IOT: INTELLIGENT LED LIGHTING

Gustavo Demesa G., RCDD

nCompass System

Enabled by Legrand – Superior Essex

AGENDA

CONNECTED WORLD
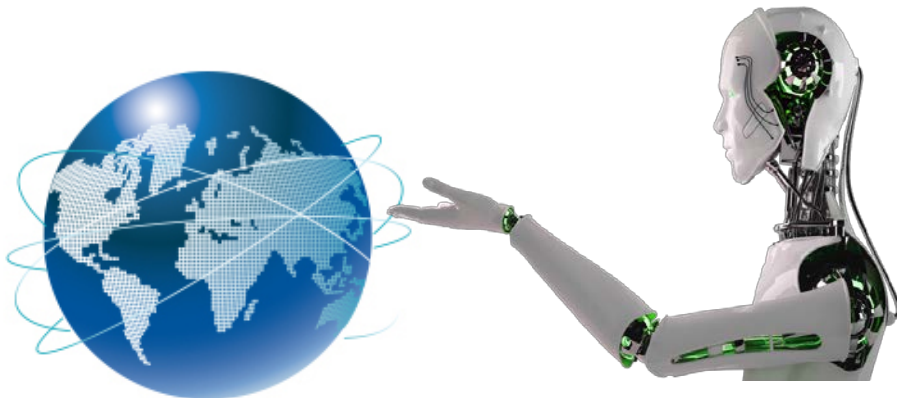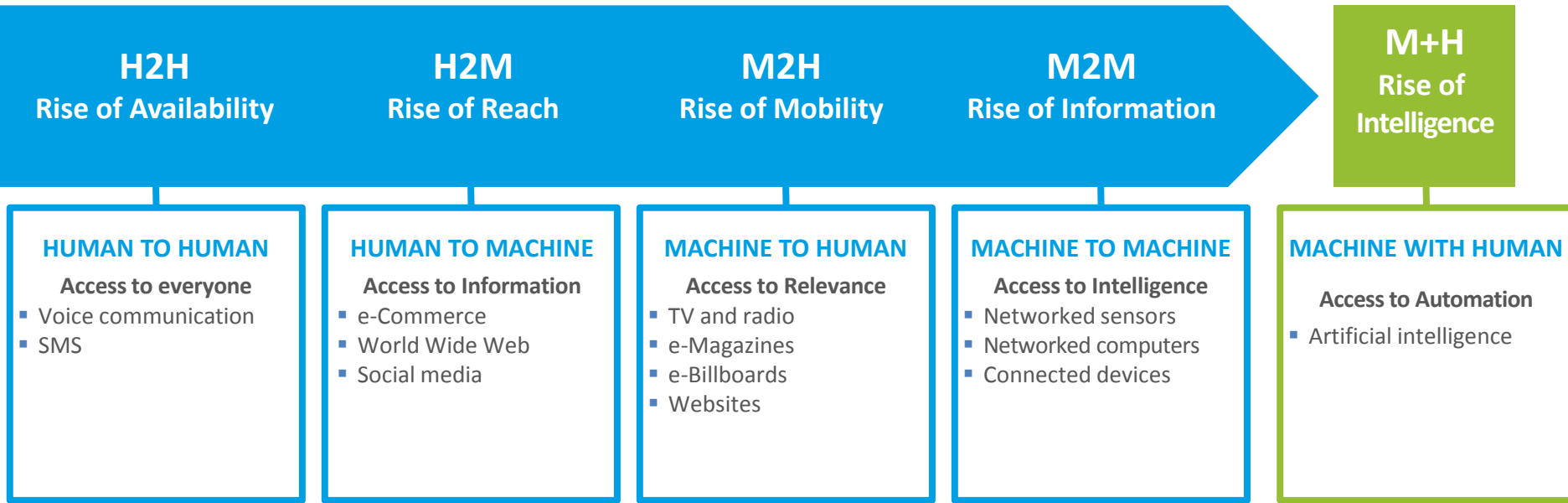
IOT - BLOCKS AND TOPOLOGY

POWER AND DATA CONVERGENCE

LED LIGHTING

Connected World Evolution

H2H **Rise of Availability**	H2M **Rise of Reach**	M2H **Rise of Mobility**	M2M **Rise of Information**	M+H **Rise of Intelligence**

HUMAN TO HUMAN

Access to everyone
- Voice communication
- SMS

HUMAN TO MACHINE

Access to Information
- e-Commerce
- World Wide Web
- Social media

MACHINE TO HUMAN

Access to Relevance
- TV and radio
- e-Magazines
- e-Billboards
- Websites

MACHINE TO MACHINE

Access to Intelligence
- Networked sensors
- Networked computers
- Connected devices

MACHINE WITH HUMAN

Access to Automation
- Artificial intelligence

Bicsi

Connected World Trends

Building Networks

Intelligent Building

Data and Power Convergence

Building Wireless

Fog Computing and IoT Gateways

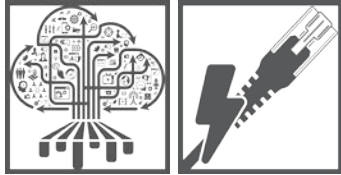**Data Centers**

Cloud vs. Enterprise

Micro Data Centers

Control/DCiM

BICSI

Connected World Impacts

Building Networks

IoT and PoE

Trade Convergence

Increased Mobility Demands

Security and IAM

Data Centers

Increased Density Demands

Availability, Latency, and Bandwidth

Power from Data Centers

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

Sound Masking

Cameras

Occupancy Sensors

Access Controls

Wi-Fi

Lighting Controls

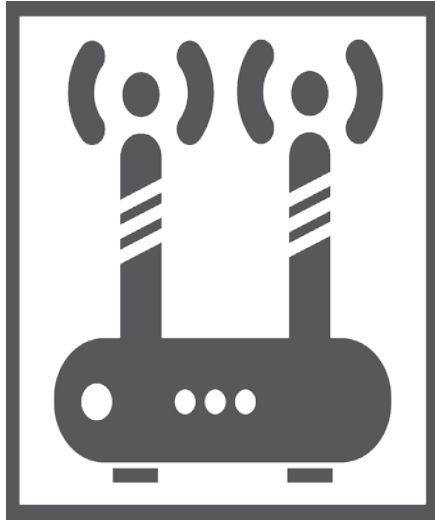**Intelligent LED Lighting**

HVAC Sensors

IP Phone

Digital Signage
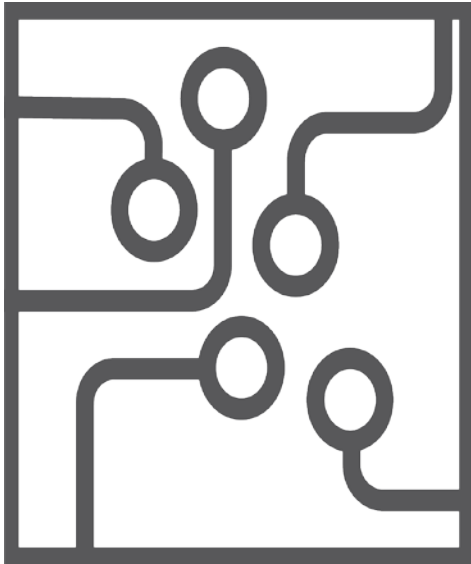
Laptops & Computers

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
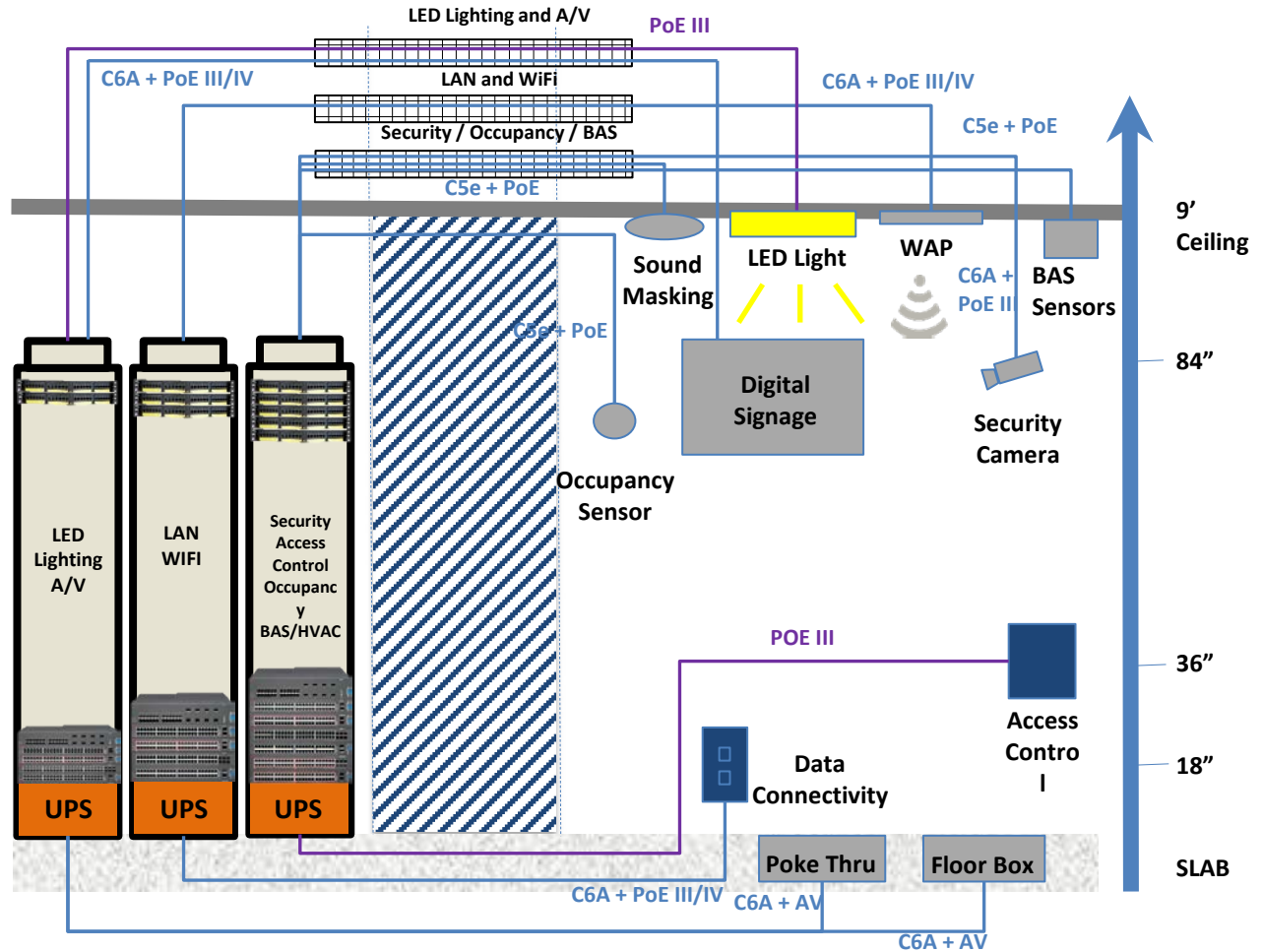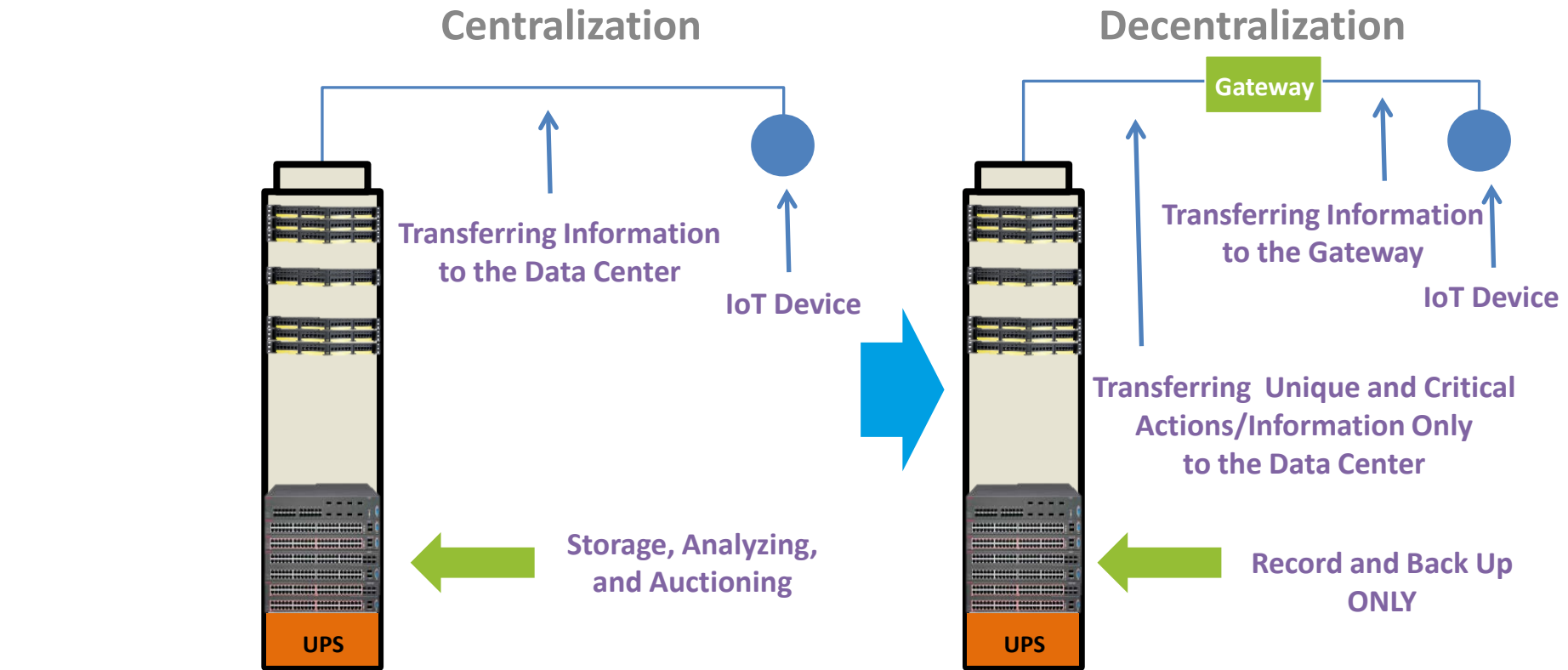
Building Blocks – IAM

The security discipline that enables the right individuals to access the right resources at the right times for the right reasons

TOPOLOGY - Centralized

Decentralization Impacting Our Mindshare

Centralization

Transferring Information to the Data Center

IoT Device

Storage, Analyzing, and Auctioning

UPS

Decentralization

Gateway

Transferring Information to the Gateway

IoT Device

Transferring Unique and Critical Actions/Information Only to the Data Center

Record and Back Up ONLY

UPS

Collect and Act Closer to the Source and Manage the Value of the Content

Bicsi

TOPOLOGY - Decentralized

Gateways — A/C

C6A or Fiber

Security Occupancy | LED Light | LAN/Wifi

C5e/PoE

C5e/PoE

POWERWISE PoE III   C6A/PoE

9' Ceiling

C5e/PoE

Sound Masking

LED Light

WAP

BAS Sensors

C6A/POE

84"

Occupancy Sensor

Security Camera

Digital Signage

LAN/WiFi

LED Light AV

Security Access Control

POWERWISE + PoE III

Access Control

36"

UPS | UPS | UPS

Data Connectivity

18"

C6A/POE

Poke Thru

Floor Box

SLAB

C6A + AV

C6A + AV

Bicsi
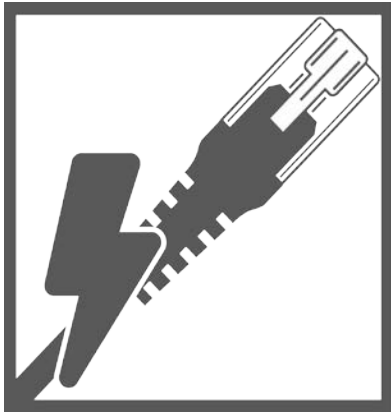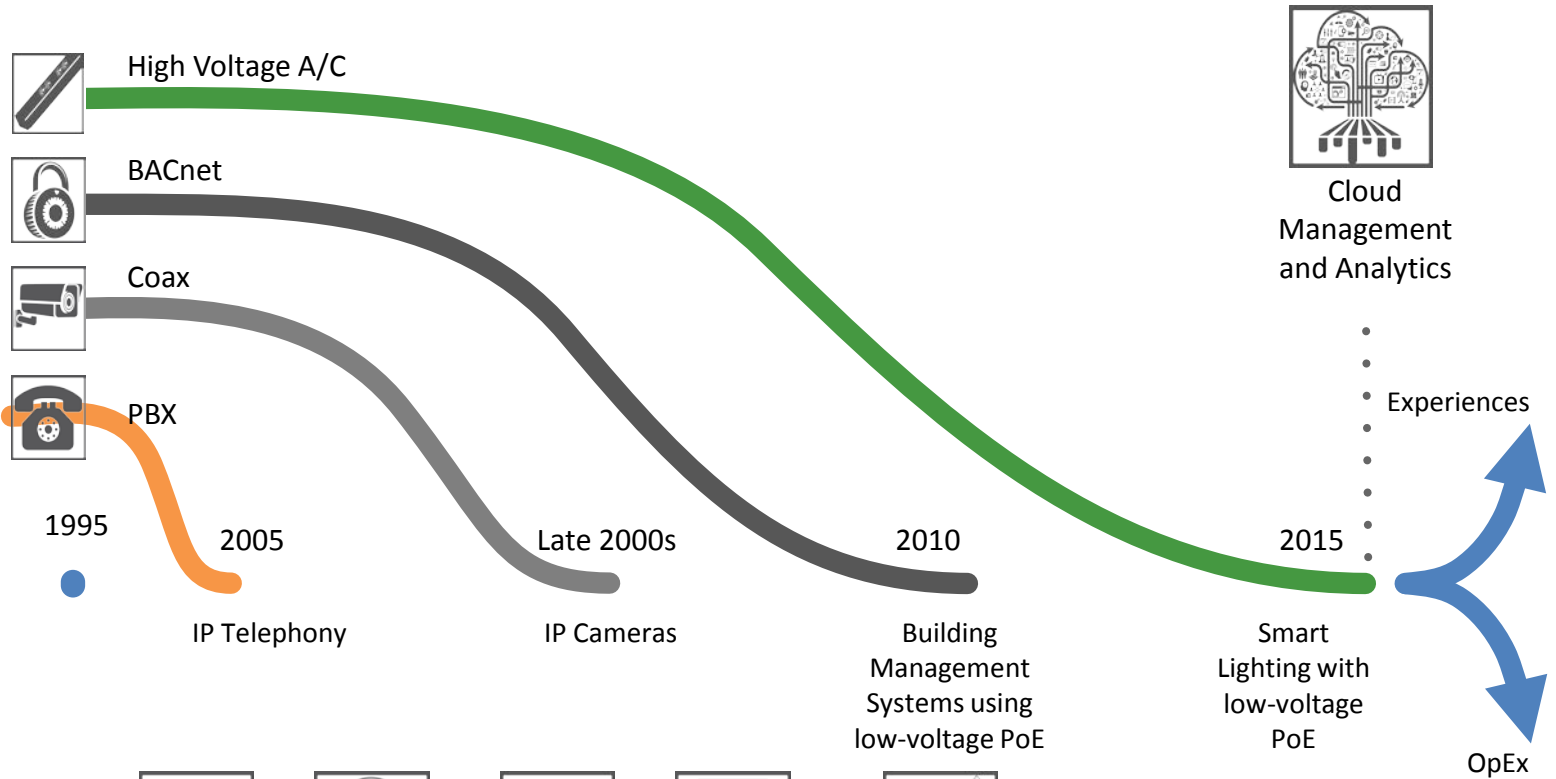
PoE, PoE+ and Beyond

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.

IP Convergence

High Voltage A/C

BACnet

Coax

PBX

Cloud Management and Analytics

Experiences

1995

2005

Late 2000s

2010

2015

IP Telephony

IP Cameras

Building Management Systems using low-voltage PoE

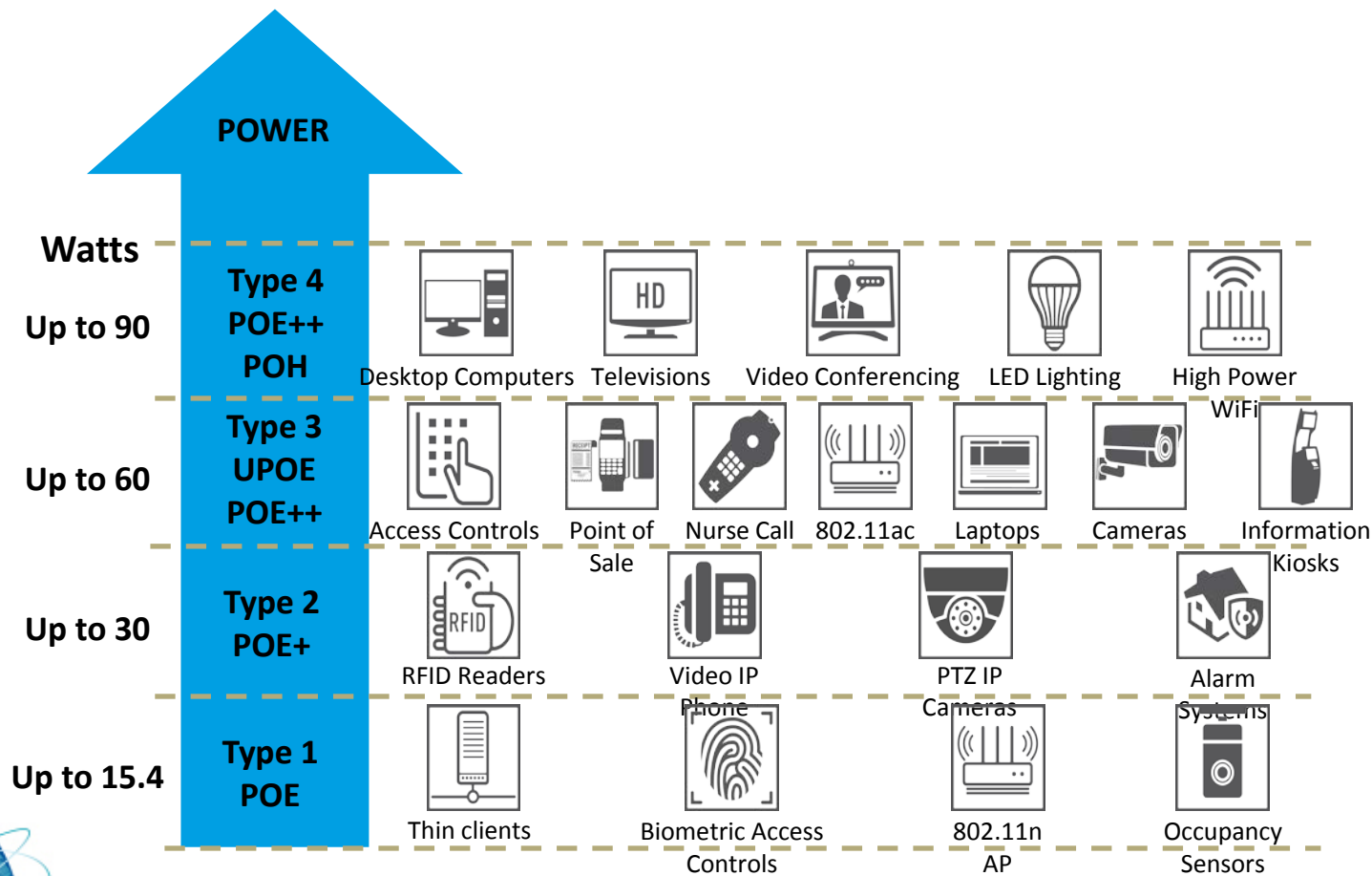Smart Lighting with low-voltage PoE

OpEx

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 ↑

Watts		
Up to 90	**Type 4 POE++ POH**	Desktop Computers, Televisions, Video Conferencing, LED Lighting, High Power WiFi
Up to 60	**Type 3 UPOE POE++**	Access Controls, Point of Sale, Nurse Call, 802.11ac, Laptops, Cameras, Information Kiosks
Up to 30	**Type 2 POE+**	RFID Readers, Video IP Phone, PTZ IP Cameras, Alarm Systems
Up to 15.4	**Type 1 POE**	Thin clients, Biometric Access Controls, 802.11n AP, Occupancy Sensors

	IEEE 802.3af	IEEE 802.3at	Cisco Proprietary	Power over HDBase-T	IEEE 802.3bt	
Common Name	PoE	PoE+	UPOE (non standard)	POH	POE++	
Type	I	II			III	IV
Status	2003	2009	2011	2011	Draft-2017	Draft-2017
Maximum number of pairs	2	2	4	4	4	4
Maximum DC current per pair	350 mA	600 mA	600 mA	1000 mA	960 mA	960 mA
Maximum power from PSE	15.4 W	34.2 W	60 W		60 W	100 W
Maximum power at PD	12.9 W	25.5 W		71 W	49 W	71 W
Voltage Rate at PSE	44 V-57 V	50 V-57 V		50 V-57 V		
Maximum Ambient Temp	60°C	50°C			50°C	50°C
Max Cable Bundle	ND	100	100	Cat 6: 48 Cat 5: 24		
Max Temp Rise			10 C			10 C

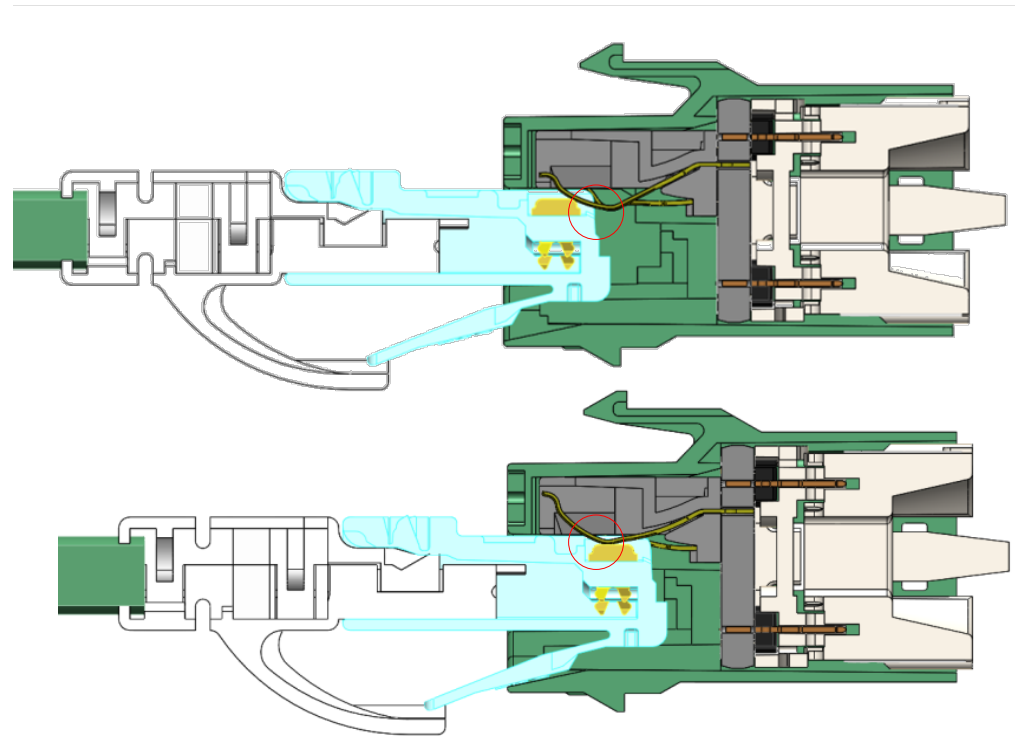# PoE Standards and Commercial Options
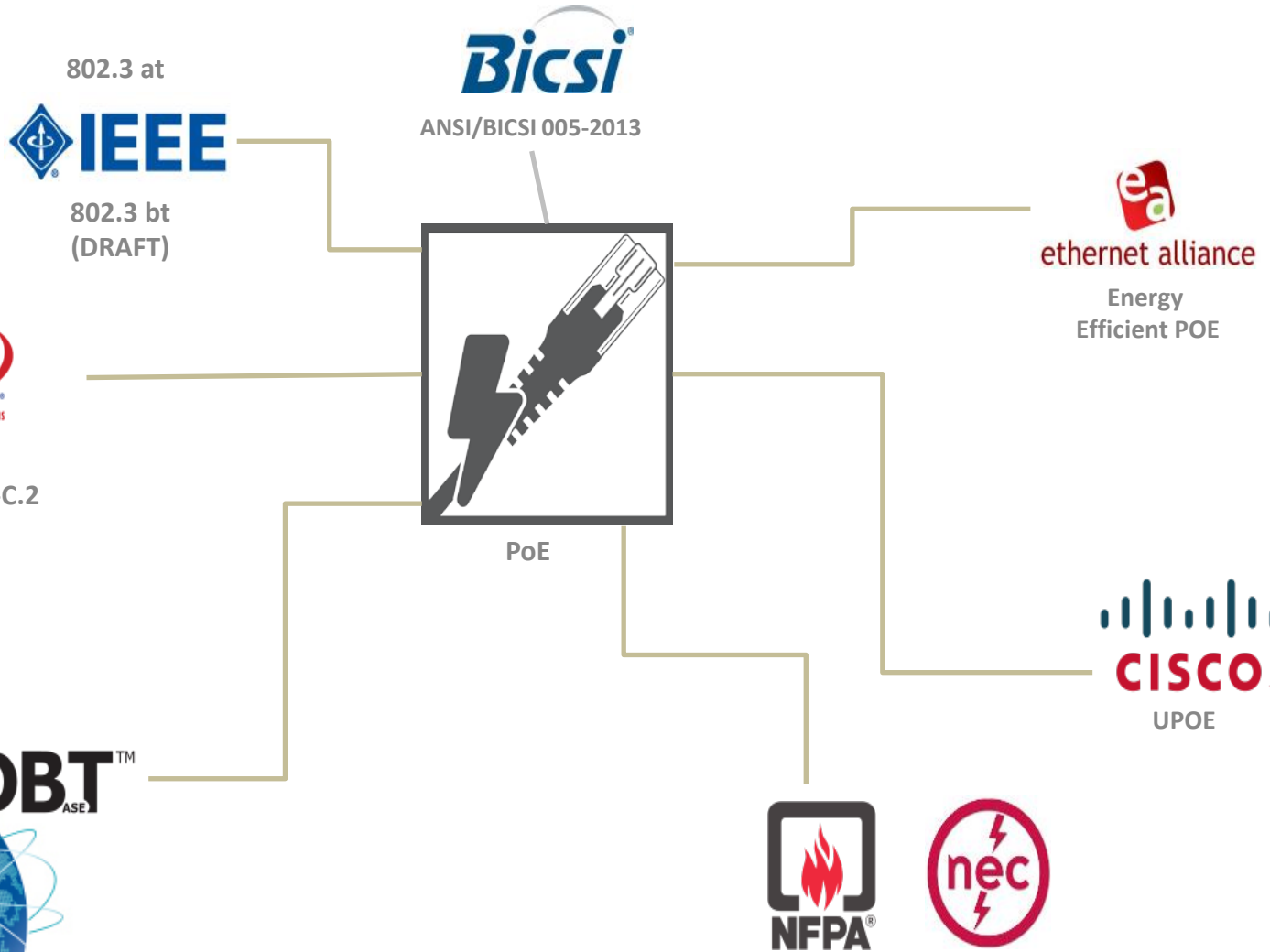
Power and Data Requirements by Application
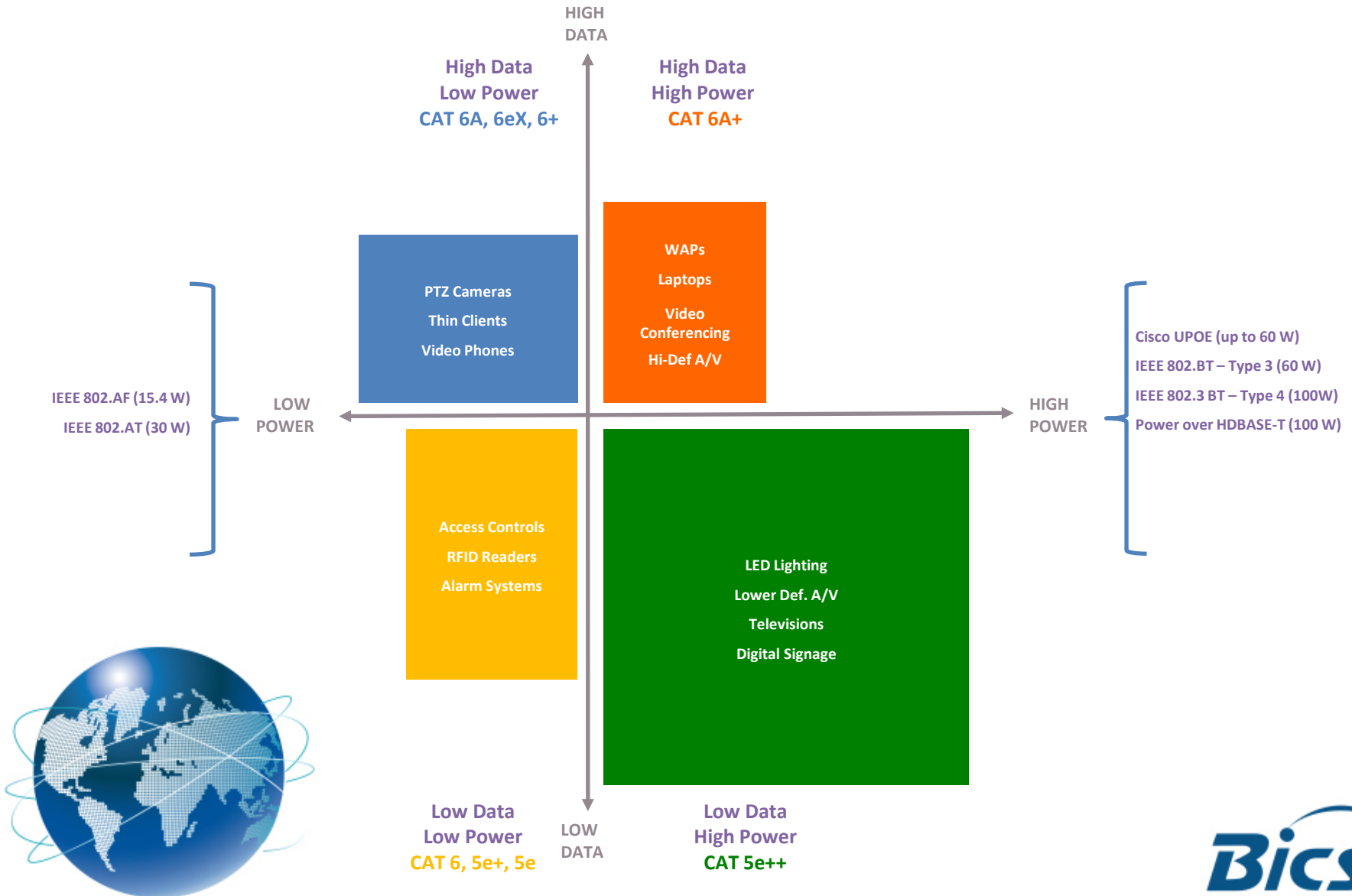
Connectivity Concerns

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

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

BICSI

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

Over
50%
Energy savings

Save Energy, Lower Costs

Intelligent LED Lighting Benefits

**Energy Savings
Lower Maintenance Cost**

**Cooling Savings
Sustainable**

**Controllable &
Tailored**

84%
Cost Savings
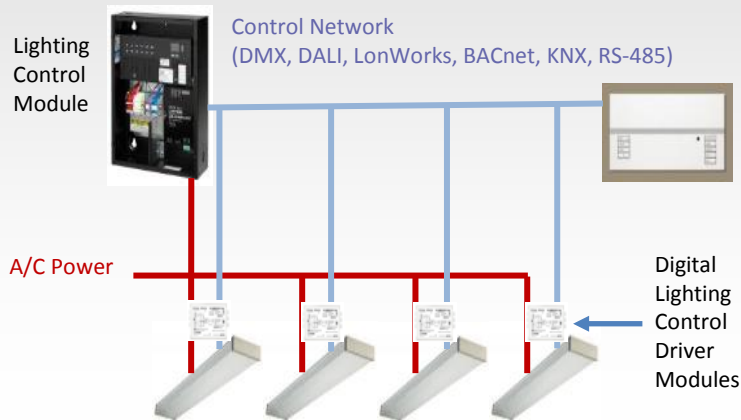Vs Incandescent Light
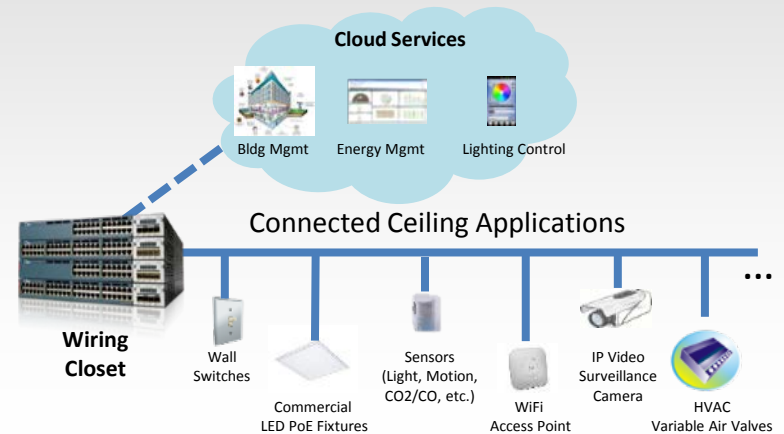
80% light
20% heat

Tailored Experience

Smart Lighting: Traditional vs POE/LED

- High voltage cabling for lighting (110V or 277V Power)

- Legacy RS-485 protocol for control

Lighting Control Module

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

A/C Power

Digital Lighting Control Driver Modules

- Switch PoE power LED light and other edge devices

- Both power and control through RJ-45 Ethernet cable

Cloud Services

Bldg Mgmt   Energy Mgmt   Lighting Control

Connected Ceiling Applications

Wiring Closet

Wall Switches

Commercial LED PoE Fixtures

Sensors (Light, Motion, CO2/CO, etc.)

WiFi Access Point

IP Video Surveillance Camera

HVAC Variable Air Valves

...

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

Traditional
AC Conduit
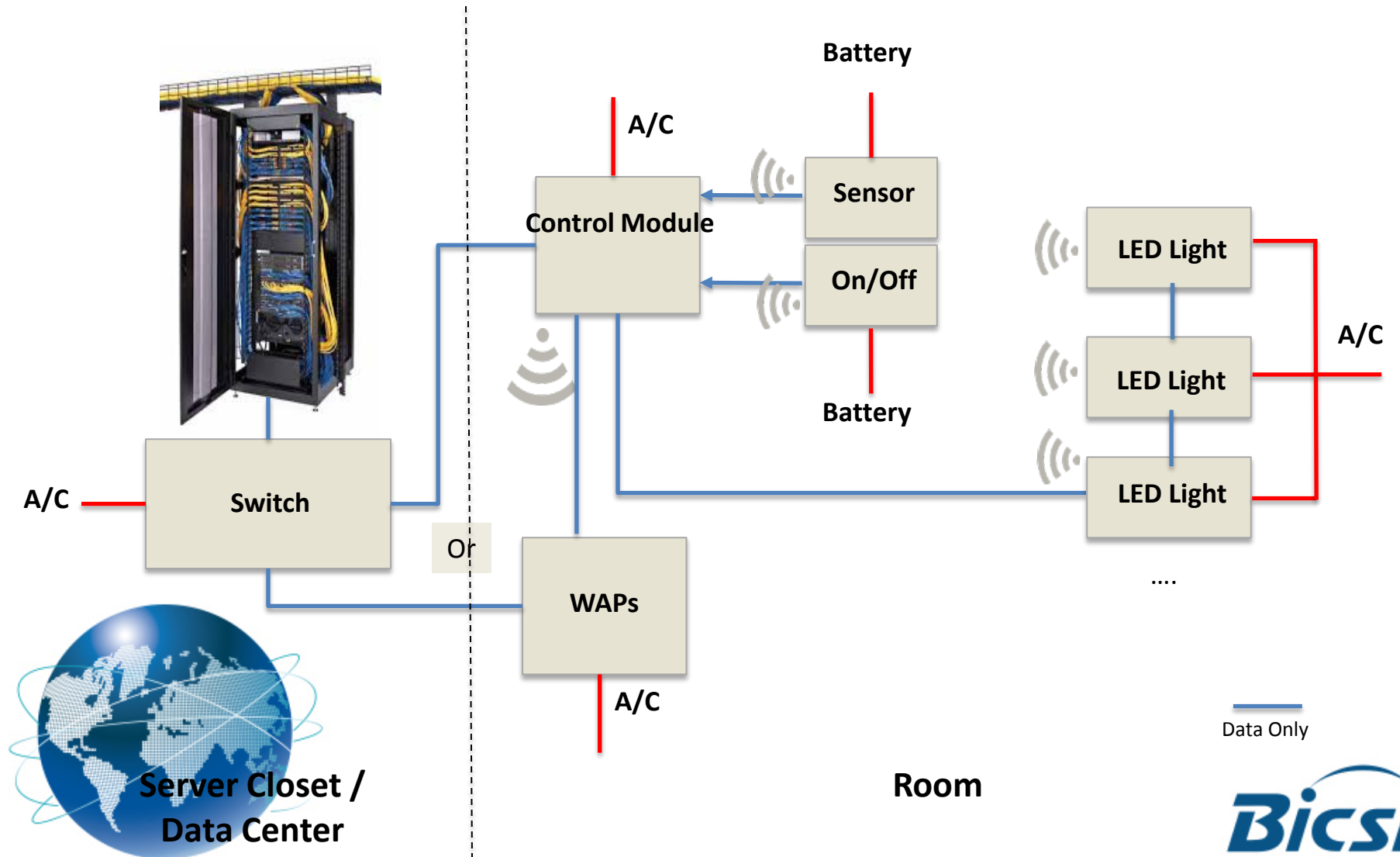High Voltage
Electrical Contractor

POE/LED
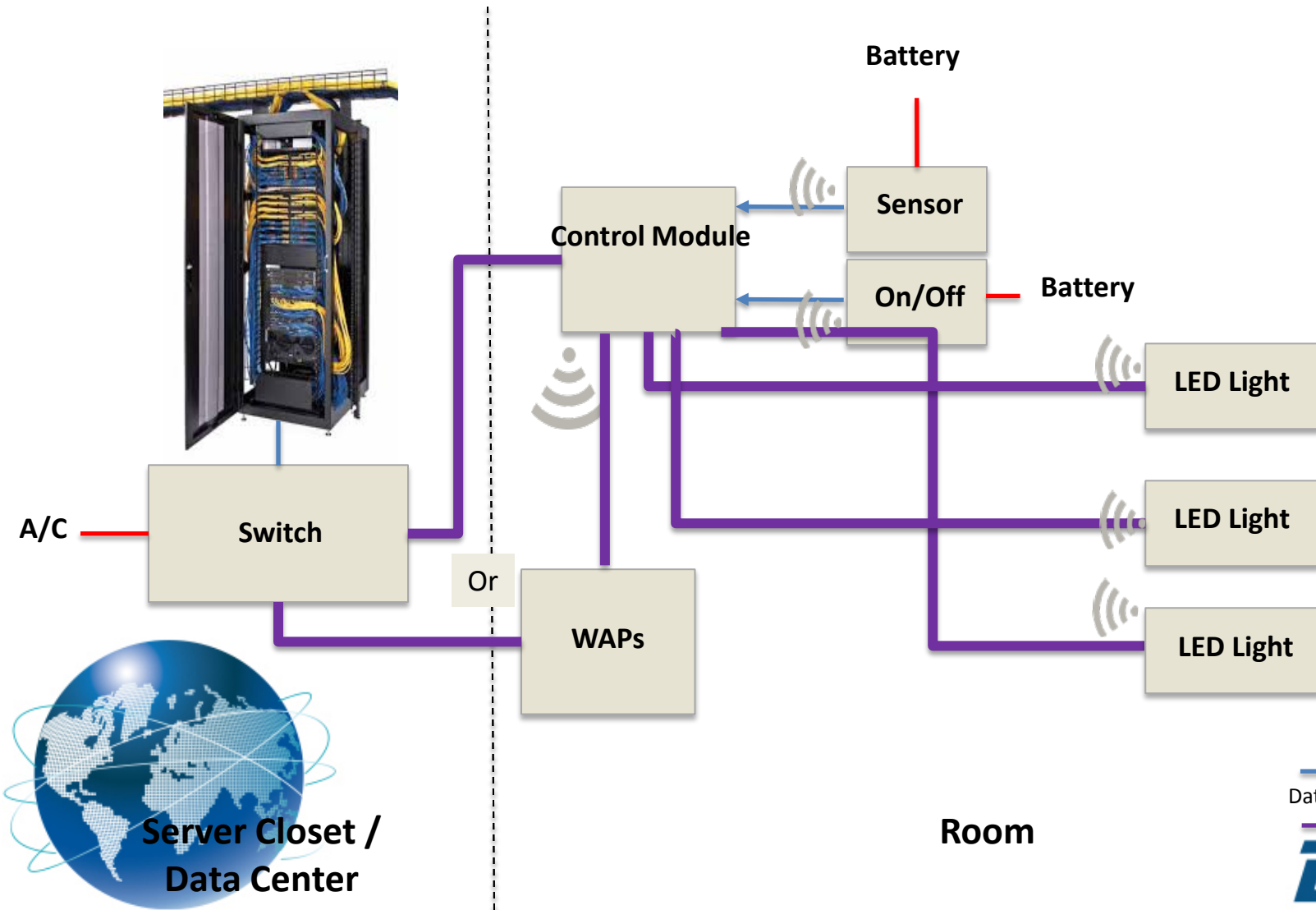Structured Cabling
Low Voltage
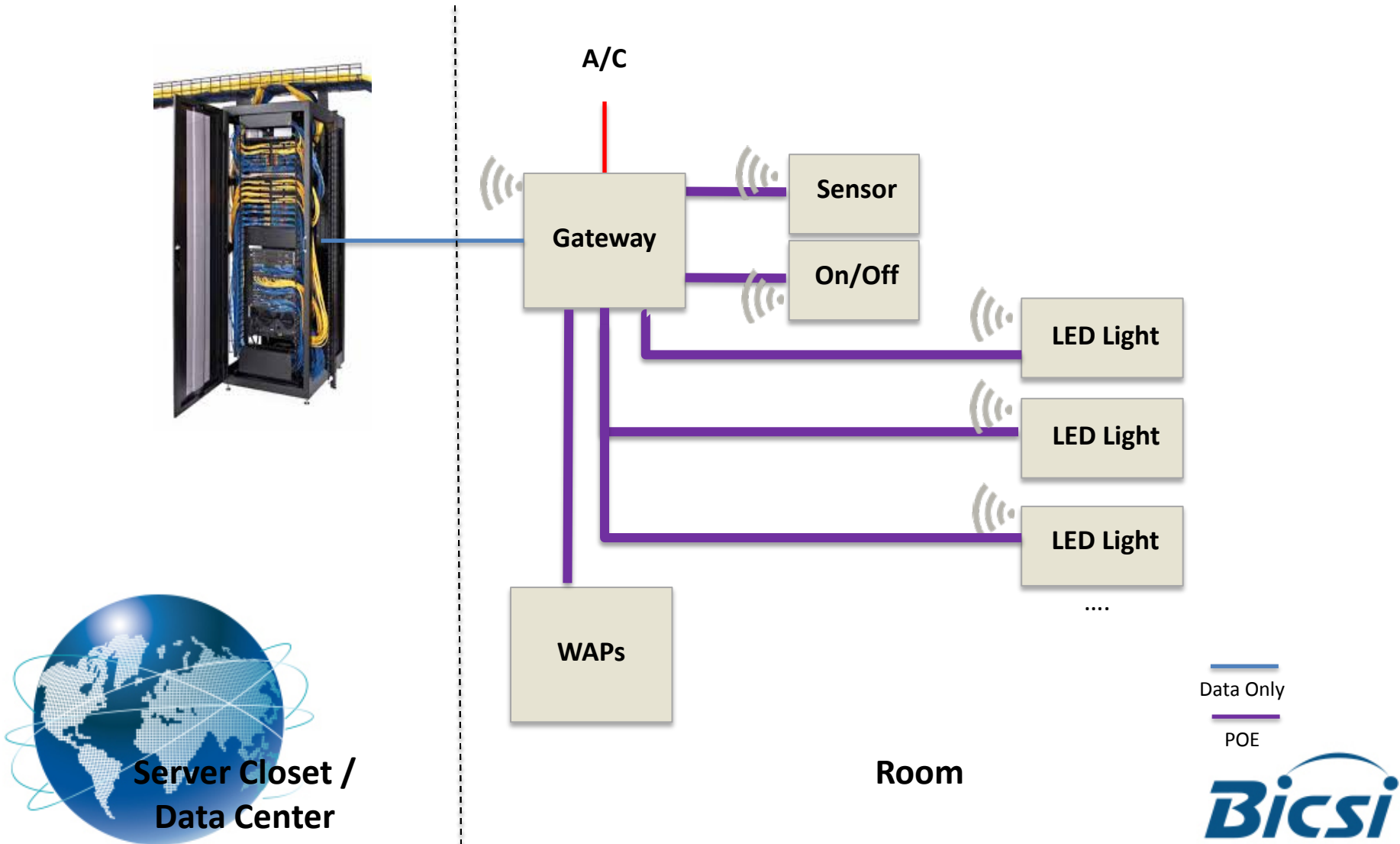Datacom Contractor

Source: Cisco, 2015

Typical Designs: Centralized Management / Localized Power

Battery

A/C

Control Module

Sensor

On/Off

Battery

A/C

Switch

Or

WAPs

A/C

LED Light

A/C

LED Light

LED Light

....

Data Only

Server Closet / Data Center

Room

BICSI

Typical Designs: Centralized POE Network

Server Closet / Data Center

Room

Battery

Control Module

Sensor

On/Off — Battery

LED Light

LED Light

LED Light

A/C — Switch

Or

WAPs

Data Only

POE

BICSI

Typical Designs: Decentralized POE Network

Server Closet / Data Center

A/C

Gateway

Sensor

On/Off

LED Light

LED Light

LED Light

....

WAPs

Room

Data Only

POE

	Design Considerations	
Centralized Management / Local Power	• Security • Centralized Manageability • Emergency/Exit Light Control • Longer Cable Runs	• Limited Scalability • Multiple Power Paths • Requires Trade Coordination • (high voltage & datacom)
Centralized POE	• Security • Better Port Utilization • UPS in Telecom Room	• Low Voltage Installer • Longer Copper Cable Runs
Decentralized POE	• Flexibility & Scalability • Zone Design • Redundancy • Shorter Cable Runs	• Low Voltage Installer • Security • Multiple Gateways • Potential Zone-level UPS

Centralized or Decentralized Design

Bicsi

DECENTRALIZED POE APPROACH

Data Only

POE

A/C

POWERWISE / POE III

LED Light Gateway

9' Ceiling

LED Light   LED Light   LED Light

Sensor   Sensor

legrand

LED Light / AV

LED Light

84"

LED Light

36"

18"

UPS

POWERWISE / POE III

Telecom Room   **TR to Room**   **Office Space**   SLAB

34
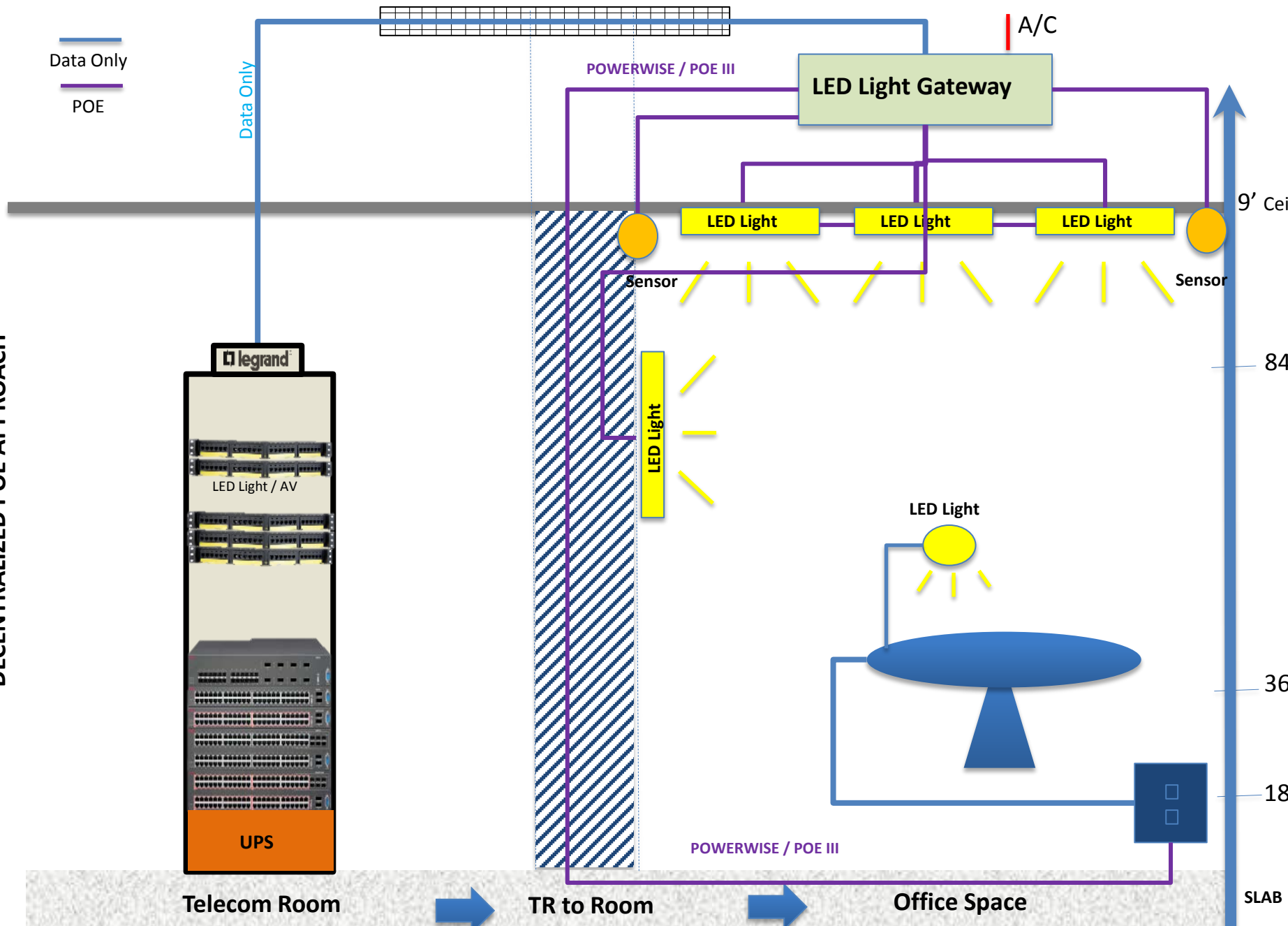
Using Cat 5e+ 22AWG Benefits & Value

COST

DATA

POWER

1/3 the cost
of Cat 6A

>10X more data
available above smart
LED Lighting
requirement

>88%
energy efficiency
in cable

TCO Analysis Period (# Yrs)	10 Years
Total Square Feet Bldg (# SF)	35,000

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

Case Study: Total Cost of Ownership (TCO)

Connected Lighting 10 Years TCO
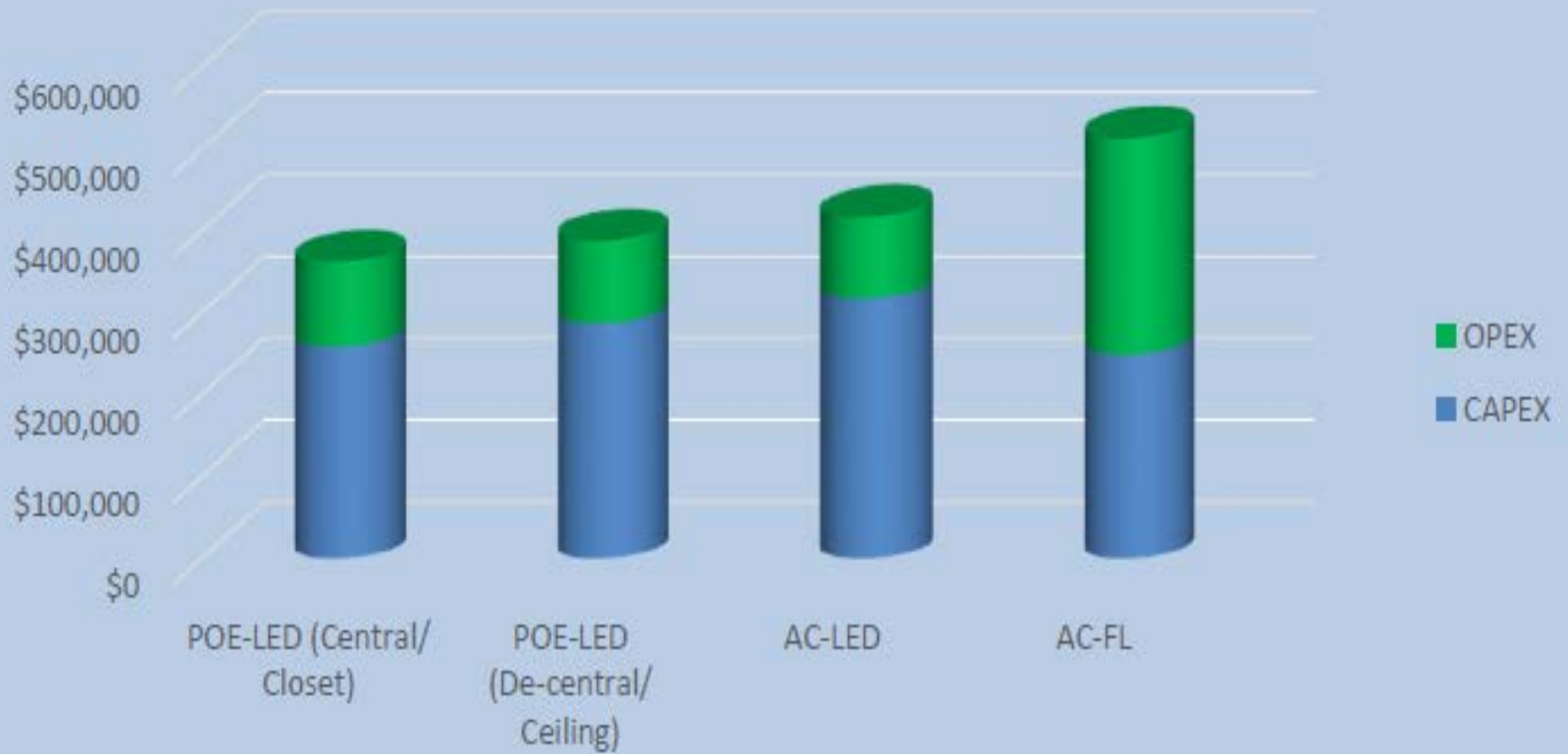
Case Study: Total Cost of Ownership (TCO)

Gracias
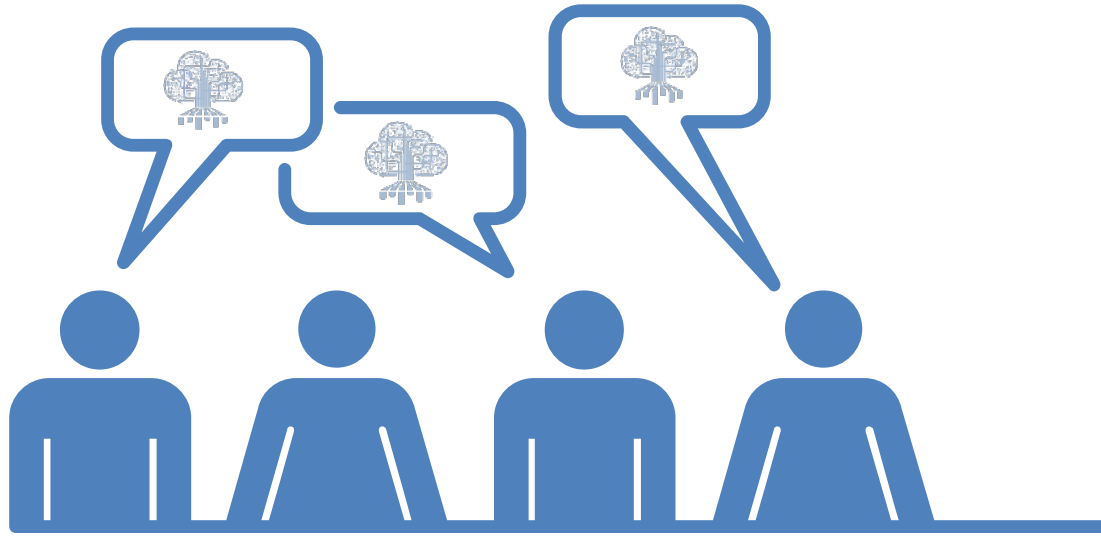
DISCUSSION

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