OARnet

An OH·TECH Consortium Member

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Chancellor John Carey 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.

"OARnet connects millions of Ohioans, enabling them to learn, collaborate, research and celebrate in incredible ways."
— *John Carey, Chancellor, Ohio Department of Higher Education*

OH·TECH | Ohio Technology Consortium
A Division of the **Ohio Department of Higher Education**

The Ohio Technology Consortium (OH-TECH) represents the technology arm of the Ohio Department of Higher Education. OSC, OARnet, OhioLINK, eStudent Services and the still-in-development Research and Innovation Center comprise a suite of technology and information member organizations unsurpassed in any other state. Their consolidation under the OH-TECH banner allows each organization to harness boundless synergies and efficiencies.

OARnet

Connect. Aggregate. Collaborate. Our powerful trilogy of goals provides the necessary technology infrastructure to assure a prosperous economic future for Ohio and beyond. At the Ohio Academic Resources Network (OARnet), we connect our clients—found throughout education, healthcare, public broadcasting and government—by increasing access to affordable broadband service. We reduce the cost of vital technologies for our members through aggregate purchasing. We collaborate with peers locally, within the state, across the country and around the globe to spur communication and collaboration.

Highlights

State on backbone

Through a $3.2 million agreement, Ohio government is moving to the OARnet backbone. More than 700 circuits have been transitioned, and nearly 2,300 end sites will be connected once fully integrated. Layering in the connectivity of federal entities, such as Wright-Patterson Air Force Base and NASA-Glenn Research Center, makes OARnet's 2,240-mile backbone a very unique, stakeholder-driven asset. The state's investment in OARnet shared services has further reduced costs for all of OARnet's communities.

Aggregate software purchasing

Organizations that purchased VMware through OARnet's shared service offering have saved an estimated $4.3 million. Additionally, 38 higher education institutions, including four new schools, are participating in the $175,000 Esri Contract for ArcGIS Software, used to create maps and share intelligent visualizations. An aggregate purchasing agreement with Salesforce Inc. provides a 65 percent discount on licenses.

K–12 upgrades

Approximately $7 million was awarded to upgrade 29 information technology centers (ITCs) and large urban districts from 1 gigabit per second broadband speed to 10 Gbps. With upgrades completed in early 2015, OARnet is now seeking funding for last-mile upgrades. OARnet provides broadband connectivity to over 700 of Ohio's K–12 schools through a partnership with ITCs and large urban districts, a deal that saves them an estimated $8 million annually.

PRICE & PROVISIONING

per gigabit cost

$6.88/Gb
in FY2015
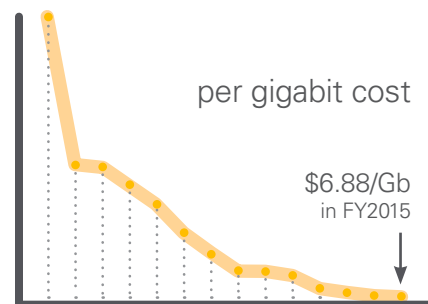
Economies of scale have allowed OARnet's Internet pricing to decrease 97 percent since 2002, while aggregated subscriptions have increased more than 8,300 percent over the same period.
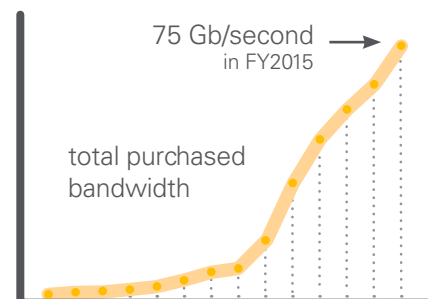
75 Gb/second
in FY2015

total purchased bandwidth

OARnet Services

OARnet delivers technology-based solutions that reduce costs, increase productivity and improve customer service—and has done so since its creation in 1987. Ohio's education, health care, public broadcasting and government communities voluntarily participate in OARnet's shared services programs because of the benefits and value-added services they receive.

Aggregation

Internet

OARnet negotiated highly competitive, aggregate pricing on Internet rates for all stakeholders in FY2016. This shared approach secures Internet access at a price that would not be attainable on an individual basis. OARnet works with multiple service providers to ensure reliability and implements diverse routing plans to support the highest service level.

Internet2

OARnet serves as the regional optical network connector for all Internet2 connections in Ohio. Through a coalition of Internet2 member schools, OARnet can provide a higher-speed connection to the national research and education network at a cost below that available to any single university.

IntraOhio

OARnet reduces the cost of Internet services for its clients by offering this in-state service that connects only to other locations that are linked to OARnet's network. This makes dedicated bandwidth between schools more affordable by provisioning service over existing connections and the in-state backbone.

Broadband network access

OARnet connects its communities using a circuit-aggregation model. With consolidation hubs located throughout the state, this reduces clients' last-mile circuit costs.

OARnet leadership: (left to right) Letha Butcher, Ann Zimmerman, Pankaj Shah, Paul Schopis, Mark Beadles, Kelly Sitz, Mark Fullmer, (left inset) Denis Walsh and (right inset) Gary Goettel

Transport Services

OARnet provides high-speed transport service throughout Ohio by way of its 100 gigabit-per-second backbone. Transport service via IntraOhio connects eligible members to other OARnet sites, resources offered by providers such as the Ohio Supercomputer Center and OhioLINK, as well as services such as Voice-over-IP, business continuity and high-speed data transfers.

Data Centers

Connectivity

OARnet offers its members access to more than 10 geographically diverse data centers around the state, from facilities at Wright State University and Ohio University to carrier-neutral data centers.

Co-Location services

OARnet collaborates with Ohio universities to offer co-location services, which include rack space, power and access to Internet, Internet2 and IntraOhio. Members are taking advantage of these connections to expand cabinet space or implement disaster recovery plans.

Virtualization

Virtualization allows IT departments to create a virtual environment at the workstation, server or data-center level. With this technology, organizations can buy less hardware and software, reduce energy usage and require less staffing to maintain it.

VMware program

OARnet, the Ohio Department of Higher Education and VMware offer a virtualization program that enables OARnet clients to purchase virtualization software and maintenance at significantly reduced prices. Through this shared-service offering, clients have saved an estimated $4.3 million.

Salesforce

An aggregate purchasing agreement between Salesforce Inc. and the Ohio Department of Higher Education, in conjunction with OARnet, the Ohio Department of Administrative Services and The Ohio State University, provides a 65 percent discount on Salesforce software licenses. Carahsoft is managing the state contract for these services.

Identity Management Offerings

Currently, 15 Ohio institutions participate in eduroam, which provides secure, global wireless access for education. Thanks to a pilot project with the University of Rio Grande and Rio Grande Community College, OARnet is working to offer a VM-based eduroam/Shibboleth server package for members to use. Additionally, OARnet, Internet2 and Ohio University conducted a successful pilot to determine how to make eduroam available as a regional offering.

24/7 NOC

OARnet clients have access to outstanding engineering solutions through the around-the-clock network operations center.

Partnering to co-host 2015 Internet2 Technology Exchange

Presented by Internet2, this annual technical event convenes the community's technology visionaries from around the U.S. and the globe. This year's event is hosted in Cleveland, Ohio, by Case Western Reserve University in partnership with OARnet and the Ohio Internet2 members, with local support from OneCommunity.

By the Numbers

Through OARnet's flagship shared service, the network and its expansion into other services, OARnet promotes community and economic development by expanding access to affordable technology. Consider the following ROIs:

$8,000,000

Combined average savings each year on Internet costs for OARnet's communities.

$47,000,000

Amount Ohio higher education, K–12 schools and state agencies have saved through August 2014 on VMware licenses, maintenance and professional services. The new program with Salesforce Inc., increases the discount for the state of Ohio from 5 percent to 40 percent.

25%

Percentage drop expected on the cost per megabit of Internet, thanks to aggregate demand from the state of Ohio, Ohio higher education and K–12 sites. The large investment in OARnet shared services from the state has greatly reduced costs for all OARnet communities.

Communities

OARnet connects Ohio's education, health care, public broadcasting and government communities through more than 2,240 miles of 100-gigabits-per-second, high-speed broadband fiber. These communities voluntarily choose to participate in OARnet's shared services programs because of the benefits and value-added services they receive.
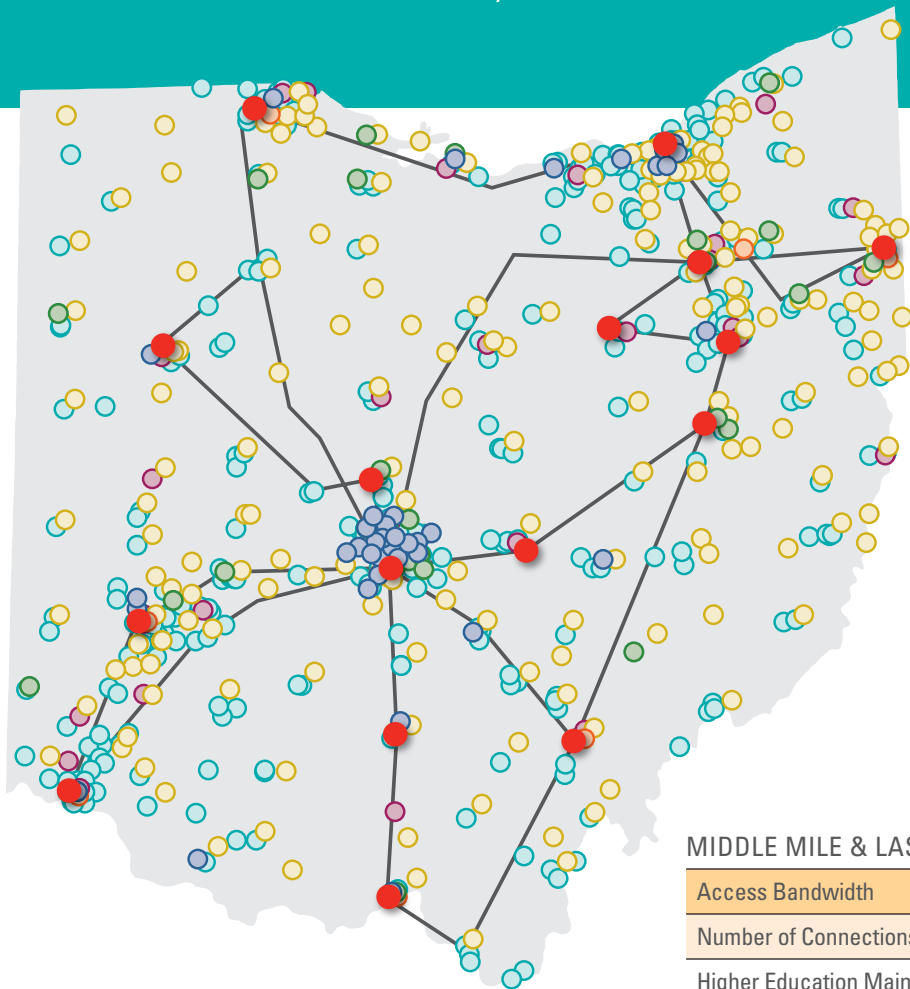
LEGEND

- **90** Higher Education Institutions & 333 Higher Education Regional Branches & Sites
- **32** K–12 Education Centers (Connecting 700 School Districts)
- **33** Local Government Agenices
- **750+** State of Ohio Sites
- **52** Health Care Sites & Research Institutions
- **14** Broadcast Education Media Stations & Services
- OARnet Backbone PoP Locations
- OARnet Backbone

MIDDLE MILE & LAST MILE CONNECTIONS

Access Bandwidth				
Number of Connections	100 Gbps	40 Gbps	10 Gbps	1 Gbps
Higher Education Main Campuses	3	—	14	62
K–12, ITCs & Large Urbans	—	—	30	—
State	2	1	10	—
Research	2	—	—	3
Shared Gbps Service*	—	—	—	38

* Shared Gbps Services for Higher Ed, State & Local Governments

Client Profile

OARnet connection improves Air Force materials research

WHO:
The Center for Electron Microscopy and AnalysiS (CEMAS) at The Ohio State University

WHAT:
OARnet provides a high-bandwidth connection between the lab and the Air Force Research Lab at Wright-Patterson Air Force Base.

IMPACT:
Air Force researchers can access the multimillion-dollar microscopes at Ohio State to improve their study of advanced materials.

As if it isn't amazing enough that the researchers at an Ohio State University lab can peer into the atomic-level workings of structural materials and biological systems, they are now operating their electron microscopes from the next room and are studying how they could leverage OARnet connectivity to do the same work from the next university or, eventually, the next continent.

The goal for the Center for Electron Microscopy and AnalysiS (CEMAS) is to "amplify what is possible" in the characterization of materials using multimillion-dollar electron microscopes. The center's director envisions the

lab as a hub for world-class characterization of materials research across all disciplines, from medicine and life sciences to engineering and physical sciences and everything in between.

Opening on Ohio State's west campus in 2013, the 20,000-square-foot center includes two electron microscopes from the Titan line—the world's most powerful, commercially available microscopes—that are optimized to perform analysis on the atomic scale.

"As we have created CEMAS to be one of the top centers in the world, we also have shouldered

Researchers at the Air Force Research Laboratory rely upon OARnet to provide the immense bandwidth necessary for "remote collaboration" with Ohio State's Center for Electron Microscopy and AnalysiS (CEMAS).

the responsibility to ensure that these capabilities are available to researchers not only at The Ohio State University, but indeed to researchers across the entire region, the nation and, to some extent, eventually the world," said David McComb, Ph.D., an Ohio Research Scholar and professor of materials science and engineering at Ohio State.

Materials and Manufacturing Directorate quickly recognized the benefit of augmenting their capabilities by also connecting to the far more sensitive instruments at CEMAS.

"The AFRL connection leverages a 10-Gbps fiber-optic link to the base between the OARnet backbone and the Defense Research and Engineering

looking at a very, very low wait, maybe only three milliseconds — that's almost the same delay you'll have just inside of a facility."

McComb recognizes that, from a funding-agency perspective, university labs at every single institution cannot continue to invest in instruments that can cost millions of dollars. The future is to place such

"The people at NSF, OARnet and the Ohio Supercomputer Center, as well as ourselves, recognize … it's undoubtedly going to be the way forward …"
— David McComb, Ph.D., director of Center for Electron Microscopy and AnalysiS at The Ohio State University

Thanks to OARnet's fiber-optic, 10-gigabit-per-second (Gbps) connection from the lab to the network's ultra-fast, 100-Gbps statewide backbone, any organization connected to OARnet's network can purchase time and directly operate the instruments from a remote location with no perceptible delay.

CEMAS technicians installed two remote stations, each about 60 miles from the microscopy center: one in the Air Force Research Lab (AFRL) at Wright-Patterson Air Force Base and another at the University of Dayton. Earlier this year, the Air Force lab purchased a pair of electron microscopes, but scientists working there for the

Network," explained Dana Rogers, OARnet client representative.

"With our direct connection to OARnet, we have a shorter, simpler path to our remote stations, since we're not traversing a university network or the commercial Internet," said Daniel Huber, a CEMAS technical officer, as well as a research engineer at Ohio State's Center for the Accelerated Maturation of Materials. Huber has been working with OARnet and the Ohio Supercomputer Center to enhance remote microscopy techniques since 2006.

"Utilizing OARnet, it's just a handful of hops—maybe three or four hops," he said. "So we're

instruments into institutions that have the infrastructure, the people and the support to optimize their performance for maximum impact.

"The people at NSF, OARnet and the Ohio Supercomputer Center, as well as ourselves, recognize that some development work and research needs to be done in order to deliver this," McComb said. "But, it's undoubtedly going to be the way forward, probably not just for electron microscopes, but for other types of high-end instrumentation." •

Through OARnet resources, OME-RESA keeps Appalachian districts well connected

WHO:
Ohio Mid-Eastern Regional Education Service Agency, better known as OME-RESA

WHAT:
OARnet provides a pair of low-cost, high-bandwidth pipelines between this Information Technology Center and the rest of Ohio.

IMPACT:
OME-RESA can now offer reliable connectivity to the 49 K–12 entities it serves, supporting such vital activities as distance learning and online standardized testing.

For many school districts in Appalachian Ohio, reliable Internet connectivity is a luxury rather than an expectation. With an assist from OARnet, the Ohio Mid-Eastern Regional Education Service Agency, better known as OME-RESA, provides districts in this area with high-quality, cost-effective technology and cooperative purchasing services.

OME-RESA is an Information Technology Center (ITC) of the Ohio Education Computer Network (OECN) that has been in operation since 1975. OME-RESA currently serves 49 entities with vital technology services, including server hosting, Internet connectivity, document management, fiscal and student applications and, most recently, support for standardized testing.

OME-RESA originally connected to the OARnet backbone on a 1-gigabit-per-second circuit around 2006 after the completion of the Ohio K–12 Network. Since that time, educational content has experienced explosive growth brought on by distance learning and virtual, rich media content. As with most ITCs, OME-RESA's school districts quickly outgrew the 1-Gbps circuits on which they were originally placed. While many districts in Ohio invested in additional bandwidth to meet demands, those in OME-RESA's area had neither the funds for nor the access to additional bandwidth. While the state of Ohio had approved the budget for a 10-Gbps upgrade to each ITC, OME-RESA's executive director, Angie Underwood, had

"OARnet has always been an unbelievable resource to us. The resources that they provide with network redundancy, manpower and support — we wouldn't be able to do what we do day-to-day without them."
— *Adam Truex, chief technology officer, OME-RESA*

Keeping schools connected: OARnet provided a 10-Gbps connection for OME-RESA.

to make a move sooner than the money could be granted.

"We were going down almost on a daily basis," Underwood said.

Through OARnet, OME-RESA was able to connect to the network ring closest to Pittsburgh, providing the 10-Gbps circuit it sorely needed. Once it received the middle-mile grant funding from the state, OME-RESA was able to establish a redundant connection out of Newark, also with 10-Gbps bandwidth.

"Because we're in a rural area, we have to be creative with what we do to provide Internet to the school districts," said Adam Truex, OME-RESA's chief technology officer. "We couldn't do it without OARnet."

The aggregate connectivity and cost-effective Internet access that OARnet provides are crucial to the rural areas that OME-RESA serves. Each year, OARnet negotiates aggregate pricing for its customers, so on average, Internet prices have decreased by 15 percent annually. While leveraging IntraOhio bandwidth on the state backbone reduces costs for OME-RESA, its school districts also benefit from the wider range of choices in Internet service providers (ISPs). In most locations, there often is only one ISP available, preventing competitive pricing.

"Our school districts don't have a lot of opportunity with telecommunications providers in our area," said Underwood. "We can backhaul their connections to us, so [OARnet] provides options and choice for districts."

OARnet further eases the cost-of-technology load on districts through its VMware virtualization software and maintenance contract. OME-RESA has leveraged this resource to virtualize its entire data center, also providing hosting to districts. Otherwise, districts would have to enter into separate contracts and purchase their own technology. This, as well as the connection to the state backbone, keeps vital, personal student and staff information secure. This is a non-negotiable requirement for K–12 schools.

"We have a lot of districts that do distance learning, which may cross other districts and ITCs," Underwood said. "The state network provides much more reliability and security to administer those types of connections."

Within the next six months, Truex said they will be upgrading OME-RESA's systems internally and building in further redundancy through a host site, possibly through another ITC. They will connect to this site through the OARnet backbone.

"OARnet has always been an unbelievable resource to us," Truex said. "The resources that they provide with network redundancy, manpower and support—we wouldn't be able to do what we do day-to-day without them." •

OARnet's high-speed links essential for virtual education

WHO:
Franklin University

WHAT:
OARnet provides connectivity between the main campus and its 16 co-locations and branch campuses around Ohio.

IMPACT:
High-speed broadband connectivity is absolutely critical for an institution where online enrollment comprises approximately 80 percent of the credit hours for a student body of nearly 10,000 students.

The explosive growth of online education in the past decade has drawn many adult learners to seek out degree programs that offer flexibility and constant access to resources. Franklin University in Columbus, Ohio, is a poster child of this phenomenon, with online enrollment comprising approximately 80 percent of its credit hours. Throw in 16 co-locations and branch campuses around the state, and it's clear why strong network connections are essential to its operations. This is why high-speed broadband connectivity through OARnet's 100-Gbps network is so critical to the university's operations.

Franklin University uses OARnet as a transit network to connect with most of its co-locations in Ohio as well as Urbana University, which Franklin acquired through a partnership agreement last year. While Franklin enrolls more virtual learners, Urbana operates under a more traditional university setting, with mostly on-campus students. However, Urbana wanted to improve its virtual presence. Fortunately, Urbana had existing connectivity through OARnet.

"OARnet was key in allowing us to make that happen because they have so much connectivity that we were able to take advantage of," said

Franklin University in Columbus is known for its online programs aimed at adult learners. OARnet's high-speed connectivity allows more instructional time for students and professors.

Richard Caldwell, manager of networking, visualization and storage at Franklin University. "We were very quickly able to get connectivity between our campus and the Urbana campus."

OARnet's extensive 100 Gbps network has allowed the university to create partnerships with other organizations as well. Metro Schools in Columbus will pilot a new public STEM high school in the fall of 2015. The Metro Institute of Technology will use classroom space at Franklin during the day, as most of the university's classes are held in the evenings. Because the existing Metro High School is on campus at The Ohio State University, a

main network node location, OARnet allows connectivity from Franklin to the school's core network using existing infrastructure and services.

While Franklin has dedicated network connections between its data centers downtown and north of Columbus, it also has a connection through the city of Columbus and OARnet to provide a redundant connection for network reliability.

"That is one more example of where OARnet's connectivity into a lot of key locations around the state has been a tremendous benefit for us," Caldwell said.

Additionally, OARnet's virtualization program with VMware allows Franklin to

purchase VMware software licenses at discount prices. Franklin has now virtualized over 95 percent of its servers, allowing the university to reduce the number of physical servers necessary, lower operational and maintenance fees and even save money on energy costs.

"There's a tremendous amount of savings in just not having to buy as many servers," Caldwell

said. "We've also seen a big difference in the amount of power used in our data center."

At the classroom level, high-speed connectivity and affordable software allow more instructional time for students and professors. Caldwell said some professors historically set aside a week or more at the beginning of a semester for students to set up online labs, for example. With the high bandwidth provided by OARnet, students today can jump right in to a course, with virtual environments set up and ready to go. And, Caldwell said, they look more realistic thanks to VMware's vCloud software.

Franklin University's excellent reputation for online coursework

"It makes for a better quality education experience they may not have otherwise."

— *Richard Caldwell, manager of networking, visualization and storage at Franklin University*

and degrees fills a need for many adult learners who would not have the time or resources to make it to a physical campus for classes. The services provided by OARnet make this virtual education experience an even better reality.

"It makes for a better quality education experience they may not have otherwise," Caldwell said. •

Morgan County NG911 makes life-saving digital upgrade

WHO:
Morgan County Next Generation 911 system

WHAT:
OARnet provides reliable, redundant connections for the county's digital first-responder dispatching system.

IMPACT:
As compared to its former system or those of surrounding counties, Morgan County residents now have a more dependable, efficient and highly responsive 911 system, which potentially saves more lives.

Nestled in valleys along the Muskingum River, Morgan County, Ohio's quiet villages have little to worry about. This could be a perk of living in Appalachia, away from the big cities. It also could be due to the security from having the county's recently implemented Next Generation 911 (NG911) system. This infrastructure, enabled by OARnet's statewide network, puts Morgan County on the cutting-edge of emergency response systems. This is something of which Morgan County NG911 Coordinator David Bailey is extremely proud.

"We're not a huge county in terms of population, and sometimes things trickle slowly down here," Bailey said.

The county's move to NG911 was a near necessity. A basic, analog e911 system was installed in 2009 through the phone company. Unfortunately, the system came with its share of issues, including being difficult to answer and slow to load location maps. Bailey said operators would sometimes be at or near the end of a call before the caller's location would load. Not only was this a headache for operators, but it also delayed potentially life-saving emergency procedures.

"The 2009 e911 system became very cantankerous," Bailey said. "Definitely not what you'd expect an emergency service to be."

That situation changed quickly. The e911 system provider informed the county that it would end total support for the system in 2015. County officials began hunting for a new system and found that NG911 was the way to go to improve operations and save lives. The switch meant a change from analog to digital, meaning the county would need to incorporate fiber-optic connections. After several meetings, Bailey found that they could use the OARnet backbone to connect not just one, but two diverse paths for 911 necessities. The system was initiated in July 2014, with a main connection linking the county to OARnet in Columbus and a second, redundant link linking to the network via Lima. Previously, Morgan
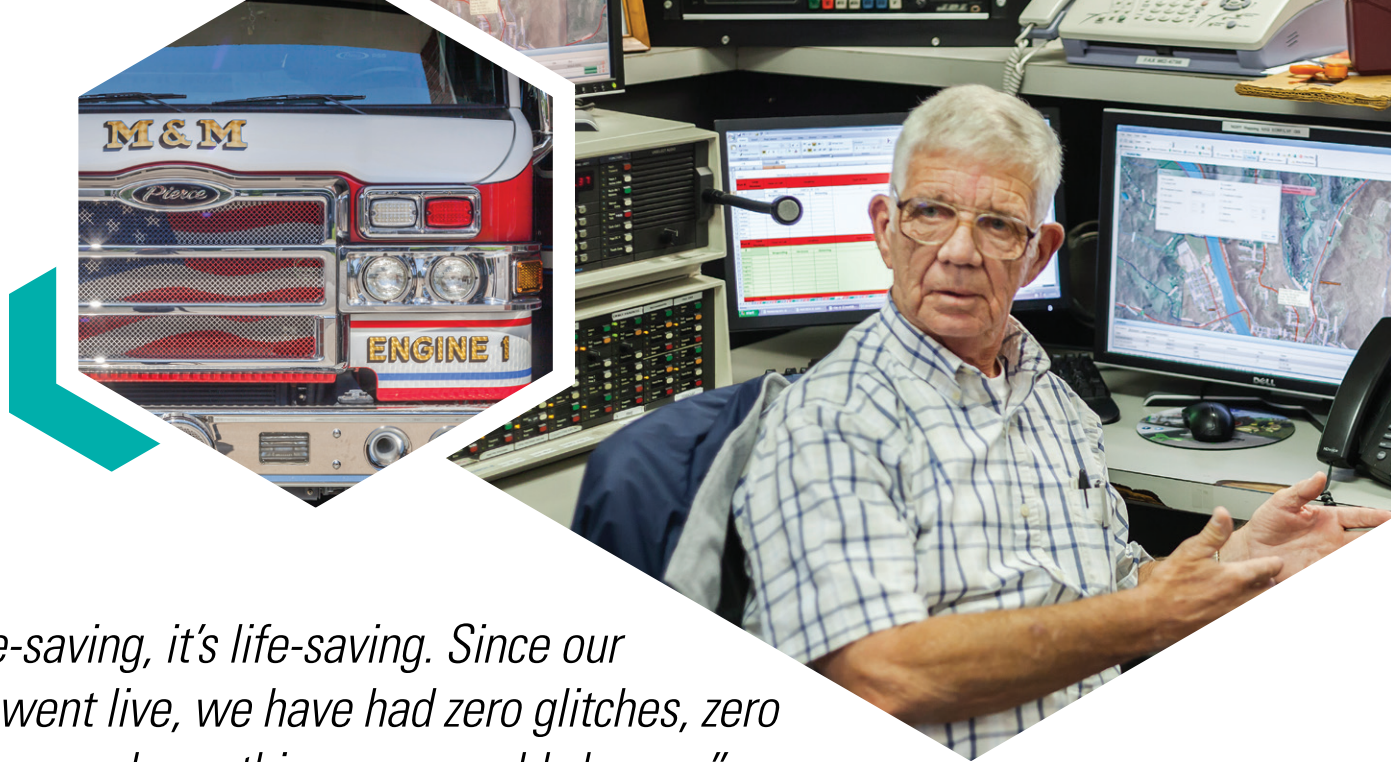
"It's time-saving, it's life-saving. Since our system went live, we have had zero glitches, zero down time and zero things we would change."

— David Bailey, Morgan County NG911 coordinator

County's e911 system had neither backup nor redundancy.

The new NG911 system also allowed the county to solve its mapping inconsistencies. The new system identifies wire line, wireless and Internet-based (VOIP) call locations as soon as they come in, allowing dispatchers to more efficiently coordinate emergency services.

"It's time-saving, it's life-saving. That's what this is all about," Bailey said. "Since our system went live, we have had zero glitches, zero down time and zero things we would change. Most importantly, I have received zero complaints or suggestions from the professionals who handle these calls on how to improve or make this NG911 system better."

The one downside? Morgan County operators have to slow the machinery down to transfer calls to surrounding counties using analog 911 systems. Bailey pointed out that the more counties that adopt NG911, the more efficient existing next-generation operations will be. With next-generation border-control mapping, Morgan County would not even receive wireless calls from out of area, and if a call did need to be transferred, the receiving location would receive all digital data, including mapping.

"OARnet's high capacity and great reliability are essential for Ohio to be able to consider state-of-the-art technology options, such as the pilot NG911 project in Morgan County," said Stu Davis, CIO for the state of Ohio.

When the county's very first 911 call system was installed, Bailey was mayor of McConnelsville, the county seat. Since then, in various roles, he has guided the safety of Morgan County's 15,000 residents. Looking forward, he has been in talks with another county looking to become next-generation compliant, also by using the OARnet backbone. Should they do so, this county could take over Morgan County's emergency calls, should a disastrous situation occur. In true form, Bailey is always taking the next step toward preparedness.

"You've gotta look down the road and say 'What's the best proven practice and best path to Next Gen 911?'" ●

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