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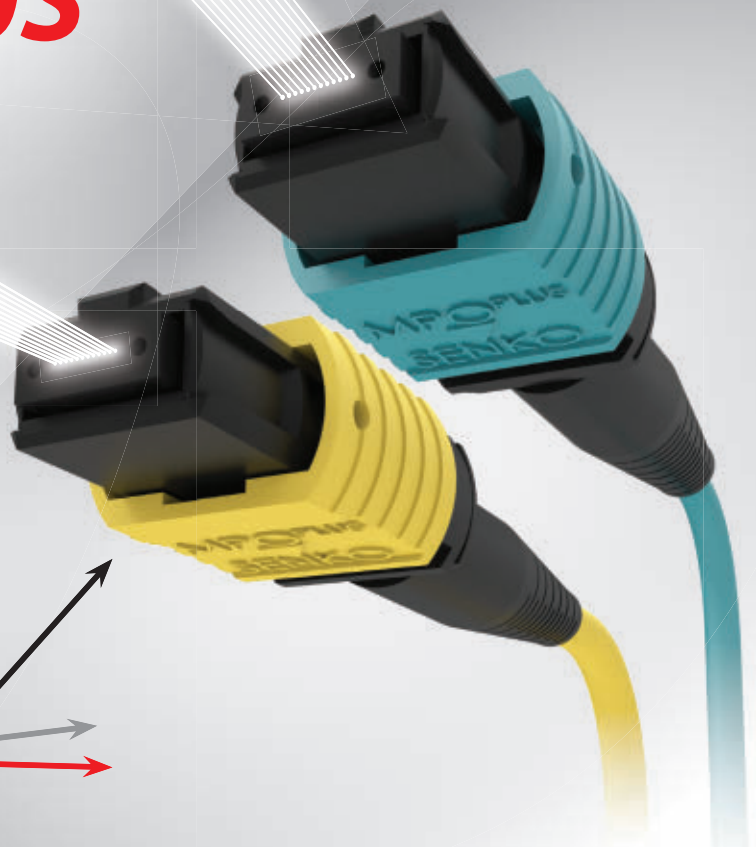

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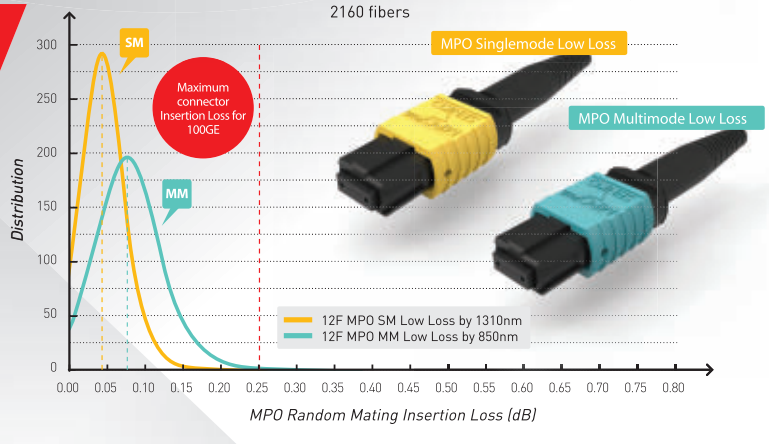

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Respect for the cabling installer

PATRICK McLAUGHLIN
patrick@pennwell.com

As we depict on our front cover, this month BICSI will host its 10th Cabling Skills Challenge. The news story on page 47 provides some detail about the event's history and the impact it has made on some of its participants. I enjoy the annual Cabling Skills Challenge for several reasons, but mostly because it shines a deserved spotlight on the cable-installation trade. So I find it both appropriate and gratifying that alongside the competition this month, BICSI is launching its Year of the Installer. I don't know any details of what the association has in store for the year, but I'll share them as I learn them, and I hope there are opportunities throughout the year for cabling installers to participate in celebratory events and be recognized for the important work you do.

This magazine's audience—you—includes just-about equal numbers of professionals who manage cabling systems in end-user organizations, and professionals who work for cabling contracting organizations, including, of course, installers. Over the years we have surveyed our audience frequently and even though there has been churn over the course of time, some of what they (you) have told us has remained consistent over the long term. One such consistency is that many end-user organizations rely on and trust their cabling contractors as technical resources as well as problem-solvers. As such, the cabling-installation professional on the jobsite has to be prepared to engage in a conversation with the customer on just about any topic. One end-user customer might want to know whether or not they can put a new OM3 fiber run in their existing OM1 backbone. Another might want the installer to make sure everything in the telecom room is properly earthed and bonded. These potentially challenging questions and requests come in addition to the physical challenges of what the installer originally was hired to do—install cable.

In these and all other scenarios, the on-site cable installer not only represents her or his employer company, whose name and logo probably appear on a shirt, hard hat and/or company vehicle. To an extent, the installer also represents the entire cable-installation trade, and is expected to do so with an appropriate level of professionalism.

I continue to be impressed by the level of professionalism exhibited by so many throughout the industry, and I salute all those who do the trade proud every day through diligent work, technical competence and customer service. I look forward to seeing some of you compete in the Skills Challenge this month.

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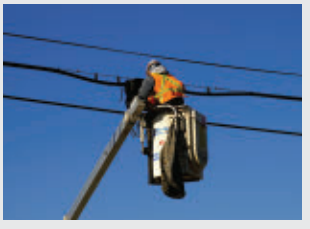

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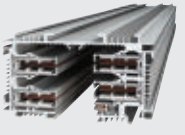

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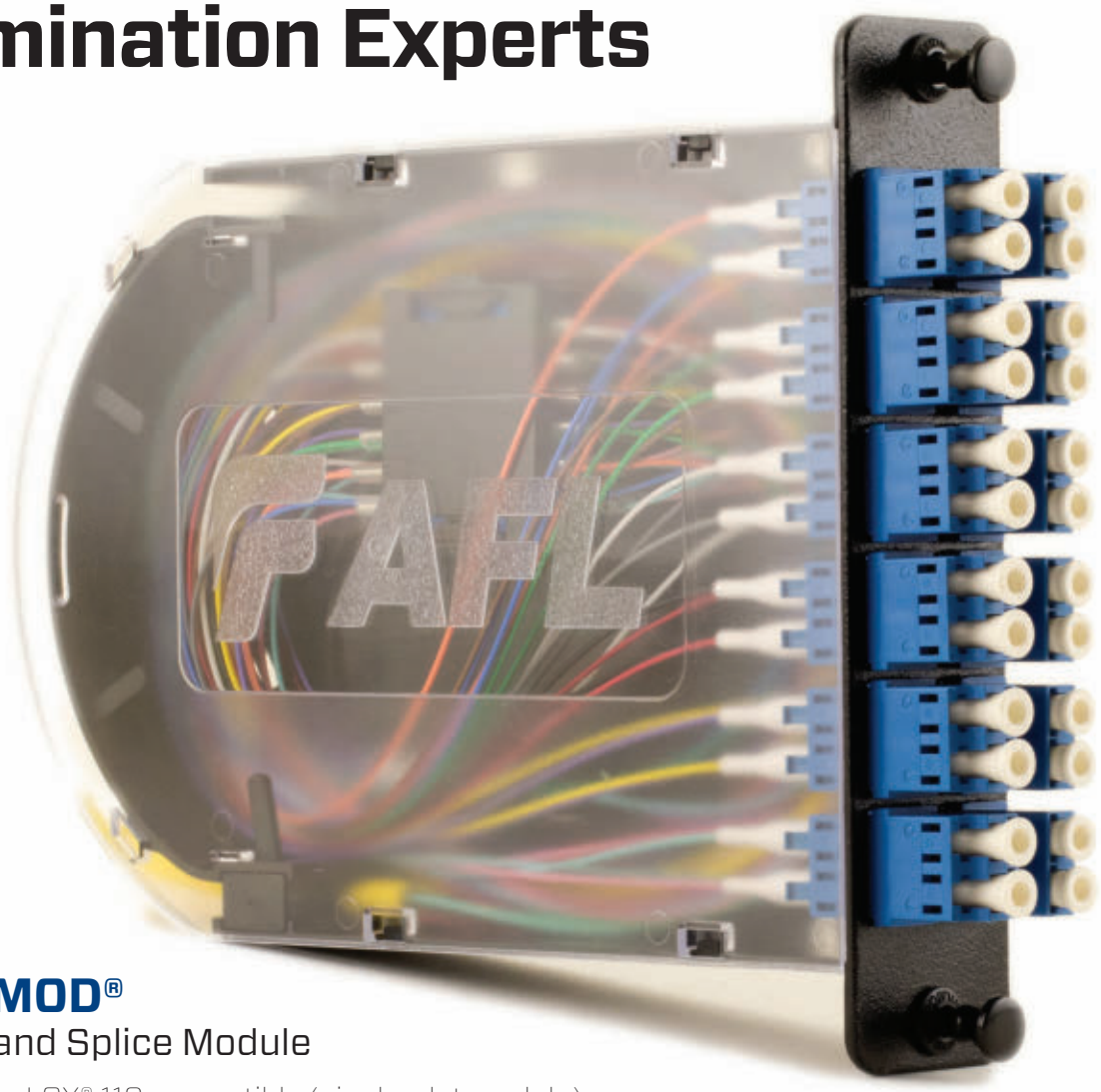

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Practical considerations for complying with the 2017 NEC requirement for power over communications cable

Designers, installers and users must balance codes and standards for the next generation of ICT infrastructure.

BY RICK FOSTER, RCDD, TLT; Innovative Engineering Services LLC

Now that we have the new 2017 *National Electrical Code (NEC)* NFPA-70, the challenge for owners, designers, and installers is to figure out how to successfully apply this code in the field for power over communications cable (PoCC) applications.

While the *NEC*'s primary focus is on installation and safety, the first order of business is to establish cable performance requirements. For the purpose of this article, we define performance as the cable's electrical characteristics (Categories), and subsequent ability to transmit data reliably and efficiently.

Until recently the information and communications technology (ICT) industry's primary focus on the performance of communications cabling and connectivity was essentially how it supported the current and future data transmission capability of the IT infrastructure. Today, PoCC adds a new dimension. Now, the challenge for designers, users, and contractors is: "How do we balance traditional ICT performance attributes of data transmission and bandwidth, with the capability to carry power and still comply with the new 2017 *NEC*?"

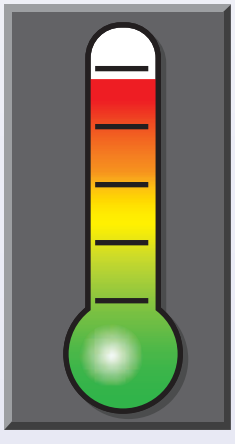
Certainly, every project is different but a common thread in the initial design phase for today's greenfield and retrofit projects is, "I don't want to keep installing new cable in my facility as bandwidth demands increase and more powered networked devices are added." In other words, "How can I 'futureproof' the cabling infrastructure for both higher-speed applications and the next generation of powered devices on the network?"

So how does one respond to that?

Heat generation = temperature rise

What contributes to heat generation?

- Bundle size
- Power source
- Ambient air temperature
- Environmental conditions
- Type of pathways - tray and conduit
- Firestopping
- Number of energized conductors/pairs
- Cable construction
- Workmanship
- Installation practices



Several characteristics, listed here, contribute to the generation of heat within a cable bundle. In the design phase of a cable-installation project, steps that can reduce heat within the completed cabling run include specifying cables that will handle higher power limits, designing support structures and pathways that provide greater airflow, and requiring lower fill ratios for conduits. During installation, loosely grouping cables together to avoid tight bundles, evenly separating cables in trays, and considering smaller bundle sizes can be effective techniques.

Typically we start by providing design options based on current and anticipated performance needs. Should I put in 10G copper cables? Are shielded cables a better option? Zone distribution? Run fiber to the desk? Hybrid composite fiber/copper cables? Passive optical LANs (POLs)? Category 8? What about manufacturers' warranties? The list goes on …

After presenting potential design options, their tradeoffs and narrowing down to hard choices comes the big question: What is the cost to "future-proof"? The final decision on the "right" design option for futureproofing the project is often a judgment call based on price-versus-performance. With performance in focus, we now need to apply code requirements. Enter the 2017 *NEC*.

The September 29, 2016 *Cabling Installation & Maintenance* webcast "The 2017 *NEC* and Its Effects on Cabling Infrastructure for PoE" is another excellent treatise on what you need to know about the new *NEC* and cable performance defined by standards organizations. The October issue of *Cabling Installation & Maintenance* presented the article "Data/Comm Cables: What's New in the 2017 *NEC*" authored by Dr. Stanley Kaufman. The article gave a thorough and detailed review of the significant changes and additions for simultaneously powering and sending data over small-gauge communications cables. At the conclusion of Dr. Kaufman's piece, he states, "The 2017 *NEC* has taken a major step toward addressing the potential hazards of using data/comm cables for powering devices."

In essence what the 2017 *NEC* did was put the ICT industry on notice that we now have to consider both the safe application of power and performance together as they relate to the cabling and IT infrastructure. Without oversimplifying the relevant sections of the new code, what follows is my distillation of a lot of information on key code-related topics that have been talked about over the last year and more.

The following perspectives on the 2017 *NEC*, presented in question-and-answer format, are for installers, designers, and users to consider. Hopefully they are useful insights to assist you in making better decisions for your next ICT cabling project.

Q1) What are the key sections in the 2017 NEC to consider for PoCC?

A1) The best place to start is with the Introduction to the NEC in Article 90—specifically, Article 90.1. It reads: **"90.1 Purpose (A) Practical Safeguarding.** The purpose of this Code is the practical safeguarding of persons and property from hazards arising from the use of electricity. This Code is not intended as a design specification or an instruction manual for untrained persons."

Most of us would recognize the statement in this section about practical safeguarding but we often overlook the fact that the NEC is *not intended* as a design specification or training manual.

The following excerpt from the NFPA website, nfpa.org, added further clarification to its purpose: "The NEC addresses the installation of electrical conductors, equipment, and raceways; signaling and communications conductors, equipment, and raceways; and optical fiber cables and raceways in commercial, residential, and industrial occupancies."

So, what is a fundamental element of the *NEC* we *must* consider around practical safeguarding? *Installation* practices.

Q2) Why does this revision of the NEC address PoCC and not previous editions?

A2) In past editions of the *NEC*, applying low levels of power over communications cabling did not present a safety concern. Today, with new powered devices and technologies such as Power over Ethernet (PoE), low-voltage LED lighting and suspended-ceiling power distribution, higher levels of power are applied over smaller wire gauges typical of LAN communications cables. This should not be a revelation to anyone in our industry.

A UL fact-finding report was commissioned to examine the impact of power levels and resultant heat that was generated over small-gauge communications cables never designed for power at these new levels. The 2017 *NEC* now defines the thresholds at which power and its attendant heat generation must be considered in cables from the point of view of safeguarding persons and property.

Additionally, setting limits on heating of cable conductors is not new to the *NEC*. The benchmark used to set such limits is called ampacity. The following is the *NEC* definition. "**Ampacity.** The maximum current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating."

Q3) Where can I find pertinent information in the 2017 NEC?

A3) In Chapter 8 Communications, installation guidelines are based on a power level ceiling. In Section 840.160 Powering Circuits, communications cables using 60 watts or less have no installation or bundle size restrictions. Over 60 watts, a threshold is crossed and the new table in Article 725 is referenced.

In Chapter 7 Special Conditions, Article 725 – Class 1, Class 2 & Class 3-Remote Control, Signaling & Power Limited Circuits, a new ampacity table has been added to Section 725.144.

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The ampacity table establishes safety parameters associated with the smaller wire (26-22 AWG) gauge conductors for Class 2 and Class 3 4-pair UTP cables. The table takes into consideration cable temperature rating, wire gauge size, and ambient air, and sets limits on the permissible number of energized conductors.

Applying the table provides installation guidelines based on the maximum number of cables in a bundle above which overheating will occur.

It is important to remember that these critical thresholds were established by actual laboratory testing based on volts, amps and watts. Furthermore, testing was done under a reasonable worst-case bundle size of 192 cables. This condition could easily represent the "first 50 feet" of a typical telecommunications room (TR) rack supporting four, 48-port patch panels. Of course, as the cable bundle is distributed downstream cable counts are reduced in many instances.

Q4) Why is the NEC, and it seems everyone else, concerned about cable bundles?

A4) Cables that are bundled together cannot dissipate heat efficiently and will heat up faster than cables not bundled.

No surprise here. Rather than debate what a bundle is, because surely we will get multiple answers, let's focus on how heat can be mitigated in a cable bundle. There are multiple options.

What can I do in the design phase? Some recommendations are to: specify cables that will handle higher power limits; design support structures and pathways that provide greater airflow; require lower fill ratios for conduits while managing code compliance.

What installation means and methods should be considered? Loosely group cables together and avoid tight bundles. Evenly separate cables in trays and consider smaller bundle sizes. Check the cable manufacturer's installation guidelines for recommendations and limitations.

All the above are conventional techniques for reducing heat load, particularly above 60 watts. It should also be obvious that the new ampacity table requires close attention to bundle sizes. So is there a way to avoid "counting cables" or the added costs of closely supervising that bundle sizes remain compliant throughout the installation process?

Two options are presented in the 2017 *NEC*. First, the table gives derating guidance by allowing bundles to exceed the maximum cable count limit of 192, if necessary, under engineering supervision. Depending on the jurisdiction this may require approval by the authority having jurisdiction (AHJ). Good practice is to always engage the AHJ early in any instances where exceptions are permitted to be implemented.

Second, in Section 725.144(B) the 2017 *NEC* offers an optional cable design that is not a requirement but is quickly recognizable in simplifying installations by transcending bundle size and counting cables. That option is known as "LP" or limited power marked cable.

"LP" is an optional designation and mark that may be added to listed cable to attest that the cable fully complies with the NEC and has been further tested to not exceed rated temperature at the maximum current capacity of each conductor. The resultant "LP" suffix is shown on the cable. Example: *CL2P-LP (0.5A), 23 AWG*. In this example "LP" cable will meet safety requirements at 100 watts by not exceeding its temperature rating when installed under reasonable worst-case installation conditions mentioned above.

Like the previously mentioned option of engineering supervision, cable identified by, and marked with, the "LP" designation, permits installers and designers the option to simplify installation without restrictive bundle size, counting cables and cable separation schemes. Some contractors and designers see "LP" cables as the "easy button" to remedy these complexities.

Q5) Will the 2017 NEC require a licensed electrician to install these new types of high-power LAN cables?

A5) The *NEC* does not define what is required for an electrical license or who may obtain one. What the NEC does define is who is a qualified person.

In the 2017 *NEC* Article 100 Definitions, "Qualified Person" is defined as follows: "One who has the skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid hazards involved."

There are three key points in this definition: skills, knowledge, and safety training.

A license is a legal credential. Electrical licensing or trade licensing is generally established by a government agency, normally at the state level. However, in some instances qualifications can be set or modified by local jurisdictions.

Licensing qualifications, requirements and testing criteria usually require the individual to prove work experience and competency. Recently safety training has been added to license requirements. Experience and knowledge can be in the form of apprentice programs, trade schools and hours of field work (OJT—on the job training).

Always check with local or state jurisdictions what the appropriate license or another legal credential is required before starting work.

Choosing any installer or installation company should be based on competency, experience and education.

Q6) Will the electrical building inspector fail installations if they believe future technologies or systems are not considered?

A6) It is unrealistic to expect an AHJ has that "crystal ball" of what future equipment or technologies will be put in place. So what is the AHJ role?

Let's again refer to *NEC* Article 90 Introduction. Section 90.4 Enforcement gives the responsibility of interpretation and enforcement to the AHJ. Article 100 Definitions (page 70-31) defines: "Authority Having Jurisdiction (AHJ). An organization, office or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure."

It is important to note that it could be an organization, office, or individual. In some projects, it could be more than one of those entities. There is also distinction between inspection and enforcement. Essentially one is a process, i.e. inspection; the other is a result, i.e. enforcement.

We previously established that at the core, the *NEC* is about installation means and methods. When an inspector or AHJ comes on site they are evaluating what has been permitted, what is in place and generally will examine and report on installation deficiencies.

If these are a result of improper design in their opinion, they will often engage with the engineer of record or permitee to resolve or clarify. The AHJ may also question products or devices that are new or unfamiliar to them. Although it may seem obvious, find out who the AHJ is for the project and engage with them prior to installation to see if they have any questions or concerns.

Q7) Does the 2017 NEC comment on the existing cable? Will the cable be "grandfathered" if I install new high-powered devices after initial installation?

A7) The *NEC* does not have the word "grandfathered" in its text. Responsibility for safety generally rests with all the building stakeholders—owners, tenants, engineers, contractors and installers. Our industry often deploys and changes out new equipment well past the initial installation, sometimes years later. What guidance did the *NEC* provide, if any, post-installation?

A new section was added: Section 725.121(C) Marking. This will require the maximum current and voltage output for each connection to be labeled. The effective date for this implementation is January 1, 2018 so that equipment manufacturers and testing agencies, as needed, can work together to define a workable solution without compromising equipment reliability.

What follows is a verbatim statement from the *NEC* Panel 3 Committee for that section.

Committee Statement on Section 725.121(C). *This new section addresses the labeling of limited power circuit output connection points on listed IT equipment and listed industrial control panels and equipment. Bundling of large numbers of Class 2 conductors from IT servers and other similar IT and industrial equipment can create safety issues with very small current levels so having the output ports identified with the current and voltage rating is critical so the installer can connect the proper cable types. Labeling the output connections will permit the installer to have ready access to the current and voltage levels at the point of connection at the equipment, rather than internally within the equipment. The effective date was inserted to allow the manufacturers to comply with this requirement.*

This new section takes into consideration that easily identifying those new levels will allow installers and owners to at least know what the equipment is outputting in the field on "Day 2." With this information, it can be determined if the thresholds of the existing cable plant will handle the new equipment by at least reading the cable jacket and observing the installed conditions.

In summary

The combination of power and data transmission on the ICT infrastructure and its related components will continue to create new technologies and innovative products for our industry to help drive the installation of new IoT devices in the enterprise.

Engagement with the local AHJ early in the project to understand local requirements and to inform them if exceptions are to be implemented for approvals will avoid last-minute complications.

Means and methods to mitigate overheating of cables must be considered during the design phase and final installation practices of the ICT infrastructure.

"Futureproofing" the ICT infrastructure is no longer just about performance. To support these new IoT devices, next generation of systems and applications, we will need to understand how to balance both performance defined by standards and power defined by codes. ◆

Rick Foster, *RCDD, TLT, is director of IT infrastructure and commissioning services at Innovative Engineering Services, LLC (www.iesllc.biz). He has been in the structured cabling and IT infrastructure market since 1979 an dhas managed a distribution company, a design/build installation company, and a network integration firm. Rick holds a CT low-voltage electrical contractor's license (C-5) and design license (TLT), and has served on various professional organization committees and panels, including NFPA, BICSI and the State of Connecticut.*

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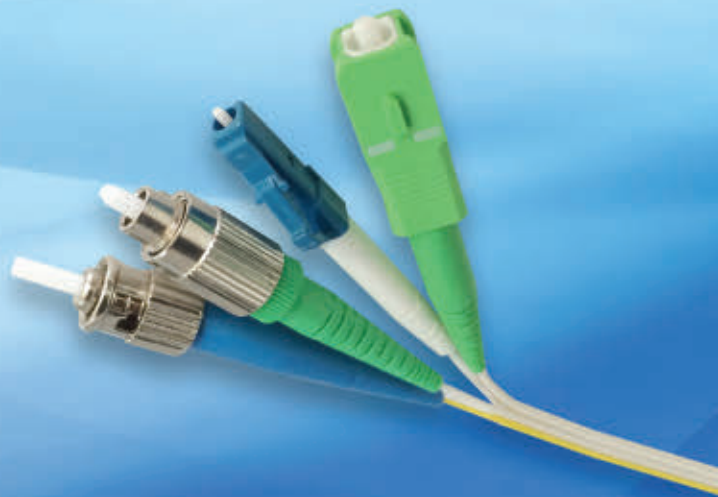

A practical approach to implementing power delivery over structured cabling

Rough guide to deploying PoE, +, ++ and more.

BY STERLING VADEN, Surtec Industries

This article will provide a "rough guide" for an IT administrator who is implementing a Power over Ethernet (PoE), PoE+ and/or four-pair PoE++ power over an existing cabling plant, and some implied guidance for new installations. The primary focus will be on "rule-of-thumb" considerations for how to distribute power over existing cabling plants, simple measurements and calculations to determine whether temperatures of cabling may exceed their ratings, and considerations for connector performance and overall reach reduction.

PoE is a general term that applies to standardized power delivery over data cabling using IEEE 802.3 standards and also to proprietary schemes that are sold by a number of manufacturers. Regardless of the type of powering method used, there are fundamental physical factors that apply, and when devices are powered over the communications cables, there is loss in the cables themselves, which raises the temperature of the cables. For IEEE 802.3 PoE and PoE+ powering over two pairs, this heating effect is low enough that it is not a concern to the IT administrator, except in certain corner cases that are outside of standard cabling plant recommendations. The guides in this article will focus on deployment of high power PoE++ where all four pairs are used and higher currents are employed. This standard is still under development by the IEEE 802.3bt DTE Power via MDI over 4-Pair Task Force, so four pair powering is primarily for future installation.

The currently standardized PoE and PoE+ IEEE 802.3af and IEEE 802.3at specifications (which have both been incorporated into the main 802.3 standard) are shown in Table 1. Both specs use two pairs of the four pairs in a cable to provide power. Note that the maximum power provided by the PSE (power sourcing equipment) is 15.4W for PoE and 30W for PoE+. This level of power will not heat the cable significantly. Notice that for PoE+ the maximum operating temperature is de-rated by 5 degrees C. This is the maximum amount the cable temperature is expected to increase. The maximum ambient temperature for most installations is 45 degrees C. Because the maximum operating temperature of standard communications cables is 60 degrees C, there are no temperature concerns for cabling providing PoE or PoE+ power levels.

What about cabling reach? If we

Table 1: PoE and PoE+ power and voltage limits

Property	802.3af (802.3at Type 1) "PoE"	802.3at Type 2 "PoE+"
Power available at PD[note 1]	12.95 W	25.50 W
Maximum power delivered by PSE	15.40 W	30.0 W
Voltage range (at PSE)	44.0–57.0 V[21]	50.0–57.0 V[21]
Voltage range (at PD)	37.0–57.0 V[22]	42.5–57.0 V[22]
Maximum current	350 mA[23]	600 mA[23] per mode
Maximum cable resistance	20 Ω[24] (Category 3)	12.5 Ω[24] (Category 5)
Power management	Three power class levels negotiated at initial connection	Four power class levels negotiated at initial connection or 0.1 W steps negotiated continuously
Derating of maximum cable ambient operating temperature	None	5 °C (9 °F) with one mode (two pairs) active
Supported cabling	Category 3 and Category 5[1]	Category 5[1][note 2]
Supported modes	Mode A (endspan), Mode B (midspan)	Mode A, Mode B

assume a maximum of 5-degree temperature rise, consulting table G.2 of TIA-568-C.2 (partially included in this article's Table 5) would indicate a 1-meter decrease in maximum length capability due to increased insertion loss. If your application is right on the ragged edge of length support, say 150 meters or so for 1000Base-T (beyond the 100-meter installation guidelines) you might run into a problem. A 1-meter problem.

First rule: For PoE and PoE+ cable temperature and reach reduction is not a significant concern.

Four-pair powering

Now for the more interesting stuff. For four-pair power with at least 60W supplied, and up to 100W per port, we are going to have to take into consideration the temperature rise in bundled cabling when a high percentage of cables are powered. Guidelines for cabling are given in TIA TSB-184-A, which is nearing publication. In that document there are tables of temperature rise for different bundle sizes and various cable types. There are tables of maximum bundle sizes for a given temperature rise, and maximum ampacities for given bundle sizes. The ampacity tables are similar to tables in the 2017 revision of the *National Electrical Code (NEC)*. The *NEC* tables use different assumptions about ambient temperature than the TIA tables. The *NEC* and TIA tables were developed from different sets of data and were also developed completely independently of each other, so they don't exactly coincide. The *NEC* tables, unlike the TIA tables, are requirements that electrical inspectors will use to determine the adequacy of communications cabling to support powering.

Some conventions that we should understand: Smaller wire gauge (26 AWG) heats up more than larger wire gauge (23 AWG). Easy. For most applications, UTP category rated cabling is installed. Patch cords can have wire gauge as small as 26 AWG stranded. Category 5e cables are 24 AWG; Category 6 and Category 6A cables are 23 AWG.

Category 7_A, Category 8, and other shielded cables are peripheral to the scope of this discussion due to their relatively small market share in the U.S. In Europe, of course, you will have a much greater installed base of shielded cable types. The good news is that they will have a lower temperature rise than the equivalent UTP cable types. Shielded cables dissipate heat better than UTP cables.

Ambient temperature—Standard ambient temperature is 20 degrees C, or 68 degrees F. Nice and comfortable for man and machine. TIA considers the maximum ambient temperature to be 45 degrees C, or 113 degrees F, which is pretty darn hot. The National Fire Protection Association (NFPA), creator of the *NEC*, considers the maximum ambient temperature to be 30 degrees C, or 86 degrees F. This is not that hot. You might find temperatures within a ceiling space that would exceed that, so for the most part we will use the TIA maximum ambient temperature.

Maximum cable temperature—For standard cable types, it is 60 degrees C, or 140 degrees F. This is the cable maximum temperature rating, rated for mechanical performance, not data transmission. We will see that data transmission reach must be de-rated at high temperatures. There are cables available with higher temperature ratings, such as 75 degrees C, or even 105 degrees C, so that it is a viable option if one is installing cabling just for high temperatures. Of course, those cable types may be more expensive, so it may not justify the expense over the whole cabling plant. Not only must these cables still be de-rated for reach at higher temperatures, but there will be greater loss, even if the high temperatures are only due to increased current levels.

As a general rule of thumb, when using four-pair powering, 600mA per pair powering current will require at least 60W of power from the PSE, yielding somewhat less power at the PD depending on the length and type of cabling in between. 1000mA per pair will require at least 100W from the PSE. This is without taking into consideration the efficiency of the PSE itself, which will vary, depending on many factors. The power input to the PSE from the electrical supply will be at least 10 percent higher than the power available at the PSE interface.

Table 2: Temperature rise in cable bundles with 600mA on all pairs

Number of Cables in a bundle	Temperature Rise for 600 mA per pair (°C)							
	26 AWG		Category 5e		Category 6		Category 6A	
	Air	Conduit	Air	Conduit	Air	Conduit	Air	Conduit
1	0.79	1.1	0.40	0.6	0.3	0.5	0.3	0.4
7	2.1	3.3	1.3	1.9	0.9	1.4	0.8	1.2
19	3.8	5.9	2.4	3.5	1.8	2.7	1.6	2.2
37	5.8	9.0	3.9	5.5	3.0	4.2	2.5	3.4
61	8.2	12.6	5.6	7.8	4.3	6.0	3.6	4.8
91	10.9	16.5	7.6	10.4	5.9	8.0	5.0	6.5
127	13.8	20.9	9.8	13.4	7.7	10.3	6.5	8.3
169	17.1	25.7	12.4	16.8	9.7	12.9	8.2	10.3

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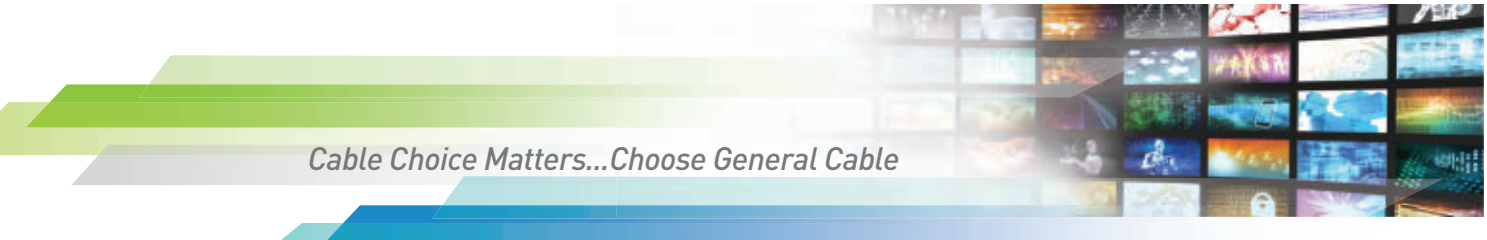

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Let's look at a partial table of temperature rise for cable bundles with 600mA per pair current, all pairs powered in a bundle, Table 2.

The first simple thing we can determine from this table, is that for one cable, in the air or conduit, the temperature rise will be less than 1 degree C. We don't expect 26 AWG patch and equipment cords to be installed in conduit. A 5-degree temperature rise is not reached until you get to about 61 Category 5e cables in air, or 37 in conduit, with all cables powered. That means you need roughly 4kW to power 61 PDs with less than 60W each, all from the same bundle. That is two-and-a-half 24-port power supplies. It's doable, but that is a lot of power required to get a 5-degree rise in the cabling. TIA recommends a maximum temperature rise of 15 degrees based upon the maximum ambient temperature of 45 degrees and the cable rating of 60 degrees. Table 2 shows that it is possible to achieve a 15-degree temperature rise only with a 169-cable bundle of Category 5e cables in conduit (11kw input) or with more than 127 cables of 26 AWG in air. One could easily substitute 24 AWG patch cables, which are the norm for Category 5e.

Table 3 is the same temperature rise table for 1A (1000mA) per pair currents, or 100W PSEs.

We can see that now there are considerably higher temperatures possible, especially for large bundles. Remember to add the ambient temperature to the figures in Table 3 to get the total temperature. Also note that for a single powered cable, the temperature rise is still less than 2 degrees, even for 26 AWG patch cords. Table 3 clearly shows that at an ambient temperature of 20 degrees C, for Category 5e cables in a fully powered bundle, you can achieve a 15-degree temperature rise with only a 61-cable bundle in air, or a 37-cable bundle in conduit. So at this point we need to be careful.

There is also an increase in copper resistance with an increase in temperature. The TIA length de-ratings for example, are based mostly on this increase in resistance. This means that the temperature rise of the cables will be higher supporting the same currents if the ambient temperatures are higher. Therefore the maximum ambient temperature anywhere the cable bundle goes must be factored into the temperature-rise calculation. For example, a current of 1A that creates a 15-degree rise at 20 C ambient may result in an 18-degree rise at 45 C ambient. It may be a small amount overall, but it can be significant.

The maximum bundle size allowable for a 15-degree temperature rise with ambient temperature of 45 degrees C is shown in Table 4. These are the maximum bundle sizes for fully powered bundles. Values are shown for 60W and 100W power.

I won't get too deep into tables of temperature rise, ampacity, and bundle size. Ampacity tables, for example, are great help to power-supply designers, but are not very much help to someone installing IEEE-compliant PoE++ into a new or existing cabling plant because the current is already determined by the application.

A single cable powered (again)—For one cable, in air or conduit, the temperature rise for horizontal cables will be less than 2 degrees. Further, it also turns out that if you surround that cable with six or more cables that are not powered, or even 18 cables or more, the temperature rise will still be less than 2 degrees, even with 100W four-pair power. In fact, you can surround that one powered cable with insulation and it still will not overheat. To extend this principle, suppose you have seven powered cables in the middle of a larger bundle of non-powered cables. The maximum temperature will still be close to what is predicted for the seven-cable bundle. If the seven powered cables are distributed

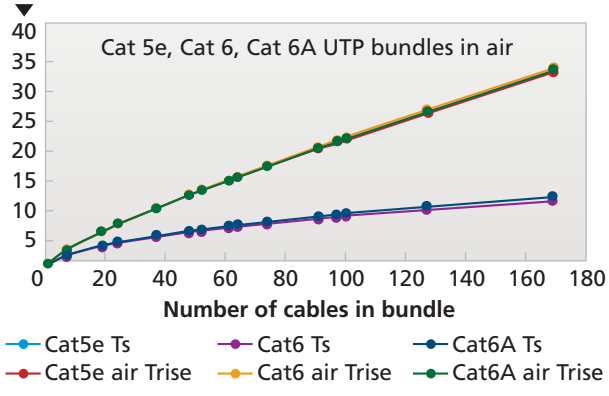
Table 4: Maximum bundle size (number of cables) for 15 degree C temperature rise at 45 degree C ambient

	Cord, min 26 AWG		Category 5e (24AWG)		Category 6 (23AWG)		Category 6A (23AWG)	
	Air	Conduit	Air	Conduit	Air	Conduit	Air	Conduit
600mA	125	69	191	130	253	183	313	242
1000mA	29	14	52	32	72	47	90	62

Table 3: Temperature rise in cable bundles with 1A on all pairs

Number of Cables in a bundle	Temperature Rise 1A per pair (°C)							
	26 AWG		Category 5e		Category 6		Category 6A	
	Air	Conduit	Air	Conduit	Air	Conduit	Air	Conduit
1	1.9	3.1	1.1	1.7	0.8	1.3	0.7	1.1
7	5.7	9.1	3.5	5.2	2.6	4.0	2.3	3.3
19	10.5	16.5	6.7	9.7	5.1	7.4	4.4	6.1
37	16.2	25.1	10.7	15.2	8.2	11.6	7.0	9.5
61	22.7	34.9	15.5	21.6	12.0	16.6	10.1	13.4
91	30.1	45.9	21.0	29.0	16.4	22.2	13.8	17.9
127	38.4	58.1	27.3	37.4	21.4	28.6	17.9	23.0
169	47.6	71.5	34.3	46.6	27.1	35.7	22.6	28.6

1) Normalized temperature rise for UTP cables in air



evenly within the larger unpowered cable bundle, the max temperature, of course, will be lower.

Fully powered bundles

Next we will delve into a little bit of data analysis to determine a very useful rule of thumb.

Imagine that you are fully powering an existing bundle of cables. You don't know exactly how many cables are in the bundle. You also don't know what category the cables are. Let's say there is a mix of Category 5e, Category 6, and a few Category 6A. You can put your hand on the cable bundle, and the outside feels warm. Is there any way that you can predict the center temperature (the hottest point) in the bundle without tearing it apart? It turns out there is, and it is fairly simple.

The estimate of temperature rise uses two calculations that are combined to get the total temperature rise at the center of the bundle. One calculation predicts the temperature rise from the outside surface of the bundle into the center of the bundle. The second predicts the temperature rise from the outside surface of the bundle out to the ambient environment temperature. These two calculations of temperature rise, when added together, plus the ambient temperature, give us the total temperature at the center of the bundle. These calculations are not that complex, and they are detailed in TIA TSB-184-A. The implication is that if we can measure the surface temperature of the bundle, we can then use that information to predict the center temperature of the bundle. That's quite useful, as the surface temperature can be measured once the bundle is powered up, with a fairly decent remote thermometer or even a thermocouple.

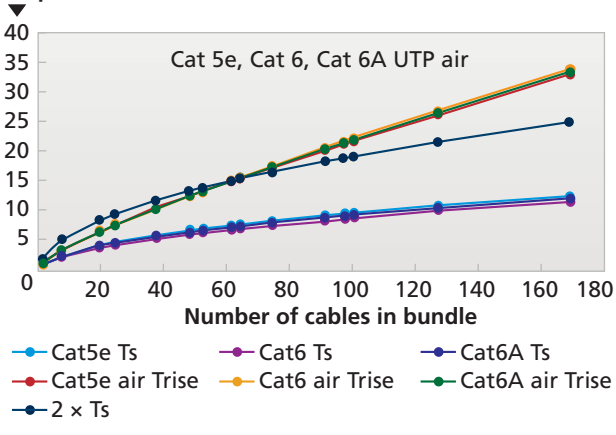
For standard PVC UTP cables, it turns out, there are two things you don't need to know at all. The first is how much power is being supplied. The second is what types of cables are in the bundle. For any given bundle size the temperature rise is determined by the power and the thermal resistance profile of the bundle. We don't care how the heat is generated or how it is dissipated; we only care about the temperature. Because all we are interested in is the temperature rise, we don't need to know the details of the cable construction or the power. This will be demonstrated by observing the results of these calculations.

We are going to assume that all the cables are powered, and therefore our prediction based upon surface temperature will give a reasonable approximation of the center temperature. Figure 1, titled "Normalized temperature rise for UTP cables in air," shows temperature rises versus bundle size (number of cables) for Category 5e, 6, and 6A cables in an air installation, with all pairs powered. In this graph, the center temperature rise has been equalized to 15 degrees for all three cable types for a 61-cable bundle. These curves are labeled "Trise" (Temperature rise). That is the total temperature rise of the bundle above ambient. That same figure also shows the outside surface temperature rise of the bundle, labeled Ts, for the same cable bundles. Notice that the curves all overlap almost perfectly. That means that for a given temperature rise, it doesn't matter what cable type is used, as long as it is UTP. Shielded cable types have a somewhat different profile. They follow the same rules, they just don't overlap the UTP curves as neatly.

Figure 1 shows us that for any given bundle size, if we know the temperature rise at the surface of the bundle, Ts, we can figure out the temperature rise at the center of the bundle, and it is the same for all standard UTP cables. For example, if you have a 100-cable bundle, and the surface temperature measurement is about 9 degrees above ambient, the center temperature will be 22 degrees above ambient. For any measured surface temperature, you can calculate the center temperature using the TSB-184-A equations. But what if you don't have a programmed calculator handy, or a spreadsheet and you only have a general idea of how many cables are in the bundle?

Here is a simple rule of thumb: The

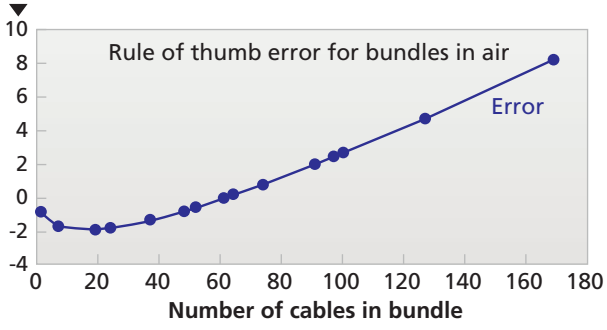
2) Normalized temperature rise for UTP cables in air with 2 X Ts plotted



center temperature rise (Trise) of the bundle is equal to approximately two times the surface temperature rise (Ts) if the bundle is in air. Figure 2 shows this calculation plotted on top of the Trise curves.

Now before you get too excited, remember this is an approximation. The 2 X Ts calculation is most accurate for the 61- to 64-cable bundle sizes. For smaller bundles it estimates higher than actual, as we can see in the graph, and for larger bundles, it estimates too low. For really large bundles it is not a very good predictor at all. But remember, fully powering such large bundles has certain practical limitations due to the power required, so you are not likely to run into 10-degree surface temperature rise on large bundles unless you are inputting loads of power. For bundles smaller than 61 cables, the maximum error is about 2 degrees, and it is to the safe side. The predicted temperature rise is higher than the actual temperature rise. The 2-degree maximum error also extends up to 91 cables, but to the "unsafe" side. So, as with most "rule of thumb" estimates, you have to know their limitations.

3) Trise calculation error using 2 × Ts rule of thumb for bundles in air with 15 degree Trsie for 61-cable bundles



The error prediction values also vary with the measured temperature rise. If we calculated the error as a percentage, it would be constant for different temperature rises, but it would be a fairly large percentage error compared to the actual temperature rise, so it isn't very helpful to calculate it that way. Using a 15-degree temperature rise for 61 cables agrees with our temperature rise table for Category 5e cables at 1A per pair, with all pairs powered. That's 100W powering, so these example calculations are maximums. You can see that you would not want to exceed 100W powering on all cables in the bundle unless you limit bundle sizes to less than, say, 7 cables.

A few things to consider when measuring bundle surface temperature.

1. Temperature rise calculations are based on surface temperature measured at the top of a bundle, the warmest part. Measuring at the bottom of the bundle, which is probably the most convenient, will lead to a lower estimate, which may not be accurate.
2. Laser thermometers have a target spot size that must be considered when making remote measurements. More expensive models have a smaller spot size for a given distance and will yield more accurate readings. It is important to understand the area over which the temperature is averaged when making a temperature measurement.
3. When not all of the cables are powered in a bundle, the above method will only work if the powered cables are evenly distributed within the bundle. If they are all to one side, or all in the center there could be higher than predicted temperatures due to measurement error and the inherent limitations of the modeling.
4. 26-AWG cables, shielded cables, and perhaps all FEP-constructed cables will have somewhat different temperature profiles, so if you have these types of cables, the simple calculation may not be close enough. For shielded cables, however, the bundle surface temperature would be higher compared to the center temperature than for UTP cables, because there is better heat dissipation from the core. Therefore the 2 X Ts rule results in overestimating the actual temperature rise.

Cables in conduit

These calculations can also be applied to cables in conduit.

If a bundle of cable enters a conduit, how does that affect the temperature rise? First, it is impractical to measure the surface temperature of the conduit, or the surface temperature of the bundle inside of the conduit. The conduit temperature rise calculations are based upon bundle surface and center measurements within the conduit. What we would like to do, would be to measure the surface temperature of the bundle in air, before it enters the conduit, and use that measurement to predict the temperature of center of the bundle within the conduit. We can indeed do that, because it is still carrying the same current. The temperature rise in conduit is higher than in air. It turns out it is roughly three times the bundle surface temperature in air. This is shown in Figure 4, with the 3 X Ts estimate already plotted on the total temperature rise curves for the three cable types. Figure 4 shows the total temperature rise inside the conduit compared to the bundle surface temperature rise in air. Note that all of the curves still basically overlap. The best estimate using the 3 X Ts estimate is for bundle sizes between 74 and 100 cables, larger bundles than in the air. This also results in a slightly higher prediction error for the smaller bundle sizes but about the same error for larger bundle sizes.

The plot of the maximum error based on Category 5e cables is shown in Figure

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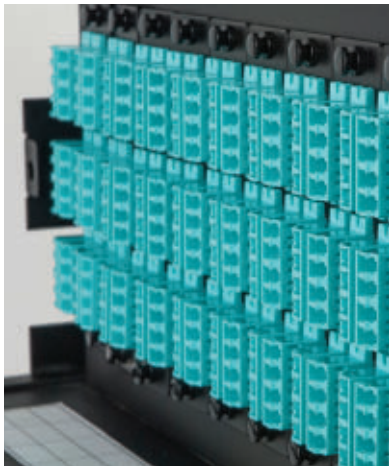

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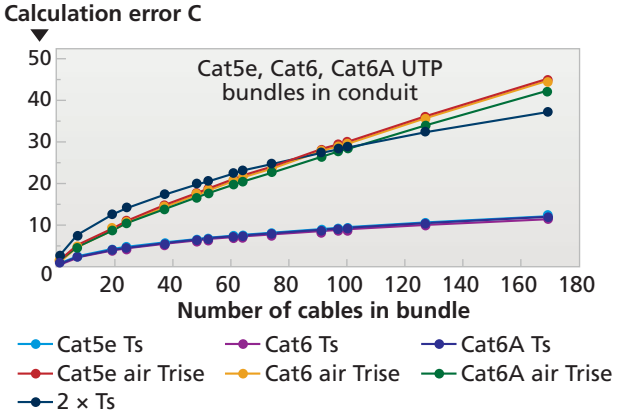
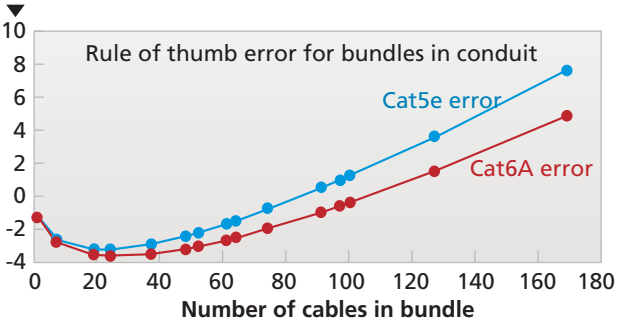
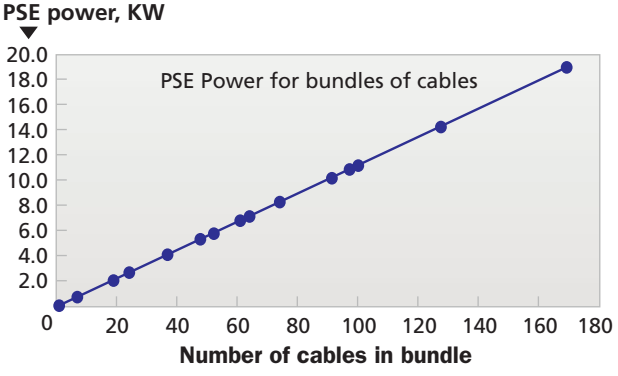
4) Normalized temperature rise for UTP cables in conduit with 3 X Ts in air plotted



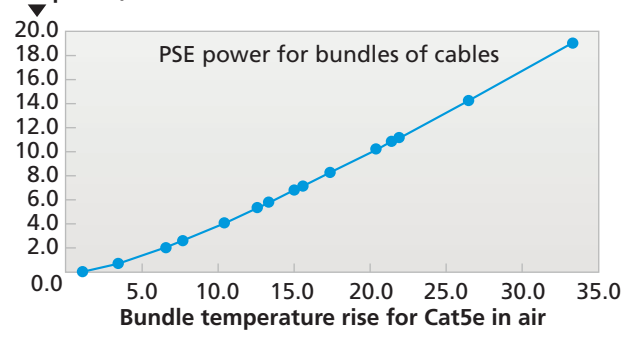
5) Trise calculation error using 3 X Ts rule of thumb for bundles in conduit



6) PSE power versus number of cables in a bundle



7) Power and temperature rise of Cat5e bundles in air



5. The maximum error is now -3 degrees for a 19-cable bundle. In the other direction, the +2 degree error extends up to 100-cable bundles. The Category 6A plot has slightly higher negative error at low bundle sizes, but much less at high bundle sizes—less than 5 degrees—due to lower temperature rise.

Power input to cable bundles

As shown in Figure 6, the power required to heat up these bundles increases linearly with the number of cables in the bundle. These calculations are assuming a 52V PSE voltage, a current sufficient to raise the temperature 15 degrees in air for Category 5e cables in a 61-cable bundle (about 0.98A), and a 90-percent efficiency for the power supply.

We can see from Figure 6 that it will take roughly 10kW to power a 91-cable bundle. Most of the power of course goes to the PDs. That would be about 3.8 24-port power supplies, all feeding the same bundle of cables. To power a 169-cable bundle with the same voltages and currents will require almost 20kw and result in a temperature rise of that bundle of roughly 33 degrees above ambient in air. It is assumed that 169 cables in a conduit is fairly impractical to implement, except for a floor or wall pass-through. For these types of installations, with such high power and large bundle sizes involved, a more-detailed engineering analysis is highly recommended.

If you were wondering what the power-vs-bundle-temperature-rise looks like for Category 5e cables in air, wonder no longer. Figure 7 shows the PSE power required to raise temperature in increasing bundle sizes but with temperature rise as the x axis. Note that for higher temperature rises in cabling, the increase in attenuation and reduction in maximum length really should be taken into account. The TIA-568-C.2 standard fully covers the reduction in reach at higher temperatures, whether that's just ambient or due to cable heating.

Table 5 shows overall cable length reduction due to elevated temperatures (up to 60 deg. C). Regardless of how the cabling gets to this temperature (elevated ambient, PoE heating, sun-baked conduit on the roof), these length reductions need to be considered.

Connectors

Steady state connector performance is not discussed much because for IEEE-style PoE applications, the current capacity of connectors easily exceeds the current capacity of the cables. There are some things to think about, though.

Figure 8 is a chart of connector current capacity requirements that is derived from ISO/IEC specifications, which are also TIA requirements by reference.

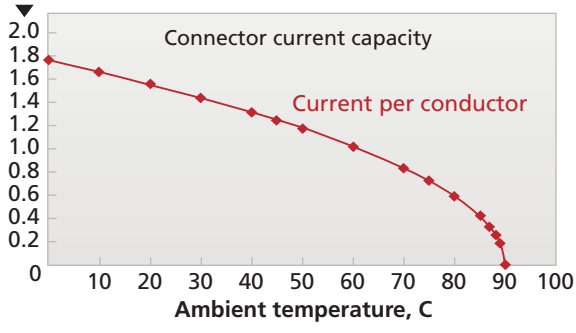
Key features of the graph are that all conductors are carrying current simultaneously, the capacity diminishes with higher ambient temperatures, and goes

Table 5: Horizontal cable length scaling due to temperature

Temperature °C (°F)	Maximum horizontal UTP cables (m)	Length de-rating (m)
20 (68)	90.0	0
25 (77)	89.0	1.0
30 (86)	87.0	3.0
35 (95)	85.5	4.5
40 (104)	84.0	6.0
45 (113)	81.7	8.3
50 (122)	79.5	10.5
55 (131)	77.2	12.8
60 (140)	75.0	15.0

to zero at 90 C ambient. At 20 C ambient, the current capacity per conductor is 1.552A. At 45 degrees C, the current capacity is reduced to 1.245A. One can conceivably flip this into a maximum temperature rise chart for connectors.

8) Modular connector current capacity



From Figure 9 we can see that 1.5A current per conductor would raise the connector temperature a little more than 8 degrees. The *NEC* ampacity tables were developed based solely on the horizontal cable type, and do not consider connectors. An example of the *NEC* 725.144 table, for 24 AWG cables, is shown in Table 6.

Table 6 shows that for 1 cable and 7-cable bundles, the current allowed would exceed the connector current capacities allowances. The allowed connector current at 30 C ambient (used by NFPA) is 1.437A.

The other issue with connectors is plugging and unplugging under load. The IEEE PoE application does not turn on power until it recognizes a powered device, so plugging under load is not really a problem. But there is no way to anticipate unplugging under load. This means that with two-pair power, PoE+ with potentially 1A per pair, the entire 1A current may try to flow through one connector contact at that last instant as the plug is being removed. This is a known issue, and there are connector designs that improve the mating conditions even after an arc has been experienced across the connector contacts.

With four-pair power, that current doubles to nearly 2A, all potentially on a single conductor while disconnecting. This can create quite an arc, depending on the inductive load characteristics of the cabling. Even though there are draft specifications to qualify connectors under these conditions, the best advice: Turn off the power before disconnecting the load.

To summarize the observations made in this rough guide ...

9) Maximum allowed connector temperature rise

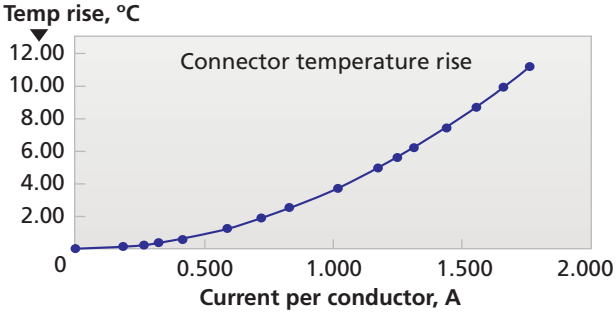


Table 6: Partial table NEC Article 725.144 (2017)

24AWG	Table 725.144		
Number	Current per conductor, A		
Cables	60 C	75 C	90 C
1	2	2	2
7	1	1.4	1.6
19	0.8	1	1.1
37	0.6	0.7	0.9
61	0.5	0.6	0.7
91	0.4	0.5	0.6
192	0.3	0.4	0.5

1. Two-pair power, PoE and PoE+ will not raise cable temperatures or cause length reductions of any significance.
2. Four-pair power supplying up to 60W will in all likelihood result in cable bundle temperatures that do not exceed the standard maximum of 60 C, regardless of bundle size.
3. Four-pair power supplying up to 100W can easily exceed cable temperature ratings, but it requires a lot of power to do so.
4. If you are concerned about bundle temperatures in air in the field, you can measure the bundle surface temperature, subtract the ambient temperature, double the result and add the ambient back in to estimate the temperature at the center of the bundle.
5. For bundle temperatures in conduit in the field, you can measure the bundle surface temperature in air, subtract the ambient temperature, triple the result and add the ambient back in to estimate the temperature at the center of the bundle.
6. For four-pair power, turn off power before disconnecting to avoid arc damage to the connector contacts. ◆

Sterling Vaden *is vice president of advanced technology at Surtec Industries and principal of Vaden Enterprises. He can be reached via email at sterlingv@charter.net.*

Intelligent building cabling solutions PoE lighting for a better education

The Mobile, AL County public school system capitalized on a PoE lighting project based on Cisco's Digital Ceiling platform.

BY BETSY CONROY, SIEMON

The Internet of Things (IoT) is changing the way of life as we know it. Low-voltage devices are now converging on a single unified physical infrastructure, allowing for the collection of large amounts of data that can be exchanged between integrated building systems and analyzed to make business decisions that help save operating expenses while improving efficiency and user experience. To further accelerate digital transformation and extend the benefits of the IoT throughout facilities, Cisco recently introduced their Digital Ceiling framework that converges multiple building networks—lighting, heating and cooling, IP video, IoT sensors and much more—on a secure and intelligent network platform.

Included in the Cisco Digital Ceiling partner ecosystem are a variety of industry-leading partners to help build a Digital Ceiling, including lighting, building automation, cabling and software providers. A key aspect of the Digital Ceiling includes the use of Cisco network switches delivering Universal Power over Ethernet (UPOE) that extends the IEEE Power over Ethernet Plus (PoE+) standard to deliver up to 60 Watts to low-voltage devices, including PoE-powered LED lighting fixtures with sensors that have the potential to provide 85-percent lower energy costs.

Siemon, a global market leader in the design and manufacturing of high-performance, low-voltage infrastructure solutions, is currently the only end-to-end provider of cabling systems within the Cisco Digital Ceiling partner ecosystem. Unequivocally aligned with Cisco's Digital Ceiling, Siemon's ConvergeIT Cabling Solutions include advanced copper shielded cables and connectivity with patented innovative technologies that provide superior support for PoE-enabled devices.

Siemon recently teamed up with Cisco and Cree, a leading provider of advanced PoE lighting solutions and also a Cisco Digital Ceiling Partner, to deliver an innovative PoE lighting system for a Mobile, Alabama school as a pilot program to collect and analyze critical

s support environment

Through the use of Cree LED fixtures outfitted with occupancy and temperature sensors, the Mobile Public School System can ensure its lights are on only when needed and they can integrate the networked light fixtures with other building automation systems.

data—all to demonstrate the overall savings and benefits for future district-wide deployments.

In light of the possibilities

When David Akridge, executive manager of IT at Mobile County Public School System, attended the 2015 Interop Expo in Las Vegas, he was intrigued by something he noticed at the Cisco booth—an LED light connected to a switch.

"I knew right away that it was a PoE-powered LED light, and after talking with Cisco about their Digital Ceiling initiative, I couldn't get all of the possibilities of PoE lighting out of my head," says Akridge. "Not only are we not afraid to pioneer within our school system, but I have always had a disdain for traditional fluorescent lighting—especially in a classroom environment. With LED lighting, I can finally see the light at the end of the tunnel."

Clark-Shaw Magnet Middle School in Mobile, AL, named a Blue Ribbon School for 2015 by the U.S. Department of Education, implemented a Power over Ethernet lighting system as a pilot program to collect and analyze critical data.

While fluorescents have provided a constant source of light for more than a decade, studies indicate that fluorescent lighting can lead to headaches and eye strain, as well as potential seizures for those with photosensitive epilepsy. Not only do LEDs light eliminate these health concerns, they are also a much more environmentally sustainable option. LED lights consume nearly half the electricity of equivalent fluorescents, emit less than half the carbon emissions of fluorescents, and contain no hazardous mercury. With a lifespan nearly five times that of fluorescents, combined with improved durability and no sensitivity to temperature or humidity, LEDs also greatly reduce maintenance costs.

By implementing Cree PoE lighting as a pilot project on one floor at the district's Clark-Shaw Magnet Middle School, named a Blue Ribbon School for 2015 by the U.S. Department of Education, Akridge can carefully analyze the impact of new lighting system on energy consumption, student productivity and overall operational savings and efficiencies compared to another floor in the same school that uses fluorescents.

"Pilot deployments make sense because it's hard to analyze the benefits of any technology unless you can experience it with your own school, your own students and your own teachers," says Akridge. "We have 8th graders in the same classes on both the floor with PoE lighting and on the floor with traditional fluorescents. This allows me to do a class-by-class comparison. We will be comparing assessment test scores, grades and overall classroom behavior and participation, as well as carefully monitoring the energy consumption and response to emergency incidents."

Through the use of Cree LED fixtures outfitted with occupancy and temperature sensors, the Mobile Public School System can ensure that lights are on only when needed and they can integrate the networked light fixtures with other building automation systems (BAS) such as HVAC to reduce unnecessary energy consumption. The ability to connect PoE lighting to the network also allows the school to integrate lighting control with networked security systems and activate blinking patterns for emergency response.

Cabling for PoE lighting: Design and deployment guidelines

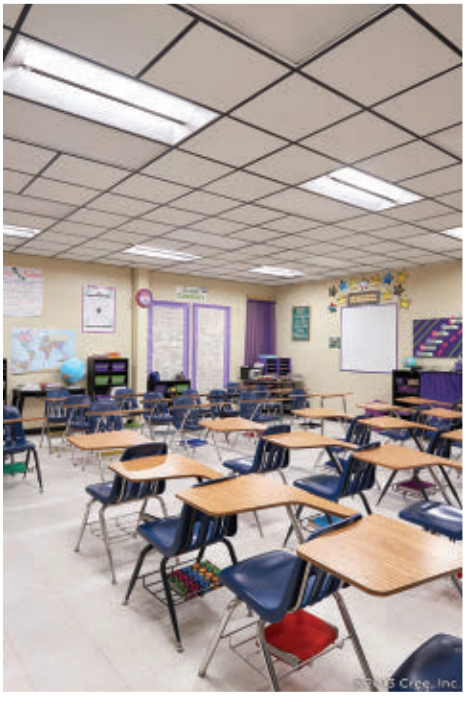
A zone cabling design for PoE lighting such as was deployed at the Clark-Shaw Magnet Middle School is very similar to that used for building automation systems and other IP devices. Siemon provided recommended guidelines for zone cabling and coverage area planning in the May 2016 issue of Cabling Installation & Maintenance magazine. Because of the high number of PoE lighting devices within a space and the static nature of lighting (i.e., few adds, moves and changes), Siemon recommends that the zone cabling system for PoE lighting overlay the zone cabling system for other building automation and IP devices and that dedicated zone enclosures be provided for PoE lighting device connections. If additional outlets beyond what are available at the dedicated PoE lighting zone enclosure are needed, they can be accessed from an adjacent zone enclosure used to support other IP devices.

Due to the density of PoE lighting devices, which is typically about 250 2ftx2ft troffers per 930m^2 (10,000 ft^2) space, Siemon also recommends that the optimum PoE lighting devices coverage area is an 18mx18m (60ftx60ft) square or grid. The dedicated PoE lighting zone enclosure should be centrally located within the coverage area, and the recommended number of outlets in the enclosure is dependent upon the number and size of the PoE lighting devices and type of system. Siemon recommends that the number of available connections within the zone enclosure should be no less than 24 (e.g. for small deployments or for enclosures located on a wall) and should not exceed 96 to ensure that cable bundle size are manageable and that remote powering current-induced heat buildup within cable bundles is controlled.

Ideally, zone enclosures should be positioned at least 30m (100 ft) from the TR. If lighting coverage areas are in close proximity to a TR, PoE lighting devices may be connected to equipment outlets instead of via outlets in a zone enclosure. In addition, when PoE lighting devices are located more than 5m (16 ft) from the zone enclosure, using an equipment outlet to connect the device can facilitate administration, simplify testing, eliminate the need to install long lengths of cable when devices are added, and remove concerns surrounding removal of abandoned cable when devices are taken out of service.

In summary, several variables must be considered prior to identifying the right PoE lighting system for an environment, and the process to design and deploy lighting devices in coverages areas can be complex and confusing. The use of digital lighting partners that are certified cabling design and installation experts can help ensure that customers receive a cost-effective, manageable infrastructure design to support the density of PoE lighting devices.

Valerie Maguire *is global sales engineer with Siemon (www.siemon.com).*



"We are working closely with the Digital Ceiling partners on this project to integrate the lights with our security systems so that we can have specific blinking patterns for certain types of emergencies," says Akridge. "For example, if there is an active shooter in the building, we want to minimize the use of the paging system and the intruder's knowledge. We can use the lights and specific blinking patterns to provide a private warning message to staff and students. Because each fixture is a node on the network with its own IP address, we can also identify the exact location of any detected movement."

In the pilot deployment at Clark-Shaw Magnet Middle School, some eighth-grade classes have PoE lighting and other eighth-grade classes have traditional fluorescents. The school district will compare the classrooms' assessment test scores, grades and overall classroom behavior and participation, and will carefully monitor energy consumption.

Akridge hopes to have the information and analysis needed to demonstrate the productivity and cost savings for justification of PoE lighting throughout the entire school system, including two new schools currently in the planning stages.

Patented technology in the zone

Once the decision was made to deploy PoE lighting at Clark-Shaw Magnet

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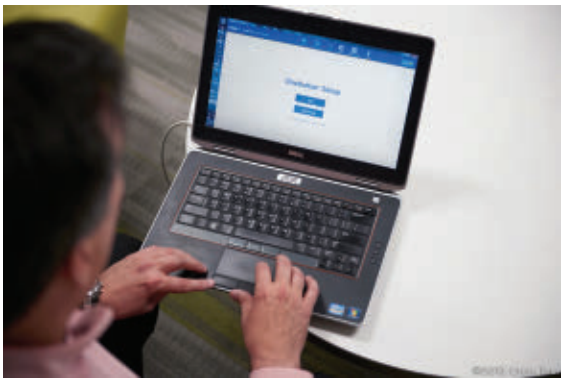

Siemon, Cisco and Cree collaborated to develop a deployment strategy that offers great flexibility and performance with low costs. Based on Cree's guidance, the design consisted of about 145 PoE lighting fixtures. "The installation itself was very quick," commented Mobile School District executive manager of IT, David Akridge.

Middle School, Siemon together with Cisco and Cree designed a deployment strategy that would offer the greatest flexibility and performance with the least amount of cost and labor. Based on guidance from Cree, the design consisted of about 145 PoE lighting fixtures. This ended up being about 30 percent fewer lights than the original fluorescent lighting design in the space, which was ultimately determined to be over-illuminated.

The PoE lighting system was also deployed using a zone cabling design that consists of horizontal cables run from Cisco UPOE switches in the telecommunications rooms (TR) to intermediate connection points housed in a zoned enclosure located in the ceiling space. From the zone enclosure, each PoE lighting node was connected via shorter, easy-to-manage connections.

"We design PoE lighting projects using a zone cabling approach because it supports a more-rapid deployment, which is especially important when you consider the sheer number of lights that can go into a facility," says Bob Allan, global business development manager for intelligent buildings and strategic alliances at Siemon. "With zone cabling, the fixtures are easily connected using patch cords from outlets mounted in the zone unit enclosure instead of connected to an entire length of horizontal cabling from the switch in the TR."

Zone cabling also significantly simplifies any reconfiguration of fixtures or addition of new fixtures with less disruption, requiring only a short connection to the zone enclosure. In addition, a zone cabling design allows the option of deploying factory preterminated and tested cable assemblies from the TR to the zone to support quick implementation, performance exceeding field terminations, and reduced field testing times.

For the zone cabling design, Siemon deployed their new 24-port MAX Zone Unit Enclosure. Part of Siemon's line of ConvergeIT Cabling Solutions for Intelligent Buildings, the 24-port MAX Zone Unit Enclosure accepts up to 24 ports using Siemon copper or fiber MAX outlets, Z-MAX Category 6A outlets or TERA Category 7A outlets. It features foam gasketing to minimize vibration and prevent dust ingress, a fully removable cover for improved access to connections, and easy-to-remove knockouts to facilitate routing cables in and out of the enclosure. The enclosure is also designed to meet UL's plenum rating requirements, which allowed the 24-Port MAX Zone Unit Enclosure to be mounted above the ceiling in the air-handling space at Clark-Shaw Magnet School.

The cabling infrastructure used to connect the PoE lighting nodes comprises Siemon's Z-MAX Category 6A shielded systems, including Z-MAX Category 6A shielded cable terminated to Z-MAX shielded jacks housed in the 24-Port MAX Zone Unit Enclosures and

Josh Bowie, RCDD, owner of Sunrise Network Services, saw the opportunity to learn more about PoE lighting deployments and develop relationships with the Cisco Digital Ceiling Partner Ecosystem. His team donated their time and expertise for the installation.

The PoE lighting system was deployed using a zone cabling design that consists of horizontal cables run from Cisco UPOE switches in the telecom rooms to intermediate connection points housed in a zone enclosure located in the ceiling space. From the zone enclosure, each PoE lighting node was connected via shorter, easy-to-manage connections.

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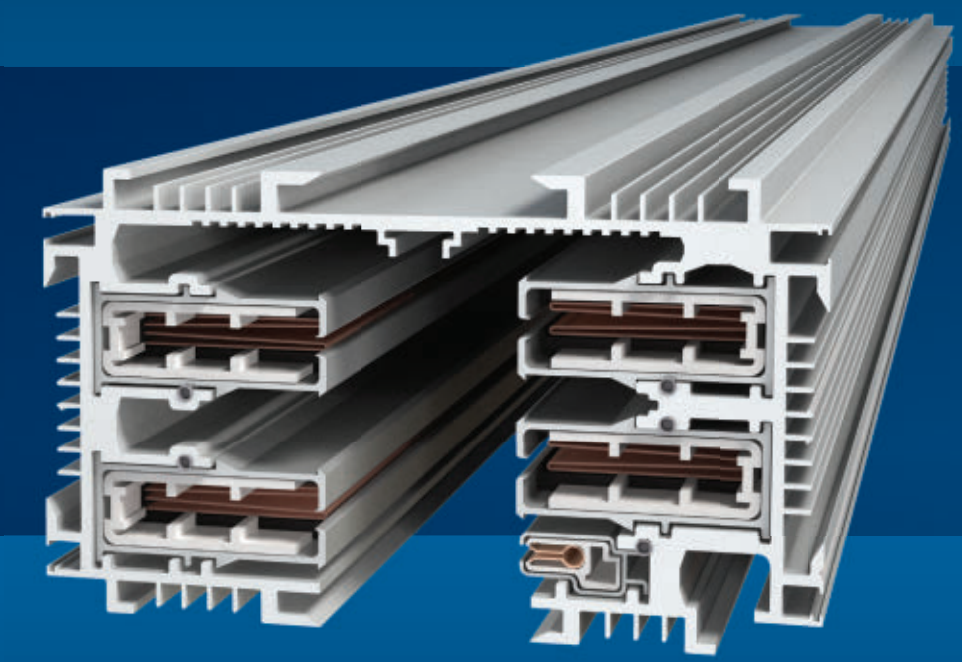

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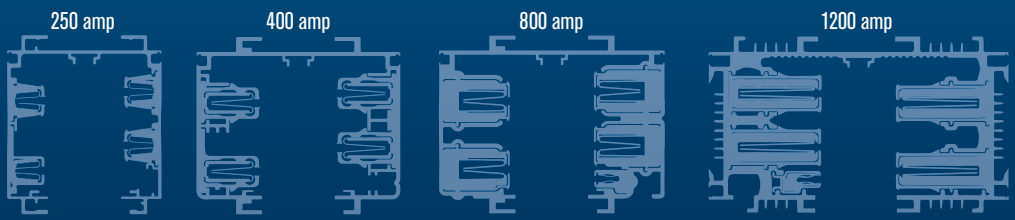

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In addition to the patented jack contact geometry, Siemon's Z-MAX Category 6A system includes higher-quality shielded F/UTP cable that is qualified for mechanical reliability up to 75 degrees Celsius (167 degrees Fahrenheit). This is important because remote power applications like UPOE can cause heat buildup inside cable bundles that increases insertion loss (i.e., signal attenuation). Both TIA and ISO/IEC specify an insertion loss de-rating factor for use in determining the maximum channel length at temperatures above 20 deg. C (68 deg. F). Using higher-quality shielded Category 6A cables like Siemon's Z-MAX Category 6A system can help overcome this obstacle, reducing any length de-rating and allowing the flexibility to support longer channel lengths where needed. In fact, Siemon's Z-MAX Category 6A shielded cable requires less than one-fifth the length de-rating than minimally compliant Category 6A UTP cables.

Siemon designs PoE lighting projects using a zone cabling approach because it supports a more-rapid deployment. Bob Allan, Siemon's global business development manager for intelligent buildings and strategic alliances, noted, "With zone cabling, the fixtures are easily connected using patch cords from outlets mounted in the zone unit enclosure instead of connected to an entire length of horizontal cabling from the switch in the TR."

For the zone cabling design, Siemon deployed its 24-port MAX Zone Unit Enclosure, which is part of the company's line of ConvergeIT Cabling Solutions for Intelligent Buildings.

solid shielded patch cords used to make the final connection.

The Z-MAX Category 6A shielded system is designed to achieve superior transmission performance and provide maximum reliability for remote power applications such as UPOE. Unmating a jack-plug connection under a UPOE load produces an arc that erodes the gold-plated jack-plug contact surfaces at the arcing location. When this erosion occurs in the area of the fully mated position, the result is an unreliable connection. Siemon's Z-MAX jacks are designed with a patented curved or "crowned" contact geometry that places arcing damage to both the plug and jack contacts away from the final mated position for superior reliability of PoE. The design of the Z-MAX jacks also eliminates risk of permanent contact deformation due to mechanical stress. In fact, Siemon's Z-MAX connecting hardware has been independently certified for compliance to the IEC-60512-99-001 standard, which was specifically developed to ensure reliable connections for remote powering applications deployed over balanced twisted-pair cabling.

Savings and a better student experience

The installation of the Cree PoE lighting system was completed in just a few short days by Sunrise Network Services (www.sns-usi.com), a leading structured cabling company founded in 2003. Because Josh Bowie, RCDD, owner of Sunrise Network Services, saw the opportunity to learn more about PoE lighting deployments and develop relationships within the Cisco Digital Ceiling Partner Ecosystem, his team donated their time and expertise for the installation.

With the installation at Clark-Shaw Magnet School now complete, Mobile Public School System is now starting to collect the data needed to analyze the success of the PoE lighting pilot installation. They have also already witnessed up-front savings by using UPOE for power rather than traditional AC power runs, as well as via the reduced maintenance offered by the LED technology.

"I was amazed at the cost savings to wire the lights with low-voltage Ethernet cables versus traditional AC power," says Akridge. "The installation itself was very quick, and we can use the cables for any network device if necessary. The reliability of the LED lights will also improve overall productivity of our maintenance staff as they will no longer have to spend as much time replacing bulbs. I'll be pushing up daisies in the cemetery before these fixtures ever need to be changed."

In recent years, the Mobile Public School System has implemented several energy-saving initiatives to ultimately cut about $5 million out of their utility costs. While Akridge is confident they will realize even greater savings with PoE lighting, the ability to improve the overall learning environment and safety and security of students is his greatest objective.

"While saving money is great, I'm more interested in what PoE lighting can do for education," he says. "Students at the school have already commented on the LED lighting and its ability to improve their overall mood. The data does not lie, and if I can show how PoE lighting improves our kids and our electric bill, it's a no-brainer." ◆

Betsy Conroy *is global marketing communications manager for Siemon. Information about how Siemon's ConvergeIT Cabling Solutions for Intelligent Buildings support Cisco's Digital Ceiling can be found at www.siemon.com/convergeit.*

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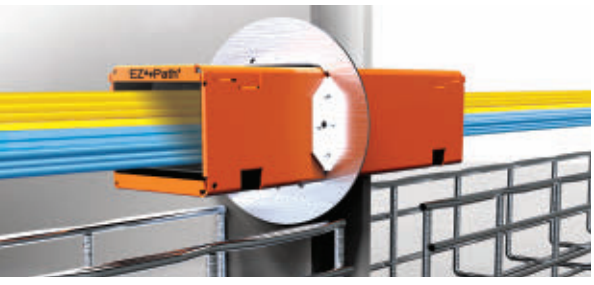

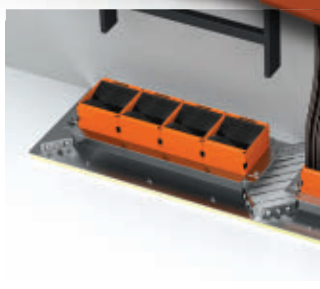

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TIA's healthcare cabling standard undergoing revision

The TIA-1179 standard, published in 2010, includes recommendations for work-area outlet densities in healthcare environments.

BY PATRICK MCLAUGHLIN

In 2010 the Telecommunications Industry Association (TIA) published the ANSI/TIA-1179 Healthcare Infrastructure Standard. The standard was the culmination of years of work within the TIA's TR-42 Engineering Committee that began in 2004 when a study group was formed in an attempt to gain an understanding of the telecommunications and connectivity needs of healthcare environments. The study group's findings prompted the formation of a task group, whose responsibility was to define those needs in the form of a standard.

The ultimate product—ANSI/TIA-1179—is based on the ANSI/TIA-568 series of standards, which specify generic telecommunications cabling for customer premises. That is to say, the 1179 standard does not rehash or deviate from the fundamentals spelled out in 568, but rather, 1179 builds upon them with requirements and recommendations specific to healthcare environments. A notable difference between the 1179 and 568 standards is that within TIA-1179, the size of the telecommunications room is increased to a 130-square-foot minimum, to allow for as much as 100-percent growth. Also, the 1179 standard takes an entirely different approach to work-area cabling and in particular the volume of connections needed within a work area. In a commercial office building, a work area may be a desk, conference room, or other shared-use space. In a healthcare facility, a work area may be anything from a waiting room to a nurses' station or a patient room. Accordingly, the 1179 standard specifies low, medium, and high densities for work-area outlet volume and includes examples of the types of spaces to which each density may apply. TIA-1179 recommends 2 to 6 work area outlets (WAOs) for low-density areas, 6 to 14 WAOs for medium-density areas, and more than 14 WAOs for high-density areas. The standard also recognizes certain twisted-pair copper, multimode fiber, and singlemode fiber media types for use in backbone and horizontal cabling circuits, as well as recommending specific performance levels.

Per ANSI (American National Standards Institute) procedures, in 2015—five years after publication of TIA-1179—work began on a revision to the standard, which will be published as ANSI/TIA-1179-A. During an online seminar hosted by ***Cabling Installation & Maintenance*** and originally broadcast on November 10, Henry Franc—national solutions specialist with Belden and chair of the TIA's TR-42.1 subcommittee that is revising the standard—delivered a presentation updating the status of the revision project.

Within that presentation Franc explained that the revised standard is currently in a fourth draft. Like the original, TIA-1179-A will be based on the TIA's 568 standard set. Because the 568 standard set has been updated since the original publication of 1179, the 1179-A standard will be based on the most-recent iteration, which is ANSI/TIA-568.1-D. Additionally, the "A" revision will include references to other TIA documents, including the following.

- ANSI/TIA-862-B Structured Cabling Infrastructure Standard for Intelligent Building Systems
- ANSI/TIA-5017 Telecommunications Physical Network Security Standard
- ANSI/TIA-606-B Administration Standard for Telecommunications Infrastructure
- ANSI/TIA-607-C Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- ANSI/TIA-942-A Telecommunications Infrastructure Standard for Data Centers
- ANSI/TIA-1005-A

Telecommunications Infrastructure Standard for Industrial Premises

- Telecommunications Systems Bulletin TSB-162-A Telecommunications Cabling Guidelines for Wireless Access Points
- Telecommunications Systems Bulletin TSB-5018 Structured Cabling Infrastructure Guidelines To Support Distributed Antenna Systems

Franc further noted that, as of its current draft, the 1179-A standard includes multiple-user telecommunications outlet assemblies (MUTOAs) and consolidation points as design elements for structured cabling systems in healthcare environments. The standard includes additional requirements for systems such as wireless access points, distributed antenna systems, security systems, intelligent building systems and others. When speaking about intelligent building systems, he pointed out that systems such as nurse-call and wayfinding fall within this framework.

Additionally, Draft 4 of the standard permits array (MPO-style) fiber connectors in the work area and it requires a minimum of two fibers in backbone and horizontal links.

The committee drafting the revision has not come to consensus on recommendations for media performance levels.

We will continue to follow the development of the ANSI/TIA-1179-A standard and will report regularly on its progress. The web seminar in which Henry Franc provided the information contained in this article also included presentations on TIA standards projects TSB-184-A Guidelines for Supporting Power Delivery over Twisted-Pair Cabling and TSB-5021 Twisted-Pair Cabling for 2.5 and 5GBase-T. It will be available for on-demand viewing through April 9 at cablinginstall.com/webcasts. ◆

Patrick McLaughlin *is our chief editor.*

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Air jetting the reinvention of the colocation data center

Forsythe Data Center embraced jetted fiber to achieve its mission of reinventing the typical data center colocation business and technology models.

BY LARRY JOHNSON, Light Brigade Inc.

Each day the internet bombards the media and IT industry sites with news of technology advancements and innovations, such as the latest emerging software, a new WiFi router product enhancement, or a cool mobile app. Rarely, if ever, can IT or network managers recall news of a reinvention, a transformation, of a network infrastructure that redefines it into something that never quite existed before, creating an entirely new category. Why is it so rare? It takes ingenuity, keen business acumen, technology and infrastructure design expertise, and a game-changing vision.

By reinventing both the typical data center colocation business and technology models, Forsythe Data Centers (datacenters.Forsythe.com), a business entity of Forsythe Technology Inc. (www.Forsythe.com), created a powerhouse of newly discovered cost savings, new data center efficiencies, unrivaled security, and unique customer services and benefits in its Elk Grove Village, Greater Chicago, IL location.

In May 2015, Forsythe launched its bold vision—the industry's first data center facility offering truly private, secure and cloud-ready data center suites with individual client-controllable suite infrastructure. Based on its Retail+ business and technology model, Forsythe's unprecedented client offering combines the flexibility and modularity, size, and shorter contract length of retail data centers with the privacy, client-controlled security and power, high density, and freedom of choice associated with wholesale data centers. Literally, clients have the ability to grow from a single cabinet to a 300-square-foot private mini-suite to their own 1,000- to 4,000-square-foot data center within a data center. Each 1,000+ square-foot suite also has an accompanying 670-square-foot support room for precision N+1 air conditioning and 2N uninterruptible power supply. Moreover, the Forsythe facility equips clients with a breadth of professional services and resources that allow them to plan, build, house and manage their personal data centers and entire IT environment under one roof.

With 45 years of Forsythe Technology IT integration expertise, Forsythe Data Center integrated the latest technologies into its new facility, such as cloud computing and virtualization, and expanded compute capacity for customers vertically rather than horizontally yielding fewer cabinets and a smaller footprint, yet with more power density than typical data centers. The result was 700-percent greater rack space utilization and 4 times the processing performance, potentially saving millions of dollars over time for its clients and greatly reducing the center's capital and operational costs.

Another crucial, advanced technology integrated into the facility and positively impacting Forsythe's reinvention of the typical data center business and technology models is the air-jetted fiber infrastructure system innovated by the Dura-Line (duraline.com) and AFL (afl.com) companies. This air-jetted (blown fiber) infrastructure technology enhances the Retail+ model, as well, by providing its own game-changing and surprising benefits to both Forsythe and its clients—benefits difficult to attain with a conventional optical fiber infrastructure. One such surprising benefit is the technology's ability to blow fiber into a new client suite in an unprecedented 20 minutes, a service unequaled in data center colocation.

Some of the many other benefits of the Dura-Line and AFL air-jet technology include continuous fiber runs throughout the facility with zero points of network failure, virtually unlimited fiber and bandwidth capacity, real-time

Using an air-jetted fiber system, Forsythe Data Centers derived cost savings, data center efficiencies, security, and unique customer services at its Elk Grove Village, IL location.

futureproofing, no end to the fiber lifecycle, only two installers, up to 90 percent savings in time and labor for fiber installs, and much more.

Meeting the needs of Forsythe clients

Forsythe's client base, many of which are typically already tech-savvy, consist largely of financial institutions, healthcare providers, retailers, manufacturers, educational institutions and the many organizations that rely on immediate and reliable access to data to serve their own clients. They are seeking advanced solutions in a hybrid cloud environment, expecting full advantages generated by both the private and public cloud. Their needs and expectations for hybrid cloud, plus their wish list for other benefits include the following.

- Flexibility to customize their data center suite quickly and easily
- Scalability to migrate from 10, 25, 40, 100 and 400 Gigabit Ethernet speeds
- High security
- Hybrid cost efficiencies, such as curbing capital expenditures and energy costs
- Speed of data center setup and subsequent moves, adds and changes (MACs)
- No attenuation loss for optimal transmission
- Zero downtime
- Futureproofing
- Protection of the fiber and easy cable management

Other clients include any enterprise across North America that requires primary data center(s) or a redundant backup to their other data center(s). Of paramount importance to its clients is speed of setup and MACs, which along with no attenuation and zero downtime, are of an utmost challenge. However, to ensure the competitive excellence of their new facility, Forsythe was adamant in finding a way to meet the essential client criteria listed. And it all depended on the type and design of the physical infrastructure Forsythe chose.

Inside the facility and choice infrastructures

According to the experience of the team at Continental Electric Construction Company, "The Forsythe Data Center is a unique facility that offers an entirely complete solution for companies." Continental Electric, established in 1912 and Chicago's leading electrical contractor with Sears Tower, Water Tower PLACE, Northlake Enterprise data center and many large colocation centers to its credits, is also Forsythe's infrastructure design and installation partner for the facility project.

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Shown is a 24-way riser-rated FuturePath MicroDuct with eABF MicroCables. Forsythe used 24-, 7-, 4-, 3- and 2-way MicroDucts through which singlemode and OM4 multimode fiber was ultimately air-jetted at speeds of up to 250 feet per minute in a continuous splice-free fiber run where fiber was needed. Empty pathways are used for quick and easy future expansions.

Based on Continental Electric's assertion, Forsythe Data Center is not referred to as a colocation facility in this study because it is that and much more. "Forsythe has created a new category—it is the data center of the future that is here and available now."

Forsythe built and Dura-Line outfitted a massive 221,000-square-foot facility. Imagine a network infrastructure providing fiber and connectivity across the floor space volume of approximately 4 football fields.

Forsythe Data Centers consist not only of cloud-ready client suites of varying sizes, but also state-of-the-art resource rooms to execute the clients' plan, build, house, and manage concept. Main areas of the facility include the following.

- **Private client suites**, clients' own data center
- **Technology evaluation center**, a proof-of-concept lab where the latest technology solutions from more than 50 leading vendors are demonstrated and evaluated in customizable simulated client environments
- **Integration and configuration center** where Forsythe technicians unload client application products to ensure proper configurations and working order integrations (e.g. server blades working with chasses)
- **Executive briefing center** and rooms for client amenities
- **The command center**, the security operations center (SOC)/network operations center (NOC) for managed hosting and client services
- **Two meet-me rooms,** located at the far ends of the facility where Forsythe connects to multiple telecom carrier(s)/service provider(s) and subsequently connects directly to client suites

Essentially, Forsythe Data Centers' infrastructure decision makers, including Thomas McKinney (CFM, ATS), director of data center development and operations and Kevin Vesely (EIT, ATS), associate project engineer, carefully evaluated both conventional and blown fiber infrastructures in their quest for the perfect infrastructure solution. The blown fiber solution was clearly the winner over the conventional infrastructure (the traditional method of pulling fiber cable) as the forthcoming technology comparisons illustrate.

Among the blown fiber solutions assessed, the air-jet infrastructure technologies developed by the Dura-Line and AFL companies were chosen due to Dura-Line's superb quality of its FuturePath MicroDucts and AFL's recent innovation of blowing greater fiber counts than other blown fiber systems. The outstanding customer service and dedication to continuous innovation, characterizing both companies, were also key to Forsythe's decision.

It is important to note that as a multi-solutions provider, Continental Electric Construction Company advocates the adoption of conventional fiber infrastructure systems and recommends either conventional or blown fiber depending on the specifics of a project and which best meets its customers' requirements and needs. The same is true for AFL that offers both conventional fiber cabling and blown fiber/air-jet solutions.

Why not conventional cabling?

Had Forsythe deployed a conventional infrastructure, which is the fiber installation method still most widely employed today, relatively expensive 12- or 24-strand armored riser singlemode trunk cables would have been pulled through cable or basket tray pathways from both meet-me rooms at the far ends of the facility to a client's suite to deliver redundant circuits. The fiber route consists of various short runs of 300 feet to larger runs of approximately 700 feet. Additionally, fiber junctions and terminations would be fusion spliced, thereby creating potential points of network failure and attenuation loss that can cause possible downtime. This is the case, as well, with the connectors associated with conventional preterminated cable assemblies and plug-and-play solutions.

To have achieved this fiber installation conventionally would have been both time and labor consuming, requiring four to six installers, disrupting the physical facility and daily operations by having to enter and re-enter walls or ceilings. McKinney, Vesely, and Continental Electric installers agree that it would have taken two to three

weeks to have completed the fiber installation versus two days with the Dura-Line FuturePath MicroDuct and AFL e-ABF MicroCable air-jet infrastructure system—yielding air-jet labor cost savings of more than 75 percent when compared to conventional cabling.

"Our clients justifiably want service yesterday. When we tell them how quickly their data center suite will be ready, fully equipped and functional including the fiber installation, they initially think it's sales spin. When we actually deliver, they're amazed," says Vesely. "The speed provided by the Dura-Line and AFL e-ABF air-jet solution, including air-jetting fiber to client suites in 20 minutes, has resulted foremost in happy customers, improves our sales cycle, and has assisted Forsythe in further differentiating us from our competitors."

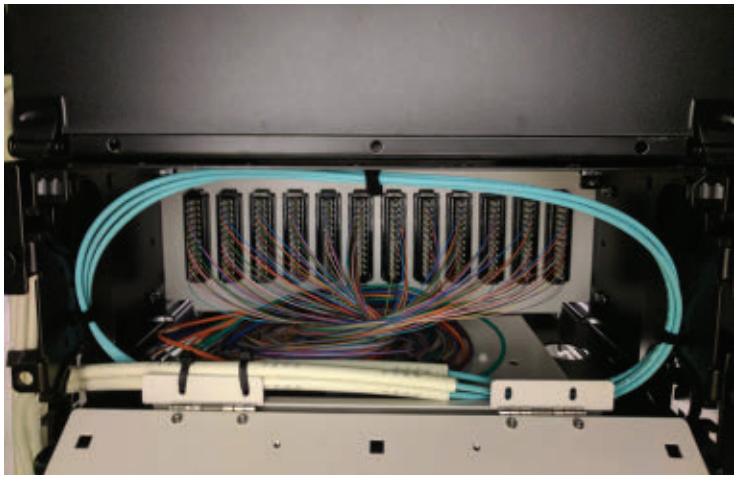
"Also, once the Dura-Line MicroDuct infrastructure is in place, the remarkable time and labor cost savings is ongoing with each fiber installation, generating continuous return on investment (ROI) for the data center," adds McKinney.

In addition to potential points of failure, attenuation loss, possible downtime, disruption, high fiber installation labor costs, and too slow speed of customer suite setup, other disadvantages cited by McKinney and Vesely if a conventional infrastructure were deployed include the following.

- Not enough protection of fiber within armored cable
- Lack of durability (defined as how much and for how long the infrastructure can be used and reused)
- The eventuality of cable mining and poor cable management for locating cables and network segregation
- Overtime union costs for installations required for 5:00pm to 4:00am work due to daytime work disruption
- Disruption of another tenant by periodically having to take another tenant out of service
- Potential threat of compromising security when secure areas need to be accessed; potential fiber damage
- Overall too slow fiber installations for the facility's backbone, distribution runs, crossconnects, and all MACs

eABF MicroCables can be blown through the Dura-Line MicroDucts anytime and anywhere at a moment's notice using only two installers, allowing for fiber to be installed into a client suite in an unprecedented 20 minutes.

Furthermore, with a conventional fiber infrastructure, Forsythe would have achieved only three of the nine of its clients' wish-list criteria of needs and minimally at that—hybrid cost efficiencies, scalability to migrate from 10, 25, 40, 100 and 400G, and futureproofing. Hybrid cost efficiencies can be affected by space savings and conventional cable is much larger when compared to eABF MicroCable. Both scalability for higher data rates and futureproofing could be achieved, but would require the additional expense of installing dark fiber that could go unused, while forfeiting the quick installation of any new fiber-type innovations. The Dura-Line FuturePath MicroDuct and AFL eABF technologies, on the other hand, successfully execute Forsythe's entire client wish-list criteria, negate all conventional infrastructure disadvantages, and introduce a new set of advantages that further benefit both Forsythe and its clients.



eABF OM4 fiber cables exit Dura-Line's MicroDucts in this fiber termination unit.

Forsythe's air-jetted fiber infrastructure

Bundled Dura-Line FuturePath MicroDucts from Forsythe Data

Center's proprietary air-jetted fiber infrastructure pathway. The bundled MicroDuct replaces traditional innerduct and can replace conduit due to its robust, protective jacket, an important feature for the ultimate fiber protection sought by Forsythe decision makers. Providing flexibility in network infrastructure design, the MicroDucts come in various bundled configurations containing 1 to 24 empty 8.5mm x 6mm inner MicroDucts and include high-density polyethylene (HDPE) OSP, riser, plenum and low-smoke/zero-halogen options as dictated by the location in the network.

Near termination points, the FuturePath MicroDuct jacket is removed allowing for easy routing and tighter bend radii. Unlike conventional infrastructures, the Dura-Line MicroDuct is a permanent pathway that is installed once and can be reused again and again for the life of the facility.

For the Forsythe Data Center, 24-way riser-rated FuturePath MicroDucts (containing 24 inner microducts) were deployed for the facility's backbone and the meet-me rooms; seven-way for the distribution applications in the network, and two-, three-, or four-way to the final drops at each client suite.

Once the MicroDuct pathway was installed, any fiber type and counts of up to 72-fiber eABF MicroCables were air-jetted through the empty inner MicroDucts at speeds of up to 250 feet per minute in a continuous splice-free (zero points of network failure) fiber run throughout the facility. MicroCables are available in all optical fiber types including standard singlemode (OS2), bend-insensitive singlemode, 62.5-micron OM1 multimode, and 50-micron bend-insensitive OM2, OM3, OM4 and OM5 multimode. Both eABF MicroCables and Dura-Line MicroDucts are National Electrical Code (NEC) compliant.

Continuous fiber runs and cost savings

Client suites received exactly the fiber and counts required for their customized data center bandwidth with empty inner MicroDucts left for quick upgrades in their future-ready network. And, fiber jetting using safe nitrogen gas or compressed air required, as usual, only two installers at each end of the pathway, thereby costing a fraction of the labor costs and fraction of the time of conventional cabling methods. Had a conventional infrastructure been in place, futureproofing the client suites would have required the installation of fiber with guesswork about which fiber and counts to use, running the risk of installing a soon-to-become-obsolete fiber type or too few fiber counts for the ever-growing high-density and bandwidth-hungry needs of the data center. With air-jet technology, just quickly and easily jet in the fiber you need when you need it.

Moreover, since the fiber jetting was done behind the scenes in a closet, there is no physical disruption to the data center, no construction work with a crew of installers accessing floors and ceilings, no odd overtime 5:00pm-4:00am installations, and no overtime labor hours. With air-jet technology, fiber installations and MACs can be done during normal business hours discreetly out of view of clients and data center visitors. Try that with a conventional fiber infrastructure.

"When we tell prospective clients that they have protected fiber due to a dedicated Dura-Line pathway and a continuous fiber run from the facility's entrance, throughout the building, and directly to their suites, they love it," asserts Vesely. "We're able to quickly and easily install crossconnects across many cabinets and deliver exactly the fiber and bandwidth needed at unbelievable speeds we've never experienced before."

McKinney elaborates, "I'm almost astounded there is a single strand of glass from one end of the building to the other without splices or terminations that can cause points of network failure and attenuation loss. When I tell our clients that our entire facility's network infrastructure has zero points of failure and we're absolutely assured of the reliability of the transmission rate after it is tested, it's a strong selling point. Where there are no terminations in the fiber, there's no likelihood of trouble."

Unlike conventional infrastructures, the Dura-Line MicroDuct is a permanent pathway that is installed once and can be reused again and again for the life of the facility (20 years or more). McKinney refers to this value as "durability." A fascinating phenomenon, for those who witness it, is that MicroCables can be jetted out as quickly and easily as jetting in and the MicroCables can be reused elsewhere in the network, furthering durability and

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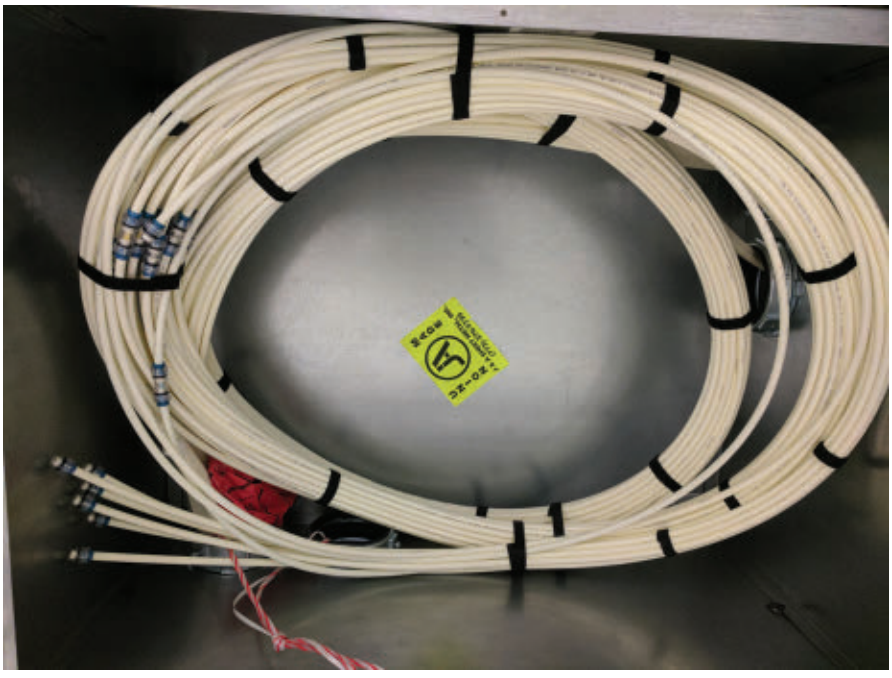
preserving Forsythe's fiber investment. By being able to quickly and easily jet in and out any fiber type and counts anywhere and at any time throughout the network, there is no end to the fiber lifecycle, and MACs can be done in minutes or hours versus the days, weeks, or months associated with conventional cabling—thereby providing data center clients immediate scalability and near-instant customer service.

Dura-Line's MicroDuct innovation also provides the Forsythe Data Center with virtually unlimited fiber and bandwidth capacity. Consequently, the data center is ready at a moment's notice to implement the latest high-density, high-bandwidth technology to keep their clients ahead of the technology curve.



The MicroDuct distribution boxes (MDBs) are used at MicroDuct fiber pathway branching locations. Rerouting, network MACs, and maintenance of the pathway ae accomplished at the MDBs. Labeling 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.

Cable management, MACs and security made easy

An important component in the MicroDuct infrastructure is the MicroDuct distribution box (MDB) that is used at strategically placed fiber branching locations. Quick and easy rerouting, MACs, and maintenance of the pathway are accomplished at the MDBs. Gone are the days of cable mining, a strong pet peeve of McKinney's, and perilous, time-consuming troubleshooting. So, too, is the possibility of disrupting another tenant or needing to take another tenant out of service when making MACs or rerouting fiber. Demarcation of each pathway within the MicroDuct facilitates fast and easy network segregation, including various classifications of data.

Security and the protection of data is an overwhelming critical concern for the data center and its clients. The air-jet technology offers peace of mind by providing the physical segregation of classified data required for multiple levels of security through the demarcation of the individual MicroDuct pathways. These segregated data classifications can be quickly and easily changed and reallocated, while protecting against one classification mixing with another, whereby the network signal can be disrupted or intercepted. Also, because secure areas do not have to be physically accessed, as with a conventional infrastructure, possible intrusion, tampering and fiber damage are eliminated.

A look ahead

Perhaps Forsythe's technology evaluation center where the latest innovations are tested on behalf of improving the customer experience best captures the character of innovation of Forsythe's leaders who reinvented the colocation facility into an entirely new entity. According to the late Steve Jobs, "Innovation distinguishes between a leader and a follower." Clearly, Forsythe is leading the way in the development of the data center through continuous innovation, driven by the focus on game-changing visions that improve the customer experience. Similarly, it can be said that the Dura-Line and AFL air-jet technology innovation is leading the way in physical network infrastructure.

According to McKinney, "The Dura-Line FuturePath MicroDuct and AFL eABF infrastructure system exceeded even our wildest expectations, met all of our clients' needs and more, and solved the constraints of conventional cabling. It's a game-changer and that's what Forsythe Data Centers and Forsythe Technology is all about." ◆

Larry Johnson *is the director and founder of Light Brigade Inc. (www.lightbrigade.com), a provider of fiber-optic training since 1987. Light Brigade recently completed the development of a new course, Fiber Optics for Enterprise Networks. Larry can be reached at larry@lightbrigade.com.*

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Cable labeling in the data center made easy: On the intelligent management of cables

DCIM can provide a comprehensive solution beyond cable labeling and administration in the data center.

BY OLIVER LINDNER, FNT Software

Managing cables in the workspace can prove a complex and difficult task, but by using static cable IDs and implementing a smart DCIM solution, the process simplifies and contributes to a more-efficient working environment.

Ensuring that your data center operates at optimal efficiency should be a primary concern at all times. One of the greatest difficulties is managing the cabling networks that connect your business-critical systems. Failing to properly label individual cables could be costly to your operation by contributing to business interruptions and unnecessary downtime. Having to shift attention to addressing network issues will take time away from focusing on other strategic IT initiatives.

However, intelligently managing cable networks is not always an easy task. There are quite a few common challenges that may interfere with your ability to do so. For example, your data center could fall victim to "the spaghetti effect" where your cable rack looks like a bowl of pasta without the sauce. Everything is cluttered, tangled together and not flowing the way it should be. Separating and properly labeling your cables will eliminate the unruly mess and provide organization.

Perhaps power outages in your data center are to blame? According to a report from Uptime Institute, human error in cabling management is responsible for this 88 percent of the time. Without intelligent labeling, recovering from the power outage becomes a time-consuming and difficult task. Wasting too much time trying to identify cables is counterproductive to business operations.

In an attempt to provide an answer or solution to this issue, many industry professionals will argue that ANSI/TIA-606 is already the best practice for labeling. However, that's really only the case when we're talking about fixing cabling. Implementing a standardized and transparent systems for intelligent labeling will always prove the best option. In this case, selecting the right DCIM software will equip administrators with the tools needed to shorten error recovery time and standardize the labeling of a cable network.

This raises an important question: How can a DCIM—data center infrastructure management—tool improve IT service and support, especially related to cabling? The combination of organizing and labeling cables and documenting the in a centralized DCIM system allows data center operators and IT staff to quickly pinpoint issues and be more proactive when it comes to maintenance, rollouts, migrations and change management.

To overcome unnecessary

complexity in the workplace, efficiency needs to be increased through planning, organization and management. Here, a DCIM system such as FNT Command can provide a comprehensive solution to assist in accomplishing this. With FNT Command, users can reap the benefits of end-to-end signal tracing, a completely customized interface to a label printer, and a mobile app that allows a DCIM administrator to access the signal path directly in the data center by just scanning a barcode or searching for a static ID.

More robust DCIM platforms support predefined interfaces to the leading automated infrastructure management (AIM) solutions, enabling automatic documentation that significantly improves data accuracy. Additionally, AIM systems offer another level of intelligence, creating alerts when connections are loose or lost. Integration with AIM also allows users to pinpoint which cables are related to an outage, improving resolution time.

Through DCIM systems, the cabling management process is more simplified, standardized, and transparent. They also provide the capability to align network resources and IT assets with strategic applications, to ensure uptime and minimize disruptions.

Currently, the popular choice for cabling network solutions are AIM systems. While these may resolve operational inefficiencies in some places, manufacturers pre-labeling cables remains an issue. Here, a DCIM tool can help in allowing the user to digitally name and manage the cable per their specific requirements and needs.

Consider managing your cabling deployments as intelligently as you manage the rest of your business. Create solutions that cut down on time spent addressing operational hindrances and instead standardize a network that can be managed quickly and easily. This will allow DCIM administrators to focus on important tasks at hand with minimized distractions. Reducing costs, improving workflow, and increasing transparency throughout your data center—that's intelligent cable management made easy. ◆

OLIVER LINDNER *serves as senior consultant for server management for FNT Software (www.fntsoftware.com). With more than 20 years of industry experience as a system analyst, he oversees FNT's business line Data Center Infrastructure Management.*

PRODUCT FOCUS

FIRESTOPPING EQUIPMENT

Large-format fire resistive wall box

FSR's PWB-FR-450, a large format wall box, provides multiple infrastructure mounting solutions for larger interfaces or equipment behind a display, or in other custom applications. Fire-resistive material is integrated within the unit's door assembly, providing 1 hour of protection. The rugged 14-gauge steel back box installs between wood or steel studs, leaving proper spacing for the door to mount flush with the wall's surface. Connections and cables are hidden behind the cover for a neat, elegant look. Three prewired integrated AC outlets aid installation. Internal compartments have a three-fourths-inch KO and concentric KO that goes up to 1.5 inches in the box's top and bottom for cable/conduit entry. A two-part vented cover provides convection cooling for internal components. One or all of the internal brackets can be removed for custom configurations. This box has also been designed to accommodate Crestron's larger DM-RMC-4K-SCALER-C 4K scaler/room receiver. Hardware is included.

FSR, *fsrinc.com*

FS-ONE MAX intumescent firestop sealant

Hilti's new intumescent firestop sealant FS-ONE MAX is an improved version of the company's popular FS-ONE firestop sealant. The new sealant still embodies the reliable features of the original FS-ONE, but now provides for better handling and longer shelf life. Its "new W-rated, multi-purpose formulation means this highly versatile product can be used for even more common through-penetrations in a variety of base materials, including concrete, masonry, and drywall," says the company. The sealant is easy to dispense and is available in multiple package types (tubes, foil packs and buckets) to meet a variety of project needs. The product's 12-month shelf life from date of manufacture helps reduce the risk of expired inventory. Now ethylene glycol-free, the sealant's low VOC content also makes it an environmentally safe formulation that is non-harmful when used as directed.

Hilti, *www.us.hilti.com*

2-hour fire resistive CIC cables

Comtran's VITALink 2 Hour Fire Resistive CIC cables are designed to protect critical life safety systems, including emergency voice alarm communications, area of refuge and firefighter's telephone systems, and visible notification appliances. Withstanding heat up to 1850 deg. F for 2 hours, these cables are vital in hospitals, high-rise buildings, government buildings, universities, airports, and stadiums where evacuation times are beyond the capabilities of standard fire alarm cabling or when partial evacuation is required. The VITALink cables are available in a wide range of constructions including 12-16 AWG stranded conductors, 12-18 AWG solid conductors, and in shielded and unshielded designs. All VITALink cables meet the requirements of UL 2196 and CAN/ULC S-139 with hose stream test. They also meet the survivability requirements of NFPA 72, 130, and 502. According to the company, "with the best conduit fill and longest vertical installation distance approved in the industry, installers can save money, time, labor, and space using VITALink."

Comtran, *comtrancorp.com*

EDITOR'S PICKS

News, products and trends for the communications systems industry

- INDUSTRIAL CONNECTIVITY HITS THE ROAD
- 100G COPPER FOR HYPERSCALES
- SUSTAINABLE CABLING PRODUCTS

COMPILED BY
Matt Vincent
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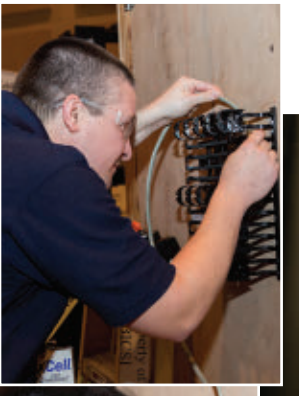

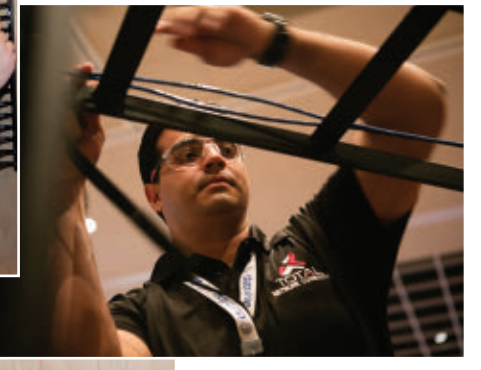

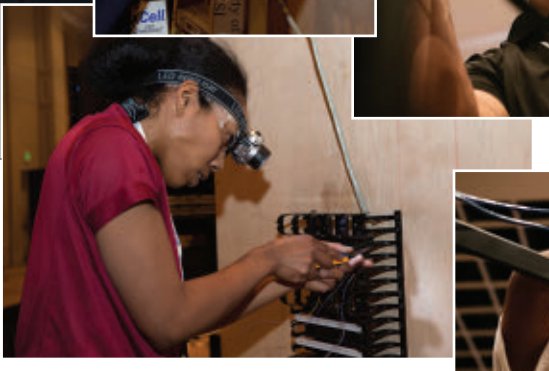

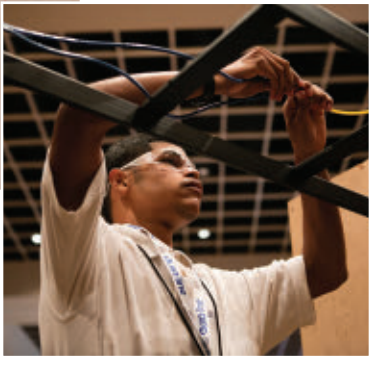

CABLING INSTALLATION

BICSI hosting its 10th Cabling Skills Challenge

During the upcoming BICSI Winter Conference, the association will host its 10th Cabling Skills Challenge. The competition will be held January 23-25, on the exhibit floor at the Tampa Convention Center. The Cabling Skills Challenge will culminate in the crowning of the Installer of the Year as part of BICSI's annual awards banquet on January 25.

Contestants are all BICSI-credentialed Installers or Technicians, selected from a pool of applicants based on criteria including professionalism, quality of resume and work experience.

The Cabling Skills Challenge has been held annually since 2008; the inaugural competition was carried out during BICSI's Spring Conference, which was held in Baltimore that year. The association subsequently discontinued a springtime conference in the United States and when it did so, moved the Cabling Skills Challenge to its Winter Conference.

The competition comprises seven judged or scored events in addition to other specialized speed-based challenges for activities including fusion splicing, 50-pair cable punchdown, and cable routing. The seven judged or scored events are:

- Structured cabling system installation
- Copper cable terminations, firestopping, grounding and bonding
- Fiber termination and splicing
- Cable assembly
- Cable troubleshooting and technical support
- Competency exam
- Professionalism/orientation

Over the course of the three-day competition, each participant cycles through the seven events as well as the speed challenges. Each participant receives a prize package; the overall winner is crowned Installer of the Year and receives a $5,000 cash prize. In the nine years the competition has been held, a total of five individuals have been Installer of the Year, with multiple repeat champions.

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Jessie Spearman of Vision Technologies "three-peated" as champion in the program's first three years (2008-2010). Other winners were Jeffrey Johnson (Staley Inc., 2011); Thomas "Lee" Renfroe (GoFroe, 2012-2013); Jeremy Vittitow (Vision Technologies, 2014); and Alberto Luna (Total Network Consulting, 2015-2016).

Competitors have come from all facets of the information and communications technology (ICT) profession—installers and technicians working for contracting companies as well as those employed by end-user organizations and service-provider organizations.

For several, participation in the Cabling Skills Challenge has been a springboard to more involvement with BICSI as an association. David Richards, chief technology officer and co-founder of ICT Training Group Inc., initially conceptualized the competition then led the effort that brought it to fruition. His vision was to establish a program that would serve as both an incentive for, and to provide recognition to, field-service technicians. Currently serving as chair of the Cabling Skills Challenge Subcommittee and as the event's head judge, Richards has invited each reigning champion to "shadow" him through conference-related activities at the Winter Conference following the champ's victory. The shadowing activity has included participation in BICSI committee meetings, and several past Installers of the Year have joined and remain on committees.

Richards also encouraged participation from installers and technicians outside of North America, and has seen that become reality as well. ICT professionals have traveled from Japan, Australia, as well as countries in BICSI's CALA (Central And Latin America) district to compete in the annual event. In most of these cases, an international competitor won a local/regional/national event to advance to the Cabling Skills Challenge.

Throughout 2017 BICSI plans to celebrate its Year of the Installer, paying tribute to this trade including professionals holding BICSI's Installer and Technician credentials, as well as commemorating the association's Cabling Installation Program, which is now 20 years old. BICSI plans to roll out celebratory information throughout 2017. ◆

PHYSICAL SECURITY

Axis upgrades Q35 series of fixed dome cameras

Axis Communications has expanded and updated its AXIS Q35 Network Camera Series with models based on the latest image sensor technology and enhanced processing via the company's Lightfinder technology, which it says provides exceptional light sensitivity and Wide Dynamic Range–Forensic Capture (WDR) capability.

The upgraded camera series also features Axis' Zipstream technology which can lower storage and bandwidth requirements by 50% or more, claims the company. Additionally, two of the new cameras are marine-grade, electro-polished models with a coated stainless steel casing, and a nylon transparent dome. With these features the cameras are able withstand the corrosive effect of ocean water and chemicals.

"The upgrade and expansion of the AXIS Q35 Series showcases our commitment to delivering high quality products that are feature-rich and cost efficient," said Fredrik Nilsson, VP Americas, Axis Communications, Inc. "This version of the AXIS Q35 Series will be able to address many surveillance challenges in the healthcare and industrial facilities segments."

The AXIS Q3505-V/-VE/-SVE Mk II models provide HDTV 1080p video at 30 fps with WDR, and 1080p at up to 60 fps or 720p at up to 120 fps with WDR disabled. They are available with wide or telephoto lenses. The AXIS Q3504-V/-VE cameras provide HDTV 720p at 30 fps with WDR, and up to 120 fps with WDR disabled. All new AXIS Q35 models offer remote zoom and focus capabilities as well as P-Iris control, ensuring optimal depth of field, resolution, image contrast and clarity.

Additionally, the AXIS Q35 Series is supported by the company's extensive base of video management software through the Axis Application Development Partner (ADP) Program and AXIS Camera Station. Third-party video analytics applications can be installed on the cameras via AXIS Camera Application Platform. ONVIF support allows for easy integration into existing video surveillance systems.

The new AXIS Q3504-V and AXIS Q3504-VE cameras, the updated AXIS Q3505-V Mk II and AXIS Q3505-VE Mk II, as well as the new stainless AXIS Q3505-SVE Mk II models are available through Axis' standard distribution channels. ◆

PERSONNEL MOVES

Technology infrastructure services firm CompuCom names Dan Stone as CEO

On December 1, CompuCom Systems, Inc., a technology infrastructure services company, announced it has appointed Dan Stone as its new chief executive officer. Stone previously served for two years as executive vice president and president of end-user enablement for the company, which it says is a core strength that "helps IT executives manage the convergence of social interaction, mobility, Big Data and cloud, empowering end users as they interact with each other and their information."

Don Doctor, who has served as CompuCom's chief executive officer since January 2015, will serve on the company's board of directors as executive chairman of the parent company board. "Dan and I have been working closely together while he established and led CompuCom's End-User Enablement business, and his strategic thinking, vision and focus on end users make him the perfect choice to lead the company," noted Doctor. "I'm excited about Dan and the talented group of leaders we now have in place, and the direction they are taking the business."

Prior to joining CompuCom, Stone served as president and general manager of Lenovo Latin America, a $3B business division, where he led 7,000 employees across 15 countries and two continents, and operated six vertically integrated manufacturing sites. Previously, he was the chief strategy officer at Lenovo, leading the development and implementation of global corporate strategy technology investments, strategic partnerships/alliances, as well as post-merger management activities across the globe.

"CompuCom is at an exciting time in its evolution and I'm proud to have the opportunity to lead our team," said Stone. "Don has been instrumental in transforming the company over the past couple of years and bringing it to the place it is today, and I look forward to continuing that transformation."

Stone becomes chief executive officer as CompuCom increases its focus on helping companies around the world acquire, deploy and manage the technology and applications that their organizations require for development and service. The company is accelerating its presence in the automation space, with the planned acquisition of the IoT business of Extensys, a top provider of IoT solutions, and the integration of its core team. CompuCom also recently partnered with intelligent automation leader Arago to integrate Arago's problem-solving artificial intelligence solution, HIRO, into all of CompuCom's managed services solutions for the data center – enabling incidents to be diagnosed and remediated more quickly, efficiently and with greater certainty.

The company also announced it has expanded its partnership with Intel to launch cloud-based managed services, in an effort toward making infrastructure management and managed security offerings affordable for organizations of any size. ◆

WIRELESS

Dali Wireless sues for DAS patent infringements

On November 1, Dali Wireless, Inc. announced it had filed a lawsuit in the United States District Court for the Southern District of Florida against Fiplex Communications for infringement of U.S. Patent Numbers 9,419,714 and 9,439,242 (case number 1:16-cv-24554-KMW).

These patents, which describe and claim systems to remotely reconfigure and time synchronize routing in a distributed antenna system (DAS), are building blocks for software-configurable digital DAS.

In its complaint, Dali alleges that Fiplex incorporated Dali's patents into its digital fiber distributed antenna system, which it then used to win bids to install DAS in the Philadelphia and Washington, D.C. metro systems. Dali has asked the court to award it monetary damages and issue an order preventing Fiplex from making and selling its Digital Fiber DAS.

This new lawsuit against Fiplex comes on the heels of Dali's assertion of three other patents against CommScope Technologies LLC, in counterclaims in a case brought by CommScope in the Northern District of Texas (case number 3:16-cv-477-M).

In that case, Dali asserts U.S. Patents Nos. 8,149,950; 9,031,521; and 9,419,837, which describe and claim, among other things, efficient baseband predistortion linearization systems, power amplifier systems and methods of operation, and software-configurable DAS, which are used in modern-day wireless transmission through digital radio distribution systems. ◆

DATA CENTER

SC16 breaks attendance records for exhibits, workshops

SC16, held November 13-18 in Salt Lake City, UT, was the 28th annual international conference of high performance computing (HPC), networking, storage and analysis, celebrated the contributions of researchers and scientists–from those just starting their careers to those whose contributions have made lasting impacts on the industry. The conference drew more than 11,100 registered attendees and featured a technical program spanning six days. The exhibit hall featured 349 exhibitors from industry, academia and research organizations from around the world.

According to Trey Breckenridge, SC16 exhibits chair from Mississippi State University, the SC16 exhibition was the largest in the history of the conference. The overall size of the exhibition was 150,000 net square feet (breaking the 2015 record of 141,430). The 349 industry and research-focused exhibits included 44 first-timers and 120 organizations from 25 countries outside the United States.

During the conference, Salt Lake City also became the hub for the world's fastest computer network: SCinet, SC16's custom-built network which delivered 3.15 terabits per second in bandwidth. The network featured 56 miles of fiber deployed throughout the convention center and $32 million in loaned equipment. It was all made possible by 200 volunteers representing global organizations spanning academia, government and industry.

For the third year, SC featured an opening "HPC Matters" plenary that this year focused on precision medicine, which examined what the future holds in this regard and how advances are only possible through the power of high performance computing and big data. Leading voices from the frontlines of clinical care, medical research, HPC system evolution, pharmaceutical R&D and public policy shared diverse perspectives on the future of precision medicine and how it will impact society.

The event's technical program again offered the highest quality original HPC research. The SC workshops set a record with more than 2,500 attendees. There were 14 Best Paper finalists and six Gordon Bell finalists. These submissions represent the best of the best in a wide variety of research topics in HPC, said event organizers.

"There has never been a more important time for high performance computing, networking and data analysis," commented SC16 general chair John West from the Texas Advanced Computing Center. "But it is also an acute time for growing our workforce and expanding diversity in the industry. SC16 was the perfect blend of research, technological advancement, career recognition and improving the ways in which we attract and retain that next generation of scientists." ◆

CONNECTIVITY

PEI-Genesis gets onboard with Harting's industrial connectivity roadshow

PEI-Genesis, a specialist in precision connector and cable assemblies, showcased its partnership with Harting when the company invited

customers and employees to experience the Harting Roadshow Truck at PEI-Genesis' global headquarters in Philadelphia last November.

The Harting Roadshow Truck is billed as "a tradeshow on wheels." It is outfitted to educate distribution partners and manufacturer representatives on connectivity technologies and trends so they can find the best solutions for customers. As an authorized distributor of Harting connector solutions, PEI-Genesis said it welcomed the chance to visibly demonstrate what the partnership can do to help customers in the industrial, transportation, energy and other key market sectors.

"The Harting roadshow is a great chance to show customers our capabilities, especially in the industrial market," commented Steven Fisher, chairman and CEO, PEI-Genesis. "At the same time, we want to make sure our own engineers and sales reps have the information they need to make the most informed choices, and guide customers to the right solutions for their projects."

The truck is equipped with interactive product stations featuring industrial connectors, small form factor industrial and communications connectors, push pull connectors, service ports for Ethernet and USB, industrial Ethernet patch cords, board level connectors, and RFID solutions. Product displays are customized to meet the host customers' focus. In addition, several touchscreens feature slick product videos, photos, and demonstrations.

"The truck is a way to share knowledge and bring products directly to our distributor partners and customers, especially engineers," said Christelle Smith, distribution account manager, Harting. "It is convenient. Customers do not have to go out to an industry tradeshow. They don't have to go offsite at all. And it's much more informative than looking at print or online catalogs."

Throughout the day, more than 60 PEI-Genesis team members and customers got a chance to visit the truck – parked right outside PEI-Genesis' doors – where they learned about innovative and reliable connector solutions. The truck, which first hit the road around summer 2015, logs about 50,000 miles a year, traveling across the U.S. and Canada.

INDUSTRIAL NETWORKING

Steel enclosures stand up to hazardous, industrial environments

Weidmuller recently expanded its Klippon Terminal Box (TB) range of hazardous-area steel enclosures by introducing three new versions: Multi-Hinge (MH), Quarter-Lock (QL), and Fixed-Screw (FS). "These new enclosures feature a range of approvals that include cULus, AEx, ATEX and IECEx ratings, making them suitable for use in Class 1/Division 2 and Class 1/Zone 0, 1, 2, 20, 21 and 22," Weidmuller explained. "These enclosures comply with the latest, stricter requirements covering equipment for use in potentially explosive atmospheres, making them ideally suited for harsh environment applications in oil-and-gas, petrochemical, nuclear and wastewater industries."

The Klippon TB MH, QL, and FS enclosures share a number of design features that their manufacturer says contribute to high performance in harsh-environment applications; they include ingress protection ratings of IP66/67 along with NEMA 3, 4X and 12. Plus, extended heat-and-cold stability testing have been administered to document the enclosures' ability to withstand temperature extremes—155 deg. C/311 deg. F for 336 hours and -65 deg. C/-85 deg. F for 24 hours.

"For cable-entry flexibility, each enclosure is equipped with up to four gland plates that are secured with M6 hex-head screws," Weidmuller added. "A silicone gasket is standard to ensure the enclosures are suitable for use in temperature extremes, ranging from -76 deg. F to + 275 deg. F [-60 deg. C to +135 deg. C]. Impact- and corrosion-resistant, these enclosures can also be used in environments that are exposed to salt air. A grounding stud on the cover and base conforms to the most recent standards, and the base grounding stud can be replaced in case of damage. The enclosures are made of 316L stainless steel with a protective electro-polished finish. The Klippon enclosure series of MH, QL, and FS are available in 12 sizes and standard depths of 5, 6, and 8 inches."

The MH enclosure's multi-hinge characteristic makes it flexible, the company said. Users choose which side the lid hinges by moving the padlock tab to allow for the reversal of lid opening (left-to-right or right-to-left). The cover locking mechanism is located outside the sealed zone to prevent interference with the seal.

The QL range's quarter-locking cover requires a keying tool to open it, which prevents accidental opening as well as intrusion.

The FS enclosure's non-hinged, fixed-screw cover is ideal for applications where space is not conducive to lid clearance when opened, Weidmuller pointed out. ◆

DATA CENTER

Aquantia unveils 100G copper technology for hyperscale data centers and cloud environments

Aquantia Corp., a specialist in high-speed Ethernet connectivity for data centers and enterprise infrastructure, has unveiled its QuantumStream technology, which the company says defines "a new class of high-performance connectivity architecture that has the potential to revolutionize next-generation hyperscale data centers."

The QuantumStream technology, which is being developed by Aquantia through a strategic collaboration with GlobalFoundries, creates a 100-Gbit/sec bandwidth all-electrical technology to deliver low latency to networking applications. The collaboration seeks to break through perceived technical barriers in continuing the current electrical connectivity roadmap to 100 Gbit/s bandwidth. In addition, Aquantia's QuantumStream technology is easily leveraged to deliver multiples of 100 Gbit/s of bandwidth on conventional DAC cables, resolving one of the most significant challenges facing the networking and data center industries today, according to the companies.

The QuantumStream technology is geared for short-distance links including: 100G over 3m direct attach cable SFP; 400G over 3m direct attach cable QSFP; and 800G over 3m direct attach cable OSFP. The new technology is aimed at inter- and intra-rack connectivity up to 3 meters, complementing longer reach optical connectivity solutions used in hyperscale data centers. "To date, industry watchers have projected that only optical

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MERGERS AND ACQUISITIONS

Mexichem acquires HDPE conduit and innerduct manufacturer Gravenhurst Plastics

Mexichem recently acquired Gravenhurst Plastics Ltd. (GPL) in a deal the company says furthers its "global growth model with bolt-on acquisitions in value-added specialty products." GPL, a privately held plastics pipe manufacturer, is based in Gravenhurst, Ontario, Canada with an additional location in Temiskaming, Ontario. The company supplies high-density polyethylene (HDPE) conduit and innerduct for fiber optics as well as building supply products to the Canadian market.

GPL had $15 million in revenues in 2015.

Mexichem said it will consolidate GPL under the Fluent Business Group and will upgrade GPL's facilities. "Our Fluent Business Group with high-tech Dura-Line brand provides a pathway for connectivity via a scalable design to accommodate high-bandwidth demands for the Internet of Things," the company said in a statement announcing the GPL acquisition. It continued, "Mexichem's Dura-Line brand is a world leader in HDPE conduit, duct and pressure-pipe solutions for telecom, data communications and infrastructure industries, specializing in facilitating enhanced networks for tier-one communication companies."

The Fluent Business Group has annual revenues of approximately $3 billion, as of September 2016. "The addition of Gravenhurst will establish a presence for Fluent in Canada and will provide a platform to expand all of Mexichem's businesses in that country," Mexichem said.

Paresh Chari, president of Fluent Business Group, commented, "Gravenhurst's telecommunications products complement Mexichem's Fluent offerings. Gravenhurst's longstanding relationships in the Canadian market will enable us to expand Fluent's international footprint, leveraging world-renowned Dura-Line branded products, while preserving Gravenhurst's local presence."

Fluent USA/Canada's president, Emmanuelle Dubu, added, "We are pleased to partner with Gravenhurst in the evolution of the Canadian datacom business. Gravenhurst's deep roots and innate understanding of the dynamics of the Canadian market will be invaluable to our shared success."

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connectivity will serve the needs of 100Gbit/s and beyond. This presents a huge barrier since optical technologies are intrinsically higher cost," said Faraj Aalaei, CEO of Aquantia.

He continued, "Aquantia's technology delivers a quantum leap in bandwidth performance over a single lane of copper previously believed to be solely the realm of optical techniques. Our expertise in complex high-speed copper transceivers, coupled with the legacy of robust SerDes leadership with GlobalFoundries' 14nm FinFET technology will enable a continuous roadmap to the required 100G connectivity and provide our customers with the best combination to differentiate and stay ahead of evolving marketplace demands. The availability of this technology will enable system vendors and data center operators to push towards higher performance and newer topologies in hyperscale architectures while keeping the reliability, low-cost and ease-of-use of electrical-based interconnects."

As stated in an Aquantia press release, "GlobalFoundries has more than 20 years of deep technical expertise in high-speed Serializer-Deserializer (SerDes) design. A SerDes integrated circuit is a fundamental building block responsible for the transport of data between switches, servers, routers and storage equipment in data centers and IT environments, over a variety of channels such as optical fibers, electrical copper cables, and backplanes. GlobalFoundries' FX-14 Application-Specific Integrated Circuit (ASIC) platform, designed on the company's most advanced 14nm Low Power Plus (LPP) process technology, delivers an optimized IP portfolio, including the latest generation of SerDes, which is capable of transporting data at speeds of 56Gbit/s."

Under the new collaboration, GlobalFoundries is providing access to its 56 Gbit/s IP core to Aquantia's team of experts. Aquantia combines the 56 Gbit/s IP core with its patented Mixed-Mode Signal Processing (MMSP) and Multi-Core Signal Processing (MCSP) architectural innovations of high-speed interconnect over copper, which it has developed over the past decade to deliver a unique 100G interconnect high-performance SerDes solution. In addition, Aquantia will provide access to its QuantumStream IP to GlobalFoundries for incorporation into its customers' ASICs, therefore expanding the ecosystem of solutions supporting this revolutionary interface.

"To meet the tremendous growth in bandwidth and data demands, GlobalFoundries is continuing its commitment to investing in network and technology enhancements including a best-in-class high-speed SerDes solution that will bring tremendous benefits to our customers," said Mike Cadigan, senior vice president of global sales and business development at GlobalFoundries. "Aquantia's innovative design expertise in high-speed copper interconnect technologies, combined with our world-class FX-14 ASIC platform and SerDes IP portfolio, will enable the continuation of electrical interconnect paradigms for hyperscale data centers."

Aquantia's press release adds, "An analysis of the deployment of switch and server connectivity in hyperscale data centers shows that a large concentration of them are within a few meters. According to Crehan Research, the majority of direct server and storage Ethernet network connections in hyperscale data centers are currently within 3 meters. Since interconnect solutions that are optimized for hundreds of meters or even a couple of kilometers would not be adequate for a few meters, this leads to the need for complementary solutions for connectivity over short-reach applications and long-reach connections. Traditionally, electrical interconnects have delivered the lowest-cost and -power options for the short reach space whereas optical solutions have been deployed in longer reach applications thanks to low-loss of optical fibers. Responding to a sweeping industry trend toward higher density switch and server configurations, a number of optical solutions have already been proposed for 100G. Aquantia's QuantumStream technology, a complementary 100G solution for mass server and switch connectivity at shorter reaches over copper lane implementations is now possible for the first time."

"As a principal engineer in global infrastructure architecture and strategy at LinkedIn, my focus is on designing next generation data centers. I have long believed that 100G connectivity would be widely deployed when it reaches a price point of one dollar per gigabit per second for optical interconnects," commented LinkedIn's Yuval Bachar. "Aquantia has come up with a very innovative 100G technology to deliver on lower cost per gigabit utilizing copper connectivity. Lower prices will transform the economics of in rack connectivity in hyper scale data centers, which obviously is of great interest to everyone looking to achieve below one dollar per 1 Gbit/s on an accelerated path within the rack." ◆

SUSTAINABILITY

Panduit connectors and cabling awarded environmental product declaration

Panduit Corporation recently announced the company has achieved environmental product declaration (EPD) certifications from UL Environmental for the company's copper cabling and jacks. Project developers can use EPDs to earn points toward LEED (Leadership in Energy and Environmental Design) certification.

"Panduit is the first structured cabling manufacturer to achieve EPD certification on both cabling and connectors," the company said when announcing this accomplishment. "The Panduit EPDs cover 18 types of RJ45 jacks and 22 different copper cables. The offering includes products for unshielded and shielded applications, in Category 5e, Category 6, and Category 6A performance, and includes both riser and plenum flame ratings for cable. In addition, health product declarations (HPDs) are in process for all the same products."

Dennis Renaud, vice president of Panduit's enterprise business, commented, "Everyone is talking about sustainability these days. At Panduit, we do more than just talk about it. We're committed to sustainable solutions and helping our customers achieve sustainability in their projects as well. This is an important step for Panduit in helping drive the marketplace toward sustainable solutions."

Panduit further explained that building projects can earn points toward LEED Version 4 certification by installing at least 20 different products, which are third-party certified to EPD and/or HPD, from at least five different manufacturers. Certified products can contribute toward two LEED points; one for an EPD and one for an HPD.

WIRELESS

In-building wireless design software tackles capacity planning

iBwave Solutions recently announced the release of its latest wireless design product suite, iBwave Release 8, which the company says "features the most comprehensive and accurate capacity planning capabilities on the market." New functionality in Release 8 identifies high-traffic hotspot zones inside venues. "The latest versions of iBwave Design and iBwave WiFi are set to revolutionize the way in-building traffic and capacity are planned today," the company proclaimed.

"The exponential growth in mobile data consumption and the end-user expectation to stay connected anywhere, anytime present a continuous challenge to system integrators and enterprise IT departments as they struggle to accurately predict and plan for traffic and capacity needs," iBwave noted when announcing Release 8. "While traditional spreadsheet-based methods offer a basic solution, they are often inaccurate and error-prone, leading to sub-optimized networks. iBwave Release 8 provides the HetNet capacity planning solutions that the industry needs as it gears up to handle the growing number of enterprise HetNet deployments. With the ability to define capacity planning requirements at both user-profile and venue levels, it is the simplest and most-accurate way to plan capacity and ensure a positive end-user experience."

Andrew von Nagy, owner of Revolution WiFi, commented, "The addition of capacity planning, integrated with iBwave's already powerful platform capabilities for 3D facility modeling and RF analysis, brings sophisticated user density and air-time demand modeling that is required to handle the increasing data consumption occurring on WiFi networks. iBwave WiFi provides telecommunications operators and carriers a unified RF design platform that serves the increasingly connected cellular and WiFi industries, and allows operators to leverage a single platform to design and deploy both networks in parallel."

Benoit Fleury, vice president of product line management for iBwave, added, "Today's enterprise success and failure depends largely on how well connected and informed its workforce is. Following extensive feedback from leading operators and integrators worldwide, iBwave has brought HetNet capacity planning to a whole new level, surpassing traditional spreadsheet methods in terms of ease and efficiency—be it for licensed, unlicensed, or a holistically integrated set of technologies." ◆

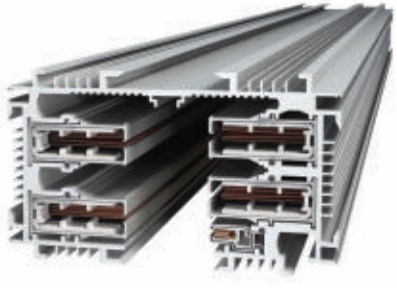
DATA CENTER POWER

Starline releases 1200-amp Starline track busway for data center, industrial environments

Starline recently introduced the 1200-amp Starline Track Busway. The latest addition to the company's line of track busway options delivers "even more power without losing any of the flexibility that Starline customers have come to rely on," the company said when introducing its largest-amperage offering.

Mark Swift, the company's director of marketing, commented, "We are excited to introduce this new design of our Starline Track Busway. With continued innovation as one of the main goals of our organization, we strive to develop and release new products that meet the increasing power and density requirements of our customers."

Like its other track busway systems, the 1200T5 1200-amp system supports mission-critical environments like data centers as well as industrial networking environments. The 1200T5 Starline Track Busway has a similar look and feel to its sibling offerings. "It uses the same patented u-shaped busbar design that creates constant tension and ensures the most reliable connection to power," the company noted. "Best of all, the same plug-in units can be used for all systems in the T5 series—from the 250-amp to the new 1200-amp. The simple



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SHOWCASE

PHYSICAL SECURITY

Arecont Vision unveils mini-panoramic surveillance cameras

Arecont Vision, a specialist in IP-based megapixel camera technology, has expanded its SurroundVideo panoramic indoor/outdoor camera series with fifth-generation models that deliver important new features in a smaller size. The compact SurroundVideo G5 Mini cameras are the latest addition to the SurroundVideo multi-sensor panoramic family. The SurroundVideo panoramic cameras provide four integrated lenses in either 180- or 360-degree configurations. The new SurroundVideo G5 Mini panoramic camera series delivers 12- or 20-megapixel (12 or 20MP) resolution at double the frame rate of previous models. The G5 Mini is also approximately 50 percent smaller than previous SurroundVideo models.

In 2006, Arecont Vision pioneered the industry's first multi-sensor panoramic megapixel cameras and has maintained its market leadership through continued innovation and development. According to the company, not only can a single, high definition SurroundVideo camera replace multiple pan-tilt-zoom (PTZ) or fixed-view cameras, but it does so while enhancing video coverage and situational awareness.

Even more important is that reducing the number of cameras through the use of SurroundVideo may lessen both project costs and complexity. Users can view each sensor of a SurroundVideo G5 Mini megapixel camera individually or cumulatively in a full 180- or 360-degree panoramic view. SurroundVideo panoramic cameras are factory-aligned with a slight image overlap as a means to ensure that nothing is ever missed in the field of view. 12MP WDR-equipped models offer up to 100dB at full resolution for an optimal image, even in extremely varied lighting conditions. SurroundVideo cameras additionally feature four individual day/night mechanical IR cut filters in order to provide the highest image quality at any time of day.

"Arecont Vision SurroundVideo multi-sensor megapixel cameras continue to be the go-to solution for knowledgeable systems integrators around the world due to the demonstrated performance, proven reliability, and outstanding cost-efficiency of the entire series," said Brad Donaldson, Arecont Vision's VP of product development. "The smaller size of the new SurroundVideo G5 Mini models, combined with double the frame rate of earlier models, will significantly benefit our customers."

The SurroundVideo series cameras also offer advanced streaming capabilities, notes the company. They are designed on the Arecont Vision highly efficient H.264 encoding platform to deliver high quality video without straining the network. Power can be supplied by either a single Power-over Ethernet (PoE) compliant network cable, or by an 18-48V DC/24V AC power supply. The camera interface allows for intuitive, fast, and easy configuration, while the convenient AV IP Utility tool enables users to quickly configure or update one or multiple cameras simultaneously.

The SurroundVideo cameras are integrated with the industry's leading video management systems (VMS) and network video recorders (NVR) through the Arecont Vision Technology Partner Program and its MegaLab testing facility and knowledge center. The result is the best-possible integration for surveillance projects; the company claims that most of its Technology Partner Program VMS/NVR members further reduce project costs by charging only a single camera license for a four-sensor SurroundVideo camera.

Made in the USA, the SurroundVideo cameras are typically mounted on walls, ceilings, rooftops, corners, light poles, and emergency call boxes. Further, the entire SurroundVideo series is subjected to, and certified by, rigorous dust, water, and impact tests while under strict manufacturing quality control. ◆

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turn-and-lock insertion of plug-in units combined with the busways continuous access slot provide endless flexibility for how end users need to lay out their operations."

The company's director of engineering, David Grafton, added, "During the design process, our main goal was to maintain the same plug-in unit compatibility and flexibility across all T5 busway systems, which we successfully accomplished with this busbar design."

The 1200-amp is available with copper/aluminum conductors and an optional ground conductor. The outer aluminum housing incorporates four data channels that are compatible with Starline's latest cable routing and management accessories. Additional accessories meant for the busway opening are also available, including access panels, restricted access points, and optional closure strip. ◆

WIRELESS

Broadcom acquiring Brocade, plans to sell off Ruckus Wireless and rest of IP networking business

Broadcom Limited agreed to acquire Brocade Communications Systems in a $5.9-billion deal, which includes the assumption of $400 million of debt.

In an announcement of the deal, Broadcom's president and chief executive officer Hock Tan said it "enhances Broadcom's position as one of the leading providers of enterprise storage connectivity solutions to OEM customers … Brocade increases our ability to address the evolving needs of our OEM customers." Broadcom plans to divest Brocade's IP networking business, which includes Ruckus Wireless as well as campus networking, data center switching and routing, and software networking businesses. Brocade acquired Ruckus Wireless for $1.2 billion in April.

"We are confident that we will find a great home for Brocade's valuable IP networking business that will best position that business for its next phase of growth," Tan added when announcing Broadcom's acquisition of Brocade.

The $5.5-billion price tag equates to $12.75 per share, which is a 47-percent premium over Brocade's closing price on Friday, October 28. Brocade's CEO Lloyd Carney said, "Our best-in-class FC SAN [Fibre Channel storage area network] solutions will help Broadcom create one of the industry's broadest portfolios for enterprise storage. We will work with Broadcom as it seeks to find a buyer for our IP networking business, which includes a full portfolio of open, hardware and software-based solutions spanning the core of the data center to the network edge."

Reporting on the deal on Wednesday, November 2, TechCrunch's Ron Miller (@ron_miller) noted, "The nature of the deal in which they are planning to sell off parts of the business will have to create a level of uncertainty among Brocade's current customer base … Ruckus Wireless … suddenly finds itself in no-man's land with no clear understanding of who its owner ultimately will be … Today's deal is expected to close in October next year, and is of course going to be subject to regulatory approval." ◆

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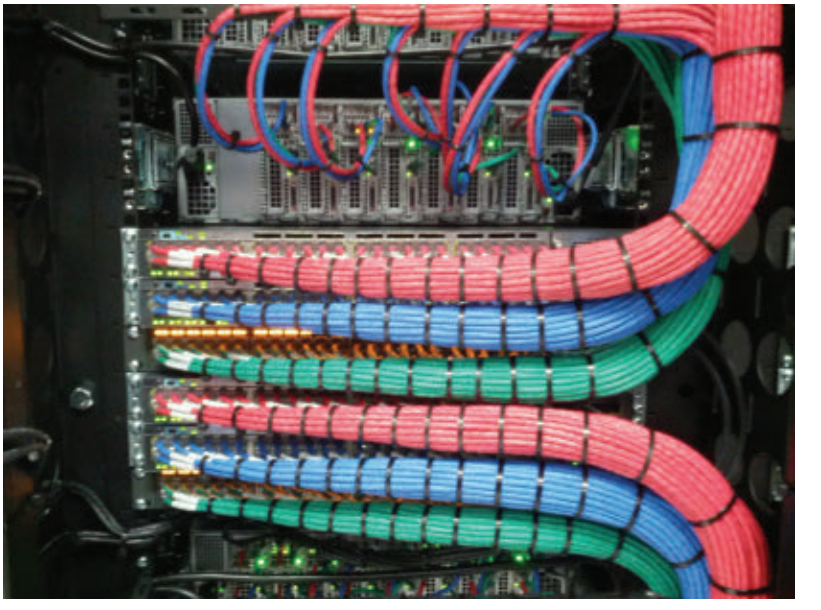
INFRASTRUCTURE INSIGHTS

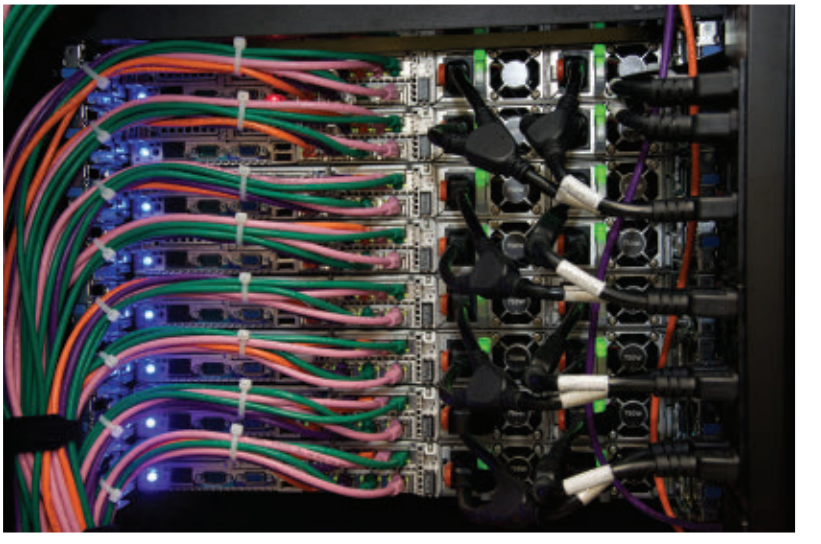
Bundles of joy

2017 is finally here and to help ring in the baby new year, we've "bundled" this pair of must-see cabling photos, both exemplifying what superior cable management can look like. The photo with the larger cable bundles is from Reddit, and the one with the smaller—but no-less-attractive—bundles is from Datcom Computer's Pinterest page.

To go with, following is a handy list of 10 "best practices" refresher points for both initial installation and daily maintenance of cable bundles within the data center. The list comes from Brocade's "Best Practices Guide: Cabling the Data Center."

1. Overbundling cables or placing multiple bundles on top of each other can degrade performance. Try to keep fiber and copper runs separated, as the weight from copper cabling can crush fiber cables that are placed beneath them.
2. Don't mount cabling components in locations that block access to other equipment within and outside of racks. Also, avoid routing cables over other patch panel ports.
3. A good rule of thumb is to keep all cable runs under 90 percent of the maximum distance supported for each media type, per relevant standards. This extra headroom will accommodate additional patch cabling to be included in the end-to-end connection.
4. Install additional cables as spares for both backbone and horizontal runs. Install higher cabling categories to futureproof for forthcoming application requirements.
5. Don't leave loose cabling on the floor; it's a safety hazard. Employ horizontal, vertical or overhead cable managers to route cables within and between racks.
6. Don't stress cables by doing any of the following: applying additional twists; pulling or stretching cables beyond specified pull load ratings; bending beyond the specified bend radius; creating tension in suspended runs; stapling or applying pressure with zip ties. Use hook-and-loop-style ties wherever possible.
7. For horizontal and backbone twisted-pair cabling, preserve the same density of twists in cable pairs up to the point of termination. Use thin and high-density cables wherever possible (per relevant standard specifications) to allow for more cable runs in tight spaces.
8. Don't mix 50-micron cables with 62.5-micron cables on a fiber-optic link.
9. As much as possible, test and label every cable as it is installed and terminated. Document all cabling components and links between components, and keep this information up to date.
10. Bundle cables together in relevant groups to ease management and troubleshooting. ◆





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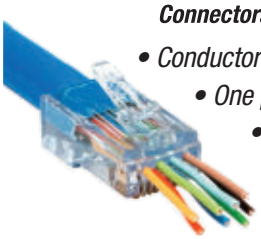

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