
cisco Live!
Let's go
#CiscoLive

The bridge to possible

Industrial Power over Ethernet (PoE)

The Ultimate Guide for Beginners

Carlos Gonzalez (cgonzale)
IIOT Technical Marketing Engineer

BRKIOT-1128

Cisco Webex App

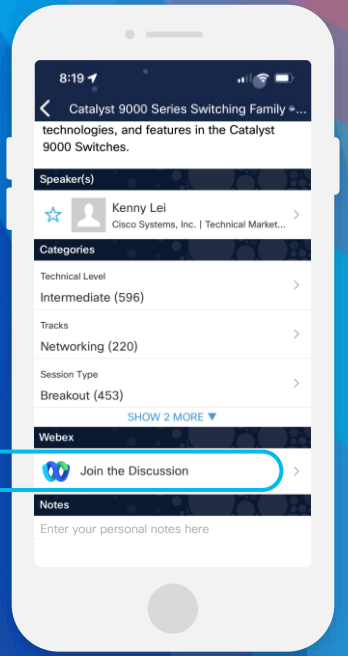
Questions?

Use Cisco Webex App to chat
with the speaker after the session

How

1. Find this session in the Cisco Live Mobile App
2. Click “Join the Discussion”
3. Install the Webex App or go directly to the Webex space
4. Enter messages/questions in the Webex space

Webex spaces will be moderated by the speaker until June 9, 2023.



https://ciscolive.ciscoevents.com/ciscolivebot/#BRKIOT-1128

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Agenda

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

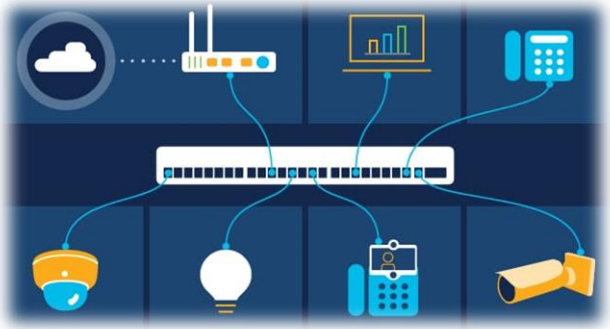
© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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.

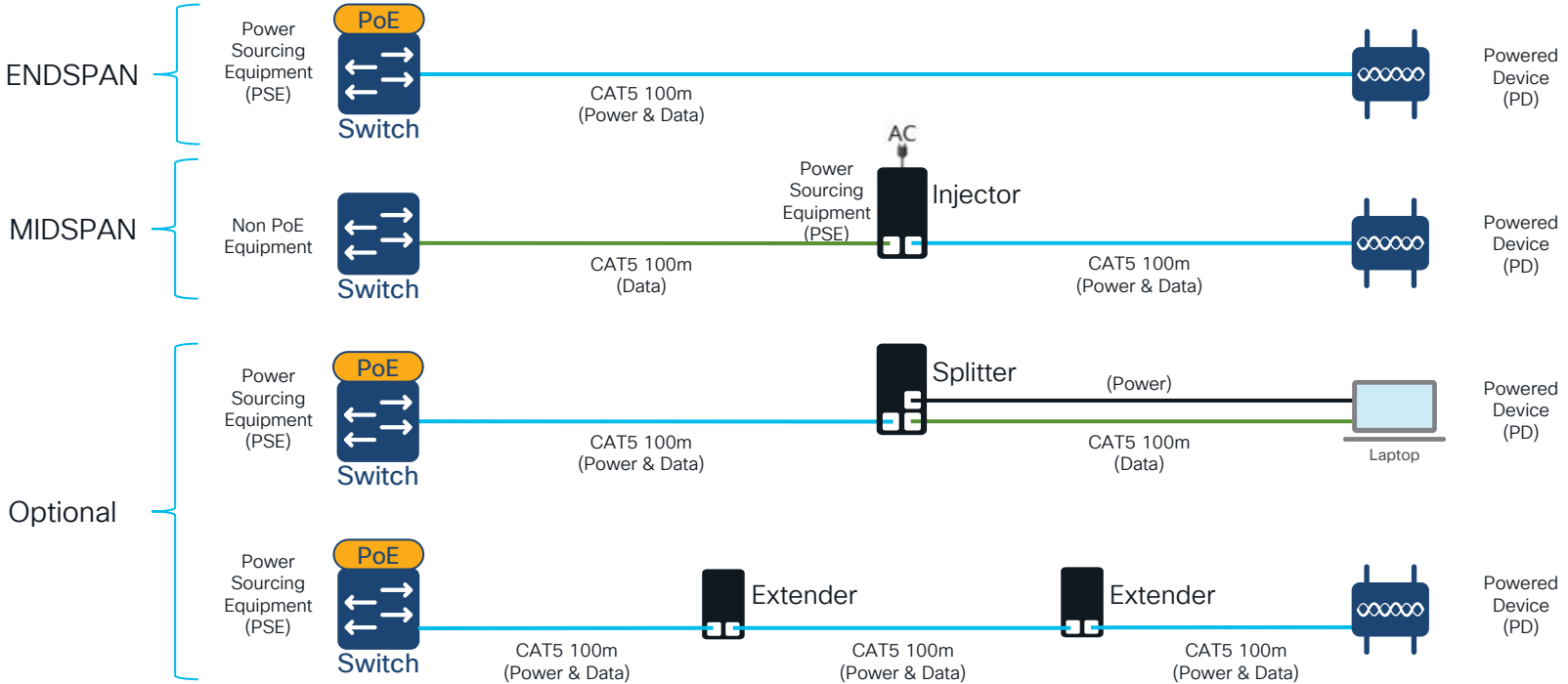
3. **To what point?**
   Reduce the need for separate power sources and connections, lowering cost, etc.

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

PoE Components & Arrangement

Basics of Power over Ethernet

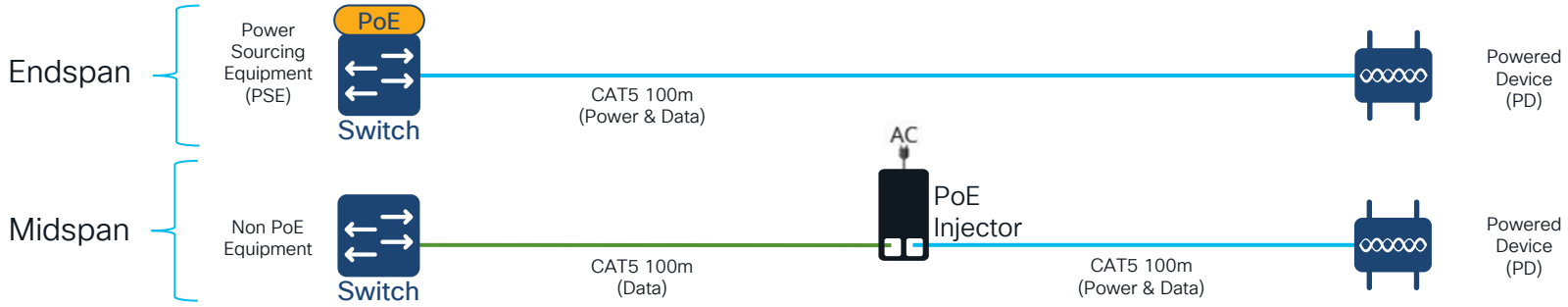




© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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.

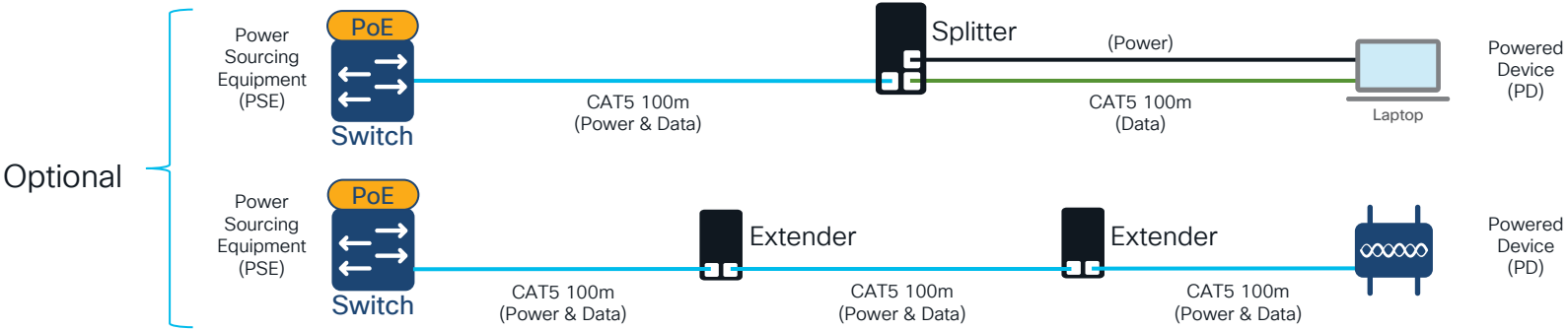
*Ensure compatibility between PDs and PSEs

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Components of a PoE system

Basics of Power over Ethernet



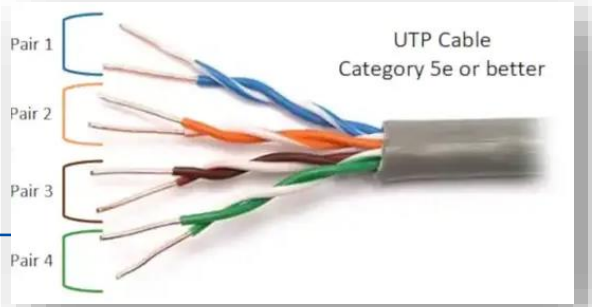


PoE Splitter	Device separates power and data transmitted together over an Ethernet cable into 2 outputs • Connects to the Ethernet cable, receives power and data from a PoE source • Allows non-PoE devices to benefit from PoE by providing separate connections for data and power.
PoE Extender	Devices that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

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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 or 90W (depending on implementation) • Uses four pairs in the Ethernet cable



Heard of UPOE?

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Lets talk quickly about the P in PoE

Basics of Power over Ethernet

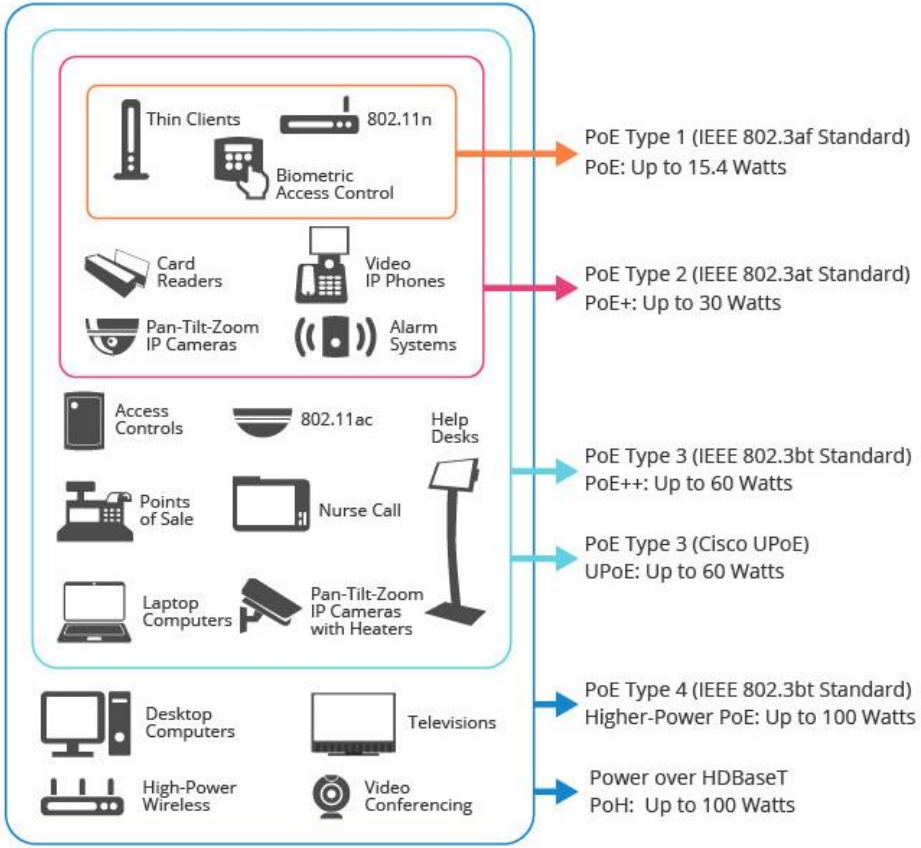
	Type 3 (802.3bt)						Type 4 (802.3bt)	
	Type 1 (802.3af)			Type 2 (802.3at)				
PSE	Class 1 4 W	Class 2 7 W	Class 3 15.4 W	Class 4 30 W	Class 5 45 W	Class 6 60 W	Class 7 75 W	Class 8 90 W
	2-pairs only (Class 0-4)				4-pairs (Class 5-8)			
PD	Class 1 3.84 W	Class 2 6.49 W	Class 3 13 W	Class 4 25.5 W	Class 5 40 W	Class 6 51 W	Class 7 62 W	Class 8 71.3 W



Cat3 Cat5 Cat6 Cat6a Cat7 Cat7a Cat8

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Powering with PoE



© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Overview of how PoE Works

Basics of Power over Ethernet



Detection of the PoE Device

Classifies devices as Class 0-8

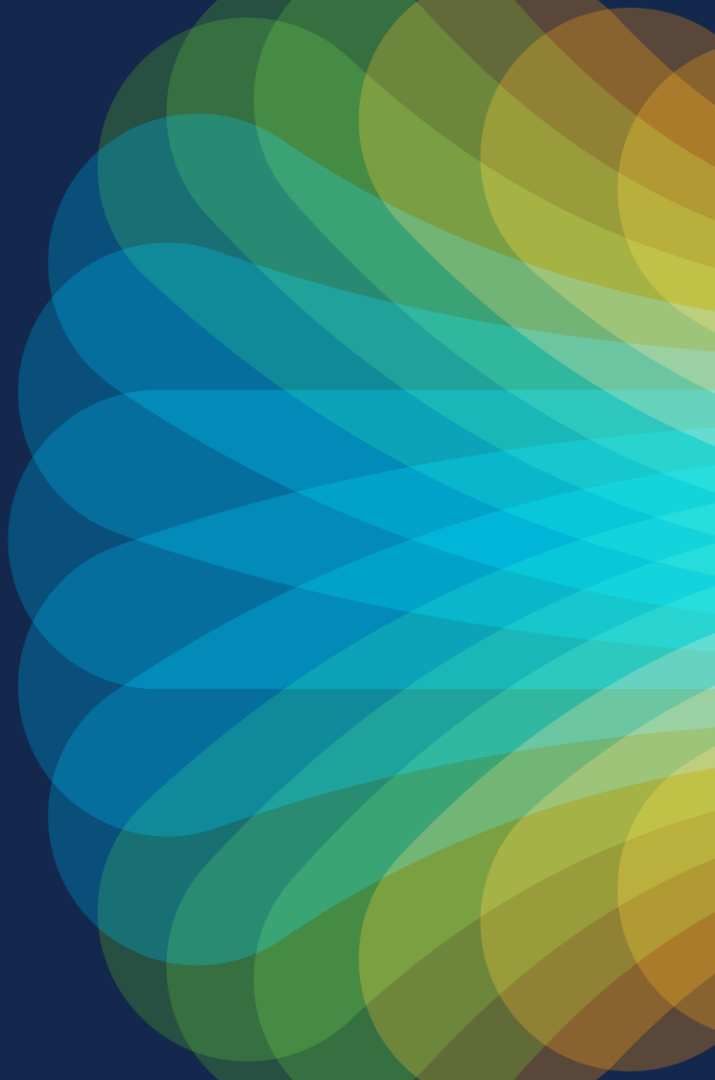
Starts low voltage then 48VDC

Provides stable DC power

If: PD is removed
If: PD Power consumption issue
If: PD power is out of PSE's power budget

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Industrial IOT

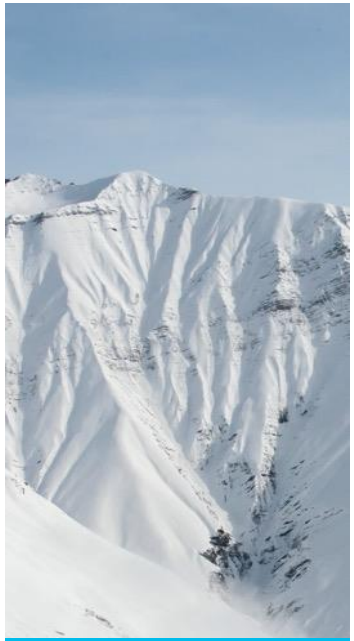


Industrial Networking on the extreme!!!



© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Network connectivity wherever you need it



- 50C



+75C



Shock / Vibration



Water



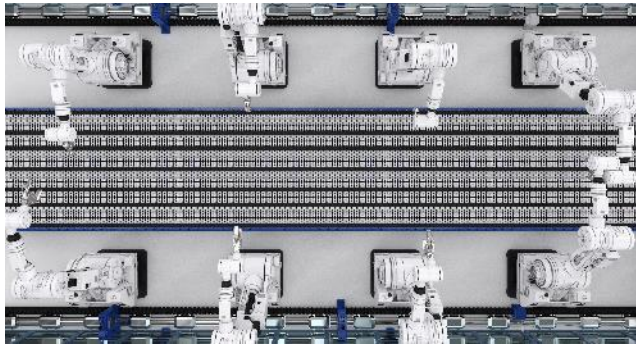
Dust

- Industrial certifications (e.g. EN50155)
- Industrial protocols

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Industrial organizations are accelerating their digital agility for a sustainable future





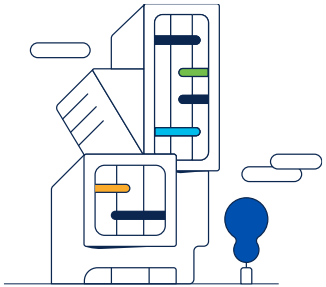


© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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



© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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
App hosting / containers	No	IOx app hosting,

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Comprehensive Industrial IoT Networking Portfolio

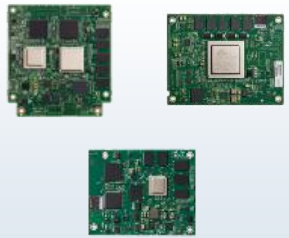
Industrial Switching
IE1000, IE3100, IE3200, IE3300, IE3400, IE4K, IE5K, IE9300



Industrial Routing
IR1101, IR1800, IR8100, IR8300



Embedded Networking
ESS3300, ESS9300, ESR6300



Industrial Wireless
IW9167EH, IW9165E, IW9165D, IW6300H, Cisco Ultra-Reliable Wireless Backhaul, LoRaWAN, IXM Gateway, IR5XX



Industrial Cybersecurity
Cisco Cyber Vision



Data Control and Exchange
Edge Intelligence, IOx



Industrial Sensor Solution
Industrial Asset Vision





Management & Automation
Cisco DNA Center, IoT Operations Dashboard, Field Network Director, SDWAN



© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

PoE & Industrial IOT



The Role of PoE in Industrial IOT

Applying PoE in Industrial IOT

- Simplified Infrastructure: By carrying both data and power over a single Ethernet cable, PoE simplifies the installation process.
- Cost-Effective: PoE 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.

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

How PoE Differs in Industrial IOT

Applying PoE in Industrial IOT

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

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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.

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

The Right Industrial Ethernet PoE Switch

Key Considerations – PoE in Industrial IOT



Power Capability

Environmental Resilience

PoE Standard Compatibility

Port Density

Network Features

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

PoE Power Budgeting



What is PoE Power Budgeting?

Basics of Power over Ethernet



Ensuring your PoE switch can support the power needs of all devices prevents system overload and ensures reliable operation.

1. Identify the power draw of each device (e.g., sensors, cameras…) including the PoE switch
2. Determine power output of the Industrial Ethernet PoE switch
3. Add up the power requirements of all devices, including the switch, to find the total power requirement.

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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 provides power and connectivity to all devices, enabling remote monitoring and control, and reducing the need for separate power supply units.
- Power Budget Planning Example:
  - Surveillance Camera x 2, IEEE 802.3at, 15W each
  - Environment Sensor x 4, IEEE 802.3af, 5W each
  - Control Unit x 1, IEEE 802.3at, 25W each
  - Industrial Ethernet PoE Switch, 25W



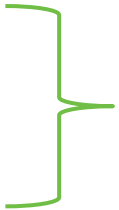
100W

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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:
  - Laptop x 3, IEEE 802.3bt, 60W each
  - Industrial Device x 2, IEEE 802.3bt, 30W each
  - Industrial Ethernet PoE Switch, 30W



270W

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Cisco Industrial IOT



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

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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



© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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+

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

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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
Total W	Up to 180W	Up to 120W	---	Up to 240W	Up to 360W/480W	Up to 480W	---	Up to 200W	Up to 385W	Up to 360W	Up to 720W

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Other PoE Features

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

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

POE Power Management and Fast POE

Other PoE features

- **PoE Power Management:** Provide dynamic power allocation to efficiently manage power resources.
- **Fast PoE:** Ensures rapid power delivery to connected devices, enabling faster startup and device replacement.

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Perpetual POE and Load Shedding

Other PoE features

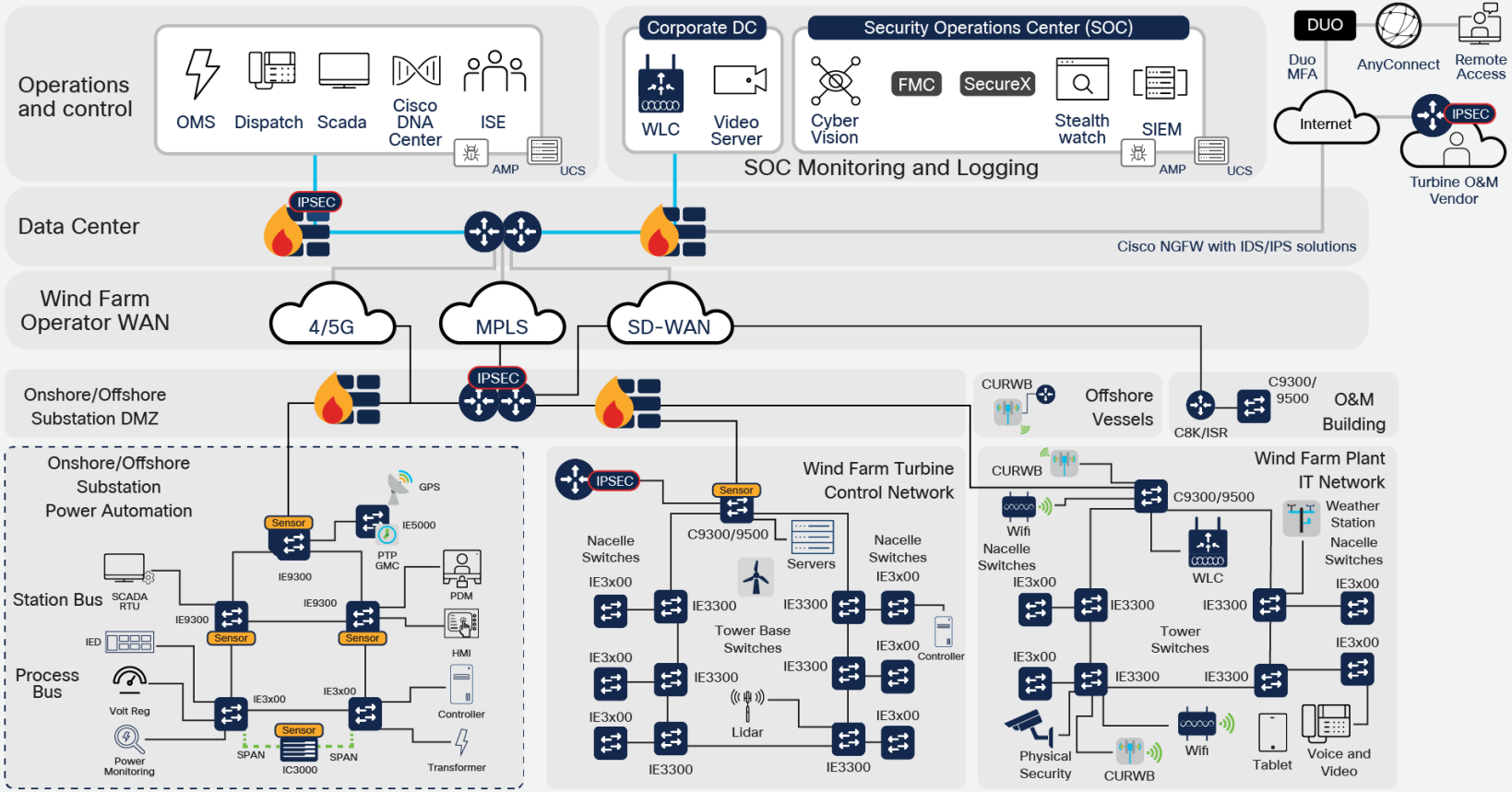
- **Perpetual PoE:** Maintain power supply to connected devices even during a switch reboot, minimizing downtime.
- **Load Shedding:** In case of power shortage, switches can prioritize power delivery based on the importance of connected devices, enhancing system resilience.

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Use Cases

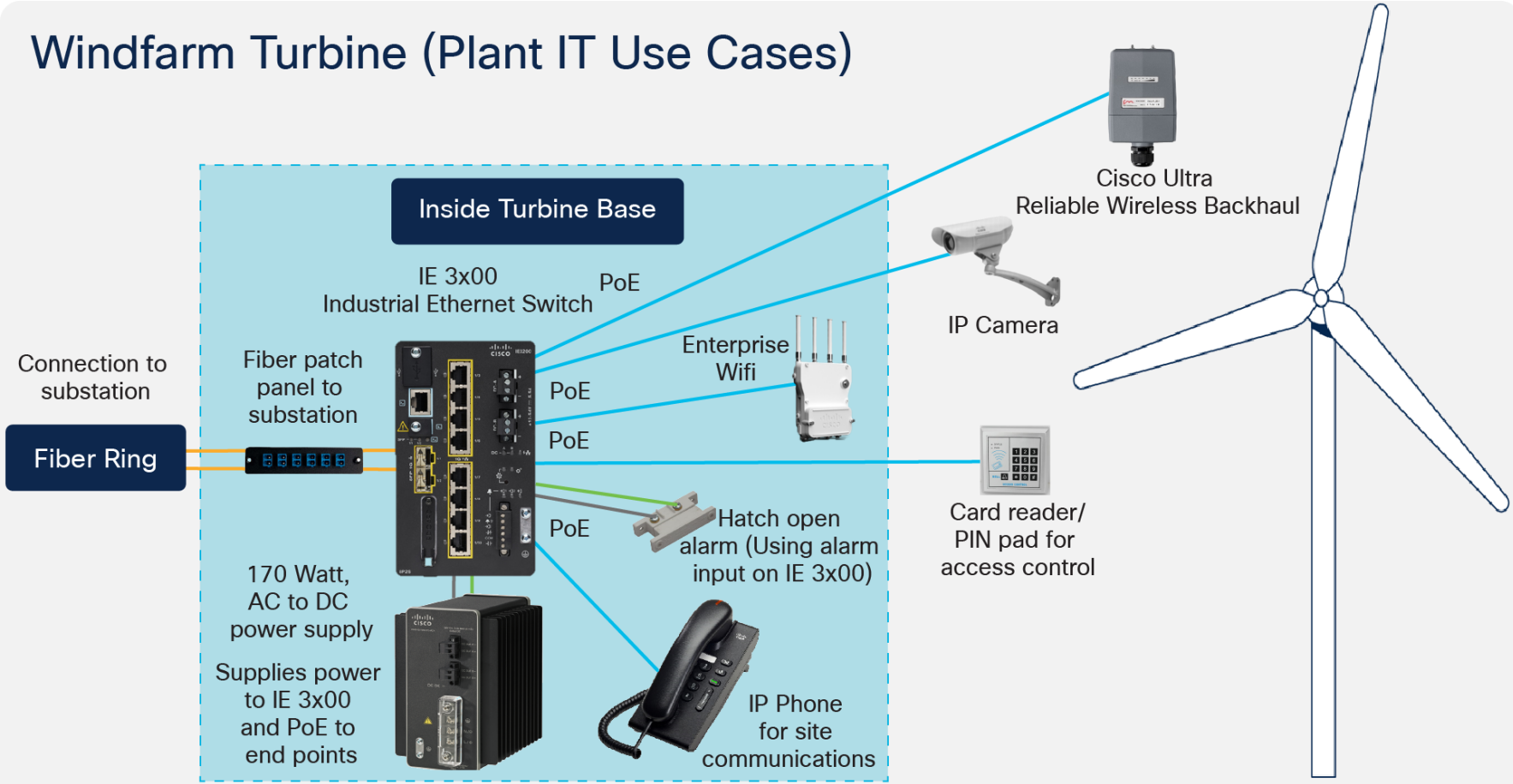
Wind Farm Network Architecture

A holistic secure connectivity solution



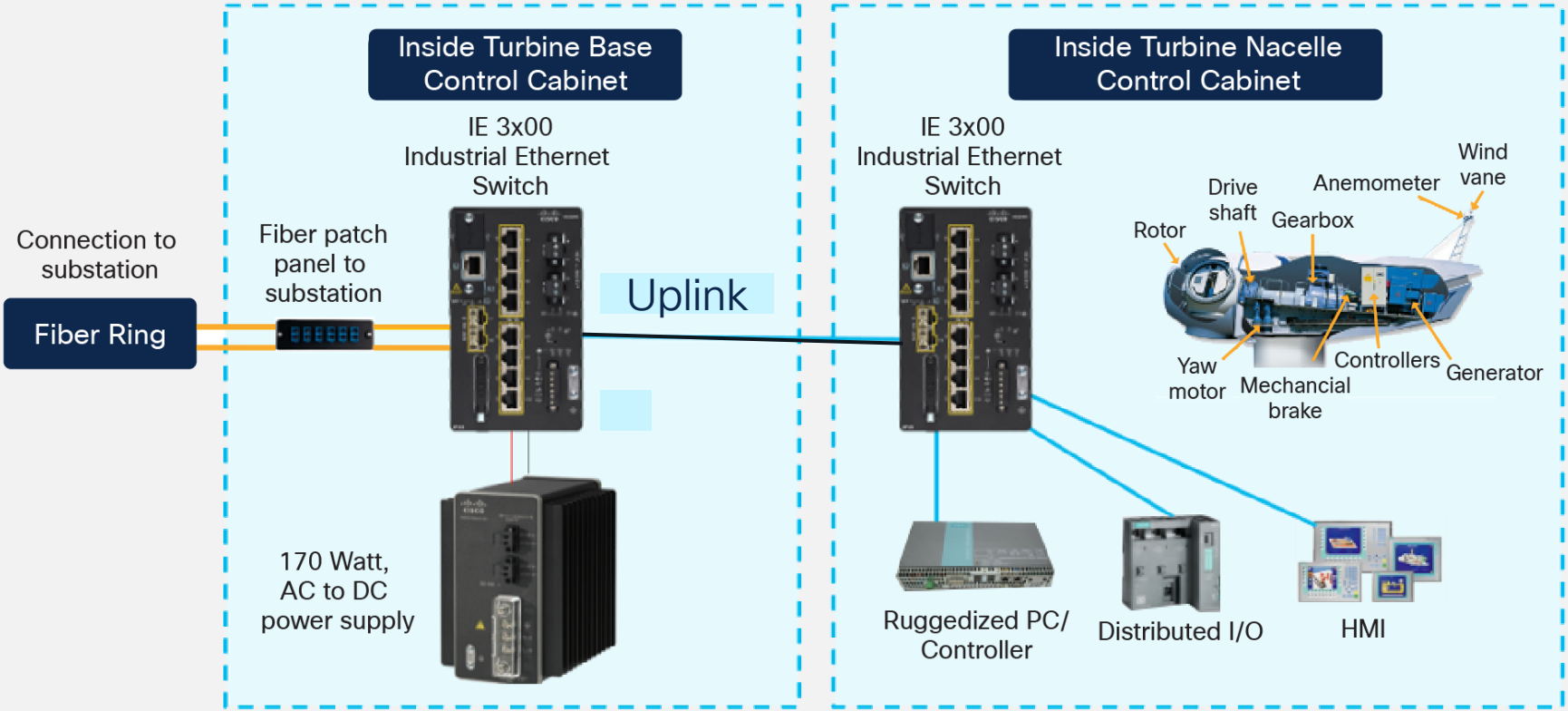
© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Windfarm Turbine (Plant IT Use Cases)



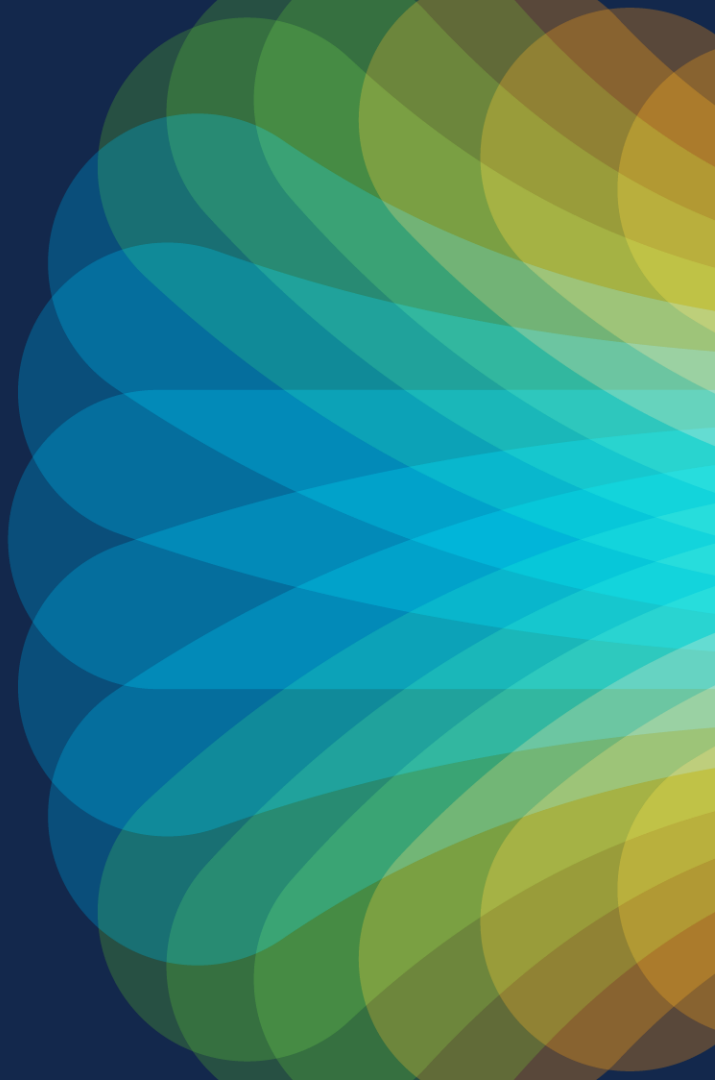
© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Windfarm Turbine (Scada/Telemetry Use Case)



© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Key Take Aways



Keep in mind

Key Take Aways

- **Understanding PoE:** PoE combines data transmission and power supply 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 precise power budgeting as showcased in our case studies.
- **Planning for PoE in Industrial IoT:** PoE planning involves power budgeting, environmental considerations, scalability, standards compliance, and the right PoE switch 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).

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

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











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)

Proven Integrations

Rockwell Automation, Schneider Electric, EMERSON, Landis+Gyr, Itron, Cohda Wireless, Actility, ECONOLITE, SIEMENS, Honeywell, MITSUBISHI ELECTRIC, EATON, EXIMPROD, SEL, iteris, BECKWITH ELECTRIC CO.INC., CIMCON Lighting, KLAS TELECOM, iOmniscient

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

Fill out your session surveys!

Attendees who fill out a minimum of four session surveys and the overall event survey will get **Cisco Live-branded socks** (while supplies last)!

Attendees will also earn 100 points in the **Cisco Challenge** for every survey completed.



These points help you get on the leaderboard and increase your chances of winning daily and grand prizes

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

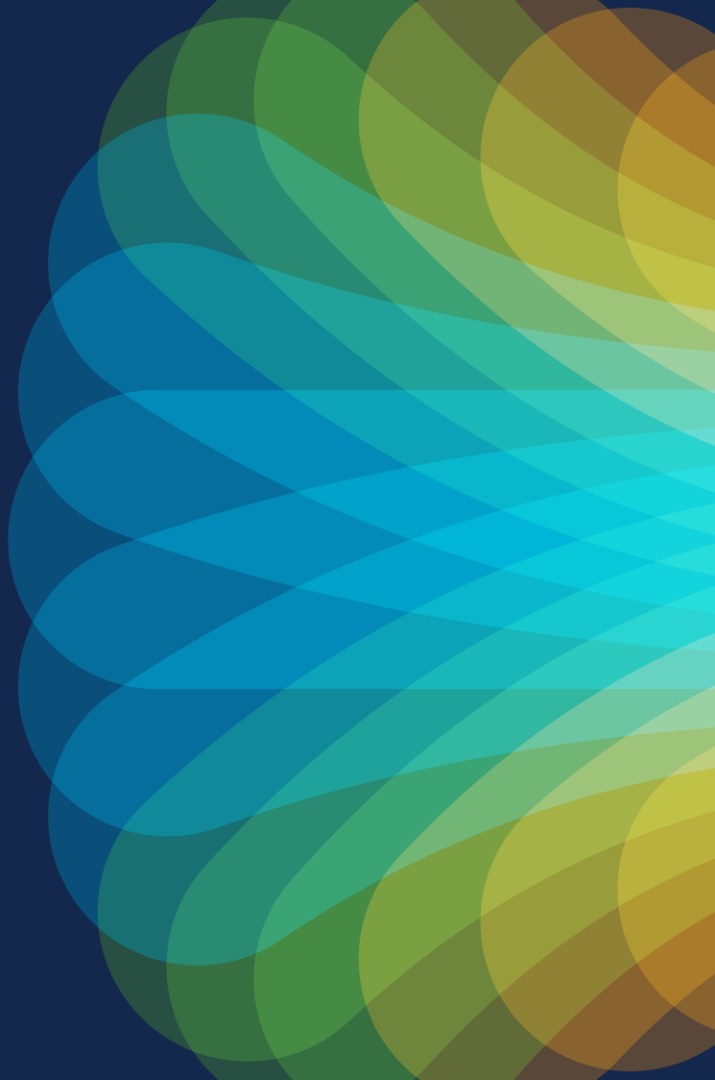
Continue your education

- Visit the Cisco Showcase for related demos
- Book your one-on-one Meet the Engineer meeting
- Attend the interactive education with DevNet, Capture the Flag, and Walk-in Labs
- Visit the On-Demand Library for more sessions at www.CiscoLive.com/on-demand

© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public

The bridge to possible

Thank you



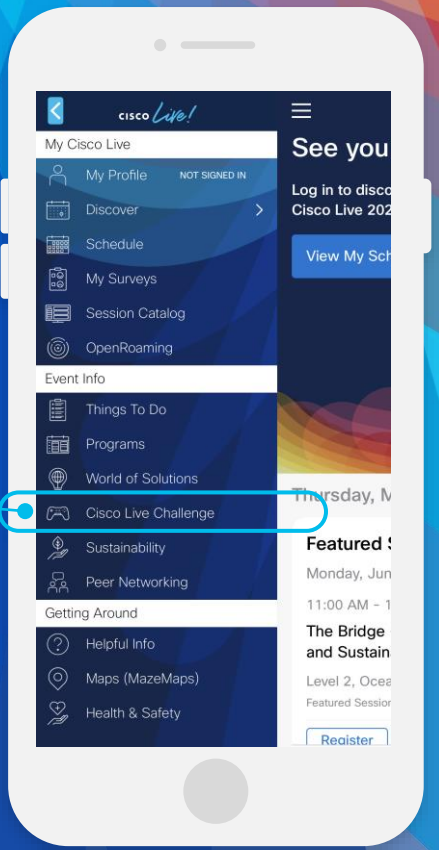
Cisco Live
Challenge

Gamify your Cisco Live experience!

Get points for attending this session!

How:

1. Open the Cisco Events App.
2. Click on 'Cisco Live Challenge' in the side menu.
3. Click on View Your Badges at the top.
4. Click the + at the bottom of the screen and scan the QR code:



© 2023 Cisco and/or its affiliates. All rights reserved. Cisco Public


cisco Live!
Let's go
#CiscoLive