PoE Lighting: Unleashing IoT and Opportunity in the ICT Industry

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There’s a Revolution Happening in Our Buildings!

- Traditional building communication use a vast array of different protocols and cabling systems
  - Difficult to administrate with extensive inventory requirements
  - Different departments working autonomously with disparate networks, software, servers and support
  - Each system requiring dedicated power, infrastructure, operation and maintenance
- Buying multiple networks in the same building to perform the same basic functions = wasted dollars for redundant servers, switches, cable and conduit
- Siloes inhibit or prevent interoperability
Moving Towards IP Convergence
Multiple IP Systems Over a Single Infrastructure

- Consolidates cabling and reduces unnecessary pathways and material cost
- Reduces subcontractors and labor costs
- Universal connectivity and cabling means less costly moves, adds and changes
- Power and control over one infrastructure
  - PoE cuts power delivery costs by 75%
- Enables integrated systems to improve building control, management and security
  - Can lower energy consumption by up to 50%
- Improves overall customer and employee satisfaction, engagement and retention
- Increases employee productivity via improved comfort, air quality and lighting

Lighting
Voice/data
Wireless
Video surveillance
Access control
Audio/video
Fire alarms/safety
Energy management
HVAC
Digital signage
DAS
PoE Lighting is One of the Biggest Opportunities in the ICT Industry

- Connects via common category twisted-pair cabling
- Average number of devices per 10,000 sq. feet is 115
- Safe extra-low voltage (SELV) application with no safety risk
- Provides strategic placement for advanced sensor technologies and other devices (e.g. speakers)
- Supports future Li-Fi where wireless data is sent via light beams
- Can receive centralized back-up power from the telecom room
- LED technology supports different colors to indicate different status for security purposes or aesthetics
Cost Savings with PoE Lighting

**Traditional AC Lighting**
- Conduit, wire and a back box for each
- Electrician wage rates
- Electrical code
- ~ $1,000 per light

**PoE Connected Lighting**
- Safe low-voltage installation with cabling and connectors
- Cabling contractor wage rates
- Established cabling standards
- ~ $250 per light
10-Year TCO - $USD (per fixture basis)

Factors driving lower TCO
- Lower installation costs
- Incremental energy savings
- Future PoE light fixtures will cost less

TCO expected to improve
- LED price/performance increase 20% per year
- LED luminosity efficiency will continue to improve

*US NYC customer, 35K Sq Ft space
Proven Savings

CompuCom 151,000 sq ft. global headquarters in Charlotte, NC

- 16% less expensive to operate
- Fully integrated building systems with IoT analytics
- Exclusively powered by PoE with only PoE lighting
  - Saved $275,000 in electrical labor
- Integrated occupancy and daylight harvesting sensors and natural light “mimicking” technology
  - Maintains circadian rhythms and improve productivity and satisfaction
- PoE lighting is programmed to flash and change color in the event of an emergency
- Eliminated batteries in sensors, alarms and emergency exit signs for reduced TCO
More Cost-Saving Examples!

50,000 sq. ft. manufacturing space with 700 lights = $202,750 savings
  • $25 saved per light for a total of $17,500
  • $185,250 saved for PoE structured cabling system vs. traditional AC power

23,000 sq. ft Erie, PA fully integrated intelligent office building = $490,637 savings
  • Hard-wire/integrate 8 disparate systems = $970,937
  • Converged systems = $480,300
  • Systems included: HVAC, LV lighting (Infrastructure, controls, reduction of circuit breakers, reduction of conduit), generators, UPS, elevator, access control, utility meters and fire life safety
  • Possible additional integration and savings: IP video, PoE Computers, clocks, CCTV, time and attendance, battery charges for phones and PDAs, vending machines, point of sale (PoS) and additional HVAC controllers
PoE Lighting

Power over Ethernet lighting uses optimized LED fixtures that are both *Powered & Controlled* via a simple category cable.
PoE - Data and POWER!

- IEEE 802.3af (PoE)
  - 2003
  - 15.4W, 13W

- IEEE 802.3at (PoE+)
  - 2009
  - 30W, 25.5W

- Cisco (UPOE Prestandard)
  - 2014
  - Four-Pair: 60W, 51W

- IEEE 802.3bt (PoE++, 4PPoE)
  - 2018
  - Four-Pair: 60W, 51W
  - Four-Pair: 90W, 71.3W

![PoE Power Chart]
Node Centric – Max Power!

**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
Node Centric

Node Centric : UPOE
- 2x Troffer (23W)
- 1x Node, Wall Switch & Sensor (3W)

4 Devices
49 Watts
Node Centric

Node Centric : UPOE
- 3x RGB Downlights (11W)
- 1x White Downlight (8W)
- 1x Node, Wall Switch & Sensor (3W)

6 Devices
44 Watts
Node Centric : UPOE
- 6x White Downlight (8W)
- 1x Node, Wall Switch & Sensor (3W)

8 Devices
51 Watts
Maturing Systems – Fixtures

Power Over Ethernet (PoE)
Low-Voltage, Direct Current & Wired (Ethernet)

LED Driver

LED Light

Classifications: UL 1598 (Luminaires) : UL 2108 (Low Voltage Lighting Systems) : UL 8750 (LED Equipment)
Building Requirements for Buildings

ASHRAE 90.1
IECC 2015
CEC - Title 24

Occupancy
Vacancy
Daylight Harvesting
Load Control
On Demand Response
Software Enabled - Features

- Tunable Light
- Motion Sensor
- Wall Switch
- 3rd Party Integration
- Light Sensor
- Notification Light
- Power Sensor
- Task Light
Auto On, Auto Off

Vacancy
Manual ON/Auto OFF

Occupancy
Auto ON/Auto OFF
Daylight Harvesting

1. The lamp lights on 100% illumination or dims to maintain the preset illumination level against ambient light.
2. The lamp dims to minimum light level but never turn off even if with sufficient ambient light.
3. Users can switch off the light manually.
Low Trim, High Trim - Layered

No motion detected, the lamp remains at a low light level all the time.

When motion is detected, the sensor brightens the lamp to 100% illumination.

After the hold time, the sensor dims the lamp at the preset low light level if no motion is detected.
Rhythm
Data - BiDirectional

Office: Tuesday, August 15, 2017
Power Usage (mW)

Front Entry: Thursday, February 21, 2018
Motion Detection
More than Just Lighting

**Financial Sense**
CAPEX & OPEX Savings

**Environmental Sense**
Maximum Sustainability

**Personnel Sense**
Health and Wellness

**Business Sense**
Impacts all Cost Centers
Cabling for PoE Lighting

Dave Valentukonis, RCDD/NTS

Siemon
Infrastructure Challenges

• Network Design Decisions
  • Centralized vs. Decentralized
  • Zone Cabling Layout vs. Point to Point

• Application Criteria
  • Node vs. Fixture

• Cable Type
  • Distance, Bandwidth, Power

• Power Options & Considerations

• Outlet Configuration
  • Structured Cabling vs. MPTL
Implications of Remote Powering

1. Cable
   - Heat builds-up within cable bundles
   - Bundle sizes may need to be reduced to improve heat dissipation
   - Overall channel length may need to be reduced to offset increased insertion loss resulting from a higher operating temperature

2. Connectivity
   - Contact arcing occurs when un-mating pairs under load and may affect connecting hardware reliability
Applicable Standards

- **TIA TSB-184-A-2017**
  - Guidelines for Supporting Power Delivery over Balanced Twisted-Pair Cabling

- **ANSI/TIA-862-B**
  - Structured Cabling Infrastructure Standard for Intelligent Building Systems

- **BICSI 007-2017**
  - Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises
Category 6A or higher performance 4-pair balanced twisted-pair cabling is recommended for new installations delivering remote power. Larger conductor sizes and shields reduce DC loop resistance and improve both energy consumption and heat dissipation. The maximum ambient temperature along the link (length of at least 1m) should be used as the basis for the calculation.
Mitigation Recommendations

- Use Category 6A or higher-performing 4-pair balanced twisted-pair cabling
- Install shielded cables
- Reduce channel length, as necessary, to offset increased insertion loss
- Minimize cable lengths in order to reduce dc loop resistance

<table>
<thead>
<tr>
<th>AWG</th>
<th>Ohms/100m (solid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>7.32</td>
</tr>
<tr>
<td>24</td>
<td>9.38</td>
</tr>
<tr>
<td>26</td>
<td>14.8</td>
</tr>
</tbody>
</table>
Mitigation Recommendations

- Leave cables unbundled
  - If bundling, smaller bundles are recommended

- Limit the number of cables per bundle to 24
Mitigation Recommendations

• Use open wire tray or similar cable management that provides for largely unrestricted airflow around the installed cables
  • Disperse cables evenly across the width of the tray

• Reduce maximum operating temperature

• Mix unpowered cables with powered cables
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>1-37</th>
<th>38-61</th>
<th>62-91</th>
<th>&gt; 91</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-continuous</td>
<td>Bundled</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Unbundled</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>N/A</td>
</tr>
<tr>
<td>Conduit (Metallic &amp; Non-metallic)</td>
<td>Bundled</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Unbundled</td>
<td>Medium</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Sealed Conduit</td>
<td>Bundled</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Unbundled</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

<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>
ANSI/BICSI 007-2017

- Technology Design and Implementation Practices for Intelligent Buildings and Premises
- 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
ANSI/TIA-862-B-2016

• *Structured Cabling Infrastructure Standard for Intelligent Building Systems*
  - Formerly known as Building Automation 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 Topology Options

Standard

Zone Cabling
## Terminology

<table>
<thead>
<tr>
<th>Location/Device</th>
<th>TIA Standard</th>
<th>Terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate connection location in a zone cabling topology supporting a voice/data device</td>
<td>ANSI/TIA-568-0.D</td>
<td>Consolidation Point (CP)</td>
</tr>
<tr>
<td>Outlet connecting to a voice/data device</td>
<td>ANSI/TIA-568-0.D</td>
<td>Telecommunications Outlet (TO)¹</td>
</tr>
<tr>
<td>Intermediate connection location in a zone cabling topology supporting a building device</td>
<td>ANSI/TIA-862-B</td>
<td>Horizontal Consolidation Point (HCP)</td>
</tr>
<tr>
<td>Outlet connecting to a building device</td>
<td>ANSI/TIA-862-B</td>
<td>Equipment Outlet (EO)²</td>
</tr>
</tbody>
</table>

¹ A TO must always be present even if a CP is present
² An EO is optional if an HCP is present
Media Selection

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

• BICSI 007-2017
  • Category 6A recommended

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

• TIA TSB-184-A-2017
  • Category 6A recommended
Benefits of Shielded Cabling

• Typically qualified for higher temperature (75°C) operation

• Reduced length de-rating

• Superior heat dissipation supporting larger bundle sizes
What is Zone Cabling?

Zone cabling supports convergence of data and voice networks, wireless (Wi-Fi) device uplink connections, and a wide range of sensors, control panels, and detectors for lighting, security, and other building communications.
Zone Cabling Methodology

- 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.

- Creates a flexible, “futureproof” infrastructure for voice, data, building devices, and wireless access points.
- Supports rapid reorganization and deployment of new devices and applications.
- MAC work costs less, is faster and less disruptive.
- Improved pathway utilization.
Centralized – Fixture Centric
Centralized – Node Centric
Centralized Zone - Fixture Centric
Centralized Zone – Node Centric
De-centralized – Fixture Centric
De-centralized – Node Centric
Decentralized Zone – Fixture Centric
Decentralized Zone – Node Centric
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.
- ANSI/TIA-568.2-D 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.
- ANSI/BICSI-007 recognizes the MPTL and refers to it as a direct connection method, with or without an HCP.
- ANSI/TIA-862-B-2016 recognizes direct connections – should be limited to devices in fixed locations that are not expected to be replaced or required to be directly connected by the AHJ.
What are the Benefits of an MPTL?

• Custom length, quick connections in the field for direction connection to devices
  • Ideal for a zone cabling design methodology
  • Can be plugged into the zone enclosure on one end and terminated to outlets on the other end for computers, phones, etc.
  • Simplifies project bill of materials and eliminates the need for predetermined patch cord lengths

• Improves performance and allows for more efficient power delivery by eliminating patch cords and outlets

• Improves security for devices like surveillance cameras by eliminating exposed patch cords
Plenum Products
Summary

- Remote powering places increased demands on network cabling systems
- Zone cabling provides a flexible infrastructure
- Be aware of the various topologies based upon PoE lighting technologies
- Modular plug terminations have a role
Thank You

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