THE
QUILT CIRCLE

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

A Letter from the President

The past year has been one of transformation for both The Quilt as well as our member organizations. Many of our members continued their work on broadband infrastructure projects funded through grants by the National Telecommunications and Information Agency's Broadband Technologies Opportunity Program (BTOP). Those projects which received funding in the first grant round are scheduled to be largely completed in 2012, thus turning the promise of broadband technology into reality for new community anchor institutions across the country.

Given the persisting economic pressure on educational institutions to do more with less, we found a growing number of our Quilt member organizations moving up the stack to provide additional value-added services to their constituent institutions that utilize the robust, flexible optical networks and aggregated demand benefits of our members. The Quilt hosts a working group for its members to exchange information about "above the net" services, to foster new models for demand aggregation at the community and state level and to facilitate Quilt members leveraging one another's expertise and services.

Another challenge in the "new normal" of doing more with less is securing the most effective resources to support our missions. This means not only investing in networking and shared infrastructure resources, but also in the human capital required to carry out the goals of our organizations. As part of The Quilt's commitment to investing in the development of our future networking leaders, we implemented a travel grants program in 2011 which funded 11 additional Quilt member staff, which would not otherwise have the opportunity to do so, to join us at Quilt member meetings. Quilt meetings provide a valuable opportunity to exchange information on best practices for operating R&E networks, hear from experts on key topics, and engage with peers around the country. The Quilt also benefits from the participation of these individuals who bring fresh ideas and new perspectives to the discussions.

Now three years old, our Quilt member peer review service continues to meet with increasing interest. This service takes the collaboration and learning that occurs naturally within our Quilt community to a deeper level by offering member organizations the opportunity for an external review of the organization by its peers. After completing two peer reviews in 2011 and with several requests in the queue, The Quilt is looking to expand this service for our members to include an organizational self-assessment tool that will enable Quilt peer reviews to focus on specific, non-technology related aspects of an organization.

Our Quilt membership has grown in the last year to include the Connecticut Education Network and the Keystone Initiative for Network Based Education and Research (KINBER) in Pennsylvania. Our recent winter member meeting in February 2012 was our largest meeting yet and included these new members as well as outside participants from groups with an increasing interest in engaging with The Quilt community.

For those of you who have recently visited our website, you may have noticed some exciting new changes we have made to the look and content of the site. As evidenced from the articles you will read in this year's Circle, our Quilt members are involved in so many significant ways on topics of key importance such as providing infrastructure to support big science research and data movement, BTOP grants, connecting remote schools to our networks, strategic service offerings and many more. As a primary communication tool for us, our new website format provides us the ability to more readily promote the work of The Quilt and our member organizations throughout the year.

Through these transformative times, The Quilt continues to thrive and to serve as a best-practices showcase for the collaborative nature of our community. The support and cooperative spirit among the consortium is remarkable and our work together this year was a valuable reminder of the stake we all share in the success of one another's organizations.

Jen Leasure

Jen Leasure
President and CEO

THE QUILT MISSION: *Founded in 2000, The Quilt is a not-for-profit collaboration of our country's advanced regional networks. It is a vibrant forum where leaders of these organizations meet with their peers to innovate, share best practices and explore new ideas with one another to collectively advance networking for research and education in the U.S. Based on its members' combined experiences in operations and development of leading edge technologies, The Quilt aims to influence the national agenda on information technology infrastructure with particular emphasis on networking. Through its collaborations, The Quilt promotes the delivery of networking services at a lower cost, higher performance, greater reliability and security. The Quilt is a member-powered organization. It derives its funding and organizational support from contributions and volunteer efforts of its members.*

Data Steward Be a reliable source of information for the R&E networking community

Advocate for regional and state research and education networks

Be the Convener for member and community forums

Quilt Goals

Build an Agile Organization to support our members in a fast changing networking landscape

Foster a collaborative environment

The Quilt: A national community of innovators with a 10-year track record of successfully working to: Collaborate—Advocate—Leverage

COLLABORATE

Member organizations collaborate to collectively advance research & education networking.

We collaborate by:
» Developing and exchanging best practices
» Solving problems together
» Sharing information
» Developing the newest advancements in networking

Examples
» Hosting community workshops, e.g., optical networking workshop series
» Providing a collection of member business model cases
» Convening the Tele-Presence working group

ADVOCATE

The Quilt serves a single point of contact to engage partners on behalf of our members and their work.

Examples
» Federal Policies such as the FCC's national broadband plan
» Federal funding sources such as the National Science Foundation and Broadband Technology Opportunities Program (BTOP)
» Industry Partners such as optical equipment providers

LEVERAGE

Members leverage the collective consortia knowledge and buying power, contributing to the value each member proviedes to their participants.

Knowledge Broker
» Support organizational review projects by peers
» Source of aggregate data about our country's R&E networks

Buying Consortia
» Commodity internet services (CIS)
» Network Equipment
» Since 2002, members have saved a total of $68,000,000 on CIS

The Quilt gathers our country's leading research and education networking organizations to promote consistent, reliable, interoperable and efficient advanced networking services that extend to the broadest possible community; and to represent common interests in the development and delivery of advanced network services. Participants in The Quilt provide network services and applications to more than 200 universities and thousands of other educational institutions.

THE QUILT

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Members and Board of Directors

Quilt Staff

Acknowledgements

Governor's Live Rural Teleconference Reaches Thousands of High School Students via UEN's Statewide Broadband Network

"If you want a good job, get a good education." That's the message Utah Governor Gary Herbert gave to thousands of high school students in a statewide videoconference over the Utah Education Network (UEN). In two unprecedented events the governor used UEN's broadband infrastructure to extend the reach of his fall tour of rural Utah. The events included live interaction with students and a live news conference from a rural school.

On the first day of his tour the governor visited Grouse Creek School in the isolated northwestern corner of the state. With just 17 students from kindergarten through 10th grade, the school is one of Utah's smallest. The governor originated a point-to-point video news conference from the school to reporters at UEN headquarters at the University of Utah in Salt Lake City. The

governor answered questions about education and economic development in rural areas. Several television stations and newspapers covered the event and their stories included UEN's Interactive Video Conferencing (IVC) system.

The next day UEN facilitated a statewide videoconference with the Governor speaking to virtually all Utah high schools from the southeast corner of the state. The purpose was to "meet with students for an hour in an interactive conversation" and stress the benefits of higher education. The teleconference originated from the remote Blanding campus of Utah State University-College of Eastern Utah. The governor's presentation included live interaction with students at four high schools.

In a first-of-its-kind event, the teleconference reached high students and teachers at 110 specially equipped IVC classrooms. UEN also provided high-quality video streaming for schools without IVC classrooms. The network distributed 405 live streams during the address and the recording has been viewed more than 1600 times. Governor Herbert used the live event to stress the importance of post-secondary education. "…by the year 2020, two thirds of the jobs in Utah will require a post secondary degree

> "If you want a good job, get a good education." That's the message Utah Governor Gary Herbert gave to thousands of high school students in a statewide videoconference over the Utah Education Network (UEN).

or some kind of certification…Education is freedom. Education will open your minds and expand your horizons," he explained.

The governor took questions from students at Orem High School, Rich High School, Murray High School and Emery High School. He also involved State Representative Ronda Menlove who joined the event from her office at Utah State University in Logan. She told the students that 74 percent of Utah mothers of school age children work outside the home. She underscored that more education means greater earning power. "Weekly earnings with a high school diploma are about $600. If you get a university degree it almost doubles to $1,000 a week. If you get an advanced degree, it's about $1600 per week," explained Dr. Menlove.

The teleconference demonstrated the interactive capabilities that many Utah instructors and students use daily on the system. It also highlighted the extent of UEN broadband improvements in remote areas. The teleconferences also showcased how UEN serves rural and urban students with high-quality interactive videoconferencing for distance education. The event required substantial logistical and technical expertise which UEN is well positioned to provide.

The effort was a rewarding one for all involved. It allowed the governor and his staff to engage with students and it utilized one of the state's most important resources to do so, UEN.

Photo caption: (Paul Fraughton | The Salt Lake Tribune) Gov. Gary Herbert, using interactive video conferencing technology, delivers a speech Wednesday, Oct. 12, to high school students sitting in their classroom at Murray High School. Other high schools around the state were part of the network receiving the governor's message about the importance of education, originating from Blanding.

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 visit www.uen.org.

OARnet to Launch 100 Gbps Statewide Network

2012 is proving to be an exceptional year for Ohio and the Ohio Academic Resources Network (OARnet). Not only is OARnet celebrating its 25th anniversary, but by year's end it will be operating the country's first statewide 100 Gbps research and education network.

Ohio Governor John R. Kasich announced the ten-fold boost to the broadband network during his February 7 State of the State address, highlighting how the initiative will leverage the 100 Gbps network speeds to advance research and job growth across Ohio's medical research, higher education, manufacturing, engineering and technology networking corridors.

By upgrading the 1,850-mile fiber optic network operated by OARnet, a member of the Ohio Board of Regents Ohio Technology Consortium, the 100 Gbps network will connect Ohio's major metropolitan areas to northern and southern connection points of Internet2.

"This is a game changer for Ohio. These almost unfathomable speeds are highly sought by leading researchers and job creators in competitive markets around the world," Ohio Board of Regents Chancellor Jim Petro said. "This will solidify Ohio's standing as a technology leader thanks to the vision of our many public and private partners."

The expansion is possible through support from the State of Ohio, the Ohio Board of Regents, The Ohio State University and OARnet members. The $8.1 million project will connect Cleveland, Columbus, Cincinnati, Dayton and Toledo by June 2012, and Akron, Athens and Youngstown by October 2012.
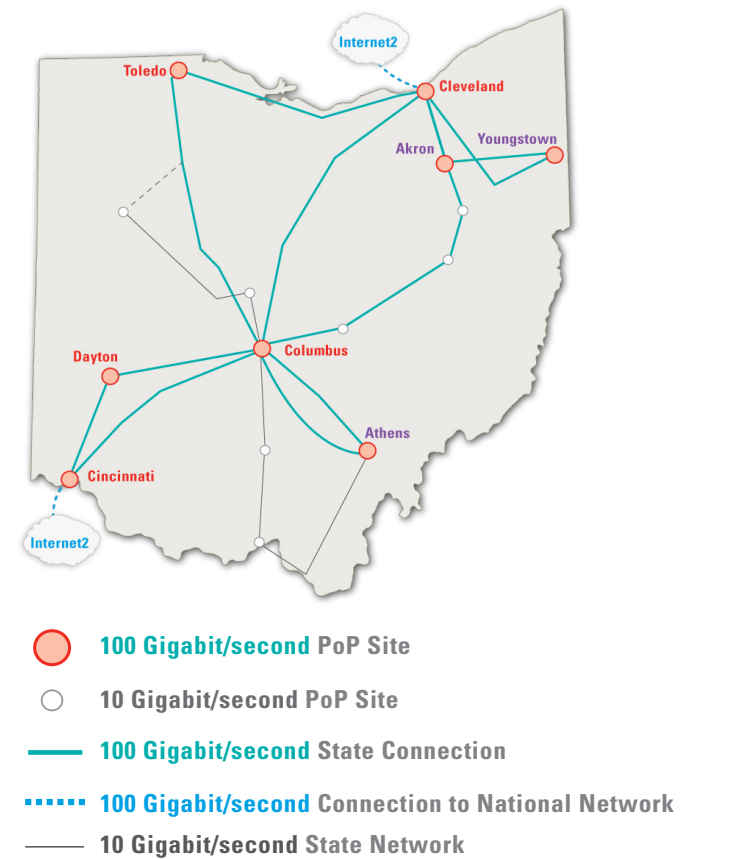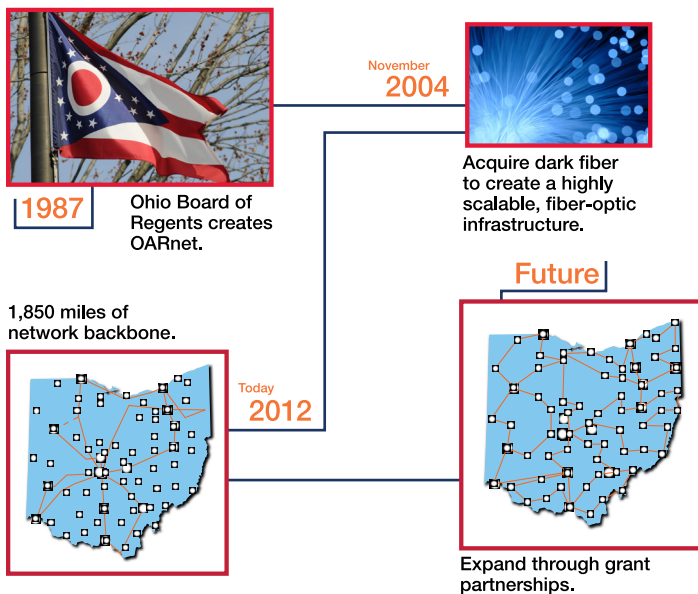
"Ten years ago, OARnet lit a high-speed fiber-optic backbone with scalable architecture. It's fitting that we are celebrating our 25th anniversary by upgrading this backbone to 100 Gigs," said Pankaj Shah, executive director of OARnet. "Ohio's economic future depends on creating high-tech environments. Through this project, we are actively providing Ohio the technology tools it needs."

Ohio public and private partners also will invest $2.3 million in a state-of-the-art innovation center that will enable and test 100 Gbps technologies and promote the development of compelling broadband, software and advanced technology applications. Located at The Ohio State University, the center will operate in research collaboration with Internet2, National Science Foundation-Future Internet Infrastructure (GENI), University of California-Berkeley and other national laboratories.

"Accelerating Ohio's research broadband backbone capacity to 100 Gbps will make Ohio even more attractive to medical research, manufacturing, engineering and other technology sectors," said Caroline Whitacre, vice president for research at The Ohio State University. "This will put Ohio far ahead of the pack in university research collaboration and competition for federal grants."

About the Ohio Technology Consortium and OARnet: The Ohio Board of Regents Ohio Technology Consortium includes the Ohio Academic Resources Network (OARnet), the Ohio Supercomputer Center and eStudent Services. OH-TECH serves as the umbrella organization for these three organizations, which offer innovative technology resources and services for Ohio higher education, K-12 schools and state and local government. www.oh-tech.org

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

Timeline:

1987 — Ohio Board of Regents creates OARnet.

November 2004 — Acquire dark fiber to create a highly scalable, fiber-optic infrastructure.

Today 2012 — 1,850 miles of network backbone.

Future — Expand through grant partnerships.

Legend:
- ⬤ **100 Gigabit/second** PoP Site
- ◯ **10 Gigabit/second** PoP Site
- ─── **100 Gigabit/second** State Connection
- ••••• **100 Gigabit/second** Connection to National Network
- ─── **10 Gigabit/second** State Network

Merit Network Partners with NJEDge.Net to Deliver Video Repository Service to Membership

Merit Network, Inc. and NJEDge.Net have teamed up to deliver Merit Cloud Media to Merit Members in the higher education community. The launch of Merit Cloud Media marks an important collaborative milestone for the longest-running research and education (R&E) network in America: it is one of the first services that Merit will offer in conjunction with an R&E contemporary.

Today higher education institutions increasingly utilize media content to enrich the learning experience of students inside the classroom and enable learning beyond the classroom to accommodate students' unique circumstances. This trend has accelerated in way that has stretched IT staff at institutions everywhere.

Existing commercial resources provide outlets for a faculty's need to store and stream content, but have several drawbacks, including lack of storage growth and limitation of size. There are also advertising, preservation and copyright issues to consider in an academic setting. So for many higher education institutions, lightening the burden on their IT departments involves a compromise they are not willing to make.

Merit Cloud Media solves this problem for Members by providing an online platform for institutions to present, access and host media resources. It features anytime, anywhere access from a multiplicity of browsers and devices, including smart phones and tablets. It also provides a backend that is easy to support and administer from a staffing stand point with a single login system that is integrated with the institutions LDAP/Active Directory. Finally, full and complete access controls preserve privacy and protects the intellectual property of educators. The content presented in Merit Cloud Media can be presented to a single class, an individual seminar or made public—all within the institution's control.

Merit Cloud Media is made possible through a partnership with NJEdge.Net, a non-profit technology consortium of academic and research institutions in New Jersey. In 2007, NJEDge.Net received a grant from the federal Institute of Museum and Library Services (IMLS) to develop a video portal and media repository. The grant funded the creation of NJVid, New Jersey's Digital Video Repository, the platform that powers Merit Cloud Media.

Merit Network's Director of Services, Leslie Williamson, sees many advantages to working with NJEDge.Net to deliver this service to Merit's membership:
"Though it may be new to our Members, this is already a mature service that has been built to suit the needs of higher education. There is redundancy built into the system already with high availability across multiple datacenters. The infrastructure and support model are in place and tested. This is a definite win-win for Merit, NJEDge.Net and our Members."

George Laskaris, president and CEO of NJEDGE.Net, is excited for the potential for future R&E collaboration that Merit Cloud Media represents:

"NJEDge is pleased to be collaborating with Merit on the deployment of Merit Cloud Media for its members. Several elements of the NJVid infrastructure form the nucleus of statewide cyber infrastructure for digital content management and reuse that goes well beyond the video itself. Outside of our New Jersey-based membership, this will be the first deployment with another state R&E network and can serve as a collaborative model for the productive exchange of services between R&E networks."

Don Welch, president and CEO of Merit Network, believes that the type of collaboration between R&E networks like Merit and NJEDge.Net as evidenced by Merit Cloud Media is the best way for the R&E community to serve its members:
"It has taken a lot of hard work to accomplish this type of collaboration, but I am sure of the benefit it will have for not only our organizations, but for the greater research and education community as well."

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.

About 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 and digital communications, NJEDge.Net supports its members in their institutional teaching and learning; scholarship; research and development; outreach programs; public service, and economic development. In providing a broadband statewide network, NJEDge.Net creates an environment for interoperability to facilitate productive use of technology across the academic enterprise. NJEDge.Net introduces emerging technologies and state-of-the-art networking to its partners in academia, government and industry for inter-institutional collaboration, scholarship and research.

Three Rivers Optical Exchange: One of the Leading Resources in the World for Network Know-How

The Pittsburgh Supercomputing Center's (PSC) Advanced Networking group is one of the leading resources in the world for knowledge about networking. Through 3ROX (Three Rivers Optical Exchange), a high-speed network hub, PSC operates and manages network infrastructure that connects universities and schools in Pennsylvania and West Virginia to research and education networks across the country, including Internet2 and National LambdaRail. In turn, these networks link to universities, corporations and research agencies nationally. PSC research on network performance and analysis — in previous projects such as Web100 and the NPAD diagnostic server — has created valuable tools for improving network performance. In a current project, Web10G, PSC network staff is helping to develop software to enable non-expert users to more fully exploit the bandwidth of advanced networks. For more information see http://www.psc.edu/networking .

Networking Support for Applications: 3ROX and National Resource for Biomedical Supercomputing (NRBSC)

Established in 1987, PSC's National Resource for Biomedical Supercomputing (NRBSC) was the first external biomedical supercomputing program funded by the National Institutes of Health (NIH). Along with core research at the interface of supercomputing and the life sciences, NRBSC scientists develop collaborations with biomedical researchers around the country, fostering exchange among experts in computational science and biomedicine and providing computational resources, outreach and training.

"Over the past decade, computing has become essential to almost all aspects of biomedicine," says PSC's Markus Dittrich, NRBSC Group Leader. "Here at the NRBSC, we're developing and distributing computational tools in simulation, visualization, and education that are helping to transform our understanding of life and disease." NRBSC research focuses on three areas of biomedicine that span many scales of space and time: spatially realistic cell modeling, large-scale volumetric visualization and analysis, and computational structural biology.

Established in 1987, PSC's National Resource for Biomedical Supercomputing (NRBSC) was the first external biomedical supercomputing program funded by the National Institute of Health (NIH). Over a six-month period NRBSC scientists transmitted more than 110 terabytes of data in the form of millions of transmission electron microscopy camera frames from Harvard.
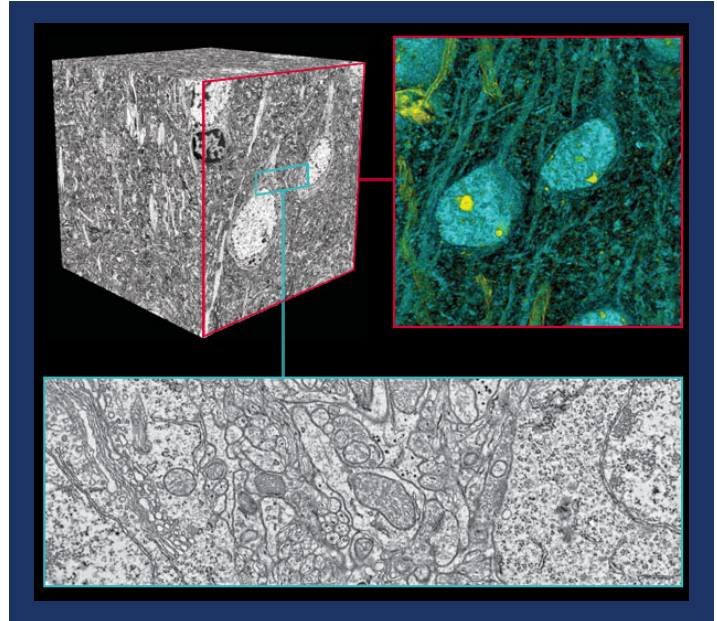
In recent work, which was featured as a cover article in the March 2011 issue of Nature, NRBSC scientists collaborated with researchers at Harvard University to reconstruct a 3D volume of brain tissue and trace the neural connectivities within (see also the PSC press release). As part of this project, NRBSC scientists transferred, processed and analyzed several tens of terabytes of electron microscopy image data, with support from PSC's networking group an integral part of the project. Over a six-month period NRBSC scientists transmitted more than 110 terabytes of data in the form of millions of transmission electron microscopy camera frames from Harvard. PSC network staff worked closely with Harvard to maximize bandwidth performance.

3ROX Research Resource Pool

As part of the National Science Foundation funded Academic Research Infrastructure grant, 3ROX established a pool of resources, which are available at no cost to the national research community or to labs associated with a 3ROX participant. Provided resources range from ports on the layer 2 switches to transponders that establish private lambdas for the researcher. These 3ROX Research Resource Pool resources facilitate experimentation by both the network research community, for projects such as NSF's Global Environment for Networking Initiative (GENI), as well as by discipline-specific communities. We expect that the 3ROX Research Resource Pool will allow researchers to experiment with and test different types of infrastructure and services, providing concrete information on what services fit best with their specific application. Network research projects can test their protocols and algorithms on experimental test beds at little or no cost prior to being deployed on permanent network infrastructure. Discipline scientists can request infrastructure for specific short-term projects as well as for demonstrations at conferences and workshops.

EROS Captures Images of Earth

The Earth Resources Observation and Science (EROS) Center in South Dakota is the primary provider of Landsat data, a 40-year, comprehensive and synoptic view of the world. But the Landsat 1.2-petabyte archive is only one of many sources of data available from EROS. The 1.0 petabytes of data from NASA's Earth Observing System (EOS) are available, as well as Landsat data archives from Alaska, Canada, Australia and Brazil. In addition to satellite imagery, EROS provides aerial photography, digital raster elevation data, land use/land cover data and digital topographic maps. The daily acquisitions of Landsat and much of the Center's entire 4.0-petabyte digital archive now are available to anyone in the world without charge.

In 2011, EROS distributed approximately 2,250 TB of data and ingested approximately 700 TB of data. If we would compare this to the Library of Congress' holdings of 74 TB of digital data, then EROS transfers the equivalent of the entire Library of Congress' digital holdings every nine (9) days. Approximately two-thirds of this data flowed through a research and education network. EROS has connections to ESnet via the Great Plains Network and to the Pacific Northwest GigaPoP (PNWGP) via a circuit through Starlight in Chicago. The former is used to reach NASA-Ames and the latter to reach Google.org. In the future, EROS may peer directly with Australia's education and research network via Pacific Wave, an international peering exchange facility designed by and for research and education networks.

While Google.org was the largest user of data in 2011, the second and third largest U.S. users of data were NASA-Ames in Mountain View, CA and South Dakota State University. Of the top 30 U.S. users of data, 53% were research and education institutions that traversed a Quilt member network to get to EROS.

> *Of the top 30 U.S. users of the EROS Landsat data, 53% were research and education institutions that utilized a Quilt member network to gain access to the data.*

> *In 2011, EROS distributed approximately 2,250 terabytes of data. EROS transfers the equivalent of the entire Library of Congress' digital holdings every nine days.*
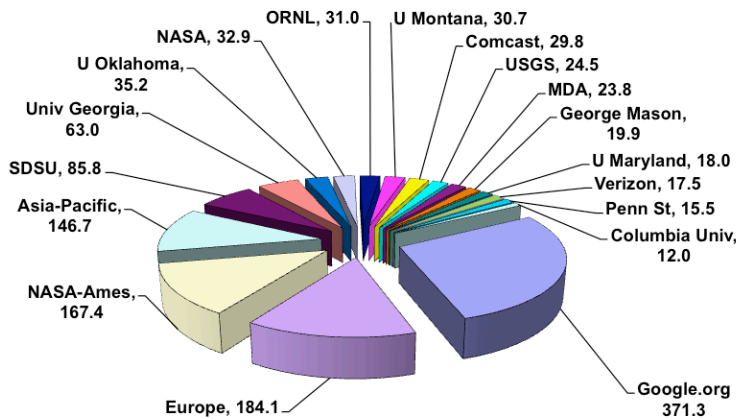
Before 2008, users of the Landsat data paid about $600 for each scene they ordered. A scene is approximately 110 miles square with a 30-meter ground [pixel] resolution. In 2008, Secretary of Interior Dirk Kempthorne announced that the Landsat archive would be available at no cost via the Internet. The number of processed scenes ordered before the announcement was approximately 70 Landsat scenes per day; EROS now distributes an average of 8,000 per day. External network data flows average 750 Mbs 24-hrs per day with peaks of 1,600 Mbs.

The current satellite makes 14 orbits a day and covers the world in 16 days. A new land satellite that will double the number of bands and provide higher resolutions is scheduled for launch in 2013. EROS expects their data distribution to grow significantly when data from the new satellite become available. When it does become available, EROS will continue to look to the advanced networking infrastructure of the country's research and education networks to ensure this data gets to the users who rely on it.

About EROS: Located in South Dakota, Earth Resources Observation and Science (EROS) Center is a remotely sensed data management, systems development, and research field center for the U.S. Geological Survey's (USGS) Climate and Land Use Change Mission Area. The USGS is a bureau of the U.S. Department of the Interior.

About GPN: The Great Plains Network Consortium is a leader in support of research collaboration, education and advanced networking for member institutions in a seven-state region. For more information, please visit www.greatplains.net.

10 TB or More of Data Distributed to Destinations CY2011 (TB)

ORNL, 31.0
U Montana, 30.7
NASA, 32.9
Comcast, 29.8
U Oklahoma, 35.2
USGS, 24.5
Univ Georgia, 63.0
MDA, 23.8
George Mason, 19.9
SDSU, 85.8
U Maryland, 18.0
Verizon, 17.5
Asia-Pacific, 146.7
Penn St, 15.5
Columbia Univ, 12.0
NASA-Ames, 167.4
Europe, 184.1
Google.org 371.3

Note: The labels 'Europe' and 'Asia-Pacific' represent many thousands of destinations in those continental areas. Google.org is Google's philanthropic organization.

LONI Initiative Stimulates Research

The Louisiana Optical Network Initiative (LONI) was the first research and education networking organization to create a grants program to stimulate and support research faculty and staff within Louisiana's postsecondary education community. Although the grants program is in its infancy, it has already produced significant new research.

The goal of the first round of funding was to stimulate research initiatives that would demonstrate the use of High Performance Computing (HPC) capabilities available from LONI in an effort to assess and respond to the Gulf of Mexico oil spill disaster. A multi-institutional team within the Louisiana research community evaluated the merit of each proposal based on the potential of the investigator to quickly and effectively demonstrate use of HPC resources in addressing practical issues and challenges related to the oil spill disaster.

The winner of the first award was 'An HPC Framework for Large Scale Simulations and Visualizations of Oil Spill Trajectories© [i] which was a collaborative research project of 10 researchers at Louisiana State University.

The objective of their research was to build a high-performance computing framework for simulating, analyzing and visualizing oil spill trajectories driven by winds and ocean currents. Accurate and timely modeling of an oil spill is helpful in not only predicting the trajectories of the spill, but also facilitating clean up. However, the large amount of data and the complexity of modeling an oil spill is a computational challenge to the scientific community. Adding a tropical storm or hurricane to the mix only increases the complexity of the problem.

Building upon the Cactus computational framework (http://cactuscode.org/), the research team created software to model and visualize trajectories of oil spills in severe storms using numerical simulation and high performance computing. The modular design of their software integrates oil spill models with coastal storm models to carry out highly scalable numerical simulations of oil spills in different weather conditions.

The visualization efforts of the project were developed by several key team members. The simulation and visualization video resulting from their research can be found at http://www.youtube.com/watch?v=I6LdrlA01wI.

Based on the success of its first round of research grants, LONI plans to offer a competitive grant program again with the research focus still to be determined.

> *The Louisiana Optical Network Initiative (LONI) was the first research and education networking organization to create a grants program to stimulate and support research faculty and staff within Louisiana's postsecondary education community.*
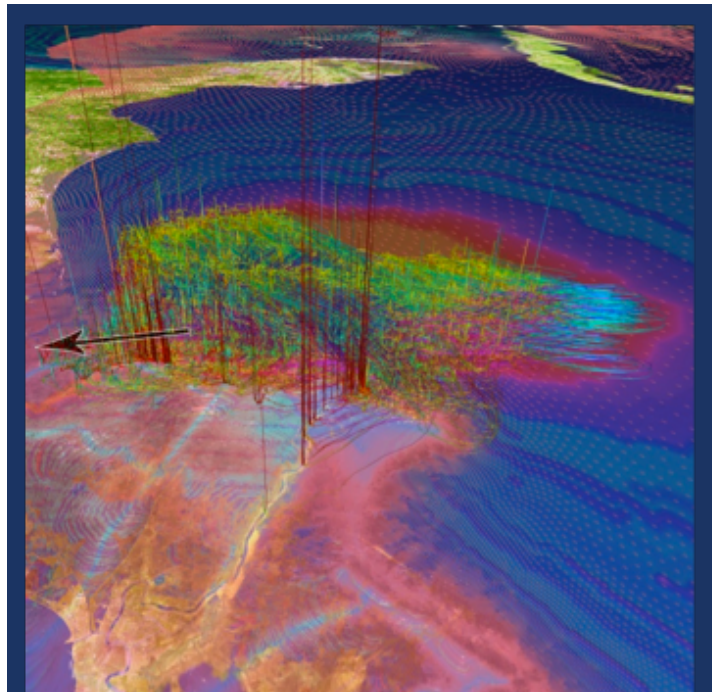
Path-lines of oil parcels in hurricane Gustav simulated in Cactus and visualized in Vish.

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 National LambdaRail and Internet2. With one of the most advanced optical networks in the country and with over 85 teraflops of computational capacity, LONI is 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 produce faster results with greater accuracy.

[ii] This is work is copyrighted by the American Society of Civil Engineers, www.asce.org
[iii] Jian Tao, Werner Benger, Kelin Hu, Edwin Mathews, Marcel Ritter, Peter Diener, Carola Kaiser, Haihong Zhao, Gabrielle Allen and Qin Chen.

NCAR and NWSC: Maximizing Scientific Research and the Benefit of that Science for Society

The University Corporation for Atmospheric Research (UCAR) who manages and operates the NCAR Wyoming Supercomputing Center (NWSC), the Front Range GigaPoP (FRGP), and the Bi-State Optical Network (BiSON) completed a major integration of the three projects in the last six months. Construction of the NWSC was successfully completed in October 2011. This is a unique and unprecedented accomplishment for UCAR and the center is at a scale and expandability new to UCAR and the atmospheric science community it supports.

UCAR selected IBM for the new supercomputer system to be the first housed at the NWSC. The system is due to be delivered and tested by mid-2012. The IBM components consist of a massive central resource for file and data storage, a high performance computational cluster, and a resource for visualizing the data. This new IBM system has been named Yellowstone.

Scientists will use these advanced computing resources to understand complex processes in the atmosphere and throughout the Earth system, and to accelerate research into climate change, severe weather, geomagnetic storms, carbon sequestration, aviation safety, wildfires, and other critical geoscience topics.

This is a unique and unprecedented accomplishment for UCAR and the center is at a scale and expandability new to UCAR and the atmospheric science community it supports.

"Yellowstone will provide needed computing resources to greatly improve our understanding of Earth and produce significant benefits to society," says Anke Kamrath, director of operations and services for NCAR's Computational and Information Systems Laboratory (CISL). "We are very pleased to have such a high-performance system inaugurate the new supercomputing center."

"The vision for Yellowstone parallels the principles that have guided the design of the NWSC," says NCAR director Roger Wakimoto. "In both instances, we have taken an approach that maximizes the science we can do and the benefit of that science to society."

In order to provide the networking infrastructure required by the NWSC researchers, UCAR expanded and upgraded the BiSON fiber infrastructure to include diverse paths into the NWSC. A National Science Foundation Advanced Research Infrastructure grant was awarded to UCAR for the project. The grant along with funds from the BiSON members provided the resources to upgrade the network hardware to support network connectivity capable of 10/40/100Gbps. The NWSC directly utilizes the FRGP services and connectivity.

For more information see:
www.ucar.edu
www.frgp.net
nwsc.ucar.edu
https://www2.ucar.edu/news/5662/ncar-selects-ibm-supercomputer-system

NWSC WAN Fiber & Bison Ring

Pacific Northwest Gigapop and North Dakota State University
Northern Wave

In autumn 2010, North Dakota State University (NDSU) and the Pacific Northwest Gigapop (PNWGP) successfully competed for a grant from the NSF Academic Research Infrastructure (ARI) program. The NDSU/PNWGP grant, "Enabling Western States NSF Research via Next Generation Networking – the Northern Tier," provides funds for equipment to build a shared 10Gbps network among participating research and education institutions along a fiber path, under a 10-year lease by the PNWGP, spanning from Seattle to Minneapolis; and then from Minneapolis to Chicago along a fiber path provided by the BOREAS network.

This shared network, now called "Northern Wave", will provide a single, layer-2, 10Gbps Ethernet and will enable researchers (and their laboratories, data, scientific apparatus) among participating campuses along the fiber path from Seattle to Chicago to connect to each other over dedicated virtual local area networks to collaborate and to share resources, data, and scientific apparatus, and to collaborate with U.S. and international colleagues.

Northern Wave is being developed as a partnership between the Pacific Northwest Gigapop and North Dakota State University, with the long-term goal of providing participants along the "Northern Tier" of the United States with a state-of-the-art national and international peering exchange facility designed to serve researchers throughout this region by connecting them to research and education networks throughout the U.S., the Pacific Rim and

the world. Northern Wave will enhance research and education network capabilities by seeking to increase network efficiency, reduce latency, increase throughput, and reduce costs.

This new capacity is intended to support data-intensive disciplines, those research domains that produce enormous amounts of data that must be captured, transported, stored, organized, accessed, mined, visualized, and interpreted in order to extract knowledge. In support of researchers, campus IT organizations may also choose to use virtual local area networks on the Northern Wave to increase their respective layer-3 peering options with other campuses or organizations along the Northern Tier, including peering facilities in Seattle (Pacific Wave) and Chicago (StarLight).

About PNWGP: PNWGP is a not-for-profit, advanced networking organization whose roots go back to the creation of the original Internet. PNWGP provides state-of-the-art broadband, optical, and other networking as well as direct peering and exchange capabilities. These offerings serve to interconnect nearly all of the major research institutions and many other schools and colleges in Washington, Alaska, Hawaii, Montana and Idaho to one another and all of the USA national research and education networks. Further international connectivity is facilitated via the Pacific Wave distributed international peering facility which PNWGP operates with CENIC, and in which most of the research and education networks in countries around the Pacific Rim participate. For more information see www.pnw-gigapop.net.

In 2010, six Quilt members received ARI grants totaling close to $10M from the National Science Foundation under its Academic Research Infrastructure Program. The purpose of this program is to enhance the Nation's existing research facilities where sponsored and/or unsponsored research activities and research training take place to enable next-generation research infrastructure that integrates shared resources across user communities.

CENIC: Resourcing Innovation in the "New Normal"

Balancing the budget and resourcing innovation for a campus in this era of the "new normal" requires radical reductions in cost structures for traditional IT services, services that no longer differentiate an institution. These cost reductions are only possible if we are willing to move from "process-tinkering" to fundamental or transformational changes that embrace IT-as-a-Service, a.k.a. the shared-services or utility service delivery models.

With the advent of new technological capabilities such as virtualization, cloud computing, cloud storage, advanced networks, and wireless/mobile computing devices, many traditional IT services can now be classified as utilities. As such, the economics of utilities leverage consolidation, standardization, and optimization of infrastructures and services to create huge synergies in terms of lower cost structures for delivery of services, thus freeing up scarce institutional resources (staff as well as funding) for reallocation to innovation initiatives that truly do differentiate an institution, as well as balancing budgets.

The transition to shared IT services and moving to the cloud requires changes in organization structure and culture. The transition also requires moving away from siloed solutions, architectures, processes, and balkanized governance models for the portfolio of traditional IT services that are good candidates for sharing.

As institutions complete their transitions to shared IT services at their respective campus levels, their executive leadership teams are shifting their attention to achieving even greater synergies via "above campus" shared-services. Recent successes of "above campus" shared-service pilots within CENIC-connected institutions have demonstrated the potential benefits of establishing a portfolio of "above campus" solution and service centers tightly aligned and integrated with on-campus IT support teams.

It is within this context that CENIC is striving to help facilitate the success of these "above campus" shared-services initiatives by brokering, or otherwise providing access to, key cloud-based infrastructures and services. CENIC Cloud-VoIP is the first of these services, and was rolled out in January 2012.

> *Recent successes of "above campus" shared-service pilots within CENIC-connected institutions have demonstrated the potential benefits of establishing a portfolio of "above campus" solutions and service centers tightly aligned and integrated with on-campus IT support teams.*

About CENIC: California's education and research communities leverage their networking resources under CENIC, the Corporation for Education Network Initiatives in California, in order to obtain cost-effective, high-bandwidth networking to support their missions and answer the needs of their faculty, staff, and students. CENIC designs, implements, and operates CalREN, the California Research and Education Network, a high-bandwidth, high-capacity Internet network specially designed to meet the unique requirements of these communities, and to which the vast majority of the state's K-20 educational institutions are connected. In order to facilitate collaboration in education and research, CENIC also provides connectivity to non-California institutions and industry research organizations with which CENIC's Associate researchers and educators are engaged. For more information see www.cenic.org.

UNM/ABQG and APS collaborate to Bridge the Digital Divide

Albuquerque GigaPoP (ABQG) of the University of New Mexico (UNM) has been working diligently to further higher speed network connectivity to educational institutions throughout New Mexico. Albuquerque Public Schools (APS) will be establishing network connections with New Mexico universities that have already joined ABQG which will create a high-speed network among higher educational institutions and the largest school district in New Mexico. With the advancement of networking services through ABQG, digital learning would assist APS to boost networking services for the Dual Credit or Distance Learning curricula that is required of all New Mexico high school students to graduate. Since ABQG keeps local network traffic local, students will have fast, direct access to any university course in New Mexico with no external networks to traverse.

Albuquerque Public Schools (APS)

APS is the 34th largest school district in the United States with 141 schools, 90,000 students, and 11,500 employees. Albuquerque Public Schools will soon have full connection and direct access to one of the fastest networks in the world.

Through this connection, made possible through UNM-ABQG, teachers, students and employees will have the capability to run hundreds of data-based applications that support school administrations, distance learning, digital learning, and overall operations. Peering (exchanging routes) among the educational networks of New Mexico via UNM-ABQG will enable applications such as online learning to be effective for students taking classes from various universities throughout New Mexico. With access to ABQG's bandwidth and high-speed data transfer, APS can establish collaboration with other school districts across the U.S. and internationally to enhance the art of teaching through an infusion of technological resources. The initiative enables good connectivity for collaborative projects among New Mexico students from high school to university level courses with other ABQG members, including Sandia and Los Alamos National Labs. Research projects such as "Little Fe" (students learning to use a supercomputer to solve real life problems), "SmartGrid" (managing power grids) and other digital learning websites, such as those offered by Hewlett Packard, McGraw Hill, and Internet2 are currently underway and will provide access to creative learning websites for K-12 curriculums.

> *New Mexico is the 5th largest state and the 6th least densely populated of the 50 United States. New Mexico is an ideal location to utilize and benefit from expanded networking services*

Academic Progress

Outside of school, students, parents, educators, and academic professionals are harnessing the power of technology to enrich their day-to-day lives. In the classroom, using technology resources is essential to prepare students for their future lives of higher education, internships, and the 21st century workforce. Students need technology-based learning environments so that education is engaging, relevant, and reflects 21st century skills to become globally aware, develop digital age literacy skills, and advance learning to prepare for future endeavors.

For teachers and school professionals, in-service, webinars, video clip libraries, and technology learning portals are available to promote digital learning. The download of toolkits, lesson portals, teacher outreach through video, and other collaboration opportunities that require large bandwidth will be instantly available because of the reliable and efficient networking services of ABQG's dual connection services.

New Mexico is the 5th largest state and the 6th least densely populated of the 50 United States. New Mexico is an ideal location to utilize and benefit from expanded networking services. By connecting schools throughout New Mexico, ABQG is enabling education and research entities to gain access to data, information, knowledge, and wisdom from local universities, national laboratories, and other sources from within each school to bridge the digital divide.

About the Albuquerque GigaPoP: ABQG is a state-of-the-art interconnection facility established by the Information Technologies group at the University of New Mexico in collaboration with New Mexico Institute of Mining and Technology, New Mexico State University, New Mexico Council for Higher Education Computing Communication Services (CHECS) and the New Mexico State Agency of IT. It is designed to serve research and education programs in New Mexico. ABQG is the on-ramp for high-speed national networks National LambdaRail and Internet2. Additionally, access is available to commodity internet and peering to keep in-state traffic local.

Broadband 'Super Network' Ignites Partnerships Across Pennsylvania

Health care professionals, educators, librarians and researchers are collaborating with one another like never before as Pennsylvanians prepare for the launch of the commonwealth's new Pennsylvania Research and Education Network (PennREN). A broadband network that will provide 1,600 miles of fiber through 39 Pennsylvania counties, PennREN will be one of the largest networks ever funded by the National Telecommunications and Information Agency (NTIA). Penn State is collaborating with other leading Pennsylvania higher education institutions in designing and shaping the scope of the new, statewide broadband superhighway.

"As we work to create and share in the opportunities of PennREN, different groups across Pennsylvania have come together in ways that has never happened in the past," said Jeff Reel, executive director of the Keystone Initiative for Network Based Education and Research (KINBER), the organization overseeing the development of PennREN. "This new research and education network will enable these institutions and organizations to do things they truly haven't been able to do before."

Reel said that through the shared experience of creating KINBER's membership, stakeholders have found they have a great deal in common. Many of these groups are already beginning to share tools and resources. Partner organizations span the breadth of the Keystone State, including major hubs such as the University of Pittsburgh, Penn State, the University of Pennsylvania, and 14 other universities and businesses.

Portions of PennREN are scheduled to begin operation in March 2012. When fully completed in March 2013, the network will span to reach 69 community anchor institutions statewide.

The network is comparable to a highway system that connects large-scale research and education hubs. Smaller networks will connect the highway to communities and users outside these major hubs, providing underserved rural communities with access to high-capacity broadband. The completed network will allow these communities to engage in efforts such as high-performance computing, video conferencing, telemedicine, digital research, collaboration with international colleagues and more.

"We're beginning to realize that all organizations involved in this effort -- large and small -- have something to share," said Bruce Taggart, vice provost of Information Technology at Lehigh University. "For example, Lehigh has a large, one-of-a-kind collection of electron

> *The network is comparable to a highway system that connects large-scale research and education hubs. The completed network will allow these communities to engage in efforts such as high-performance computing, video conferencing, telemedicine, digital research, collaboration with international colleagues and more*

microscopes, Pittsburgh has a world-renowned supercomputing center and Penn State has its vast science and research data. All these resources are network-accessible if users have the requisite bandwidth which PennREN will provide. We're finding out that all these different resources exist, and that we can work together to enable organizations throughout the state to share their benefits with one another."

Until the project began, Pennsylvania had been among the last states in the U.S. without a high-speed broadband network focused on connecting its higher education and health care institutions. All this has changed however, with the implementation of KINBER, Reel said. Federal stimulus funds also have helped make the shift.

"We want communities of users to talk to each other about how they can use this regional network as a way of pulling their different groups together," he said. "These conversations are taking place now -- Pennsylvania's newly connected health and education groups are sharing best practices and opportunities as we speak."

Wendy Huntoon, director of Advanced Networking at the Pittsburgh Supercomputing Center, said an exciting future prospect is that higher network speeds will allow teleconferencing between regional hospitals and urban hubs, reducing the need for patient transfers. "Imagine how things could change for burn victims who are seeking treatment at rural facilities," she said. "Right now, a team of doctors has to transfer a patient to a major hospital just to diagnose the degree of the burn. However, when the PennREN network goes live, a server that handles teleconferencing could make it possible for hospitals to immediately provide over-the-screen diagnosis."

The new network also will allow students to move across universities and institutions digitally. For example, a university might offer a first-year writing course through a streamlined interface. Students at other Pennsylvania colleges and universities (and even college-bound high school students) would have the opportunity to take the same course remotely. In addition, the system will enable world-renowned experts to immediately reach classrooms and training venues throughout the state.

To learn more about KINBER, visit www.kinber.org.

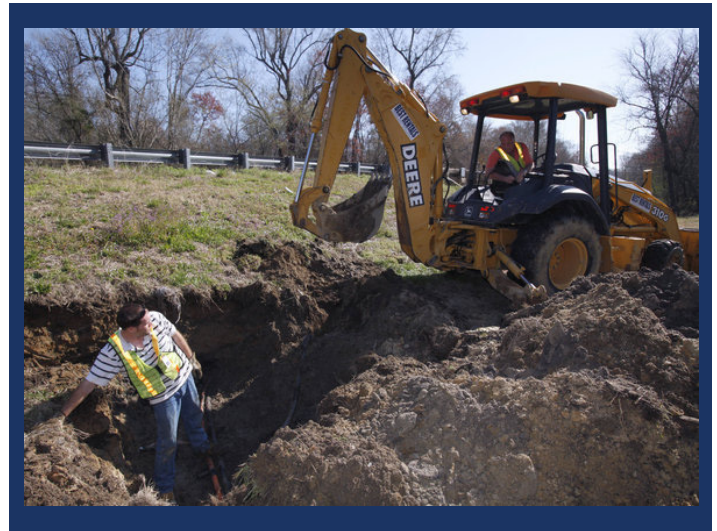# Communities Will Drive Innovation on North Carolina's New Digital Highway

The North Carolina Research and Education Network (NCREN) is the digital highway allowing many North Carolinians to thrive in today's globally-interconnected society. The current NCREN expansion will benefit almost every citizen in every community throughout the entire state.

Two federal Broadband Technology Opportunities Program (BTOP) grants awarded in 2010 represent the largest known single investments in "middle-mile" broadband infrastructure in North Carolina history. These awards will help MCNC deliver critical middle-mile infrastructure and direct fiber connections to universities, community colleges, schools, health care facilities, public health organizations, public safety facilities, libraries, and many other community anchor institutions throughout the state.

MCNC's two BTOP awards totaled $104 million. This amount was matched by $40 million in privately-raised funds representing a $144 million investment in broadband infrastructure in rural North Carolina. The Golden LEAF Foundation contributed $24 million of the matching funds, thus the effort has been dubbed the Golden LEAF Rural Broadband Initiative (GLRBI). MCNC also contributed $8 million from its own endowment to help fund the project. Approximately 99.3 percent of the total project value will be spent in the private-sector.

Work related to the first BTOP award will be complete in the spring. Some sections of the expanded NCREN already have been placed into service. East Carolina University, University Health Systems East through the N.C. Telehealth Network, and the National Climatic Data Center in Asheville are on expanded bandwidth connections built under the Round 1 award. The Round 2 project is three-times the size and currently is under construction with about 40 percent of the project complete.

The GLRBI will allow the institutions served by NCREN to increase their use of Intranet and Internet resources while keeping costs stable at today's rates. In 2012, MCNC will begin using this high-capacity network to benefit communities and maximize private-sector opportunities to deliver emerging shared/cloud services to NCREN customers. MCNC also is working to forge key partnerships in rural North Carolina that will utilize the GLRBI fiber to offer more affordable broadband service to citizens, businesses, and community anchor institutions with an eye toward creating opportunities for the for-profit telecommunications providers and cable operators in the state.

Two federal Broadband Technology Opportunities Program (BTOP) grants awarded in 2010 represent the largest known single investments in "middle-mile" broadband infrastructure in North Carolina history.

Construction on the GLRBI must be completed by Jan. 31, 2013 to allow MCNC time to equip and place fiber into service on or before July 31, 2013. More information can be obtained at www.mcnc.org/btop.

About NCREN: Founded more than 25 years ago, NCREN was one of the nation's first statewide education and research networks. NCREN currently has 338 connections in North Carolina servicing 2,500,000 users in public education (1,450,000 in K-12; 850,000 in Community Colleges; and 200,000 at universities). NCREN also serves the broadband needs of many health care community anchor institutions in the state. The demand for bandwidth among health care and education institutions grows annually between 20 and 40 percent. And, the applications these institutions operate require a level and type of connectivity for optimal performance that is not commercially available. For more information on MCNC and its BTOP projects visit www.mcnc.org/btop.

StarWave: A Multi-100 Gbps Communications Exchange Facility in Chicago Showcased at SC11

The annual SC conference is the foremost international high-performance computing conference. At SC11 held in Seattle, Washington, the U.S. Midwest's Metropolitan Research and Education Network (MREN) announced the implementation of StarWave, a multi 100 Gbps exchange facility located at the StarLight International/National Communications Exchange Facility in Chicago.

StarWave is being used to support multiple national 100 Gbps demonstrations that show how high-performance, high-capacity networks can significantly improve the way scientific research is conducted worldwide. With major funding provided by the National Science Foundation, the StarWave facility was designed by the MREN and StarLight consortia to exclusively support large-scale data-intensive scientific research.

Increasingly, scientific research requires gathering, analyzing, and transporting extremely large volumes of data among multiple locations. These data volumes far exceed the capacity of commonly implemented data networks. Beyond providing more capacity, StarWave supports dynamic and complex data flows required by a variety of scientific communities, by creating flexible dynamic lightpaths that can be created instantly for short periods or for the long term. The requirements, which cannot be met by today's general data networks, include those that are related to high-performance, advanced programmability, dynamic provisioning, and support for specialized protocols.

In partnership with the International Center for Advanced Internet Research (iCAIR) at Northwestern University and the Laboratory for Advanced Computing (LAC) at the University of Chicago, StarWave is also used to enable research in developing innovative high-performance communications architecture, technologies, capabilities, and infrastructure to meet the emerging and anticipated demands of 21st-Century e-Science. StarWave will also provide 100 Gbps gateways to national and international R&E networks.

"Data intensive scientific research requires new services and techniques for extremely high-capacity, high-performance, and flexible optical transport locally and worldwide, said Joe Mambretti, Director of iCAIR and MREN. "With our research partners, we are improving methods for data intensive scientific research by leveraging innovative transport services based on 100 Gbps technologies."

Other key enablers of future scientific research that are being developed are new techniques for investigation based on extremely large volumes of data by closely integrating dynamic high-performance networks with dynamic high-performance clouds. These techniques can accelerate scientific discovery because cloud-based networks can easily and flexibly transfer and process science data at the petascale level.

"A special focus of the StarWave facility will be the development of new capabilities for data-intensive science based on advanced cloud computing architecture," said Bob Grossman, Director of the LAC and Co-Director of the Open Cloud Consortium.

iCAIR, Ciena, MREN, and LAC are building a long-term research partnership directed at creating next-generation services, capabilities, technologies and facilities for advanced high-performance applications.

"We are proud to partner with MREN, iCAIR and LAC in showcasing these ground-breaking demonstrations, including those providing end-to-end 100 Gbps streams that push beyond the limitations of today network capabilities to improve the way researchers interact and conduct complex research innovation," said Rod Wilson, Ciena's senior director for external research

About MREN: The Metropolitan Research and Education Network (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. The MREN facility exclusively focuses on providing service and infrastructure support for large-scale data-intensive R&E activities, including connections to major national and international advanced networks. (www.mren,org)

About StarLight: StarLight is the world's most advanced national and international communications exchange facility. StarLight 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 International Center for Advanced Internet Research (iCAIR) at Northwestern University: The International Center for Advanced Internet Research (iCAIR) at Northwestern University accelerates leading-edge innovation and enhanced global communications through advanced technologies, in partnership with numerous international community, and national partners. (www.icair.org).

About the Laboratory for Advanced Computing: The Laboratory of Advanced Computing (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 Ciena: Ciena is the network specialist, collaborating with customers worldwide to unlock the strategic potential of their networks and fundamentally change the way they compete. With focused innovation, Ciena brings together the reliability and capacity of optical networking with the flexibility and economics of Ethernet, unified by a software suite that delivers the industry's leading network automation. (www.ciena.com).
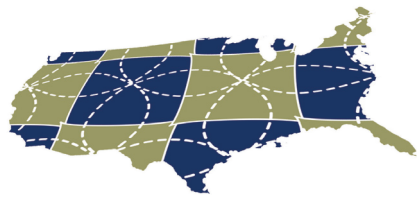
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