

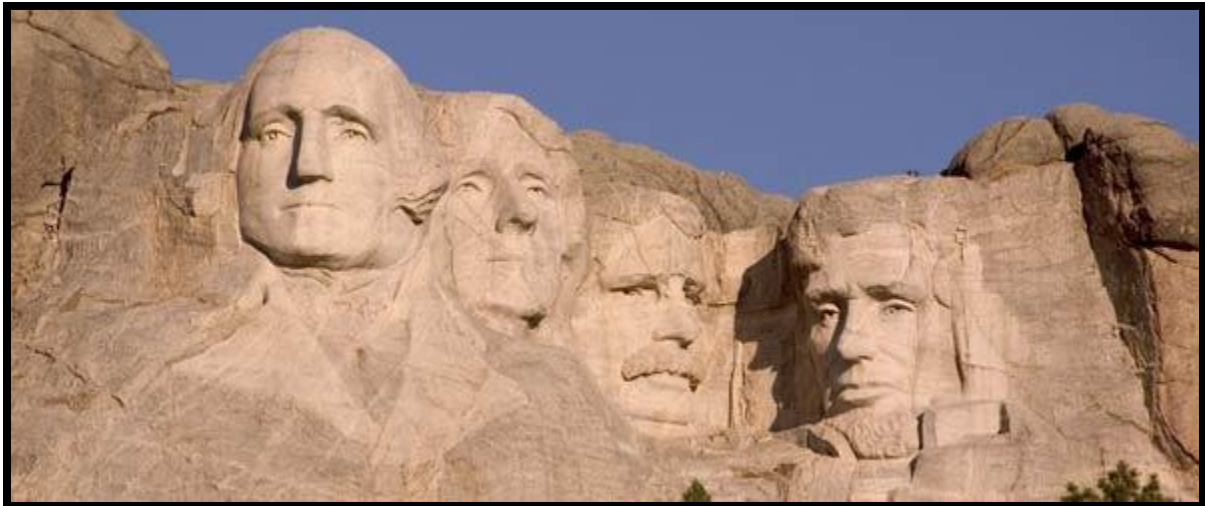


*Research, Education & Economic Development Network
(REED)*

2009 NASCIO Recognition Awards

Category

Information Communications Technology Innovations



Executive Summary

The research community in South Dakota (SD) and across the northern portion of the United States had a legitimate complaint about their lack of high-speed broadband network facilities. Efforts to transform SD's Public Higher Education System towards an emphasis in research, as well as efforts to further develop SD's private sector footprint, were shunned by this absence of necessary connectivity. To respond to the current and future needs of research, education and business in SD, the Research, Education and Economic Development (REED) Network was built.

A tremendous step forward, the REED Network provides very high-speed next-generation networking functionality to SD's research and education community. In a frontier state where previous research connections were as low as 5Mbps, the REED Network delivers multiple 10,000Mbps connections to every higher education campus location through a proven, scalable architecture without being tied to a particular networking technology. The REED Network, by way of its abundant capacity, provides opportunities for previously unseen networking speeds, data transfer rates, knowledge sharing, and collaboration. This is achieved by way of the institutions' incoming network speeds being greater than the out-bound network speed.

The REED is the result of a combination of an effective public – private partnership that overcame many hurdles, the willingness to break the mold of traditional research networking design, and the ability to champion a previously unseen open optical networking architecture. Researchers and the business community in SD now enjoy the benefits of a next-generation high-speed network, equal or greater in performance than nearly any other research network in the United States. Yet the REED was built for a fraction of the price of similar capacity networks, and fully operational in mere months, far ahead of our consortium partners. SD's Bureau of Information and Telecommunications (BIT) worked with Governor Rounds and the SD Board of Regents to build a one-of-a-kind network to provide advanced solutions and benefits for the education and research communities. Additionally those same broadband benefits are extended towards the business community. As businesses find themselves in need of the same copious capacity, or somebody eyes the Mount Rushmore state as a potential home for their business, SD's investment and open optical design pioneered in the REED Network allows any private sector party to gain access to the same capacities, and opportunities, enjoyed by our research community.

Problem Description

In 2003 there were no national research networks spanning the northern tier of the United States. Connectivity to research networks at nationally-acceptable speeds was not available. To compete for 21st century research activity, the research community had to have leading edge connectivity to accelerate collaboration and transmission of data.

Historically, SD universities utilized an asynchronous transfer mode-based (ATM) wide area network using DS3 and OC3 technology. Within these ATM circuits the dedicated research connections ranged in pedestrian-like speeds from 5Mbps to 15Mbps. A single institution had a 1Gbps dedicated research circuit. The speeds of these research connections were hampering the grant application and researcher recruiting activities of these institutions and that was a contributing factor to the research communities' requests for a 10Gbps network.

Further complicating the problem were the efforts of converting an abandoned gold mine into a world-class deep underground research center. The National Science Foundation (NSF) was hesitant to commit significant grant investments into a state with research facilities limited in part by the lack of an adequate network.

Problem summarization

- No high-speed research out-of-state connections
- Limited research connections in-state
- Missed grant opportunities
- Research challenges based on inadequate networking facilities

Barriers, Challenges & Opportunities

There were eight major areas, each offering initial barriers which turned into challenges and finally opportunities.

1. No high-speed connectivity, particularly in the research facilities.
2. Schools and institutions were missing grant opportunities.
3. Challenge of conducting research with inadequate networking facilities.
4. Could a single workable and acceptable solution be found?
5. Intense political pressure from those who wanted to "do their own thing."
6. Who would control a new high-speed network?
7. Dark fiber vs dim fiber argument.
8. Broadband technology investment: public vs private monies.

In addition to the eight areas there was also a consultant recommendation for a dark fiber solution. Historically, state government has utilized the "anchor tenant" approach of building telecommunications services across the state. The dark fiber recommendation raised a number of questions regarding costs, management, and philosophy.

Solution

To find a solution to the multi-state problems a group was formed in 2003 to study broadband connectivity, particularly as that technology applied to research and education. The consortium came from nine northern plains states, who represented organizations ranging from State governments to university personnel in research groups and other areas. The group, named the Northern Tier Network Consortium, had, as one of its main goals, finding opportunities to expand broadband telecommunications in not only the northern plains but throughout the northwestern United States. After the initial meetings a telecommunications consultant was hired to study and make recommendations regarding connectivity for each state. In November 2006, the consultant's report was received and recommended a university-owned dark fiber infrastructure.

SD is an original member of the Consortium and the following provides information on how we proceeded from those early meetings to find our own solution to solving the high-speed networking problem in SD. The information gathered supported the installation of a new network. In the winter of 2007 a team composed of members from the Governor's technology organization (BIT) and the SD Board of Regents was formed to write a Request for Information (RFI).

The RFI was released to the telecommunications community and there were five responses. Ultimately the team narrowed the proposals to two viable proposals. One was a dark fiber solution, (dark fiber being the leasing of individual fiber optic strands from a network provider with the State responsible for the equipment and electronics to make those strands work), and the other proposal was a dim fiber solution (dim fiber is provided by a telecommunications company, who also provides all the equipment and electronics to operate the fiber communications. Dim fiber differs from dark fiber in that the telecommunications company owns the electronics necessary to operate the network, yet the customer has access to a portion of the resulting capacity.)

All of the RFI responses showed that no existing infrastructure was in place to provide 10Gbps services and any services at that speed would need to be built. Further complicating the responses was the question of who would manage the network. Would the network be carrier managed, Regental System managed or BIT managed? The cost proposals showed that the 20 year amortized costs were similar. The dark fiber was approximately 25% higher and the factors of ongoing equipment and maintenance were important considerations. See Table 1 for a summary of the proposals.

Table 1: Solution Comparison

Dim Fiber Proposal	Dark Fiber Proposal
Shared network infrastructure between public & private sectors	Private network only for Higher Education
25% Less Expensive	
5 year agreement	20 year agreement
Expand as needed – immediate capacity of (5) 10Gbps waves	Purchase “unlimited” capacity up front
Only “dim fiber” research solution in the country	All research networks are “dark fiber”
Carrier owns equipment	State owns equipment
Redundancy potential	No redundancy options
Managed Service Offering	Self-management
Carrier Expertise	No experience
Implement in 6 months	Implement in 6 – 18 months

The dim fiber option was chosen as the solution. The primary factor driving this choice was the ability to go beyond research and education and provide broad economic benefits for the entire state. A dark solution would have placed virtually all of the network capacity in an “unused” state for many years yet this approach is acceptable to many institutions. Research networks across the country ubiquitously endorse dark fiber networks. Yet, that philosophy is not efficient and does not promote wise investment of taxpayer funds. The preference in SD is to pay for capacity as usage and demand is created.

The dark fiber solution placed the success of this broadband investment completely within the research sector and past experience made that a risk not palatable. Instead, diversifying the potential across research, education and the private sector fields presented far less risk. The resulting infrastructure would provide economic development opportunities for all of SD plus encourage a partnership between state government, higher education and the private sector. The capacity not dedicated to the research community is now available for anybody else to tap into. (NASCIO 2009 CIO Strategy Priority #2).

The RFI led to contract negotiations and an agreement with a vendor was reached in January 2008. An illustration of how well “partnerships” work in SD, the vendor started the planning and engineering work immediately even though the contract wasn’t signed until July 2008, a mere two weeks before the first location was installed on the network. A tremendous amount of planning, construction and field work was completed on a trust and a handshake agreement.

August 2008 through November 2008 found on-site migrations of 9 institutions were completed. Each site was completed on schedule and at or under projected costs.

Solution summary

- Leading edge network available for researchers – no network constraints
- Anchor tenant philosophy retained – private and public sector clientele
- 10Gbps per wave network / 50Gbps capacity per location immediately
- Multiple 10Gbps out-of-state connections
- Implementation completed on schedule, under budget

Significance to the improvement of Government

The obvious significant improvement is the increase in bandwidth. The per campus gains are astronomical. The smallest bandwidth gain achieved is 5,000%. The largest increases realized are 1,000,000%! Network speeds of this nature are becoming the norm for many advanced research grant applications. The REED enables researchers across the state to pursue grants with that requirement. Furthermore, it is an additional tool in the recruitment of researchers.

An important result of the solution was the reversal of the normal networking dilemma. The wide area network is now faster than the local area or campus backbone network. This allows for virtually any applications to be implemented (voice, video and data-wise). (NASCIO CIO Technology Priority #4). This presents tremendous opportunities to consolidate existing university de-centralized services. The age-old argument of “not enough bandwidth” is now a moot point. The REED network bandwidth and mesh design between campuses allows faster communications between sites than within a campus! (NASCIO 2009 CIO Strategy Priority #1).

State government in addition to the Regental community is pursuing disaster recovery options within the state. Sharing of data center resources and building continuity of operations plans can occur in-state for all institutions.

Significance Summary

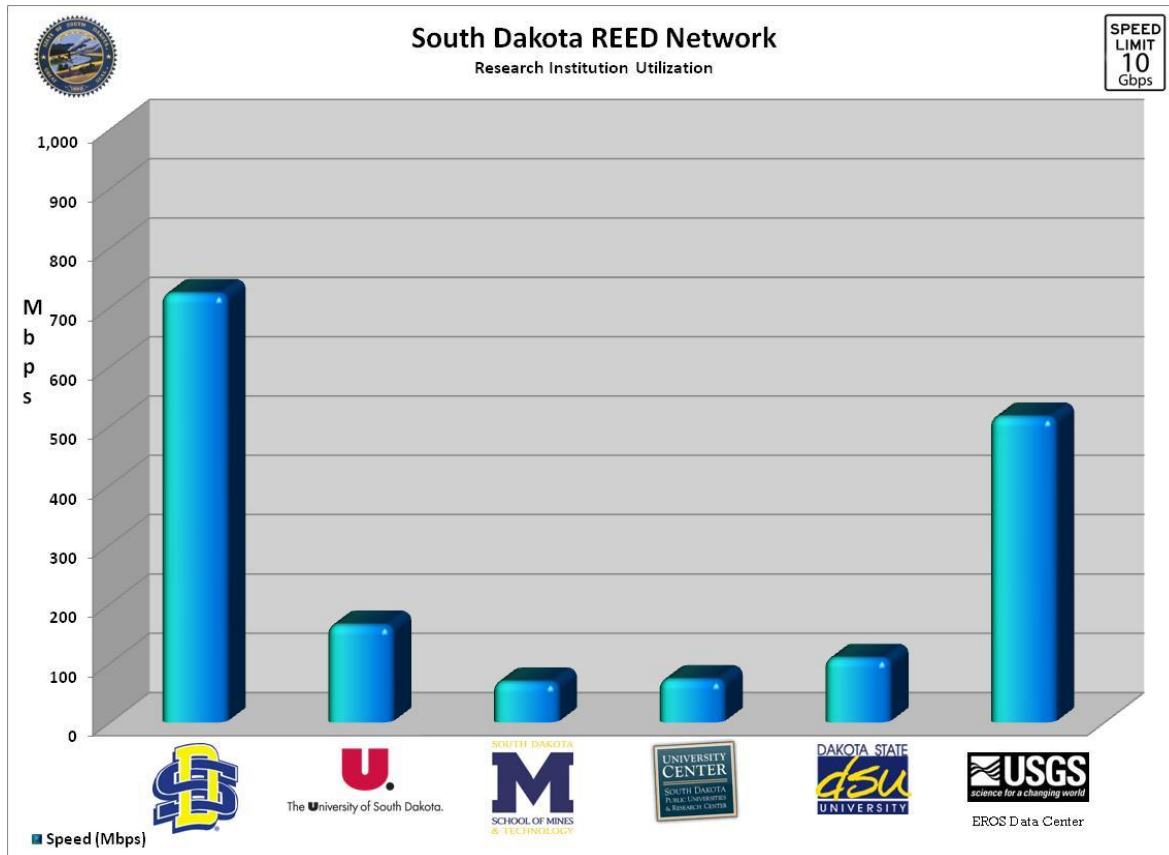
- Today and near future, no bandwidth constraints whatsoever
- Grant opportunities increase and recruiting actions profit
- Paradigm shift in networking – any application can be supported
- Disaster Recovery / Continuity of Operations Plans can be improved

Benefits of the Project

Budget constraints prevented general funding of the project and thus an \$8M one-time grant paid for the network installation. The state added an additional \$800K to an existing \$1.4M appropriation to fund the recurring the costs. The network previously funded was consolidated into the new network achieving greater efficiencies.

The initiative and resultant opportunities and partnerships are a cornerstone to the technology aspect of the Governor’s 2010 Economic Development Initiative. This was further emphasized when leaders from the state’s medical, banking and commerce industries testified in front of the Legislature in support of the final solution. The immediate REED contribution to the 2010 initiative was the NSF naming Homestake the site of the prestigious Deep Underground Science and Engineering Laboratory (DUSEL). This is a multi-million dollar economic impact to the state.

Neither network response time nor capacity is a bottleneck to the research and education community. Each location is actively professionally managed and monitored from a performance perspective 7x24x365. Here is a summary usage graph showing peak usage on a particular day.



A custom-built web application was developed for SD as the primary tool to manage government network and host resources. This tool allows us to easily identify up / down status along with a deep toolset of utilization views. In addition, this application allows key decision makers to measure and monitor their investment through easy-to-interpret graphs and charts. It adds a very granular layer of accountability to the investment that at times is often difficult to achieve with government projects.

Benefits Summary

- One-time non-government funds for start-up costs
- Sustainable through nominal increase in recurring costs
- DUSEL site at Homestake
- Statewide public and private sector impact on economic development opportunities
- Consolidation and efficiency opportunities for all of the campuses
- Professional, granular network management
- Accountability through objective measurement