

DON'T BE FOOLED BY EXAGGERATED NUMBERS

The other guys like to boast about how fast or durable their splicers are. They always like to compare their numbers to ours. It's flattering and all, but we don't really need the attention. We have been pioneers in the splicing industry for over 39 years. There's a reason why other splicers are compared to ours.

Visit us at BICSI Winter, Booth #1019 to see for yourself.

AFL

www.AFLglobal.com/Truth
864.433.0333



Fujikura 70S Splicer

- 14-second automated tube heater
- 7-second splice time
- 6-direction drop proof

Sterlite Ex-1029

FEBRUARY 2016

FOR PROFESSIONALS MANAGING THE CABLE AND WIRELESS SYSTEMS THAT ENABLE CRITICAL COMMUNICATIONS

Cabling Installation & Maintenance®



JETTING BANDWIDTH at UNLV

PAGE 21

DATA CENTER PAGE 7

Ohio racino hits the jackpot

INSTALLATION PAGE 13

The importance of transmission testing

SECURITY PAGE 17

Benefits of a powered fiber cable

What Will Corning do to Competing Data Center Product Offerings?



Corning, makers of EDGE™ Solutions, the industry-leading Base-12 preterminated optical cabling system for your data center, now offers EDGE8™ Solutions. Combining the best-in-class density, speed of installation, and modular components of Pretium EDGE Solutions with the superior network scalability, improved link performance, and 100 percent fiber utilization of the first true Base-8 optical solution.

With **EDGE8™** solutions, less really is more.
www.corning.com/edge8/cim

CORNING

© 2016 Corning Optical Communications. LAN-2052-AEN / February 2016

CONTENTS

FEBRUARY 2016
vol. 24, no. 2



ABOUT THE COVER
Inside a vault at the University of Nevada, Las Vegas, a Microduct distribution box enables air jetting of fiber without disrupting the campus.
SEE ARTICLE ON PAGE 21.

FEATURES

7 DATA CENTER
Racino hits the jackpot with fast, efficient network
SUSAN LARSON

13 INSTALLATION
Differences between transmission testing and qualification testing
DAN PAYERLE

17 SECURITY
Powered fiber cable drives video security
RYAN CHAPPELL

21 CABLE PATHWAYS
Air jetting bandwidth for a real-time future-ready network
BRANDON JOHNSON

DEPARTMENTS

3 EDITORIAL
Cabling pros share pain points

27 PRODUCT FOCUS
Multi-fiber Connectors

29 EDITOR'S PICKS

Cabling Installation & Maintenance

Group Publisher Alan Bergstein
(603)-891-9447; alanb@pennwell.com
Chief Editor Patrick McLaughlin
(603) 891-9222; patrick@pennwell.com
Senior Editor Matt Vincent
(603) 891-9262; mattv@pennwell.com
Editorial Creative Director Meg Fuschetti
Production Director Mari Rodriguez
Senior Illustrator Dan Rodd
Marketing Manager Joni Montemagno
Audience Development Manager Debbie Bouley
Ad Traffic Manager Glenda van Duyne

PennWell www.pennwell.com

EDITORIAL OFFICES
Cabling Installation & Maintenance
61 Spit Brook Road, Suite 401, Nashua, NH 03060
Tel: (603) 891-0123, Fax: (603) 891-9245
www.cablinginstall.com

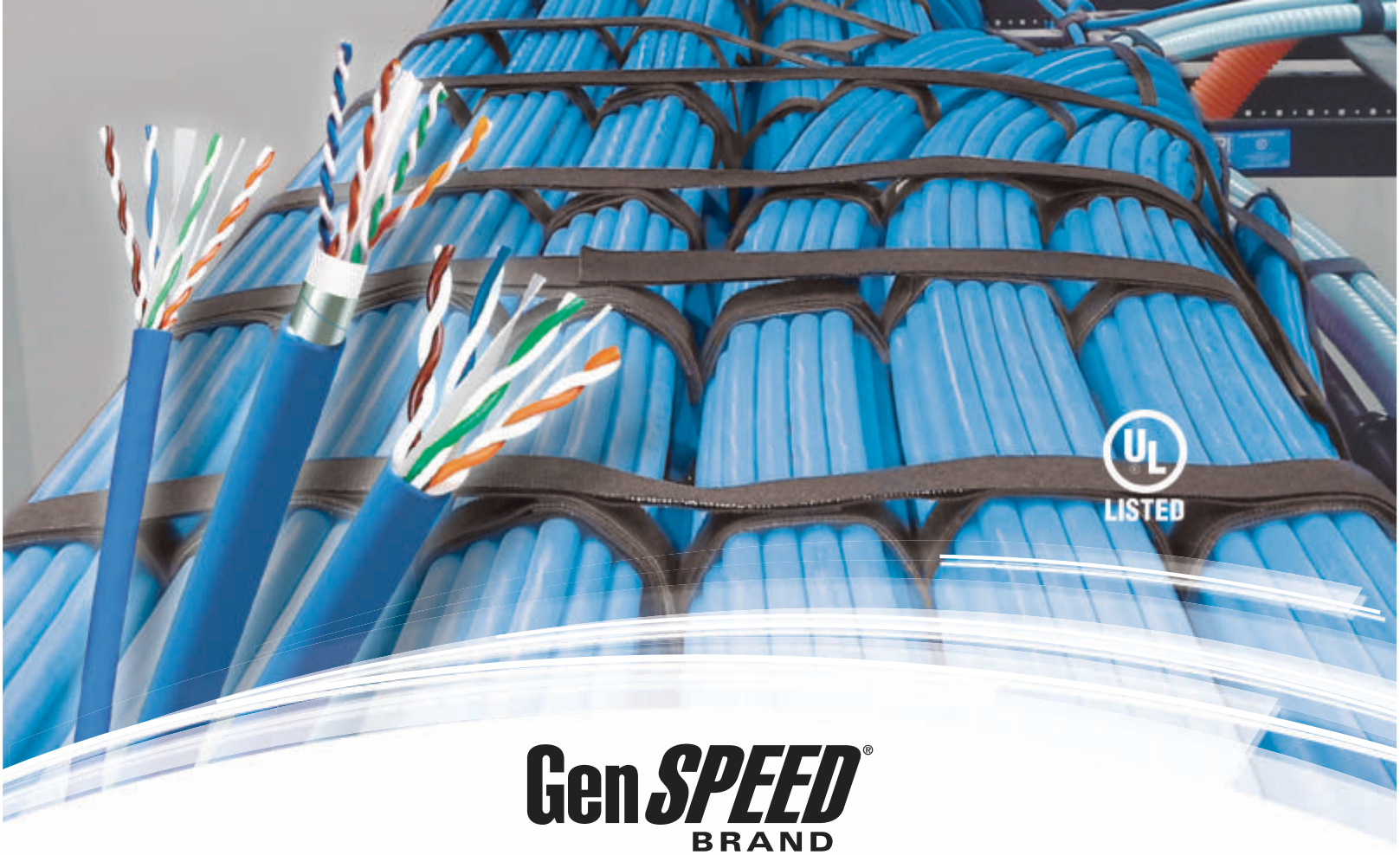
CORPORATE OFFICERS
Chairman Robert F. Biolchini
Vice Chairman Frank T. Lauinger
President and Chief Executive Officer
Mark C. Wilmoth
Executive Vice President, Corporate Development and Strategy Jayne A. Gilsinger
Senior Vice President, Finance and Chief Financial Officer Brian Conway

TECHNOLOGY GROUP
Senior Vice President & Publishing Director
Christine A. Shaw

FOR SUBSCRIPTION INQUIRIES:
Tel: (847) 763-9540; Fax: (847) 763-9607
www.cim-subscribe.com; e-mail: cim@halldata.com

BPA WORLDWIDE

Cabling Installation & Maintenance® (ISSN 1073-3108), Volume 25, No. 2. *Cabling Installation & Maintenance* is published 12 times a year, monthly by PennWell® Corporation, 1421 S. Sheridan, Tulsa, OK 74112. Periodicals postage paid at Tulsa, OK 74112 and at additional mailing offices. **SUBSCRIPTION PRICES:** USA $74 1yr., $110 2 yr.; Canada/Mexico $86 1 yr., $130 2 yr.; International $108 1 yr., $160 2 yr. **POSTMASTER:** Send address corrections to Cabling Installation & Maintenance, P.O. Box 3425, Northbrook, IL 60065-3425. Cabling Installation & Maintenance is a registered trademark. © PennWell Corporation 2016. All rights reserved. Reproduction in whole or in part without permission is prohibited. Permission, however, is granted for employees of corporations licensed under the Annual Authorization Service offered by the Copyright Clearance Center Inc. (CCC), 222 Rosewood Drive, Danvers, Mass. 01923, or by calling CCC's Customer Relations Department at 978-750-8400 prior to copying. We make portions of our subscriber list available to carefully screened companies that offer products and services that may be important for your work. If you do not want to receive those offers and/or information via direct mail, please let us know by contacting us at List Services *Cabling Installation & Maintenance*, 61 Spit Brook Rd, Suite 401, Nashua, NH 03060. Printed in the USA. GST No. 126813153. Publications Mail Agreement no. 1421727.



GenSPEED® BRAND

High-Powered PoE Applications Call for

Cables That Keep Their Cool

Future-proof your installations now with General Cable's new UL Listed Limited Power (LP) cabling solutions ... **the first to be certified.**

Independently validated by Underwriters Laboratories (UL), LP cables provide a simple way to ensure installations are future-proofed against the continually evolving Power over Ethernet (PoE) standards. As PoE applications draw more power in the coming years, make sure the cables you install today won't be susceptible to performance issues caused by heat generation down the road. Ensure a hassle-free installation without constraints to bundle size by choosing one of General Cable's Gen*SPEED*® Brand solutions that feature the new LP rating.

Learn more about the new rating and our LP listed Gen*SPEED* Brand solutions by calling us at 800-424-5666 or visit gcna.us/LP.

Delivering solutions that keep you connected.

Check out General Cable's Calculation & Catalogs Apps and other mobile tools

General Cable
1.800.424.5666
www.generalcable.com
info@generalcable.com

Cabling pros share project pain points



PATRICK McLAUGHLIN
patrick@pennwell.com

DeLorean Motors announced in late January that it plans to build replicas of the DMC-12 that probably is best remembered as the vehicle that was converted to a time machine in the movie "Back to the Future." If the company built actual time machines, it likely would have a decent market to sell into within the cabling industry. I say that because results of a survey we recently conducted show that one of the biggest pain points among cabling contractors, end users and consultants is that there never seems to be enough time to plan and execute cabling projects the way everyone would like.

We conducted the survey in mid-January and asked respondents specifically about the relative "pain" associated with several aspects of product selection, project operations, and logistics as they relate to cabling installations. The survey results suggest that if that DeLorean time machine could contain a giant bag of money, that would be great, because "working within a realistic budget" was also another top pain point. No great surprise there, I know. Cabling is like life itself: Things would be better if we just had more time and more money.

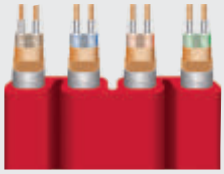
Beyond those rather predictable results, here are a few of the other highest-pain-inducing elements of cabling projects, according to the survey: obtaining all products needed from a single source; procuring older-generation products to be used with installed-base cabling systems; the bidding process.

When compiling the survey results, we separated data based on whether a respondent identified him/herself as a cabling system designer/installer/integrator, an end user, or a consultant working on behalf of an end user. Going in I wondered if we would find wildly different responses from each of these professional types. We really didn't. There were some slight differences for sure, but on the whole the same handful of topics represented the most significant "pain" across the board.

One objective of obtaining this information is to use it as the basis for a series of articles here in the magazine and on our website, cablinginstall.com. The survey results are fresh as I write this column, and have been compiled but not really analyzed. We'll get into that analysis in the weeks to come. Then in these pages as well as on our web pages, we'll go into greater depth on the industry's headaches and, if we're doing it right, what can be done to ease them.

Thanks to the many of you who completed our survey. Your input, based on your professional experience, is leading us in this effort.

WHAT'S NEW AT *www.cablinginstall.com*



NETWORK CABLE
Category 8 cable arrives, sort of



CONNECTIVITY
Cable strippers rated for electrical safety



NETWORKED LIGHTING
Clemson University deploys PoE lighting system



OUTSIDE PLANT
Magnetic locator finds buried iron, steel objects

INSTALLATION
Dust-free drilling for cleaner installs



Turn your mobile phone or tablet into a powerful wireless jobsite labeling partner.

Amazing mobile apps. Amazingly simple connectivity.

Print datacom and electrical labels up to 24mm wide with text, graphics and symbols fast, one at a time or on half-cut easy-peel strips.

Print practically anywhere, from Wi-Fi®-enabled laptops, tablets or smartphones - without cords, cables or power outlets!

Touch. Type. Print.

Touch your NFC-enabled device to the PT-P750WVP to set up a wireless direct connection. Easy to use Brother labeling apps for iOS® and Android™ come with preloaded templates to quickly print labels designed for cables, face plates and patch panels.

It's that easy.

So let's see: the power and performance of a desktop label printer but completely portable, including half-cut auto cutter to produce easy-peel labels on strips. Easy to use, full-featured PC software and mobile apps. NFC for effortless wireless-direct connection.

Simply touch, type and print.

P-touch EDGE®

PT-P750WVP

NEW



Kit includes PT-P750WVP label printer with built-in auto cutter and NFC assisted Wi-Fi® connectivity, long-life Li-ion rechargeable battery, AC adapter/charger, label media, USB cable and protective carry case.

Label design and printing software available for easy download from www.brother.com/inst, Apple Store or Google Play, depending on host device.

Other easy-to-use labelers your crews will actually use.

Easy to use. Powerful features. P-touch EDGE® handheld labelers.

Make the labels you need. Onsite. Without reading a manual.

What good is a labeler nobody knows how to use?

Don't waste your money buying labelers your crews won't use. Get P-touch EDGE® labelers instead.

Designed by labeling pros, EDGE® handhelds feature smart label application keys to simplify the process of making the types of labels you need most often.

So now almost anybody can make even complex, multi-line labels for datacom and electrical projects without reading a manual. Just pick the type of label you want. Enter the data into a preformatted template. Add symbols from the built-in libraries. Then print, cut, peel and apply your label.

EDGE® handheld labelers use both TZe and HGe laminated tapes on convenient easy-swap cassettes, so you can change label colors, sizes and adhesive types in seconds. Your content is printed under a clear laminate layer, so your labels are already laminated and ready to apply when they emerge from the labeler.

To learn more, visit: www.EDGElabeling.com



HSe tube is a printable heat shrink tubing designed for the PT-E300, PT-E500 and PT-E550W handheld labeling tools to mark cables, fiber and wires.

2 YEAR

2-Year Exchange Warranty

Choose from four easy-to-use models:



For making cable wrap/flag, faceplate and other labels up to 12mm wide



For making labels up to 18mm wide and heat-shrink tube for bigger projects



With PC connectivity and auto cutter; downloads and stores templates and data from the office for use in the field to make labels up to 24mm wide and heat-shrink tube



All the features of the PT-E500 plus wireless connectivity and auto "half-cut" cutter to produce labels one at a time or in easy-peel strips

BROTHER MOBILE SOLUTIONS, INC.

For more information, call 1-800-543-6144, or visit www.EDGElabeling.com

Brother™ is a registered trademark of Brother Industries, Ltd. in the United States. Images are for illustrative purposes only.
© 2015 Brother Mobile Solutions, Inc., 100 Technology Drive, Suite 250A, Broomfield, CO 80021
Labels shown are illustrative only. Actual output (such as font and margins) varies with labeler used.

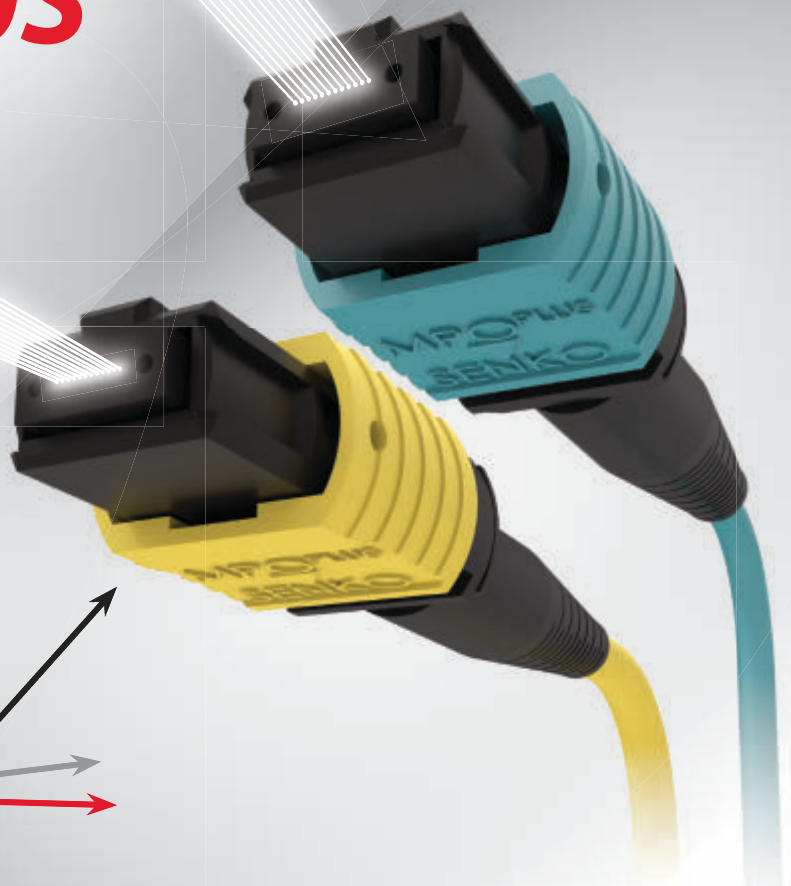
brother at your side

SENKO
SENKO GROUP® Advanced Components

www.senko.com

MPO PLUS

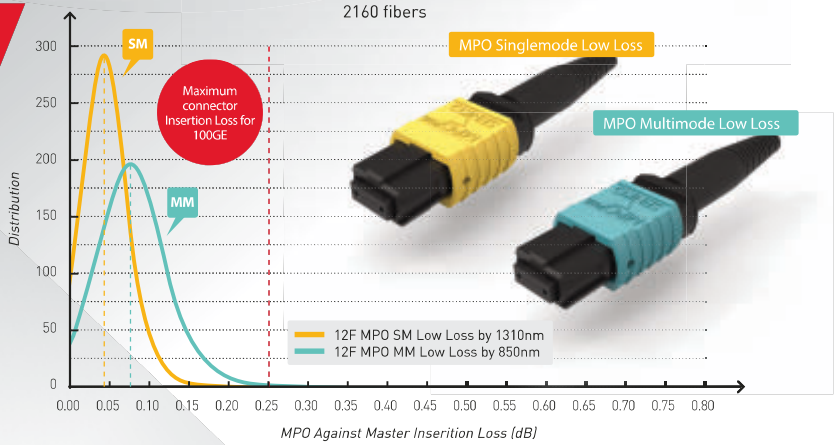
The Best Insertion Loss in the market



0.25 dB

Senko's MPO Plus MT ferrules are the most common used MT Ferrule in the market which gives the best combination of easy-to-use and low insertion loss. The SM Low Loss and MM Low Loss now guarantees the industries lowest insertion loss of 0.25dB, which exceeds the IEC 61755-3-31 Grade B Requirement. Quality, Price, durability and ease of assembly makes Senko's MPO Plus MT ferrules your best choice.

SENKO Low Loss 12F MPO Connectors - Made for 100GE and beyond
2160 fibers



SENKO ADVANCED COMPONENTS, INC.

CALL 1-888-32-SENKO

Americas
USA EAST 1-888-32-SENKO
USA WEST 1-858-623-3300
TEXAS 1-972-661-9080
Sales-Americas@senko.com

South America
BRAZIL +55-21-3736-7065
Sales-Brazil@senko.com

Asia
HONG KONG +852-2121-0516
SHANGHAI +86-21-5830-4513
SHENZHEN +86-755-2533-4893
Sales-Asia@senko.com

Europe
UK +44 (0) 118 982 1600
ITALY +39 011 839 98 28
POLAND + 48 71 396 36 59
Sales-Europe@senko.com

Asia Pacific
AUSTRALIA +61 (0) 3 9755-7922
Sales-Asia-Pacific@senko.com

Middle East North Africa
DUBAI +971 4 8865160
Sales-MENA@senko.co

Japan
TOKYO +81 (0) 3 5825-0911
Sales-Japan@senko.com

Racino hits the jackpot with fast, efficient network

The multi-building complex in Dayton, OH proved to be both a challenging and rewarding cabling design and installation project.

BY SUSAN LARSON, BERK-TEK

As soon as the new Racino entertainment complex opened, residents from Dayton, OH and surrounding towns flocked to try their hands at Lady Luck on the venue's new video gaming equipment. Slot machines are no longer "one-armed bandits"; they have been replaced by new digital video lottery terminals (VLTs) and winning is based on random algorithms.

Racino, which is part of the Hollywood Casino franchise owned by Penn National Gaming, sits on 170 acres. This newly constructed multi-building complex features a gaming facility with 1,000 VLTs, a sports bar and food court, retail shops, an outdoor horse track, a horse paddock (stalls) and outbuildings. Built from the ground up, bets were on as to whether or not the facility would be completed on time in 10 months due to many challenges, including one of the worst winters on record.

"This Racino location is similar to many of our other 28 national Hollywood Casino locations in fit and form, except the focus is on video terminals and horse racing, and this location does not have any table games," says Brad Wagner, IT manager at Penn National Gaming. The facility is divided into two sections, a front section and a back section. The front section houses the casino, dining area, and a stage. The back section houses the offices, the race track, and the customer betting and seating area. There are also different small structures that required network cabling—camera towers, parking lot towers, vet trailers, VIP areas, the paddock, and the maintenance building. "Providing a reliable and secure infrastructure to handle the many different IP applications in such a challenging layout is key to our operations," Wagner says.

The winning team of Chapel Electric of Dayton, OH and their sister company, Chapel Romanoff Technologies (CRT) collaborated to provide Racino with an efficient and reliable infrastructure. The CRT team included Dennis Severance, RCDD, vice president of operations; Jeff Carr, project manager; and Lee Olinger, general foreman. CRT specified the indoor and outdoor cable plant,



Racino in Dayton, OH, part of the Hollywood Casino franchise owned by Penn National Gaming, is a newly constructed multi-building complex featuring a gaming facility, sports bar, retail shops, an outdoor horse track, a horse paddock and outbuildings.



The project team, from left to right: Jeff Carr, project manager, CRT; Brad Wagner, manager of IT, Penn National Gaming; Lee Olinger, general foreman, CRT; Kevin Mousa, network administrator, Penn National Gaming; Dennis Severance, RCDD, vice president of operations, CRT.

and Chapel Electric designed the pathway system. For CRT, installing so many different cable types created challenges because the "workstations" were very diverse. The network infrastructure had to support multiple applications and devices including voice (VoIP) and data in the offices, VLTs on the casino floor, outdoor digital signage, a clocking system around the track, and data to the horse stalls. Additionally, throughout the complex, the network infrastructure connects security cameras, retail point-of-purchase devices, and AV systems. All of these IP devices had to be integrated into a converged IP network.

The CRT-led team also included Michael Raiser Associates (MRA), a nationally known technology consultant specializing in the hospitality market segment, as well as Turner, who served as the general contractor. Together, the project team was faced with adhering to extremely tight deadlines, harsh winter conditions and a multifaceted network layout. The team had to plan and install three different networks including separate backbone and horizontal cabling, and tie them together in redundant main distribution frames (MDFs). The three segmented networks included the IT data system, AV, and electronic safety and security (ESS).

Against the odds

The cabling and electrical contracts were awarded to the Chapel teams in November 2013, which meant that most of the initial cabling project would include trenching and laying the outside plant in the winter months. "The winter of 2014 was one of the coldest and most brutal winters we have seen in a long time in Southern Ohio," says Jeff Carr. "There were a few days when we couldn't work because temps hit a low of 22 degrees."

"And even when the buildings were closed up, the cold temperatures meant filling the propane tanks daily," adds Lee Olinger.

"Since the telecommunications industry lives and breathes by standards, we were able to follow the published guidelines for the cabling and connectivity, however, we had to think outside of the box on a few pathways," Severance explains. Chapel Electric worked with the CRT low-voltage team to design the pathways. Pathways from the telecommunications rooms (TRs) to the 1,000 VLTs located in the gaming facility included duct banks in the slab floor and were installed by Chapel Electric. "Duct banks are not typically used in enterprise locations, such as office buildings, but in this environment, it provided a more-secure raceway for the horizontal cables to the VLTs," notes Carr. "In addition, the electrical cable could be run in the same ducts, which provided physical separation between low voltage and power." Both power and data were provided to each VLT. Power outlets were located in the ducts and the data cable was pulled up through slot openings and terminated to outlets under the terminals.

"Because we were pulling the data cable alongside of the electrical cable, MRA selected shielded Category 6A cable," notes Severance. "Performance-wise, in regards to bandwidth, we might have been fine with Category 6, but when installing in a casino environment, we wanted to make sure that the cable would handle the video needed for these sophisticated VLTs. And BICSI and TIA standards now recommend Category 6A cables as the horizontal cable for all new installations," he adds.

There are a total of seven TRs or intermediate distribution frames (IDFs), and two equipment rooms that house the MDFs—one as a core and the other as a backup. The MDFs for the IT data and AV were physically separated to protect the core IT system from outside vendor-operated systems. The surveillance system has its own MDF. The redundant cabling between the equipment and telecom rooms included different singlemode and multimode fiber-optic cable constructions.

The majority of the backbone fiber-optic cable and connectivity comes from Berk-Tek Leviton Technologies. The installed ArmorTek cabling by Berk-Tek consists of a flexible armor around the cable jacketing for added protection. "The armor protection is preferred because of weather and environmental threats in outdoor trenches and for protection in indoor cable tray as well," explains Carr.

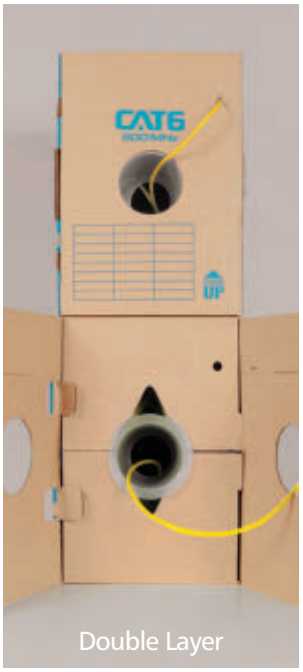
It's Not Complicated, One Brand Performs Better!

Outlets + Cables + Patch Panels = 40% Savings



Reelex® Tangle-free


Verified Performance



Double Layer



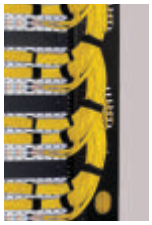
Plenum Made in USA















Like thousands of **ICC** installers, you have been using **ICC** jacks and patch panels and you know how reliable they are. Our jacks and panels never fail, are easy to terminate, perform better, and are priced 20 - 40% lower than most big brands.

ICC realized that compatibility between cables, jacks, and patch panels is the biggest factor of the cabling system performance. Therefore, we tuned our premise cables to perform the best with our jacks and patch panels. **ICC** also gives you an automatic 15 year end-to-end performance warranty without lifting a finger*. Best of all, **ICC** can save you 20 - 40% on your entire installation. So if you are happy with **ICC** jacks and patch panels, please install them on **ICC** Premise Cable. Don't let them talk you into an inferior line of cable. After all, you wouldn't put a sub-standard brand of engine into your top quality car!

Don't settle for less, ask for **ICC** Premise Cable; demand **ICC** Premise Cable.

Available at these Premise Cable Stocking Distributors:

JENNE	TELEDYNAMICS	TARGET DISTRIBUTING	fonte l	Coleman's TELECOM	Tristate Telecom
800-422-6191	800-847-5629	888-792-7463	800-238-0787	801-484-5238	800-223-4534
Avon, OH	Austin, TX	Germantown, MD	Aurora, NE	Salt Lake City, UT	Brooklyn, NY

888-ASK-4ICC icc.com/better 12 csr@icc.com

© Copyright 2016, ICC. * You must enroll as an ICC Elite Installer. Free enrollment at icc.com/Elite.

There were two fiber-optic cable types within the armoring. One type was Berk-Tek's Adventum loose-tube plenum, which was selected primarily for outdoor applications. The second was Berk-Tek's premise distribution plenum tight-buffer cable used for indoor applications. "We installed a variety of 6- and 12-strand singlemode fiber, totaling almost a mile. Between closets, our multimode runs included 12,000 feet of 6-strand, 8,500 feet of 12-strand and 600 feet of 48-strand, depending on the requirements and applications that each TR served," Carr notes. "The most time-consuming installation procedure for the fiber backbone was fusion splicing all of the LC connections in the TR." All the fiber-optic cable used Berk-Tek's GigaLite-10 OM3 glass for high-bandwidth applications, with connections patched in Leviton Opt-X 1000i Rack-Mount Enclosures.

Great track record pays off

"This was our first casino but as the saying goes, not our first rodeo," states Dennis Severance. "In our 15 years as one of the major cabling contractors in southern Ohio, CRT has designed and installed in a variety of unique industries, all with different applications, cabling types and layouts—including healthcare and government—so we were thrilled to get the opportunity and the experience of cabling a casino and horse track.

"Our go-to manufacturer is Berk-Tek Leviton Technologies because of their warranty and customer service. We installed a variety of LANmark-10 F/UTP shielded Category 6A, LANmark-1000 and LANmark-6 Category 6 cables for all the horizontal cabling. The network infrastructure had to support more than 1,300 IP devices, which included VoIP phones, computers, audio/visual equipment, digital signage, security cameras, and wireless access points. For this jobsite, CRT installed different colors of Category 6A and Category 6 to designate specific applications and redundancy per the request of the customer," explains Severance.

The horizontal cable was color-coded to correspond to separate applications. Cable redundancy to the 1,000 VLT machines included running 30,000 feet each of Category 6A green and white. An additional 8,000 feet of shielded Category 6A blue was installed for data applications through the casino. The AV video network, which included signage, video displays and baseband video, was cabled with 65,000 feet of shielded Category 6A gray cabling. The horizontal cable for AV was also plenum because it ran near the ceilings in cable try and J-hooks to the 300 TVs and video monitors.

To maintain the signal isolation and reduce interference and noise, the Berk-Tek shielded cable was terminated with the robust Leviton eXtreme Category 6A shielded QuickPort connectors. These connectors are hinged for easy access and allow for tool-free termination. They snap into Leviton shielded QuickPort patch panels.

"Because of the fast pace of the cable installation, we needed to make sure that the cable was onsite when we needed it, but storage onsite was a concern," explains Carr. "Our local distributor, Graybar, warehoused the Berk-Tek cable and at some point there was more low-voltage cable in that facility than electrical products, which are their main products, but it was moved quickly." Other Graybar warehouses located in nearby Youngstown and Cincinnati also staged some of the cabling.



In one of the Racino telecommunications rooms, CRT's Jeff Carr, Dennis Severance, and Lee Olinger make a final check on the installed cabling plant.

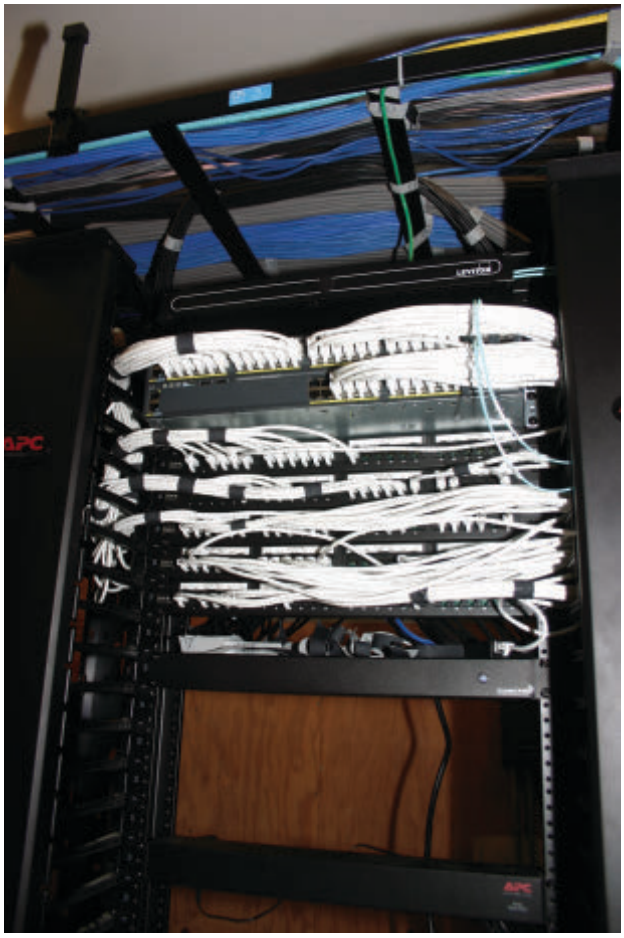
Due to the large quantity of Category 6A shielded cable, CRT ordered 2,500-foot reels of Berk-Tek's LANmark-10G F/UTP. "Berk-Tek offers both 1,000-foot and 1,500-foot boxes, but those would have been too copious at this site and our guys wanted to pull eight cables at a time," says Severance. "We tasked our warehouse engineers to design a cable cart to hold eight reels that would be on wheels, fit through a doorframe and have good stabilization and bearings," he adds. "Give a shop electrician a bunch of unistrut and a challenge, and you'd be amazed at the solution that they can put together," he notes, describing the eight-reel payout designed for this install.

Where there's gaming, there's security

Security in a casino environment is a top priority and it has to comply with the state gaming regulations. At Racino,

the third separate network is the security system, which is segmented from the other network applications. VLTs are regulated by the state and all are under careful surveillance by IP video cameras. There are 500 cameras within the gaming area and all connected to the TRs through 145,000 feet of black LANmark-1000 Category 6 cable. Unlike the Category 6A F/UTP cables, the Category 6 UTP cable did not require shielded connectivity or additional grounding and bonding. The LANmark-1000 cable was terminated to the Leviton eXtreme Category 6+ 110-style patch panels. These panels include a patented retention force technology that protects against connector tine damage and adds to the longevity of the system.

The gaming area at Racino has high ceilings, which created another cabling pathway challenge. All the indoor PTZ cameras, projector mounts and several TVs are exposed and needed to be camouflaged. In addition, the cable from the tray and J-hooks needed to be covered and protected coming down to the devices. The CRT team devised a creative solution by designing and constructing custom conduit pathways for the cable, which would also provide physical support for the cameras. Using 1.5-inch rigid conduits, CRT cut these to specific lengths, attached flanges to secure the cable to the cameras and painted everything black to blend in with the black ceiling. "Because the job was moving so quickly, we could do this behind-the-scenes in our warehouse tandem with the construction schedule. Once on site, our installers could easily bring the cable from the tray down through the prefabricated conduit assembly and attach to the cameras," adds Carr.



Redundant cabling systems supporting 1,000 video lottery terminals (VLTs) include 30,000 feet of white Category 6A F/UTP (shown here) as well as 30,000 feet of green Category 6A F/UTP cable.

Before the state could approve the gaming area, all the cameras had to be tested. "In many areas the glare from the lighting, particularly near the stage, posed a problem and blocked some of the PTZ operations of the cameras," Carr notes. "We had to further adjust each camera to make sure there was full area coverage."

The outdoor cameras, which were installed on camera towers, were cabled with Berk-Tek's outside plant single-mode fiber combined with 16-AWG copper conductors for power. In addition, many of the smaller structures were also cabled with fiber-optic cables including the VIP parking gates, the horse paddocks and maintenance buildings. The sophisticated timing system used for horse racing has its own headend equipment and is tied to the network over the fiber-optic backbone.

A winning combination

"We had 10 months from start to finish to install the entire IP network, which is a very short timeframe for the amount of work," states Carr. "My biggest challenge was to get enough people and materials on site so we could get it all done."

After all the cable was pulled and terminated, each run was fully tested to comply with the Berk-Tek Leviton Technologies system warranties. In this project, the four system warranties included CX6100 Category 6 Enhanced UTP System for up to 1-Gbit Ethernet; CS6600 Category 6A+ F/UTP System for up to 10-Gbit Ethernet; Premium OM3 Multimode Fiber backbone with Berk-Tek Adventum cables and OS2 single-mode fiber for the campus and equipment room building backbone.

"Because Berk-Tek and Leviton have supported CRT in many installations for so long, we knew they would support our customer well," states Severance. "To assure long-term reliability, we pulled in additional cabling for future use and are well-prepared to expand the facility or add more networked devices, as IP convergence is growing, especially in the casino environment," he concludes. ◆

Susan Larson *is marketing communications manager at Berk-Tek (www.berktek.com).*

LanTEK III

Cable Certifier

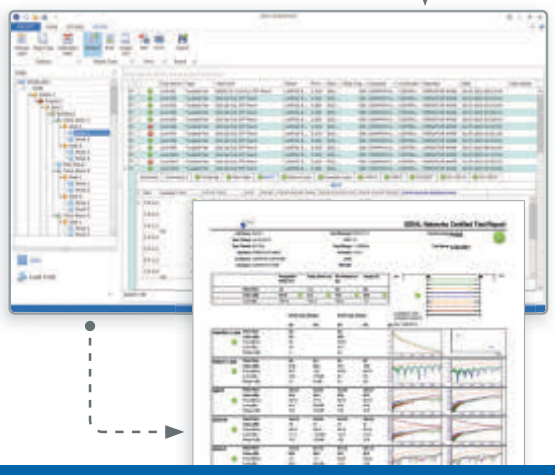
Test data when you want it, where you want it



Send test data from anywhere using the free **IDEAL AnyWARE™** app



IDC IDEAL Data Center software



Using the free IDEAL AnyWARE app, field technicians can share test data with colleagues or customers without leaving the jobsite, resulting in greater collaboration, more on-time job completions and reduced costs.

- **New troubleshooting features that save time and money** – Locate hidden connections, splices and cable faults using Time Domain Return Loss (TDRL) and Time Domain Crosstalk (TDX).
- **New permanent link adapter saves money** – Reduce down time and lower maintenance costs with field replaceable RJ45 contacts.
- **New FiberTEK III modules** – Tier 1 certification of fiber cabling eliminates the need for additional fiber testers. Available on 500MHz and 1000MHz models.
- **Industry leading battery life** – 18 hours of continuous testing without interruption.
- **New test data software** - Create powerful client reports quickly and easily from multiple testers using one PC application.

IDEAL AnyWARE

Download the FREE App today

Download on the App Store | GET IT ON Google play

Apple and the Apple logo are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc. Android is a trademark of Google Inc.

A subsidiary of IDEAL INDUSTRIES INC.

IDEAL INDUSTRIES, INC.

© IDEAL Networks 2015



Free iPad Mini 2 or Samsung Galaxy Tablet S 8.4 with your LanTEK III cable certifier. For details, please visit **www.idealnetworks.net**

Differences between transmission testing and qualification testing

The more-capable transmission tester can check more than just the physical connection between two points.

BY DAN PAYERLE, Ideal Networks

Three types of testers are available to installers of local area network (LAN) cabling who require testing beyond what a verifier (wiremapper) provides: qualifiers, transmission testers, and cable certifiers. At the top end, cable certification testers perform comprehensive, high-frequency measurements of the electrical characteristics of a cabling system to ensure it meets the requirements of the TIA-568 and ISO 11801 standards. Up until the mid-2000s, certifiers and verifiers were the only options installers had for testing LAN cabling.

In about 2004, a new type of tester offered cable installers an option to document an installation when a certifier was not needed to provide test reports for a warranty program. The TIA and ISO cabling standards define the measurements, pass/fail limits and accuracy requirements for certifiers to test various performance cabling categories, such as Category 5, 5e and 6 (called "classes" in ISO standards). These new testers did not have defined parameters in the standards for commercial building cabling systems the way that certifiers did. The word "qualification" first appeared in a standard when the TIA-570-B—a standard for residential cabling—was published. The section of the 570-B standard that addresses cabling is vague compared to the content of the 568 series of standards.

TIA-570-B reads: "Cable qualification tests the cabling to determine that certain network technologies (e.g. 1000Base-T, 100Base-T, FireWire) will perform on the cabling system. Cable qualification shall be performed using network equipment installed on the cabling, or by use of a qualification test instrument."

There are no further definitions of qualification. This broad statement opened the door for new types of testers that have capabilities exceeding those of a verifier and do not meet the requirement of a certifier. The rest is left up to the manufacturer to decide how their product will "qualify" a cable. The result is that different qualifiers can be purchased that do not measure or report the same parameters and can give completely different results on the same cabling link.

Qualifiers and transmission testers

A standard provides a set of rules allowing different companies to manufacture products that operate with each other or provide the same function. Different brands of certifiers that meet the TIA/ISO standards will report the same results on a cabling link when compared side-by-side. Unless a qualifier is testing to a standard, there is no way for the user to compare the measurement results of one tester to



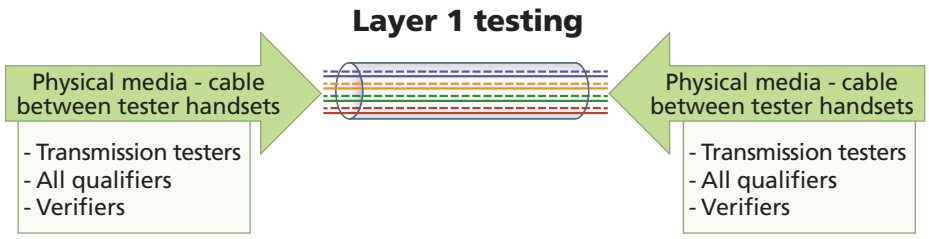
The SingalTEK family of transmission testers provides proof of IEEE-compliant data transmission on cabling links and through active networks.

another. The reason this alternate, yet undefined method of testing is in TIA-570-B is to encourage performance testing of residential cabling to support high-bandwidth applications without requiring a residential installer to purchase an expensive certifier that meets the TIA-568/ISO-11801 requirements.

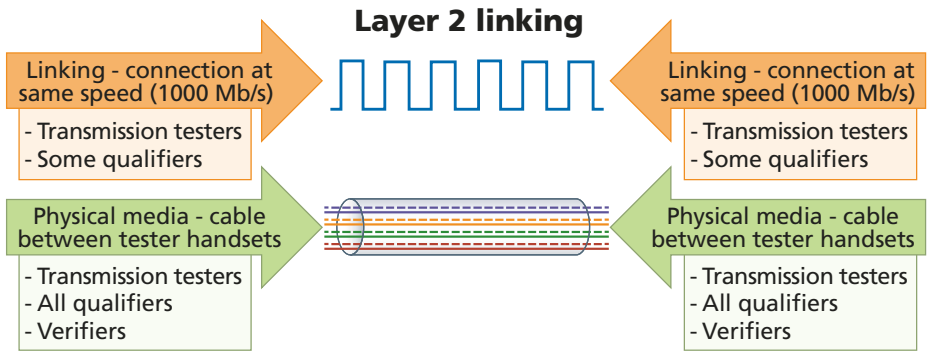
As an alternative, some companies introduced a technology that is commonplace in wide area network (WAN) testing. Data transmission testing, or simply transmission testing, is a tried-and-true method of testing that has the advantage of pass/fail parameters defined by a standard, meaning the tester is not providing a "trust-me" report. A "trust-me" report is one in which the measurements, measurement criteria and pass/fail limits are either unspecified or cannot be traced back to an industry-recognized test method.

Within the scope of LAN testing, a transmission tester fits into the category of a qualification tester because it is providing performance testing of the cabling but is not performing the same measurements of a certifier. However, to call a transmission tester a qualifier is an understatement. Unlike LAN cable qualifiers, transmission testers perform specific measurements and make pass/fail determinations in accordance with an industry standard. The standard used for LAN testers is the IEEE 802.3 Ethernet standard that is an umbrella document for all the different varieties and implementations of Ethernet.

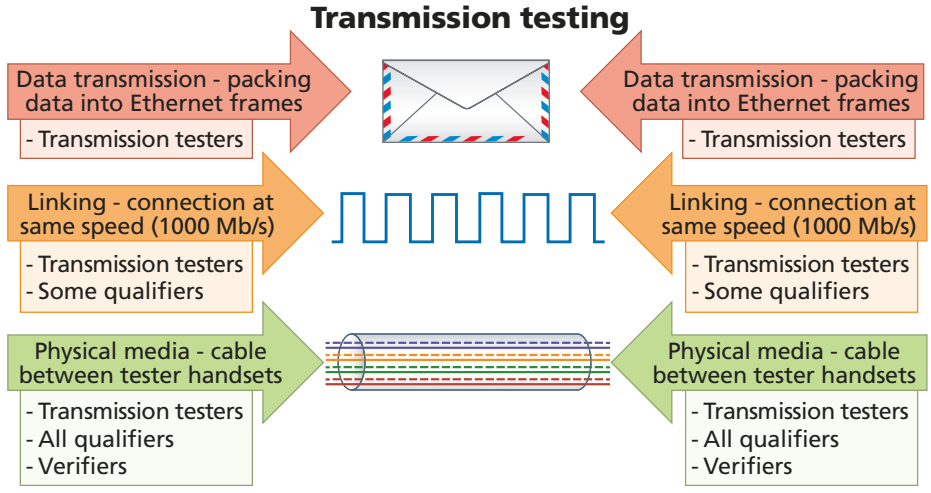
The Gigabit Ethernet standard, IEEE 802.3ab, defines the data rate, frame size, and allowable delay and loss rate for a "good" Ethernet system. By referencing the 802.3ab standard, a transmission tester provides results that the user can be assured represent the true capabilities of the cabling and not what the tester manufacturer believes to be true.



A Layer 1 tester, such as a wiremap verifier, checks only the cable.



Layer 2 linking is a basic electrical connection between the two sides. Some qualifiers simply sense the voltage pulses of a network switch to qualify a cable.



A transmission tester performs complete data frames that are sent across the link to ensure transmission of full-speed data is possible.

Network layers

To better understand how a transmission tester operates, one needs to have a basic understanding of the Open Systems Interconnection (OSI) model. The OSI model separates the process of transmitting data across a network into functional blocks. Following is a characterization of the OSI layers.

Layer 1 – Physical Layer: The electrical/optical signaling and physical cabling components that connect devices on the network.

- Horizontal and backbone cabling, both copper and fiber-optic.
- WiFi and other wireless signals, which are considered physical even though they cannot be touched
- Hubs and repeaters.
- Copper and fiber-optic network interface ports (PHY) on network devices, e.g. PCs, switches, routers, IP cameras and wireless access points. Devices are referred to as

nodes or hosts.
- The electrical or optical signaling between network devices, i.e. electrical current, light and radio waves.

Layer 2 – Data Link Layer: Provides data transfer between two directly connected nodes or two nodes of the same network.
- Detects and corrects physical layer problems, for example, automatic crossover switching between two Ethernet switches when a crossover cable is not used.
- Media Access Control (MAC)—controls the physical addressing of devices on the network, i.e. every Ethernet device in the world has a unique MAC address.
- Encodes and decodes data frames, adds a source and destination MAC address to each frame.
- Performs error checking and discards bad data frames transmitted on Layer 1.
- Synchronizes devices with systems such as auto-negotiation between 10/100/1000-Mbit/sec devices.

Layer 3 – Network Layer: Provides data transfer between nodes on different networks.
- Encapsulates Layer 2 frames inside of a data packet.
- Adds source and destination IP address to each data packet.
- Assigns an IP address that is unique to each node on its own network.

Layers 4-7: These layers are outside the scope of this article and for brevity, will not be discussed.

Transmission testing requires the two handsets that make up the test system to communicate on at least Layers 1 and 2 of the OSI model. Some testers can operate up to Layer 4 when required for specific applications.

To measure the parameters defined in 802.3ab, a test system must generate Ethernet frames, transmit them across a cabling link or through a network, and measure the number of frames that are corrupt and dropped from the data transmission over a specified period of time. This needs to occur in both directions simultaneously, which means the test device must have active components at both ends of the cabling link or network being tested. The results of the test indicate whether the link supports transmission of data at the rate at which it is designed.

Phases of transmission testing

Transmission testing is a process that can be complicated, especially when

SIEMON's
ConvergeIT™


24-Port MAX Zone Unit Enclosure


Shielded and UTP
Z-MAX and MAX Outlets


Surface Mount Boxes


Shielded and UTP Copper Cords

WWW.SIEMON.COM



Plenum-Rated Cabling Solutions for Intelligent Buildings

Ideal for converging all low-voltage systems onto a single unified physical infrastructure, Siemon's line of plenum-rated ConvergeIT Cabling Solutions for Intelligent Buildings supports a variety of IP-based devices within a building's plenum (air handling) spaces. Siemon's plenum-rated cabling solutions include:

- **Category 5e, 6, 6A and 7A Plenum Balanced Twisted-Pair Cables**
- **Category 5e, 6 and 6A Solid Plenum Modular Cords**
- **Category 5e, 6 and 6A Outlets**
- **Surface Mount Boxes**
- **4-Port MAX Zone Unit Enclosure**

To learn more about ConvergeIT visit; **www.siemon.com/convergeit**

SIEMON

testing between locations across the Internet. Because this article is comparing transmission testers to qualifiers, it will be limited to LAN testing.

Step 1 – Physical media connection (Layer 1): The handsets are connected at either end of the link being tested. At this point the two handsets have established an electrical connection across the cable (or optical when testing fiber) to perform basic tests. On copper, the tester will be able to perform a wiremap test to check for termination faults and damage to the cable. The tester may also measure the length of the cable. When connected to the cable, the RJ45 link LEDs will light, indicating the electrical connection has been established. The link "speed" depends on the capability of the transmission tester. A Gigabit tester should be at 1-Gbit/sec when connected to a cable with all four pairs properly terminated. The indicators are usually present when testing fiber. The LEDs on the fiber port of the equipment will light and stay on when they detect a signal at the input port. This helps when troubleshooting polarity (crossing transmit/receive) problems.

Some might mistake the 1-Gbit/sec link as proof that the cable will support 1-Gbit/sec data transmission. Not true. The auto-negotiation process is an electrical "handshake" between the devices. No data is transmitted during the link process.

There are qualifiers on the market that use the auto-negotiation process alone to qualify a cable and generate a "Pass" report. This is very misleading because, for example, a short link of Category 3 cable with Category 5e connectors, or even a Category 5e cable with a split-pair fault will often link at 1 Gbit/sec, yet will completely fail to transmit data, or will transmit with a very high error rate.

Step 2 – Linking (Layer 2): Each handset broadcasts its unique MAC address and listens for the MAC address of its partner. When connected to a common cable, they establish a Layer 2 link and are prepared to transmit data frames across the cable.

In addition to linking on a single cable run, some testers may have the capability to link across the LAN. Each handset will broadcast its MAC address to the LAN and the network switches will learn a path to link the two handsets, regardless of location, as long as they are on the same network. This system allows testing of every section of cabling, and each switch and media converter between the handsets. Even when a handset is connected to an RJ45 port in one building and the other handset is connected to a fiber-optic port of a switch in a different location, they will still link to each other.

It is worth noting that typical qualifiers are not active network devices (they do not have an Ethernet PHY) and do not have this capability. Their connection stops at Layer 1.

Step 3 – Data transmission test (Layer 2): The data transmission test is where the proof of performance lies. The tester creates Ethernet frames packed full of data and sends them out its network port to begin the test. Each frame has the source and destination MAC addresses of the two test handsets. This is a full-duplex operation, meaning each handset is performing this process at the same time, transmitting data in both directions on the cable simultaneously.

The test system will transmit continuous data at a specified rate for a specific amount of time. The IEEE standard provides a ratio of good to bad frames and the tester will send the minimum amount of data required to prove whether or not the system meets this performance requirement. Users can also choose to have the test run for a number of minutes or hours, which is helpful when troubleshooting network problems that happen at random times.

If the testers are connected to each other by a single cabling link, those are the only components under test. However, if connected to a live LAN the data frames will be sent to the nearest switch and from that point on, it is the responsibility of the network to transport the test frames between the two handsets. This is a complete test of the data transmission path between any two points on a LAN, proving that all the network components between the two testers are functional. This is an important function qualifiers cannot perform.

Advantages of transmission testers

A transmission tester checks more than just the physical connection between two points to infer that the cable is capable of supporting error-free transmission of data. It establishes a complete electrical and data link connection to the cabling or LAN and making pass/fail determinations of performance by transmitting and checking Ethernet frames. This is a direct measurement of the flow of data versus qualifiers that perform measurements that are not traceable back to any standard to make a pass/fail determination.

When testing cable and networking components on an Ethernet LAN, the best way to be certain it meets performance is to perform tests that measure the physical, electrical and data transmission capabilities of those components to the requirements of the IEEE 802.3 standard that defines Ethernet. ◆

Dan Payerle *is business unit manager, U.S., for Ideal Networks, a subsidiary of Ideal Industries Inc. (www.idealnetworks.net).*

Powered fiber cable drives video security

Latest-generation surveillance cameras' needs for both bandwidth and power can be met by an innovative cable technology.

BY RYAN CHAPPELL, CommScope

Cabling Innovators Honoree The deployment of a powered fiber cable system at a golf course in Florida, as briefiy described in this article, was honored with a 2015 Cabling Innovators Award. The awards program's judges determined that the innovations put to use in that deployment resulted in a substantial improvement over previous methods deployed, approaches taken, or products and systems used. Congratulations to CommScope on this honor. Look for more Cabling Innovators Awards honorees in future issues of *Cabling Installation & Maintenance* magazine.

High-definition video cameras are increasingly popular as a means to secure sites such as hospitals and university campuses, but evolution in camera technology and the demands of specific venues are driving changes in the cabling systems used to connect these cameras. The need to bring power and high-bandwidth data resources to every camera in a broad-based deployment often means high construction costs and suboptimal placement of cameras. In this article, we'll look at the changing technology in surveillance cameras, how this impacts the type of cabling used to connect them, and how hybrid cable systems can support future deployments.

Rising demand for video security

According to Transparency Market Research, the demand for video surveillance systems is rising, expected to approach $40 billion USD by 2020. Similarly, securitysales.com predicts a market of $42 billion USD by 2019 with a compound annual growth rate for IP-based video surveillance in particular of 24.2 percent from 2013 to 2019.

Of course, market reports are only estimates, but all notable sources predict a continued increase in demand for video surveillance equipment. Many factors have been cited to explain the rise in demand for video security systems including, but not limited to, increased threat of terrorism, crime/violence prevention, the rise in the "Internet of Things" (IoT), and new applications such as commercial advertising (Imagine as you walk into a mall the system "recognizes" you, allowing delivery of various context-appropriate advertising tailored to your typical buying habits).

Changing camera technology

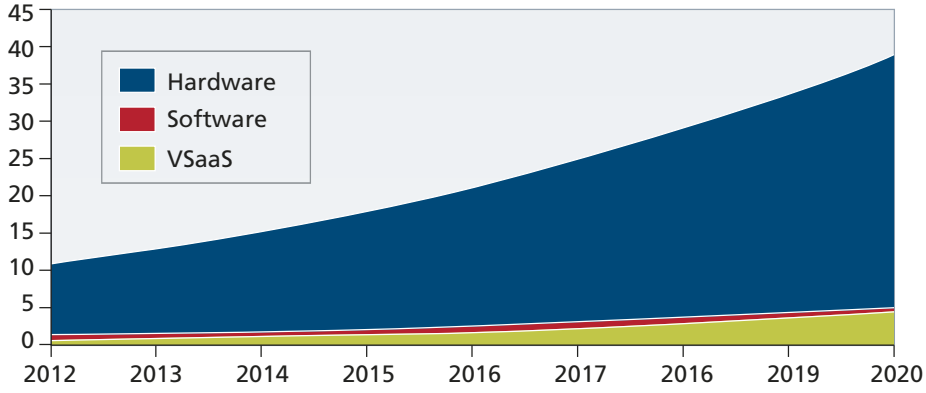
In the past, lower-resolution analog security cameras have been widely deployed. But the quality of the video in these 920H and lower resolution cameras is far lower than the new wave of IP-based high-definition (HD) video cameras (meaning cameras with resolution of at least 720p).

HD video cameras support 720p (720 vertical lines) or 1080p resolution. But, even higher resolution is always better in surveillance video because it allows those monitoring the video feed to see smaller objects, or to see people, license plate numbers, and other elements more clearly. With the advent of 4K video standards, security cameras are now supporting 3840 pixels by 2160 lines, or 2160p resolution, and camera makers are already experimenting with 8K video to once again double a camera's resolution.

4K video cameras are already making significant improvements in security. With high resolution, these cameras can be placed at considerable distances from the area they monitor and still allow digital zoom to pick up small objects. In one instance, a camera located two miles from a city center can be digitally zoomed to pick up license plate numbers.

In addition, sites are enhancing security by using low-cost facial recognition servers to process the video feed.

Global video surveillance and VSaaS market size and forecast, 2012-2020 (US$ Bn)



Source: TMR Analysis, January 2015

Transparency Market Research produced this forecast for video surveillance and video surveillance as a service (VSaaS) market, approaching $40 billion USD by 2020. That projection is similar to other forecasts from other analysts for the video-surveillance market.

One customer recently cited to us that for as little as $6,000, users can deploy a facial recognition server and integrate this into the video camera control system (network video recorder) to provide quick identification of suspicious people.

With higher resolution comes the need for higher bandwidth. Yesterday's video cameras could be connected with coaxial cable because they needed fairly low bandwidth. Some estimates are that a single 4K camera video feed, with modern video compression, needs about 15 Mbits/sec minimum of bandwidth (without video compression the bandwidth need is much higher). If one imagines a campus deployment with many cameras, then the bandwidth demand begins to add up. According to ABI Research, The Video Surveillance Report, 2010, the average Las Vegas casino has more than 2,000 cameras. By itself, this still might not absolutely require a move to optical fiber as the communications medium, however when the distances from head-end locations to these cameras are factored in, optical fiber begins to be attractive as opposed to traditional copper-based solutions.



These images are examples of analog versus high-definition camera quality levels.



Standard definition, HD and 4K video quality.

The need for bandwidth and power

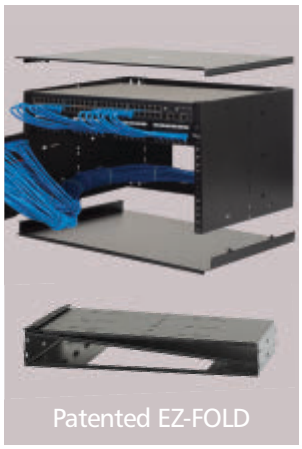
But in addition to bandwidth, video cameras also need a source of power, and this can be problematic. Colleges, for example, want to deploy cameras on light poles around campus, but those poles are often in power-off mode during daylight hours (controlled by photocells), so they cannot always provide 24-hour power to video cameras. In other venues, cameras may be placed on the sides of buildings or on utility poles, but in these cases the camera owner may have to negotiate access to power from the building owner or utility and may have to pay for that power on a monthly basis.

If the decision is taken to tap into local power, then the cameras are themselves subject to the reliability of that local power source. To counteract this, network operators sometimes want to install local uninterruptible power supply (UPS) batteries, but these remote batteries are difficult and expensive to maintain.

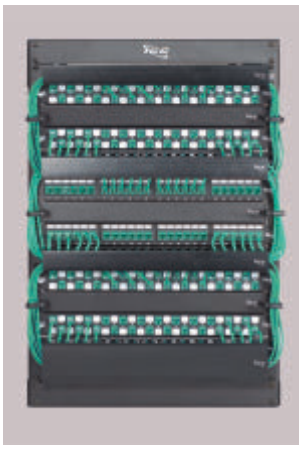
IEEE ratified a standard for delivering both power and data in a single Ethernet cable; it is called Power over Ethernet, or PoE. The standards 802.3af (PoE) and 802.3at (PoE Plus) define how power and data can be delivered at distances up to 100 meters via category cabling. More than a simple direct current (DC) power solution, the PoE standard incorporates excellent safety features,

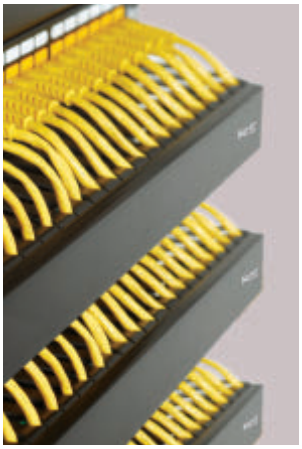
Overpaying for RCM?
Not with ICC

Brackets	+	Racks	+	Managers	=	40%* Savings



Patented EZ-FOLD







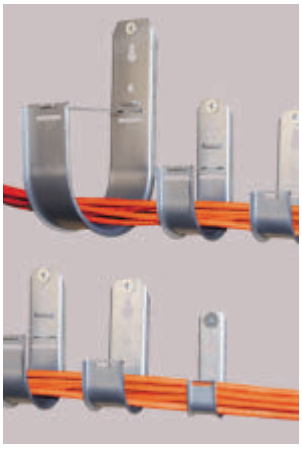


6" and 15" Depths



Tough Cabinets





Much like other brands, ICC manufactures a full line of Racks and Cable Management (**RCM**) products made of metals and plastics. The biggest difference is that we have actually **priced** them like metals and plastics, not as high tech gadgetries! So when the cable manager panels are more expensive than the patch panels, we need to talk.

Call ICC or any of our Premise Cable Stocking Distributors™ listed below for competitive pricing to help you win **projects** and increase your **margin**.

Available at these Premise Cable Stocking Distributors:

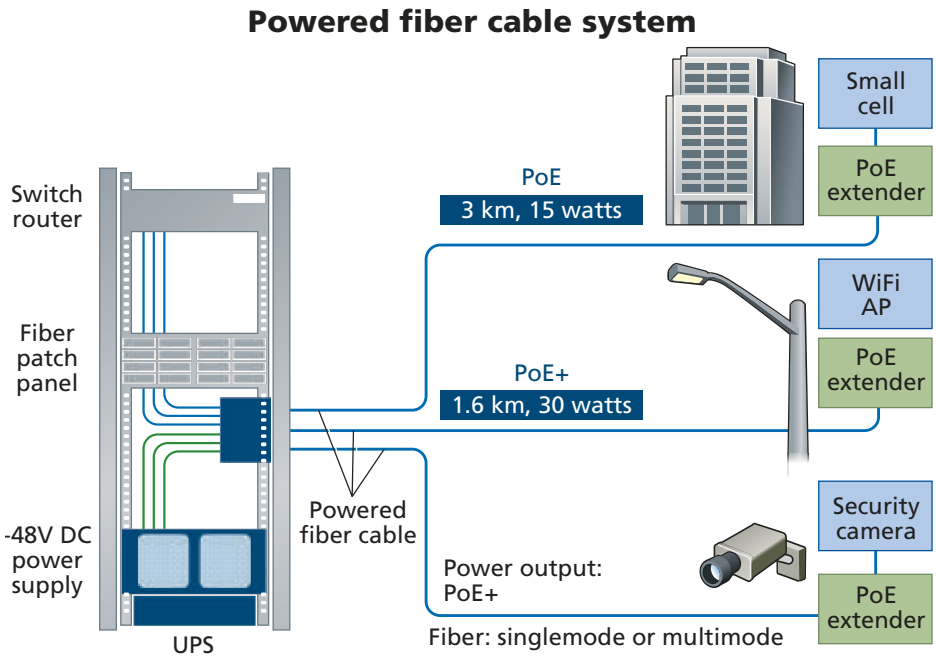
JENNE	TELEDYNAMICS	TARGET DISTRIBUTING	fonte l	Coleman's TELECOM	Tristate Telecom
800-422-6191 Avon, OH	800-847-5629 Austin, TX	888-792-7463 Germantown, MD	800-238-0787 Aurora, NE	801-484-5238 Salt Lake City, UT	800-223-4534 Brooklyn, NY

888-ASK-4ICC icc.com/better **22** csr@icc.com

© Copyright 2016, ICC. * Compared to big brands.

software handshaking, etc. into a truly useful solution.

The broad placement of video cameras throughout a campus or other facility means that cameras can be hundreds of meters from the video head end. In fact, if very long distances can be supported, it becomes possible to reduce the number of head-end locations, further saving capital expenses and operating expenses. As a result, installers will often want to use optical fiber to form connections. Singlemode fiber can carry nearly unlimited data, so it is more than ample for connecting 4K or 8K cameras, and its reach can extend for miles. Multimode fiber, especially newer 50-micron core-size OM3 and OM4 fibers, can handle distances in the "hundreds of meters" range and so is also a viable option for many situations.



In a powered fiber cable system (PFCS), each cable can deliver power to any PoE-compliant device at a distance up to 30 kilometers. The PFCS also includes DC/DC conversion technology.

Powered fiber cable systems

So fiber is a great option for handling long-distance data transmission, but what about also delivering power?

A powered fiber cable system (PFCS) addresses the need for local power as well as the need for fiber data connectivity. The PFCS incorporates a rack-mounted power and optical-fiber termination point, a hybrid cable that includes both singlemode and multimode fiber and electrical conductors, and a remote termination node that plugs into the camera being powered.

In a PFCS, each cable is capable of powering any PoE-compliant device at a distance of up to 3 kilometers, giving the system 30 times the reach of standard PoE systems. An integrated media converter and PoE chipset work together to deliver a simple PoE or PoE Plus output in an RJ45 jack. The system incorporates DC/DC conversion technology to eliminate DC line powering calculations, and it features primary, secondary, and tertiary electrical protection for use in harsh outdoor environments as well as indoor venues.

Powered fiber cable systems significantly reduce deployment costs and time to deployment by putting control over local power back in the hands of the network operator. These cable systems simplify power negotiations, metering, and monthly recurring charges for power at the remote sites, and they streamline deployments by providing power and network connectivity at the same location.

Deploying surveillance cameras with a PFCS

With a PFCS, deploying video cameras becomes a fairly straightforward process. The PFCS acts as a long extension cord for data and power connectivity to any location desired, so the cameras can be placed exactly where they will do the most good, rather than at locations where power is available. The PFCS also eliminates the need for licensed electricians by staying within the *National Electrical Code (NEC)* Class 2 and Safety Extra Low Voltage (SELV) limits for low power, intrinsically safe electrical systems. Cables may be routed in the same cable pathways as Ethernet cable and other fiber-optic communications cables.

Moreover, the PFCS saves the cost of running separate data and power cables. In a south Florida golf course, for example, a design for a power/data network supporting 36 surveillance cameras was initially done using separate power and fiber cables at a cost of $981,000, but the same design with PFCS cost only $839,0000—a savings of $142,000, or 14.5 percent.

As video cameras come to support 4K and higher resolutions, installers and users can slash deployment costs, eliminate power negotiations and costs, and significantly speed camera rollouts by using a PFCS. ◆

Ryan Chappell *is North American solutions architect at CommScope (www.commscope.com). He holds bachelor's and master's degrees in engineering from NC State University.*

Air jetting bandwidth for a real-time future-ready network

A look at the University of Nevada, Las Vegas's air-jet fiber installation.

BY BRANDON JOHNSON, DataPlus Communications

Since its first classes were held on campus in 1957, University of Nevada, Las Vegas (UNLV) has transformed itself from a small branch college into a thriving 332-acre urban research institution, currently one of only 99 universities classified as RU/H, high research activity, by the Carnegie Classification of Institutions of Higher Education.

UNLV's success as a research institution is mirrored by the commitment and mission of its IT department—"The Office of Information Technology provides leadership in helping faculty, students and staff utilize innovative technologies … including development and support of applications that meet their changing needs."

True to its promise, an innovative decision was made in 2006 to adopt a new, yet still unfamiliar, blown fiber network infrastructure technology versus the still widely used, decades-old installation method of pulling optical fiber cable. That decision was critical to meet the onslaught of continuous bandwidth-hungry research applications and ever-increasing network Gbits/sec speeds within a constrained budget. Did UNLV's IT decision makers make the correct choice?

Its blown fiber infrastructure technology has served the university well. However, recent innovations in microduct and air-jet technology by the Dura-Line and AFL companies respectively would allow UNLV to increase network capacity even further and introduce greater optical fiber counts than the older system would support. In November 2014 UNLV installed the new MicroDuct and fiber to quickly upgrade the bandwidth requirements in key buildings.

UNLV is assured that its network has the maximum capacity possible for the growth, expansion, mega bandwidth increases, and the latest technology applications required by a research institution. Unlike conventional optical fiber network infrastructures, air-jet technology provides unprecedented benefits for today's high-density, high-speed enterprise networks including the following.

- Virtually unlimited fiber pathway and bandwidth capacity, eliminating congested conduit and duct problems
- Immediately scalable, real-time already futureproofed sustainable network; eliminating dark fiber
- Fast and easy fiber installations, upgrades, and network moves/adds/changes in hours versus the days or weeks associated with a conventional



Since its inception, the University of Nevada, Las Vegas has transformed from a small branch college to a 332-acre urban research institution.

infrastructure, even in hard-to-reach campus areas
- Flexibility in infrastructure design, reducing or eliminating the need for innerduct and additional conduit
- No physical disruption to campus grounds or inside building fiber installations, promoting safety
- Continuous fiber runs, eliminating splicing and potential points of network failure
- Faster network restoration, reducing or eliminating network downtime
- More than 90 percent labor cost savings for continuous return on investment

These attributes address UNLV's mission and can serve as a model for all colleges and universities, regardless of size, given bring-your-own-device (BYOD), high-definition video, growth of online courses, and the ongoing influx of emerging high-density-driven technology challenges necessary to best meet the needs of students, faculty and staff.

Air-jetted fiber infrastructure

At the heart of an air-jetted fiber infrastructure is the MicroDuct. The bundled Dura-Line FuturePath MicroDuct pictured herein makes up the campus fiber pathway topology in and between buildings. These ducts include high-density polyethylene (HDPE) OSP, riser, plenum, and low-smoke zero halogen options as dictated by location in the network. For inter- and intranetwork connectivity, these MicroDucts are independently riser and plenum rated, for example.



The bundled Dura-Line FuturePath MicroDuct, pictured here, makes up the campus fiber pathway topology in and between buildings on the UNLV campus.

The interconnection of UNLV's buildings from one to another simply requires that outdoor MicroDuct be connected with push-fit couplings to an indoor plenum or riser MicroDuct in seconds. Because the Jetted MicroCable is installed after the connections are made, splicing and related labor costs for skilled workers have been eliminated. By eliminating splicing, which creates potential points of network failure and is necessary with conventional cable pulls, an air-jetted infrastructure's point-to-point connectivity improves signal integrity for better transmission and reliability.



Connecting one UNLV building to another requires outdoor MicroDuct to be connected with a push-fit coupling, like this one, to an indoor plenum or riser MicroDuct. The connection takes just seconds.

These bundled MicroDucts, enclosed in a protective jacket, replace traditional innerduct, can be direct-buried thereby eliminating the need for conduit, or can be placed within existing conduit, as was the case with UNLV's installation. The bundled MicroDuct fiber pathway provides virtually unlimited bandwidth and fiber capacity. The new Dura-Line MicroDuct innovation, when considering 5 bundles of MicroDucts (each made up of 12 individual inner MicroDucts) for a total of 60 reusable pathways, provides a 1900-percent increase in capacity over conventional cabling. The increased capacity (detailed in the figure on page 24) solves congested conduit and duct-bank problems, while reducing or eliminating the need for additional conduit and related installation costs. Unused pathways remain empty for future expansion.

It is through the bundled MicroDuct pathway that any optical fiber type Jetted MicroCable can be jetted in and out of the network anywhere and at any time at typical speeds of 200 feet per minute. Because UNLV can jet in and out the exact type of fiber and counts quickly and easily for its changing requirements, the university always has sufficient capacity and is no longer pigeonholed to the guesswork of which type and count of fiber it will need in the future. This reality enables the university to do the following.

- Eliminate the potential waste and cost of installing dark fiber that could become obsolete



Shown here is a MicroDuct distribution box (MDB) in a telecom room, where they typically are housed. MDBs are used at fiber pathway branching locations and accommodate rerouting, MACs, and pathway maintenance.

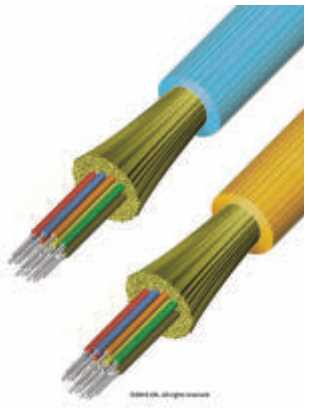
- Install only the fiber types and counts the university needs, paying as it goes and grows
- Ensure the university network is ready to install the latest fiber-type innovations, staying ahead of the technology curve
- Allow university IT with real-time control over the network to quickly respond to the needs and requirements of more than 28,000 students and a growing number of faculty and staff

The bundled MicroDuct pathway supports multiple fiber-optic cabling topologies, including centralized/home-run, star, hierarchical star, and passive optical LAN and also offers maximum flexibility for infrastructure design based upon the use and locations of MicroDuct distribution boxes.

Flexibility and cost savings

The MicroDuct distribution boxes (MDBs) are used at MicroDuct fiber pathway branching locations. Rerouting, network MACs, and maintenance of the pathway are accomplished at the MDBs. Demarcation of each pathway within the MicroDuct facilitates fast and easy network segregation, including various security classifications of data, and eliminates cable hunting for ease of troubleshooting. These units are typically located in telecom rooms and in strategically located outdoor vaults.

The MicroDuct pathway and MDBs provide UNLV with maximum versatility in its network infrastructure design, eliminating entrance into manholes, handholes, and access points. When UNLV adds new facilities, the bundled MicroDuct needs to be extended only from the local or closest MDB to the new building. This allows for the fiber to be air-jetted in minutes to the fiber termination unit also located in the telecom room, thereby eliminating disruption and saving the considerable labor and pathway infrastructure costs associated with conventional cabling. Had a conventional cabling infrastructure been in place for this scenario, a large installation crew would have had to undergo the time-consuming process of



Using a 72-fiber Jetted MicroCable that fits into a 8.5-mm x 6-mm 24-day MicroDuct enables UNLV to meet high-density applications for its research buildings.



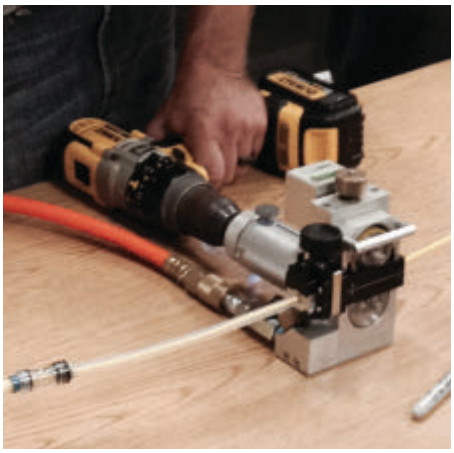
installing conduit and innerduct from the building back to wherever the central data center is located and then pull in the optical fiber.

For UNLV's 2014 capacity upgrade, the new 7-way and 24-way bundled FuturePath MicroDucts were installed in this fashion, from the closest MDBs in pre-existing vaults to the nearest buildings requiring the upcoming fiber installation upgrades. Jonathan Myers, UNLV's information technology network engineer, explains, "We installed MDBs in some areas where we could have pulled straight through the vault. That way, it is easy to branch out at any time in the future, without additional disruptive access to the campus."

Non-disruptive installation

With the bundled FuturePath MicroDuct fiber pathway in MDBs in place, UNLV is ready for the optical fiber installation upgrades in the buildings requiring additional bandwidth. Using the industry's latest 72-fiber Jetted MicroCable innovations that fits into the 8.5-mm x 6-mm 24-way MicroDuct, UNLV will meet the highest density applications for its research buildings. Installers quickly jetted out the previous 24-strand fiber from the older system and jetted in the greater-fiber-count Jetted MicroCable.

The optical fiber used in Jetted MicroCables is the same 250-micron glass as used in conventional fiber cables. All optical fiber types are available including standard singlemode (OS2), bend-insensitive singlemode, 62.5-micron OM1 multimode, and 50-micron bend-insensitive OM2, OM3, OM4 and OM4+ multimode. These optical fibers are protected in a robust fiber cable with aramid strength members, water-blocking material, and a specially designed lightweight ribbed outer jacket that provides very low surface friction with the MicroDuct, yet provides the necessary air drag to allow for very long jetting distances of 3,000 feet-plus when using compressed air and a jetting head.



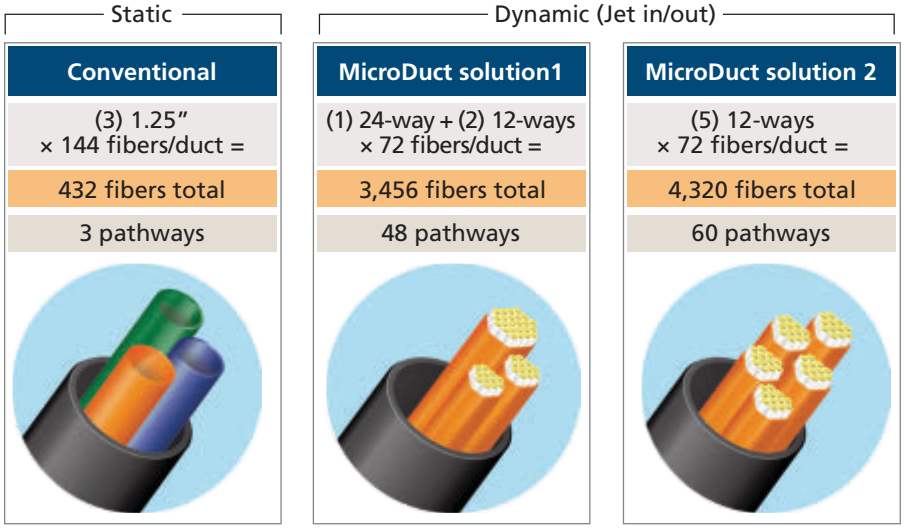
Jetted MicroCables include a lightweight ribbed outer jacket that provides very low surface friction with the MicroDuct, yet provide the necessary air drag to allow for long jetting distances when using compressed air and a jetting head.

With two installers located at strategic locations on campus, 3,000 feet of 72-count singlemode fiber was jetted in a continuous splice-free fiber run providing the needed bandwidth for several science and technology buildings. The fiber was then terminated using the same methods as used with conventional cabling.

The fiber upgrade took the two installers only 30 minutes to complete without ever getting their hands dirty. Had the installation been done conventionally, it would have taken a crew of six to eight installers a full eight-hour day to have pulled 3,000 feet of cable. The Jetted MicroCable installation was 94-percent faster than conventional, saving the equivalent percentage in labor costs. Once the bundled MicroDuct infrastructure is in place, these savings are repeated with each fiber-installation project, yielding continuous ROI. According to Chris Tettamanti, RCDD, general manager of one of UNLV's contracting companies DataPlus, "Savings of up to 95 percent in jetting future fiber additions compared to conventional fiber are not unusual."

Because the MicroDuct pathway distribution and fiber installation are completed behind the scenes in telecom rooms, blown-fiber technology is environmentally clean, non-obtrusive to the daily activities of students and staff, and physically non-disruptive to the university's grounds and buildings.

Capacity comparison



MicroDuct solutions provide many times the optical-fiber capacity, when compared to conventional fiber-optic cable, in a 4-inch conduit pathway.



This Microduct distribution box (MDB) is strategically located in a vault. Demarcation of each pathway within the MicroDuct facilitates network segregation, including various security classifications of data, and eliminates cable hunting for easier troubleshooting.

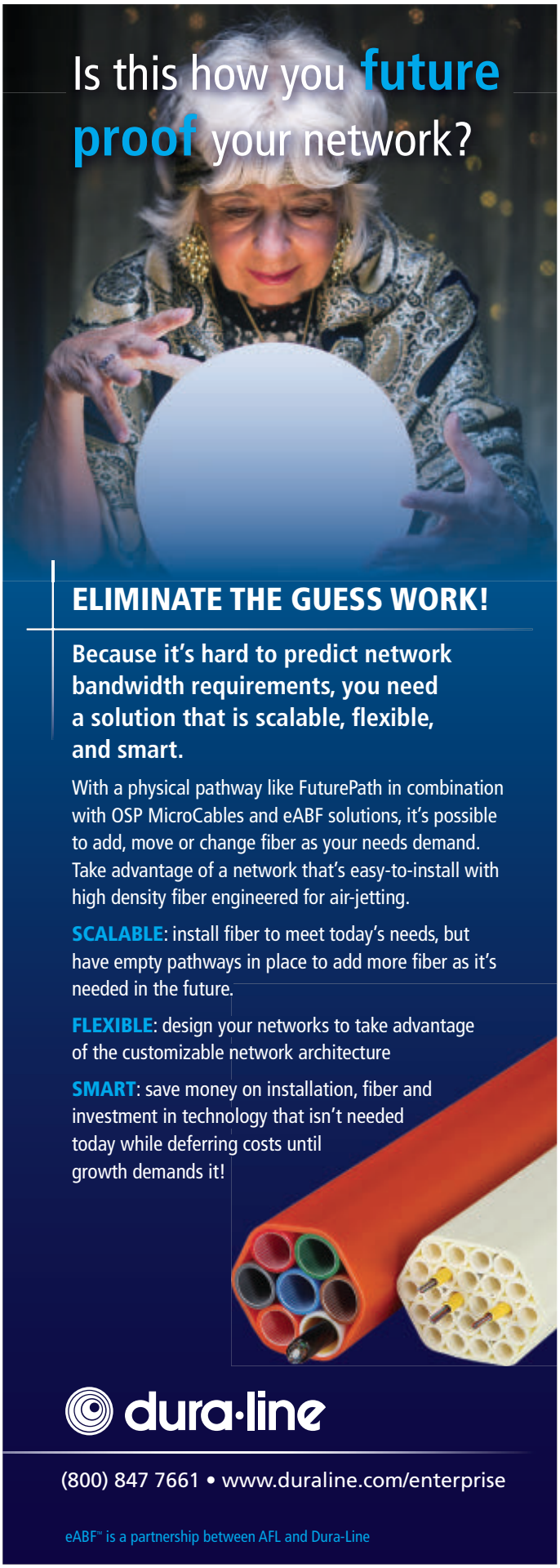
"Part of being an RU/H, high-research activity, institution is that network bandwidth is in increasingly high demand with researchers moving large files over the network. The ability to take any infrastructure that's currently in the ground and leverage it with high-density fiber, without having to further dig up the campus, is a very important factor," states Myers.

A look ahead

UNLV plans additional installations of optical fiber to meet the bandwidth needs and goals of the university, including a new hotel administration building, a new two-story clubhouse next to the baseball field, and a major addition to the Thomas and Mack arena.

With the ability to jet in and out optical fiber anywhere and at any time throughout the UNLV network, there is no end to the university's fiber and bandwidth lifecycle. Equipped with a real-time, continuously futureproofed network, UNLV can quickly and easily implement the latest bandwidth-rich, high-speed technologies necessary to meet the continuous high-tech needs of a prominent research institution. The university's IT department, true to its mission, is ready at a moment's notice to respond rapidly, efficiently, and cost effectively to the emerging technology needs, growth, and changing requirements of students, faculty, staff, and the Las Vegas community that it serves. ◆

Brandon Johnson *is the owner of DataPlus Communications (www.dpcnv.com), a UNLV contractor company. He can be reached at (702) 795-3282 or Brandon@DPCNV.com.*



INNOVATION WANTED

Looking for submissions in product or system design and implementation

Cabling Installation & Maintenance 2016 Innovators Awards



This September Cabling Installation & Maintenance will celebrate the most-innovative applications of cabling and communications technology products and systems at BICSI's 2016 Fall Conference (San Antonio, TX).

Help inspire others by your innovative applications of cabling technologies

- Great publicity for your company
- Great attention for your project
- Great limelight for your customers
- Great exposure for your career

You are invited to submit projects that exemplify industry innovation–in product or system design and implementation.

SUBMIT by APRIL 29 and SAVE $100



For more details and to submit your entry visit cablinginstall.com/innovation-awards.html

In cooperation with:

BICSI

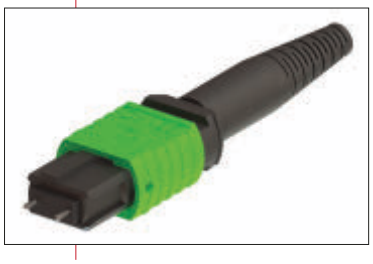
PennWell

PRODUCT FOCUS

MULTI-FIBER CONNECTORS

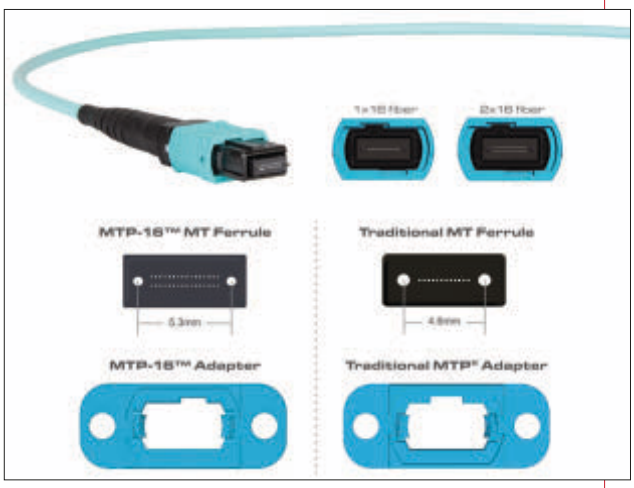
16- and 32-fiber ferrules

Senko's new MPO Plus MT 16- and 32-fiber ferrules are designed to meet the new TIA604-18 standard, which addresses 16-fiber hole width MPO requirements. The ferrules are available in single row 16-fiber and 32-fiber 2x16 configurations. A multimode version is available for 100G and 400G parallel optics applications.



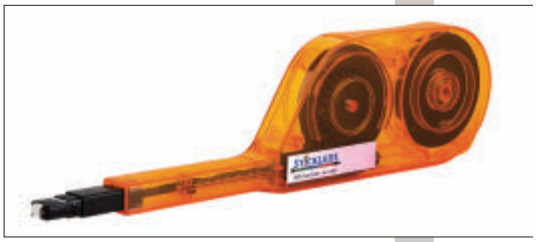
Senko Advanced Components, *www.senko.com*

Multi-fiber optical connector for 400G



Designed to support next-generation parallel transmission protocols, US Conec says its MTP-16 connector offers the highest density physical contact multi-fiber connector format on the market today. The MTP-16 connector is billed as ideal for high-density structured cabling applications that support aggregation of multiple parallel or duplex links requiring low insertion loss. In addition, the MTP-16 connectors couple directly into emerging 16x25G active devices. Utilizing the same external footprint as the existing traditional 12-fiber MT ferrule, the MTP-16 consists of a US Conec MT Elite ferrule with one or two rows of 16 fibers, leveraging all the proven MT Elite ferrule technology in a higher-density format. A unique offset keying feature is designed into the connector to ensure proper mating without inadvertently connecting 16-fiber hardware with standard MPO-compliant hardware. The new keying hardware specifications were recently published in TIA 604-18 (FOCIS 18).

US Conec, Ltd., *www.usconec.com*



Fiber-optic connector cleaner

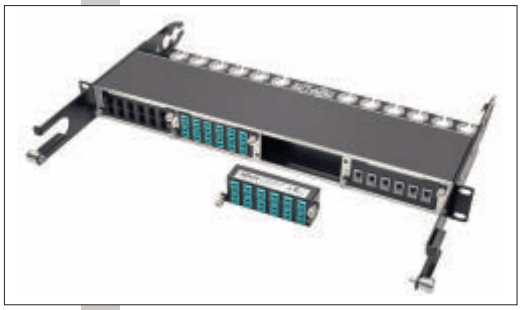
Sticklers' MPO CleanClicker 600 fiber-optic connector cleaner cleans both male MPO/MTP connectors in bulkhead adapters and female unmated connectors on trunk assemblies. The cleaner uses a push engagement to advance the cleaning ribbon for effective cleaning of flat polished multimode and angled singlemode MPO/MTP connectors; the cleaning ribbon gently lifts away dust and residues on MT fiber arrays. This cleaner is ideal for 12-, 24- and 48-fiber MPO cassettes and trunk assemblies and MPO interface transceivers. Each cleaner provides 600+ cleaned MPO/MTP connector endfaces. Sticklers also offers field cleaning kits featuring the MPO CleanClicker 600, as well as the company's CleanClicker 750 cleaners, Fiber Optic Splice & Connector Cleaner precision cleaning fluid, CleanStixx cleaning sticks (including one for MT ferrules), and CleanWipes optical grade wipes.

Sticklers MicroCare Corp., *www.sticklerscleaners.com*

PRODUCT FOCUS

High-density copper and fiber cassettes

Tripp Lite's N484 series of high-density copper and fiber cassette solutions allows for the connection and interconnection of 10-, 40- and 100/120-Gbit/sec equipment. The N484 Series works with



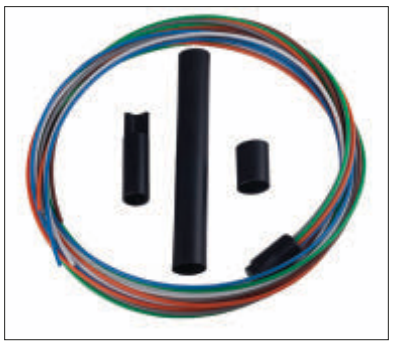
both copper and fiber cables; the interchangeable cassettes allow for the connection of different generations of equipment. In a 1U chassis, users can populate LC, MTP, SFP and Cat 6 cables all at the same time.

One solution in the N484 series is the N484-12M24, a high-density passthrough cassette with (x12) 24-fiber MTP/MPO connections. The company explains that working with the cassette is simple, as it is easily installed or removed using screw tabs to lock or unlock it from the panel. No tools are required.

Tripp Lite, *www.tripplite.com*

Multi-ribbon fiber breakout kits

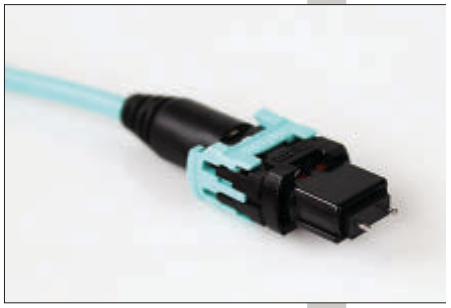
The Opticonx UBR Series ribbon breakout kits for multi-ribbon cable management of 12- to 144-fiber ribbon cables are an ideal means to breakout, manage and directly terminate high-fiber-count ribbon cables with MTP connectors. Each 12-fiber ribbon in the unitube cable is routed through individual, color-coded tubes, allowing for protection and ease of management. These protected ribbons can then be directly terminated with MTP connectors. The UBR series ribbon breakout kits require no special tooling, install in minutes and fit any manufacturer's unitube ribbon cable.



The company points out that if single-fiber termination is desired, UBR Series kits can be combined with Opticonx SPKR Series splitter kits to allow ST/SC/LC connectors to be directly terminated.

Opticonx, *www.opticonx.com*

Flexible MPO connector



Sumitomo Electric Lightwave has introduced a new MPO connector with features optimized to better accommodate changing network designs. With the ability to change gender from male-to-female and female-to-male in the field and a boot up to 36 percent shorter than other connectors in the industry, this flexible MPO connector also includes the ability to change polarity in the field, and supports single-handed push/pull operation for installation and removal.

Sumitomo also offers MPO connectors as part of its Lynx2 CustomFit Splice-On connector product line. The Lynx2-MPO is a fusion splice-on field-installable connector for customized, on-site terminations. It can be used in a variety of applications including data centers, enterprises, outside plant, central offices and others.

Sumitomo Electric Lightwave, *www.sumitomoelectric.com*

EDITOR'S PICKS

News, products and trends for the communications systems industry

- KINGLY NBA INFRASTRUCTURE
- PATENTED FIBER TECHNOLOGY
- HIGHLY VISIBLE TOOLS

COMPILED BY
Matt Vincent
CIM@PENNWELL.COM



DATA CENTER CONNECTIVITY

CommScope expands NGF series with new frame, enhanced high-density fiber block

CommScope has significantly enhanced its Next Generation Frame (NGF) portfolio by introducing its Enhanced High Density NGF, designed to help data center owners and operators plan and deploy fiber systems for more bandwidth. The company says the new frame's increased fiber density blocks allow technicians to seamlessly add fiber terminations, without requiring significant changes to the data center layout, while conserving floor space.

At 7 feet tall and 24 inches deep, the new frame can be installed directly next to existing traditional 30-inch wide NGF frames. The frame's preterminated fiber blocks eliminate the need to individually plug in hundreds of connectors at the rear of the panel, thus replacing a large number of installation steps. Installers plug preterminated MPO assemblies directly into the frame's rear-located modules, which distribute trunk fibers into 10G or 40G channels at the front. All prepopulated blocks are factory-tested, assembled, and packaged to provide maximum craft-friendliness. Preterminated blocks with cable stubs are also available.

Via exceptional fiber density with improved front and rear connector access, the Enhanced High Density NGF and preloaded fiber blocks are optimized to support rapid and cost-effective deployment, notes CommScope. Other key platform features include: simplified patching and ample cable management provisions; blocks available in 288 count, LC-MPO and 288 count LC-stub versions, with singlemode blocks available in 10-, 40- and 100G formats; assured performance, as each module is pretested in the factory, and test data is traceable via a barcode to a test database; packaging that protects the connectorized blocks and speeds "bolt-in" installation; and modules clearly marked for simplified labeling and documentation.

"Network managers need rapid deployment and space efficiency to cope with the accelerated need for bandwidth due to increased mobile traffic, Big Data demands, and other factors," says Jaxon Lang, general manager and vice president of broadband network solutions for Central and North America, CommScope. "Our Enhanced High Density NGF system promotes speed and efficiency by delivering outstanding density and flexibility."

MULTIMEDIA IN PLACES OF ASSEMBLY

Comcast deploys 100-Gigabit Ethernet back end infrastructure for NBA's Sacramento Kings

The Sacramento Kings recently announced that the NBA team's Golden 1 Center will rank among the world's most connected indoor sports and entertainment venues as the result of a new multi-year agreement with Comcast Corporation.

According to a press release, "Comcast Business, the business services unit of Comcast, will deliver a connectivity platform with unparalleled bandwidth [to the venue] by installing fully redundant transport facilities and two, 100-Gigabit Ethernet dedicated Internet circuits. The services will provide the back end infrastructure enabling the team to provide free WiFi for fans, power the Kings mobile app, and supply cloud-based voice and unified communications services for team members at the arena and at the team's corporate offices. As a result, the Internet connection at Golden 1 Center, as well as the public plaza and Downtown Commons (DOCO), will be over 17,000 times faster than the average home Internet connection, with the ability to handle more than 225,000 Instagram photo posts per second."

In addition, Comcast Business will provide the in-house video feed to all television monitors throughout Golden 1 Center, allowing patrons to access ancillary programming while attending concerts and other events at the arena. The new agreement continues an existing partnership that includes a long-term broadcast partnership with Comcast SportsNet California, the exclusive local television home of Sacramento Kings basketball, which airs nearly 500 hours of Kings-related programming each year, including 80 2015-16 regular-season games.

"We're pleased to extend Comcast's ever-evolving partnership with the Sacramento Kings and honored that Comcast Business will allow the fervent fans at Golden 1 Center to experience a live event in innovative and exciting ways, from ubiquitous WiFi to advanced mobile applications and rich video content," said Comcast's regional vice president of business services for California, Ted Girdner. "This agreement is representative of how Comcast can deliver reliable, high-capacity Internet connectivity for fans, media and arena team members while supporting various multimedia initiatives by deploying our full suite of consumer and business products."

"The best fans in the world deserve the most connected arena in the world," adds Kings president Chris Granger. "Our partnership with Comcast enables fans and visitors to share their experiences and connect online seamlessly. It also ensures that Golden 1 Center, the public plaza and DOCO's connectivity will remain well above industry standards, even as consumer technology improves."



FIBER-OPTIC TECHNOLOGY

AFL receives 5 new patents for fiber-optic cable, fusion splicing technologies

AFL has been awarded five patents for new technologies used in the enhancement of the company's optical connectivity and apparatus (OCA), fiber-optic cable and fusion splicing products.

Patrick Dobbins, AFL's director of products and applications engineering, received a patent for a new technology for all-dielectric self-supporting (ADSS) fiber-optic cable. By using a more traditional lower cost polyethylene outer jacket material with a co-extruded, semi-conducting, longitudinal strip, the same or better resistance to the electoral stress mechanism (i.e., tracking or dry band arcing) is achieved.

Wenxin Zheng, engineering director for AFL's fusion splicing systems, was the recipient of a patent for an "Apparatus and Method for Arc Calibration of Fusion Splicers," a feature developed by both AFL and Fujikura that have been incorporated into Fujikura factory fusion splicers. The technology allows for several production fusion splicers using the same program to attain consistent results from machine to machine. By using this method to establish a machine calibration for large diameter fibers (> 250 µm), each machine's program is adjusted via this calibration method. Once calibrated using the Special Arc Calibration Method, each machine produces the same results with the same fiber.

AFL's OCA business unit also received three new patents.

Roger Vaughn, product technology manager and Edward Morris, product development engineer, received a design patent for a new network interface device (NID).

The team of Chris Donaldson, Lou Guzzo, Matthew Johnston, Eddie Kimbrell, Ted Lichoulas, Run Ron, and Chuck Turner received a patent for a "Fiber Optic Cable Management Module and Panel." Known as the Xpress Fiber Management High Density (XFM-HD) products, this product line supports the management of fiber densities up to 576 in a traditional four rack unit (4RU) space.

Lastly, AFL's OCA business unit received a patent for the arrangement of an interface module within a NID. The new design enables filter and balun connectivity within a single NID line space.





INSTALLATION TOOLS

High-visibility tools for cabling and wireless installers

Klein Tools has expanded its line of high-visibility (Hi-Viz) tools to include three new driver products. The Hi-Viz drivers feature Klein's exclusive glow-in-the-dark handles to easily locate tools in the dark or dimly lit places.

The company says its Hi-Viz tools are designed to help technicians find their tools in low or no-light environments such as ceilings, walls, closets, attics, basements, etc. The handles charge in either natural or artificial light, creating a bright glow that lasts over 30 minutes. The new chrome-finished Hi-Viz drivers also come with the company's Cushion-Grip handle for better torque and less fatigue.



Newly available models in the product line include Klein's: Hi-Viz #2 Phillips Screwdriver (Cat. No. 603-4GLW); Hi-Viz ¼" (6 mm) Cabinet-Tip Screwdriver (Cat. No. 605-4GLW); and Hi-Viz 6-in-1 Multi-Bit Screwdriver/Nut Driver (Cat. No. 32451GLW).

Other Klein Tools products available with high-visibility handles include the: Hi-Viz Side-Cutting Pliers – High Leverage (Cat. No. D20009NEGLW); Hi-Viz Diagonal-Cutting Pliers – High Leverage (Cat. No. D200028GLW); Hi-Viz Diagonal-Cutting Pliers – Angled-Head High Leverage (Cat. No. D248-8-GLW); Hi-Viz Long-Nose Pliers – Heavy Duty Side-Cutting (Cat. No. D203-8-GLW); and Hi-Viz Wire Stripper/Cutter (Cat. No. 11054GLW).

"Tradespeople often work on job sites that lack electricity or proper lighting which lead to lost tools that not only slow down the job and cause potential hazards but, can be very costly to replace," comments Raul Rosales, senior product manager at Klein Tools. "With high visibility tools, they can find their tool immediately without fumbling in a bag or in the dark, eliminating lost tools and lost time while increasing safety."

INDEX OF ADVERTISERS

AFL..... CV4

Brother Mobile Solutions Inc. 4-5

Corning Optical Communications LLC..... CV2

Diamond Ground Products Inc.....31

Dura Line Corporation 25

General Cable Company 2

Hyperline Systems Canada Ltd. 23

ICC Premise Wiring 9, 19

Ideal Industries Inc. 12

Senko Advanced Components Inc.....6

Siemon Company.....15

Telegartner Karl Gartner GmbH 31

The index of advertisers is published as a service, and the publisher does not assume any liability for errors or omissions.

Cabling Installation & Maintenance

ADVERTISING SALES OFFICES

MAIN OFFICE
61 Spit Brook Road, Suite 401
Nashua, NH 03060
(603) 891-0123
fax: (603) 891-9245

GROUP PUBLISHER
Alan Bergstein
(603)-891-9447
alanb@pennwell.com

ASSOCIATE PUBLISHER/ NATIONAL SALES MANAGER
Ed Murphy
(603) 891-9260
fax: (603) 891-9245
edm@pennwell.com

REPRINTS
Ed Murphy
(603) 891-9260
fax: (603) 891-9245
edm@pennwell.com

DIRECTOR, LIST RENTAL
Kelli Berry
(918) 831-9782
kellib@pennwell.com

INTERNATIONAL
AUSTRIA, EUROPE, GERMANY, NORTHERN SWITZERLAND
Holger Gerisch
+49-(0)8801-9153791
Fax: +49-(0)8801-9153792
holgerg@pennwell.com

ISRAEL
Dan Aronovic
+972 9 899 5813
aronovic@actcom.co.il

ASIA
Adonis Mak
+852 2 838 6298; Fax: +852 2 838 2766
adonism@actintl.com.hk

JAPAN
Masaki Mori
+81 3 3219 3561
mori-masaki@ics-inc.co.jp

TAIWAN
Ms. Rebecca Tsao
+886 2 23965128 ext.203
Fax: 886 2 23967816
rebecca@arco.com.tw

SHOULD YOU NEED ASSISTANCE CREATING YOUR AD, PLEASE CONTACT MARKETING SOLUTIONS
VICE PRESIDENT Paul Andrews
240.595.2352; pandrews@pennwell.com

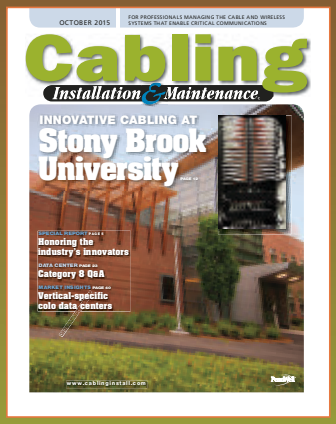
Cabling Installation & Maintenance

Subscribe now

at www.cablinginstall.com/subscribe

Request a FREE subscription to Cabling Installation & Maintenance magazine and e-Newsletters and visit our comprehensive website to see for yourself why structured cabling professionals rely on Cabling Installation & Maintenance.

For professionals managing the cable and wireless systems that enable critical communications



MAGAZINE



E-NEWSLETTERS



WEBSITE

Visit cablinginstall.com/subscribe today

For advertising and sponsorship information, contact Ed Murphy at edm@pennwell.com.



DON'T BE FOOLED BY EXAGGERATED NUMBERS

The other guys like to boast about how fast or durable their splicers are. They always like to compare their numbers to ours. It's flattering and all, but we don't really need the attention. We have been pioneers in the splicing industry for over 39 years. There's a reason why other splicers are compared to ours.

Visit us at BICSI Winter, Booth #1019 to see for yourself.

AFL

www.AFLglobal.com/Truth
864.433.0333



Fujikura 70S Splicer

- 14-second automated tube heater
- 7-second splice time
- 6-direction drop proof