



The bridge to possible

Saving Energy and Money with Your Cisco Wireless Network

Simone Arena, Distinguished TME
Cisco Wireless

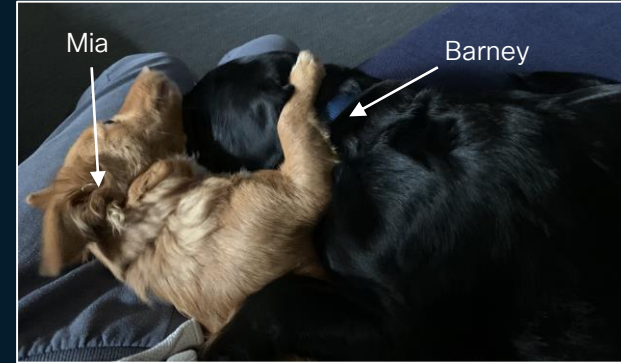
BRKEWN-2043

CISCO *Live!*

#CiscoLive



cisco *Live!*



The Boss, what else??



Tube amplifier



Querciabella Chianti
Classico Riserva 2019



Fiorentina soccer fan

Cisco Webex App

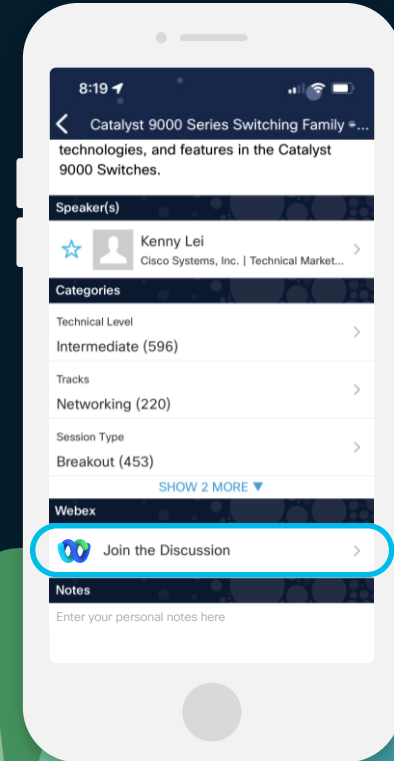
Questions?

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 7, 2024.



It all started 7000 Years Ago....



There is
NO Planet B

A hand is holding a rectangular piece of cardboard with the text "There is NO Planet B" written on it. The words "There is" and "Planet B" are in blue paint, while "NO" is in red. A thick red horizontal line is drawn across the bottom of the sign. The background is blurred, showing a large yellow balloon and other people at what appears to be a protest or rally.

Why now?

63%

sustainability
is a business
priority



37%

have formulated their
targets and goals



Enabling Sustainability Through Investments in Technology Is
Critical to Driving Business Value, IDC, 2023

Why now?

66%

of customers willing to
pay more for products
manufactured
sustainably

*Nielsen's Global Corporate
Sustainability Report*

49%

of purchasing
decisions influenced
by manufacturer's
sustainability efforts

AT Kearney

up to 10%

sales increase in
response to
manufacturer greater
sustainability

Accenture



ORANGE VELODROME

- 1041 APs
- 43 switches

This infrastructure is turned on day and night and 365 days per year and consumes **105 MWh** for only **30 days** of use.

Goal:

- Cut network equipment energy consumption by 50%
- Save 70K€/year on energy bill
- Significant reduction in MWh and CO2 emission

Solution:

- Turn off APs and switches in unused areas
- Possibility to turn off the network infrastructure dynamically depending on presence
- More here: <https://www.youtube.com/watch?v=8Y5kD9VEJzI>



Wrexham County Borough Council

Rethinking IT infrastructure to reduce cost and carbon emissions across 70 schools

Wrexham County Borough Council

- 1100+ Meraki MR Wi-Fi 6
- 250 Meraki MS switches

Wrexham is the fourth-largest city in Wales. Wrexham County Borough Council (WCBC) manages 70 schools, used by 20k students.

Goal:

- WCBC itself wants to be carbon neutral by 2030
- Future-proofs the schools' networks to reduce energy use and enable smart building management

Solution:

- Using WiserWatts* and MS port schedules, the network starts-up at 7:30am, and switch off at 8:30pm
- £22,000 in potential cost reductions for fiscal year 2023/2024
- Expected annual reduction of ten metric tons of CO₂e

More here: <https://meraki.cisco.com/customers/wrexham-county-borough-council/>

* in partnership with

CAE
TECHNOLOGY ON POINT

Where to start?

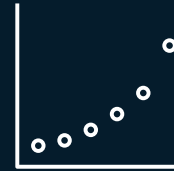


Sustainable Goals



<https://sdgs.un.org/goals>

cisco *Live!*



Metrics



Data

Goals

Cisco's Goal

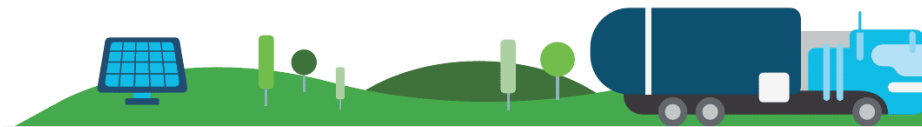
Net zero GHG emissions across our value chain by 2040

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

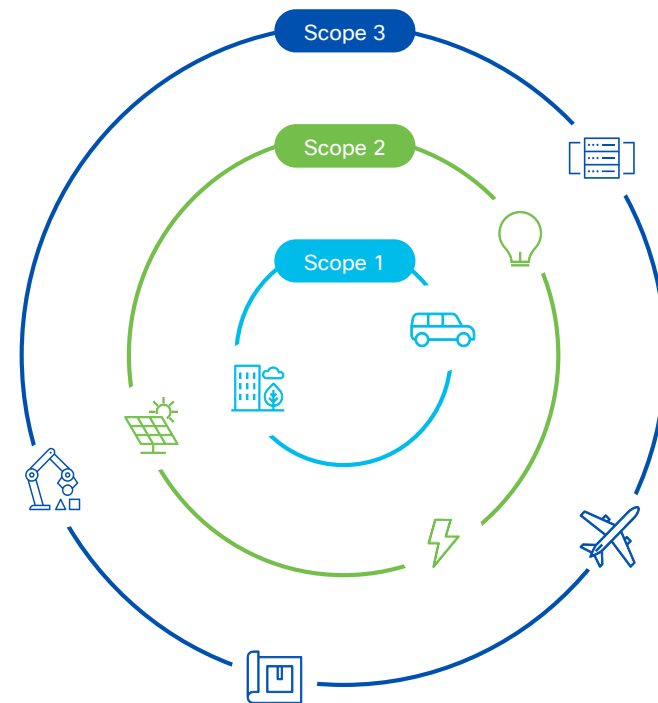
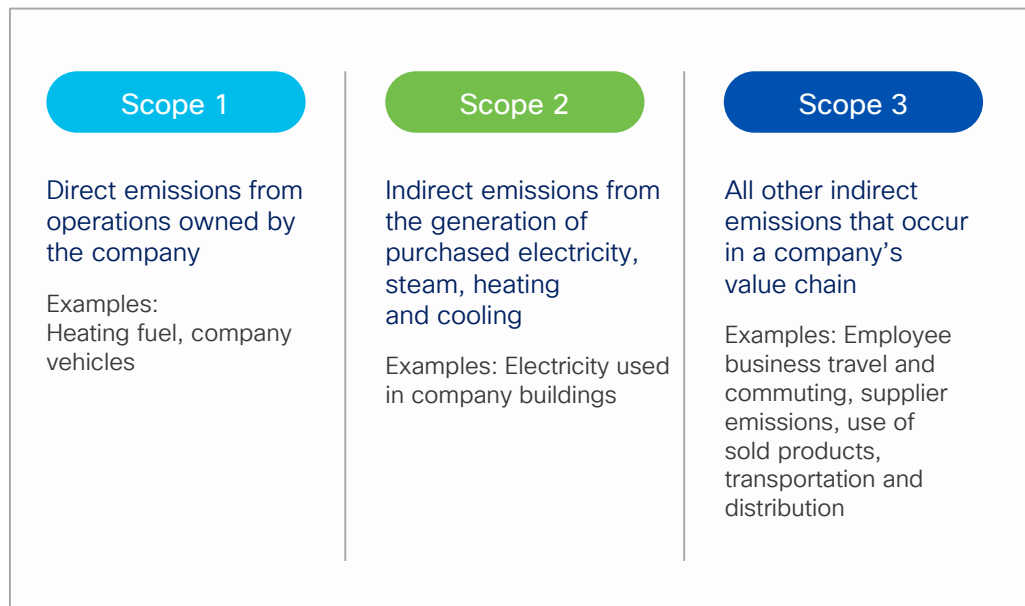


DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

CISCO *Live!*



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



Goals

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

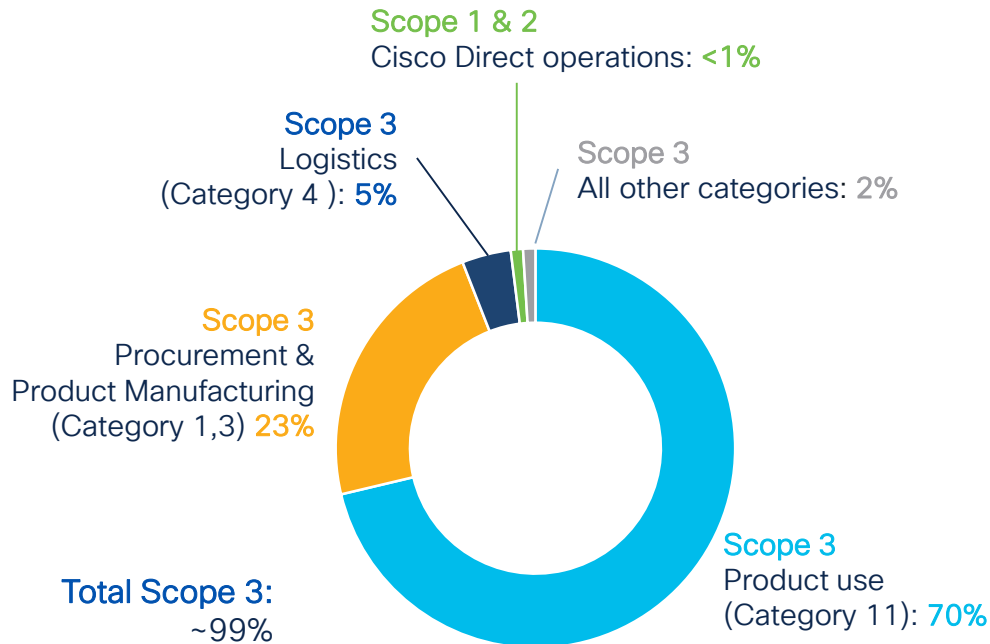
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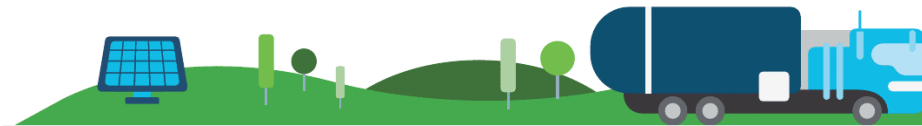
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

CISCO *Live!*

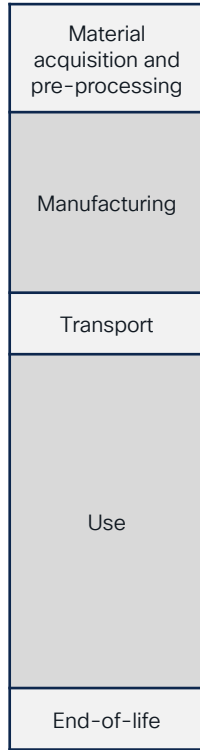
Metrics



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



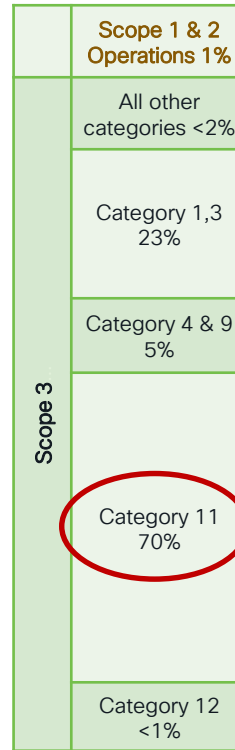
Product Carbon Footprint (PCF)



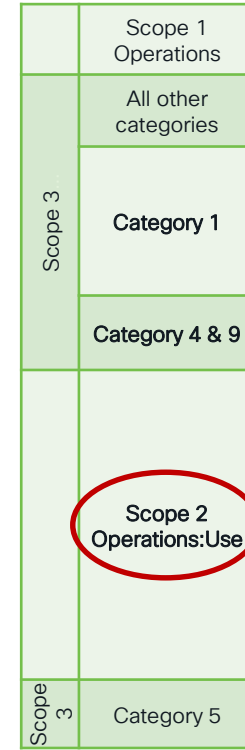
PCF



Cisco and customer's GHG inventory



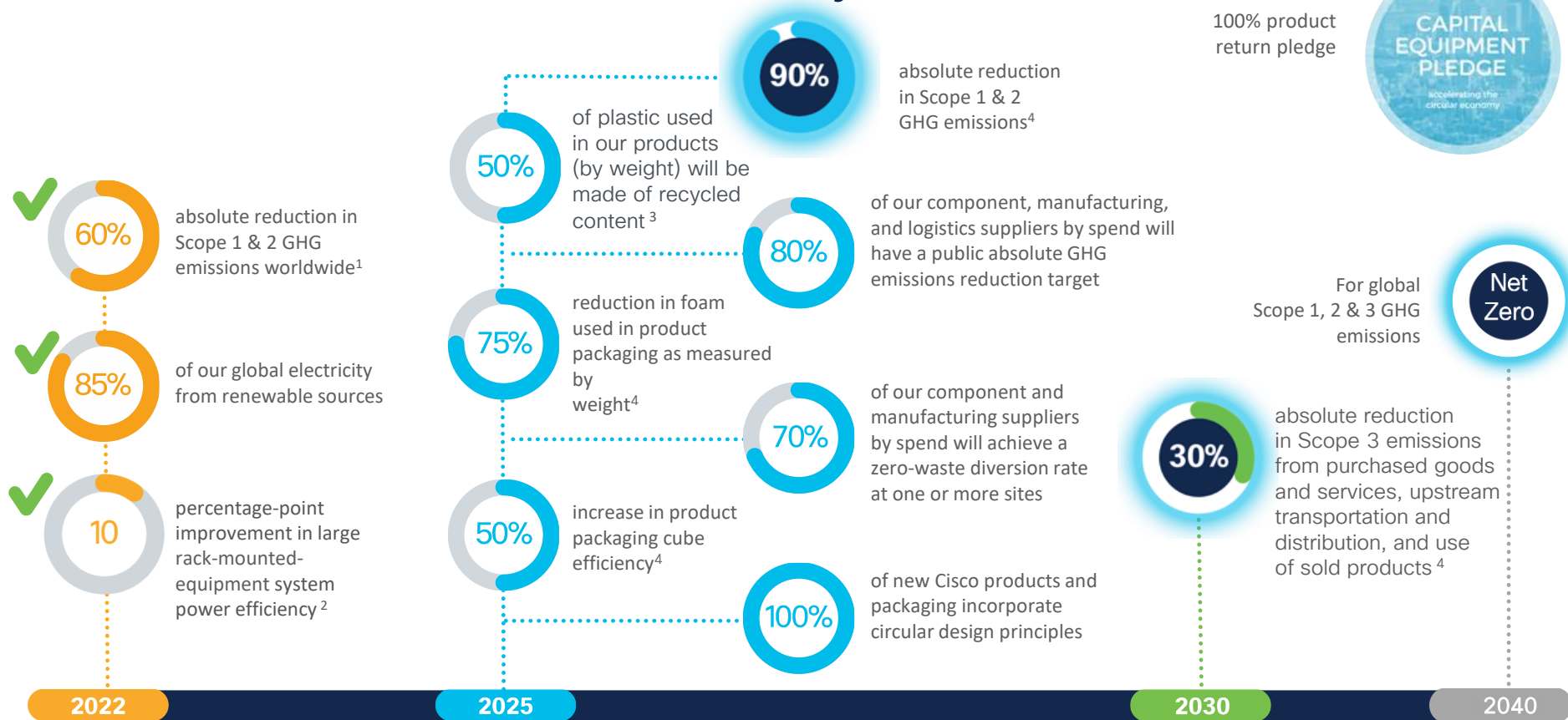
Cisco's GHG Inventory



Customer's GHG Inventory



Cisco's Public Sustainability Goals



¹ FY07 base year
² FY16 base year

⁴ FY19 base year

³ Excluding those contained in commodity components sourced from suppliers (e.g., plastic screws, fans, and cables)

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

#2

**Gartner Supply
Chain Top 25**



#1

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

MSCI
ESG RATINGS



CCC B BB BBB A AA AAA

AA rating



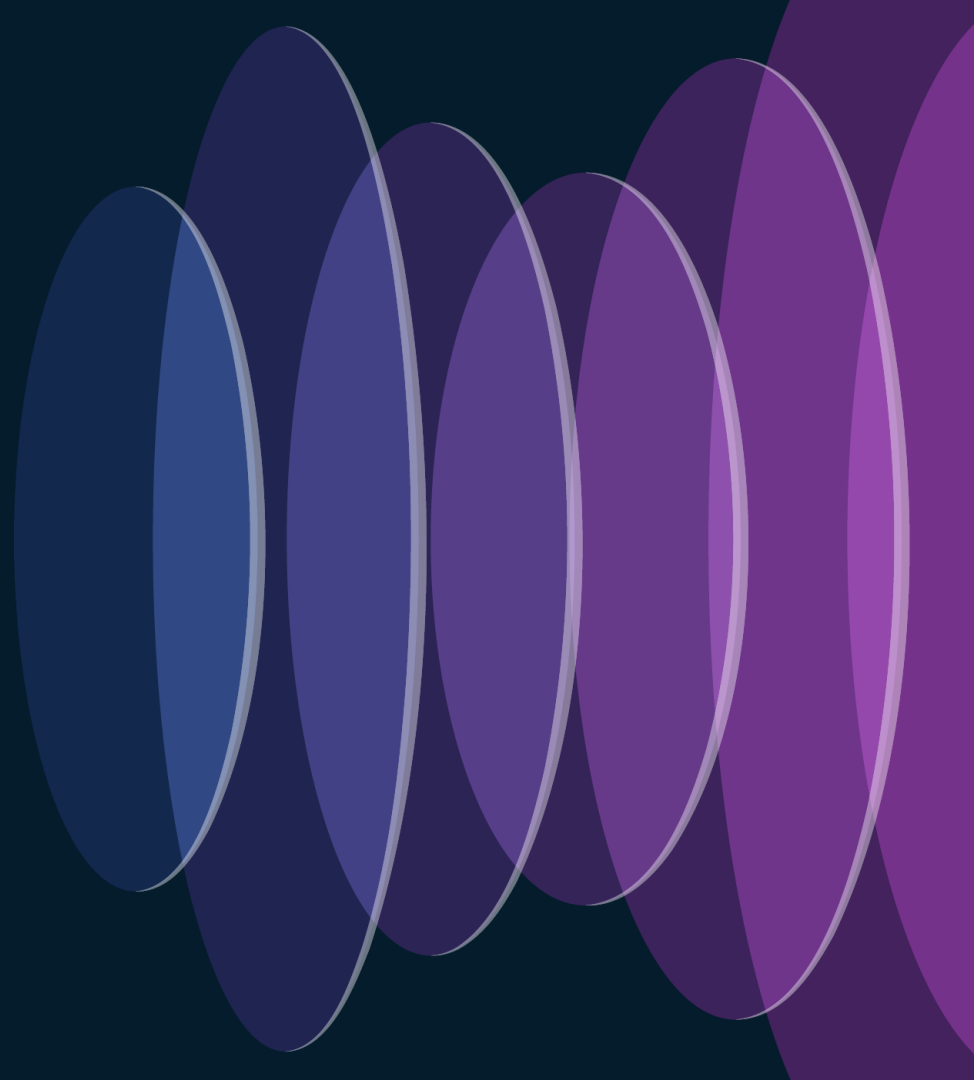
#3

* ESG = Environmental Social and Governance

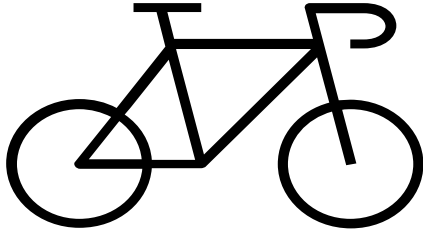
Current as of December 14, 2023

Source: [Cisco ESG Reporting Hub](#)

Sustainability: The role of data

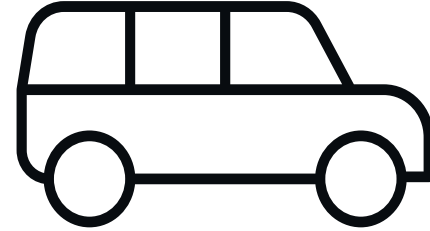


What does generate more CO₂?



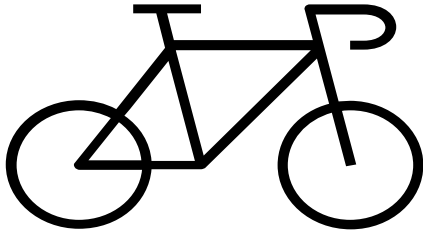
cycling a mile

?



driving a mile

What does generate more CO₂?



cycling a mile

40g CO₂e powered by bananas

170g CO₂e by cereal & milk

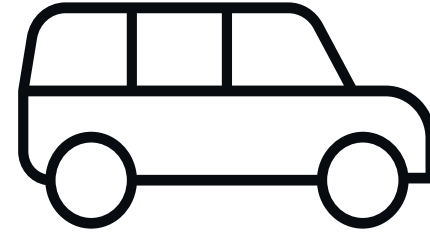
640g CO₂e by cheeseburgers

3.2kg CO₂e by airfreighted asparagus

+

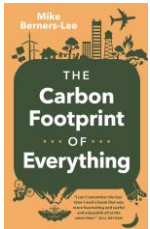
10-100g bike embodied carbon

=



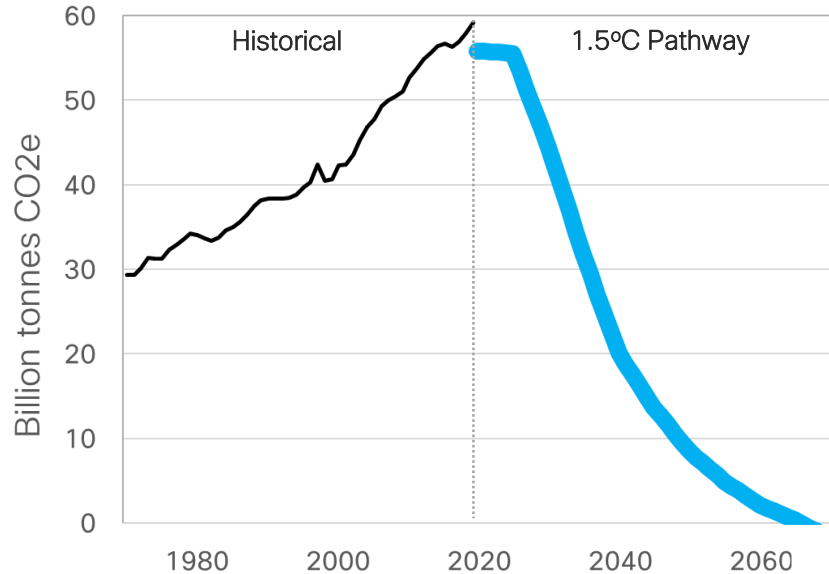
driving a mile

source: **The Carbon Footprint of Everything**
by Mike Berners-Lee



What is the role of the Network and IT?

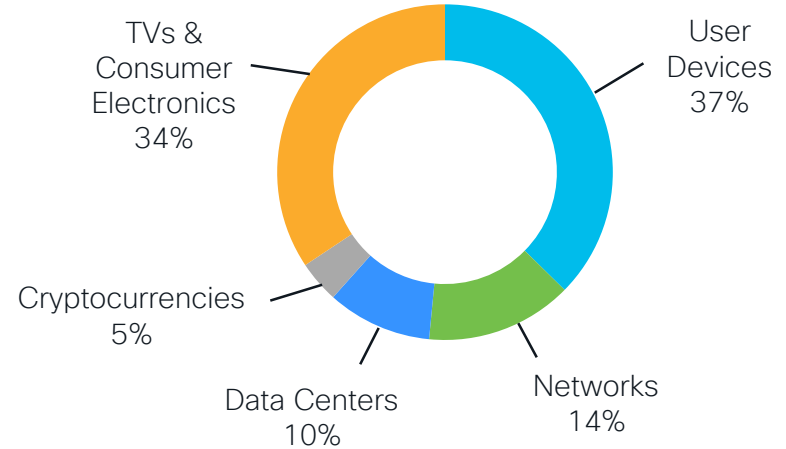
Total GHG emissions
~60 Billion tonnes CO₂e



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)



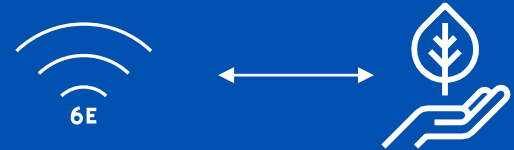
Digital = ICT + Entertainment & Media

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

What is the role the Network and IT?

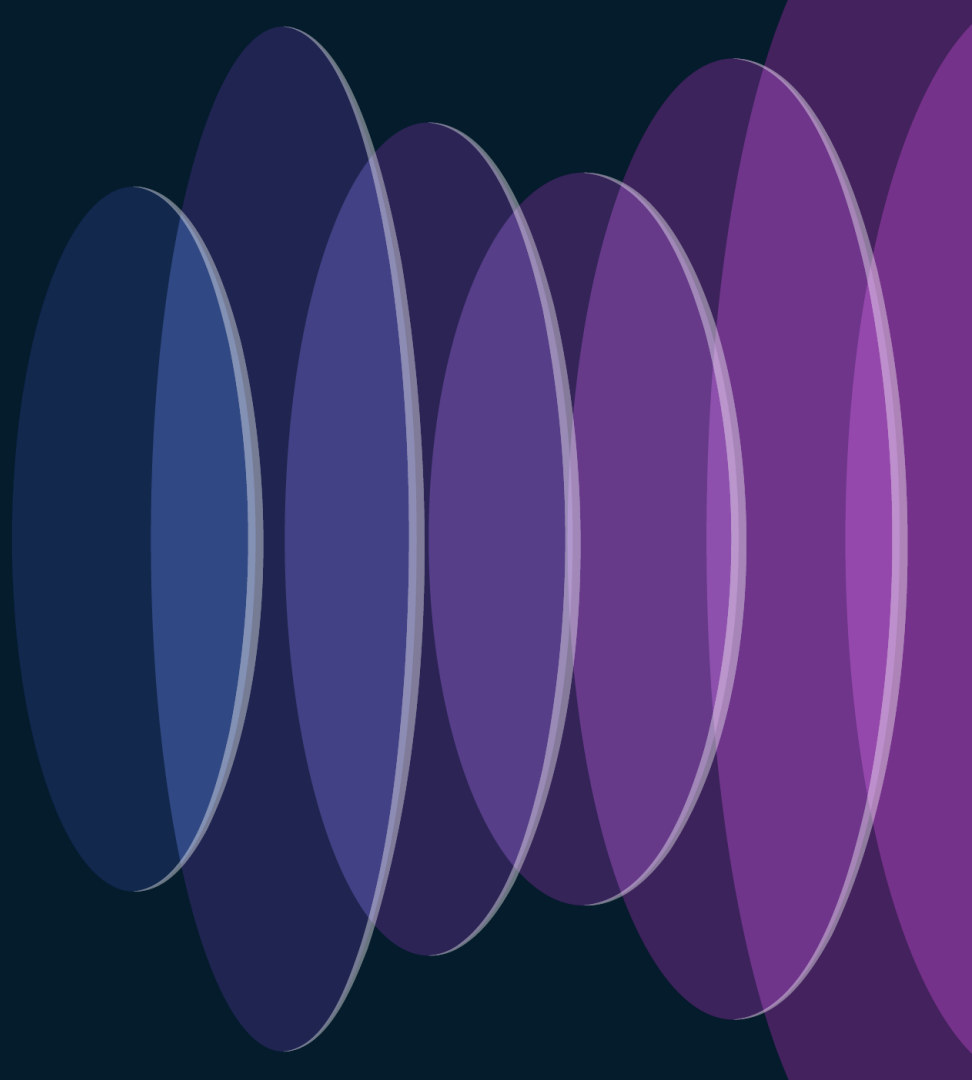
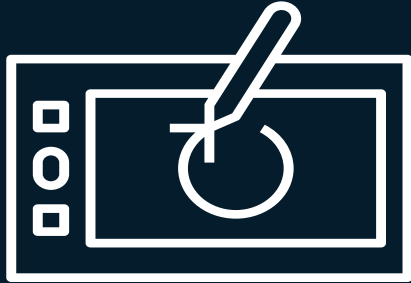


IT plays a bigger role than you think in Sustainability and NetZero strategy



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

Circular Design for Cisco Wireless

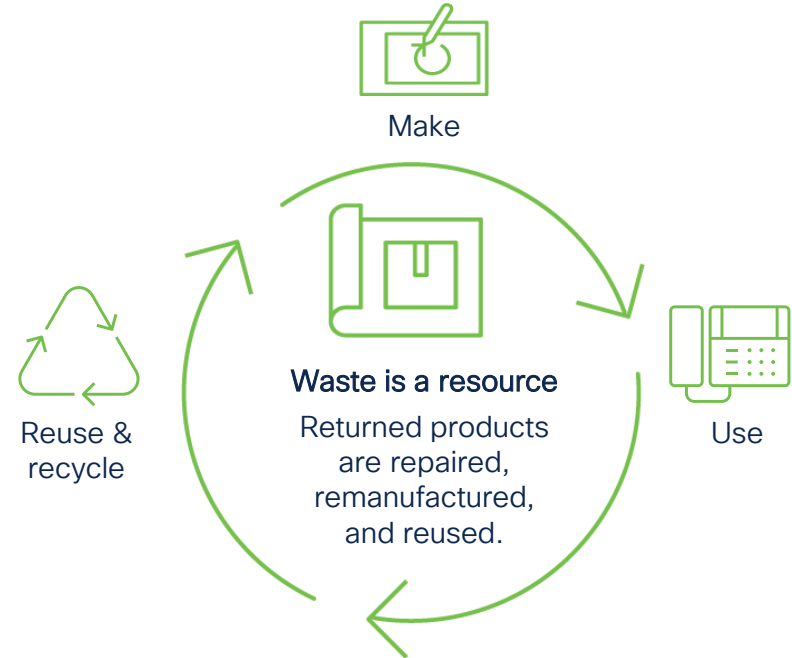


Circular Design

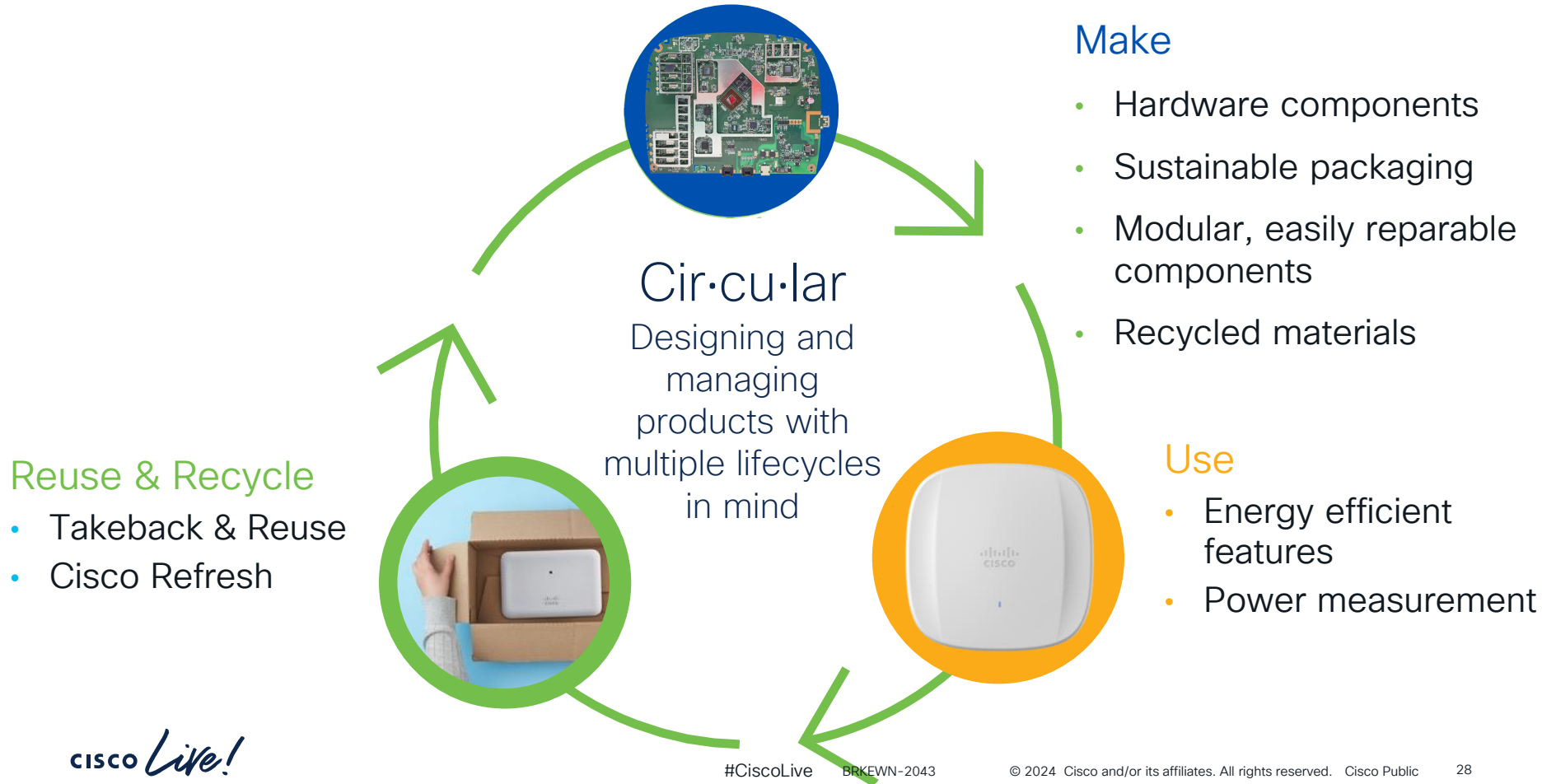
Linear Design



Circular Design



Designing for Circularity



Not all APs are created equal!

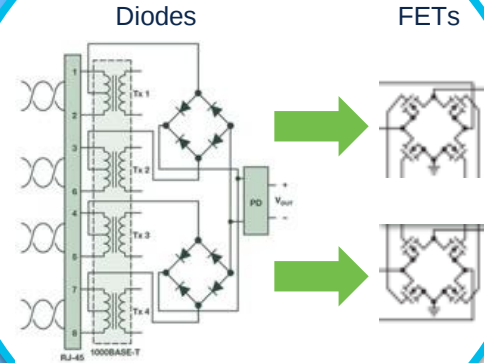
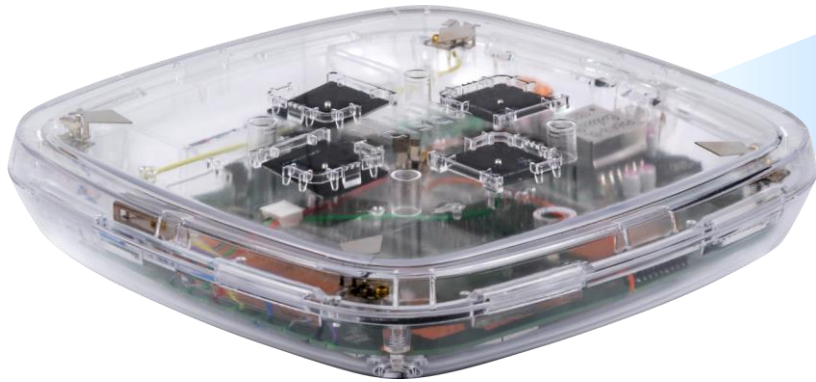
Printed Circuit Board Design



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



Not all APs are created equal!



Every Watt, or fraction of a Watt matters!

Not all APs are created equal!

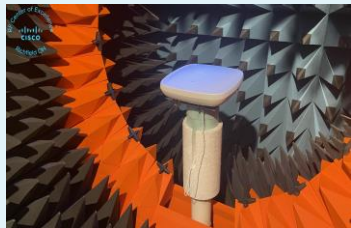
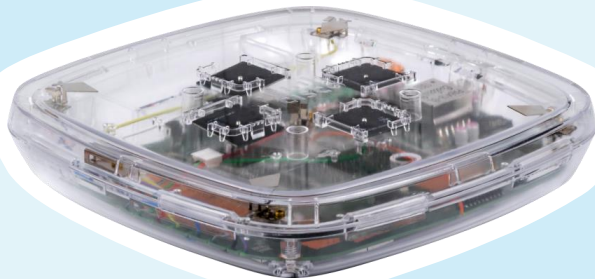
Printed Circuit Board Design



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Antenna Design and Prototype

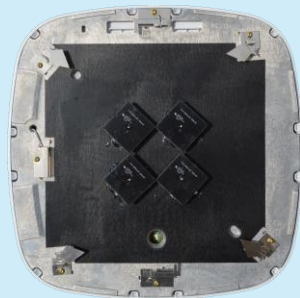
- No off-the-shelf components
- Radio Frequency (RF) Design
- Cisco Custom Antenna Designs and Characterizations



- 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
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Antenna Design and Prototype

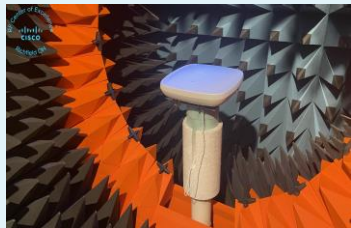
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RF Excellence

=

Power Efficiency

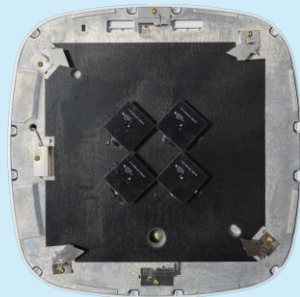


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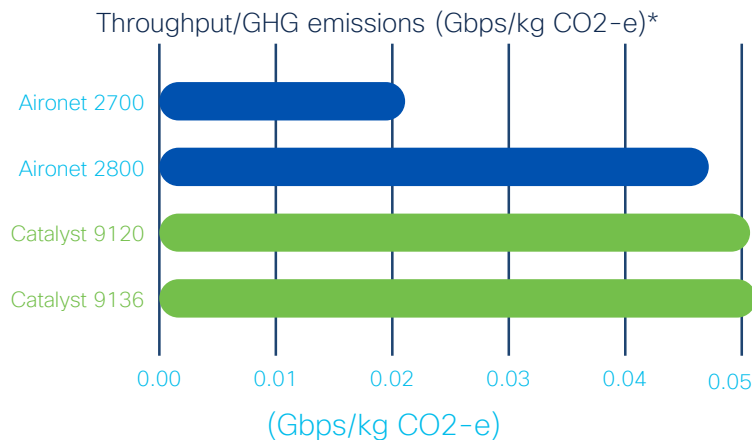
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Housing design & Antenna Layout

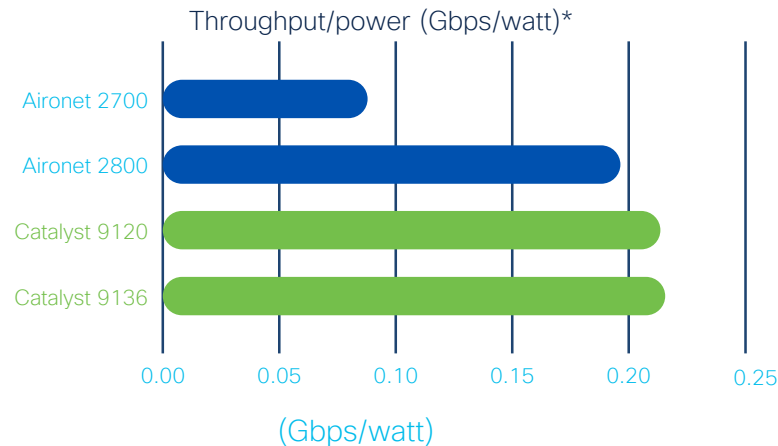


Throughput efficiency has improved with each new generation of Catalyst APs

Make



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



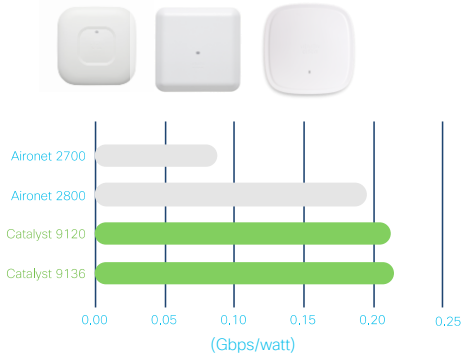
Throughput efficiency relative to power (W) required in the Catalyst series

(*) based on internal testing

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

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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*



* Catalyst mode 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 for existing Catalyst APs and accessory kits, with paper packaging.

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



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Wi-Fi 6E APs

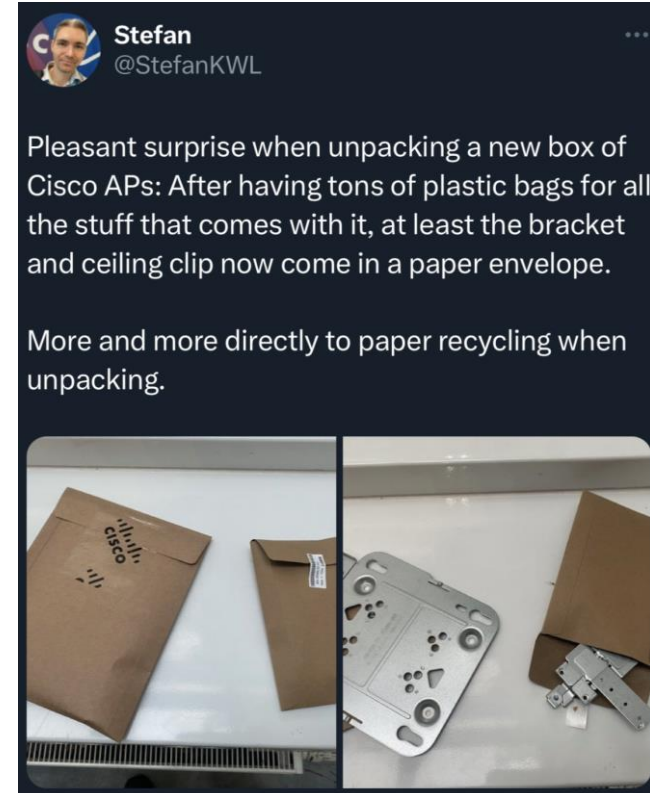
CW9162
CW9164
CW9166
CW9166D1

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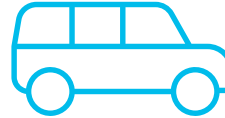


Sustainable Packaging – CO₂ Savings

88 tons
of CO₂
saved



CO₂ emission from **9,711,007**
smartphone charged



GHG emission from **204,654**
driven miles by average
gasoline-powered car



CO₂ emission **15.5 homes'**
electricity use for one year

Source: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

Catalyst CW9800M Wireless Controller



1/10/25G Uplinks

32,000 Clients

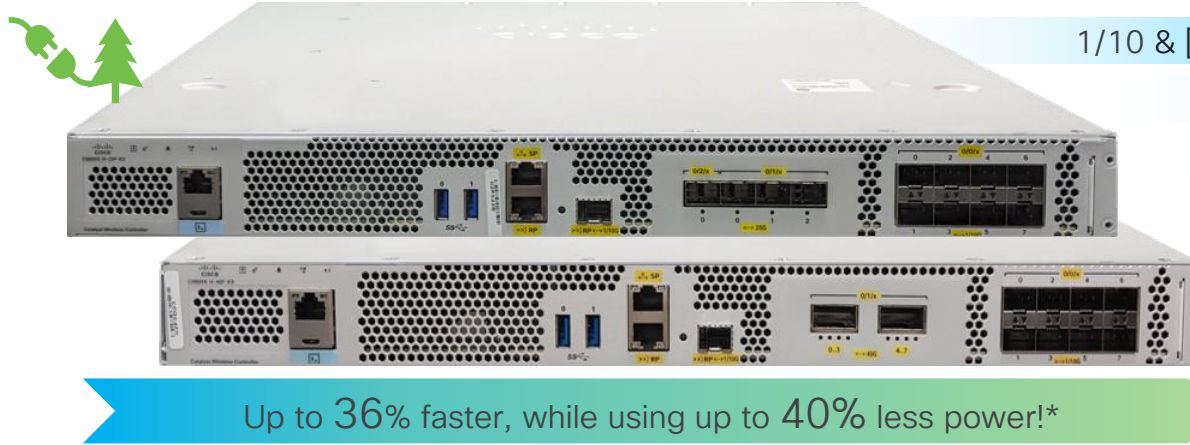
3,000 APs

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 (*)

(*) based on internal engineering testing
Throughput tests consist of bi-directional (simultaneous 50% up/down) "IMIX" real-world traffic, with 50% load on CPU and 80% load on the data plane

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

Cisco Catalyst Wireless 9800: new packaging



Before

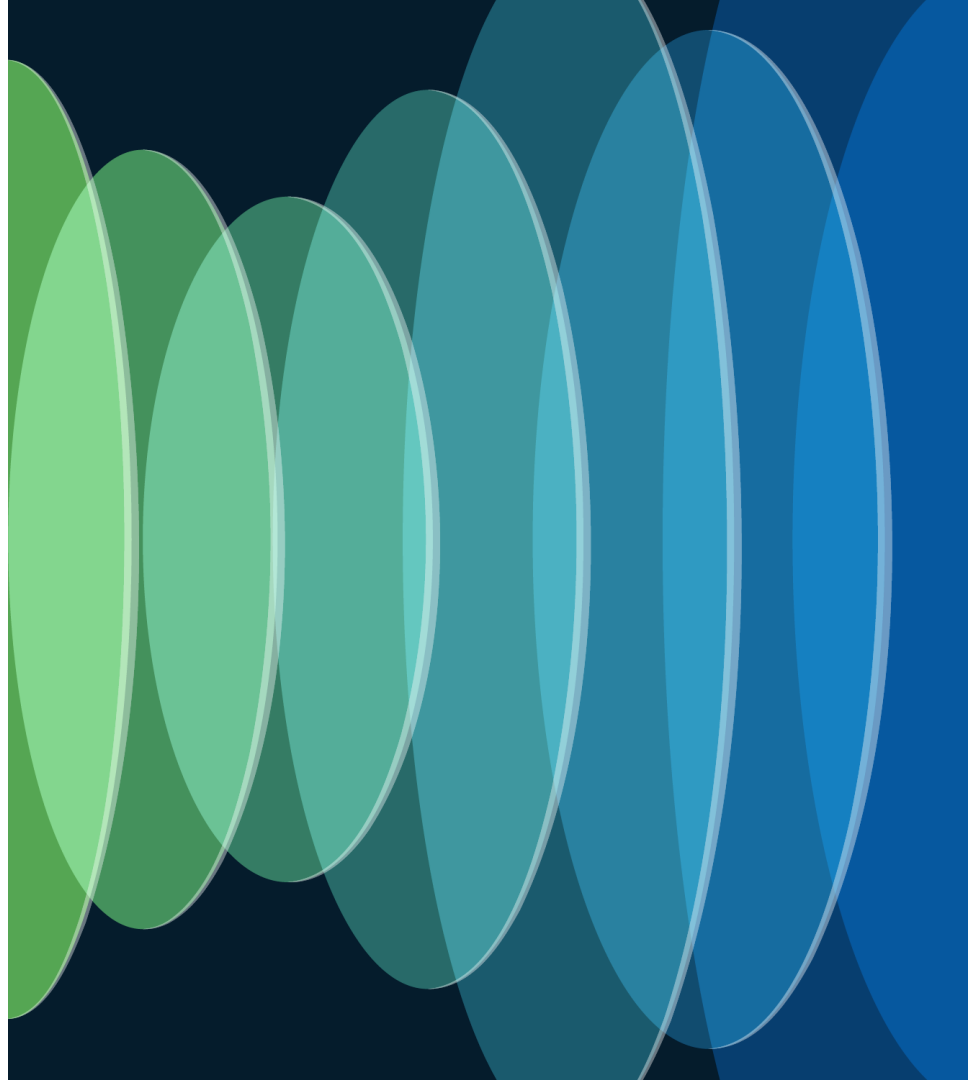
- PE Foam for top and bottom (16 oz)
- Large accessory tray
- 10 units per pallet



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 and re-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.

Calendar Power Profiles (3)				Add	
Search table					
0 selected Edit Delete					
☐	Power Profile Name	Recurrence	Schedule (1x Power Profile Enabled 1x Power Profile Disabled) As of Today @ 2:10 PM (PST)		
☐	Default_Profile_02	Weekly	Monday, Tuesday, Wednesday, Thursday, Friday	Start Time: 5:00 PM	End Time: 11:59 PM
				8:00	4:00 8:00 12:00 16:00 20:00 24:00
☐	Default_Profile_03	Monthly	2nd, 3rd, 4th, 5th, 10th, 11th, 12th, 13th, 14...	Start Time: 8:00 PM	End Time: 10:00 PM
				8:00	4:00 8:00 12:00 16:00 20:00 24:00
☐	Default_Profile_04	Daily		Start Time: 12:00 AM	End Time: 6:00 AM
				8:00	4:00 8:00 12:00 16:00 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)

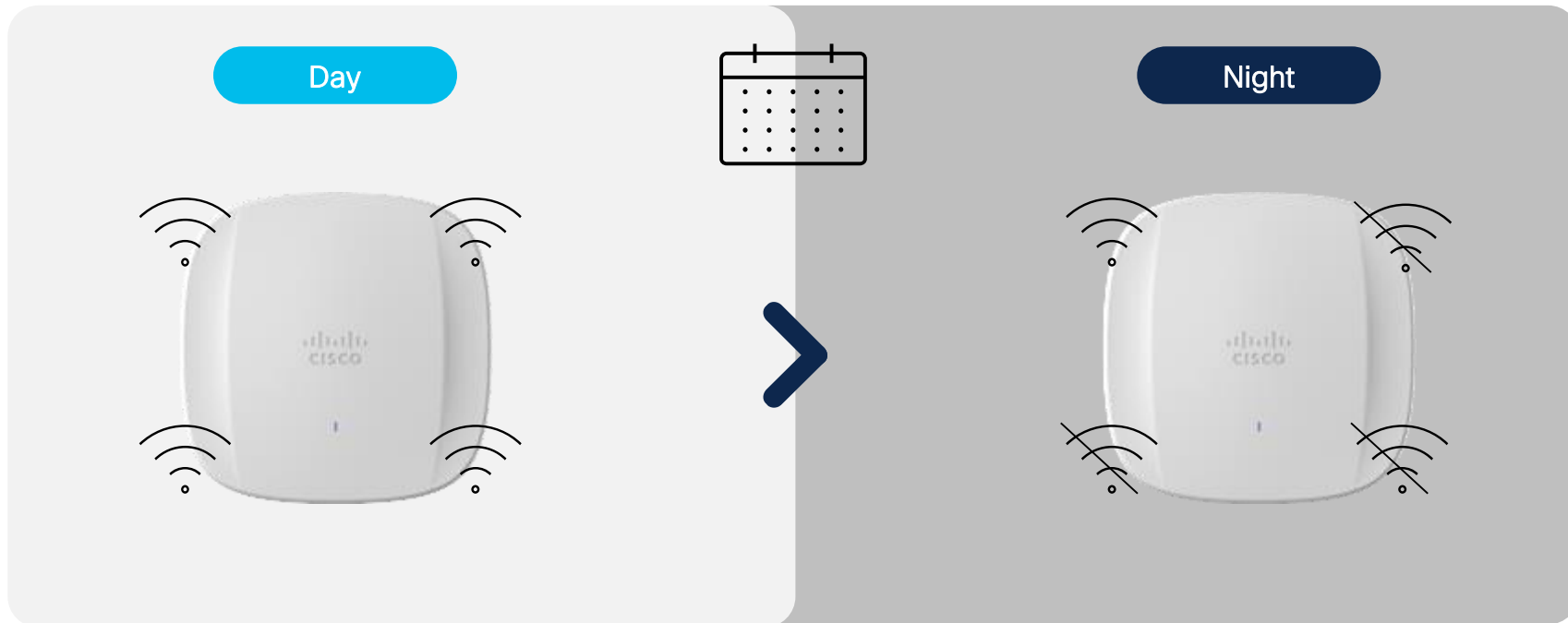
CISCO Live!

AP Power Optimizations Feature Suite

AP Power Save

Use

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 Optimizations Feature Suite

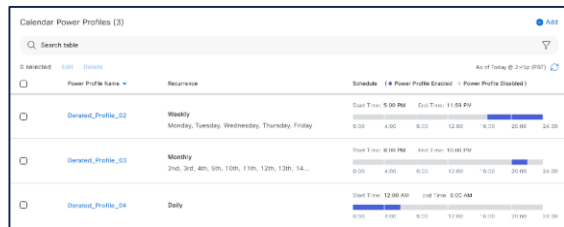
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IOS-XE 17.8

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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.
- Power Savings, Money Savings, Emissions Reductions.
- 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 2.3.9

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?

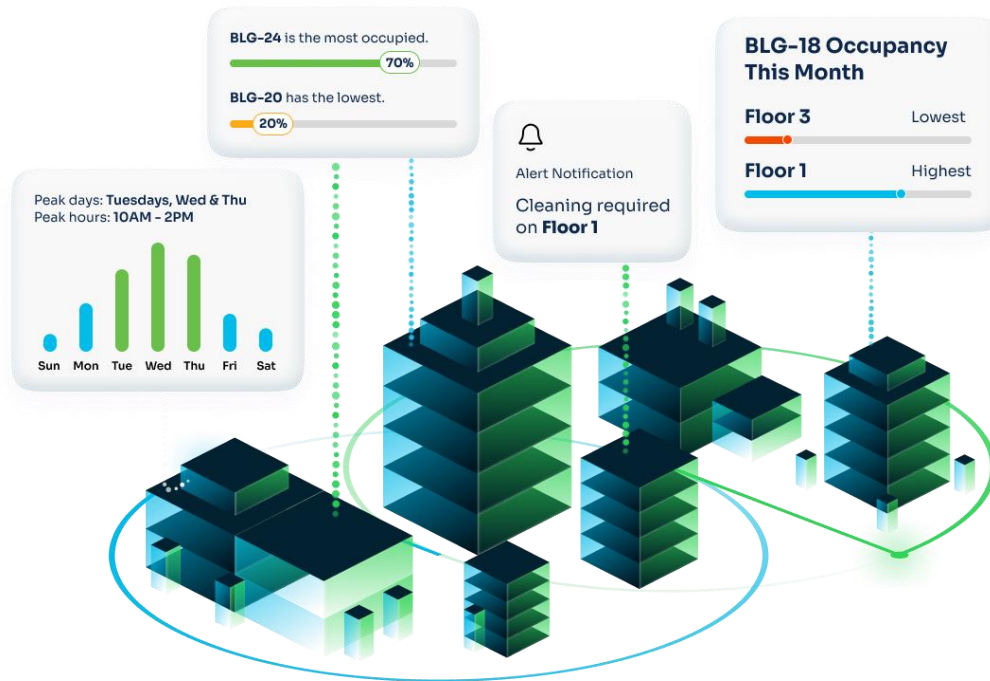
Do you know when your buildings are busiest? What time of the day and what day of the week?

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?



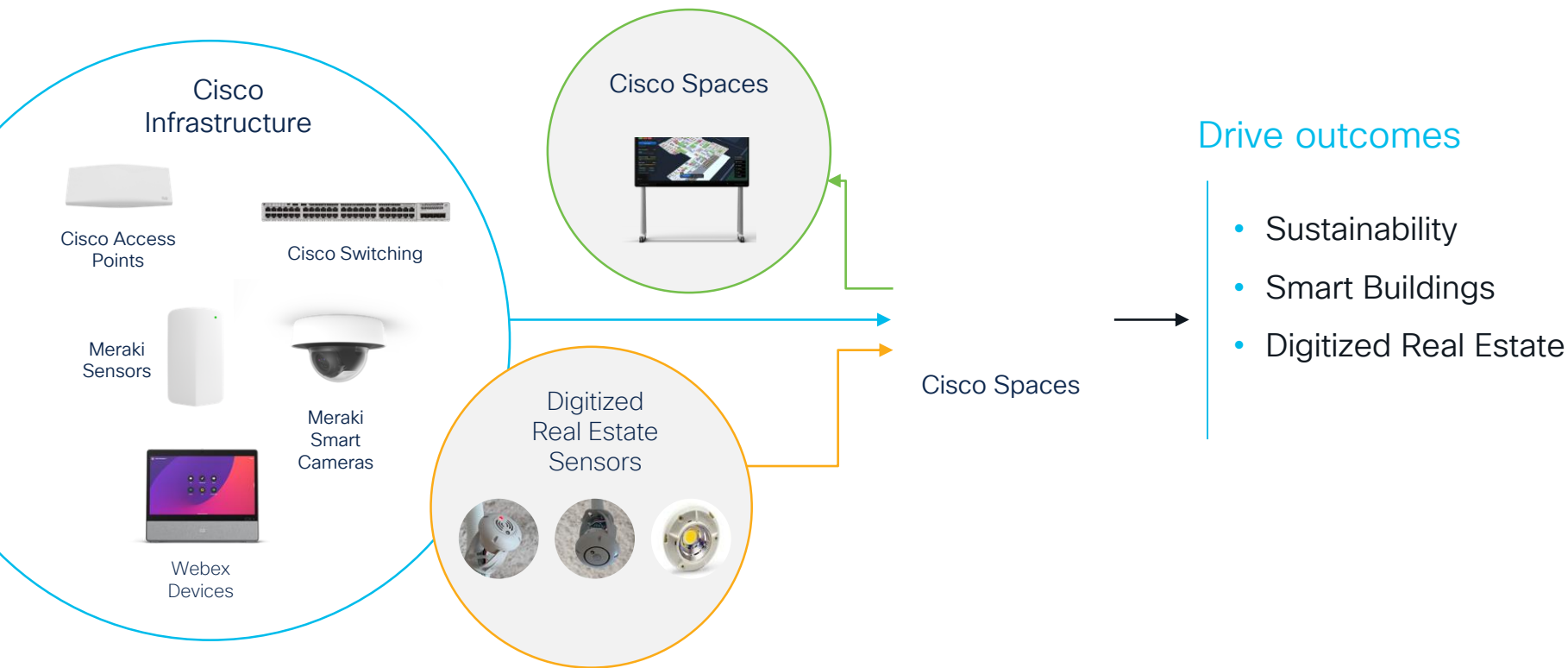
[Calculate your potential energy savings with Cisco Spaces using our Sustainability calculator](#)



Cisco Wireless + Cisco Spaces

Use

An easy way to get started on your Sustainability Journey



cisco Live!

Cisco Wireless + Cisco Spaces

Environmental Analytics and Room Occupancy reports

Use

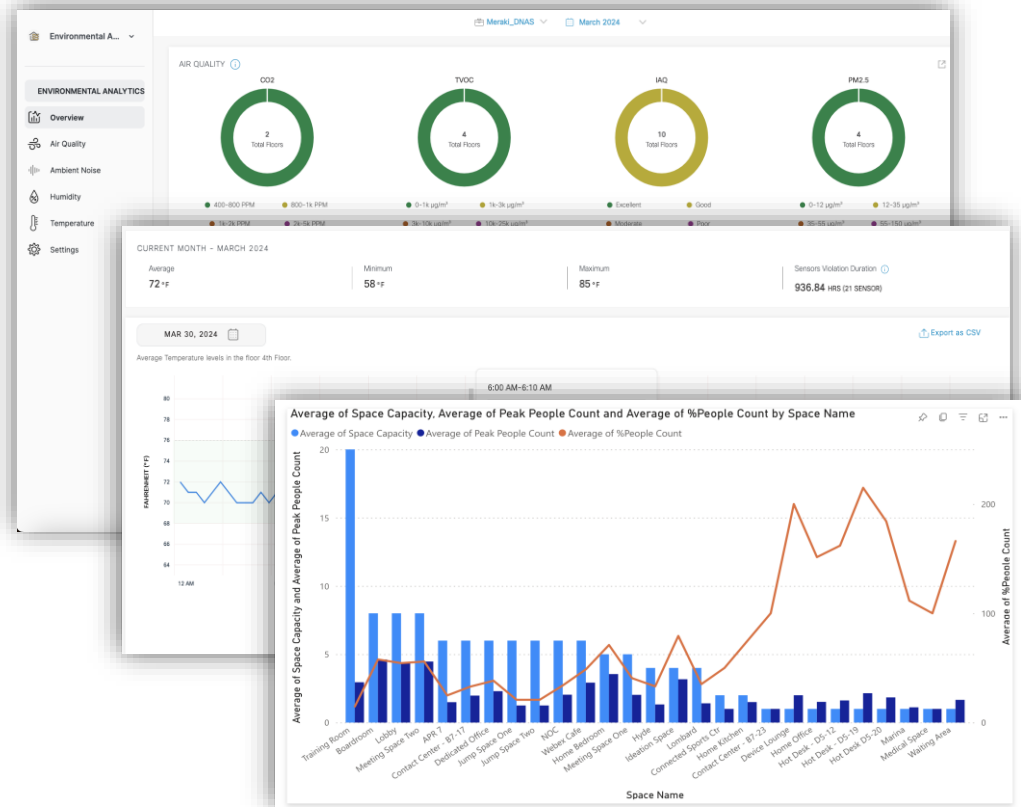
Aggregated view of all your environmental sensors

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)

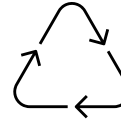


cisco Live!

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

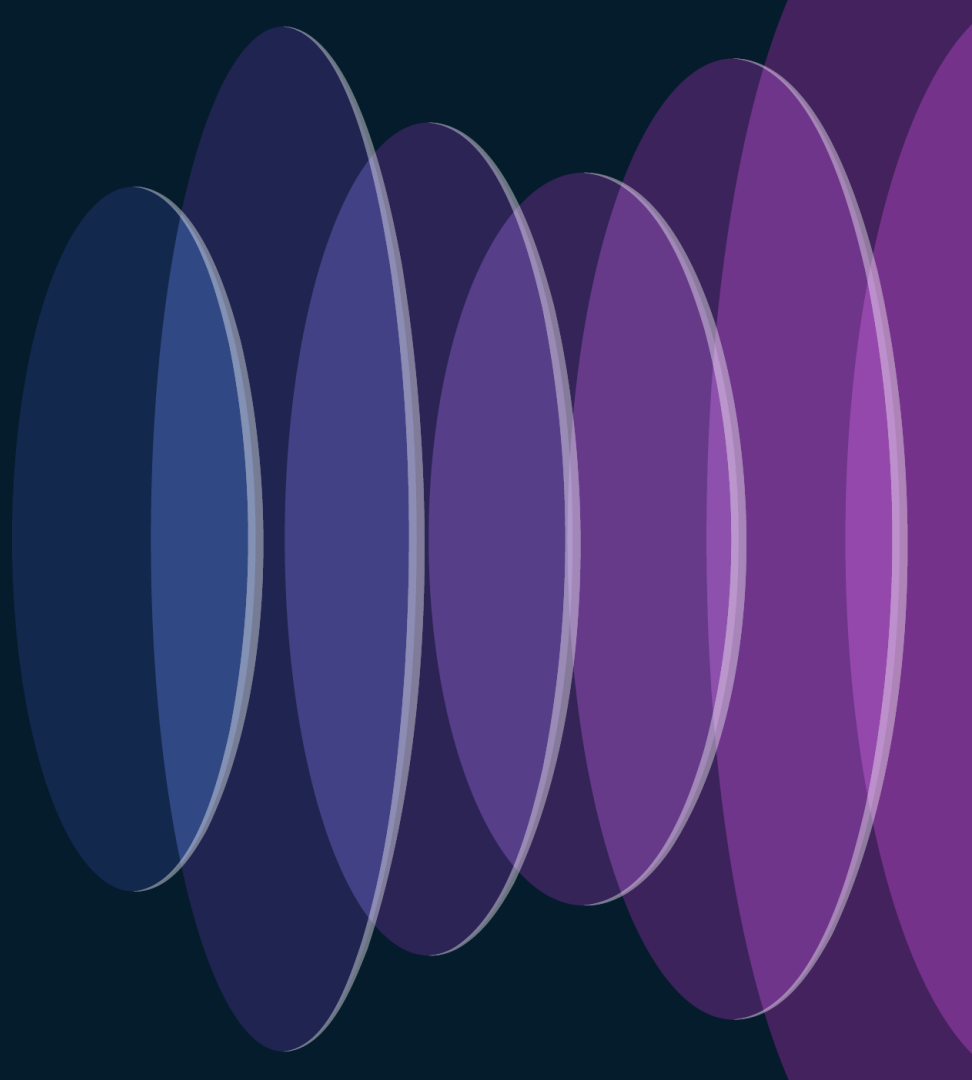
https://www.cisco.com/c/en/us/about/circular-economy.html?socialshare=lightbox_takeback#~programs

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>



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.



(*) 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...

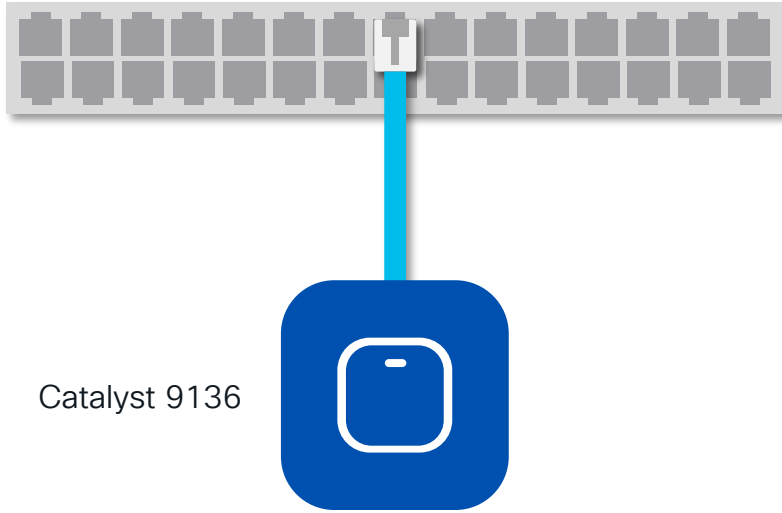
What are the Cisco Best Practices to implement power saving modes?

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



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	Max PoE Power Consumption
	802.3bt (UPOE)	4x4	4x4	4x4	5 Gbps	Y (4.5W)
	802.3at (PoE+)	4x4	4x4	4x4	5 Gbps	N
	802.3af (PoE)	-	-	-	1Gbps	N
	DC power	4x4	4x4	4x4	5Gbps	Y(4.5W)

- Not official testing, this is my home lab 😊
- CW9166 power measured via the switch:

```
3560-CX#sh power inline gig 1/0/4 detail | i Measured
```

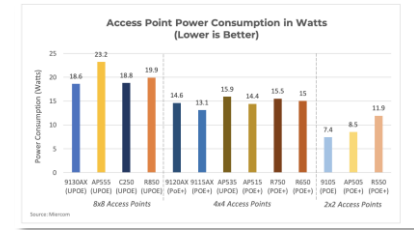

Measured at the port: 12.3
- AP in idle (no clients): **12.3 W/h**
- AP with #4 clients (no traffic): **12.5 W/h**
- AP with #4 clients doing speed test: **13.66 W/h**
- “Typically” CW9166 would consume between 12.3 and 25.5 W/h (assuming no USB)

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** > Catalyst Wi-Fi 6 and 6E 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:

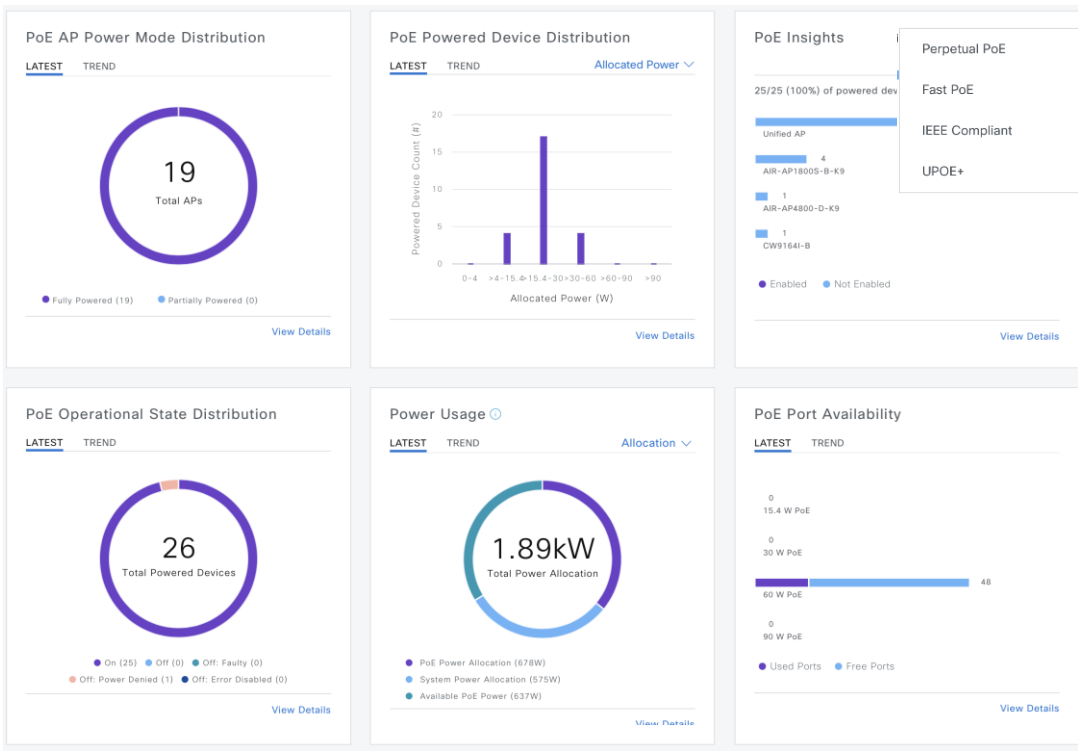
```
3560-CX#sh power inline gig 1/0/3 detail | i Mea
```

Measured at the port: **12.8**

Radios off

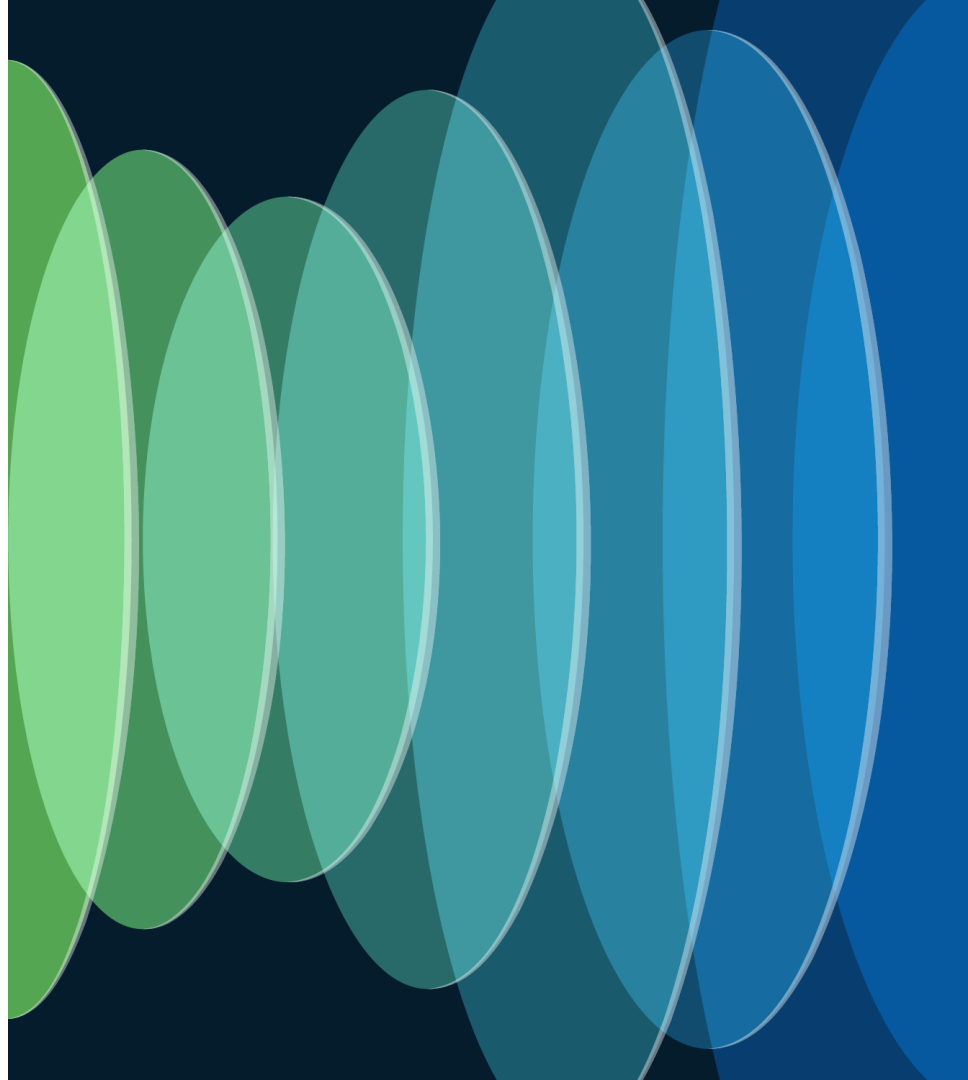
> save **1.6 W - 11%**
(over idle)

PoE Power Management In Catalyst Center Dashboard



- Monitor Catalyst switches and PoE enabled devices power consumption
- Provides information such as:
 - Used power, remaining power, and power usage
- Monitor switch's power budget
- Relay on streaming telemetry from Catalyst switches to Catalyst Center

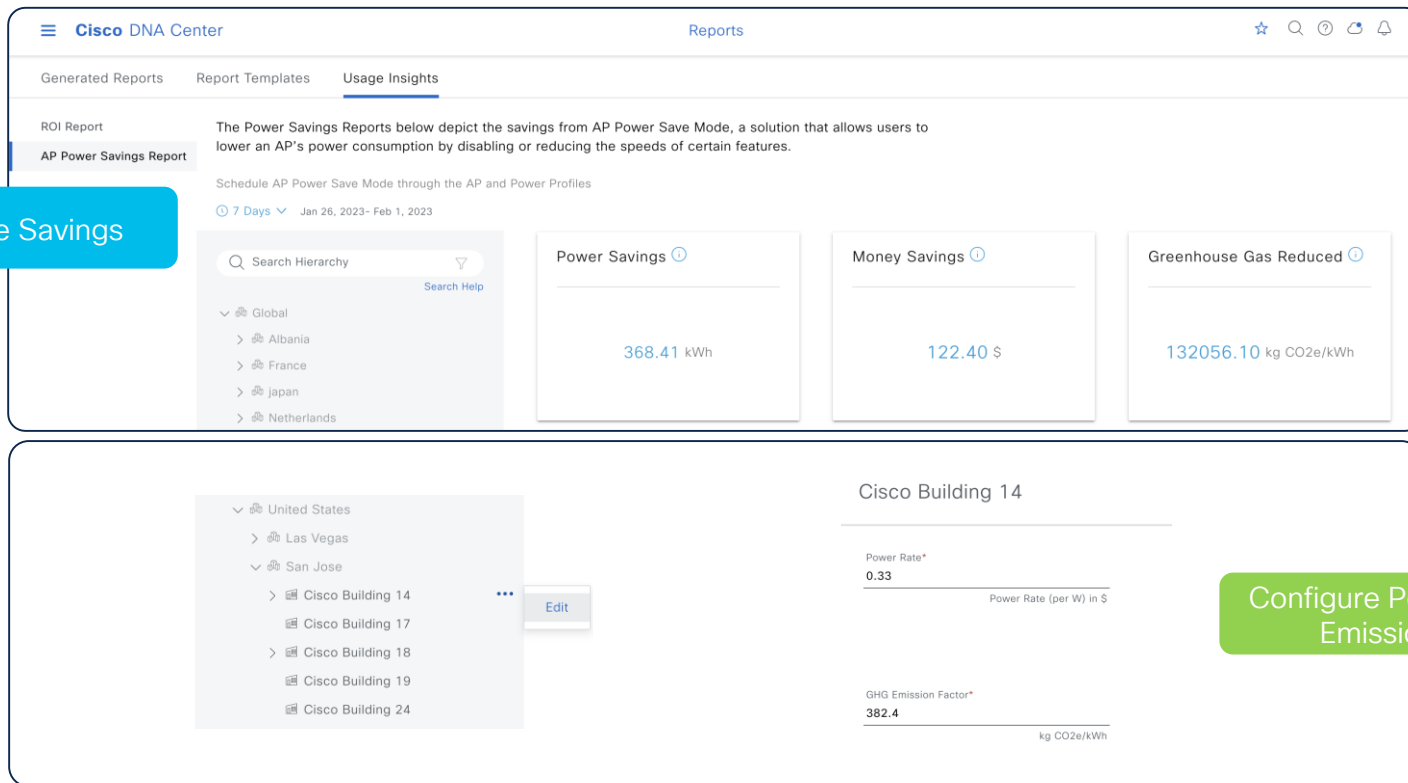
Demo time!



Power, Money, and Greenhouse Gas Savings on the Usage Insights Dashboard

roadmap

Visualize Savings



Configure Power Rate and Emission Factor

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!*

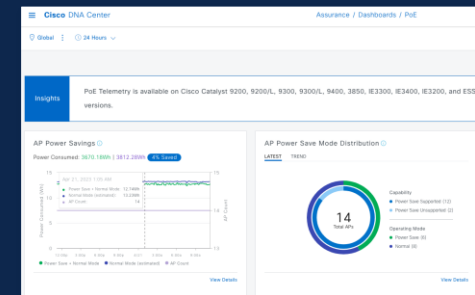
Discover

Device	Device Name	Device ID	Model	AP version	AP Name	Actual Power	Estimated Power	Power Mode	Power Source
AP001-0001	AP001-0001	AP001-0001	AP001-0001	17.10.1.0	10.14.10.10	1.5W	1.5W	Power Save	Unidirectional 140W
AP002-0002	AP002-0002	AP002-0002	AP002-0002	17.10.1.0	10.14.10.11	1.5W	1.5W	Power Save	Unidirectional 140W
AP003-0003	AP003-0003	AP003-0003	AP003-0003	17.10.1.0	10.14.10.12	1.5W	1.5W	Power Save	Unidirectional 140W
AP004-0004	AP004-0004	AP004-0004	AP004-0004	17.10.1.0	10.14.10.13	1.5W	1.5W	Power Save	Unidirectional 140W
AP005-0005	AP005-0005	AP005-0005	AP005-0005	17.10.1.0	10.14.10.14	1.5W	1.5W	Power Save	Unidirectional 140W
AP006-0006	AP006-0006	AP006-0006	AP006-0006	17.10.1.0	10.14.10.15	1.5W	1.5W	Power Save	Unidirectional 140W
AP007-0007	AP007-0007	AP007-0007	AP007-0007	17.10.1.0	10.14.10.16	1.5W	1.5W	Power Save	Unidirectional 140W
AP008-0008	AP008-0008	AP008-0008	AP008-0008	17.10.1.0	10.14.10.17	1.5W	1.5W	Power Save	Unidirectional 140W
AP009-0009	AP009-0009	AP009-0009	AP009-0009	17.10.1.0	10.14.10.18	1.5W	1.5W	Power Save	Unidirectional 140W
AP010-0010	AP010-0010	AP010-0010	AP010-0010	17.10.1.0	10.14.10.19	1.5W	1.5W	Power Save	Unidirectional 140W

Act

Sequence	Interface	Interface ID	Parameter	Parameter Value
0	Radio	5 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!



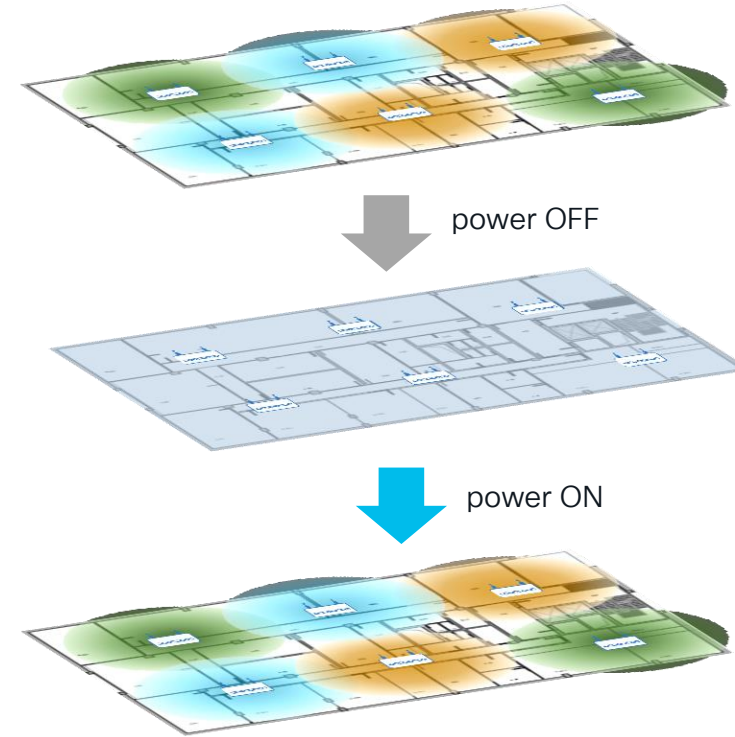
Turning off APs – What do you need to consider?

- 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?

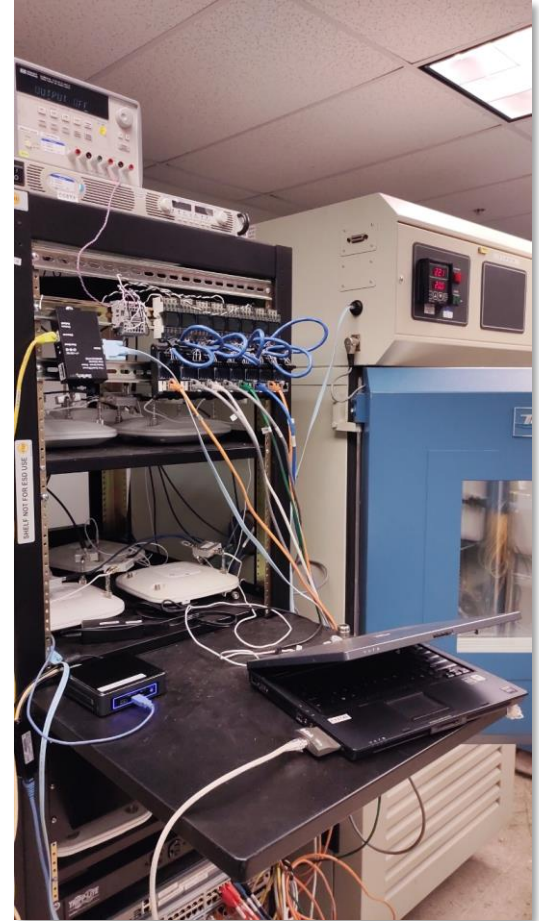


Turning ON/OFF APs – MTBF

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.

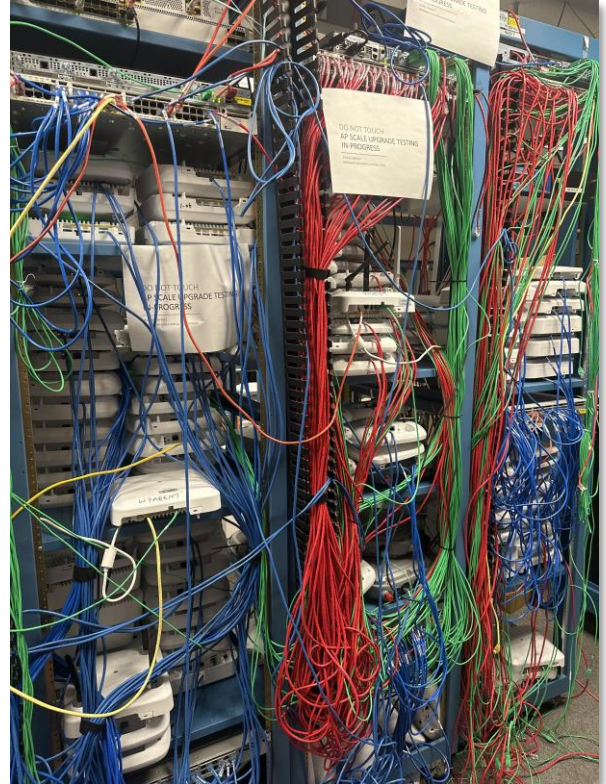


Turning ON/OFF APs – Software Integrity

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 (17.3.7, 17.6.5, 17.9.5, 17.12.3)
- 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



Turning ON/OFF APs – Software Integrity

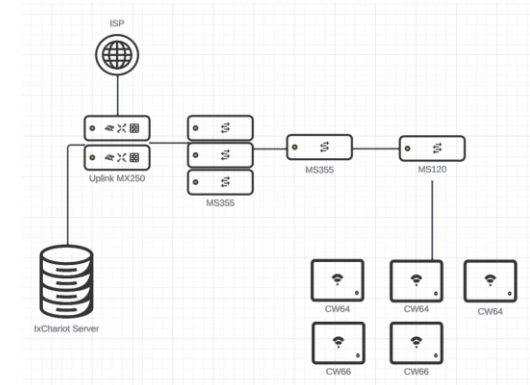
Meraki MR Software integrity test:

- 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

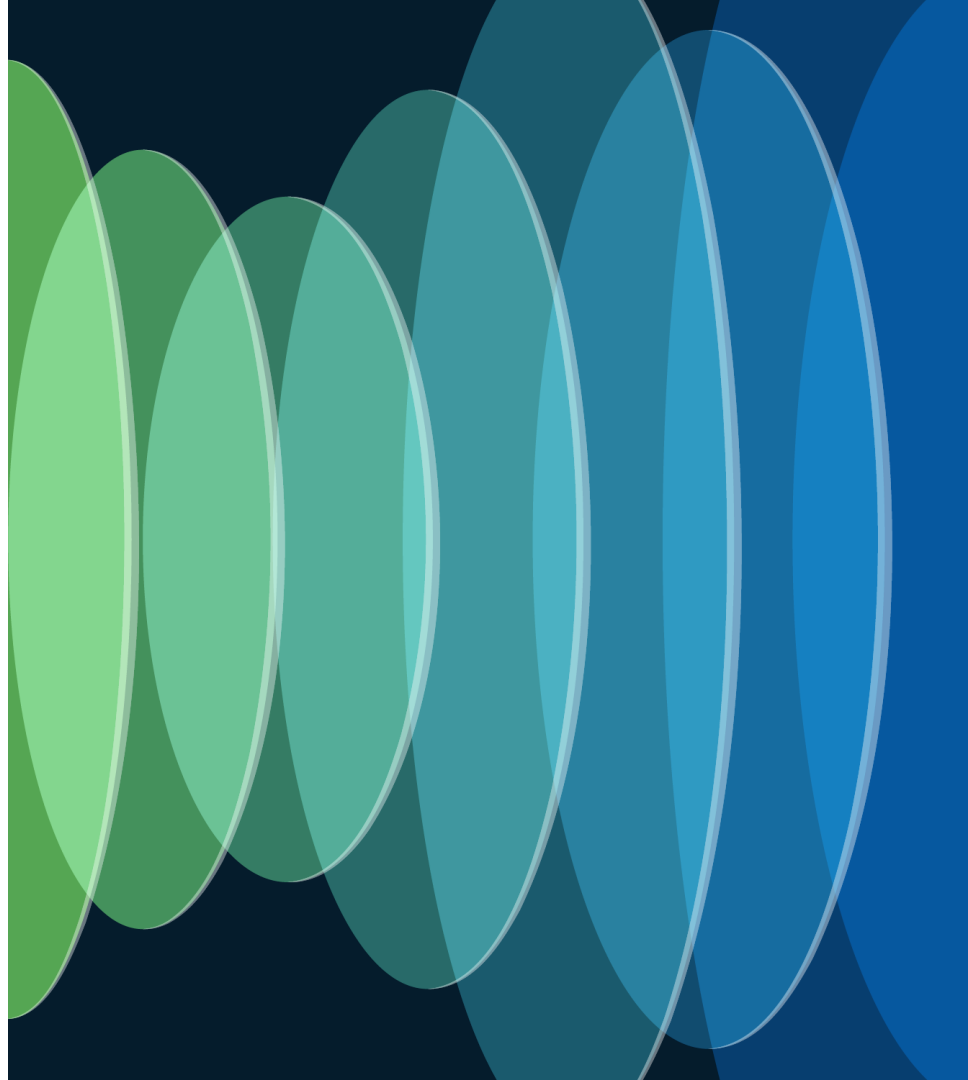
Test Plan: Sustainability Power Test

Test Topology

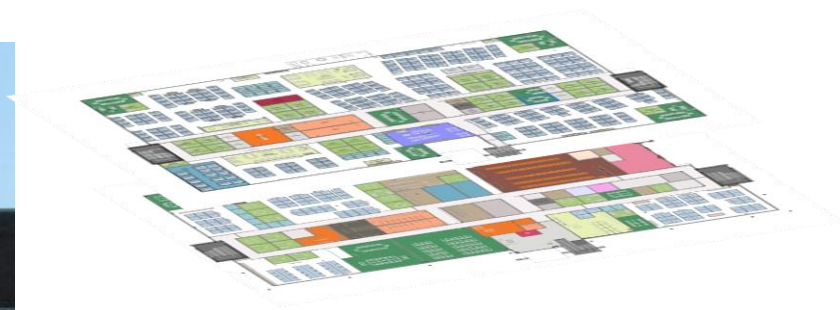


Radio Resource Management (RRM)

Considerations



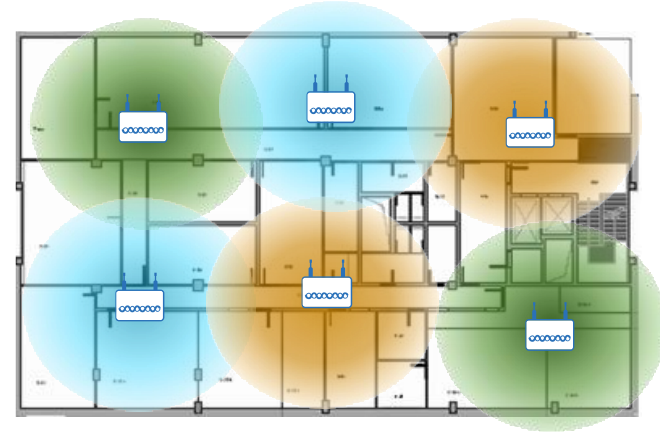
We are testing...



- #2 floors building in RTP campus, North Carolina
CW9166
- 58 APs (Aironet 4800) and #2 C9800-L in SSO pair
- #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'. The '5 GHz Band' is selected. The 'DCA' tab is active, showing the 'Dynamic Channel Assignment Algorithm' section. The 'Channel Assignment Mode' is set to 'Automatic'. The 'Interval' is set to '10 minutes', which is highlighted with a red box. The 'Anchor time' is set to '0'.

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				10 minutes	
Anchor time				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

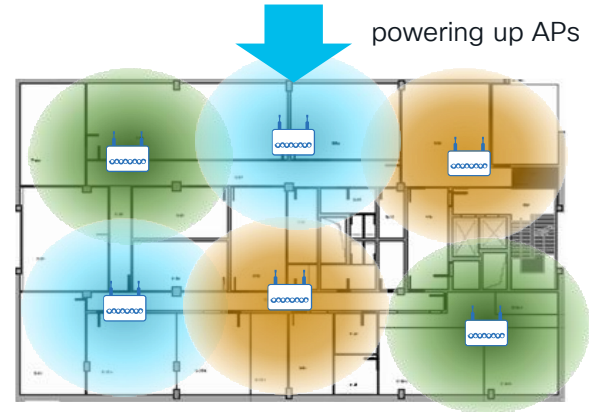
RRM learning process:

- 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

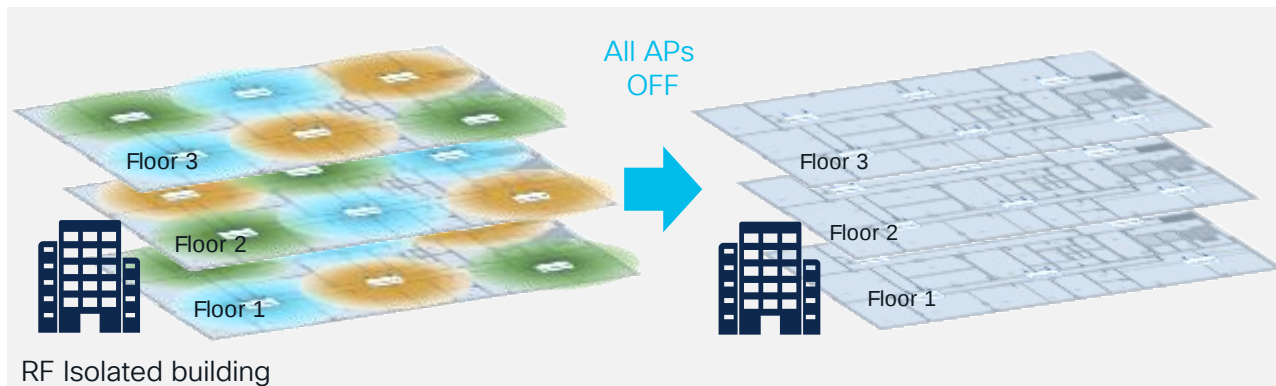


powering up APs

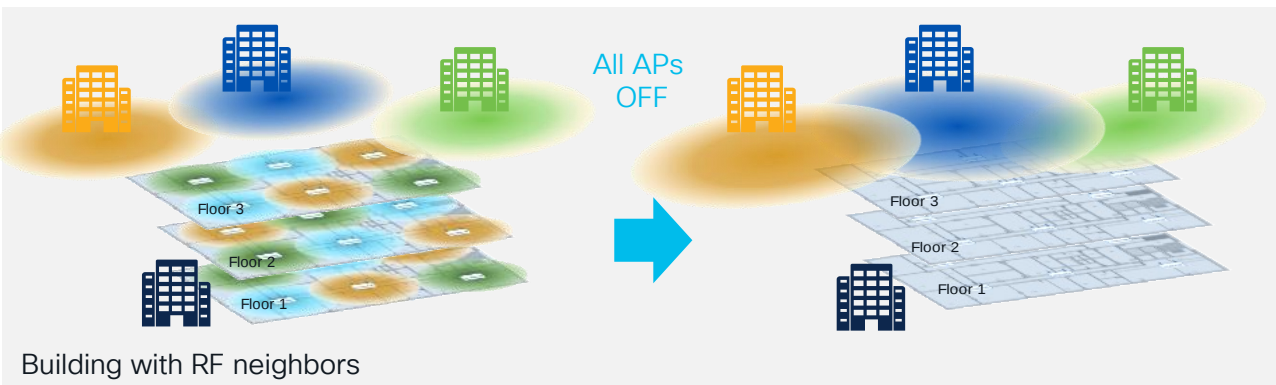


Powering off/on: RRM Design Implications

Building total shutdown



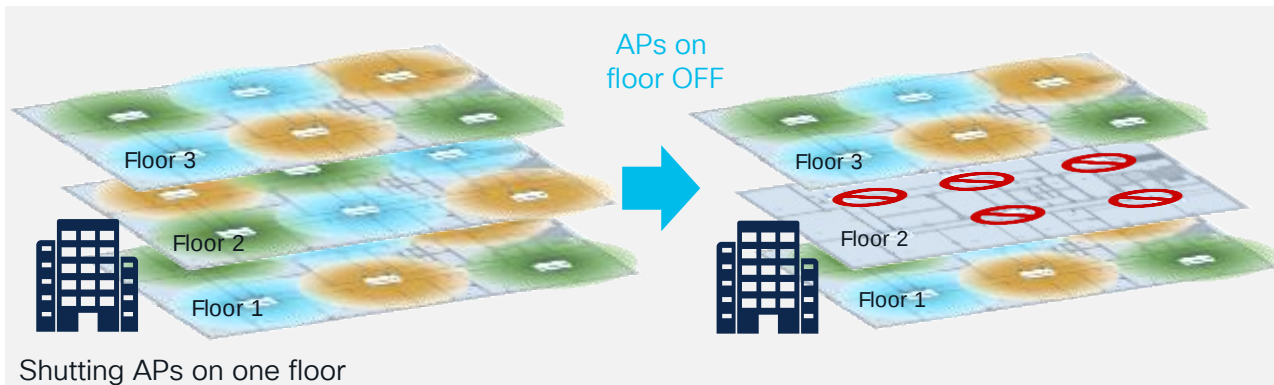
If shutting down **all APs** in the building and **no RF neighbors** > no RF changes are expected when powering back up



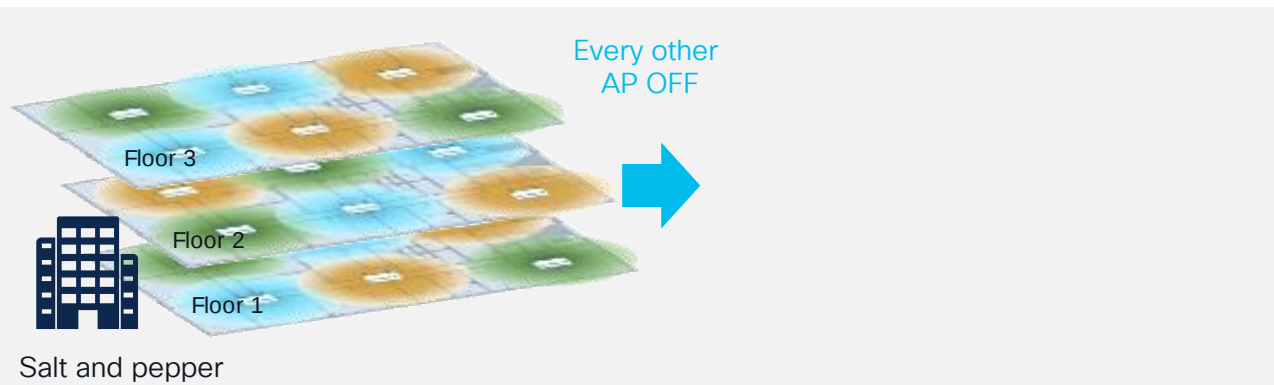
If shutting down **all APs** in the building **with RF neighbors** > RF changes are expected when powering APs back ON as the RF neighbors (**rogue APs**) might have taken over the channels previously used

Powering off/on: RRM Design Implications

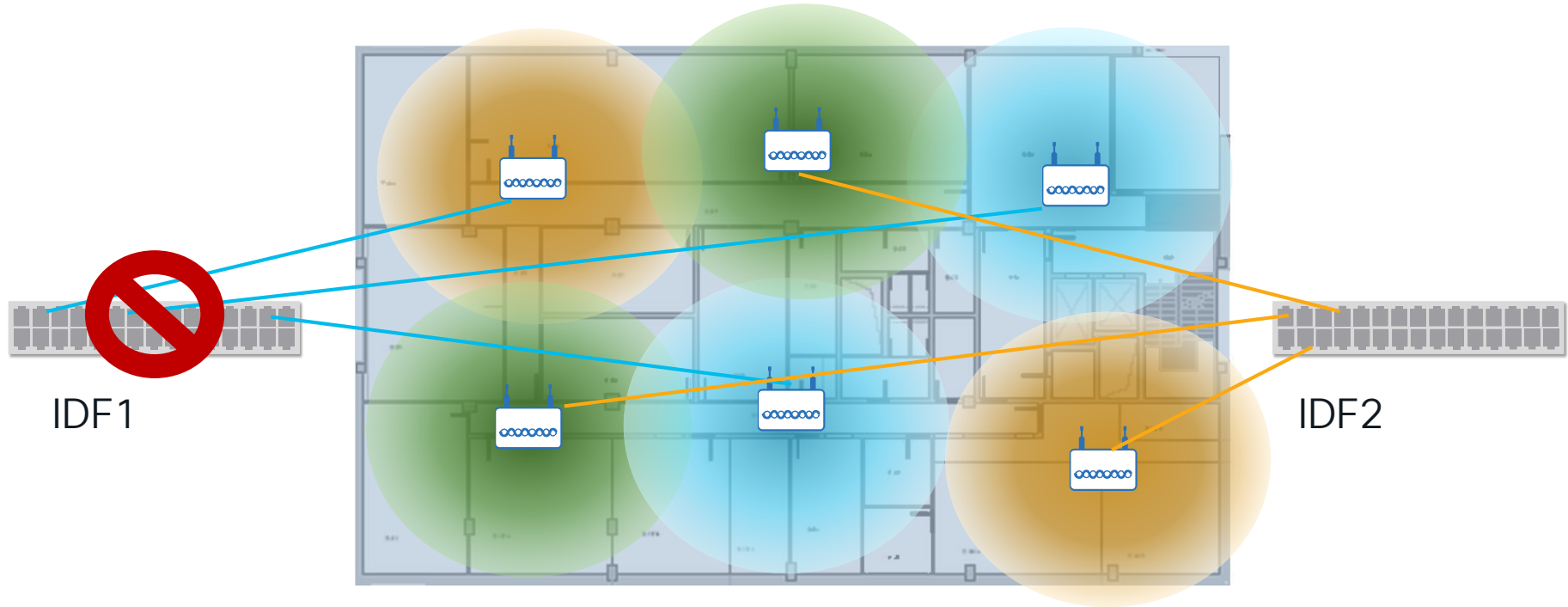
Building partial shutdown



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

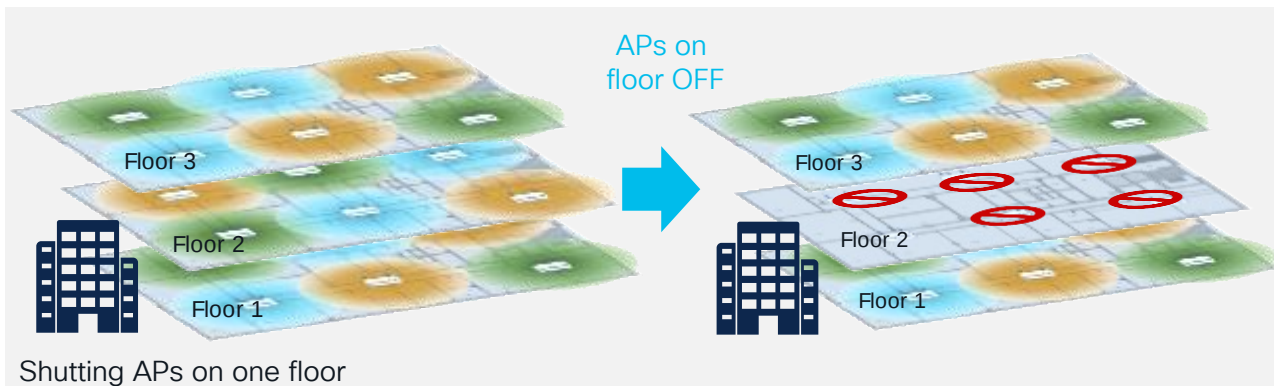


Powering on/off APs: Salt and Pepper

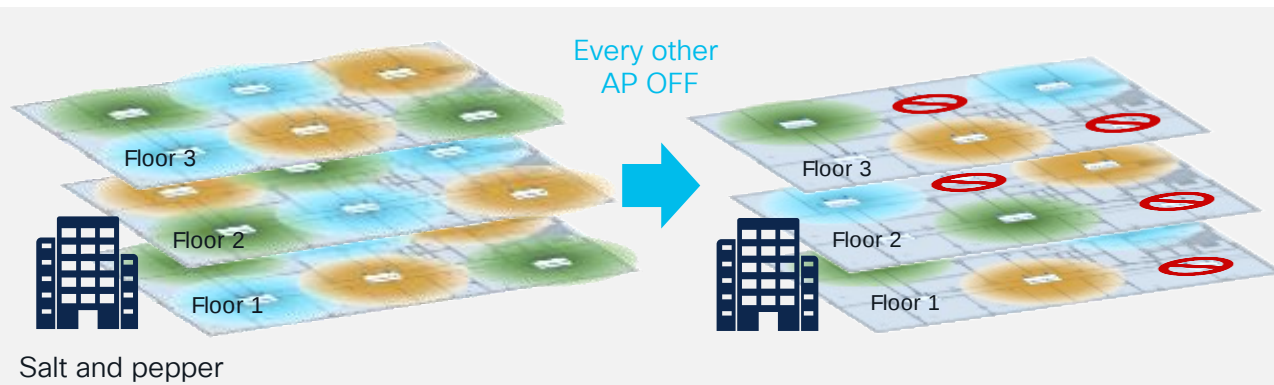


Powering off/on: RRM Design Implications

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

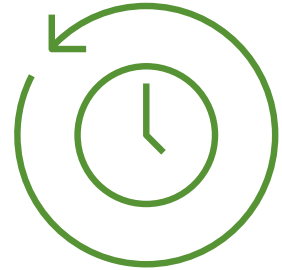


If shutting down APs in a “salt and pepper” way on each floor > RF changes may happen as the remaining APs might take over the channels previously used by APs powered down

Powering off/on: RRM Recommendations

How to choose the Anchor time:

- During business hours or off-peak?
- Usually this is not so important as the network is always operational.
- But if you are planning to shut APs during non-working hours...Make sure that the **Anchor time is within the time the APs are up**.
- If not, RRM would come up and run in the state where the AP are all down; if you shut off the network before RRM Anchor time, RRM would never run again 😊

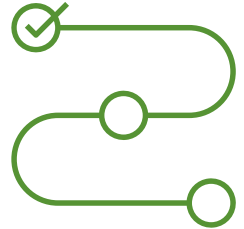


Powering off/on: RRM Recommendations

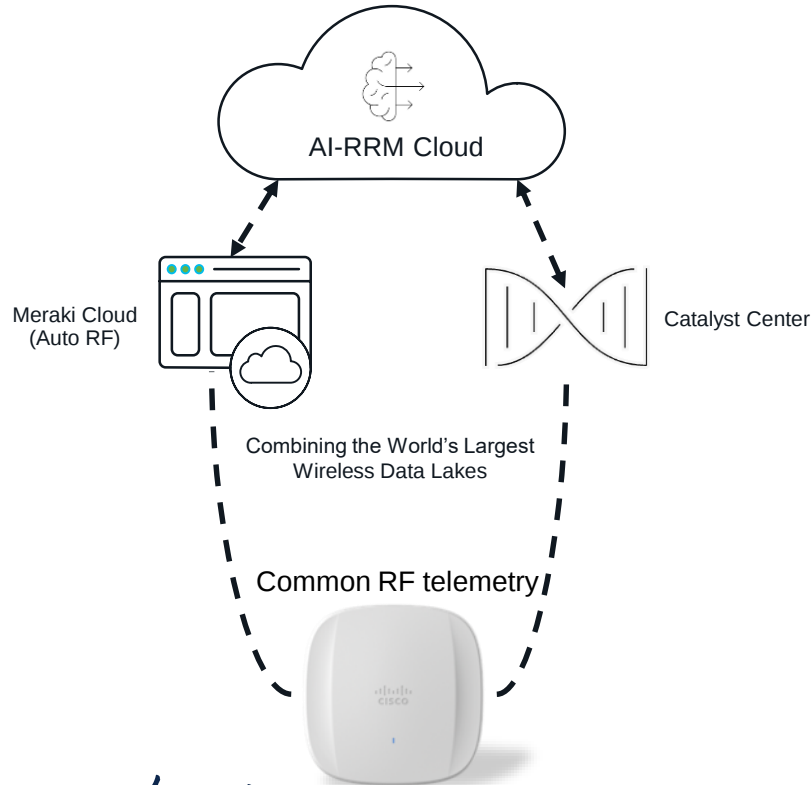
Recommended procedure for RRM:

Same if you run RRM every 10 mins or with Anchor time:

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**

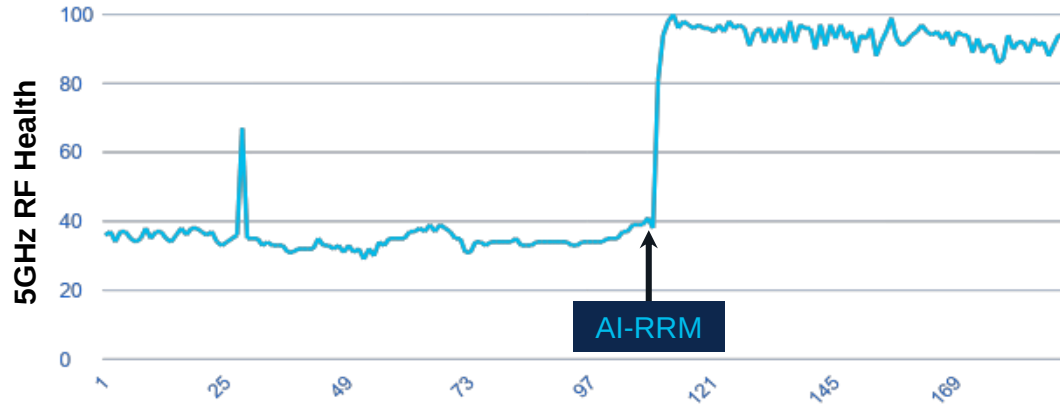


Powering off/on: AI-Enhanced RRM



- 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

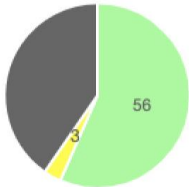
Better Experience with AI-Enhanced RRM



- Dramatic improvement in RF Health Score
- Significant Co-Channel Interference reduction
- Reduced Channel Changes from Auto Busy Hour
- Greatly improved Client Experience

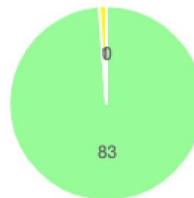
5GHz RF Health (before Mar 6th)

Good Fair Poor



5GHz RF Health (after Mar 6th)

Good Fair Poor



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	0:00	4:00	8:00	12:00	16:00	20:00
Tuesday	enabled	8:00 17:00	0:00	4:00	8:00	12:00	16:00	20:00
Wednesday	enabled	8:00 17:00	0:00	4:00	8:00	12:00	16:00	20:00
Thursday	enabled	8:00 17:00	0:00	4:00	8:00	12:00	16:00	20:00
Friday	enabled	8:00 17:00	0:00	4:00	8:00	12:00	16:00	20:00
Saturday	enabled	8:00 17:00	0:00	4:00	8:00	12:00	16:00	20:00
Sunday	enabled	8:00 17:00	0:00	4:00	8:00	12:00	16:00	20:00

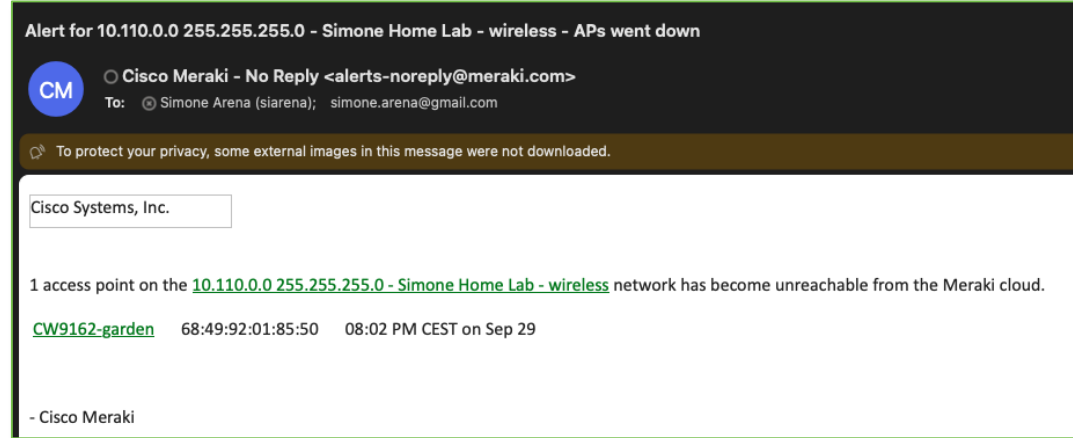
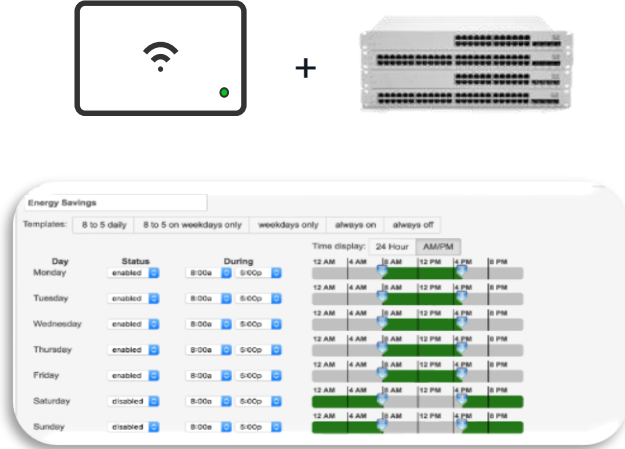
[Add a new port schedule](#)

Energy Saving Port Schedules

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

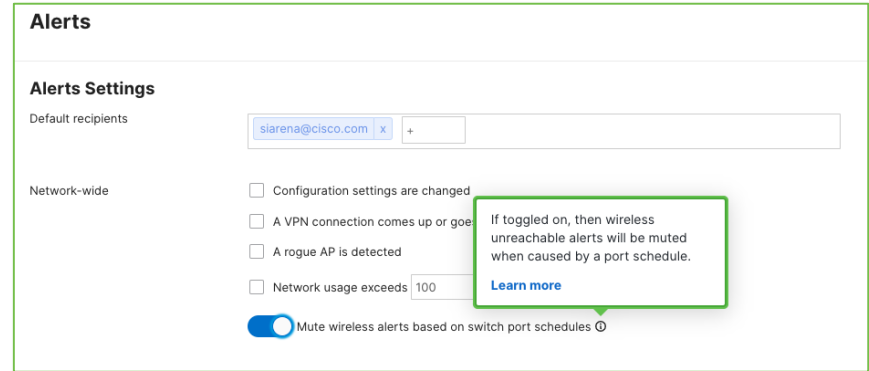
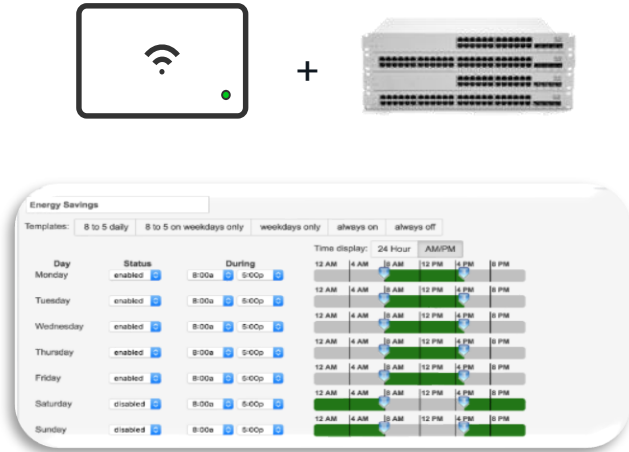
Powering off/on: AP alarms

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 >



- 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

AP Power Measurement In Meraki Dashboard

SFO12-1-AP08
MR53 88:15:44:60:73:b4

Live data

Ports

FIRMWARE
Up to date
Current version: MR 29.5.1
[Open source licenses](#)

CONFIG
Up to date

POWER
9.38 W
PoE 802.3at

REGULATORY INFO
Enforced Country: US

AP Real Time Power Monitor

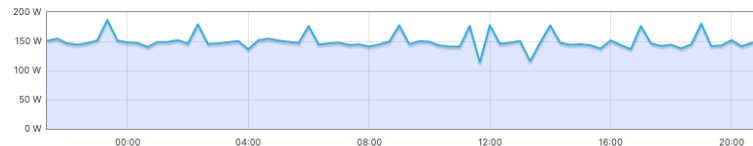
- Monitor the actual power consumption of each AP on your network

Summary Report from the last day

NETWORK(S) Entire organization
DEVICE TAG All devices
SSID All SSIDs
SHOW TOP RESULTS 10

Ethernet Power Details

Power rate over time



Top switches by power usage

Name	Model	Power usage
9300_M	C9300-24U	3.16 kWh
MS220-Simo	MS220-8P	429 Wh

Power Monitor at Org level

- Monitor the actual power consumption for all the switches in the network or Org

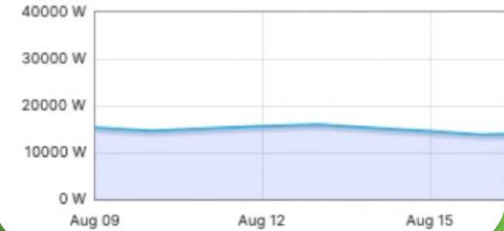
Save Energy with Meraki Switch Port Schedules

- 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

Discover

Power rate over time



Act

Time display: 24 Hour AM/PM

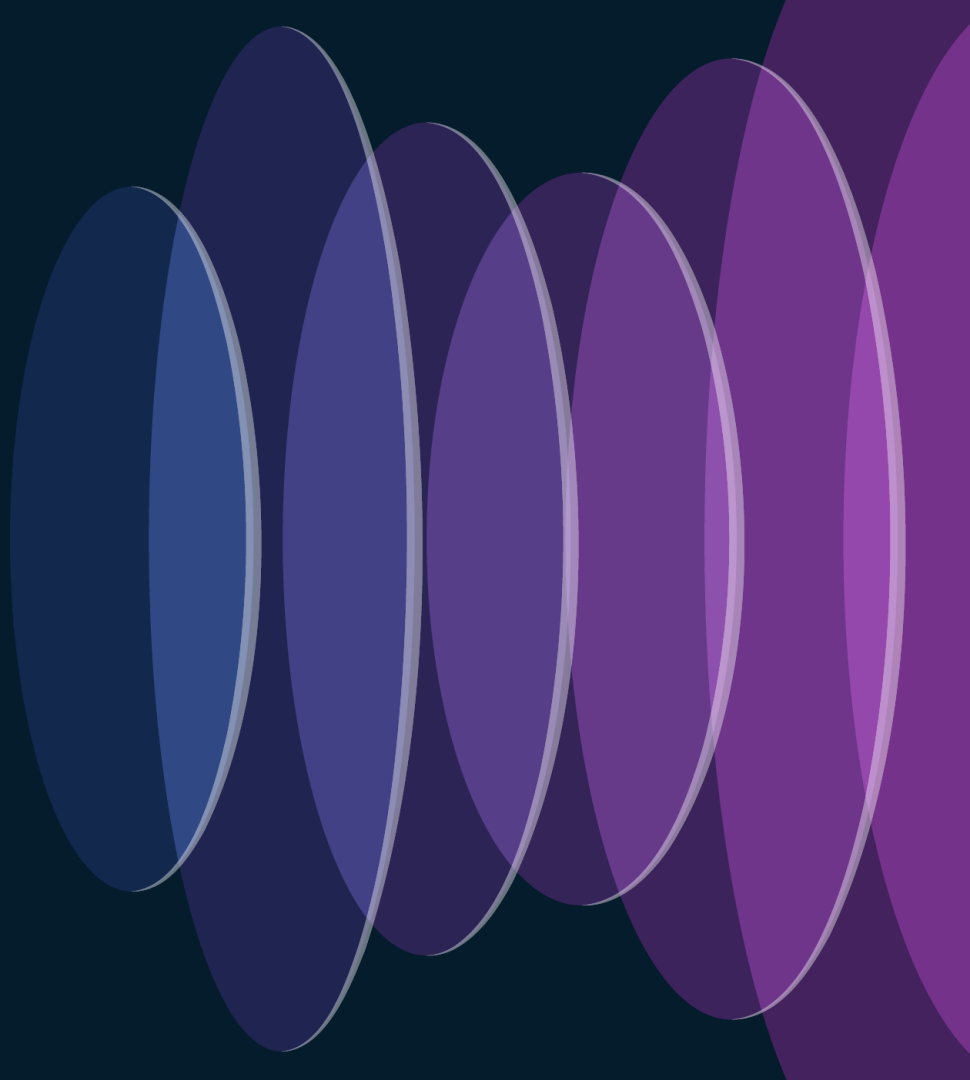


Report

Power rate over time



Conclusion



3 Steps to Save Energy with Cisco Wireless

01

Refresh to energy-efficient APs

- Catalyst Wi-Fi 6 and 6E APs are on average 53% more efficient than older generations*
- Cisco 6/6E APs have the highest power efficiency in the market
- With new Catalyst APs you can leverage Power save mode

02

Optimize AP Power

- Use Power Save Mode to turn off AP features when they are not required (Catalyst only)
- Use AP Power Distribution to allocate AP resources at reduced power levels (Catalyst only)
- Example: Reducing AP functions during off-peak hours could potentially save an estimated additional 20% in energy costs compared to regular idle mode*

03

Measure & Act

- New Power Save Insights on DNA Center to quantify reduction in energy & costs
- Use Meraki Dashboard to easily schedule AP power OFF and measure impact
- Use occupancy data from Spaces to enable informed decisions about powering down resources in off-peak hours

(*) based on internal testing

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

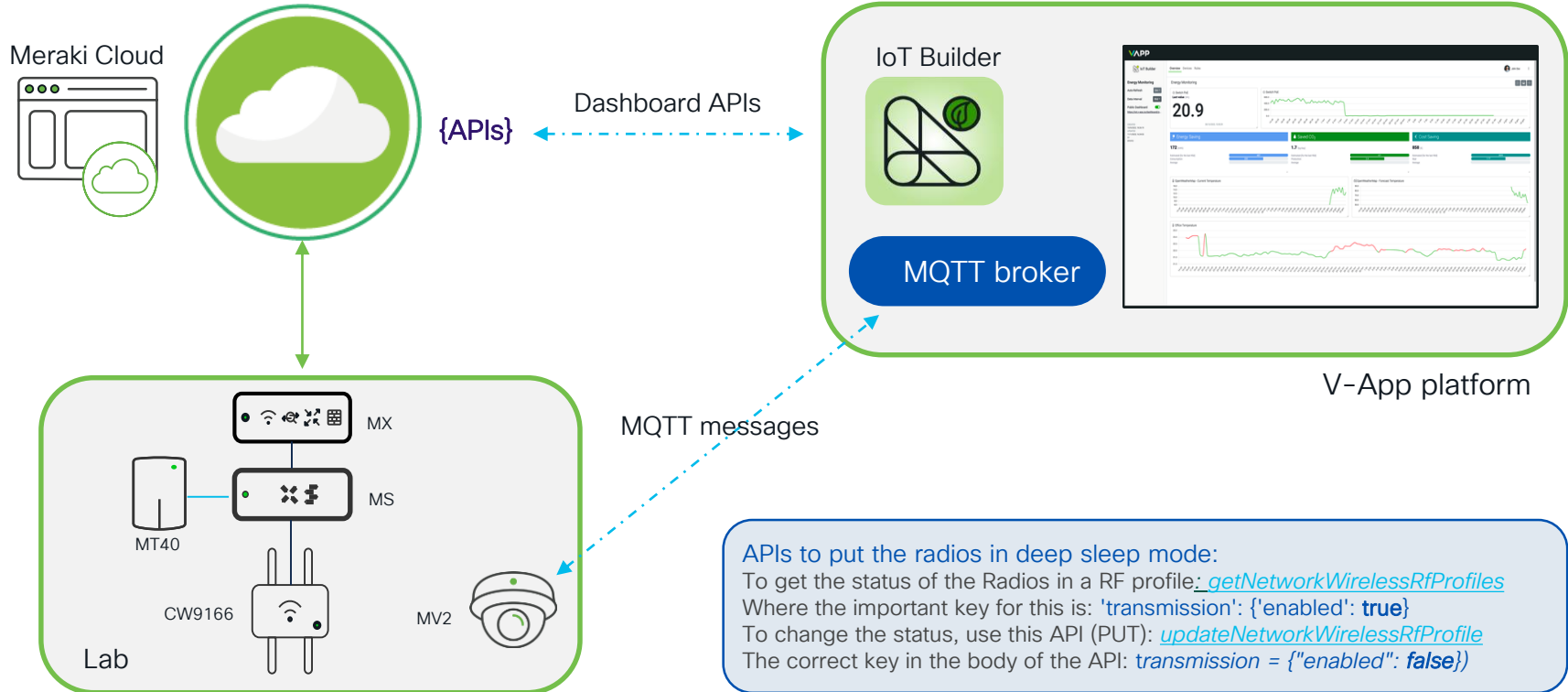
Take-back Program

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**

My sustainable Lab!



APIs to put the radios in deep sleep mode:

To get the status of the Radios in a RF profile: [getNetworkWirelessRfProfiles](#)

Where the important key for this is: **'transmission': {'enabled': true}**

To change the status, use this API (PUT): [updateNetworkWirelessRfProfile](#)

The correct key in the body of the API: **transmission = {"enabled": false}**

Complete Your Session Evaluations



Complete a minimum of 4 session surveys and the Overall Event Survey to be entered in a drawing to **win 1 of 5 full conference passes** to Cisco Live 2025.



Earn 100 points per survey completed and compete on the Cisco Live Challenge leaderboard.



Level up and earn **exclusive prizes!**



Complete your surveys in the **Cisco Live mobile app**.

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



The bridge to possible

Thank you

CISCO *Live!*

#CiscoLive