Urban Evolution: Advancements in Smart Cities and Intelligent Building

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Agenda

- Introduction to Smart Cities
- Understanding Smart Cities
- Smart City Solution
- Challenges and Risks
- Smart Cities Future Outlook
- Trends in Smart Building
- Fault Managed Power System (FMPS)
- Smart Building Design Consideration
- Q&A

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Smart Cities

Introduction

- Smart Cities Definition
  - ✓ A smart city is an urban area that utilizes advanced technology,
  - ✓ data-driven insights, and innovative solutions to enhance the quality of life for its residents,
  - ✓ improve sustainability and optimize resource management.
  - ✓ Cities That leverage interconnected systems and digital infrastructure to enhance efficiency, connectivity, and responsiveness to the needs of citizens and the environment.

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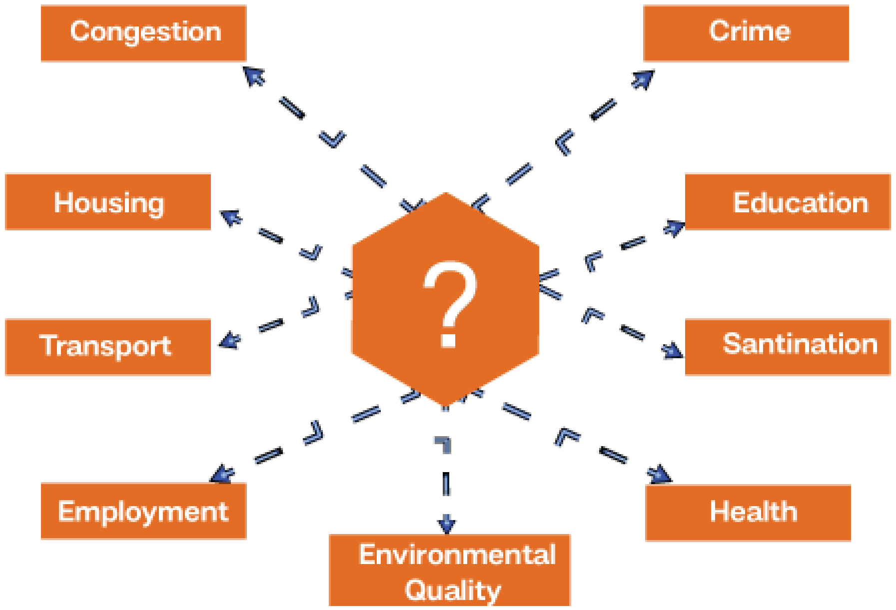
Introduction – Continued

- Overview of the current challenges facing urban areas
  - ✓ Rapid Urbanization
  - ✓ Infrastructure Strain
  - ✓ Environmental Degradation
  - ✓ Social Inequities
  - ✓ Digital Divide
  - ✓ Public Safety Concerns
  - ✓ Resource Management



Addressing these challenges requires holistic and integrated approaches that prioritize sustainability, resilience, and inclusivity in urban planning and development.

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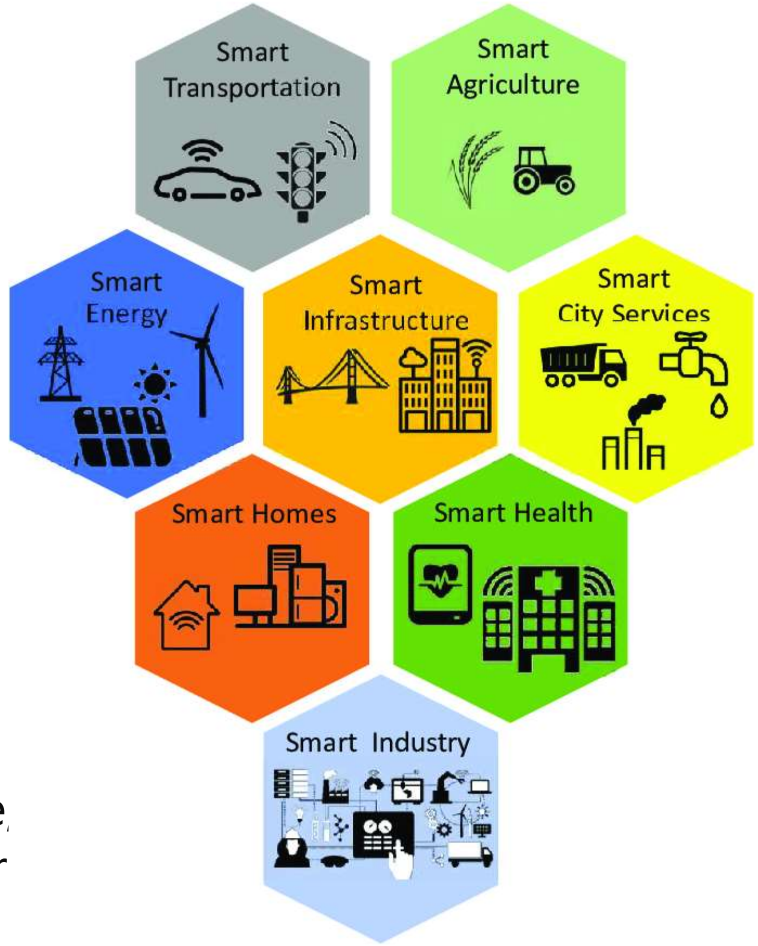
Introduction – Continued

- Importance of implementing smart city solutions
  - ✓ Efficiency
  - ✓ Sustainability
  - ✓ Quality of Life
  - ✓ Economic Growth
  - ✓ Innovation
  - ✓ Resilience
  - ✓ Inclusivity:

Implementing smart city solutions is essential for creating sustainable, and inclusive urban environments that enhance the well-being and pr current and future generations.



Understanding Smart Cities

- Defining smart cities and their components
  - ✓ Smart cities use technology to enhance urban living.
  - ✓ Components: interconnected infrastructure, data-driven governance, and sustainable practices.

  Goal: Improve efficiency, sustainability, and quality of life.

- Role of technology and data in smart city solutions
  - ✓ Technology and data drive smart city solutions.
  - ✓ They enable interconnected infrastructure and data-driven decision-making.

  Result: Enhanced efficiency, sustainability, and citizen services.

- Benefits such as improved efficiency and quality of life
  - ✓ Technology and data in smart cities improve efficiency and quality of life.
  - ✓ They optimize resource allocation and streamline services.

  Result: Enhanced urban living, reduced environmental impact, and better citizen experiences.

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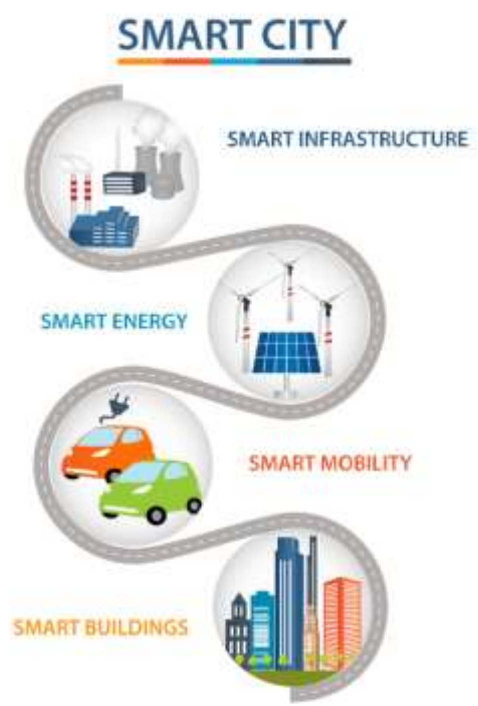
Smart City Solution Overview

- Features such as IoT integration, data analytics, and automation
  - ✓ IoT integration enables real-time data collection and connectivity of devices.
  - ✓ Data analytics processes large volumes of data for insights and decision-making.
  - ✓ Automation streamlines processes and improves efficiency in various urban systems.
- Benefits for residents and businesses
  - ✓ Enhanced convenience through IoT-connected services and personalized experiences.
  - ✓ Improved decision-making and resource allocation based on data-driven insights.
  - ✓ Increased productivity and cost savings through automated processes and optimized operations.



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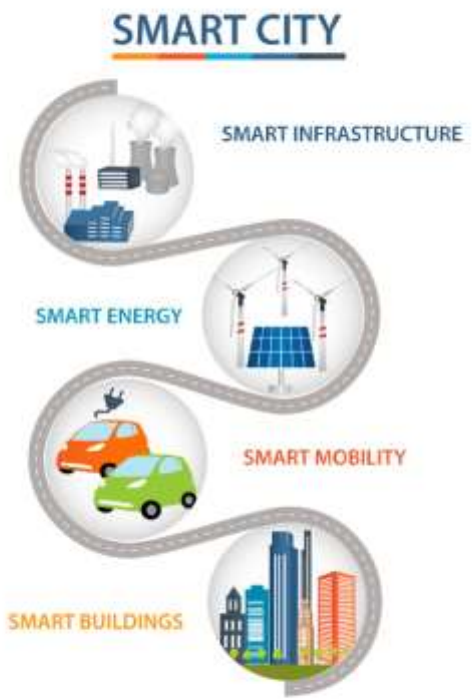
Smart City Solution Overview – Continued

- Emphasizing the importance of reliable cabling infrastructure
  - ✓ Reliable cabling infrastructure forms the backbone of smart city technology.
  - ✓ It ensures seamless connectivity and data transmission across various systems.
  - ✓ Robust cabling systems support the scalability and reliability of smart city solutions.
- Efficient data transmission and communication networks powered by robust cabling systems
  - ✓ Robust cabling systems enable fast and secure data transmission.
  - ✓ They support the seamless integration of IoT devices and applications.
  - ✓ Efficient communication networks ensure reliable connectivity for smart city services and operations.



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Challenges and Risks

- Potential obstacles like funding constraints and technological hurdles
- Strategies for risk mitigation such as pilot testing and contingency planning
- Potential risks associated with inadequate infrastructure, ,data bottlenecks and connectivity issues
- Importance of investing in high-quality infrastructure solutions to mitigate risks and ensure reliability

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Smart Cities Future Outlook

- Emerging technologies shaping the future of smart cities
- Importance of ongoing innovation and adaptability
- Trends such as AI, IoT, and blockchain in smart city development
- Long-term sustainability and scalability considerations
- Emerging trends in cabling technology high-speed data transmission, POE++, Fault Managed Power
- Role of advanced cabling infrastructure in supporting future smart city innovations and scalability
- Long-term sustainability considerations for cabling infrastructure, including durability and adaptability to evolving technologies

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Trends in Smart Buildings

Definition of a Smart Building

- A smart building is one that uses technology to enable efficient and economical use of resources, while creating a safe and comfortable environment for occupants.
  - Lighting, HVAC, access control, temperature, and other systems can be integrated, monitored, optimized, and controlled.
  - Typically utilize elements like sensors, building management systems, and artificial intelligence to help
- Smart Buildings are ~30% lower cost to implement when using "open" systems
  - 30% is compared against similar systems that are closed
  - Savings only seen when comparing systems with similar functionality

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Standardized

- Lack of standardization viewed as a top obstacle to IoT deployment
  - Concerned about adopting unproven technology
  - Concerned about adopting proprietary technology
  - Security concerns
  - Want a large ecosystem available
- Integrating different systems speaking different languages is challenging
  - Integration difficulties
  - Can be source of errors
- Future buildings need the different systems to follow the same communication standards

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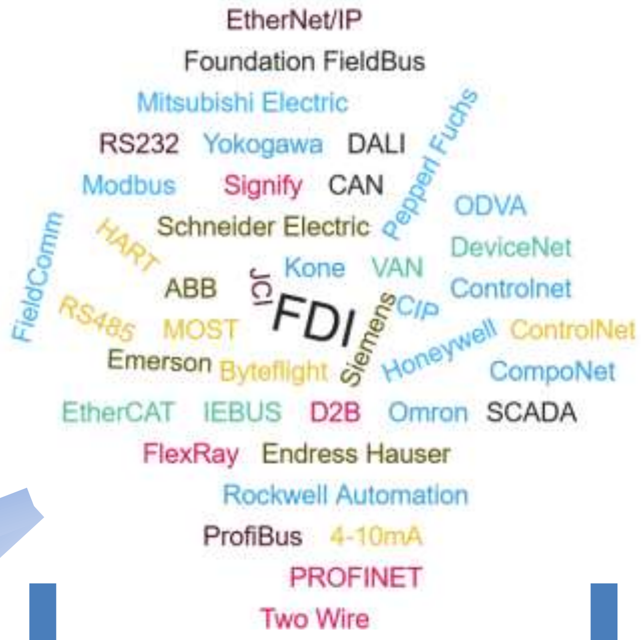
Two Foundations of Smart Building

+

Single Pair is the Next Generation

Remember?

State of Building Automation Today



Single Pair Ethernet

Single Pair Ethernet Applications support

SPE specifications

Physical Layer Type	Data Rate	Maximum Distance	Bandwidth	Technology	Primary Application	Configuration
10BASE-T1L	10 Mb/s	1000 m STP (3281 ft)	20 MHz	PTP + PoDL	Industrial and Building Automation	10 In-Line Connectors
10BASE-T1S	10 Mb/s	15 m (50 ft) UTP	20 MHz	Point-to-multipoint NO PoDL	Industrial and Building Automation	At least 8 nodes each up to 25 m (82 ft) long
100BASE-T1	100 M/b/s	15 m (50 ft), UTP 40 m (131 ft) STP	166 MHz	PTP + PoDL	Automotive	
1000BASE-T1	1000 Mb/s	15 m (50 ft) UPT, Link Segment *Type A*	600 MHz	PTP + PoDL	Automotive	Maximum 4 In-Line Connectors
1000BASE-T1	1000 Mb/s	40 m (131 ft) STP, Link Segment *Type B*	600 MHz	PTP + PoDL	Aircraft, Railway, Bus, and Heavy Trucks	Maximum 4 In-Line Connectors
Multi-Gigabit	2.5/5/ 10 Gb/s	15 m (50 ft) STP	4–5 GHz	PTP + PoDL	Automotive	

PoDL = Power over data lines
PTP = Point-to-point
STP = Shielded twisted-pair
UTP = Unshielded twisted-pair

Standardization Solutions for Today's Problems

RS 485	Ethernet
Proprietary Interfaces	Standardized Interfaces
Inconsistent Security	Consistent & Robust Security
Different topologies	Consistent topology
Different data rates	Standardized data rates
Lack of Interoperability	Complete Interoperability

Standardization solves many of the issues seen today

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Reliable Wireless is a Business necessity

- A good and reliable network is a business necessity
  - Reliable connectivity brings people to the office
  - People do not want to live / shop / work in places that do not enable seamless connectivity
- A robust wired system is critical to support

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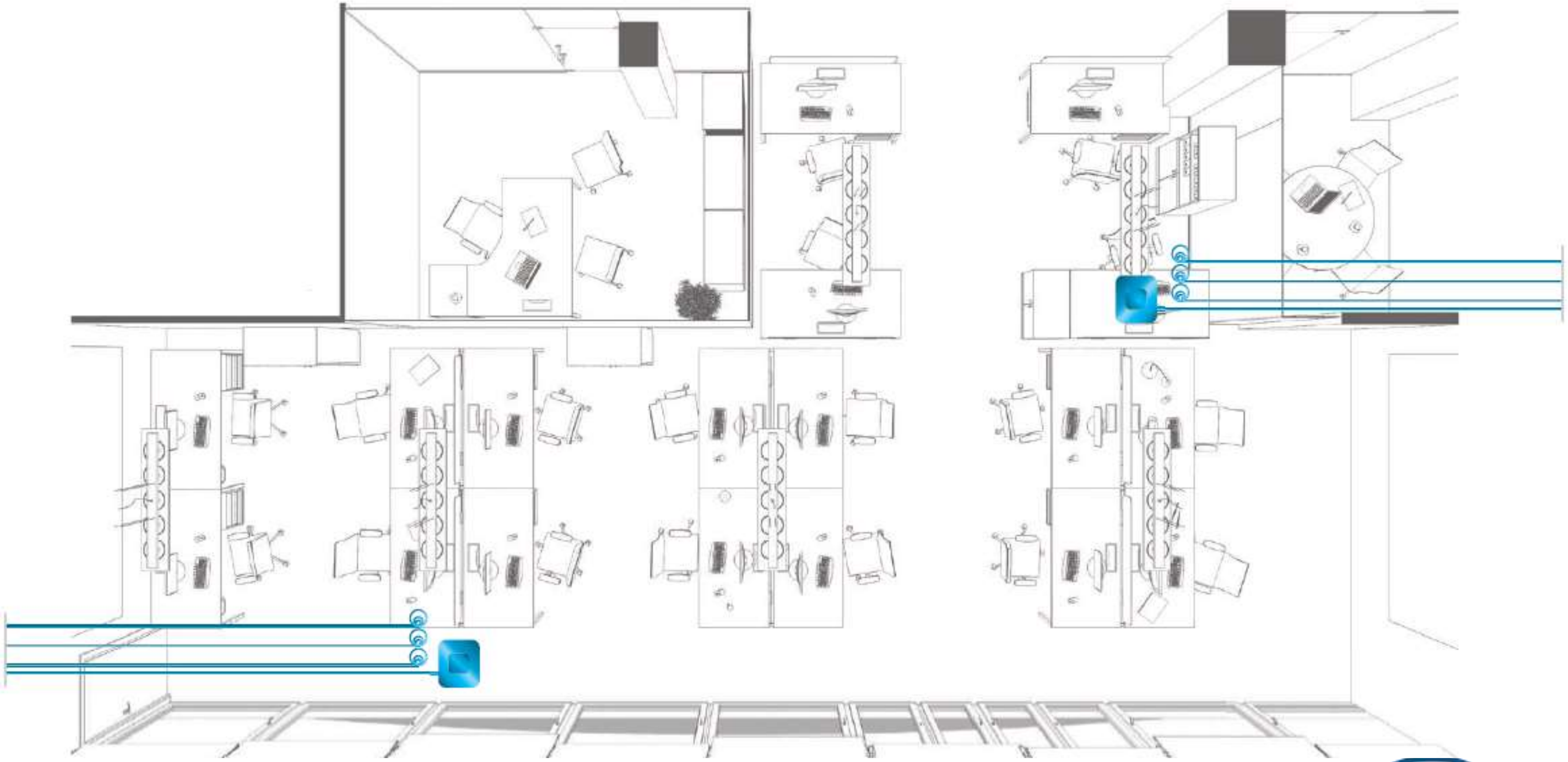
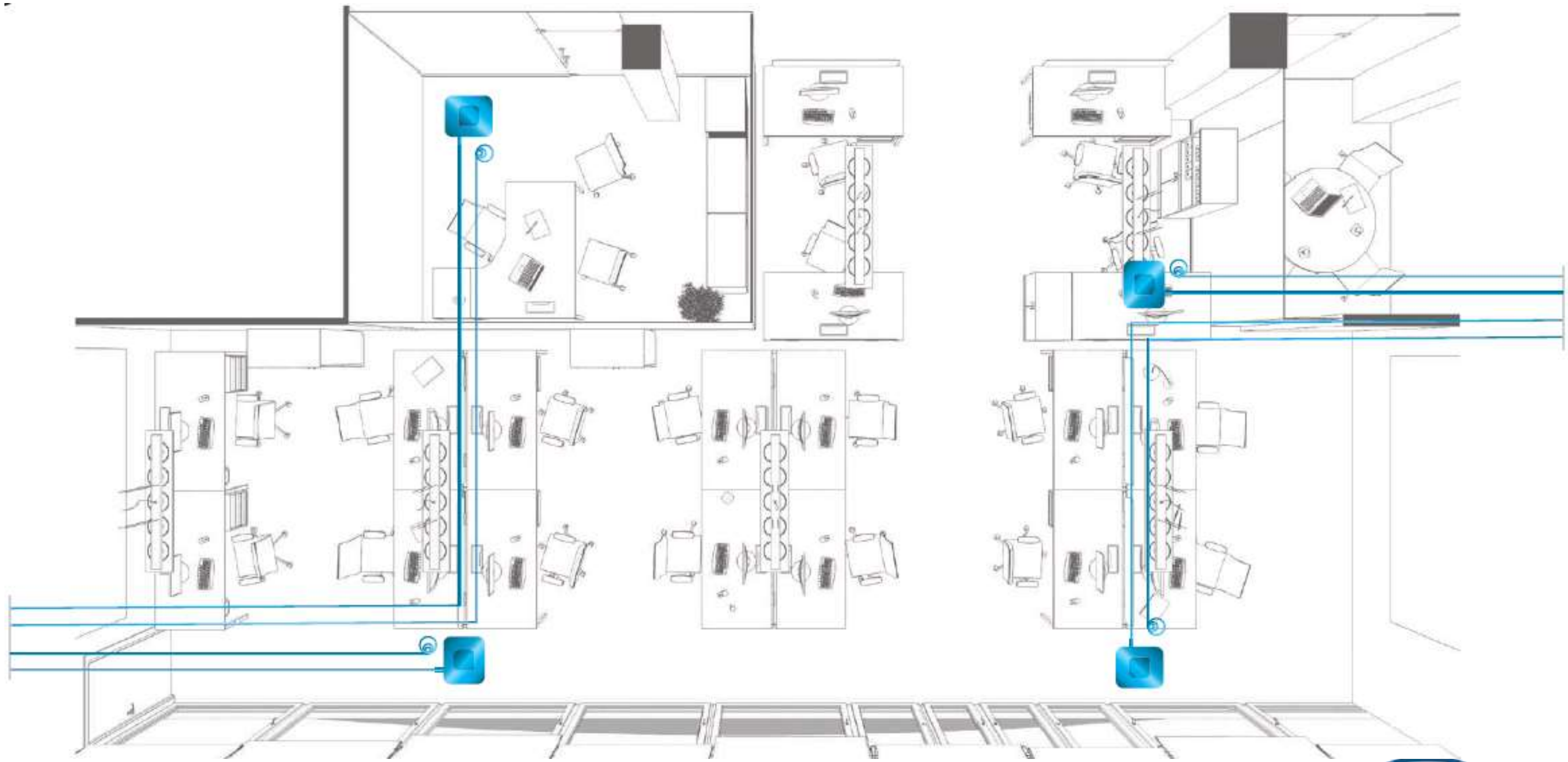
Day 1: Wi-Fi 5 or 6

- 2 access points
- 4 Cat 6A cables installed per access point
- 1 Cat 6A cable used per access point
- 1 out of 4 installed cables used



Day 2: Increase Density with Wi-Fi 6

- 4 access points
- 2 Cat 6A cables installed per access point
- 1 Cat 6A cable used per access point
- 2 out of 4 installed cables used



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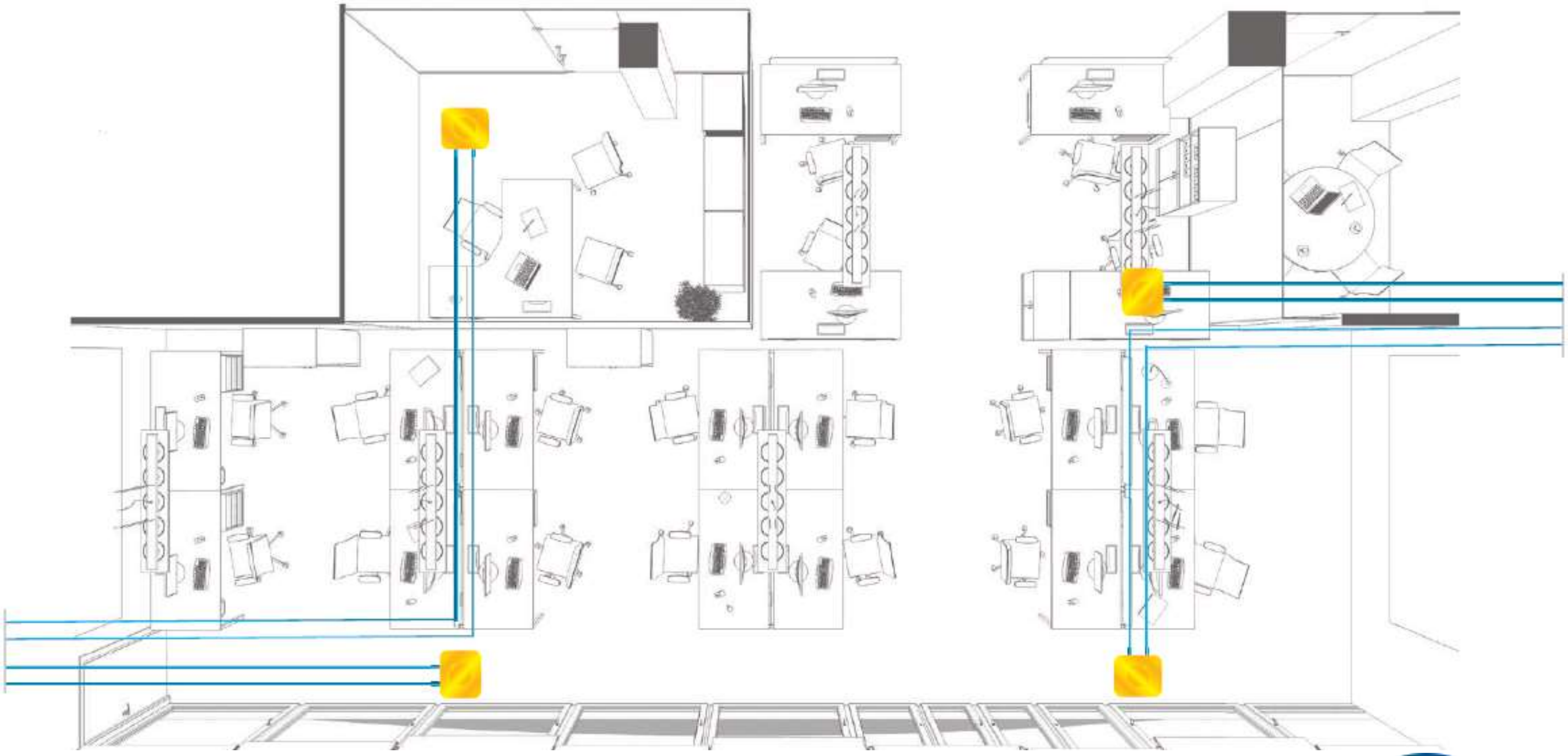
Day 3: Wi-Fi 7 and Beyond

- 4 access points
- 2 Cat 6A cables installed per access point
- 2 Cat 6A cables used per access point
- 4 out of 4 installed cables used



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POE Overview

Type	Standards	Maximum Current	Number of Energized Pairs	Power at Source	Power at Device	Maximum Data Rate	Standard Published
PoE	IEEE 802.3af (802.3at Type 1)	350 mA	2	15.4 W	13 W	1000BASE-T	2003
PoE+	IEEE 802.3at Type 2	600 mA	2	30 W	25.5 W	1000BASE-T	2009
PoE++ **(4PPoE)**	**IEEE 802.3bt Type 3** **IEEE 802.3bt Type 4**	**600 mA** **960 mA**	**4**	**60 W** **99 W**	**51 W** **71 W**	**10GBASE-T**	**2018**
No IEEE standard	Cisco UPOE HDBaseT (www.hdbaset.org)	600 mA 1000 mA	4	60 W 100 W	51 W 100 W	Varies	Exists today – no official ratification

- Next generation of PoE is a 3X increase in power
- Next generation of PoE supports 10GBASE-T
- Category 6A
  - 10GBASE-T
  - Optimal thermal efficient & performance!

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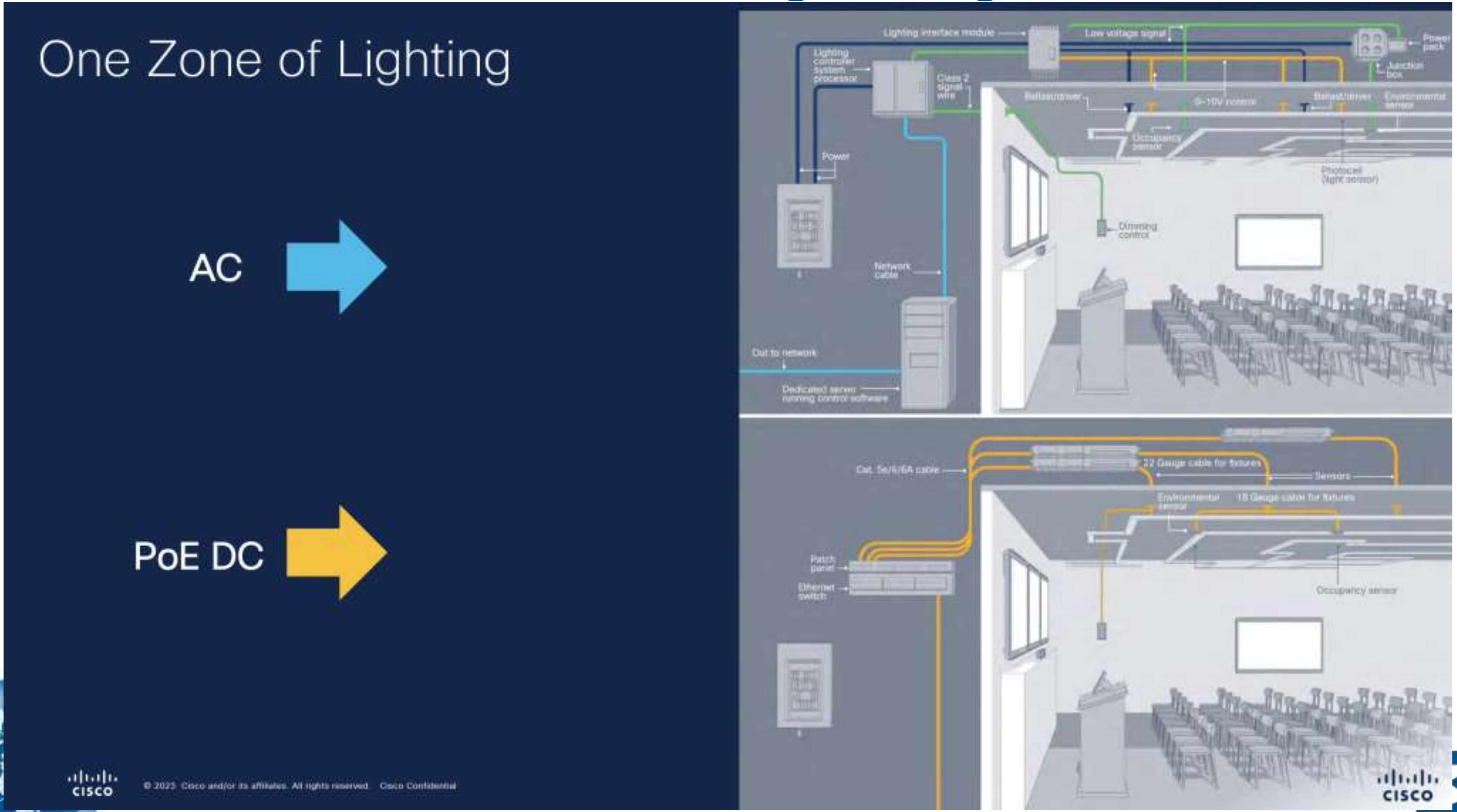
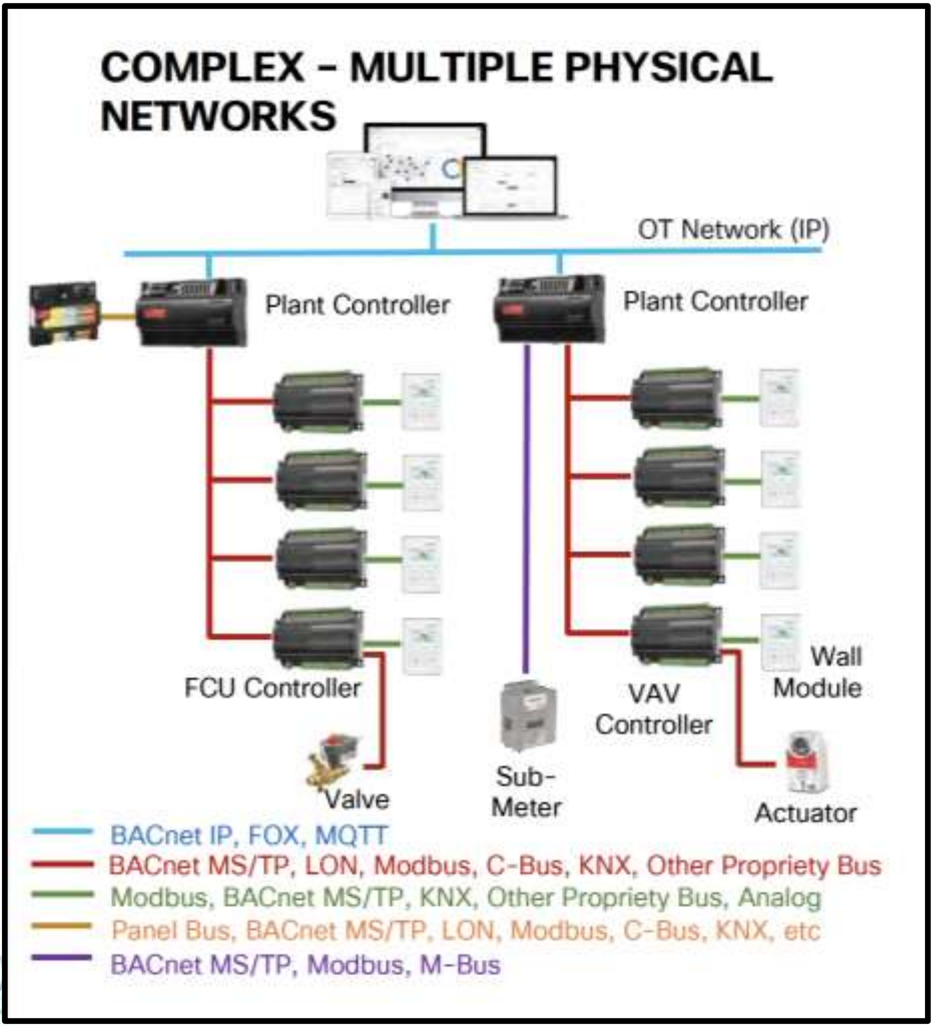
POE Lighting

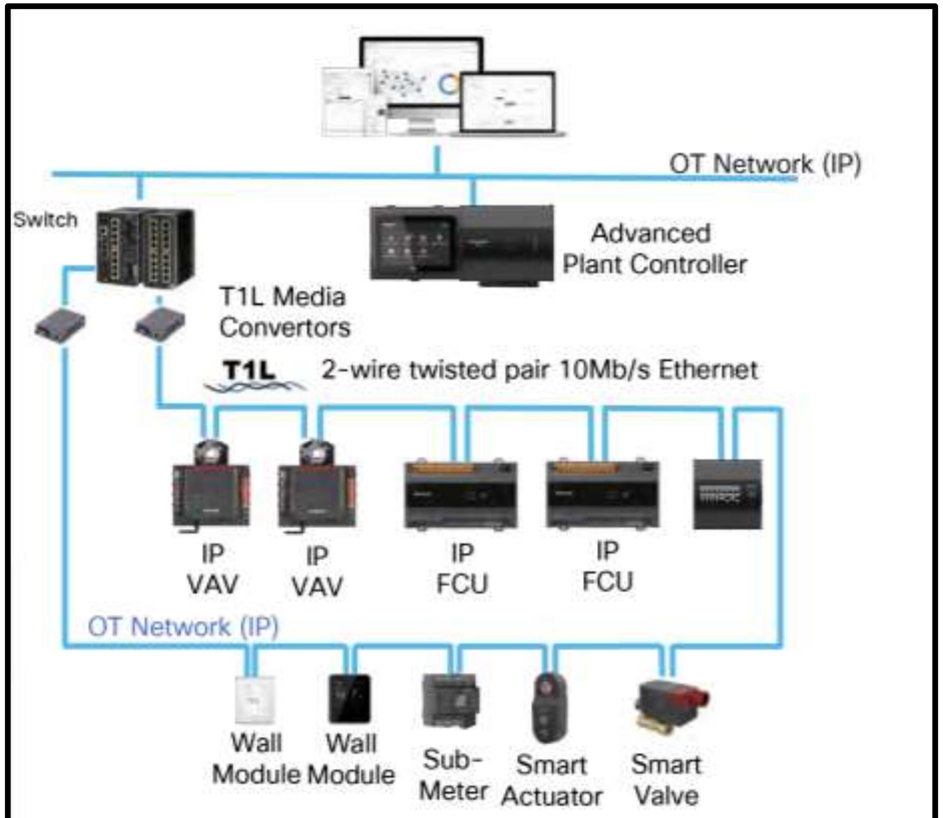


BMS Trend

Tradition BMS



Next Gen BMS



- Ethernet with resilience to the Edge
- 10Mb/s, full-duplex, over twisted pair
- Removes complexity
- Only IP knowledge needed

Fault Managed Power System (FMPS)

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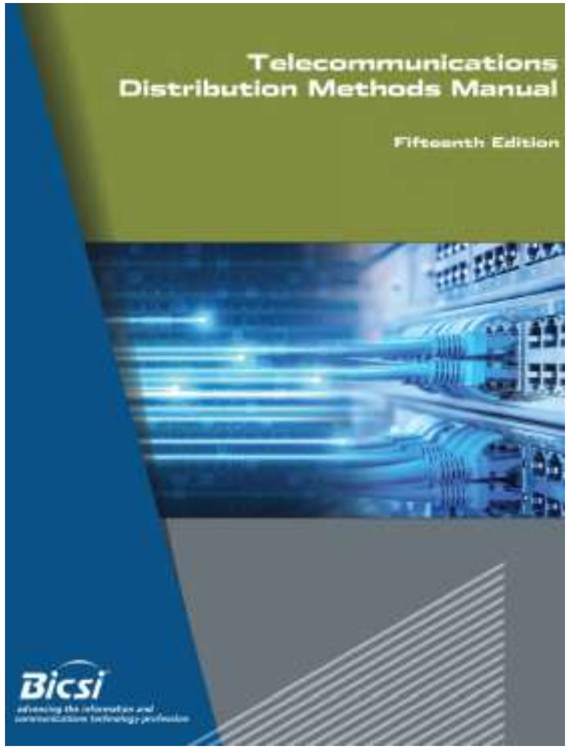
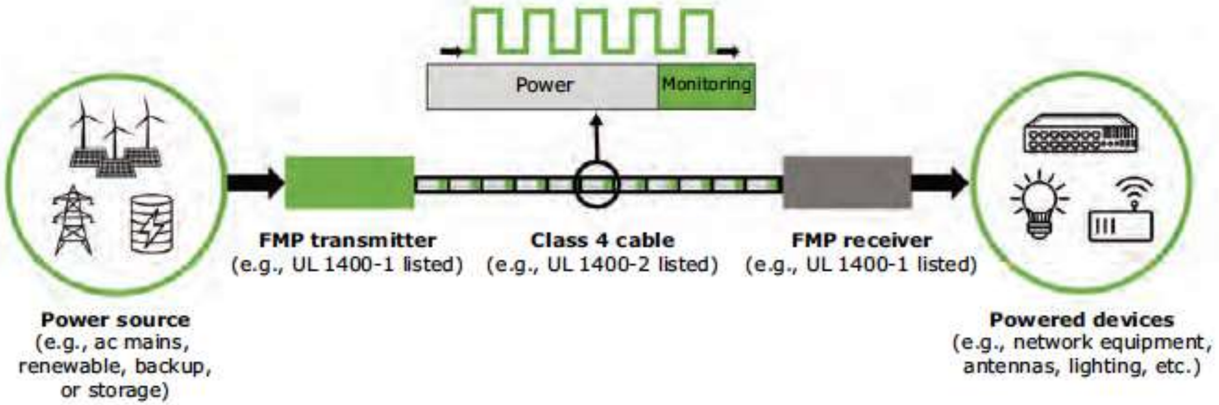
Fault Managed Power System



Class 4 fault-managed power circuits are an additional methodology available for both premise and OSP power distribution (see Figure 10.28). The Class 4 classification standardizes an improved format of electrical power delivery utilizing a digitized or packetized format of dc for transporting electrical power.

NOTE: These systems may have other names such as fault-managed power systems, packet energy transfer, Digital Electricity™, pulsed power, or smart transfer systems. These terms are used interchangeably, but they all refer to Class 4 circuits.

Figure 10.28
Example of a generic Class 4 fault-managed power system



ac = Alternating current
FMP = Fault-managed power
UL = Underwriters Laboratories, Inc.

What are the NEC Classes of Power?

	Class 1	Class 2	Class 3
Power Limit	NOT power limited	100 W	100 W
Voltage Limit	600 V	60 V	150 V
Most Common Uses	Widely deployed building wiring (110VAC and 220VAC) Any portable appliances without a Class rating should be treated as a Class 1 appliance.	Power over Ethernet (PoE) Wireless radios Doorbell	Home theatre and sound systems
Safety	Very common type of power widely deployed.	Considered safer from a fire initiation standpoint and provides acceptable protection from electric shock.	Considered safer from a fire hazard only but not from shock Hazard.
Installation/Wiring	Stringent installation practices require licensed electricians	Non stringent installation practices – can be installed by low-voltage technicians	Stringent installation practices require licensed electricians

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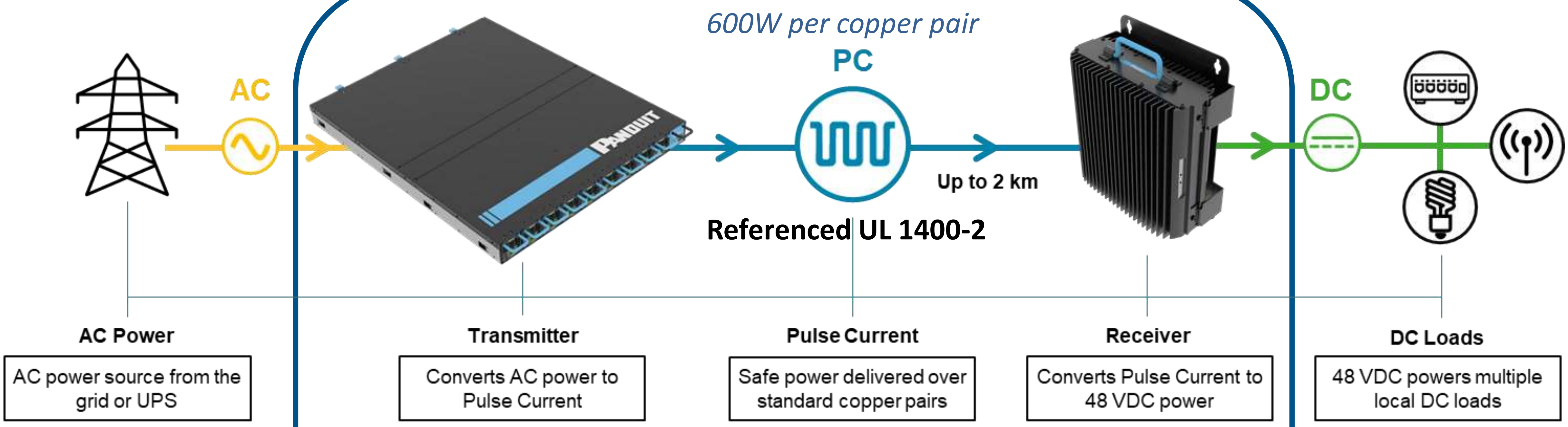
Now there is Class 4! What is it?

NEC Class 4 References UL-1400-1 which was Published Dec 19, 2022

Combining the best of both worlds (Class 1 and Class 2), Making higher voltages safe!

- Class 4 is not power limited and has a maximum voltage of 450V.
- It is energy limited concerning electric shock and fire hazards, making the delivery of 450V safe.
- Like Class 2, it does not have stringent installation practices and is not required to be performed by licensed electricians.

How Does it Work?



Every channel is constantly monitoring for all faults in UL-1400-1.

Turns channel OFF instantly to mitigate against shock or fire hazards.

Automatically restarts if the fault is cleared.

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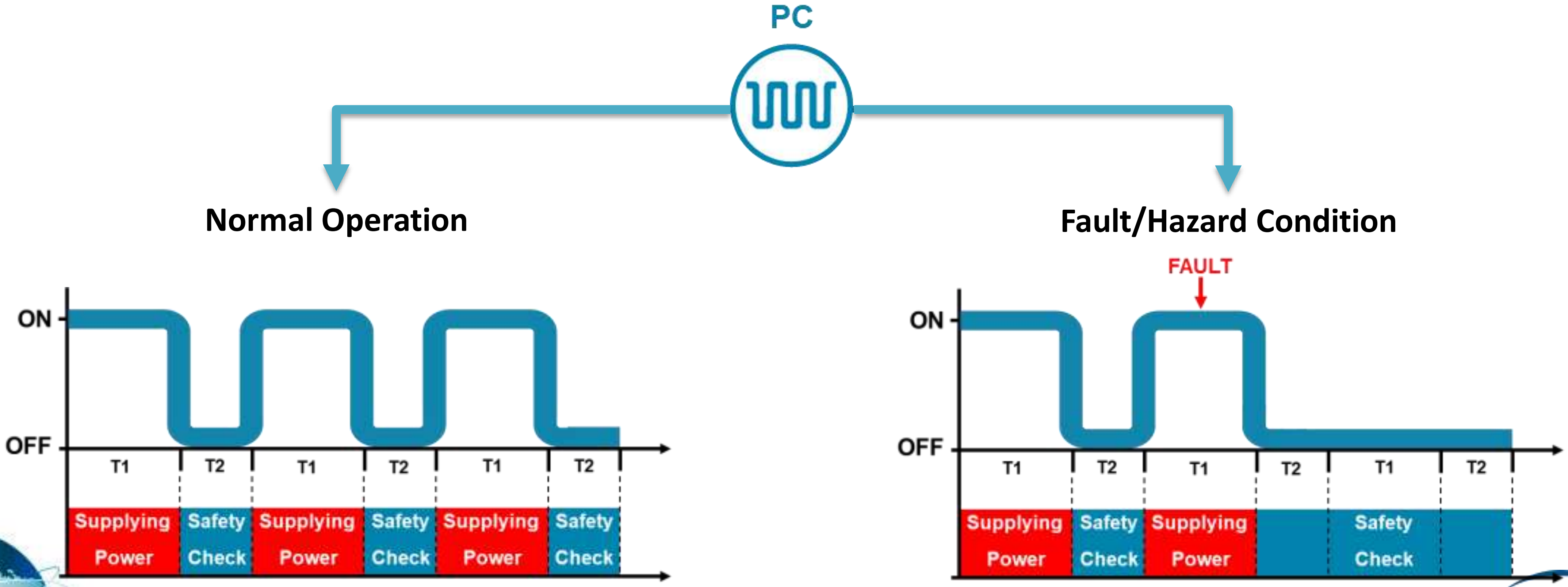
How Does it Work?

- Each Pulse is 3 ms long - 2 ms Power ON; 1 ms Power OFF
- Maximum time from fault detection to turning OFF is 2 ms



Class 4 Cable Overview

Class 4 Cable is covered in NFPA Article 722 (Referenced UL 1400-2)

UL-1400-2 Specifications	
Insulation rating	450 VDC minimum
Copper gauge	6 – 24 AWG
Copper	Solid & Stranded
# of Copper Pairs	Single or multiple
Temperature Rating	Not less than 60 C (140 F)

General:

- Standard covers plenum (CL4P), riser (CL4R), and general-purpose (CL4) cables
- May be used outdoors and/or for direct burial
- Class 4 cable can be hybrid – Copper and fiber in one cable
- Specified Labeling throughout cable length
- **Copper pairs** are typically twisted to easily identify pairs and make installation simpler/faster – driven by feedback from the field
- Termination: vendor specific but **field termination** is typical

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FMPS Applications/Verticals

Class 4 can be leveraged for many applications….

- Outdoor Wireless
- In-Building Wireless
- Digital Signage
- Lighting
- GPON
- Controlled Environment Agriculture
- Smart Building

Across many verticals..

Sports stadiums and arenas

Hotels and resorts

Education

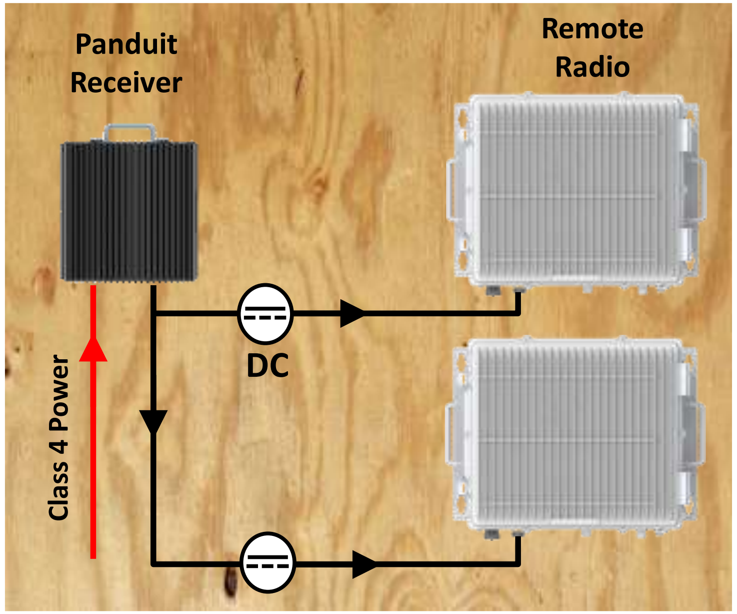
Office buildings

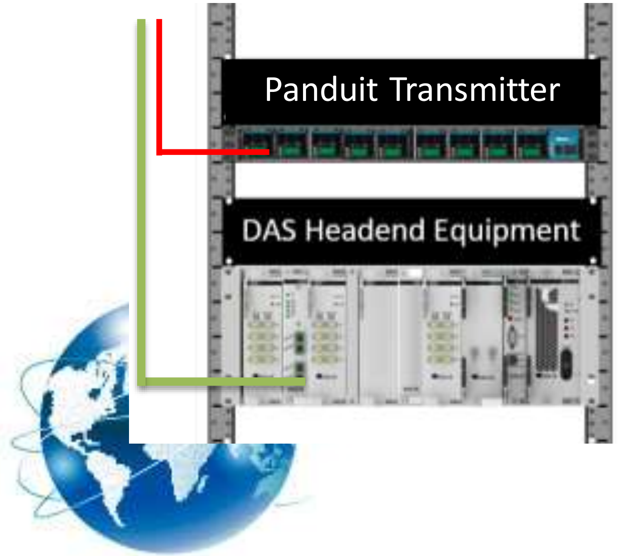
Airport/bus/train terminals

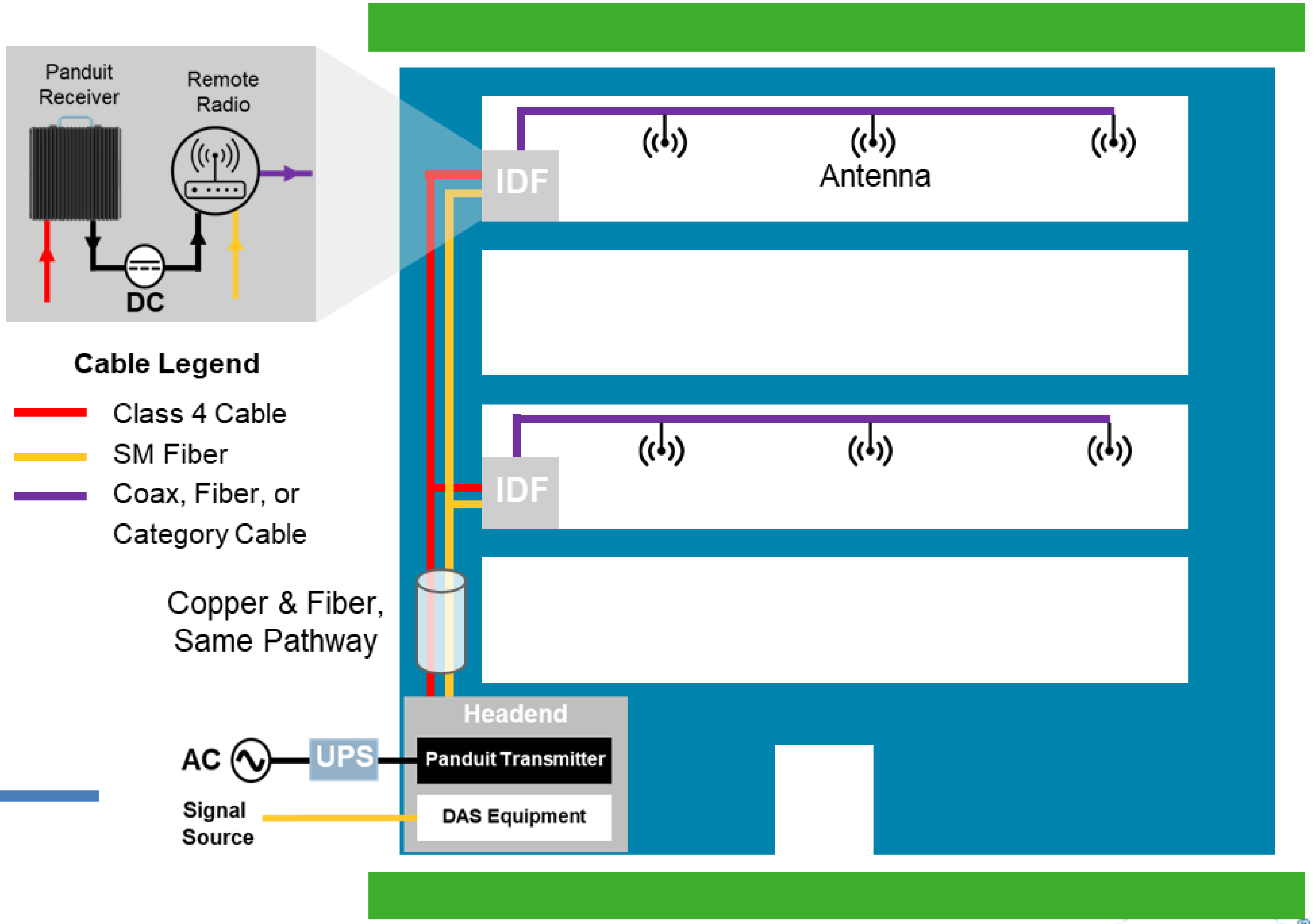
Manufacturing, Industrial, Warehouse facilities

FMPS for

In-Building Wireless



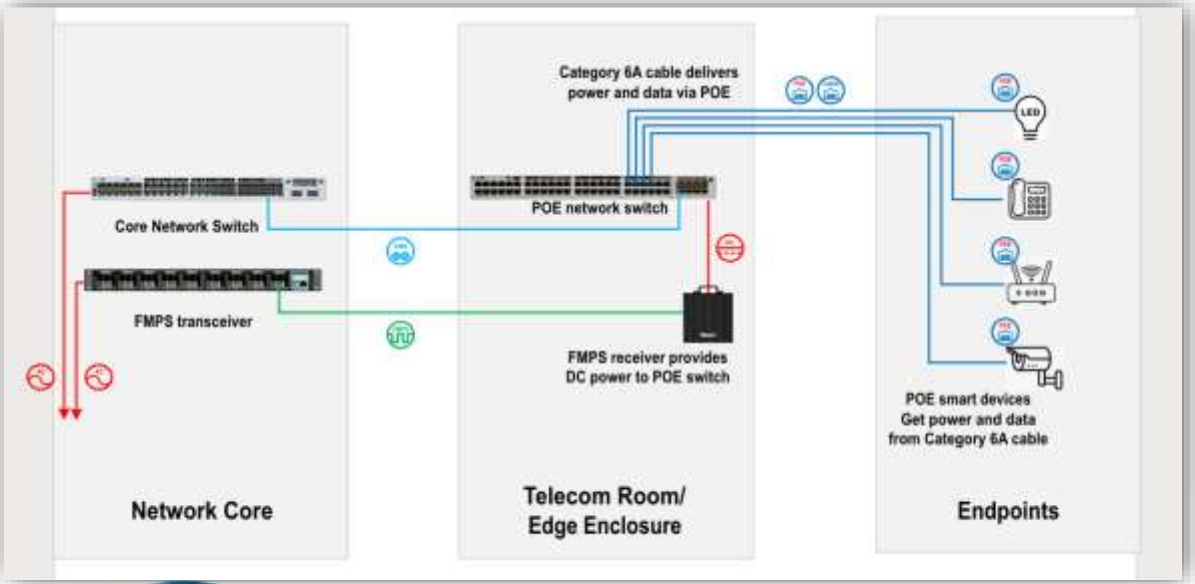


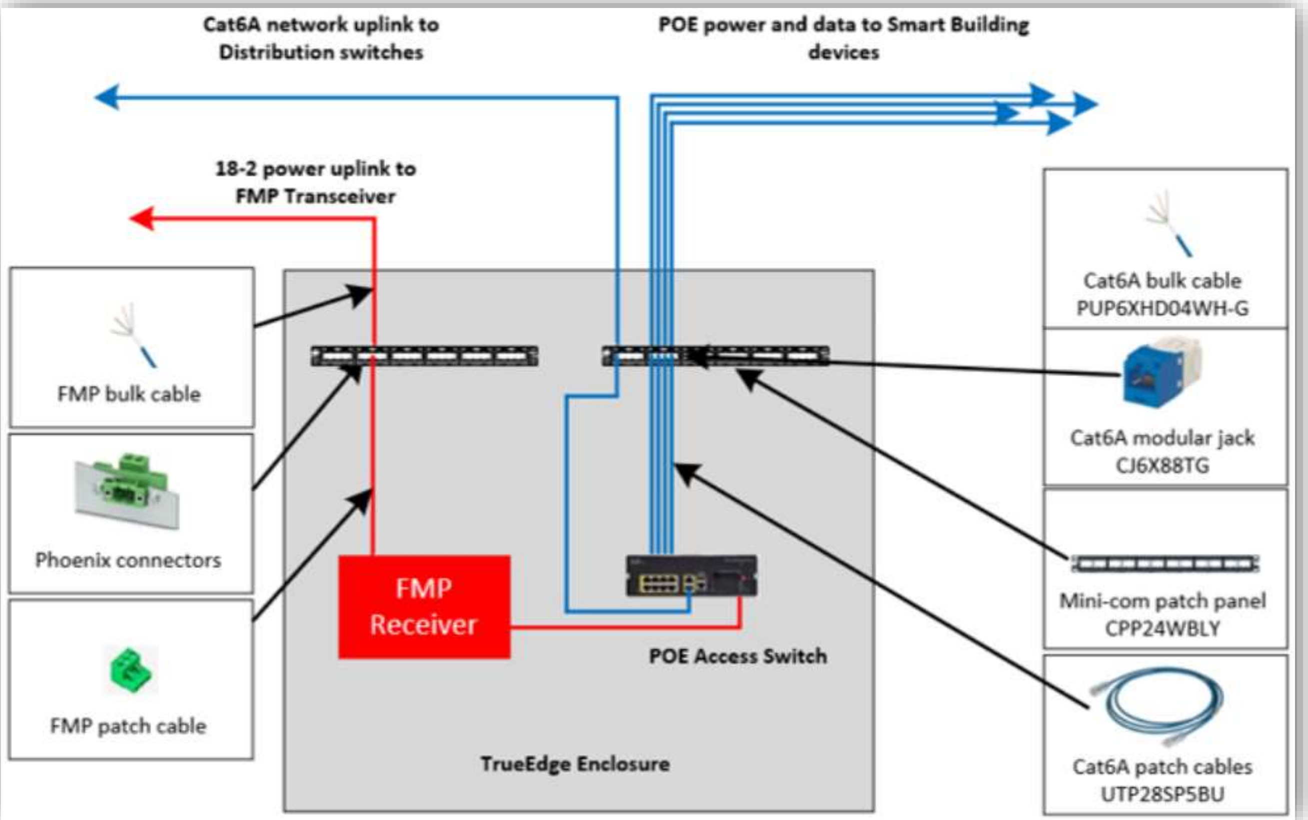


How do the classes compare in a snapshot?

	Class 1	Class 2	Class 4
Power Level	High Power Levels	Max 100 W per copper pair	High Power Levels – Up to 600W per copper pair (Typical)
Wiring Method	NEC Article 300 Wiring Methods	NEC Article 725 Wiring Methods	NEC Article 726 Wiring Methods
Installer	Electrician Required	Low-Voltage Technician	Low-Voltage Technician
Install Requirements	Conduit and Permits required	No conduit or permits required (unless required by AHJ)	No conduit or permits required (unless required by AHJ)
Wire Gauge	Large wire gauge	Gauge is power and distance dependent	Small wire gauge (16-18 AWG Typical)
Distance	Long range – No Limit	Limited Range (300 m Typical)	Long range – No Limit (2 km Typical)

Smart Buildings FMPS and PoE





Smart Building Design Consideration

Recommended Number of work area for BAS

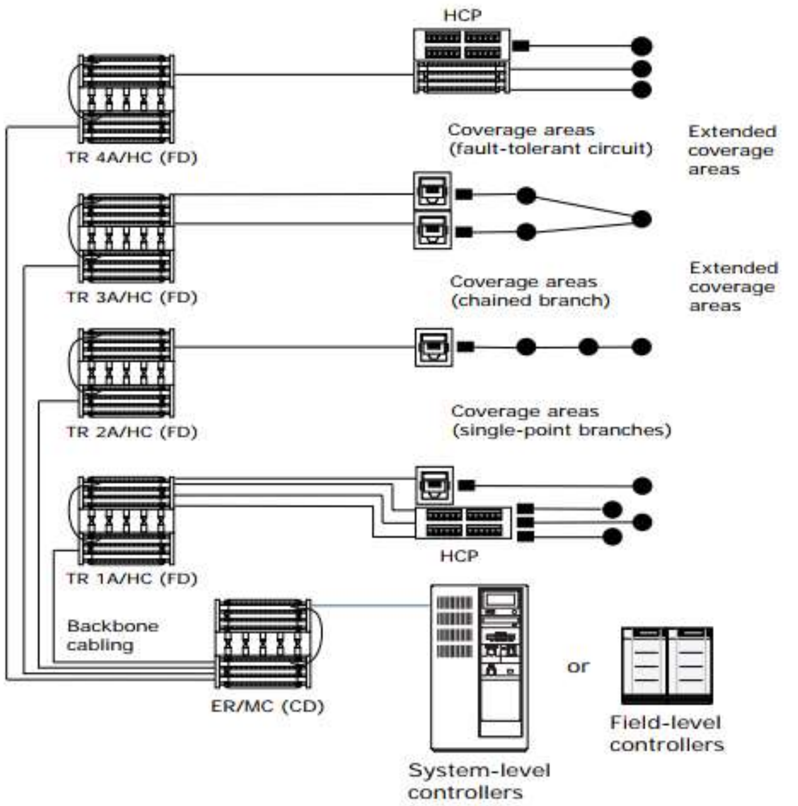
Telecommunications Cabling Structure Elements, continued

Table 15.1 gives the typical size for the recommended number of work areas and BAS devices for each type of building area.

Table 15.1
Typical work and BAS coverage area sizes

Building Area Type (One Work or Coverage Area)	Voice/Data (Per [X] ≈m^2/ft^2)	BAS (Per [X] ≈m^2/ft^2)	Additional Factors
Commercial office buildings	9.3/100	23/248	Determine average size of modular furniture or office work area space.
Commercial indoor parking	N/A	50/538	May also require voice connections for security. Identify fire, security, and HVAC requirements.
Commercial retail space	47/506	23/248	Determine point-of-sale positions and administration areas.
Factory/manufacturing	84/904	50/538	Determine office areas, factory areas, and process control needs.
Hotel/guest room	23/248	23/248	Determine voice and data connections and BAS requirements per room.
Education classroom	5/54	23/248	Determine number of students computer connections per classroom. Work area will primarily be used for data connection.
Hospital	14/151	23/248	Work area density is averaged to compensate for a variety of environments (office, patient rooms, labs, operating rooms). Identify individual building area types.
Mechanical room	84/904	5/54	Determine location of equipment (e.g., air handlers, chillers, boilers, pumps, fans, compressors). Air handlers will typically have a higher concentration of points.

Figure 15.7
Cabling system topologies for BAS



Reference BICSI TDMM 15

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Example of Integrated System in a Building

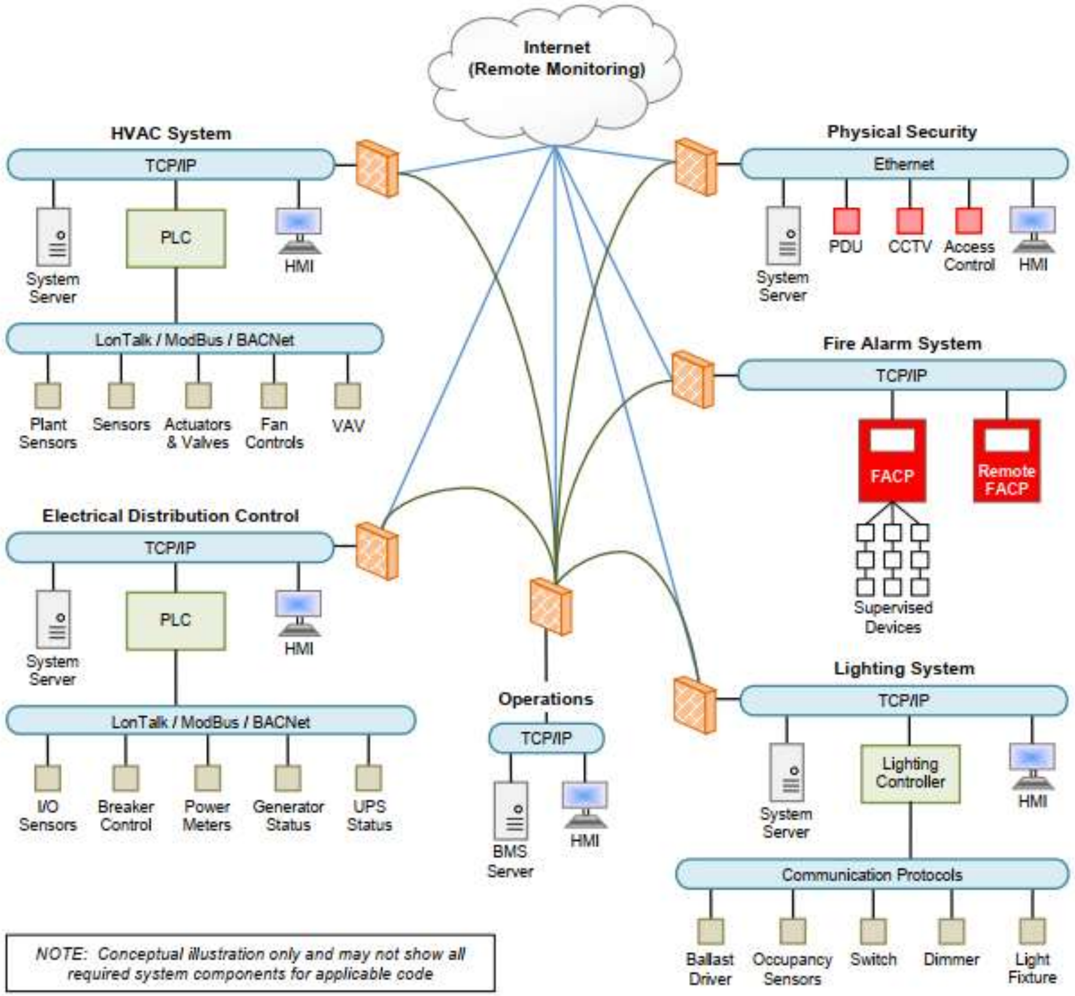


Figure 12-2
Example of Integrated Systems in a Building

Reference BICSI 007-2024

Matrix of Common System Integration

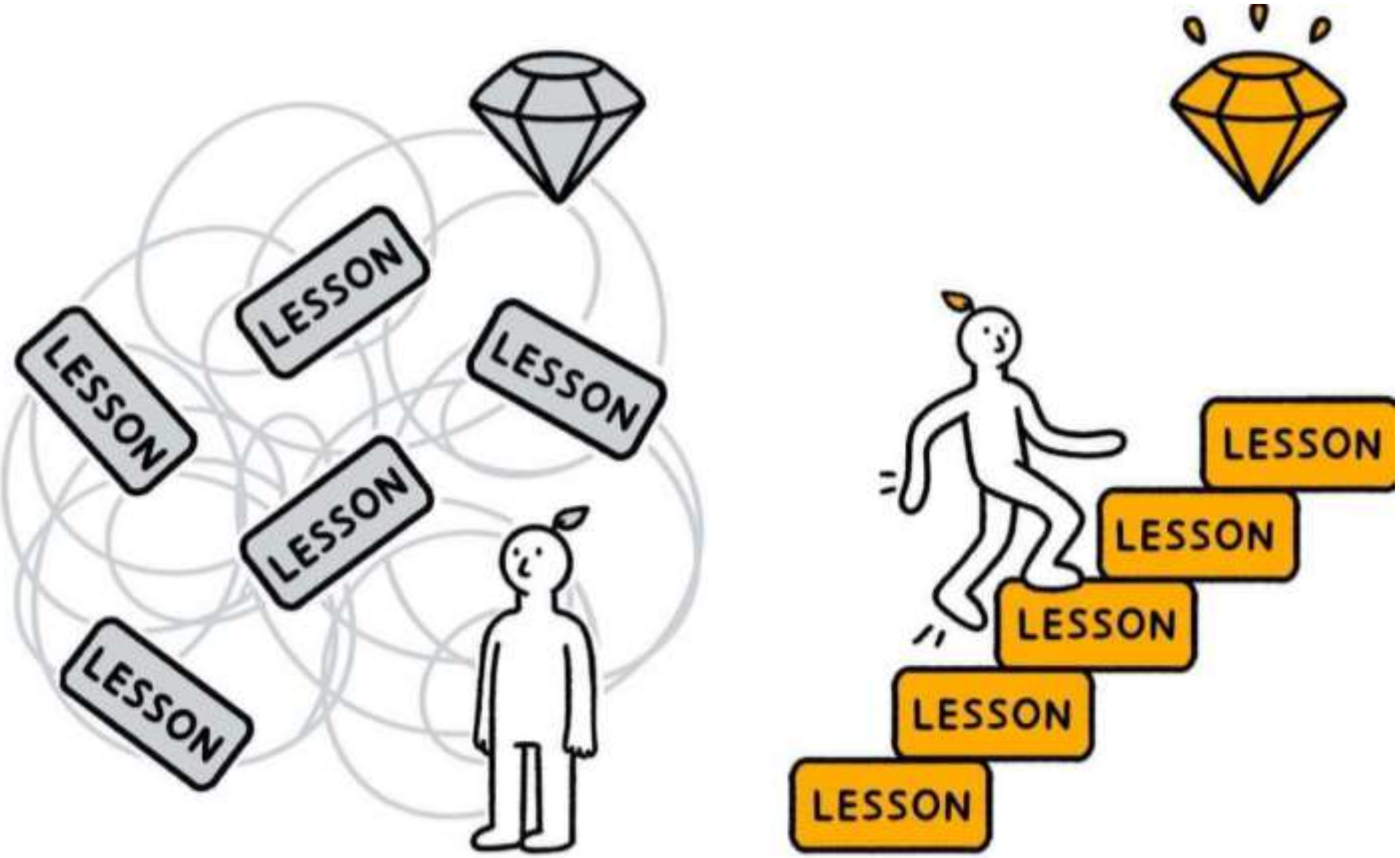
Table 12-1 Matrix of Common System Integrations

System	*Integrates With:* Data Network	Structured Cabling	Grounding System	VoIP	Wireless System	Video Distribution System	Audiovisual System	Access Control System	RTLS	Surveillance / CCTV	Intrusion Detection	HVAC / BAS	EMS	Lighting	Fire Systems	Building Transport	Facility Management	SCADA	HR Systems
Data Network	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Structured Cabling	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Grounding System	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VoIP	X	X	X	X	X							X				X			
Wireless System	X	X	X	X	X	X	X		X	X		X							
Video Distribution System	X	X	X			X		X		X									
Audiovisual System	X	X	X			X	X												
Access Control System	X	X	X				X	X	X	X	X								
RTLS	X	X	X		X	X	X	X	X	X									
Surveillance / CCTV	X	X	X			X	X	X		X									
Intrusion Detection	X	X	X					X		X	X								
HVAC / BAS	X	X	X	X	X							X	X	X	X	X	X	X	X
EMS	X	X	X									X	X	X		X	X	X	
Lighting	X	X	X			X						X	X	X	X	X	X	X	
Fire Systems	X	X	X				X	X		X		X	X	X	X	X	X		
Building Transport (Elevator/Escalator/Moving Walkway)	X	X	X	X				X		X		X	X	X		X			
Facility Management	X	X	X									X	X	X	X	X	X	X	
SCADA	X	X	X		X				X	X	X		X				X	X	
HR Systems	X	X	X					X									X		X

NOTE: SCADA is the acronym for supervisory control and data acquisition

Reference BICSI 007-2024

Remember



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Q&A

Thank you

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