Leading Research University Expands Research Networking Capabilities for an Enhanced User Experience

Discover how Montana State University uses Cisco Software-Defined Access and Digital Network Architecture to improve scalability, and read some of the school's best practices for success.

Expanding the horizons of research

How moving to a user-based approach to networking is reshaping the research landscape at Montana State University (MSU).

Challenges:

- Researchers need to quickly and securely transmit large quantities of data without affecting other researchers or network performance.
- Regardless of their location on campus, researchers need a consistent user experience that meets their research requirements.
- The IT team needed to simplify management, updates, and refresh without adding more staff.

Solution:

- Cisco Software-Defined Access built on Cisco Digital Network Architecture

Results

- The ability to converge multiple physical architectures enables the university to work within its existing footprint and staffing allowances.
- With roles defined in the software, researchers get the network performance they need regardless of where they log in on campus.
- A single point of network control allows end-to-end visibility into the user experience, regardless of segmentation and the user's role in the network.

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Jerry Sheehan
Vice President for Information Technology
and Chief Information Officer
Montana State University

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Gregory Hess
Network Manager
Montana State University

4 best practices for research networking

1. View research networking as the harbinger of advances to come. The team at Montana State University believes that if they get research networking right, they'll see, then master, the challenges and opportunities possible for their enterprise network, and ultimately improve services for all users.

2. Keep mission in mind. MSU's land-grant mission is at the core of everything it does, and when it comes to technology investments, enabling learning, discovery, and engagement are top of mind. First and foremost, Sheehan notes, "We are focused on technologies that empower our users to do the work they need to do in the most efficient way possible. Our technology strategy is designed to make sure we invest in the resources that will meet our user needs."

3. Use research networking to shift the conversation. To understand researcher requirements, MSU's IT team had to engage closely with researchers in their labs and in their communities. It was critical to see beyond whether the network was working to how the network could be a resource to empower work.

4. Leverage alternative sources for funding. Vendors and other partners can provide valuable support for efforts to solicit and win grants for technology investments. MSU worked with Cisco on its proposal to the National Science Foundation Campus Cyberinfrastructure Grant Program and was awarded funding for the Bridger Scientific Research Network. The innovation made possible through the Bridger Network became the foundation for the university's expanding research capabilities.

Challenges

Established in 1893 in Bozeman, Mont., as the state's land-grant university, Montana State University is now the state's largest university–with more than 16,500 students who represent every state and 72 countries. More than 1,000 faculty engage with students to help realize the university's mission: Montana State University educates students, creates knowledge and art, and serves communities by integrating learning, discovery, and engagement.

Montana State University is recognized nationally among leading public research universities for its prominence in research; the university ranks in the top 3 percent of colleges and universities for research expenditures, which exceed $130 million annually. Its top research departments include immunology, chemistry and biochemistry, transportation, physics, and land resources and environmental sciences. MSU holds more than 260 active technology licenses and has been awarded 75 patents and 34 plant variety certificates.

The university's commitment to learning, discovery, and engagement extends into its IT organization, which is often an early adopter of evolving technologies that align with user requirements. Montana State was the first academic licensee of Cisco Webex Teams, for example. "Technology enables us to achieve our mission," explains Jerry Sheehan, vice president for information technology and chief information officer at Montana State University. "We are focused on technologies that empower our users to do the work they need to do in the most efficient way possible. Our technology strategy is designed to make sure we invest in the resources that will meet our users' needs."

Research: a core pillar of the university's land-grant mission

"One of the core pillars of any land-grant university's mission is research," Sheehan continues. Today, the university's focus on its research mission is enabled and supported by research networking, which allows the university to share information broadly–and quickly. "Research networking supports our land-grant mission," Sheehan continues. "The breakthroughs that come from research today are digital, and to inform and allow further exploration and knowledge sharing, this data needs to be transferred over networks. This is why we are so focused on implementing scalable solutions that meet researcher requirements."

The catalyst for Montana State University's expansion of its research network began several years ago when a researcher came to the university IT team with a complaint. The climate scientist was attempting to share large-scale climate modeling data with a colleague at Oxford as part of the UN's International Government Climate Assessment and his efforts at data transfer kept failing. "He told us our network wasn't very good," Sheehan says. "We knew that he worked in one of the older buildings on campus, with an antiquated access layer network. When we did our own research, we found that the data transfer failed because on our enterprise network, his data movement had appeared as a denial-of-service attack because of its size." Sheehan and his colleagues worked with the researcher to move his data to a data transfer node in the Department of Energy Science DMZ architecture. From there, he could share it at much greater speeds, enabling his colleagues in the international research community to complete their own derivative research to enhance the original discoveries–exactly supporting the land-grant mission.

Of course, relying on IT department assistance anytime a researcher needs to transfer massive quantities of data isn't practical or sustainable. Sheehan and his team began looking for a new approach that would allow researchers to work from their labs where the discoveries are made, while transmitting data securely and at high speeds.

"Montana State University entered into a collaborative partnership with Cisco and worked together on a proposal to the National Science Foundation's Campus Cyberinfrastructure Grant Program. We were awarded about $500,000 to build out a physically separate network in seven research-intensive buildings," Sheehan explains. "We had researchers across disciplines with a common need to share data with colleagues. We wanted to make sure we facilitated that and provided a network to enable their discovery."

The university's Bridger Scientific Research Network became an important example of technology innovation on campus as it extended a dedicated high-speed network for scientific data into those seven campus buildings. Each lab connected to the research network could move data both on and off campus at the highest possible speeds. Importantly, the research network was distinct from the university's enterprise network, so there was no competition for resources.

Unfortunately, while the implementation of the Bridger Scientific Research Network accomplished the goal of facilitating research and data sharing in some campus locations, it wasn't able to support all researchers, and MSU confronted additional challenges as well. "Operating, managing, refreshing, and upgrading two distinct, parallel networks was costly and time-consuming for our IT team," notes Gregory Hess, Montana State University network manager. "The multiple, distributed points of visibility threatened the security of both networks. In addition, there were different use cases—research, administrative, IoT, and student—across multiple networks, and there were multiple authentication and network services domains, including ISE, AD, ClearPass, and InfoBlox."

Solution

"Since we implemented the separate research infrastructure, we watched the development of newer, software-based solutions in software-defined networking or Cisco's Software-Defined Access (SD-Access)," Sheehan adds. "We decided that we would take the next step in the evolution of our network. We evaluated a number of solutions and chose to bring Cisco SD-Access to campus to meet our research needs." Cisco SD-Access offered a level of performance that was unmatched by other solutions.

Why Software-Defined Access?

Sheehan outlines three reasons that led to the university's choice of Cisco SD-Access. First, SD-Access allows MSU to use its existing infrastructure, giving MSU the flexibility to meet its goals without building out another physical connection. "Our focus in all things is on the user and making sure we meet the research requirements of our university colleagues," he says. "Research needs span the campus, and it would be cost-prohibitive to build out new physical connections in each of our 45 buildings. Expanding connectivity in seven buildings met the immediate need, but it just wouldn't scale. SD-Access gave us more options."

Second, unlike a physical network solution, Cisco SD-Access is fully scalable. "Right now, we have two physical architectures that require ongoing maintenance, updates, and refresh," he continues. "SD-Access scalability allows us to converge our physical architectures. We can work within our existing footprint and staffing allowances, which means an excellent return on our investment."

And third, a focus on research networking is a bit like having a time machine that sees into the future. "I'm convinced that when we deliver what is needed to support research, we gain insight into the future needs of our enterprise network," Sheehan explains. "For example, if the research network doesn't offer the persistent monitoring or flexibility that users like our researchers demand, we can use this knowledge to advance our understanding of how we should improve services. The lessons we're learning from our researchers can easily apply to our core business."

3 reasons MSU chose SD-Access

1. Operates on their existing infrastructure
2. Offers options for scalability
3. Provides insights into future network needs

Learn more about SD-Access

Montana State University's new research network leverages Cisco SD-Access and the Cisco Digital Network Architecture (DNA) for more efficient storage and greater computing functionality in addition to the highest possible processing speeds. "We deployed the Catalyst 9000 with DNA controllers for maintenance, troubleshooting, and reporting," Hess says. "At the same time, Cisco SD-Access decouples network functions from hardware so it is extremely efficient; we'll be able to operate the new, expanded research network with minimal staff and low operational investment. Configuring a converged software-defined network versus two physical networks is transformative."

Security and analytics are critically important, and Hess explains that these elements are integral to the MSU deployment as well. "With Cisco SD-Access, we gain full visibility across the entire network, including SD-Access analytics and 360 client experience tracking," he says. "We've extended our security capabilities beyond Cisco firewalls to include Cisco Identity Services Engine (ISE) for policy management and control."

Montana State University's SD-Access deployment complements Cisco solutions that are already in place for access and distribution switching, core switching, and compute. The university plans to extend its use of Cisco DNA across its enterprise network once the research solution is fully operational.

Results

Montana State University has begun to implement Cisco SD-Access in locations across campus, including in some of the university's research-intensive buildings so that, over time, the IT team—and researchers—can evaluate the performance of a software solution compared to a physical network. Preliminary results show a statistically significant performance improvement over the dedicated research network. Other pilot deployments are addressing the needs of researchers outside core research buildings.

"Cisco Software-Defined Access is a very user-centric way to think about networking," Sheehan says. "Roles are defined in the software, which means that researchers have the credentials to get the network performance they need regardless of where they log in on campus. With a physical network, a user is limited by their physical space; with Cisco SD-Access, a user's location doesn't matter. The real promise of SD-Access is that we can change the environment to meet the needs of any user, and this approach ties directly back to our values, our vision, and our emphasis on the user experience."

The experience is improved for Montana State University's IT team as well. "We've converged our production and research networks," he says. "This means we have the dynamic flexibility, scalability, and enhanced capabilities to meet user needs—and improve the user experience—and that we can do it with our existing staff. Cisco SD-Access ensures that deployment is now faster and easier, as is IT management, reporting, and troubleshooting. Importantly, we have a single point of network control, and we gain end-to-end visibility into the user experience, regardless of segmentation and the user's role in the network."

Those in the university's research community agree. Coltran Hophan-Nichols, a systems analyst in the Center for Biofilm Engineering, notes that with the converged networks, researchers can easily take advantage of the fastest network connection available. "As an example, our genomic sequence analysis servers currently have 10GB connections to the production network but are in a data center without a direct connection to the research network," he says. "Now, that distinction won't matter. We'll be able to allow access to resources on Bridger (the university's research network) without running new cables."

Significantly, the benefits of SD-Access will be felt across all fields of study—not just in the sciences. "Today's film and photographic technologies are expanding at a rapid pace. Look at the credits of any recent major motion picture and it is easy to see how computer and networks technologies are driving so many aspects of the production process. We are seeing generational increases in film depth, bit rate, and data usage, which impact data storage, transfer, and the throughput necessary to work with these increasingly massive files. With increased storage needs for raw footage, the need for increased bandwidth and production connectivity becomes more critical," explains William Cirullo, a technician in the university's School of Film and Photography. "Having the option of software-defined access that can enable the transfer of student files to storage creates a lot of flexibility in production, storage, and security while allowing for increased uptime on the scanner itself. This provides us with a wonderful opportunity to help our students and faculty create at levels that were previously impossible."

Montana State University envisions that its research networking capabilities will align with goals for the national research platform (NRP), an interoperable Science DMZ that will facilitate collaboration among researchers and research universities across the country.

The unexpected ripple effect

Technology, Sheehan notes, enables a dynamic environment that enhances the experience of everyone at Montana State. Often the school's technology investments have a profound—and unexpected—ripple effect. As one example, Sheehan cites MSU's use of Webex and Webex Teams. "One of Montana's greatest challenges is the limited number of practicing medical professionals, particularly in rural areas. It's not unusual for a patient to have to travel a long distance even to access an urgent care center," he says. "The university offers a comprehensive nursing program that spans five campuses (Bozeman, Billings, Great Falls, Kalispell, and Missoula), with course content delivered at distance with Cisco technology through nursing enclaves in Great Falls, Billings, and Missoula."

Sheehan describes a classic distance-learning paradigm originally centered on Cisco point-to-point video solutions. "With our investment in Webex Teams, we're now beginning to pilot the delivery of some of these distance courses through the Webex environment," he notes. "It's a turnkey solution that allows faculty to focus on teaching and provides a simpler, smoother operational interface as they teach each course. Our IT organization also benefits because we don't have to support or manage the point-to-point hardware."

The "ripple," Sheehan continues, is that students' experience with Webex will go with them beyond the education environment into their professional lives. "The most profound reason to make this transition to Webex is for our users, which ties directly to our vision for technology at Montana State University," he says. "Certainly, Webex is easy to use and support, but in this case, it's especially effective because it provides a better, more realistic experience for those who use it. They are using the tools in their coursework that they'll use when they move into the work environment, even in a rural Montana care setting."