A Research Network Grows in Pennsylvania

Thanks to a broadband stimulus grant, anchor institutions across Pennsylvania will be able to connect and collaborate using a statewide research and education network. Tight integration between network layers makes the network flexible and cost-efficient.

By Masha Zager ■ *Broadband Communities*

Not long ago, Pennsylvania was one of only a few states without a research and education network – a serious problem for its educational institutions in general and particularly for those in the state's 22 remote, underserved counties. As soon as the broadband stimulus program was announced, state educators saw an opportunity to remedy that lack. Seven large universities, along with a number of associations that represent educational, health care and research institutions, quickly formed a coalition they called the Keystone Initiative for Network Based Education and Research, or KINBER, and began planning a network.

In 2010, the National Telecommunications and Information Administration awarded KINBER $99.7 million – the sixth largest broadband stimulus grant – to build the 1,600-mile Pennsylvania Research and Education Network, or PennREN. PennREN will deliver competitively priced networking services to universities, colleges, K–12 schools, libraries, public media organizations, health care organizations and other anchor institutions.

Nearly 70 Pennsylvania institutions are slated to be connected directly to the fiber optic network with broadband speeds of between 10 Mbps and 10 Gbps; many more will be close enough to the network to connect to it through their last-mile providers. In fact, according to the NTIA, PennREN will be able to offer wholesale services to last-mile providers that will enhance broadband access for more than 2 million households, more than 200,000 businesses and nearly 1,700 additional anchor institutions.

The new Pennsylvania Research and Education Network will link 70 educational institutions, research centers, health care providers and other institutions across the state – and allow many more to connect through last-mile providers.

Jeff Reel, executive director of KINBER, explains, "We've had active conversations with a number of last-mile providers. … The ones we've had the opportunity to sit down and talk with are interested and willing to engage with us as an opportunity to provide additional capabilities to the people they already serve. If they have a customer that is a library or health care provider, now [that institution] can tie into our statewide resource to meet other members of the same group." In addition, Reel says, KINBER will be able to provide backhaul for services such as mobile data that might not have been economically possible to deliver in those areas before.

CROSS-SECTOR COLLABORATION

In addition to providing high-speed connectivity to the Internet and to Internet2 (the national research and education network), PennREN will help member institutions work collaboratively across sectors – for example, by allowing a hospital to participate in a university research study or by giving high school students a chance to take college courses or use specialized library resources.

Bruce Taggart, vice provost for library and technology services at Lehigh University and one of the project founders, commented at the time the grant was awarded, "PennREN is not a 'Band-Aid project.' It will have a lasting impact on

About the Author

Masha Zager is the editor of ***Broadband Communities****. You can reach her at masha @bbcmag.com.*

generations of Pennsylvanians by providing a statewide broadband technology infrastructure that allows Pennsylvania to grow and prosper in the 21st century." Taggart said that Lehigh, which is a core node in the new network, will benefit in the fields of data-intensive research, high-performance computing, videoconferencing, telemedicine, collaboration with international students and faculty and real-time access to remote resources.

According to Reel, "The network will provide the foundation for collaboration among health care, education, libraries, public schools, municipalities and public safety organizations. All those groups feel they do not have the broadband capabilities they need to perform their missions. All the entities are anxiously awaiting the increased capabilities their institutions will be able to perfom."

Health care providers will be able to collaborate more easily with university researchers, and high school students will be able to take college courses and access specialized resources.

TECHNOLOGY CHOICES

The contract for engineering, design and construction of PennREN's outside plant was awarded to Sunesys and Blair Park Services, both subsidiaries of Quanta Services. Sunesys provided $24 million in matching funds for the project, and in return it will receive right-of-way access on the PennREN network.

GlobalNOC, the Global Research Network Operations Center at Indiana University, was chosen to provide network operations services, help desk services and engineering support for PennREN. GlobalNOC provides these services for I-Light, Indiana's research and education network, and a number of similar networks and has developed network management software specifically for research and education networks.

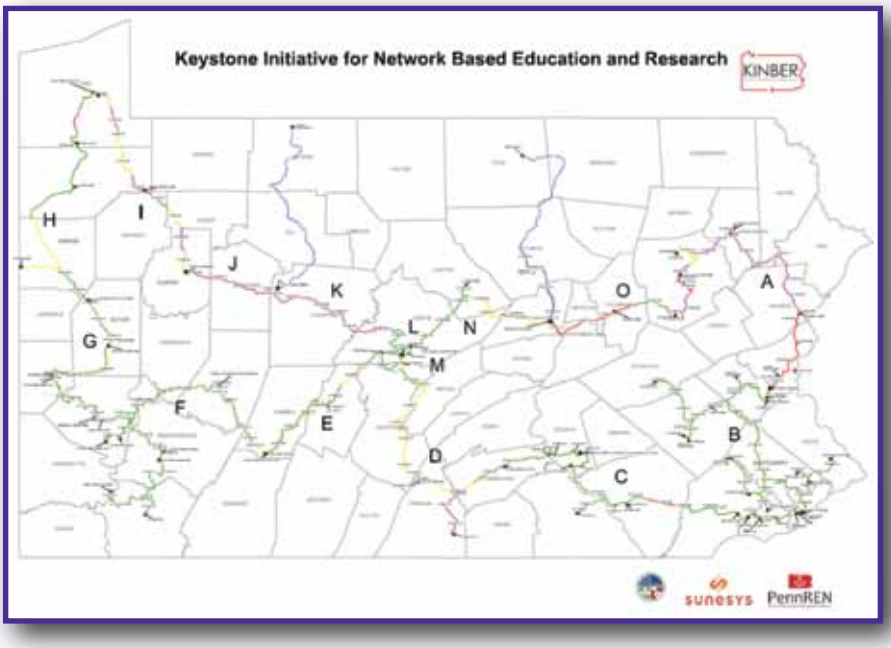
KINBER made a strategic technology choice in awarding a contract to TorreyPoint Group, a consultant and integrator, to engineer and install network equipment from Juniper Networks and ADVA Optical Networking. TorreyPoint proposed, as a turnkey solution, an integrated packet optical network. This approach uses Generalized Multi-Protocol Label Switching (GMPLS) technology to integrate wave, metro Ethernet and traditional Layer 3 services into a single, cohesive system. Juniper provides the routing and switching equipment, along with its JUNOS network operating system; ADVA Optical Networking provides its FSP 3000 optical transmission equipment. Thirteen sites are designated as add/drop nodes, and there are an additional 56 access nodes at universities, hospitals and research centers.

One reason the TorreyPoint proposal appealed to KINBER is that Juniper and ADVA, which have a strategic partnership, had already integrated their equipment control planes so thoroughly that Juniper routers can not only talk to the ADVA FSP 3000s but also control them. JUNOS can actually reconfigure the transport network as needed to best route packets, based on information acquired from the ADVA transport gear across a GMPLS UNI interface.

Jim Theodoras, senior director of technical marketing at ADVA Optical Networking, explains that ADVA decided to better integrate its control plane with routers precisely because nontraditional network operators such as KINBER are becoming more prevalent.

"Most of these networks grow out of campus LANs run by an IT department," he says, explaining that IT departments tend to be expert in using routers but not necessarily in architecting and maintaining optical transport networks, which can involve managing wavelengths, link budgets, dispersion compensation, amplifier noise and configuration rules. "Fortune 100 companies, research and education institutions, health care providers – they're all forming co-ops and coalitions and tying their campuses together with fiber. But now they can't just plug routers together; they have to deal with transport, and that's a new skill set.

"The options are either to hand everything over to a traditional service provider, or to 'do it yourself' with the help of integrators, consultants and NOC services, and many are choosing the latter. So we make the transport layer act like a simple extension of the



TorreyPoint's integrated solution automates provisioning of the optical transport equipment. New circuits are automatically set up and torn down in real time to meet changes in demand.

familiar routing management system. Network engineers provision a path in the router domain between two IP addresses, just as if the two routers were sitting next to one another in the same room, and the transport gear automatically gets provisioned to set up a link between the routers."

A key factor in KINBER's decision, according to Theodoras, was the ability of the Juniper routers to control the transport layer. "They needed a flexible transport network because there aren't enough resources to let everyone have dedicated bandwidth everywhere, all the time. They had to have a dynamic reservation system so institutions on the network could reserve the bandwidth they needed and pay for only what they need when they need it. When they saw that the transport solution ran itself and they would just have to manage the routers, that was a huge thing for them.

"Their people would be more efficient, and there were power savings, too. As the routers see changes in bandwidth demand or requests, the ROADMs [reconfigurable optical add/drop multiplexers, or optical transport devices] reconfigure themselves in real time to set up and tear down new circuits in seconds rather than weeks or months. Hence, the network can get by with fewer fiber pairs on long-haul routes."

Reel confirms, "We needed hardware that spanned the gamut from optical hardware to the Ethernet handoff, and we looked for an integrated solution." The ADVA/Juniper solution, which he calls a "holistic, integrated solution," was the easiest to maintain and operate, was based on mature and established technology, and will support the network into the foreseeable future. "Having a GMPLS control plane allows us to operate and provision the network easily as we grow," he says, adding that ADVA's technology roadmap will allow PennREN to deploy parts of the network at 100 Gbps.

KINBER is on track to meet its 2013 deadline for completion of PennREN, with large portions of the network already completed and the first sections having gone live in August. "Broadband is a critical infrastructure that's lacking in Pennsylvania, and we're excited to be able to provide that," Reel says. ❖