will lead the world in the success of each student."

Kansas Research and Education Network (KanREN, Inc.) is a non-profit, member-driven organization focused on providing advanced network services, innovative and cost-effective network technology and attention to individual needs for all of its members. Members include colleges, universities, school districts and other organizations in Kansas.

www.kanren.net

I-Light Celebrates 10 Years of Discovery, Collaboration

What exactly is the universe made of? How did art shape ancient Roman culture? What causes disorders like epilepsy and schizophrenia?

Thanks to the I-Light network, Indiana researchers are finding answers to these and other pressing questions. “I-Light is the indispensable enabler and equalizer for research and education across the state,” said Brad Wheeler, Indiana University (IU) chief information officer, vice president for IT, and interim dean of the School of Informatics and Computing.

Reflecting on I-Light’s 10th Anniversary, I-Light director Marianne Chitwood stated, “I-Light’s first 10 years have seen unimaginable growth, and I’m looking forward to what the next decade will bring. Our goal will always be to enable new discovery. Whether it’s a cure for cancer or a better way to receive imagery from Mars, I-Light gives researchers quick and convenient access to the tools they need to find answers to their research questions. The future of I-Light is very bright.”

In 2016, I-Light announced a bandwidth increase from 10 Gigabits per second (Gbps) to 100 Gbps. The new 100G capability allows I-Light to provide the following services even more efficiently: high-quality video connections; exchange of large data files; access to supercomputers and scientific data storage facilities; multi-campus collaborative research projects.

The ability to share large data files is certainly crucial to Norbert Neumeister’s research. A physics professor at Purdue University, Neumeister studies experimental particle physics, collaborating with researchers at the Large Hadron Collider (LHC) in Switzerland to better understand the universe and the Big Bang theory. The LHC, a 17-mile-long accelerator, is the largest scientific instrument on the planet. It produces massive amounts of data.

“My lab provides storage for 4 petabytes of data, which is equivalent to 1 million DVDs of data,” said Neumeister, whose research is funded by the National Science Foundation and the U.S. Department of Energy. “We use I-Light to efficiently move and transfer this data from the experiment, to our site, and also to other scientists who want to access it for analysis. The excellent network connectivity that I-Light provides is key to our future funding.”

For Lige Hensley, chief technology officer of Ivy Tech Community College, being a member of the I-Light network means his 32 campuses save money while offering top-notch connectivity to all students.

“I-Light gives us much more bang for our buck when it comes to networking,” said Hensley. “I-Light gives us a fixed number we can budget for, it’s very reasonable, and it certainly gives us far better performance than we’ve had with any other vendor.”

“Having I-Light connectivity in the rural parts of the state allows Ivy Tech to offer consistency to all of our students,” he continued. “In the past if you were in one of the denser populated areas such as Fort Wayne or Indianapolis, you got the full experience. If you were in Logansport or Warsaw, perhaps it was a bit less. Today, with good connectivity to all of our locations, there’s no more discrepancy. All of our students are equal, from a technology perspective.”



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

LEARN/TETN Partnership Benefits ESCs & Texas School Children

In support of the K-12 students in Texas, LEARN member Texas Education Telecommunications Network (TETN) provides services to enhance the classroom experiences of students in school districts throughout the state that are supported through the 20 Education Service Centers (ESCs) throughout Texas. As classroom teachers become ever more dependent on bandwidth to support their need to deliver quality education, TETN continues to add bandwidth capacity to serve the ESCs, with four more members expanding to 10 GBPS connections within the past year. Recognizing that network expansion means that additional management tools will be needed, TETN continues to improve its security and bandwidth management services as well as its video content platforms.

TETN provides a Distributed Denial of Service (DDoS) solution to five of the ESCs to prevent downtime due to attacks. These types of attacks are becoming more prevalent and thus are causing more issues for school districts. TETN purchased a solution through a third-party vendor and maintains it for those ESCs that choose to participate. DDoS attacks are mitigated with the solution thus preventing ESCs from having long periods of downtime that would impact the districts they service.

As video becomes increasingly in demand in classrooms, TETN's network connects ESCs and districts with the broadband capability needed to expand their video services. Videoconferencing has always been a primary use of the network and as this technology becomes more cloud-based, TETN is utilizing more cloud services to support the ESCs who in turn support the districts. This year TETN purchased cloud services

through AWS to provide scalability in their cloud bridging and desktop video platform. Needed bandwidth is available to send large amounts of video for special programs and now the service is available in the cloud to "burst" and scale when needed. In addition to the video cloud service, TETN has also added service for ESCs and district personnel to have a video content portal to upload and distribute videos. Videos available on the portal are used to provide information to students who may have missed class or need additional assistance on homework as well as providing videos produced for projects and training.

As a part of the LEARN community, school districts enjoy the tremendous benefits of the caching services provided through LEARN, with Microsoft and Google being the largest suppliers of cached content to schools. This enables school districts to continue classroom work without interruptions on the days when products from those companies have large software upgrades that can shut down a network.

The Texas Education Telecommunications Network has stated they are proud to be included in the membership of LEARN and are particularly gratified that LEARN's services significantly enhance the high quality of service that TETN provides to Educational Service Centers and school districts throughout Texas. TETN truly adds value to LEARN's educational mission.



LEARN is a 501(c)(3) consortium of 39 organizations throughout Texas that includes public and private institutions of higher education, community colleges, the National Weather Service, and K-12 public schools. LEARN connects these organizations, and over 500 affiliated organizations, together with high performance optical network services to support their research, education, healthcare, and public service missions.

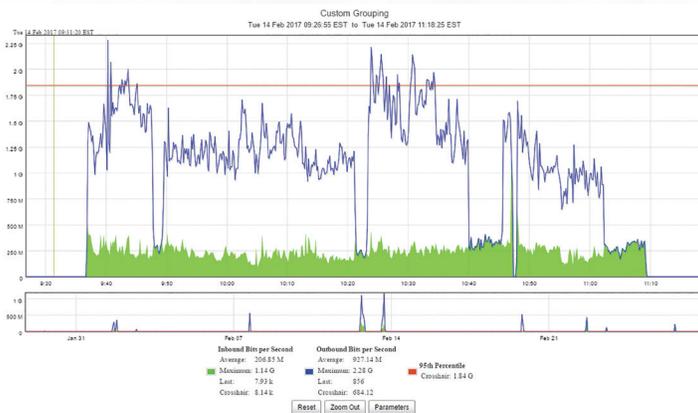
www.tx-learn.org

Connecticut Education Network (CEN): Deepening Member Engagement through Service Offerings

Connecticut recognizes that the business opportunities of tomorrow require networking far beyond current capabilities and has partnered with universities, municipalities and private industries to drive continued innovation and investment into the high-tech infrastructure across the state.

Current economic realities mean doing more with less and CEN has risen to that challenge over the past year through the revamping of our service offerings. CEN has incorporated DDoS mitigation into the baseline Internet service offering, become a service provider for E-rate, and established new peering and caching services.

The image below depicts an example of CEN's effective DDoS mitigation: The graph shows no traffic passing through CEN's mitigation system, then a DDoS is detected. Traffic for that /32 address is now diverted using BGP to the mitigation system (around 9:38AM). As the traffic flows, "good" and "bad" requests are identified. The blue lines represent total traffic, with green as good traffic and white space representing traffic dropped at the mitigation border. This graph depicts four attacks tightly grouped together. The attacks stop around 11:10, and traffic gets diverted back to normal backbones.



Becoming a service provider for E-rate, is allowing K-12 schools and libraries to leverage federal funding to offset their broadband costs. CEN is working with the CT State Library to expand fiber connectivity to an additional 40+ libraries this year, leveraging bond dollars and E-rate funding. Another new service that CEN offers is managed Wi-Fi, which also qualifies for E-rate reimbursement.

CEN's total bandwidth from all members is sustained at greater than 70 Gbps during peak hours and peaks much higher with Google Cache and non-cache ~22 Gbps peak hours and Akamai Cache ~5 Gbps peak hours. CEN's peering connectivity is ~200G with new peering and caching with Mass-IX, Yahoo and Hurricane Electric, in addition to existing connections with Akamai, Amazon AWS, Apple, Google, Microsoft, and VMWare.

CEN is looking to the future, especially in meeting the computational and data-intensive science needs of CT higher education institutions. We are pursuing collaboration with Connecticut researchers to foster collaboration and research exchanges with active members such as the University of Connecticut's High Performance Computing Center, Yale University's Research Computing Center, and partners at the Massachusetts Green High Performance Computing Center (MGHPCC) in Holyoke, MA.



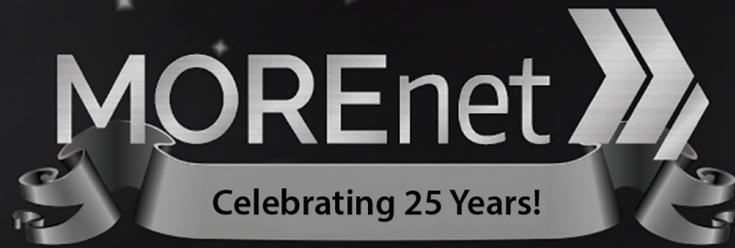
In addition to bringing on new services driven by member needs, CEN welcomed a new Director, Ryan Kocsondy. Ryan spent the past four years restructuring and revitalizing IT service and support as the Director of UConn Hartford Information Technology Services and comes to CEN with over ten years of network experience as the former manager of UConn Network Engineering and Data Center Operations.

He will work in partnership with statewide and regional leaders to continue garnering support for CEN's activities.

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.

www.cen.ct.gov

Missouri Research and Education Network Celebrates Twenty-Five Years



Proudly serving Missouri's education and public sector since 1991.

In 1991, Missouri's four-year public colleges expressed the desire to connect to the NSFnet, a precursor to today's Internet. The result was the creation of one of the first statewide higher education networks in the country, the Missouri Research and Education Network (MOREnet). Operating as a separate business unit within the University of Missouri System, MOREnet began with 13 public college and university charter members with the primary purpose of developing, maintaining and cultivating applications for electronic interchange in support of the educational research and service missions of our members.

Over the next 10 years, growth was rapid. Collaborations with the Department of Elementary and Secondary Education, the Office of the Secretary of State, State Library and the Missouri Department of Higher Education led MOREnet to begin delivering secure, reliable and robust Internet connectivity to a wide variety of member organizations in academia and the public sector. By 2002, 509 Missouri public school districts, 64 higher education institutions, 125 tax-supported public libraries and state government had joined the MOREnet consortium.

Over the past 25 years, MOREnet evolved from an Internet service provider to an education service provider, deploying and supporting the technology resources members and their end-users need to be successful. Our revised mission is to promote information exchange and activities that support a broader cooperation among our members. MOREnet now proudly fulfills the role of convener for all member institutions and contacts.

As the consortium has held steady, MOREnet has witnessed individual member connections expand from a mere 56Kbps connection to 10 Gbps for some of its higher education members. Many K-12 members have exceeded 1Gbps. In 2014, MOREnet became an early adopter of the research and education networks to support up to 100 Gbps. In September 2016, total aggregate member connection capacity exceeded 100Gb.

Today, MOREnet is proud to be a member-driven consortium connecting Missouri's K-12 schools, colleges and universities, public libraries, health care providers, state and local government offices and other affiliated organizations to better Internet service, essential technical services and peer-to-peer resources. MOREnet strives to deliver relevant and reliable solutions through innovative technologies, accessible staff and a deep understanding of their members' technology needs.

MOREnet is humbled by its community of members and as they kicked-off their silver anniversary, it seemed only appropriate to engage directly with those that have continued to support the consortium through the years. Team members pledged to visit each member location to offer a heart-felt thank you while discussing goals, technology concerns and service needs. We are proud to report that we visited with more than 700 members during our year-long celebration. Most visits capped off with selfies that were shared on social media via the MOREnet Flickr site.

Here's to another 25 years!

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

Strategic Initiatives Guide Merit Network in 2017

Merit Network's diverse membership includes state and local governments, healthcare, K-12 education, higher education, libraries and other nonprofits. We provide services to our Members that help them accomplish their missions and better serve their communities. For 2017, Merit's strategic initiatives are focused on three key areas: networking, security, and collaboration.

For many years, Merit has provided internet and networking services to a large number of intermediate school districts in Michigan. Through a new initiative led by the State of Michigan, Merit is using its advanced fiber-optic infrastructure to create a K-12 education network, the Michigan Statewide Educational Network (MISEN). MISEN will connect 55 intermediate school districts, as well as local education agencies (LEAs), and many public school academies. The network will provide new opportunities for learning and support classroom activities on a daily basis.

In Merit's recently conducted Member survey, security was a major concern for organizations, and to meet the demand, Merit has created several new security services for its membership: Community CISO, Security Community of Practicing Experts, Security Operations Center, and Regional Cybersecurity Education Collaboration.

Many organizations cannot afford to have their own chief information security officer (CISO) to oversee their security concerns. To remedy this, Merit created the Community CISO service, where Merit's CISO Jason Brown provides cybersecurity guidance and recommendations to organizations at a fraction of the cost an organization would need to spend to have a full-time CISO.

The Security Community of Practicing Experts (SCOPE) was created to help facilitate discussion and idea exchange among chief information security officers in Michigan. Jason Brown leads the community of practice, and the group meets to regularly discuss cybersecurity policies, cyber attacks, and other concerns.

Cyber attacks have become an everyday concern for organizations, and Merit is helping to reduce the effects of distributed denial-of-service (DDoS) attacks for its Members with its new Security Operations Center (SOC). When the SOC team detects a DDoS attack, they will notify the Member and begin to mitigate the attack.

Michigan and many other states will be facing a dire shortage of qualified cybersecurity professionals in the near future. To help meet this desperate need, a new educational partnership,

the Regional Cybersecurity Education Collaboration (RCEC), was started by the State of Michigan and Merit's Michigan Cyber Range to boost the cybersecurity workforce in Michigan. Central Michigan University, Northern Michigan University and Wayne State University are the initial university partners, and the partnership will provide military veteran re-training, workforce development and a broader cybersecurity curriculum for students.

To spur collaboration and communication among its Members, Merit launched a social portal, the Merit Commons, in 2016. This year, Merit will continue to encourage its users to interact with each other and with Merit staff to discuss networking, cybersecurity, staffing, and other important topics. Merit is developing a mobile app version of the Merit Commons to make it easier for users to participate using their mobile devices.



Merit Network Inc., is a nonprofit corporation owned and governed by Michigan's public universities. Merit owns and operates America's longest-running regional research and education network. Since its formation, Merit Network has remained at the forefront of research and education networking expertise and services. Merit provides high-performance networking and IT solutions to Michigan's public universities, colleges, K-12 organizations, libraries, state government, healthcare, and other non-profit organizations.

www.merit.edu

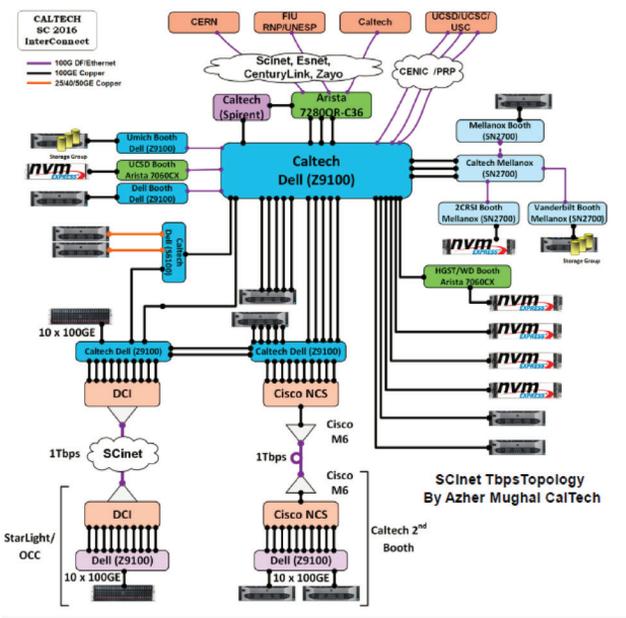
MREN Developing Advanced Networking Services

MREN continues to define current and emerging requirement information from its many domain science partnership communities. This information is being used to develop further the architecture, services, technologies, and facilities that are necessary to support those requirements within production operation environments, especially large scale, data intensive, high performance capabilities. As part of this process MREN supports the design, development and operation of national and international testbeds and prototype services and facilities. In addition, MREN provides access to specialized remote instrumentation, research facilities at national research labs, and international research sites through its partnership with the StarLight International/National Communications Exchange Facility.

The capabilities of two Software Defined Exchanges (SDXs) implemented at the StarLight facility were also showcased, one supported by the National Science Foundation's (NSF) Global Environment for Network Innovations program, the other supported by the NSF's International Research Connections program. These SDXs were used to demonstrate advanced services for data intensive sciences, including those that use E2E single 100 Gbps streams across national and international WANs.

Among the 100 Gbps based capabilities showcased were those for a Bioinformatics SDX for Precision Medicine, real time analytics using Earth Observing Satellite data, remote I/O and controlled pipelining, dynamic WAN provisioning, ultra resolution media streaming, large scale data transfer services, interconnecting SDN and legacy L2 domains, application driven intelligent data movement for Large Hadron Collider high energy physics, programmable privacy-preserving network measurement for network usage analysis and troubleshooting, multicore-aware data transfer middleware, high performance data transfer nodes, real time network analytics, and scheduling for large scale data flows.

With its local, regional, national, and international partners, MREN has undertaken multiple initiatives to address the three macro themes in emerging capabilities for next generation communication services and technologies: 1) large scale capacity, including those based on bonded lightpaths provisioned over superchannels; 2) network programmability, especially by using Software Defined Networking Techniques (SDN); and 3) techniques that enable highly granulated network customization, enabling a migration from "one-size-fits-all" networks to distributed platforms that can support many different types of networks providing precise support required for different communities and applications.



At the 2016 international supercomputing conference in Salt Lake City, Utah, MREN, the StarLight consortium, and multiple national and international research partners, designed and staged a series of 43 sets of demonstrations to showcase emerging services and capabilities for next generation data intensive science networks. To prepare for these demonstrations, MREN and its partners, implemented eight 100 Gbps paths from StarLight to the conference venue in Salt Lake City, as well as three 100 Gbps from MAX to the venue and one 100 Gbps from New York City. On the showfloor, MREN, in partnership with StarLight, SCinet and CalTech, implemented a Tbps ring on the showfloor, including Tbps nodes in the StarLight booth and one of the Caltech booths. The StarLight booth supported 2.2 Tbps during the conference.

The Metropolitan Research and Education Network (MREN) is an advanced, high performance regional network supporting organizations in seven states in the upper mid-west. MREN's primary focus is on providing advanced digital communications for leading-edge research and educational applications, primarily communication services for data intensive science.

www.mren.org

KINBER: Nothing but Net(work)

On April 4, 2016, millions of college basketball fans were fixated on their screens watching the 2016 NCAA Men's Basketball Finals. The second-seeded Villanova Wildcats had a six-point lead with less than two minutes on the clock and watched it evaporate when top-seeded North Carolina's Marcus Paige hit an epic three-pointer to tie the game at 74 with 4.7 seconds left. Overtime was almost a certainty. A timeout was called and both teams regrouped.

At the sound of the whistle, Villanova's Kris Jenkins passed to Ryan Arcidiacono, who flew up the court and passed the ball back to Jenkins. The shot went up and the net's swoosh signaled the game-winning, buzzer-beating, 3-pointer that lifted Villanova to a 77-74 win and the 2016 national championship.

The emotion and energy was electric on the suburban Philadelphia campus of Villanova University the night of the Championship win, where students, alumni and friends watched the live streaming video and rejoiced.

And KINBER assisted with creating that magical night on campus by helping Villanova meet its technology needs.

KINBER held a staff meeting on March 17, which happened to be the first day of the NCAA tournament. Around 5:15 p.m. as the meeting was concluding, the office phone rang. Apparently, Villanova's 1 Gbps connection to PennREN, KINBER's next generation broadband network, was congested due to all the streaming video coming into the campus.

When KINBER installed the connection, Villanova was concerned about possible equipment failure and wanted a redundant 1 Gbps connection. To meet Villanova's needs, KINBER included a backup one Gbps along with its connection. Having planned ahead, this backup connection made the difference. Within 15 minutes of the phone call, KINBER was able to bring up the second 1 Gbps connection and configure it with the initial connection so that Villanova had a seamless 2 Gbps of connectivity to PennREN to support increased streaming video of the tournament. The 2 Gbps connection continued to provide relief for the campus network connection as the basketball team continued to win and advance through the brackets.

As the team gained momentum, so did Villanova's need for increased network bandwidth. KINBER received a request on Tuesday, March 29 seeking a 10 Gbps upgrade to the Villanova connection by that Friday, in time for the team's appearance in the Final Four.



KINBER made the upgrade and was able to help Villanova meet student demands to watch the tournament and, ultimately, the game many sports columnists consider to be the best NCAA men's basketball final in history.

"During the middle of the basketball tournament, KINBER's expertise and quick response allowed us to meet student demand while maintaining our operations across the University, which we very much appreciated," said John Center, director of Network & Communication Services at Villanova.

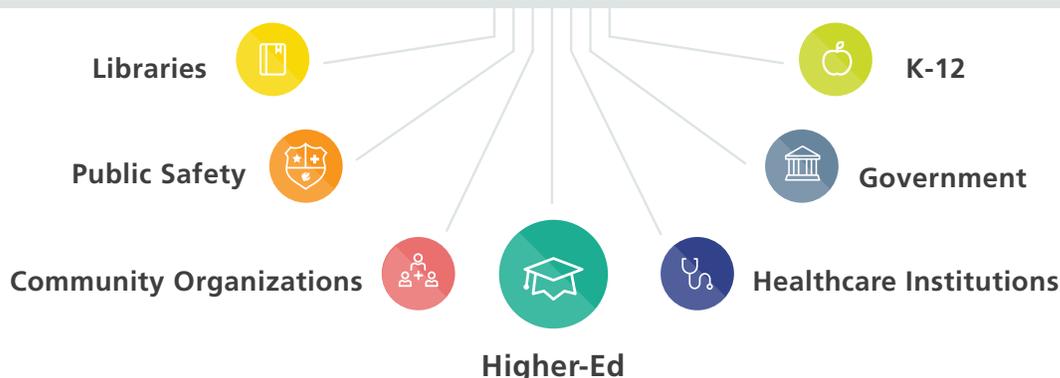
"The Villanova story demonstrates KINBER's value as a membership based organization and illustrates how it provides strategic opportunities for our community. We are not just a network, but a partner that offers compelling services often specifically tailored to meet the needs of our community," said KINBER President and CEO Wendy Huntoon.

As a non-profit membership organization, the Keystone Initiative for Network Based Education and Research (KINBER) is Pennsylvania's statewide research, education and community network devoted to fostering collaboration through technology.

www.kinber.org

Research and Education Networks: Enabling Breakthrough Innovations that Power the Greater Good

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>Equitable and shared cost recovery model that seeks to 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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