“The PoE Market is Heating Up: What You Need to Know to Create a Best-In-Class PoE System”

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Why PoE?
Market Drivers

- Internet of Everything (IoE)
- RJ45 universal compatibility
- Simplicity of device deployment
- Fueling copper cabling growth
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
Benefits Continued
PoE vs. Traditional Power

• Safety
  – Auto sensing for power needed
  – Safer power levels than A/C circuit

• Energy Efficiency and Savings
  – Building Automation Sensors and Control

• Flexibility
  – Standardized power levels and Ethernet ubiquity
Power over Ethernet
The Evolution

• 802.3af completed in 2003
  – 15W 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)
• Since 2009 more new devices requiring increased power have hit the market
Applications
Why We Need More Power

- Thin Clients
- Video IP Phones
- PTZ IP Cameras
- RFID Readers
- Alarm Systems
- Access Controls
- Information Kiosks
- Point of Sales
- Laptop Computers
- PTZ IP Cameras with Heaters
- Nurse Call
- 802.11ac

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IEEE 802.3bt
Newest PoE Standard in Development

• 4-pair power delivery
  – Increases system efficiencies
  – Higher complexity

• Two power variants
  – Type 3 = 60W power sent
  – Type 4 = 100W power sent

• Support for 10GBASE-T
  – 802.11ac Wireless Access Point bandwidth
Next Generation PoE Challenges
Managing Heat Rise

• Telecommunications Industry Association (TIA) evaluating from a performance/installation practice standpoint

• National Fire Protection Agency (NFPA) evaluating heat rise from a safety/code standpoint
Managing Heat Rise

• TIA examining installed cabling issues
  – TSB 184-A under development
  – Bundle sizes to limit temperature rise to 15°C with a 60°C listed cable
  – Assumes 45°C ambient and power on all 4 pairs

  – *Note: there is no definition of what a “bundle” is*
High Power PoE and Cable Temperatures Increase

- 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:
  - Cables to operate at temperatures above their listed rating
  - Reduced performance
TIA TSB-184A
Maximum Bundle Size Recommendations
For Maximum 15°C Temperature Rise in Bundle @ 100W

Assumes cable listed to 60°C and ambient temp of 45°C and all cables are carrying power on all pairs

Cat 5e 58 Cables
Cat 6 82 Cables
Cat 6A UTP 101 Cables
Cat 8 (draft) 280 Cables

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High Quality Cables Can Perform Better Than TSB-184A*

<table>
<thead>
<tr>
<th>Example Cable Type</th>
<th>Max Number of Bundled Cables in Open Pathway Within Listed Temperature Rating</th>
<th>TSB-184A Bundle Size for 15°C Rise</th>
</tr>
</thead>
<tbody>
<tr>
<td>LANmark-6 (75°C) Cat 6</td>
<td>264</td>
<td>82</td>
</tr>
<tr>
<td>LANmark-1000 (75°C) Cat 6</td>
<td>312</td>
<td>82</td>
</tr>
<tr>
<td>LANmark-2000 (90°C) Cat 6</td>
<td>480</td>
<td>82</td>
</tr>
<tr>
<td>LANmark-XTP (90°C) Cat 6A</td>
<td>720</td>
<td>101</td>
</tr>
</tbody>
</table>

For Type 4 power @ 100W (1000mA/pair) in open tray with cable remaining within listed temperature  *TSB-184A (Draft 7.1)
To “Bundle” or Not To “Bundle”

• Bundled cables and unbundled cables in open cable tray behave very differently
• “Bundle” tests are conducted on group of cables held tightly together continuously for 6 to 8 feet – no space between cables allowed
Open Cable Tray vs. Bundles

Temperature Rise in Wire Basket Tray

Tray depth noted in legend

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Managing Heat Rise
Safety

- National Fire Protection Agency (NFPA 70/NEC) - 2017
  - Addressed heat-related safety concerns
  - New requirements for communications cable carrying power over 60W
  - Bundle size for power over 60W limited by maximum cable temperature rating and ampacity
  - Assumes 30 °C ambient temperature
Premises Powering of Communications Equipment over Communications Cables

- Article 840.160 “Where the power supplied over a communications cable to communications equipment is greater than 60 watts, communication cables and the power circuit shall comply with 725.144 where communications cables are used in place of Class 2 and Class 3 cables.”
## Cable Bundle Size Restrictions

### Ampacity Based

Table 725.144 Ampacities of Each Conductor in Amperes in 4-Pair Class 2 or Class 3 Data Cables Based on Copper Conductors at an Ambient Temperature of 30°C (86°F) with All Conductors in All Cables Carrying Current, 60°C (140°F), 75°C (167°F), and 90°C (194°F) Rated Cables

<table>
<thead>
<tr>
<th>AWG</th>
<th>Number of 4-Pair Cables in a Bundle</th>
<th>1</th>
<th>2-7</th>
<th>8-19</th>
<th>20-37</th>
<th>38-61</th>
<th>62-91</th>
<th>92-192</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>60°C</td>
<td>75°C</td>
<td>90°C</td>
<td>60°C</td>
<td>75°C</td>
<td>90°C</td>
<td>60°C</td>
<td>75°C</td>
</tr>
<tr>
<td>24</td>
<td>2</td>
<td>2</td>
<td>1.4</td>
<td>1.6</td>
<td>0.8</td>
<td>1.1</td>
<td>0.6</td>
<td>0.7</td>
</tr>
<tr>
<td>22</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>1.2</td>
<td>1.5</td>
<td>1.7</td>
<td>0.8</td>
<td>1.1</td>
</tr>
<tr>
<td>22</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1.4</td>
<td>1.8</td>
<td>2.1</td>
<td>1</td>
<td>1.2</td>
</tr>
</tbody>
</table>

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.

Ampacity of 0.5 Amperes per conductor in a 4-pair cable ≈ 100 Watts
Underwriters Laboratories
Limited Power (LP) Cable Certification Program

• New optional UL Limited Power (LP) cable marking
  – NOT a listing or listing requirement
  – Alternative to table 725.144, bundle size agnostic
  – 30 °C ambient temperature assumed
  – Above 30 °C, refer to 310.15 for ampacity de-rating
Optional Cable Certification for PoE Power

• Goal of LP rating is to indicate power capability without bundling restrictions in any “reasonable worst case”

• Cables are tested to assure temperature rating is not exceeded when used at the LP-rated current in an 8 foot 192 cable bundle enclosed in conduit
LP Certified Cable Markings

• Cable Legend to include “…CMP-LP(0.xA)”
• \( x \) = Ampacity of the cable (\( A = \text{Amps} \))
  
  - \( 0.5A = 100\text{W} \) using 50 Volts over 4 pairs
  - \( 0.6A = 120\text{W} \) using 50 Volts over 4 pairs
  - \( 0.7A = 140\text{W} \) using 50 Volts over 4 pairs
  - LP cables are not mandated by the new 2017 NEC but included as an option
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 of PoE greater than 60W has new requirements
  - 2017 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
What 100 Watt PoE Means to You

• Installers need to consider bundle size, environmental temperatures and power level

• Elimination of bundling will improve heat dissipation
  – Use of cables in open cable tray reduces thermal effect

• Code and standards work associated with PoE has addressed cables only
Connectivity Should Be Engineered to Maximize Heat Dissipation

- Patch cords that utilize an F/UTP construction dissipate heat more efficiently than solutions using standard UTP cords.
- Connectors that feature a solid metal body, dissipate heat 53% more efficiently than plastic alternatives.
Additional Connectivity Standards to Ensure Best PoE Performance

• IEC 60512-5-2 connectors for electronic equipment standard
  • Proposed Standard: Temp rise should be less than 45°C

• Good Results = Temp rise of <25°C
Additional Connectivity Standards to Ensure Best PoE Performance

- IEC 60512-99-001 connectors for electronic equipment standard
  - Proposed Standard: Minimum of 25 insertions under load with \(<20 \text{ m}\Omega\) contact resistance increase

- Good Results: >100 cycles with very little degradation in performance
PoE Arcing Damage Protection

- Contacts Designed to Retain Constant Force
  - Constant contact force at the connector/plug interface
  - Prevents inadvertent intermittent disconnects
  - Extends the life of the connectors
  - Prevents tine damage
  - Saves on costly repairs
Additional Layer of Protection Against PoE Arcing Damage

• PoE Optimized Tine Geometry
  – Prevents arcing damage in critical contact-mating zone between the plug and connector.
TIA-568-C.2 Compliant Patch Cords

- TIA-568-C.2 requires 50 micro-inches of gold
  - Pitting from disconnect under load wears away gold plating
- Gold plating on tines is a big part of patch cord cost
  - Skimping on gold is easy way to lower costs
- Non-compliant patch cords will fail over time when used in PoE applications
Recommendations for PoE
Category 6A systems for all new installations

- Solutions that meet and exceed current standards
  - 802.3at (Type 1) = 15.5 Watts
  - 802.3at (Type 2) = 30 Watts
  - UPOE = 60 Watts 802.3bt (Type 3)

- Capable of meeting emerging standards, up to 100 watts
  - 802.3bt (Type 4) / PoH = 100 Watts
Category 6A XTP/FTP Systems
Operational Advantages

• 23 AWG conductors and metallic tape/shield provide better heat dissipation
  – Reduces ampacity de-rating – running cooler without compromising insertion loss, enabling longer areas of bundling
  – Cooler temp maintains cable integrity & lifespan
  – Reduced OPEX, less facility cooling required
Thank You

Todd Harpel, RCDD