IoT and Intelligent Building Infrastructure Planning

- Carol Everett Oliver, RCDD, ESS - Legrand North America
- Farukh Aslam, CEO - Sinclair Holdings LLC
Agenda

- Intelligent Building Trends & Challenges
- Planning the Network Architecture and Infrastructure
- Convergence of Power (PoE) and Data
- Standards’ Updates
- A Digital Building Deployment Use Case
IoT/IP Applications in Building Networks

- Wireless Access Point
- Security Cameras
- IP Phones
- Climate Sensors
- LED Lighting
- Access Control
- Climate Sensors
- Occupancy Sensors
- Sound Masking
Trends and Challenges

Building Networks
- Intelligent Buildings
- Data & Power Convergence
- Building Wireless

Data Centers
- Cloud vs. Building Enterprise
- Micro Data Centers
- Control/DCIM

Edge Computing, IoT Gateways and Data Security
Today’s Infrastructure:
How will IoT change the Infrastructure?
Network Architecture Design Decision

Centralized

Hybrid

Decentralized
Hybrid Architecture

- PoE Lighting
- PoE Light Switch
- CCTV Camera
- Network Jacks
- Wireless Access Points
- Twisted Pair
- AC Power

KEY:

A: Telecom Room
B: Pathways
C: Cabling
D: Consolidation Point
E: Wall-mount Cabinets
F: Device Termination
G: Workstation Outlets
H: WAP Enclosures & Connection Points
PoE and Data

Using Twisted-Pair Copper Cable for Data & Power Transmission

- Energy Savings
- Labor Savings
- Increase Safety
- Simplifies Installation
- Flexibility
- Ease of Maintenance
PoE - Commercial Building Applications

PoE Infrastructure

- LED Lighting: 389
- Phone, Client, Monitor: 470
- Display: 15
- Occupancy Sensors: 89
- WAP: 102
- Shade Control: 40
- Security Camera: 12
- Access Controls: 8
- Total: 1125

25,000 SQ Feet

222'-10"
112'-9"

2017 BICSI Fall Conference & Exhibition
September 24-28 | Las Vegas, NV
Power Over Ethernet Standards

- **Up to 15.4 Watts**: Standard: IEEE 802.3at Type 1 (2009), 2-Pair POE
  - IP Phones
  - 802.11n Wireless
  - IP Camera

- **Up to 30 Watts**: Standard: IEEE 802.3at Type 2 (2009), 2-Pair POE
  - Video Phone
  - PTZ Camera
  - Access Control
  - 802.11ac Wireless

- **Up to 60 Watts**: Standard: Cisco Proprietary (2011), 4-Pair UPOE
  - Laptop & Thin Clients
  - Outdoor PTE Camera
  - Point of Sale
  - LED Lighting
  - Nurse Call

- **Up to 90 Watts**: Standard: Power over HDBaseT (2011), 4-Pair PoH
  - Flat Panel TV
  - Desktop PC
  - Digital Signage/Kiosk
  - LED High Bay
  - High Power Wireless
Application-based Cable Selection for PoE

- **High Data, Low Power**
  - Category 6 or 6a
  - Example: Security Cameras

- **Low Data, Low Power**
  - Category 5e
  - Example: A/V

- **High Data, High Power**
  - Category 6a
  - Example: WiFi AP Video Conferencing

- **Low Data, High Power**
  - Category 5e or 6
  - Example: LED Lighting
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.
Rising Power over Ethernet Heat Effect

As more current flows through a copper conductor in the twisted pair cable, the conductor gets hotter.
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-A
- Copper Cable Installation Requirements for PoE
- Bundle Size & Max. Temperature rise (+15°C)
- De-rating of cable
Cabling Subsystem Components for Intelligent Buildings

Patch Cords + Cables + Connectors

1

2

3
New Standards Addressing Infrastructure Planning
TIA-862B Structured Cabling – Star Topology* 
Horizontal Termination Examples

* In a star topology in TIA standards, the use of an equipment outlet and cord to the device is preferred
Introducing ANSI/BICSI-007

Best practices for designing and integrating diverse applications on the ICT network.

Ratified: August 2017
ANSI/BICSI-007: Planning Telecom Rooms

- Allow for additional systems and cabling
- Segmenting systems from core network
- Allow for future racks and systems
ANSI/BICSI-007: Planning Outlets
Key Elements in Infrastructure Planning
A Digital Building Case Study

Farukh Aslam
CEO, Sinclair Holdings LLC
Current Digital Building Projects

- Sanger Office Building
- Sinclair Marriott Autograph Hotel
- Hilton Annex Apartments
The Digital Building Structure

- Lighting
- WiFi
- Internet
- Fiber
- Cat5e IP TV
Design Possibilities of PoE
PoE Safe and Easy to Install

Before Installation

During Installation

After Installation
The Sanger Office Building
Power Infrastructure

Electricity that is safe to touch & smart!
IEC 62368-1 Approved Limited Power Source!

1) Send Pulse
2) STOP
3) Analog/Digital safety verification
4) OK? send another, otherwise STOP

VoltServer
System Management & Policy Control

Evaluating Technology
functionality, viability, and cost structure

2017 BICSI Fall
CONFERENCE & EXHIBITION
SEPTEMBER 24-28 | LAS VEGAS, NV
### Sinclair Holdings

#### Energy Consumption

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Forecast kWh</th>
<th>Min kWh</th>
<th>Max kW</th>
<th>Actuals kWh</th>
<th>Under kWh</th>
<th>Under usage Cost</th>
<th>Commodity Cost</th>
<th>Total Monthly Commodity (excluding taxes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>July</td>
<td>151,077</td>
<td>113,308</td>
<td>188,846</td>
<td>132,233</td>
<td></td>
<td></td>
<td>$6,340.57</td>
<td>$6,340.57</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>189,791</td>
<td>142,343</td>
<td>257,239</td>
<td>189,823</td>
<td></td>
<td></td>
<td>$9,102.03</td>
<td>$9,102.03</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>189,341</td>
<td>142,006</td>
<td>236,676</td>
<td>168,945</td>
<td></td>
<td></td>
<td>$8,100.91</td>
<td>$8,100.91</td>
</tr>
<tr>
<td></td>
<td>October</td>
<td>172,463</td>
<td>129,347</td>
<td>215,579</td>
<td>126,679</td>
<td>-2,668</td>
<td>$69.52</td>
<td>$6,074.25</td>
<td>$6,143.77</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>161,615</td>
<td>121,211</td>
<td>202,019</td>
<td>68,298</td>
<td>-32,913</td>
<td>$831.83</td>
<td>$4,233.89</td>
<td>$5,125.71</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>147,818</td>
<td>110,863</td>
<td>184,772</td>
<td>87,590</td>
<td>-23,333</td>
<td>$716.18</td>
<td>$4,197.07</td>
<td>$4,913.25</td>
</tr>
<tr>
<td>2016</td>
<td>January</td>
<td>177,011</td>
<td>132,758</td>
<td>221,264</td>
<td>85,206</td>
<td>-47,552</td>
<td>$1,341.56</td>
<td>$4,085.64</td>
<td>$5,427.20</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>148,059</td>
<td>111,044</td>
<td>185,074</td>
<td>84,440</td>
<td>-26,604</td>
<td>$810.58</td>
<td>$4,048.91</td>
<td>$4,859.49</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>124,098</td>
<td>93,074</td>
<td>155,123</td>
<td>106,648</td>
<td></td>
<td></td>
<td>$5,113.77</td>
<td>$5,113.77</td>
</tr>
<tr>
<td></td>
<td>April</td>
<td>156,402</td>
<td>117,301</td>
<td>195,502</td>
<td>114,248</td>
<td>-3,054</td>
<td>$78.29</td>
<td>$5,478.17</td>
<td>$5,556.46</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>169,520</td>
<td>127,140</td>
<td>211,900</td>
<td>128,786</td>
<td></td>
<td></td>
<td>$6,175.30</td>
<td>$6,175.30</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>182,587</td>
<td>136,940</td>
<td>228,234</td>
<td>146,618</td>
<td></td>
<td></td>
<td>$7,030.33</td>
<td>$7,030.33</td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>209,725</td>
<td>157,294</td>
<td>262,156</td>
<td>164,454</td>
<td></td>
<td></td>
<td>$7,885.55</td>
<td>$7,885.55</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>189,791</td>
<td>142,343</td>
<td>237,239</td>
<td>158,973</td>
<td></td>
<td></td>
<td>$7,622.73</td>
<td>$7,622.73</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>189,341</td>
<td>142,006</td>
<td>236,676</td>
<td>140,732</td>
<td></td>
<td></td>
<td>$6,748.08</td>
<td>$6,748.08</td>
</tr>
<tr>
<td></td>
<td>October</td>
<td>172,463</td>
<td>129,347</td>
<td>215,579</td>
<td>122,260</td>
<td>-7,088</td>
<td>$157.14</td>
<td>$5,862.35</td>
<td>$6,019.49</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>161,615</td>
<td>121,211</td>
<td>202,019</td>
<td>83,316</td>
<td>-37,895</td>
<td>$992.88</td>
<td>$3,995.00</td>
<td>$4,987.88</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>147,818</td>
<td>110,863</td>
<td>184,772</td>
<td>57,958</td>
<td>-52,905</td>
<td>$1,175.42</td>
<td>$2,779.11</td>
<td>$3,954.52</td>
</tr>
<tr>
<td>2017</td>
<td>January</td>
<td>177,011</td>
<td>132,758</td>
<td>221,264</td>
<td>61,894</td>
<td>-70,713</td>
<td>$1,379.29</td>
<td>$2,972.59</td>
<td>$4,351.88</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>148,059</td>
<td>111,044</td>
<td>185,074</td>
<td>63,115</td>
<td>-47,930</td>
<td>$1,281.52</td>
<td>$3,026.34</td>
<td>$4,307.86</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>124,098</td>
<td>93,073</td>
<td>155,122</td>
<td>82,372</td>
<td>-10,701</td>
<td>$279.28</td>
<td>$3,949.74</td>
<td>$4,229.02</td>
</tr>
<tr>
<td></td>
<td>April</td>
<td>156,402</td>
<td>117,302</td>
<td>195,503</td>
<td>70,099</td>
<td>-47,202</td>
<td>$1,105.22</td>
<td>$3,361.27</td>
<td>$4,466.49</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>169,520</td>
<td>127,140</td>
<td>211,900</td>
<td>42,438</td>
<td>-84,702</td>
<td>$1,550.83</td>
<td>$2,034.89</td>
<td>$3,585.72</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>182,587</td>
<td>136,940</td>
<td>228,234</td>
<td>34,182</td>
<td>-194,052</td>
<td>$2,103.45</td>
<td>$1,639.03</td>
<td>$3,742.48</td>
</tr>
</tbody>
</table>

**Weighted Average**

<table>
<thead>
<tr>
<th>kWh</th>
<th>$0.05343</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,541,346</td>
<td>$135,790.50</td>
</tr>
</tbody>
</table>
### Sanger Office Building

#### Energy Consumption

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Forecast kWh</th>
<th>Min kWh</th>
<th>Max kWh</th>
<th>Actual kWh</th>
<th>Commodity Cost (excluding taxes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>June</td>
<td>51,278</td>
<td>38,459</td>
<td>64,098</td>
<td>48,943</td>
<td></td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>436,733</td>
<td>327,550</td>
<td>545,916</td>
<td>408,933</td>
<td>$19,322.08</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>447,933</td>
<td>335,950</td>
<td>559,916</td>
<td>416,273</td>
<td>$19,668.91</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>436,012</td>
<td>327,009</td>
<td>545,015</td>
<td>376,828</td>
<td>$17,805.12</td>
</tr>
<tr>
<td></td>
<td>October</td>
<td>432,264</td>
<td>324,198</td>
<td>540,330</td>
<td>364,903</td>
<td>$17,241.67</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>377,487</td>
<td>283,115</td>
<td>471,859</td>
<td>318,212</td>
<td>$15,035.51</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>383,143</td>
<td>287,357</td>
<td>478,929</td>
<td>314,829</td>
<td>$14,875.66</td>
</tr>
<tr>
<td>2017</td>
<td>January</td>
<td>378,007</td>
<td>283,505</td>
<td>472,509</td>
<td>311,130</td>
<td>$14,700.88</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>345,435</td>
<td>259,076</td>
<td>431,794</td>
<td>283,270</td>
<td>$13,384.50</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>363,170</td>
<td>272,377</td>
<td>453,962</td>
<td>311,621</td>
<td>$14,724.10</td>
</tr>
<tr>
<td></td>
<td>April</td>
<td>369,994</td>
<td>277,496</td>
<td>462,493</td>
<td>295,371</td>
<td>$13,956.26</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>394,511</td>
<td>295,883</td>
<td>493,139</td>
<td>306,449</td>
<td>$14,479.71</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>421,714</td>
<td>316,286</td>
<td>527,143</td>
<td>338,830</td>
<td>$16,009.73</td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>140,260</td>
<td>105,195</td>
<td>175,325</td>
<td>115,320</td>
<td></td>
</tr>
</tbody>
</table>

Before Renovations

After Renovations
Conclusions

- IoT is finally making gains in modernizing Building Infrastructure
- Digital Building Network Infrastructure should be taken seriously
  - Lower CapEx and OpEx
  - Low Voltage simplifies installation
  - Enables greater project control
  - Enhances the look and feel of the space
- Digital Building infrastructure is the 4th Utility for Buildings
- We are just scratching the surface of changing the way Buildings are built
Q & A

Carol Everett Oliver, RCDD/ESS
Manager, Training and Technology, Legrand
Secretary, BICSI Board of Directors
Carol.oliver@legrand.us

Farukh Aslam
CEO, Sinclair Holdings, LLC
Farukh@aol.com