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Best Practices from the Classroom to the Campus

# CLASS-ACTION CABLING

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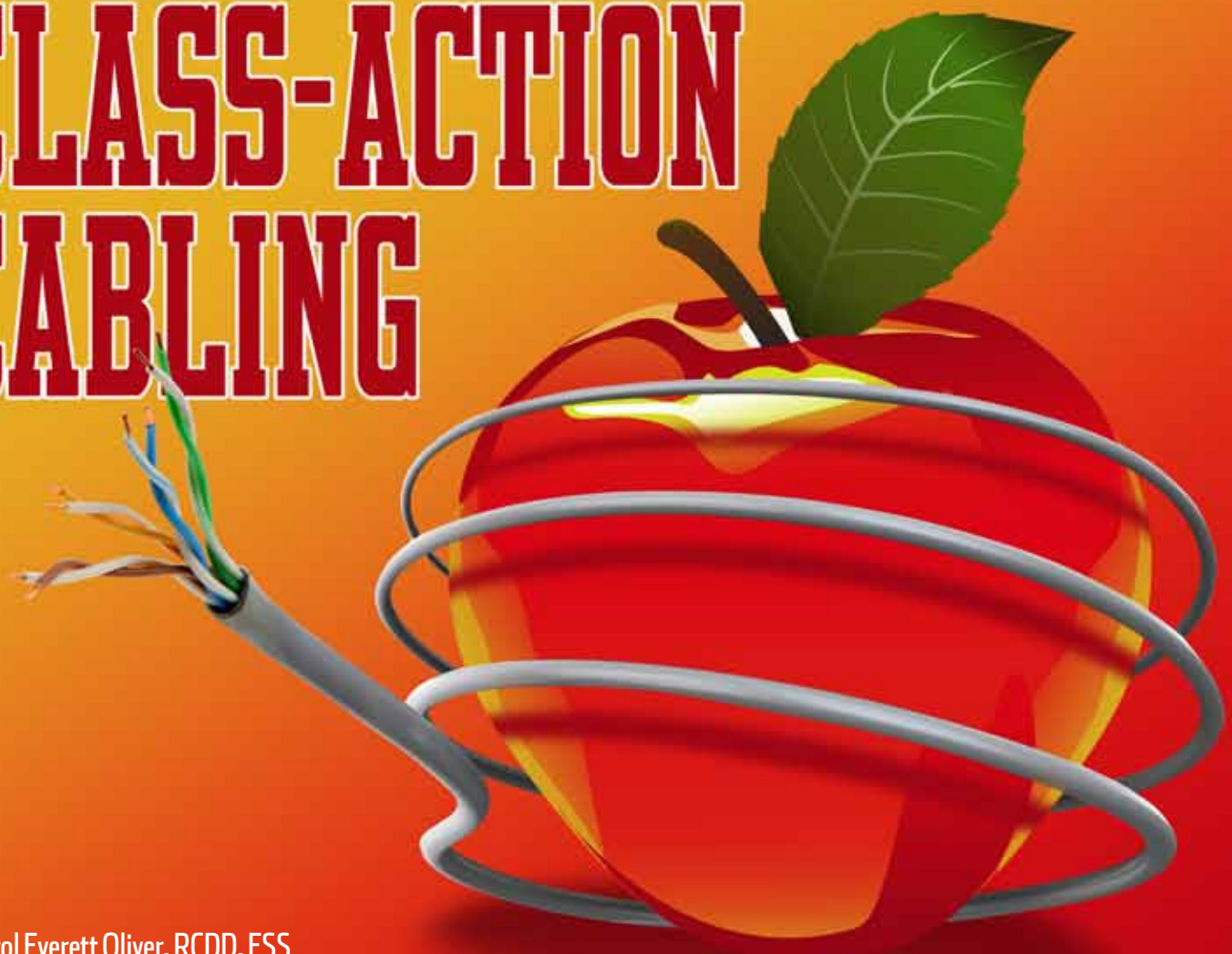
Best Practices from the Classroom to the Campus

# CLASS-ACTION CABLING



by Carol Everett Oliver, RCDD, ESS

Remember the smell of the printed books in the school library? That is becoming something of the past. Teaching tools deployed over the last decade are evolving our schools into bookless systems, relying on the Internet and other on-line learning tools such as video-on-demand, Internet e-learning and electronic tablets. Throughout this evolution, information technology systems (ITS) in the education environment are being pushed to become multi-faceted, enabling Internet protocol (IP) convergence to support applications that span outside the typical realm of telecommunications.

In the education market segment, ITS are facing constant changes and exploding bandwidth demands. Teachers, administrators and students are relying more on the network to aid in their everyday life—on and off campus. Because of the influx of applications on the network, the BICSI International Standards Program is taking action to develop standards for education facilities that will aid in the planning and installation of an efficient cabling infrastructure to support network capabilities for today and tomorrow.

With the publishing of ANSI/BICSI 001-2009, *Information Transport Systems Design Standard for K-12 Educational Institutions*, the standards program turned its attention to the needs of the post-secondary environment. While a standard for post-secondary is still in the development process, contributors to the standard noted that K-12 (primary and secondary education) environments were now beginning to share some of the same needs that were once thought to be unique to

the post-secondary world. As each grade, school, campus and district can vary greatly in its network requirements and approach to providing technology to their students, and an all-inclusive education standard is still only an idea, this article takes a look at some of these current, real-world issues.

## Standardizing Non-standard Environments

Standards, which specify minimum requirements and guidelines for the design of the ITS, are "living documents" and subject to revisions and updates as warranted by advancements in both construction and technology. For example, do you remember when schools were striving to provide hardwired network connections to every desk? Today, those same connections are likely in the form of wireless access points (WAPs). Education is an evolving and ever-changing market that consistently challenges system designers, cabling contractors and manufacturers.

Existing cabling standards, such as TIA-568, *Generic Telecommunications Cabling for Customer Premises*, address general commercial buildings, and these guidelines can be followed for most facilities. However, the BICSI-001 standard focuses on application diversity, providing guidelines for designers, installers, owners, architects, consultants and project engineers involved in the deployment of ITS for education facilities.

BICSI-001 addresses the unique areas of an education facility, including classrooms, administration offices, arts, auditoriums, building services, cafeterias and gymnasiums. Within each area, the standard makes recommendations for pathways, spaces, cabling media and termination types needed to support the diverse applications. Realizing that as the grades ascend, the applications and cabling requirements increase, this standard provides real examples of "typical" classroom layouts.

The BICSI Post Secondary Education Standard subcommittee was originally formed to produce a separate ITS design standard for colleges and universities, addressing the differences between K-12 and college campus applications. Even though the two BICSI standards groups are now combining their efforts, the Post Secondary Education Standard subcommittee will continue to focus on the specific differences as a university campus has a much wider scope of IP-based applications than K-12 school environments.

"In a nutshell, K-12 and universities are like night and day," explains Jeff Silveira, RITP, AStd, standards director at BICSI. "K-12 is basically a collection of commercial building spaces and, although ESS (electronic safety and security) systems are on a major upswing, and there are paging, AV and intercom systems in these facilities, there isn't a major call for heavy data storage on-site."

According to Silveira, while universities may have similar classroom needs, university systems are larger, especially in wireless, and need to support a heavy bandwidth backbone. "Beyond the normal classroom environment, on a given campus, you can find almost any major industry element, such as medical, theater, manufacturing and laboratories," he says. "Also, while dorms are residential

While universities may have similar classroom needs, these post secondary systems support a larger geographical area, serve a much larger number of individuals and require more services and diverse applications.

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in nature, they not only require a 24/7 network availability, but also have a much higher density of outlets and service points that may need to be independently tracked and billed."

## K-12 Challenges—Not Very Elementary

According to Shelly Patton Hoffmaster, RCDD, with RA Technologies of Baltimore, Md., most K-12 schools do not have an RCDD or IT network person. "Most either have shared resources within the district or they rely on outside consultants or facilities personnel," she says.

Due to the proliferation of IP convergence, facilities personnel need to work closely with the district IT teams or consultants as they are faced with implementing a network that can handle diverse applications, including:

- Data (wired and wireless).
- AV (intercom, paging, emergency notification, and digital signage).
- Video (distance learning, streaming video and video-on-demand).
- Security (cameras, access control).
- Building management systems (HVAC, lighting, electronic clocks).

Funding is a key issue in the K-12 environment, and there is a big difference between public and private school budgets. In private schools (including post secondary), the funds are mainly provided by tuition, alumni and sponsors. With public schools, the funding comes from town bonds and taxes and must be approved by a town board and scrutinized through a finance committee.

"When building a school, particularly one with a multi-building campus, planning the core infrastructure is a challenging task. On one hand you want to provide the school with the latest technologies and future-proof implementations for IP-based integrated systems; but on the other hand, you need to be constantly aware of the budget," says Bruce Osborn, RCDD, systems specialist with Bala Consulting who recently designed and implemented the mechanical, electrical, plumbing, fire protection, telecommunications and security system for Episcopal Academy's new campus in Newtown Square, Pa.

Scott Tubbs, partner with Corporate Technology Solutions (CTS), headquartered in Tempe, Ariz. agrees. "For public schools, we are dealing with the entire district or town and not just one campus," he says. "As a system designer and installer, we bid from soup to nuts—the design and build and installation according to their every wants. We then scale down from their wants to their needs, and determine how to accomplish these within their budget."

## Kingman K-12—Building from the Bottom

Whether a K-12 school district is expanding, retrofitting, or building an entirely new campus, it is always best practice for the cabling designers and contractors to be included in the initial planning stages with facilities and IT personnel. According to Tubbs, a lower overall cost to install can be accomplished when they are able to participate in the design from the beginning. A good example of this is the Kingman K-12 district in Arizona, which was granted a bond in 2006 to build a new district office, a new elementary school and new middle school, and upgrade the two existing high schools over five years.

"The design alone can be astronomical as there are so many factors to research—from pathways to outlet configurations—but when the design is incorporated into the installation, major savings of time, money and headaches can be realized," explains Tubbs.

During the design phase, Tubbs' CTS team met with both the IT and facilities personnel to complete a room-by-room schematic drawing to review cable runs, termination configurations and the telecommunications room (TR) locations and equipment requirements. A budget was then prepared according to the schematic drawings. "At that point, the budget is reviewed with the realistic view of what is needed and what is not. However, it's better to cable as much as possible to save money in the long run," explains Tubbs. "Coax is going away, and everything is shifting to IP. We decided to use a category 6-based infrastructure to attach all the diverse applications to the network." The network applications for the Kingman project included:

- Wireless access to every classroom and outdoor common area.
- Distance learning and video streaming from the classroom.

- Smart boards and IP projectors in every classroom.
- Voice over IP (VoIP) and data to each teacher's desk.
- Video on Demand (VoD).
- RFID-based asset tracking system to keep tabs on all the equipment and books.
- Electronic clocks and bell system.
- Visual paging and notification.

Because of the variety of IP services over a structured cabling system, the cable was color coded. "For the high school, there was 360,000 feet (ft) of unshielded twisted-pair (UTP) cabling. We designated blue for data, yellow for security, black for paging and white for AV," explains Tubbs. "In a school environment, there are always some unique challenges, such as cabling the gym or stadiums. In the new Kingman gym there is an AV rolling rack system with network connection versus a standalone system."

Often, there are unforeseen obstacles in any installation, typically with pathway design. In the case of the excavation around the Kingman stadium to locate trenches for the backbone cabling, the CTS installers hit a cemetery site from the early 1900s. Archeologists were brought in and the conduit had to be rerouted. "This was an unusual incident, but often the most challenging part of the installation is the pathways since they vary from existing tunnels to creating new ones," says Tubbs.

## Gilbert K-12—Retrofitting and Upgrading

On a larger scale, CTS is in the middle of a seven-year Gilbert, Ariz. project that involves recabling schools that are undergoing structural renovations. Gilbert includes more than 40 schools, including 27 elementary, six junior highs, five high schools and two special-needs schools.

"We have completed a network equipment refresh and total wireless deployment that includes 2,200 access points," says Ward Heineman, IT director for the Gilbert school district. "Computer usage and IP convergence have been rapidly growing, and it is hard to keep up. Although we are constantly building new schools, we needed to focus on getting the older schools up to speed and funding is based on that priority."

Since schools have a very short installation period (mainly summers and breaks), pre-planning is critical during the school year. "The first step, and sometimes most difficult, is locating the pathways and pulling out old cable," says Chad Blotkamp, senior project manager with CTS. "We also look at the location and size of the TRs since space is always at a premium. At Mesquite High School in Gilbert, we were able to centralize the TRs by migrating from two on the same floor

During expansion of Kingman High School, a wing was connected to the previous school, which required the TR to be located between the outer wall of the existing building and the new addition.

Chad Blotkamp with CTS in Tempe, Ariz. Checks out the patching of the new cable in one of Gilbert's high school's TR.

to one larger area, which allowed for maximum space utilization."

The network upgrade for Mesquite High School includes 5000 ft of optical fiber cable for the backbone infrastructure and more than 369,000 ft of UTP cable for the classrooms. All cables and outlets are color-coded for the various services and terminated to flush-mount jacks. "In Arizona, we have rodents that chew on cables, but the kids are even more destructible, so you have to think about ways to alleviate possible damage, such as using flush mounted jacks and stocking and inventory of replacement patch cords," comments Grant Meeker, network specialist with the Gilbert School District. In addition, the district tried to place the majority of WAPs above the ceiling tiles. In situations where the WAPs were exposed, they placed a plastic covering over them.

## Graduating to Post Secondary

While universities may have similar classroom needs, these post secondary systems support a larger geographical area, serve a much larger number of individuals and require more services and diverse applications. A university campus expands beyond classrooms to encompass residential buildings, research labs, hospitality/entertainment venues (e.g., theater and sports arenas), security (e.g., blue light phones, access control, and cameras), building systems and retail point-of-sale (POS) systems (e.g., bookstores, ATMs, cafeterias).

The additional applications recognized by the BICSI Post Secondary subcommittee expands typical low-voltage applications over the structured cabling network to include such applications as widespread wireless, building automation systems (BAS), virtual classroom streaming, AV systems, TV production, security, access control, public address, fire, clocks and POS systems.

In addition, university networks require very high bandwidth due to the growth of video distance learning, large graphical files, onsite data centers and student downloads. Due to bandwidth requirements and the variety of systems, the design and implementation of network and cabling systems within this environment can be complex.

"The more network capacity we provide to the students, the more they will use up," says Greg Asman, IT project manager with Johns Hopkins University in Baltimore, Md. "College students expect the network at school to match what they have been used to at home. Unlike their network at home, the campus network is subject to viruses so there are added firewalls and virus blocking applications built in."

## Common Campus Practices

"While K-12 systems may share an IT person or resources for an entire district or town consisting of multiple schools, university campuses typically have an IT department and dedicated personnel for each campus," reiterates RA Technologies' Hoffmaster.

CTS installers Daryl Begay (on ladder) and Dillon Fransen install category 6 cable for the Gilbert School District.

Networked blue light security stations are located throughout the Johns Hopkins University campus, requiring outside environmental cabling considerations.

"Although each campus is different, a commonality among universities is the increase in diverse IP systems. Many separate departments within the campus, including facilities, security and IT, must collaborate to implement these disparate systems onto a common or parallel network."

"We call it the 'I' concept as we are trying to introduce IP so that within the next few years, everything will be IP-based and attached to the network," comments Kevin Schukraft, manager of network technology for Kutztown University in Kutztown, Pa. where each IP device is connected to a control box, which is usually segmented by device and application type. For example, the access control boxes serve only the access control devices, and the laundry room card swipe boxes are designed for that sole purpose. However, these two applications are tied together on the network. This is known as a "one card system" where applications such as access control and point-of-purchase ranging from laundry to on-campus food service and bookstores operate using the same card but are programmed for different functions.

According to John Hopkins' Asman, most of the IT jobs on their college campuses involve retrofitting the cabling for new applications, many of which are still running on separate networks, such as security surveillance and access control. "Security at universities is a top priority. At the five campuses of Johns Hopkins, we have emergency security systems, also known as 'blue light' alert stations," says Asman. "Since these stations are outside, it creates a challenge due to the environment. We have to make sure the copper cables to the phones are grounded and enclosed, and we opted to use optical fiber cable to the cameras as we are worried about lightning and losing video."

The IT team at Hudson Valley Community College (HVCC) in Troy, N.Y. also was faced with a challenging security situation when designing their power over Ethernet (PoE) camera system for their new garage facility. Because of the long distances, they selected a copper-fiber composite cable that could carry both the power and data, enabling PoE out to an extended reach of 4000 ft.

"Because of the extreme harsh weather in our area, we also had to give careful consideration to the pathways and spaces, such as conduit for the cable and enclosure boxes at the termination end to house the media converters and extra cable," says Robert Kwiatkowski, senior network specialist II, for HVCC. "In selecting the steel enclosures, we needed to consider the appropriate size of the box and the NEMA (National Electrical Manufacturers Association) rating to sufficiently house the passive converter on the device end and the cable loop and make sure that there would not be a problem of overheated equipment and cabling in the confined space." Due to the lack of space in the conduit and the need for a more secure connection to the camera, the college opted to direct attach a plug to the solid conductor cable—a method that is commonly used in BAS and security installations.

## Standards for Standards

The good news for designers and installers is that the majority of both K-12 districts and post-secondary campuses have internal standards documents that provide guidelines for the network infrastructure implementation to aid the internal IT personnel and contractors. These documents are mainly used for project-specific criteria and are often upgraded with technology. Although each school district and campus differ, these documents contain general specifications on the products (e.g., optical fiber and copper cabling and hardware), a list of codes and existing cabling standards, administrative templates, approved contractors and manufacturer warranties.

"The cabling infrastructure has to evolve with the network through the years. All IT projects are formalized through internal building standards and have become the cornerstone of Mason's technological future," says David Bellinghoven, manager of network infrastructure for TSD Network Engineering and Technology ITU at George Mason University in Virginia.

Like at George Mason University, internal standards documents created by the IT departments for each school are mainly for planning purposes and to keep the cabling infrastructure consistent. The updated BICSI education standards will provide further guidelines for best cabling practices and provide an infrastructure model to promote reliability and future proofing to meet the constant evolution of technology in education and the unique challenges of schools, districts and campuses. ■