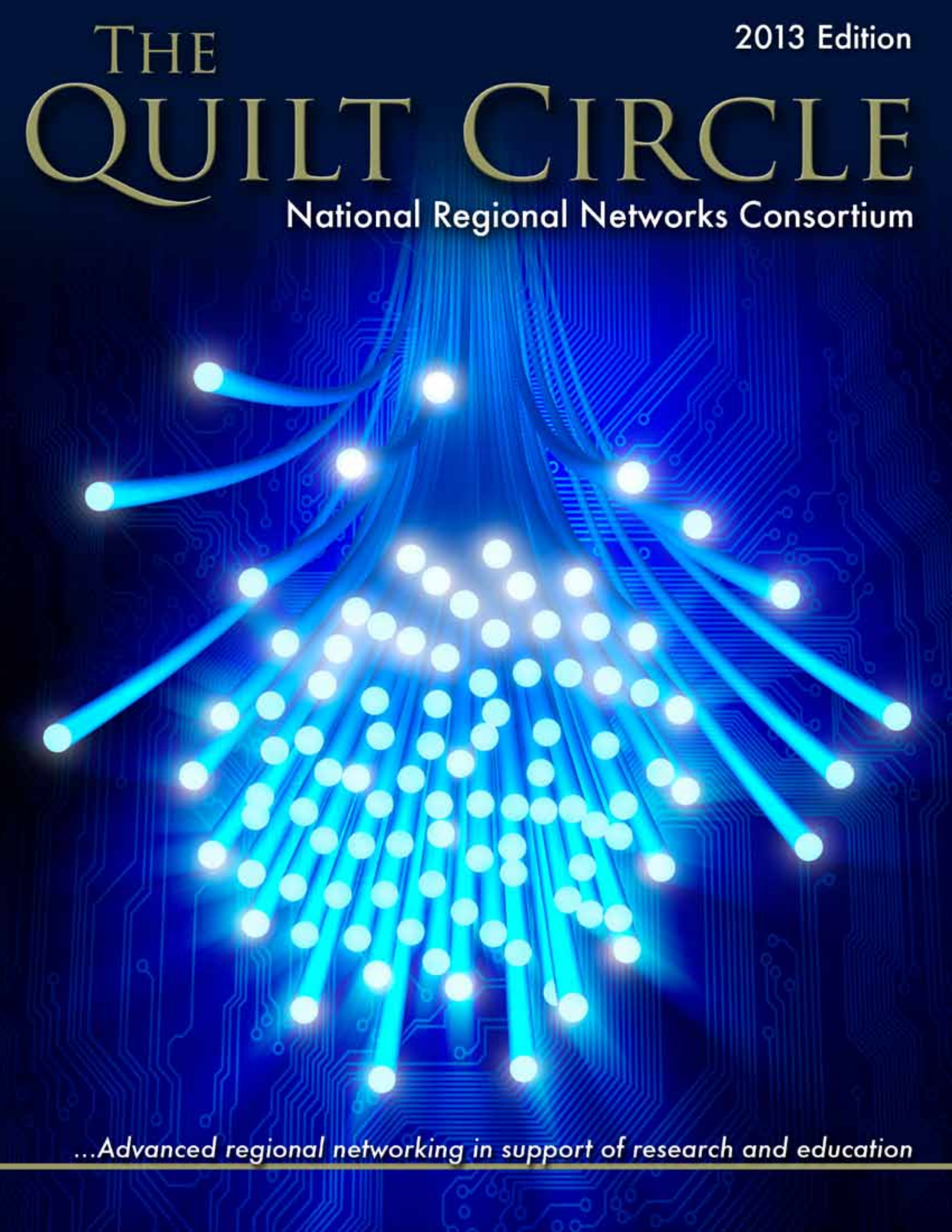
2013 Edition

The Quilt Circle

National Regional Networks Consortium



...Advanced regional networking in support of research and education

A Letter from the President

Leaders and builders of high-capacity, high performance networks, trusted partners, facilitators, community builders and conveners. These are the critical roles played by our Quilt members in their communities, and you can read all about them in our latest edition of The Quilt Circle. This year's publication showcases our Quilt member efforts in: providing tools and infrastructure to support big science research and data movement; deploying leading-edge networking technologies including software defined networking; deploying network infrastructure funded through Broadband Technologies Opportunity Program grants; supporting health care research and telehealth initiatives, connecting schools and other anchor institutions to our networks; providing strategic services to members and much more.

The Quilt recognizes how important communication and outreach is to the community-building goals of our member organizations and to the success of our national Quilt community. The Quilt Circle is a key part of our national communication plan and captures only a few of the many important initiatives our Quilt member organizations undertook in the last year to support the missions of the universities and other community anchor institutions they serve. Many of our members publish similar compilations which highlight additional stories about the impact of our member networks on their local communities. I encourage you to look for these publications on our respective member websites.

Several of our members are completing work this year on broadband infrastructure projects funded through grants by the National Telecommunications and Information Agency's BTOP. It is an exciting time as these projects near completion and turn the promise of broadband technology into reality for new community anchor institutions across the country.

We strengthened our Quilt community in the last year with the addition of WVNET in West Virginia and the New Jersey Research and Education Network, NJEDge.Net. These organizations contribute their expertise, insights and staff talents to our Quilt discussions, to the benefit of our entire Quilt community. In welcoming our new members, The Quilt continues to grow as a vibrant community where leaders from our regional networking organization members come to engage with one another.

The Quilt gathered an increasing number of attendees at its 2012 events, which attracted representatives of Quilt member organizations as well as our colleagues from other community partner organizations such as Internet2, NOAA, CoSN and our Canadian research and education networking colleagues. These meetings provide invaluable networking opportunities for Quilt members' staff to engage with one another and share ideas and experience that help to advance our community.

The Quilt continues to build strategic partnerships to enhance the value of our organization to its members. By leveraging our Quilt member staff technical expertise and marketplace knowledge for the benefit of our consortium, the Quilt completed two requests for proposal efforts which defined a framework for more than 250 regional network and higher education institutions to purchase Commodity Internet Services and OpenFlow-enabled switches.

The Quilt and its members have been focused on providing value-added services that utilize our member networks to deliver new services in a cost-efficient and effective manner for the institutions. The Quilt continues its long tradition of seeking opportunities for consortium buying agreements for the benefit of its members and their institutions as well as facilitating collaboration among our members to provide these services. There is no greater compliment to The Quilt than to be asked by a member or strategic partner to explore new ideas for services and collaborations within our Quilt community.

The work of The Quilt is a reflection of our members' priorities, opportunities, challenges and successes. The support and cooperative spirit among our membership is remarkable. Our work together this year is a valuable reminder of the roles we all play in the success of one another's organizations and in building the national fabric of regional networks into a Quilt community.

Jen Leasure

Jen Leasure
President and CEO

Acknowledgements

The Quilt wishes to recognize and thank our affiliate member, MIDnet, for its contributions to this publication.

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OneNet's 100G Connection to Internet2 Advances Severe Weather Forecasting

In October 2012, when Internet2 announced its upgrade to a 100G-enabled network, OneNet jumped ahead of the scheduled launch and was the first member network to make the connection. By leveraging the new upgrade, Quilt member OneNet can ensure Oklahoma's network capabilities will keep pace with the state's research and education initiatives. In Oklahoma, major research projects depend on high broadband capabilities for large data movement, and one of those projects touches the everyday lives of people across the state and the nation.

Access to more sophisticated tools is expected to lead to better forecasts, and improved forecasts mean better weather preparedness.

Each spring, the Center for Analysis and Prediction of Storms (CAPS) at the University of Oklahoma (OU) runs an ensemble of high-resolution weather prediction forecasts covering the continental United States. This ensemble of forecasts, known as the Storm-Scale Ensemble Forecast, is part of the annual Spring Experiment, a collaboration among CAPS and research and operational units of the National Oceanic and Atmospheric Administration (NOAA) at the National Weather Center (NWC) at OU.

"A forecast ensemble consists of 25 or more member forecasts, each with unique features so that meteorologists make more accurate forecasts of severe weather that affects Oklahoma and the nation," explained Keith Brewster, associate director and senior research scientist for CAPS. "No forecast is perfect, but by combining the results from many forecasts into a consensus forecast, many of the sources of error can be reduced."

According to Brewster, the CAPS ensemble of forecasts is unique compared to other forecasts around the world because of the number of forecasts run, the use of real-time Doppler radar data, and the high resolution – one grid point every two-and-a-half miles across the entire continental United States.

Forecasts such as these require high-speed networks for daily data transfer during the six-week experiment every spring. The CAPS forecast ensemble is run at the National Institute for Computational Science (NICS) operated by the University of Tennessee, and data must be transferred from CAPS to NICS and back to the NWC each day. This data travels through local networks in Tennessee to Internet2 then through OneNet's network in Oklahoma.

In the past, network capacity has limited data transfer to a select set of forecast graphics. OneNet's new connection, along with increased network capacity in Tennessee and upgrades to OneNet's statewide network and the connection into OU (as part of a National Science Foundation Cyber Connectivity grant led by OneNet, OU and Oklahoma State University), will change that by enabling the transfer of more complete data among the collaborating partners.

"With the increased network speed, we expect to deliver the full three-dimensional gridded data from some members of the forecast ensemble to the forecasters," explained Brewster. "The scientists will now be able to interactively interrogate the forecast products and use more sophisticated visualization tools. They will no longer be limited by the pre-determined products. This is like going from a single two-dimensional X-ray image to a 3-D CAT scan."

Access to more sophisticated tools is expected to lead to better forecasts, and improved forecasts mean better weather preparedness. "Improved severe weather prediction helps the public better prepare for severe weather," said Brewster. "With greater lead time and accuracy, businesses, public institutions and individuals are able to take actions to protect lives and mitigate loss from hail and tornadoes."

Research like the Spring Experiment truly touches everyday lives, and the technology OneNet brings to the state empowers Oklahoma's researchers to take their work to the next level. By advancing technology and removing barriers to innovation, OneNet and its network partners are changing the future for the state of Oklahoma and the nation.

About OneNet: OneNet is a division of the Oklahoma State Regents for Higher Education. OneNet's mission is to advance technology across Oklahoma. OneNet enhances economic growth by meeting the mission critical needs of our state's education, research, healthcare and public service communities.

About CAPS: CAPS's mission is to develop and demonstrate techniques for the numerical analysis and prediction of high-impact local weather and environmental conditions, with emphasis on the assimilation of observations from Doppler radars and other advanced in-situ and remote sensing systems.

LONI Infrastructure Supports Louisiana's Health Research Strategies

In recent national studies on public health, Louisiana is tied for last place. The Bayou State's low ranking is indicative of high rates of obesity, diabetes, cardiovascular disease and cancer among its residents, as well as of the state's other challenges including the high prevalence of sedentary lifestyles and of children in poverty. However, the Louisiana health care and higher education research community, with support from Quilt member the Louisiana Optical Network Initiative (LONI), is engaged in aggressive efforts to address these significant health challenges. The National Institutes of Health (NIH) recently awarded the Louisiana Clinical and Translational Science (LA CaTS) Center at LSU's Pennington Biomedical Research Center a five-year, $20 million grant to support biomedical research in Louisiana. The overarching objective of the LA CaTS Center is to transform the clinical and translational research efforts away from the status quo, where institutions operate in isolation to pursue their individual institutional missions, and toward a cohesive, mutually supportive enterprise for clinical and translational research. The LA CaTS Center represents a unified, comprehensive approach targeting the theme of "prevention, care and research of chronic diseases in the underserved population".

Pennington has partnered with and has highly synergistic and collaborative programs with the LSU Health Science Centers in New Orleans and Shreveport, the LSU Health Care Services Division, LSU A&M, Tulane University Health Sciences Center, Xavier University and Children's Hospital.

The teleconferencing and data communications infrastructure necessary to facilitate and support this collaborative research environment will be provided largely by the LONI network. According to Guy LaVergne, Director of the Communications Core for the project, the LONI network and its advanced high-speed data and communication capability will be used to connect and support the eight project institutions as they join in the single research initiative.

The LONI network has also supported the on-going deployment of an electronic health record (EHR) system within the LSU Health Sciences Centers, the LSU Health public hospitals, and hundreds of physician clinics statewide. The EHR and its interfaces to auxiliary systems such as radiology and labs, known collectively as the Pelican (Patient Electronic Information and Care Network) Project, as well as its high-speed connection through LONI to the LSU Health data centers provide a sophisticated capability to transmit critical health data quickly and securely. A common electronic health record makes information available to the providers at the point of care, provides real-time decision support to enhance performance, tracks patients across the state (with unique identifiers), and feeds into a data warehouse to support disease management programs, quality improvement studies, and health services research.

As observed by Interim Louisiana State University System President and Interim LSU A&M Chancellor William L. Jenkins, "The NIH grant represents an unprecedented opportunity for our universities, medical schools, hospitals, clinics and research institutions to collaborate in ways never seen before by taking advantage of the expertise of our scientists and of LSU's new statewide electronic health records system. The resulting, rich source of patient biomedical data will help us search for clues as we develop treatments and educational programs for those afflicted by the chronic diseases."

With support from LONI, Louisiana health care and higher education are engaged in aggressive efforts to address the significant health care challenges of the Bayou State.

About LONI: The Louisiana Optical Network Initiative (LONI) is a state-of-the-art, fiber optic network that runs throughout Louisiana and connects Louisiana and Mississippi research universities to one another as well as to the National LambdaRail and Internet2. LONI provides Louisiana researchers with one of the most advanced optical networks in the country and with over 85 teraflops of computational capacity, LONI provides one of the most powerful distributed supercomputing resources available to any academic community. Connecting to LONI allows greater collaboration between research universities on projects that produces faster results with greater accuracy. For more information on LONI, visit www.loni.org.

Indiana GigaPOP Launches Top-Speed Network

Indiana's leadership in high-speed computer networks continues with the installation of Monon100—the fastest research and education network to date. The installation of two 100 Gigabits per second (Gbps) network links connects Quilt member the Indiana GigaPOP to national research and education network Internet2 and to the rest of the world.

"Through Monon100 and the Indiana GigaPOP, Indiana's networking leaders work together to benefit the state's universities and their research," said Dave Jent, Indiana University's (IU) associate vice president for networks. "I-Light, the GlobalNOC, IU, and Purdue each bring impressive value to the partnership and together push technology forward. Monon100 is latest example of the commitment to provide Indiana with most advanced networking services and tremendous cost-saving measures."

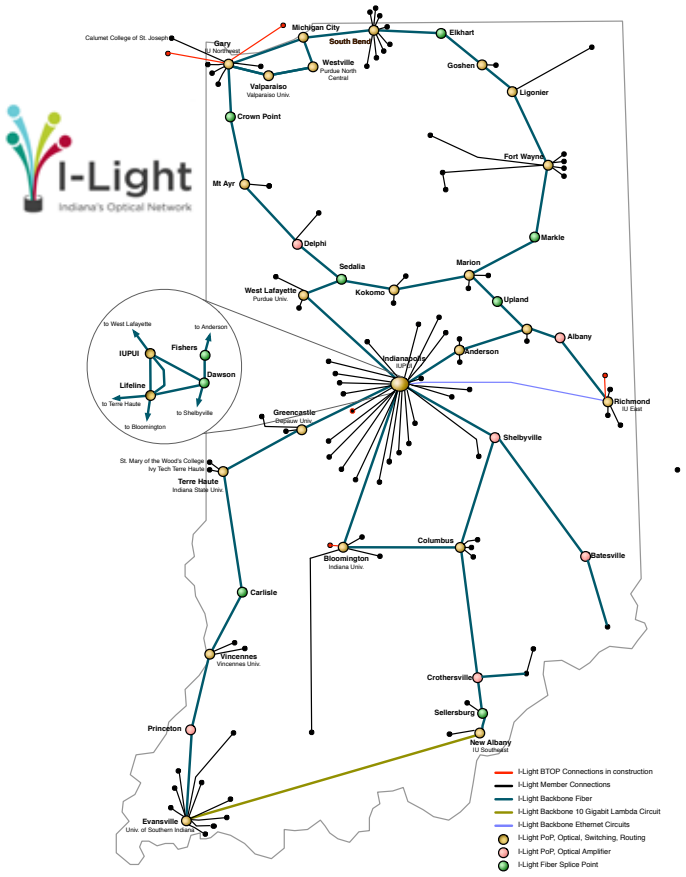
With speeds 10 times faster than the previous network, Monon100 will increase Indiana's research capacity, save resources, and open the door for scientific and medical breakthroughs.

Scientists will use the network to rapidly share the massive amounts of data created by modern digital instruments such as gene sequencers, powerful microscopes, or the Large Hadron Collider.

At IU, Monon100 enables research computing through new systems such as Big Red II—the nation's fastest university-owned supercomputer. Operating at a peak rate of one petaFLOPS, Big Red II is 25 times faster than its predecessor Big Red. The new supercomputer will play a key role in accelerating research and discovery in a range of fields, including medicine, physics, astronomy, global climate research, public health, informatics, and computer science.

With speeds 10 times faster than the previous network, Monon100 will increase Indiana's research capacity, save resources, and open the door for scientific and medical breakthroughs.

Monon100's impact does not stop at IU. The University of Notre Dame and other I-Light members across the state will also benefit from the network's top-speeds. A recent National Science Foundation (NSF) award granted $1.6 million to help Notre Dame with research and development for the first US-based underground accelerator laboratory. With the help of Monon100, nuclear physicists will gather and process data for this project faster than ever before.



The resulting laboratory will simulate space conditions to help scientists understand the evolution and the lifetime of stars. Monon100 has established three precedents in computer network speeds for higher education. The Global Research Network Operations Center (GlobalNOC) at Indiana University began the network's two-phase installation in July 2012 by launching a 100Gbps network link between Indianapolis and Chicago. Indiana is the first state to connect to Internet2 at this speed. In January 2013 Purdue University will bolster this link by moving its 100Gbps circuit to the general Indiana GigaPOP. With this added support, the research and education community in Indiana will be one of the first in the country to have a 200Gbps backbone.

The final phase of Monon100 will use I-Light infrastructure to connect Indianapolis and Bloomington, establishing IU as one of the first in higher education to join separate campuses through a 100Gbps network. The GlobalNOC, which handles all engineering and operations for Monon100, expects to complete the installation process by January 2013.

About Indiana University, Indiana GigaPOP and the Global NOC: The Indiana GigaPOP is a partnership of Indiana University and Purdue University that serves as the network hub for the state's colleges and universities. For more information on the Indiana GigaPoP, visit http://indiana.gigapop.net/.

Scientists Showcase Innovations in 100 Gbps Network Services Required for Next-Generation Research and Discovery

At the 12th Annual Global LambdaGrid Workshop in October 2012, sponsored by the Global Lambda Integrated Facility (GLIF), a consortium of researchers demonstrated a wide area 100 Gbps optical network testbed established to develop advanced services and technologies for next-generation, data-intensive "petascale science." Participating in the consortium were researchers from Quilt members Mid-Atlantic Crossroads (MAX) and the Metropolitan Research and Education Network (MREN).

Petascale science is comprised of many new techniques and methods scientists are using to undertake research in an increasing number of disciplines, including computational bioinformatics, high-energy physics, weather and climate simulation, earth science, computational genomics, nuclear simulations, cosmology, quantum chemistry, brain simulations, fusion science, and astrophysics. Petascale science requires both the generation of massive datasets using supercomputer, instrumentation, and experimental facilities and detailed computational data analysis at sites throughout the U.S. and the world.

In contrast to more general implementations of 100 Gbps services, which aggregate many millions of small traffic flows, this facility supports extremely large-capacity data flows, including a 98 Gbps data transfer between a single pair of high-performance servers with zero packet drops from the East Coast to Chicago and back (approximately 2,000 miles). The research consortium, whose members include NASA Goddard Space Flight Center, the International Center for Advanced Internet Research at Northwestern University (iCAIR), and the Laboratory for Advanced Computing at the University of Chicago (LAC), was established to investigate new networking techniques, technologies, and services for petascale science, with a focus on 100 Gbps end-to-end data flows, including disk-to-disk and memory-to-memory.

Photo of OptIPuter courtesy of the 2011 GLIF Brochure http://www.glif.is/publications/info/brochure.pdf.

The University of Illinois at Chicago's Electronic Visualization Laboratory uses SAGE (Scalable Adaptive Graphics Environment) on its Cyber-Commons tiled display wall for weekly meetings, class instruction, and special events.

These innovations were showcased during the demonstrations; for example, transporting extremely large-volume individual data flows over long distances with high performance and low latency.

To establish the petascale science optical-network testbed, the consortium formed a partnership with MAX, MREN, Sidera Networks, Ciena, the StarLight International/National Communications Exchange Facility and the Open Cloud Consortium. For the GLIF demonstrations, Sidera Networks provided a 100 Gbps low-latency path from the MAX exchange facility in Washington, DC to the StarLight exchange in Chicago. Ciena is supported this initiative with their high-performance 6500 Packet-Optical Platform and 5410 Reconfigurable Switching System. MREN and StarLight provided support with StarWave, a multi-100-Gbps exchange facility.

About the Metropolitan Research and Education Network (MREN): MREN, an advanced research and education (R&E) network, provides services among seven states in the upper Midwest, including the management of a metro-area optical networking facility located at the StarLight International/National Communications Exchange Facility. MREN exclusively focuses on providing service and infrastructure support for large-scale data-intensive R&E activities. (www.mren.org)

About StarLight: StarLight, the world's most advanced national and international communications exchange facility, provides advanced networking services and technologies that are optimized for high-performance, large-scale metro, regional, national and global applications. (www.startap.net/starlight)

About the Laboratory for Advanced Computing (LAC): The LAC at the University of Chicago performs research in the analysis of big data, data intensive computing, cloud computing and high performance networking. (www.labcomputing.org)

About Sidera Networks: Sidera Networks, LLC is the premier provider of tailored, high capacity communications services to carrier and enterprise customers. (www.sidera.net)

About Ciena: Ciena enables a high-scale, programmable infrastructure that can be controlled and adapted by network-level applications, and provide open interfaces to coordinate computing, storage and network resources in a unified, virtualized environment. (www.ciena.com)

About the Open Cloud Consortium (OCC): The OCC manages cloud computing infrastructure to support scientific research and provides support to advanced research projects related to cloud technology. The OCC is managed by the Center for Computational Science Research, Inc., an Illinois based not-for-profit corporation. (www.opencloudconsortium.org)

Enabling Research and Education by Leveraging Resources and Partnerships

During the last year, the KanREN network has changed significantly, but not in the ways one would expect. While some capacity has been added, the biggest growth has been in leveraging partnerships along with existing and new resources to meet the needs of the KanREN research and education community. One of KanREN's mantras is "It's not just about the connectivity. It's making the connectivity useful that is important."

Using OpenFlow for Smart Grid Research

In order to conduct experiments to test a Smart Grid prototype, graduate students at Kansas State University needed infrastructure and protocols that would allow them to run experiments between power generators at Kansas State University (KSU) in Manhattan, Kansas and a control center located in Cambridge, MA. With collaboration from National LambdaRail, Internet2, and the Great Plains Network consortium, KanREN built a network layer 2 path from KSU to the controller located at Raytheon BBN in Cambridge, MA.

> ***"It's not just about the connectivity. It's making the connectivity useful that is important."***

In order for the experiment to be successful, power generators have to be locked in at a frequency of 60Hz, the frequency that our residences require. In the experiment, there were three synchronous generators, static and automatic loads configured at KSU. The generators supplied electricity to the loads at a frequency of 60Hz. The frequency measurements were transmitted through the layer 2 network to the control center. The control center has control logic that includes a frequency deviation threshold. If this threshold is exceeded, power load-shedding commands are transmitted back to the automatic load at KSU in an effort to get the frequency back to 60Hz. The experiment purposefully triggered a deviation in the frequency by creating a generator failure in order to collect data on the frequency response as load-shedding was conducted.

The experiment also created a failure on one of the network links to see how the Fast Reroute mechanism of the OpenFlow controller worked to reroute traffic through a longer path. OpenFlow, an open standard, is currently a popular specification for creating a software-defined network. OpenFlow allows network administrators to remotely control a data packet's routes at a central controller rather than through a network router.

Leveraging Expertise and Resources

KanREN recently developed a scalable video service powered by Vidyo to enable high quality video conferencing across diverse network connections. Southeast Kansas Education Center in Greenbush, Kansas has begun using KanREN's video service and its ability to integrate with existing H.323 classrooms for distance learning. Because Vidyo adjusts for variable bandwidth connections, teachers can teach from their home or wherever they may be. While Vidyo's technology has great potential for rural states, like Kansas, it is the engineering expertise and the partnerships and relationships provided by KanREN that turned the potential into reality. While optimal performance is achieved when a member has a direct connection to the KanREN network, KanREN's suite of Net+ services, like scalable video, does not require direct connectivity to the KanREN backbone. By leveraging its peering relationships with local ISPs, KanREN and its partners have created a new "tier" of connectivity in Kansas.

When Jeff Sorrels, Network Administrator, moved to Seattle, KanREN did not want to lose this valuable employee. The staff at KanREN worked as a team to develop JeffBot, an innovative Telepresence robot that enables Jeff to maintain a physical "presence" in the office even though he has moved to Seattle. The JeffBot is a robotic vacuum cleaner that the KanREN staff adapted with electronics and an iPad so that Jeff can collaborate with other staff members and do his work. Using Vidyo and the high quality broadband service at his home in Seattle, Jeff can attend meetings and visit with colleagues. To see the JeffBot in action, visit http://www.youtube.com/watch?v=QDRLPXxSfjU

Other staff members are beginning to use KanREN's communication technology to telecommute as well. Network Engineer, Casey Russell currently lives in Ft. Scott, Kansas and telecommutes several days a week, as does the Application Team's leader, Indika McCampbell. Between scalable video, instant messenger and SIP-based phones, KanREN members receive the same level of support service whether these individuals are communicating with a staff member in the main Lawrence, Kansas office, or one who is telecommuting. KanREN Executive Director, Cort Buffington adds, "We promote the value of these technologies to our member community so we feel that it is important to utilize the technology ourselves to demonstrate its benefits."

The knowledge and capabilities that KanREN has to implement these projects originated with projects to enable research. The KanREN staff has adapted the knowledge and skills gained to fit projects that are smaller, but no less important for the other communities they serve.

About KanREN: 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. For more information on KanREN, visit www.kanren.net.

Quilt Member MCNC Helps Advance Telehealth Applications in North Carolina

Despite many hurdles, telehealth continues to grow as an effective solution for the many shortfalls in the current health care experience – whether it's gaining access to the right specialist at the right time, or ensuring a patient can manage his or her medications. The continuing alignment of health care with information and communication technologies makes the telehealth industry one of the most transformative spaces in the world.

The continuing alignment of health care with information and communication technologies makes the telehealth industry one of the most transformative spaces in the world.

As health care begins to depend more on Health Information Exchanges, Electronic Medical Records and Internet-enabled research, the North Carolina TeleHealth Network (NCTN), using the backbone infrastructure of the North Carolina Research and Education Network (NCREN) operated by Quilt member MCNC based in Research Triangle Park, N.C., will serve the high-bandwidth, low-latency network needs of health practitioners and researchers throughout the state.

With 85 active sites on the network and more than 20 additional sites anticipated to join in 2013, the NCTN will enable patients, especially in rural areas, to receive top-quality care that includes home-based care and disease management monitoring; remote physician or specialist services; personal emergency response systems; video diagnostic consultations; and remote cardiac services. It will also enable health care providers to have quick and convenient access to the latest research and medical advances, faster ways to share medical records, and more.

Dave Kirby, president of Kirby Management Consulting and project manager for the NCTN, said that in many instances health care requires information to move faster than patients do. Added Kirby, "We have created a robust network to meet and exceed the health care needs of North Carolina citizens for years to come."

There are currently three phases of the NCTN now in action. The NCTN-PH phase for public health, free clinics and some community health centers now serves 61 locations; the NCTN-H phase for non-profit hospitals currently has 24 subscribed locations; and the NCTN Extension phase, which focuses on broadening services for many existing NCTN health care sites as well as adding new sites. NCTN subscribers can routinely engage in high-quality video and audio applications, especially telehealth-based services and tele-education programs. Broadband services with high reliability, low latency, low jitter, and high security are required for most health care providers to obtain the full value from health IT-enabled programs. Kirby said the design of the NCTN includes elements to support these essential requirements.

"These broadband demands are likely to grow over the next several years as more health care providers become more dependent on their broadband services for clinical and other business operations," said Kirby.

The NCTN is coordinated through the Cabarrus Health Alliance (CHA) and to date has been a $14.2 million investment, of which 85 percent has been provided by the FCC for discounts through the Rural Health Care Pilot Program, which earlier this year became a permanent program called the Healthcare Connect Fund. Dr. William Pilkington, CEO and Public Health Director of the CHA, said "the additional funding is welcome news in North Carolina where we have created a unique partnership that is capable of using these monies to rapidly expand broadband throughout the state."

MCNC, in collaboration with N.C. Office of Information Technology Services, is providing connectivity services for each phase of the NCTN. In addition, private telephone, cable and telecommunications companies have been contracted to provide last-mile transport services for the project. The three-year contract for broadband services linking health programs and sites across the state greatly expands the capabilities of NCREN.

MCNC will complete a $144 million expansion of NCREN called the Golden LEAF Rural Broadband Initiative (GLRBI) this spring. This historic investment also will further boost the capabilities and bandwidth of the NCTN.

About MCNC: MCNC is an independent, non-profit organization that employs advanced networking technologies and systems to continuously improve learning and collaboration throughout North Carolina. The North Carolina Research and Education Network (NCREN) is operated by MCNC. Visit www.mcnc.org.

Michigan Cyber Range as a Reliable, Accessible Service for Merit Members and Beyond

In November 2012, Michigan Governor Rick Snyder joined the staff of Quilt member Merit Network as they cut the ribbon on the Michigan Cyber Range. The Michigan Cyber Range will prepare the next generation of cybersecurity professionals in the detection and prevention of cyber attacks.

The Michigan Cyber Range is one of the largest unclassified ranges in the country, meaning that one does not need to obtain specialized government clearance to participate. The Michigan Cyber Range is a logically-isolated system overlaid on Merit's extensive network. As a "live fire" range, it utilizes virtualization technology, customized thin clients and dynamic multipoint networking to model complex networks safely. Users are able to perform real cyber exercises without impacting everyday network activity.

What sets the Michigan Cyber Range apart from similar programs in the country is its ability to leverage the network and multiple sites for failover and fault tolerance. Other unclassified cybersecurity programs are housed on a single server or collection of servers at a single site.

The three primary sites of the Michigan Cyber Range are located on Merit Governing Member campuses: Eagle, located at Eastern Michigan University; Bulldog, located at Ferris State University; and Wildcat, located at Northern Michigan University. Each site has the ability to support 1000 nodes and is located on a different corridor of Merit's statewide network.

The Michigan Cyber Range will prepare the next generation of cybersecurity professionals in the detection and prevention of cyber attacks.

If there is a failure or network outage at one of the sites, that site is immediately restored and accessed at another site. Even within the rack environment at individual sites, a problem in one server blade is automatically remedied by shifting to another blade. This design functionality is aided by VMware's vCenter Virtualization and Server software.

According to Dr. William "Joe" Adams, Merit's executive director of research and the Michigan Cyber Range, that much attention to redundancy in the R&E community is typically reserved for enterprise applications like email. As a former CIO and academic, Adams speaks from experience.

"Many education-based services are provided on a best effort approach," he explains. "For example, if an essential classroom service goes down on your campus, it is considered an emergency. The outage could last days, during finals even—but ultimately, faculty and students begrudgingly work through it."

"Our goal in the design of the Michigan Cyber Range is that students and faculty can store and access courseware where and when they need it. Multiple sites and effective management of the individual servers and blades within each site will ensure a high level of availability. End-users will access the Range not at specific locations, but rather via Merit's network."

In January, Merit will pilot the first Michigan Cyber Range course. The course will be offered through Washtenaw Community College (WCC), a Merit Member located in Ann Arbor, though its success will be made possible through collaboration between Merit Network, WCC and Eastern Michigan University.

The WCC pilot is just one way the Michigan Cyber Range can be used as a cybersecurity training resource. Like the WCC example, it is available as a platform, where students and instructors can access the Range as a secure sandbox for learning. Another model will see Merit offer complete turnkey courses from their offices in Ann Arbor. Additionally, Merit is working with government and industry to develop structured training that addresses an organization's unique needs. For example, Merit might work with a utility company to provide smart grid protection skills to their workforce.

With its expected growth in the coming years, Adams and Merit are excited by the opportunity to offer the Michigan Cyber Range as a service to organizations beyond Michigan's borders. Merit's network features direct links to neighboring regional research and education networks OARnet in Ohio, WiscNet in Wisconsin, and Orion in Ontario, Canada. And as an Internet2 Member, Merit is able to collaborate with other academic, research, and not-for-profit organizations throughout the United States.

For more information see www.merit.edu/cyberrange/

About Merit: Merit Network Inc., a nonprofit corporation owned and governed by Michigan's public universities, owns and operates America's longest-running regional research and education network. In 1966, Michigan's public universities created Merit as a shared resource to help meet their common need for networking assistance. Since its formation, Merit Network has remained on the forefront of research and education networking expertise and services. Merit provides high-performance networking solutions to Michigan's public universities, colleges, K-12 organizations, libraries, state government, healthcare, and other non-profit organizations. For more information on Merit, visit www.merit.org.

Utah Broadband Project Improves Communication at Special Needs School

Jordan Valley School doesn't look out of the ordinary. It's located in a quiet suburban neighborhood in the Canyons School District about 15 miles from downtown Salt Lake City. But the school has extraordinary technology, staff and students.

"Most of our students are non-verbal," says principal Mark Donnelly. "Many are medically fragile. Some are in wheelchairs and tube-fed." Jordan Valley serves special needs students with severe disabilities such as autism and Down syndrome. Donnelly says the school's new broadband connectivity has improved student engagement and communication.

"Communication plays a pivotal role," says Canyons School District network engineer Max Mulliner. "The enhanced speed and Internet resources, including access to video--that's what enriches the learning environment at this school."

"When I got here we had slow Internet and maybe three phones in the building," says Donnelly. Now there's high speed Internet and a phone in every classroom and conference room.

UEN, the University of Utah, CenturyLink and the Canyons District used funds from the BTOP program to replace old T1 circuits with high capacity Geomax broadband. It integrates data, video and voice services. BTOP is the U.S. Commerce Department's Broadband Technologies Opportunity Program.

The improvements have made it much easier for the faculty and staff at Jordan Valley to help students. For example, special education teacher Derek Menlove sometimes needs assistance from the school's speech and language pathologist. "Now I can quickly pick up the phone and even if they're not available at that moment I can leave a quick voicemail and they can easily get back to me."

"Communication plays a pivotal role," says Canyons School District network engineer Max Mulliner. "The enhanced speed and Internet resources, including access to video--that's what enriches the learning environment at this school."

Donnelly says his teachers now use Internet-based applications like Apple TV. "Broadband helps teachers and students access the Internet when they want to rather than having to wait." Prior to broadband, sluggish connections forced some teachers to shy away from using the Internet.

That's changed. Teachers can now rely on video and interactive applications to engage and involve their students. "Working with this specific population, a lot of people may think they're not going to learn very much," says teacher Derek Menlove. "But we're definitely seeing that [they are]. With new technology, we're seeing more increases in that learning, and we're seeing [the students] just grow and blossom, and I love that."

Thanks to BTOP, the Jordan Valley School and 61 other Utah elementary schools now have 1 GB broadband. The project has also extended 100MB broadband to 26 charter schools and 35 public libraries, and broadband Ethernet on fiber and copper to seven central Head Start programs. They are among 140 schools, libraries, higher education and government sites connected by the three year, $13 million award.

Mulliner says that investment has certainly improved the Jordan Valley School. "No one comes away from this facility without having a greater appreciation and a greater commitment to investing in the needs of students."

The impact extends beyond Salt Lake. "I think looking across the whole state of Utah, it's going to benefit every student. Technology is an ever-changing thing in our society that students are going to need to know how to use," explains Menlove. "By having that faster Internet, more students are going to be able to access the Internet, more students are going to be able to use that technology to learn and understand the world around them."

About UEN: UEN provides broadband infrastructure and support to more than 1,000 public schools, nine state institutions of higher education, eight applied technology campuses and public libraries. It serves more than 780,000 students of all ages and more than 61,000 teachers, faculty, administration and staff throughout the state of Utah. For more information on UEN, visit www.uen.org.

A student and an aide working with a laptop

MOREnet: Making Possible Technology that Touches Lives

In early 2013, the Missouri Telehealth Network (MTN), in conjunction with the University of Missouri Women's and Children's Hospital and Quilt member MOREnet, will launch its new Telehealth Love and Care Program (TLC). This free service will offer two-way videoconferencing, allowing families located throughout the state to see their newborn babies and interact with the care team in the Neonatal Intensive Care Unit (NICU) at the University of Missouri Women's and Children's Hospital in Columbia, Mo.

MOREnet's Mobile Videoconferencing service allows members to offer users a mobile video experience that can be accessed on desktops, laptops, smart phones and personal tablet devices, transforming almost any device into an HD-quality videoconferencing endpoint.

MOREnet began offering Mobile Videoconferencing through Vidyo in 2011, allowing members to offer users a mobile video experience that can be accessed on desktops, laptops, smart phones and personal tablet devices, transforming almost any device into an HD-quality videoconferencing endpoint.

Rachel Mutrux, director of the Missouri Telehealth Network—a MOREnet member, was looking for just this type of technology. "Many other large hospitals offer video services to the parents and guardians of NICU patients, but we were looking for a way to make this communication two-way so interaction could also take place," states Mutrux. "Half of the babies in our NICU are transported to Columbia from other places. In many cases the mom needs to stay in the regional hospital while the baby is in our hospital here in Columbia. It is important for the mother to stay and heal in the hospital, not leave early to see the baby. This technology allows mom to see the baby and communicate with the care givers in NICU." Also, if a baby has to stay in the NICU for an extended period of time, moms, dads and siblings can use TLC to visit the baby when they can't physically be at the hospital.

So staff from three University of Missouri entities – MOREnet, MTN and Women's and Children's Hospital – began to work together to define the software, equipment and logistical requirements that would morph MOREnet's mobile videoconferencing service to meet the unique needs of parents and babies in mid-Missouri. "All of the technology was in place to offer just what Rachel was looking for," states George Miller, MOREnet video consultant and project manager of the TLC Program for MOREnet. "It was just a matter of tailoring it to fit the needs of this unique program."

The TLC Program will use MOREnet's secure Mobile Videoconferencing to connect family members to the NICU where care providers will use iPads to conduct the videoconference. Family members can connect from their locations via any mobile or desktop device that has adequate Internet connectivity and webcam functionality. This could include their local hospital, home or even their local library. Fifteen top referral hospitals within Missouri will also be equipped with laptop computers for the purpose of connecting families and new moms with their babies who have been transported to Columbia's NICU.

This project is funded through the Children's Miracle Network Telethon and the Missouri Telehealth Network, with technology support from MOREnet. As such, it is free of charge for the families of babies in the NICU at Women's and Children's Hospital.

About MOREnet: The Missouri Research and Education Network (MOREnet) provides Internet connectivity, access to Internet2, technical support, videoconferencing services and training to Missouri's K-12 schools, colleges and universities, public libraries, health care, state government and other affiliated organizations. For more information on MOREnet, visit www.more.net

About the Missouri Telehealth Network: The Missouri Telehealth Network began in 1994 as one of the nation's first public-private partnerships in telehealth. MTN has a two-gigabit (2 Gbps) backbone infrastructure that is managed by MOREnet and funded with federal, state and institutional dollars. This network connects to the Internet via a high-speed intrastate network consisting of six major circuits connecting several major population centers in the state. Missouri Telehealth Network has more than 202 sites in 62 Missouri counties.

Southern Crossroads (SoX): Pioneering the Application of Software Defined Networking in Research and Education

The development and commercial availability of products based on Software Defined Networking (SDN) are allowing network operators to fundamentally re-think the way networks are designed to support their customers. Quilt member Southern Crossroads (SoX) regional network is seizing this opportunity with a passion to provide its members with access to the national testbed where tomorrow's network advancements are being piloted.

"With the SoX deployment of SDN at the regional level, we have an opportunity to try out the research ideas in routing and peering that we had previously been unable to validate at a meaningful scale," says Associate Professor Nick Feamster of Georgia Tech.

In a software-defined network, a network administrator can prioritize traffic, block specific types of packets and overall manage traffic loads in a dynamic, flexible and more efficient way – all from a centralized control console without having to touch individual switches. This allows the administrator to use less expensive, commodity switches and have more control over network traffic flow than ever before. The implications for the research and education community of this enhanced traffic control are significant, since it allows research ideas to be tested on a live network without interfering with production traffic.

While there has been significant work on SDN applications for the data center and the enterprise, use cases for regional network and peering have been less well defined. "With the SoX deployment of SDN at the regional level, we have an opportunity to try out the research ideas in routing and peering that we had previously been unable to validate at a meaningful scale," says Associate Professor Nick Feamster of Georgia Tech. The SoX team is initially looking at the use of SDN primarily for policy management and applications such as content distribution and time of day routing.

A key to the SoX SDN efforts has been a successful partnership with the National Science Foundation's Global Environment for Networking Innovations (GENI) project office. Two of the SoX member schools (Clemson University and The Georgia Institute of Technology) were part of the OpenFlow Campus Trials work during an early phase of the GENI project. Building on this work, SoX proposed and was awarded a GENI grant to build out OpenFlow capabilities within the Southeast region to reach more campuses. During the first year, a core OpenFlow switch was deployed at the SoX POP in Atlanta, bringing both Clemson and GT a direct SDN connection to GENI. During the second year this will be extended to additional member campuses and will provide an important experimental platform connecting GENI racks to the national GENI infrastructure with a fully sliceable network path.

In addition to the work creating a research infrastructure with GENI, SoX is actively bringing SDN into the production side of the house. SoX is working with Colo Atl (www.coloatl.com), one of its networking partners in the region, to create the Southeast Network Access Point (SNAP) (www.southeastnap.com) in Atlanta that includes a unique SDN peering platform for both research and education networks as well as commercial partners. This deployment includes diverse hardware and software platforms to promote interoperability. "Our goal is to leverage the SDN research results for the benefit of all of our members to provide the most agile and scalable network access point possible," said Tim Kiser, owner and founder of Colo Atl.

About SoX: SoX is a federation of Research and Education Institutions providing high-speed, global connectivity to the Southeastern US Research and Education community. SoX is the Southeast Connector for National LambdaRail and Internet2, and other major US and International research networks. SoX is interconnected through several carrier hotels in Atlanta, Chicago, Nashville, Jacksonville, Miami, and Dallas. For more information on SoX, visit www.sox.net.

FLR is Connector for Sunshine State Education & Research Computing Alliance, Linking High-Performance Computing Resources

Florida's public and private universities are home to talented scientists, high-end computing facilities, massive data storage systems, highly specialized research instruments, and high-speed networks. Made possible through grant funding from the New Florida initiative of the Florida Board of Governors, the Sunshine Grid: Florida's Research and Education Cyberinfrastructure and the Sunshine State Education & Research Computing Alliance (SSERCA) were established. Together, the two initiatives have begun the process of creating a coherent core infrastructure for the state of Florida to promote and support research and education.

The mission of SSERCA is to further the development of a state-wide computational science infrastructure of advanced scientific computing, communication and education resources by promoting cooperation between Florida's universities. Participants include: Florida State University (FSU), University of Central Florida (UCF), University of Florida (UF), University of Miami (UM), University of South Florida (USF), Embry-Riddle Aeronautical University (ERAU), Florida Agricultural and Mechanical University (FAMU), Florida Atlantic University (FAU), Florida Institute of Technology (FIT), Florida International University (FIU), and University of North Florida (UNF).

SSERCA brings together geographically distributed organizations and resources in such a way that their collective impact is far greater than the sum of their individual parts. SSERCA participants collaborate to share High-Performance Computing (HPC) center resources. Researchers are not limited by what is on individual campuses. As developed, SSERCA allows universities to maintain their autonomy though they share a portion of their capacity with other institutions.

In order for this shared HPC infrastructure to be effective, SSERCA uses Quilt member Florida LambdaRail's (FLR) next-generation infrastructure as the connector for the HPCs. FLR, an ultra-high speed, inter-connected, broadband service delivery network, enables Florida's higher education institutions and partners to collaborate, connect, utilize and develop new innovative broadband applications and services in support of high performance e-science projects.

The user community (i.e., university scientists, researchers, faculty, and their collaborators) is better able to leverage access to advanced computational capabilities and participate in leading-edge research activities effectively with one another and with international partners promoting scientific discovery. In addition to the value SSERCA provides to faculty researchers, master's and dissertation students use SSERCA resources to assist with faculty research as well as conduct their own independent research. These students are the people that industry needs to continue growing Florida's high tech economy.

Descriptions of projects and other SSERCA-related presentations, activities and events are available on SSERCA's website, http://sserca.org. Additionally, the site serves as a showcase and clearing house for information related to the hardware and intellectual assets hosted by participating universities. The searchable database gives researchers an easy way to locate resources needed to effectively face the challenges associated with 21st century research.

SSERCA is a glowing example of the value of collaboration in the sharing and use of research tools.

About Florida LambdaRail: Created to facilitate advanced research, education, and 21st century economy initiatives in the State of Florida, utilizing next generation network technologies, protocols, and services, Florida LambdaRail (FLR) provides opportunities for Florida university faculty members, researchers, and students to collaborate with colleagues in-state, across the country, and around the world.

The Florida LambdaRail is an independent research and education network owned and operated on behalf of the FLR partner institutions and affiliates of the Florida LambdaRail, LLC, a not-for profit limited liability corporation. For more information on FLR, visit www.flrnet.org.

FLR, an ultra-high speed, inter-connected, broadband service delivery network, enables Florida's higher education institutions and partners to collaborate, connect, utilize and develop new innovative broadband applications and services in support of high performance e-science projects.

Ohio's 100 Gbps Network: Accelerating Economic Growth

"OARnet. You heard it here first. It can change the face of the entire state of Ohio," said Ohio Governor John R. Kasich during his 2012 State of the State address, as he promised Ohioans a state research and education network with a capacity of 100 Gigabits per second (Gbps).

To meet that pledge, the State of Ohio, led by the Ohio Board of Regents and Quilt member the Ohio Academic Resources Network (OARnet), invested $13 million to expand OARnet's 1,850-plus miles of fiber-optic network from 10 Gbps capacity to 100 Gbps. The investment also included financial assistance to OARnet member colleges and universities to upgrade their backbone connections to a minimum of 1 Gbps.

The high-speed network, which officially launched on Dec. 11, 2012, is expected to advance research and job growth across Ohio's medical research, higher education, manufacturing, engineering and technology networking corridors.

"Ohio's economic future depends on creating high-tech environments," said Pankaj Shah, executive director of the Ohio Supercomputer Center and OARnet. "By upgrading the OARnet network to 100 Gbps, we are actively providing Ohio a valuable technology to entice and retain talents and businesses."

For example, Ken Murray Jr., president and CEO, Transformatix, established a new company in Columbus to develop virtual microscopy technologies in collaboration with Nationwide Childrens' Hospital. "When you're talking about the modern health care research industry – medical imaging, genomics, DNA sequencing – you're talking about enormous data sets that require huge bandwidth," said Murray. "One reason we located our new company in Ohio, rather than California, is because Ohio demonstrated the most forward-thinking approach to technology and high-speed innovation."

"Ohio's economic future depends on creating high-tech environments."

The 100 Gbps network links Cleveland, Columbus, Cincinnati, Dayton, Toledo, Akron, Athens, Wooster, Portsmouth and Youngstown to northern and southern connection points of Internet2, a nationwide advanced networking consortium led by the research and education community.

OARnet is part of the Ohio Board of Regents Ohio Technology Consortium (OH-TECH), an umbrella organization that also includes the Ohio Supercomputer Center, eStudent Services, OhioLINK, and the Research & Innovation Center.

"As members of OH-TECH, we provide innovative technology resources and services for Ohio higher education, K-12 schools and state and local government," Shah said. "The 100 Gig network serves as a tool for building dynamic collaborations across our organizations."

Case in point: Ohio public and private partners also are investing $2.3 million in a state-of-the-art innovation center that will develop and test 100 Gbps services and technologies, promote the development of compelling broadband, software and advanced technology applications and expand upon Big Data research taking place at the Ohio Supercomputer Center and OARnet member universities. To be located at The Ohio State University, the center will operate in research collaboration with Internet2 while working in conjunction with GENI, US-Ignite, University of Missouri, UC-Berkeley, and other national laboratories.

About OARnet: OARnet provides technology solutions for Ohio's education, public broadcasting, health care and government communities. Since 1987, OARnet has identified, aggregated, and deployed shared services that reduce costs, deliver quality programs, increase productivity and improve customer service. For more information see www.oar.net.

Delivering Practical Solutions While Building Community: Four Examples from NJEDge.Net

NJEDge.Net is a non-profit technology consortium of academic and research institutions in New Jersey. Through its deployment of advanced Internet technologies, digital communication, and collaborative academic initiatives NJEDge.Net supports its members in their institutional teaching and learning; scholarship; research and development; outreach programs; public service, and economic development. In 2012, NJEDge joined the Quilt Community.

This past year, NJEDge.Net collaborated with its members on a number of projects to create sustainable network and service tools that secure future growth opportunities. Four of them, described below, showcase diversity and demonstrate the culture of community building.

NJEDge.Net's mission is to build community through collaboration, bit by terabyte.

NJEDge has provided video conferencing services to its members for years, but with the recent purchase of Vidyo, a scalable, 'personal' telepresence product, NJEDge can now provide video services to the office, home, desktop or mobile device regardless of bandwidth. During Hurricane Sandy, NJEDge was able to provide Vidyo service to the Office of New Jersey Homeland Security and Preparedness (NJOHSP) and the New Jersey State Police, Regional Operations Intelligence Center, Office of Emergency Management and National Guard. New Jersey OEM and NJOHSP were able to hold briefings with federal, state and local first responders to effectively disseminate critical information. Vidyo web streams were viewed by Governor Christie, his cabinet and staff. NJEDge's network design permits easy virtual colocation and redundancy which were critical elements to the state's ability to maintain communication during and after the storm.

NJEDge's digital video portal and repository service for New Jersey, NJVid (www.njvid.net), is based on the 'shared model' approach that allows faculty, staff and students to not only upload, publish and share their own videos but also to access commercially informative videos licensed by their institution. Through its two leading-edge services – the Commercial Video Service and the Learning on Demand Service, NJVid provides a common online platform for publishing and archiving research and educational digital video content. For Montclair State University (MSU), the NJVid service is a vital online platform for presenting, accessing, hosting, and archiving the University's licensed and locally produced videos. Dr. Edward Chapel, Chief Information Officer at MSU, notes that "as the NJVid service evolves and is more fully integrated into the University's learning management systems and collaboration tools, it presents us with an opportunity to share valuable learning objects and subject matter as well as videos in the public interest…I foresee continued growth and adoption of the NJVid service and the emergence of many new and creative uses by our colleague institutions throughout the NJEDge network as NJVid matures."

When NJEDge member Rider University installed two diverse connections to the Internet, it had two goals: provide the security of redundant connectivity and balance the ingress traffic across the two links in order to alleviate congestion. Despite the best efforts of all involved, Rider was simply unable to achieve the goal of two well-balanced Internet links causing the university to pay for bandwidth it couldn't use. Further, Rider University was told the slowness it was experiencing at the Internet edge could only be alleviated by purchasing additional bandwidth on the already saturated link. When NJEDge learned of Rider's network issues, it applied its staff technical expertise to recommend a solution to install Locator/ID Separation Protocol (LISP) to bolster its internal infrastructure with load balancing. With this leadership from NJEDge staff, the installation of the Cisco equipment took only a few minutes and had immediate results. Within hours, bandwidth data collected from the router showed that Rider was now getting diverse and balanced traffic across its two Internet links with a noticeable improvement in performance. With its network connectivity issues solved, and with the support of the NJEDge technical staff, Rider is now considering the other benefits that LISP can provide such as security and disaster recovery.

NJEDge collaborated with New Jersey Institute of Technology's (NJIT) Information Services and Technology division to build the foundation for a statewide community cloud that will provide cost-effective cloud-based infrastructure, platform and application services. NJEDge already provides a trusted broadband statewide network to over 50 members, mostly higher education institutions. NJIT has built a local cloud infrastructure and developed a set of robust and scalable provisioning and management processes based on VMware's virtualization offerings. By partnering and using VMware technology and several virtual organizations (vOrgs) established on NJIT's cloud infrastructure, multiple institutions are able to co-exist and operate separately and securely on the same hardware infrastructure. NJEDge members, acting as separate vOrgs, are able to provision their own VMs with compute and storage resources on demand for any purpose, such as test and development, standby web server, backup site, etc… With "developing an institution-wide cloud strategy" high on the EDUCAUSE Top-Ten IT Issues List for 2012, this NJEDge and NJIT collaboration brings member institutions significant options for cloud strategies in 2013 and beyond.

Photo courtesy of Vidyo shows New Jersey Command Center during Hurricane Sandy making use of NJEDge's Vidyo service.

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