NORTHERN TIER NETWORK
NORTH DAKOTA

North Dakota State University, University of North Dakota and North Dakota Information Technology Department
The Northern Tier Network—North Dakota (NTN–ND) is a joint network effort between the State Information Technology Department (ITD), North Dakota State University (NDSU) and the University of North Dakota (UND) to connect North Dakota to the nation’s research and education network. This high-speed backbone network depends upon North Dakota’s state government and education network (STAGEnet) for institutional connectivity and is operated through contracts with private telecommunications companies such as AT&T and Midcontinent Communications and higher education service providers such as Broadband Optical Research, Education and Sciences Network (BOREAS). NTN–ND also is part of a larger, regional effort to provide high-speed network connectivity to research universities. This group, the Northern Tier Network Consortium (NTNC), consists of 12 member states between Michigan and Washington, and also includes Alaska. As indicated in Figure 1, these state networks interoperate to form a larger whole, which serves to function as the governing body for the Northern Tier Network. As built, NTN–ND has a raw capacity of 10 circuits capable of 10 gigabits per second (10 billion bits per second) each. In comparison, advertised residential broadband is typically around 12-50 megabits per second (12-50 million bits per second) with the fastest available advertised speed being approximately 200 megabits per second (200 million bits per second). The high capacity of NTN–ND is used to facilitate collaborations in research, including access to shared computing resources, access and transfer of large data sets and use of high-performance networking applications for shared, real-time access to remote instruments across the country and around the world. This includes not only institutions of higher education, but also federal research labs such as Los Alamos National Lab and Pacific Northwest National Lab. Transport of this data takes place primarily over Internet2 (www.internet2.edu), the member-owned research and education network founded by the nation’s leading higher education institutions. NTN–ND enables North Dakota’s institutions of higher education to connect to this national resource.

Figure 1 Full Northern Tier Network Consortium path spanning from Chicago to Seattle, including spurs to partner regional networks. NTN-ND is responsible for operations and maintenance of the portion of the NTNC segment that spans North Dakota, including end points in Minneapolis and Glendive, Montana.
NORTHERN TIER NETWORK CONSORTIUM

The NTNC seeks to develop and sustain advanced networking capabilities and shared cyber infrastructure facilities in order to support the educational, research and economic vitality of the Northern Tier region. Primary goals of the NTNC include providing a premier research network that connects the Northern Tier states, from current endpoints in Chicago and Seattle to ensure that every Internet2 member in the Northern Tier has the ability to establish an appropriate high speed connection to a national or international aggregation point; maximizing network peering and interconnection opportunities between Northern Tier networks and other research networks and networking consortia; providing a network which can serve as a foundation for regional economic development, as well as academic and educational development; leveraging intellectual, political and financial resources across the region to expand relationships with state and national leaders, attract greater federal interest, maximize opportunities for grant and contract support and create greater leverage with vendors; and enhancing national security and network redundancy by establishing one or more interconnection points between NTNC and Canadian national networks.

REGIONAL PARTNERS

Institutions and individuals engaged in the management of NTN-ND represent the North Dakota segment by meeting and communicating regularly with partners at institutions and research and education networks at the national level. These include the NTNC and several regional partners such as the BOREAS, the Great Plains Network (GPN), Michigan's research and education network (Merit), the Northern Lights Gigapop (NLGP), the Pacific Northwest Gigapop (PNWGP) and the University of Wisconsin-Madison. All regional partners are part of the national research and education network, Internet2.

INTERNET2

In addition to more than 440 member institutions, including leading universities, corporations, government research agencies and not-for-profit networking organizations, the broader Internet2 community includes over 93,000 institutions across the U.S. and represents international networking partners in more than 100 countries. Thought leaders from the domains of science and academic research, arts and humanities and health sciences, as well as, advanced network researchers and developers join forces with Internet2's core staff to offer unparalleled possibilities for exploration and innovation.

www.internet2.edu/media/medialibrary/2014/03/17/AboutInternet2.pdf
Figure 2. National Research and Education (R&E) network backbone and spurs of Internet2, indicating connections to regional R&E connectors and networks.
NTN-ND PARTNERS AND RESPONSIBILITIES

At the state level, the NTN-ND is the segment of consortia-shared cyber infrastructure that spans across North Dakota and is part of the larger, regional effort of the Northern Tier Network Consortium whose aim is to provide high-speed network connectivity to research universities in states along the span. NTN-ND is owned and operated by its three in-state partners, ND-ITD, NDSU and UND. At the time of its inception, initial operational agreements for NTN-ND between ND’s research universities and the ND-ITD resulted in establishment of the NTN-ND, a partnership among these three entities. NDSU holds the responsibility to provide administrative and fiscal agent responsibilities for NTN-ND. As a principal connecting state-level segment of the NTNC, NTN-ND subscribes to the mission and goals of the larger regional research and education network consortia.

STATEWIDE PARTNERS

Serving as the administrative and fiscal agent for NTN-ND, NDSU brings together representatives of its research and education stakeholders on an annual basis for the purpose of providing updates related to network use and activities and how these activities impact research and academics for all connected institutions. Stakeholders include representatives of the statewide North Dakota University System and representatives from each of the public universities and technical colleges in that system, the Tribal Colleges, K-12 education technology services and the state Information Technology Department.

“We were able to initiate this project using existing NDSU network resources, because it allowed us to better serve students, faculty and staff who work at the lab,” said Terry Wieland, director of network engineering and operations at NDSU.
Extending network resources to a regional USDA research center

A recent initiative between NDSU and the Red River Valley Agricultural Research Center has extended NDSU’s existing cyber infrastructure to the federal research site. The Red River Valley Agricultural Research Center is located on NDSU’s main campus in Fargo. It is part of the U.S. Department of Agriculture’s Agricultural Research Service, the USDA’s chief scientific research agency.

North Dakota’s U.S. Department of Agriculture Agricultural Research Service (USDA-ARS) Biosciences Research Laboratory in Fargo was notified in August 2014 that their site has been selected by the National Corn Growers Association to be the home of the new National Agricultural Genotyping Center (http://ndcorn.org/genomicscenter). In partnership with the Los Alamos National Laboratories in New Mexico, the development of the multiplexed assay test will be applied to the next phase of development of an assay for corn pathogens with the bulk of that work located at the new National Genotyping Center. These extended research activities will require the Fargo USDA-ARS Lab to make substantial improvements to its current lab facilities, in particular addressing the need for improved technology network connectivity and capacity. In anticipation of this project, the Fargo ARS Lab staff began working with NDSU’s central IT Division to develop a plan to extend the campus network to the lab. This work will serve to prepare for both the required expansion to the lab to house the new Genotyping Center, and also develop a network that is Internet2 capable once the national organization achieves Internet2 membership and access to the national research and education backbone. The National Genotyping Center is anticipated to begin lab renovation in preparation for full functionality later in 2015.

William Kemp, agricultural administrator at the Red River Valley Agricultural Research Center, said the network expansion is key to the center’s continued success. “Extension of the NDSU network, and ultimately Internet2 into USDA-facilities will expand opportunities for collaborative research, and will likewise enhance the ability of NDSU and USDA collaborators to attract jointly submitted competitive grants,” Kemp said.
Because NDSU is a member of the Northern Tier Network Consortium and Internet2 communities, the Red River Valley Agricultural Research Center’s researchers also have high-capacity and high-speed connectivity to more than 500 national and international academic, industry and government research sites.

These connections have set the stage for future collaborative research. The initiative between NDSU and the Red River Valley Agricultural Research Center aligns with recent efforts to enhance high-performance computing and scientific research activities across the USDA Agricultural Research Service sites. Internet2 announced last year it would partner with the USDA to implement a high-speed, research-only network, known as the ARS Science Network. Initial implementation of the network will connect six major Agricultural Research Service centers at speeds of 10 or 100 gigabits per second, depending on the location. Those centers are located in Albany, California; Fort Collins, Colorado; Ames, Iowa; Beltsville, Maryland; Stoneville, Mississippi; and Clay Center, Nebraska. www.internet2.edu/news/detail/7558
An exemplary illustration of reliance on the global research and education network resources is presented by the United States Geological Survey Earth Resources and Observation System (USGS-EROS) located just outside of Sioux Falls, South Dakota. EROS is one of the largest land remote sensing centers in the world, housing the longest and most comprehensive record of Landsat images of earth’s conditions ever assembled. Images include aerial photography, cartographic, topographic and satellite image collections. With two satellites in orbit, USGS is capable of collecting data for any location on earth’s surface every eight days. Two new satellites are being prepared for launch in 2015 and 2016, each with daily capacity to ingest 1.6 TB of data and distribute 3.2 TB data. http://eros.usgs.gov

To provide this amount of data in a timely manner to global users, USGS-EROS must depend on secure high bandwidth network infrastructure that can continue to grow to meet the increased needs of scientific and engineering research dependent on access to this data. Access to a new 10G connection to the NTNC positions USGS-EROS to maintain their ability to distribute Land Science Imagery throughout the academic and science communities worldwide.
North Dakota EduTech continues to facilitate and support curriculum-based content programs and international classroom collaborative projects involving resources available through global R&E networks. During fiscal 2015, approximately 1,100 students from 24 schools in North Dakota and seven schools in South Dakota have participated in programs highlighting content in social studies, mathematics, language arts and science. www.edutech.nodak.edu

Dakota's K-12 STEM Initiative – Collaboration between higher education and K-12 to provide experiences in STEM careers and research is the focus of the Dakota K12 STEM Initiative. Activities continued in 2015 with a series of STEM-based videoconference sessions for more than 250 students in K-12 schools across North Dakota and South Dakota. Key components of the project include professional development exercises for participating teachers, followed by live videoconference sessions for their classes where students are introduced to various STEM topics and given the opportunity to interact with scientists at higher education institutions and research centers. Curriculum resources are made available for use during and after the STEM series. Sessions are delivered via videoconference, remote access and online by content experts, researchers and faculty across the two states. Partners in 2015 are HQC Biosciences (www.hqcbio.com) with their session on Thin Layer Chromatography and Nanoscale science titled “ChemDetectives: Find Which Farm has Troubled Soil;” University of North Dakota biology, computer science and high-performance computing with their session on the Wildlife@Home Citizen Science Grid (volunteer.cs.und.edu/csg/wildlife/); NDSU College of Engineering (www.ndsu.edu/coe/k_12_outreach/) with their session on Project Lead the Way; EduTech (www.edutech.nodak.edu) and their session on “Scratching the Surface of Programming with Students;” NDSU’s Electron Microscopy Center (www.ndsu.edu/em_lab) and their session on remote instrumentation titled “Seeing is Believing;” North Dakota State College of Science STEM Outreach (www.ndscs.edu/stem) and their session on “You’re Hired! Infusing STEM and 21st Century Skills;” and the Sanford Underground Research Facility (SURF) (http://sanfordlab.org) and their session on physics titled “Studying the Universe from Deep Underground.”

Internet2 K20 Initiative’s “Human and Civil Rights” – The Presidential Primary Sources Project has completed its third year. The annual event is a collaborative program sponsored by the U.S. Presidential Libraries and Museums, National Park Service, the Internet2 K20 Initiative, the Library of Congress and related primary source stakeholders. The goal is to engage classrooms throughout the national and international education community with an overarching theme utilizing primary source documents for student research and presentation. The project involves connecting K-12 students and instructors to primary sources and professional development opportunities by using the national and international research and education network to support videoconference events and access to digitized U.S. Presidential library and museum archives. More information on this project is available at https://k20.internet2.edu/presidents.
FY15 FINANCIAL SUMMARY

For fiscal 2015, NTN-ND brought in $1,238,172 of revenue, expended $723,619 and had $346,200 in depreciation expense. Excess revenue from fiscal 2015 ($168,353) is designated toward future equipment replacement and acquisition. Since completing the full build for this path in 2009 NTN-ND has remained fiscally healthy. No money is used to fund staff of NTN-ND partners ITD, UND or NDSU during this time period.

Annual revenue is obtained through appropriated funds and reimbursements.

- **Equipment**: Costs related to equipment acquisition and maintenance fees.
- **Fiber**: Operations and maintenance fees on fiber, and rack and power fees required to house equipment in space provided by the vendor.
- **Network Operations Center (NOC)**: Management of network equipment, including troubleshooting and response coordination for unplanned outages.
- **Internet2 Dues and Participation Fees**: Annual Internet2 and NTNC membership dues and fees, and costs for Internet2 to accept and route traffic to and from NTN-ND. Beginning in January 2014 Internet2 implemented a new fee structure for member institutions applied to annual fee renewals. All Internet2 fee increases were completed by the end of fiscal 2015 and are reflected in this report.
- **Other Operating**: Includes travel expenses for NTN related meetings, and minor supplies and shipping costs.

Looking to the future…

There are indications of potential increases to current expenses. Network improvements at both national and regional levels will result in increased connector and membership costs for member institutions and sponsored participants alike. The equipment for the NTN-ND segment is original to the initial build in 2007 and is nearing end of life, thus it will need to be included in refresh cycles going forward. Contracts that allowed the NTN-ND to lease fiber from other entities will begin to cycle through renewal periods in 2018 and any new leases will likely include higher rates to renew the same services.
# NTN-ND Partners

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<thead>
<tr>
<th>Partner</th>
<th>Website</th>
<th>Relationship</th>
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<tbody>
<tr>
<td>AT&amp;T</td>
<td><a href="http://www.att.com">www.att.com</a></td>
<td>Provides fiber between Montana and Minneapolis.</td>
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<tr>
<td>BOREAS</td>
<td>boreas.net</td>
<td>BOREAS is a Regional Optical Network providing services to the advanced production and experimental network requirements of the research and education institutions in this region. BOREAS is based on a collaboration of four major research institutions in the upper Midwest: Iowa State University, the University of Iowa, the University of Minnesota and the University of Wisconsin-Madison. BOREAS members are part of the NTNC.</td>
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<tr>
<td>EduTech</td>
<td><a href="http://www.edutech.nodak.edu">www.edutech.nodak.edu</a></td>
<td>Serves as North Dakota’s K-12 education technology services organization.</td>
</tr>
<tr>
<td>Infinera</td>
<td><a href="http://www.infinera.com">www.infinera.com</a></td>
<td>Vendor for optical networking hardware.</td>
</tr>
<tr>
<td>Internet2</td>
<td><a href="http://www.internet2.edu">www.internet2.edu</a></td>
<td>The primary provider and operator of the nation’s research and education network.</td>
</tr>
<tr>
<td>Midco</td>
<td><a href="http://www.midco.com">www.midco.com</a></td>
<td>Provides fiber between Grand Forks and South Dakota.</td>
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<tr>
<td>Northern Tier Network Consortium</td>
<td><a href="http://www.ntnc.org">www.ntnc.org</a></td>
<td>The NTNC consists of member states that represent the collective interests of their institutions in activities related to networking and network infrastructure.</td>
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<tr>
<td>Pacific Northwest Gigapop (PNWGP)</td>
<td><a href="http://www.pnwgp.net">www.pnwgp.net</a></td>
<td>Interconnect hub in Seattle, providing connections between the Northern Wave and other national and international research and education networks.</td>
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<tr>
<td>University of Wisconsin, Madison</td>
<td><a href="http://www.wisc.edu">www.wisc.edu</a></td>
<td>Provides network operations center services for NTN-ND.</td>
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