

Regional and state networks play a critical role in the future of the national advanced research and education network infrastructure. Increasingly, R&E networks in the United States provide not just critical networking services, but their offerings and services require complex business and operations models. Many state and regional networks have moved to facilities-based models and continue to evolve from layer 3 service providers to offering more comprehensive network services at multiple layers. From governance, membership, financial and funding perspective, there's hardly any homogeneity in the current models used and implemented for state and regional networks. Below are a few pointers to some initial points for further study.

During the Internet2 Member meeting, we had a session that highlighted a recent joint study on R&E network models (specifically focused on regional and state aggregators that participate on the Quilt www.thequilt.net) as well as two case studies within Ohio (OSCNNet) and Michigan (Merit Network Inc.)

Session abstract and link:

<http://events.internet2.edu/2007/fall-mm/sessionDetails.cfm?session=3416&event=273>

Stream: <http://winmedia.internet2.edu/fmm07-vod/fmm07-6.wmv>

Presentations:

<http://events.internet2.edu/2007/fall-mm/sessionDetails.cfm?session=3416&event=273>

Quilt/MIDnet compilation of case studies and business models of regional and state optical networks

In the spring of 2007, The Quilt and MIDnet, Inc, began a collaborative project to document the business models of research and education optical networks. Specifically, the two organizations were interested in collecting information on organizational structure, governance, management and operations, initial funding sources, cost recovery methodologies, services and service pricing strategies, outreach, and lessons learned and future directions.

Summary of findings to date

<http://www.thequilt.net/casestudy-overview-20070717.pdf>

Summary presentation:

<http://www.internet2.edu/presentations/fall07/20071010-casestudies-farnham.htm>

Highlights (from personal notes taken during presentations made at both Quilt meeting and at San Diego meeting)

- Not one entity or state/RON is alike. Mission statements are unique, but they all have similar elements:
 - Supporting research and education
 - Enabling research and education
 - Providing advanced network technologies and applications
- Commonalities in the following program areas:
 - Outreach and community building
 - Lessons learned
 - Future directions
- Organizationally, of the 13 entities surveyed:
 - Non-profit or 501(c)(3)s make up 53%
 - 23% are organized as a project of a university system Board

- 15% are consortiums under a non-profit
- One is university based
- Of the 13 entities, 12 run networks and provide:
 - Majority offer services beyond Layer 1
 - Majority outsource to a member organization some or all of NOC services
 - Half outsource remote hands to a member organization
 - Depending on network design and geography, staffing decisions (for network operations) are made.
- Re infrastructure, Owned vs. Leased Network Assets, of the 13:
 - All have IRU's on dark fiber
 - Majority own rather than lease the equipment
- Funding sources: mainly state or members
 - State funded
 - Administrative costs - membership fee or state allocation
 - Operations and services costs - bundled service pricing
 - Opt-in services priced at cost plus margin
 - Member funded
 - Administrative costs - membership fee or markup on service
 - Operations and services costs - tiered pricing, shared equally or cost plus standard fee-for-service
 - Funding for capital investment in fiber for 13 surveyed entities:
 - in 67% of organizations studied, founding members provided initial source of funding to buy dark fiber
 - o In one case, founding member acquired all dark fiber on behalf of the organization. When the organization received special program funding from the state, the organization bought the fiber from the founding members
 - o Rest of organizations, founding members provided funding for the organization to create a facilities-based network
 - 3 organizations received special appropriations from the governor or state legislature. The appropriations included:
 - o One time funding from bonds
 - o One time appropriation paid over a number of years
 - o Annual appropriation paid for several years

Highlights (have added some comments from my end) - captures the 13 entities surveyed in the aforementioned study done by the Quilt and MidNet:

- 3RoX (Pennsylvania) - <http://www.3rox.net/>
combination between a network/aggregator and exchange facility to serve some universities in PA, including CMU, Penn State, Univ Pittsburgh, amongst others and West Virginia Internet2 members. Some K-12 served). Model is based on cost sharing – with possible more funding coming in via universities.
- FLR (Florida) -- <http://www.flrnet.org/>
Operates as a LLC; oversight is centralized and invested in a Board of Directors made up of equity members which are considered accredited investors and owners of the FLR, LLC and are 501(c) (3) tax exempt entities or public corporations that are either private, non-profit educational institutions or Florida Public universities with an interest in participating in the NLR. Currently, there are ten Equity

Members (see www.flrnet.org).

FLR LLC owns a 20 year IRU on 1,540 miles of fiber plus the equipment. FLR has been trying to get the state involved and/or to provide funding. No success so far.

- FRGP (Colorado) -- <http://www.frgp.net/>
provides networking services to most research universities, agencies based out in Colorado like NOAA and others, including Wyoming. Project is actually based out of UCAR – University Cooperation for Atmospheric Research. May own some fiber from Denver metro and other areas. Funding is via member paying for services at a la carte type of service (purely IP and Layer 2 services)
- LEARN (Texas) -- <http://www.tx-learn.org/>
established as a 501c3 non-profit university membership association with roughly 31 members. Each contributes \$20K/per year to support organization. In 2004, Governor Perry approved close to 10M in funding to build a Texas-wide infrastructure to support connectivity of higher education and to enable sharing of resources via grid computing.
Most operations and management of infrastructure is done via staff from board organizations – several points of aggregation (PoPs) are located around the state – with management from a few universities that play role of aggregator within the LEARN infrastructure.
- LONI (Louisiana) -- <http://www.loni.org/>
provides networking services to most research universities in Louisiana and connectivity to national infrastructure to MS research universities. Provide IP and Layer 2 services. Governor Blanco provided incentive for creating LONI via 40 Million pledge over ten years for the support and development of LONI. LONI's model relies on major research universities sharing cost of acquiring fiber, management and operations of infrastructure. Cost sharing model amongst LONI members.
- Merit Network (Michigan) -- <http://www.merit.org/>
See presentation at
<http://www.internet2.edu/presentations/fall07/20071010-REN-Moran.htm>
Merit runs and operates the network that serves R&E in Michigan. Operated as a 501c3 corporation governed by the state universities in Michigan; statewide backbone IP network that is increasingly built on Merit-owned dark fiber rather than leased circuits.
Working in partnership approach with different entities to extend this model to the last –mile. Has synergized and enabled collaborations for organizations within a geographic community to aggregate to aggregate demand and collaborate on network builds (to reduce cost.
Helped/working to develop financial approaches to sharing expenses and amortizing construction costs (laterals and last mile)
Initial funding for fiber came via industrial revenue bond issue and low-interest loan. Operate on a for fee basis for services
- NCREN (North Carolina) -- <http://www.mcnc.org/index.cfm?fuseaction=page&filename=network.html>
Statewide IP data/video network to connect 16 member institutions and medical schools in North Carolina (UNC system, Wake Forest University/School of Medicine, and Duke University/School of Medicine.) also provides connectivity to 40+ private colleges and universities within North Carolina, and to the North Carolina state government network (ITS). NCREN is operated by MCNC, a private nonprofit organization established in 1980 to support technology-driven economic development for North Carolina.
- NEREN (portions of northeast: Connecticut, Massachusetts, Rhode Island, and partnership with New York – others may include Vermont?) -- <http://www.merit.org/>
Structured as corporation with different classes of members (Connecticut Education Network, Northern Crossroads, NYSERNet, OSHEAN, and Univ Mass-Amherst). Collectively pitched in to buy fiber (owned by the corporation) and some of it was lit and paid for by Corporation.

- NTC (Montana and other Northern Tier states) -- <http://www.ntnc.org/>
Loose but increasingly strong group interested in networking infrastructure in the northwest area of the US. Have member paying dues. Entities which participate include many Internet2 members and other educational and governmental organizations in Idaho, Iowa, Minnesota, Montana, North Dakota, South Dakota, Washington, and Wisconsin.
Significant efforts now underway to get fiber IRU to connect all states from West of US (via Seattle) to Mid-US (via Chicago) via Northern Tier route. Each state has had different founding sources or potential issues facing with legislatures for models. Most of the efforts have resulted from significant lobbying by university representatives.

- NYSERNet (New York) – <http://www.nysernet.org>
private not-for-profit corporation created to foster science and education in New York State (501c3 established in 1986) Spun several for profit efforts which were later sold.

NYSERNet members include New York State's leading universities, colleges, museums, healthcare facilities, primary and secondary schools, and research institutions. NYSERNet's Board of Directors is composed of CIO's and other senior personnel drawn from and representing New York's leading research universities and institutions.

Created New York City Metropolitan Fiber Project, which has greatly enhanced facility-based (via dark fiber) for connecting R&E in Manhattan and then creating the international exchange interconnection point called Manhattan Landing.

In 2004, NYSERNet acquired a pair of dark fibers extending 516 miles from Buffalo to New York City.

Financial model is currently based on members paying for transport services based on a tier-model. For dark fiber and colo, services are based on a cost-recovery basis. Initial funding came from cash reserves and endowment.

- OneNet (Oklahoma) – <http://www.onenet.net/>
Created in 1992 when statewide capital bond issue that provided \$14 million for the implementation of a statewide telecommunications network. In late 1995, the State Regents approved the OneNet business plan and began implementation in 1996. After that, OneNet put forth several hubs and extended infrastructure throughout the state. Early on bought significant amount of fiber throughout the country
- OSCNet (Ohio) -- <http://www.osc.edu/oscnet/>
Runs and operates the network that serves R&E in Ohio.
OSCnet is a dedicated high-speed fiber-optic network that serves K-12, colleges and universities, hospitals and public broadcasting.
More than 1,600 miles of fiber create the network backbone, making it the most advanced, statewide research and education network in the nation.
Governor of Ohio recently issued an executive order requiring all state agencies to use the OSCnet backbone – see <http://www.osc.edu/networking/broadband/index.shtml>
 - In light of this, a governance structure had to be worked out with the state to both ensure that the needs and requirements for R&E in the state were met but also, those of the state agencies. See slides from presentation made at Internet2 member meeting.
 - OSCnet is funded by the Board of Regents. Financial model is based on selling services on its network plus what Board of Regents provides for capital and operations.
- SoX/SLR (Georgia) -- www.sox.net
A project of Georgia Tech – in collaboration with different R&E entities. Provides access to national infrastructure via facilities located in Atlanta (mainly IP and Layer 2 services plus commodity). Sox is

an aggregation point with facilities in Atlanta. It is operated as cooperative although Sox was incorporated as a 501c3 via Georgia Tech. Fees are based on shared, cost recovery model. SLR is a related project of GA Tech along with others– they own some metro fiber into Atlanta but it's not a RON like NYSErnet or OSCnet are.

Of note or worth checking out

Regional Optical Network Map (see http://paintsquirrel.ucs.indiana.edu/fiber_map.pdf/archive/fiber_map_current.pdf)

A map produced and maintained by the [Advanced Network Management Laboratory](#), one of the [Pervasive Technology Labs](#) at [Indiana University](#). Map shows fiber-optic networks owned and/or run by state and regional educational and research organizations within the US.

The map shows the extent of fiber-optic networks across the country, with the aim of showing the extent of the connectivity, encouraging interconnectivity and collaborative efforts, and aiding in planning, resource allocation and policy determination efforts on the local, state, regional and national scale

Recommend a conversation/more information on the following entities:

- GPN – Great Plains Network
- CENIC – California
- CIC-OmniPoP
- Emerging KY RON/effort to bring state together through single infrastructure

For more information, contact:

Ana Preston, Assist. Director, State and Regional Networks, Internet2

apreston@internet2.edu

Cell +865-368-3151, office +865-974-2923