

The Cisco Live! logo features the word "CISCO" in a dark blue, sans-serif font, followed by "Live!" in a dark blue, cursive script font.

CISCO *Live!*

The text "Let's go" is displayed in a dark blue, sans-serif font, centered horizontally and positioned to the right of the Cisco Live! logo.

Let's go



The bridge to possible

Industrial Power over Ethernet (PoE)

The Ultimate Guide for Beginners

Albert Mitchell (mitchell)
IIOT Technical Marketing Engineer

CISCO *Live!*

BRKIOT-1128

Agenda

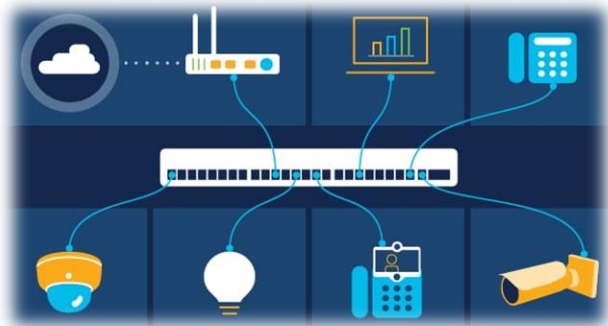
- Introduction
- Basics of Power over Ethernet
- PoE Standards and Variations
- Industrial Ethernet and POE
- Use-Cases and Benefits
- Conclusion

What is Power over Ethernet (PoE)?



Quick! What is Power over Ethernet?

Basics of Power over Ethernet



1

Power over Ethernet (PoE)

Technology that delivers DC power to devices over copper Ethernet cabling.

2

Powering what? PoE Devices

Used for devices like IP cameras and wireless access points but extends to a wide range of options.

3

To what point?

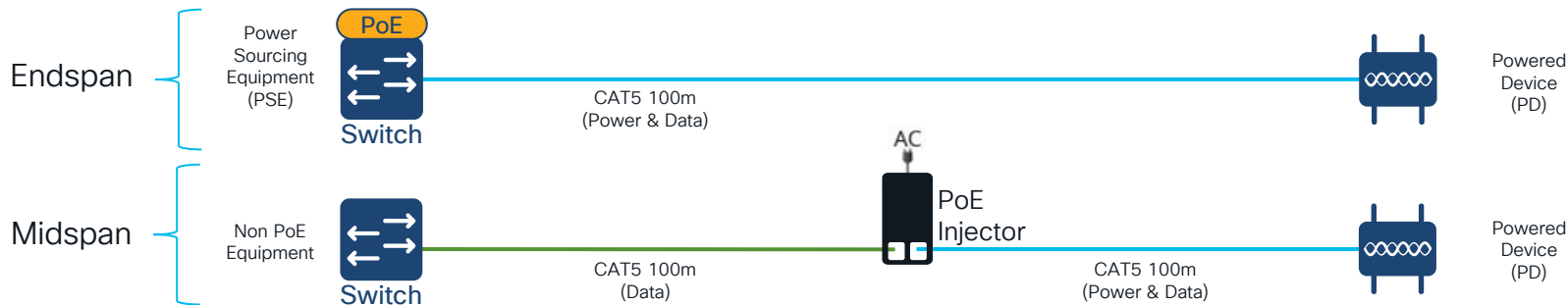
Reduce the need for separate power sources and connections, lowering cost, etc.

Fun Fact: power units in Watts



Components of a PoE system

Basics of Power over Ethernet



Power Sourcing Equipment (PSE)

Device that supplies or injects power into the Ethernet cable for transmission along with data.

- **Endspan:** network switch with PoE capabilities. Supplies power directly to the end device
- **Midspan or Injector:** standalone device that adds PoE power to a non-PoE network
- PSE is governed by various IEEE 802.3 standards* that dictate maximum power, etc.

Powered Devices (PDs)

Devices that receives power through the same Ethernet cable that carries its data connection.

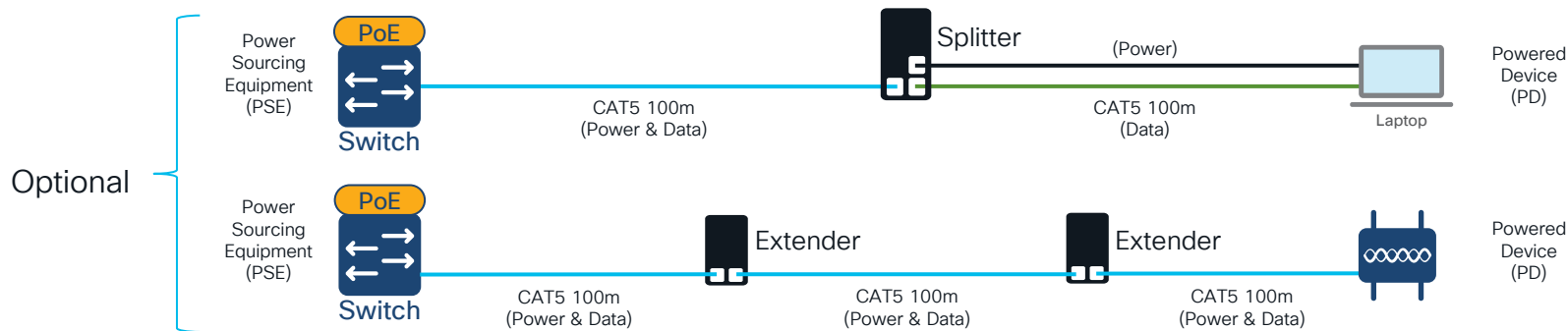
- Examples: IP Cameras, VoIP Phones, Wireless Access Points, Networked / IOT devices
- PDs are governed by various IEEE 802.3 standards* that dictate maximum power, etc.

*Ensure compatibility between PDs and PSEs



Components of a PoE system

Basics of Power over Ethernet



PoE Splitter

- Device separates power and data transmitted together over an Ethernet cable into 2 outputs
- Connects to the Ethernet cable, receives power and data from a PoE source
- Allows non-PoE devices to benefit from PoE by providing separate connections for data and power.

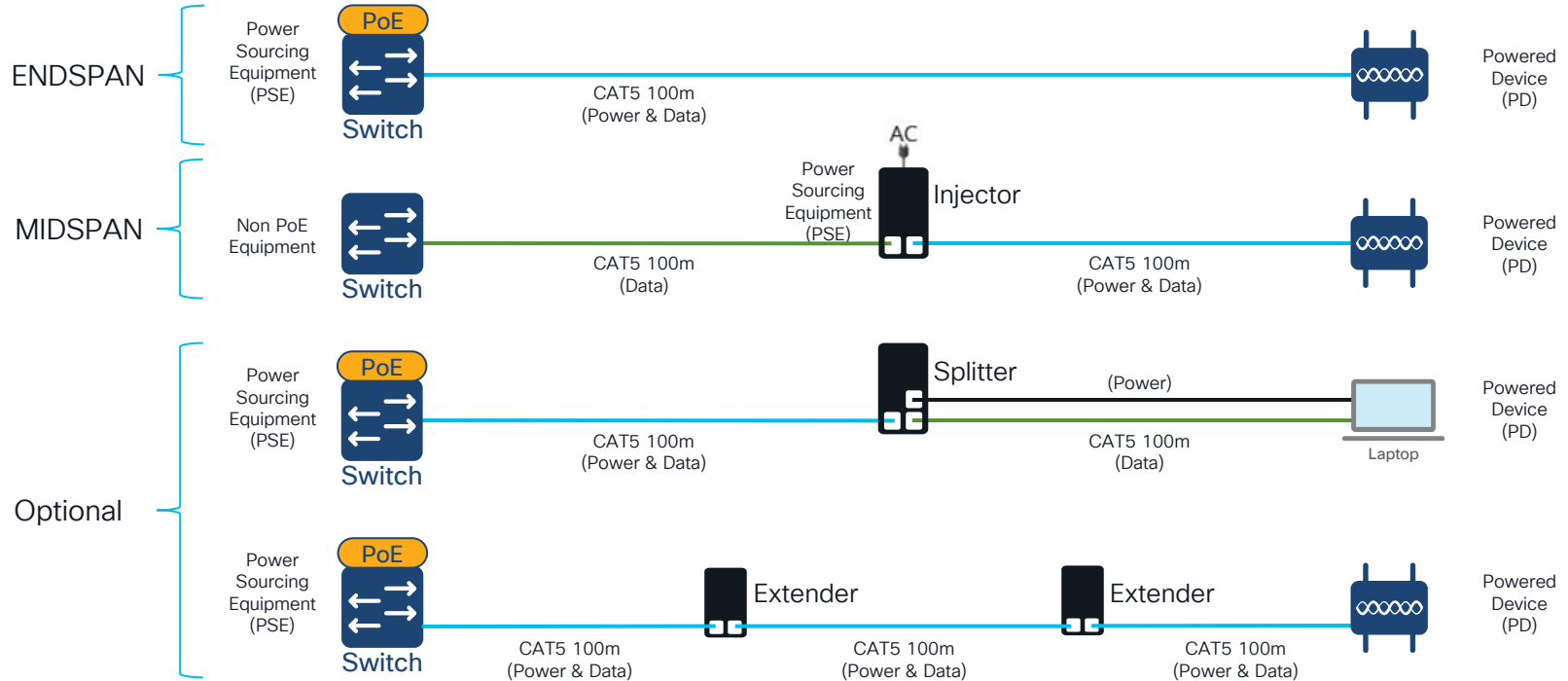
PoE Extender

- Devices that increases Ethernet's standard maximum distance beyond 100 meters
- Carries power and data over the same cable
- May be daisy-chained to extend the range (may increase latency, decrease available power)



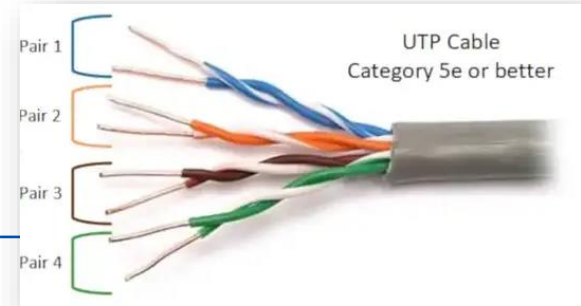
PoE Components & Arrangement

Basics of Power over Ethernet



Standards defining PoE

Basics of Power over Ethernet



IEEE PoE Standard

Description

IEEE 802.3af (PoE)

- Supplies up to 15.4 watts of DC power
- Uses two of the four pairs in the Ethernet cable

IEEE 802.3at (PoE+)

- Supplies up to 30 watts of DC power
- Uses two of the four pairs in the Ethernet cable
- Backwards compatible with IEEE 802.3af

IEEE 802.3bt (PoE++ / 4PPOE)

- Supplies up to 60W (type 3) or 90W (type 4)
- Uses four pairs in the Ethernet cable (4 Pair Power over Ethernet)

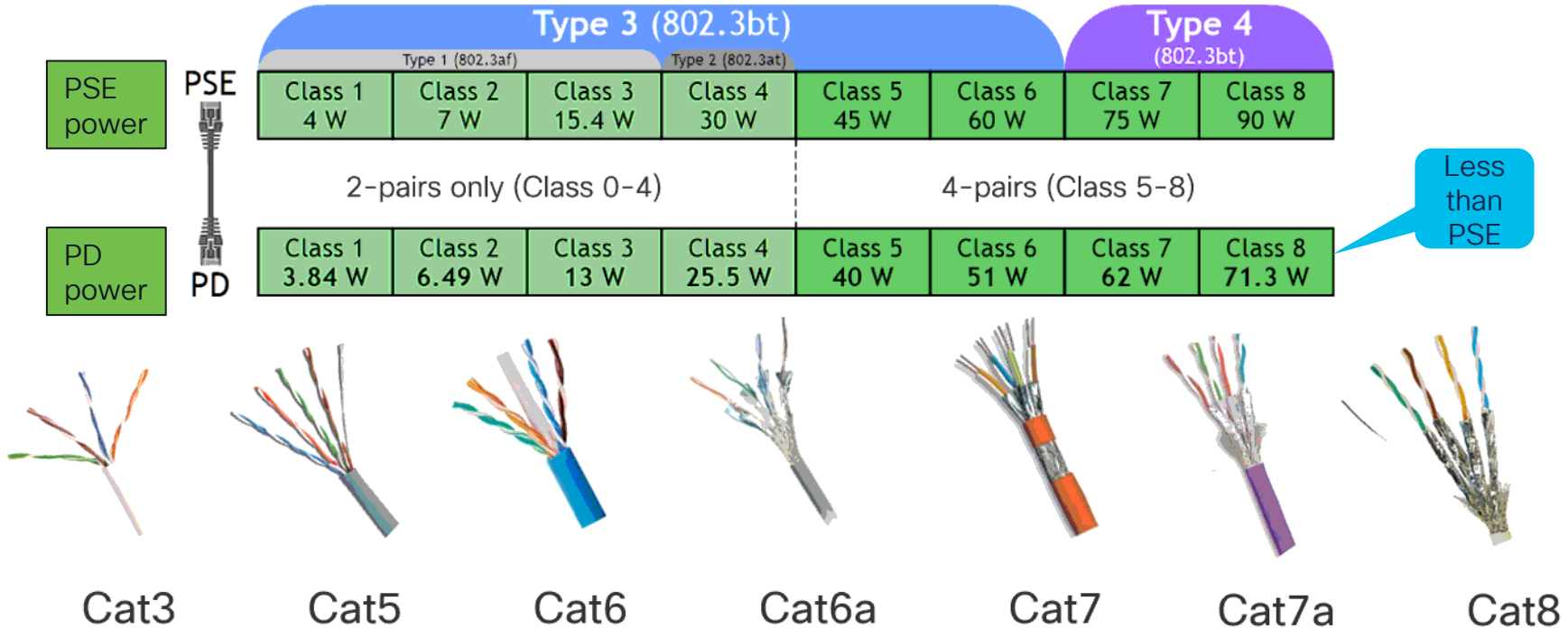
4PPoE = 4 Pair PoE



Heard of UPOE?

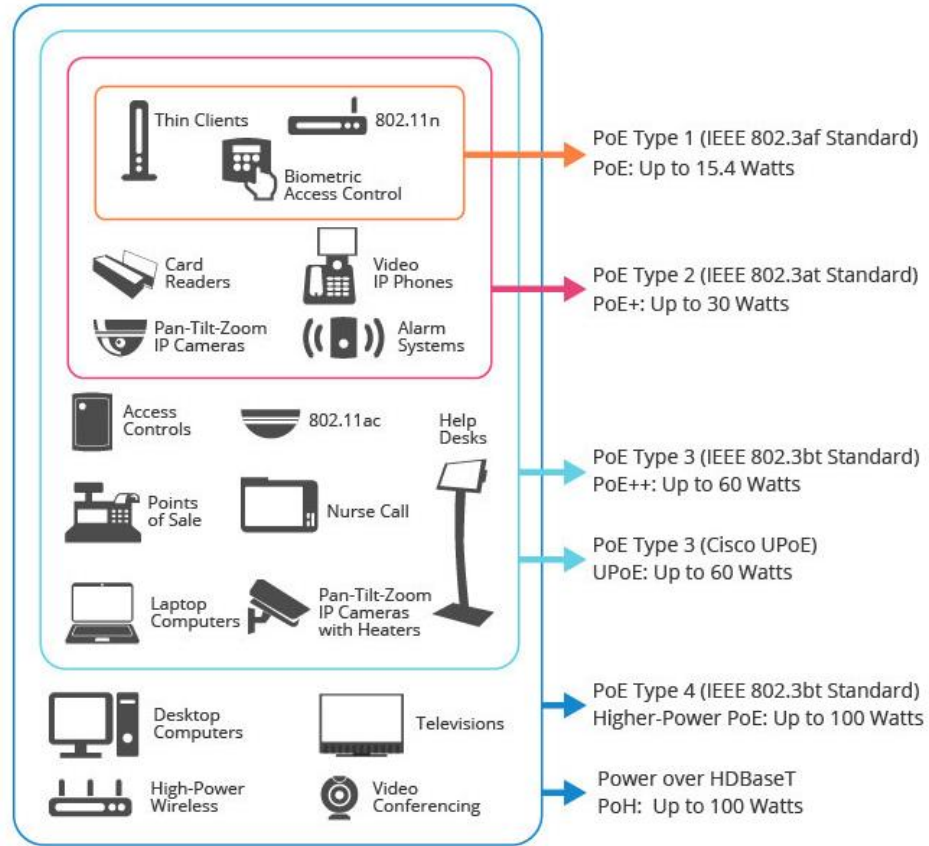
Lets talk quickly about the P in PoE

Basics of Power over Ethernet



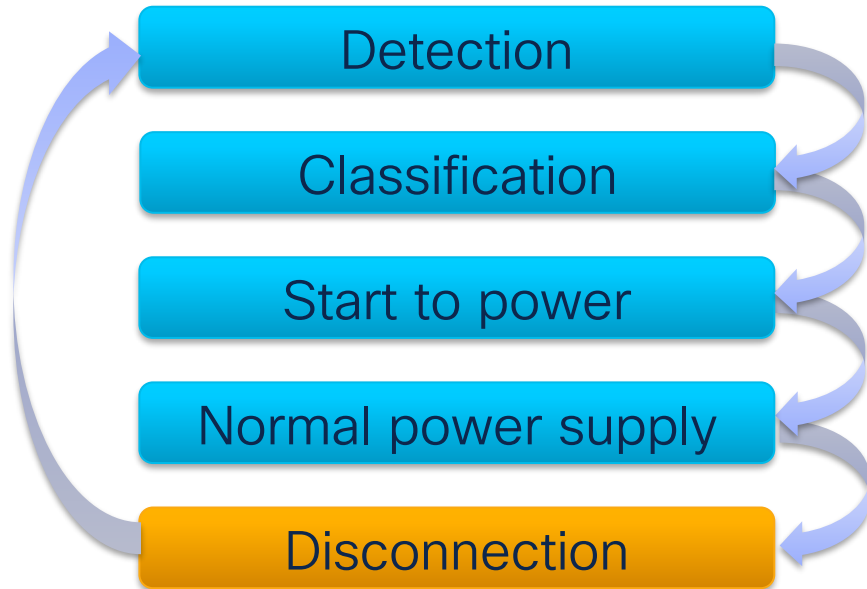
Powering with PoE

types of Powered Devices (PD)



Overview of how PoE Works

Basics of Power over Ethernet



Action by PSE

Detection of the PoE Device

Classifies devices as Class 0-8

Starts low voltage then 48VDC

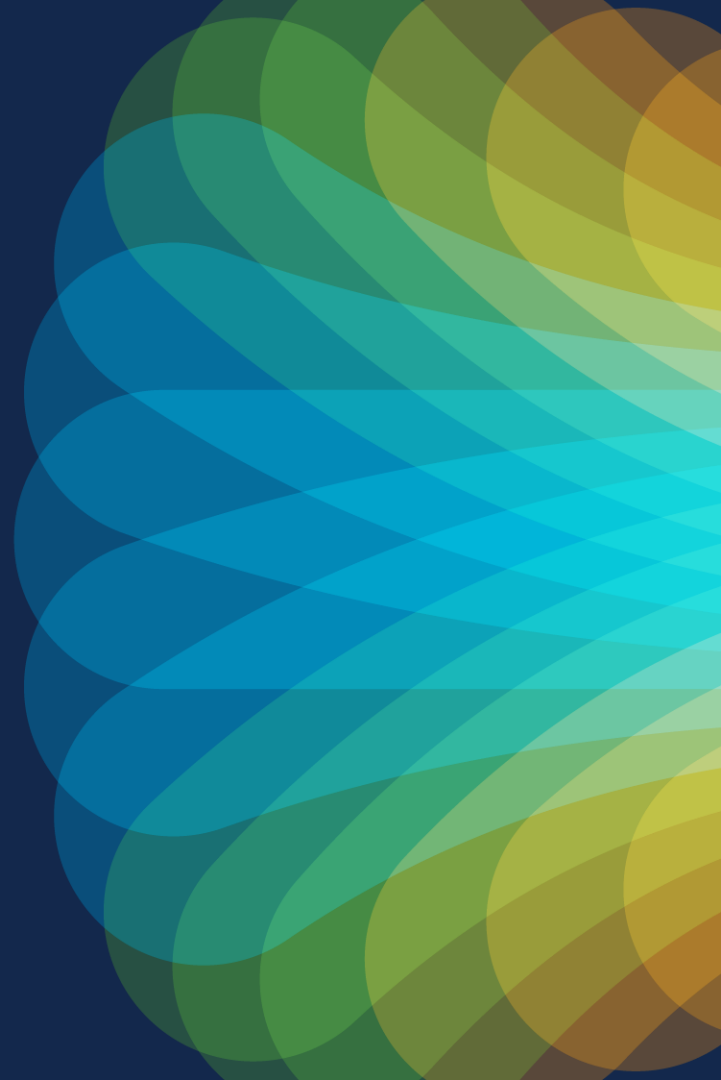
Provides stable DC power

If: PD is removed

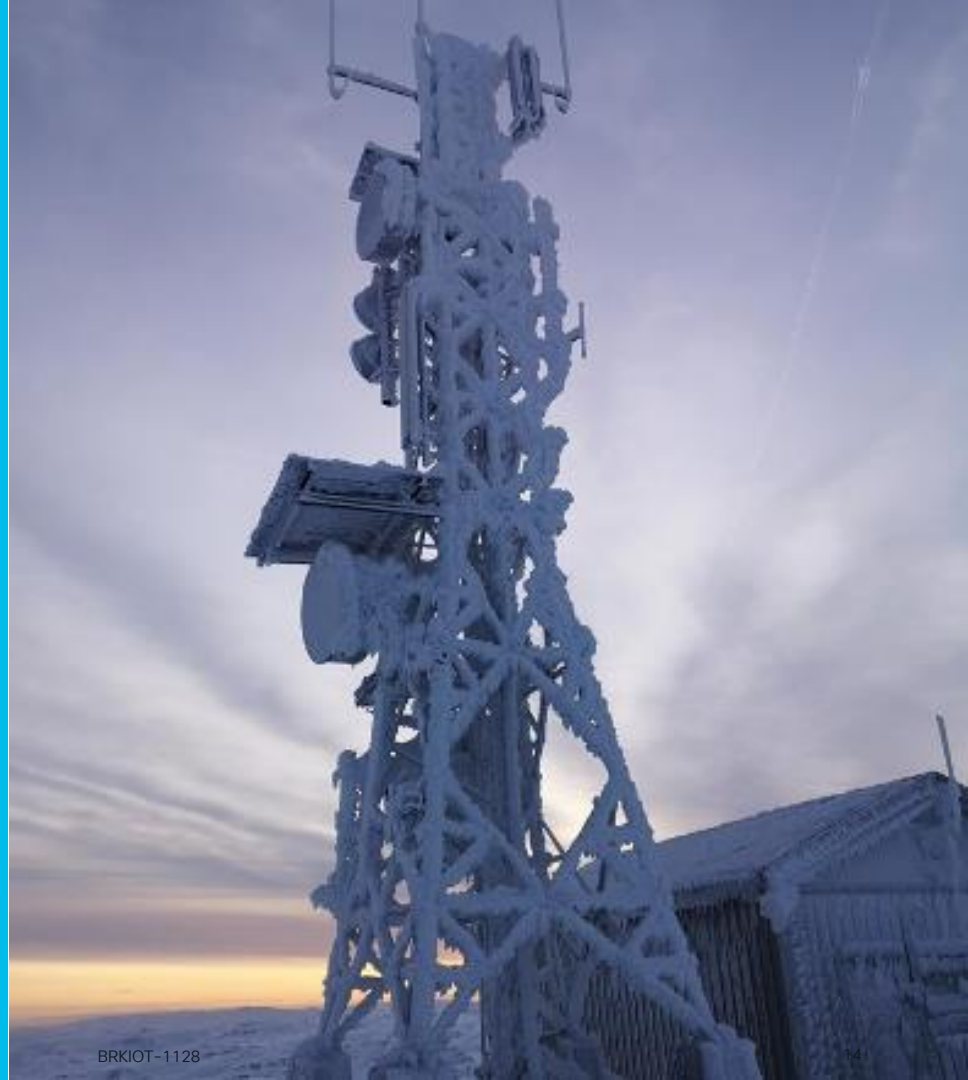
If: PD Power consumption issue

If: PD power is out of PSE's power budget

Industrial IOT



Industrial Networking on the extreme!!!



Network connectivity wherever you need it



- 50C



+75C



Shock / Vibration



Water



Dust

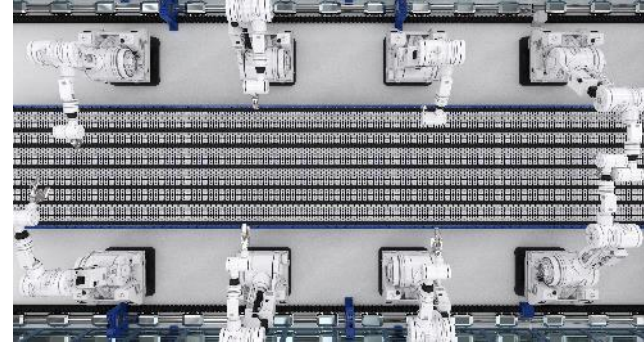


Industrial certifications
(e.g. EN50155)



Industrial protocols

Industrial organizations are accelerating their digital agility for a sustainable future



Cisco Industrial Grade, IT's tough siblings

Industrial IOT



Industrial Grade

Purpose built for Operations



Enterprise IT Grade

Leverage existing knowledge and investments

- Built for harsh and outdoor environments
- Industry use-cases and certifications
- Industrial protocol support and integrations
- Machine data and control

- Industry-leading end-to-end Cisco security architecture
- Less complexity at scale: one network architecture
- Consistent commercial model – software, licensing



Industrial Ethernet Switching vs. Enterprise Switching

Features	Enterprise or Campus Switching	Industrial Ethernet Switching
Operating Tem Range	-5°C to +45°C (Built for Air conditioning)	-40°C to +75°C (Built for extreme temps)
Fan	Fan Cooled / Moving Parts	Fanless / convection-cooled / No Moving Parts
Shock & Vibration	Enterprise Level (less stringent than industrial)	Compliant to ruggedized industrial levels
Corrosion Resistance	No Corrosion Resistance	Deployment in Humid/corrosive environments
Electromagnetic Immunity	Light Industrial Immunity	Wide Electromagnetic Immunity conformance
Platform resiliency	FRU Fans/power supply/uplink	FRU power supply / No Fans



Comprehensive Industrial IoT Networking Portfolio

Industrial Switching

IE1000, IE3100, IE3200, IE3300, IE3400, IE4000, IE5000, IE9300



Industrial Routing

IR1101, IR1800, IR8100, IR8300



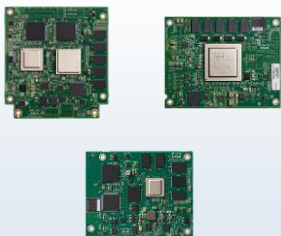
Industrial Wireless

IW9167EH, IW9165E, IW9165D, IW6300H, Cisco Ultra-Reliable Wireless Backhaul, IXM Gateway, IR510, ESW6300



Embedded Networking

ESS3300, ESS9300, ESR6300



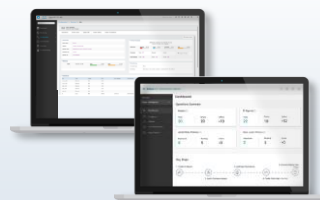
Industrial Cybersecurity

Cyber Vision, Secure Equipment Access



Data Control and Exchange

Edge Intelligence, Application Hosting



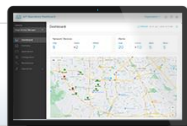
Industrial Sensor Solution

Industrial Asset Vision



Management & Automation

Cisco Catalyst Center, Cisco Catalyst SD-WAN, Field Network Director



Part of a broad market-leading industrial switching portfolio



DIN rail
Catalyst® IE3100, IE3200, IE3300, and IE3400



IP67
Catalyst IE3400 Heavy Duty Series



Embedded
ESS3300, Catalyst ESS9300



Rack-mount Gigabit Ethernet copper/fiber
IE 4010, IE 5000



Stackable rack-mount all fiber or all copper
Catalyst IE9300

A complete portfolio

Secured and optimized for *every* use case

Demanding, mission critical deployments

Embedded / versatile deployments

ATMs, low voltage substations,
roadside traffic cabinets

Remote monitoring,
streetlights, intersections

Embedded solutions for Routing, Switching
and Wireless



Fleet, first-responders, pipelines

Factory, high voltage substations

IoT Industrial Modules



Cisco's Outdoor and Industrial APs Today



Cisco Catalyst
IW6300 Series
802.11ac W2



Cisco Catalyst
9124 Series
802.11ax



Cisco Catalyst
IW9167 Series
802.11ax+6 GHz



Cisco Catalyst
IW9165 Series
802.11ax+6 GHz



Cisco industrial DIN-rail power supplies

A full line of compact, rugged, and reliable AC and DC power supply options



PWR-IE50W-AC-L
50W AC to DC



PWR-IE50W-AC
50W AC to DC
or High DC to DC



PWR-IE50W-AC-IEC
50W AC to DC power supply
with an IEC connector



PWR-IE65W-PC-AC
65W AC to DC or
High DC to DC, PoE/PoE+



PWR-IE65W-PC-DC
65W Low DC to DC
power supply, PoE/PoE+



PWR-IE170W-PC-AC
170W AC to DC or
High DC to DC, PoE/PoE+



PWR-IE170W-PC-DC
170W Low DC to DC,
PoE/PoE+



PWR-IE240W-PCAC-L
240W AC to DC,
8 ports of PoE/PoE+



PWR-IE480W-PCAC-L
480W AC to DC,
16 ports of PoE/PoE+

Recommended for
POE

Reduce wiring complexity | Control costs with less wiring, distribution panels, and circuit breakers

Cisco IE POE Support

	DIN-Rail							Rackmount			
	IE1000	IE2000/U	IE3100	IE3200	IE3300	IE3400	IE3400H	IE4000	IE4010	IE5000	IE9300
PoE IEEE 802.3af	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓
PoE+ IEEE 802.3at	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓
PoE++ 4PPoE IEEE 802.3bt	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✓
Total Ports	Up to 8 ports	Up to 4 ports	---	8 ports	Up to 24 ports	Up to 24 ports	---	Up to 8 ports	Up to 24 ports	Up to 12 ports	Up to 24 ports
Max PoE budget in W	Up to 180W	Up to 120W	---	Up to 240W	Up to 360W/48 0W	Up to 480W	---	Up to 200W	Up to 385W	Up to 360W	Up to 720W

IE Switch Power redundancy and PoE

Q: does the IE din rail have dual Active DC power input?

A: No. Active and standby. All Power from Active power source

Q: does IE9300 POE have dual Active Power supplies

A: Yes. Both power supplies are active and provide power for PoE

PoE & Industrial IOT



The Role of PoE in Industrial IOT

Applying PoE in Industrial IOT

- Simplified Infrastructure: data and power over single Ethernet cable. Simplifies the installation process.
- Cost-Effective: reduces the need for electrical wiring and power outlets near each device.
- Scalable: PoE supports the addition of new devices to the network with ease.

How PoE Differs in Industrial IOT

Applying PoE in Industrial IOT

- Environment: Industrial environments may require more robust PoE equipment (PSE) due to harsh conditions.
- Power Requirements: Industrial IoT devices (PDs) may have higher power requirements, possibly requiring higher-standard PoE.
- Safety Standards: Industrial settings have stricter safety standards, which can influence PoE implementation.

Benefits of Using PoE in Industrial IOT

Applying PoE in Industrial IOT

- Reduces Downtime: PoE can provide uninterrupted power to critical IoT devices, reducing downtime.
- Enables Remote Power Management: With PoE, you can manage power supply to devices remotely.
- Promotes Safety: By reducing the need for high-voltage electrical wiring, PoE increases safety in industrial environments.
 - Reduce install costs as well. No Electricians.

Key Considerations PoE in Industrial IOT

What to keep in mind when thinking about PoE

Key Considerations – PoE in Industrial IOT



Power Budgeting



Environmental Conditions



Network Architecture



Standards and Compliance



Selecting the right Industrial Ethernet PoE switch

The Right Industrial Ethernet PoE Switch

Key Considerations – PoE in Industrial IOT



Power Capability

Environmental Resilience

PoE Standard Compatibility

Port Density

Network Features

Cabling Considerations for Industrial PoE

- **Cable Type and Length:** PoE can be delivered over any Ethernet cabling. However, for best performance and power delivery, use Cat5e or higher-grade cable. Cable length should not exceed the Ethernet limit of 100 meters (328 feet) to avoid signal degradation.
- **Power Dissipation:** Power dissipation in the cable can result in a reduction of the power received by the Powered Device (PD). This is more pronounced over longer distances and is a key factor in calculating power budgets.
- **Cable Quality:** In industrial settings, cable quality is crucial due to harsh environmental conditions. Consider industrial-grade, shielded cables to protect against electromagnetic interference (EMI) and physical damage.
- **Cable Routing:** Be mindful of cable routing. Avoid running Ethernet cables near high-voltage lines or sources of high EMI, as they can degrade data transmission.
- **Temperature Considerations:** High temperatures can impact power capacity. If your setting has high ambient temperatures, consider this in your power budgeting calculations.

PoE Power Budgeting





What is PoE Power Budgeting?

Basics of Power over Ethernet

Ensure your PoE switch(PSE) has budget to meet power needs of all devices(PDs).

Prevents system overload and ensures reliable operation.

1

Identify the power draw of each device (e.g., sensors, cameras...) including the PoE switch.

2

Add up the power requirements of all devices, including the switch, to find the total power requirement.

3

Determine power output of the Industrial Ethernet PoE switch

4

Do not exceed capacity of power Source (aka Power supply)

Utility Substation: Monitoring and Control

PoE Power Budgeting

- Need: Monitoring and controlling utility substation equipment for optimal operation and safety.
- Solution: An Industrial Ethernet PoE switch for power and connectivity to all devices, enabling remote monitoring and control, and reducing the need for separate power supply units.
- Power Budget Planning Example:
 - PDs
 - Surveillance Camera x 2, IEEE 802.3at, 20W each
 - Environment Sensor x 4, IEEE 802.3af, 5W each
 - Control Unit x 1, IEEE 802.3at, 25W each
 - PSE
 - Industrial Ethernet PoE Switch, 25W

110W total power draw

Recommend 170W PSU

Industrial Workspace: Powering Laptops & Devices

PoE Power Budgeting

- Need: Powering multiple high-power devices like laptops and specialized equipment in an industrial environment.
- Using Industrial Ethernet PoE switches supporting the IEEE 802.3bt (PoE++) standard, which can deliver up to 90W per port.
- Power Budget Planning Example:
 - PDs:
 - Laptop x 2, IEEE 802.3bt, 60W each
 - Industrial Device x 6, IEEE 802.3bt, 30W each
 - PSE
 - Industrial Ethernet PoE Switch, 30W



330W total power draw

Recommend 480W PSU

Troubleshooting POE usage

```
IE3300-8P2S_Right3# show power inline
Available:125.0(w) Used:0.0(w) Remaining:125.0(w)
```

PoE Budget

Only
POE
capable
ports

Interface	Admin	Oper	Power (Watts)	Device	Class	Max
-----	-----	-----	-----	-----	-----	-----
Gi1/3	auto	off	0.0	n/a	n/a	30.0
Gi1/4	auto	off	0.0	n/a	n/a	30.0
Gi1/5	auto	off	0.0	n/a	n/a	30.0
Gi1/6	auto	off	0.0	n/a	n/a	30.0
Gi1/7	auto	off	0.0	n/a	n/a	30.0
Gi1/8	auto	off	0.0	n/a	n/a	30.0
Gi1/9	auto	off	0.0	n/a	n/a	30.0
Gi1/10	auto	off	0.0	n/a	n/a	30.0
-----	-----	-----	-----	-----	-----	-----
Totals:		0 on	0.0			

```
IE3300-8P2s_Right3# config term
IE3300-8P2S_Right3(config)#power inline wattage max ?
<4-480> watts
```

IE Switch Power redundancy and PoE

Q: When IE-3300-8U2X has 240W PSU attached, what is default PoE budget?

A: Default is 125W PoE power budget. IE3x00 cannot detect Power capacity of attached Power source

But Wait, there's
more



Additional PoE Features

- PoE Power Management
- Fast PoE
- Perpetual PoE
- Load Shedding

POE Power Management and Fast POE

Other PoE features

- **PoE Power Management:** Provide dynamic power allocation to efficiently manage power budget.
- **Fast PoE:** Ensures rapid power delivery to connected devices (PDs), enabling faster startup for PD and device replacement.
 - Power to PD even before Switch has completed boot process
 - Supported on IE9300

Perpetual POE and Load Shedding

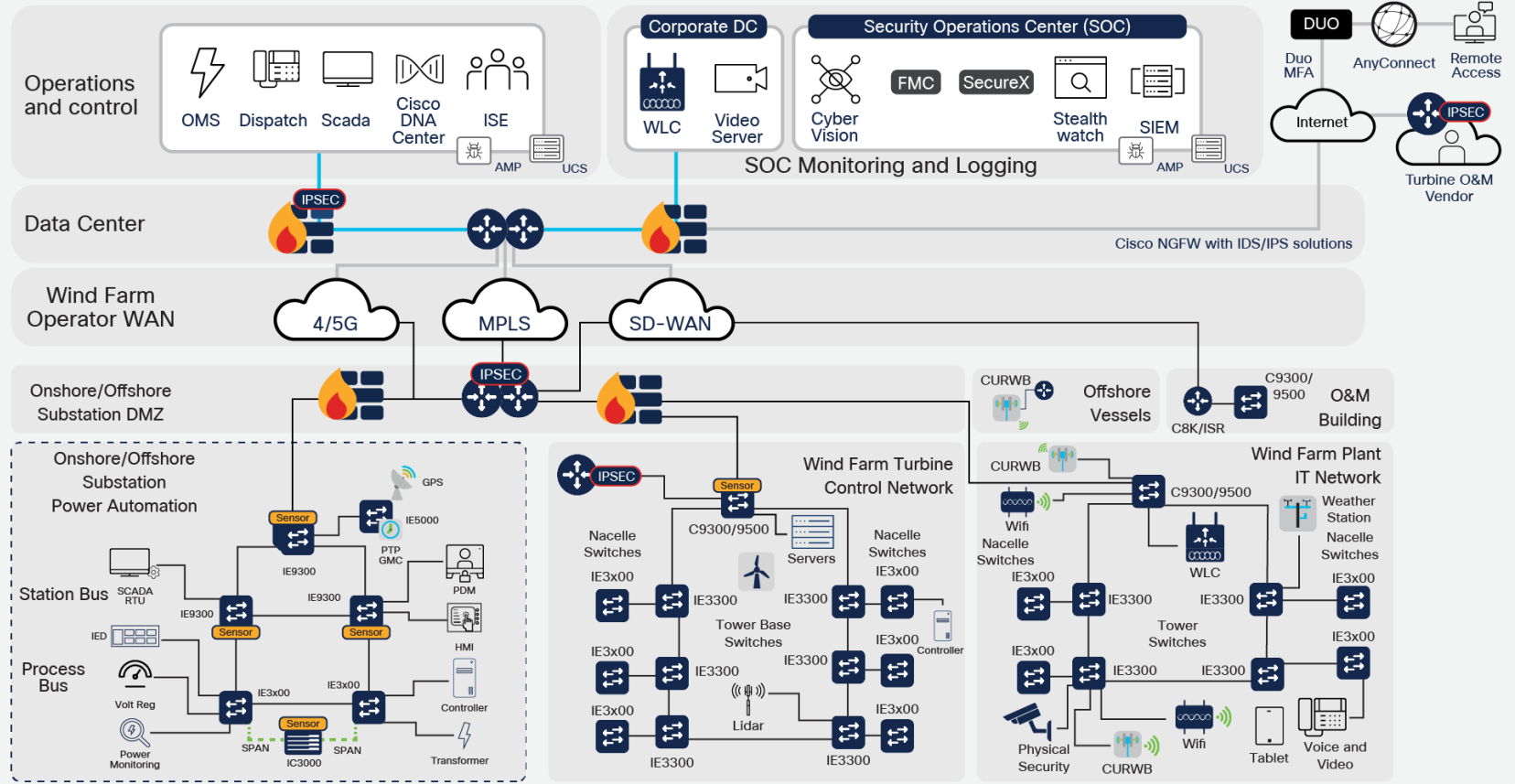
Other PoE features

- **Perpetual PoE:** Maintain power to connected devices (PDs) even during a switch reboot, minimizing downtime.
 - Supported on IE9300
- **Load Shedding:** In case of power shortage (1 power supply/source lost), switches prioritize power delivery based on the importance of connected devices, enhancing system resilience.

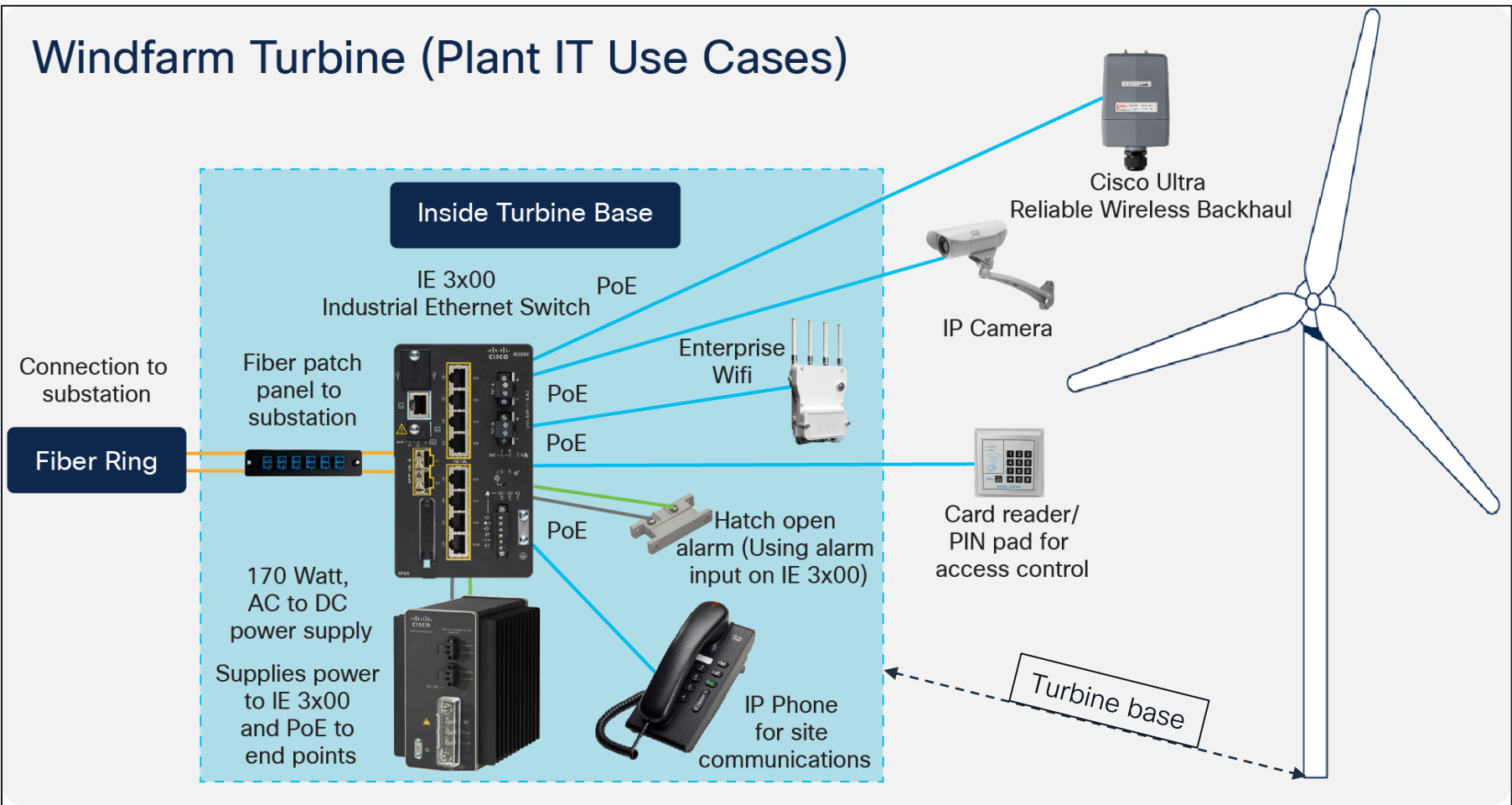
Use Case

Wind Farm Network Architecture

A holistic secure connectivity solution



Windfarm Turbine (Plant IT Use Cases)



Key Take Aways

Keep in mind

Key Take Aways

- **Understanding PoE:** PoE combines data transmission and power source over a single Ethernet cable.
- **PoE in Industrial IoT:** PoE simplifies the network, cuts costs, and scales efficiently in Industrial IoT applications.
- **Power Budgeting and Case Studies:** Successful PoE implementation requires power budgeting.
- **Planning for PoE in Industrial IoT:** PoE planning involves power budgeting, environmental considerations, scalability, standards compliance, and the right PoE PSE selection.
- **Cisco Industrial Ethernet PoE Switches:** Cisco's Industrial switches provide POE/POE+/POE++ support and advanced PoE features (power management, Fast PoE, Perpetual PoE, and load shedding).

Only Cisco provides the blueprint for success

Simplicity

Best Practice Design and Deployment Guide

Security

Incorporates security best practices

Scalability

Scale from small to large deployments on global scale



Industrial Automation



Oil & Gas, Process



Utilities



Cities / Transportation



Horizontal

Industry Cisco Validated Designs (CVDs)

- Industrial Automation
- Plant Wide Connectivity (CPWE)

- Connected Pipeline
- Digital Oilfield (CRD)
- O&G / Process

- Substation Automation
- Smart Metering (AMI)
- Distribution Automation
- Grid Security

- Connected Communities Infrastructure
- Connected Rail
- Connected Mass Transit
- Connected Roadways

- Extended Enterprise
- Remote and Mobile Assets (RAMA)

Rockwell Automation

Schneider Electric

EMERSON

Landis Gyr

Itron

Proven Integrations

Cohda Wireless

Activity

ECONOLITE

SIEMENS

Honeywell

MITSUBISHI ELECTRIC

FATON Powering Business Worldwide

EXMPCO Power Systems

SEL

iteris

BECKWITH ELECTRIC CO. INC.

CIMCON Lighting

KLAS TELECOM

omniscent

CISCO Live!

IOT Learning Map

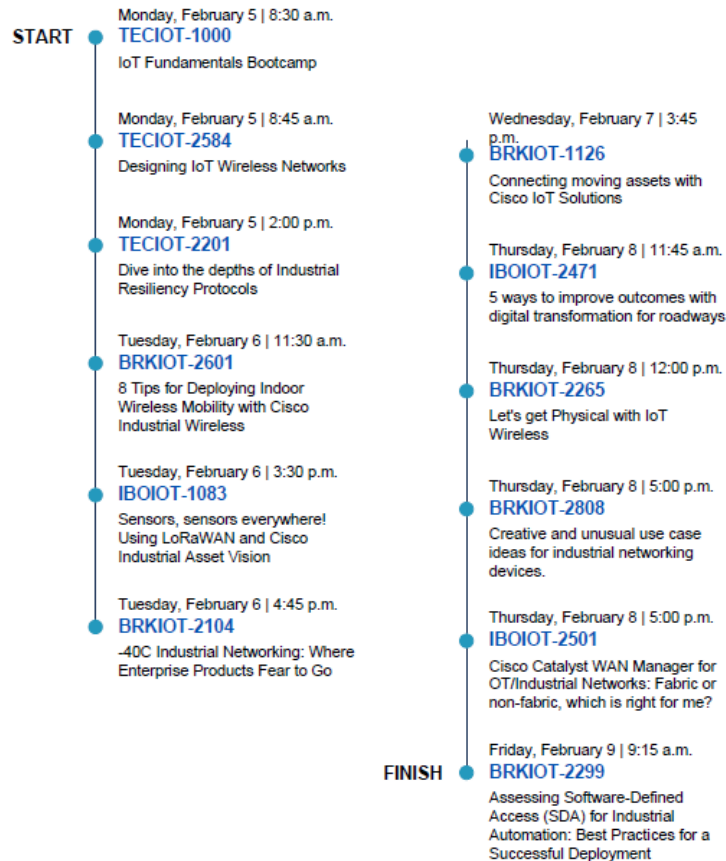
Internet of Things

Transform your IoT Infrastructure

In this new IoT world, the network is the nervous system that allows everything to work together. And while it's creating limitless possibilities, it also introduced more complexity. Today everything is a connected device, from a robot to a power transformer, from a vehicle to crane.

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Amsterdam | February 5-9, 2024



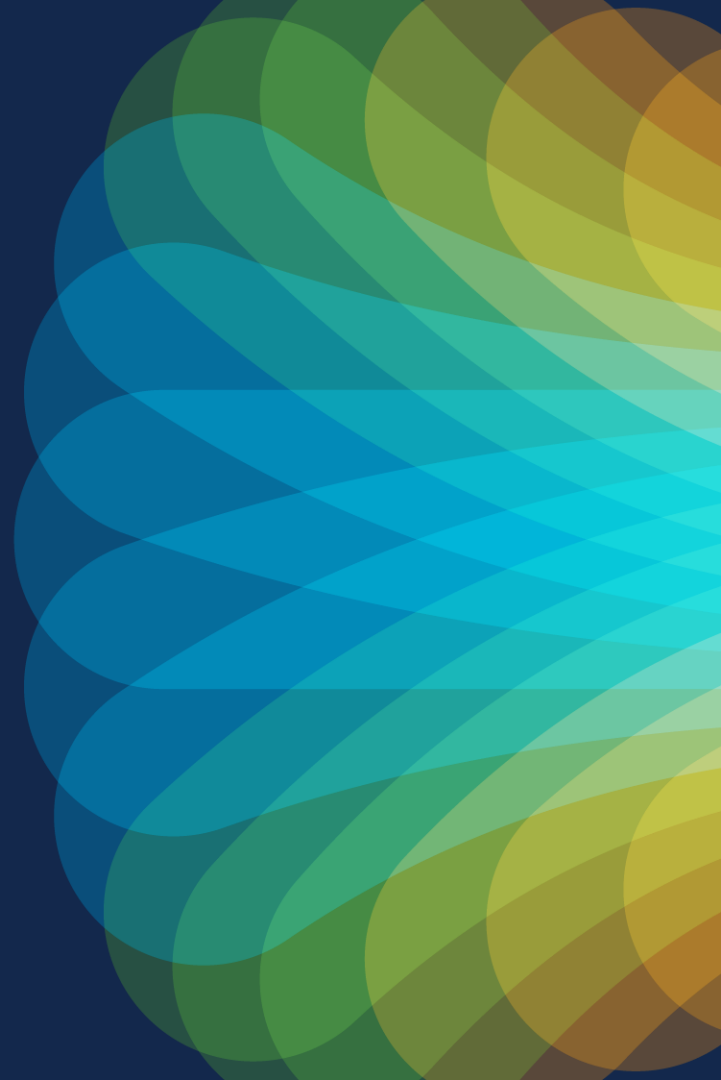
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The bridge to possible

Thank you

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CISCO *Live!*

Let's go

Windfarm Turbine (Scada/Telemetry Use Case)

