PoE, IoT, Emergency Services and Emerging Technologies

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Intelligent Building Trend

Traditional Building
- Multiple systems
- Multiple proprietary cabling types
- Multiple trades
- Multiple AC outlets

Converged Building
- Multiple building systems over a single IT cabling infrastructure
- Power and control over the same infrastructure
Agenda: Planning Your IP Infrastructure

- Structured (IP) Cabling and Market Trends
- Codes & Standards
- Power (PoE) Options & Concerns
- Cabling System Layouts for LED Lighting
IP Cabling Selection

Copper and fiber cable types for bandwidth/resolution and distance for data and power
Trending – the Move to IP Cabling

Traditional Building
Employ a vast array of different protocols and cabling systems

Converged Building
Multiple building systems over a single IT cabling infrastructure (fiber and copper)

One cable type means:
• Rapid deployment
• Reduced labor costs
Recognized Horizontal Cables

The following types of horizontal cables are recognized in TIA Standards

- Four-pair 100Ω balanced twisted-pair
- Two-core (two strand) OM1, OM2, OM3, OM4 and OM5 multimode optical fiber
- Two-core OS1 & OS2 single mode optical fiber
Balanced Twisted Pair Copper Cable Types

Category 3 (voice only), 5e, 6, 6A

U/UTP (UTP)

F/UTP

Category 7, 7A, 8

S/FTP
## Copper Performance Categories

<table>
<thead>
<tr>
<th>Components (cable and connecting hardware)</th>
<th>Bandwidth (Characterization Frequency)</th>
<th>Maximum Recommended Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO/IEC</td>
<td>ANSI/TIA</td>
<td></td>
</tr>
<tr>
<td>Category 3</td>
<td>Category 3</td>
<td>16 MHz</td>
</tr>
<tr>
<td>Category 5</td>
<td>Category 5e</td>
<td>100 MHz</td>
</tr>
<tr>
<td>Category 6</td>
<td>Category 6</td>
<td>250 MHz</td>
</tr>
<tr>
<td>Category 6(_A)</td>
<td>Category 6A</td>
<td>500 MHz</td>
</tr>
<tr>
<td>Category 7</td>
<td>--</td>
<td>600 MHz</td>
</tr>
<tr>
<td>Category 7(_A)</td>
<td>--</td>
<td>1000 MHz</td>
</tr>
<tr>
<td>Category 8.1</td>
<td>Category 8</td>
<td>2 GHz</td>
</tr>
<tr>
<td>Category 8.2</td>
<td>--</td>
<td>2 GHz</td>
</tr>
</tbody>
</table>

Optical Fiber Types

- **OM1, OM2** (62.5µm) - Multimode
- **OM3, OM4** (50µm) - Multimode
- **OS1a, OS2** (9µm) - Singlemode

**Multimode**

**Singlemode**
### Features & Benefits

<table>
<thead>
<tr>
<th></th>
<th>Copper</th>
<th>Fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bandwidth</strong></td>
<td>Category 6 – 250 MHz</td>
<td>OM3 – up to 1500 MHz/km(^1)</td>
</tr>
<tr>
<td></td>
<td>Category 6A – 500 MHz</td>
<td>OM4 – up to 3500 MHz/km(^1)</td>
</tr>
<tr>
<td></td>
<td>Category 7A – 1000 MHz</td>
<td>Singlemode - unlimited</td>
</tr>
<tr>
<td><strong>Distance</strong></td>
<td>100 m (90m of horizontal cable; 10m of patch cables)</td>
<td>Multimode – Up to 2km(^2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Singlemode - Up to 40km(^2)</td>
</tr>
<tr>
<td><strong>Applications</strong></td>
<td>Data and PoE (Power over Ethernet)</td>
<td>Data only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Power can be achieved through a hybrid cable with media converters)</td>
</tr>
<tr>
<td><strong>Termination</strong></td>
<td>RJ45 field termination</td>
<td>Factory terminated (trunks) or Requires trained/skilled labor for field termination</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>$ - Most cost effective cable and connectivity</td>
<td>Multimode cable - $$$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Singlemode cable - $$</td>
</tr>
</tbody>
</table>
|                  |                                                      | Electronics/Transceivers - $$$$

\(^1\)Minimum Overfilled Modal Bandwidth at 850nm wavelength

\(^2\)Application and fiber type dependent
Codes and Standards

Resources to help with your infrastructure design
Meeting Applicable Codes & Standards

• ANSI/TIA-862-B “Structured Cabling Infrastructure Standard for Intelligent Building Systems”

• ISO/IEC 11801 part 6 “Distributed Building Services”


• NEC 2017 Code
Copper Media Selection

• TIA TSB-184-A-2017
  • Category 6A recommended

• TIA-862-B-2017
  • Category 6; category 6A recommended

• ISO/IEC 11801-6 Ed1.0
  • Class $E_A$ or higher

• BICSI 007-2017
  • Category 6A/Class $E_A$ or higher recommended
ANSI/TIA-862-B-2016

- Structured Cabling Infrastructure Standard for Intelligent Building Systems
- General substitution of the term “intelligent building system” for the previous term “building automation system”
- Addition of guidance for cabling for:
  - Wireless systems
  - Remote powering over balanced twisted-pair cabling
  - Smart lighting
ANSI/TIA-862-B-2016 Horizontal Topology Options
ANSI/BICSI-007-2017: ICT Design for Intelligent Buildings

Integrating Applications on ICT Network

- Communications Infrastructure & Network Integration
- Design Considerations (Power, Data, Zone Cabling)
- Building Systems (Lighting, Digital Signage, Vertical Transportation, Sound Systems, ESS, etc.)
- Building Monitoring Systems
- Commissioning
Designing a Telecom Room that Supports Multiple Systems

Wireless Device Systems

Future Racks and Systems

Wall-Mounted Systems

Specialty Systems

Core Network
Dual TRs that Provides Restricted Access to the Core Network

Critical/Sensitive Information Systems

Restricted Access
BICSI 007: Horizontal Cabling Elements

Direct Connection Method
Non-structured option
Modular Plug Terminated Link (MPTL)

• The MPTL is constructed by direct field termination of horizontal cabling at the device end with a modular plug - replacing the TO/SO and associated Work Area (WA) cord.

• TIA-568.2-E requires that horizontal cable be terminated onto a TO. In certain cases there may be a need to terminate horizontal cables directly to a plug.

• BICSI-007 recognizes the MPTL and refers to it as a direct connection method, with or without an HCP
MPTL/Direct Connect Applications

- IoT and Intelligent Buildings driving the proliferation of IP-based and PoE-based devices in the walls and ceilings of modern buildings
Zone Cabling/HCP (Horizontal Consolidation Point)

- Zone cabling is a standards-based approach to support convergence of devices
- Consists of cables run from connections in the telecommunications room (TR) to outlets housed in a zone enclosure servicing coverage areas
- Shorter cables run from outlets in the zone enclosure directly to devices or to outlets servicing devices

- 25% spare port availability recommended for best ROI
- Supports rapid reorganization and deployment of new devices and applications
- MAC work costs less, is faster and less disruptive
- Factory pre-terminated and tested trunking cables can be installed from the TR to the zone enclosure for quicker deployment
Power over Ethernet
Running parallel power over the data cabling
## Existing IEEE PoE Applications

<table>
<thead>
<tr>
<th>PoE Application</th>
<th>Minimum Power at PSE Output</th>
<th>Number of Pairs</th>
<th>Maximum Current Per Pair (Per Conductor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power over Ethernet (Type 1)</td>
<td>15.4 W</td>
<td>2-pairs</td>
<td>350 mA (.17 Amp)</td>
</tr>
<tr>
<td>Power over Ethernet Plus (Type 2)</td>
<td>30.0 W</td>
<td>2-pairs</td>
<td>600 mA (.3 Amp)</td>
</tr>
<tr>
<td>4-pair PoE (Type 3)</td>
<td>60.0 W</td>
<td>4-pairs</td>
<td>600 mA (.3 Amp)</td>
</tr>
<tr>
<td>4-pair PoE (Type 4)</td>
<td>90.0 W</td>
<td>4-pairs</td>
<td>960 mA (.48 Amp)</td>
</tr>
<tr>
<td>Power over HDBase-T (POH)</td>
<td>100.0 W</td>
<td>4-pairs</td>
<td>960 mA (.48 Amp)</td>
</tr>
</tbody>
</table>
Temperature Rise Considerations

• Heat builds up within cable bundles:
  • Cabling insertion loss increases at temperatures above 20°C/68°F
  • The temperature of any cable should not exceed the temperature rating for the cable
  • Cables with higher temperature ratings are listed and marked accordingly

• Contact arcing occurs when un-mating pairs under load and may affect connecting hardware reliability
Pathway Capacity

• Maximum pathway (cable tray/wireway) capacity shall not exceed a calculated fill ratio of 50% to a maximum of 150 mm (6 in) inside depth.

• But what happens when powered cables heat up in bundles?
Temperature Rise vs. Current in 100 Cable Bundle

![Graph showing temperature rise vs. current for different cable types.]

- Type 1
- Type 2/3
- Type 4

**Cables**
- Category 5e
- Category 6
- Category 6A UTP
- Category 6A F/UTP
- Category 6A UTP, slim profile
- Category 7A S/FTP
Resources for Cabling Heat Concerns

- NFPA 70 (2017 NEC)
- TIA TSB-184-A-2017
- TIA-569-D-2-2018
2017 NEC Code Revisions

- Cable Ratings and Markings for Safety
- Ampacity Table for Bundles

Part VI. Premises Powering of Communications Equipment over Communications Cables

840.160 Powering Circuits. Communications cables, in addition in carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment. 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.
2017 NEC Table 725.144

- Conductor gauge, bundle size and temperature rating are used to establish a safe power rating (Ampacity) for each conductor.

<table>
<thead>
<tr>
<th>AWG</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></td>
<td>Temp Rating</td>
<td>Temp Rating</td>
<td>Temp Rating</td>
<td>Temp Rating</td>
<td>Temp Rating</td>
<td>Temp Rating</td>
<td>Temp Rating</td>
</tr>
<tr>
<td></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>
</tr>
<tr>
<td>26</td>
<td>1.1</td>
<td>0.7</td>
<td>0.8</td>
<td>0.5</td>
<td>0.5</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>24</td>
<td>2</td>
<td>1.4</td>
<td>1.6</td>
<td>0.8</td>
<td>1</td>
<td>1.1</td>
<td>0.6</td>
</tr>
<tr>
<td>23</td>
<td>2.5</td>
<td>1.2</td>
<td>1.5</td>
<td>0.7</td>
<td>1.1</td>
<td>1.2</td>
<td>0.6</td>
</tr>
<tr>
<td>22</td>
<td>3</td>
<td>1.4</td>
<td>1.8</td>
<td>2.1</td>
<td>1</td>
<td>1.2</td>
<td>1.4</td>
</tr>
</tbody>
</table>
Example: Can this cable support Type 4 PoE?

- 24 AWG category 5e cable
- Bundle size of 75 cables
- Mechanically rated to 60°C (Operating Temperature)
TIA-569-D-2-2018

Additional Pathway and Space Considerations for Supporting Remote Powering Over Balanced Twisted-Pair Cabling (July 2018)

• Pathways differ in regard to geometry and contact area between cables, pathway, and air
• Provides general guidance on heat dissipation of various pathways by bundle size
<table>
<thead>
<tr>
<th>Pathway Type</th>
<th>Cable Routing</th>
<th>Cable Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1-37</td>
</tr>
<tr>
<td>Non-continuous</td>
<td>Bundled</td>
<td>High</td>
</tr>
<tr>
<td>Unbundled</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Conduit (Metallic &amp; Non-metallic)</td>
<td>Bundled</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Unbundled</td>
<td>Medium</td>
</tr>
<tr>
<td>Sealed Conduit</td>
<td>Bundled</td>
<td>Low</td>
</tr>
<tr>
<td>Unbundled</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>
# TIA-569-D-2-2018: Cable Tray

<table>
<thead>
<tr>
<th>Tray Type</th>
<th>Fill Depth (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Wire Mesh/Ladder</td>
<td>High</td>
</tr>
<tr>
<td>Ventilated</td>
<td>High</td>
</tr>
<tr>
<td>Unventilated</td>
<td>Medium</td>
</tr>
</tbody>
</table>
Mitigation Recommendations

- Use Category 6A or higher-performing 4-pair twisted-pair cabling, or larger AWG or shielded cables
- Reduce channel length, as necessary, to offset increased insertion loss
- Use open wire tray or similar cable management that provides for largely unrestricted airflow around the installed cables
- Mix unpowered cables with powered cables
- Reduce bundle size (24) and allow space between bundles
Potential for arcing under load conditions

• “Unmating under load” produces an arc as the applied current transitions from flowing through conductive metal to air before becoming an open circuit

• Remote powering applications offer some protection to these critical connection points by ensuring that dc power is not applied over the structured cabling plant until a PD is sensed by the PSE

• Connecting hardware should be qualified for mating and unmating under electrical power load. IEC 60512-99-001 is referenced as a suitable test schedule
Cable Layout Options for LED Lighting

Different cable layouts
Cabling Layout Selection based on Active Equipment
Node Centric vs. Fixture Centric

**Fixture Centric**
- One to One
- More Powered Ports
- More Costly

**Node Centric**
- One to Many
- Less Powered Ports
- Less Expensive

*Where N fixture(s) power requirements are less than the supplied PoE power*
Typical PoE LED Lighting System

- Building System Dashboard
- Control Platform
- Remote Interface / Tech Support
- User Interface
- Wireless Router
- Interactive Video Board
- User Interface
- Network
- Linear Light Fixture
- PoE Gateway/Node
- LED Fixtures (linked in serial)
- Sensor
- Room Sensors
- Wall Interface
- LED Light Fixture
- LED Light Fixture
- LED Light Fixture
Example: Centralized Cabling – Fixture Centric
Example: Centralized Cabling – Zone Fixture Centric
Example: Centralized Cabling – Node Centric
Example: De-centralized – Zone Node Centric
Making the transition to Fire Alarms

• Today PoE for LED Lighting – tomorrow, powering an entire Fire Alarm System?

• Challenges with PoE
Emergency Services

• Where and how is technology currently being used?
Emerging Technologies

• Constantly Changing
• AHJ Approval
• Proof Of Concept
• Looking towards the future…..
Key Takeaways:
Planning Your Infrastructure for Intelligent Buildings

• Familiarize with the codes and standards
• Power and data will co-exist, but can create cabling & pathway challenges
• Zone cabling provides a flexible infrastructure
• Direct connection (MPTL) now acceptable at the device end
• Understand the requirements of the specific applications, requirements and locations before planning the cable infrastructure
• Infrastructure needs to be incorporated at the beginning of the building planning stage
Thank You

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