A WHITE PAPER FROM

CENTER FOR DIGITAL EDUCATION

6 Steps to Network Modernization Success

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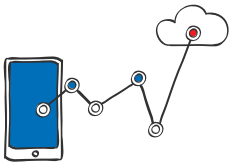
Today's K-12 schools are hungry for bandwidth. The reason is clear: high-performing, reliable and easily expanded network services support the latest classroom innovations, including videoconferencing, 1:1 computing, distance learning and modern learning management systems. It's no surprise then that progressive educators now see a direct link between the overall success of their school districts and access to high-capacity networks. This emerged as a clear trend in new research by the Center for Digital Education (CDE) — a commanding 98 percent of administrators and IT representatives said the future of K-12 education hinges on ubiquitous connectivity.

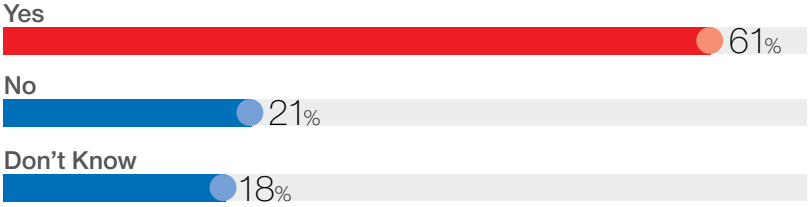
David Digiovanni, director of technology and information systems for Marietta City Schools in north-central Georgia, agrees. "In today's highly connected education environment, we see digital resources as a big factor in our success, both in where we are now and how we move forward," he says, adding the district is home to state and nationally recognized schools of excellence. "We know there's more exciting technology to come, so we want to be sure we're ready for it."[1]

But without a comprehensive strategy for high-performance networks, supplying enough capacity can turn into a planning and budgeting nightmare. The answer is to develop a multi-year roadmap that accurately predicts ongoing capacity requirements and then addresses them with modern but cost-effective services.

With insights gleaned from the CDE survey, along with guidelines based on industry best practices, this white paper lays a framework for planning and implementing high-performance networks. In addition to explaining why now's the time to plan network upgrades, this paper answers one of the fundamental questions asked by IT managers at schools everywhere: "How much network capacity will we actually need?"



Does your district have an IT strategic plan that addresses your bandwidth and connectivity needs?



Source: CDE "Insights into K-12 District Connectivity" survey, 2014

Digital Schools Come of Age

The rise of digital classrooms is compelling school administrators and their IT staffs to redouble efforts to give their schools a solid technology foundation. In particular, this group sees networks as a win or lose resource. For example, an overwhelming majority — nearly 93 percent of the respondents in the CDE survey — said there's a direct link between their school district's success and a modern network infrastructure.

This focus on networks isn't a case of being smitten with technology for technology's sake. School officials understand how important digital teaching resources depend on reliable, high-speed communications. Eighty percent of the schools represented in the survey use online learning tools, while 73 percent take advantage of streaming video in their classrooms. Sixty-two percent offer bring-your-own-device (BYOD) or 1:1 computing initiatives.

The ability to communicate effectively with outside resources is another important component for learning. Marietta's high school offers the International Baccalaureate curriculum, which relies on efficient Internet connections. Some students in the program use the latest 3D

computer-aided dispatch (CAD) software to design prototypes and then bring them to life with 3D printers. “Students need access to sophisticated resources while they’re in school instead of learning how to use them once they’re in a work environment,” Digiovanni says.

But digital classrooms aren’t the only reason to look more closely at underlying network resources. Eighty-seven percent of the schools represented in the survey conduct online testing and assessments, such as those from the Smarter Balanced Assessment Consortium (SMARTER Balanced) and the Partnership for Assessment of Readiness for College and Careers (PARCC). These tests require high-performance, reliable network services to support examination processes. Otherwise, transmission delays between a student and the test server may produce frustration among students and educators and even negatively skew the results. For example, some online tests stipulate that any interruption during testing aborts the exam and students must start from the beginning. Students who prepped to be in top form on the original test day may not be in the same mindset at a later date when the network is ready to support the increased traffic.

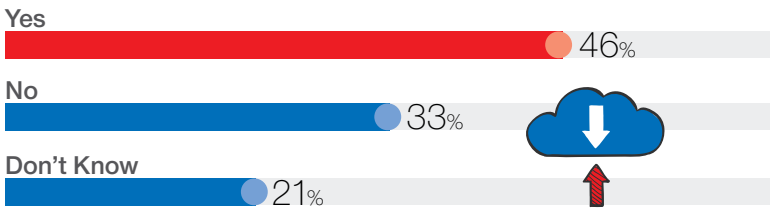
Taking all of the instructional and administrative considerations into account, 86 percent of respondents said they are making the modernization of their network infrastructures a top priority.

Turn Priorities into Realities

Savvy educators may appreciate the importance of modern networks, but many administrators don’t know how to reach their goals. Only about 46 percent of respondents have a plan that maps out long-term network capacity needs. Without this benchmark, network modernization strategies lack vital information required for shaping investment decisions over the next 18 months, 36 months and beyond.

Clearly, now’s the time to modernize network foundations. The reason: Gaps are already materializing in the form of network performance problems that threaten further advancements in digital education and online assessments. Forty-two percent of school officials said their network services are too slow, while a similar percentage said they lack network capacity to accommodate growing digital needs. Network reliability is also suffering — nearly 40 percent of the executives said downtime and interruptions challenge their organizations, and they found it difficult to quickly increase capacity.

Has your district developed a plan that maps out your long-term bandwidth needs?



Source: CDE “Insights into K-12 District Connectivity” survey, 2014

To overcome these challenges, school administrators and IT managers need a solid strategy for creating and maintaining modern network infrastructures that can support digital schools now and in the future. These six steps can help districts turn their goals into reality.

Step 1: Set concrete goals. School officials should first delineate the plans for digital learning, including the types and numbers of devices, services and applications that require network support. For example, learning management systems should be included in such an assessment.

Step 2: Determine how much network capacity will be required to support the applications. An accurate forecast is important for two reasons. First, it will ensure individual schools can maintain reliable performance even as more devices come online.

Second, schools will better support a growing number of Internet-enabled activities. For example, important external resources range from recorded news coverage of pivotal events studied in a history class to videoconferences that enable students learning Cantonese to converse with peers in Hong Kong.

Unfortunately, many school officials don't know how to accurately determine their needs. Are 10 megabit per second (Mbps) Internet services — a common rate for home broadband customers — enough? Or should schools opt for increments closer to 1 gigabit per second (Gbps) services to accommodate current and future demand?

Officials can begin to answer these questions by first gathering statistics about current network utilization rates to determine how close today's loads are coming to maxing out capacity. Standalone meters or dashboards available from network service providers can provide a school with these statistics.

Also consider recommendations from outside sources, such as the State Educational Technology Directors Association (SETDA), a nonprofit organization that publishes guidelines for minimum broadband resources for K-12 institutions.[2] Current recommendations call for at least 100 Mbps per 1,000 users for external connections to Internet service providers. However, SETDA is also advising school officials to prepare for 1 Gbps connections by the 2017-2018 academic year. The guidelines for internal wide area network (WAN) communications between district offices and schools and among schools within the district call for even higher rates: 1 Gbps per 1,000 users today, and 10 Gbps by 2017.[3]

"We do our planning by looking at historical information and using the guidelines we get from the state and SETDA," Digiovanni says. "A big driver for us now is the state's Georgia Milestones assessments. As students go online we'll watch to see how our network runs, as well as our utilization rates. Based on that we can plan for where we'll need higher capacity, new equipment and other enhancements."

Some networking experts suggest schools upgrading from outdated services subscribe to 100 Mbps services going to each school. IT managers can review monthly usage statistics to determine if that capacity is overkill for their needs, or conversely, nearing overload levels. District officials can then make any necessary adjustments. Similarly, usage reports gathered over time will identify annual trends and help school administrators understand if they'll have sufficient capacity if a major initiative, such as rolling out Wi-Fi to all students, is on the near-term roadmap.

Step 3: Choose appropriate broadband technology. After quantifying capacity needs, school districts should evaluate which networking services will serve their requirements in the years ahead. Traditional time-division multiplexing (TDM), the networking technology that underpins commonly deployed T1 and T3 lines, may still satisfy current requirements at many K-12 schools. But some industry experts say it's difficult to add capacity to these foundations when demand increases quickly.

For applications that require the highest performance levels, an all-fiber network for the local area network (LAN) and WAN may be the best choice. A fiber-optic network backbone balances high-performance, scalability and economical needs. Scaling is simple with fiber — schools can simply contact their service providers to adjust their contracts if demand increases and they need to upgrade from initial 100 Mbps services. Schools can buy what they need when they need it and can scale up in any increment when they need additional capacity.

If fiber is not available, other options include a coaxial cable running from the fiber backbone

A Smooth Move to the Fast Lane

Digital classroom technology is taking hold at Marietta City Schools, a charter school system in central Georgia. The district serves almost 9,000 students in eight elementary schools, a sixth-grade school, middle school and a high school. Four of the schools have been named Georgia schools of excellence and one a national school of excellence.

Each school runs a wireless network to connect tablets and e-readers for students. All of the classrooms are equipped with interactive flat-panel displays mounted on walls that used to hold traditional blackboards. The high school recently rolled out a bring-your-own-device (BYOD) initiative, and elementary schools are slated to do the same over the coming year.

But none of these innovations would have been possible without a lot of work behind the scenes. When David Digiovanni became director of technology and information systems three years ago, the district was running an inadequate 25 Mbps connection to the Internet, primarily to handle email for district staff. A steady stream of new demands to support digital learning tools prompted a series of upgrades — the network now runs two 1 Gbps Internet connections.

In addition to contracting for faster services, Digiovanni refreshed related hardware, including servers and network switches.

The changes are all part of a three-year technology plan. "It lays out what we want to accomplish with some achievable milestones to help us meet our goals within our timeframe," he says.

To create the roadmap, Digiovanni estimated the number of networked devices the district would have to support over the period. He then factored in network bandwidth recommendations published by SETDA, which coincided with state guidelines. For example, the Georgia Connections to Classrooms grant program, with a total $39 million in available funding, advises schools similar to Marietta's provide 1 Gbps service to each desktop, Digiovanni says.

An important element in the plan's success is making sure it's not a project that is solely promoted by the IT department. Digiovanni cultivates the backing of superintendents and other administrators in the district to champion digital technology and network upgrades. "When you make people like this part of the process, you eliminate some of the concerns their staff might feel when we make changes at their schools," Digiovanni says.

Digiovanni is already eyeing a move to 10-Gbps WAN connections. "Network performance is a moving target," he says. "Every time you think you reached a new plateau, someone pushes you to climb higher up the mountain."

or digital subscriber line (DSL), which runs data over copper telephone wires. Proponents say DSL offers Internet service at lower prices than fiber or fiber/coax networks. However, DSL performance may be lacking in some cases due to old infrastructure (copper wires) or distance from the central office.

In addition to picking the right broadband technology, IT managers should fully vet potential service providers. Develop a short list of candidates based on contenders that balance years of experience in the market with a track record for reliability and the ability to meet the tight budget constraints of schools. Then contact references in other districts for their insights and experience with those service providers.

Step 4: Plan with reliability in mind. To guard against service downtime, officials at Marietta City Schools contract with two broadband providers and divide traffic across the two services. "We wanted vendors with different network paths so we wouldn't be affected by an outage caused by someone digging into a network link or a utility pole getting knocked down," Digiovanni explains.

If disruptions like that happen and one company's service goes dark, the second network temporarily supports the district with the remaining capacity. This strategy won't maintain normal performance levels, but schools that use this approach will still be able to function until the outage is repaired. When not in recovery mode,

the dual resources keep traffic flowing smoothly with the help of a network load balancer. The technology constantly monitors the utilization levels across both network streams and directs traffic to keep volumes roughly equal. This ensures one of the communications links doesn't become overloaded if, for example, an online assessment suddenly puts new strains on the service.

Another option for maintaining reliability is to sign separate contracts with a primary and a secondary service provider. If for any reason the main network fails, traffic automatically gets routed to the backup resource. One thing to note is that while businesses are used to backing up their data, this may not be a routine procedure for all schools. With all of the data a school creates — including test data, grades, e-mails, surveillance video, etc. — education personnel must be vigilant in backing up data, either on-site or in a third-party, off-site data center.

Whether schools choose to use two primary services or go with a primary/backup approach, success hinges on finding providers with networks in diverse geographical areas. This decreases the chance they'll both be disrupted by the same event. Ask for a map of each provider's backbone and network spurs to make sure the services are separated sufficiently. Also make sure both service providers are not telecommunications companies, which often buy from each other and are co-located in the same office and lease the same regional fiber routes. Using a cable company as the primary provider and a telecommunications company as the secondary provider (or vice versa) ensures backup is sound.

Success also requires negotiating favorable service level agreements (SLA). Every SLA will promise high levels of uptime; the trick is knowing exactly what to expect if problems occur. For example, some service providers maintain their own network infrastructure, while others lease capacity from a prime network operator and then sell services to customers. Companies that install and manage their own infrastructure have more control over the resource and thus may be in a better position to address performance problems. By contrast, a subcontractor will have to contact the prime network operator if a school's service is degraded, which may lead to delays.

District officials should also discuss the finer points of SLAs with providers before they sign a contract. In particular, get details about time-to-repair guarantees. For example, if the contract specifies a four-hour response time, does that mean the network will be back to full operation within that period or that a service ticket will be opened and the school will be notified of the status in that timeframe?

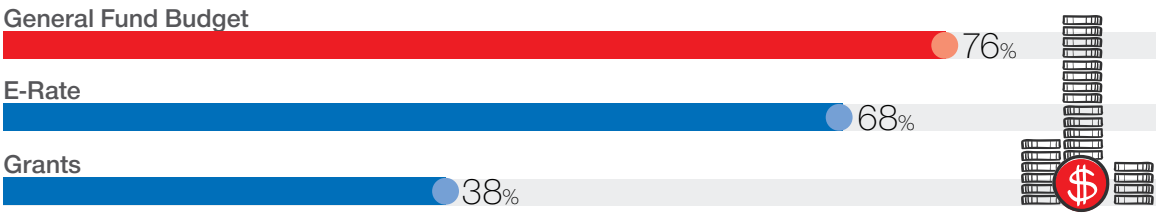
Finally, SLAs should specify how often the service provider will meet with the school to review utilization rates. Typically, these joint analyses occur monthly or quarterly to make sure districts aren't over- or under-subscribed, and if either problem is apparent, that the proper adjustments are made.

A Checklist for Successful Networks

- ✓ Set concrete goals for implementing digital classroom tools.
- ✓ Create accurate forecasts of network capacity requirements.
- ✓ Understand broadband technology options.
- ✓ Partner with multiple service providers to enhance reliability.
- ✓ Fully utilize national, state and local funding resources.
- ✓ Keep end users informed about upgrade goals and implementation schedules.

Step 5: Take advantage of available funding. E-rate funding is a particular benefit to schools with high percentages of students in the National School Lunch Program, which provides free and reduced lunch based on income. But these

How K-12 Schools Fund Connectivity and Bandwidth Needs



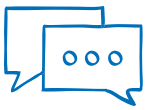
Source: CDE "Insights into K-12 District Connectivity" survey, 2014

institutions or wealthier districts may have funding gaps that require administrators and IT managers to present proposals to voters for new investments in networking technology. In these cases, school officials must offer a clear picture of what digital capabilities are needed, how they'll be used and what will be the likely return on investment.

Some districts are also taking advantage of local initiatives, such as the special purpose local option sales tax, or SPLOST, in Marietta. Revenues from the tax provide some technology funding for Marietta City Schools. "Locally, people are very supportive when we show them why we need to spend the money," Digiovanni says.

The challenge for IT administrators is to demonstrate the benefits of contracts for the highest-performance network services won't be fully realized if the district runs on outdated routers, switches and related networking gear.

To bolster E-rate funds and a combination of local and federal grants, financially prudent school districts should create contingency funds to help cover ongoing modernization projects. The technology assessments and resulting IT roadmaps developed in the first steps of the networking strategy will help planners determine how much money to set aside each year.



Step 6: Communicate early and often with end users.

IT managers must keep instructors and administrators informed about upgrade schedules and any possible disruption in network services. "If you know there will be an impact to their daily routine, make people aware there will be a slowdown in performance," Digiovanni says. "If they're aware of that they'll be more apt to forgive you than if something just happens without any warning."

Rest Easy

A clear idea of networking requirements and a comprehensive plan for delivering adequate service levels will help school districts thrive in the digital age. This will help IT managers stage modernization activities as a series of manageable steps rather than undergo a single and potentially disruptive overhaul project.

Although he's developed a formal, multi-year modernization strategy and documented the business case for a high-performance network, Digiovanni says the benefits of network modernization boil down to one simple metric. "I sleep better at night (because of the increased capacity)," he says. "Prior to doing the upgrades we were a 9-to-5 shop. But I soon realized we just couldn't continue to do business that way, because that's not how the world works," he adds. "We wanted to run a 24/7 facility where students, teachers and administrators can access resources when they're at home, at any time of the day and on weekends. We have put ourselves in a really good position now to accommodate those needs."

Endnotes

1. All quotes from CDE interview with David Digiovanni on Sept. 29, 2014
2. www.setda.org/wp-content/uploads/2013/09/The_Broadband_Imperative.pdf
3. Ibid.

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