Four Pair PoE: Powering the Future of Intelligent Buildings and the IoT

Murat Erenturk – Goradata
Valerie Maguire, BSEE – SIEMON
Christian Schillab – Fluke Networks
Tertius Wolfaardt– Axis Communications

Agenda

- **Intelligent Buildings – An Introduction to PoE**
  - **Murat Erenturk – Goradata**
- **Cabling Systems Design and Installation Considerations**
  - **Valerie Maguire, BSEE – SIEMON**
- **Testing**
  - **Christian Schillab – Fluke Networks**
- **End Products and Security**
  - **Tertius Wolfaardt – Axis Communications**

Digital Buildings

An Introduction to 4 Pair PoE

Murat Cudi Erentürk, DCDC

Agenda

- Introduction
- Overview
- Value Proposition
- Architecture
- Identification/Security
- Codes and Standards
- Deployment Example
- Summary

“Predicting rain doesn’t count; building arks does.”

- Warren Buffett

Generation Z’ers

Born after 1995 -
World Population Age – 42% 0-24, 20% 35-49, 14% 50-64, 8% 65+

2016 entered the workforce

66% think technology makes anything possible

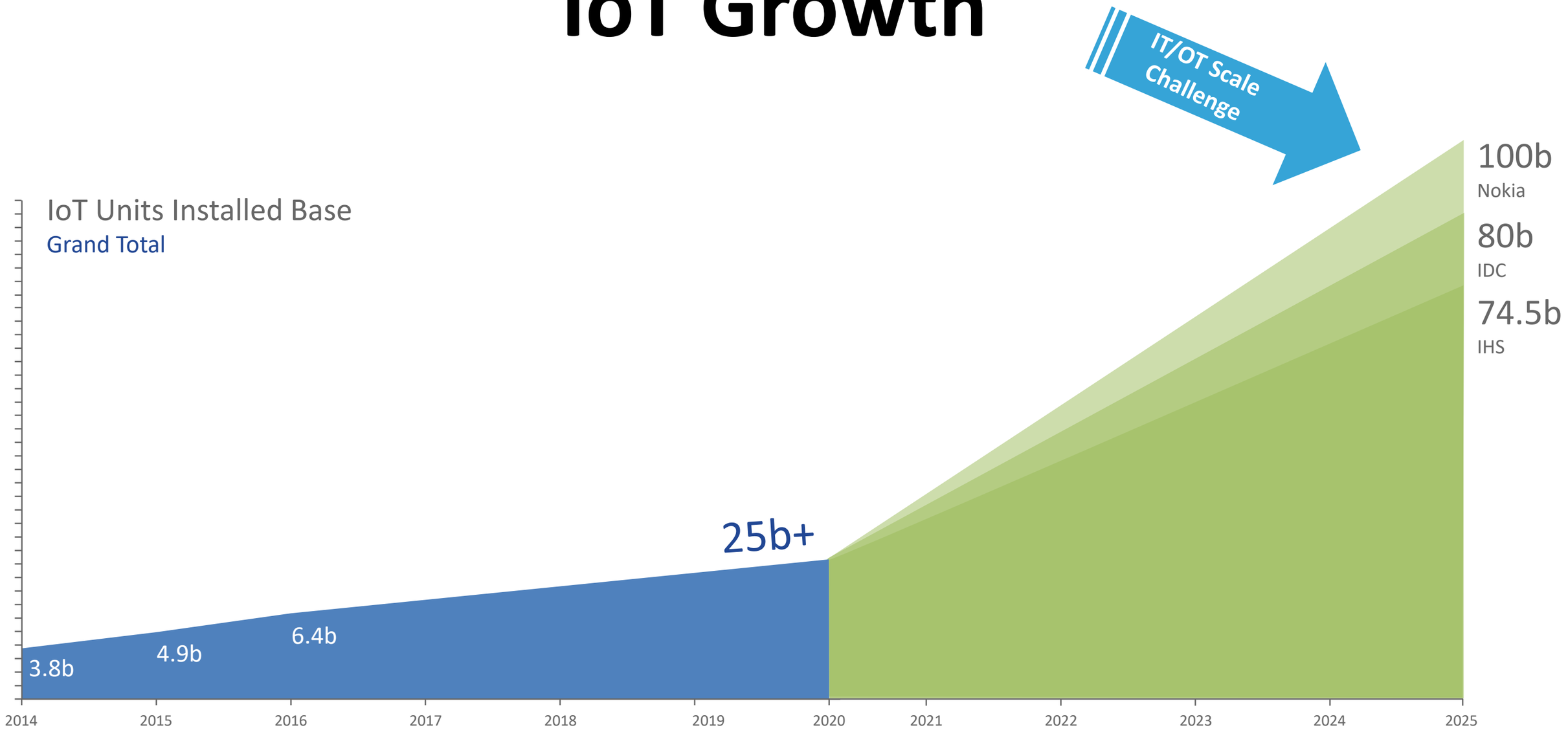
80% display emotional distress if separated from devices

90% would be upset if they had to give up the Internet

51% still want to communicate to managers in person

60% want to have an impact on the world at work

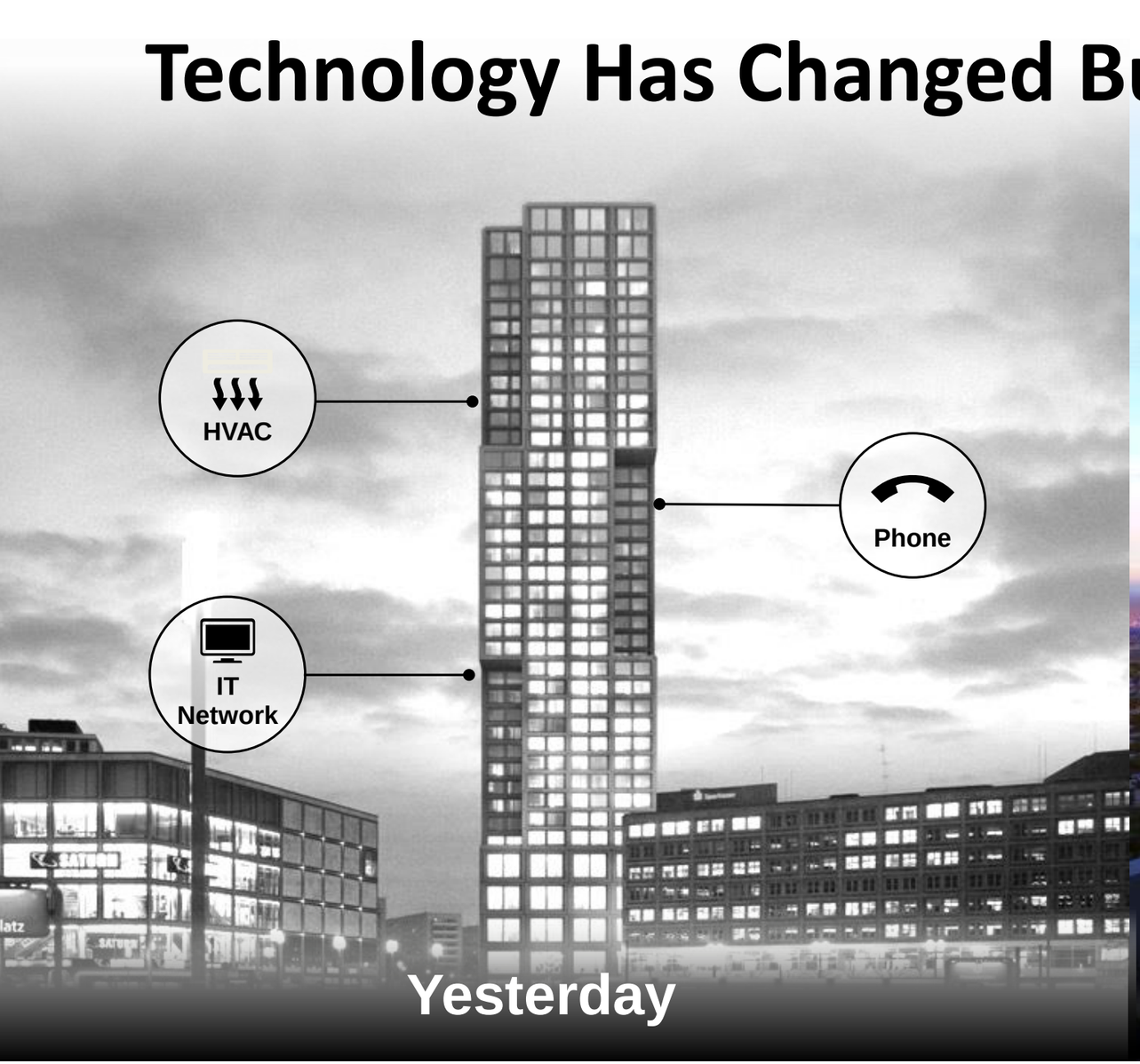
IoT Growth



Source: http://www.cisco.com/c/en/us/solutions/service-provider/visual-networking-index-vni/index.html

OVERVIEW

Technology Has Changed Buildings……



Demand for new customer experiences and workforce innovation mandate improved efficiencies

Activity-Based Working (ABW) *was the first wave*

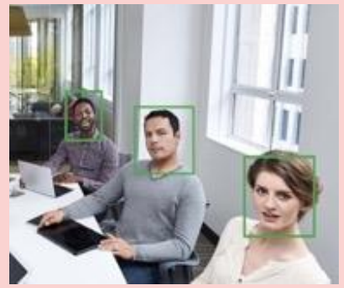
Enablers for smart/automated workplace

Mobile & Digital First

Cloud / Hybrid Cloud

Virtual Assistants

AI & Machine Learning



Robotic Process Automation & APIs

Mobility & Location Analytics

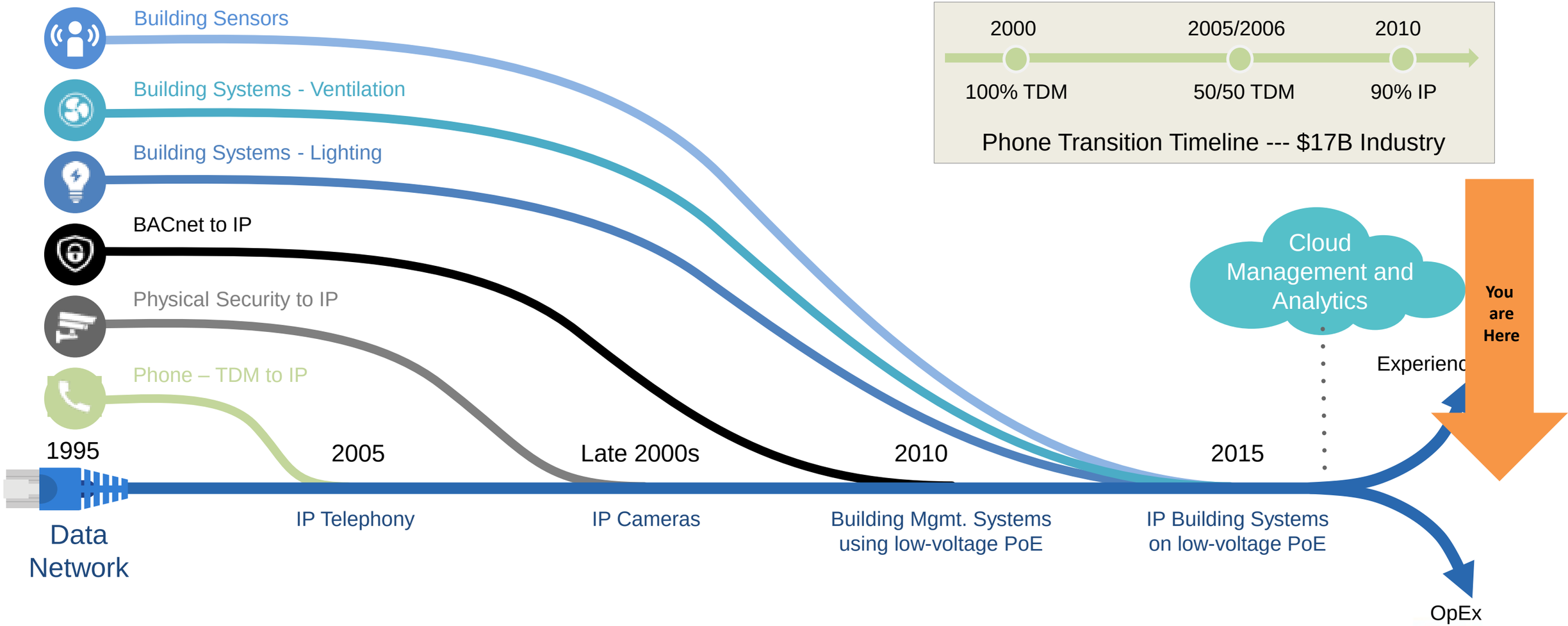
Augmented Experiences

Smart Buildings Smart Communities

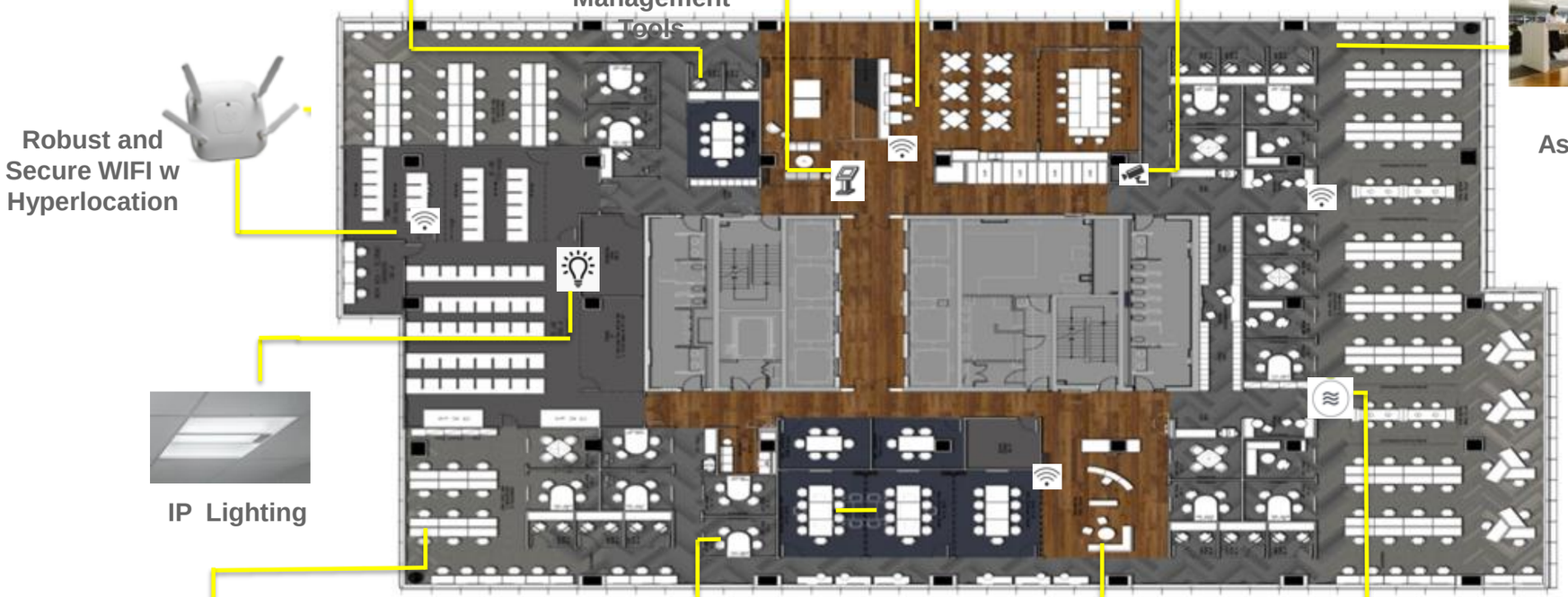
IoT & Wearables

Advanced Analytics

IP Convergence for Digital Building Technologies



Technology is the enabler……



Video enabled Privacy Rooms

Workplace Management Tools

Digital Signage

Physical Security & Access Control

Robot Assistance

Robust and Secure WIFI w Hyperlocation

IP Lighting

Individual video workspaces / IoT sensors

Video enabled Huddle Rooms

Innovation spaces with video & content creation

IoT-enabled building sensors

Employee Services

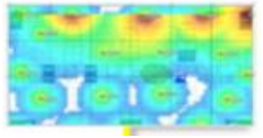
Collaboration Workspaces

Working from Anywhere / Connecting to the Workplace

Secure Mobility Solutions

Management Services

Space and Environment Management



Workspace Utilisation Analytics

Robot Down!!

VALUE PROPOSITION

PoE End Devices

- Use less energy due to no AC/DC Conversion
- Cheaper due to DC usage

Lower Cost Operations

More Data

Granular, device-level Visibility and Control

Centrally Manage Via the Network

>More Energy Saving Over Traditional Methods

Save Energy, Lower Operations Costs

ARCHITECTURE

Mid-Span Operation

Non-Intelligent
Ethernet Switches

No Standards

No State Data

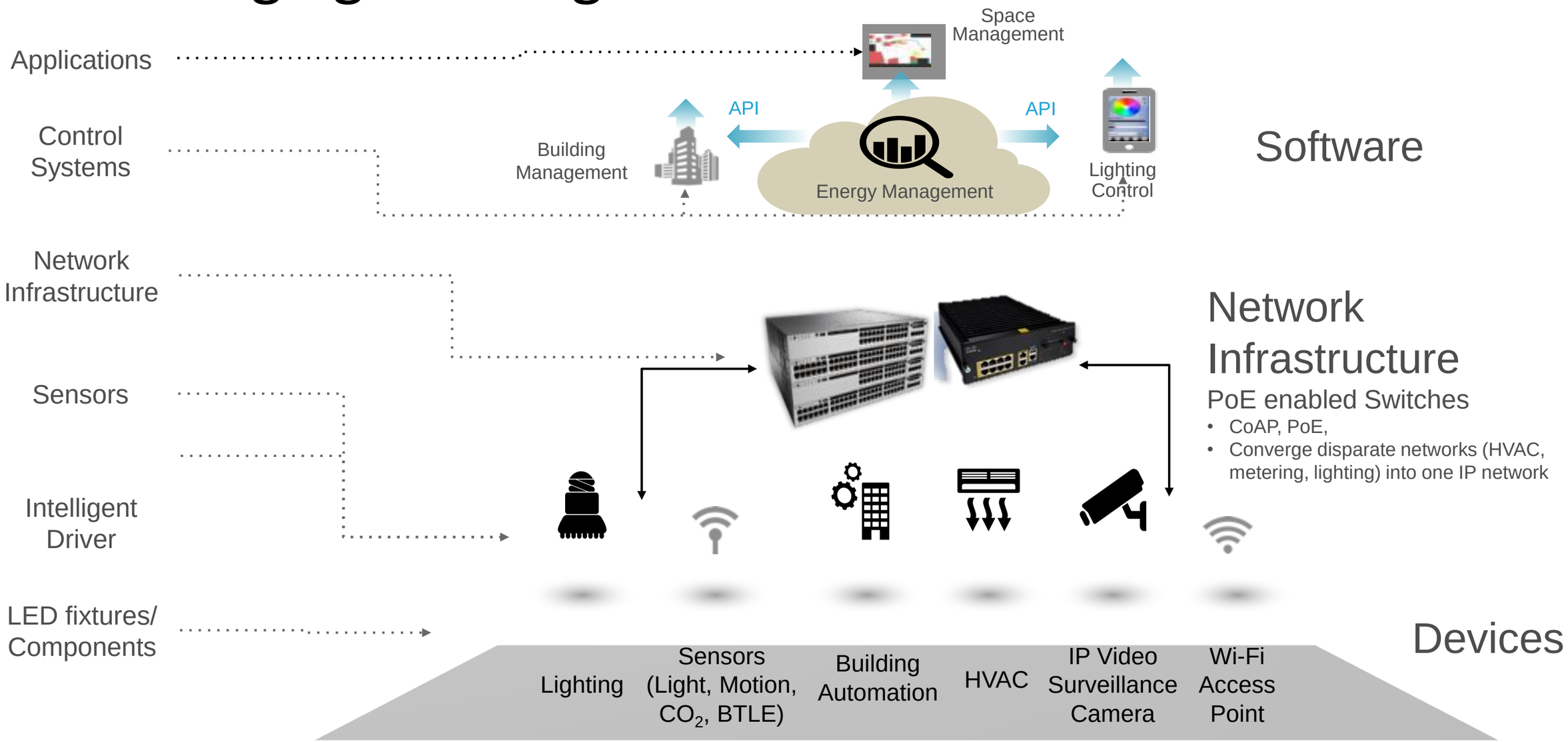
Mid-Span

Powered Devices (PD)

Mid-Span Impact

- Creates another failure point
- Do not participate in Data Channel
- Can’t share power information
- Cost swap between PoE Switch and Mid-Span
- Obscures power troubleshooting

Bringing it all Together



Power Over Ethernet – IEEE 802.3bt

Power over Ethernet (PoE)
Delivers DC Power and data over a Standard Copper Ethernet Cable(RJ45)

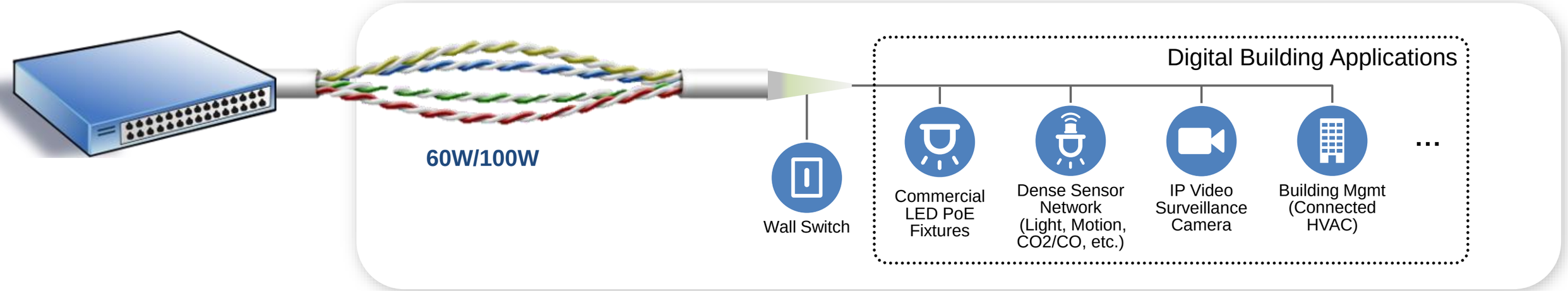
IEEE 802.3bt

Copper Cable

Up to 91W

Proprietary high power POE available since 2012
Standardized in 2018

Enhanced PoE Capabilities



PoE Type 3	PoE Type 4
▪ Increased PoE Budget: 60W per port	▪ Increased PoE Budget: 90W per port

DoE Cable Testing

https://www.energy.gov/sites/prod/files/2018/01/f47/cls_poe-cable-pt1_nov2017_0.pdf

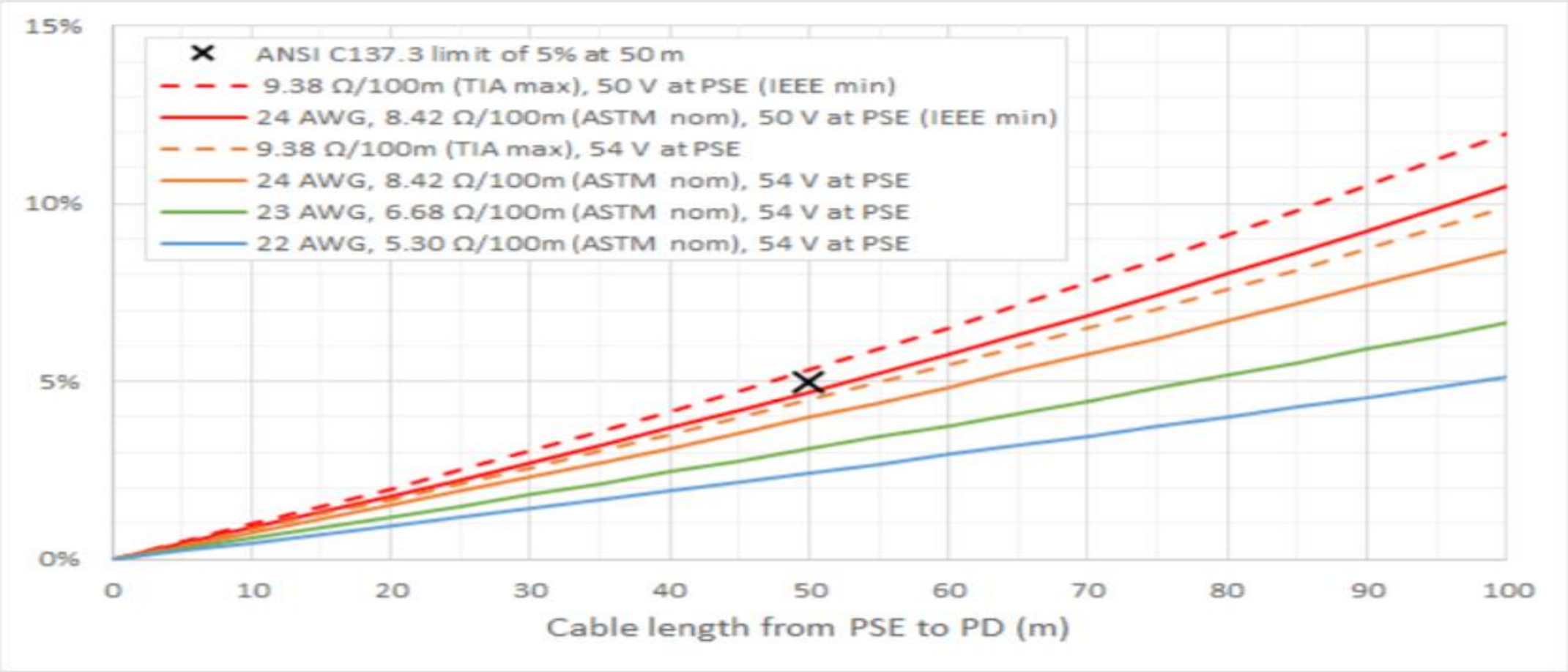


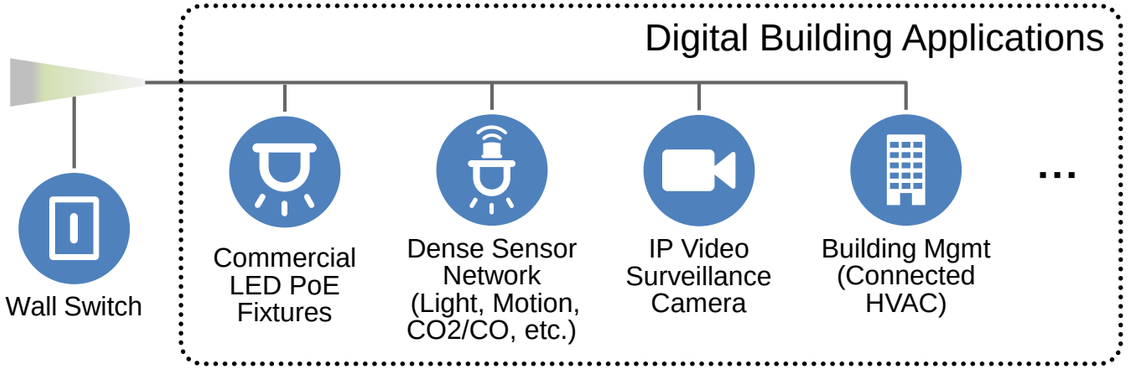
Figure 6.1. Range of expected cable losses for 51 W PD at 20°C ambient

Heat Dissipation Example

Power/Heat

Power/Heat

Data Sheet 600W
Power Available 480W
88-93% Efficient



Impact at Switch

- Switch Load
- Input Power
- BTU at the Switch Small

Impact across Cable

- Wire Gauge
- Cable Length
- Bundle Size
- 1.7 – 2.8w drop @ 100M

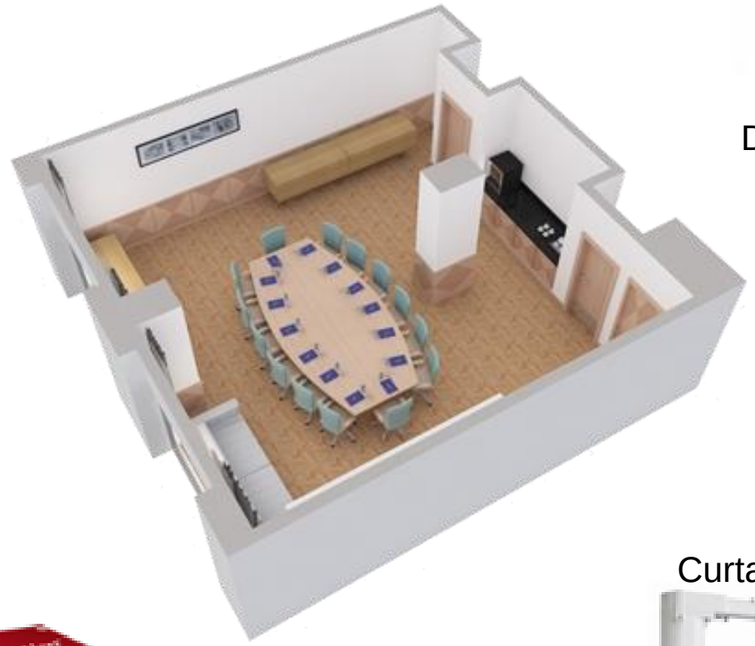
Existing POE Devices (Type 1,2)

Status Signs

Temp Sensor

Blind Motors

Access Points



Biometric Door Locks

Ceiling Fans

Facial Recognition Systems

Horns and Sirens

Badge Readers

HVAC VAV's

IP Call Stations

Light Fixtures

IP Call Tower

Entry Barriers And Turnstiles

Environmental Sensor Hubs

Curtain Motors

Meeting Room Nameplate

Power Meter

POE Devices with higher Power needs (Type 3,4)

Pan and Tilt Cameras

Large Displays

802.11ac AP

POS Systems

LED Lights

Kiosks

Many more to come!

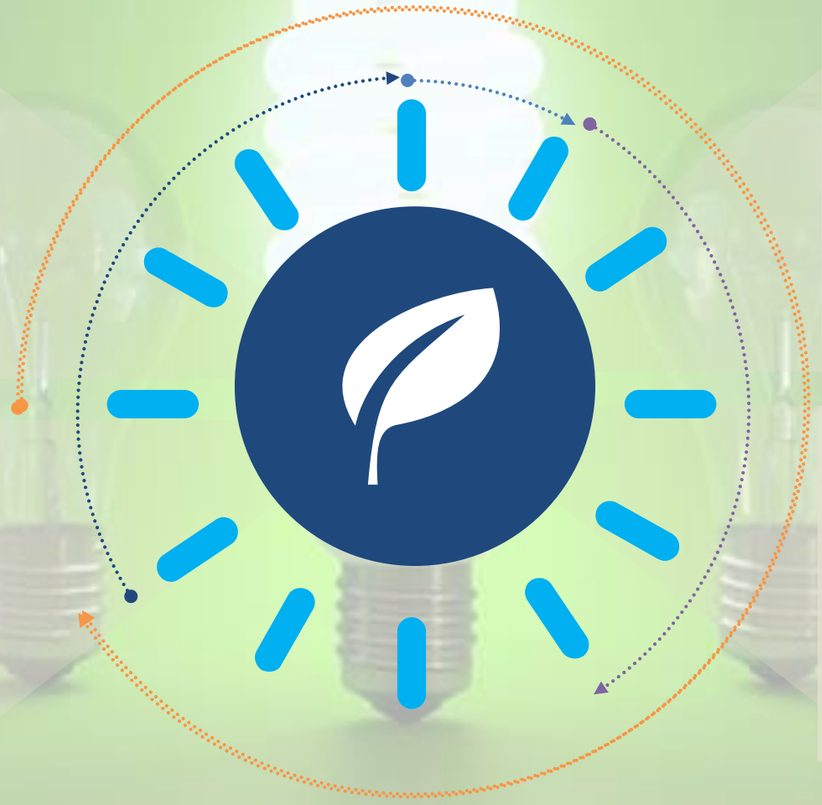
Structured Cabling Considerations

- Cable Selection – Application based
- Pathway sizing and planning
- Bundles in pathway, racks, and cabinets

Digital Building Switches have a 5x Improvement in Switch Power

Everything Active
10% Power Saving.
Efficient design, 80-Plus Gold Power Supplies

No PoE Draw
Switch Idle Mode with up to 50% savings

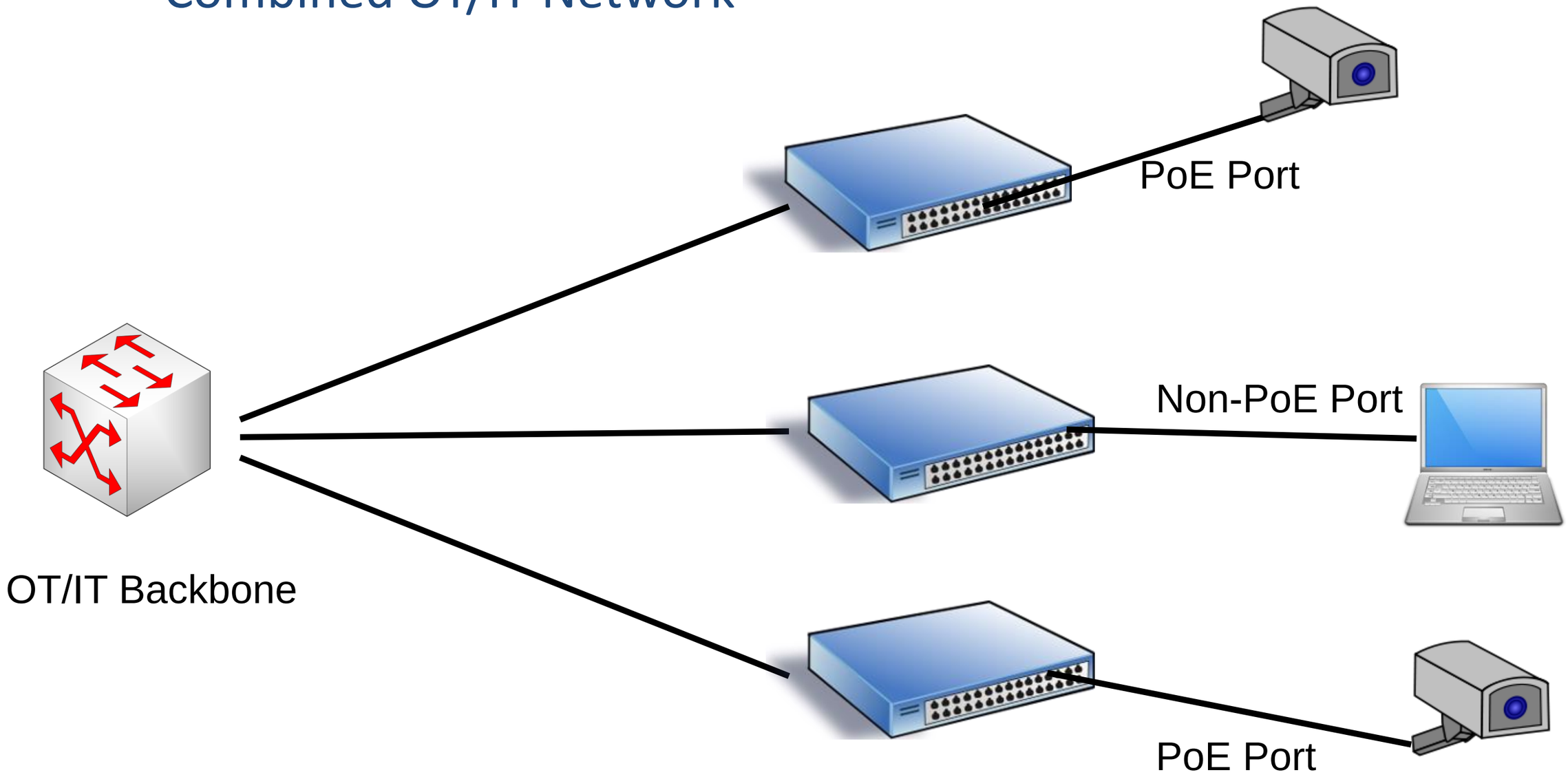


Low Ethernet Traffic
Power Savings with EEE or Energy Efficient Ethernet

No Ethernet Traffic
Switch Hibernate Mode with up to 75% savings

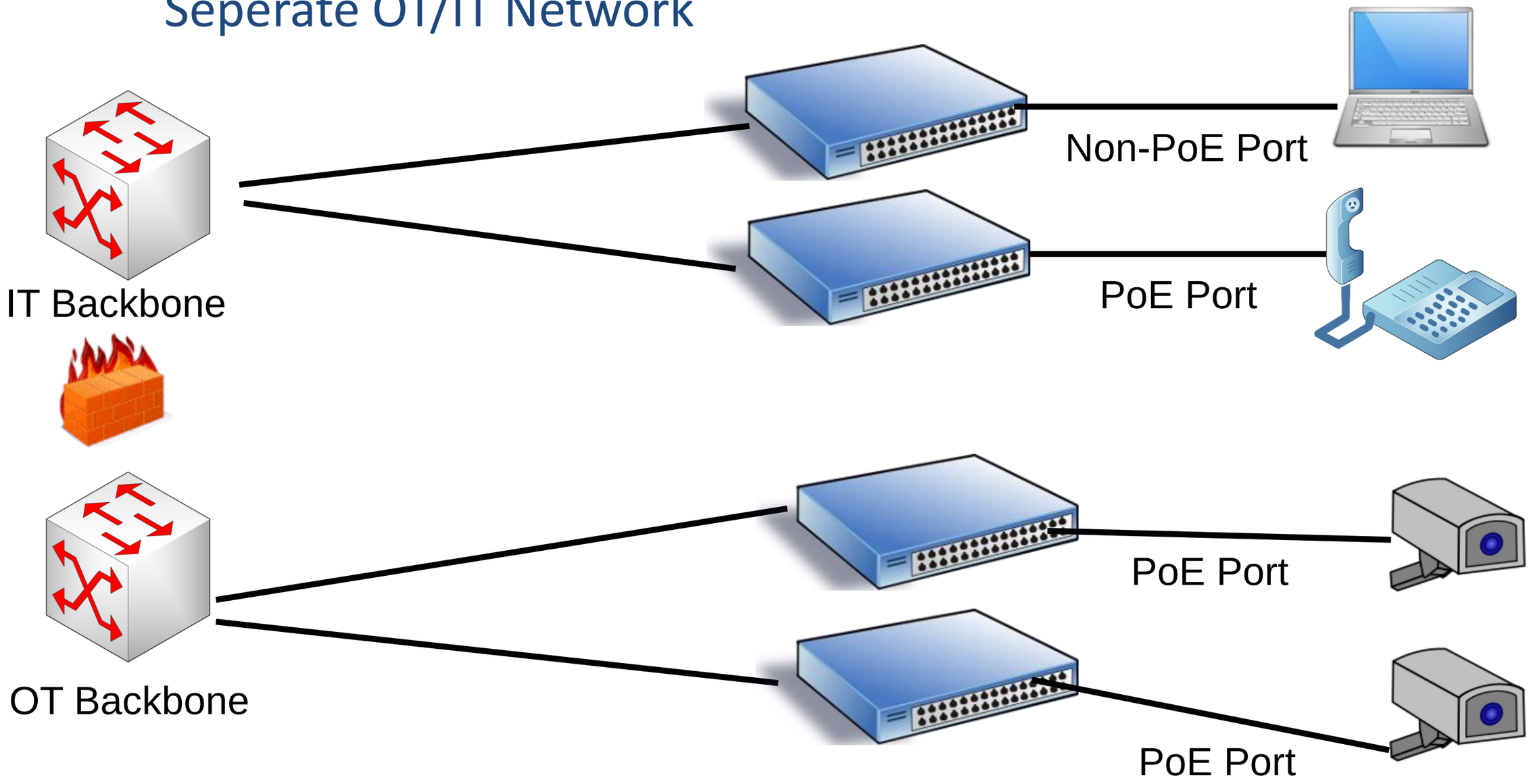
Architectures

Combined OT/IT Network



Architectures

Seperate OT/IT Network



Security Concerns

What is this thing?

Who is responsible for it?

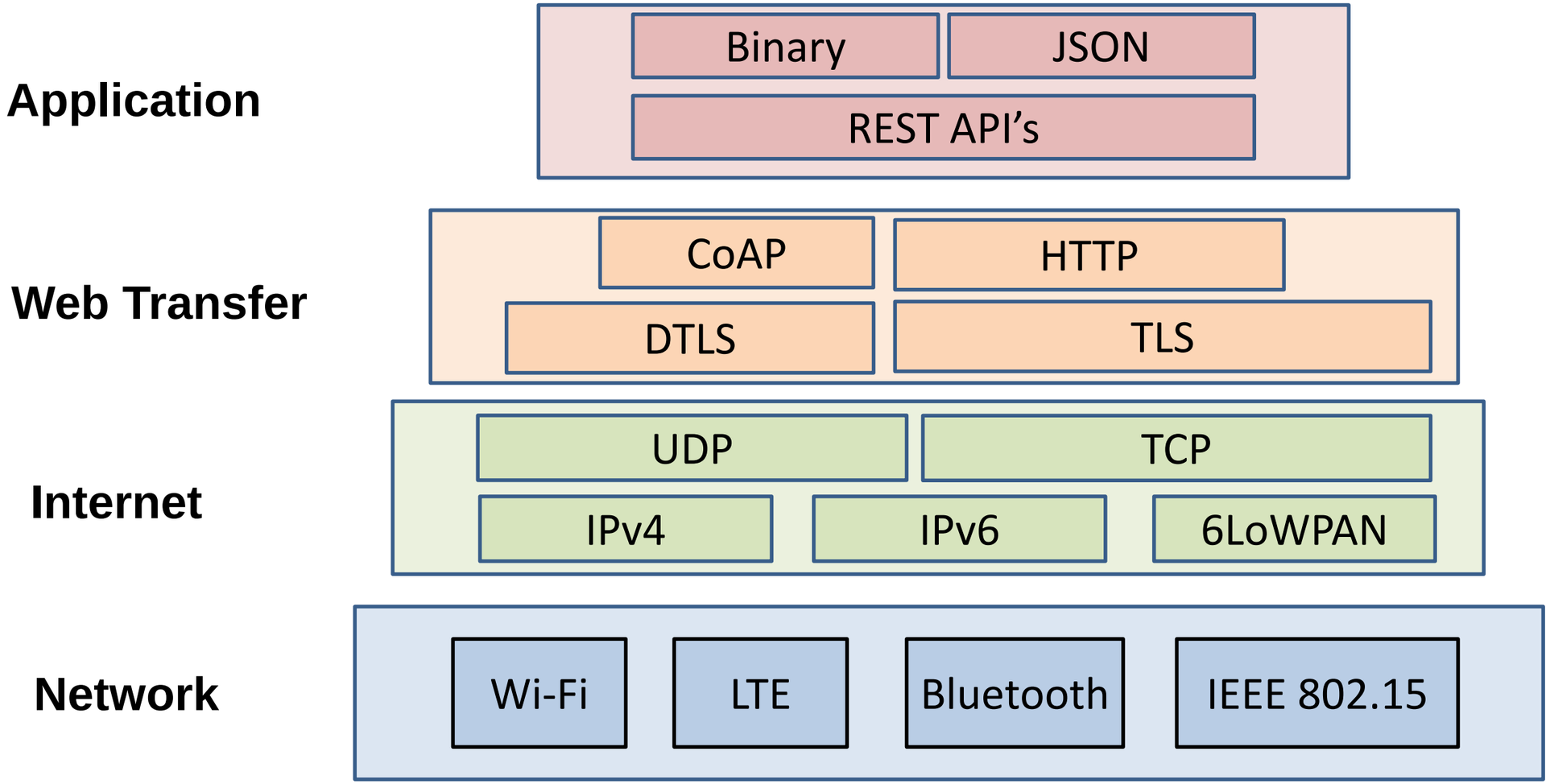
What access does it need?

Technologies

- IEEE 802.1X,
- IEEE 802.1AR
- EAP

CODES AND STANDARDS

Protocol Stack



Constrained Application Protocol (CoAP)

RFC 7252 – Constrained Application Protocol

- Developer Friendly
  - Available libraries in C, C#, Java, iOS, Andorid
  - Based on REST Model
- Made for small – lots of devices
  - Efficient
- Secure

DEPLOYMENT EXAMPLE

Marriott Sinclair Hotel (Autograph Collection)

Project Overview

- 1920's Art Deco Building in the heart of downtown Fort Worth
  - Roof Top Bar
  - Restaurant
  - High-end Spa
- Designated in the National Register of Historic Places
  - Need for minimally invasive renovations to preserve historic value
- Technology drives Customer Satisfaction and Repeat Business
  - High Speed Internet, Room Automation, Scene Control
- Low Voltage Lowers Construction Costs

Expense Category	AC Infrastructure	DC Infrastructure	
Electrical	$2,000,000	$1,200,000	See Note 4
Network		$160,000	
Cabling	$16,000	$20,000	
VoltServer		$150,000	
Total	$2,016,000	$1,530,000	
Savings		**$486,000**	**25.00%**

  - Faster Installation
- IP Enables Systems Integration and Better Management
  - Greater Energy Efficiency
  - Granular Controls
  - Enables Guest Room Automation
  - Increased Property Management Capabilities
  - Provides a Sustainable Message

Future Marriott Sinclair Hotel, Fort Worth, TX

Customer Profile Video:
https://www.youtube.com/watch?v=uomF2xznbB8

Notes:

1) Inclusive of Labor and Materials for the infrastructure.
2) Infrastructure Powers: Lighting, Motorized Blinds/Curtains, MiniBar, TV embedded Bathroom Mirror, Door Locks, Shower Valve
3) Device Costs (AC/POE comparable)
4) DC Infrastructure Electrical Costs include backup AC Outlet for Minibar and Bathroom Mirror in case that POE versions are not ready in construction timeline. **An additional $200,000 savings (*yielding 35% Savings over AC Infrastructure*) would be had if these electrical circuits were not installed.**
5) Building Electrical service changed from 4000A service to 2500A service.

SUMMARY

Digital Transformation must be part of your Building and Cities Strategy

- Buildings and Cities are changing
  - IT and OT teams need to work together
  - Buildings and Cities are become digital
- Digital Transformation is essential in the Communities of the Future
- The Smart Infrastructure will be play a major role
- Talk to new people!!
- Build an Ark, Change the world!!

Cabling for Remote Powering

Valerie Maguire, BSEE

Agenda

- Remote Powering
- Impact on Cabling
- Intelligent Buildings
- Converged Cabling Designs

Remote Powering

- Running power concurrent to data over structured cabling
- Estimated 140 million PoE enabled ports are shipping annually
- Annual Wi-Fi enabled router shipments will soon exceed 200 million
  - Power over Ethernet (PoE) is the preferred powering method

UPOE compatible Cisco Catalyst 4500E Series Switching platform

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
  - The average cost to provide typical power to a device is about USD $1,000
  - The average cost of a PoE network port plus the structured cable drop is USD $250 per drop

Quiz Question #1

What is the maximum power delivery associated with the four IEEE 802.3 Types of PoE?

A: 15, 30, 60, 90

IEEE Std 802.3bt™-2018

- *"Physical Layer and Management Parameters for Power over Ethernet over 4 pairs"* (September 2018)
- Employs four balanced twisted-pairs to deliver remote power
  - Improves efficiency and increases power
- Introduces Type 3 (≥ 60W at the PSE output) and Type 4 (≥ 90W at the PSE output) technologies
- Compatible with 10GBASE-T
- Operates over category 5e or higher cabling

Remote Powering Applications

	Minimum Power at PSE Output	Number of Pairs	Maximum Current per Pair
Power over Ethernet (Type 1)	15.4 W	2-pairs	350 mA
Power over Ethernet Plus (Type 2)	30.0 W	2-pairs	600 mA
4-pair PoE (Type 3)	60.0 W	4-pairs	600 mA
4-pair PoE (Type 4)	90.0 W	4-pairs	866 mA
Power over HDBaseT (POH)	100.0 W	4-pairs	960 mA

Agenda

- Remote Powering
- Impact on Cabling
- Intelligent Buildings
- Converged Cabling Designs

Implications of Remote Powering

1. Heat builds-up within cable bundles
2. Bundle sizes may need to be reduced to improve heat dissipation
3. Overall channel length may need to be reduced to offset increased insertion loss resulting from a higher operating temperature
4. Contact arcing occurs when un-mating pairs under load and may affect connecting hardware reliability

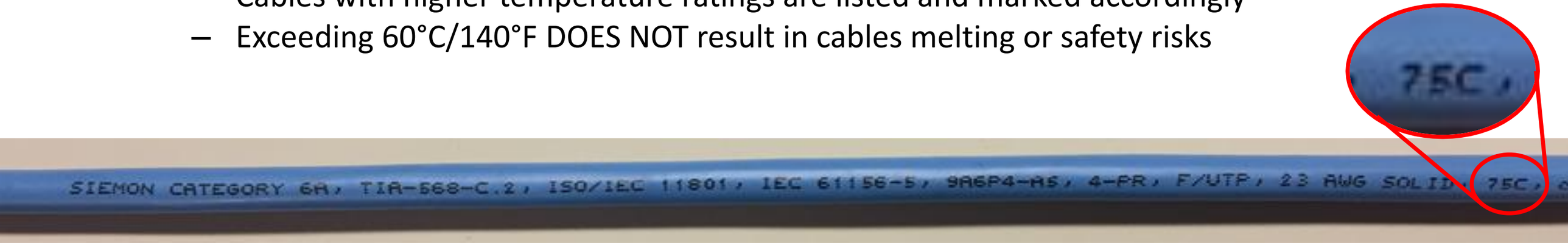
Quiz Question #2

What is the TIA specified operating temperature range for cabling?

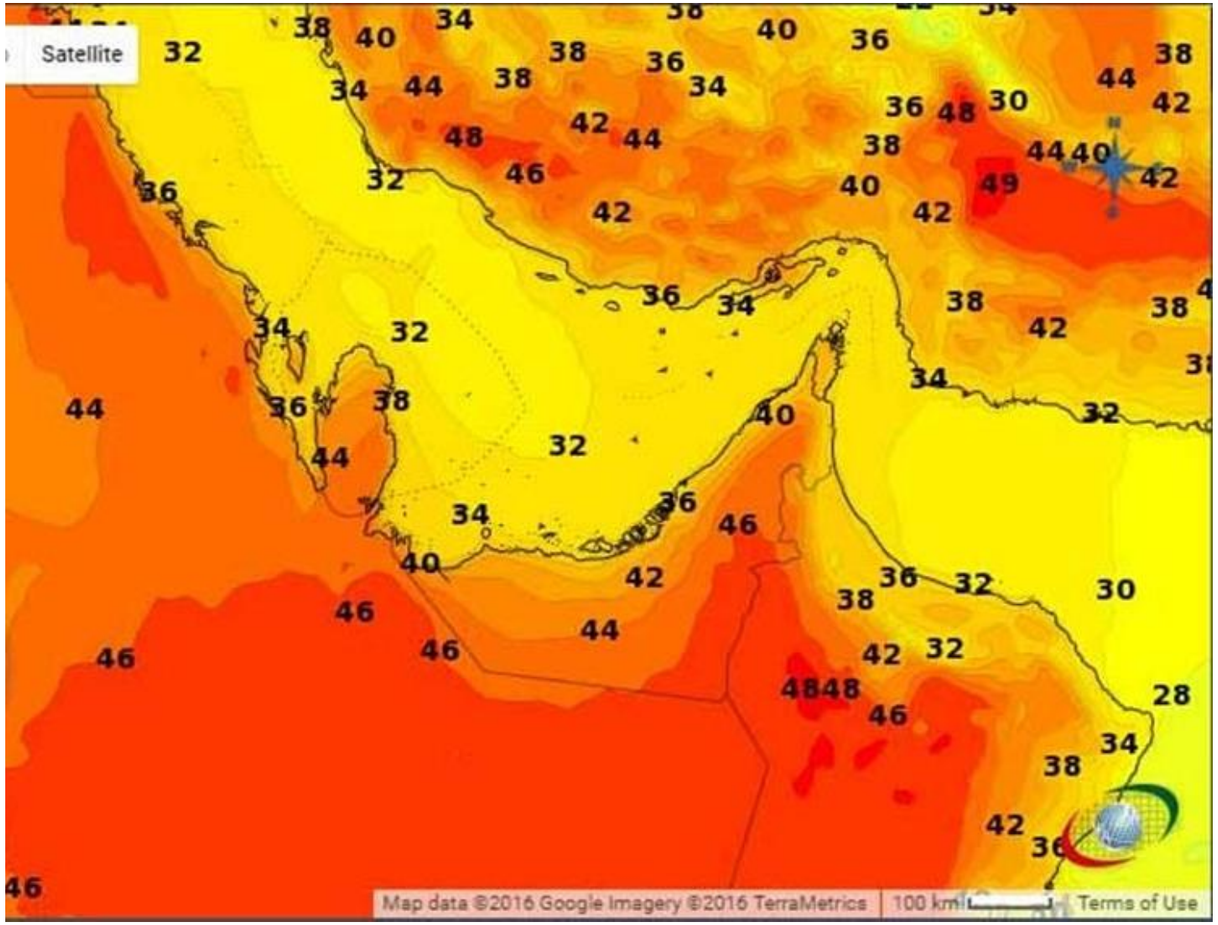
A: -20°C to 60°C (-4°F to 140°F)

Temperature Rise Considerations

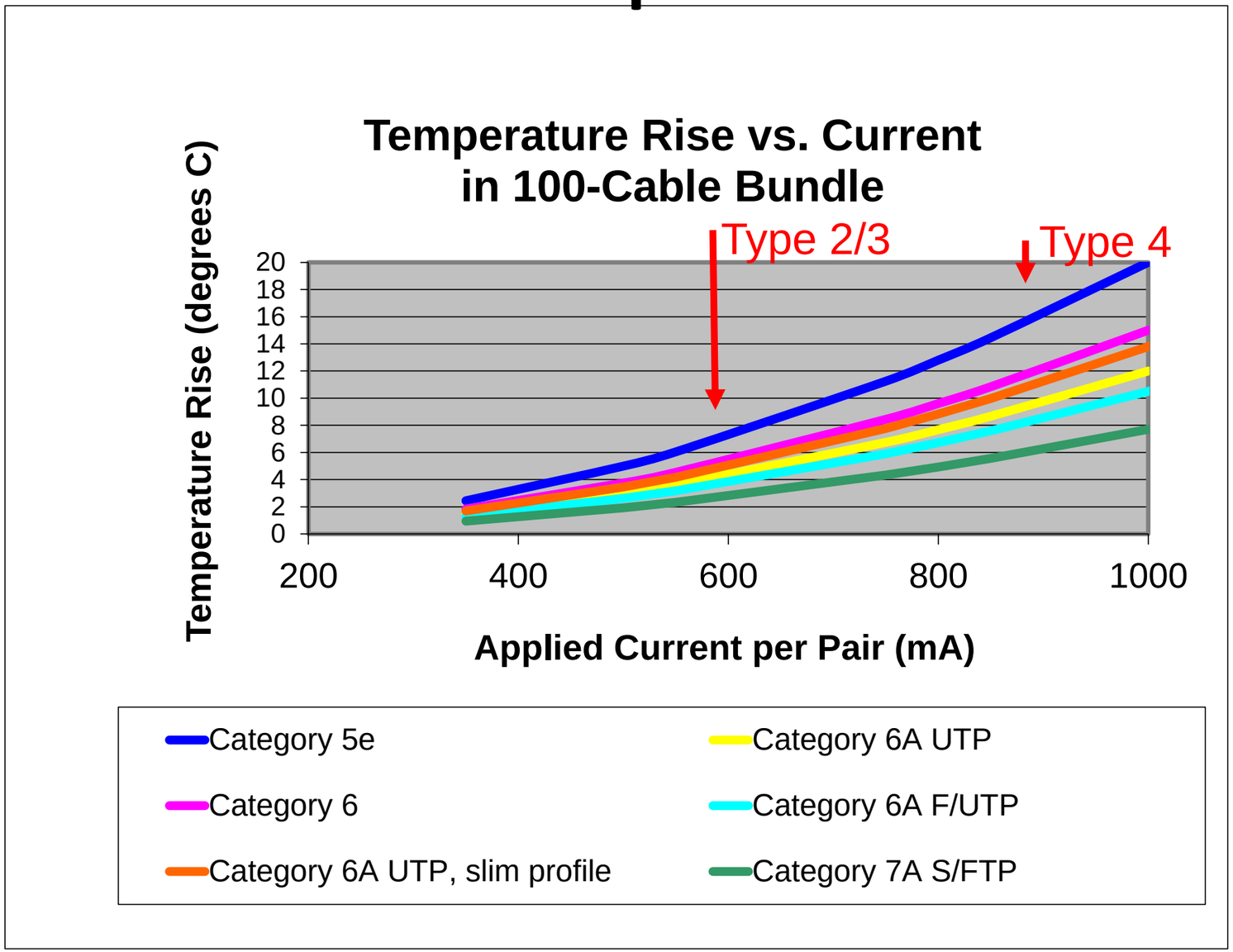
- Remote powering can cause heat build-up within cable bundles
- Cabling insertion loss increases at temperatures above 20°C/68°F
- The temperature of any cable should not exceed the temperature rating for the cable
  - Generally, cables used in commercial premises have a temperature rating of 60°C
  - Exceeding a cable's specified operating temperature may result in long term cable degradation
  - Cables with higher temperature ratings are listed and marked accordingly
  - Exceeding 60°C/140°F DOES NOT result in cables melting or safety risks



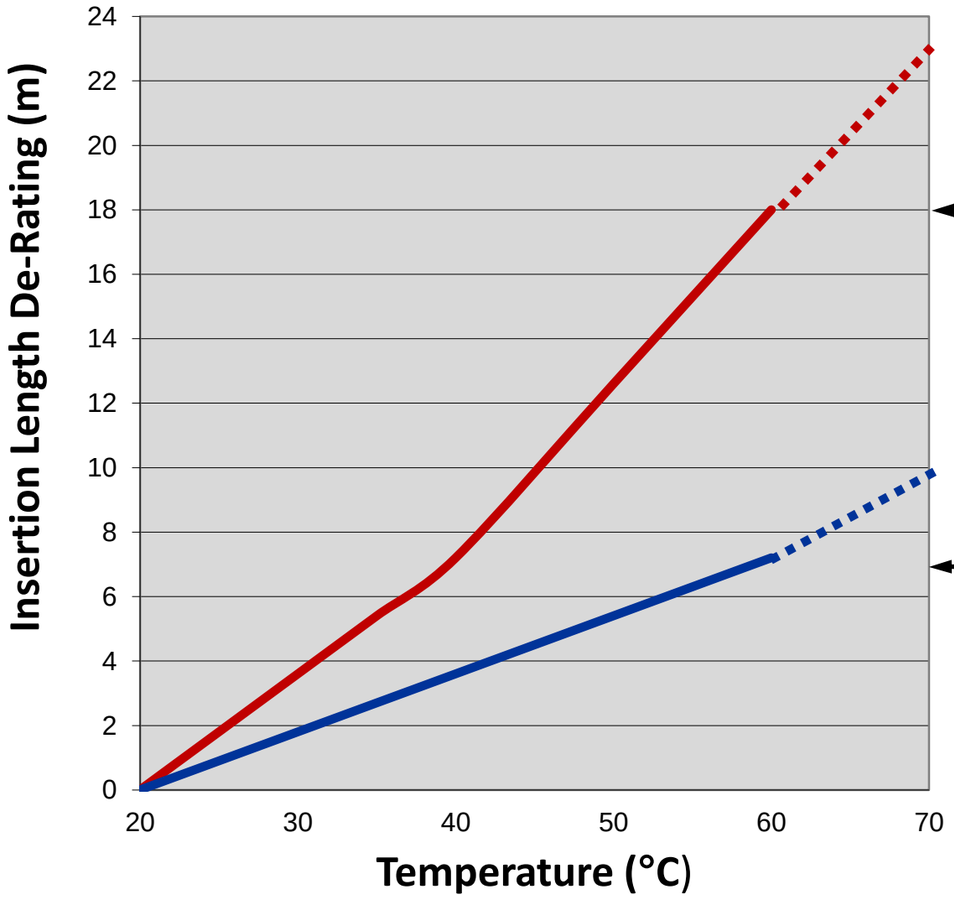
It’s not getting colder…



PoE Cable Temperature Rise



Channel Length De-Rating

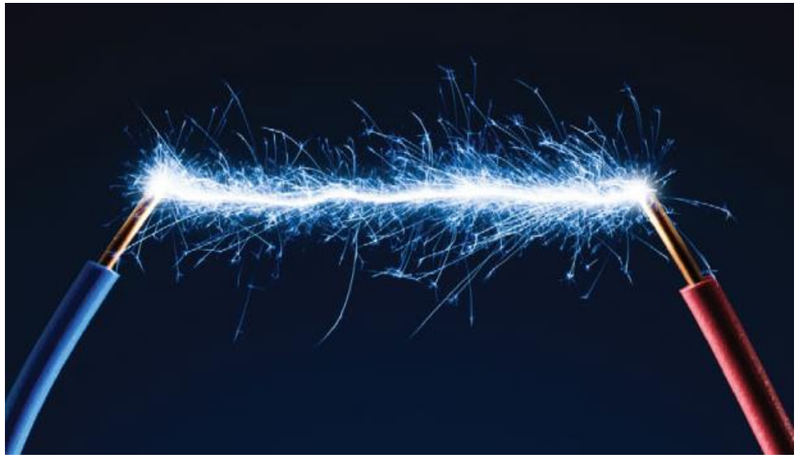


TIA, ISO/IEC Category 6A UTP
Subtract 18 m at 60°C/140°F

TIA, ISO/IEC Category 6A F/UTP
Subtract 7 m at 60°C/140°F

Potential for Arcing Under Load

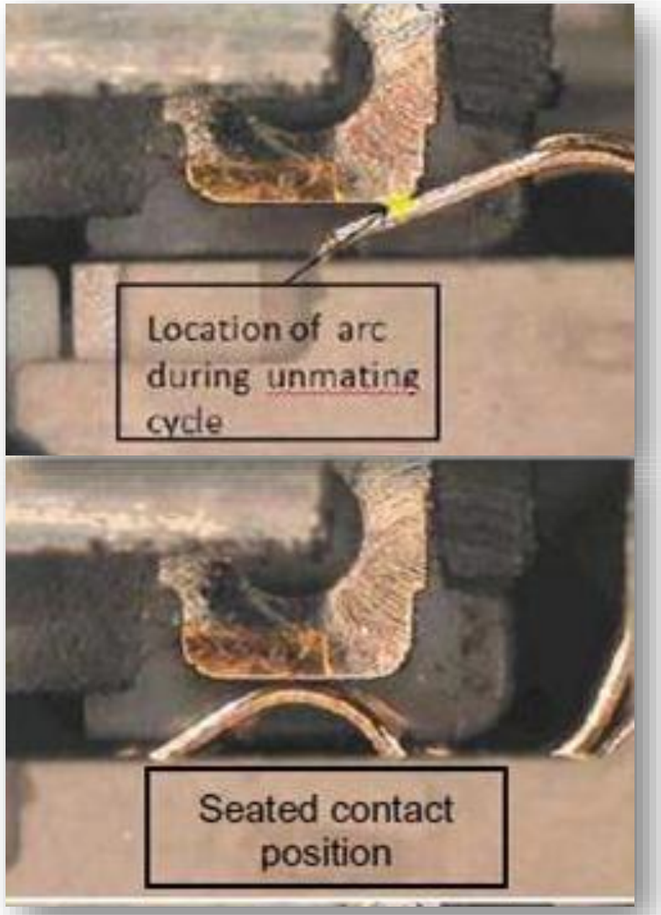
- Remote powering applications do not apply DC power until a PD is sensed by the PSE
- Device disconnections can’t be anticipated



- “Un-mating pairs under load” produces an arc as the applied current transitions from flowing through conductive metal to air before becoming an open circuit
- Arcing can result in corrosion and pitting damage on the plated contact surface at the arcing location

Ensuring Contact Integrity

- Informative Annex B of TSB-184-A contains the following guidance:
  - Connecting hardware having the required performance for mating and un-mating under the relevant levels of electrical power and load should be chosen
  - IEC 60512-99-001 is referenced as a suitable test schedule

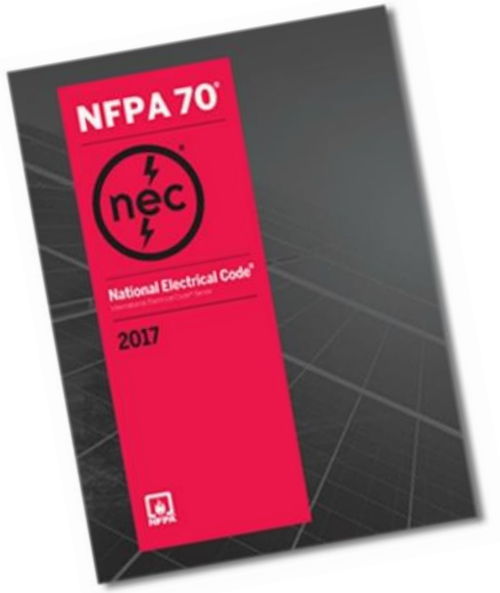


Standards Resources

- NFPA 70 (2017 NEC)
- TIA TSB-184-A-2017
- TIA-569-D-2-2018

2017 NEC Code Revisions

- Cable Ratings and Markings for Safety
- Ampacity Table for Bundles



Part VI. Premises Powering of Communications Equipment over Communications Cables

840.160 Powering Circuits. Communications cables, in addition in carrying the communications circuit, shall also be permitted to carry circuits for powering communications equipment. Where the power supplied over a communications cable to communications equipment is greater than 60 watts, communication cables and the power circuit shall comply with 725.144 where communications cables are used in place of Class 2 and Class 3 cables.

2017 NEC Table 725.144

- Conductor gauge, bundle size and temperature rating are used to establish a safe power rating (Ampacity) for <u>each conductor</u>

AWG	Number of 4-Pair Cables in a Bundle																				
	1			2-7			8-19			20-37			38-61			62-91			92-192		
	Temp Rating			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	60°C	75°C	90°C
26	1	1	1	1	1	1	0.7	0.8	1	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	NA	NA	NA
24	2	2	2	1	1.4	1.6	0.8	1	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.7	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3	3	3	1.4	1.8	2.1	1	1.2	1.4	0.7	0.9	1.1	0.6	0.9	1.1	0.6	0.8	0.9	0.5	0.6	0.7

Example: Can this cable support Type 4?

- 24 AWG category 5e cable
- Bundle size of 75 cables
- Mechanically rated to 60°C

AWG	Number of 4-Pair Cables in a Bundle																				
	1			2-7			8-19			20-37			38-61			62-91			92-192		
	Temp Rating			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	60°C	75°C	90°C
26	1	1	1	1	1	1	0.7	0.8	1	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	NA	NA	NA
24	2	2	2	1	1.4	1.6	0.8	1	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.7	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3	3	3	1.4	1.8	2.1	1	1.2	1.4	0.7	0.9	1.1	0.6	0.9	1.1	0.6	0.8	0.9	0.5	0.6	0.7

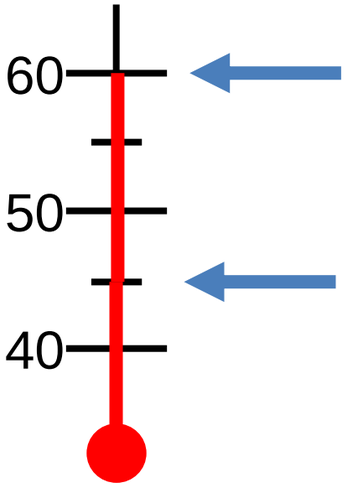
Alternatives

1. Use cables with a larger conductor or higher mechanical rating
2. Reduce bundle size
3. Changes to the table to improve precision and correct errors expected in 2020

AWG	Number of 4-Pair Cables in a Bundle																				
	1			2-7			8-19			20-37			38-61			62-91			92-192		
	Temp Rating			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	60°C	75°C	90°C
26	1	1	1	1	1	1	0.7	0.8	1	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	NA	NA	NA
24	2	2	2	1	1.4	1.6	0.8	1	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.7	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3	3	3	1.4	1.8	2.1	1	1.2	1.4	0.7	0.9	1.1	0.6	0.9	1.1	0.6	0.8	0.9	0.5	0.6	0.7

TIA TSB-184-A

- *"Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling"* (March 2017)
- The standard presumes a maximum ambient temperature of 45°C/113°F in conjunction with cabling with a maximum rating of 60°C/140°F, thus allowing a maximum temperature rise of 15°C/27°F on any cable within the bundle due to dc powering
  - The maximum ambient temperature along the link (length of at least 1m) should be used as the basis for the calculation



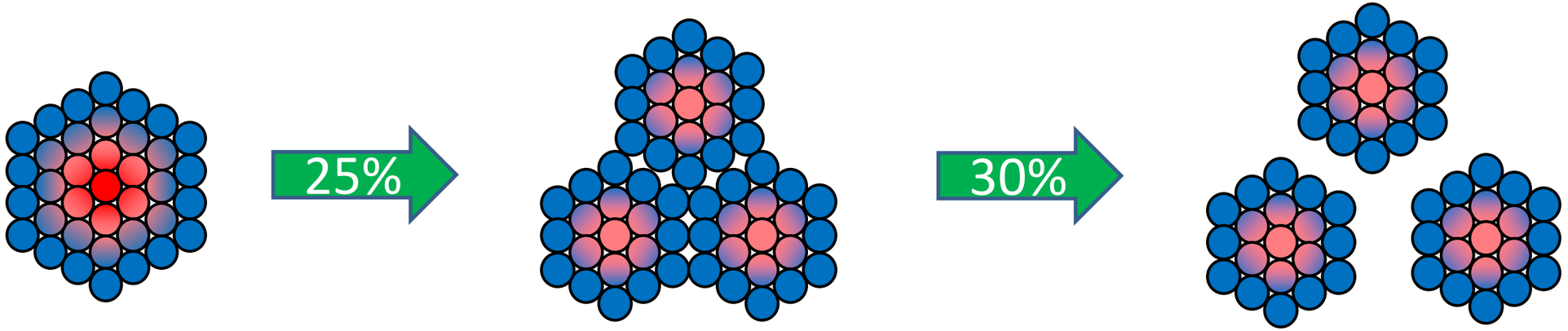
Mitigation Recommendations

- Use Category 6A or higher-performing 4-pair balanced twisted-pair cabling
- Install shielded cables
- Reduce channel length, as necessary, to offset increased insertion loss
- Minimize cable lengths in order to reduce dc loop resistance

AWG	Ω/100m (solid)
23	7.32
24	9.38
26	14.8

Mitigation Recommendations

- Leave cables unbundled
  - If bundling, smaller bundles are recommended



  - Limit the number of cables per bundle to 24

Cable Bundle Recommendations

- When in doubt about cable mechanical or heat dissipation capability, installation environment, or remote powering application, a conservative practice is to limit maximum bundle size to 24 cables

AWG	Number of 4-Pair Cables in a Bundle																				
	1			2-7			8-19			20-37			38-61			62-91			92-192		
	Temp Rating			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	60°C	75°C	90°C
26	1	1	1	1	1	1	0.7	0.8	1	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	NA	NA	NA
24	2	2	2	1	1.4	1.6	0.8	1	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.7	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3	3	3	1.4	1.8	2.1	1	1.2	1.4	0.7	0.9	1.1	0.6	0.9	1.1	0.6	0.8	0.9	0.5	0.6	0.7

Mitigation Recommendations

- Use open wire tray or similar cable management that provides for largely unrestricted airflow around the installed cables
  - Disperse cables evenly across the width of the tray
- Reduce maximum operating temperature
- Mix unpowered cables with powered cables

TIA-569-D-2-2018

- *"Additional Pathway and Space Considerations for Supporting Remote Powering Over Balanced Twisted-Pair Cabling"* (July 2018)
- Pathways differ in regard to geometry and contact area between cables, pathway, and air
- Provides general guidance on heat dissipation of various pathways by bundle size

Pathway Heat Dissipation Effectiveness

Pathway Type	Cable Routing	Cable Quantity			
		1-37	38-61	62-91	> 91
Non-continuous	Bundled	High	High	High	N/A
	Unbundled	High	High	High	N/A
Conduit (Metallic & Non-metallic)	Bundled	Low	Low	Low	Low
	Unbundled	Medium	Low	Low	Low
Sealed Conduit	Bundled	Low	Low	Low	Low
	Unbundled	Low	Low	Low	Low

Tray Type	Fill Depth (in.)		
	1	2	≥ 3
Wire Mesh/Ladder	High	High	High
Ventilated	High	Medium	Low
Unventilated	Medium	Medium	Low

Agenda

- Remote Powering
- Impact on Cabling
- Intelligent Buildings
- Converged Cabling Designs

Planning for Intelligent Buildings

- Design 10-15 years out
  - Allow for additional systems and cabling
  - Plan for future builds
  - Accommodate future applications

Quiz Question #3

What is the TIA standard for the Structured Cabling Infrastructure Standard for Intelligent Building Systems?

A: ANSI/TIA-862-B

Quiz Question #4

What is the BICSI standard for the Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises?

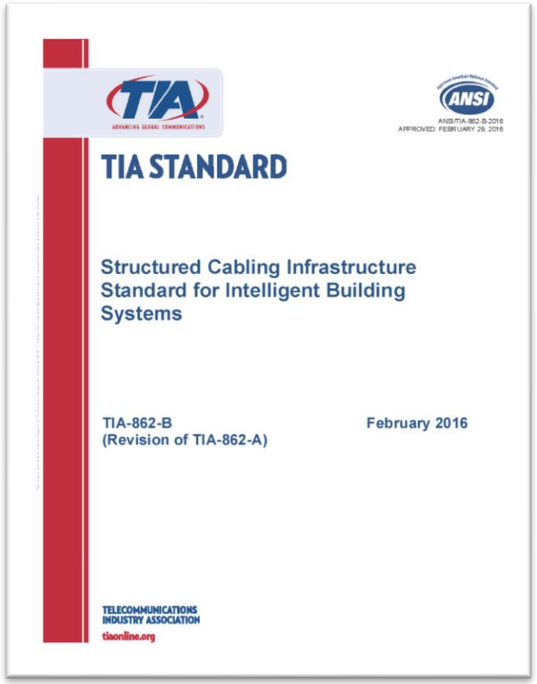
A: BICSI 007

Meeting Applicable Codes & Standards

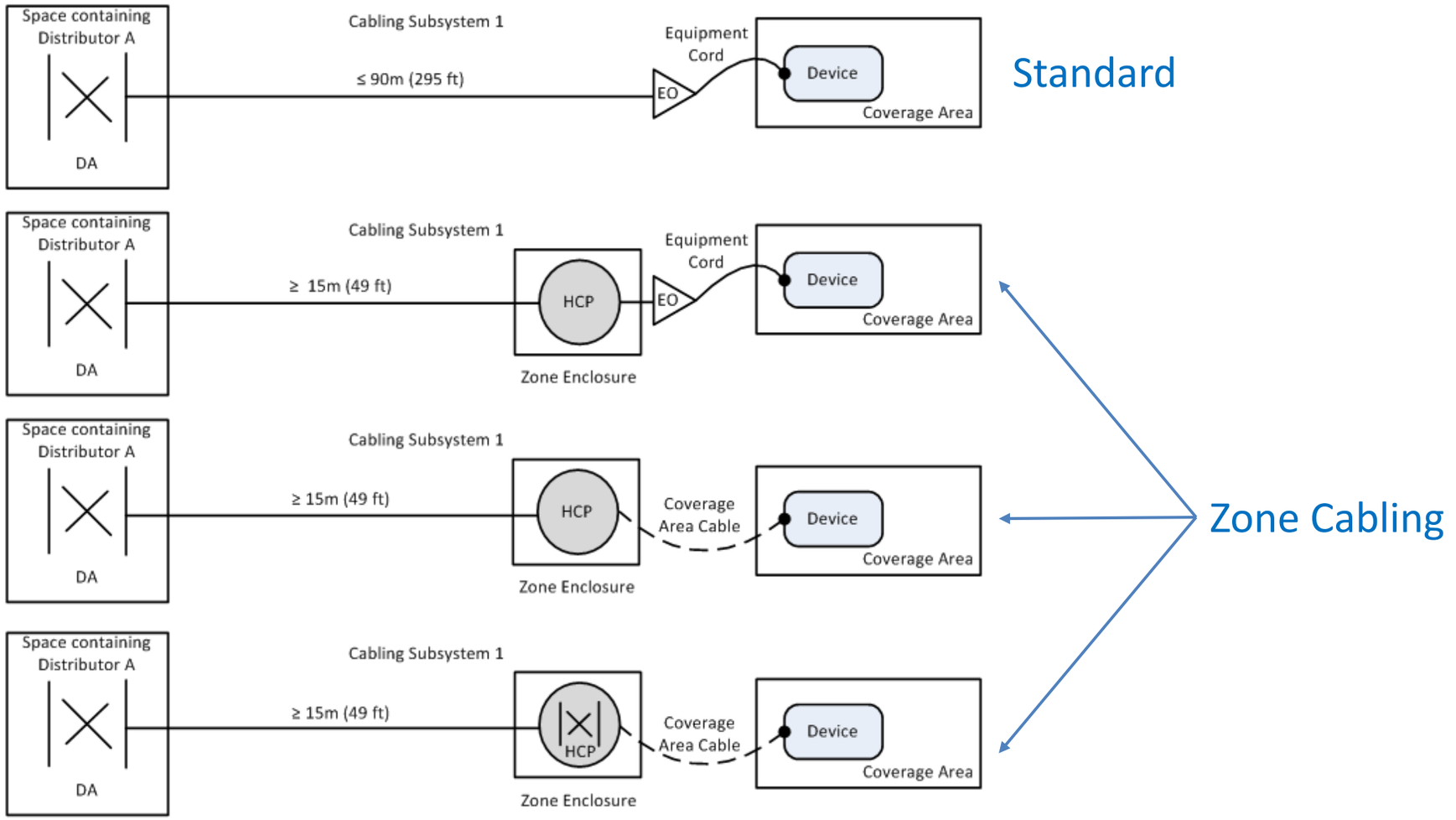
- ANSI/TIA-862-B “Structured Cabling Infrastructure Standard for Intelligent Building Systems”
- BICSI 007, “Information Communication Technology Design and Implementation Practices for Intelligent Buildings and Premises”

TIA-862-B-2016

- *Structured Cabling Infrastructure Standard for Intelligent Building Systems*
  - Change of title (was Building Automation Systems Cabling Standard)
- General substitution of the term “intelligent building system” for the previous term “building automation system”
- Addition of guidance for cabling for:
  - Wireless systems
  - Remote powering over balanced twisted-pair cabling
  - Smart lighting



Topology Options



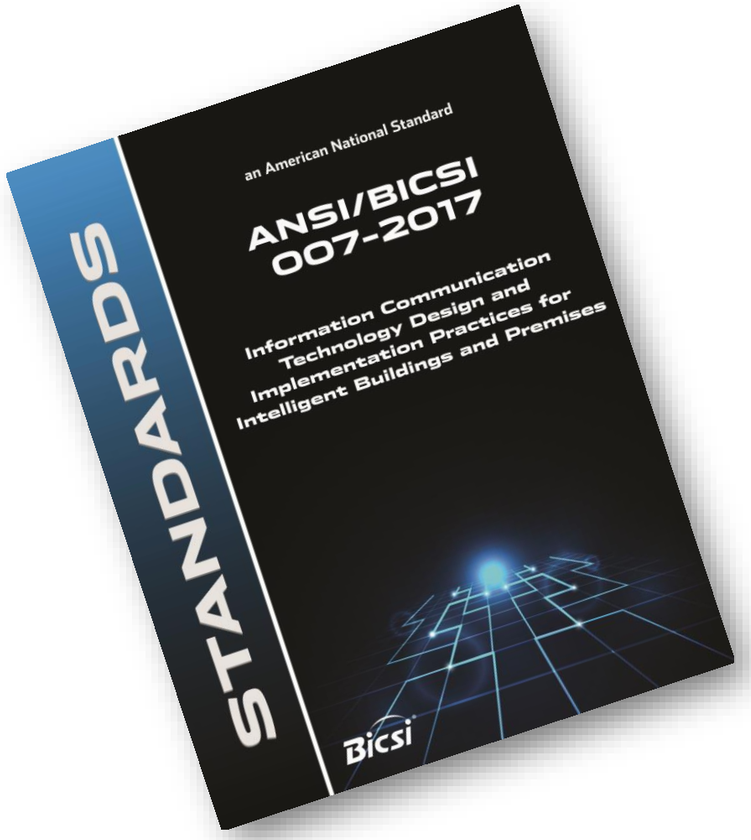
Terminology

Location/Device	TIA Standard	Terminology
Intermediate connection location in a zone cabling topology supporting a voice/data device	ANSI/TIA-568-0.D	Consolidation Point (CP)
Outlet connecting to a voice/data device	ANSI/TIA-568-0.D	Telecommunications Outlet (TO)[1]
Intermediate connection location in a zone cabling topology supporting a building device	ANSI/TIA-862-B	Horizontal Consolidation Point (HCP)
Outlet connecting to a building device	ANSI/TIA-862-B	Equipment Outlet (EO)[2]

[1] A TO must always be present even if a CP is present
[2] An EO is optional if an HCP is present

ANSI/BICSI 007-2017

- *Technology Design and Implementation Practices for Intelligent Buildings and Premises*
- Communications Infrastructure & Network Integration
- Design Considerations (Power, Data, Zone Cabling)
- Building Systems (Lighting, Digital Signage, Vertical Transportation, Sound Systems, ESS, etc.)
- Building Monitoring Systems
- Commissioning



Agenda

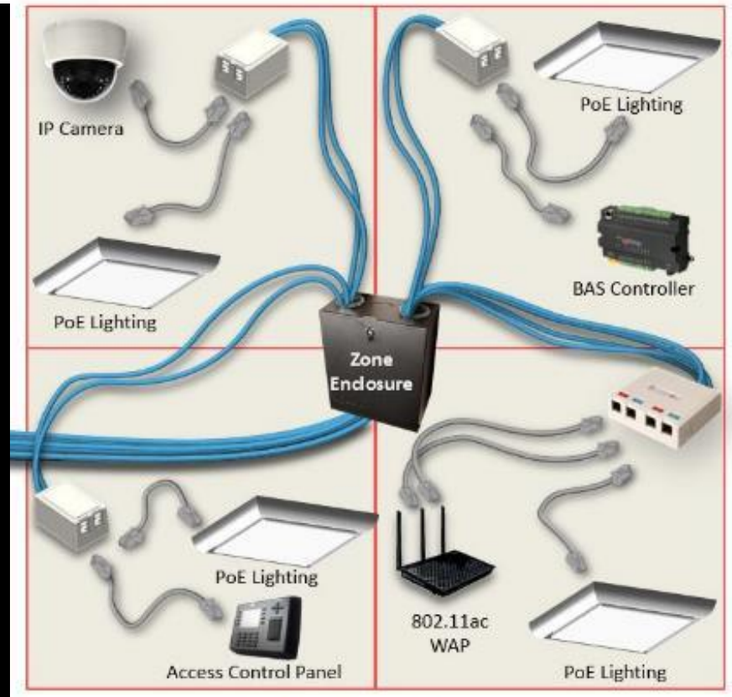
- Remote Powering
- Impact on Cabling
- Intelligent Buildings
- Converged Cabling Designs

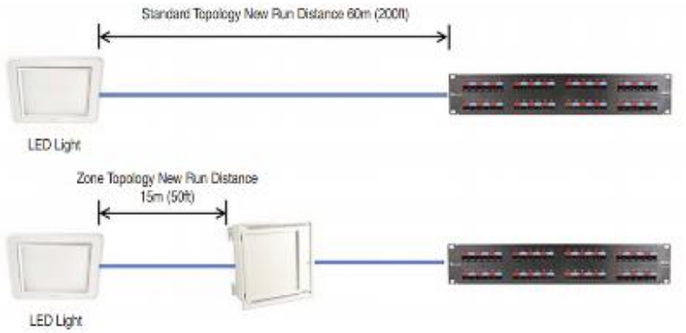
What is Zone Cabling?

Zone cabling supports convergence of data and voice networks, wireless (Wi-Fi) device uplink connections, and a wide range of sensors, control panels, and detectors for lighting, security, and other building communications

Zone Cabling Methodology

- Zone cabling is a standards-based approach to support convergence of devices
- Consists of cables run from connections in the telecommunications room (TR) to outlets housed in a zone enclosure servicing coverage areas

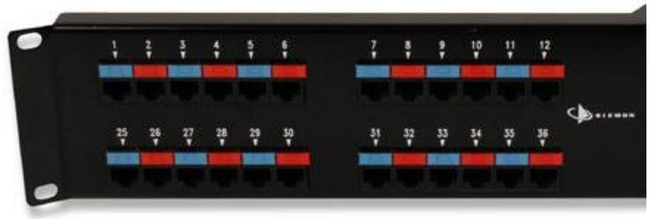




- 25% spare port availability recommended for best ROI
- Supports rapid reorganization and deployment of new devices and applications
- Factory pre-terminated and tested trunking cables can be installed from the TR to the zone enclosure for quicker deployment

What is Zone Cabling?

SCP/HCP Housed in a Zone Enclosure

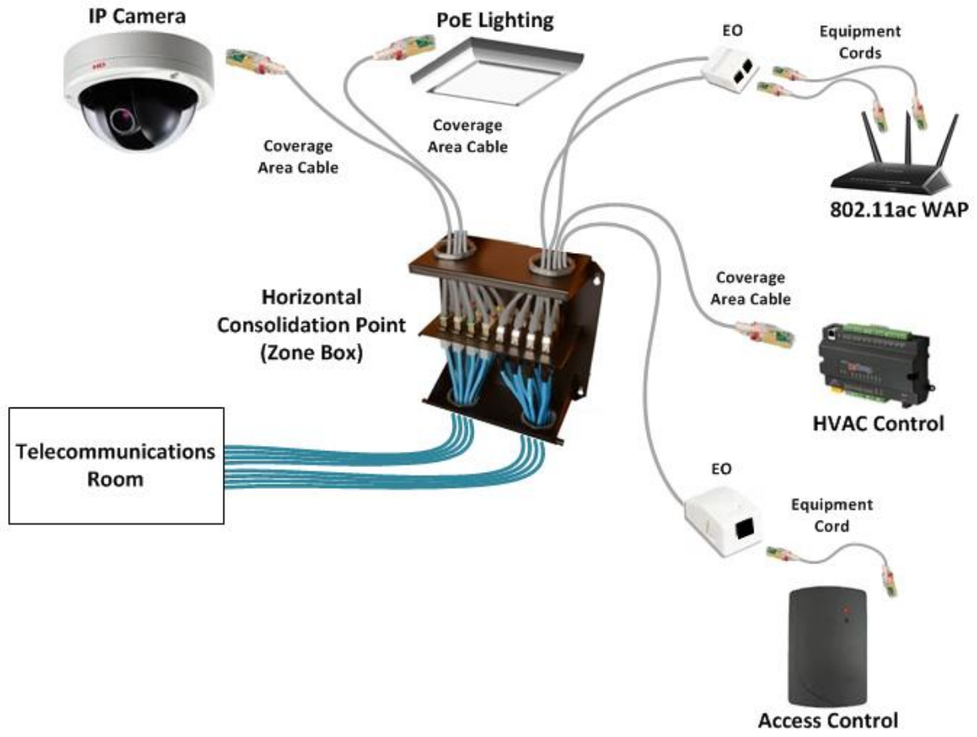


Patch Panel in a TR

Device Outlet

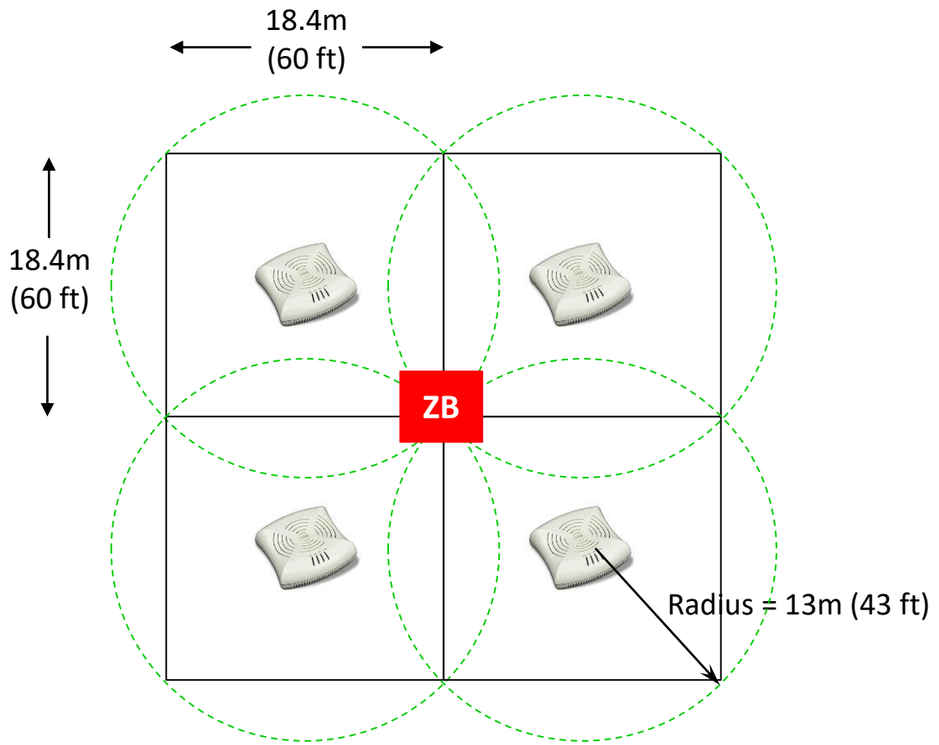
Benefits of a Zone Cabling Design

- Supports rapid reorganization of work areas and equipment
- Simplifies deployment of new devices and applications
- Improved pathway utilization
- MAC work
  - Less costly
  - Faster to implement
  - Less disruptive
- Creates a flexible, “futureproof” infrastructure for voice, data, building devices, and wireless access points



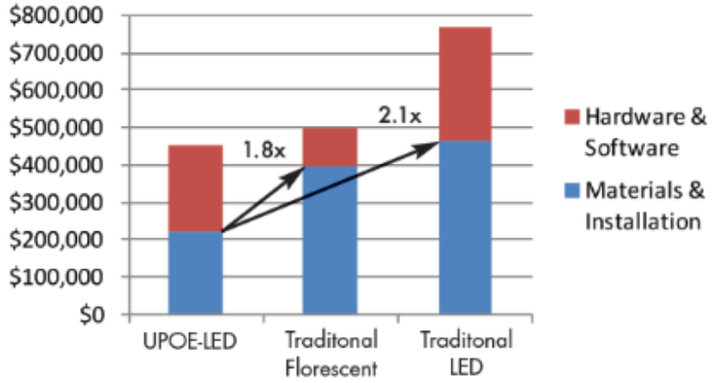
Zone Cabling Considerations

- A coverage area radius of 13m is generally recommended as an optimum size to accommodate most converged cabling networks
- The number of connections within the zone enclosure should not exceed 96
- Need to factor in future expansion



PoE Lighting: Unleashing Efficiency

- PoE now delivers enough power to operate commercial LED lighting
- Delivers significantly lower capital and labor investment
- LED lights consume half the energy of fluorescents and last 5X longer
- Earth and tenant friendly with less emissions and no hazardous mercury
- Integrates with other IoT applications and can receive centralized IT back up power



Upfront Cost Comparison for a 35,000ft^2 building in New York City

PoE Lighting: Unleashing Efficiency

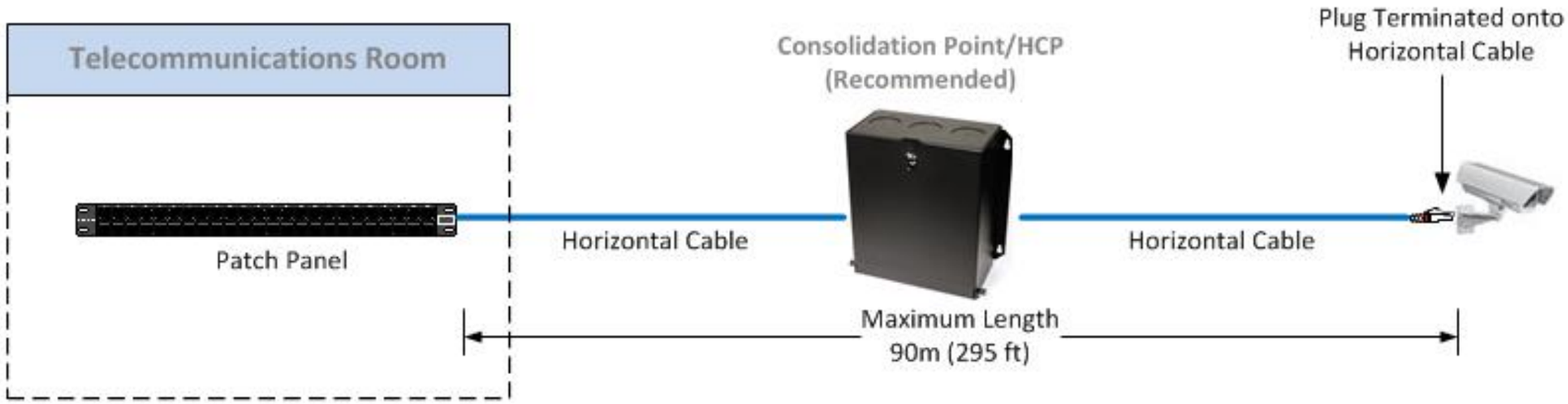
- Centralized control
- Occupancy sensors
- CO_2 sensors
- Humidity sensors
- Daylight harvesting
- Energy consumption
- *Li-Fi network connectivity*
- Intelligence to adapt to patterns and preferences
- Color coding and flashing patters for security and/or threat level notification

Quiz Question #5

What is an MPTL?

A: Modular Plug Terminated Link

Modular Plug Terminated Link (MPTL)



- The MPTL is constructed by direct field termination of horizontal cabling at the device end with a modular plug - replacing the TO/SO and associated Work Area (WA) cord.
- ANSI/TIA-568.2-D requires that horizontal cable be terminated onto a TO. In certain cases there may be a need to terminate horizontal cables directly to a plug.
- ANSI/BICSI-007 recognizes the MPTL and refers to it as a direct connection method, with or without an HCP.
- ANSI/TIA-862-B recognizes direct connections – should be limited to devices in fixed locations that are not expected to be replaced or required to be directly connected by the AHJ

MPTL Market Drivers

- IoT and Intelligent Buildings are driving the proliferation of IP-based and PoE-based devices in the walls and ceilings of modern buildings
- LED lights, security cameras, wireless access points, digital displays, distributed antenna systems (DAS), building automation control devices and more can be directly connected using plug-terminated links rather than via boxes, outlets, and patch cords

MPTL Considerations

- Benefits:
  - Custom length, quick connections in the field for direction connection to devices
  - Simplifies project bill of materials and eliminates the need for predetermined patch cord lengths
- Disadvantages:
  - No provision for service loops/ cable slack
  - Reduced “plug and play” functionality
  - Abandoned cabling needs to be removed when device is removed

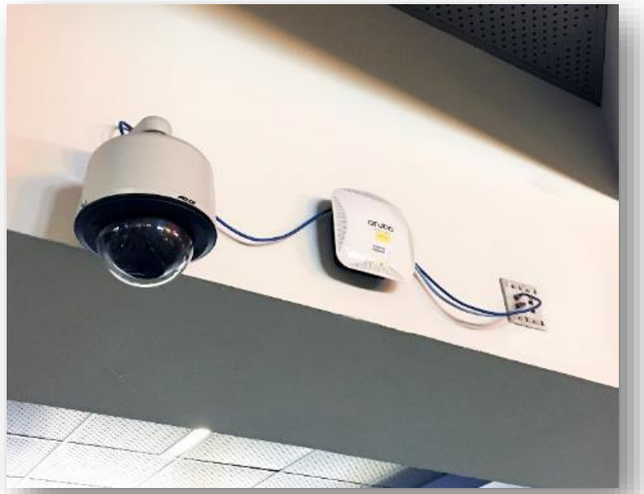
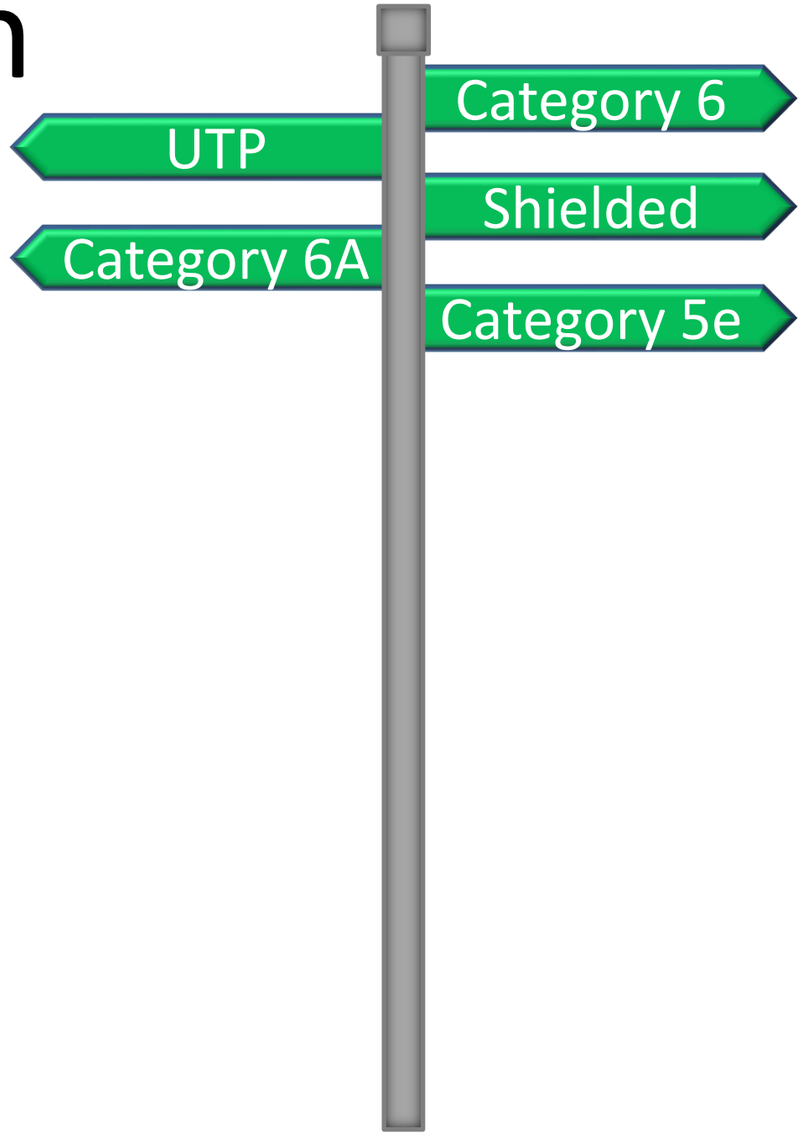


Photo taken at McCarran Airport in Las Vegas – Anyone could jump up and pull out the patch cord to the surveillance camera and wireless access point.

Media Selection



- TIA TSB-184-A
  - Category 6A recommended
- TIA-862-B
  - Category 6; category 6A recommended
- ISO/IEC 11801-6 Ed1.0
  - Class E_A or higher
- BICSI 007
  - Category 6A/Class E_A or higher recommended

Benefits of Shielded Cabling

- Typically qualified for higher temperature (75°C) operation
- Reduced length de-rating
- Superior heat dissipation supporting larger bundle sizes

The Shielded Evolution

- Shielded outlet technology has improved significantly
- Termination practices simplified
- Outlets can be color coded

Summary

- Remote powering puts increased demands on network cabling systems
- Consider PoE implications when specifying cabling infrastructure
- Zone cabling provides a flexible infrastructure
- Modular plug terminations have a role

Testing for Four Pair PoE

Christian Schillab

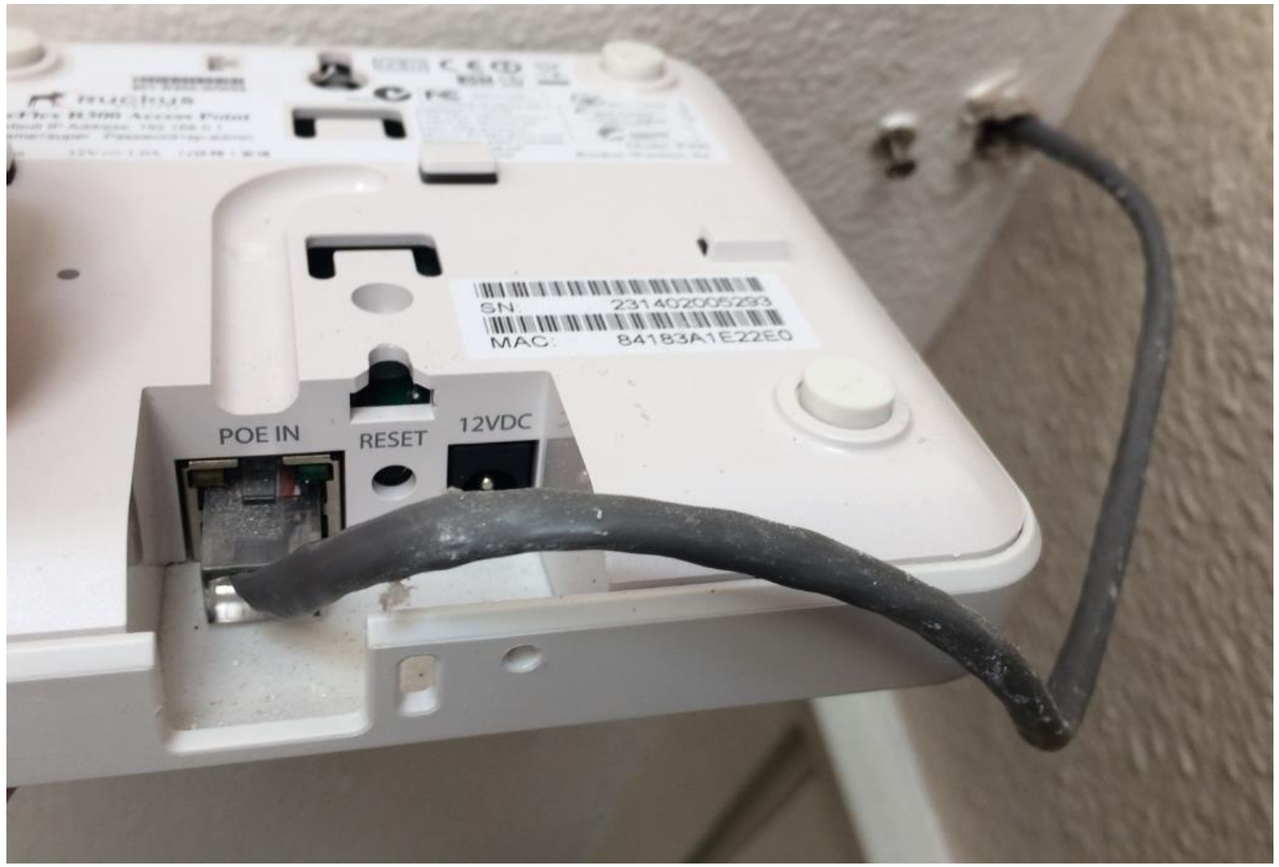
Modular Plug Terminated Link

Ethernet Alliance Certification

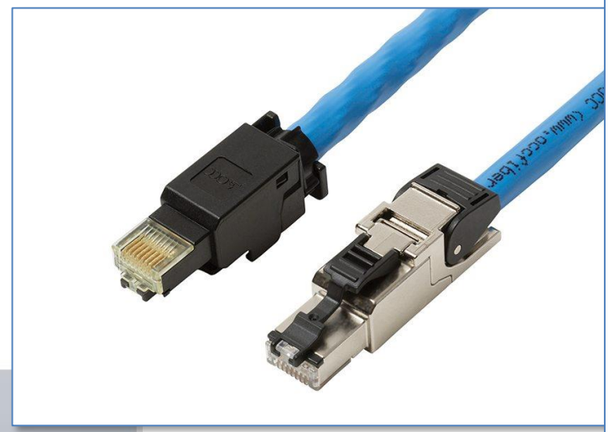
Resistance Testing for PoE

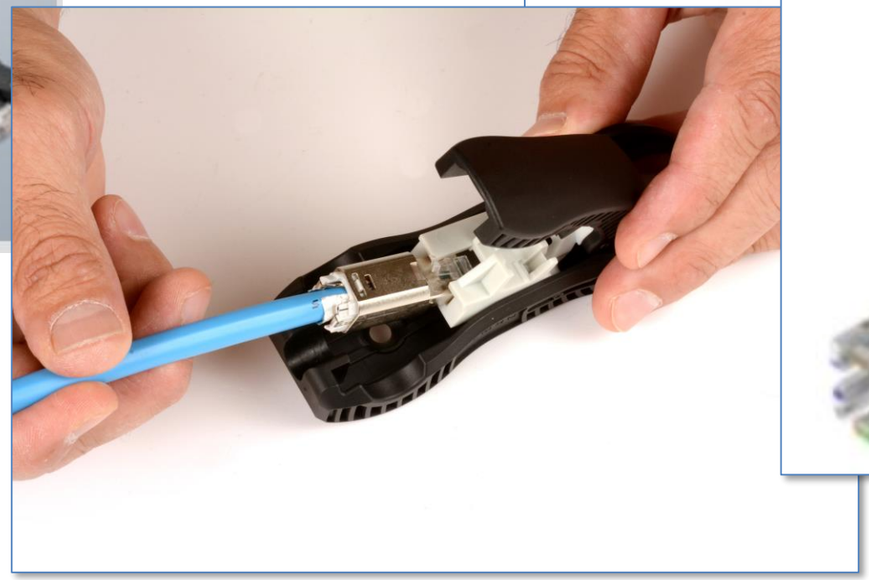
A Simplified Installation Technique

- ✓ AP’s, Cameras, Locks, Sensors, etc.
- ✓ Lower Cost
- ✓ Cleaner Look
- ✓ More Secure

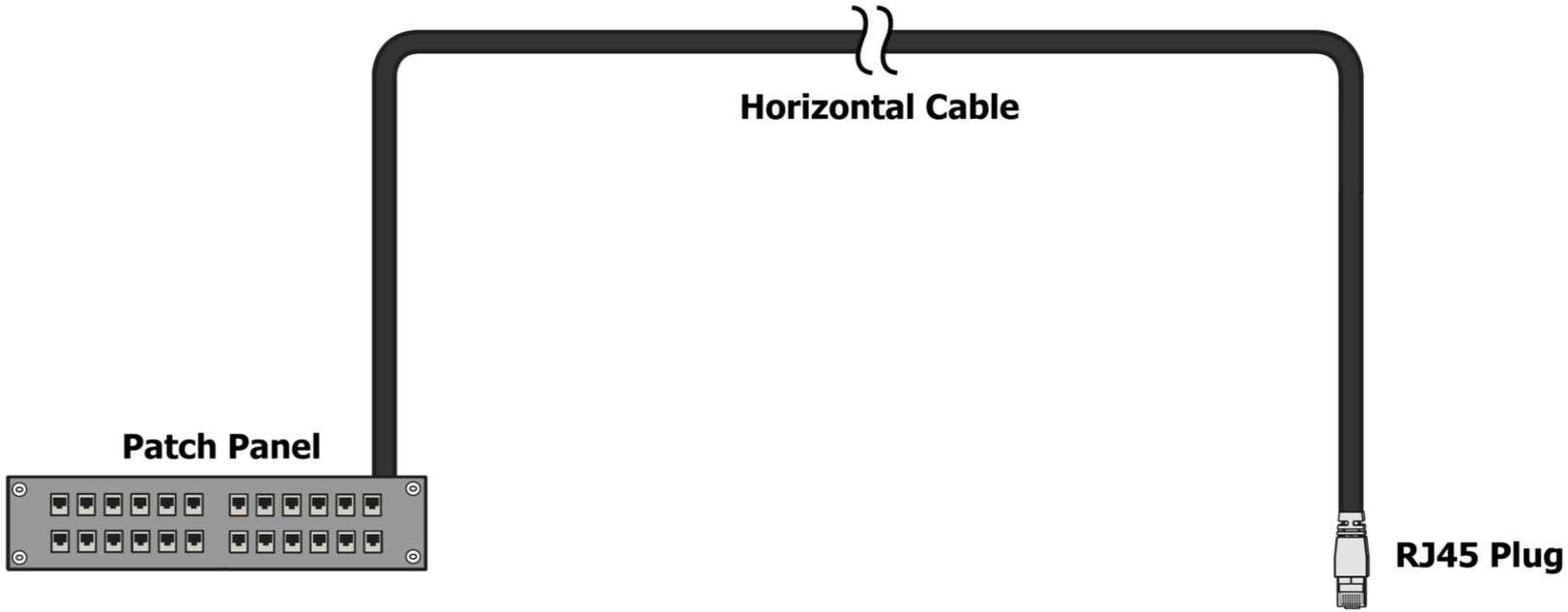


Field Terminated Plug Examples





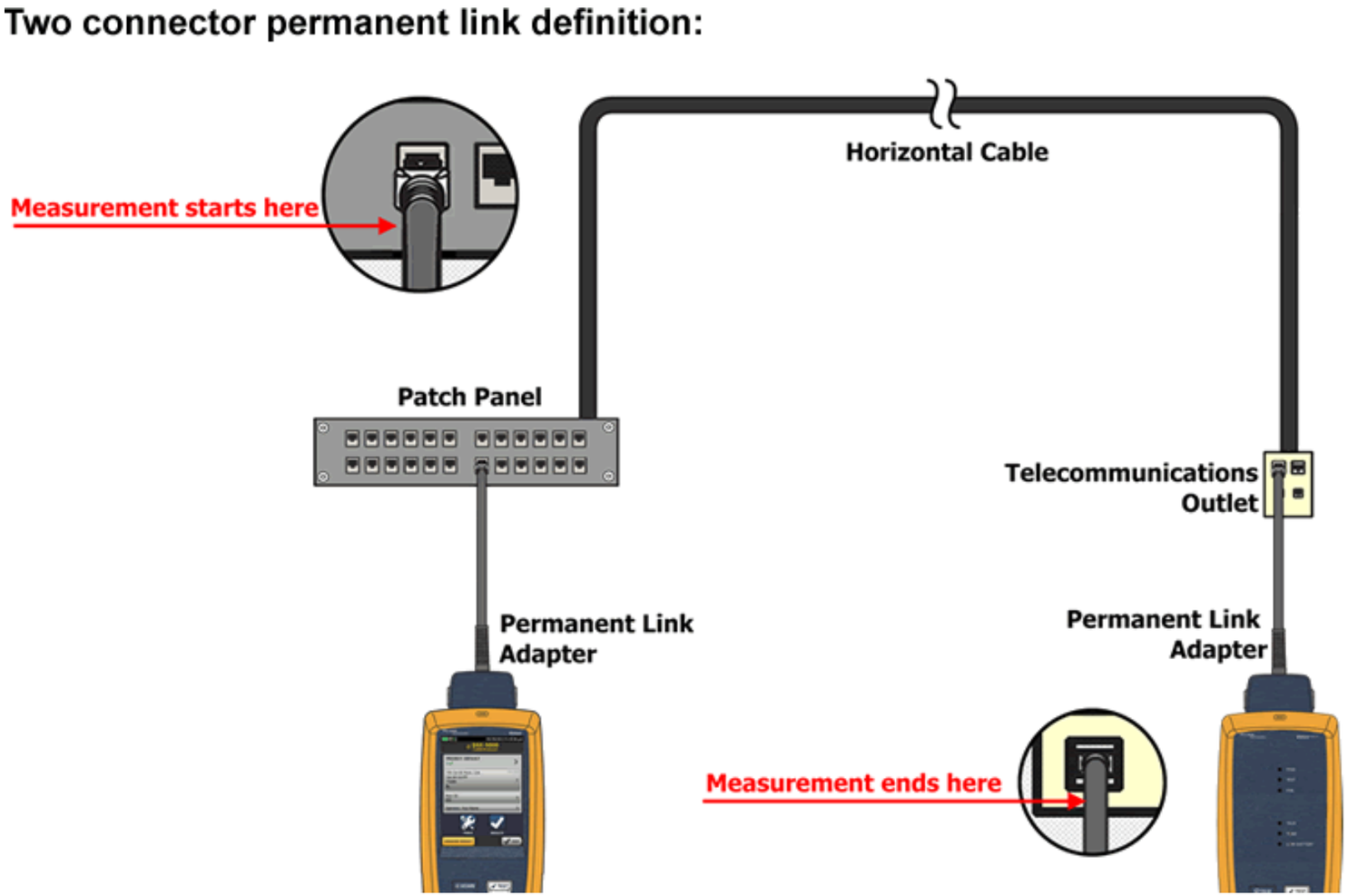
Modular Plug Terminated Link (MPTL)



So, How Do I Test This Thing?

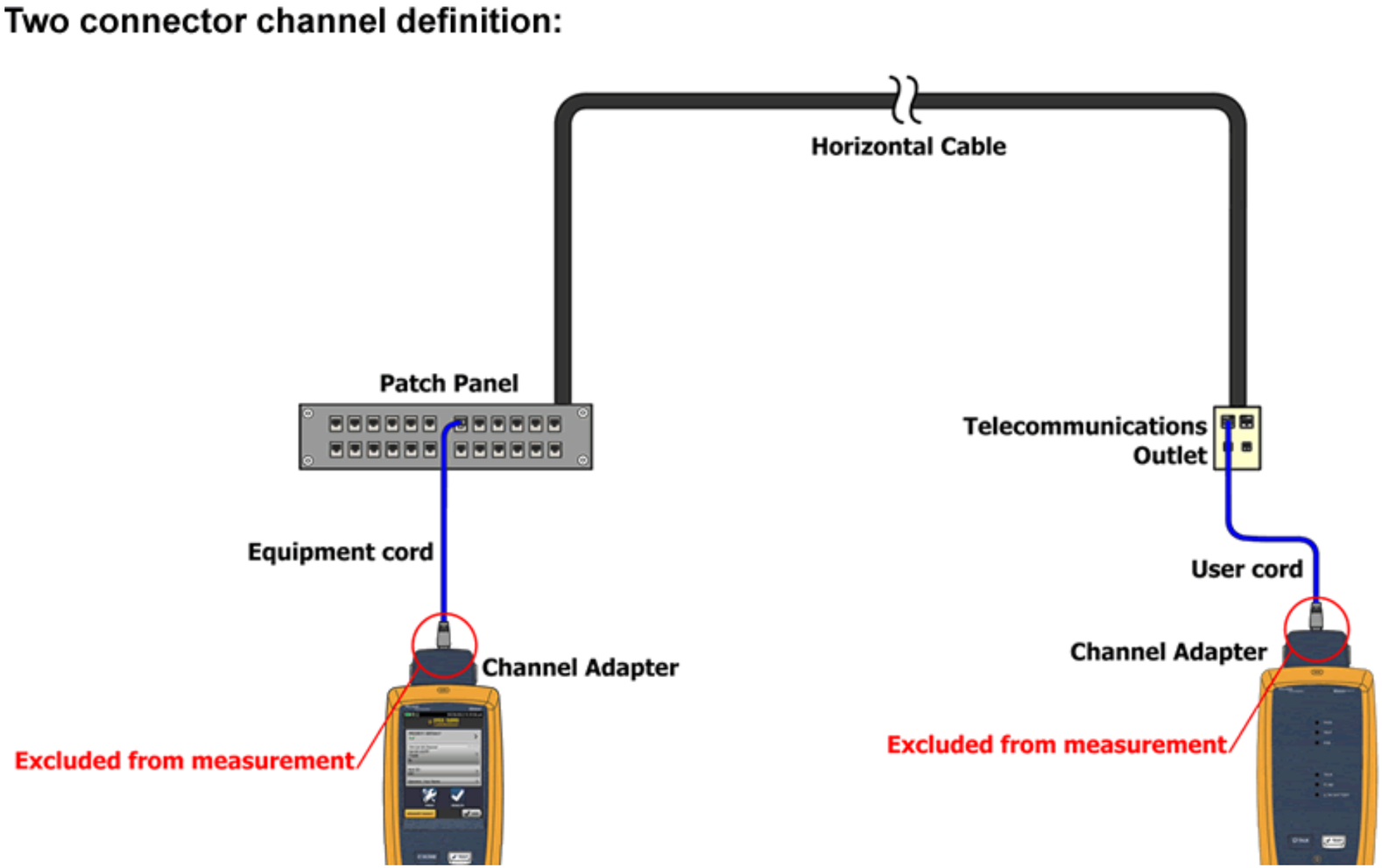
Is This a Permanent Link?

- ✓ Starts at a Patch Panel
- ✗ Includes Outlet
- ✗ No Final Plug



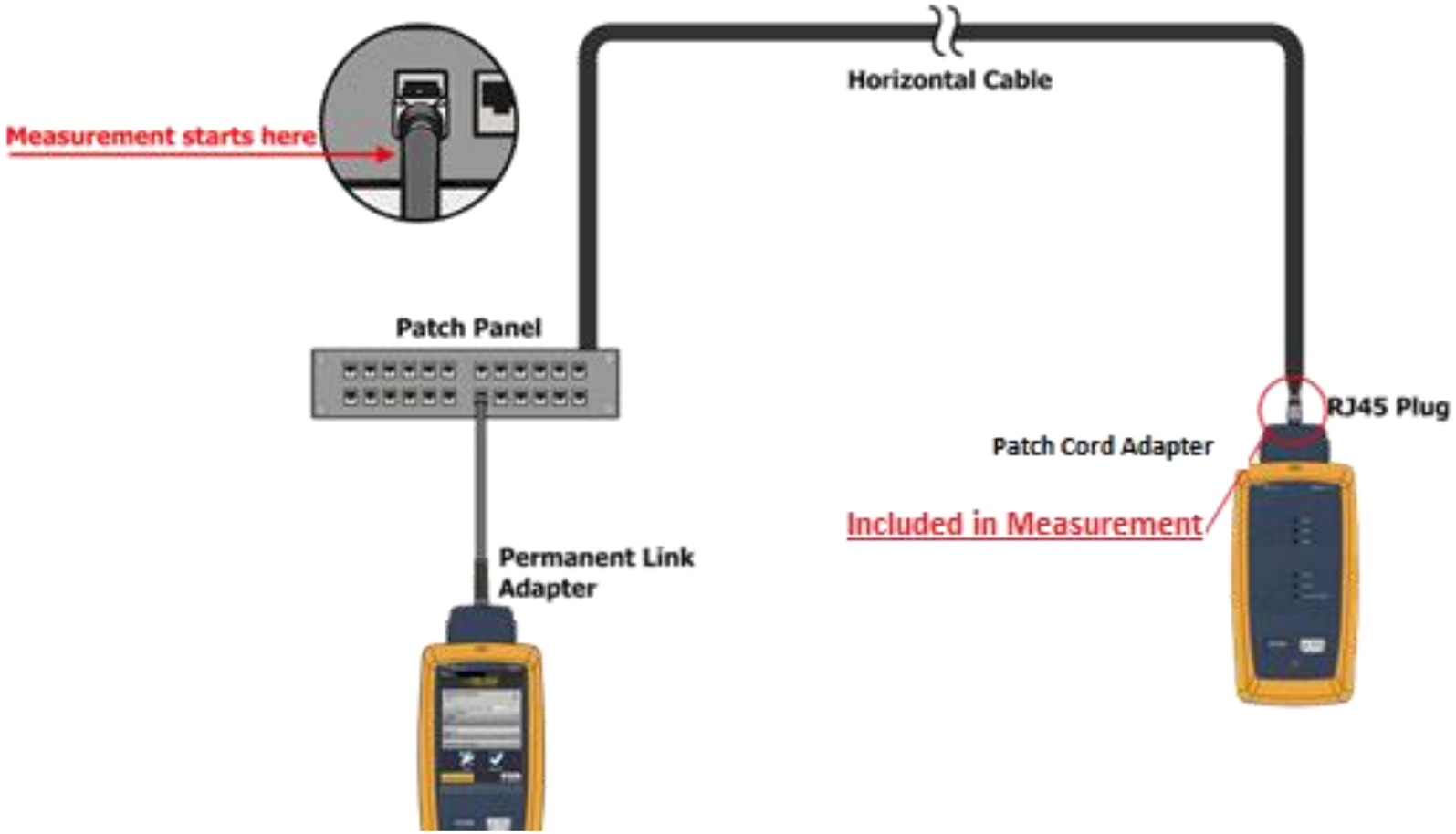
Is This a Channel?

- ✓ Includes Patch Cord
- ✗ Starts with Patch Cord
- ✗ Doesn’t Include Last Plug



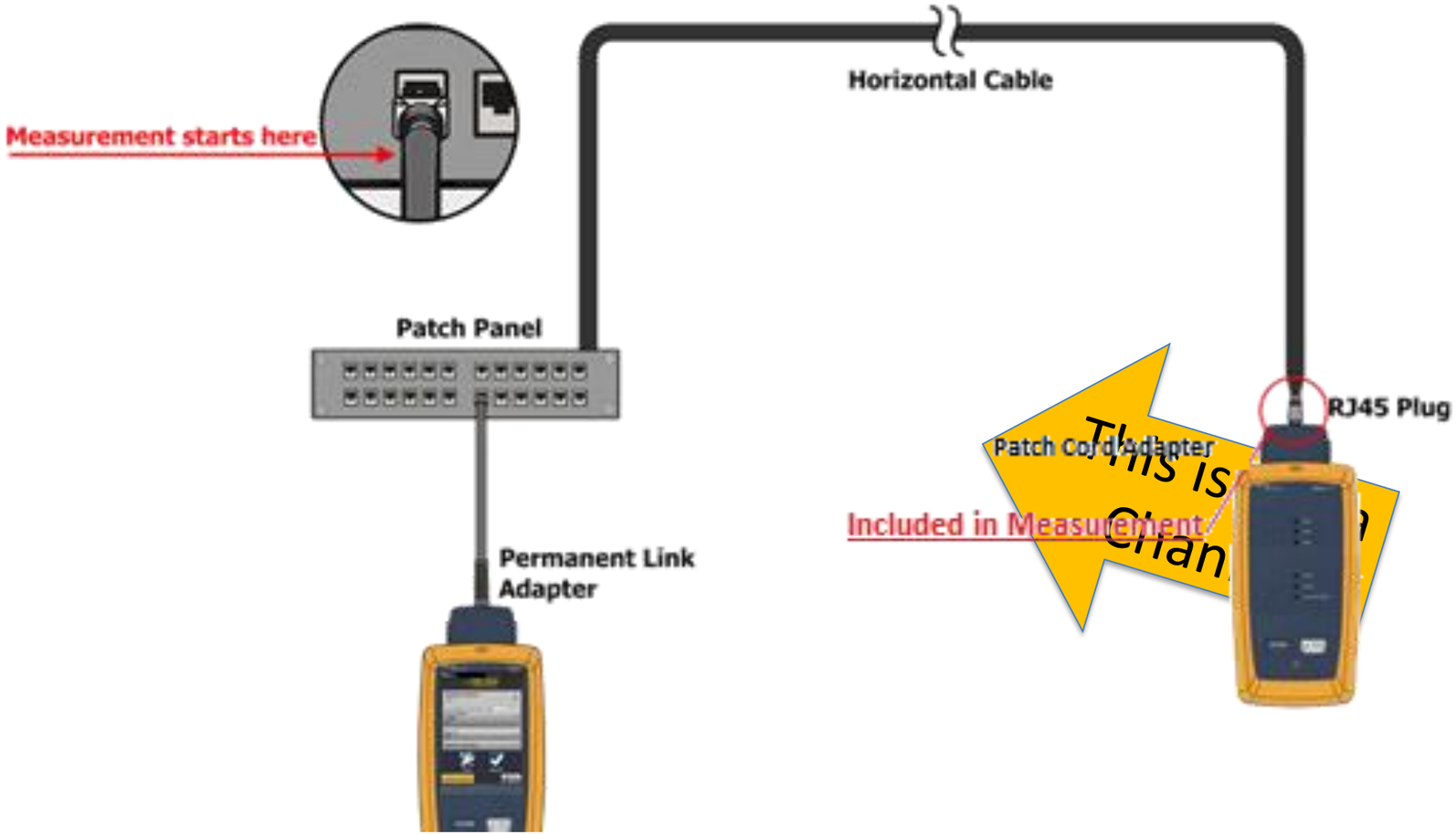
MPTL Definition

- Formerly Defined by BICSI as “Direct Attach”
- Defined in ANSI/TIA 568.D-2 (Approved June 2018) Annex F
- ISO to Discuss in Fall 2018
- Max. 295 ft. (90 m)
- Category 5e, 6, 6A

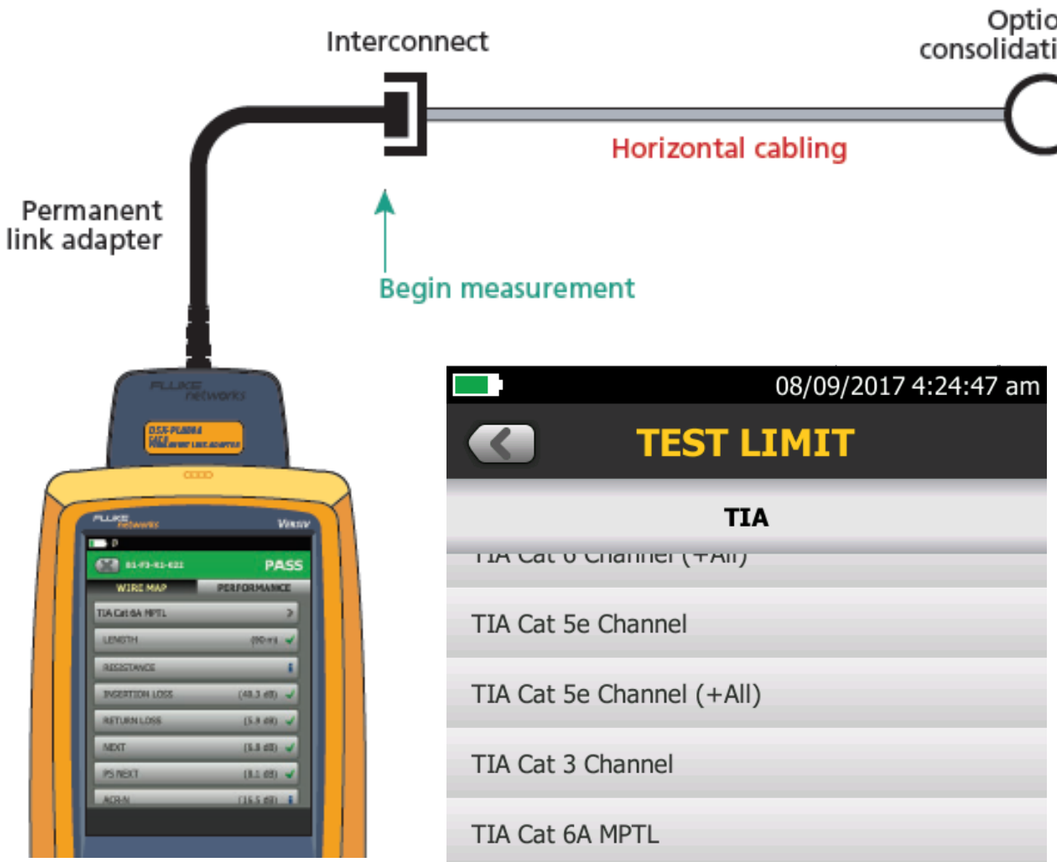


MPTL Definition

This is like a Permanent Link



Testing the MPTL: What You Need



Modular Plug Terminated Link

Ethernet Alliance Certification

Resistance Testing for PoE

Quiz Questions

- What's the power available at the PD for Class 3?
- 13W

- Based on 802.3bt, what class of power is available from a PoE++ device?
- Class 5 or 6

- How many pairs are used in Class 4 implementations?
- Two or Four

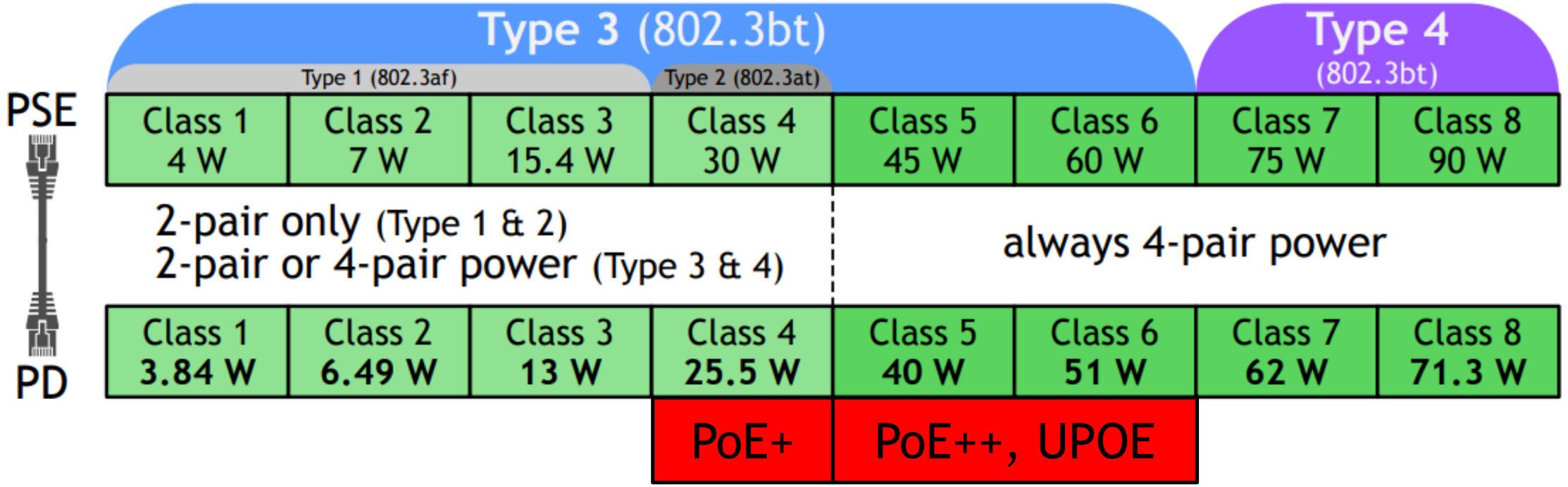
Power Over Ethernet

- IEEE 802.3bt – 4 pair Power over Ethernet
  - Now technically complete and no new features to be added
    - Type 1 and Type 2 PSE devices are as per 802.3af and at standards
    - Type 3 and Type 4 PSE devices added, 60W and 90W respectively
      - » Updated end types to support 2.5G, 5G and 10G Ethernet
      - » New midspan PSE to support the higher speeds
    - Warning added not to use smaller than 26AWG cabling with PoE
  - Out for sponsor ballot, expected to publish Q3 2018.

PoE Confusion

- Not a Licensed Term
- Three Standards: 802.3af, 802.3at, 802.3bt
- Eight Classes / Wattage Levels
- Four Types: 1 and 2 (two pair), 3 and 4 (four pair)
- Common Names: PoE, PoE+, PoE++, UPOE
- Passive, LLDP, and Negotiated Implementations
- Interoperability?

Understanding Classes and Types



Ethernet Alliance PoE Certification

(Number Indicates Class of Device)

ethernet alliance

Power Sourcing Equipment

Powered Device

This Won’t Work

ethernet alliance

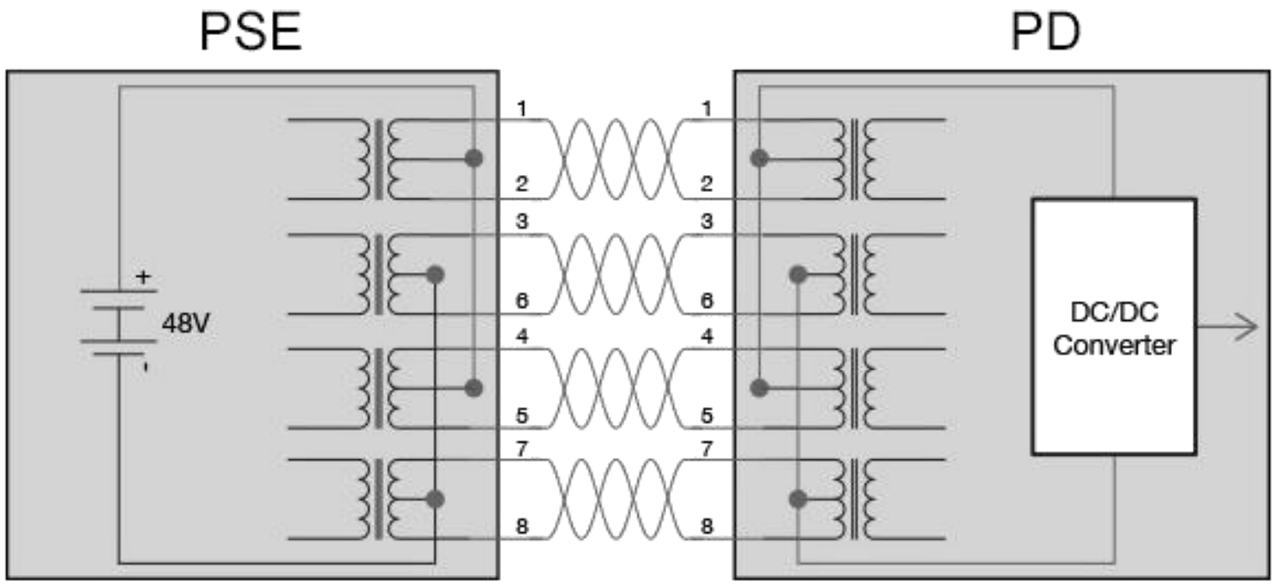
Modular Plug Terminated Link

Ethernet Alliance Certification

Resistance Testing for PoE

Four Pair PoE in Operation

- The powered device completes the current loop, enabling the device to work
- The current is “balanced” across all 4 wires used.
- Requires <u>low</u> and <u>balanced</u> cable resistance



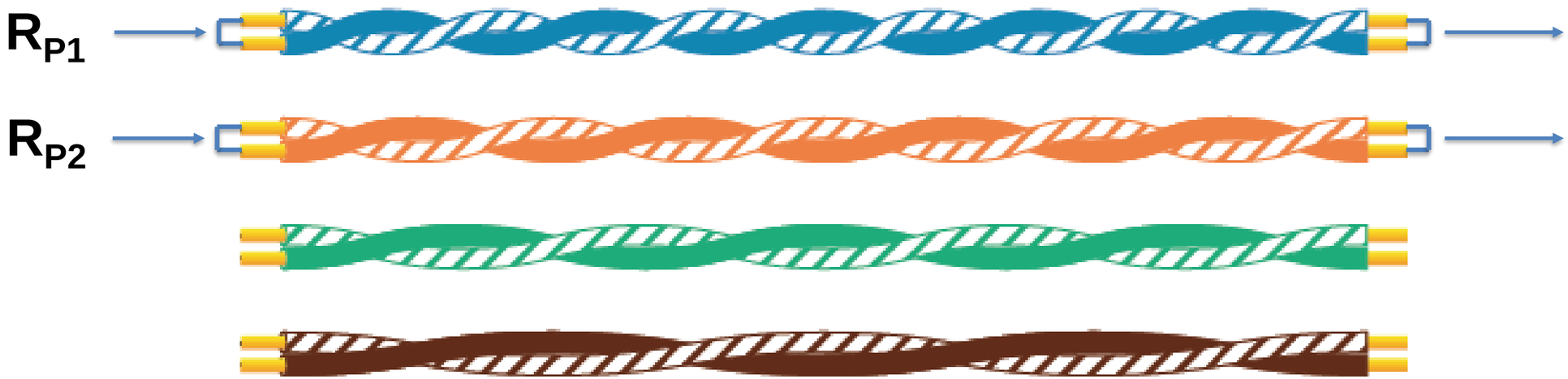
Cabling Requirements

- Your standard Cat 5e, 6, or 6A field test is probably not good enough
- Within ANSI/TIA-568.2-D and IEEE 802.3, you will find:
  - dc loop resistance
  - dc resistance unbalance within a pair
- The measurements are “optional” in TIA-1152-A

1. Loop Resistance

All Four Pairs < 25 Ω

2. P2P Resistance Unbalance

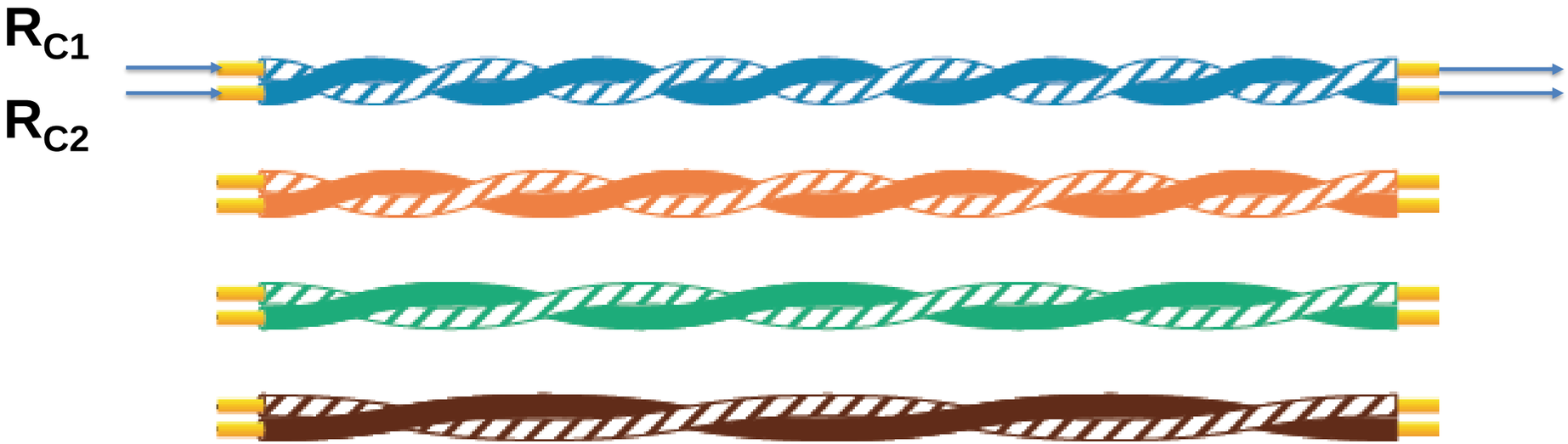


$$\text{Resistance Unbalance}_{\text{between pairs}} = \left[\frac{|R_{P1} - R_{P2}|}{R_{P1} + R_{P2}} \right] 100\%$$

All Six Measurements < 0.2 Ω or 7.5%

802.3bt Draft 1.1

3. Pair Resistance Unbalance



$$\text{Resistance Unbalance}_{\text{within a pair}} = \left[\frac{|R_{C1} - R_{C2}|}{R_{C1} + R_{C2}} \right] 100\%$$

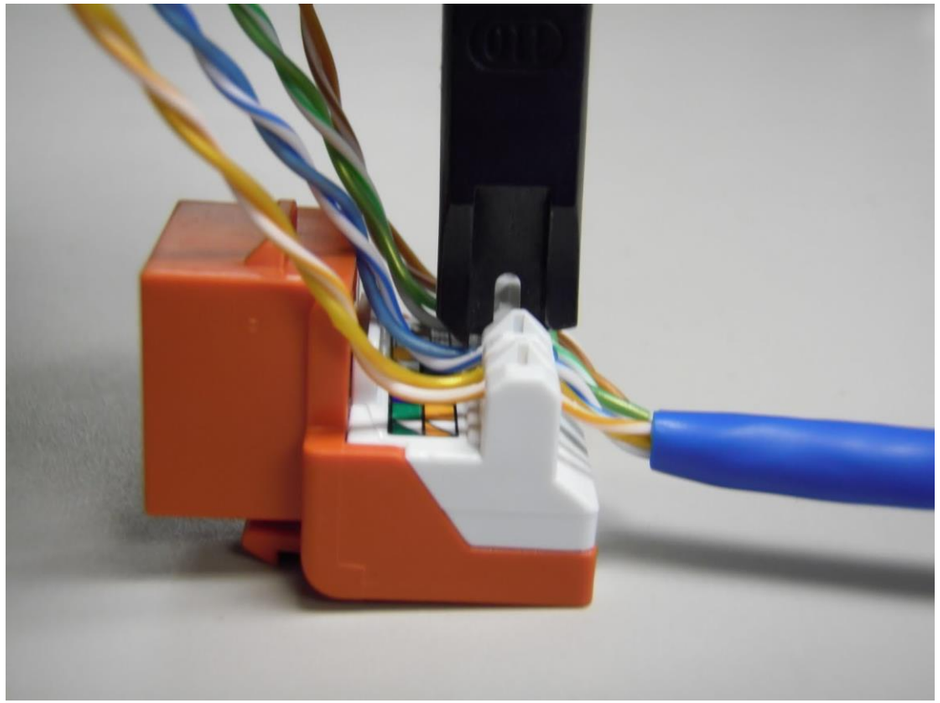
All Four Measurements < 0.2 Ω or 3.0%

802.3bt Draft 1.1

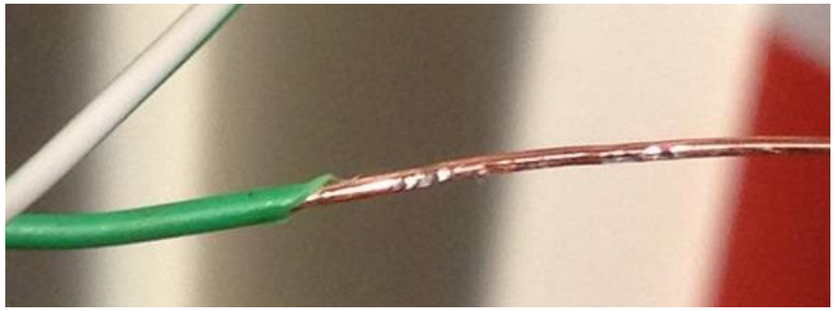
Problems Resulting From Resistance Issues

- Overheating
- Power Loss
- Data Loss

Causes of Resistance Issues

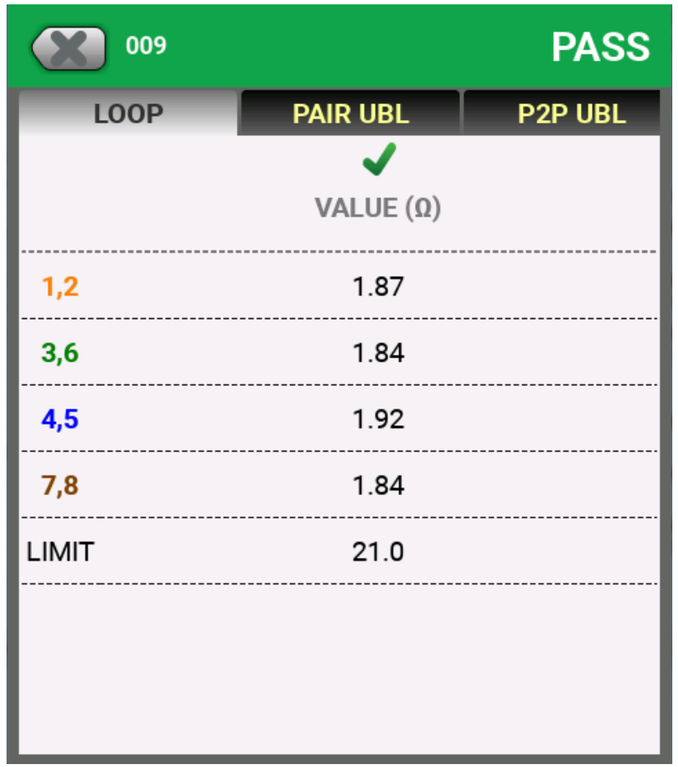


Workmanship

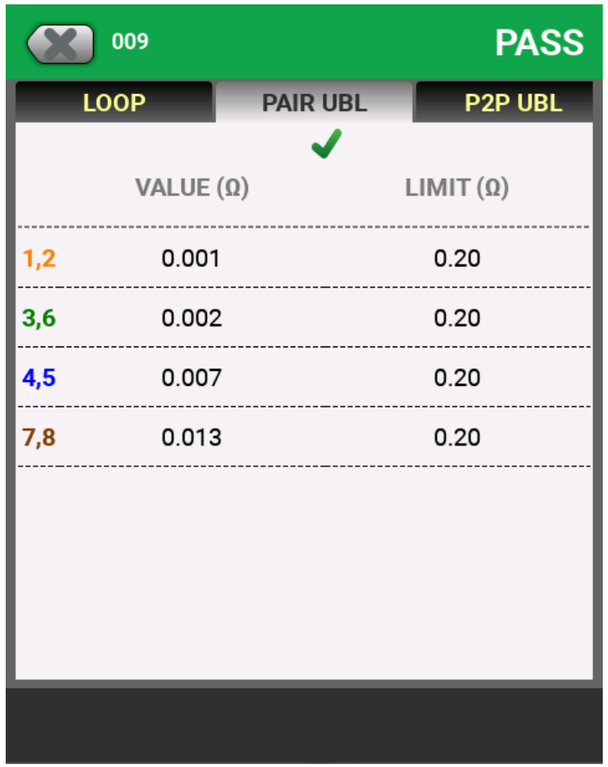


Cable Quality

Resistance Testing



Loop Resistance



Pair Unbalance

Pair-to-Pair Unbalance

Questions

Thanks for Your Attention

End Products and Security

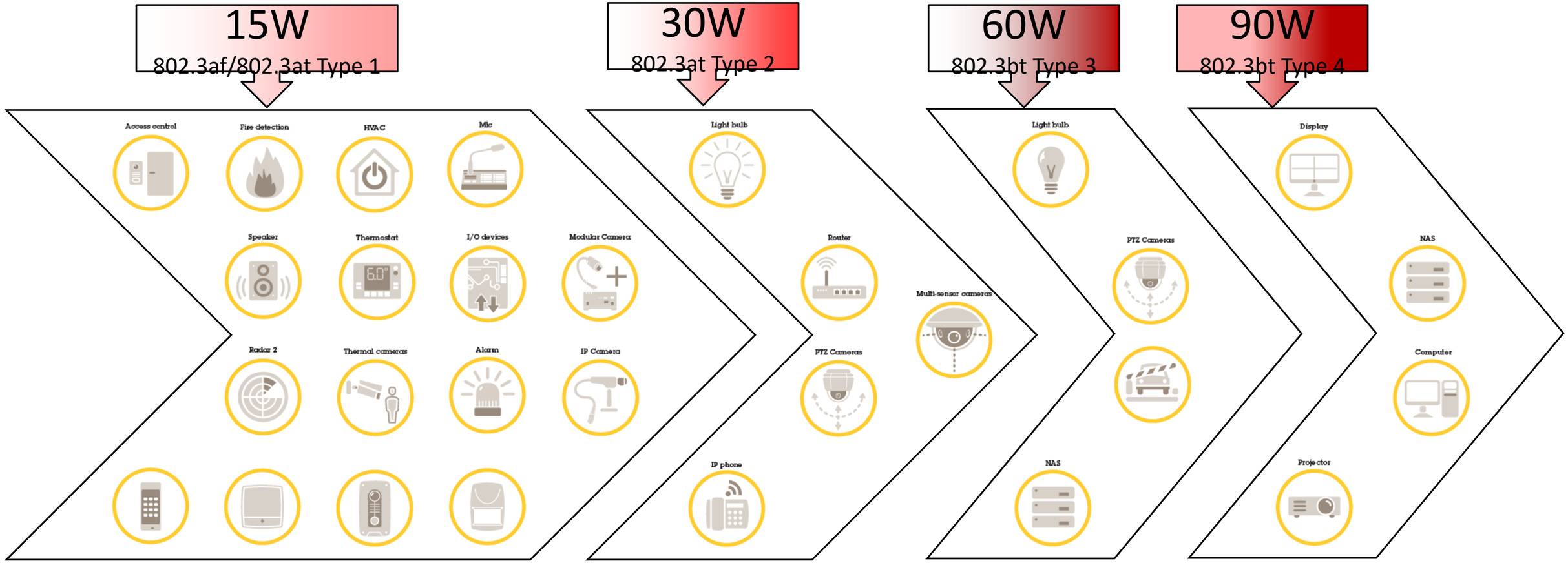
Tertius Wolfaardt

Internet of Things (IoT)

- 50 Billion Internet Of Things Connections Projected By 2022 (www.mediapost.com)

Internet of Things (IoT) - Security

We need more power



PoE Midspan devices

- PoE “injector” options
  - 15W (IEEE 802.3af)
  - 30W (IEEE 802.3at) PoE+
  - 60W (IEEE 802.3bt) PoE++
  - 90W (IEEE 802.3bt)

- Midspans are either unmanaged or managed out of band
  - PoE is managed as part of the data path and the statistics show up as part of the line communication and on the switch
    - Midspan power information has to come from the midspan or through a separate tool

Physical Security

"Detect"

PoE Intrusion Monitoring

- Motion Detectors
  - Powered by the device (camera) via the I/O port
  - Z-Wave Connectivity (wireless to PoE device)
  - Hidden sensors for video (covert)
- Laser scan detector
  - Detects object's size, speed, and distance
- LIDAR & RADAR
  - Delivers exact position of a moving object
  - Minimizes false alarms from spiders, small animals
  - Reliable detection even in bad weather (rain, fog, snow)

Monitoring and Control

"Detect" and "Deter"

Network Input / Output control

- Powered using PoE/PoE+ (or external power)
  - Analog alarm inputs
    - Supervised / Non-supervised inputs
      - Door contact, Window sensor, Motion detector, all things analog
  - Relays
    - TTL and Form C relays
      - Typical 12VDC / 24VDC / Dry contact relays
    - Trigger analog audio devices
    - Trigger analog lighting displays
    - Trigger ADA release sequence for entry doors
  - Elevator Control
    - Control what floors are accessed
    - Provide details of persons movement

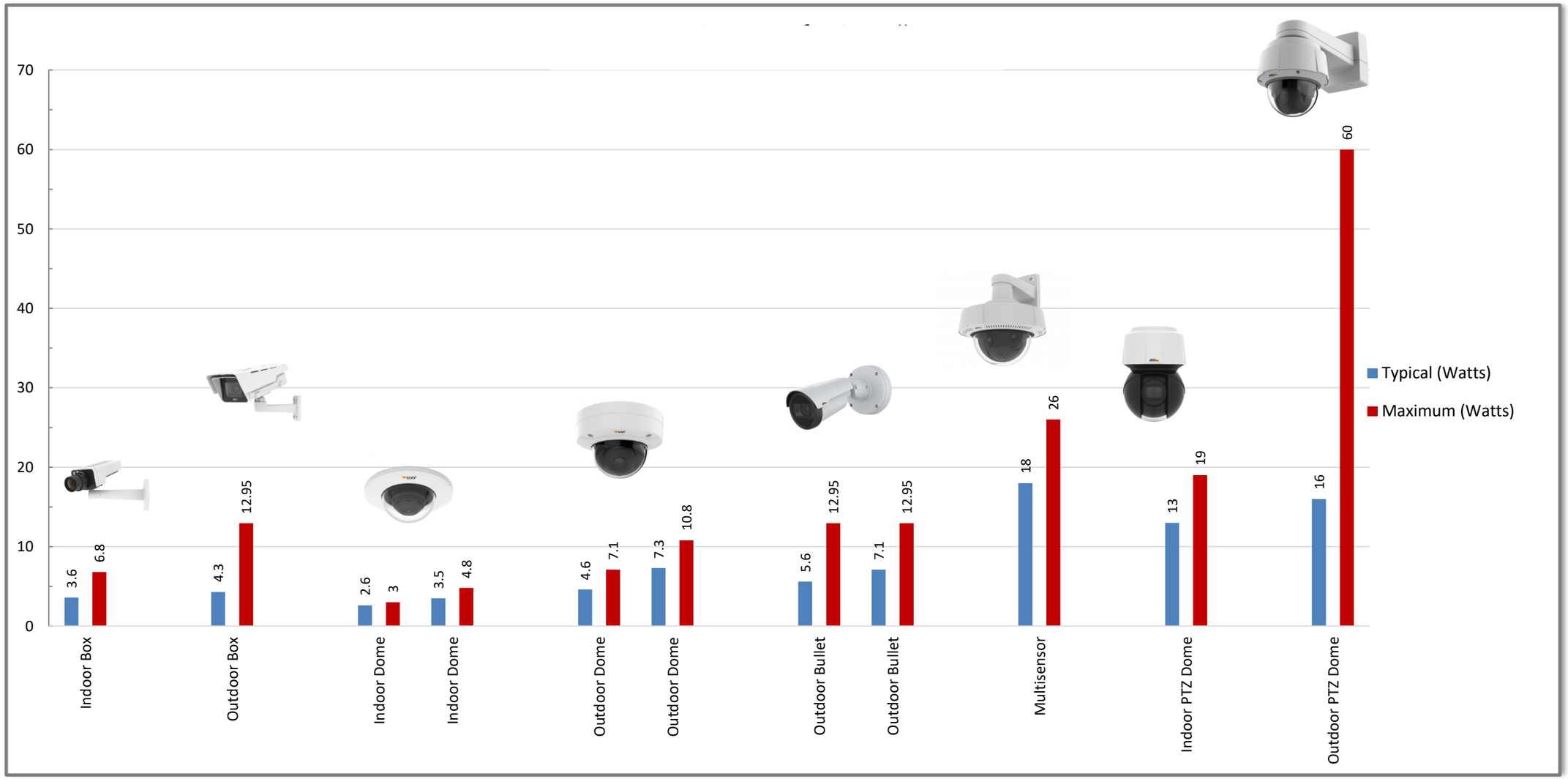
IP Surveillance

IP Cameras for the “eyes”

Types of cameras

- Covert
- Fixed Box
- Fixed Dome
  - Panamorph
  - Multi-Sensor
  - PTRZ
- Bullet
- Thermal
- Positioning
  - Dome
  - Bi-spectral
  - Professional AV
- Explosion proof

PoE requirements for Surveillance



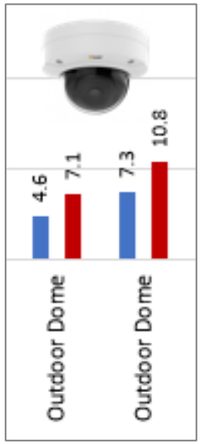
PoE requirements for Surveillance

- Positioning Camera
  - SFP or RJ45 10BASE-T/100BASE-TX/1000BASE-T network connector
  - 24VAC/VDC Max 200-300 W, typical **16-64 W** (IR)
    - Temperature: Normal: -50 °C to 55 °C (-58 °F to 131 °F)
      - Arctic Temperature Control: start-up at -40 °C (-40 °F)
    - Operational wind load of 106mph
    - Precision motors with presets
    - Bi-spectral

How does more power influence project designs?

Using surveillance as an example …

Resolution

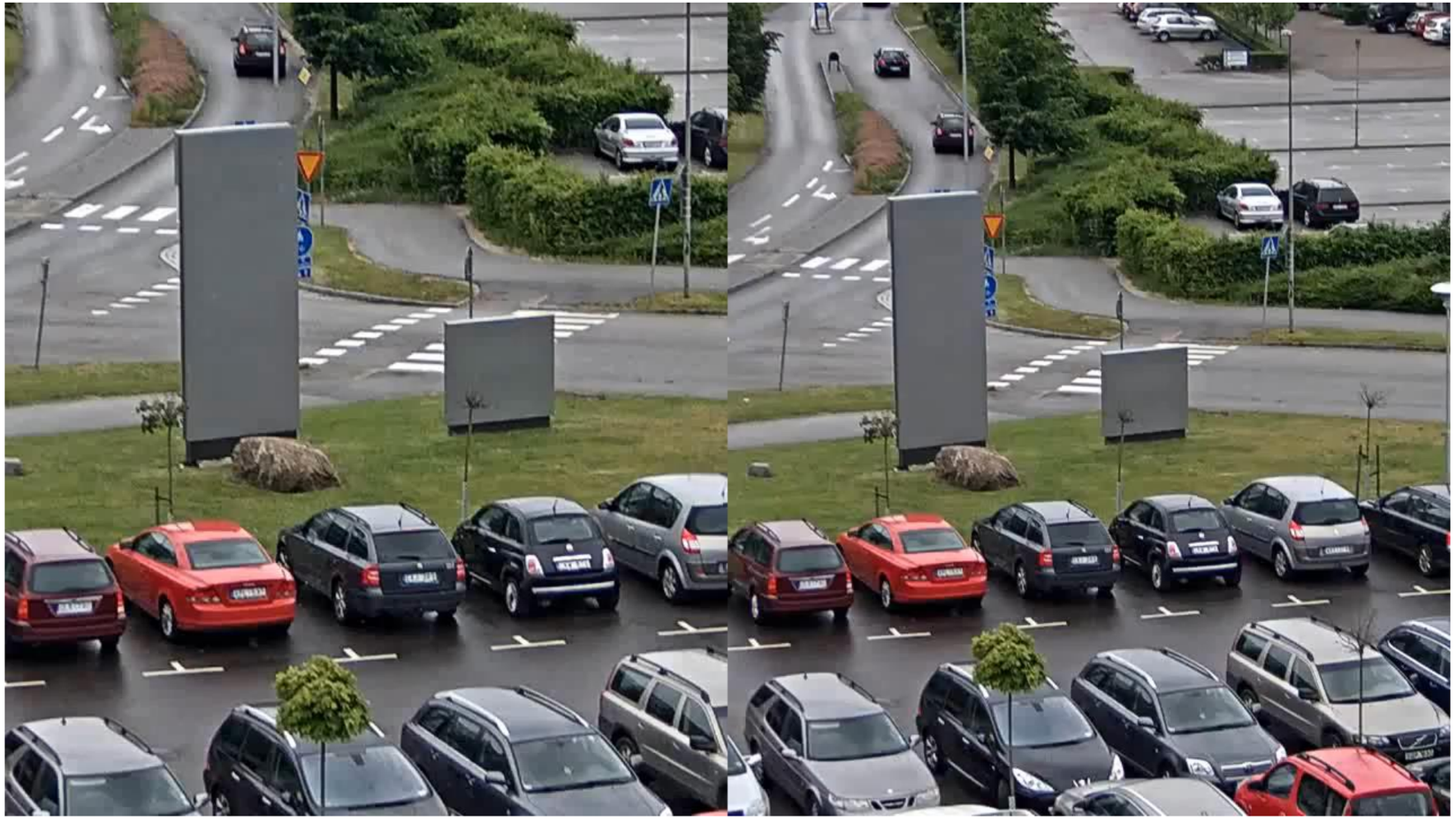


Wide Dynamic Range

WDR - On

WDR - Off

Image stabilization



Low-light

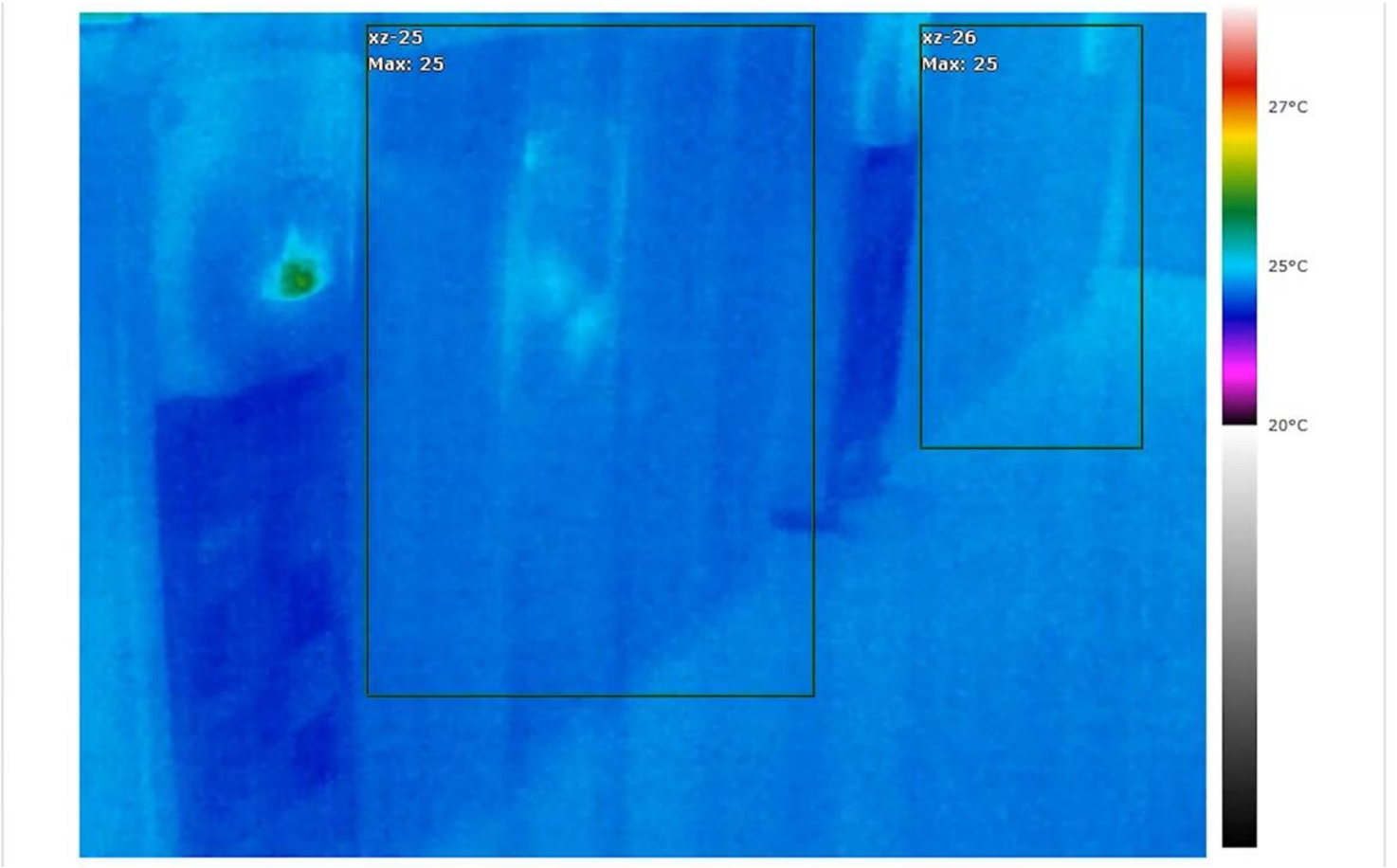
- Indoor storeroom at approximately 0.4 lux.

IR illumination

Operational in extreme cold and extreme heat

Long-range video surveillance

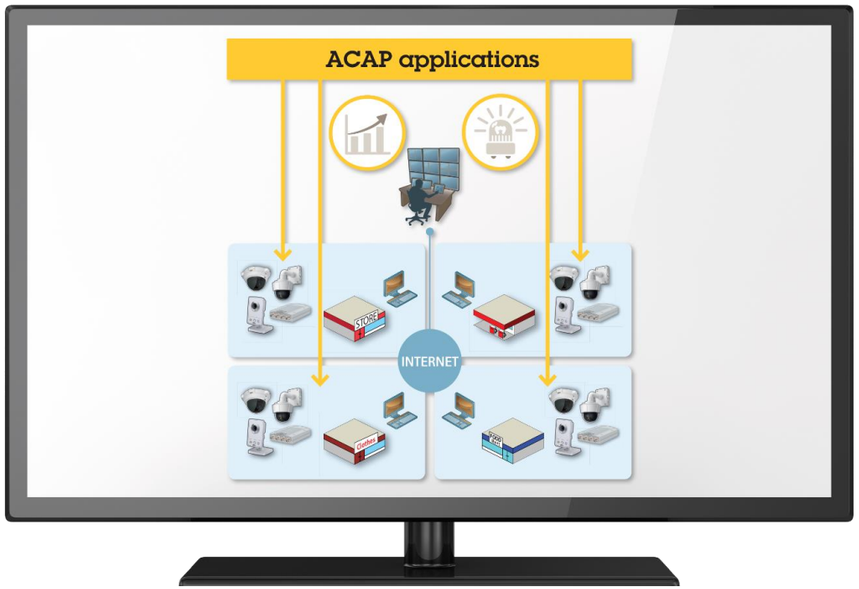
Thermal



Video compression

Intelligent Applications

- Edge processing
  - Access to applications **at the edge**
    - Present a wide range of intelligent applications for efficient surveillance, data analysis and business management
    - Open platform allows for application development partners to meet specific needs
- Adapting to the IoT world will require the ability to connect in ways beyond standard security
- Almost all of the enterprise customers desire customization to accomplish business goals

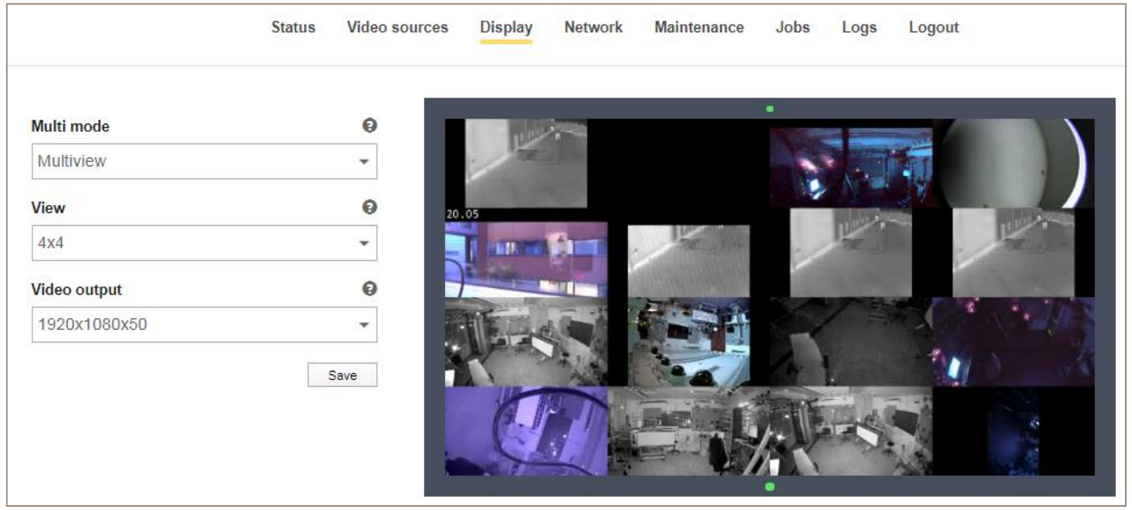


Decoding

“Detect”

PoE Decoders

- Decoding
  - Connecting digital monitors to display live video from network cameras

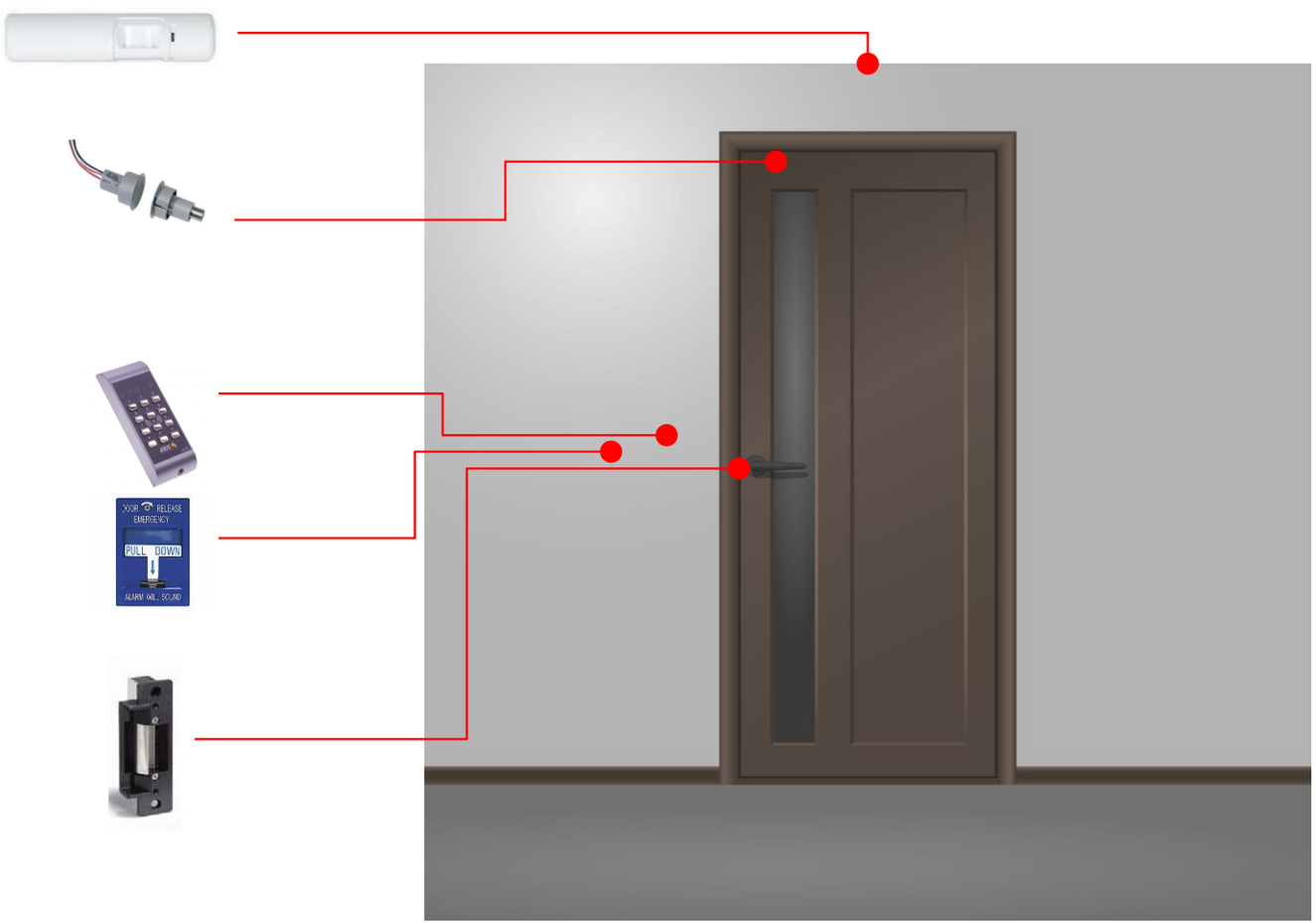


Access Control

"Delay"

PoE Controllers

- Door connections
  - Request-to-Exit
  - Door Position Switch
  - Card Reader
  - Emergency Door Release
  - Power for Electric Lock (Strike)



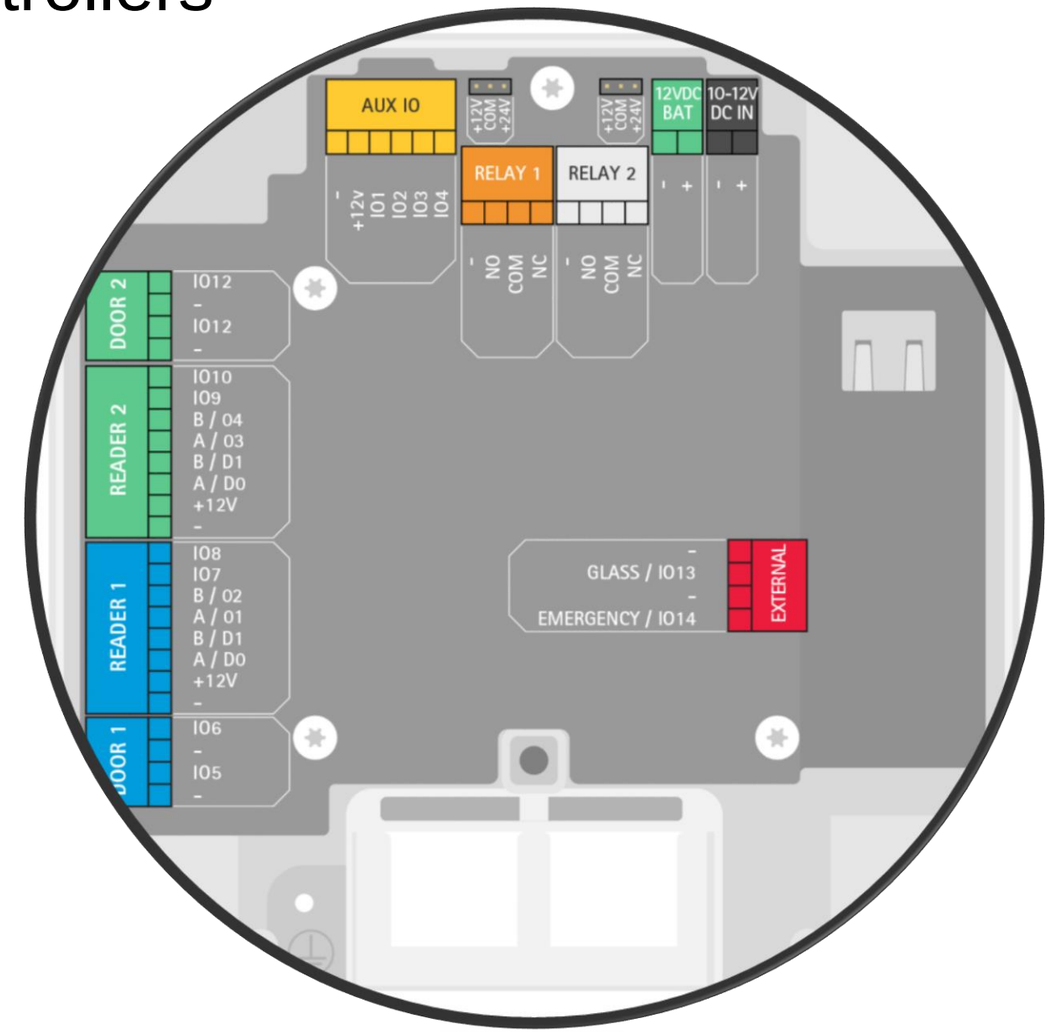
PoE Door Devices

- RFID Door Readers
- Biometric Readers
- Door Locking Hardware

- ~~Electromagnetic~~ / Door Strike

PoE Controllers

- Powers door devices
  - Request-to-Exit motion
  - Card Reader
  - Power for Electric Lock (Strike)
- Runs autonomous from software
  - Controls access to access portal
    - Stores cardholder records
    - Stores time schedules
    - Stores user permissions
  - Alarm and Relay Linking
  - Event recording



IP Intercom

Devices for “Communication”

Types of IP Intercom

- Facility
  - Building entrance
    - Front / Employee / Dock doors
  - Remote building Remote gate
  - Parking Garage
  - Parking Lot
- Residence
  - Entry gate
  - Apartment call center
- Management

SIP Communication – an overview

- **S**ession **I**nitiation **P**rotocol
  - SIP is the standard protocol used in Voice over IP (VoIP) applications and unified communication platforms.
    - Initiate, maintain and terminate sessions between clients
    - Usually audio, but video too
    - SIP phones, Intercom devices, Audio, Radio-over-IP, etc.







IP Audio

La …la …la …la

PoE Loudspeakers

- “See something … Say Something”
  - Extending the reach of a security program
    - The loudspeaker can be remotely accessed and/or play a pre-recorded audio file when it is manually or automatically triggered (alarm event)
  - Compatible with major video management software and SIP-based VoIP systems
  - Address individual speaker from anywhere with network connectivity

PoE Speakers

- PoE (IEEE 802.3af/802.3af Type 1 Class 3)
- A complete audio system
  - Speaker
  - Amplifier
  - Signal processing, equalization
  - Microphone
- Streaming audio
- Customized announcements

PoE Speakers

Traditional analog speaker solution

Speaker

Speaker audio cable

Amplifier

Line level audio cable

Tone control / Equalizer

Line level audio cable

Streaming box

Network cable

Network switch

Network speaker solution

All-in-one

Network cable

Network PoE switch

IP Lighting

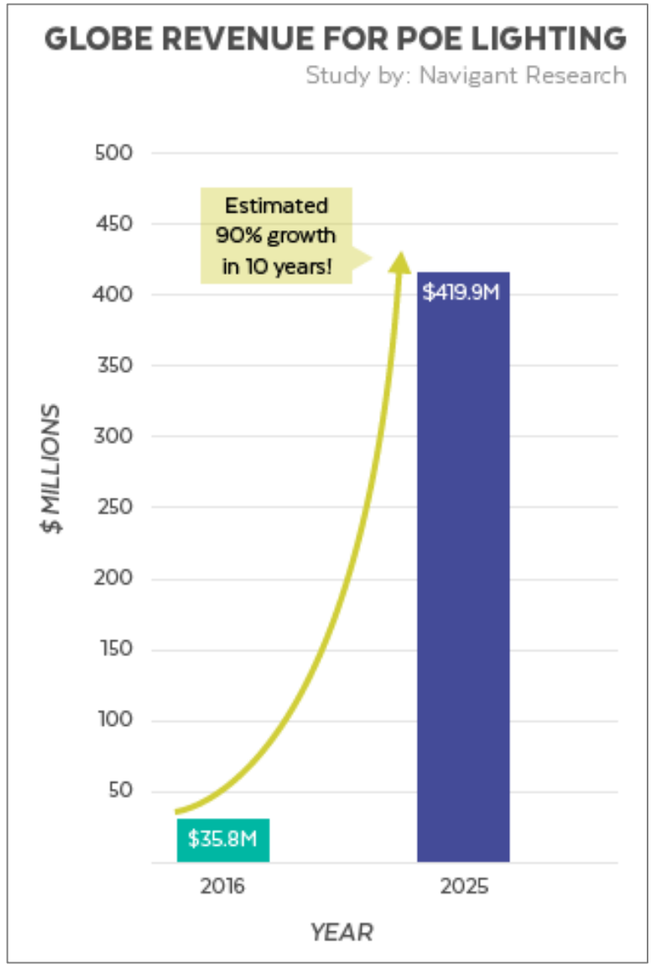
PoE Lighting - Security

- Security
  - Visible Light
    - 802.3af compliance – draws 12W
  - IR (850nM or 940nM)
    - 802.3af compliance – draws 12W

iluminar

PoE Lighting - Buildings

- Intuitive sensors to learn and interact
  - Occupancy – turn on and off
  - Dimming – adjusts to ambient lighting
  - Color temperature
  - Business analytics
- Efficient
  - Dramatic energy savings
- Installation
  - Eliminate heavy duty copper wire and conduit used for traditional lighting
- Flexibility
  - Ability to easily move or replace fixture



Cyber

IoT and the precautions for networked devices

High profile breaches make headlines

Powered by ThreatCloud Intelligence

THREATCLOUD

LIVE CYBER ATTACK THREAT MAP

Check Point SOFTWARE TECHNOLOGIES, INC.

ATTACKS TODAY

(since 12AM PST)

4,713,387

ATTACKS YESTERDAY

1,836,876

LEARN ABOUT CHECK POINT THREAT PREVENTION SOLUTIONS ›

TOP TARGETS BY COUNTRY

- India
- USA
- Indonesia
- Australia
- Mexico
- United Kingdom
- Brazil
- Norway
- Philippines
- China

USA

THREAT STATS

Last Week | Last Month

Average Infection Rate

15.75%

Most Frequent Attack Source

USA

Infecting Malware Types

Malicious file transfer	1.4%

TIME	ATTACK	SOURCE	TARGET
13:35:42	REP.TC.fgmrw	CA,USA	Greece
13:35:41	Emotet.TC.gzl	Azerbaijan	Greece
13:35:41	Emotet.TC.hvr	MO,USA	Greece
13:35:41	Emotet.TC.gzi	NY,USA	Greece

Source

Target

What is cybersecurity?

- Cybersecurity refers to a set of techniques used to protect the integrity of networks, programs and data from attack, damage or unauthorized access.
- Cybersecurity involves mitigating risks by reducing the attack surface area, or more simply – by reducing exposure.
- Cybersecurity cannot be defined as a single product or tool.

What is cybersecurity?

- It is important to understand that 100% protection against intrusion is very hard to achieve, if indeed possible at all.

IoT and Network Device Cybersecurity Concerns

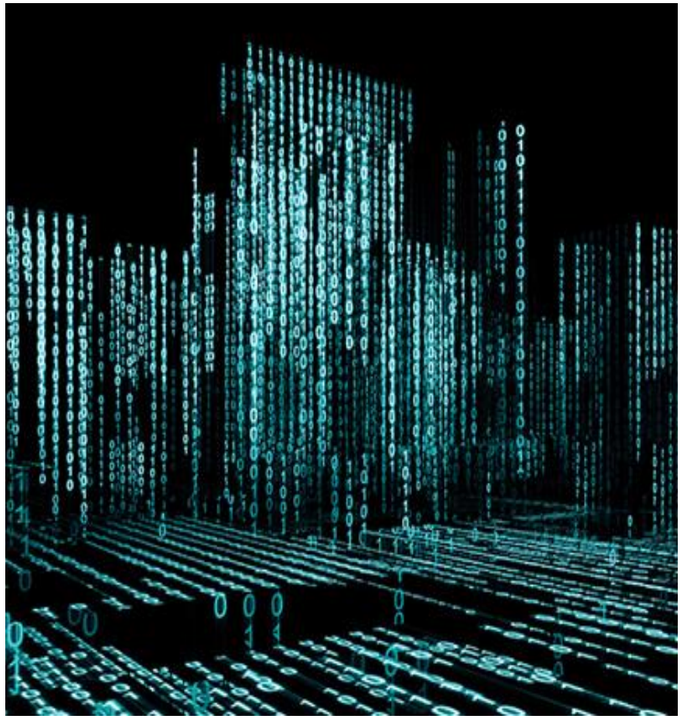
- **Unsecured endpoints used as a point-of-entry on the network**
- *Poor password complexity protocol*
- *Open ports and unused services*
- *Man-in-the-middle packet capture*
- *Malware*
- *UDP-flood, DoS, DDoS*

Where should I start?

- To protect a network against attack, various security controls can be implemented. These controls are safe guards or countermeasures to avoid, detect, or mitigate secure interest to **physical property**, **networks**, appliances, servers, information, or other assets.

Where should I start?

- In a security system, the main areas to focus on are:
  - **Physical exposure** - protecting the system hardware
  - **Network exposure** - preventing unauthorized access
  - ***Service exposure*** *- preventing access via unused services*
  - ***Encryption*** *- securing transmission to/from appliance*
  - ***Credentials*** *- the use of robust credentials*
  - ***Authentication*** *- authentication policies (certificates)*

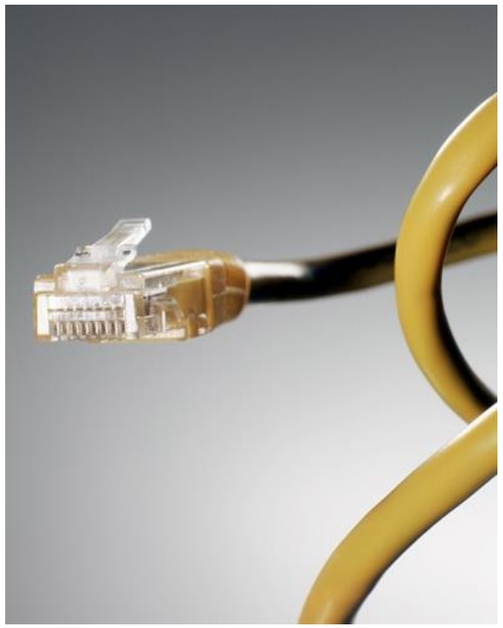


Where should I start?

- Physical
  - The first line of defense is the physical protection of the primary access points to your network
  - Various measures may include:
    - Secure network equipment and servers
    - Mounting appliances out-of-reach
    - Using tamper switches
    - Using vandal-resistant enclosures
    - Use protective shielding for exposed cabling
    - Protect the cable ends and open ports

Where should I start?

- Network
  - The second line of defense is protecting your network infrastructure from unauthorized access
  - Various measures may include:
    - Protect the perimeter
      - Control access to the facility - Manage who comes and goes
      - Video Surveillance – Record the identity of each person
    - Protect the interior
      - Conceal cabling - Structured cabling should be out of sight
    - Control access from public and employees
      - Physically secure MDF/IDF locations
      - Control access to internal sensitive areas
      - Security at the cabinet level



Final thoughts …

- IoT drives appliances to the network
  - Integration between appliances transitions from “Analog” to “Digital”
  - IPV6 implementation is absolutely necessary
- PoE will continue to drive edge-based technology
  - Security industry is quickly adapting and innovating
- PoE will challenge the status-quo
  - Video / Audio / LED Lighting / Automation / Smart buildings / BYOD
- PoE standards will recognize higher power requirements
- PoE requires different design considerations
- Cyber threats will keep you up at night

Thank you!

Thank You