

# Best Practices in K-12 Cabling Strategies

*(Or, how to untangle the snarl in your school's wiring closet)*

If cabling sounds ho-hum, think again. Failure to consider the effects of modern technologies on your wiring infrastructure can lead to big problems. Here's how experts and leading districts are updating their infrastructure to handle higher-performance Wi-Fi, a surge in IP-enabled systems, and new Power-over-Ethernet technologies.

*By Anne Rawland Gabriel*

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# INTRODUCTION

Whether it's interactive whiteboards, 1:1 computing, or online testing, it's no secret that technology is powering teaching and learning in today's K-12 classrooms. What's being overlooked is how many of today's technologies make new demands on your cabling infrastructure. Even the latest high-performance Wi-Fi doubles the amount of cabling required for connecting access points. Plus, technologies like IP-enabled security cameras, IP intercoms, VoIP phones, and new Power-over-Ethernet (POE) implementations are compounding the situation.

All these new requirements are straining wiring closets, where heat buildup can be dangerous and potentially create serious downtime problems. The solution? First, realize there is an issue. And then evaluate how you can optimize your cabling infrastructure using new techniques and technologies designed to save space, dissipate heat, and bring order to the chaos.

## ABOUT THE AUTHOR

Anne Rawland Gabriel is a business and education technology writer who has contributed to numerous leading technology publications for many years. A graduate of Grinnell College, Gabriel is a long-time supporter of K-12 and higher education. She is based in the Minneapolis-St. Paul metropolitan area.

## A MULTITUDE OF ED TECH DEMANDS

According to Furturesource Consulting, interactive display devices already sit at the front of about 60 percent of U.S. classrooms, with over 70 percent expected by 2019. Similarly, a recent Market Data Retrieval report shows that mobility and 1:1 are playing an increasingly significant educational role, with 64 percent of K-12 districts distributing laptops to students (See Figure 1: More Access to Technology). Another 34 percent of districts provide tablets and an equal share permit BYOD in high schools. The MDR study further notes that a majority of districts are implementing the online assessments related to the Common Core. Even states by passing the Common Core are moving rapidly toward their own versions of online testing.

Yet classroom technologies tell only part of the K-12 IT story. Educational institutions also provide voice communications for teachers, administrators, parents, and students. Plus, schools ensure the safety and security of all campus constituencies with various types of physical and video controls.

## DISTRICT LEADERS SAY “ALL OF THE ABOVE”

For the San Ramon Valley Unified School District, new technologies include “all of the above” and more. “We’re undergoing an extensive Wi-Fi upgrade to meet the demands of state testing, the adoption of hundreds of Chromebooks at our high schools, and BYOD throughout all K-12 grade levels,” explains Ric Johanson, a Senior Project Manager for the 32,000-student district in Silicon Valley’s East Bay region.

“Where we previously had one or two wireless access points per building across our 35 campuses, we’re now approaching one per classroom,” he adds. “Plus, we’re installing multiple APs in large spaces, such as auditoriums. We’re also enabling mobility in outdoor spaces, including playing fields, because our physical education teachers now take attendance online. Overall, it means we’ve moved from dozens of APs to hundreds.”

But that’s not all. San Ramon Valley is also upgrading classrooms to include interactive touch boards, the latest generation of interactive whiteboards. Additionally, a new digital solution combining intercom, public address, and clock functions is replacing the previous separate analog versions of all three systems. Further, the district already relies on digital technologies for telephony and for environmental and physical security. This includes VoIP phones, energy management systems, security cameras, access controls, and intrusion alarm systems.

Unsurprisingly, the single characteristic shared by all of these technologies is connectivity to an institution’s LAN. This means even technologies like Wi-Fi rely on wiring infrastructure to plug them into the network. To get a better understanding of what technologies schools are adopting, and how they impact an institution’s wiring infrastructure, let’s drill down on several key innovations.

## GIGABIT WI-FI TURBO-CHARGES MOBILE LEARNING POTENTIAL

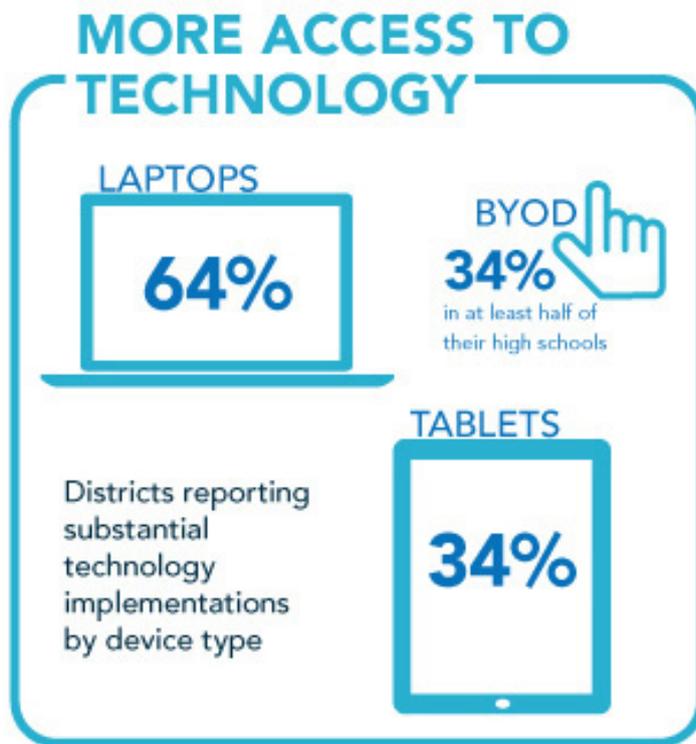
With the recent introduction of access points based on the most recent IEEE standard, 802.11ac, wireless networking solutions finally offer wire-quality experiences that make classroom mobility practical. Also called “Gigabit Wi-Fi,” 802.11ac-based wireless is about to get even speedier with the second generation of APs, called Wave 2.

**Significantly Faster.** Compared to the previous standard, 802.11n, the first generation of 802.11ac improved speeds by about 3X. Initially, Wave 2 will increase throughput another 30%, with subsequent updates contributing further enhancements. In addition to eliminating lag time barriers for effectively using rich content, such as delays in accessing streaming video, both waves can also provide seamless mobility by allowing non-disruptive movement between learning spaces.

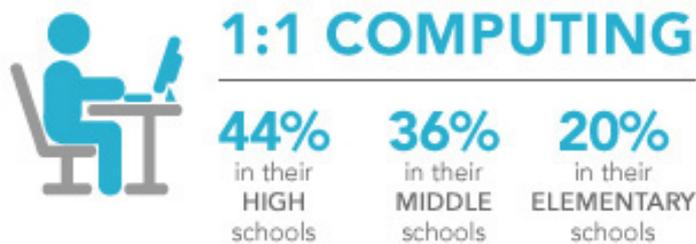
**Higher Device Densities.** Gigabit Wi-Fi also enables schools to support greater mobile device densities. Just as higher education institutions are already experiencing three or four devices per individual, K-12 schools are expecting similar densities as they plan modern Wi-Fi set-ups.

**More E-rate Funds Available.** In addition to the Gigabit Wi-Fi’s performance qualities, there’s now a budget incentive with the latest revision to the federal E-rate program. Through 2019, E-rate includes a \$1 billion annual target budget for Category 2 funds—those which are designated for implementing modern Wi-Fi. According to integrator Cory Brymer, President of Texas-based BryComm, the E-rate commitment has opened the spigot for 802.11ac adoption in his region. “We’ve seen a gigantic increase in school districts initiating Gigabit Wi-Fi projects recently,” he says.

Figure 1: More Access to Technology



Districts with substantial implementation of



Source: State of the K-12 Market 2014, Market Data Research  
For original infographic: <http://schooldata.com/ednet-insight/state-of-the-k-12-market-2014-findings>

## IP-BASED OPTIONS ABOUND

The move from analog to digital has brought with it a cascade of Internet Protocol-enabled systems and devices to K-12 institutions. Whether for communications, security, or even timekeeping, each of the related systems relies on wires to connect it to an organization's network. IP-enabled trends in K-12 include the following. (See Figure 2: K-12 Infrastructure Transformation)

**VoIP & Video IP Telephony.** After more than a decade of replacing analog telephones with VoIP (Voice over Internet Protocol) telephony, few see any end to the trend in sight. Analysts like Frost & Sullivan are not only predicting VoIP growth through 2025, but also a quadrupling in the adoption of new IP media phones with their larger displays and cameras for personal video communication.

Although the impact of video phones on education is currently small, what matters is that the cabling needs for telephony will continue to impact schools as VoIP-enabled systems continue to play a critical communications role.

**IP-based Security Cameras & Access Controls.** While safe and secure learning environments have always been a K-12 priority, the effects of Sandy Hook, Santa Monica, and other tragedies are moving more schools to adopt integrated security systems for real-time emergency response. According to IHS, the K-12 market for these types of systems will rise 80 percent by 2017 versus pre-Sandy Hook levels.

Data collected by the National Center for Education Statistics backs this trend. In

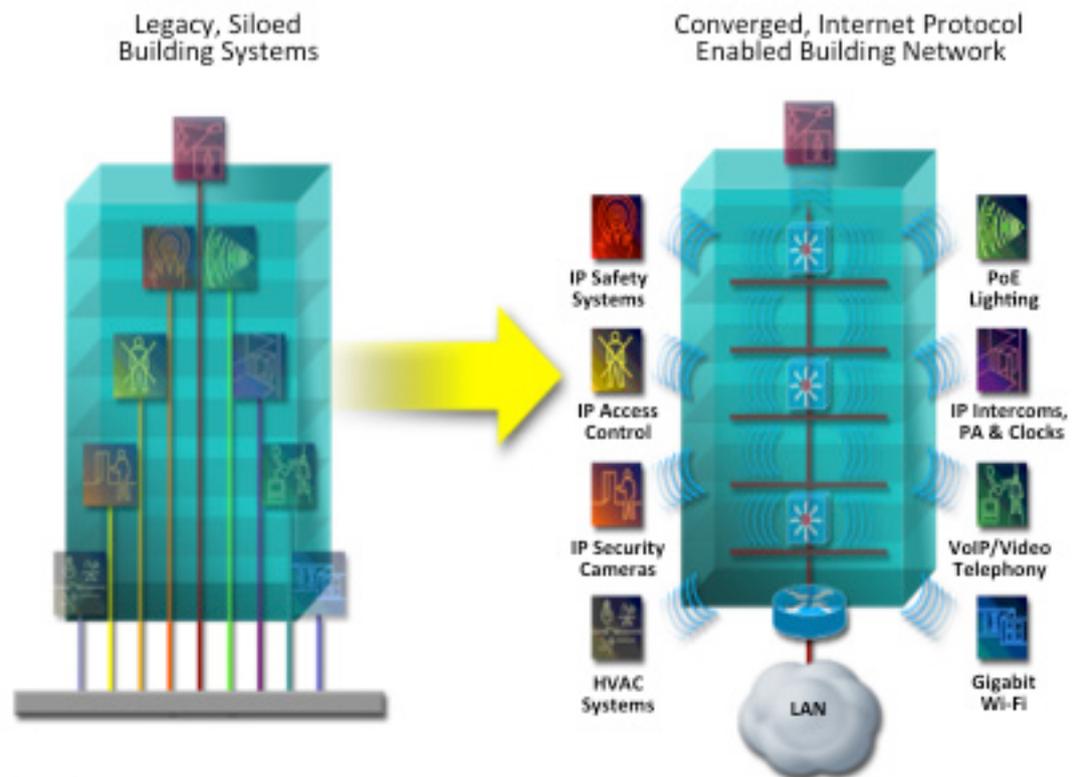
the most recent NCES survey, 75 percent of public schools reported using security cameras, up a full 10 percent over the previous report. Similarly, controlled access to school buildings now stands at 93 percent, versus 88 percent during the preceding survey.

### **IP Intercoms, PA Systems & Clocks.**

As noted by San Ramon Valley, other campus-wide systems going digital include intercoms, public address systems, and clocks. Just like all IP-based solutions, they require network connectivity rather than analog's stand-alone hard-wired systems. Attractive for many reasons, these systems can all be controlled from a central location, significantly improving reliability while reducing maintenance and troubleshooting costs. In the case of clocks, a key advantage is automatic synchronization, which has myriad K-12 benefits.

“Just as higher education institutions are already experiencing three or four devices per individual, K-12 schools are expecting similar densities as they plan modern Wi-Fi set-ups.”

Figure 2: K-12 Infrastructure Transformation



Source: Panduit

### POE-ENABLED CLASSROOM SYSTEMS ON DECK AND IN THE PIPELINE

As key classroom devices gain more features they also continue to require more electricity. This is placing a strain on hard-wired electrical systems in buildings constructed well before most of today's technologies were conceived, let alone deployed. Fortunately, Power over Ethernet (PoE) is beginning to supply the answer by enabling components and devices to get energy from a school's LAN network rather than an electrical outlet.

In general, most existing IP-enabled systems now utilize PoE. Other emerging PoE devices and systems include:

**PoE A/V Systems & Displays.** With teachers embracing all things video –

whether for streaming or conferencing – comes the demand for more advanced A/V systems and displays. The latest entrants include PoE connectivity, with the incumbent electrification and centralized management rewards. According to Brymer, a 140-campus district in his region is in the process of adopting a PoE-enabled A/V system at this time. "They're in the design and specification phase," he says.

**PoE Lighting.** Somewhat further down the road is PoE lighting, which combines energy-efficient LCD lighting with PoE power delivery. Like other PoE systems, advantages include centralized management and troubleshooting to minimize energy consumption and maintenance overhead.

## IMPACTS ON K-12 WIRING STRATEGIES

On the infrastructure side of the equation, connecting so many systems and devices to K-12 LAN networks requires rethinking wiring strategies.

“As recently as 15 years ago, various different types of systems had their own wiring leading to their own dedicated brains inside of wiring closets,” notes Brymer. “Now, with phones, intercoms, and A/V systems joining computers and Wi-Fi on K-12 LANs, administration of these systems is streamlined but more cables are being run to wiring closets.”

**Cabling ABCs.** To understand the challenges, it’s important to remember that the networking cables that connect IP and PoE-enabled components to K-12 LAN can only run for a maximum distance of about 300 feet before they must be plugged into a networking switch. Switches are, in turn, connected to the network via a backbone cable.

As switches serve dozens of different components simultaneously, they are stacked up and housed in wiring closets. Within each wiring closet, cables from components terminate in a junction box. From the junction box a shorter cord, known as a patch cord, runs to an appropriate networking switch.

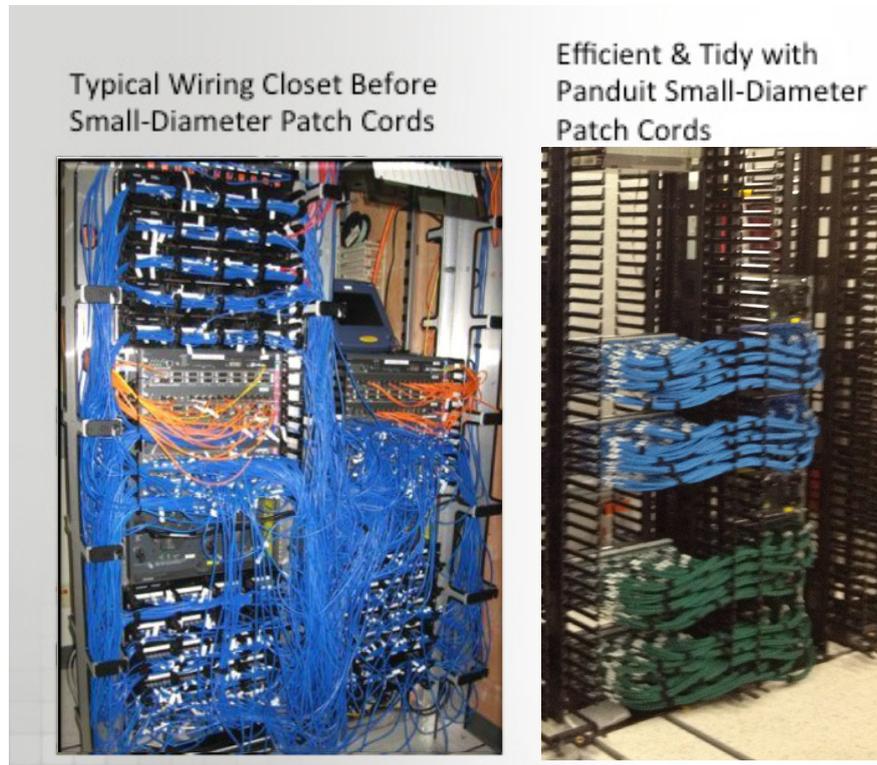
**Small Closets, Big Demands.** Unsurprisingly, the proliferation of components and devices with cables travelling to individual wiring closets means space inside the closets grows ever-tighter. In addition to greater numbers of single-cable IP-enabled systems, technologies such as Gigabit Wi-Fi, now require one cable for data and another to deliver PoE.

According to broadband experts like Dan Hoops, Director of Engineering at Minnesota-headquartered All State Communications, the magnitude of the problem adds up to “400 to 500” cables per rack. And, many closets hold multiple racks.

**Heat Is The Enemy.** Also, as IP-enabled systems add capabilities and grow more complex, they generally require greater PoE wattage. This adds to heat in the closets, resulting in more demands on cooling systems and associated costs. Adequate cooling is critical, as switches cost thousands of dollars and overheating electronics gear causes failure rates to approximately double for each 10°C (18°F) rise in heat above its allowable temperature according to U.S. Defense Department testing. For most IT gear, the American Society of Heating, Refrigerating, and Air-Conditioning Engineers recommends a maximum temperature of 80.6°F.

**Gigabit Wi-Fi Adds Burdens.** In the case of Gigabit Wi-Fi, the challenges are compounded by the number of APs in any given area, which are doubling, tripling, or more as schools add access points to meet mobile density demands. In addition to taking up more space in wiring closets, more heat is generated, as Gigabit Wi-Fi APs require higher PoE wattage. Further, Wi-Fi performance resembling wired networks can only be delivered over faster Category 6A cables, which can be up to 50% larger than Cat 6. “Although it’s tempting to consider using existing Cat 5E or Cat 6 cables, realizing Gigabit Wi-Fi’s benefits requires updating to Cat 6A,” says Nat Basset, a Panduit Technical Systems Engineer.

Figure 3: Untangling K-12 Wiring Closets



A cascade of Internet Protocol-enabled systems and devices are being added each year to K-12 district facilities. While previously these functions were separately provisioned, today they are being integrated into a structured wiring scheme that allows for superior management and organization.

### HOW PANDUIT CAN HELP

While new schools can be designed for digital-age wiring infrastructure, wiring closets in many decades-old school buildings are bursting at the seams. Regardless, as more electronics move to higher performance Cat 6A wire and greater PoE wattage, this means that a bundle of 100 cables—let alone new amped-up switches—can potentially increase heat by 10°F. Therefore, wiring strategies that mitigate heat deliver significant benefits. (See Figure 2: Untangling K-12 Wiring Closets)

**Small-Diameter Patch Cables to the Rescue.** Sometimes the smallest and simplest solutions are also the most elegant. Such is the case with Panduit's 28 AWG patch cords. At about half the diameter of standard 24-gauge patch cords,

28-gauge cords enable greater air flow in cramped wiring closets because they simply take up less space. "Anything that improves air flow is important," says San Ramon Valley's Johanson. "We're always looking for ways to improve energy and operational efficiency."

Of course, improved airflow is a significant contributor to heat reduction. And, with reduced heat comes less wear and tear on cooling equipment. "As cooling fans are self-regulating, lower temperatures not only save energy but also can improve cooling fan life span," Basset says.

### Reducing Complexity Saves on

**Overhead.** Another benefit of smaller-diameter patch cords is faster troubleshooting of connected devices, components,

and systems. "With about 300 percent more patch cords in a wiring closet now than in the 1990's, you've added that much more complexity to locating and fixing networking issues," notes Basset. Anything you can do to improve visibility in a wiring closet will also contribute to lowering IT overhead."

Finally, small diameter patch cords are just plain easier to move around, as Brymer points out. "It's not uncommon for us to have a K-12 project that requires 10,000 patch cords," he says. "If they're 50 percent smaller, that's significantly less weight and bulk for us to transport and manage. This, in turn, can help us get our jobs done faster and we can pass those efficiencies right on to our K-12 customers in the form of lower costs."



#### ABOUT PANDUIT

Panduit is a world-class developer and provider of leading-edge solutions that connect, manage, and automate the physical infrastructure. Panduit Unified Physical Infrastructure (UPI) solutions help customers integrate core business systems for a smarter, unified business foundation. Our robust partner ecosystem, global staff, and unmatched service and support make Panduit a valuable and trusted partner.

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## CONCLUSION

Despite all of the excitement around wireless mobility, wiring still plays a fundamental role in powering the many new innovations schools rely on for teaching, learning, and administration. Whether adopting Gigabit Wi-Fi, adding to IP-enabled systems, or installing new PoE options, wiring infrastructures carry the load and wiring closets are feeling the effects.

Fortunately, small-diameter patch cords offer K-12 organizations a reliable and cost-effective option for reducing the resulting wiring closet congestion and easing the incumbent burdens.

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