Connecting Buildings to a Smart World with IoT, Cloud Computing and Digital Ceiling

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aws
Smart Buildings - Main Considerations

- Green Building concepts
- Technology & Comfort for employees
- Office's experience
- Traditional costs reduction
- Preparing for the future
Smart Buildings - Technologies

- Building automation devices
- Building automation integration systems
- Building Analytics
- Remote monitoring services
- Smart lighting and connected lighting
- IoT: Connectivity, Devices, Software and Services
Structured Cabling

Cabling for work area:

• IT devices only
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Power over Ethernet

Occasionally add devices:
• WAP and CFTV
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Digital Ceiling
Structured cabling for building automation devices:
• LED Lighting
• Sensors

Digital building,
Intelligent building,
Connected lighting,
Smart Buildings – Evolution 4.0

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Converged Network
Full Integration:
• All assets and protocols over IP network
• IoT
Smart Buildings – Automation and IP Integration
Power-Over-Ethernet (PoE)

- PoE is still one of the most discussed topic in the LAN industry nowadays;

- The version with 90W (4PPoE) is being introduced by IEEE;

- The PoE subject is critical for discussion including in pre-project phase, product purchasing and mainly during implementation.
PoE was already simply considered a way to deliver power to VoIP phones.

Nowadays a lot of devices are using PoE:
- CFTV Cameras
- Wi-Fi Access Points
- VoIP communication systems
- Data Center lightning
- Building Automatic Systems

The PoE capacity has increased enormously over the years.
PoE: Powering options

Endpoint PSE Powered Link

Midspan PSE Powered Link
PoE: Protocols evolution

- Powering increasing:

<table>
<thead>
<tr>
<th>Level</th>
<th>Power (W)</th>
<th>Name</th>
<th>Code</th>
<th>IEEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13</td>
<td>Power over Ethernet</td>
<td>PoE</td>
<td>802.3af</td>
</tr>
<tr>
<td>2</td>
<td>22</td>
<td>PoE Plus</td>
<td>PoEP</td>
<td>802.3at</td>
</tr>
<tr>
<td>3</td>
<td>55</td>
<td>4-Pair PoE</td>
<td>4PPoE</td>
<td>802.3bt</td>
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<tr>
<td>4</td>
<td>90</td>
<td>4-Pair PoE</td>
<td>4PPoE</td>
<td>802.3bt</td>
</tr>
</tbody>
</table>

- Table showing peak and continuous power levels for different PoE levels:

  - Peak power: I_{max}
  - Continuous power: I_{nom}

- Diagrams showing peak and continuous power levels.
PoE: Impact on Cabling Infrastructure

- Due to the conductors resistance, PoE generate powering and significant heat

- Depending on the installation conditions (cables bundle and environmental conditions) the cable temperature can increase

- High temperatures in the cable impact on increased link attenuation
Intelligent Lighting: Advantages

- The luminaire can become a sensor platform for smart buildings automation
  - Temperature & Air Quality
  - Presence & Occupation

- The building management systems can provide an increased comfort and power savings
  - Custom environmental settings
  - Air conditioning and lighting based on the occupation

- Indoor positioning system (modular lighting)
  - Functions "Where I am" and "Where to go"
  - Heat Map
Intelligent Lighting: Power Savings

Relative power consumption and impact on costs:

<table>
<thead>
<tr>
<th></th>
<th>Light bulb</th>
<th>LED</th>
<th>Intelligent LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightning</td>
<td>100%</td>
<td>10%</td>
<td>6%</td>
</tr>
<tr>
<td>Environment Control</td>
<td>100%</td>
<td>100%</td>
<td>70%</td>
</tr>
<tr>
<td>Operational Costs</td>
<td>100%</td>
<td>95%</td>
<td>66%</td>
</tr>
<tr>
<td>Building Efficience</td>
<td>100%</td>
<td>100%</td>
<td>133%</td>
</tr>
</tbody>
</table>

Source: Phillips, Cisco; R&M

Experts say that up to 40% savings in operating costs can be achieved in a smart building.
Intelligent Lighting: Ethernet Implementation

- The LED light spots require approximately 30W

- Proprietary lighting systems
  - Centralized intelligence
  - Centralized electronic LED
  - Distributor centralized on floor

- Lightning PoE based systems
  - Distributed intelligence (lighting system with IP address)
  - The light spot can act as sensor for building automation
  - Distributed active devices
Ethernet Single Pair is the next step in the concept of digital ceiling. If there are several devices, RJ45 can be replaced by SPE in the ends.

Some microsplitter are available in the market through some manufacturers allowing compatibility with previous versions of RJ45.

SPE aims to replace existing systems for building automation and bus connections, such as: KNX, EIB, DALI, Digital Strom, BACnet, LON, Profibus, AS-Interface, VARAN, INTERBUS.
Unified service outlets for all building automation applications

Works as a consolidation / distribution point

The network equipment and patch panels are located in the technical room and each link connects over there

Connection to luminaires by patch cords

Routing of cables to comply with 4PPoE, managing the length of the PL (temperature and IL)
Digital Ceiling: Alternative solution using zone switch

- Capacity of at least 30W of continuous power per port
- Maintenance free (Fanless)
- Only uplinks connection from switch to technical room
- Luminaires connected to the switch in the area through patch cords
Digital Ceiling: Pictures and Examples

Mounting Example
Field Termination with Plug

- Demand for field plugs are increasing
- The new cabling standards are allowing permanent link with a unique female connector
- The adjustment of cables lengths are essential for an adequate installation
- Solutions are already available in the market for performance levels up to Cat.6A
Internet of Things: Definition

A1) intelligent form of Machine-to-Machine (M2M)?
A2) Communication between a group of machines?
A3) Insert new definition here
IoT: Applications
IoT: Protocols

Wired
- Ethernet, Coax, Fiber, etc. considered as a single category

WPAN
- ANT+
- Bluetooth® – Classic & Smart Ready
- Bluetooth® Smart
- NFC

W-Mesh
- ZigBee PRO
- ZigBee RF4CE
- ZigBee Multi-Protocol
- EnOcean
- ISA100.11a
- WirelessHART
- Z-Wave
- Other 802.15.4
- 6LowPAN

WLAN
- 802.11a/b/g
- 802.11n
- 802.11ac
- 802.11ad
- Other 802.11
- DECT ULE
- Other 2.4GHz
- Other Sub-GHz

WWAN
- 2G Cellular
- 3G Cellular
- 4G Cellular
- Neul
- LoRaWAN
IoT: Architecture
IoT: Communication Protocol

1. subscribe to topic: “temperature”
2. publish to topic: “temperature”

Temperature sensor → publish: “21°C” → MQTT-Broker → subscribe → publish: “21°C” → laptop → subscribe → publish: “21°C” → mobile device
Cloud Computing: IoT Integration

Things
Sensors & Gateways

Cloud
Storage & Computing

Intelligence
Insights & Processing → Actions
Cloud Computing: IoT Integration

Things
Sensors & Gateways

Cloud
Storage & Computing

Devices connection and secured messages
Cloud Computing: IoT Integration

**Things**
- Sensors & Gateways
  - Data Sync with local security featuring

**Cloud**
- Storage & Computing
  - Devices connection and secured messages
  - Devices provisioning, management and SW updates
  - Devices securing and auditing

**IoT Data Analytics and Intelligence**

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Cloud Computing: IoT Microcontroller

- Local Connection Library
- Cloud Computing Library
- Security Library for Connections
- Code Signature

FreeRTOS Kernel
Cloud Computing: Connecting IoT Gateway to Cloud

- Long-term connections
- Auth based on SigV4, X.509 and tokens
- TLS 1.2 for messages encryption
- MQTT, WebSockets, HTTP

**MQTT vs HTTPS**

- 93x faster throughput
- 11.89x less battery to send
- 170.9x less battery to receive
- 50% less power to keep connected
- 8x less network overhead
Cloud Computing: IoT Devices Management

- Devices Configuration Update
- Behavior Devices Monitoring
- Anomalies Identification
- Alerts Generation
- Security Patches Deployment
The Future ...

Smart Buildings, IoT, Cloud Computing and Digital Ceiling
Building automation systems will deliver the benefits beyond energy efficiency

Smart cities will drive the development of smart buildings

Smart buildings will optimize the occupants' experience

The implementation of the climate change policy will demand efficiency in buildings
Questions?

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