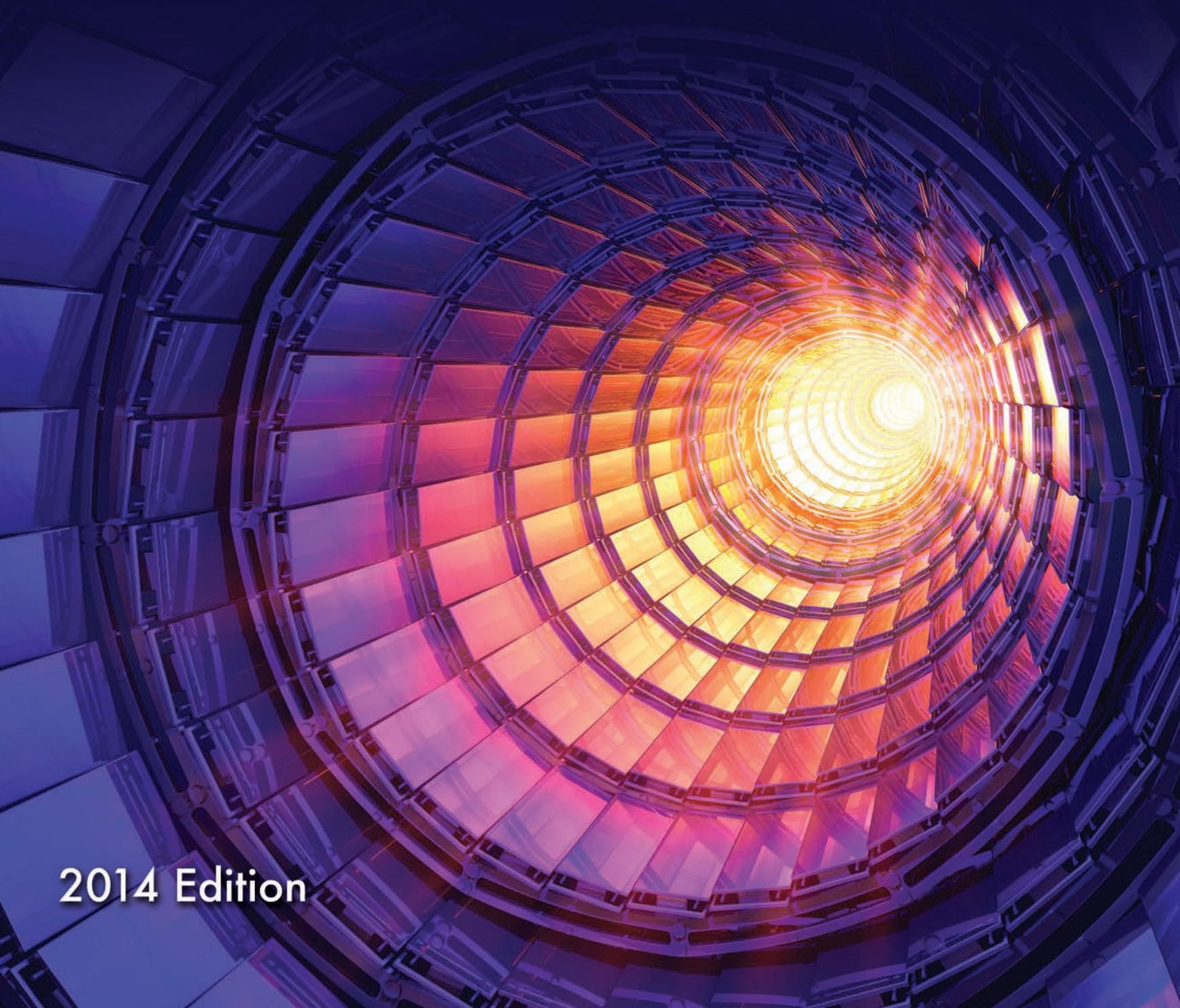




THE QUILT CIRCLE

National Regional Networks Consortium

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



2014 Edition

A Letter from the President

The cover of The Quilt Circle this year is a photo from the inside of the Large Hadron Collider (LHC) in Geneva, Switzerland. We chose this cover for several reasons.

First, it depicts a renowned example of global, collaborative scientific research that requires specialized networking infrastructure. This type of effort would not be possible today if not for the advanced networking infrastructure deployed by research and education networks all over the world. Through extensive collaboration, coordination and interconnection, these networking facilities bring new high-energy physics data to the desktop of the physicists dispersed worldwide leading to new scientific discoveries.

Secondly, the LHC photo is significant because it is an example of collaborations within the research and education community at the highest level. These types of collaborations toward the pursuit of common goals are the hallmark of the research and education (R&E) networking community. Collaboration is a vital component of our community's work, and our Quilt members are the ultimate collaborators bridging the human network with physical networks at the community, state, national and international levels. You can read all about these types of collaborations in this latest edition of The Quilt Circle.

This year's publication showcases our members' efforts in providing tools and infrastructure to support science research and the big data movement; deploying and training on leading-edge networking technologies including software-defined networking; the completion of statewide network infrastructure projects funded through the Broadband Technologies Opportunity Program; the role of R&E networks in economic development; connecting libraries, municipal and county governments to our networks; partnering with member institutions for education technology; providing strategic services to members, and much more.

While our members facilitate collaborations among the institutions in their communities and states, The Quilt facilitates collaboration among our members at the national level. This collaborative spirit among our members is what drove the creation of The Quilt 14 years ago and is the driving force behind the success of the organization today in accomplishing our program objectives.

We are pleased to have added three new member organizations to our Quilt community in the last year – KINBER in Pennsylvania, ARE-ON in Arkansas, and MDREN in Maryland. With the addition of these organizations, we enrich our collaborations through their contributions of expertise, perspectives and staff talents. 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.

National broadband programs such as the White House ConnectED initiative, modernization of the FCC's E-rate program for schools and libraries, and the newly-announced Connect America Fund rural broadband trials, all have the potential to impact the communities of institutions connected to and supported by our Quilt members. In the last year, our Quilt community focused significant efforts on collaborating with policymakers regarding these programs and contributing our members' collective expertise in serving these communities to these national discussions.

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 each institution. 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

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OneNet Builds Capacity to Support Big Data Movement

Oklahoma's demand for big data movement has grown, and new strategies are needed to support the state's research investments. OneNet's leadership identified the need for a high-speed network to enable the work of leading-edge scientists, high-end supercomputing centers and massive data movement.

After connecting to Internet2's 100G network in fall 2012, Quilt member OneNet launched a plan to address this need by building a 100G ring around the state to support Oklahoma researchers' need for big data movement across the state and around the globe. The first phase was completed in January 2014 and connects Oklahoma State University (OSU) campuses in Stillwater and Tulsa, the University of Oklahoma (OU) in Norman, and OneNet in Oklahoma City.

"Particle physics experiments have large networking needs, since data must be transferred among scientists," OU research scientist Horst Severini said. "Network consumption will double annually for the expected 15 or more years of the ATLAS experiment as raw data production and analysis increase. The 100G connection will assist us in coping with the impending data tsunami."

"Through our partnerships with research teams at Oklahoma's higher education institutions, we saw a need for higher bandwidth to support the production, analysis and transfer of big data among institutions and outside the state," OneNet Executive Director Vonley Royal said. "The 100G network provides the infrastructure necessary to maximize research investments in Oklahoma."

One research program that will benefit from the network expansion is the Oklahoma Center for High Energy Physics (OCHEP), a collaboration of researchers at OU, OSU and Langston University. OCHEP scientists are conducting research for the ATLAS project, a high-energy physics experiment at the Large Hadron Collider at the European Organization for Nuclear Research. ATLAS is one of the largest physical science collaborations ever, with more than 3,000 physicists from more than 150 universities and laboratories in 34 countries.

ATLAS explores the fundamental nature of matter and the basic forces that shape our universe by examining head-on collisions of protons of enormously high energy. To analyze ATLAS data, massive computing, storage and data transfer are needed, and those needs are expected to grow over the next few years.

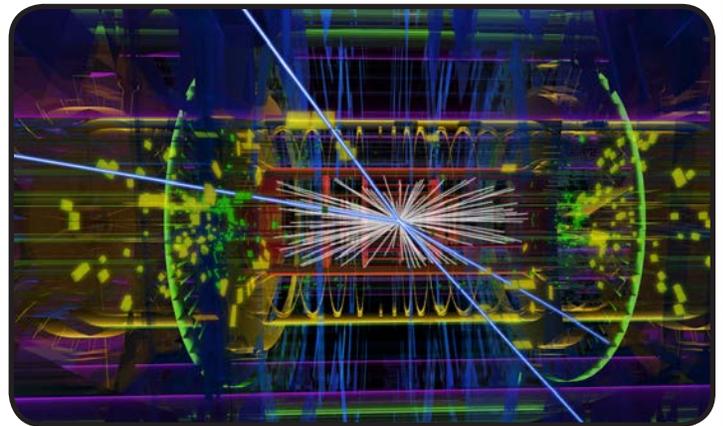
"Particle physics experiments have large networking needs, since data must be transferred among scientists," OU research scientist Horst Severini said. "Network consumption will double annually for the expected 15 or more years of the ATLAS experiment as raw data production and analysis increase. The 100G connection will assist us in coping with the impending data tsunami."

Researchers will benefit not only from the higher-speed connection but also from the network design. The 100G ring utilizes software-defined networking (SDN), which offers enhanced support for users.

"SDN enables OneNet to prioritize traffic and better manage traffic loads to optimize performance and efficiency," Royal said. "This ability allows us to coordinate network traffic and facilitate big data movement across the state."

The implications for research in Oklahoma are significant. Supporting big data movement is vital to advancing the research efforts of the state's scientists, and their work not only impacts the state, but the future for all of us. OCHEP's project is one example that will have far-reaching effects for the scientific community.

"The ATLAS project is probing the frontier of human knowledge through innovative technologies," Severini said. "OneNet is a vital partner in supporting that technology by providing the bandwidth capacity needed to implement it."



ATLAS Experiment © 2013 CERN

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 the state's education, research, health care and public service communities. For more information see: www.onenet.net.

Mid-Atlantic Crossroads' Software-Defined Networking Enables Advancements in Astronomy Research

Throughout 2013, Quilt member Mid-Atlantic Crossroads (MAX) kept a steady focus on its core mission: to provide innovative cyber solutions for the research and higher education communities through the expansion and evolution of its high-performance networking infrastructure.

Suvi Gezari, Assistant Professor of Astronomy at the University of Maryland, is just one researcher to benefit from MAX's expanding network and advanced services. Gezari, a member of the Pan-STARRS1 (PS1) Science Consortium, is leading a study to search for transient flares from supermassive black holes in the Medium Deep Survey, which requires nightly monitoring of the sky.

The PS1 survey observes large areas of sky with a fixed cadence in multiple filters. These observations allow the research team to characterize a large range of variable objects, from pulsating stars in our own Galaxy, to supernova explosions in distant galaxies. PS1 is not only groundbreaking, but also a very data-intensive study, requiring a combination of nightly observations taken over the course of one year. Therefore, Gezari and her team needed access to a network that could transfer high volumes of data at high speeds. MAX met this demand by providing Gezari and her team access to the Multi-Service eXchange (MSX) platform.

"Scientists often rely on traditional mail services to deliver discs containing large datasets, and the introduction of MSX is a true technological advancement in the research community," said Tripti Sinha, Executive Director of MAX.

MAX developed and integrated MSX into its high-performance infrastructure under the Software-Defined Networking Exchange (SDNX) project, which is funded by National Science Foundation (NSF) grant number 1246386. The goal of this project is to make existing, advanced network functions an integral component of science application workflows in the end-to-end sense, thus helping to facilitate big data flows.

"Scientists often rely on traditional mail services to deliver discs containing large datasets, and the introduction of MSX is a true technological advancement in the research community," said Tripti Sinha, Executive Director of MAX. "MSX works like the on and off ramps of a highway, allowing highly-specialized research traffic to be isolated from the campus production network in order to protect it from the effects of unrestricted big data flows. Therefore, scientists have a more immediate and direct access to critical research data."

"While working on PS1 before SDNX, I obtained data by carrying a 2-TB drive with me to Hawaii and then bringing it back to Maryland," said Sebastien Heinis, Research Associate at the University of Maryland and part of Gezari's PS1 team. "It already took quite some time, typically a few days, to retrieve static sky data. Without SDNX, PS1 would be completely unfeasible since we need to retrieve several hundred times more data."



*The PS1 Observatory on Haleakala, Maui.
(Source: http://ps1sc.org/Photo_Gallery.shtml)
Photo by Rob Ratkowski. Copyright © by PS1SC.
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PS1 produces roughly hundreds of gigabytes of data each night, which will result in hundreds of terabytes of data by the end of the survey in March 2014. Before SDNX, Gezari and her team planned to download the entire dataset over the course of nine months. However, by using SDNX, the download time is reduced to only one-and-a-half days.

"Since the performance is improved this much, we do not even have to download the data, but rather process the sets in real time as the data flows in," said Jaroslav Flidr, Director of Services at MAX and architect of SDNX.

"I have been really excited to work alongside the MAX team," said Gezari. "SDNX enables us to perform groundbreaking research, and it is a great feeling to know that we are joining in on cutting-edge science and technology."

About the Mid-Atlantic Crossroads (MAX)

MAX is a multi-state regional network led by the University of Maryland which owns and operates an all-optical, Layer 1 core network that is the foundation for a high-performance infrastructure providing state-of-the-art 100 Gbps network technology and services. MAX participants include universities, federal research labs, and other research-focused organizations in the Washington and Baltimore metropolitan areas. Its mission is to provide cutting-edge network connectivity for its participants, tailored and generic data-transport solutions, and advanced services to accommodate and optimize large data flows, and to facilitate network and application research. For more information see: www.maxgigapop.net.

Rhode Island's New High Speed, High Capacity Broadband Infrastructure is Completed

One of the most significant new local infrastructure projects, OSHEAN's Beacon 2.0, was completed in late 2013. Beacon 2.0, a new 450-mile, fiber-based, cyber infrastructure that connects over 100 Community Anchor Institutions (CAI) in Rhode Island, equips Rhode Island and South Eastern Massachusetts with an unparalleled cyber infrastructure, laying the foundation to support students, expand businesses, and improve the overall ability of the state to better compete on a regional and global scale

Beacon 2.0 is one of the most significant new local infrastructure projects. It equips Rhode Island and South Eastern Massachusetts with an unparalleled cyber infrastructure, laying the foundation to support students, expand businesses, and improve the overall ability of the state to better compete on a regional and global scale.

"This is a significant milestone for the state and surrounding region," said Quilt member OSHEAN's President and CEO, David Marble. "Rhode Island now has an amazing asset that enables it to be on the cutting edge of digital technology capability. Its uses are widely varied and extremely valuable allowing us to connect, collaborate, and innovate in a variety of ways. The infrastructure now in place affords major advances in everything from virtual classrooms to telemedicine."

Beacon 2.0 was funded with a \$21.7 million federal stimulus grant and \$10.7 million in private funds. Senator Jack Reed, working with other members of Rhode Island's congressional delegation, spearheaded the 3-year federal initiative under a program entitled the Broadband Technology Opportunities Program (BTOP). The Beacon 2.0 network provides necessary cyber-infrastructure to support the state's growing knowledge economy and the hundreds of industries and jobs it is expected to create.

Application examples include:

- Medical institutions utilizing video to capture and stream for on-line learning and delivering on-line certification training and testing.
- Healthcare Community Anchor Institutions are using the network for remote diagnostics and electronic medical records access.
- Community Anchor Institutions are utilizing the new network to create a disaster recovery platform for back up of critical infrastructure to a number of local and geographically disperse locations.
- Statewide coordination through an emergency management video system over the Beacon 2.0 infrastructure.
- High-speed fiber connectivity allows access to a world of digital learning tools and learning management systems in the network for both Higher Ed institutions and K-12.

"Thank you to OSHEAN and their community partners for making this advanced fiber-optic network a reality," said Senator Reed. "With the completion of Beacon 2.0, more Rhode Islanders in

schools, libraries, research institutions, and hospitals throughout the state can connect to new opportunities, and access and share information. We need to continue investing in our digital infrastructure to ensure that all Rhode Islanders have access to reliable, affordable broadband access so they can connect, compete, and succeed."

"Cyber-infrastructure provides the fuel to grow our knowledge-based economy. Today, we celebrate the completion of more than 450 new miles of fiber optic network across all five Rhode Island counties, which makes Rhode Island one of the top three in the nation for broadband coverage," Governor Lincoln D. Chafee said. "The result will be even more broadband capacity and digital literacy in Rhode Island's schools, libraries, and hospitals. Broadband expansion is essential to fostering greater social, economic and political equality and narrowing income disparities throughout Rhode Island."

About OSHEAN

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



CENIC Enabling Public Libraries to Serve a Broader Community

During 2013, Quilt member CENIC conducted interviews with librarians, asking them to describe current uses of technology in their libraries, to identify the obstacles they face as a result of limited bandwidth, and to share ideas they have for using expanded broadband capacity. These interviews revealed that videoconferencing, streaming media, content creation, specialized software, longer sessions on terminals, unlimited wireless access, and more are badly needed by many libraries in the California State Library System, but insufficient bandwidth thwarts these libraries' efforts to fulfill their vital community role in research and education.



To respond to these needs, work is underway to connect California's public libraries to CENIC, with the California State Librarian acting as the libraries' interaction point with CENIC. To understand the requirements and benefits of connecting public libraries to CalREN, four groups of libraries are currently being connected to the network as a part of a pilot project. The Peninsula Library System, a consortium of 35 public and community college libraries, was the first to connect to CalREN in August 2013. A Gigabit connection has also been completed to the San Francisco Public Library System, a 27-branch library system serving the San Francisco area. The San Joaquin Valley Library System and a group of 9 libraries in the northern Valley of California will be connected in Fall 2014. Libraries in California's Central Valley will also be connected to CENIC as part of the Central Valley Next Generation Broadband Infrastructure Project.

The Peninsula Library System (PLS) is a consortium of 35 public and community college libraries. Located in Silicon Valley, PLS library leaders have actively sought out and implemented programs and services that take advantage of the latest technology. For example, the Redwood City Libraries have the highest Internet usage per capita in the country. These libraries have enjoyed a higher bandwidth than most as San Mateo Community College has enabled them to connect to CENIC's CalREN through the College's connection.

Despite this, the libraries face denials of connectivity, extreme network slowdowns during high usage times, saturated connections, and other obstacles that prevent patrons and libraries from making full use of the current connectivity. PLS Director Linda Crowe says, "Public libraries in California have been bandwidth-challenged. Once the barriers are removed, libraries will not only be able to provide content in the form of expanded programs and services for the community, but they also will have the ability to create it."

The main library and 27 branches of the San Francisco Public Library (SFPL) serve one of the country's largest metropolitan areas, with a diverse population including highly connected patrons from high-tech

focal points as well as recent immigrants and their families. To fulfill its mission, the SFPL puts out a variety of bandwidth-hungry programs including city-wide scavenger hunts, performances, presentations by top authors, and exhibits of interest to all members of the greater San Francisco area's diverse population. Computer, healthcare, and career-related classes, media presentations, and children's events are other ways by which the SFPL serves the millions of Californians within its scope.

The San Joaquin Valley Library System is comprised of 10 main libraries and their associated branch libraries in seven counties in the Central Valley of California. In contrast to the more connected population served by the PLS, the communities served by the San Joaquin Valley Library System (SJVLS) have a larger immigrant population and higher rates of poverty than other area of the state. For many residents, English is their second language, and they face high unemployment, obstacles to educational attainment, and a low standard of living relative to other communities in the state.

The San Joaquin Valley libraries play a critical role in providing access to the 21st century tools that can help address these challenges. However, the libraries in this system generally have minimal connectivity, on the lower end of average home connection speeds. Thus, many programs that could be of help to the communities served by the SJVLS are not possible. States Laurel Prysiazny of the Fresno County Public Libraries, "Low educational attainment, unemployment, and ill health are persistent problems in the communities we serve. Libraries level the playing field and allow access to all. In rural areas, libraries are the community center."

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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 respond to 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.

OARnet's 100 Gig Boost Supports AweSim New Initiative

In 2012, the State of Ohio invested \$13 million to boost speeds from 10 Gbps up to 100 Gbps on the statewide fiber-optic backbone of Quilt member Ohio Academic Resources Network (OARnet). The 1,500 miles of ultra high-speed bandwidth is expected to advance research and job growth across Ohio's academic, health care, manufacturing, engineering and technology networking corridors.



Pankaj Shah, Executive Director of OARnet

we are actively providing Ohio a valuable technology with which to entice and retain talents and businesses.”

In addition, OARnet's statewide 100 Gig network supports next-generation business applications by serving as an incubator for public/private partnerships. These partnerships are aimed at commercializing advanced software and hardware, by providing a platform for development of new applications for large-scale scientific research and by supporting the transmission of information for “Big Data” projects.

“OARnet's 100 Gig network really helps Ohio, not just by how it supports great research institutions, but by what it does for cutting-edge industrial innovations, such as AweSim.”

- Ray Leto, president of TotalSim USA

One use case that easily illustrates how the 100 Gbps network will enhance economic development is AweSim, a new platform to leverage the power of supercomputers and high-speed networks to enhance the competitive position of small and mid-sized businesses in the global marketplace.

In June, the Ohio Third Frontier Commission awarded Ohio Supercomputer Center (OSC) and its project partners \$3 million to develop and market innovative web-based modeling and simulation resources. Manufacturing partners P&G and Intel, engineering partners TotalSim USA, AltaSim Technologies and Kinetic Vision and online marketing partner Nimbis Services are funding the balance of the three-year, \$6.4 million project.

AweSim aims to make simulation-driven design more accessible, so researchers can discover solutions more quickly, and businesses can reduce costs, improve prototyping and increase speed-to-market. Normally, simulation technology requires a massive

investment in hardware, software and expertise, which can make adoption cost-prohibitive.

With AweSim, companies can use simple apps to harness powerful computational resources via the high-speed network. These apps integrate unique manufacturing domain expertise, sophisticated simulation software and cloud-based computing resources inside a digitized workflow. For example, clients can simulate the flow patterns and properties of a liquid by clicking a few buttons in an app that models pipe manifolds.

“Our business focuses on modeling and simulation for the automotive industry, and we chose Ohio over other states like North Carolina, Indiana or Michigan because of the advanced technology and infrastructure available here in Ohio,” said Ray Leto, president of TotalSim USA. “OARnet's 100 Gig network really helps Ohio, not just by how it supports great research institutions, but by what it does for cutting-edge industrial innovations, such as AweSim.”



Ray Leto, President of TotalSim USA

OSC has been at the forefront of the national effort to help industry gain easy and affordable access to advanced modeling and simulation technologies, starting with the 2004 launch of its innovative Blue Collar Computing initiative. In more recent years, the OSC team has developed prototypical manufacturing apps for companies in such sectors as consumer goods, advanced materials and automotive.

About OARNet

A member of the Ohio Board of Regents' Ohio Technology Consortium and located at The Ohio State University, 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. Communities voluntarily participate in the OARnet consortium because they value these benefits and services. Ultimately, OARnet promotes community and economic development by expanding access to affordable technology. For more information see: www.oar.net.

KanREN Finds New Collaboration with Community Anchor Institutions

Municipal and county governments may seem like odd members for a research and education (R&E) network, but Quilt member KanREN has found an entirely new and valuable group of participants within their ranks. When the NTIA BTOP program was announced, most R&E networks gave little thought to the idea of “community anchor institutions” (CAIs) beyond K12 and post-secondary institutions. For those who received BTOP grants, this wider scope of CAIs was immediately part of their future, but for other R&E networks it has been a longer road.

KanREN, one of the statewide R&Es that did not seek BTOP funding, gave little thought to expanding its membership beyond the traditional group of K12, higher education, libraries and a few others associated with these institutions. Ultimately, it was a municipality that brought the idea of expansion to KanREN. The City of Lawrence, Kansas (where KanREN’s offices reside) opened a dialogue with KanREN in early 2013 about becoming a member. When KanREN heard about the City’s vision for sharing municipal fiber between the City of Lawrence, Douglas County, Lawrence public schools, Lawrence public library, Lawrence memorial hospital and the University of Kansas, they realized immediately that the City of Lawrence shared KanREN’s vision for connecting public institutions.

As the connectivity and performance needs for the City of Lawrence continued to grow, we needed a provider that was very flexible and cost effective. KanREN has proven to be a perfect fit.” Jim Wisdom, IT director for the City of Lawrence stated, “The ability to work directly with the knowledgeable and responsive technical staff at KanREN has been very satisfying and we are looking forward to utilizing KanREN’s additional capabilities, resources and services.”



Both the City of Lawrence and Douglas County brought their own fiber to KanREN’s backbone PoP co-located at the University of Kansas in late 2013, and have been using KanREN for their upstream connectivity needs for several months. “While there has been much national debate over public fiber builds,” said Cort Buffington, KanREN Executive Director, “the economies of scale that this public fiber has brought to public institutions in Kansas has been phenomenal.”

In the process of completing this project, KanREN learned that many municipal and county governments fit KanREN’s vision and mission just as well as their traditional members. Buffington said, “The fit was perfect. We had no idea how closely our own vision, mission and values aligned with the goals of the city and county in connecting their CAIs.”

Jim Lawson, IT director for Douglas County stated, “KanREN is a great fit for the County’s needs and provides excellent service and support. We look forward to a long relationship and are interested in exploring other KanREN services to better serve our citizens.”

And the growth hasn’t stopped with just these two municipalities. As soon as Wisdom and Lawson, began talking with their colleagues in other cities and counties, word started spreading fast, and interest in KanREN has grown rapidly. Currently, KanREN is in discussions with several other municipalities including the City of Pittsburg, with fiber resources near the KanREN backbone PoP at Pittsburg State University, and Johnson County which includes the cities of Olathe, Overland Park, Lenexa, Leawood, Gardner, Shawnee, and Merriam.

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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 see: www.kanren.net.

IU's GlobalNOC: Advancing Indiana, The Nation, and The World

Since its inception, the Global Research and Network Operations Center (GlobalNOC) has been the heart of networking at Indiana University, supporting and connecting highly advanced research and education networks nationally and internationally. Celebrating its 15-year anniversary in 2013, the GlobalNOC has dedicated itself to the research and education communities it serves, helping further scientific discovery and knowledge. Human genomics sequencing in Asia, massive physics data from the Large Hadron Collider in Europe, and astrological images from Australia and South America move across the vast networks the GlobalNOC manages and operates.

With more than 80 highly skilled, full-time employees, the GlobalNOC supports the communities it serves by operating the networks that connect all of Indiana's universities and colleges, facilitating collaboration between doctors in China and the US, moving vast amounts of data from Asia and Europe to researchers in the US and around the world, and enabling severe weather prediction models.

In the state of Indiana, the GlobalNOC has been an economic engine, bringing skilled professionals to the state, creating jobs for Indiana graduates, and attracting more than \$20 million in research funding. The GlobalNOC has positively impacted communities throughout Indiana by attracting new IU faculty to study network performance, winning federal research grants, and recruiting highly talented students.

"GlobalNOC has been a triple success for IU's service to the state, the nation, and the world," said Brad Wheeler, IU vice president for information technology and chief information officer. "The university and the state have the service of some of the nation's most advanced network engineers via the I-Light network, and the GlobalNOC has helped stem and reverse the state's so-called 'brain drain' by creating jobs and recruiting staff and their families to Indiana. IU's networks team has earned the respect of networking teams around the country and brought in numerous federal projects and public sector work from other states."

Some of the GlobalNOC's current partners and projects include: TransPAC3, a 10 Gbps network that directly connects the US to Asia – and the first US-China connection specifically dedicated to academic scientific research; N-Wave, the National Oceanic and Atmospheric Administration's science network that connects researchers to the data and resources they need to advance environmental science; America Connects to Europe, a network that connects US scientists and researchers to their counterparts in the European Union; KINBER, Pennsylvania's Research and Education Network, a statewide network that extends over 1,600 miles and reaches 50 Pennsylvania counties; and Monon 100, a network link dedicated to research and education that allows scientists and medical researchers to share data created by modern digital instruments.

The GlobalNOC has been an economic engine, bringing skilled professionals to the state, creating jobs for Indiana graduates, and attracting more than \$20 million in research funding.

About GlobalNOC

Formed in 1998 through a partnership between Indiana University and Internet2 and staffed with only three employees, today the GlobalNOC is the preeminent network operations center of its type and home to Internet2's network operations center. Nearly a decade after the partnership formed, the GlobalNOC – working as the Internet2NOC – completed its new 100 Gigabits per second (Gbps) national network, making it the nation's fastest, coast-to-coast research and education network. Service Desk, Network Engineering, and Software and Systems teams from the GlobalNOC provide support, and ensure reliability, performance, and advanced capabilities for the network, as well as more than 20 advanced network projects. For more information see: www.globalnoc.iu.edu.



MCNC Completes Golden LEAF Rural Broadband Initiative

From alligators, bears and superstorms, to mountains, trains and incredible engineering challenges, the \$144 million Golden LEAF Rural Broadband Initiative (GLRBI) remains an historic achievement for North Carolina.

Quilt member MCNC, the non-profit owner and operator of the North Carolina Research and Education Network (NCREN) announced the completion of this ambitious project in August 2013 and held a celebration from four locations in the state (the National Climatic Data Center in Asheville, UNC Charlotte, Elizabeth City State University, and the MCNC campus in Research Triangle Park), showcasing the expanded capabilities NCREN.

In 2007, NCREN consisted of 72 endpoints and about 200 miles of fiber. Less than 10 of the state's 115 public school districts had access to NCREN and the educational resources on the network. In February 2010, MCNC embarked on a massive statewide expansion of the network aimed at delivering affordable high-speed broadband to more than 1,500 community anchor institutions; and through private-sector service providers, potentially reach 180,000 businesses and more than 300,000 underserved families in 82 mainly rural counties in North Carolina.

MCNC's role in the GLRBI also involves leading discussions with economic developers and private-sector broadband service providers to use the GLRBI fiber to improve broadband access and grow jobs in North Carolina.

The GLRBI was funded through grants from the U.S. Department of Commerce's National Telecommunications and Information Administration's (NTIA) Broadband Technology Opportunities Program (BTOP) with significant matching funds from private donations and investments including \$24 million from the Golden LEAF Foundation and \$10 million from the MCNC Endowment. No state funds were utilized as matching funds for the MCNC awards.

Today, NCREN is a fiber-based network spanning more than 2,600 miles across the state and serving more than 450 connectors including; all K-20 public education in North Carolina; many private education institutions and charter schools; most of the state's leading research institutions; other government, judicial and public safety customers; and more than 120 health care providers – including non-profit hospitals and public health clinics. MCNC's role in the GLRBI also involves leading discussions with economic developers and private-sector broadband service providers to use the GLRBI fiber to improve broadband access and grow jobs in North Carolina. North Carolina now is one of just a handful of states with an open access, middle-mile fiber network available to economic developers, businesses, and broadband service providers.

U.S. Senator Kay Hagan (D-NC) said broadband access is crucial for economic development, access to education, and for quality health care for families in rural communities. North Carolina Gov. Pat McCrory called this project "a tremendous success" for North Carolina. U.S. Representative Renee Ellmers (R-NC) said the GLRBI is a "success story" for North Carolina. U.S. Representative David Price (D-NC) added that this project is another example of how strong public-private partnerships give North Carolina an advantage over other states. U.S. Representative G. K. Butterfield (D-NC) called it an "historic investment" for rural areas of the state.

North Carolina is increasingly reliant on technology and leading-edge broadband infrastructure, and just about every sector in the state will benefit from this important investment. The upgrades and expansion of NCREN will help ensure that North Carolina will have the digital infrastructure required to scale to future needs.

"We are very proud of this work, and we already have so many great examples of success from this project. But, this is a marathon, and we are only in the first mile," said Joe Freddoso, MCNC President and CEO. "MCNC will continue to partner and follow its public benefit mission to help grow the broadband business in North Carolina and to enable our citizens to have access where they learn, where they work, where they receive health care, and where they live. We have constructed the infrastructure to help do just that throughout North Carolina."

About MCNC

MCNC is a technology non-profit that builds, owns, and operates the North Carolina Research and Education Network (NCREN). For more than a quarter century, a growing number of research, education, non-profit health care, and other community institutions have connected to NCREN to utilize this leading-edge broadband highway. Today, NCREN serves the broadband infrastructure needs of more than 450 of these institutions including all K-20 public education in North Carolina. For more information see: www.mcnc.org.



MOREnet Partners with Members on Technology Research Projects to Advance Missouri Learning

In addition to providing its Missouri members with high quality Internet connectivity and essential technical services, Quilt member MOREnet is continuously researching and exploring new technologies, processes and solutions to help members adapt and succeed in a rapidly changing technology environment. To further the research of new technologies to meet member needs, MOREnet recently announced up to \$830,000 in grant and in-kind contribution funds to support multi-year research partnerships with two K-12 member districts and one member library.

The two school districts have partnered with MOREnet for the next three years to develop and align curriculum, services, training, policies, best practices and related resources that other districts could potentially adopt and adapt. Fulton Public Schools recently unveiled leading-edge technologies in its newly constructed Fabrication Laboratory (Fab Lab); Missouri's first K-12 Fab Lab. A Fab Lab is a small-scale, STEM (Science, Technology, Engineering and Mathematics)-based, multi-disciplinary workshop. Fulton's lab offers students the opportunity for personal fabrication of almost anything using both a clean and dirty lab environment.

Community partners such as the University of Missouri College of Engineering, Ameren UE and Linn State Technical College are committed to providing Fulton with professional and technical support for the lab. By supporting all subject areas, the lab is expected to become a catalyst for interdisciplinary instruction. The lab consists of a variety of rapid prototyping machines such as 3-D printers, CNC (computer-numerically-controlled) machines, laser cutters and 3-D scanners.

"It's just unbelievable what they'll be able to do in this lab. It is our vision and MOREnet's hope that Fulton's Fab Lab becomes a model for other schools in the state," says Dr. Suzanne Hull, Assistant Superintendent of Fulton Public Schools.

Grandview R-II is a Missouri K-12 district with fewer than one thousand students. The goals of the Grandview R-II research project is to enhance technology and teacher commitment to ensure that students have access to the same opportunities as those in larger school districts. Grandview is personalizing student learning in both blended and flipped classroom settings through the use of Moodle, the Learning Management System (LMS) offered by MOREnet which also provides formal data analysis of student progress.

Through the project, Grandview also plans to extend the district's high school 1:1 initiative program to all grades as well as grow its catalog of blended and virtual courses available to students. Grandview students will be able to take greater responsibility for their own learning to ensure college and career-readiness upon graduation.

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"We are very excited the research project partnerships with these schools are well underway," states John Gillispie, executive director of MOREnet. "We look forward to working closely with these schools and believe the outcomes will serve as a blueprint for others in the advancement of technology and learning."

The University City Public Library's (UCPL) research project includes developing a technology MakerSpace with a variety of equipment and software for use by all library patrons. UCPL's physical and digital MakerSpace will include facilities, equipment and software for audio and video recording and editing, and equipment and software for 3D modeling, printing and fabrication, providing the tools and resources to enable limitless creativity.

Working closely with MOREnet and other community partners, UCPL will provide learning opportunities related to this new equipment and software. The library will develop a digital repository for community-generated work such as digital images, documents, audio files and videos that will help preserve the community's collective past and document present-day while imagining and designing a shared future. It is UCPL's desire to leverage existing community partnerships and the creativity of the residents to make this project successful.



About MOREnet

Created in 1991, the Missouri Research and Education Network (MOREnet) is a member-driven consortium serving Missouri's K-12 schools, colleges and universities, public libraries, state and local government, teaching hospitals and clinics and other affiliate organizations. MOREnet, operates as a separate business unit within the University of Missouri, delivers secure, reliable and robust Internet connectivity to its members. For more information see: www.more.net.

WVNET Launches MOOC About Software-Defined Networking

Quilt member West Virginia Network (WVNET), created and presented a Massive Open Online Course (MOOC) about Software-Defined Networking (SDN) on COURSEsites by Blackboard. Entitled SDNOPS, this was the first MOOC ever to teach SDN using an interactive lab component and was recognized by top5onlinecolleges.org as one of the “99 Best Resources on Open Courseware and MOOCs,” coming in 11th in the company of Harvard, Stanford, Ed-X, Coursera and other outstanding online course sites. The primary goal of the course was to provide practical knowledge and practical application, or as WVNET Director Judge Dan O’Hanlon likes to say, “See one, create one, and teach one.” SDNOPS went beyond lecture and exam to include innovative hands-on labs taught by industry experts, Brent Salisbury, Dustin Burns, Bill Owens, and others. Learners in the course were fortunate to have access to resources contributed by Ivan Pepinjak, Greg Ferro, and Steven Wallace, groundbreakers in SDN theory. Although there were “self-checks” along the way to help learners build competency in the basic skills necessary to successfully configure and launch their own SDN, there were no exams. Instead, learners downloaded virtual machines and applied practical knowledge in an interactive lab environment.

WVNET developed the MOOC not only from a passionate interest in SDN and online learning, but also as a learning experience so that it may assist other WV educational institutions in creating MOOCs.

Students from around the world enrolled in the MOOC and achieved participation and completion statistics above the U.S. national average. In addition to international students enrolled in both undergraduate and graduate courses at colleges and universities in the United States, professionals from Australia, Brazil, Bulgaria, Canada, Denmark, Egypt, France, India, Korea (North & South), Mexico, Russia, and the United Kingdom also enrolled as students in the course.



Of the learners who participated in this grand experiment in MOOC pedagogy, 56% completed lab exercises to earn badges and 10.5% of the active learners completed the course to successfully create their own software defined network, while 5% of the total users during the live course completed all activities to earn their final SDNOPS badge. Of the 71% of the students who completed the course evaluation, 80% indicated that they enjoyed the course and would enroll in another course of the same design offered by WVNET. Moreover, 100% of those surveyed agreed that the tools and resources provided in the course were designed for universal access, and that they enabled students to meet the course outcomes.

WVNET developed the MOOC not only from a passionate interest in SDN and online learning, but also as a learning experience so that it may assist other WV educational institutions in creating MOOCs. Although the live course ended on July 14, 2013, students continued to enroll and complete the labs in a self-paced course without instructor facilitation. Enrollments in the self-paced version of the course increased by 45%; the course officially ended on December 31, 2013. Following the same pedagogy, WVNET plans to develop a MOOC on Gamification for launch in 2015.

About WVNET

WVNET is the West Virginia Network, which is a dynamic service organization providing telecommunications and computing services within West Virginia. WVNET was created in 1975 to provide central computing facilities and wide-area network communications linking its “central site” computing resources in Morgantown with the campus computing systems at most of the colleges and universities throughout the state. WVNET is transitioning to expand its impact by offering services to State government, K-12, public libraries and county government. As a centralized state resource, WVNET reacts to customer needs by providing efficient and cost-effective deployment of technology, services and support. For more information see: www.wvnet.edu.

The Front Range GigaPoP Expands the Bi-State Optical Network

After nearly 10 years with the original five core members, BiSON is expanding. The core members of The University Corporation for Atmospheric Research (UCAR), NOAA-Boulder, The University of Colorado, Colorado State University, and the University of Wyoming, will soon be joined by a new primary member, Colorado School of Mines (CSM) based in Golden, Colorado, and two secondary members, the State of Wyoming and the new University of Wyoming/Microsoft joint Dry Creek Data Plant (www.wired.com/wiredenterprise/2012/11/microsoft-data-plant/).

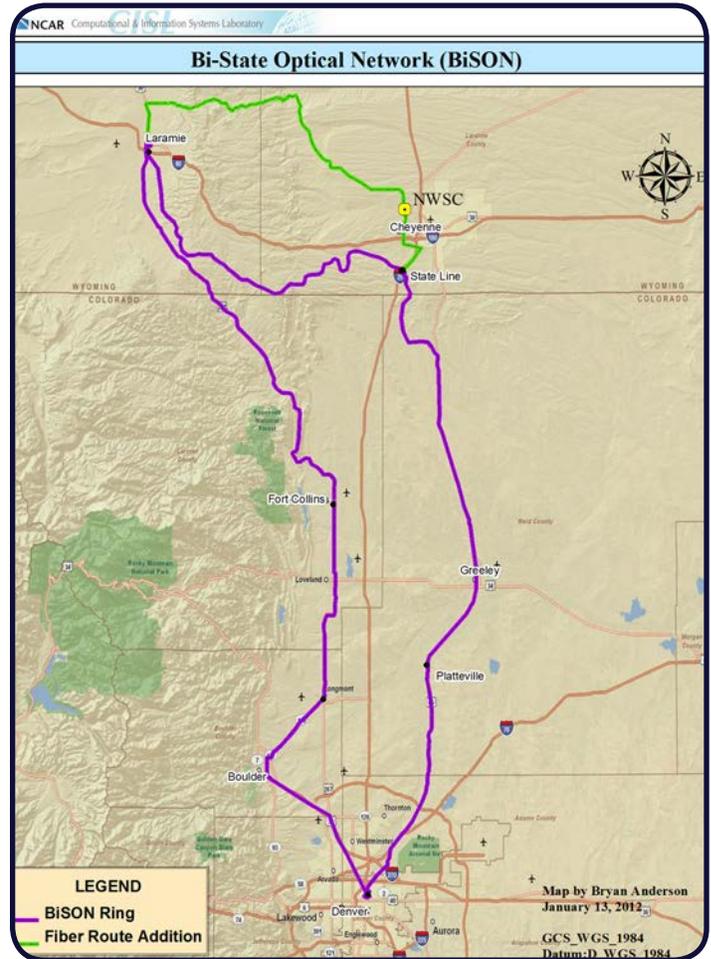
Increasing demand for dedicated high-bandwidth networking and the availability of Colorado Department of Transportation (CDOT) and vendor fiber are driving and enabling these efforts. CSM is the recipient of a National Science Foundation award that facilitated the purchase of a dedicated supercomputer for the energy and geological science research work that CSM leads. CSM and the National Center for Atmospheric Research (NCAR) reached an agreement to house the supercomputer at the NCAR Mesa Lab in Boulder, Colorado. BiSON will connect the researchers at CSM with the supercomputer at NCAR using a combination of BiSON and CDOT fiber. This spur will formally become part of BiSON and enable future connections to other research and education institutions in the area of Golden, Colorado such as the Department of Energy National Renewable Energy Lab (NREL) and possibly others in the future.

A similar requirement for high-bandwidth networking between the Dry Creek facility and the University of Wyoming researchers is driving the expansion of BiSON to meet this need with a combination of vendor services and BiSON fiber.

Increasing demand for high speed networking for the State of Wyoming and the nearly 400 K-12 schools it serves is motivating the State of Wyoming to become a BiSON user and a UCAR Point of Presence (UPoP) member. This expansion of BiSON will utilize vendor fiber as well as BiSON services.

These three new spurs have forced BiSON to rethink its membership, cost, and support model, which presents new opportunities for the members.

Increasing demand for high speed networking for the State of Wyoming and the nearly 400 K-12s it serves is motivating the State of Wyoming to become a BiSON user and a UCAR Point of Presence (UPoP) member.



About FRGP

The FRGP is a consortium of Universities, non-profit corporations, government agencies, and secondary members (such as the UCAR Point of Presence) behind primary FRGP members who cooperate as part of a Regional Optical Network (RON) in Colorado and Wyoming in order to share wide area networking services including the commodity Internet, Internet2, and peering connectivity. For more information see: www.ucar.org.

Merit Network and the Michigan Cyber Range: To Alphaville and Beyond

Following a successful launch in 2012, the Michigan Cyber Range hit the ground running in 2013. Leveraging one of the world's only cloud-based cybersecurity education platforms, Quilt member Merit formed a collaborative partnership with Mile2 to provide cyber security courseware and certifications through the Michigan Cyber Range. Mile2 is a recognized worldwide leader in providing vendor neutral professional certifications for the cyber security industry. Together, Merit and Mile2 provide accessible, world-class training to companies, students and cyber security professionals across the country. A full cyber security training curriculum is available for Merit Members and Non-Members nationally.



The Michigan Cyber Range offers certification courses across 14 cybersecurity disciplines recognized by the National Security Agency (NSA). Participants may attend in person or take courses live online. All online courses feature a live instructor. Online participants are able to ask questions and interact with the class just as they would if attending in person.

"Our goal in offering online participation is to push training to where it's needed," said Dr. Joe Adams, vice president of Research and Cyber Security at Merit Network. "Online courses enable us more flexibility and provide our students with improved access. Through online participation, the truly unique capabilities of the Michigan Cyber Range and its premier learning environment are available to students and professionals nationwide."

Town locations, such as the library, public school, city hall and power company, are created using virtual machines, each with varying security levels and vulnerabilities. Users learn to defend an interconnected network of systems with working examples of real world assets and threats.



The year 2013 also introduced Michigan Cyber Range users to the notional town of Alphaville, a virtual learning environment developed by the Michigan Cyber Range.

It includes typical locations and services common to a small town in the United States, but in Alphaville, these represent training areas. Town locations, such as the library, public school, city hall and power company, are created using virtual machines, each with varying security levels and vulnerabilities. Users learn to defend an interconnected network of systems with working examples of real world assets and threats. For instance, information gleaned at the public library can be used to exploit even more sensitive information at the police station.

For Adams, Alphaville embodies the Michigan Cyber Range's core principle of experiential learning:

"A typical cyber security course is made up of lectures, seminars and hands-on labs. The labs are often scripted to ensure students accomplish each learning objective. Learning on the Michigan Cyber Range takes that script away, while maintaining the learning objectives. It makes students go beyond a rote understanding of the content and apply what they've learned to analyze and evaluate the course material."

When an instructor uses Alphaville, they are provided their own customizable copy of the town and each of its training modules. Once the course or exercises are finished, Alphaville and all its components are reset and ready for another run.

To learn more about Alphaville:

www.merit.edu/services/securesandbox/alphaville

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 see: www.merit.edu.

UEN Broadband Empowers Live Tri-State Teleconference on Gettysburg Anniversary

The idea of equality and freedom is just as prevalent today as it was in 1863, when Abraham Lincoln delivered The Gettysburg Address. To help celebrate the 150th anniversary of the historic speech, the Utah Education Network (UEN) collaborated with community partners to form GettyReady.org. UEN's broadband network also made possible an unprecedented teleconference between high school students in several states and park rangers at the battlefield.

UEN leadership and expertise brought the project into fruition and expanded the broadband infrastructure that supports it. Thus far, the site has logged more than 33,000 visits from all 50 states and 53 nations.

Quilt member UEN is one of the organizing partners in GettyReady.org and produced the website which features text of Lincoln's address, learning resources and a showcase of Utahans reciting the Gettysburg address. When the website was released on September, Utah Governor Gary Herbert asked, "If you have already learned the Gettysburg address, congratulations and thank you. If not, I urge you to do so and then incorporate its message into your lives." Then on the actual anniversary of November 19, 2013 about 50 students from Salt Lake City's East High School participated in a teleconference with their peers on the east coast.

UEN's broadband network connects Utah public education and higher education throughout the state. In December UEN completed a three-year, \$13.4 million BTOP project extending 1 Gbps fiber to 62 elementary schools. The project also extended 100 Mbps connections to charter schools, public libraries and Head Start preschools. The Network now serves more than 800,000 students from playful preschoolers to grandparents in graduate school.

In 2013 UEN upgraded its backbone connections to 10 Gbps. This refresh included the installation of new equipment, a reconfiguration of many of the school connections and much more. Early in 2014 UEN will turn up a 100 Gbps connection to Internet2. With these changes the UEN network adds greater capacity and reliability, positioning the students of Utah with leading technology infrastructure to meet the expanding future needs of the education community.

Ray Timothy, UEN's executive director, says collaboration is key to this level of inclusion. "We're more than a broadband network. We're also a consortium of human collaborators who want the best for Utah students. In a sense, we're the table where diverse leaders from education, telecom providers and government meet to sustain an ongoing partnership providing world-class resources to learners and educators."

These resources allowed Cameron Jones of Salt Lake City's East High and his class to talk with Gettysburg, Pennsylvania park rangers and students in other states on the morning of the anniversary celebration. After students recited the Gettysburg

address in unison, Jones asked Park Ranger Caitlyn Kostic, "If Utah wasn't even a state back when the Civil War was going on, why is it important for us to study the Civil War?"

Kostic said Gettysburg address is "currently essential for the makeup of our country today and without studying the events of the American Civil War you cannot come to understand why your state was created."

She gripped the students' attention as she explained why the battlefield and national park are so important to her. "I realized this place is real. The men we talk about existed, they're not fiction, they're not made up characters."

The GettyReady project was conceived after three Utah leaders viewed previews of the new Ken Burns film "The Address". The documentary premieres on PBS this spring. "We want parents, we want families, we want entire communities, the statewide community, to memorize and live the principles in the Gettysburg Address," said Derek Marquis managing director of BYU Broadcasting and a founding member of the site along with executives from KUED-TV and UEN.

UEN leadership and expertise brought the project into fruition and expanded the broadband infrastructure that supports it. Thus far the site has logged more than 33,000 visits from all 50 states and 53 nations. More than a few of those visitors are discovering "it is altogether fitting and proper" to integrate the ideals of the Gettysburg Address into their studies and their lives.

About UEN

UEN connects all Utah school districts, schools, and higher education institutions to a robust network and quality educational resources. UEN is one of the nation's premier education networks. For more information see: www.uen.org.



Texas State University System Leverages LEARN

Authorized by the Texas Legislature in 1899, Texas State University opened its doors in 1903. From humble beginnings as a teacher's college set on 11 acres of Texas hill country along the San Marcos River, Texas State University has grown to become one of the largest universities in the State of Texas, sprawling 457 acres in San Marcos with an additional satellite campus in Round Rock that is home to a growing Health Professions program, including the newly constructed School of Nursing.

One of the challenges in providing information technologies on a campus with both historical longevity and explosive growth is maintaining a reliable communications infrastructure. Today's students rely on access to digital information not only for their studies, but also for entertainment and keeping connected with family and friends. As Texas State University has modernized and improved its communication network infrastructure, Quilt member, the Lonestar Education and Research Network (LEARN) has been a key resource and partner.

LEARN has helped Texas State University to provide more reliable access to commodity Internet and research networks, as well as, better disaster tolerance for inter-campus communications. Texas State's San Marcos campus currently connects to LEARN's statewide FrameNet transport network in San Antonio with the Round Rock campus connecting to LEARN in Dallas. This provides geographically diverse redundant links that help ensure connectivity even in the event of a fiber cut or other disaster. During normal operations, Texas State can route traffic across both links, improving network performance. The LEARN FrameNet network also serves as a backup transport path between Texas State's two campuses should the metro-ethernet link between San Marcos and Round Rock ever experience an outage.

Recently, Texas State sought to improve geographic diversity for commodity Internet providers. LEARN was able to provide a solution. As a member of the LEARN Dallas/Fort Worth collaboration, Texas State obtains commodity Internet through LEARN in Dallas. LEARN was able to begin providing commodity services from another Internet Service Provider, TeliaSonera, out of its Houston facility. This provides Texas State with the regional diversity it needs to guarantee availability of network services to its students, faculty and staff.

LEARN has helped Texas State University to provide more reliable access to commodity Internet and research networks, as well as, better disaster tolerance for inter-campus communications.



LEARN enables Texas State University students to connected to resources and peers around the world.

About LEARN

The Lonestar Education And Research Network (LEARN) is a consortium of 39 organizations throughout Texas that includes public and private institutions of higher education, community colleges, the National Weather Service, and K-12 public schools. The consortium, organized as a 501(c)(3), connects these organizations, and over 500 affiliate organizations, together with high-performance optical network services to support their research, education, healthcare and public service missions. LEARN is also a part of a national community of research optical networks, and provides Texas connectivity to the national and international research and education networks. For more information see: www.tx-learn.org.





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