Digital Building and the PoE evolution

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IP Convergence for Digital Building Technologies

- Sensing
- Ventilation
- Lighting
- BACnet
- Coax
- PBX

1995
2005
Late 2000s
2010
2015

Data Network

IP Telephony
IP Cameras
Building Management Systems using low-voltage PoE
IP Building Systems on low-voltage PoE

Cloud Management and Analytics

Experiences

OpEx
Building management impact

- **Safe** Low Voltage
- Moves, Adds & Changes without turning circuit power off
- **Common cabling** system
- Potential **energy savings**
What is a Digital Ceiling

- Wireless Access Points
- Security cameras
- Speakers
- Clocks
- Signage
- Life safety systems
- Lighting
Intelligent lighting transforms the Enterprise

- LED technology
- Sense **occupancy**
- Control individual light levels
  - adapt to ambient
- Control **colour temperature**
  - Improve mood & productivity
“The possibilities of this connected lighting system are endless. There are so many capabilities of this system that we haven’t even explored yet.”

Richard Lees, Senior Project Manager at CBRE Limited, a commercial real estate and investment services firm

- Digital ceiling implementation
- **Converged** network
  - HVAC
  - LED Lighting
  - Access control
  - Metering
  - Security cameras
- **Green** certification
- **Lower CapEx** (10%)
- **Lower OpEx** (600k PA)
PoE lighting adoption

- Intel research campus - **Bangalore**
- Torre Europa office building - **Madrid**
- Alliander campus – **Netherlands**
- Waterpark place – **Toronto**
Current State of Digital Building

- So far some **early adopters**
- CapEx cost considerations
  - Network *switch port required for each device*
  - **Common cabling infrastructure** simplifies deployment
  - Cabling installation *does not require Electrician*
  - **LED lighting** technology can use PoE
- Hardware, sensors and software are available today
- Legacy building management systems difficult to switch over.
- **Green field** opportunity
PoE Lighting Topology – Home Run

Patch panels for PoE

Light Dimmer

Switches used for any converged network device

PoE+ light fixtures and light switches
PoE Lighting Topology – Passive Zone

- Passive zone box for patching (in ceiling)
- New patch panels for PoE lighting use
- New switches
  - Can be used for any converged network device
- PoE+ light fixtures and light switches
PoE Lighting Topology – Active Zone

- PoE+ light fixtures and light switches
- Active zone box for patching (in ceiling)
- 120V
- Data Switches

Bicsi
Standards for PoE cabling

- **IEEE 802.3bt**
  - PoE electrical interface standard
- **TIA TSB-184-A**
  - Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
- **IEC 60512-99-002**
  - Standard for connectivity with engaging / disengaging PoE
- **ANSI/TIA-568-C.2**
  - Cabling performance standard
- **ANSI/TIA-569-D**
  - Additional guidelines for pathways
- **ISO/IEC TR-29125 and CENELEC TR 50174-99-1**
  - International cabling guidelines for PoE++
PoE technology migration

- **2002**: Up to 15.4 Watts Standard: IEEE 802.3AF, Type 1 (2002), 2-Pair PoE.
- **2009**: Up to 30 Watts Standard: IEEE 802.3AT Type 2 (2009), 2-Pair PoE+.
- **Today**: Up to 60 Watts Standard: Cisco Proprietary (2011), 4-Pair UPOE; Proposed IEEE 803.2BT Type 3 (2016-2017), 4-Pair PoE.
- **Today**: Up to 90 Watts Standard: Power Over HDBase-T (2011), 4-Pair PoH; Proposed IEEE 802.3BT Type 4 (2016-2017), 4-Pair PoE.
<table>
<thead>
<tr>
<th>Type</th>
<th>Standards</th>
<th>Maximum Current</th>
<th>Number of Energized Pairs</th>
<th>Power at Source</th>
<th>Power at Device</th>
<th>Maximum Data Rate</th>
<th>Standard Ratified</th>
</tr>
</thead>
<tbody>
<tr>
<td>PoE</td>
<td>IEEE 802.3af (802.3at Type 1)</td>
<td>350 mA</td>
<td>2</td>
<td>15.4 W</td>
<td>13 W</td>
<td>1000BASE-T</td>
<td>2002</td>
</tr>
<tr>
<td>PoE+</td>
<td>IEEE 802.3at Type 2</td>
<td>600 mA</td>
<td>2</td>
<td>30 W</td>
<td>25.5 W</td>
<td>1000BASE-T</td>
<td>2009</td>
</tr>
<tr>
<td>PoE++ (4PPoE)</td>
<td>Proposed IEEE 802.3bt Type 3</td>
<td>600 mA</td>
<td>4</td>
<td>60 W</td>
<td>51 W</td>
<td>10GBASE-T</td>
<td>Expected 1Q2018</td>
</tr>
<tr>
<td></td>
<td>Proposed IEEE 802.3bt Type 4</td>
<td>960 mA</td>
<td>4</td>
<td>99 W</td>
<td>71 W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No IEEE standard</td>
<td>Cisco UPOE</td>
<td>600 mA</td>
<td>4</td>
<td>60 W</td>
<td>51 W</td>
<td>Varies</td>
<td>Exists today – no official ratification</td>
</tr>
<tr>
<td></td>
<td>HDBaseT (<a href="http://www.hdbaset.org">www.hdbaset.org</a>)</td>
<td>1000 mA</td>
<td></td>
<td>100 W</td>
<td>100 W</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PoE Temperature rise in cable bundles

- **TIA TSB-184-A**
  - Sets guidelines
- **Limit temperature rise to less than 15°C above ambient**
- **Temperature rise in centre of bundle**
- **Temperature rise concerns:**
  - Signal attenuation
  - Physical damage
- **Cat 6A has best performance**
PoE Maximum Cable Bundle Size Guidelines

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>PoE++ Type 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat 5e 24 AWG</td>
<td>52</td>
</tr>
<tr>
<td>Cat 6 23 AWG</td>
<td>64</td>
</tr>
<tr>
<td>Cat 6A 23 AWG</td>
<td>74</td>
</tr>
</tbody>
</table>

- TIA TSB-184-A
  – Sets guidelines
  – Conservative
- Cat 6A has best performance
PoE causing “sparks to fly”

- **IEC 60512-99-002**
  - PoE connectivity performance testing standard
- **Unplugging live PoE causes a spark** between plug and jack contacts
- **Potential carbon build up**
## PoE Effect of Heat on Channel Length

<table>
<thead>
<tr>
<th>Temperature °C</th>
<th>Maximum* horizontal length, unscreened (m)</th>
<th>Maximum* horizontal length, screened (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>90.0</td>
<td>90.0</td>
</tr>
<tr>
<td>25</td>
<td>89.0</td>
<td>89.5</td>
</tr>
<tr>
<td>30</td>
<td>87.0</td>
<td>88.5</td>
</tr>
<tr>
<td>35</td>
<td>85.5</td>
<td>87.7</td>
</tr>
<tr>
<td>40</td>
<td>84.0</td>
<td>87.0</td>
</tr>
<tr>
<td>45</td>
<td>81.7</td>
<td>86.5</td>
</tr>
<tr>
<td>50</td>
<td>79.5</td>
<td>85.5</td>
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<tr>
<td>55</td>
<td>77.2</td>
<td>84.7</td>
</tr>
<tr>
<td>60</td>
<td>75.0</td>
<td>83.0</td>
</tr>
</tbody>
</table>

* Assumes 10 meters of patch at 20 degrees C
From ANSI/TIA-568-C.2, Table G.2

- **ANSI/TIA-568-C.2**
  - Structured cabling standard.
  - Guidance on link length with respect to temperature.
- **Insertion loss increases with temperature**
- **Derating of maximum channel length**
- **Shielded has better heat dissipation**
PoE Pathway implications

- ANSI/TIA-569-D
  - Pathways and spaces

Temperature
Resistance
Insertion Loss
Network Performance
Summary

• The digital building is a reality
  – On going migration and adoption of IP enabled devices
  – More power available for devices with PoE ++

• Designs need to consider
  – Updated standards
  – Cabling topology & performance
    • Category 6A recommended for PoE ++
  – Temperature rise due to PoE