Design Considerations for PoE Lighting Networks

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Hubbell Premise Wiring
Design Resources

• It Takes a Team
  – BICSI ICT
    • RCDD (design), INSTC – TECH (installation)
  – NCQLP Lighting
    • National Council on Qualifications for the Lighting Professions
    • LC (lighting certified)
  – Networking
    • Cisco CCNA, CCDA, or equivalent
  – Licensed Electrician
Technology Merge

Solid State Lighting

Ethernet SDN Network

Digital Building Infrastructure

PoE Lighting
Solid State Lighting

- No Lamps
- LEDs
- Traditional
  - AC Electrical Facility
  - Driver
- PoE
  - DC
  - Network Ethernet Connection
- Luminaires Require UL
Traditional Lighting Control

AC Power

Wired or Wireless

Lighting Control System

Room Lighting Control

Control Interface
PoE Lighting Control
### PoE Switches

<table>
<thead>
<tr>
<th>Type</th>
<th>Standard</th>
<th>Max Current</th>
<th>Power Pairs</th>
<th>PSE</th>
<th>PD</th>
<th>Voltage</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>PoE Type 1</td>
<td>802.3af</td>
<td>350 mA</td>
<td>2</td>
<td>15 W</td>
<td>13 W</td>
<td>44-57 V</td>
<td>2003</td>
</tr>
<tr>
<td>PoE + Type 2</td>
<td>802.3at</td>
<td>600 mA</td>
<td>2</td>
<td>30 W</td>
<td>25.5 W</td>
<td>50-57 V</td>
<td>2009</td>
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<tr>
<td>PoE ++ (4PPoE) Type 3</td>
<td>802.3bt</td>
<td>600 mA</td>
<td>4</td>
<td>60 W</td>
<td>51 W</td>
<td>50-57 V</td>
<td>2018</td>
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<tr>
<td>PoE ++ (4PPoE) Type 4</td>
<td>802.3bt</td>
<td>960 mA</td>
<td>4</td>
<td>100 W</td>
<td>71 W</td>
<td>52-57 V</td>
<td>2018</td>
</tr>
<tr>
<td>UPOE</td>
<td>Cisco</td>
<td>600 mA</td>
<td>4</td>
<td>60 W</td>
<td>51 W</td>
<td>42.5-57 V</td>
<td>2011</td>
</tr>
</tbody>
</table>

**Note:** Universal PoE (UPOE) was developed by Cisco in 2011. It ultimately became the 802.3bt (Type 3) standard when ratified Sept. 2018.

PD Available Power at 100m w/ 24AWG Cat. 5e
PoE Switches

Read the Specs

Switch manufacturer “A” has a 60W 24 port PoE switch with 820 available PoE power.

- 13 ports at 60 watts each ... or ... 9 ports at 90 watts each

Switch manufacturer “A” offers a dual power supply option providing 1640 watts available PoE power.

- 24 ports 60 watts each ... or ... 18 ports 90 watts each
Common PoE Ethernet Switches

CDB-8U
- 42U Cabinet Density
- 20 switches
- 160 ports
- Special Rack Mount Kit
- Plenum Rated

CDB-3850-24U-L
- 42U Cabinet Density
- 16 switches
- 384 ports
- 4 Point Mount Kit

Design Considerations:
- AC Power, Air Space (cooling), Patch Panels, UPS
Node

- Ethernet Network Interface
- Node Connectivity
  - Ethernet PoE
  - Lights
  - Wall Control (on, off, dimming)
  - Sensors
  - Additional I/O
    - 24VDC
    - Relay control
    - Ground
- Common Sensors
  - Occupancy / Vacancy
  - Ambient Light
    - Daylight Harvesting
- Common Wall Control
  - Momentary Push-Button
    - On, Off, Dimming
    - Gestures
- Plenum Rated
Node Connectivity

- Wall Controller
- Ethernet Switch
- Occupancy Sensor
- Ambient Light Sensor
- Daylight Harvesting
- Node
Node Connectivity

• Node Internal to Light

• Node External to Light

Note:
Rules may prevail for remote node mounting. Play it safe and check with AHJ for remote nodes
Node Connectivity

- Daisy Chain
Node Connectivity

Tunable White

- 2 light connections
- Different color temperatures
- Each connection addressable
- SDN
- Match sunlight
- Circadian rhythm
Node Connectivity

String is addressable, but not individual lights

All lights addressable

Total lights per node cannot exceed PD power budget
Software Defined Network
More Than On, Off, and Dimming

• Advanced Controls
  – Spaces
  – Actions
  – Schedules
  – Devices
  – Policies

• Advanced Programming
  – Application Programming Interface (API)
  – Polling
  – Web Hooks
Addressable Lights

- Software Defined
- Addressable Components
- Programmable
- Commissioning
Spaces

Software Defined
Addressable Components
Programmable
Commissioning
Light Scenes

Software Defined
Addressable Components
Programmable
Commissioning
Actions

Software Defined
Addressable Components
Programmable
Commissioning
Actions

Software Defined
Addressable Components
Programmable
Commissioning
Actions

- Software Defined
- Addressable Components
- Programmable
- Commissioning
Actions

- Software Defined
- Addressable Components
- Programmable
- Commissioning
Actions

Software Defined
Addressable Components
Programmable
Commissioning
Actions

Software Defined
Addressable Components
Programmable
Commissioning
Intelligent Building (IoT)

- Occupancy Volume (mass)
- Load Control
  - Wiring devices
  - AC circuit relays
- Temperature
- Humidity
- Gasses

- Circuit Monitoring
  - Electricity consumption
  - Demand responses
- Motor Control
  - Shades
- Locating
  - Wayfaring
  - Beaconing
- On the horizon
  - LiFi
Modular Plug Terminated Link (MTLP)

- Standards legitimize a common practice
  - ANSI/TIA 568.2-D
  - ANSI/BICSI 007-2017
- Not always the best / economical solution
1. Install Horizontal Cabling early in the construction and leave the job.
   – Easier to install without ceiling grid, etc.
2. Return for easy finish work. Install lights with patch cords.
Distributed Ethernet Switches

- Repetitive Zones (rooms) with multiple IP Ports
- Hospitality, Healthcare, Sr. Living, Education
Emergency Lights

Emergency Lighting Factors
- Load - Ethernet Switch
- Includes lights attached
- Time – Backup
- UL 924

[Diagram showing Ethernet Switches connected to UPS/Inverter and Facility Power]
Reflective Ceiling Plan
## Planning

<table>
<thead>
<tr>
<th>Luminaire Type</th>
<th>Symbol</th>
<th>Watts per Light</th>
<th>Qty</th>
<th>Lights per Switch Port</th>
<th>Number of Switch Ports</th>
<th>Number of Switches</th>
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<tbody>
<tr>
<td>Recessed Can 6”</td>
<td></td>
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<td>Troffer 2 x 4</td>
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<td>![Symbol]</td>
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<td>5</td>
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</table>

More Calculations
- Nodes
- Wall Controls
- Sensors
- Cabinets
- Pathway
- Connectivity
- UPS
- Switches