There’s a Revolution Happening in our Buildings!

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Total Convergency

- ConvergeIT is an Intelligent cabling solution
- Multiple building systems can be run over a single IT cabling infrastructure
- Power and control over the same infrastructure
- Zone topology deployment
- These systems can include
  - Lighting
  - Voice/data
  - Wireless
  - Video surveillance
  - Access control
  - DAS
  - Audio/video
  - Fire alarms/safety
  - Energy management
  - HVAC
  - Digital signage

Traditional – Multiple systems, multiple proprietary cabling types
ConvergeIT – Multiple systems, one structured cabling infrastructure
IP Convergence for Digital Building Technologies

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

Data Network

- 1995
- 2005
- Late 2000s
- 2010
- 2015

Cloud Management and Analytics

Experiences

OpEx
Today’s and Future Intelligent Buildings

- Today’s building communication systems are moving towards IP Convergence

- One infrastructure using a zoned cabling topology, means substantial CAPEX savings
Attributes of Connected and Converged

- Reduce installation, infrastructure, training, and operational costs
- Change, Update, Add, and Refresh Subsystems without changing the Platform
- Offer unique services to all departments, students, vendors, patients and visitors
- Collect and analyze facility and usage data through IP enabled sensors
- Leverage Cisco wireless and video infrastructure to enable analytics based services and marketing
- Realize measurable return on investment
Case Study

- 50,000 sq. ft. enterprise space at a manufacturing facility
- Drawings were 60% complete when engaged
- Tasked to find construction savings without any material changes in the current designs
- Suggested to change the specification to utilize Power over Ethernet
- Savings came from reduce cabling and power cost.
- The savings would have been much greater if the engagement was earlier in the design process.
<table>
<thead>
<tr>
<th></th>
<th>PoE Access Control</th>
<th>PoE HVAC VAV Box</th>
<th>PoE HVAC Fan Coil Box</th>
<th>PoE Lighting</th>
<th>Total Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional cost per device</td>
<td>$351.50</td>
<td>$275.00</td>
<td>$425.00</td>
<td>$375.00</td>
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<tr>
<td>PoE per device cost</td>
<td>$280.50</td>
<td>$355.00</td>
<td>$550.00</td>
<td>$350.00</td>
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<tr>
<td>Savings per device</td>
<td>$71.00</td>
<td>-$80.00</td>
<td>-$125.00</td>
<td>$25.00</td>
<td></td>
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<tr>
<td>Savings on devices</td>
<td>20%</td>
<td>-29%</td>
<td>-29%</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Estimated number of devices</td>
<td>35</td>
<td>24</td>
<td>24</td>
<td>700</td>
<td></td>
</tr>
<tr>
<td>Total device savings</td>
<td>$2,485.00</td>
<td>-$1,920.00</td>
<td>-$3,000.00</td>
<td>$17,500.00</td>
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<tr>
<td>Estimated system cost with AC building power</td>
<td>$38,552.50</td>
<td>$24,600.00</td>
<td>$28,200.00</td>
<td>$617,500.00</td>
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</tr>
<tr>
<td>Estimated cost using PoE over structured cabling</td>
<td>$18,567.00</td>
<td>$14,520.00</td>
<td>$19,200.00</td>
<td>$432,250.00</td>
<td></td>
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<tr>
<td>Savings per CCSM</td>
<td>$22,470.00</td>
<td>$8,160.00</td>
<td>$6,000.00</td>
<td>$202,750.00</td>
<td>$239,380.00</td>
</tr>
</tbody>
</table>
23k square foot building – Erie, PA

**Systems Identified**
- HVAC
- Lighting
- Generators
- UPS
- Elevator
- Access Control
- Utility Meters
- Fire Life Safety

**Possible Additions**
- IP Video
- IoT Devices
- Appliances
- Printers/Copiers

Hard-Wire and Integrate Eight (8) Disparate Systems per Current Specifications = $970,937
23k square foot building – Erie, PA

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**Outcomes of Integration**
- Reduce Controls First Costs by 49%
- Optimize Building Performance
  - Maximize Occupant Productivity
  - Reduce Utility Consumption
  - Reduce Operating Expenses
  - Reliability-Centered Maintenance
- Minimize Risk
  - Minimize/Eliminate Downtime
  - Reduce Unplanned Capital Repairs
- Visibility (meaningful data)
- Showcase/Marketing

Hard-Wire and Integrate Eight (8) Disparate Systems per Current Specifications = $970,937
- or -
Modify Design and Integrate “Single Pane of Glass” = $480,300
What does Intelligent Buildings Mean to an Installer?

<table>
<thead>
<tr>
<th>Voice and Data BOM</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>Office Drops</td>
<td>128</td>
</tr>
<tr>
<td>Cubical Drops</td>
<td>136</td>
</tr>
<tr>
<td><strong>Total Drops</strong></td>
<td><strong>264</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intelligent Building BOM</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>PoE Doors</td>
<td>66</td>
</tr>
<tr>
<td>Security Cameras</td>
<td>7</td>
</tr>
<tr>
<td>PoE Light Nodes</td>
<td>283</td>
</tr>
<tr>
<td>Access Points</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total Drops</strong></td>
<td><strong>366</strong></td>
</tr>
</tbody>
</table>
23k square foot building – In Summary...

- Voice and Data: 264
- Total Building Drops: 640
- Intelligent Building: 366
23k square foot building – In Summary...

Number of LV Drops increased by

~243%
Utilize PoE Wherever Possible

- Part of the DC Micro Grid
- No Vampire power loss
Cost Savings with PoE

• The cost of a power outlet includes conduit, wire, a back box for the outlet and the labor of an electrician

• PoE Example: Purdue University installed over 1,100 PoE wireless access points and saved up to $1,000 per location

• An average cost to provide typical power to a device is about $1,000, the whole cost of a PoE network port plus the structure cable drop is $250 per drop
PoE Applications

- Access Control
- Computer Systems
- Building Automation Systems
- CCTV
- HVAC
- WLAN
- Smart Signs/Web Signs
- Vending Machines
- Gaming Machines
- Audio And Video Juke Boxes
- Electronic Point Of Sale (EPOS) Information Systems
- Time And Attendance Systems
- Battery Chargers For Mobile Phones And PDAs
- Electronic Musical Instruments
## Average Number of Drops per Device

Per 10,000 square feet

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Number of devices</th>
<th>CAPEX Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>PoE Lighting</td>
<td>115</td>
<td>$82,250</td>
</tr>
<tr>
<td>Wireless Access Points</td>
<td>10</td>
<td>$7,500</td>
</tr>
<tr>
<td>Public Address</td>
<td>4</td>
<td>$3,000</td>
</tr>
<tr>
<td>Access Controls</td>
<td>4</td>
<td>$3,000</td>
</tr>
<tr>
<td>Security Cameras</td>
<td>4</td>
<td>$3,000</td>
</tr>
<tr>
<td>HVAC</td>
<td>4</td>
<td>$3,000</td>
</tr>
<tr>
<td>Life Safety</td>
<td>4</td>
<td>$3,000</td>
</tr>
<tr>
<td>Digital Signage</td>
<td>2</td>
<td>$1,500</td>
</tr>
<tr>
<td>IP Clocks</td>
<td>2</td>
<td>$1,500</td>
</tr>
<tr>
<td>Intercom</td>
<td>2</td>
<td>$1,500</td>
</tr>
<tr>
<td>Other</td>
<td>22</td>
<td>$16,500</td>
</tr>
</tbody>
</table>

**Totals:** 169  $126,750
IT Network for LED Lighting Systems
The Transition to a Digital Building

Traditional Lighting Infrastructure

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

Connected Building Infrastructure

- 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

Connected Ceiling Applications

Cisco/Partner Cloud Services

Lighting Control

Connected Building Infrastructure

Traditional Lighting Infrastructure

Wireless Access Point

Network

Energy Management

Wiring Closet

Wiring Closet

- Wall Switches
- Commercial LED/PoE Fixtures
- Sensors (Light, Motion, CO2/CO, etc.)
- IP Video Surveillance Cameras
- HVAC Variable Air Valves

Lighting Control

Control Network (DMX, DALI, LonWorks, BACnet, KNX, RS-485)

Digital Lighting Control Driver Modules

A/C Power

Lighting Control Module
PoE Slashes Cabling Cost for New Construction

- Electrician wage rates
- Bending conduit
- Electrical code

- Structured cabling cost structure
- Pull bundles
- Low-voltage
Fixture Centric
PoE Lighting Sensor and Topology
PoE Lighting Sensor and Topology

- LiFi network connectivity
- Occupancy sensors
- Switches
- AV Integration
- Advanced scheduling
- CO2 sensors
- Humidity sensors
- Ambient light
- Energy consumption
- Daylight harvesting
- Fine-grain indoor location tracking system
Connected Lighting - Lower TCO

- Key factors driving lower TCO for UPoE-LED
  - 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
Connected Lighting – Part of a Digital Building

- Color beacons create pathway lighting or indicate room status
- Integrated BTLE for nearby devices
- Integrated Speaker modules
- Any light can be backed up with a UPS
- Integrated CO2 and other gas or particle sensors
- LiFi to data streaming applications

Connected Lighting provides strategic ceiling placement for advanced sensor technologies and other devices
Connected Lighting – Part of a Digital Building

Color beacons create pathway lighting or indicate room status. Any light can be backed up with a UPS. Integrated BTLE for nearby devices and Integrated Speaker modules. Connected Lighting provides strategic ceiling placement for advanced sensor technologies and other gas or particle sensors. LiFi to data streaming applications. Connected Lighting can be used for

- Blue - Life Threatening
- Yellow - Non-Life Threatening
- Red - Fire
- White - Workplace Violence
- Orange - Active Shooter
- Purple - Hazardous Material
- Green - Bomb Threat
- Gray - Severe Weather
- Black - Earthquake
Power over Ethernet (PoE) Trends

- Over 100 million Power over Ethernet (PoE) enabled ports are shipping annually

- Cisco® 60w Universal PoE (UPOE) technology is driving the adoption of virtual desktop infrastructure (VDI)

- Power over HDBaseT (POH) technology can deliver up to 100w over twisted-pair cable, supporting full HD digital video, audio, 100BASE-T and control signals in television and display applications

- The IEEE 802.3bt DTE Power via MDI over 4-Pair Task Force is developing a new remote powering application that will provide superior energy efficiency compared to a two-pair application which will significantly expand the market for PoE systems
Imagine Configuring Lights to Match your Work

A Cisco Example:

- White-Tuneable Connected Lighting in Audio Privacy Rooms (APRs)
- Cisco HQ Connected Lighting user interaction:
  - Find Vacant APRs
  - Scan QR Code to reserve rooms
  - Choose room color mood and intensity

• This is a PROTOTYPE GUI
## Top Use Cases

<table>
<thead>
<tr>
<th>Incremental Energy Savings</th>
<th>Productivity &amp; Health/Comfort</th>
<th>Generic Lighting Applications</th>
<th>Digital ceiling unlocks the power of IoT analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incremental energy savings based on highly dense sensor network and individual fixture control</strong></td>
<td><strong>Human Centric Lighting</strong></td>
<td><strong>Real time conference room availability</strong></td>
<td><strong>Integrated Sensors</strong></td>
</tr>
<tr>
<td>- Electrical Load Shedding</td>
<td>- Change lighting temperature to follow the circadian rhythm of workers and students</td>
<td>- Customized lighting for retail stores</td>
<td>- Light</td>
</tr>
<tr>
<td>- Personalized Workspaces</td>
<td></td>
<td>- Emergency pathway lighting for first responders</td>
<td>- Occupancy / motion</td>
</tr>
<tr>
<td>- Granular Occupancy</td>
<td></td>
<td></td>
<td>- WiFi</td>
</tr>
<tr>
<td>- Granular Daylight Harvesting</td>
<td></td>
<td></td>
<td>- LiFi</td>
</tr>
<tr>
<td>- Highly Flexible Scheduling</td>
<td></td>
<td></td>
<td>- BTLE</td>
</tr>
</tbody>
</table>

**Integrated Radios**
- WiFi
- LiFi
- BTLE

**Metering**
- Code blue visual indicator

**Analytics**
- Energy
- Resources
- Space / occupancy
- Grouping / interactions
Summary

- Part of the Next-gen Workspace Experience
- Robust, Scalable and Lower TCO thru IP Convergence
- Digital Ceiling enables future IoT Applications

Creating the Next-generation Workspace Experience
Cisco Digital Ceiling

WaterPark Place III
Create an Innovative and Efficient Workspace

Challenge
- Build an innovative, energy-efficient workspace

Digital Transformation
- PoE-powered lighting with Catalyst switches
- Sensor-based access to workspaces
- Analytics with fixture-level visibility

Business Outcomes
- Converge five networks—HVAC, metering, lighting, CCTV, access—into one
- Lower CapEx (~10%) and OpEx (~$600k)
- Reduce energy costs by 50% by replacing fluorescent lights with LEDs and using PoE
- Anticipate earning Toronto’s first Enterprise Leadership in Energy and Environmental Design (LEED) Platinum Certification