

AN INFRASTRUCTURE FOR THE FUTURE

A RESEARCH REPORT FROM
THE CENTER FOR DIGITAL EDUCATION

A. Michael Berman,
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A photograph of a man with grey hair, wearing a dark blue polo shirt and dark jeans, standing in a garden. He has his arms crossed and is looking off to the side. The garden is filled with various plants, including purple flowers in the foreground and a large tree trunk on the right. In the background, there are green trees and a white building with a red roof.

Building a Strong
Foundation for a
Scalable Education
Environment

THE CENTER FOR DIGITAL EDUCATION SPECIAL REPORT is a one-of-a-kind publication that provides education leaders with research-rich content that includes perspectives from industry experts and public sector peers. It consolidates current thinking, best practices, tips for successful implementation, professional development guidance and more — all within a single source. We hope you enjoy this Special Report on An Infrastructure for the Future. Don't miss the next Special Report on Big Data in Education coming out this fall! www.centerdigitaled.com/reports



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On an average day in 2014, more than 22 million cyberattacks threatened to infiltrate Penn State.

WHY A STRONG IT FOUNDATION MATTERS IN THE DIGITAL AGE

On a typical day in 2014, more than 22 million cyberattacks threatened to infiltrate Penn State. Two attacks targeting the university's College of Engineering managed to slip past security systems. Thanks to an alert from the FBI, the university investigated the attacks and disconnected the college's computer network from the Internet for three days while it beefed up security.¹

In K-12, school districts are constantly launching digital learning initiatives that require large amounts of bandwidth and mobile devices. But many of them don't address the IT infrastructure beforehand. And that leads to horror stories of the network slowing to a crawl with students and teachers unable to connect their devices to the Internet due to lack of wireless coverage.

"Infrastructure is one of those things that is not sexy and is not glamorous," says

Susan M. Bearden, director of information technology at Holy Trinity Episcopal Academy in Melbourne, Fla. "I mean, who really wants to hear about switches or bandwidth or choke points in a network? But if you don't have that infrastructure in place, then you are setting yourself up for failure."²

Unfortunately, education institutions don't always recognize the tenuous situation they're in until they fall prey to successful cyberattacks and show-stopping network failures. But it doesn't have to be that way.

This Center for Digital Education (CDE) Special Report guides education IT leaders through the trends, technologies and tips that will help them build a future-ready infrastructure to carry their institutions through the challenges of life in the digital age. ■



Only 17% of K-20 campuses are equipped to handle more than two devices per student or faculty member.

Source: CDE Technology Infrastructure Survey, February 2015

THE TECH TRENDS THAT PUT PRESSURE ON IT INFRASTRUCTURE

Bring-your-own-device (BYOD) initiatives are once again at the top of the 2015 NMC Horizon Report's list of emerging technology trends that are likely to become mainstream in both K-12 and higher education.³ In fact, the number of mobile devices used

by students and faculty puts more strain on IT infrastructure than video and audio content, online testing or even increasing amounts of data. This is according to 69 percent of higher education and 78 percent of K-12 leaders who participated in a recent CDE survey conducted for this report.

On average, college students bring six devices on campus – they expect Wi-Fi that's fast, reliable and ubiquitous.



Respondents also noted that 21 percent of K-20 institutions can't handle even one device on the network for every student and staff member.⁴

This is especially problematic in higher education where, on average, students bring six devices to campus, including smartphones, tablets and laptops.⁵ These college students expect to connect to Wi-Fi from any of their devices like they expect electricity in the classroom — ready, fully functional and available at the flip of a switch.

"They've grown up using Netflix, Amazon and Facebook, and it's hard for them to understand why universities and even K-12 schools can't provide services like that," says A. Michael Berman, vice president of technology and communication at California State University Channel Islands.⁶

Along with an increase in devices, the number of students on campus is rising dramatically. Across the U.S., higher education went through a 46 percent growth spurt while K-12 had a more moderate 6 percent increase in students between 1996 and 2010. By 2021, projections peg university enrollment to increase by 15 percent to 24 million students, while K-12 school districts will serve nearly 60 million students.⁷

These student and mobile device increases are inundating campuses with copious amounts of data. Whether it's from the classroom, the back office or research labs, education institutions are trying to figure out how to store, manage, secure and access mountains of information.

At the policy level, governors signed more than 25 of the 110 student data privacy bills introduced in 2014, and legislators have already introduced more than 130 bills in 2015 — including several at the federal level.⁸ Additionally, more than 100 technology vendors signed a student privacy pledge to protect the data for which schools and universities have granted them access. Those who signed the pledge committed to policies such as not selling student data; collecting, using and retaining student information only for purposes for which they are authorized; and supporting

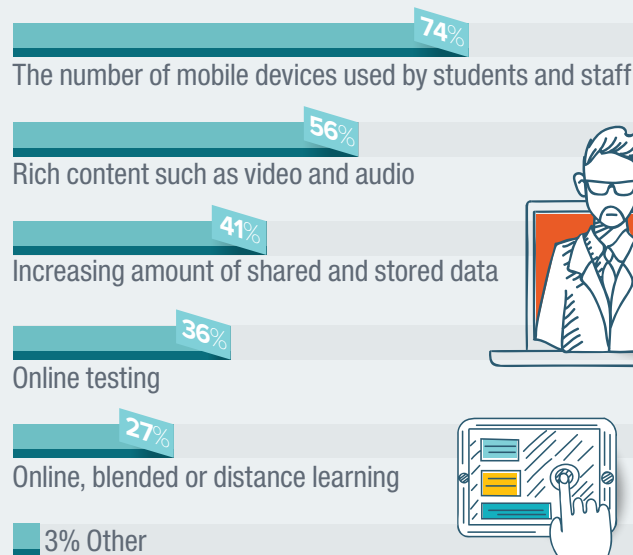
By 2021, K-12 school districts will serve nearly 60 million students.

access to and correction of student personally identifiable information.⁹

Another hot policy topic met reality this year as states started using online assessments to measure students' mastery of the Common Core and other state standards. School districts that increased their bandwidth recently cited online assessments as one of the three main factors influencing their decision.¹⁰

These trends stretch an already thin layer of IT infrastructure to the point of breaking on some campuses. It's time to dig into the digital toolbox to figure out how to build an infrastructure that will withstand the converging trends of people and technology. ■

Technologies straining education infrastructures include:



Source: CDE Technology Infrastructure Survey, February 2015

A DIGITAL TOOLBOX FOR NEXT-GENERATION INFRASTRUCTURE

Education institutions must consider implementing new technologies, or expanding upon existing technologies, to ensure the needs of students and faculty are met both now and in the future. A flexible, scalable infrastructure is necessary to building a future-ready campus. Fast networks, redundancy, virtualization and shared services are just a few of the tools that can help education institutions respond to increasing demands on their infrastructure.

Fast and Reliable Networks for a 24/7 Campus

Students and faculty expect the Internet to support 24/7 collaboration, research, learning and teaching. In this environment, IT staff must keep the Internet accessible on all areas of campus, just like the maintenance staff do with water, heat and electricity. “Infrastructure, Wi-Fi and Internet access are all now considered the fourth utility in the sense that many schools cannot run without them,” says Andrew P. Marcinek, director of technology for Grafton Public Schools in Massachusetts.¹¹

The need for speed. Approximately 81 percent of higher education IT leaders say addressing the rapidly growing demand for network bandwidth is an important issue on their campus.¹² In fact, more than half of them increased funding and doubled the speed of their residential networks to at least 1 gigabit in 2014.¹³

Over the last decade, state groups, including the Ohio Academic Resources Network (OARnet), have built fast fiber-optic networks to serve colleges, K-12 schools and government agencies, among other organizations. More than 1,500 miles of Ohio’s 1,850 fiber-optic backbone runs at blazing 100 gigabit speeds.¹⁴ Because of its extensive coverage and volume purchasing negotiations, the network helps education institutions tap into more cost-effective broadband that’s fast enough to handle rising infrastructure demands.

As K-12 schools continue to shift to digital learning, they’re finding out how much bandwidth they really need to serve their students. By the 2017-18 school year, the State Educational Technology Directors Association (SETDA) recommends school districts have at least a 1 gigabit external connection to their Internet service provider for every 1,000 students and staff — a recommendation the Federal Communications Commission (FCC) and the Partnership for Assessment of Readiness for College and Careers (PARCC) also endorse. SETDA also recommends at least 10 gigabits for an internal wide area network (WAN) connection between the district and schools.¹⁵

That’s a huge jump for school districts. Approximately 15 percent can reach 10 gigabit internal WAN speeds with their current infrastructure, and the same is true for their external Internet connection. Another 44 percent have



5% of school districts had at least 30 days of Internet downtime in 2014.

Source: CoSN’s 2nd Annual E-rate and Infrastructure Survey 2014

1 gigabit connections among schools on their WAN.¹⁶

Two of the biggest barriers to high-speed connectivity are Internet affordability and large capital expenses. However, the modernization of the federal E-rate program provides schools with additional opportunities to earn a discount to increase the speed and strength of their internal network connections. The E-rate program is phasing out discounts for telecommunications in favor of broadband, with \$1 billion annually available for internal connections, basic maintenance and managed internal broadband for fiscal years 2015 and 2016.¹⁷

The need for reliability. Along with speed, reliability is a key component to an efficient network. Infrastructure often takes a backseat to shiny new devices, and that's a major problem as institutions provide more digital content and personalized online learning opportunities. Education institutions need adequate bandwidth, up-to-date wireless access points that provide pervasive coverage and wired network switches that can handle increases in bandwidth.

Surprisingly, 5 percent of school districts had at least 30 days of Internet downtime during the school year. And just over half of school districts only contract with one Internet service provider, which means they have no backup if their network goes down.¹⁸

That's why redundant fiber connections, microwave connections or cellular broadband between the campus and the Internet are so important. If one Internet connection goes down, the other one will stay up so students and instructors can continue learning without interruption.

"If there's one day where a classroom doesn't have what they need and technology gets in the way of learning, then I need to fix that immediately," says Marcinek from Grafton Public Schools. "There's no waiting time."

In order to fix these Internet problems, institutions often need to install more access points in

classrooms and open spaces so students have access to wireless no matter where they are. Marcinek is in the process of slowly moving over to 802.11ac access points, which meet the latest wireless standards and are more robust than the previous model.

However, the solution isn't always just to add more access points — reliable connectivity also means looking at the network's other components to address the overall network architecture. For example, an institution might have a gigabit of bandwidth for every 1,000 students, but the network switch doesn't have a gigabit connection. That causes the network to stall, and depending

"Infrastructure, Wi-Fi and Internet access are all now considered the fourth utility in the sense that many schools cannot run without them."

Andrew P. Marcinek, Director of Technology,
Grafton Public Schools



According to Andrew P. Marcinek, director of technology at Grafton Public Schools, technology and a faulty infrastructure should never impede the learning process.

CHRIS COE

on the network configuration, firewalls and Web filters can also create the same problems.

“You can have all the bandwidth in the world, but if you have a chokepoint on a particular network device, then that’s the best performance you’re going to get,” says Bearden from Holy Trinity Episcopal Academy.

Along with outdated network infrastructure, high-bandwidth applications can also cause chokepoints. It’s important for education institutions to prioritize bandwidth so activities such as streaming videos and music don’t prevent educational tools from working correctly.

In higher education, a reliable network is no longer a “nice-to-have,” it’s a necessity. Beyond impeding the learning process, difficulties accessing the network can also overwhelm staff.

For instance, Utah Valley University (UVU) saw an increase in the number of mobile devices used on campus after it launched a

BYOD initiative. While beneficial for learning, the initiative came with a few challenges, one of which was a reliable connection to the network. “This went hand-in-hand with a significant increase in the number of calls to our help desk because of associated network access and security problems,” says Duke Heaton, wireless network engineer at UVU.²⁰

To resolve these challenges and ensure easy network access, UVU implemented software to automate network access control, which yielded immediate results. Within two months, more than 30,000 unique devices were registered on the network, eliminating frequent calls to the help desk and providing faculty and staff with a secure, reliable connection.

“We’re now seeing a more productive classroom experience, a more rewarding student experience and a better learning experience overall because we’re able to use mobile,” says Ray Walker, associate vice president of information technology at UVU.²¹

Making a Good Return on Network Investments



Unified communications allows universities to take advantage of their investments in fiber backbones, switches, routers and 10 gigabit networks. Instead of running two different Ethernet wires for data and devices, the University of North Alabama (UNA) runs all communications across one Ethernet line, which means it pays lower labor and cabling costs on new construction projects.

“The biggest thing is that unified communications streamlines communications, and it helps you save time, money and people so users can stay in touch and get their work done wherever they are, using whatever device that’s most convenient for them,” says Stephen Putman, CIO at UNA.¹⁹

Building a Virtual Foundation

Over the years, many technologies have promised to cut costs and help IT shops run more efficiently. But oftentimes, the best way to reach these goals is to combine several different technologies rather than one “fix-it-all” solution.

That’s the case with virtualization. Coupled with cloud computing, hyper-converged infrastructure and software-defined networking, virtualization can help education institutions save time and money while increasing their ability to quickly scale their IT infrastructure.

IT on the virtual farm. Life in this virtual world looks a little different. Instead of having one application run on one computer server, virtualization enables one computer server to handle a number of different applications and operating systems at the same time. Furthermore, that computer server can run virtual machines that host different desktop operating systems.

Virtualization can give education institutions a more flexible and scalable infrastructure that is easier to upgrade in the future. According to the recent CDE survey, 52 percent of K-20 institutions rely on virtualization to ensure their IT infrastructure is robust and readily available, while 24 percent plan to implement virtualization in the next 12 months.

Fort Worth Independent School District (Fort Worth ISD) in Texas operates in a virtual environment that includes virtual servers and approximately 3,000 virtual desktops, which are distributed throughout the district. Instead of buying new physical servers every four years, the school district invests in more processors and allocates random access memory (RAM) to its virtual servers when needed. And instead of spending six weeks ordering and installing a physical server, it only takes a few days to set up a virtual server.

This quick uptime means institutions don't have to worry about buying hardware or having enough servers for projects, says Putman from the University of North Alabama. If the university needs another server, they just spin up a new one in a few minutes, which saves both money and time for institutions with small IT shops. On the same note, education institutions can instantly scale the amount of storage they have available through virtual storage area networks (SANs). This software-defined storage allows them to set storage policies that virtual machines control.

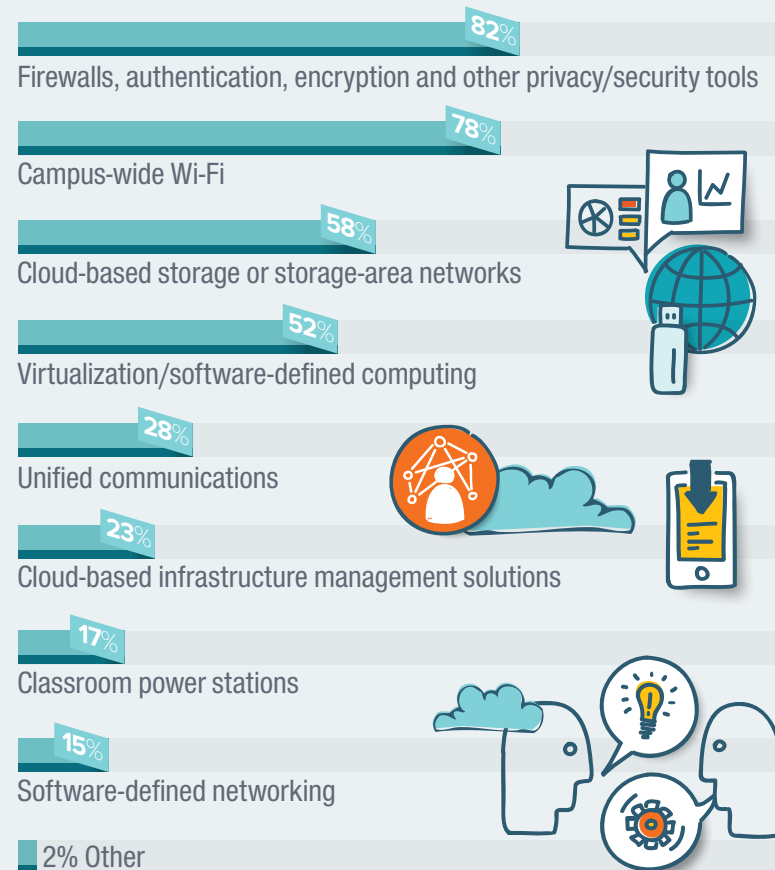
When disaster strikes, virtualization makes it easier for IT staff to get everything back online. Some argue that business continuity and disaster recovery are the greatest benefits of virtualization. "In a virtual environment, it takes a lot less to build a system, and if you have snapshots or backups of your virtual environment, you can recover faster," says Mcdeny Mojica, director for network services at Fort Worth ISD.²²

But that doesn't mean virtualization comes without challenges. At first, the Fort Worth IT team

put too much on the new virtual environment and experienced network failures as a result. While the environment was set up to reap the benefits of virtualization, it wasn't done in such a way that it could recover from itself. "It is important to have a recovery strategy and proper technical training to ensure the staff is well prepared to support this environment," says Mojica.

These challenges emphasize how important technical training is to the very

K-20 education leaders report using the following technologies to ensure a robust, scalable and accessible IT infrastructure:



Source: CDE Technology Infrastructure Survey, February 2015



A. Michael Berman, vice president of technology and communication at California State University Channel Islands, is using cloud services to lower costs and improve services and security.

fabric of any core infrastructure and how it must be factored into the planning, implementation and budgeting processes.

“I would say the professional services is a critical part of the implementation,” says Kyle Davie, chief technology officer for the district. “You want to take your time, ensure you thoughtfully design the environment, move slowly with it and have a fallback plan.”²³

IT in the clouds. Virtualization can act as an onramp to cloud computing, which allows education institutions to outsource some of their backup and disaster recovery services through third parties — including regional school support organizations and the private sector. For example, infrastructure-, desktop- and disaster recovery-as-a-service all mean that third parties host virtualized computing resources in the cloud for institutions.

And it’s not just useful for emergencies. Cloud computing increasingly gives schools and universities the ability to scale services quickly, access information from anywhere and pay for services as they go — freeing up IT staff time that can be spent supporting the institution’s educational efforts.

Whenever possible, the North Carolina Department of Public Instruction in Raleigh asks vendors to provide new infrastructure-as-a-service options in the cloud. This way, its technology staff members can focus on carrying out the state’s plan to personalize and digitize education so students can excel after high school.

“We are not in the business of IT; we are in the business of education,” says CIO Michael Nicolaides. “We believe that by using the technologies that exist in the cloud, it makes it easier so we don’t have to worry about the infrastructure.”²⁴

According to a recent study, nearly half of higher education IT leaders are reviewing cloud storage, archiving and business continuity applications, while almost 20 percent are already using these services. Eighty-four percent of higher

“We are not in the business of IT;
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Michael Nicolaides, CIO, North Carolina Department of Public Instruction

education institutions already use cloud-based student email.²⁵

Universities are starting to recognize that classifying storage and email as commodity IT services that are better managed in the cloud can benefit their campuses. According to Gartner’s framework for analyzing technology services, universities spend the majority of time on “run” items, which are day-to-day needs such as email and storage that are ubiquitous. IT staff spend a much smaller percentage on “grow” items that provide better or newer services and “transform” items — big ideas that dramatically change how they do business.²⁶

“We’re having a lot of conversations within our IT and library departments about how to spend less time on ‘run’ items — and some of that is by pushing it to the cloud,” says Chris Rhoda, vice president for information services and CIO at Thomas College in Waterville, Maine.²⁷

Using software in the cloud helps campuses implement technology faster and solve problems more quickly with less staff. While some staff members at California State University Channel Islands initially were skeptical of the move to the cloud, they came around when they realized it empowered their team to get more done with fewer resources. And because some of their tasks were offloaded to the cloud, they are making progress on the long backlog of projects the university wants accomplished.

“We’re really looking at lowering our costs and improving our services and security at the same time. We think we can do that by going through a thoughtful process of using certain cloud services,” says Berman from California State University Channel Islands.



As budgets declined for many universities, state higher education leaders began to consider alternatives to survive the shift from being state funded to state supported.

But cloud computing comes with its challenges too. Education institutions need enough bandwidth and a consistent Internet connection to access the large files and digital learning resources they store in the cloud. To overcome this hurdle, Thomas College shifts traffic like this onto Internet2, a high-speed research and education network connection, to avoid congestion.

“We can create the best connections in the world, we can use the best cloud services in the world, but if we don’t have a high-speed path between us and wherever that cloud system is, folks will complain about sluggishness,” says Rhoda.

Another challenge is portability between cloud vendors — transitions between providers don’t always go as planned. When this happens, institutions can end up stuck in limbo while their data is held hostage.

Fort Worth ISD solved this problem by moving to a hybrid cloud environment where

essential services, including the student information system (SIS) and child nutrition system, are hosted in the cloud, but the district also keeps a copy locally.

“We’re kind of saying, ‘We’re putting in enough that we’re trusting you, but we’re not naïve enough to think that we’re giving you everything plus the keys to the kingdom,’” says CTO Davie.

IT on a single platform. Along with cloud computing, hyper-converged and converged infrastructure help education institutions reap more benefits of virtualization, including scalability and cost control.

A typical virtualized network architecture features a virtualization hypervisor that controls physical servers and the virtual machines that run on the servers. The storage for these machines comes from direct attached storage, network attached storage or a storage area network (SAN).²⁸

William Jessup University in Rocklin, Calif., estimates it saved \$10,000 to \$15,000 by buying integrated storage and computing network nodes instead of buying separate servers.

When converged infrastructure comes into play, flash storage attaches directly to the physical servers, and hardware components such as storage and servers from different vendors work together. This allows education institutions to easily manage communication and collaboration systems across campus as well as take a unified approach to their data centers.

With a hyper-converged infrastructure, storage and computing integrate on a single software platform. A storage controller function runs as a software service that attaches to each virtual machine, essentially creating a large storage pool and potentially eliminating the need to buy expensive SANs and network attached storage.

Both of these approaches promise the ability to intelligently manage and scale infrastructure services quickly. And that helps campuses tackle big data projects, as well as collaboration among students and faculty from any location.

They also help education institutions cut overhead, centralize backup and disaster recovery for key applications, and reduce network latency — the roundtrip time the network takes to send and receive a packet. For example, Blue Springs School District in Missouri consolidated 22 data centers down to one, paid less money for hyper-converged storage and estimates that it will cut electrical expenses by \$100,000 each year.²⁹

In Rocklin, Calif., William Jessup University needed to replace its 10-year-old SAN that could only handle 2.5 terabytes of data. It also had 34 old servers, including 20 virtualized servers.³⁰

The university estimates it saved between \$10,000 and \$15,000 by buying integrated storage and computing network nodes instead of buying separate servers. On top of that, it saves nearly \$12,000 per year on power. Now the storage controller function runs 46 virtual machines, which power databases for remote desktop services, an SIS and application development, among other things.

IT on two planes. A related technology to hyper-converged infrastructure and virtualization is software-defined networking, which takes network control away from hardware and gives it to a software application called a controller. This approach helps education institutions scale network resources quickly whenever they need them and makes the network more programmable.

But education institutions have been slow to adopt software-defined networking. Just 18 percent of higher education institutions and 11 percent of K-12 institutions have adopted the technology, which has seen more traction in the business world. While it represents the future of networking, it is mainly large company data centers and research and education networks that are reaping the benefits of software-defined networking currently.

Care to Share? IT Services Cross Institutional Boundaries

As budgets declined for many universities, state higher education leaders began to consider alternatives to survive the shift from being state funded to state supported. That's where shared services comes in. It promises to give institutions a lower cost of ownership, better quality service and more competitive pricing options because of collaboration among multiple institutions.³¹

The State University of New York System (SUNY) encouraged its 64 campuses to collaborate and share IT services as part of a strategic plan to be more efficient in non-instructional areas so more resources could directly support student learning.³² As a result, Hudson Valley Community College (HVCC) and the University of Albany share the community college's data center and have a fiber link that connects them. But the two CIOs of these campuses have more than technology in common.

"My philosophy is one CIO cannot do all," says Steve Chen of HVCC. "Share leadership,

Privacy and Policy

Two major federal laws govern how schools and universities treat student data: The Family Educational Rights and Privacy Act (FERPA) and the Children's Online Privacy Protection Act (COPPA) of 1998. FERPA primarily protects data about students, including educational records such as grades, while COPPA prevents the collection of student data.³³

FERPA: Prevents education institutions from sharing personally identifiable information from student records with third parties without written consent from parents and students. Two notable exceptions exist: 1) schools can share this information with school officials who have a legitimate educational interest in it, and 2) directory information, such as an address, can be shared with others.³⁴

COPPA: Prevents website operators or administrators from knowingly collecting personally identifiable information from children under age 13. COPPA also ensures parents, guardians and schools have the ability to access and delete collected data.

As education institutions adopt more technology tools to personalize learning, third-party tools increasingly log large amounts of student data, which can be stored for long periods of time. The longer data is stored, the more valuable it becomes to hackers and other third parties who want to use it to benefit their companies. Not all of this data needs to be collected and shared, and of the data that is collected, much of it should not be stored long term or put in the hands of people who aren't using it to improve education. That's why these laws are so important — they're designed to safeguard student data.

Legislators, privacy watchdogs and educators are split on whether FERPA and COPPA should be updated for today's digital age. Some argue for revised federal laws with more stringent policies, while others feel current legislation sufficiently protects student data as written. A number of legislators have introduced bills to overhaul these laws in the past year as states pass their own privacy bills.

Regardless of whether these laws are updated, education institutions need to be able to show they're compliant with them. And in higher education, proof of compliance can mean the difference between being awarded a grant or operating without funding. As a result, a number of education institutions have created their own policies and procedures to safeguard student data, including requiring education technology vendors to meet specific standards and implementing a vetting process for technology tools that educators want to use in the classroom.

share vision, share the service and share the cost, and in the end improve the services and provide better and up-to-date technology for all students, faculty and staff within the SUNY system.”³⁵

This extends to K-12 and city government collaborations as well. In February 2015, Grafton Public Schools started supporting the city of Grafton's infrastructure. The school district prepares for disaster recovery via virtualization, archiving email through a cloud-hosted provider, and backing up student and health information onsite and offsite.

But as more institutions share services, additional challenges begin to emerge. Sharing services costs a lot of time upfront because the institutions have to establish a common view of the service, figure out what each campus needs and make sure their missions align. A shared services arrangement can also be difficult to sustain as key proponents and stakeholders retire or move on to different positions. In addition, campuses typically are better at consuming than providing services to each other.

“In my experience, it's a lot harder than it sounds to make that work,” says Berman from California State University Channel Islands.

Berman believes there are four factors that are critical to the success of shared services: 1) Tying initiatives to something that's strategically important to the university; 2) establishing effective governance; 3) finding sustainable funding sources; and 4) providing consistent and predictable service.

The Security and Privacy Tightrope

Nearly half of higher education IT leaders responding to a recent survey experienced a cyberattack on their campus network in a year's time.³⁶ Meanwhile, direct denial of service (DDoS) attacks are on the rise in K-12 school districts, leaving schools with networks so slow that they can't function.³⁷ At the same time, education institutions are trying to avoid being

caught in the crosshairs between security and user privacy.

To solve these challenges, approximately 80 percent of community colleges are looking to network access control systems and other initiatives to help secure their networks.³⁸ The system works with a number of other systems to defend the network, including a next-generation firewall, mobile device management software and cloud network security systems. Ultimately, these technologies ensure computing devices have a clean bill of health and can be trusted before they're allowed on the network.

With network access control systems, IT staff members can set security policies that determine who is allowed on the network, what criteria they have to meet before they can log on and where they can go once they have connected. For example, the University of North Alabama specifies that computers on its network must have up-to-date antivirus software installed.

Fort Worth ISD is using E-rate and capital improvement bond funds to upgrade its core network, including adding network access control systems and access points in each classroom. In the end, the district will have 10,000 virtual desktop infrastructure (VDI) units, 22,000 1:1 devices for high school students, 30,000 laptops, 5,000 tablets and more than 85,000 students on the new infrastructure.

While network access control systems enforce policies at the device level, next-generation firewalls can stop sophisticated attacks by enforcing policies at the application, port and protocol levels. Firewalls integrate enterprise firewall capabilities, an intrusion prevention system and application control. This type of setup gives users more freedom and still protects the network because IT staff can allow specific applications while denying others. Eighty-two percent of K-20 education leaders who participated in the CDE survey rely on



Mobile device management software helps IT departments monitor, manage and secure devices connected to the network, regardless of brand or operating system.

Balancing Act: Security and User Privacy Rights

With security threats on the rise, sometimes it's hard to find a balance between security and user rights to privacy. The IT department at the University of North Alabama offers four steps that can help institutions strike the right balance:

1) Communicate. The university clearly communicates its security policies in as many places as possible so members of the campus community are aware of them. Users have to click "OK" to signify that they've read the policy in order to continue using the university systems.

2) Record. Most technology systems have built-in monitoring, logging and recording features. Some of them can be turned off, and some can't, but CIO Putman controls what is recorded whenever possible. He also limits who can access recordings such as firewall logs. He doesn't record unnecessary things, and he doesn't keep them longer than necessary.



3) Block. Instead of targeting security policies to specific individuals or roles, the IT staff members block known malicious sites and apps for everyone through the antivirus, firewalls and network security services.

4) Educate. Rather than blaming staff members for a security issue, the IT department helps faculty and students be part of the solution through education. After all, they don't want their data to fall into the wrong hands or see their institution break federal privacy laws. When IT staff work together with the campus community to help them buy into security, it makes life easier for the technology team and gets everyone on the same page. "We're not the mean IT person," Putman says. "We want to come across as their friend and not their foe."



firewalls, authentications, encryption and other privacy solutions to protect their infrastructure.

Together with next-generation firewalls, cloud network security services have cut support requests for viruses and spyware by at least 75 percent at the University of North Alabama. These services work with the network access control system to block vicious items before they enter the network. If a malicious item does evade security, it won't be able to get back out of the network.

Especially in K-12 education, mobile device management software helps IT departments monitor, manage and secure devices on the network, no matter what operating system or service provider is being used. With this software, the IT department at Grafton Public Schools keeps a transparent inventory of devices, knows when they last signed onto the network, and pushes apps and e-books out to student devices.

IT leaders at Grafton can control whether students access native apps, including messaging and photo apps, by pushing out different profiles to student devices. This comes in handy for teachers to help minimize distractions in the classroom.

The district also controls who accesses the network, as well as what device is used to do it. To save bandwidth, high school students can only log their school-issued devices onto the network, while teachers and administrators can use up to 10 devices, though not many of them have more than three. The district gives both the school community and guests access to the same filtered network, but they authenticate it differently depending on the user. Students, faculty and staff access the network through their active directory credentials, while guests type in a password from an index card at the front desk that changes monthly and agree to the acceptable use policy before they log on. ■

ADVICE FROM THE TECHNOLOGY TRENCHES

All of this technology and the rapid pace of change can get a little dizzying for any education decision-maker. That's why it's so important to let the institutional mission drive IT efforts, plan for more demand than expected and see how infrastructure technology affects learning. Following are some insights and best practices shared by both the private and public sector leaders interviewed for this report.

Undertake Mission-Driven IT Work

Without understanding what drives the technical decisions and teaching and learning efforts on campus, technology leaders may spin their wheels trying to finish countless projects that don't make much of a difference. That's why IT governance and project portfolio management are so important. Education institutions need to be good stewards of taxpayer dollars and digital resources so they can align their efforts with the institution's mission and produce valuable results that matter.

"The No.1 thing is to understand the mission of your institution so you know what the priorities are. There are so many more things you can do than you're ever going to have time to do, and it's always about making choices," says Berman of California State University Channel Islands.

For example, the university places students in the center of its efforts to provide integrated learning experiences and service opportunities.³⁹ This mission helps guide education technology leaders down a path of working on the right things at the right time for their institution.

By asking these five questions, IT leaders can focus more on supporting the institution's mission via technology:

1. What are your institution's mission, vision and goals?
2. Where can you play a role in supporting the institution's mission, vision and goals?
3. How much time do you spend on projects that don't directly advance the mission?
4. Where does it make sense to delegate some operational IT tasks to third parties?
5. What projects will you take on that will advance the institution's mission?

Plan for the Future

As part of the planning process for specific projects, it's best to overestimate how much infrastructure your institution will need. Once you put in a faster network or increase the amount of storage that's available, the education community will use those services more, and demand will grow exponentially.

By designing the network to handle up to twice the amount of usage you think it will have, you'll be in much better shape. Network usage should be actively monitored to identify possible problems and proactively manage network capacity. The ability to scale the network and other infrastructure services quickly becomes even more valuable as demand continues to rise.

"The biggest thing is to get a partner that you're comfortable with, vet the ideas and take the time," says CTO Davie from Fort Worth ISD. "Don't rush into it, and know that whatever you feel you need today, you're going to need at least 25 percent, if not 30 percent more capacity than what you're estimating."

It's important to look at not just the bandwidth and capacity that the lines can handle now, but also what they can handle in the future. Look down the road to project enrollment rates and plan for that population growth. As assessments become digital and more data is collected and analyzed, adequate bandwidth will be essential.



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University Channel Islands

Although it can be expensive, laying down fiber in between sites qualifies for E-rate funding and can lower reliance on local telecom providers. Fiber can handle more bandwidth, which is increasingly critical as demands for digital education increase.

When it comes to wireless access, faculty, students and visitors who come on campus expect to access the Internet. That means IT departments should be able to accommodate any type of device and operating system on the network.

The key is to provide these guests with secure access. Instead of allowing everyone to access the entire network, IT staff can use routers and switches to create different segments on the network. Guests go on one network segment, students on another and faculty on yet another.

An education institution has already lost the battle if students or faculty have to think about how to get onto the wireless network or store a file. The goal is to make the back-end infrastructure work seamlessly so that all students and faculty know is that they can access whatever services and resources they need anytime and from anywhere.

Strategically Finance Technology Purchases

Eighty percent of education leaders who participated in the CDE survey for this report identified cost and funding as a primary challenge in achieving a robust infrastructure.

To overcome this, some institutions are financing technology purchases much like they would a car. This practice gives them a sustainable long-term plan to upgrade wireless networks and switches so they can support new devices and meet emerging wireless standards. It also helps build professional training and capital expenses into their budgets so they can provide top-rate infrastructure consistently.

Additionally, purchasing the best technology available at the time can help mitigate future

spending as the newest technologies are likely to last longer before needing to be replaced. And oftentimes, vendors offer new versions of their products with three years of support. By taking this deal, institutions can use the latest technology without having to spend much more than the cost of renewing support services for their existing technology.

Ensure Cloud Security and Disaster Recovery

To make sure cloud services are secure, it's important to trust and have a good relationship with service providers who will protect the institution's data. To ensure the best results, institutions should:

1. Encrypt information between the institution and the service provider
2. Know where their data is stored
3. Make sure there is an understanding that data will not be mined and will remain private

When campuses consider cloud-based services, it makes sense to think about ways to recover key data after a disaster strikes. For critical data, backing it up daily to the cloud ensures that it will be accessible later if something does happen to local storage. A hybrid cloud allows an institution to mirror both onsite and offsite services as well as move them back and forth easily through a private network.

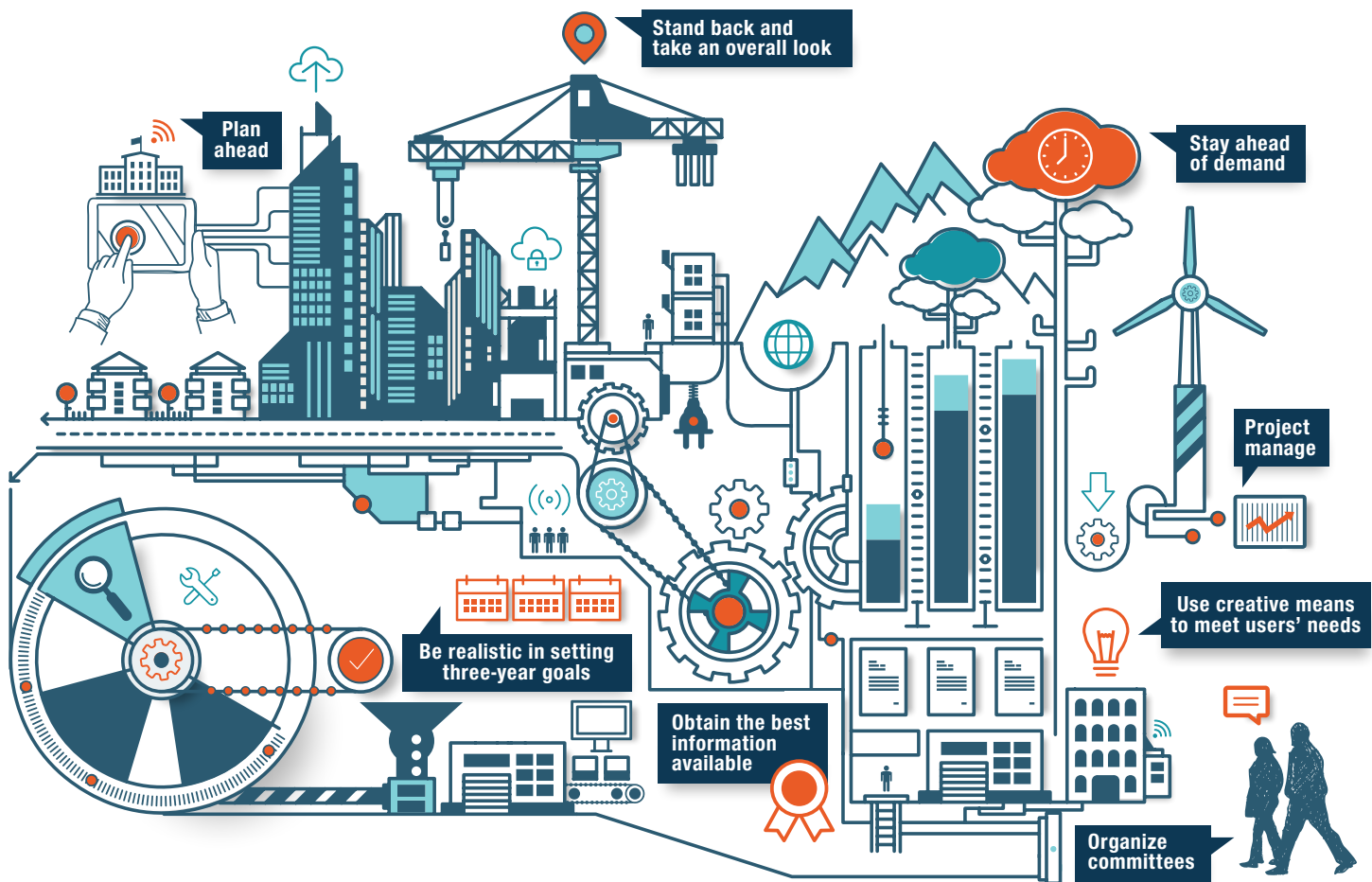
Understand the Classroom Impact

IT leaders should visit schools often so they can see how the infrastructure is working on a day-to-day basis. They also need to understand what's happening in the classroom and how the technology they're putting in place is making the learning process more efficient. Talking to and surveying educators and students will help them better understand the need and demand for a robust infrastructure. ■



80% of education leaders identify cost and funding as a challenge in achieving a robust infrastructure.

Source: CDE Technology Infrastructure Survey, February 2015



Words of Wisdom

Below are tips for implementing new infrastructure technologies as outlined by education leaders who participated in the CDE research survey for this report.

- ✓ Obtain the best information available on the upgrade planned and trust your vendor.
- ✓ Pre-planning, planning and more planning, then precise implementation.
- ✓ Well-controlled virtualization may be the single most productive improvement that can be made to infrastructure if it is currently all non-virtualized.
- ✓ Stand back and take an overall look at how other districts are implementing new technologies and what problems they encounter before jumping on the latest trends.
- ✓ Stay ahead of demand. Monitor capacity and service levels. Address issues before users notice the problem.

- ✓ Organize a committee of teachers, students, parents, board members and town citizens to put together a plan that will work best for students at both school and home. The infrastructure is the key component to a successful technology-enriched environment.
- ✓ Be intentional and illustrate the ROI. In reality, it's users that are driving change — they are demanding, we are simply using creative means to meet their needs.
- ✓ Make sure staff is accustomed to project management standards.
- ✓ In public education it's hard to justify and finance bleeding-edge technologies, especially with infrastructure. Be realistic in setting three-year goals and plan for fewer resources in each successive year.



FINISHING STRONG

With a future-ready IT infrastructure, districts and universities will be able to not only support their institutional mission, but also make their IT operations more efficient so more money can go back into the education of students.

Ideally, this infrastructure is flexible and scalable so it can handle the inevitable fluctuations in demand. And it's built to withstand the changing winds of technologies that come and go.

As the fourth utility, infrastructure, Wi-Fi and Internet should always be on and have the built-in capacity to recover when some components fail so that teaching and learning can continue. Whether a hurricane strikes or an Internet connection goes down, redundant Internet connections and virtualized computing resources in the cloud can help education institutions access the information they need quickly.

By learning from each other's mistakes and successes, education institutions can build a

"The infrastructure should be so good that no one even thinks about it. The best IT systems are the ones that people don't realize are there."

Chris Rhoda, Vice President for Information Services and CIO, Thomas College

future-ready infrastructure that will make the most of limited resources. And they can collaborate in ways that benefit multiple campuses.

Ultimately, the infrastructure should be just like a freshly paved road that carries information on its way without hitting a pothole. This invisible infrastructure lays a foundation for teaching and learning in the digital age. Thomas College's Rhoda sums it up by saying, "The infrastructure should be so good that no one even thinks about it. The best IT systems are the ones that people don't realize are there." ■

INFRASTRUCTURE

ACCORDING TO THE EXPERTS

“If there’s one day where a classroom doesn’t have what they need and technology gets in the way of learning, then I need to fix that immediately. There’s no waiting time.”

Andrew P. Marcinek,
Director of Technology, Grafton Public Schools

“Spending money on security doesn’t educate more students, but we don’t have any choice because otherwise we’re going to be really vulnerable.”

A. Michael Berman,
Vice President of Technology and Communication,
California State University Channel Islands

“Wireless is the shiny new object that people want to talk about. But if you don’t have your house in order on the infrastructure side, none of that really matters.”

Joe Simone, Director of K-12, CDW•G

“We are not in the business of IT; we are in the business of education. We believe that by using the technologies that exist in the cloud, it makes it easier so we don’t have to worry about the infrastructure.”

Michael Nicolaides,
CIO, North Carolina Department of Public Instruction

“We can create the best connections in the world, we can use the best cloud services in the world, but if we don’t have a high-speed path between us and wherever that cloud system is, folks will complain about sluggishness.”

Chris Rhoda, Vice President for Information Services and CIO, Thomas College

“Infrastructure is one of those things that is not sexy and is not glamorous. I mean, who really wants to hear about switches or bandwidth or choke points in a network? But if you don’t have that infrastructure in place, then you are setting yourself up for failure.”

Susan M. Bearden, Director of Information Technology,
Holy Trinity Episcopal Academy



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INFRASTRUCTURE for the Future

What is almost unnoticeable in classrooms but can mean the difference between a successful 1:1 deployment and a classroom full of frustrated teachers and students? What supports BYOD, online lessons and virtual field trips? What is the one item schools need before they can move forward with any major technology plans? The answer is a solid infrastructure.

The average school has about the same connectivity as the average American home, but serves 100 times as many users, according to Education Superhighway. "Over time, teachers become frustrated with the lack of technology performance," says Chad Stevens, CDW•G K-12 strategist. "Frequently, because of Wi-Fi network capacity, a perfectly fine device is deemed too slow, so teachers simply stop using it, but the real issue is the network infrastructure."

Thanks to E-rate, nearly all of America's K-12 public schools are connected to the Internet; however, as the needs of districts have evolved, the Wi-Fi networks have not scaled to support the increased bandwidth usage of staff and students. As schools and districts begin to implement new technology programs, they must first consider their wireless infrastructure.

"Teachers' No. 1 priority is helping their students learn, so while they may not see the wireless infrastructure they will quickly realize its value," says Stevens. "It will ensure that teachers can spend less time focusing on how to make the devices 'work' and more time making the most of online resources, engaging students and creating more interactive lessons. A strong network also means that as schools adopt new policies such as BYOD, the infrastructure can support the influx of technology."

CDW•G recommends schools and districts ready to embark on a technology upgrade follow a six-step process to deploy a successful wireless infrastructure:

- 1. Identify requirements.** Start by reviewing coverage and security to determine your districts' wireless needs. Coverage determines the speed of network operation and security defines how users will connect and their associated access controls.
- 2. Conduct a site survey.** This is an integral step. It helps determine the placement and number of access points required.
- 3. Select products.** Engineering practices discourage merged wired and wireless networks. As such, institutions should consider all options.
- 4. Install equipment.** Installing wireless equipment generally involves new cabling, patch panels and Ethernet. This process may also include testing, verification and enterprise integration requirements.
- 5. Tune for optimal performance.** This is the second site survey. It verifies network performance after the installation of the new access points.
- 6. Bonus step.** The wireless is up and running. To make the most of the new infrastructure, schools and districts should adopt fully managed wireless solutions, proactively manage and prioritize usage, and enforce smart guest policies. These steps will ensure wireless infrastructure success.



CDW•G is dedicated to helping districts and institutions realize the infrastructure of the future by ensuring thorough site surveys, determining the best resources for your unique campus or classroom, and sharing other districts and institutions' experiences to help make yours a success. Give us a call at **(800) 808-4239** or visit **www.CDWG.com**

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Acknowledgements:

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