

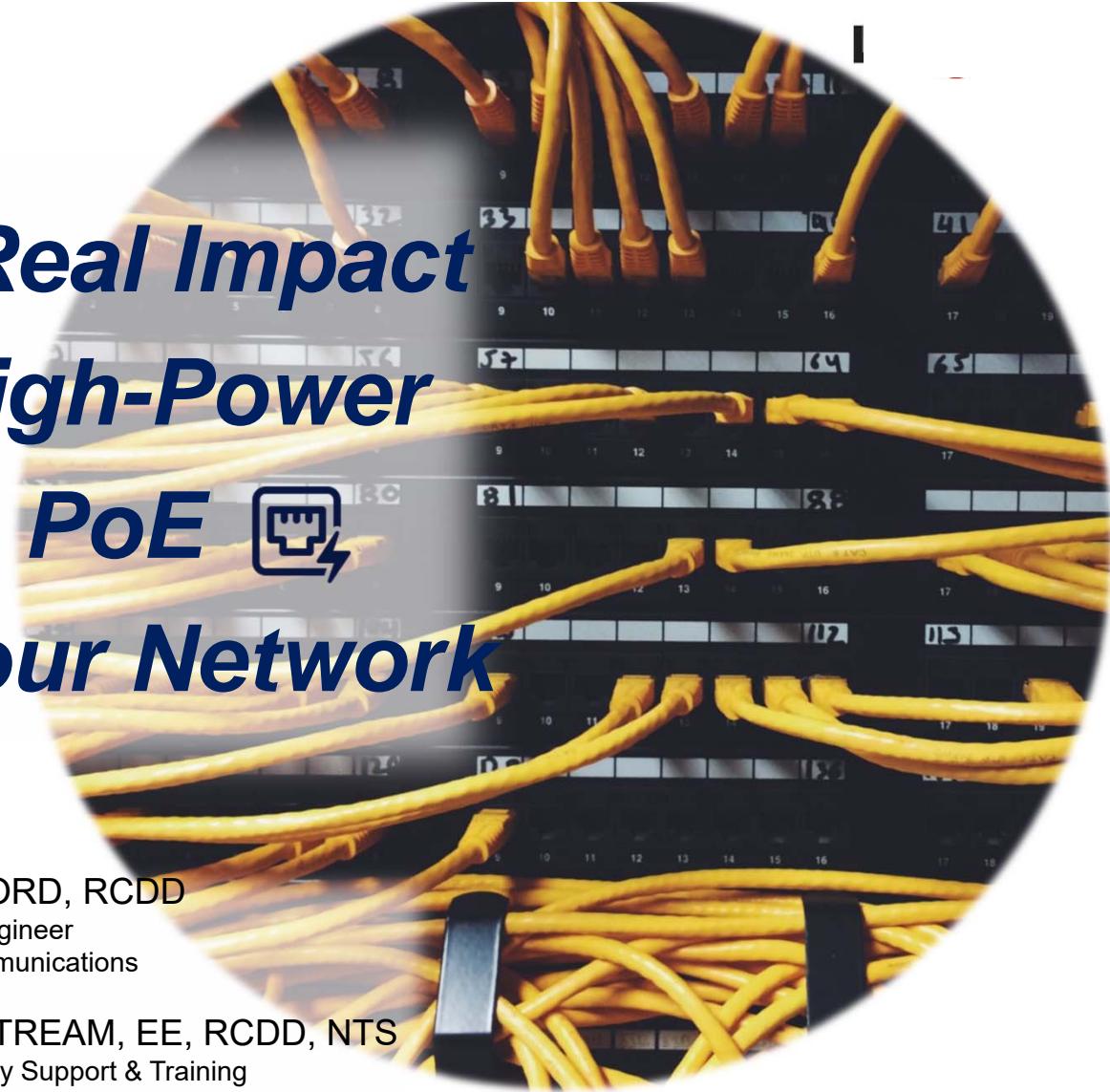


NECA • BICSI
SUMMIT 2023

The Real Impact of High-Power PoE on Your Network

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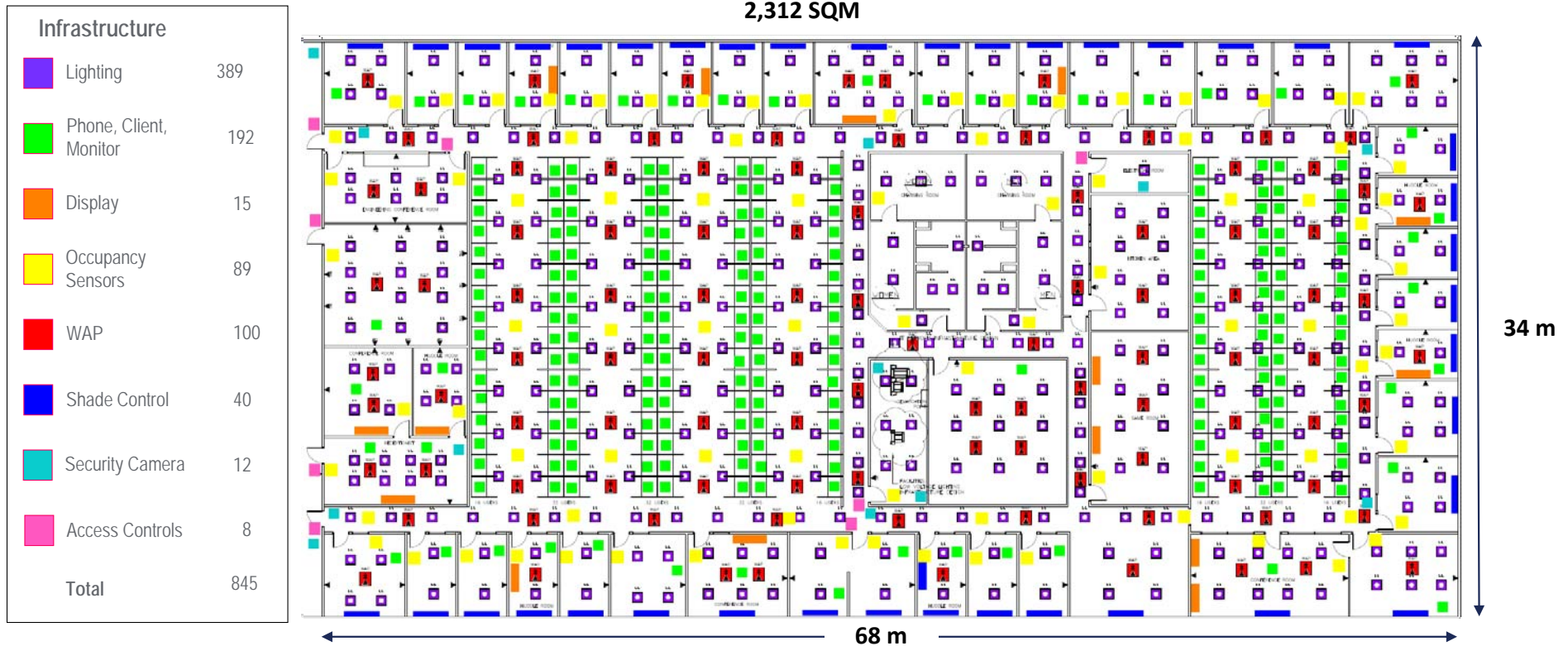


DISCUSSION

- Introduction
- Power Over Ethernet (PoE)
- The Real Impact of Hi-PoE & Design Considerations
- Case Studies
- Key Takeaways

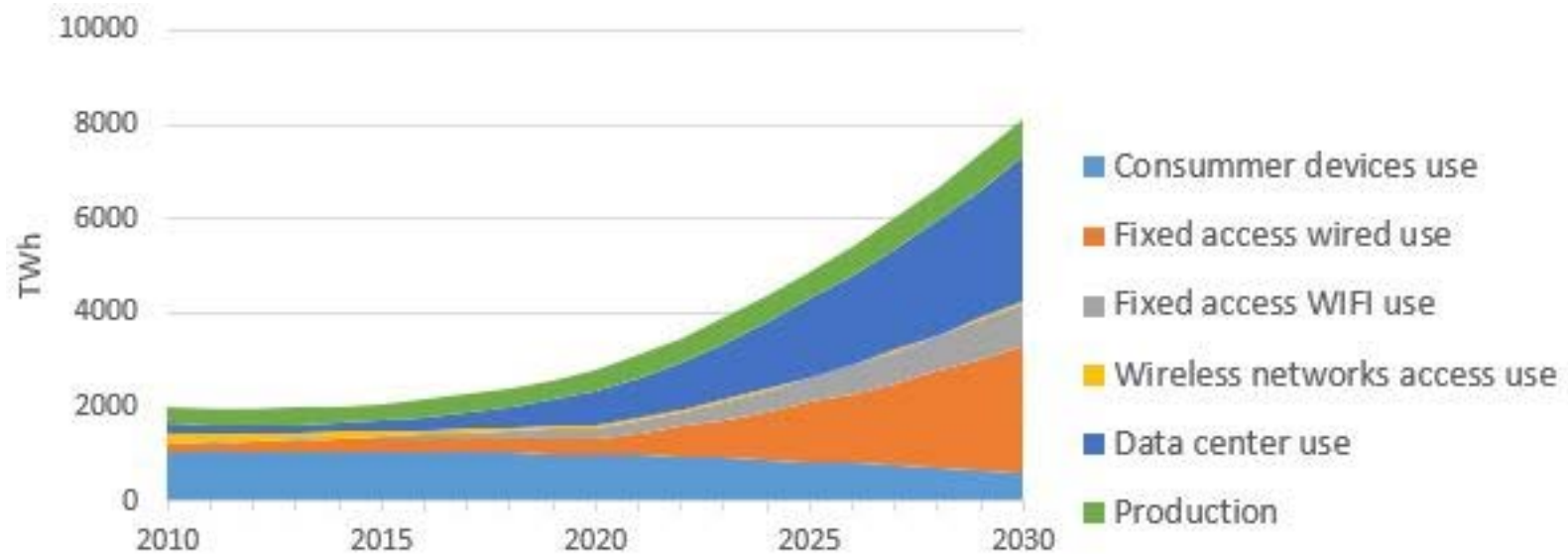


Demanding More From The Network Infrastructure



Thousands of meters of cable to support data and power

Power Consumption Linked To ICT, 2010 - 2030

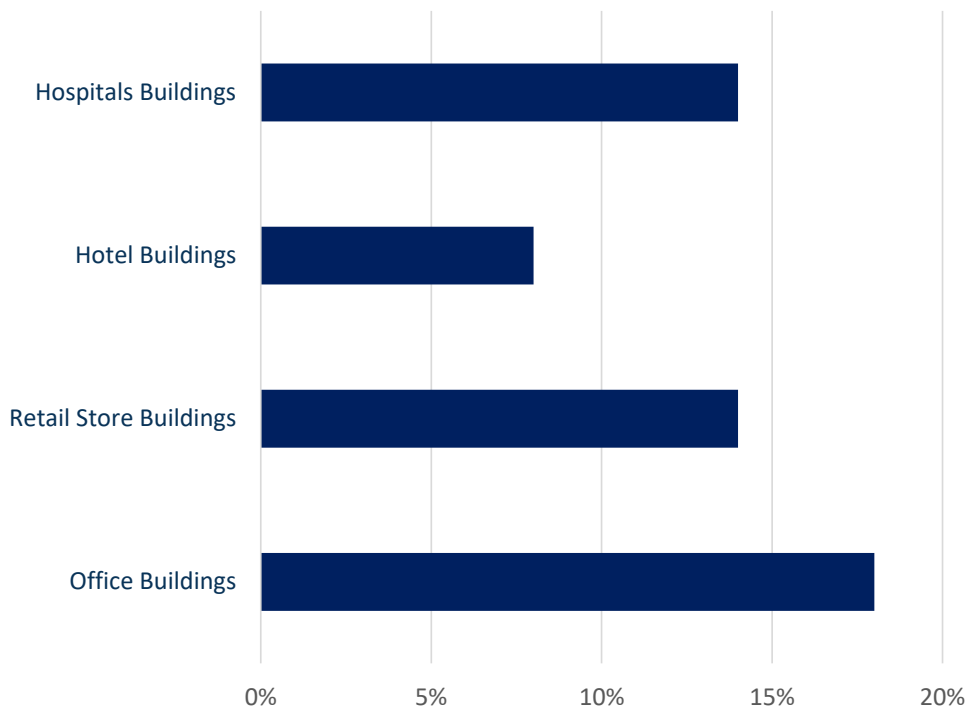


ICT accounts for between 5% and 9% of total electricity consumption, and their development suggests a deep transformation of energy systems, from smart networks to customer management or decentralized energy exchanges.

Source: [Enerdata](#)

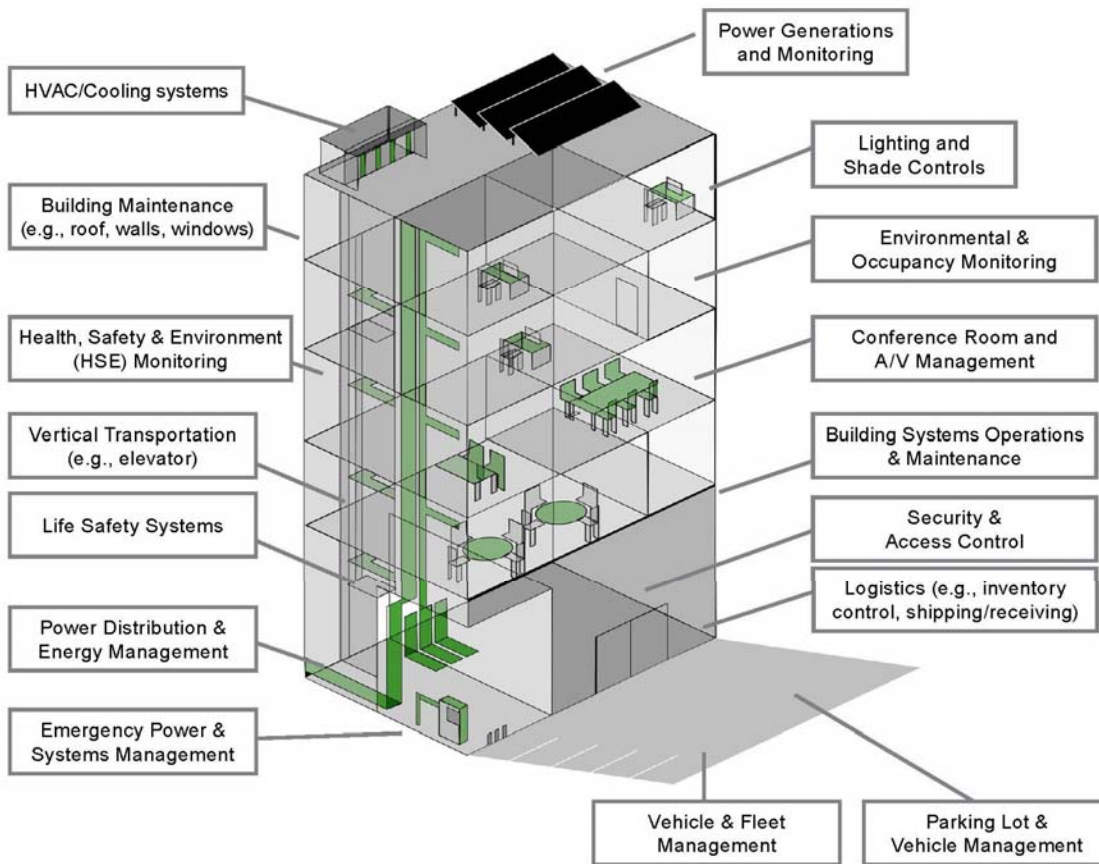
Sustainability Through Smart Building Technologies

Annual Whole-Building Energy Savings by Installing Smart Building Technology



Smart building technologies like occupancy sensors, smart thermostats, HVAC and lighting controls can significantly reduce energy consumption in a variety of building types.

What Is A “Smart Building”?



“A **smart building** is one with integrated technologies that are networked instead of separate, providing data to allow system adjustments based on the rules set in an automated environment or even an environment that is learning from the data.”

Source: BICSI/NECA - [The True Impact of High-Power Applications on Your Network](#)

Why Sustainable Smart Buildings?



ENHANCED OCCUPANT SATISFACTION

Guests can experience advanced control and customization using connected technology, and Operations will be made easy with accessible centralized control and notification platforms

CAPEX & OPEX COST SAVINGS

By using less physical materials, utilizing less expensive labor, and reducing energy consumption, luxury hospitality projects can **save money** on both capital and operational costs



REDUCED ENVIRONMENTAL IMPACT

Using DC Technology, we can **eliminate the use of fossil fuels**, and substantially reduce the operational and embodied carbon being used in the project

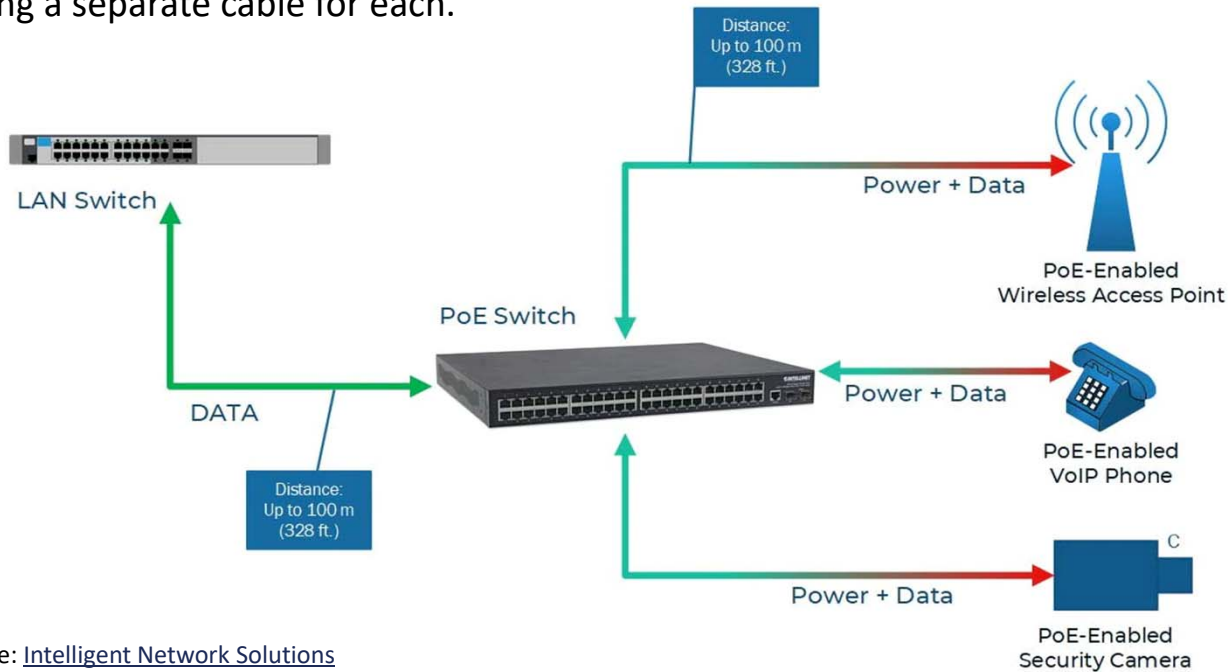


MORE USABLE SPACE

Using intelligent distributed design gives the opportunity to generate **more usable space** by eliminating the need for IDFs and Electrical Closets

What Is POE?

Power over Ethernet (PoE) is a technology that passes electric power over twisted-pair Ethernet cable to powered devices (PD), such as wireless access points, IP cameras, and VoIP phones, in addition to the data that the cable usually carries. It enables one RJ45 cable to provide data connection and electric power to PDs instead of having a separate cable for each.



Source: [Intelligent Network Solutions](#)

PoE Standards

PoE Standard	PoE Common Name	Power Output	Year	Comment
IEEE 802.3af	PoE	15.40 W	2003	12.95 W power available for connected device (PD)
IEEE 802.3at	PoE+	30 W	2009	25.50 W power available for connected device (PD)
IEEE 802.3bt Type 3	4PPoE, Ultra PoE, UPoE	60 W	2018	51 W power available for connected device (PD)
IEEE 802.3bt Type 4	Ultra PoE, UPoE	100 W	2018	71 W power available for connected device (PD)



Source: [Intelligent Network Solutions](#)

Electrical Specifications of PoE Standards

For most users, the "Minimum power for PD" value is the most significant, as that value dictates which PoE standard provides sufficient power for the required application.

PoE Standard	Voltage @ PD	Voltage @ PSE	Minimum power for PD*	Maximum output @ PSE	Supported Modes	Maximum cable length
IEEE 802.3af	37-57 V	44-57 V	12.95 W	15.40 W	Mode A + B	100 m
IEEE 802.3at	42.5-57 V	50-57 V	25.5 W	30 W	Mode A + B	100 m
IEEE 802.3bt Type 3	42.5-57 V	50-57 V	51 W	60 W	Mode A + B, 4-pair mode	100 m
IEEE 802.3bt Type 4	41.1-57 V	52-57 V	71 W	100 W	Mode A + B, 4-pair mode	100 m

* Short distances via high-quality cable result in power values that are closer to the power output at the PSE.

NOTE: High-quality may result in achieving power and data transmission beyond the 100m standard.

Source: [Intelligent Network Solutions](#)

PoE: Creating a World of Building Endpoints



Base building services



Tenant Access & Security



Workspace Transformation



Access Points



HVAC VAV's



Ceiling Fans



Smoke alarm



Power Meter



Touchscreen PC's



Surveillance cameras



Biometric Door Locks



Facial Recognition Systems



Entry Barriers And Turnstiles



Badge readers



IP Call Tower



Meeting Room Nameplate



POE Displays



Temp Sensor



Light Fixtures



Status Signs



Horns and Sirens



IP Call Stations



Environmental Sensor Hubs

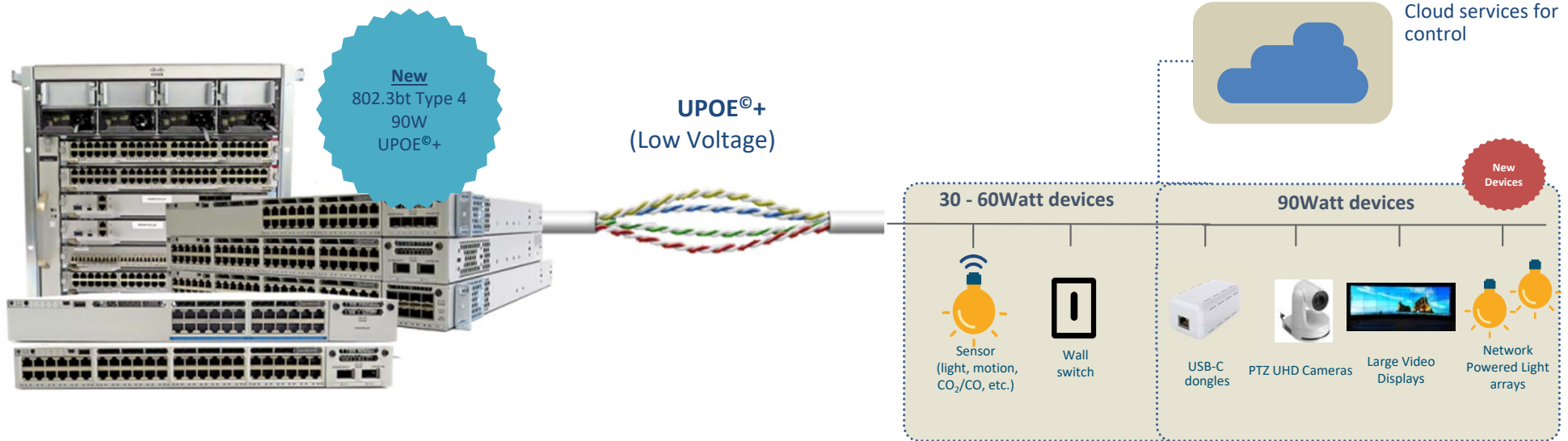


Blind Motors



Curtain Motors

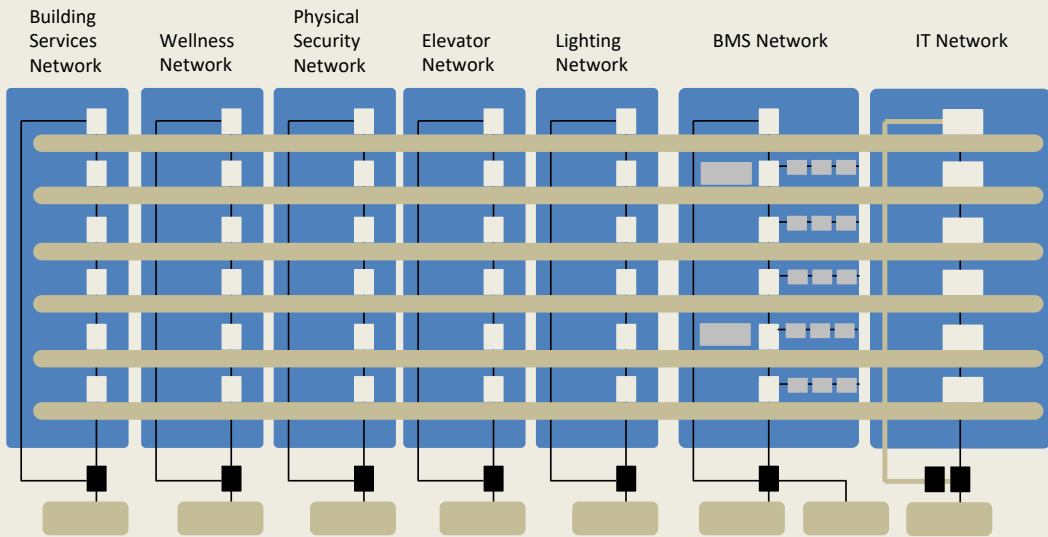
PoE: Enables Greater ROI for IT/OT Convergence



End-to-end solution managed by central IT provides lowered costs, intelligent control, and new experiences.

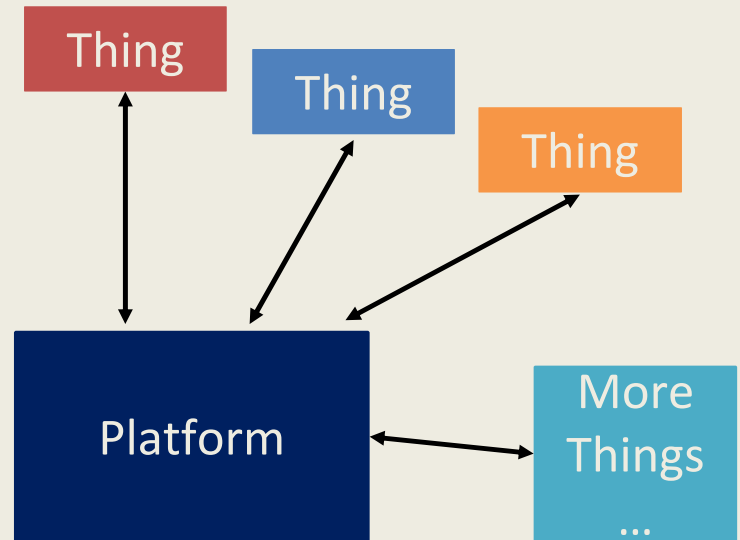
PoE: Eliminates Duplicity & Waste – Enables Convergence

Current state



Multiple, physically separate networks

Future state



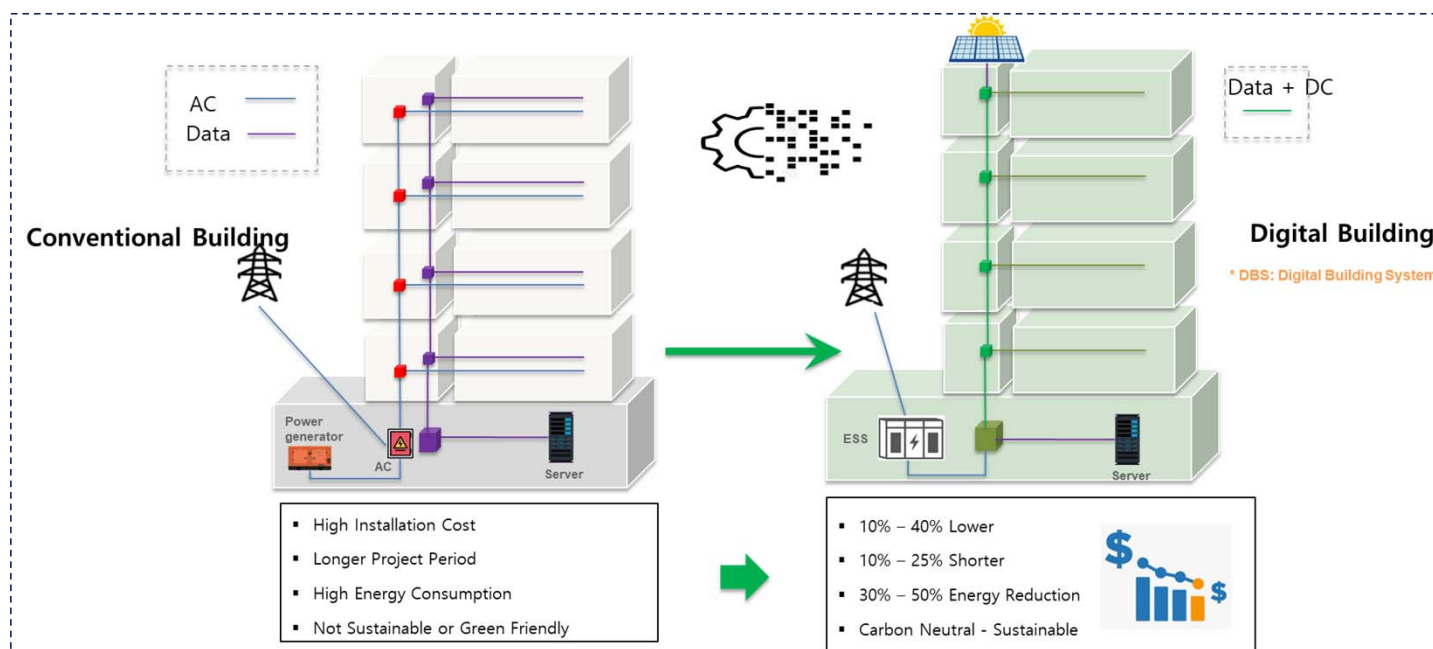
Software defined, AI converged network

Courtesy of ACA

Advantages of Deploying PoE

- Reliability
- Cost Effectiveness
 - Cable
 - Design Flexibility
 - Energy Consumption
- Broad Applications
- Revolutionizes Smart Buildings
- Enables IoT Convergence
- Backwards Compatible

Digital Transformation of Smart Buildings



Source: [Versatek - 7 Myths About Power over Ethernet \(PoE\)](#)

The Real Impact of Hi-PoE on Your Network

- What is Hi-PoE?

Name	Power Available to PD	Ethernet Pairs	Power Delivered by PSE	Min.Cable Rating for PoE
High Power PoE (Hi-PoE)	71.3W	4-Pair	90W to 100W	Cat5e or higher
High Power PoE (PoE++)	51W	2-Pair or 4-Pair	60W	Cat5e or higher

- Challenges

- Delivering up to 100 watts of power while.....
 - Maximizing power efficiency
 - Maintaining data integrity
 - Maximizing life span of cabling
- Justifying Capex & ROI

Source: FS Community - [Understanding IEEE 802.3bt High Power PoE \(Hi-PoE\)](#)

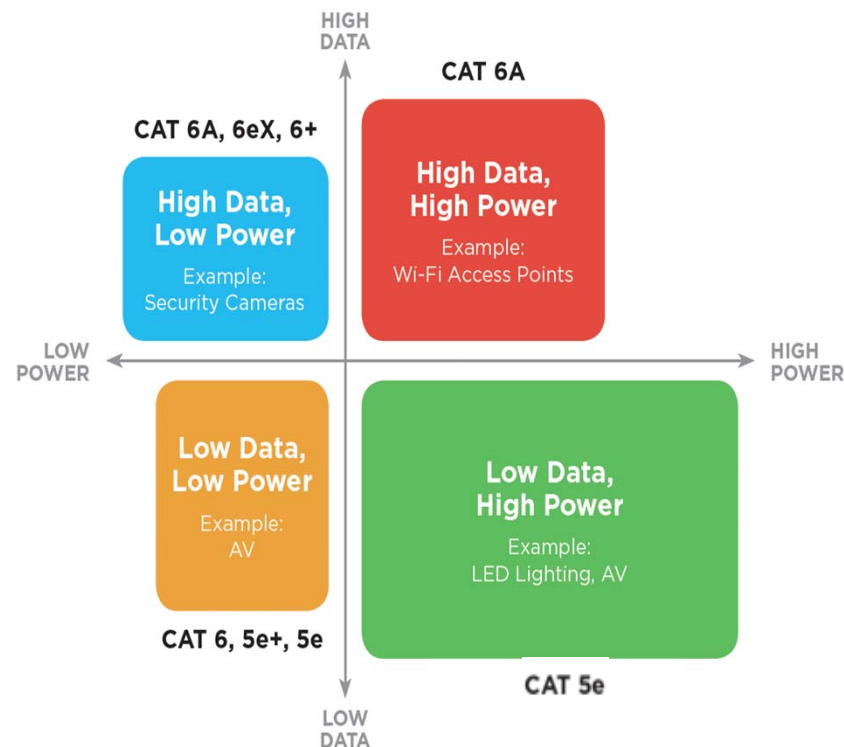
Hi-PoE on Your Network – Network Speed

- Uses For High Power PoE Switches
 - Flexibility & Scalability
 - Extended network and power coverage
 - Time & Cost Savings
 - No need for additional electrical power outlets
 - Reliability
 - Remote power-management capabilities that support both IPv4 & IPv4/6 addressing
 - Simple and efficient monitoring & control over powered devices
 - Reliable for smart buildings or IoT deployment as the network scale & complexity increase.

Source: FS Community - [Understanding IEEE 802.3bt High Power PoE \(Hi-PoE\)](#)

Hi-PoE on Your Network – Power Efficiency

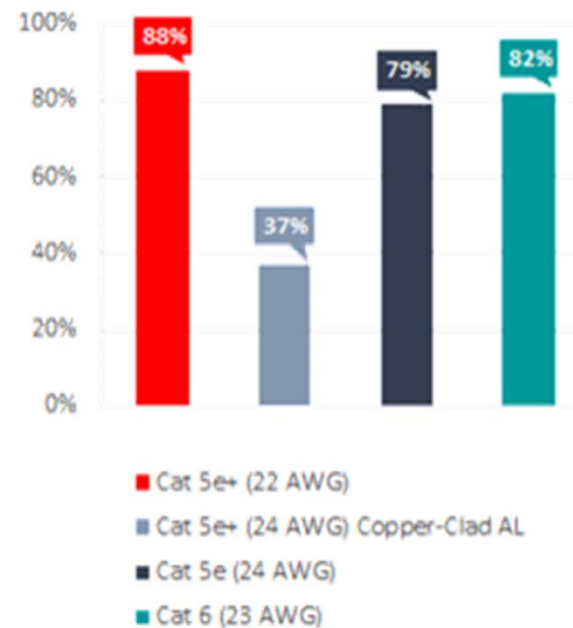
- What is the Application?
 - High-speed Data vs. High power vs. Mix
 - Is AWG more important than the cable performance category?
- If high power is your main application, a high-performance category cable may not provide the best ROI



Hi-PoE on Your Network – Power Efficiency

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Power Efficiency Per 100m Length



Hi-PoE on Your Network - Temperature

Higher Temp = Higher Attenuation

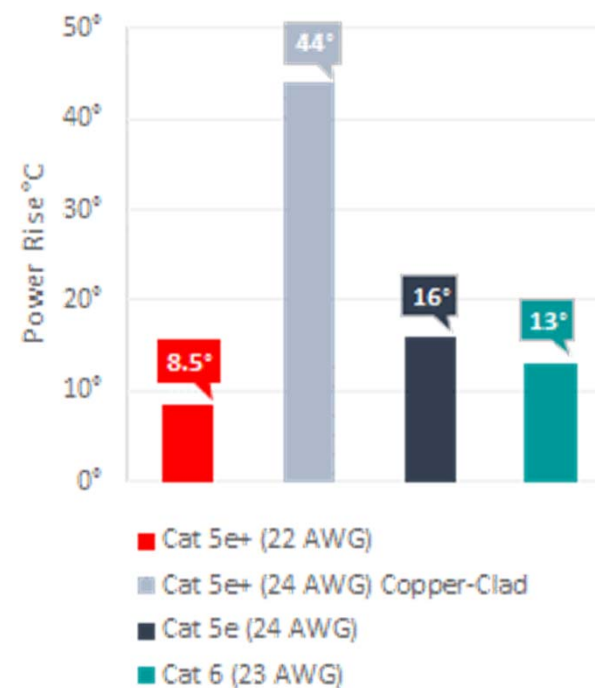


Higher Attenuation = Signal loss



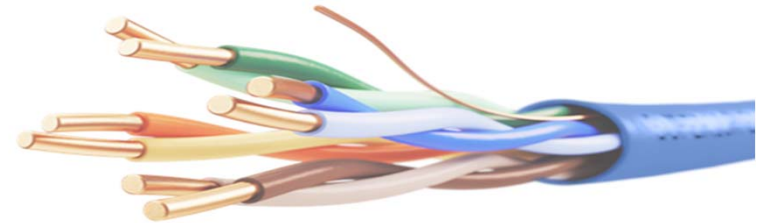
Signal Loss = Shorter Channel Distance

Temperature Rise in 100 Cable Bundle

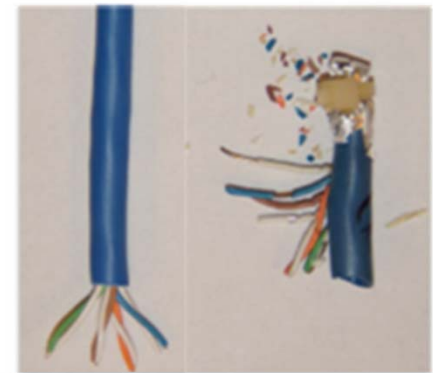


Hi-PoE on Your Network - Temperature

- **Gauge Size**
Larger copper gauge = less heat & better mitigation of rising heat
- **Cable Size**
Larger cables are better at dissipating heat
- **Temperature rating**
 - Cables with a higher temp rating = better ability to mitigate heat rise
 - 100% FEP (Plenum) insulation will have a higher rating than partial FEP or polyolefin insulation (Riser)
- **Other elements of cable construction**
Shielded products dissipate heat down the length of the cable & improve heat dissipating capability



Top Challenges of Implementing Cost-Efficient 4PPoE (IEEE 802.3bt) Cable Solutions



Cable Sample #2 with Polyolefin insulation after 10 days at 120°C

Hi-PoE on Your Network - Temperature

	Cat 5E+	Cat 6A	Cat 6
AWG	22	23	23
Design	UTP	F/UTP	UTP
Energy Savings (W)	300	90	0
Temperature Increase (°F)	+10	+13	+20



- 100 cables in a bundle
- 100 meters
- 100W for 5 days

Hi-PoE on Your Network - Temperature

LP (Limited Power) Cabling

- 2017 NEC
- Addresses only safe use.
- Not a performance specification



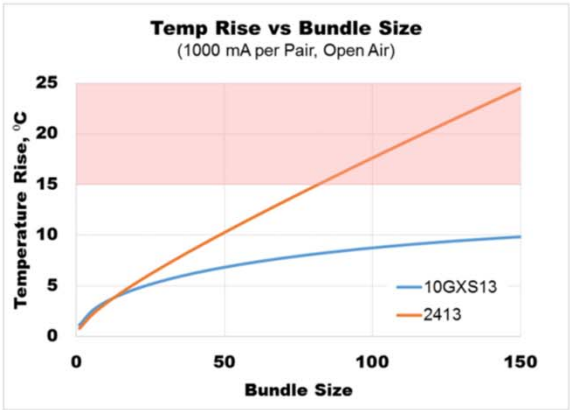


LP Ratings are required when

- Power is over 60W

AND

- Cable bundle size is not controlled



LP Rating Permits

- Cables carrying <= 60W to be bundled at will
- Cables carrying over 60W must be LP Rated or follow NEC's table 725.144 in the NEC

Hi-PoE on Your Network - Temperature

NEC Ampacity Table 725.144

AWG	Number of 4-Pair Cables in a Bundle																	
	1-7			8-19			20-37			38-61			62-91			92-192		
	Temp Rating			Temp Rating			Temp Rating			Temp Rating			Temp Rating			Temp Rating		
	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
	Maximum Current (A) per Conductor																	
26	1.00	1.23	1.42	0.71	0.87	1.02	0.55	0.68	0.78	0.46	0.57	0.67	0.45	0.55	0.64	NA	NA	NA
24	1.19	1.46	1.69	0.81	1.01	1.17	0.63	0.78	0.91	0.55	0.67	0.78	0.46	0.56	0.65	0.40	0.48	0.55
23	1.24	1.53	1.78	0.89	1.11	1.28	0.77	0.95	1.10	0.66	0.80	0.93	0.58	0.71	0.82	0.45	0.55	0.63
22	1.50	1.86	2.16	1.04	1.28	1.49	0.77	0.95	1.11	0.66	0.82	0.96	0.62	0.77	0.89	0.53	0.63	0.71

Table 725.144, Ampacities of Each Conductor (in Amperes) in a 4-Pair Class 2 or Class 3 Data Cables, Based on Copper Conductors at Ambient Temperature of 30°C (86°F) with all Conductors in All Cables Carrying Current, 60°C (140°F), 75°C (167°F) and 90°C (194°F) Rated Cables

Hi-PoE on Your Network - Connectivity

➤ **Interface contact displacement (spark gap)**

Prevent arc damage

➤ **Increase electrical area for power**

Support higher current

➤ **Improved housing cavity**

Withstand usage, extended life cycle, improved electrical performance

➤ **Improved cavity airflow**

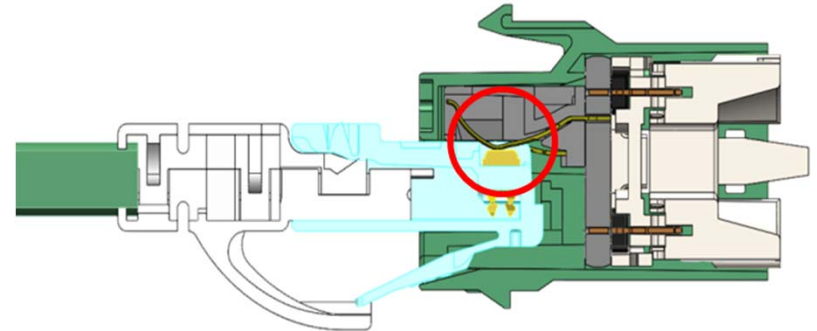
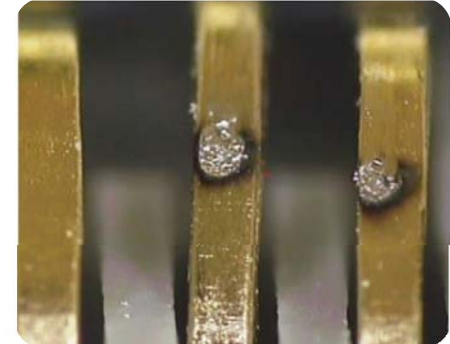
Heat dissipation

➤ **Power transfer heat dissipation**

Support higher current

➤ **Connectivity Selection**

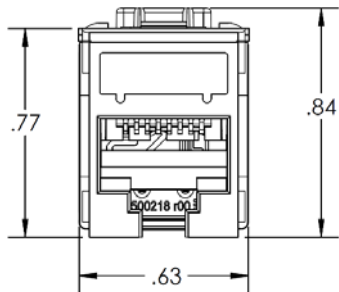
Ready for emerging devices & designed to withstand the stressors of usage and extended life cycles



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

Hi-PoE on Your Network - Connectivity

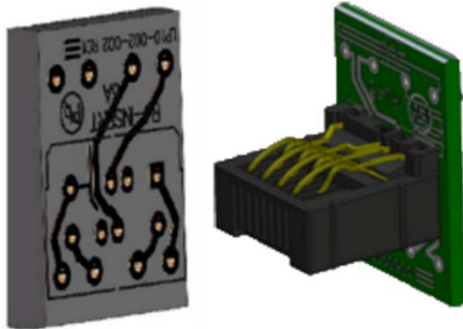


- IEC 60512-99 recommendations support 1 amp on each circuit path

802.3af supports a max of 350mA

802.3at supports a max of 600mA

802.3bt supports a max of **960mA**



- 960mA is **dangerously close** to 1 amp
 - Connectivity should be designed to support at least 1.5A
- Pick connectivity ready for emerging devices & designed to withstand the stressors usage and extended life cycles

Power-over-Ethernet Standards & Codes

Applications



- IEEE 802.3

Cabling, performance, premises & best practices



- TIA /TSB 184-A



- BICSI 005--2013
- BICSI 007--2017

Codes



- NEC 2017

No Standard for Hi-PoE on Your Network – Extended Distance applications

Hi-PoE on Your Network – Extended Distance applications

In Reality . . .

The longest the twist lay and core lay affect how far you can extend the distance

Critical electrical characteristics: Delay Skew and Propagation Delay



Not a question of Category

Cat 6A will not necessarily extend the performance distance further than Cat 6 or Cat 5e

Cables are designed for 100m per the standard

Hi-PoE on Your Network – Extended Distance applications



BER, is the only valid test to check how far a signal will transmit for a device



Test performed at ambient temperature (Type 1 and 2) and LP temperature of the cable (Type 3 and 4)



Direct attached: furthest horizontal cabling



Power efficiency



For security cameras, we tested low grade, mid grade and high-grade cameras

Hi-PoE on Your Network – Conclusions

- Very Reliable
- Cost Effective
 - Cable
 - Design Flexibility
 - Energy Consumption
- Supports Broad Applications
- Revolutionizes Smart Buildings
- Enables IoT Convergence
- Backwards Compatible
- Temperature & Connectivity Challenges are easily Mitigated
- Extended distance application



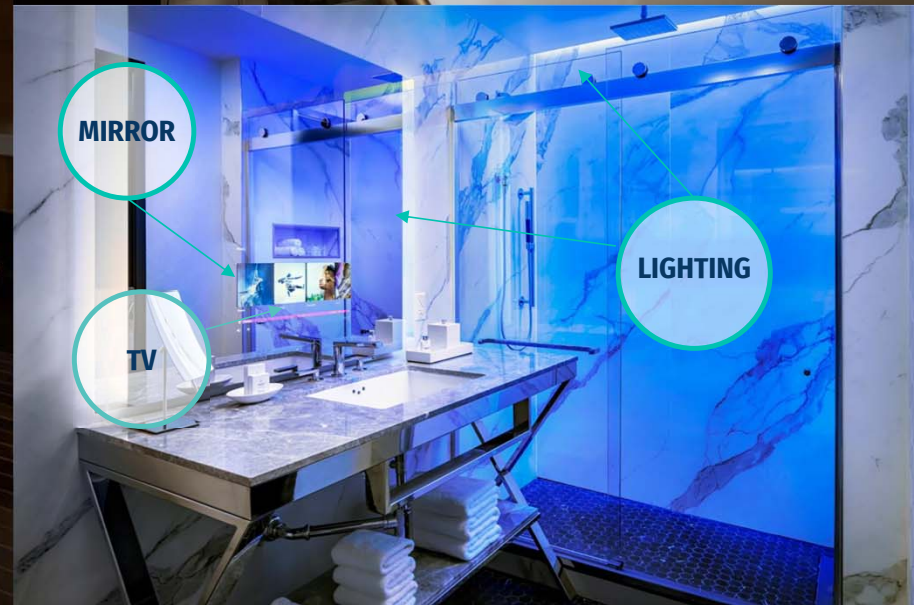
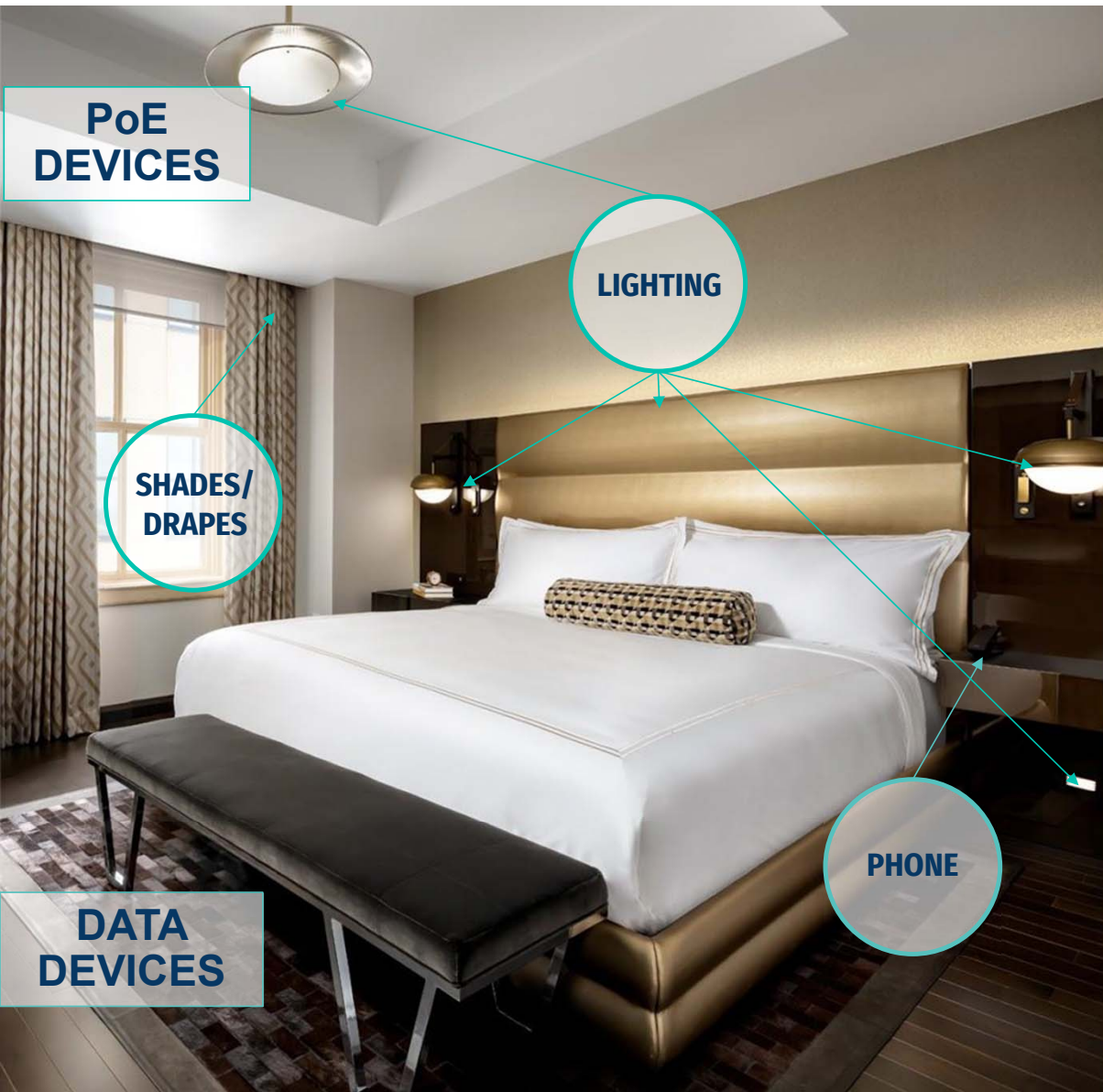
The Sinclair Hotel

A Marriott Autograph
property
Fort Worth, Texas

Sinclair Hotel - Overview

- The first hotel in the world to use PoE (Power over Ethernet) to power all lighting, mini-refrigerators, smart mirrors, & motorized window treatments.
- Results:
 - 39% Energy savings month to month vs. pre-renovation
 - 16% CapEX Savings (1st Install construction savings)
 - 50% fewer electrical and IDF closets
 - Reduction of incoming power to building from 3000 Amps to 2500 Amps
 - Decreased Construction Time
 - Substantial Reduction of electrical labor and materials

Source: [Sinclair Digital, LLC](#)





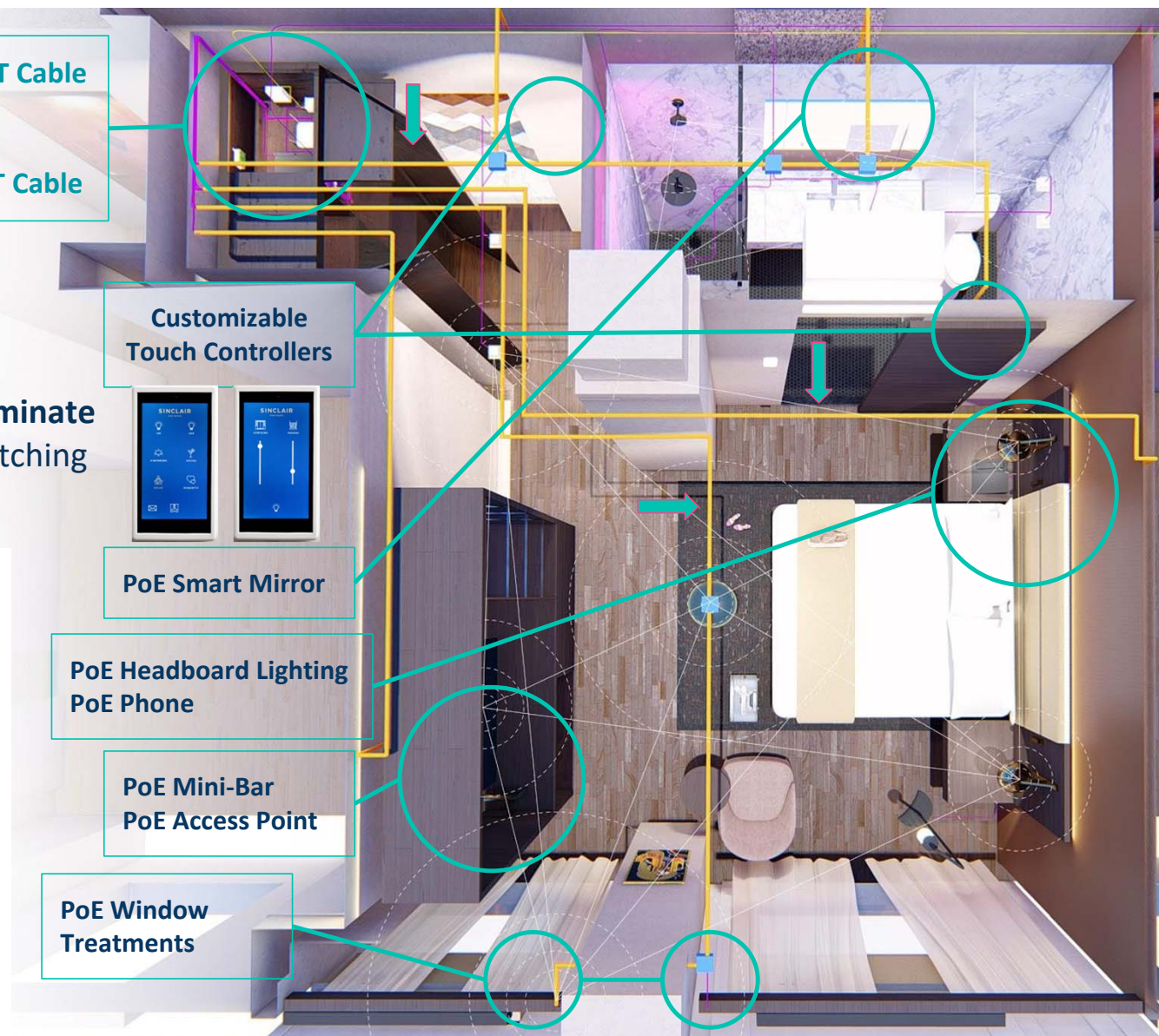
Network Switch: 1X CAT Cable
GPON: 1X Fiber
DE Receiver: 1X 18/2
Lighting Drivers: 4X CAT Cable

SINCLAIR HOTEL ROOM TYPICAL TOPOLOGY

Hotel rooms use a distributed network to **eliminate IDF closets** from the floor by locating the switching and GPON components inside the room.

Other key features include:

- Use of conduits behind sheet rock to enable future proofing of infrastructure
- Customizable Touch Panels: 2X Category Cable
- PoE smart mirror: 2X Category Cable
- LV light fixtures: 10X 18/2
- PoE mini-refrigerator: 1X Category Cable
- PoE window treatments: 3X Category Cable
- Bluetooth sensors enabling occupant detection, associate alert, people counting, and device tracking: 1X Category Cable



Key Takeaways (Conclusions)

- The real impact of Hi-PoE on IP networks is minimal. Challenges in deployment are easily mitigated
- Hi-PoE has kept pace with the evolution of IoT devices and is a safe, reliable power source
- The latest generation of Hi-PoE—802.3bt—has a higher power with more efficient delivery and backward compatibility
- Hi-PoE maximizes the ROI of technology and power distribution deployment
- Implementation of Hi-PoE prepares for the future today!



Thanks!

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