IP-based School of the Future

By Carol Everett Oliver, RCDD

When the school bells toll in September for students (K-12) and faculty of the Episcopal Academy, a new chapter in the school's history will unfold. For more than 30 years the Episcopal Academy has lived a split existence, operating out of two campuses – one in Merion, PA, and the second in Devon, PA. Space – or lack thereof – was the driving force behind the relocation of Episcopal Academy to the new 123-acre location in suburban Newtown Square, PA. This school is a rare collaboration of well-planned engineering, both architecturally and fundamentally.

The new campus encompasses seven major buildings, as well as athletic fields, playgrounds, and expansive gardens. At the heart of the new campus is an iconic steepled chapel that was designed by an alumnus of the school, now a well-known architect, Robert Venturi. In 2001, the school hired four different, prominent architectural firms to design the facilities so that each building would have a distinct appearance, as well as to effectively allocate resources for this immense undertaking.

Though each building differs in form, they are coordinated through common elements in landscape, materials, equipment and systems. The most prevalent example of this coordination can be seen through an efficient networking infrastructure that manages the school's multiple IP-based applications – from BAS (Building Automation Systems) controls for maximum energy efficiency to Video on Demand (VoD) for extended beyond-the-textbook learning opportunities. To assure that the network cabling infrastructure would provide the required bandwidth capacity and flexibility for the complete IP-based communications environment installed in the school today, as well as accommodate the next generation of IP applications, a versatile, well-balanced network solution needed to be implemented. For this reason, the NetClear® MM10 fiber and NetClear GT2 Category 6 copper warranted structured cabling solutions, from Berk-Tek, a Nexans Company, and Ortronics/Legrand, were selected for the physical infrastructure.

The Academy chose to re-locate their campus in verdant hills; however the locale is not the only thing that is "green." The 400,000 square feet of indoor facilities, although not LEED-certified by the U.S. Green Building Council, was constructed utilizing some of the standard green and energy-efficient concepts proposed by Bala Consulting Engineers, Inc. Bala Consulting Engineers provided design and engineering services for the mechanical, electrical, plumbing, fire protection, telecommunications and security systems. Bala implemented a comprehensive plan to minimize construction waste, as well as conserve water and energy throughout, to keep with the Academy's philosophy of being stewards of their environment and community.

IP TO THE MAX

"When building a school, particularly one with a multi-building campus, planning the core infrastructure is a challeng-

Episcopal Academy, located on 123 acres in Newtown Square, PA.

Berk-Tek's LANmark™-1000 enhanced Category 6 cable for horizontal distribution to all the workstation outlets were terminated into Ortronic's Clarity® 6 patch panles in the TRs.

ing 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, which is essentially based on donations and fund raising efforts from Episcopal Academy alumni and sponsors," explains Bruce Osborn, RCDD, systems specialist with Bala Consulting. "As a result, Bala tasked manufacturers and distribution partners to provide the best possible price for the life of the project, while avoiding the costly escalations that can occur when a project build-out lasts for more than one year," he further explains. "There was a tremendous amount of time associated with researching each of the individual IP-based systems that were implemented on the project."

"We spent a lot of one-on-one time investigating the true needs of the campus with the Head of Upper School, Geoff Wagg, who is a highly-experienced network and enterprise engineer," states Osborn. "It was a great opportunity to assist, challenge, and validate his vision and ideas of consolidating a large campus from several proprietary analog, or non-IP-based, subsystems into a design optimized IP-packet based architecture through a common cable plant infrastructure," Osborn continued. Episcopal Academy's convergence philosophy was extremely forward thinking throughout the entire design effort. Any conventional, new, and legacy building system that had the ability to operate over a copper cable medium was considered a candidate for possible IP-based systems over UTP in the new campus. The Academy's integrated and intelligent design philosophy, looked at creating a true IP-based platform where a single, high-performance, twisted-pair cable plant could provide each facility on the campus to function as a fully integrated intelligent building, offering each student the ability to obtain the most accessible, adaptable, and advanced technology and learning platforms available."

The intelligent technology infrastructure implemented at the Episcopal Academy affords the faculty the ability to access multimedia content from a centralized mass media storage section located in the Campus Center, which is also the network core for the entire campus. A state-of-the-art video retrieval system, also housed in the Campus Center, is able to route a virtual library of on-demand multimedia packages throughout the campus over a first level backbone. VoD and broadband CATV conversion is then distributed from the Media Center in the Campus Center through the structured cable plant from each zone serving the TRs out to classrooms and designated learning platforms in each building. "Through the network, IP packets, or blocks of multimedia content and training, can be downloaded from an outside service through their onsite server," explains Osborn. "This onsite server allows the entire school to watch the same program simultaneously. The technology also permits the broadcasting of scheduled academic content for specialty classrooms or learning seminars, or for announcements, or in-school production events, such as theater, music, or sports."

In addition to the voice, data, and video IP-based platforms, several other technologies utilizing the NetClear structured cabling systems include security cameras, access control proximity readers and associated master controller units, overhead paging and audible bell scheduling system, digital clocking, and lighting controls.

JUMP BALL

When the cabling RFP was published, it quickly became a jump ball for specification position between the selected manufacturer, distribution channels, and bidding telecommunications contractors. Bala identified the selected manufacturing partnerships that offered a Category 6 cable plant with a mated connectivity solution and performed a detailed specification comparison of each manufacturer's solution against the published

ANSI/TIA/EIA-568-B.2.1 Category 6 standard. This comparison detailed the desired criteria for the performance of the cable, headroom, and mated connectivity options.

The contractor bid package identified the critical parameters, installation labor, and itemized material associated with each task and total project costs.

"Having the bid responses returned in a structured format was beneficial for the project because we were able to quickly identify each contractor's quantities, labor rates, and pricing breakouts for each building. This factor allowed the project team to efficiently narrow the list down based on the most accurate response, scope of work and, of course, the most cost-effective installation," explains Osborn.

GRADING CABLE

Based upon project experience and a fundamental understanding of the bandwidth and headroom requirements for current IP-based systems that primarily operate over a gigabit network channel, Bala Consulting Engineers wanted a "better than standard" Category 6 infrastructure. John Santilli of C&C sales recalls the circumstances surrounding the cable choices, "When Bala was conducting its comparison analysis for all the different grades of Category 6 cables and the associated matched system components, Berk-Tek was in the process of re-engineering their Category 6 UTP cable. The LANmark™-1000 cable was already tested to perform above the published standards for Category 6 cabling, so the fact that it was being re-engineered for better performance gave the NetClear GT2 solution a clear advantage in the field."

"The improved cable was a result of both the re-engineering of the core design combined with investment in manufacturing equipment and new processes at the New Holland, PA, facility which includes across-the-board crosstalk performance such as an 85 percent improvement in the PS-ACR, which means much more signal integrity and strength which greatly reduces vulnerability to noise interference," details Jim Frey, Berk-Tek copper product manager. Through the redesign, this solution increased all crosstalk parameters by 4 dB over the previous design, which already exceeded component performance as specified by TIA/EIA-568-B.2-1 Category 6.

"All the improvements did not change the outside diameter (.226") or the price," adds Todd Harpel, director of marketing, Berk-Tek. "Enhanced electrical properties also deliver superior performance of any application specified to run on Category 6 systems," notes Harpel.

"It surpassed our specifications and therefore Bala selected this cable and the inclusive Category 6 channel solution for the horizontal network infrastructure," states Frank Goldcamp, Jr., project manager with H.B. Frazer Company, the installation contractor. "We were very impressed with the stability of the cable, especially since the installation mainly took place in the cold, winter months and the jacketing was resilient and resistant to cracking or kinking," Goldcamp notes.

THE CAMPUS INFRASTRUCTURE

The primary network core or electronic "heart" of the campus for all LAN and IP-based functions is located in the data center in the Campus Center Building.

Additionally, the Campus Center houses the only true FCC Part 68 recognized entrance facility and demarcation point for the campus. The NetClear MM10 solution, from Berk-Tek and Ortronics/Legrand was selected as the fiber backbone from the data center servicing each telecommunications room. A total of 11,000 feet of

Bruce Osborn, RCDD, systems specialist with Bala Consulting, checks out the cable connectivity in the main computer room.

In each TR, fiber optic backbone cable was terminated in fiber cablnets (above) and was patched into patch panels (below) for horizontal distribution.

fiber was encompassed in the backbone. Between the core buildings six strands of laser-enhanced 50 micron multimode fiber and six strands of single-mode fiber were terminated in rack-mounted fiber cabinets, utilizing small form factor LC connectors to tie all the TRs. The data and voice requirements for each building, dictated the number of TR's per building:

- Campus Center (four TR's and one MC/ data center)
- Academic Building (Also housed the Upper and Middle School, five TR's)
- Lower School (Grades K-6, three TR's)
- Athletic Center (two TR's)
- Chapel (one TR)
- Several support buildings, mansion and staff buildings that also contained one TR each.

For the intrabuilding horizontal cable plant, the system components included angled patch panels in 24- and 48-port configurations for network presentation ports on each floor. "During the build-out of the cable plant, we had about ten installers on site to pull and terminate more than 500,000 feet of Category 6 between the closets and the outlets," explains Goldcamp. "But the angled patch panels made termination easy and quick because of the spatial accessibility. And, the engineering of the cable, in which the pairs are laid out to line up with the color-coded termination slots, added to the speed of the punchdown procedure," he adds.

The workstation outlets contained various multimedia configurations and quantities of Category 6 cables ranging from two to four copper ports per workstation to support the application requirements specific to each individual area or learning space, as well as standard configurations for typical requirements for A/V, CATV, VoD, network, and IP paging that were common to all learning spaces.

COLOR ME GREEN

As a pioneer in engineering LEED-certified buildings, Bala continued that trend in developing the cabling infrastructure design. "Although the cabling infrastructure is not a direct contributor to the green initiative, we utilized some of the cabling functions and the network to provide energy efficient savings and to further integrate the control and monitoring systems. One such example of this utilization can be seen in the time clock system, which is also tied into the lighting controls, and other BAS monitoring," explains Osborn.

Bala designed most of the energy efficient concepts into the school's mechanical, electrical and plumbing systems. The mechanical equipment utilizes high-efficiency motors with variable frequency drives to reduce energy consumption. For example, the energy savings in most of the buildings is monitored by an energy heat wheel that transfers heat and humidity from the exhaust air in the winter to the supply air, and in the summer from the outside air to the exhaust air. During summer months the air conditioning units operate to maintain humidity levels, even when the school is vacant, to alleviate any mold issues. In the Academic Building, all of the air-conditioning systems modulate the outside air damper to maintain CO_2 levels, which varies with the occupant levels for substantial energy savings.

Lighting is controlled by a programmable time clock system through the BAS – both indoor and out. The light fixtures employ the use of energy saving electronic ballasts in conjunction with the motor light-level metering for reduced energy consumption.

The plumbing system utilizes low-flow faucets and toilets that reduce the excessive consumption of water. As a function of the BAS system, a water meter tracks the overall usage that allows Episcopal to monitor (through the network) consump-

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tion and helps to identify other waste factors including a potential leak.

MAKING HISTORY

When the new campus opens this fall, it will be a historical event and hopefully the last major move for the Academy. The Academy originally started in several downtown Philadelphia locations in the 1790s, then moved out to the "countryside" of Merion in the 1920s, expanding to the Devon campus in the 1970s for overflow. This latest incarnation has a campus layout that looks more like a college than a primary or secondary school. The motif is being compared to the University of Virginia and other similar campuses that contain a central lawn surrounded by buildings on both sides.

With a price tag swelling to upwards of $213 million and multiple private donors involved, it was essential that every detail from pre-construction planning to project completion was scrupulously examined. "When designing a brand new campus, it's easy to get caught up in trying to provide every 'bell and whistle', but we were prudent with the budget and wanted to make sure funds were allocated where best utilized, particularly in regards to their networking needs," notes Osborn. "In doing so, we specified NetClear solutions for total LAN and BAS integrated networks and feel confident that the cabling plant will stand-up to the test of time." A cabling infrastructure that cost-effectively meets the demands of today's applications with ample headroom for emerging technologies is intelligent planning for the future. ■

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