IOT: INTELLIGENT LED LIGHTING

Gustavo Demesa G., RCDD
nCompass System
Enabled by Legrand – Superior Essex
AGENDA

CONNECTED WORLD

IOT - BLOCKS AND TOPOLOGY

POWER AND DATA CONVERGENCE

LED LIGHTING
Connected World Evolution

- **H2H**
  Rise of Availability
  - HUMAN TO HUMAN
    - Access to everyone
    - Voice communication
    - SMS

- **H2M**
  Rise of Reach
  - HUMAN TO MACHINE
    - Access to Information
      - e-Commerce
      - World Wide Web
      - Social media

- **M2H**
  Rise of Mobility
  - MACHINE TO HUMAN
    - Access to Relevance
      - TV and radio
      - e-Magazines
      - e-Billboards
      - Websites

- **M2M**
  Rise of Information
  - MACHINE TO MACHINE
    - Access to Intelligence
      - Networked sensors
      - Networked computers
      - Connected devices

- **M+H**
  Rise of Intelligence
  - MACHINE WITH HUMAN
    - Access to Automation
      - Artificial intelligence
Connected World Trends

Building Networks
- Intelligent Building
- Data and Power Convergence
- Building Wireless

Data Centers
- Cloud vs. Enterprise
- Micro Data Centers
- Control/DCiM
- Fog Computing and IoT Gateways
Connected World Impacts

Building Networks
- IoT and PoE
- Trade Convergence Mobility Demands

Data Centers
- Increased Density Demands
- Availability, Latency, and Bandwidth
- Power from Data Centers
- Security and IAM
What is IoT?

The Internet of Things is a network of uniquely identifiable endpoints (or “things”) that contain embedded technology to sense, collect, communicate and exchange data locally or with external environments, without human interaction affecting our daily life.

Enables person responsible for various operations to be more effective/efficient.

- Delegate better
- Immediate changes
- Improved quality/control
What is IoT?

- Building Automation Controls
- Cameras
- Access Controls
- Lighting Controls
- HVAC Sensors
- Digital Signage
- Sound Masking
- Occupancy Sensors
- Wi-Fi
- Intelligent LED Lighting
- IP Phone
- Laptops & Computers
Building Blocks - Gateway

An IoT gateway is a device that enables machine-to-machine communication by connecting appliances in the home, workplace or smart city to networks.
Building Blocks - Fog

An architecture approach that uses a collaborative multitude of end-user clients or near-user edge devices to carry out a substantial amount of temporary storage, communication, control, configuration, measurement and management.
Building Blocks – Edge and Cloud

An architecture that process the data in the border and transmit only the right amount of information to the central backup.
Building Blocks – IAM

The security discipline that enables the right individuals to access the right resources at the right times for the right reasons
Decentralization Impacting Our Mindshare

Centralization
- Transferring Information to the Data Center
- IoT Device
- UPS
- Storage, Analyzing, and Auctioning

Decentralization
- Transferring Information to the Gateway
- IoT Device
- Gateway
- UPS
- Transferring Unique and Critical Actions/Information Only to the Data Center
- Record and Back Up ONLY

Collect and Act Closer to the Source and Manage the Value of the Content
TOPOLOGY - Decentralized

- Decentralized topology
- WAP Occupancy Sensor Sound Masking
- Access Control
- Digital Signage
- Security Camera
- A/C
- Gateways
- POWERWISE + PoE III
- UPS
- LED Light AV
- Security Access Control
- LAN/Wifi
- BAS Sensors
- Powerwise PoE III
- SLAB
- 9' Ceiling
- 84''
- 36''
- 18''
PoE, PoE+ and Beyond
PoE Definition

Power over Ethernet or PoE consists of several standardized systems which enable transferring data and power through a single Ethernet cable, from a power source equipment (PSE) to several low voltage powered devices (PD), such as cameras, VoIP phones, Wi-Fi routers, VoIP phones and others.

Notes: Power over HDBaseT (POH) is a version of PoE specifically for multimedia applications, enabling up to 10.2 Gbps of uncompressed video and audio, 100BaseT Ethernet, control signals and power to all share the same cable, across distances up to 100 m, using RJ45 connectors.
Industry Drivers for PoE Adoption

- Critical building block for IoT devices and applications
- Eliminates AC-DC adapters – higher efficiency
- Worldwide standard
- Access to remote locations – hard to reach
- Lower cost/less downtime
- Easier maintenance and installation
- Power backup (with UPS)
IoT Applications Driving PoE

**POWER**

- **Type 1** POE
  - Up to 15.4 Watts
  - Thin clients
  - Biometric Access Controls

- **Type 2** POE+
  - Up to 30 Watts
  - RFID Readers
  - Video IP
  - Thin clients

- **Type 3** UPOE
  - Up to 60 Watts
  - Access Controls
  - Point of Sale
  - Nurse Call

- **Type 4** POE++
  - Up to 90 Watts
  - Desktop Computers
  - Televisions
  - Video Conferencing

- **POE++**
  - Up to 15.4 Watts
  - Thin clients
  - Biometric Access Controls

- **POH**
  - Up to 30 Watts
  - RFID Readers
  - Video IP

**Applications**

- **Desktop Computers**
- **Televisions**
- **Video Conferencing**
- **LED Lighting**
- **High Power WiFi**
- **Access Controls**
- **Point of Sale**
- **Nurse Call**
- **802.11ac**
- **Laptops**
- **Cameras**
- **Information Kiosks**
- **Thin clients**
- **Biometric Access Controls**
- **802.11n AP**
- **Alarm Systems**
- **Occupancy Sensors**
## PoE Standards and Commercial Options

<table>
<thead>
<tr>
<th></th>
<th>IEEE 802.3af</th>
<th>IEEE 802.3at</th>
<th>Cisco Proprietary</th>
<th>Power over HDBase-T</th>
<th>IEEE 802.3bt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Name</td>
<td>PoE</td>
<td>PoE+</td>
<td>UPOE (non standard)</td>
<td>POH</td>
<td>POE++</td>
</tr>
<tr>
<td>Type</td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td>Maximum number of pairs</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Maximum DC current per pair</td>
<td>350 mA</td>
<td>600 mA</td>
<td>600 mA</td>
<td>1000 mA</td>
<td>960 mA</td>
</tr>
<tr>
<td>Maximum power from PSE</td>
<td>15.4 W</td>
<td>34.2 W</td>
<td>60 W</td>
<td>60 W</td>
<td>100 W</td>
</tr>
<tr>
<td>Maximum power at PD</td>
<td>12.9 W</td>
<td>25.5 W</td>
<td>71 W</td>
<td>49 W</td>
<td>71 W</td>
</tr>
<tr>
<td>Voltage Rate at PSE</td>
<td>44 V-57 V</td>
<td>50 V-57 V</td>
<td>50 V-57 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Ambient Temp</td>
<td>60°C</td>
<td>50°C</td>
<td>50°C</td>
<td>50°C</td>
<td>50°C</td>
</tr>
<tr>
<td>Max Cable Bundle</td>
<td>ND</td>
<td>100</td>
<td>100</td>
<td>Cat 6: 48</td>
<td>Cat 5: 24</td>
</tr>
<tr>
<td>Max Temp Rise</td>
<td>10°C</td>
<td></td>
<td></td>
<td></td>
<td>10°C</td>
</tr>
</tbody>
</table>
Power and Data Requirements by Application

- **High Power, High Data**: CAT 6A+
- **High Power, Low Data**: CAT 6A, 6eX, 6+
- **Low Power, High Data**: CAT 5e++, 5e+
- **Low Power, Low Data**: CAT 6, 5e+, 5e

- **Low Data, High Power**: LED Lighting, Lower Def. A/V, Televisions, Digital Signage
- **Low Data, Low Power**: Access Controls, RFID Readers, Alarm Systems

- **IEEE 802.AF (15.4 W)**
- **IEEE 802.AT (30 W)**
- **IEEE 802.3 BT – Type 3 (60 W)**
- **IEEE 802.3 BT – Type 4 (100W)**
- **Power over HDBASE-T (100 W)**
- **Cisco UPOE (up to 60 W)**
Connectivity Concerns

Spark Gap Concerns When Un-mating Under PoE Load
Connectivity designs that locate the last point of contact away from the fully mated connection protected area of the mated connection from any arc damage
Industry Activities and References

- IEEE
- 802.3 at
- 802.3 bt (DRAFT)
- ANSI/BICSI 005-2013
- TIA TR-42
- ANSI/TIA-568-C.2
- PoE
- Ethernet Alliance
- Energy Efficient POE
- HDBaseT
- NFPA
- NEC
- Cisco
- UPOE
References for Supporting PoE over Twisted Pair Cabling

NEC 2017 Handbook
- Cable Ratings (60°C) and Markings for Safety
- Ampacity Table for Bundles
- LP (Limited Power) Cables

TIA TSB-184
- Copper Cable Installation Requirements for PoE
- Bundle Size & Max. Temperature rise (+15°C)
- De-rating of cable
Intelligent LED Lighting Definition

- Intelligent LED lighting refers to lighting that has automated or mechanical abilities beyond those of traditional lighting, utilizing DC power and control delivered through partial or complete Ethernet based structured cabling, for improved efficiency and tailored user experience.
Improving the Physical Aspects for Occupants

- Customized Lighting (Intensity and Color)
- Natural Light
- Room Temperature
- Preset Phone & Video Profile

Adapt Environment to Personal Preferences
Lowering Energy Costs

- Harvest Daylight
- Granular, Fixture-level Visibility and Control
- Centrally Manage Lights Via the Network
- >50% More Energy Saving Over Traditional Methods

Save Energy, Lower Costs
Intelligent LED Lighting Benefits

Energy Savings
Lower Maintenance Cost

Cooling Savings
Sustainable

Controllable & Tailored

84% Cost Savings
Vs Incandescent Light

80% light
20% heat

Tailored Experience

Bicsi
Smart Lighting: Traditional vs POE/LED

**Traditional**
- AC Conduit
- High Voltage
- Electrical Contractor

**POE/LED**
- Structured Cabling
- Low Voltage
- Datacom Contractor

- **High voltage cabling for lighting** (110V or 277V Power)
- **Legacy RS-485 protocol for control**

- **Switch PoE power LED light and other edge devices**
- **Both power and control through RJ-45 Ethernet cable**

- **Lower TCO: reduced material & labor cost, energy savings**
- **Intelligent IP platform, software analytics for broader building automation initiatives**

Source: Cisco, 2015
Typical Designs: Centralized Management / Localized Power
Typical Designs: Centralized POE Network

Server Closet / Data Center

Switch

Control Module

Sensor

On/Off

Battery

WAPs

LED Light

Battery

LED Light

LED Light

LED Light

RO get

Room
Typical Designs: Decentralized POE Network
<table>
<thead>
<tr>
<th>Design Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Centralized Management / Local Power</strong></td>
</tr>
<tr>
<td>• Security</td>
</tr>
<tr>
<td>• Centralized Manageability</td>
</tr>
<tr>
<td>• Emergency/Exit Light Control</td>
</tr>
<tr>
<td>• Longer Cable Runs</td>
</tr>
<tr>
<td>• Limited Scalability</td>
</tr>
<tr>
<td>• Multiple Power Paths</td>
</tr>
<tr>
<td>• Requires Trade Coordination</td>
</tr>
<tr>
<td>• (high voltage &amp; datacom)</td>
</tr>
<tr>
<td><strong>Centralized POE</strong></td>
</tr>
<tr>
<td>• Security</td>
</tr>
<tr>
<td>• Better Port Utilization</td>
</tr>
<tr>
<td>• UPS in Telecom Room</td>
</tr>
<tr>
<td>• Low Voltage Installer</td>
</tr>
<tr>
<td>• Longer Copper Cable Runs</td>
</tr>
<tr>
<td><strong>Decentralized POE</strong></td>
</tr>
<tr>
<td>• Flexibility &amp; Scalability</td>
</tr>
<tr>
<td>• Zone Design</td>
</tr>
<tr>
<td>• Redundancy</td>
</tr>
<tr>
<td>• Shorter Cable Runs</td>
</tr>
<tr>
<td>• Low Voltage Installer</td>
</tr>
<tr>
<td>• Security</td>
</tr>
<tr>
<td>• Multiple Gateways</td>
</tr>
<tr>
<td>• Potential Zone-level UPS</td>
</tr>
</tbody>
</table>

Centralized or Decentralized Design
Using Cat 5e+ 22AWG Benefits & Value

COST

1/3 the cost of Cat 6A

DATA

>10X more data available above smart LED Lighting requirement

POWER

>88% energy efficiency in cable
# Case Study: Total Cost of Ownership (TCO)

<table>
<thead>
<tr>
<th>Case Study: Total Cost of Ownership (TCO)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>TCO Analysis Period (# Yrs)</th>
<th>10 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Square Feet Bldg (# SF)</td>
<td>35,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connected Lighting TCO with Controls</th>
<th>POE-LED (Central/Closet)</th>
<th>POE-LED (De-central/Ceiling)</th>
<th>AC-LED</th>
<th>AC-FL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CAPEX</td>
<td>$258,356</td>
<td>$287,063</td>
<td>$316,808</td>
<td>$248,973</td>
</tr>
<tr>
<td>Per Square Foot</td>
<td>$7.38</td>
<td>$8.20</td>
<td>$9.05</td>
<td>$7.11</td>
</tr>
<tr>
<td>Cost Delta (relative to AC-LED)</td>
<td>-18.5%</td>
<td>-9.4%</td>
<td>0.0%</td>
<td>-21.4%</td>
</tr>
<tr>
<td>Total OPEX</td>
<td>$103,409</td>
<td>$100,761</td>
<td>$100,564</td>
<td>$264,327</td>
</tr>
<tr>
<td>Per Square Foot</td>
<td>$2.95</td>
<td>$2.88</td>
<td>$2.87</td>
<td>$7.55</td>
</tr>
<tr>
<td>Per Square Foot (per year)</td>
<td>$0.30</td>
<td>$0.29</td>
<td>$0.29</td>
<td>$0.76</td>
</tr>
<tr>
<td>Cost Delta (relative to AC-LED)</td>
<td>2.8%</td>
<td>0.2%</td>
<td>0.0%</td>
<td>162.8%</td>
</tr>
<tr>
<td>Total INVESTMENT</td>
<td>$361,765</td>
<td>$387,823</td>
<td>$417,372</td>
<td>$513,300</td>
</tr>
<tr>
<td>Per Square Foot</td>
<td>$10.34</td>
<td>$11.08</td>
<td>$11.92</td>
<td>$14.67</td>
</tr>
<tr>
<td>Per Square foot (per year)</td>
<td>$1.03</td>
<td>$1.11</td>
<td>$1.19</td>
<td>$1.47</td>
</tr>
<tr>
<td>Cost Delta (relative to AC-LED)</td>
<td>-13.3%</td>
<td>-7.1%</td>
<td>0.0%</td>
<td>23.0%</td>
</tr>
</tbody>
</table>
Case Study: Total Cost of Ownership (TCO)
Gracias

DISCUSSION

Gustavo Demesa G., RCDD
nCompass enable by Legrand – Superior Essex