CC* Regional Networking:
Creating Opportunities for Research & Education – Multiple Organization Regional – OneOklahoma Friction Free Network - CORE-MORe-OFFN

The Oklahoma State Research and Education Network (OneNet) is requesting funding under Program Area (2) Regional Connectivity for Small Institutions of Higher Education of the Campus Cyberinfrastructure (CC*) program. The proposed project will connect Connors State College (CSC), Eastern Oklahoma State College (EOSC), Northeastern Oklahoma A&M College (NEO), and Oklahoma Panhandle State University (OPSU) to the OneOklahoma Friction Free Network (OFFN), the ultra-high-speed regional Science DMZ. These new connections will support an initial set of research and education science drivers and extend to other applications identified at each site.

1 Background

1.1 Overview

OneNet, Oklahoma's research and education network, is the comprehensive digital communications entity of Oklahoma State Regents for Higher Education (OSRHE) and is an integral part of the Oklahoma State System of Higher Education [1, 2]. OFFN, established in 2013 through funding from the National Science Foundation (NSF 1341028) and operational by 2014, was developed based on the needs identified by members of the OneOklahoma Cyberinfrastructure Initiative (OneOCII) for a dedicated Oklahoma-based, multi-institutional and research-only regional Science DMZ. In and of itself, OFFN operates as a separate high-performance research and education network that leverages existing OneNet networking investments and facilities to interconnect higher educational computational facilities at a minimum speed of 10 Gbps and up to 100 Gbps. As a dedicated route to internet and research networks, OFFN functions much faster than traditional internet highways and provides Oklahoma researchers the ability to reliably connect to state, regional, national, and international resources, including regional supercomputing centers and Internet2. This connectivity to external resources supports access to computational capabilities and facilitates moving large datasets quickly and reliably.

Since its inception, OFFN has been managed by OneNet, supplying the design, deployment, maintenance and expansion of the OFFN network with scientific leadership provided by the University of Oklahoma. The OFFN network has been expanded six times since it became operational in 2014 (NSF 1659235, 1925744, 2018453, 2126285, 2201442, 2321401) and will soon connect 25 campuses and one research center, including under-resourced organizations within Oklahoma. All OFFN projects bolster research capabilities statewide by offering access to cyberinfrastructure-based resources, including computing platforms, regardless of location or geography, thus serving to make Oklahoma's research environment more robust. With each expansion, new groups of students, researchers, and educators gain access to improved network bandwidth. Furthermore, expanded bandwidth supports the proposed education and research projects and creates the foundation for additional future projects. Increased use of state, national, and international supercomputing and network-based resources is a natural result.

Since its establishment in 1996, OneNet reaches all 77 Oklahoma counties and manages more than 1,450 internet connections across the state. OneNet leverages local, national, public, and private partnerships to provide world-class broadband connectivity to institutions that sustain communities and enrich lives. OSRHE is authorized by the State Constitution to coordinate with

private, denominational, and other institutions of higher learning to assure affordable quality education [3, 4, 5]. OneNet's high-performance optical network meets the mission-critical needs of Oklahoma's education, research, health care and government agencies.

OneNet also partners with other research and education (R&E) networks to connect Oklahoma to research programs throughout the nation and around the globe, thus serving the diverse set of research and education needs of Oklahoma. OneNet has developed and operated a statewide fiber backbone with a 100 Gbps infrastructure serving Oklahoma's largest research institutions. Additionally, OneNet serves as the state connector for Internet2, the nation's premier research and education network. OneNet has a history of accomplishments and partnerships that advance research, education, workforce development, human services and economic development across the State of Oklahoma [6].

1.2 Project Objectives

The specific objectives of the CORE-MORe-OFFN project are to:

1. Extend the OneOklahoma Friction Free Network to four under-resourced Oklahoma campuses. The network deployment consists of dedicated optical pathways, including the necessary fiber builds, to the optical transport provider (OneNet), as well as to the local campus backbone.
2. Deploy campus Science DMZ and necessary internal campus network infrastructure at each site and integrate into the OFFN network.
3. Engage technical staff and academic staff at each campus in order to facilitate deployment and adoption of the new technology in support of the application drivers.
4. Facilitate cross-campus collaborations, including shared uses of research and education network infrastructure, computing tools and scientific equipment.
5. Disseminate project results via presentations at state, regional and national meetings and publications.

1.3 Intellectual Merit

Nearly 90% of Oklahomans who graduate from state system colleges and universities — and almost two-thirds of nonresident graduates —remain and work in the state one year after graduation, serving in the state's labor force and contributing to our economy. Five years after graduation, nearly 88% of Oklahomans and over 60% of nonresident graduates from a public college or university are still working and earning in Oklahoma [7]. The project provides advanced cyberinfrastructure tools and services to a diverse set of organizations in Oklahoma, covering a wide variety of scientific disciplines including agriculture, biology, climate science, computer science, environmental science, psychology, and sociology, with opportunities for expansion into many other disciplines.These tools help bridge the digital divide by bringing advanced networking capabilities to organizations that heretofore had limited connectivity. Therefore, it follows that the intellectual merit of the project ensures that the network tools implemented in the higher education system will result in a diverse future workforce gaining additional skills and degrees in critical STEM-related occupations and remaining in the state to use them. The project is clearly articulated and builds on the success of previously NSF-funded proposals to extend high-speed reliable connectivity to a diverse set of organizations in Oklahoma.

1.4 Broader Impacts

By connecting four new sites to the OFFN network, the broader impact of the CORE-MORe-OFFN project is the continued expansion of research partnerships and collaborations statewide with institutions who have yet to benefit from advanced network access. The project extends existing and creates new and diverse research collaboration opportunities for faculty, staff and students at the organizations associated with the project, as well as within the state of Oklahoma. The four schools connecting to OFFN will benefit from better connectivity to support deeper collaborations with the 25 existing OFFN campuses and research centers. Furthermore, with each new addition to OFFN, members of underrepresented groups, in particular Native Americans and Hispanics, who make up a significant percentage of the student bodies of these collaborating institutions, will have exposure and access to the benefits of joining this project. All of the schools offer associate degrees and certificates, essential and cost-effective entry points for students interested in STEM careers. As indicated by the recent National Science Board Report [8], roughly two-fifths of graduating high school students immediately enrolling in college choose a community or similar college. These programs prepare students to directly enter the workforce with associate degrees or certificate credentials or transition to 4-year institutions [8]. Through projects, classroom instruction, and programs resulting from inclusion in the CORE-MORe-OFFN project, Oklahoma's higher education student population will develop the technical skills leading to a more diverse STEM workforce in the critical needs occupations as outlined in OSRHE's *Blueprint 2030* strategic plan [9, 10].

2 Driving Research and Education Applications/Needs

This project's objectives are driven by the needs of the four Oklahoma-based organizations connecting to OFFN. Descriptions of the applications enabled by the infrastructure are provided below.

2.1 Connors State College

Connors State College has a long history of providing the people of eastern Oklahoma with access to higher education. Originally founded as an agricultural high school in 1908, CSC is a rural community college with two campuses located in Warner and Muskogee, Oklahoma. The total student enrollment is over 2,500 students annually, with more than 50% first-generation college students and 28% Native American representation. The college offers 22 associate degrees in Arts, Science or Applied Science as well as 16 certificates in areas including agriculture, child development and education, math and science, nursing and health sciences. The Warner campus houses the school's traditional students, athletics, and agricultural programs and is the virtual hub of all operations. The Three Rivers Port campus in Muskogee is focused on commuter students and supports CSC's Nursing and Allied Health programs.

Researcher/Educator: Jes Farquhar, Biology Instructor
Project: Data Collection and Cataloging for STEM Curriculum
Needs: Collecting and cataloging scientific data is a critical curriculum component of many science courses at CSC. This project focuses on student research at the Connors State farm in support of three core classes, Botany (BIOL 1404), Zoology (BIOL 1604) and Investigative Lab (BIOL 1131). For all of the projects described below, students are expected to gain experience in a) identifying species, b) identifying habitats in relation to species present, and c) assessing habitats in relation to conservation/management practices and needs. Projects include: catalog

species diversity for both vertebrate (animal) and invertebrate (arthropod) species; catalog species diversity for the four major plant groups (Angiosperms, Gymnosperms, Pteridophytes, & Bryophytes) and collect, test water quality and share analyzed data between students for comparison and recommendations; and document the presence of various tick species, of medical and veterinary importance, as well as for tick vector species. For the tick collection project, students will gain an understanding of epidemiology of different diseases caused by ticks and how vector species play an important role. Once available, a microlab will be used to test ticks for presence of bacteria that cause disease. For every project, students will individually collect samples at the farm and upload the information to a cloud-based repository, allowing for the sharing and archiving of information collected. In addition, this information will be used to create presentations that will also be archived for future use. Resources required include the ability for over 20 students each semester to upload, store, archive and share data using cloud-based collaboration services collectively in the classroom lab as well as independently. The current campus and wide area network limits the number of students able to perform these tasks simultaneously. Thus, improved network connectivity is necessary to support classroom-based activities as well as individual student access to the classroom data.

2.2 Eastern Oklahoma State College

Eastern Oklahoma State College has campuses in four locations: Wilburton, McAlester, the Idabel Teaching Site and the Antlers Teaching Site. The Wilburton campus is the main EOSC campus and maintains an enrollment of about 1,350. Over 30% of these students are Native American. EOSC offers associate degrees and certificates in agriculture, health sciences, social sciences, education, and science and mathematics. This past summer, EOSC hosted its third annual *Native Americans Who Code* summer camp.

Researcher/Educator: Paul Wills, Division of Behavioral and Social Sciences, Chair/Instructor of Psychology/Sociology/Child Development
Project: Multidisciplinary STEM Research Supporting Critical Thinking
Needs: Behavioral and Social Sciences, one of the most diverse divisions at EOSC, includes the psychology and sociology department and emphasizes techniques of scientific inquiry and the disciplines' contribution to the well-being of society and its members. Over 300 psychology, sociology, nursing and library science students participate each year in critical thinking research projects requiring access to data sets and other online resources associated with their fields of study and often located at their planned transfer college or university, including Southeastern Oklahoma State University, Northeastern State University, Oklahoma State University and the University of Oklahoma, all of which are connected to OFFN. Students typically access the databases from the college library or the nursing labs. Database access varies depending on the specific discipline. In general, the improved network connectivity will provide faster access to larger databases as well as support more simultaneous users. Examples include access to 1-10GB files for library science research materials and nursing program access to external and often cloud-based resources including EBSCOhost (MEDLINE, CINAHL, Health Source) and health data websites (HealthData.gov, Health Data Catalog) where data sets are also 1-10GB in size. The nursing program also plans to access simulations that are also available through OSCER supercomputers supporting data sets of roughly 3GB. Other nursing specific data sets include OSU Biomedical Imaging and OSU Bioinformatics requiring sustained data transfer of over 1 Gbps. Finally, the Psychology and Sociology programs also access a set of EBSCOhost based databases, including APA database, Psychology & Behavioral Science Collection, Sociology Source Unlimited, Sociological Collect with data sets ranging in size from 1-10GB. Access to and data transfers from these databases are currently limited by the wide area network connection.

2.3 Northeastern Oklahoma A&M College

Founded in 1919, Northeastern Oklahoma A&M College is a rural community college in Miami, Oklahoma. The student population is 1,770. Nearly two-thirds of NEO's student population take classes full-time with most living on campus. Forty-six percent of students are a minority of two or more races with a significant Native American representation of 28%. NEO offers associate degrees and certificates in 42 academic majors across five academic departments. NEO attracts over 400 students annually for participation in activities including sports and agriculture, where students have access to a 200-acre farm. The farm includes an animal sciences building, an indoor arena, equine facilities, and other facilities supporting a comprehensive agriculture curriculum. With 12 agriculture degree options, faculty advisors work closely with students to select courses to meet their academic and career goals. In addition, for a small community college, NEO has a sizable endowed fund of over $10 million that supports many scholarship programs.

Researcher/Educator: Brad Claggett, Department of Math and Sciences, Physical Science Instructor
Project: "Hear to Observe" Program for NASA's Planetary Science Division
Needs: Undergraduate students partake in NASA relevant planetary science research, including the origin, evolution, and content of the solar system and the potential for life beyond Earth. Specific projects include reproducing hypothesized planet and icy moon conditions in the laboratory to make observations and record data and identifying biomarker signatures on other celestial bodies. The project includes a collaboration with Dr. Brett McKinney, University of Tulsa (TU) and Dr. Bethany Theiling, NASA Goddard SFC. The project will develop a machine learning tool that uses geochemical data to predict the chemical composition of a sample, taken either by orbiter or lander from a planet or moon, and estimate whether that sample has a biological origin or not. Project support needs include improved data transfer rates, regular access to NASA-related research facilities and planetary environment simulations. For example, one TU database is 1.2GB in size and the three other databases under consideration are roughly the same size. The upgraded infrastructure will enable the establishment of relationships with University of Oklahoma and Oklahoma State University (both OFFN campuses) climate modeling researchers. In addition, climate models available from the NASA Goddard Institute for Space Studies (GISS) will be investigated as instructional tools for the students, with some models containing up to 100TB of data. [11]

Researcher/Educator: Brad Claggett, Department of Math and Sciences, Physical Science Instructor
Project: Climate Change Modeling: Using Climate Models as an Undergraduate Student Teaching Tool in Environmental Science
Needs: This project will integrate access to current and hypothetical climate models to obtain hands-on experience as part of the core environmental science class. Activities will include the input of local observation-based proxies into hypothetical climate models. Resources include improved data transfer rates to support transfer of local observational data, as well as access to regional and national climate databases. Access to climate modeling research facilities is needed as well. Undergraduates will not only develop an interest in STEM and environmental science degrees, but also have experience needed for pursuing these careers at other institutions of higher education.

Researcher/Educator: Brad Claggett, Department of Math and Sciences, Physical Science Instructor
Project: NASA Technology Transfer Idea Competition

Needs: This project supports an NEO team to participate in the NASA Minority University Research and Education (MUREP) Innovation Tech Transfer Idea Competition (MITTIC) [12]. MITTIC, a multidisciplinary team challenge, was established to develop new ideas for commercialization by seeking concept papers from teams enrolled at Minority Serving Institutions (MSIs). Teams submit a concept paper associated with a NASA Intellectual Property (IP) concept [13] explaining commercial viability of the proposed idea using the MITTIC challenge guidelines. An interdisciplinary team of aeronautical engineering, information technology, and business students will select from the current list NASA IP and patent portfolio and, using the MITTIC guidelines, develop and submit a proposal. Resources required for the project will depend on the specific topic selected by the team but may include: network connectivity for participation in the NASA L'SPACE Program [14]; access to project specific databases or simulations; and access to cloud-based collaboration tools.

Researcher/Educator: Dr. Mary Booth, Agriculture, Northeastern Oklahoma A&M College
Project: Research Topics in Equine and Ranch Management
Needs: Three equine and ranch management research topics have been identified as initial science drivers associated with the upgraded connectivity to the animal sciences building located at the NEO farm. The first, impact on livestock reproduction cycles, will investigate the impact of environmental conditions on the reproductive cycle of livestock, specifically beef cows and sheep. Multi-species grazing looks at the full effects of multi-species grazing on pasture quality and quantity and will shed light on the ideal number of cattle and sheep for a balanced multi-species grazing program. The third, crop fertilization innovation techniques investigate using precision techniques in crop fertilization. All three science drivers require better network connectivity between the NEO farm animal sciences building and campus as well as to the wide area network. All projects require access to the USDA databases, specifically the National Agricultural Library. In addition, for the livestock reproduction research cameras are used to monitor the livestock, requiring streaming of real-time data. The improved network connection will enable external collaborations, including with Oklahoma State University.

2.4 Oklahoma Panhandle State University

Oklahoma Panhandle State University, located in Goodwell, Oklahoma, is the first and only four-year Hispanic student-serving institution in Oklahoma. The fall 2021 student population was 1,294, with a 25% Hispanic/Latino representation. Associate and bachelor degrees, as well as certificates, are offered in agriculture, animal science, health sciences, and other STEM disciplines. In 2023, OPSU was named the #3 Best Value Regional College in the West [15].

Researcher/Educator: Steve Martin, Department Chair for Computer Information Systems, Oklahoma Panhandle State University
Project: Integrating Supercomputing into Rural Education: A Hands-on Learning Pathway for Hispanic Students
Needs: Hispanic students residing in rural communities have limited access to study supercomputing. The Computer Information Systems department will provide problem-solving training through a supercomputing curriculum using remote supercomputing facilities, such as those available through the OU Supercomputing Center for Education and Research (OSCER). The project will assess how supercomputing prepares Hispanic students for research projects, including the impact of supercomputing on job placement rates among these students. It will assess the relationship between supercomputing and the development of analytical and data skills among rural students. In addition to access to remote supercomputing resources, the project requires access to statistical software as well as high-speed network connectivity to and from the remote resources. The project also aims to serve as a key element in the improvement

of integrating computer information systems with math and business disciplines, allowing OPSU to broaden and improve its training and research by engaging in cross-collaboration that leads to more innovative solutions to improve rural communities.

Researcher/Educator: Dr. Katy Levings, Assistant Librarian, Reference
Project: Improving Access to Online Databases
Needs: The mission of OPSU's Marvin E. McKee Library is to select, acquire, organize, and preserve relevant materials to support educational curriculum. The library facilitates the dissemination of information, arrangement for access and use, and provision of information services for the university's students, faculty, and staff and the surrounding community. The library provides three main types of resources: information, equipment, and space. Information resources include access to a range of online resources. In support of the College of Agriculture, Science and Nursing, better access to online databases is needed, particularly in the area of anatomy and biology tables. For example, the upgraded network connectivity will allow better access to the allied health and nursing collection from Films on Demand [16]. With over 600 titles available including both single topic "shorts" and full length titles streaming video run times range from a few minutes to hours. Specific topics include patient care, interventions or diseases, disorders or disabilities. All program videos have captions, interactive transcripts, citations and translation options and are segmented into multiple pedagogical clips, convenient for intermittent use during classroom lectures or as assigned classwork. Access to the National Institute of Health National Library of Medicine Electronic Databases & Directories [17] will also be improved.

2.6 Science and Education Drivers Table

To summarize, the projects above cover the four under-resourced campuses' initiatives to expand science and education activities, with a focus on conducting scientific activities that contribute to curriculum development, improve the STEM workforce, promote undergraduate research in STEM, and prepare students for future graduate work. The main applications and their network requirements are provided in Table 1.

Table 1: Summary Table of Science Drivers and Network Requirements.

Campus	Project	Field(s)	Project Needs
CSC	Data collection and cataloging for STEM curriculum	Biology	Access to cloud-based collaboration resources; ability to upload and share datasets associated with data collection activities both individually and classroom based.
EOSC	Multidisciplinary STEM research	Behavioral and Social Sciences	Access to remote data sets 1- 10GB in size. Upgrade to 10 Gbps campus backbone.
NEO	Hear to Observe	Math and Sciences	Access to and manipulation of 100 GB to 1 TB data sets.
NEO	Climate Change Modeling	Math and Sciences	Improved data transfer; access to climate modeling research facilities.
NEO	NASA Technology Transfer Idea Competition	Aeronautical engineering, information	Access to external databases and cloud-based collaboration resources.

		technology, and business	
NEO	Research Topics in Equine and Ranch Management	Agriculture	Connectivity from NEO farm animals sciences building to main campus; access to USDA databases; support for real-time streaming for livestock cameras.
OPSU	Integrating Supercomputing into Rural Education	Computer Information Systems	Access to remote supercomputing resources; access to statistical software; ability to move large data sets.
OPSU	Improving Access to Online Databases	Agriculture, Science and Nursing	Access to online databases and streaming video for both simultaneous and asynchronous use.

3 Proposed Technical Solution

The OFFN network has successfully expanded six times, connecting a growing set of organizations and supporting a broad set of applications in Oklahoma. This project proposes the seventh expansion. As described below, connectivity to OFFN includes up to three components: wide area network (WAN) connectivity to the OFFN network, the campus or site Science DMZ, and any internal campus network infrastructure required for the identified science drivers.

3.1 OFFN Connectivity

Table 2 lists current and planned wide area network connectivity to OneNet and OFFN for each campus. All sites are currently connected to OneNet. Each site will receive an OFFN 10 Gbps connection, separating research and education traffic from campus enterprise traffic.

Table 2: Current Campus OneNet and OFFN Connectivity.

Participant	OneNet Connectivity	Current OFFN Connectivity	New OFFN Connectivity
CSC	10 Gbps	None	10 Gbps
EOSC	1 Gbps	None	10 Gbps
NEO	10 Gbps	None	10 Gbps
OPSU	1 Gbps	None	10 Gbps

As shown in Figure 1, each campus will be connected to a OneNet node and then to the OFFN network. CSC, EOSC and NEO already connect to OneNet via fiber and a separate 10 GE connection over the existing fiber will be installed to support the new OFFN connection. OPSU, located in the Oklahoma panhandle, is connected to OneNet via a leased circuit. Given the location, a fiber build is too costly for the OFFN connection, thus a leased 100 GE wave

supporting multiple 10 GE services will be used. New optical equipment including a shelf and muxponders will carry the wave from the provider network to the OneNet optical core in Oklahoma City.

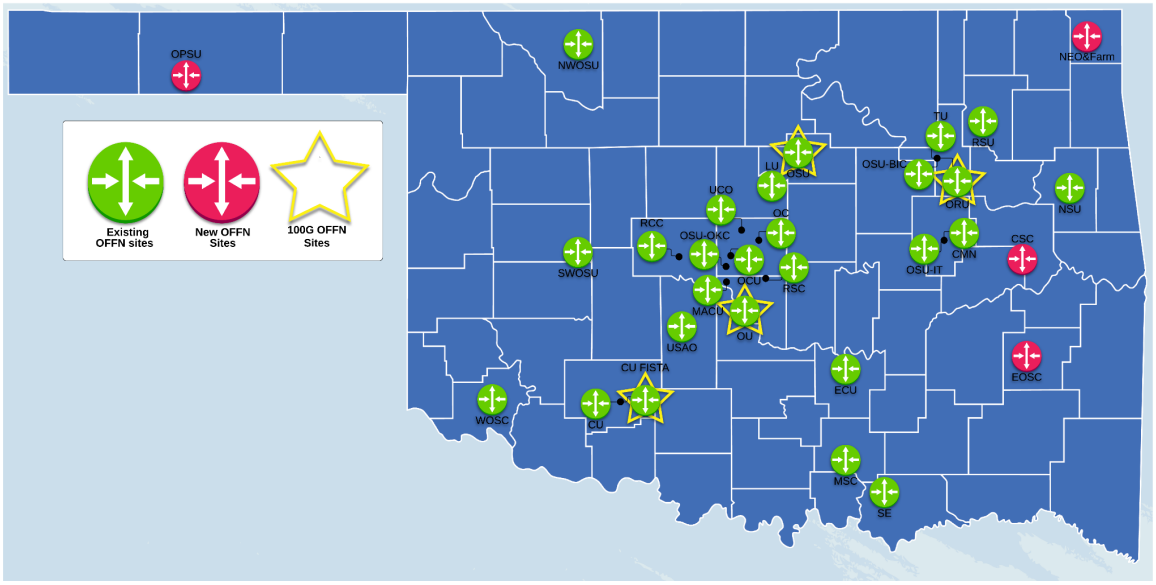

Figure 1: OFFN Network Design with CORE-MORe-OFFN Participants.

3.2 Campus Science DMZ

The campus Science DMZ infrastructure (Figure 2) consists of Dell S4128 Series and Dell S3048 Series switches at each campus. OneNet will work with each campus IT team to install, configure, test, and place into production the project-provided switches into the campus environment. The team will ensure the equipment is configured and tested to meet the needs of the academic teams. The Data Transfer Node (Dell R750) will be connected to the Dell S4128 switch. The proposed Dell switches are also used for other OFFN connected campus Science DMZs. They not only simplify the deployment process, but more importantly have demonstrated the buffer queue size necessary to support the end-to-end performance required for the project applications. The project will use host-based ACLs at the start of the project, but will eventually include virtual routing and forwarding (VRF) as well. Specifically, ACLs will be configured to only allow traffic to necessary DTN ports and subnets and host port control will be used where necessary. This approach has been successfully implemented at existing OFFN sites. It performs well with no discernable hindrance to data transfer rates and provides flexible security controls for each site.

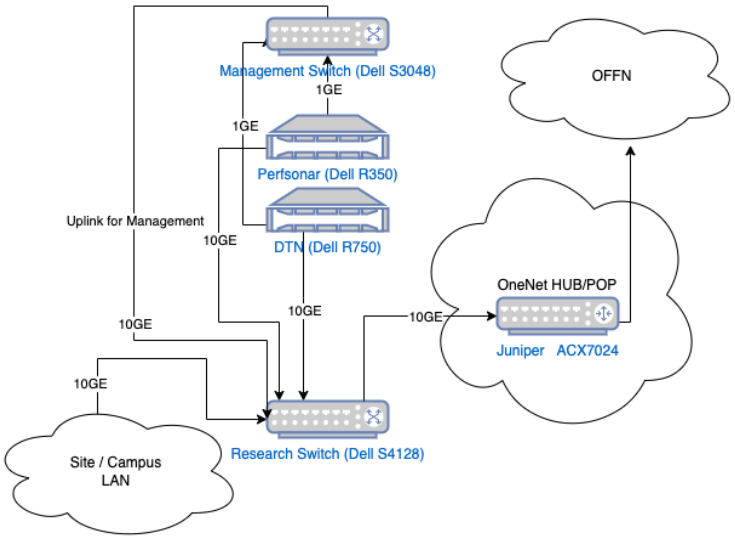

Figure 2: Campus Science DMZ infrastructure

At NEO, the animal sciences building will be connected back to the main campus via a new fiber build. Optics will be purchased to light the fiber at 10 Gbps and connect to a research switch in the farm computer room.

The campus IT at each institution, under the guidance of OneNet, will handle setting up the system to allow OneNet to configure the equipment accordingly from off-site. The perfSONAR platform (Dell R350) will be connected to the research switch and configured with the monitoring capabilities associated with the OneNet MaDDash mesh [18]. The project provides necessary cables, connectors and power equipment. Warranties are included for all the equipment.

Each participating institution will contribute personnel time to set up, maintain and monitor equipment, as well as collaborate with the OFFN technical group. Each participating institution has identified a science lead to help the research and education communities on campus to understand the benefits of the campus upgrades in the context of research and education and to serve as a member of the OneOCII research and education community.

4 Project Personnel and Management

As an integral part of the state of Oklahoma's higher education system, OneNet provides leadership in advanced networking across the state in support of research, education, workforce development and economic expansion. OneNet has been involved in the design of the OneOklahoma Friction Free Network (OFFN) since inception. The project as a whole will be managed by the PI, Mr. Brian Burkhart who is the OneNet Chief Technology Officer.

The project is organized into four functional areas described below. Each team will collaborate, as appropriate, with similar teams associated with previous expansions of the OFFN network. All team member commitments to the project are documented in letters of collaboration.

1) Network Technology Implementation & Training led by Sky Pettett (co-PI), OneNet Senior Director of Network Services, and Bill Bradford (Senior Personnel), OneNet Director of Network Systems, with responsibility for purchase and installation of equipment, connecting each campus to the OneNet backbone and OFFN, including routing and switching, and training staff at each participating institution.

2) Planning, Coordination and Communications led by April Goode (co-PI), Director of OneNet Strategic Planning and Communications, and John Hennessey (Senior Personnel), OneNet Associate Vice Chancellor, with responsibility for action planning, project management and dissemination of internal and external communications.

3) Research and Education Application Adoption led by Paul Wills, co-PI and Chair/Instructor of Psychology/Sociology/Child Development (EOSC), advised by Dr. Henry Neeman of the University of Oklahoma, and includes Lynett Rock, (Senior Personnel, CSC), Dustin Grover (NEO), Steve Martin (OPSU) and Brian Burkhart (OneNet). The team will be responsible for the engagement of researchers, scientists, and students at participating institutions in the OneOCII collaboration and research-related symposia and meetings.

4) Campus Technology Technical Leadership Team (Technology Team), led by Heath Hodges, co-PI and CIO (OSU A&M Colleges) and include Kevin Isom (CSC), Chris Smith (NEO), George Larson (EOSC), Bill Bradford (Senior Personnel, OneNet), Randy Crosby (Senior Personnel, OneNet) and Sky Pettett (OneNet). The team will collaborate with the Campus Technology

Technical Leadership Teams associated with previous expansions of the network.

5 Project Plan

An initial meeting with project participants will be held virtually and led by OneNet staff, with subsequent meetings virtual or in-person as appropriate.

The specific objectives, described in detail below, of this project are to:

1) Extend the OneOklahoma Friction Free Network to CSC, EOSC, NEO and OPSU.
2) Deploy campus Science DMZ and integrate into the OFFN network. Deploy internal campus network infrastructure required to support the initial applications.
3) Engage technical and academic staff at each campus in order to facilitate deployment and adoption of the new technology in support of the application drivers.
4) Facilitate cross-campus collaborations, including shared uses of research and education network infrastructure, computing tools and scientific equipment.
5) Disseminate project results via publications and presentations at state, regional and national meetings.

5.1 Objective 1: Extend the OneOklahoma Friction Free Network

In Year 1 of the project, OneNet will connect each campus to the OFFN network. The first step will be to finalize and then manage the required fiber build, order the optical equipment and leased wave. While the layer 1 infrastructure provisioning is in process, the necessary equipment, including routers and switches will be reviewed and ordered. Technical staff at each campus will be included in the equipment review and purchase as well as trained on the configuration, capabilities and maintenance of the equipment.

5.2 Objective 2: Campus Science DMZ Upgrade

In Year 1, the campus Science DMZ will be deployed on campus, any internal campus network infrastructure will be installed and the campus will be integrated into OFFN. At project start, the campus Science DMZ equipment at each site will be reviewed and purchased. Equipment will include the campus switches, perfSONAR platforms and Data Transfer Nodes. The equipment will be deployed within the campus machine room and connected to the OFFN network and internal campus network. Figure 2 illustrates the expected network configuration; however, the final configuration will be based on campus network technology at the time of deployment, taking into account the requirements and, if applicable, the campus location of the science drivers. The campus Science DMZ will be configured to enable fast and secure data transfers in high volumes required by the applications. The Data Transfer Nodes and perfSONAR platforms will be integrated into the OFFN environment. Technical staff at each campus will be trained on the capabilities and maintenance of the equipment. The NEO farm animal sciences building connection will be done in collaboration with the campus IT staff.

5.3 Objective 3: Engage campus technical staff and academic staff

Engagement of technical and academic staff at each campus will be done in parallel through the Campus Technology Leadership (Technology Team) and the Research and Education Application Adoption (Application Team) Teams with the team composition described above.

Through the direction of the Technical Team, technical leads at each campus will participate in

regular calls. Initially these calls will focus on preparing the campus for the installation of the OFFN network, including any site preparation associated with the fiber builds. As the project progresses, the meetings will include familiarizing the IT staff with the capabilities of both the OFFN network and the Science DMZ. Technical leads will participate in statewide meetings in support of the new technology, providing a broader community for support and advice.

Similarly, the Application Team will bring together the application leads for each campus. During Year 1, these calls will focus on supporting the identified research and education application drivers. Additional science research and application drivers will be identified in anticipation of expanding the use of the OFFN connection during the project period.

Once the infrastructure is in place and the initial applications have been tested, challenges to using the infrastructure will be identified by both teams and addressed by working together to streamline and improve access to the infrastructure, including optimizing end-to-end network performance for the applications. In Year 2, both groups will focus on refinement of the infrastructure use for the initial subsequent research and education applications.

5.4 Objective 4: Facilitate cross-campus collaborations

This project will facilitate cross-campus collaborations engaging faculty, staff and students, where appropriate, in OFFN and OneOklahoma Cyberinfrastructure Initiative (OneOCII).

Technical leads will participate in the regular OFFN conference calls while science/research leads will participate in regular OneOCII group calls. As indicated through previous expansions of the OFFN network, inclusion in these statewide collaborative groups will help facilitate the adoption of the new technology at the participating campuses and also enable new collaborations. Researchers and students will participate in the annual Oklahoma Supercomputing Symposium through attendance, poster presentations, general sessions, and special sessions devoted to this project. Participation in other regional and national conferences, such as the Internet2 Community Exchange and Technology Exchange or the yearly national Supercomputing Conference (SC) will be encouraged.

5.5 Objective 5: Disseminate project results

Reports on progress toward objectives and accomplishments as measured in section 6 below will be made regularly at state, regional and national meetings.

6 Project Deliverables, Schedule and Dissemination

6.1 Project Schedule

	Year 1				Year 2			
	Q 1	**Q 2**	**Q 3**	**Q 4**	**Q 1**	**Q 2**	**Q 3**	**Q 4**
Objective 1: Extend OFFN to CSC, EOSC, NEO and OPSU.								
Review current OneNet infrastructure	X	X	X	X				

Order OFFN connection equipment, begin NEO fiber build and CSC leased wave	X	X	X					
Install and test circuits, NEO animal sciences building fiber and equipment				X	X			
Provide technical training and support					X	X	X	X
Objective 2: Deploy campus Science DMZ, campus network components and integrate into the OFFN network.								
Review and order campus equipment	X	X						
Install equipment				X	X			
Site visits			X			X		
Tie new perfSONAR nodes into related meshes				X				
Provide technical training and support					X	X	X	X
Objective 3: Engage campus technical and academic staff to facilitate deployment and adoption of the new technology in support of the application drivers.								
Technical Team Calls/Meetings	X	X	X	X	X	X	X	X
Application Team Calls/Meetings	X	X	X	X	X	X	X	X
Annual meetings of participants	X				X			
Objective 4: Facilitate cross-campus collaborations, including shared uses of research and education network infrastructure, computing tools and scientific equipment.								
Engagement of science leads on OneOCII calls	X	X	X	X	X	X	X	X
Engagement of technical leads in OFFN calls	X	X	X	X	X	X	X	X
Engagement of science and education drivers projects				X	X	X	X	X
Objective 5: Disseminate project results at state, regional and national meetings.								
Provide periodic progress updates (OneNet website and constituent communications)		X		X		X		X
Presentations at state, regional and national meetings				X	X	X	X	X
Publication of project results								X

6.2 Project Dissemination Plan

As noted in Section 6.1, the project outcomes and progress toward stated goals as measured in section 6.3 will be shared with other campuses in the state of Oklahoma, with state and regional

networks, with regional colleges and universities and with the greater science and research community through presentations at the Oklahoma Supercomputing Symposium, Great Plains Network Annual Meeting, The Quilt Meeting, Internet2 Meetings, and NSF CC* PI Workshops. Results will be disseminated in written form through OneNet website updates and submission of results to professional publications (e.g., Educause publications).

6.3 Measuring Progress

Periodic progress towards objectives will be measured as shown in Table 3.

Table 3: Progress Measurement.

Objective(s)	Measurement
Objective 1, 2	Volume of traffic over Science DMZ
Objective 1, 2	Reliability of network connections as measured via perfSONAR
Objective 2	Number/volume of data transfers per unit of time
Objective 2	Number of visits to MaDDash web page
Objective 3, 4	Number of participants on teleconferences, in workshops, at outreach events.
Objective 4	Number of unique projects at each campus using infrastructure
Objective 5	Number of presentations, publications

These numbers, compiled and reviewed regularly, will be used by project personnel to evaluate and adjust the project's focus and activities for maximum beneficial impact to the community. The data will also be used in presentations and publications.

7 Network Management Plan

Network implementation and operations will be a shared effort by OneNet technical staff and campus IT staff. OneNet staff will have authority to make changes on the OneNet side of a campus demarcation, campus IT staff will have authority to make changes on the campus side, and changes that affect the operation of routing, packet handling and admission control will be made by the proper owner of the interface in consultation with the other entity's technical staff. All notifications, modifications and changes relating to the scope of this project will be handled through established and agreed communications and change management practices.

The Campus Technology Technical Leadership Team will assist OneNet staff in the process of specifying, acquiring and implementing connectivity upgrades for the participating sites, together with the institution CIOs and network leads. Since the participating institutions will have specific needs and requirements and will assume responsibility for sustaining network upgrades, CIO and network leads at each institution will be involved in determining the details of each institution's connectivity upgrade solution. OneNet will procure and install all equipment, train staff and provide ongoing technical support. OneNet staff will track the perfSONAR (pS) network monitoring infrastructure output as a proactive mechanism for problem detection, in addition to providing training and oversight for system administration on pS nodes.

8 Project Impact and Sustainability

This project will have a substantial impact on the campuses participating in the project and on the Oklahoma higher education community as a whole, as explained in Section 2. As noted in Section 1, OneNet has a history of facilitating and sustaining projects that improve Oklahoma cyberinfrastructure. OneNet will continue to maintain the OFFN network in partnership with the University of Oklahoma and the OFFN technical working group. As indicated in the letters of institutional support, the participating campuses will continue to budget for and cover the costs of OneNet network R&E connectivity/services and hardware maintenance. In the case of public universities, OneNet network connectivity costs are budgeted and paid for directly by OSRHE.

9 Partnership Overview

OneNet is supported in the proposed effort by others in the national R&E networking community. These entities share a common interest in the advancement of research via innovative and advanced cyberinfrastructure that is reliable and secure.

Partnering organizations include:

- The ***Great Plains Network (GPN) Cyber Team Project***, funded by the National Science Foundation, will assist in outreach and training efforts with the campuses.
- The ***University of Oklahoma*** (OU) and the ***OneOklahoma Cyberinfrastructure Initiative*** (OneOCII) will partner with OneNet as a scientific advisory organization as well as continue to advise on the design of the Science DMZ configuration.
- ***The Quilt*** is the national state and regional networking membership organization and will provide assistance in disseminating project results nationwide.
- ***Internet2*** will provide a national platform for the dissemination of project results to member colleges and universities.
- ***EPOC*** (Engagement and Performance Operations Center) will engage with OneNet to help participating institutions address gaps in understanding scientific adoption and technology use, along with addressing any friction in supporting end-to-end workflows.

10 Results from Prior NSF Support

Brian Burkhart, Sky Pettett and April Goode: (a) NSF Award Number ACI-2321401 period of support 09/01/2023-08/31/2025; (b) CC* Regional: Setting Up Research Foundations - Multiple Organization Regional - OneOklahoma Friction Free Network (SURF-MORe-OFFN) (c) The project's intellectual merit is to make cyberinfrastructure tools and services available to four smaller campuses and one research center in Oklahoma covering a wide range of scientific disciplines. The broader impacts of the project include providing opportunities for faculty across Oklahoma, enabling smaller institutions to expand their research and education activities and providing additional STEM and CI educational opportunities for undergraduate and graduate students. These opportunities will, in turn, lead to a stronger and more diverse workforce both within Oklahoma and nationwide. (d) Publications: None; (e) Data produced by the project includes project documentation and network data; (f) Renewed support: N/A – one time funding.

Paul Wills: None

Heath Hodges: None