



OARnet

An **OH·TECH** Consortium Member

Annual Report

2021–2022



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Chief Technology Officer

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oar.net



“For 35 years, OARnet has provided critical resources and service to Ohio’s higher education, research, K–12 education, libraries, government, public broadcasting and health care communities. With initiatives such as the 400 Gbps fiber-optic backbone upgrade, OARnet ensures that the state remains on the cutting edge of technology.”

**Randy Gardner, Chancellor,
Ohio Department of Higher Education**

OARnet: Leadership. Solutions. Innovation. The Ohio Academic Resources Network (OARnet) strives to ensure Ohio’s role as a technology leader by implementing next-generation technologies in our network to meet the needs of government, education and health care communities. By teaming with our communities to develop technology solutions designed to address the demands of an ever-changing environment for the delivery of services, OARnet facilitates innovation as a competitive edge in Ohio’s economic development and prominence as a leader in research and development.

Ohio Technology Consortium: Governed by the Chancellor of the Department of Higher Education, the Ohio Technology Consortium (OH-TECH) serves as the technology and information division of the Ohio Department of Higher Education. The consortium comprises a suite of widely respected member organizations collectively unsurpassed in any other state: the Ohio Supercomputer Center, OARnet and OhioLINK. The consortium drives efficiencies through common services provided to member organizations through the Shared Infrastructure and Consortia Services divisions.

Above: Chancellor Randy Gardner directs the Ohio Department of Higher Education and oversees the strategic initiatives of the Ohio Technology Consortium and its member organizations in support of the state’s technology infrastructure needs.

From the Director



Pankaj Shah
Executive Director

This year the Ohio Academic Resources Network (OARnet) celebrates its 35th anniversary. We have grown tremendously since 1987, when we were created to connect Ohio researchers to the Ohio Supercomputer Center. Today OARnet manages more than 5,500 miles of fiber-optic backbone and serves a variety of clients—from higher education and PreK–12 schools to state and local government agencies, libraries, public broadcasters, health care entities and NG-911.

Over the last year, OARnet has made great strides in reaching its next major milestone, an upgrade to 400 Gigabits per second (Gbps) service. In December 2021, we were one of only five networks in the country to boost our connectivity to Internet2’s new Next Generation Infrastructure, upgrading our 100 Gbps connections in Cincinnati and Cleveland to 400 Gbps to provide dedicated services for peering, research traffic and cloud computing services.

OARnet also continues to make progress on its Last Mile Enhancement Program, which will offer all our higher education members a minimum of 10 Gbps last-mile capacity by the end of 2022. The project is supported by the Governor’s Emergency Education Relief Fund.

These improvements have paved the way for the Virtual Research-Education Ohio (VROhio) program. With a planning grant from the National Science Foundation, we are working with public and private partners to develop a network of science, technology, engineering and mathematics (STEM) training and research resources for smaller higher education institutions in Ohio.

In addition to OARnet’s support for higher education over the last year, we also are moving forward with a major connectivity upgrade for the state’s PreK–12 system. In partnership with Ohio’s Information Technology Centers (ITCs) and the Management Council, OARnet is boosting Ohio’s PreK–12 network to 100 Gbps. Slated for completion in 2024, the project is funded by the Elementary and Secondary School Emergency Relief (ESSER) Fund, which is part of the federal Coronavirus Aid, Relief and Economic Security (CARES) Act.

I also am pleased to report that we have renewed our contract with VMware, a global leader in cloud infrastructure and digital workspace technology, to provide software and services to OARnet clients at significantly reduced prices. Over the past 14 years, this contract has become one of the most significant aggregation agreements in the state of Ohio and has established Ohio as a national leader in virtualization. With VMware’s partnership, OARnet is moving from on-premises to cloud-based solutions.

The State of Ohio and the federal government have prioritized strengthening broadband infrastructure and access, and both are awarding new funding this year for a variety of projects that support that goal. OARnet looks forward to collaborating with BroadbandOhio and InnovateOhio, as well as various public and private partners, to fulfill the vision of bringing high-speed internet access to the unserved and underserved areas of Ohio.

Pankaj Shah
Executive Director

Highlights

Connecting Denison Edge

OARnet worked with Denison University to provide connectivity to its new downtown Columbus initiative, Denison Edge, which is designed to support Ohio liberal arts students seeking to gain technical expertise, leadership skills and business acumen. The location offers ready access to Columbus industry professionals who teach the program’s courses and workshops.

Boosting the BMV

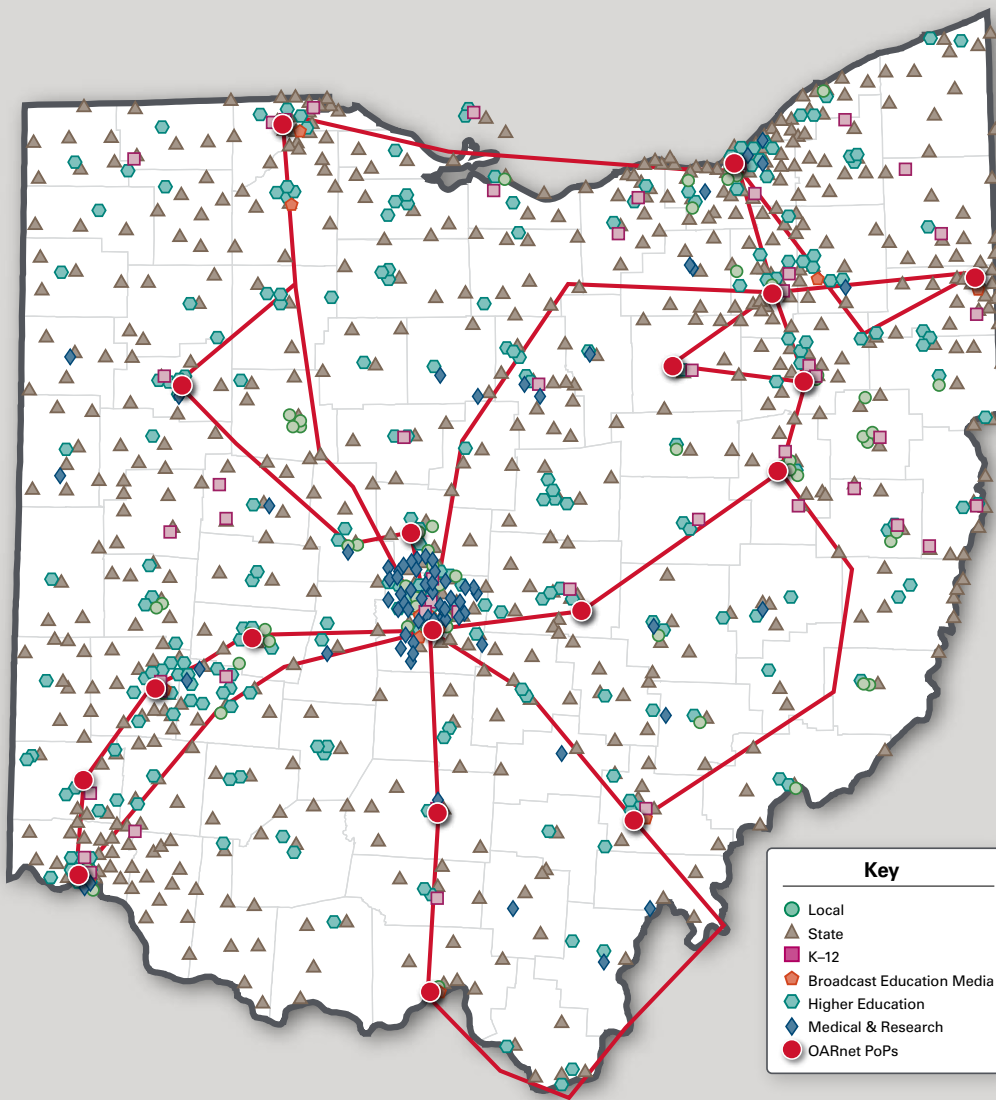
The Ohio Bureau of Motor Vehicles (BMV) launched nine self-service kiosks at deputy registrar and retail locations around the state in 2021. OARnet supported the project by upgrading the BMV’s network equipment and providing reliable and secure connections from the kiosks to the statewide fiber optic network.


WOSU on the Move

After decades of operating from the basement of The Ohio State University’s Fawcett Center, WOSU Public Media has now completed a move to a brand-new facility just east of campus. OARnet partnered with the Broadcast Educational Media Commission (BEMC), the city of Columbus and Ohio State to develop and implement new fiber-optic network connections to the Pearl Street site.

Connecting Ohio to the World

OARnet has delivered innovative, technology-based solutions to reduce costs, increase productivity and improve customer service since 1987. Through strategic partnerships, we provide service to our education, research, health care, libraries, public broadcasting and government clients by connecting them to the digital world through ultra-high-speed fiber across the state.



 **625+**
K-12 Schools Sites

 **469**
Higher Education Sites

 **102**
Health Care Facilities

 **13**
Research Sites

 **27**
Public Broadcasting Sites

 **98**
Local Government Sites

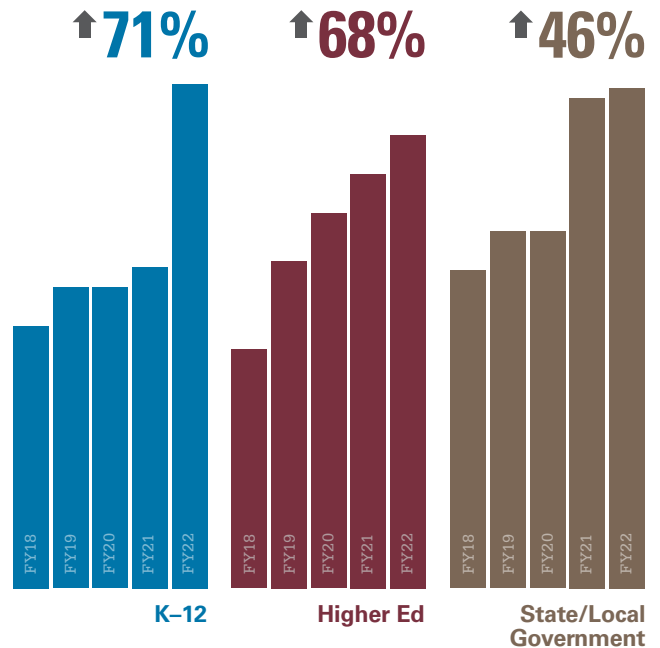
 **2,879**
State Government Sites

Financial Impact

OARnet aggregates demand for services to generate the best possible discounts for our statewide clients. Our driving principles are to:

- Increase access to affordable broadband service. OARnet’s fiber-optic backbone stretches more than 5,500 miles, which lowers broadband access cost.
- Reduce the cost of technology through aggregate purchasing. On behalf of its members and clients, OARnet negotiates volume purchase prices for software, hardware and/or network services.
- Maximize shared services opportunities. By centralizing technology hardware, software and network requirements needed to support the overall community, OARnet reduces the cost of service delivery. Offerings include a network operations center, co-location, emergency web hosting and cloud computing.

5-Year Bandwidth Increases



Savings

In Fiscal Year 2021



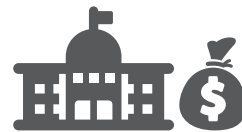
\$15 MILLION

savings for K-12 schools



\$17 MILLION

savings for higher education



\$16 MILLION

savings for State of Ohio agencies

OARnet Services

OARnet provides value-added services to clients through the development of the network to ensure the newest technology is available to meet the needs of our communities. The OARnet network can deliver the next generation of service, including VMware, internet, Internet2 and cloud services, as well as support the demand for collaboration required for federal grant-funded research.



Integrated Network Services

With more than 5,500 miles of fiber, OARnet’s network backbone extends into the education, research, health care, libraries, public broadcasting and government communities and results in lowered cost to broadband access for clients. OARnet aggregates internet providers and connectivity to public internet exchange points to optimize these costs and provide a high standard of reliability.

- MPLS L3VPN & L2 Circuits
- IPV4 & IPV6
- Domain Name Service (DNS)
- Co-Location
- Last Mile Access
- Commodity Internet Access
- Optical Transport
- On-Net (IntraOhio)



Application Services

OARnet works with trusted partners to provide clients with reliable services to enhance their communications and operations. Members can connect securely through public and private cloud services, VoIP, discounted software licensing and server virtualization.

- VMware
- ESRI
- Voice Over IP (VoIP)
- Emergency Web Hosting
- Grant Development



Support Services

OARnet clients have access to solutions through an around-the-clock network operations center with Tier I and Tier II support that includes troubleshooting, ticketing and engineering support. Additionally, OARnet engineers provide consulting services for areas such as fiber and access circuit planning, optical support and routing design, including developing failover plans. OARnet’s engineering team can remotely configure and manage environments as well as provide onsite support when necessary.

Support Center (NOC)
Network Design and
Engineering Consulting
Quality of Service (QoS)



Cybersecurity Services

Avoiding cyberattacks and security breaches requires being vigilant about emerging threats. OARnet’s portfolio of cybersecurity services mitigates and prevents attacks and ensures information and infrastructure remain safe. OARnet offers multiple types of cybersecurity services, from preconfigured filtering and on-demand DDoS mitigation to pilot programs for penetration testing and vulnerability management. Through a defense-in-depth approach, ranging from local filtering and BGP signaling to packet scrubbing, OARnet can meet your institution’s needs. Additionally, OARnet participates in the REN-ISAC program that tracks emerging threats.

DDoS Mitigation
EDUROAM
InCommon Federation
Penetration Testing (Pilot)
Vulnerability
Management (Pilot)



Network Peering

OARnet is Ohio’s Internet2 connector, with two 400 Gbps connections located in Cleveland and Cincinnati. These services allow researchers to collaborate across institutions and apply to funding sources such as the National Science Foundation. OARnet also has 10 Gbps connections to NASA Glenn Research Center and to Wright-Patterson Air Force Base.

Research Network Peers
Commercial Network Peers

BroadbandOhio leverages OARnet's statewide backbone to boost connectivity

State initiative unites public, private and not-for-profit partners to expand affordable high-speed internet access

In early 2020, the DeWine-Husted Administration created BroadbandOhio to implement the Ohio Broadband Strategy, which is focused on providing high-speed internet access to the 300,000 underserved or unserved households across the state. These households, which represent about 1 million citizens, do not have the technological capabilities to support online education or work.

OARnet has been a key partner in the effort, working closely with BroadbandOhio on public-private partnerships that have extended connectivity to rural and urban communities in the state. The organization also lends its expertise to statewide planning efforts at a time when Ohio is slated to receive new federal funding that will accelerate broadband expansion.

With deep technical expertise and a wide reach into many Ohio communities, OARnet is a valuable partner in these efforts, said Peter Voderberg, chief of BroadbandOhio.

"OARnet has a great deal of on-the-ground awareness of various state entities, and their collaboration has been helpful from that perspective," he said.



In just two years, OARnet has collaborated with BroadbandOhio and the state's InnovateOhio initiative on public-private partnerships that are providing affordable high-speed internet to thousands of Ohioans in the Riverside Local School District in rural northwestern Ohio and the City of East Cleveland. These pilot projects provide a template for how such initiatives could be implemented with other partners, Voderberg said.

In addition, OARnet regularly participates in a BroadbandOhio working group and in strategy sessions for proposals for grant funding that the state and federal governments are making available for new broadband projects.

BroadbandOhio and its partners are monitoring the implementation of the federal Infrastructure Investment and Jobs Act, which designated \$65 billion for national improvements to broadband equity. Each state will receive at least \$100 million, with more allocated depending on the level of need to address unserved or underserved populations. In addition, the act has set up a competitive \$1 billion grant program for middle mile projects.

The Ohio General Assembly also created the Ohio Residential Broadband Expansion Grant Program which has awarded \$232 million to 33 applications, primarily in southeast Ohio, to help internet service providers boost household connectivity over the next four years.

OARnet is in a prime position to help BroadbandOhio and its various public and private partners secure competitive funding and execute these broadband expansion projects, as it has a robust infrastructure already in place that can be leveraged to lower costs, Shah said. In addition, as a leading member of the national research and education network community and a participant in Internet2 and The Quilt, OARnet brings an understanding of larger trends and opportunities at the national level to the table. •

OARnet launches network upgrade for Ohio's PreK–12 schools

Federal grant supports major boost to educational bandwidth

The Management Council, which provides network and digital resources to the state's PreK–12 community, received a grant from the U.S. Department of Education's Elementary and Secondary School Emergency Relief (ESSER) Fund that will enable the Ohio Academic Resources Network (OARnet) to boost the bandwidth of Ohio's PreK–12 schools.

The project, slated for completion in 2024, will increase internet connectivity between OARnet and 18 Information Technology Center (ITC) sites and seven large urban school districts from 10 Gigabits per second (Gbps) to 100 Gbps with up to 200 Gbps capability for further expansion.

"This technology upgrade will support the growing use of online courses and remote learning resources in PreK–12 education, allow school districts to extend wireless internet service into nearby homes, and also expand access to mental health and security services," said Denis Walsh, chief relationship officer for OARnet.

OARnet began providing connectivity to Ohio's PreK–12 schools more than 15 years ago, when it received funding through a partnership to extend its statewide fiber-optic backbone to large urban districts as well as the ITCs that provide shared technology services to a majority of Ohio's school districts. Since that time, the districts have exceeded the capacity of the original 10 Gbps bandwidth, and OARnet has been performing one-time upgrades along the network as needed.

With the new federal funding, which is part of the broader Coronavirus Aid, Relief and Economic Security (CARES) Act, OARnet now can provide a system-wide upgrade to the overall PreK–12 service. The project involves an upgrade to the backbone's existing Dense Wavelength Division Multiplexing transport technology, which will support the 100 Gbps connectivity to the schools, said Mark Fullmer, chief technology officer for OARnet.



"The new project will provide greater, more reliable bandwidth for Ohio's ITCs and large urban districts, which is critical for student success during a time when many students are using remote learning tools, such as online subscriptions, web tools, digital resources and virtual field trips," said Geoff Andrews, chief executive officer of the Management Council, which coordinates and supports the Ohio Education Computer Network (OECN), composed of Ohio's 18 ITCs.

The upgrade also will better position the districts to take advantage of online resources and future-proof schools to support the new hybrid learning environment.

"As ITCs and large urbans become more capable and comfortable with their abilities to meet future bandwidth demands, they can make informed decisions that incorporate predictable budgeting and costs," said Scott Gaughan, director of networking for the Management Council.

In conjunction with the ITCs, OARnet's client services team has developed a project plan which will be completed in multiple phases over the next two years. In addition to the Management Council and OECN, OARnet will work with equipment suppliers PacketLight Networks and Juniper Networks on the project. •

New partnership bolsters Cincinnati-area higher education network

OARnet takes on management of fiber network segment serving several colleges and universities

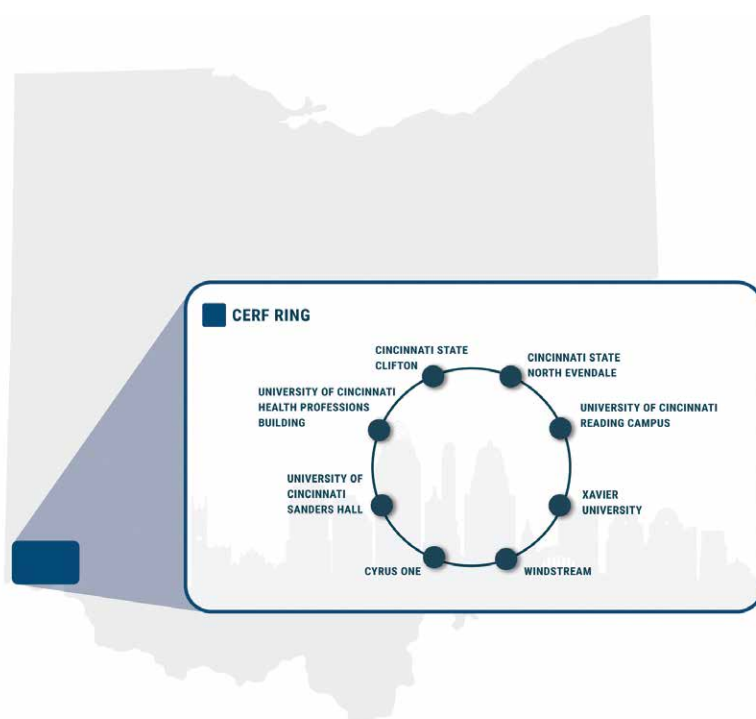
For 15 years, the University of Cincinnati, Cincinnati State Technical and Community College and Xavier University shared the Cincinnati Education and Research Fiber Ring (CERF) to support the education and research missions of their schools. When the schools learned in fall 2021 that the CERF ring would no longer be donated by their benefactor, the members asked OARnet to take over management and maintenance of the ring.

OARnet oversees several other rings for clusters of higher education institutions around the state, such as one that serves the University of Toledo and Bowling Green State University, one used by Case Western Reserve University and Cleveland State University, and another that supports Kent State University, the Northeast Ohio Medical University and Youngstown State University.

A ring is the physical fiber-optic infrastructure, including transmission lines and routing equipment, that links institutions to OARnet’s high-speed network and the internet. A ring connects institutions in two directions, which provides redundancy for continued service in the event of trouble at any single point.

“We have a wealth of experience managing these types of rings, setting up the equipment and provisioning the traditional OARnet services, such as internet, IntraOhio and Internet2 bandwidth. It fits well with our concept of providing redundant architecture to our members,” said Mark Fullmer, OARnet chief technology officer.

OARnet’s management of the ring will save the higher education institutions the time and expense of performing equipment upgrades or repairs on their own, said Denis Walsh, chief relationship officer. The upgraded ring also provides strong reliability. The architecture features built-in



backups that protect against service disruptions from equipment or fiber failures.

“It’s mission critical—these schools have to be open; students need to be in classes,” Walsh said.

For the University of Cincinnati, the enhanced relationship with OARnet has opened the door to join additional UC campuses to the ring, providing faster and more reliable network connectivity to research facilities that require it, said Matthew Williams, executive director of information security at the University of Cincinnati.

“Transitioning the ring to OARnet made sense both for the present and the future of the university,” Williams said. “It has allowed our network engineers to concentrate on other matters tied closely to our digital transformation.” •

Looking Ahead

This next year will be pivotal for boosting connectivity—both in the areas of speed and access—for all of the communities we serve in the state of Ohio. OARnet is excited about new state and federal funding streams that will help close the gaps for unserved or underserved citizens by leveraging public-private partnerships. Over the next year, we will be focused on:

- Upgrading our 5,500 miles of fiber-optic backbone from 100 to 400 Gbps capacity to support increased network demand in the higher education and K–12 communities.
- Completing the Last Mile Enhancement Program upgrades at 41 higher education institutions in 2022.
- Working with PreK–12 education partners to complete an initial round of upgrades to 100 Gbps.
- Adding 100 Gbps circuits to data centers in Chicago and Ashburn, Virginia, to support peering, cloud and research network connectivity.
- Completing the initial work funded by the National Science Foundation planning grant for the Virtual Research-Education Ohio (VROhio) program.
- Exploring and implementing new cybersecurity initiatives, including external penetration testing, cloud risk-based vulnerability management (scanning services), aggregate purchasing opportunities, identity and access management, and the addition of a network cybersecurity architect.
- Expanding our relationship with BroadbandOhio and InnovateOhio to promote public-private partnerships designed to mitigate the digital divide in Ohio. This includes exploring Middle Mile Expansion to reduce the cost of broadband, increase availability and improve resiliency of network services.





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OH-TECH is the technology and information division
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