What You Need to Know About Power over Ethernet (PoE)

Standards and Installation Best Practices

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About Today's Presenter

Kirk Krahn, Senior Product Manager – Leviton Network Solutions .

- **12 years of experience in telecommunications industry**
- **Held a variety of roles in manufacturing and consulting firms**
- **Role at Leviton is to manage copper cable and cable assemblies product line**
- **Graduate of Bradley University and MBA from DePaul University**
- **Lives in Geneva, IL with wife and son**

What You Need to Know About PoE

Agenda

- **PoE Overview**
  - Market Drivers | The Evolution of PoE | Applications
- **Understanding PoE**
  - Managing Temperature Rise | Applicable Codes and Standards | LP Cabling and NEC
- **Canadian differences in approach**
  - The CEC perspective
- **Recommendations for PoE**
  - Design Advice | What to Consider

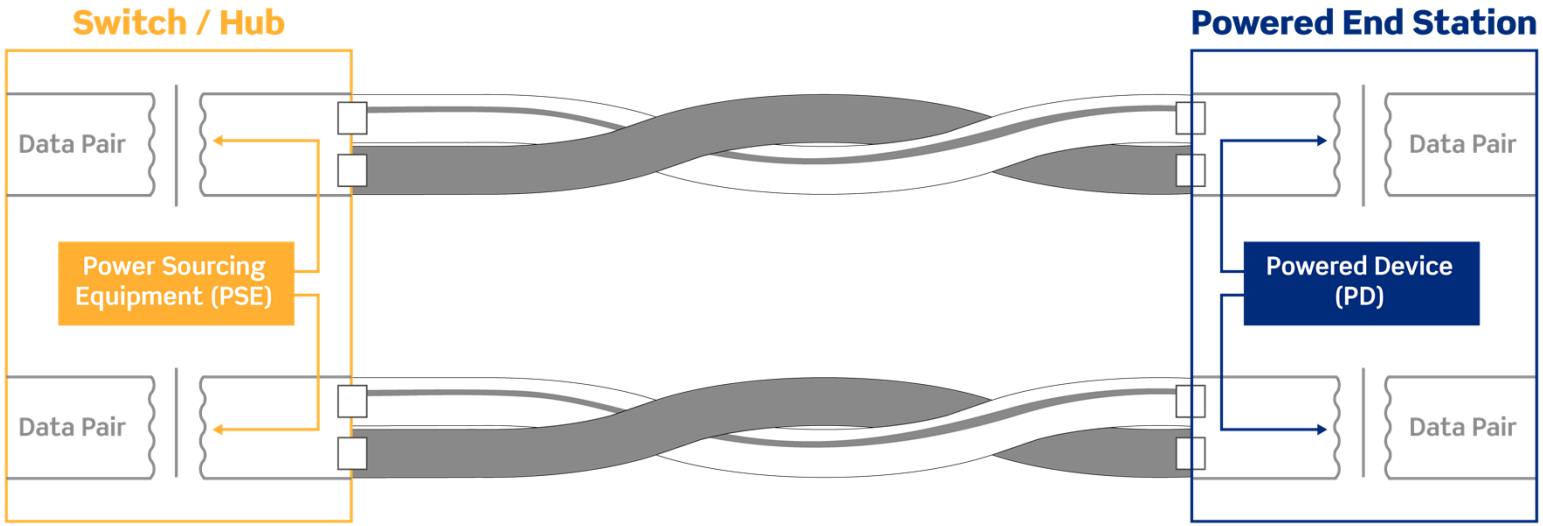
PoE Overview

Market Drivers | The Evolution of PoE | Applications

First – The Basics

What is PoE?

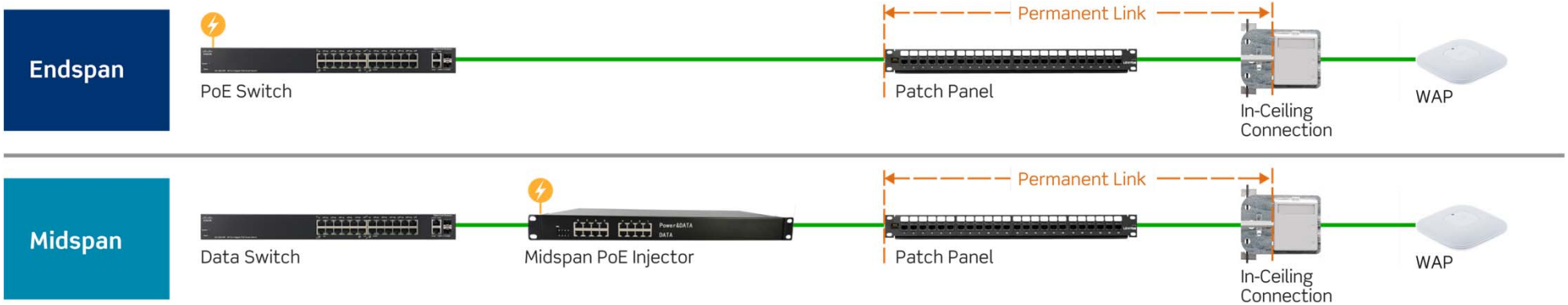
Delivery of power and data over the same twisted pair cable



Equipment

The Power in PoE

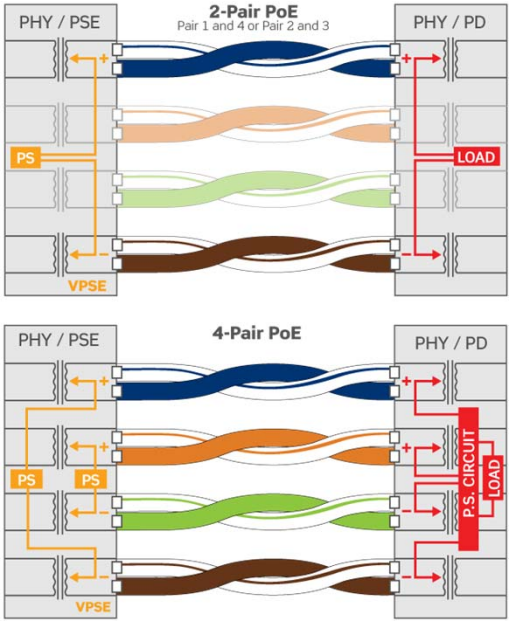
- **Two primary components:**
  - Power Sourcing Equipment (PSE)
  - Powered Device (PD)



Power and Data

Over the Same Pair Simultaneously

- **Power delivered via center tap of data transformer combining power and data**
- **Both conductors of one pair are (+) while both conductors of the other pair are (–)**
  - 2 pair PoE: pairs 1 & 4 or 2 & 3 used
  - 4 pair PoE: pairs 1 & 4, AND 2 & 3 used
- **Data "rides on top" of DC voltage – DC voltage does not interfere with data**



Market Drivers

Demand for PoE

- **Internet of Everything (IoE)**
- **RJ45 compatibility**
- **Ease of deployment**
- **Economical, centralized power backup**
- **Device mobility**

Power Over Ethernet

The Evolution – How We Got Here

- **802.3af completed in 2003**
  - 15.4W power sent = 12.95W of delivered power (Type 1)
- **802.3at PoE+ completed in 2009**
  - 30W power sent = 25.5W of delivered power (Type 2)
- **802.3bt PoE expected to be published in 2018**
  - 60W and 100W power sent

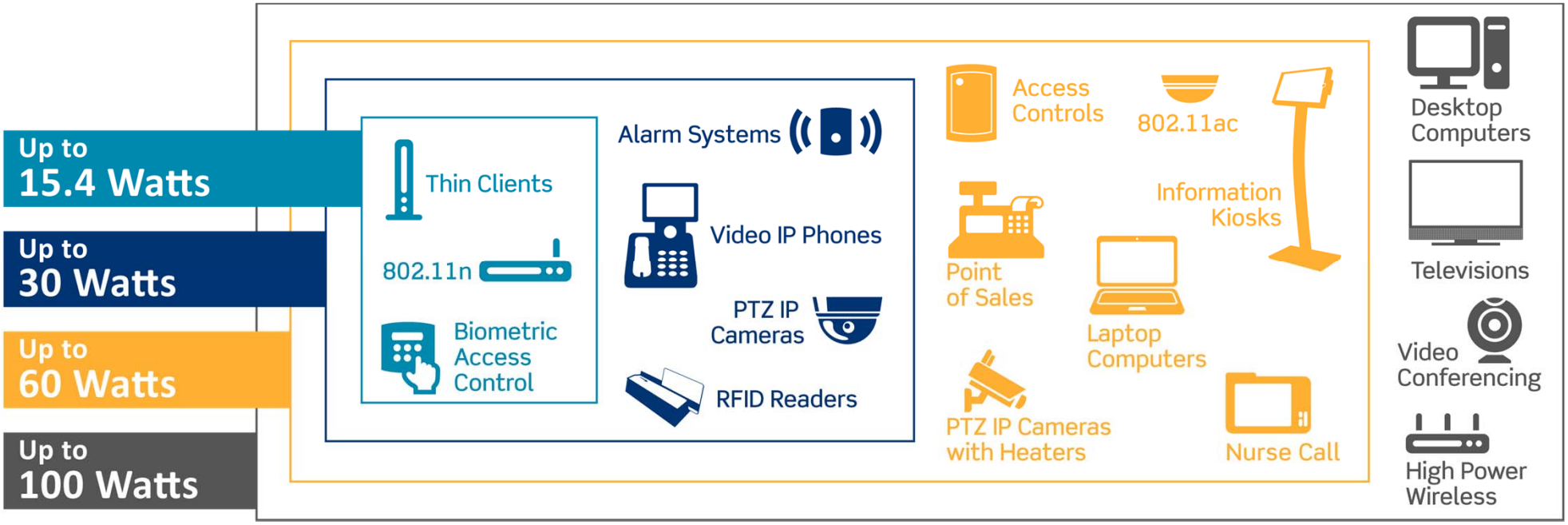
Power Over Ethernet

Higher Power and Bandwidth Driving Cat 6A Solutions

- **Next-gen devices require greater than Gigabit Ethernet**
  - Wireless access points
  - HDTV, Kiosks and IP cameras
- **Build networks with future needs in mind**

Applications

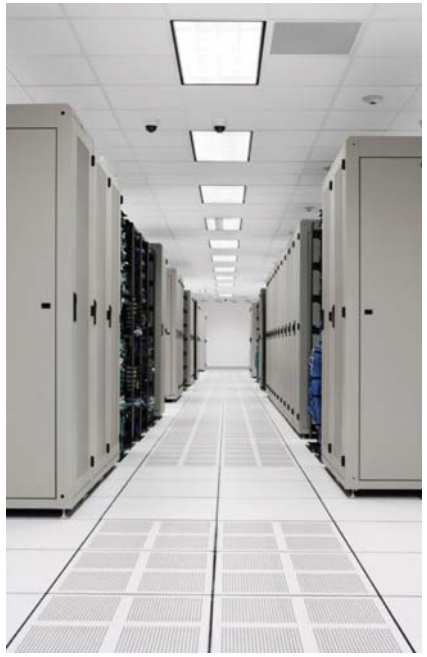
Why We Need More Power



Benefits

PoE vs. Traditional Power

- **Reduced costs**
  - One system to be installed
  - Easier to maintain and administer
  - Faster deployment of powered devices
- **Centralized control**
  - Emergency back-up power
  - Disaster recovery
  - Improved business security



Benefits Continued

PoE vs. Traditional Power

- **Safety**
  - Power applied and capacity reserved after handshake
  - Safer power levels than A/C circuit
- **Energy Efficiency and Savings**
  - Building Automation Sensors and Control
- **Flexibility**
  - Standardized power levels and Ethernet ubiquity

Understanding PoE

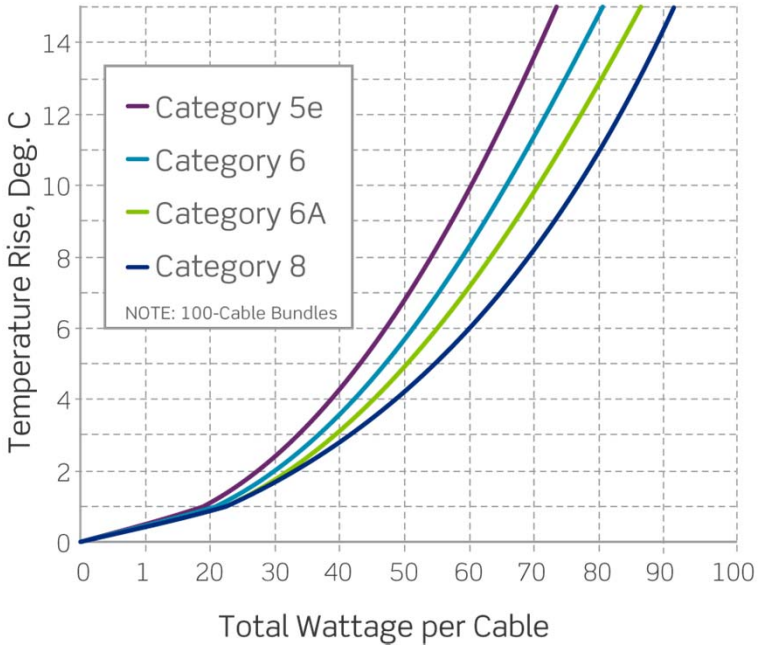
Managing Temperature Rise | Applicable Codes and Standards | LP Cabling and NEC

Excessive Temperature Rise

PoE Challenges

- **The higher the category cable, the lower the temperature rise (in general)**

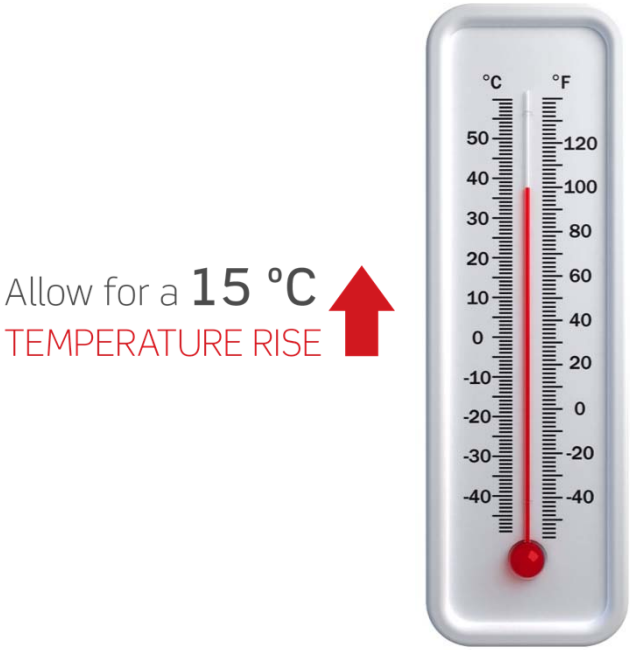
- **At levels above 60W, the heat rise for 100-cable bundles running PoE can cause:**
  - Increased insertion loss
  - Reduced performance



Next Generation PoE Challenges

Managing Heat Rise – TIA

- **TIA examined installed cabling issues**
  - TSB 184-A (now published)
  - Bundle sizes to limit temperature rise to 15 °C with a 60 °C cable
  - Assumes 45 °C ambient and power on all 4 pairs



Next Generation PoE Challenges

Managing Heat Rise – NFPA

- **National Fire Protection Agency (NFPA 70/NEC)**
  - Heat-related concerns
  - New requirements for communications cable carrying power
  - Bundle sizes limited by maximum cable temperature rating and ampacity
  - Assumes 30 °C ambient temperature

Next Generation PoE Challenges

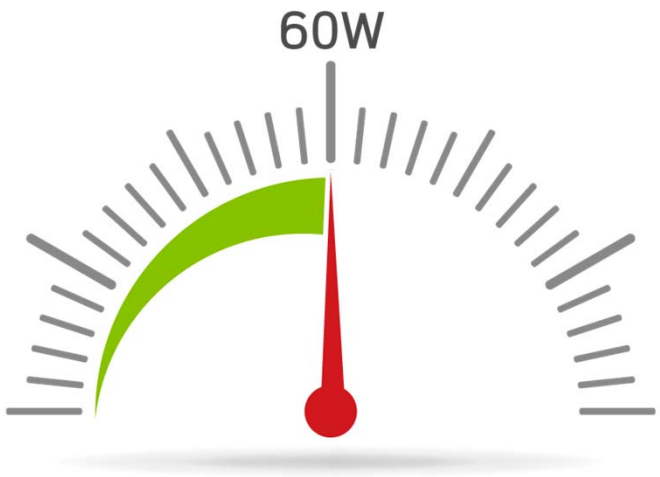
Managing Heat Rise – Canadian perspective

- **CSA Z462, Safe work practices**
  - Not a direct equivalent of NFPA 70
  - Concentrates on arc flash related concerns
- **CE Code, Electrical installation code**
  - One year behind NEC in edition
  - 2018 Edition will not contain product requirements: this is the scope of product standards
  - Very similar to NEC but contains some more stringent requirements
  - Sometimes NEC requirements cannot be bridged to CEC

NEC 2017 Code Changes

60W and Below

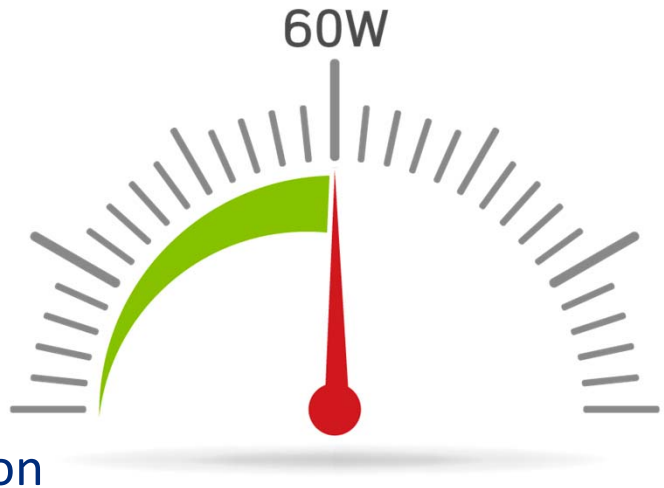
- **Adopted changes have little effect on PoE installations at 60W and below, per article 840:**
  - NEC 2017 places no new restrictions on bundle size



NEC 2017 Code Changes

Article 840 Above 60W

- **In June 2016, NFPA finalized Articles 725 and 840 (published in August 2016)**
  - New Ampacity table 725.144
    - Maximum bundle sizes
    - This table referenced in Article 840 (when above 60W)
    - Only when ambient temperature at/below 30 °C
- **Ambient temperatures above 30 °C**
  - Refer to table 310.15(B)(2)(a)
  - De-rating may impact bundle size and cable selection



NEC 2017 Code Requirements

Article 725 Table 725.144

Table 725.114, Ampacities of Each Conductor (in Amperes) in a 4-Pair Class 2 or Class 3 Data Cables, Base on Copper Conductors at Ambient Temperature of 30°C (86°F) with all Conductors in All cables Carrying Current, 60° (140°F), 75°C (167°F) and 90°C (194°F) Rated Cables

AWG	Number of 4-Pair Cables in a Bundle																				
	1			2-7			8-19			20-37			38-61			62-91			92-192		
	Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating			Temperature Rating		
	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
26	1.0	1.0	1.0	1.0	1.0	1.0	0.7	0.8	1.0	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	NA	NA	NA
24	2.0	2.0	2.0	1.0	1.4	1.6	0.8	1.0	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.8	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3.0	3.0	3.0	1.4	1.8	2.1	1.0	1.2	1.4	0.7	0.9	1.1	0.6	0.8	0.9	0.6	0.7	0.8	0.5	0.6	0.7

Note 1: For bundle sizes over 192 cables, or for conductor sizes smaller than 26 AWG, ampacities shall be permitted to be determined by qualified personnel under engineering supervision.

Note 2: Where only half of the conductors in each cable are carrying current, the values in the table shall be permitted to be increased by a factor of 1.4

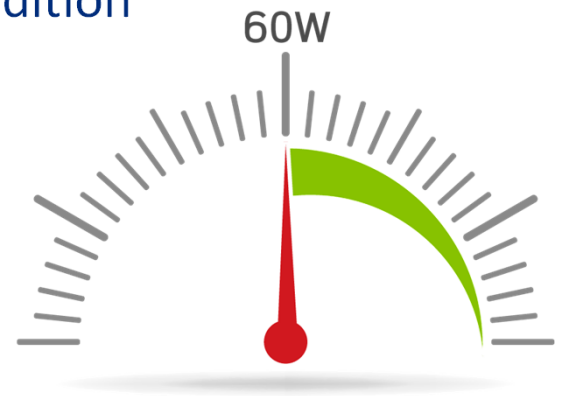
Informational Note: The conductor sizes in data cable sin wide-spread use are typically 22-26 AWG.

2017 Edition

"existing low power implementations of powering (<60 watts), such as PoE and PoE+, there is little chance of overheating the cables regardless of cable type, bundle size or installation method" UL Document

CEC 2015 Requirements for PoE

- **Next edition of CEC is 2018**
  - Proposal similar to NEC not yet submitted to CEC for 2018 edition
    - CEC will not reflect NEC until 2021!
- **Ampacity configurations different than NEC**
  - CEC has only partial configuration overlap with NEC
  - In the end , similar results but different installation
- **Ambient temperatures above 30 °C**
  - De-rating tables may impact bundle size and cable selection same as NEC



NEC 2017

LP Cabling

- **New UL optional Limited Power (LP) cable rating**
  - Alternative to table in 725.144, bundle size agnostic
  - Same 30 °C ambient temperature limitations apply
  - Above 30 °C, refer to 310.15 for cable derating

Conductor Ampacity Correction Factors for Ambient Temperatures				
Ambient Temp. °C	For ambient other than 30°C, multiply conductor allowable ampacities by factors below (NEC® Table 310.16)			Ambient Temp. °F
	60 °C	75 °C	90 °C	
21-25	1.08	1.05	1.04	70-77
26-30	1.00	1.00	1.00	78-86
31-35	0.91	0.94	0.96	87-95
36-40	0.82	0.88	0.91	96-104
41-45	0.71	0.82	0.87	105-113
46-50	0.58	0.75	0.82	114-122
51-55	0.41	0.67	0.76	123-131
56-60	—	0.58	0.71	132-140
61-70	—	0.33	0.58	141-158
71-80	—	—	0.41	159-176

2017 Edition

New UL Rating Program

What are LP-rated cables?

- **Cables are tested to assure temperature rating is not exceeded when used at the LP-rated current – 30 °C is ambient regardless of the number of cables in the bundle**

- **Cable legend to include: "…CMP-LP(0.xA)"**

New UL Rating Program

LP Cables Continued

- **x = Ampacity of the cable (A = Amps)**
  - 0.5A = 100W using 50 Volts over 4 pairs
  - 0.6A = 120W using 50 Volts over 4 pairs
  - 0.7A = 140W using 50 Volts over 4 pairs
  - LP cables are not mandated by the 2017 NEC but included as an option

- **Refer to UL.com guide information for LP-rated cable**

- **Do not forget Little "c" in front of UL mark for Canadian certification!**

2017 NEC

What happens next, what do you need to know?

- **Adopted changes have little effect on PoE applications at 60W or lower, per Article 840**
- **Impact to PoE greater than 60W are more significant**
  - New NEC was published in August 2016
  - Every state has different process/timeline for adopting codes
  - Check with local authority on PoE installation codes/requirements
  - Using LP cabling is optional, check with cable manufacturer for specific information on product capability

2017 Edition

2018 CEC

What happens next, what do you need to know?

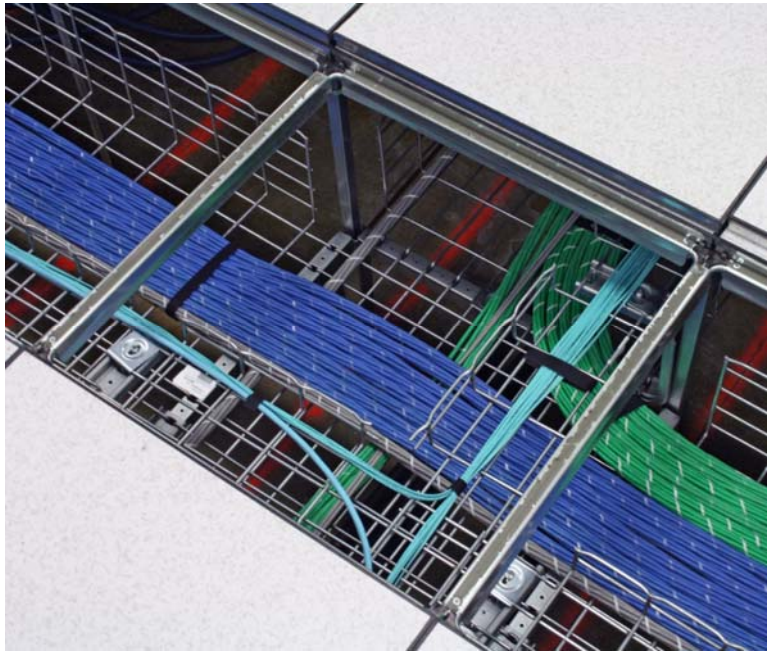
- **We have to wait for 2021 edition for full consideration of PoE by the CEC**
  - New CEC gets published at the January 2nd mark of edition year
  - Every province/territory has similar timeline for adopting CEC, usually within 6 months of new edition, with 100% adoption
  - Local authority on PoE installation requirements not covered yet by CEC may require special inspection

Recommendations for PoE Using Non-LP Cable

Design Advice | What to Consider

Design Considerations

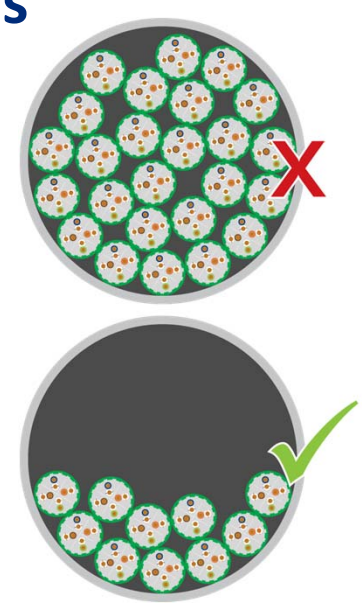
- **Reduce number of cables per bundle**
- **Use wire cable trays or similar cable management**
  - Allows for largely unrestricted airflow around the cables or cable bundles
- **Keep cables loosely bundled**



No Cramming

PoE Installation Best Practices

- **Avoid cramming or “necking down” cables into small areas**
- **Provide as large an area possible for this transition**
  - Keep transitional length as short as possible – use multiple conduits or larger conduit as needed
- **If available area is limited, loosely arrange cables on either side to help dissipate heat**



Use Cables With Higher Temperature Ratings

PoE Installation Best Practices

- **Consider using cables with higher temperature ratings**
  - Assures that cables stay below their maximum rated temperature
- **60 °C has been a very common rating for premise cables**
- **Today 70 °C and 75 °C and even 90 °C cables readily available**

Why Category 6A?

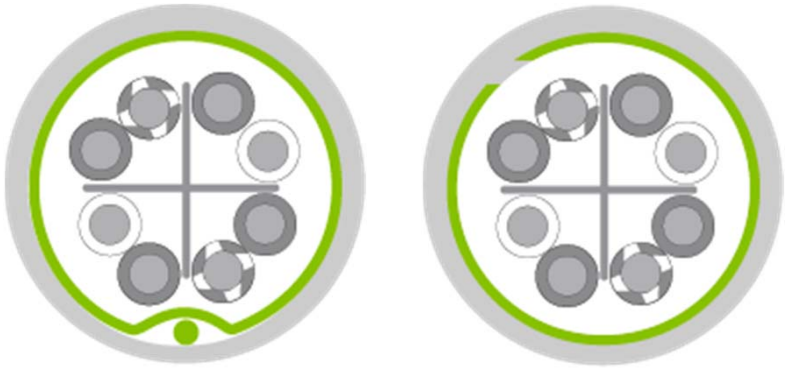
Operational Advantages

- **23 AWG conductors generate less heat than 24 AWG**
  - 23 AWG is larger in diameter than 24 AWG
  - Limits cable derating – running cooler without compromising insertion loss, enabling longer runs
  - Cooler temp maintains cable integrity and lifespan
  - Reduced OPEX, less facility cooling required
  - Improved environmental impact
- **Lower costs by supporting higher power per cable, avoiding additional bundles and trays**
- **Cat 6A delivers best performance, supports future applications**

Consider Shielded Cabling

PoE Installation Best Practices

- **Consider using a shielded cabling system, or unshielded cables with patented metallic isolation wrap**
  - Radiates heat better than traditional unshielded cables
  - Reduces the cables' temperature rise



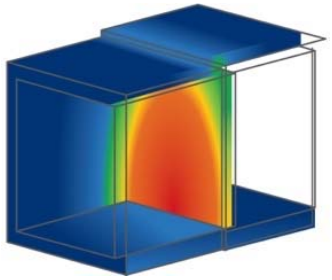
Use Metal Bodied Connectors

PoE Installation Best Practices

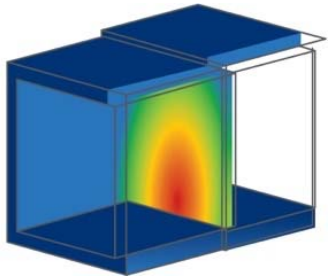
- **Shielded and solid metal bodied UTP Cat 6A connectors dissipate heat better than plastic alternatives**

Thermal simulation of connector bodies **using plastic and metal**

Plastic

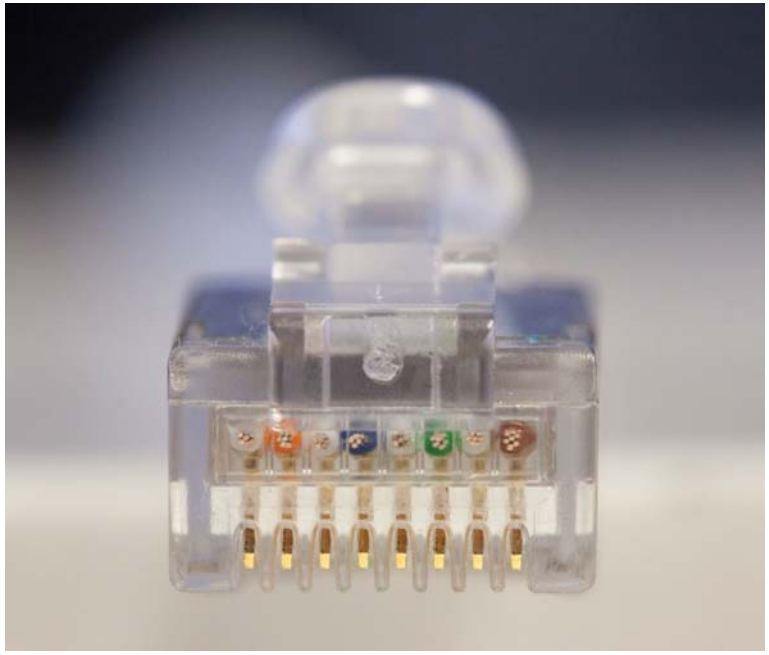


Metal



TIA-568-C.2 Compliant Patch Cords

- ANSI/TIA-1096-A requires 50 micro-inches of gold
- Arcing from disconnect under load causes pitting and wears away gold over time
- Gold plating is a big part of cord cost
- Non-compliant cords will have lower reliability when used in PoE applications



Use Category 6A Systems for New Installations

- **Solutions that meet and exceed current standards**
  - 802.3at (Type 1) = 15.5 Watts
  - 802.3at (Type 2) = 30 Watts
  - 802.3bt (Type 3) / UPOE = 60 Watts
- **Capable of meeting emerging standards, up to 100 watts**
  - 802.3bt (Type 4) / PoH = 100 Watts
- **Component-rated end-to-end system with enhanced margins for better performance and easier installation**

Conclusions

- **When designing structured cabling solutions consider both current and future possible PoE applications**
- **New applications are being developed daily**
  - PoE enabled LED Lighting
  - Cisco Digital Ceiling




Conclusions

Continued

- **High-quality connectivity and cabling is essential**
  - Use standards-based solutions designed to support emerging PoE applications

- **Be aware of any changes to local codes as they relate to PoE installations**

Thank You