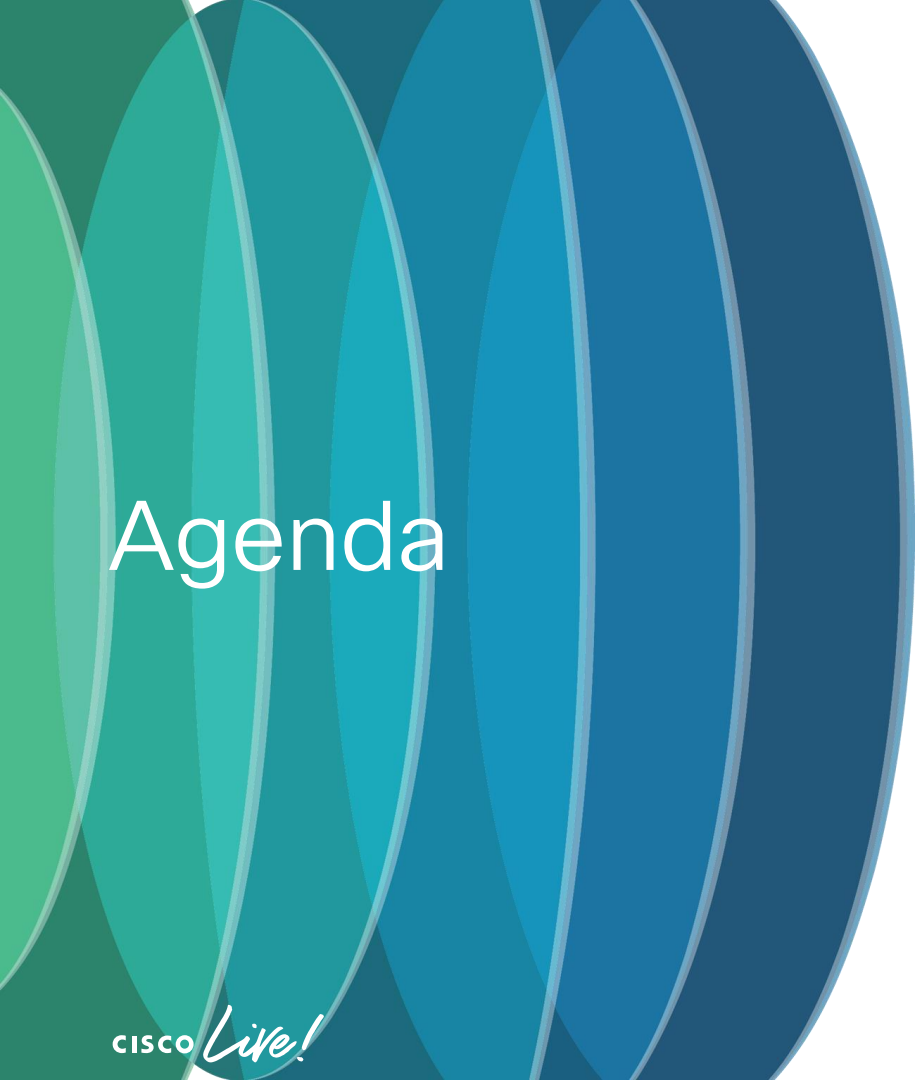




Saving Energy and Money with Your Cisco Wireless Network

Subtitle goes here

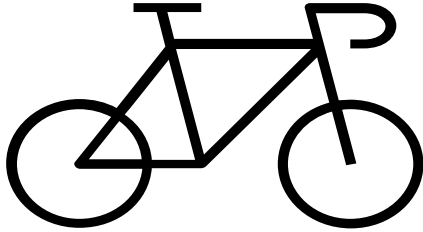
Simone Arena - Distinguished TME, Cisco Wireless
BRKEWN-2043



Agenda

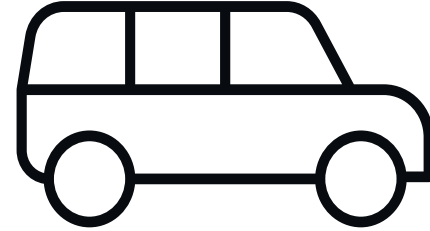
- Sustainability: The role of data and the role of IT (and the network)
- Cisco Wireless Sustainability
- Circular Design
- Saving energy with Cisco Wireless
- Conclusions

What does generate more CO₂?



cycling a mile

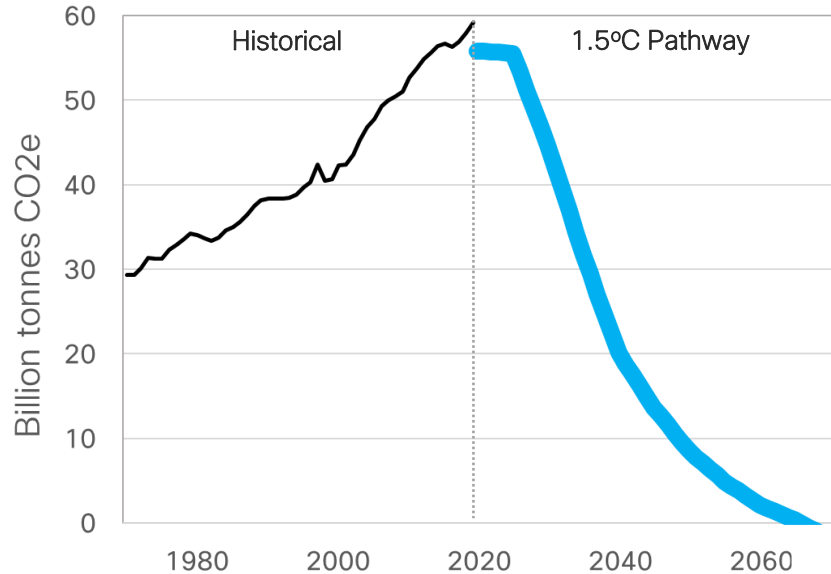
?



driving a mile

What is the role of the Network and IT?

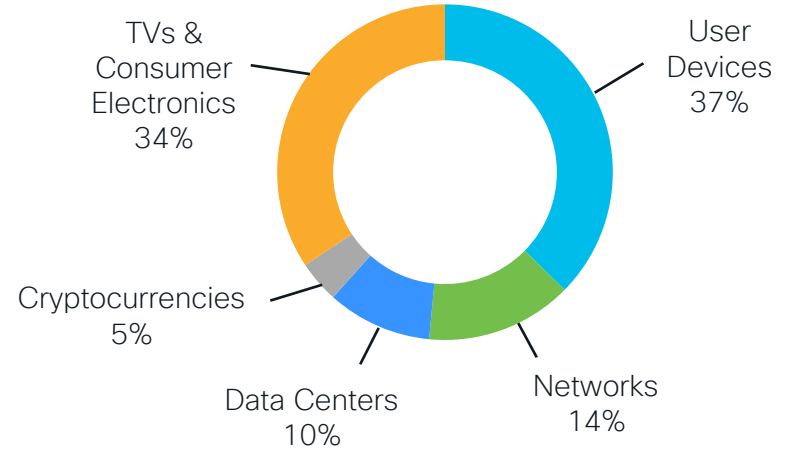
Total GHG emissions
~60 Billion tonnes CO₂e



Based on data from: EDGARv7.0, Crippa et al (2021, 2022), IIASA (AR6 Scenario database)

Digital GHG emissions

~1.4 Billion tonnes CO₂e (2-4% Total)



Digital = ICT + Entertainment & Media

Source: Freitag (2021), Malmodin (2018), Andrae (2019)

What is the role the Network and IT?



IT and the Network plays a bigger role than you think
in Sustainability and NetZero strategy

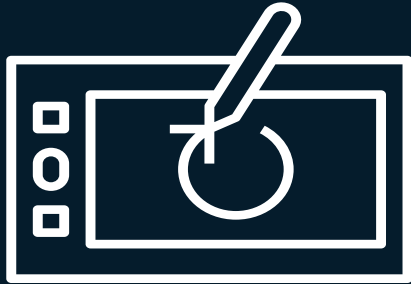
* Berners Lee (2020) - <https://howbadarebananas.com/>
* https://smarter2030.gesi.org/downloads/Full_report.pdf

Cisco Wireless commitment to sustainability

- Apply best principles for circular design
- Adopt zero-plastic packaging
- Optimized HW and SW for energy efficiency
- Clear visibility into energy use and footprint



Circular Design for Cisco Wireless

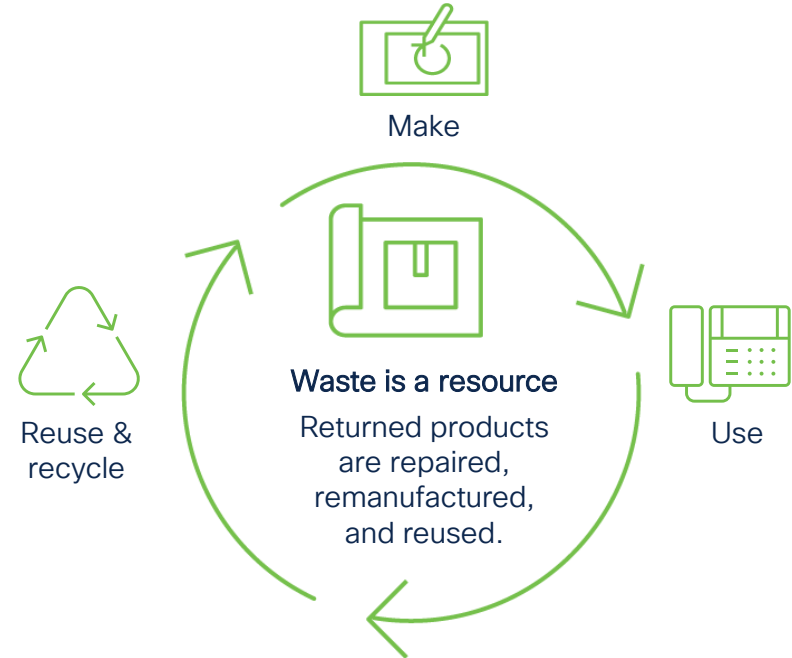


Circular Design

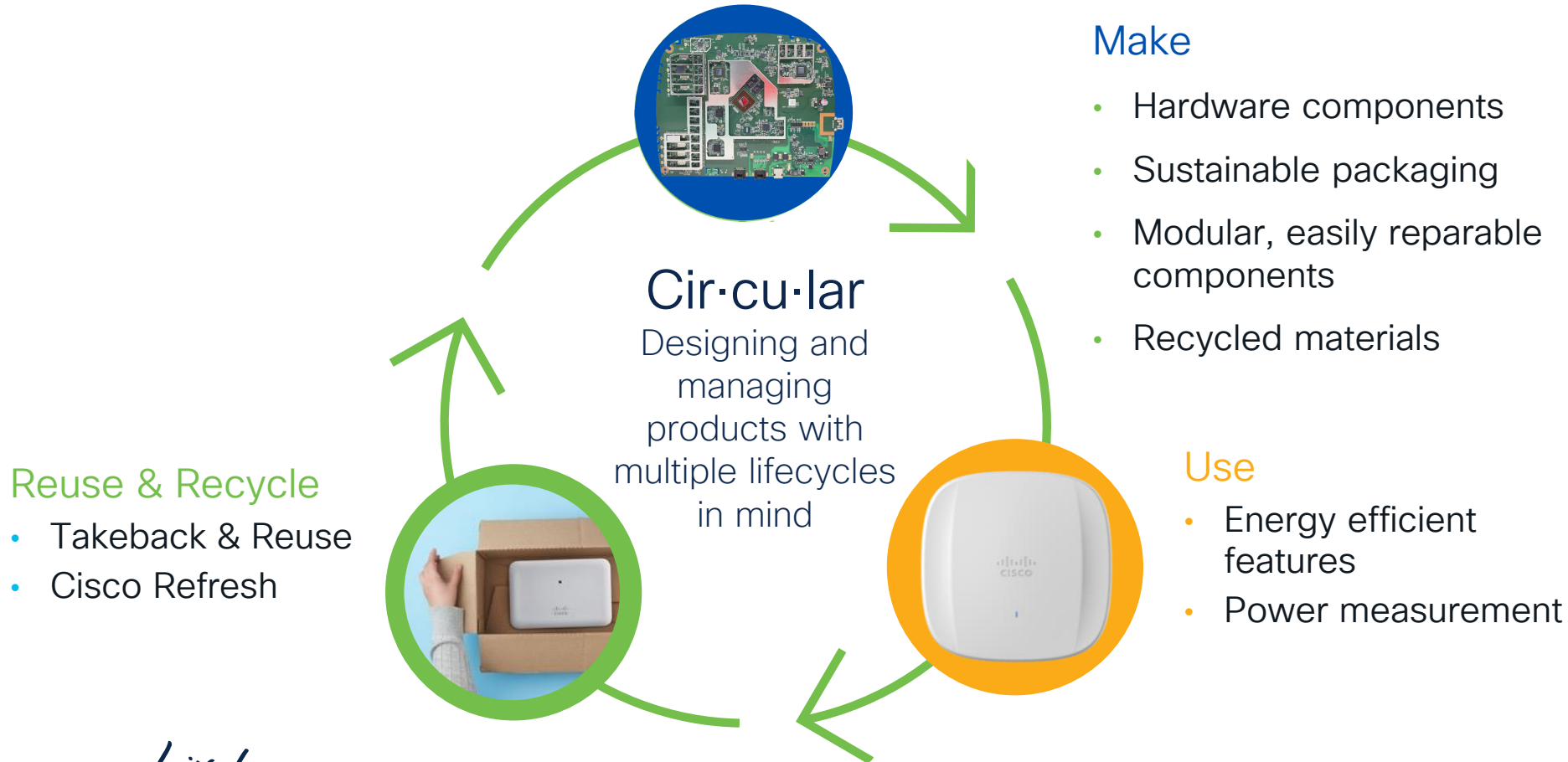
Linear Design



Circular Design



Designing for Circularity



Not all APs are created equal!

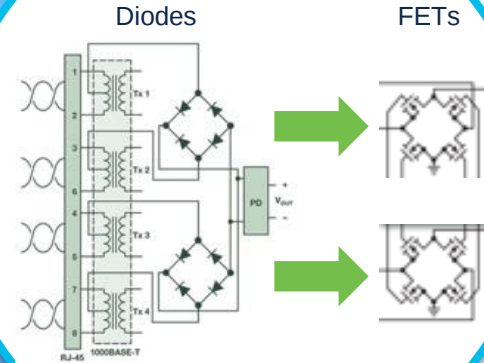
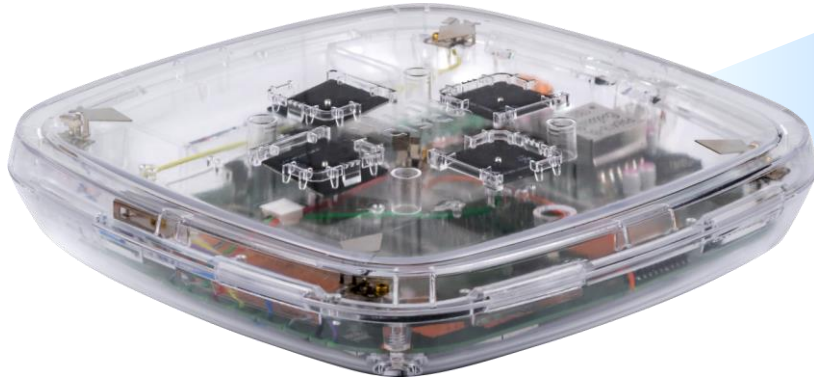
Printed Circuit Board Design



- Design of the PoE front end
- Transformer custom design
- FETs (Field Effect Transistors)
- Components easily reused



Not all APs are created equal!



Every Watt, or fraction of a Watt matters!

Not all APs are created equal!

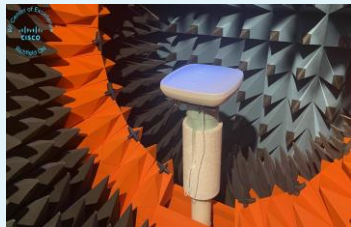
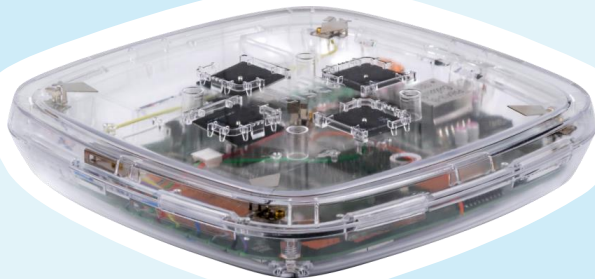
Printed Circuit Board Design



- Design of the PoE front end
- Transformer custom design
- FETs (Field Effect Transistors)
- Components easily reused

Antenna Design and Prototype

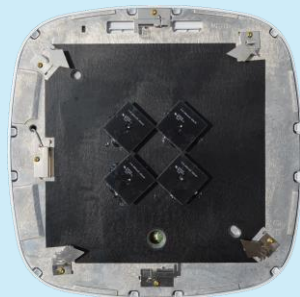
- No off-the-shelf components
- Radio Frequency (RF) Design
- Cisco Custom Antenna Designs and Characterizations



- RF Antenna modeling
- Electromagnetic compliance
- RF interoperability testing

Spectrum analysis & Compliance

- Housings/3D printing & Mounting Bracketry
- Co-existence of all the different radios in the same AP with no performance degradation



Housing design & Antenna Layout

Not all APs are created equal!

Printed Circuit Board Design



- Design of the PoE front end
- Transformer custom design
- FETs (Field Effect Transistors)
- Components easily reused

Antenna Design and Prototype

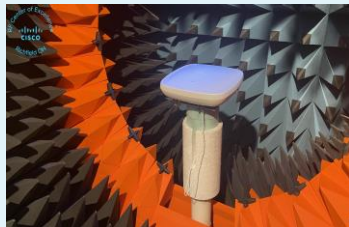
- No off-the-shelf components
- Radio Frequency (RF) Design
- Cisco Custom Antenna Designs and Characterizations



RF Excellence

=

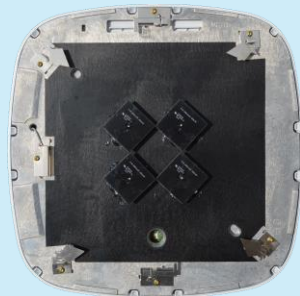
Power Efficiency



- RF Antenna modeling
- Electromagnetic compliance
- RF interoperability testing

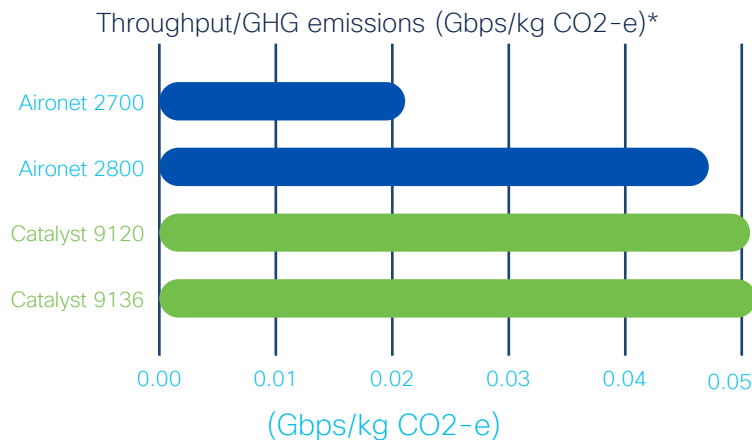
Spectrum analysis & Compliance

- Housings/3D printing & Mounting Bracketry
- Co-existence of all the different radios in the same AP with no performance degradation

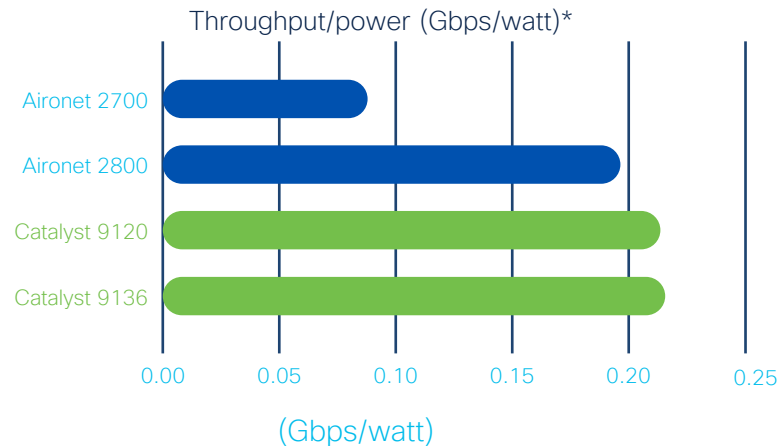


Housing design & Antenna Layout

Throughput efficiency improvements



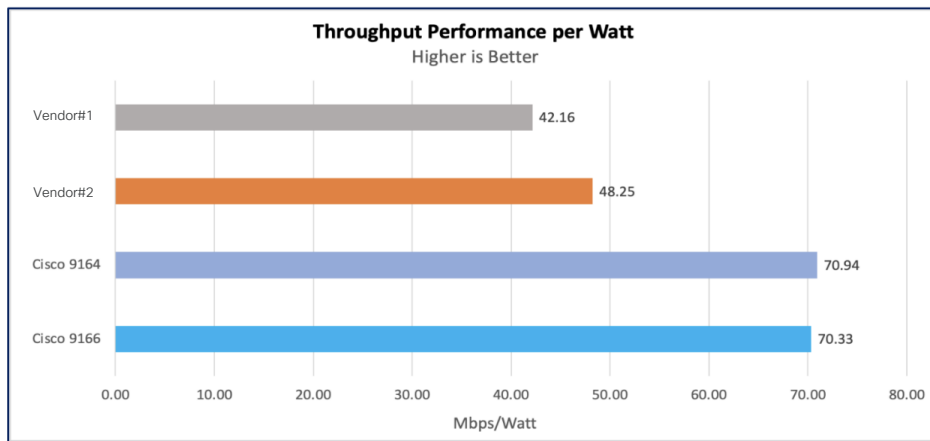
Throughput efficiency relative to CO₂-e emissions in the Catalyst series



Throughput efficiency relative to power (W) required in the Catalyst series

(*) based on internal testing

Throughput efficiency improvements

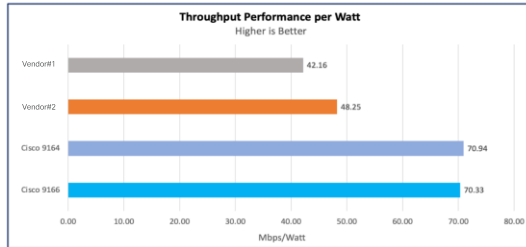


- The Cisco 916x AP is built on new sustainable hardware
- PoE throughput efficiency is **67%** superior to competitor 1
- PoE throughput efficiency is **46%** superior to competitor 2

Sustainability Built into Product Design

Sustainable Hardware Designs

- Power-efficient ASICs
- High efficiency power supplies
- Post consumer resin in plastic housing



Throughput efficiency relative to power has improved with each AP generation

cisco Live!

Reusable Mounting Brackets

- Same mounting bracket has been in use for over a decade
- Simplify upgrades and reduce waste by reusing existing brackets
- Save time during deployment
- Opt-out for bracket*



* CW APs only

Sustainable Packaging

- Minimize use of plastic packaging materials
- No more paper documentation
- Multi-packs to reduce waste



Multi-pack

CW9166

Sustainability Built into Product Design

Replace plastic bags and accessory kits, with paper packaging for Cisco APs.

Estimated to save **22 metric tons** of plastic by FY2026 or **88 metric tons of Co2***.

Wi-Fi 6 APs

C9115
C9120
C9130
C9124

Wi-Fi 6E APs

CW9162
CW9164
CW9166
CW9166D1

Accessory kits

AIR-AP-BRACKET-1=
AIR-AP-BRACKET-2=
AIR-AP-T-RAIL-R=
AIR-AP-T-RAIL-F=
AIR-CHNL-ADAPTER=

i CW9163E will be no plastic bags from start. Same for future platforms

i Wi-Fi 6E APs that are “Meraki born” (-MR) are already no-plastic



Sustainability Built into Product Design

Replace plastic bags and accessory kits, with paper packaging for Cisco APs.

Estimated to save **22 metric tons** of plastic by FY2026 or **88 metric tons of Co2***.

Wi-Fi 6 APs

C9115
C9120
C9130
C9124

Wi-Fi 6E APs

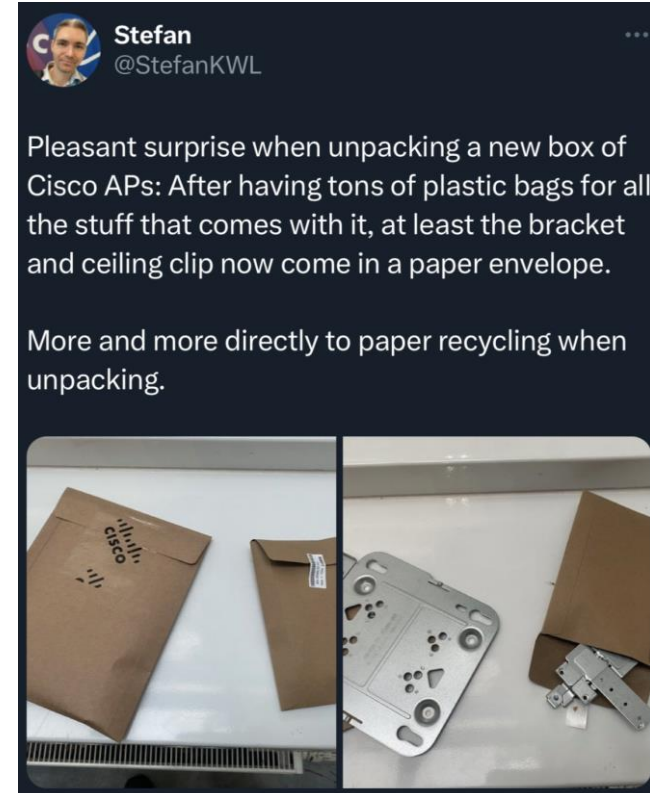
CW9162
CW9164
CW9166
CW9166D1

Accessory kits

AIR-AP-BRACKET-1=
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AIR-CHNL-ADAPTER=

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The Wi-Fi 7 portfolio

Make

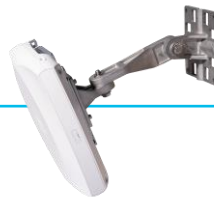


CleanAir® Pro

CW9176I

12 Spatial Streams
4x4: 4 MU-MIMO
across 3 radios, 3 bands
(2.4/5GHz (XOR), 5 GHz, 6GHz)

BLE/IoT radio
Single 10Gbps multigigabit
Ultra Wide Band (UWB)
USB 2.0 – 9W
Accelerometer
Built-in GPS/GNSS, w/ support for
ext. antenna
Integrated Omnidirectional Antenna



CleanAir® Pro

CW9176D1

12 Spatial Streams
4x4: 4 MU-MIMO
across 3 radios, 3 bands
(2.4/5GHz (XOR), 5 GHz, 6GHz)

BLE/IoT radio
Single 10Gbps multigigabit
Ultra Wide Band (UWB)
USB 2.0 – 9W
Accelerometer
Built-in GPS/GNSS, w/ support for ext.
antenna
Integrated Directional Antenna (70x70)



CleanAir® Pro

CW9178I

16 Spatial Streams
4x4: 4 MU-MIMO
across 4 radios, 3 bands
(2.4 GHz, dual 5GHz, 6GHz)

BLE/IoT radio
Dual 10Gbps multigigabit
Ultra Wide Band (UWB)
USB 2.0 – 9W
Accelerometer
Built-in GPS/GNSS, w/ support for
ext. antenna
Integrated Omnidirectional Antenna

Same brackets as always > Reduced Time, Reduced Waste

The Wi-Fi 7 portfolio

Make



CW9172I

6 Spatial Streams

2x2:2 across 3 radios, 3 bands
(2.4GHz, 5GHz, 6GHz)

-or-

2x2:2 on 2.4GHz and 4x4:4 on 5GHz

BLE/IoT and dedicated scan radio
Single 2.5Gbps multigigabit uplink
USB 2.0 – 4.5W
DC Power Jack
Integrated Omnidirectional Antenna
Global Use AP



CleanAir® Pro

CW9172H

6 Spatial Streams

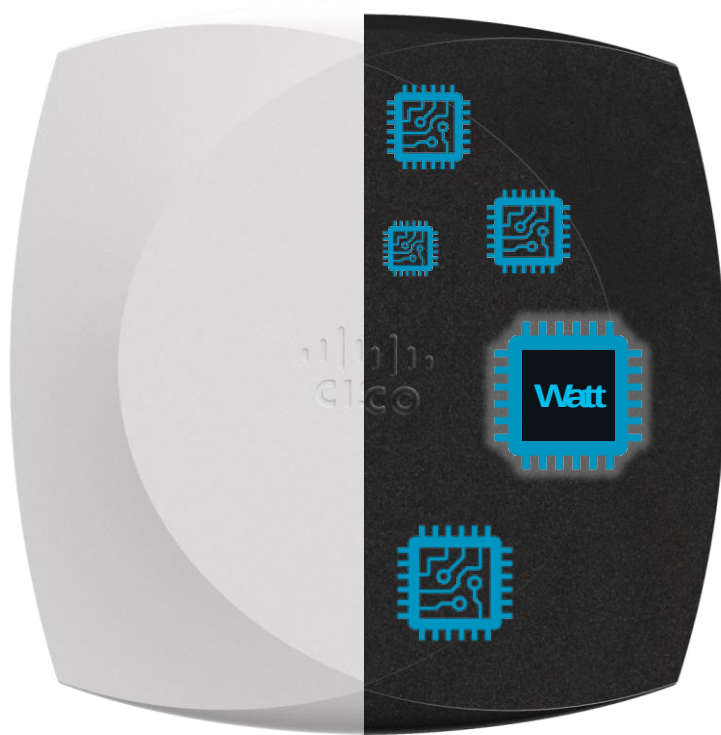
2x2:2 across 3 radios, 3 bands
(2.4GHz, 5GHz, 6GHz)

BLE/IoT and dedicated scan radio
Single 2.5Gbps multigigabit uplink
3x 1Gbps LAN port with 1x POE out
1x Passthrough port
Integrated Omnidirectional Antenna
Global Use AP

Same brackets as always. 9172H compatible with MR36H or 9105XW brackets

Sustainability Built into Product Design

Embedded Power Meter chipset in Wi-Fi 7 APs



- Embedded in Wi-Fi 7 APs
- Accurately Measure power consumption at the AP
- Can measure power between the power sourcing equipment (PSE) and powered device (PD)
- Measure power cable loss



Catalyst CW9800M Wireless Controller



1/10/25G Uplinks

32,000 Clients

3,000 APs

up to 50Gbps

Up to 53% faster, while using up to 18% less power!

- Up to 18% more power efficient than C9800-40
- 46% higher throughput per Watt (*)

Catalyst CW9800H1 & CW9800H2 Wireless Controller



1/10 & [25G or 40G] Uplinks

64,000 Clients

6,000 APs

up to 100Gbps

1RU

Up to 36% faster, while using up to 40% less power!*

- Up to 40% more power efficient than C9800-80
- 76% higher throughput per Watt (*)

Hardware Sustainability: C9800 Power supplies

80 PLUS® is a performance specification and certification for power supply units (PSUs). Measures AC/DC conversion



Platinum



C9800-40/80

80 PLUS® offers five level of certifications at increasing levels of energy efficiency

		Load %			
		80 Plus	20%	50%	80%
Efficiency %	Standard	80%	80%	80%	80%
	Bronze	82%	85%	82%	82%
	Silver	85%	88%	85%	85%
	Gold	87%	90%	87%	87%
	Platinum	90%	92%	89%	89%

Cisco Catalyst Wireless 9800: new packaging



Before

- PE Foam for top and bottom (16 oz)
- Large accessory tray
- 10 units per pallet



After

- No PE Foam cushion
- 100% Fiber base Packaging
- 12 units per pallet (20% more)
- Reuse inbound packaging for outbound shipment (Waste Reduction)

What about the USE phase?



AP Power Optimizations Feature Suite

Save Power, reallocate power, and visibility into saving

Use

Power Save Mode

Lower AP Power Usage



- Power off components during off peak hours
- Calendar Profile determines when it's off-peak hours.
- Power Profile: Shut AP Radio or lower spatial stream, lower port speed, disable USB port.

Power Profile Name	Recurrence	Schedule
Default_Profile_02	Weekly Monday, Tuesday, Wednesday, Thursday, Friday	Start Time: 9:00 AM End Time: 5:00 PM 9:00 4:00 8:00 12:00 5:00 20:00 24:00
Default_Profile_03	Monthly 2nd, 4th, 6th, 8th, 10th, 12th, 14th, 16th, 18th, 20th, 22nd, 24th, 26th, 28th, 30th, 31st	Start Time: 9:00 AM End Time: 5:00 PM 9:00 4:00 8:00 12:00 5:00 20:00 24:00
Default_Profile_04	Daily	Start Time: 9:00 AM End Time: 5:00 PM 9:00 4:00 8:00 12:00 5:00 20:00 24:00

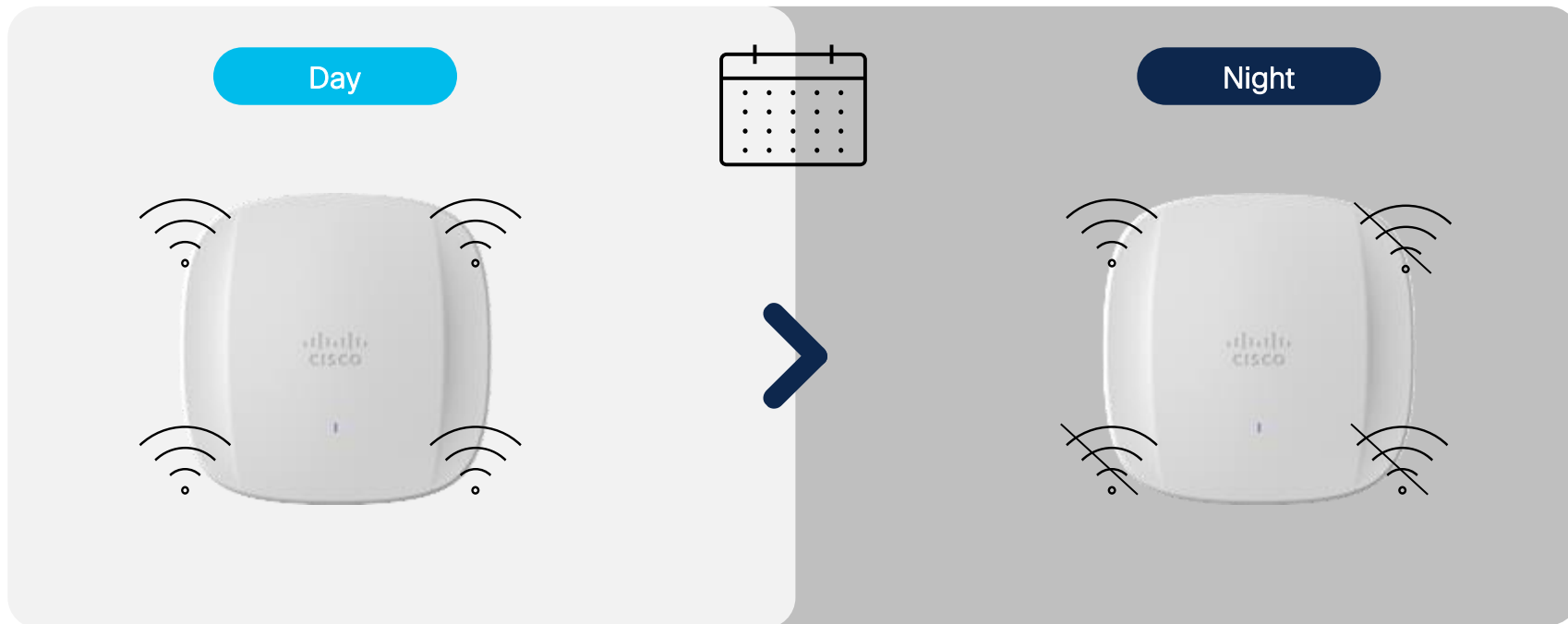
IOS-XE 17.8

Supported only on Catalyst APs: 9115, 9120, 9130, 9136, 9166, 9164, 9162 and 9124 (from 17.13) and later APs

CISCO Live!

AP Power Save

AP power save leverages Calendar Profiles to define off-peak hours



AP Power Profile

AP Power Profile



- Prioritized set of rules that define how the AP can reduce power consumption
- Interfaces that can be configured:
 - Radios: 6GHz, 5GHz, 2.4GHz
 - Ethernet uplinks and RLAN
 - USB port
- Applied via Calendar profile

Edit AP Join Profile

Calendar Profile - Power Profile Map

[+ Add](#)[Delete](#)

Calendar

Recurrence

Start Time

End Time

Power Profile

Add Calendar - Power Map

Calendar Profile Detailed

Calendar*

Off-peak



Recurrence

Daily

Start Time

00:00:00

End Time

06:00:00

Power Profile Detailed

Power*

turn-off-radios



Sequence	Interface	Interface ID	Parameter	Parameter Value
0	Radio	6 GHz	State	Disabled
1	Radio	5 GHz	State	Disabled
2	Radio	2.4 GHz	State	Disabled
3	Radio	Secondary 5 GHz	State	Disabled

[<<](#) [<](#) 1 [>](#) [>>](#)

5

1 - 4 of 4 items

AP Power Save configuration

1

Edit Power Profile

Name*

Description

Power Save Client Threshold

[Add](#) [Delete](#)

Sequence	Interface	Interface ID	Parameter	Parameter Value
0	USB	USB 0	State	Disabled
1	Ethernet	GigabitEthernet0	Speed	100 MBPS
2	Radio	6 GHz	State	Disabled
3	Radio	5 GHz	State	Disabled
4	Radio	Secondary 5 GHz	State	Disabled

1 - 5 of 5 items

2

Edit Calendar Profile

This profile will be in effect at 13:00:00 and has a duration of 17:00:00 which extends to next day ending at 06:00:00

Name*

Recurrence

Start Time

End Time

Day

Edit Calendar Profile

This profile will be in effect at 18:00:00 and has a duration of 12:00:00 which ends at 06:00:00

Name*

Recurrence

Start Time

End Time

Day

3

Edit AP Join Profile

General Client CAPWAP **AP** Management Security ICap QoS Geolocation

General **Power Management** Hyperlocation AP Statistics

Regular Power Profile

Regular Power Profile

Calendar Profile - Power Profile Map

[Add](#) [Delete](#)

Calendar	Recurrence	Start Time	End Time	Power Profile
☒ off-peak-we	Weekly	13:00:00	06:00:00	PSprofile
☐ Off-peak	Weekly	18:00:00	06:00:00	PSprofile

Edit Calendar - Power Map

Calendar Profile Detailed

Calendar*

This profile will be in effect at 13:00:00 and has a duration of 17:00:00 which extends to next day ending at 06:00:00

Recurrence Day

Start Time

End Time

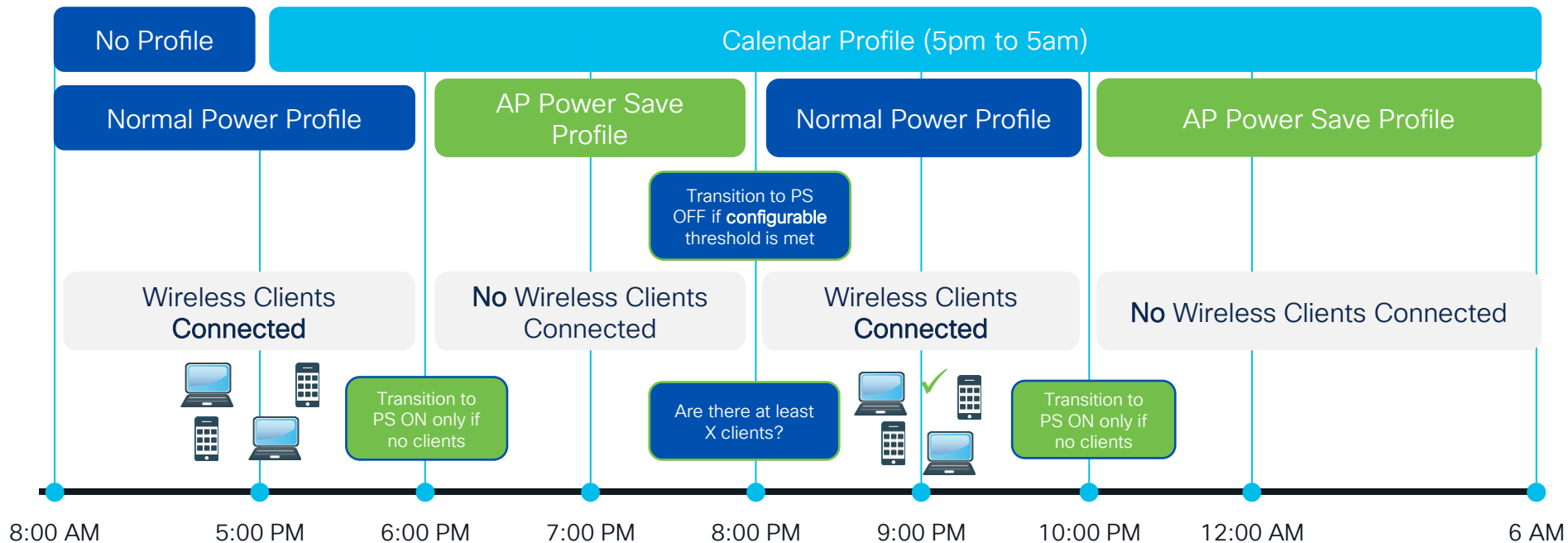
Power Profile

Power*

Sequence	Interface	Interface ID	Parameter	Parameter Value
0	USB	USB 0	State	Disabled
1	Ethernet	GigabitEthernet0	Speed	100 MBPS
2	Radio	6 GHz	State	Disabled
3	Radio	5 GHz	State	Disabled
4	Radio	Secondary 5 GHz	State	Disabled

1 - 5 of 5 items

AP Power Save (PS) logic



AP Power Optimizations Feature Suite

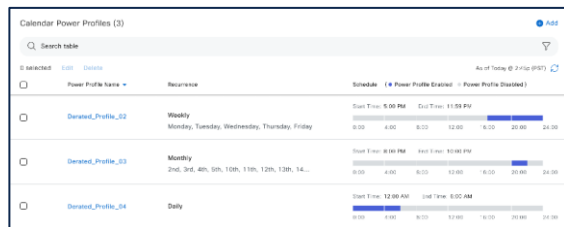
Save Power, reallocate power, and visibility into saving

Use

Power Save Mode

Lower AP Power Usage

- Power off components during off peak hours
- Calendar Profile determines when it's off-peak hours.
- Power Profile: Shut AP Radio or lower spatial stream, lower port speed, disable USB port.



IOS-XE 17.8

Power Distribution

Control over how power is used

- Decide how to allocate available power when running with less than required.
- Example: Wi-Fi 6E AP on 30W > Disable 2.4 GHz radio and use extra power for the 6 GHz radio.
- Leverages Power profiles

Sequence	Interface	Interface ID	Parameter	Parameter Value
0	Ethernet	GigabitEthernet0	Speed	5000 Mbps
1	Radio	6 GHz	State	Disabled
2	USB	USB 0	State	Disabled

IOS-XE 17.10*

Power Savings Insight

Power, Money, and Emissions Savings on Cisco DNA Center*

- Catalyst Center PoE dashboard integration.
- Catalyst Center Energy Dashboard.
- Visibility into trends and insights.
- Both site level and AP level view.



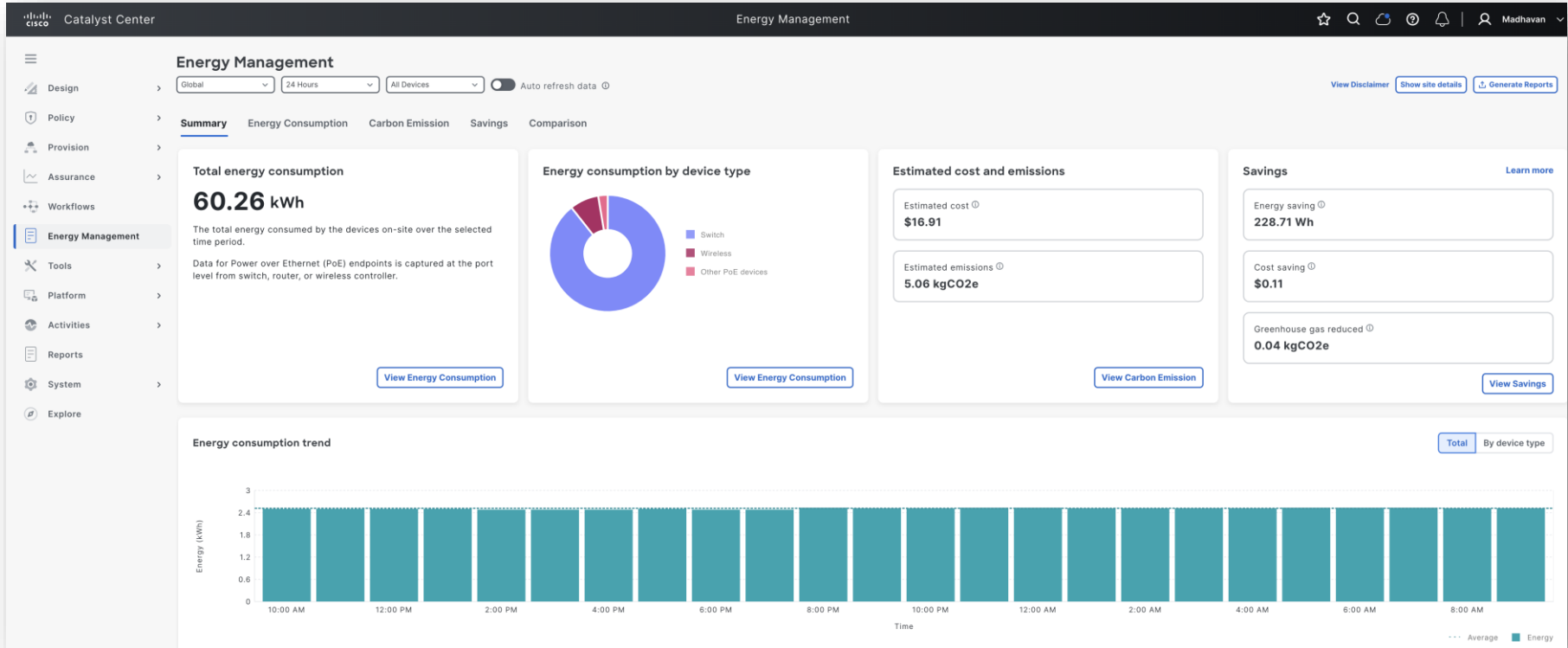
(*) Catalyst Center Automation and Assurance PoE Visibility is in release 2.3.6, Visibility of \$ and CO2 from 3.1.1

Supported only on Catalyst APs: 9115, 9120, 9130, 9136, 9166, 9164, 9162 and 9124 (from 17.13) and later APs

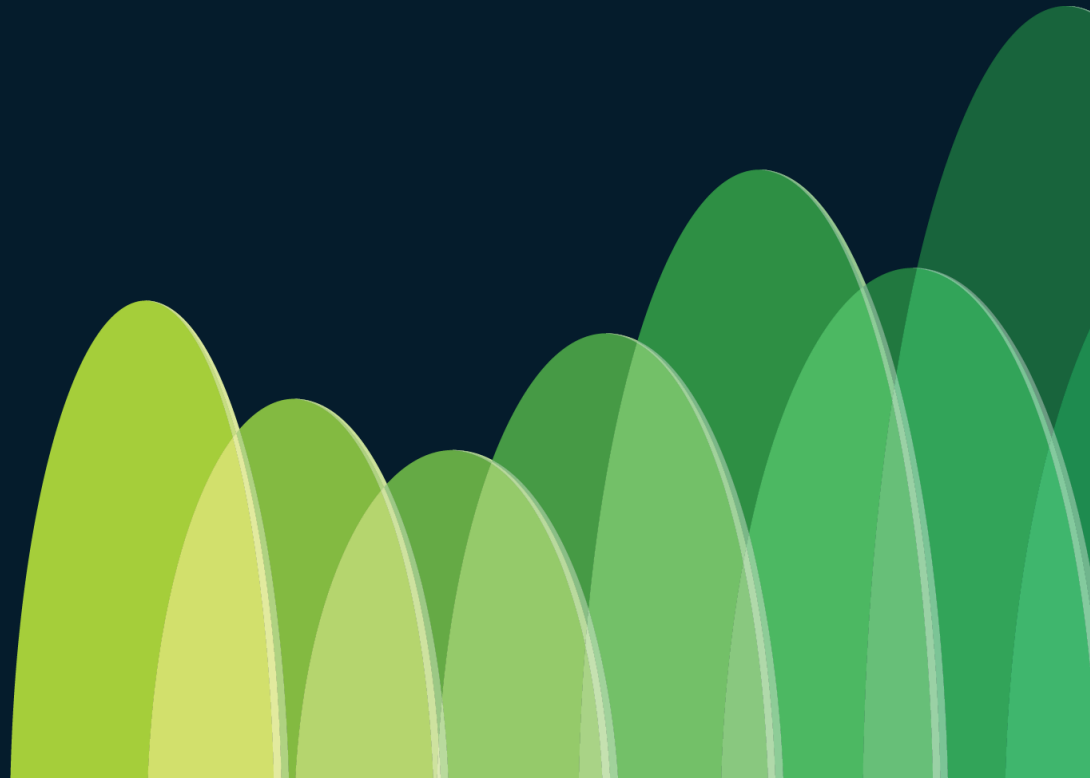
CISCO Live!

Energy Management in Catalyst Center

CatC
3.1.3



Saving Energy with Cisco Wireless



What are the customers asking?

- Network products with clear **Sustainability requirements**:

An example: Design recommendations from **UK Department for Education***

- **4.7.2.1** Enterprise-level Active switching, edge, and core shall be provided that:
 - n) **PoE ports should be configured to save energy by powering down devices when they are not required**

- **Product Carbon Footprint (PCF)** of Cisco products:

- Lots of info on the Cisco Environment Social and Governance (ESG) Hub**

- **Typical AP power consumption** to estimate power savings and/or properly size their PDU / UPS systems, install the proper number of outlets with proper amperage, etc.
- Help to reach their NetZero goals



(*) https://assets.publishing.service.gov.uk/media/6580017d95bf65001071912b/FE-OS_GDB_GenericDesignBrief-A-C04.pdf

(**) https://www.cisco.com/c/m/en_us/about/csr/esg-hub/environment/product-sustainability.html

If customer decides to go on this journey...

What are the Cisco Best Practices to implement power saving modes?

What happens to an AP MTBF* if powered on/off at night, every night?

Would the RF network be back to “normal” after powering APs back on?

(*) MTBF : Mean Time Between Failure?

AP Power Consumption



Catalyst 9136

Power Allocated

48.3 W

Power Consumed

16.5 W

PoE Power Negotiation happens at boot time through CDP/LLDP

Power allocation is what you need to consider for power budget

Actual Power consumption is dependent on the AP operation

AP Power Consumption

Catalyst 9166 data sheet

PoE power consumption	2.4GHz radio	5GHz radio	6GHz radio (LPI)	Link speed	USB	Link Layer Discovery Protocol (LLDP)
802.3bt (UPOE)	4x4	4x4	4x4	5 Gbps	Y (4.5W)	30.5W
802.3at (PoE+)	4x4	4x4	4x4	5 Gbps	N	25.5 W
802.3af (PoE)	-	-	-	1Gbps	N	14.0 W
DC power	4x4	4x4	4x4	5Gbps	Y(4.5W)	-

- This should say (we have now fixed this) **Max PoE Power consumption**
- The max power consumption is measured under the **worst conditions**:
 - 100m of Cat5 cable between AP and switch
 - Max temperature as per data sheet
 - 80% CPU load
 - 80% duty cycle on all radios
 - MCS0 data rates

AP Power Consumption

Input power requirements	• 802.3bt, Cisco Universal PoE (Cisco UPOE), 802.3at Power over Ethernet Plus (PoE+) • Cisco power injectors: AIR-PWRINJ7=, AIR-PWRINJ6=, MA-INJ-6 • 802.3af PoE (only for configuration staging, all radios off) • DC power input (54V/MA-PWR-50WAC)					
	Catalyst 9166					
	Power Source	2.4GHz radio	5GHz radio	6GHz radio (LPI)	Link speed	USB
						Max PoE Power Consumption
	802.3bt (UPOE)	4x4	4x4	4x4	5 Gbps	Y (4.5W) 30.5.W
	802.3at (PoE+)	4x4	4x4	4x4	5 Gbps	N 25.5 W
	802.3af (PoE)	-	-	-	1Gbps	N 14.0 W
	DC power	4x4	4x4	4x4	5Gbps	Y(4.5W) -
Note: Actual power consumption may vary depending on AP usage. It is recommended that you ensure that LLDP/CDP is enabled to allow proper power negotiation.						

- Catalyst and Meraki data sheets have been updated to use the right terminology
- The typical/normal/real power consumption depends on multiple factors:
 - Cable length and quality
 - Number of clients
 - Client traffic
 - Temperature
 - Features
 -
- So, it depends...hence we don't report it because it's not a deterministic number

OK, but I need a “typical” power consumption

Input power requirements

- 802.3bt, Cisco Universal PoE (Cisco UPOE), 802.3at Power over Ethernet Plus (PoE+)
- Cisco power injectors: AIR-PWRINJ7=, AIR-PWRINJ6=, MA-INJ-6
- 802.3af PoE (only for configuration staging, all radios off)
- DC power input (54V/MA-PWR-50WAC)

Catalyst 9166

Power Source	2.4GHz radio	5GHz radio	6GHz radio (LPI)	Link speed	USB	Max PoE Power Consumption
802.3bt (UPOE)	4x4	4x4	4x4	5 Gbps	Y (4.5W)	30.5W
802.3at (PoE+)	4x4	4x4	4x4	5 Gbps	N	25.5 W
802.3af (PoE)	-	-	-	1Gbps	N	14.0 W
DC power	4x4	4x4	4x4	5Gbps	Y(4.5W)	-

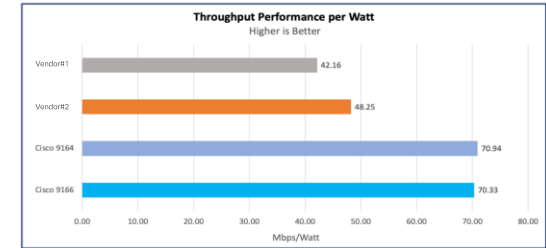
- Not official testing, this is my home lab 😊
- CW9166 power measured via PoE+ switch:
`3560-CX#sh power inline gig 1/0/4 detail | i Measured`
Measured at the port: 12.3
- AP in idle (no clients): **12.3 W/h**
- AP with #4 clients (no traffic): **12.5 W/h**
- AP with #4 clients doing speed test: **13.66 W/h**
- **Typically**, CW9166 would consume between 12.3 and 25.5 W/h (assuming no USB)

Max power from data sheet for CW9166

Calculating AP energy savings

If you want calculate AP energy savings, you need to consider three different tiers/modes of operations for the APs when it comes to energy consumption:

- **AP is fully operational/full power** > Cisco Wireless APs have the highest power efficiency in the market* thanks to the Cisco hardware and software innovation
- **AP Power Save mode** > Power save mode optimizations (e.g. radio off) can save an additional 20% in energy cost vs. regular idle mode (no clients on AP)
- **AP shut down** > Automating the power off/on of the Access Points during off-peak hours, you can maximize your energy savings



MAX savings

(*) Miercom report: <https://miercom.com/pdf/reports/DR201007K.pdf>

Calculating AP energy savings (Power Save)

C9120 AP in idle with all radios up:

```
3560-CX#sh power inline gig 1/0/3 detail | i Measured
```

Measured at the port: **8.6**

C9120 with power profile to shut 5GHz, 2.4 GHz with SS 4x4

```
3560-CX#sh power inline gig 1/0/3 detail | i Measured
```

Measured at the port: **7.9**

C9120 with power profile to shut 5Ghz and 2.4 with SS 1x1

```
3560-CX#sh power inline gig 1/0/3 detail | i Measured
```

Measured at the port: **7.7**

C9120 with power profile applied to shut all radios

```
3560-CX#sh power inline gig 1/0/3 detail | i Measured
```

Measured at the port: **7.1**



Calculating AP energy savings (Power Save)

C9164 AP in idle with radios up:

```
3560-CX#sh power inline gig 1/0/3 detail | i Mea
```

Measured at the port: **12.1**

Idle mode

C9164 with power profile to shut all radios:

```
3560-CX#sh power inline gig 1/0/3 detail | i Mea
```

Measured at the port: **10.7**

Radios off

> save 1.4 W – 12%
(over idle)

C9136 AP in idle with radios up:

```
3560-CX#sh power inline gig 1/0/3 detail | i Mea
```

Measured at the port: **14.4**

Idle mode

C9136 with power profile to shut all radios:

```
3560-CX#sh power inline gig 1/0/3 detail | i Mea
```

Measured at the port: **12.8**

Radios off

> save 1.6 W – 11%
(over idle)

Save Energy with AP Power Save

We estimate that using Power Save on 2,000 APs (1.5 W saved) for 10 hours a day (10pm to 8am), saves up to ca.*:

- 54,600 kWh energy
- £8800 cost (€ 10200)
- 21 metric tonnes CO2e emissions

over 5 years.

*Based on internal analysis. Actual estimate that varies depending on the location where the devices are operated. Location in the example: UK, assumed energy price: 40p/kWh

CISCO *Live!*

Discover

Profile Name	AP Name	AP ID	AP Model	AP Version	AP Location	Active Power	Estimated Power	Power Mode	Power State	Power Source
AP001-0001-0001	AP001-0001-0001	AP001-0001-0001	AP001-0001-0001	17.10.1.0	10.10.10.10	1.5W	1.5W	Power Save	On	Overriding 14h00m
AP001-0001-0002	AP001-0001-0002	AP001-0001-0002	AP001-0001-0002	17.10.1.0	10.10.10.10	1.5W	1.5W	Power Save	On	Overriding 14h00m
AP001-0001-0003	AP001-0001-0003	AP001-0001-0003	AP001-0001-0003	17.10.1.0	10.10.10.10	1.5W	1.5W	Power Save	On	Overriding 14h00m
AP001-0001-0004	AP001-0001-0004	AP001-0001-0004	AP001-0001-0004	17.10.1.0	10.10.10.10	1.5W	1.5W	Power Save	On	Overriding 14h00m
AP001-0001-0005	AP001-0001-0005	AP001-0001-0005	AP001-0001-0005	17.10.1.0	10.10.10.10	1.5W	1.5W	Power Save	On	Overriding 14h00m
AP001-0001-0006	AP001-0001-0006	AP001-0001-0006	AP001-0001-0006	17.10.1.0	10.10.10.10	1.5W	1.5W	Power Save	On	Overriding 14h00m
AP001-0001-0007	AP001-0001-0007	AP001-0001-0007	AP001-0001-0007	17.10.1.0	10.10.10.10	1.5W	1.5W	Power Save	On	Overriding 14h00m
AP001-0001-0008	AP001-0001-0008	AP001-0001-0008	AP001-0001-0008	17.10.1.0	10.10.10.10	1.5W	1.5W	Power Save	On	Overriding 14h00m
AP001-0001-0009	AP001-0001-0009	AP001-0001-0009	AP001-0001-0009	17.10.1.0	10.10.10.10	1.5W	1.5W	Power Save	On	Overriding 14h00m
AP001-0001-0010	AP001-0001-0010	AP001-0001-0010	AP001-0001-0010	17.10.1.0	10.10.10.10	1.5W	1.5W	Power Save	On	Overriding 14h00m

Act

Edit Access Point Profile

Access Point Profile is used to manage and provision access points. AP Profiles can be assigned to APs by associating them to Wireless Network Profiles.

AP Profile Name:

Description:

Management Security Mesh **Power** Additional

AP Power Profile

Select the AP Power Profile that should be applied to Access Points. If an Access Point does not receive the required power, it will function in a derived state as defined by the sequence of rules in the Power Profile. Only Power profiles with rules will be listed below. This setting is applicable only for IOS-XE based Wireless Controllers running 17.10.1 and above.

AP Power Profile: **Power Save** [View Details](#)

View Power Profile

If an access point does not receive the required power, it will function in a derived state as defined by the sequence of rules in the Power Profile.

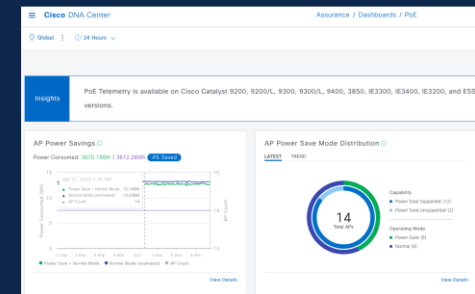
Power Profile Name: **Power Save**

Description: **Radio Off**

Rules (4)

Sequence	Interface	Interface ID	Parameter	Parameter Value
0	Radio	6 GHz	State	Disabled
1	Radio	5 GHz	State	Disabled
2	Radio	Secondary 5 GHz	State	Disabled
3	Radio	2.4 GHz	State	Disabled

Report



Turn APs off, or not turn APs off
...THAT is the question!



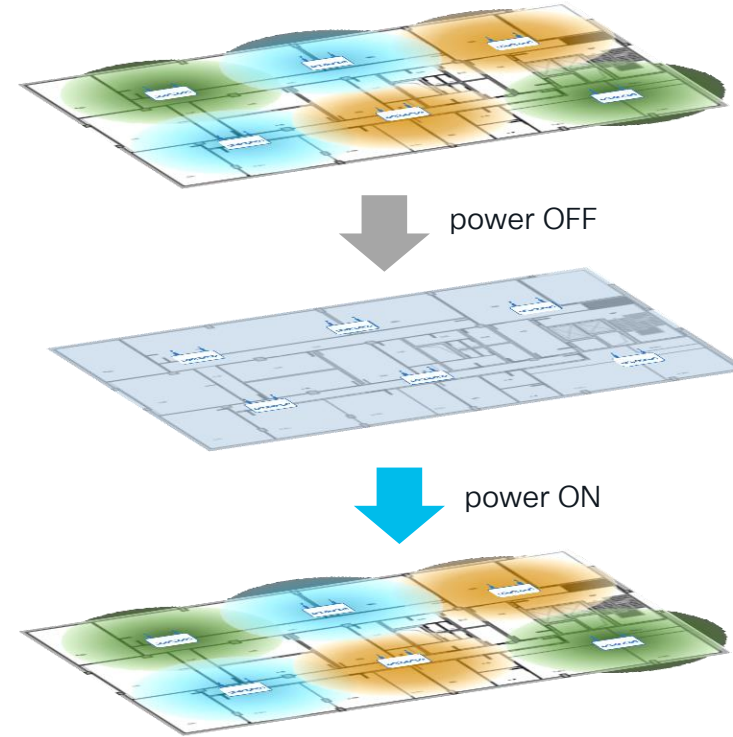
Turning off APs – What do you need to consider?

- You need to consider the possible impact on:
 - Hardware and Mean Time Between Failure (MTBF)
 - AP software integrity



Turning off APs – What do you need to consider?

- You need to consider the possible impact on:
 - Hardware and Mean Time Between Failure (MTBF)
 - AP software integrity
 - RF stability and Radio Resource Management
 - Wireless Security (e.g., no rogue detection)
 - IT operations (how to select the ports? alarms?)
- If you decide to do it, which APs to turn off?
 - Turn off all APs; turn off a floor, an area, salt and pepper style?

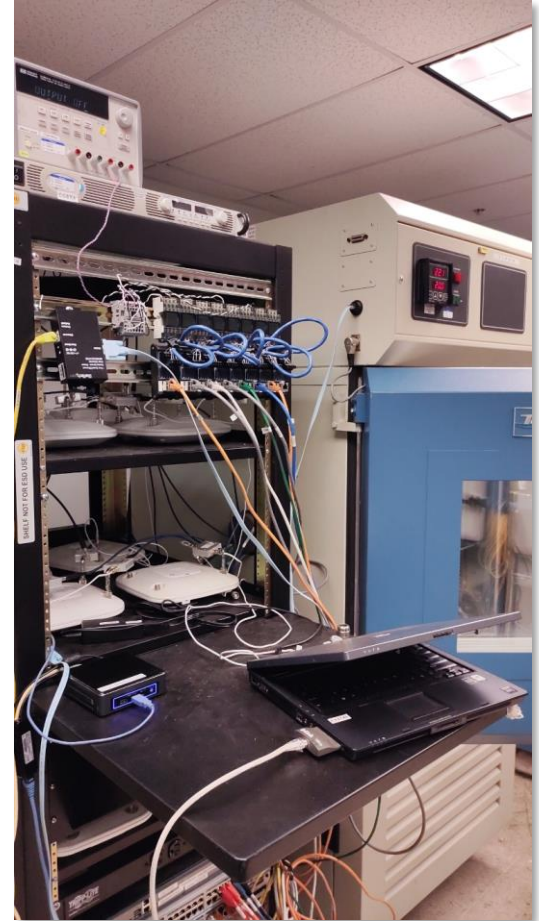


Turning ON/OFF APs – MTBF

EIM (Ethernet Interrupter Module) test:

- Fully automated procedure
- Verify the proper function of the AP after multiple power ON/OFF cycles. At least 300 cycles
- Test is done at the different temperatures supported in the data sheet
- Test includes client connectivity through the AP to verify proper functions

No impact on MTBF and hardware quality is expected by switching ON and OFF APs.



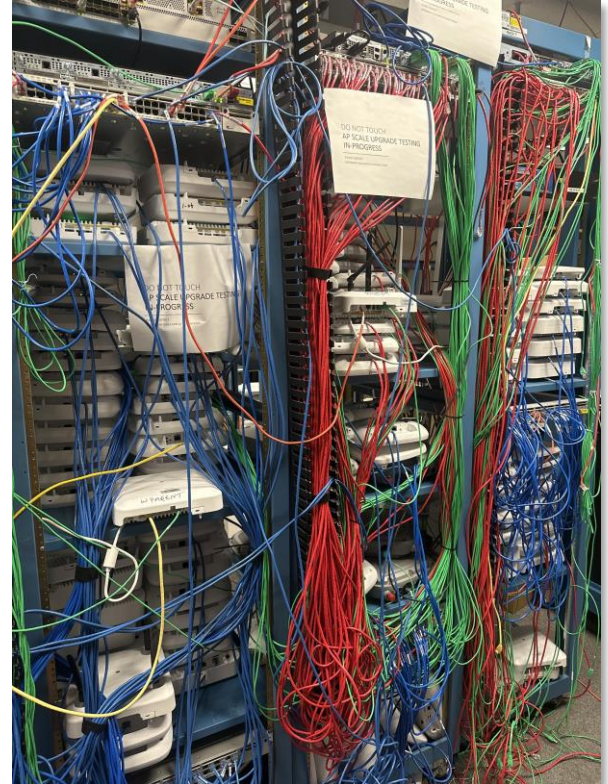
Turning ON/OFF APs – Software Integrity

Catalyst AP Software integrity test:

- Verify that AP image doesn't get corrupted upon a non-grateful shutdown (AP port is shut down)
- #120 APs test bed of all Wi-Fi 5/6/6E models. Tests run against all the CCO recommended images (17.3.x, 17.6.x, 17.9.x, 17.12.x)
- Script to automate the following behavior:
 - AP is turned on, connects to WLC and download software
 - In the middle of the download, AP switchport is shutdown
 - Verify AP reboot, and start downloading again

No impact on software integrity is expected. Cisco recommends to be on 17.9.3 or above

cisco *Live!*



Turning ON/OFF APs – Software Integrity

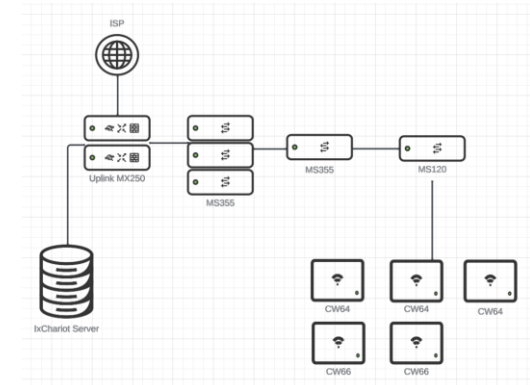
Meraki MR Software integrity test:

- Verify that AP image doesn't get corrupted upon a non-grateful shutdown (AP port is shut down)
- Initial test with CW9166/64 with MR29 code
- Few different tests conducted:
 - AP power turned off/on during firmware upgrade.
 - AP power cycle during configuration radio channel change.
 - Verified AP recovers and behaves as expected

No impact on software integrity is expected

Test Plan: Sustainability Power Test

Test Topology

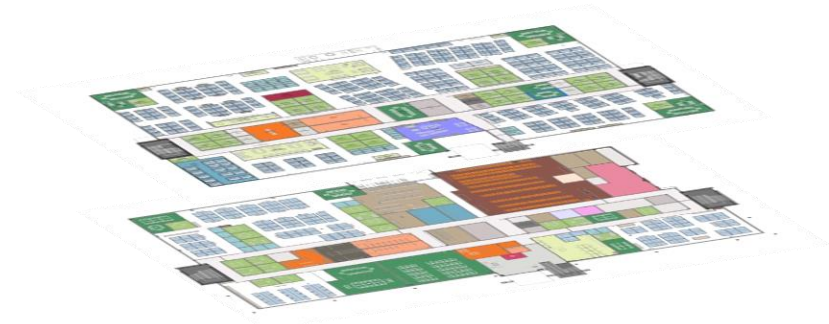


Radio Resource Management (RRM)

Considerations



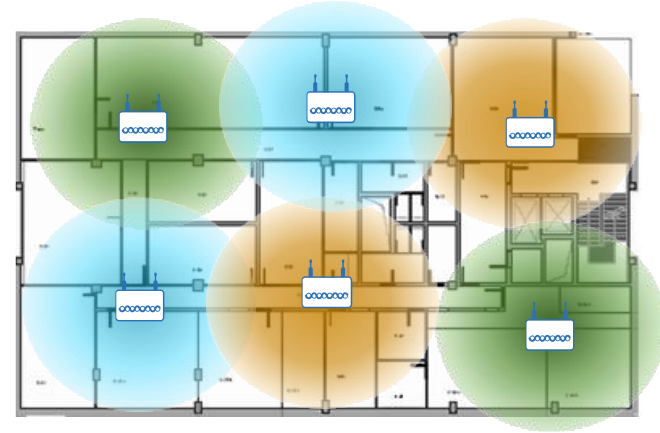
We are testing...



- #2 floors building in RTP campus, North Carolina
- 58 APs (Aironet 4800) and #2 C9800-L in SSO pair CW9166
- #3 switches (one per IDF + distribution)
- DNA Center 2.3.7
- Building is RF isolated

RRM – Facts

- RRM's algorithms operate automatically:
 - Dynamic Channel Assignment (DCA) runs either every 10 mins (auto) or periodically, configured for Anchor Time with an interval (every x hours)
 - Coverage Hole Detection (CHD) runs when triggered (threshold -80 dBm default)
 - Transmit Power Control (TPC) runs every 10 mins
- RRM always uses the last 10 minutes of collected data:
 - For Auto, that's 10 minutes after the controller boots up.
 - For a configured Anchor time and interval – that is 10 mins before the scheduled time
- APs store last channel/power/bandwidth settings
 - This means, if you turn off APs at 10pm and you have channel/power distribution X, you will get same distribution X at 7am when you turn the network back on. For Meraki, values are retained for 7 days



RRM Design Considerations

- How do we choose the DCA interval?
 - Why only DCA, why not TPC? DCA channel changes might create disruptions to clients. Changing power have marginal effect on clients.
 - If DCA running every 10 mins > potential disruption to clients during business hours, as RRM might do channel changes during a voice call for example.
 - If DCA running rarely (e.g., once/twice a day), shall I run it on peak time or off peak? The risk of running on peak is potential disruption due to channel changes; the risk of running it off peak is that RRM doesn't have a correct representation of the RF network.
 - When configured with Anchor time, RRM runs an “aggressive” cycle at every anchor time > runs every 10 mins for 60 minutes (six times)

The screenshot shows the 'RRM' configuration page under 'Radio Configurations' for the '5 GHz Band'. The 'DCA' tab is selected. Under the 'Dynamic Channel Assignment Algorithm' section, 'Channel Assignment Mode' is set to 'Automatic'. The 'Interval' is set to '10 minutes' (highlighted with a red box), and 'Anchor time' is set to '0'.

RRM Design Considerations

- Cisco recommendations for DCA
 - Running DCA every 10 mins is the default and it's recommended for most networks.
 - If you have interactive or delay sensitive traffic like voice, the recommendation would be to run DCA less often, but at least twice a day
 - Should be same settings for all RF Bands

Configuration > Radio Configurations > RRM

6 GHz Band 5 GHz Band 2.4 GHz Band FRA

General Coverage DCA TPC RF Grouping Spatial Reuse

Dynamic Channel Assignment Algorithm

Channel Assignment Mode

☒ Automatic

☐ Freeze

☐ Off

Interval 6 hours

Anchortime 7

Powering off/on: RRM Design Implications

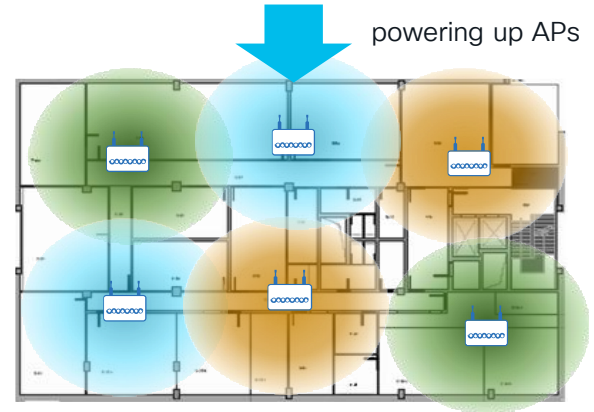
RRM learning process:

- If you shut down APs > when APs are coming back up, RRM need to learn again all AP neighbors.
- This will take some time for the on-channel neighbor discovery messages. For DFS channels it takes even more time if we don't have clients.
- It's important to run RRM when the network is back to stable state, with all APs that are UP, and all neighbors discovered.
- At anchor time, RRM runs a startup procedure which will optimize the RF present when it executes.
- If you run RRM every 10 mins, then the first run after APs are powered up may not have all the APs joined > this may trigger some channel changes and possible disruption. A second DCA run will be needed to optimize.

AP powered down

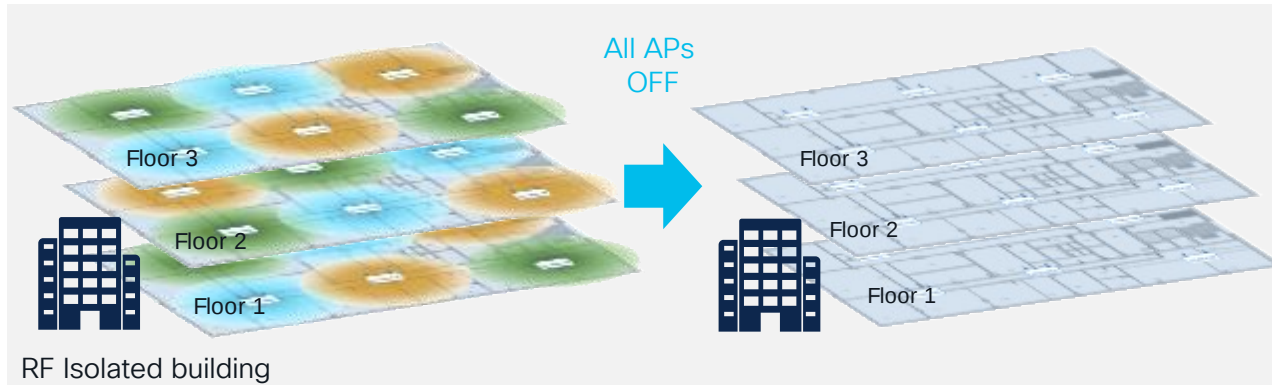


powering up APs

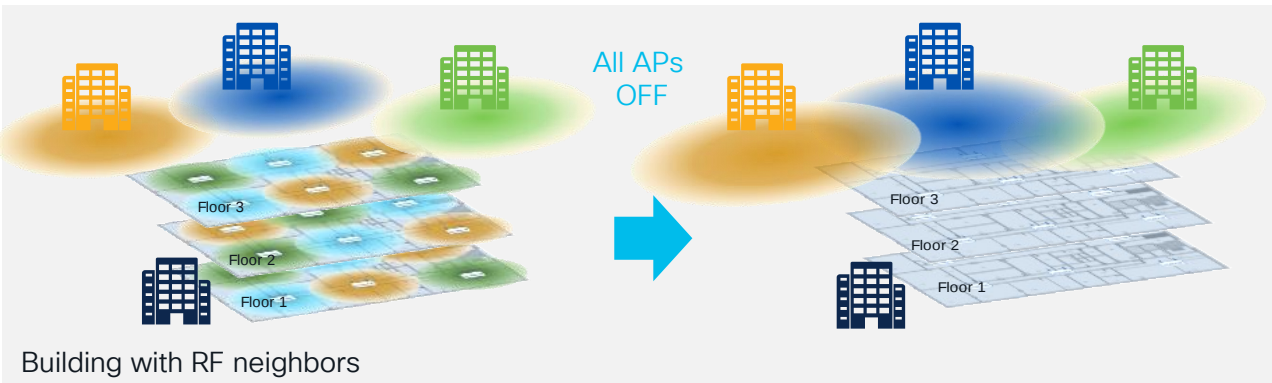


Powering off/on: RRM Design Implications

Building total shutdown



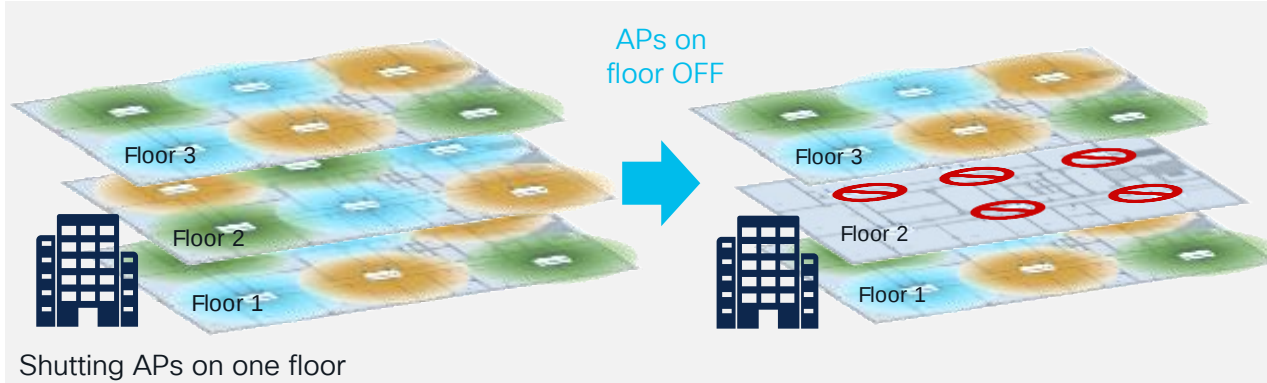
If shutting down **all APs** in the building and **no RF neighbors** > no RF changes are expected when powering back up



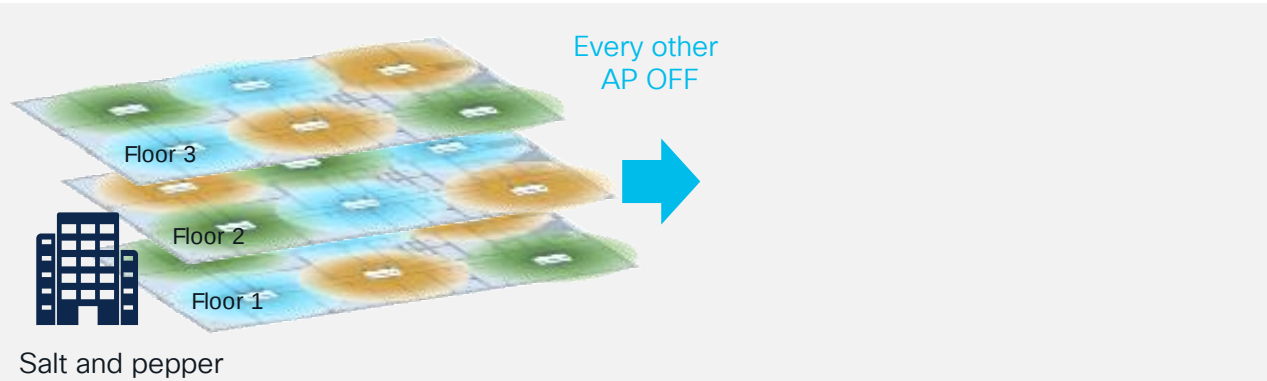
If shutting down **all APs** in the building **with RF neighbors** > RF changes are expected when powering APs back ON as the RF neighbors (**rogue APs**) might have taken over the channels previously used

Powering off/on: RRM Design Implications

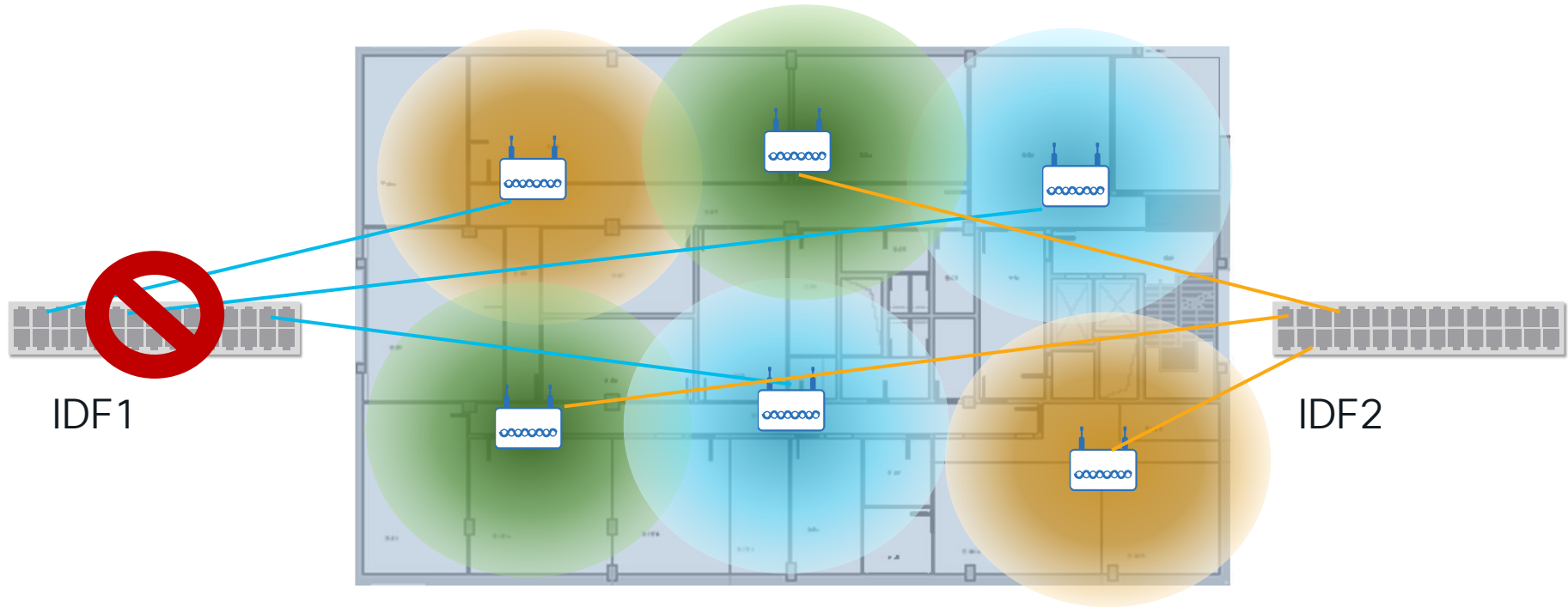
Building partial shutdown



If shutting down all APs on a floor, if there is RF leakage between floors> RF changes are expected after powering back up the APs

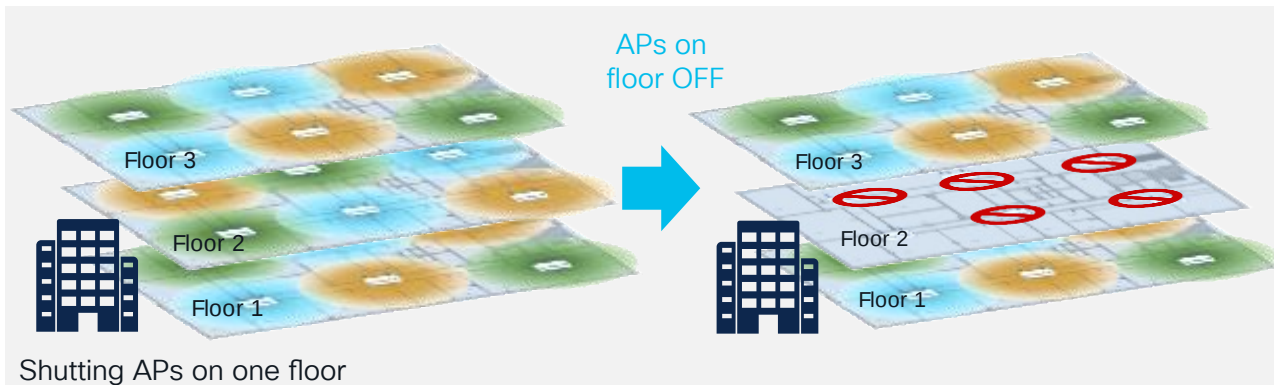


Powering on/off APs: Salt and Pepper

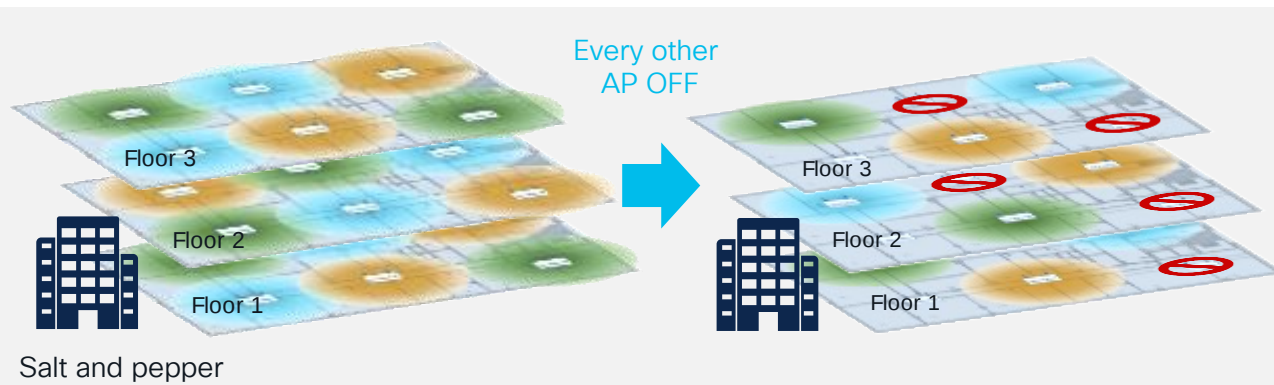


Powering off/on: RRM Design Implications

Building partial shutdown



If shutting down all APs on a floor, if there is RF leakage between floors > RF changes are expected after powering back up the APs

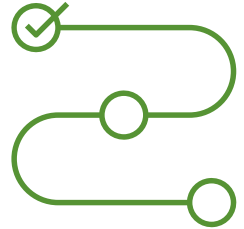


If shutting down APs in a “salt and pepper” way on each floor > RF changes may happen as the remaining APs might take over the channels previously used by APs powered down

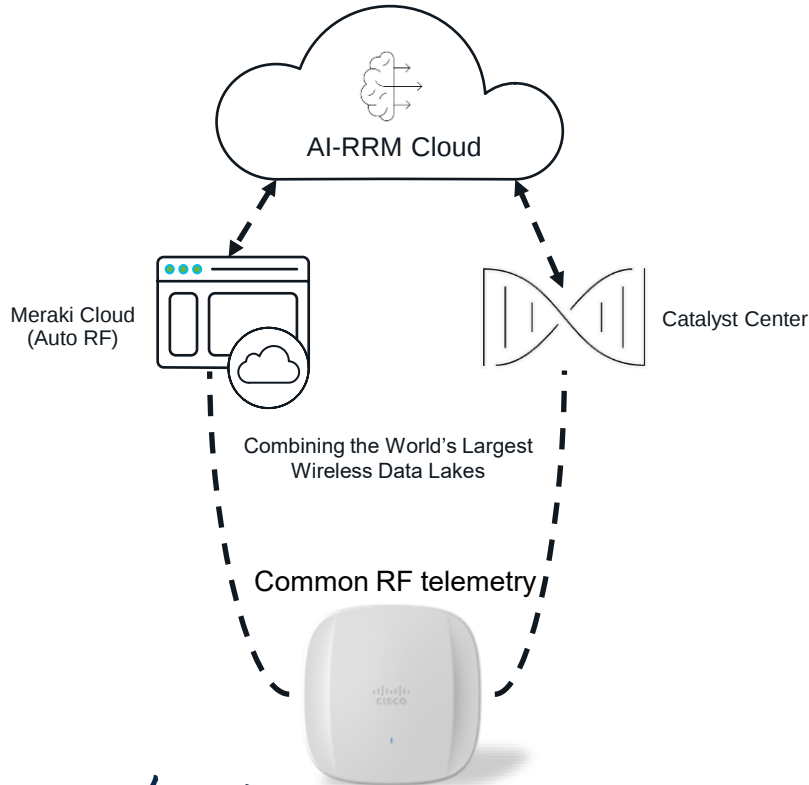
Powering off/on: RRM Recommendations

Recommended procedure for RRM:

1. **Freeze RRM (DCA)** before shutting down APs > no changes are done when APs are down
2. Shut APs down
3. **Power APs at least 1h before** the clients shows up in the morning, to give time for APs to build the neighbor relationships.
4. If RRM runs few times a day, make sure to **turn the APs back on 1 hour before the next RRM run**, to allow neighbor relationships
5. After the APs have all joined back and are stable, **unfreeze DCA**



Powering off/on: AI-Enhanced RRM



- No need to decide between Anchor time or interval > **AI RRM always runs** in the Cloud
- No need to identify best time to run RRM > **RRM automatically learns and set business hours**
- **Changes happen outside busy hours** > minimize impact on the production network
- **Changes optimize** the network for **business hours** operations
- **Optimizations** are proactive and powered by Cisco's AI Cloud

Powering off/on: Switch Port Schedules

Meraki MS Switches

Port schedules

Local time zone: America - Los Angeles (You can set this on [General](#))

Energy Savings used by [1 port](#)

Templates: 8 to 5 daily | 8 to 5 on weekdays only | weekdays only | always on | always off

Time display: 24 Hour | AM/PM

Day	Status	During	0:00	4:00	8:00	12:00	16:00	20:00
Monday	enabled	8:00 - 17:00	Grey	Grey	Green	Green	Green	Grey
Tuesday	enabled	8:00 - 17:00	Grey	Grey	Green	Green	Green	Grey
Wednesday	enabled	8:00 - 17:00	Grey	Grey	Green	Green	Green	Grey
Thursday	enabled	8:00 - 17:00	Grey	Grey	Green	Green	Green	Grey
Friday	enabled	8:00 - 17:00	Grey	Grey	Green	Green	Green	Grey
Saturday	enabled	8:00 - 17:00	Grey	Grey	Green	Green	Green	Grey
Sunday	enabled	8:00 - 17:00	Grey	Grey	Green	Green	Green	Grey

[Add a new port schedule](#)

Energy Saving Port Schedules

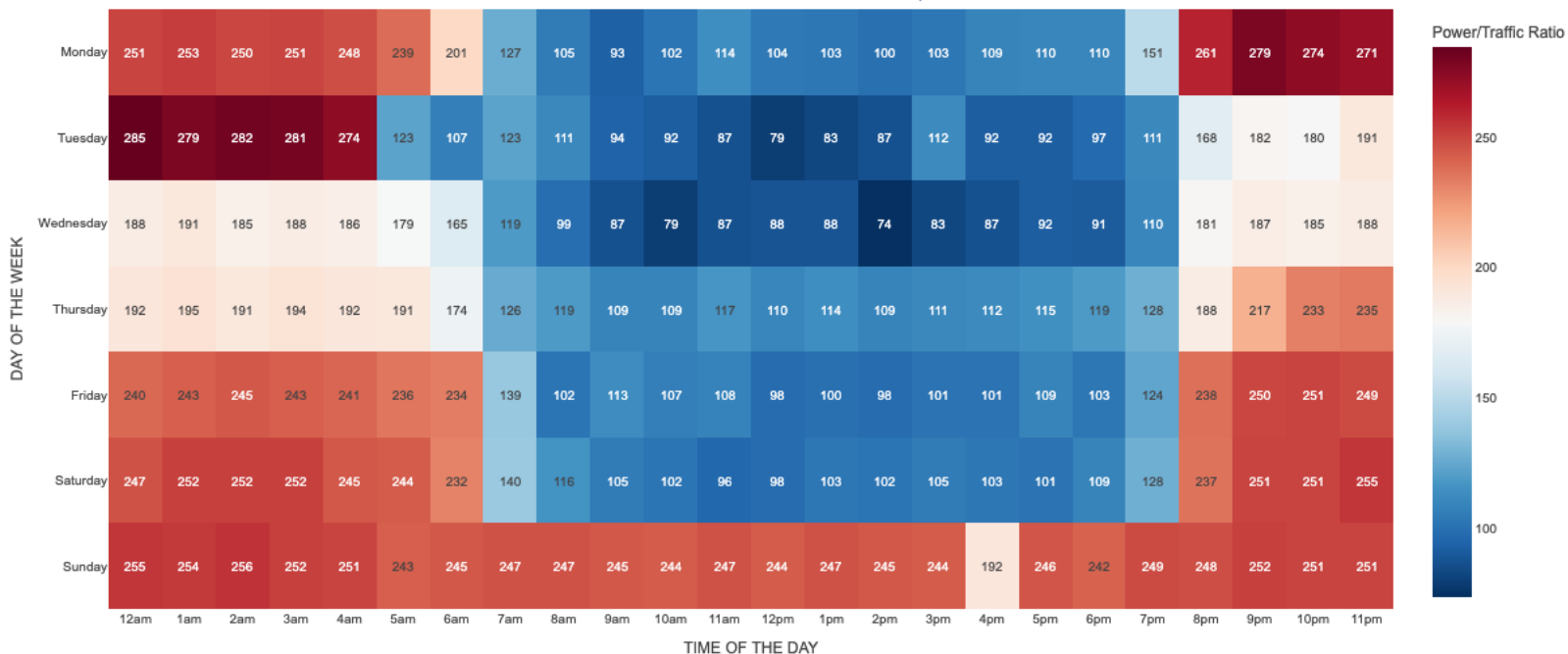
Create port schedules to turn off POE power to access points during off peak hours

Powering off/on: Switch Port Schedules

Cisco CX tool: Heatmap of Power to Traffic Ratio

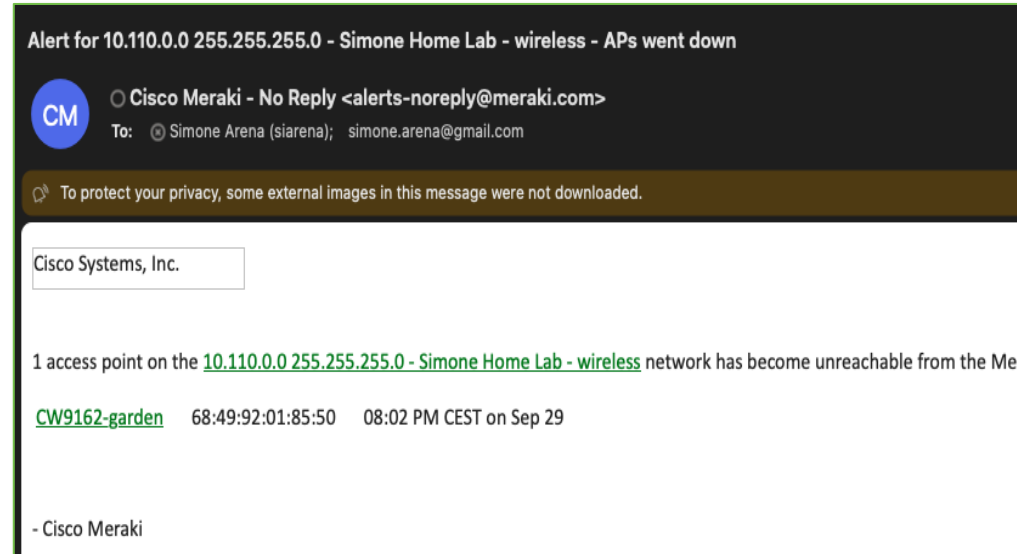
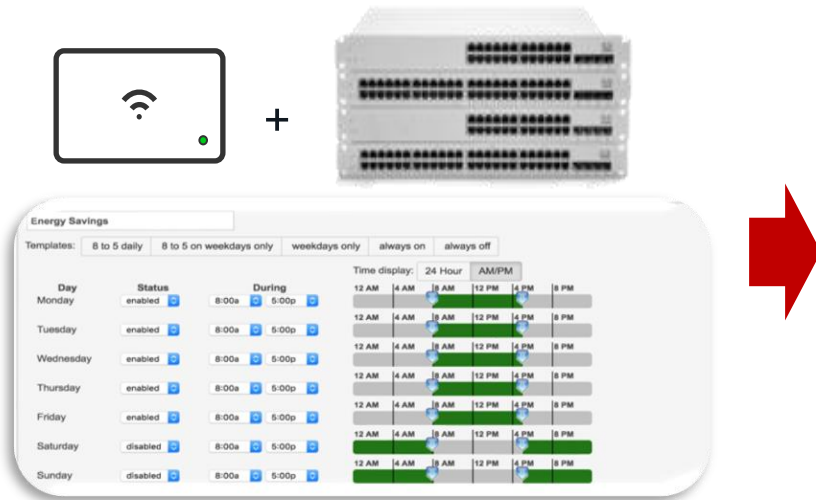
Retail store

Activity shown as 6 days a week,
12 hrs per working day



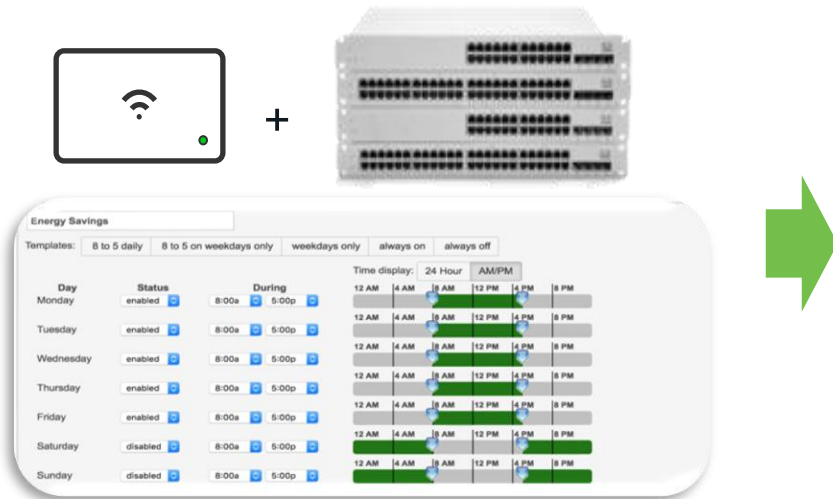
Powering off/on: AP alarms

Problem: Every time the AP goes down, you get a notification...



Powering off/on: AP alarms

Solution: Mute Wireless Notification based on switch port schedule !!
Helping Customers meet Sustainability Goals without the 📢 noise >



Alerts

Alerts Settings

Default recipients:

Network-wide

- ☐ Configuration settings are changed
- ☐ A VPN connection comes up or goes down
- ☐ A rogue AP is detected
- ☐ Network usage exceeds

☒ Mute wireless alerts based on switch port schedules ⓘ

If toggled on, then wireless unreachable alerts will be muted when caused by a port schedule.

[Learn more](#)

- Configure under Network-wide > Alerts or [via API](#)
- Only alerts related to schedule will be muted
- Alerts outside of the schedule will still be sent

See also: https://documentation.meraki.com/MS/Access_Control/Port_Schedules#Muting_Notifications

Save Energy with Meraki Switch Port Schedules

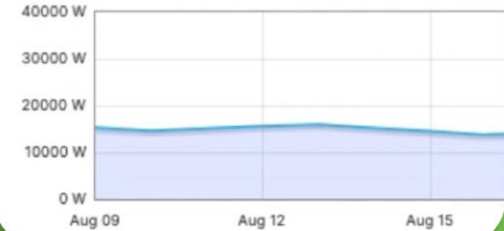
- Powering off 2,000 PoE devices (10W) for 10 hours a day, is estimated* to save up to ca.:
- 364,000 kWh energy
- £145,000 (€ 168,000) cost
- 76 metric tonnes CO2e emissions
- over 5 years.

*Based on internal analysis. Actual estimate that varies depending on the location where the devices are operated. Location in the example: UK, assumed energy price: 40p/kWh

CISCO *Live!*

Discover

Power rate over time



Act

Time display: 24 Hour AM/PM



Report

Power rate over time



Conclusion



Sustainability Profiles of Cisco Wireless

Powering customer's journey to Net Zero through its lifecycle

Manufacturing

Efficient Architecture

Parts to serve **multiple functions** and designed out parts where possible;
Access Point: Replaced diodes with FETs (Field Effect Transistors)

Reduced plastic usage

Replacing plastic bags for accessory kits, with paper packaging;
Access Point: **Post Consumer Resin (PCR)** for plastic housing

No wet paint on WLC

Eliminated use of oil-based wet paint, reducing environmental impact of manufacturing process.

Transport

Reduced weight for transportation

Multi-pack option to reduce corrugated cardboard material and hence weight

No paper manuals

No more paper documentation (when allowed by country regulation);
Leverage postcard size pointer card to connect user to digital documentation

Accessory opt in/out

Customers can opt-in to receive only the product accessories they need;
Access point **reusable mounting brackets**. **Reduce resources** by not manufacturing it, **reduce waste** by reusing existing brackets

Use

AP Power Optimizations Feature Suite

Increased performance per Watt

ASIC and HW innovations enable higher bandwidth at less than proportionate increase in power

Platinum/Titanium rated AC PSUs for WLC

Energy management

Energy reporting for all devices in one view reporting energy usage, mix, cost and CO2e allowing you to make smart energy choices

End of Life

Sustainable packaging

Corrugated packaging made from **recycled** content;
Redesigned packaging to remove all foam, replacing it with a **recyclable fiber-based** solution

Take-back Program

Cisco **picks up the product when done** and recycles it, ensuring that your **end-of-life emissions are minimal**.

Cisco refresh

Nearly 100% of products returned to Cisco are reused or **recycled**

Sustainability- check list

	Cisco Wireless	Other vendor
Common Mounting Bracket	✓	?
Multi-pack Packaging	✓	?
No use of plastic in AP packs	✓	?
Power Policy	✓	?
Power Save Mode	✓	?
Power Save Insights	✓	?

Webex App

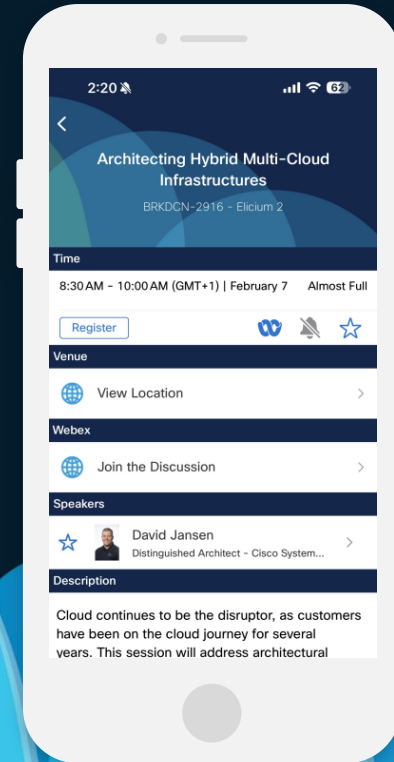
Questions?

Use the Webex app to chat with the speaker after the session

How

- 1 Find this session in the Cisco Events 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 February 28, 2025.



Fill Out Your Session Surveys



Participants who fill out a minimum of 4 session surveys and the overall event survey will get a unique Cisco Live t-shirt.

(from 11:30 on Thursday, while supplies last)



All surveys can be taken in the Cisco Events mobile app or by logging in to the Session Catalog and clicking the 'Participant Dashboard'



Content Catalog

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- 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 ciscolive.com/on-demand. Sessions from this event will be available from March 3.

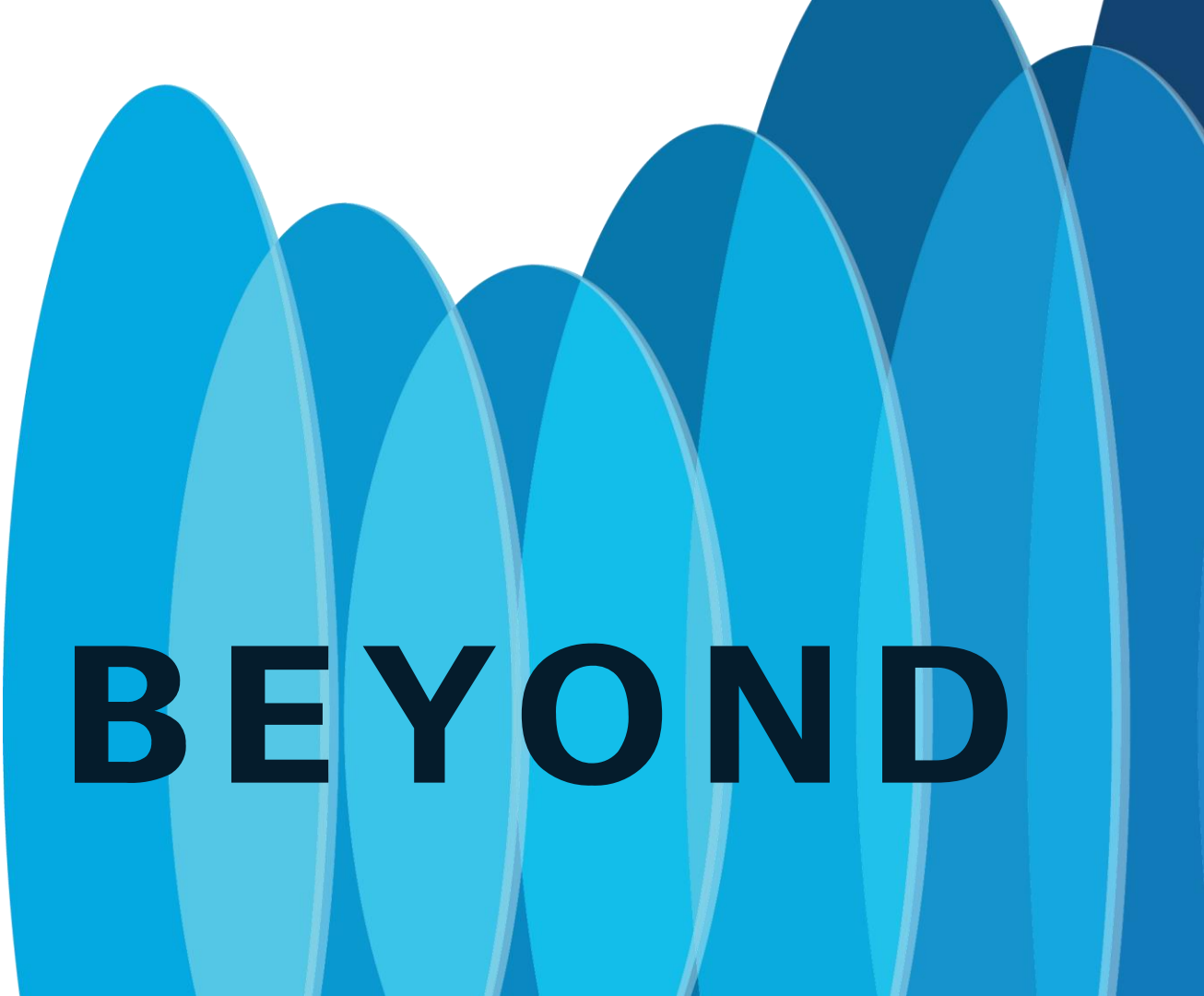


Thank you



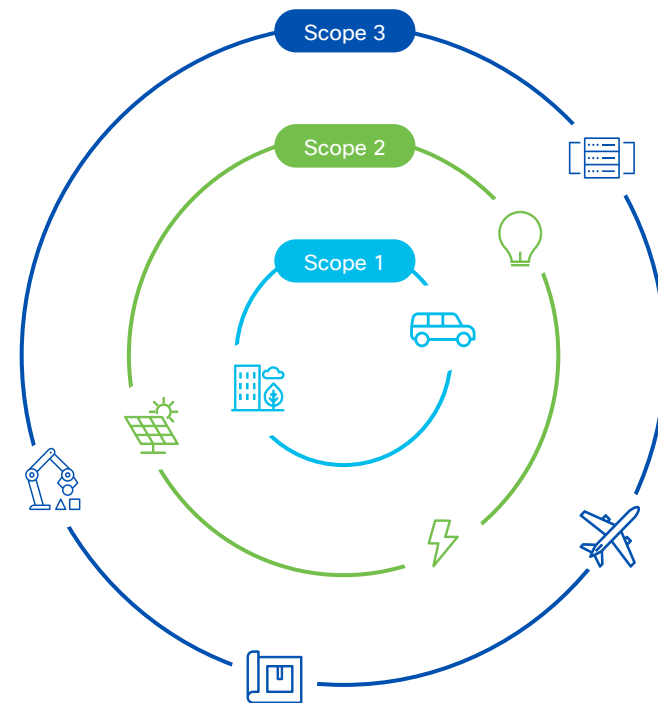
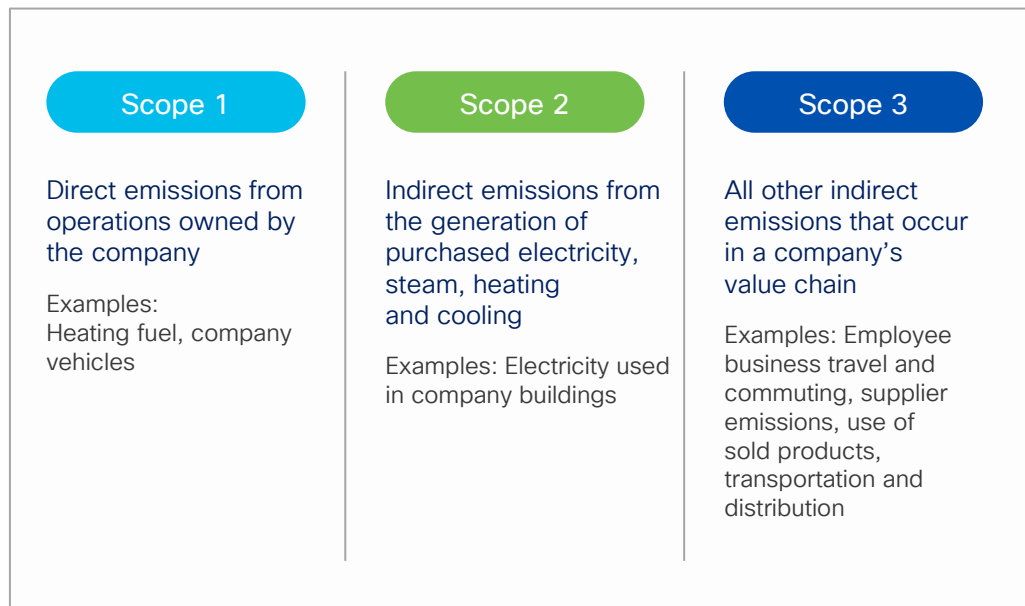
CISCO *Live!*

GO BEYOND

The background of the slide features a series of overlapping, teardrop-shaped elements in various shades of blue, ranging from light sky blue to deep navy blue. These shapes are arranged in a way that creates a sense of depth and movement, resembling a stylized horizon or a series of waves. The overall aesthetic is clean and modern.

Some definitions...

Sustainability Metrics



The three scopes of greenhouse gas emissions

Scope 1
Emissions from
fuels we buy
and burn within
our operations.

- Natural gas used to heat our buildings
- Back-up generators that run on diesel
- The gasoline and diesel used in Cisco-owned vehicles

The three scopes of greenhouse gas emissions

Scope 2
Emissions from
electricity we buy
for our operations.

- Electricity we use in our labs and data centers to run our equipment
- Running our HVAC systems and keeping the lights on

The three scopes of greenhouse gas emissions

Scope 3
Emissions related
to our business
that we don't own
or control.



- Electricity our products consume after we sell them
- Our suppliers' energy use
- Transporting our products
- Employee commuting in their personal vehicles

More on the Use and Re-Use phase

Make your building smarter and sustainable

Do you know...

How many of your buildings and floors operated on low occupancy in the last month? Is there a need for consolidation?

Do you know when your buildings are busiest? What time of the day and what day of the week?

Is your energy optimized against the actual usage and occupancy of the buildings?

Do you know how many people are in your building, floors, real-time?



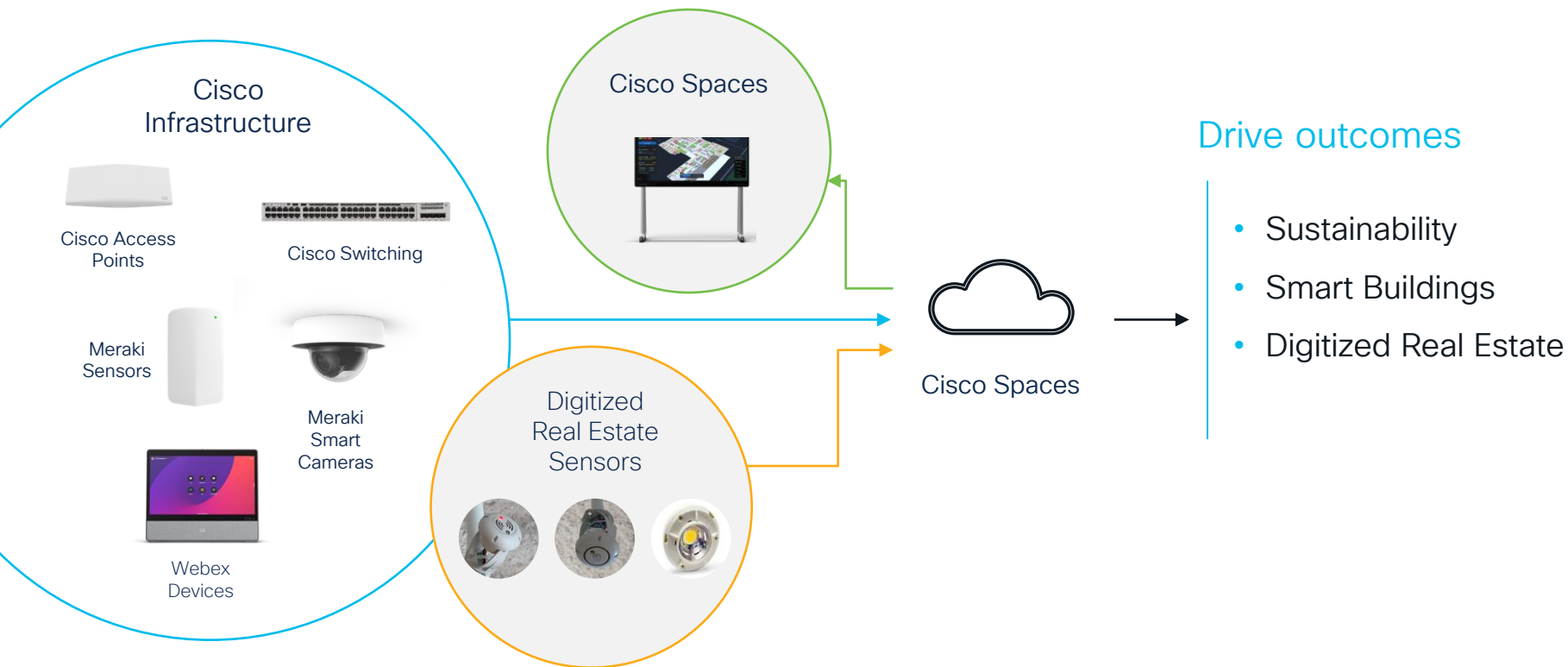
[Calculate your potential energy savings with Cisco Spaces using our Sustainability calculator](#)



Cisco Wireless + Cisco Spaces

Use

An easy way to get started on your Sustainability Journey



cisco *Live!*

Cisco Wireless + Cisco Spaces

Use

Environmental Analytics and Room Occupancy reports

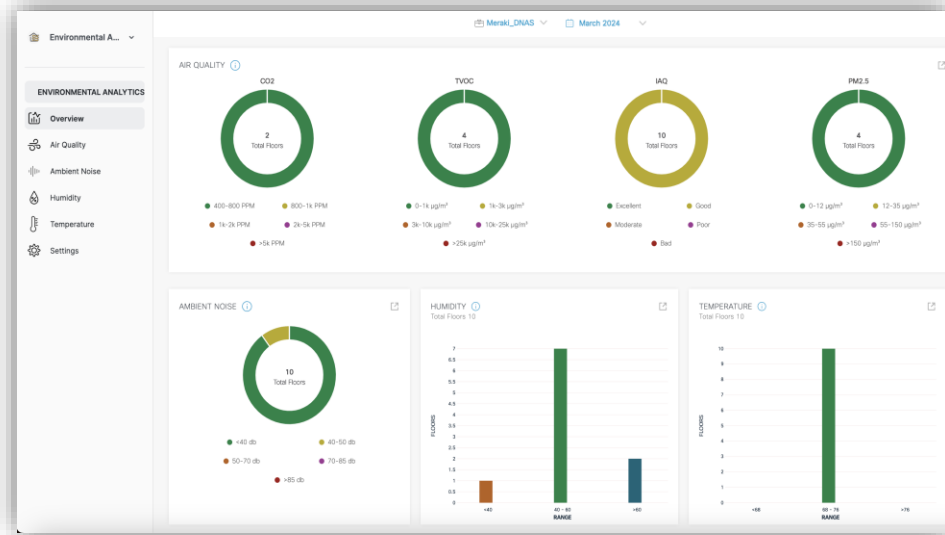
Aggregated view of all your environmental sensors

Visualize detailed trends at your workplace – air quality, temperature, humidity, CO₂, noise

Room Occupancy: Understand historic trends and reports to set building schedules or take corrective measures

What can I do with this data?

- Ensure building systems are operating as expected. Assess and improve performance of building's ventilation systems.
- Improve employee wellbeing, performance and productivity (air quality linked to cognizance & productivity)



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Environmental Analytics and Room Occupancy reports

Use

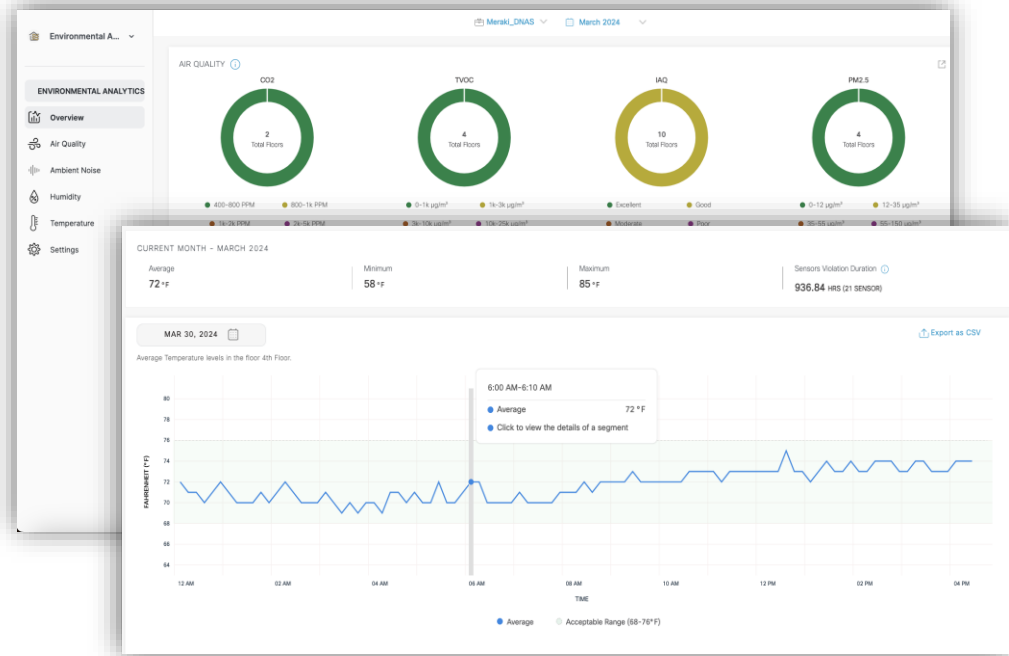
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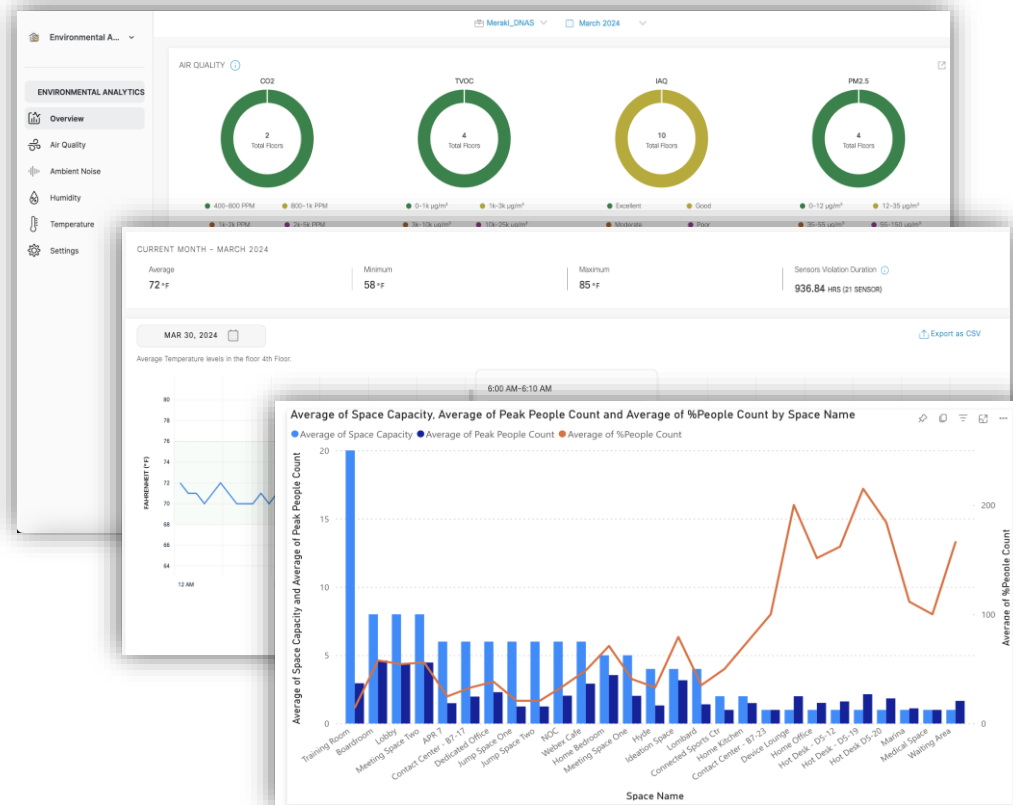
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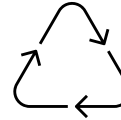
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Reuse: Product Takeback & Reuse Program

Simple, Secure, and Sustainable

Free removal and transport of equipment at customer end-of-use. Returned equipment is stored in a secure location and data is cleared from returned hard drives to protect data security. Cisco reuses and recycle nearly 100% of products that are returned.



Cisco Take Back

Available in 100+ countries
If equipment can be powered on



Send IT Back Mobile App

Available in EU, UK and US



Customer Recycling Solutions

Available globally; for equipment that cannot be powered on



Green Pay

Part of Cisco Capital

More here: <https://www.cisco.com/c/en/us/about/circular-economy.html>

Cisco Green Pay



Diego Zengin
CTO
at Cosentino Group

How Cosentino Is Financing Zero
Waste and Zero Obsolescence with
Cisco Green Pay

"We have embraced sustainability as a core value needed to consolidate our business model, which we hope is embraced by all players through the value chain."

- The company: 6k users across 170 international locations, rock-solid IT infrastructure that is **low waste, up to date**, and operates 24/7
- **Cisco Green Pay** is a new circular IT payment solution, it shifts equipment provision from an ownership model to a circular economy mode
 - Instead of buying the equipment outright, we signed a three-year payment agreement, at the end of which Cisco will refurbish, recycle, or reuse the equipment instead of sending it to a landfill.
 - Cisco replaces the devices with new, state-of-the-art equipment.

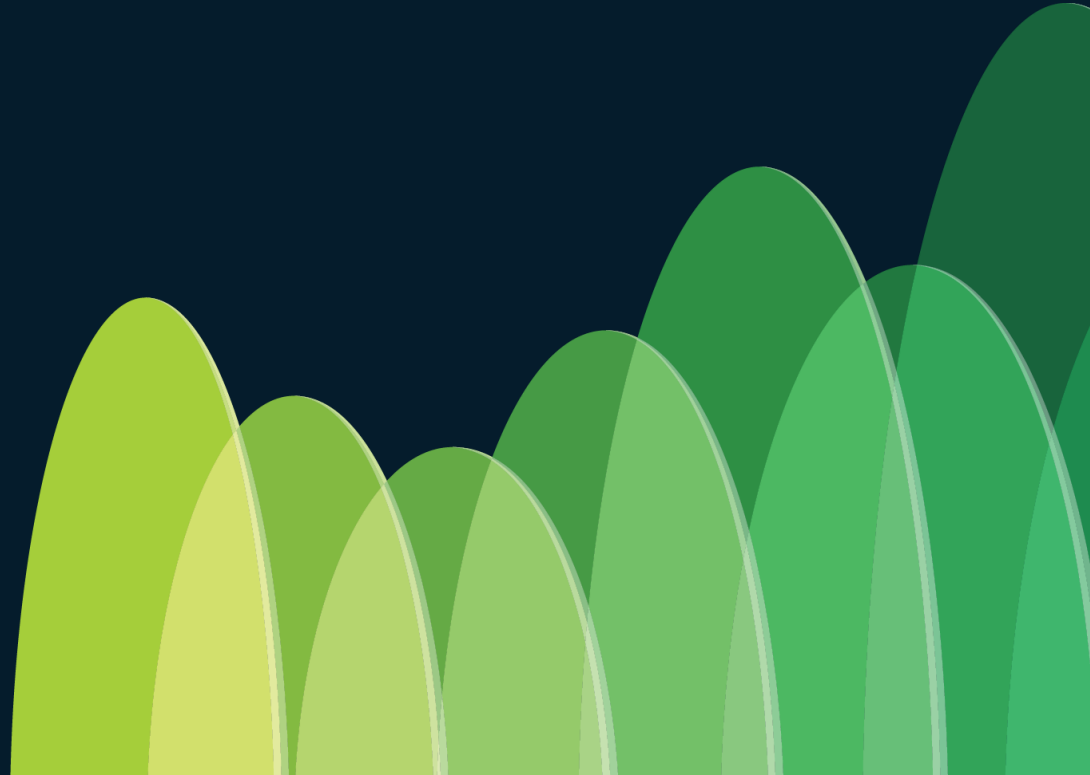
Available Countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, UK

Product Takeback: Simple. Secure. Sustainable.

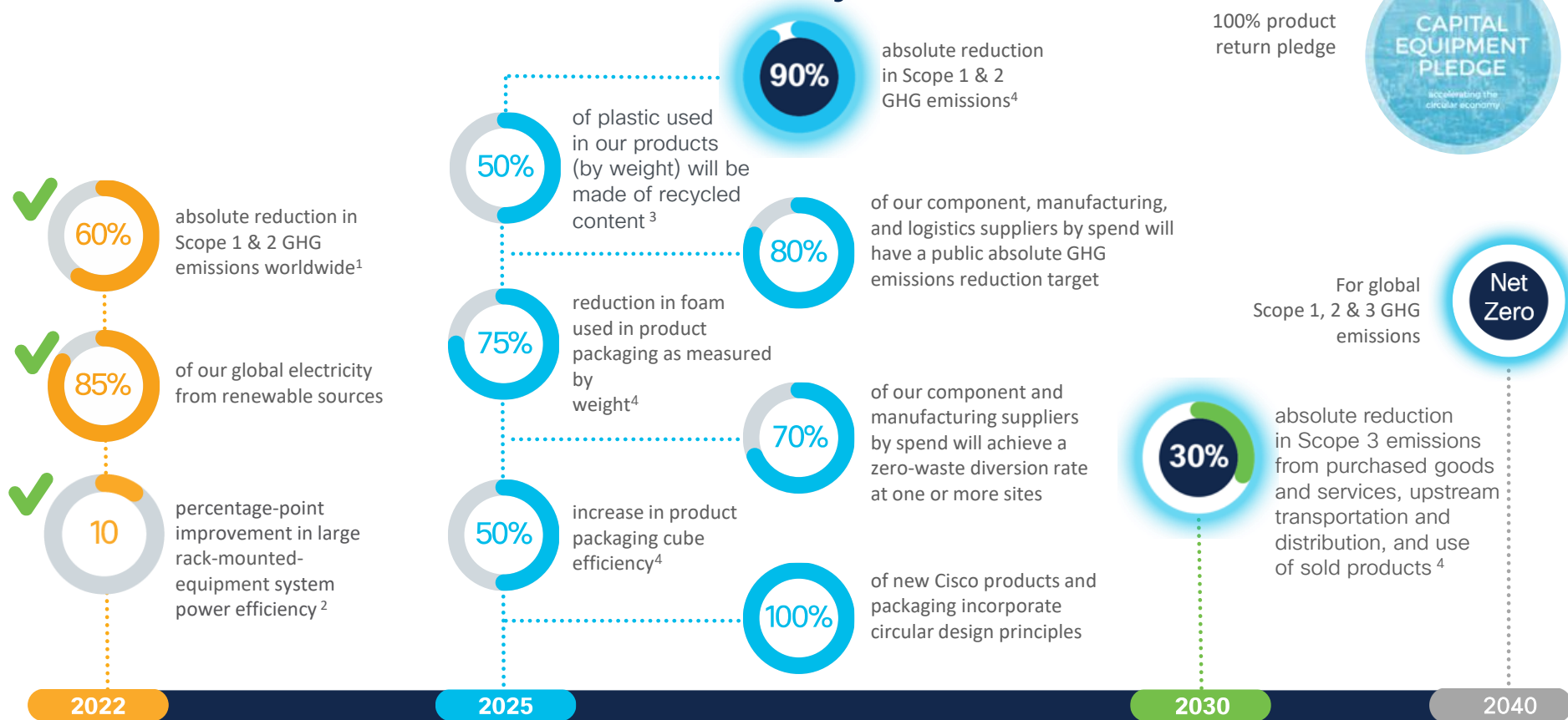
- Any Cisco customer, partner, or distributor can use the Product Takeback and Reuse program to return end-of-use Cisco equipment at no cost.
- The program is currently available in 100+ countries.
- Not sure where to start?
https://www.cisco.com/c/dam/en_us/about/takeback-and-reuse/product-takeback-decision-tree.pdf
- For more info visit the website:
<https://www.cisco.com/c/en/us/about/takeback-and-reuse.html>



What is Cisco commitment?



Cisco's Public Sustainability Goals



Goals

Cisco's Goal Net zero GHG emissions across our value chain by 2040

Our 2040 net-zero goals and near-term targets are approved by the Science Based Targets initiative (SBTi).

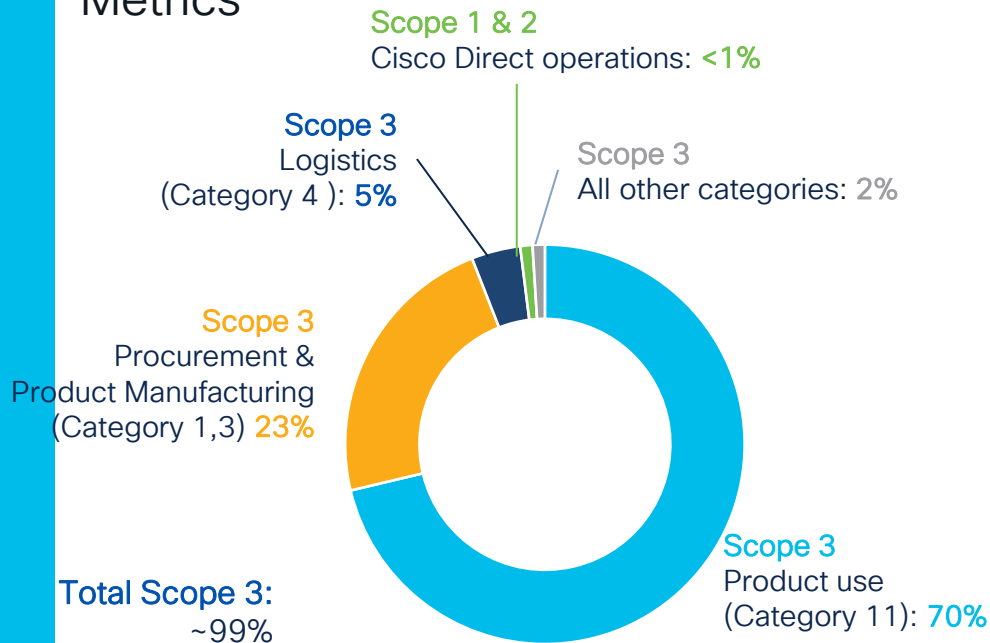


SCIENCE
BASED
TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

CISCO *Live!*

Metrics



Source: Cisco's Fiscal Year 2023
Scope 1, 2, and 3 GHG emissions



Cisco is recognized for ESG* leadership



“A List”

Member of
**Dow Jones
Sustainability Indices**
Powered by the S&P Global CSA

**World Index &
North America Index**

ecovadis

99th percentile

**Corporate
Knights
Global 100**

10+ years on index



#1
Green Supply Chain
Corporate Information
Transparency Index
(CITI) in IT sector
2021, 2022 & 2023



AA rating



#3

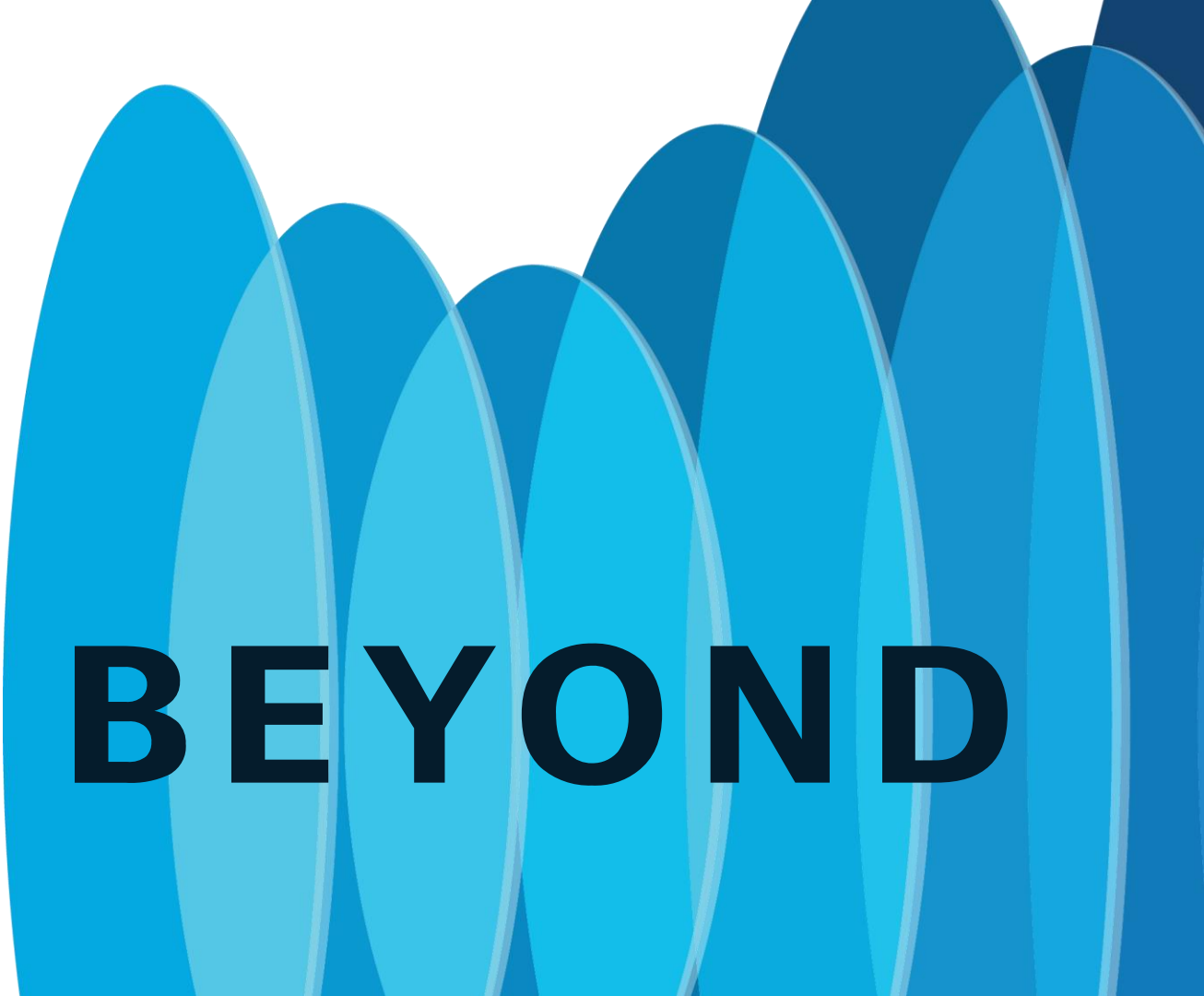
* ESG = Environmental Social and Governance

Current as of December 14, 2023

Source: [Cisco ESG Reporting Hub](#)

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GO BEYOND

The background of the slide features a series of overlapping, teardrop-shaped elements in various shades of blue, ranging from light sky blue to deep navy blue. These shapes are arranged in a way that creates a sense of depth and movement, resembling a stylized horizon or a series of waves. The overall composition is clean and modern, with the text elements clearly legible against the white background.