The bridge to possible

# Architecting Next Generation Wireless Network with Catalyst Wi-Fi 6E Access Points

Anand Gurumurthy, Sr. Technical Marketing Engineer

# Cisco Webex App

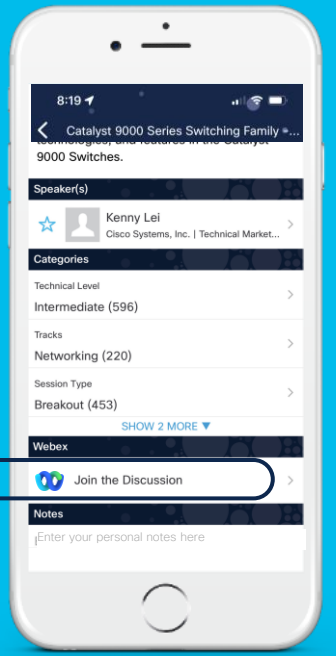
## Questions?

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

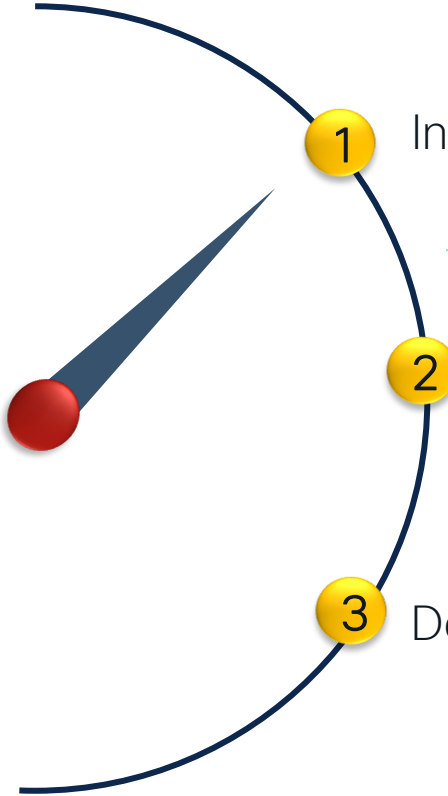
## Webex spaces will be moderated until February 24, 2023.



# Meet the Speaker (MTS-1068)


- Location: Meet the Speaker, Area 1
- Date: Feb 7th
- Time: 3:00 P.M

# Agenda



1. Introduction to Wi-Fi 6E
   - New 6 GHz Band
   - Global Availability
   - Device Classes
   - Protocol Enhancements
2. Cisco Catalyst Wi-Fi 6E Access Points
   - Catalyst Wi-Fi 6E Access Point Portfolio
   - Common Hardware
   - Environmental Sensors
   - CleanAir Pro
3. Design, Deployment and Migration Considerations
   - Network Infrastructure
   - RF Design
   - WLAN Security & Design
   - Client Eco System

# Why Wi-Fi 6E?


# Primitive applications of the past to ....

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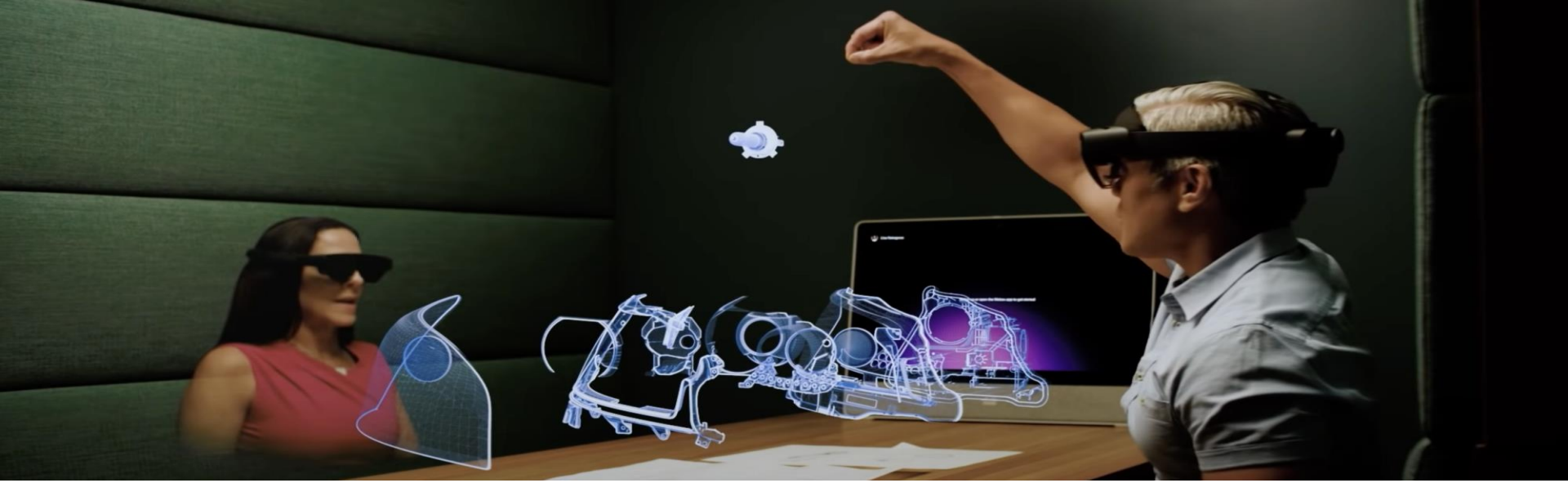
# Immersive Experiences of Today...

cisco Live!



Webex Hologram https://www.youtube.com/watch?v=YEx7h0NKnXE

# and Tomorrow…

# It’s all About the Wireless Experience!

## New Technology Trends > New Requirements :

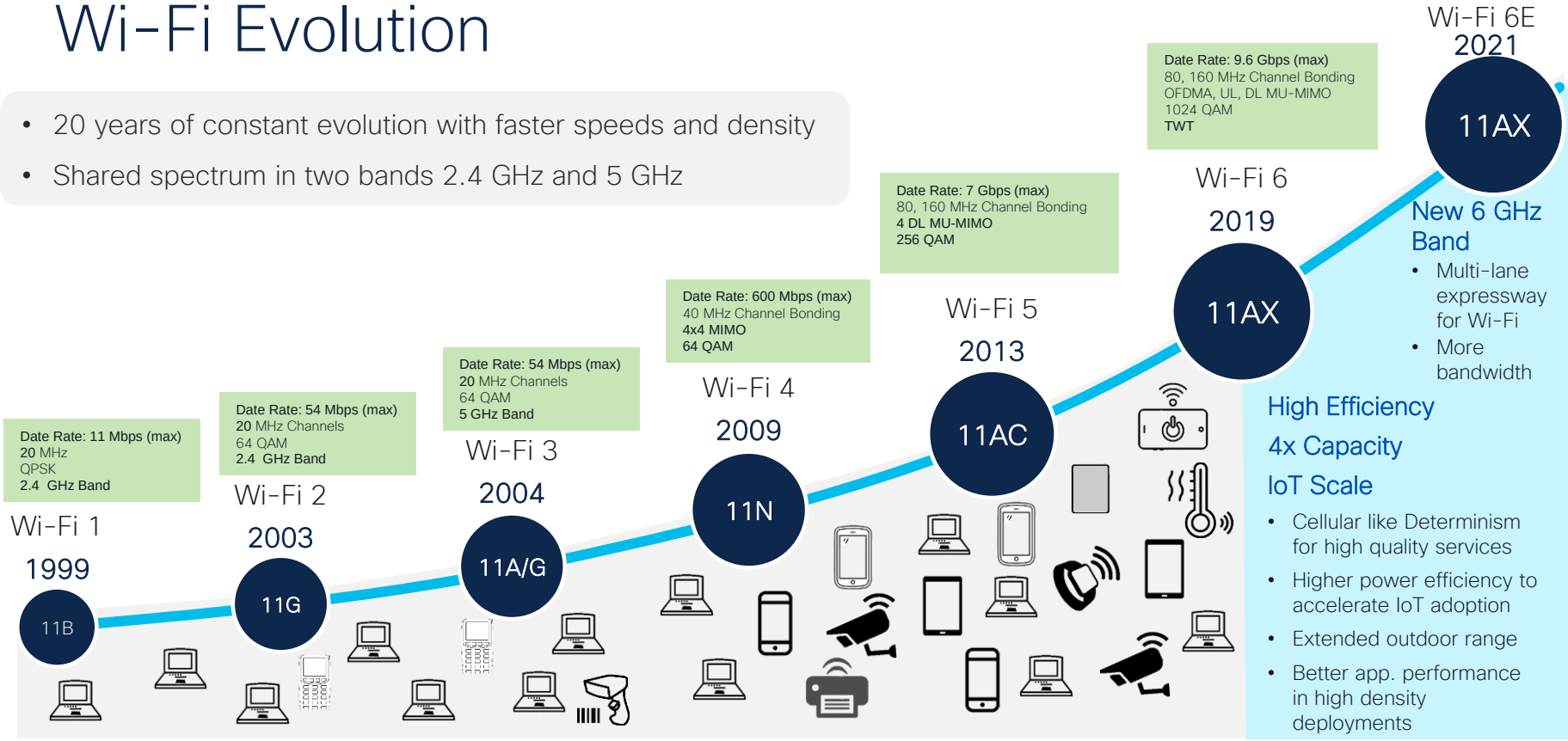
- More IoT devices, M2M communication > high density and critical communication
- SLA-bound applications, video and delay sensitive apps > need for less latency, minimal jitter
- VR/AR and High-resolution video > more throughput

Wi-Fi 6 is all about efficient use the spectrum…

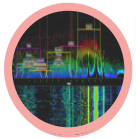
Service Leve Agreement (SLA)
Internet of Things (IoT)
Machine to Machine (M2M)
Virtual reality/Augmented Reality (VR/AR)

# Wi-Fi Evolution

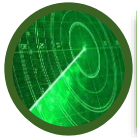
- 20 years of constant evolution with faster speeds and density
- Shared spectrum in two bands 2.4 GHz and 5 GHz



# Current Challenges



Channel Congestion



DFS Channels

Shared Spectrum – Interferes

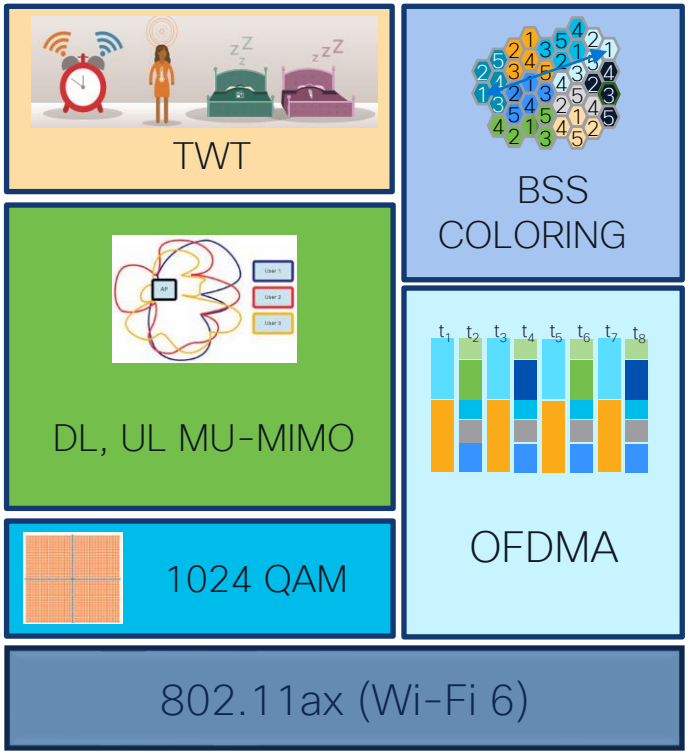
Legacy Devices

Too Many Devices

Limited Re-usable Channels

# Before Wi-Fi – 6E …..

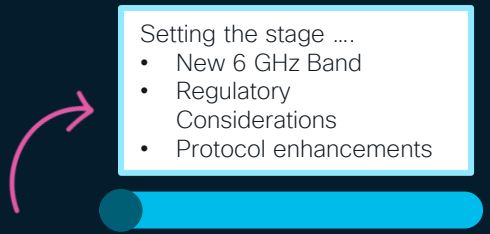
# Wi-Fi 6E
# Wi-Fi 6 and 6GHz are friends!




1. **Additional Spectrum**
   1200 MHz (5.925 to 7.125 MHz) – US
   500 MHz (5.925 to 6.425) – EU
2. **Security Upgrade**
   WPA3 Mandatory
   Improves Security
3. **Clean RF**
   (Fixed Mobile Service Operators in UNI-5 and UNI-7)
4. **No Legacy (Slow) Devices**
   Improves performance
5. **6 GHz WLAN Discovery**
   Airtime Efficiency
6. **Wider RF Channels**
   80 MHz channels – 1200 MHz
   40 MHz channels – 500 MHz

# With Wi-Fi – 6E …..

# Setting the stage ….

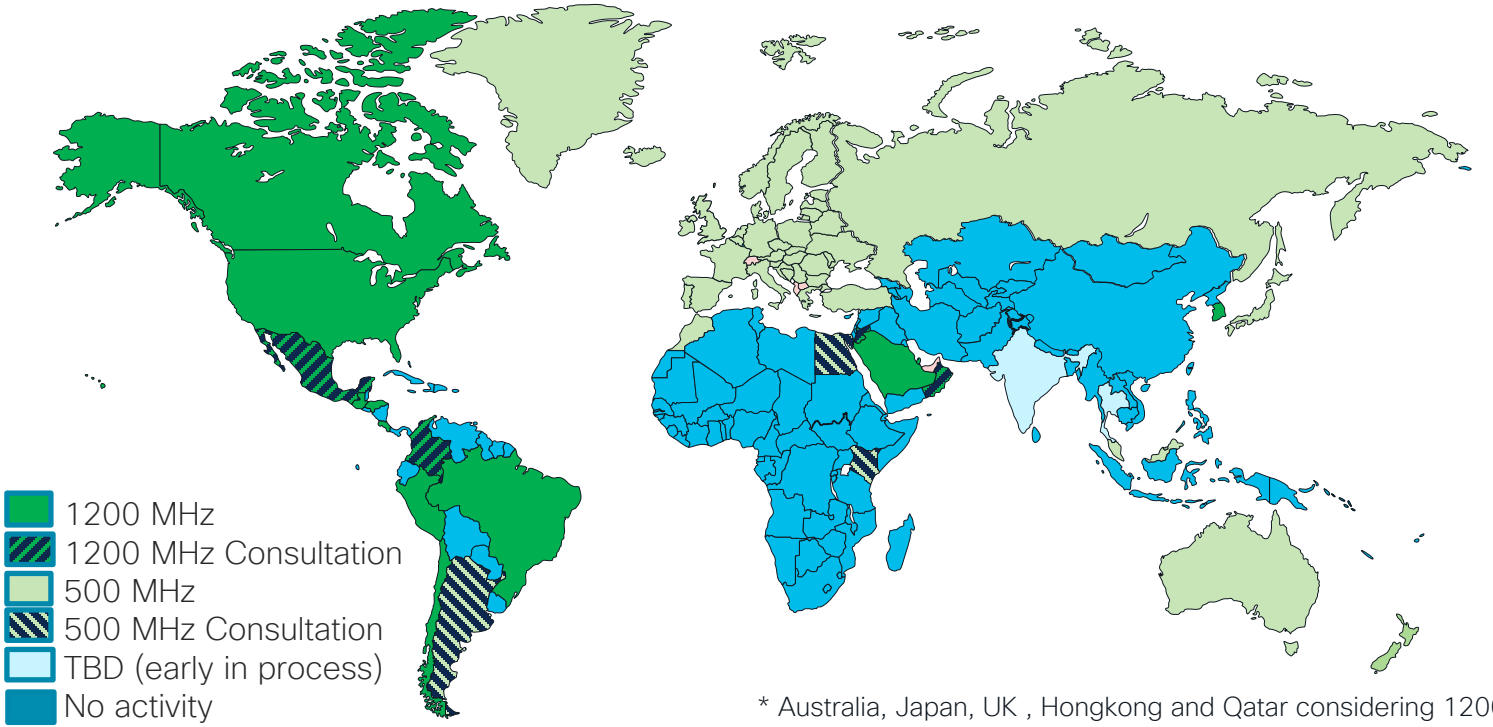


# Wi-Fi 6E – 6GHz Around the World

cisco Live!

# Global availability of 6 GHz band for Wi-Fi

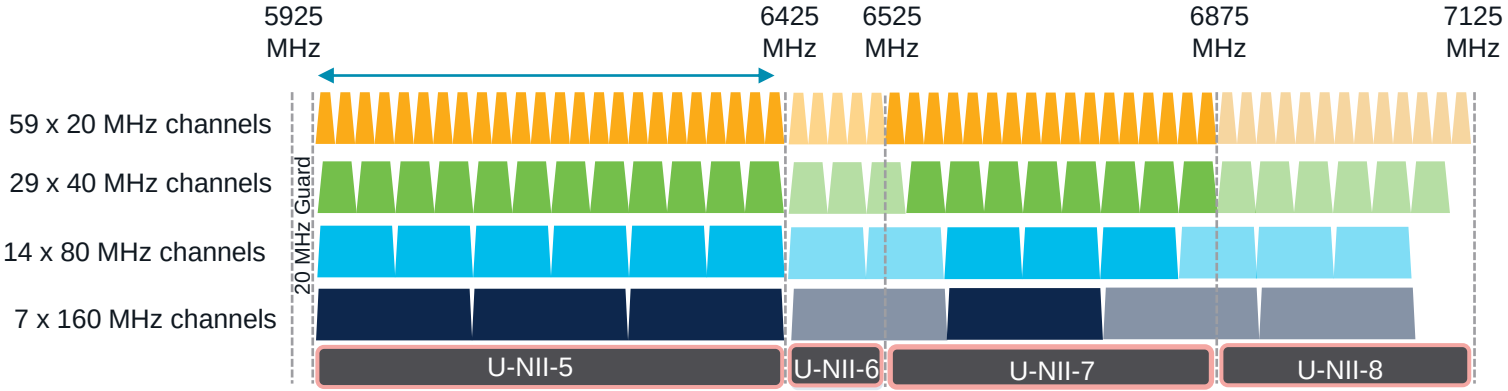
(https://www.wi-fi.org/countries-enabling-wi-fi-6e)



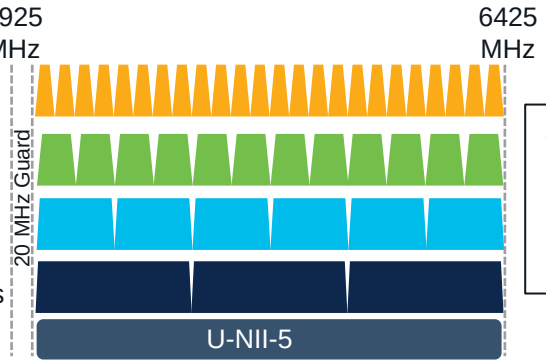

* Australia, Japan, UK , Hongkong and Qatar considering 1200 MHz

# The new 6 GHz band :

United States
Canada
S Korea
1200 MHz

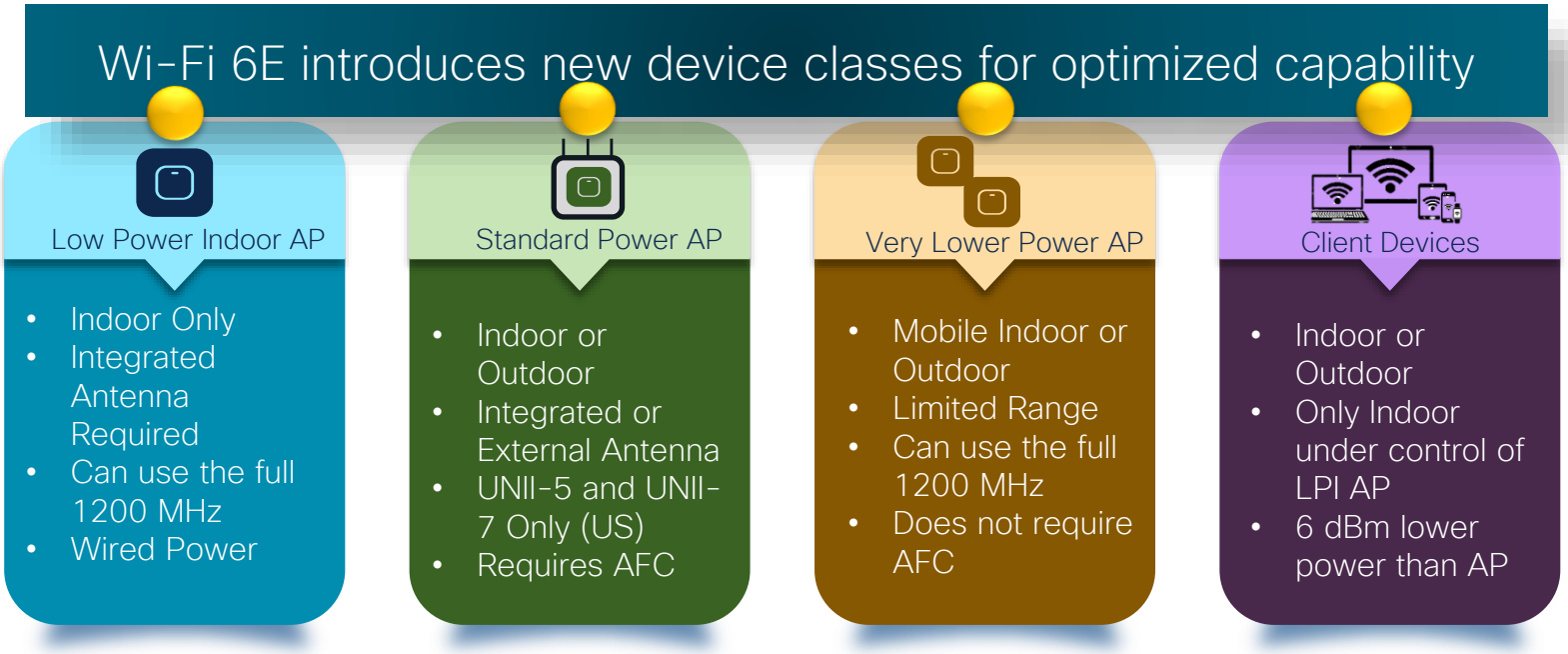



Europe/CEPT
Most APAC
500 MHz



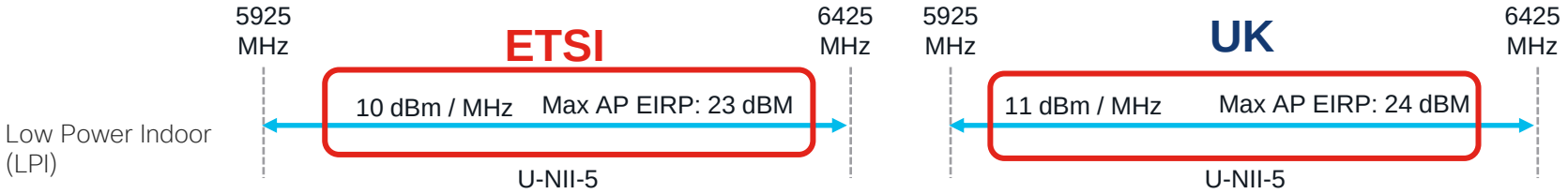

5955 – Central Frequency of the first 20 MHz channel
→ Starting at 5925 MHz +
20 MHz of guard band +
10 MHz to get to the center of the first 20 MHz channel

# 6 GHz – New Device Classes




Regulations vary by country

# Low-Power Access Points (indoor) (ETSI & UK)




Calculation for ETSI :
6 GHz power is measured as **Power Spectral Density (PSD)** a Maximum of 10 dBm/MHz is permitted for LPI.
(***Power Spectral Density*** – *Amount of Power over a given bandwidth*)

10 dBm = 10 mW

10 mW x 20 MHz = 200 mW = 23 dBm
10 mW x 40 MHz = 400 mW = 26 dBm (**Max is 23 dBm**)
10 mW x 80 MHz = 800 mW = 29 dBm (**Max is 23 dBm**)

| Channel BW | AP PSD EIRP (ETSI) | AP MAX EIRP (ETSI) | AP PSD EIRP (UK) | AP MAX EIRP (UK) |
|---|---|---|---|---|
| 20 MHz | 23 dBm | 23 dBm | 24 dBm | 24 dBm |
| 40 MHz | 26 dBm | 23 dBm | 27 dBm | 24 dBm |
| 80 MHz | 29 dBm | 23 dBm | 30 dBm | 24 dBm |
| 160 MHz | 31 dBm | 23 dBm | 33 dBm | 24 dBm |

# Summary 6GHz Tx Requirements

- Breaking down the PSD Values vs Max TX EIRP
  - FCC = 3 dB more power per channel width doubling and MAX TX EIRP of 30 dBm
  - ETSI/UK = PSD value = MAX TX EIRP at 20 MHz, remaining channel widths = Max TX EIRP

| Mode | Country | Max Tx Power EiRP | | Max PSD EiRP | |
|---|---|---|---|---|---|
| | (Frequency Range MHz) | AP (dBm) | Client (dBm) | AP (dBm) | Client (dBm) |
| | FCC (5925-7125) | 30 | 24 | 5 | -1 |
| | ETSI (5945-6425) | 23 | 23 | 10 | 10 |
| | UK (5925-6425) | 24 | 24 | 11 | 11 |

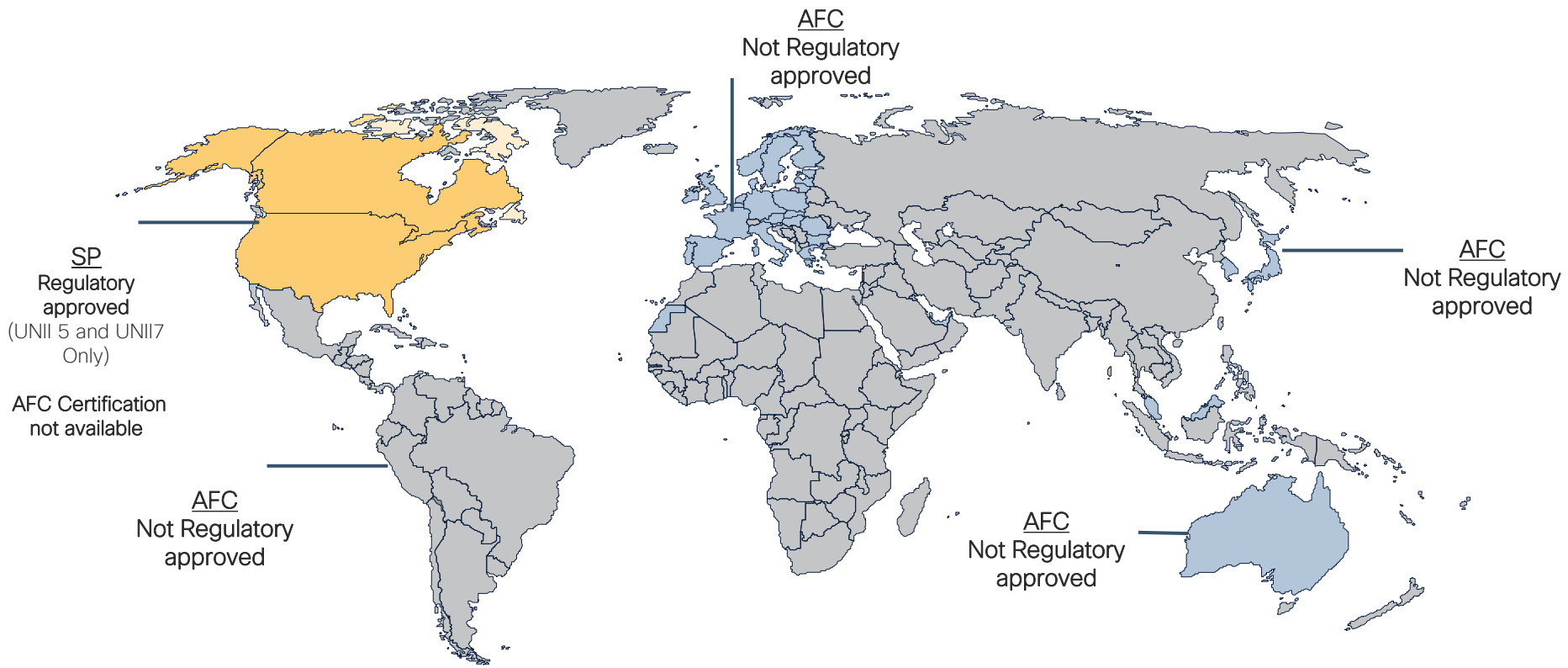
| | 20 MHz | 40 MHz | 80 MHz | 160 MHz |
|---|---|---|---|---|
| FCC 5 dBm/MHz | 18 dBm | 21 dBm | 24 dBm | 27 dBm |
| ETSI 10 dBm/MHz | 23 dBm | 26>23 dBm | 29>23 dBm | 32>23 dBm |
| UK 11 dBm/MHz | 24 dBm | 27>24 dBm | 30>24 dBm | 33>24 dBm |

# Summary 6GHz Tx Requirements*


| Mode | Country | Max Tx Power EiRP | | Max PSD EiRP | | Max Ch BW |
|---|---|---|---|---|---|---|
| | (Frequency Range MHz) | AP (dBm) | Client (dBm) | AP (dBm) | Client (dBm) | (MHz) |
| LPI | FCC (5925-7125) | 30 | 24 | 5 | -1 | 320 |
| | ETSI (5945-6425) | 23 | 23 | 10 | 10 | |
| | UK (5925-6425) | 24 | 24 | 11 | 11 | No Max |
| | Australia (5925-6425) | 24 | 24 | 11 | 11 | |
| | New Zealand (5925-6425) | 24 | 24 | 11 | 11 | |
| | S Korea (5925-7125) | 24 | 24 | 2 | 2 | 160 |
| | HongKong (5925-6425) | 24 | 24 | | | |
| | Malaysia (5925-6425) | 23 | 23 | 10 | 10 | |
| | Brazil (5925-7125) | 30 | 24 | 5 | -1 | |
| | ISED (5925-7125) | 30 | 24 | 5 | -1 | |
| | Chile (5925-7125) | 30 | 24 | 5 | -1 | |
| | Peru (5925-7125) | 30 | 24 | 5 | -1 | |
| | UAE (5925-6425) | 24 | 24 | | | |
| | Saudi Arabia (5925-7125) | 30 | 24 | 10 | 10 | |
| | ATU (5945-6425) (Kenya/Uganda/Congo/Niger/Ghana) | 23 | 23 | 10 | 10 | |
| | Morocco (5945-6425) | 23 | 23 | | | |
| SP | FCC (U-NII-5/7) | 36 (21<30°) | 30 | 23 | 17 | 320 |

* Includes only the countries and regions that approved the allocation; Empty cell means regulation is silent

# External(SP)/Outdoor Antenna Wi-Fi 6E Status

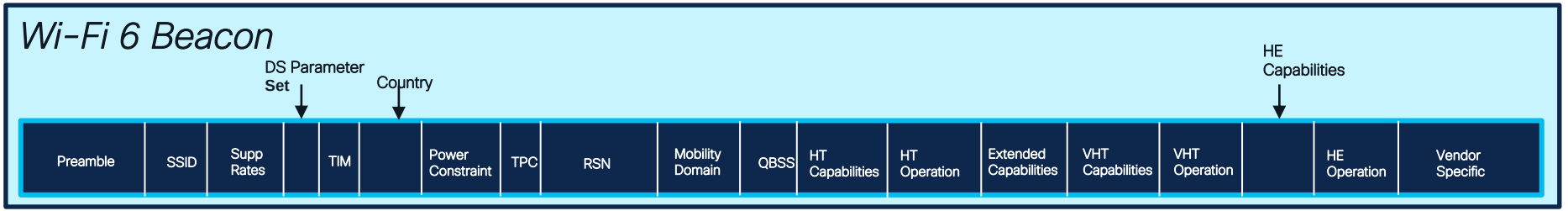



AFC conditional approval in USA

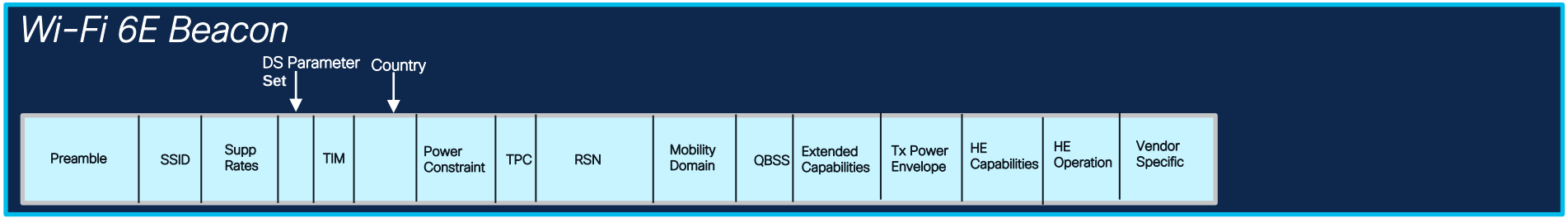
# *Wi-Fi 6E – Protocol Optimizations*

# Wi-Fi 6E Beacon Changes

## Legacy HT/VHT Information Element Removed



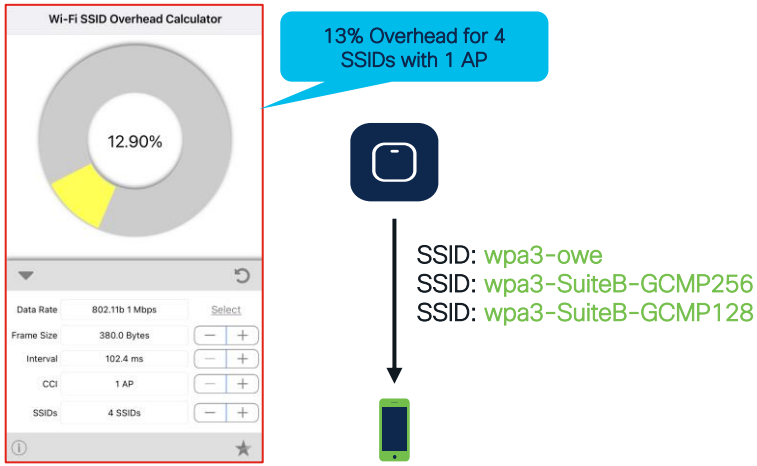

## Comparison of Wi-Fi 6 and Wi-FI 6E Beacon Frame

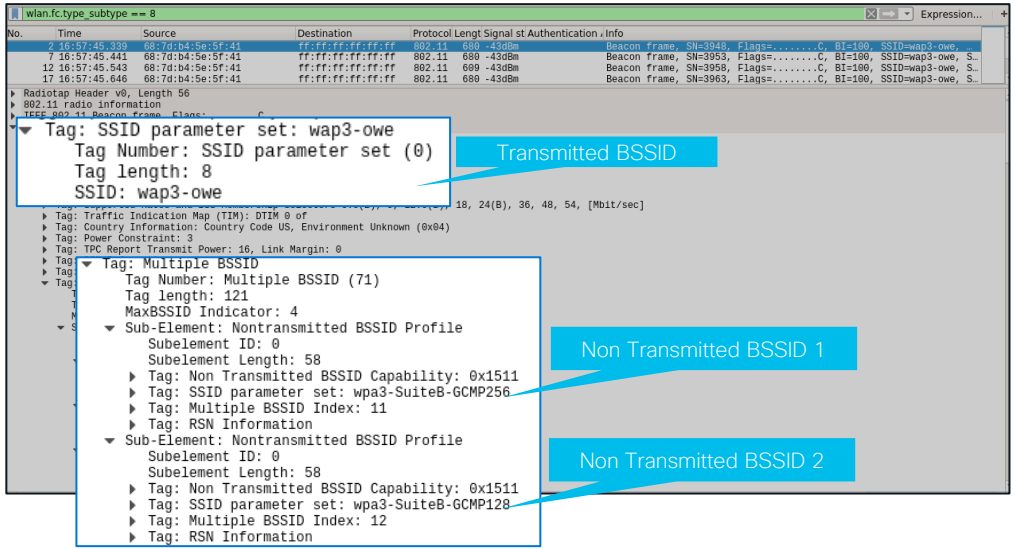



**Reduced Beacon Size helps conserve AirTime**

# Multiple BSSID

- Capability originally specified in 802.11v
- Combines multiple SSID information in a single beacon frame



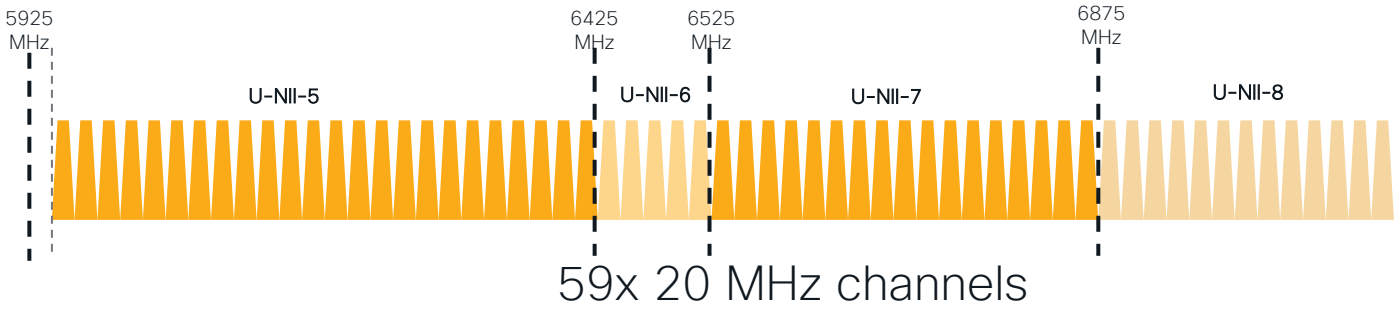

- Conserves Airtime
- Mandated in Wi-Fi 6E

# Wi-Fi 6E
# 6GHz SSID Discovery

# AP Discovery by Wireless Clients – Legacy Methods

- Hunt and seek method to scan Basic Service Sets or for APs

# Why won’t Legacy Scanning Methods scale in 6 GHz ?




- A Whopping 59 x 20 MHz Channels!
- Wi-Fi Clients can send only Probe Requests on 20 MHz Channels
- 6 seconds to passive scan all 59 channels.

# Wi-Fi 6E – New AP Discovery Mechanisms

## Out of Band

**Reduced Neighbor Report**

*Co-located Discovery*


## In Band

**Passive Scan:**

Fast Link Setup (FILS) Discovery Frames
Unsolicited Broadcast Probe Response Frames

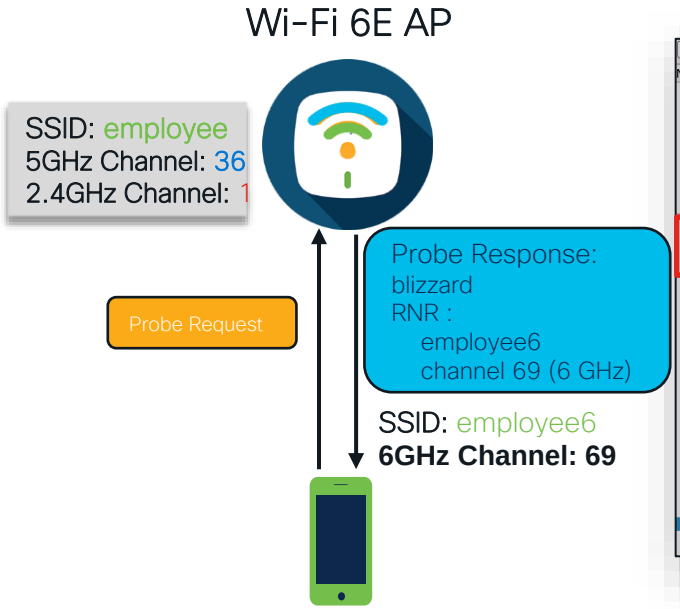
**Active Scan:**

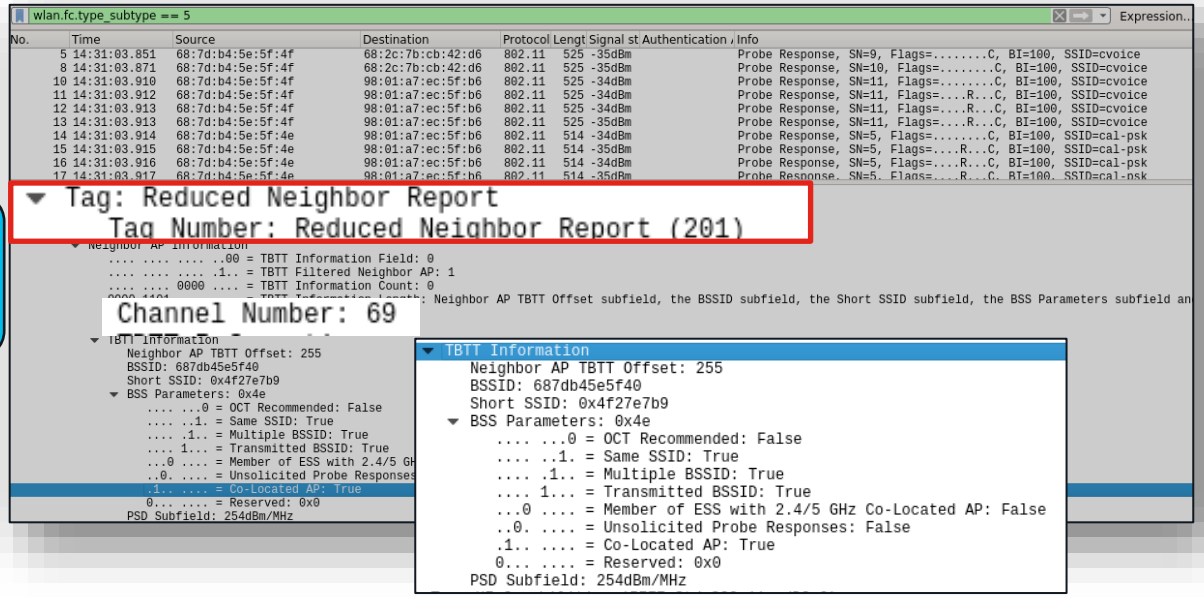
Preferred Scanning Channels (PSC)

# Wi-Fi 6E  Out of Band AP Discovery

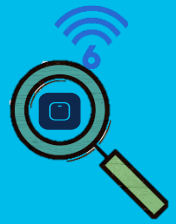
# Reduced Neighbor Report

Co-located “Neighbor” 6 GHz radio information in Beacon and Probe Response of 2.4 and 5 GHz radios.




Clients start with 2.4 and 5 GHz bands discovery mechanism to learn 6 GHz SSIDs



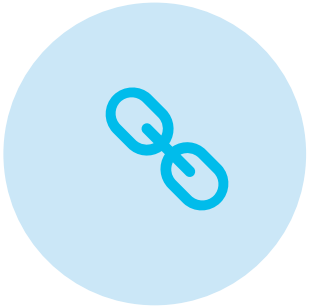
# Wi-Fi 6E Inband AP Discovery

# Wireless Clients always Probe!

# FILS Discovery Frames helps AP Discovery Faster

## Reduces AirTime Utilization by Management Frames

SMALLER BEACONS THAT IS TRANSMITTED MORE FREQUENTLY (APPROX. 20 MSEC), CONSUMES LESS AIR TIME.

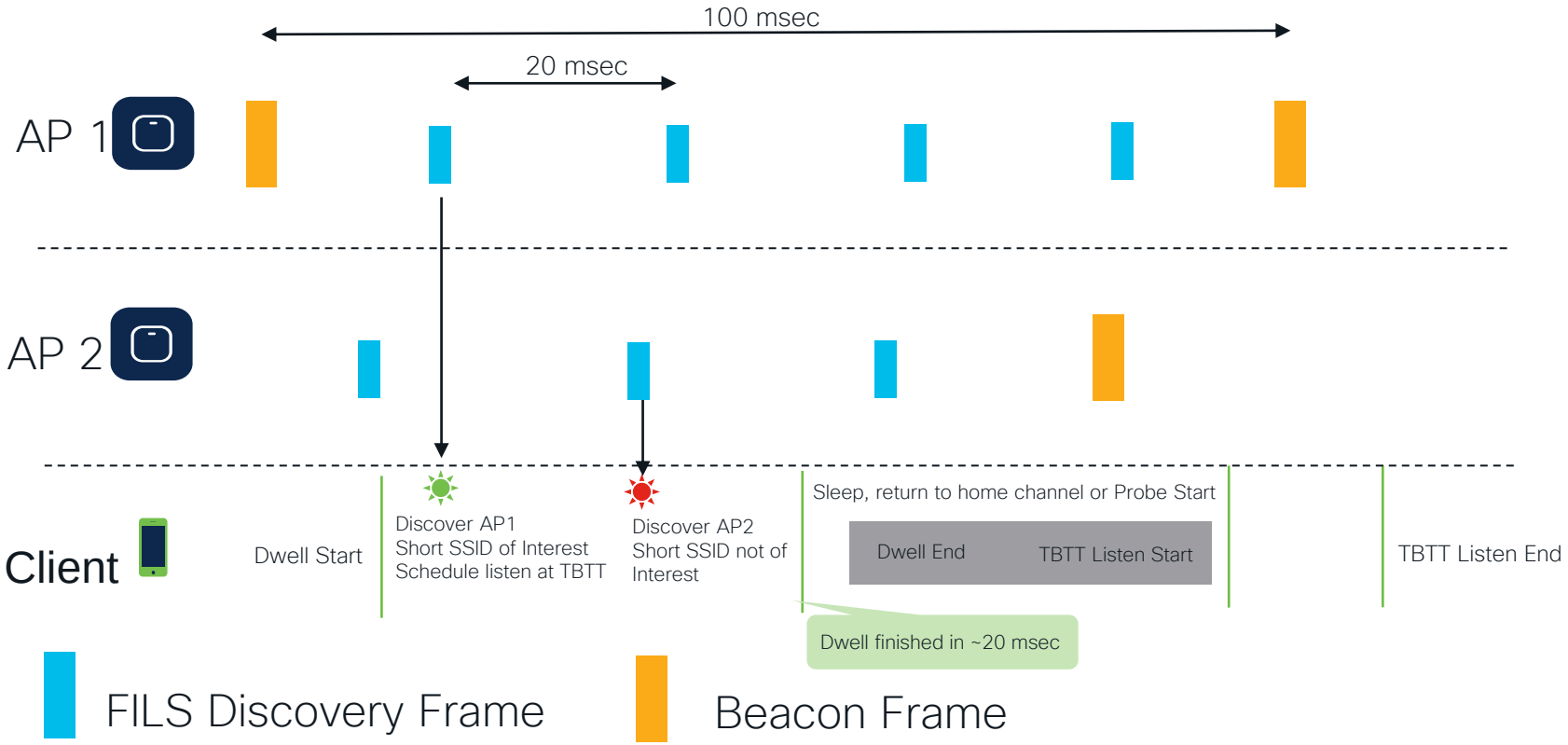


CONTAINS INFORMATION FOR THE CLIENT TO DECIDE ON THE AP TO CONNECT (SHORT SSID, CHANNEL, TBTT ETC)

REDUCES PROBE REQUEST OVERHEAD

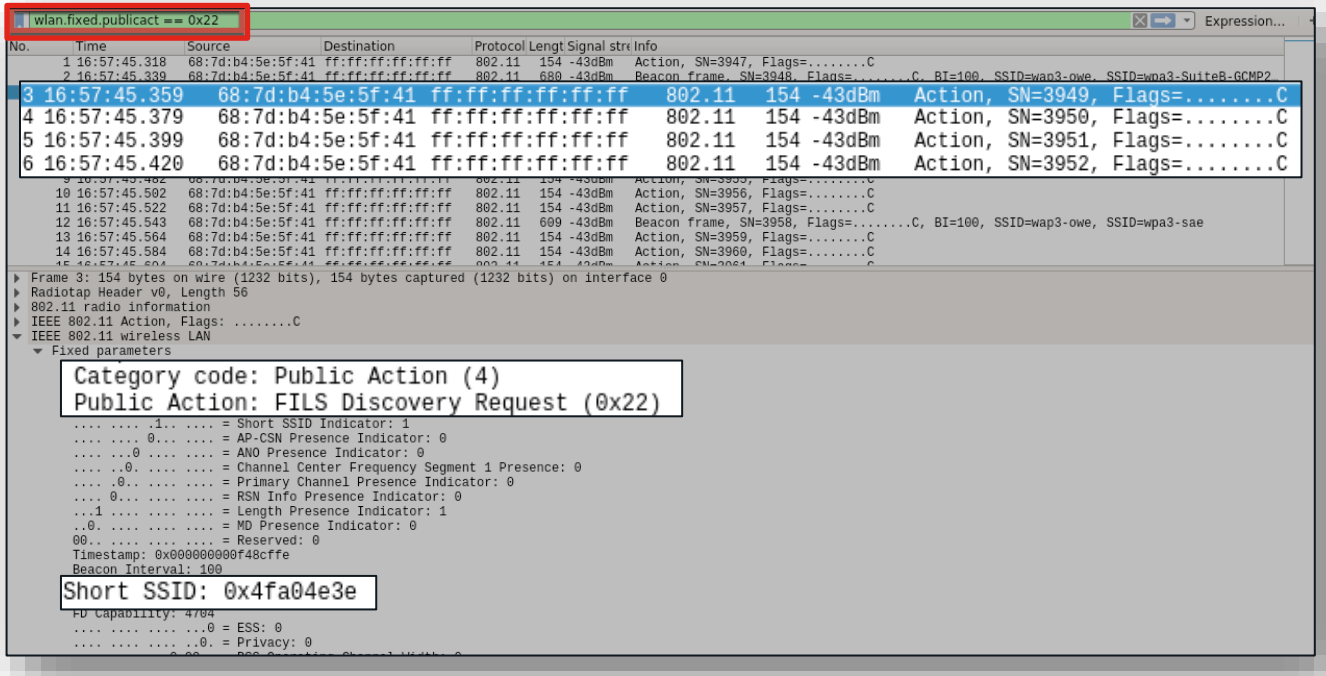
# Fast Initial Link Setup (FILS) Discovery Frames

In-Band (passive)



# FILS Discovery Frame – Packet Capture

In-Band (passive)




Broadcast Action Frames

Contains Short SSID, Channel, TBTT etc

Transmitted every 20 msec

# Unsolicited Broadcast Probe Response

In-Band (passive)

Reduces Probe Request Overhead

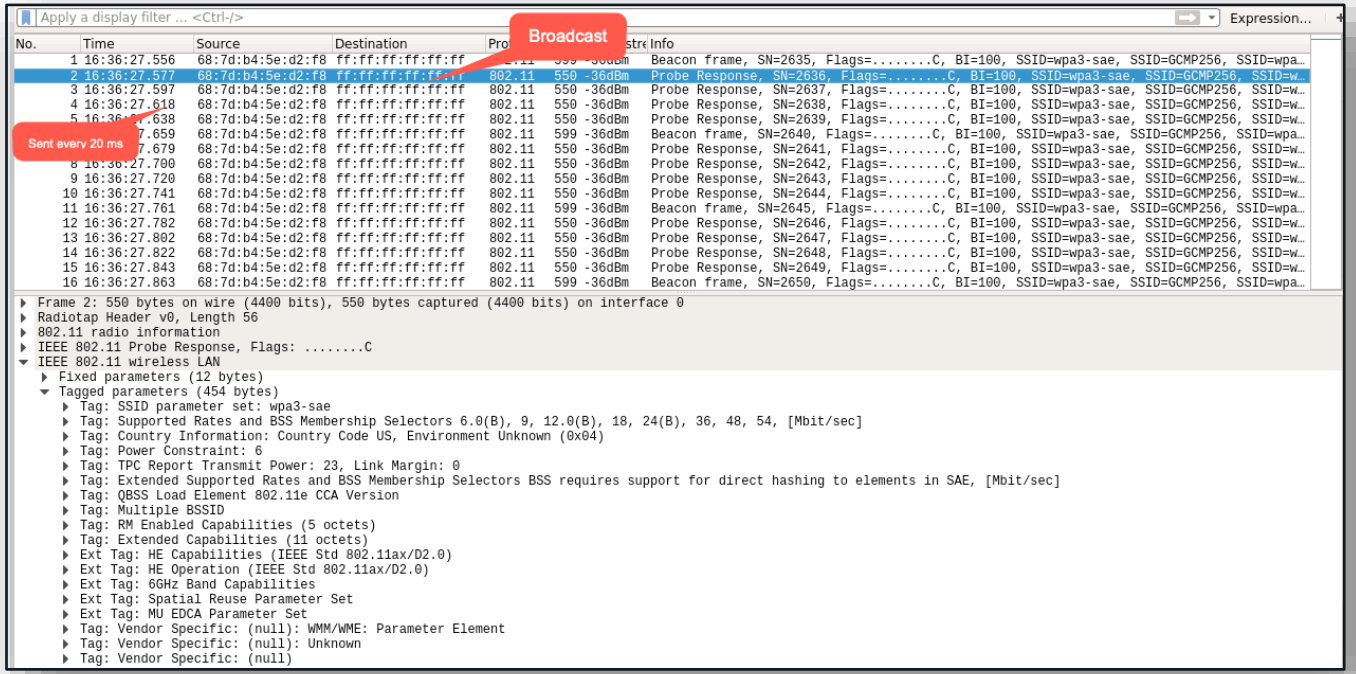
Broadcast probe response every 20 msec

Contains detailed information as a Beacon

**Helps Avoid Probe Storm**

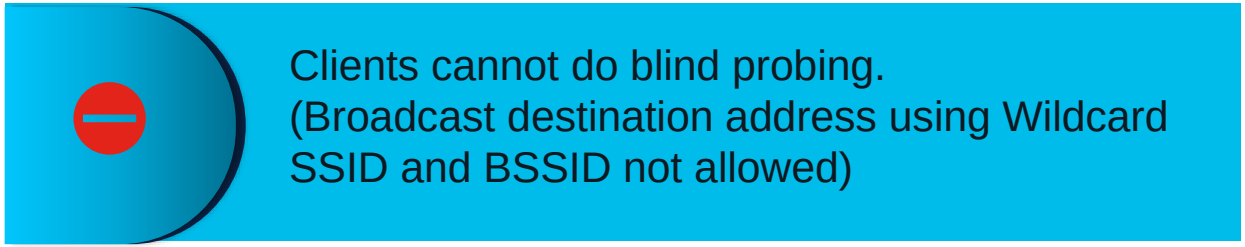
# Unsolicited Broadcast Probe Response Packet Capture

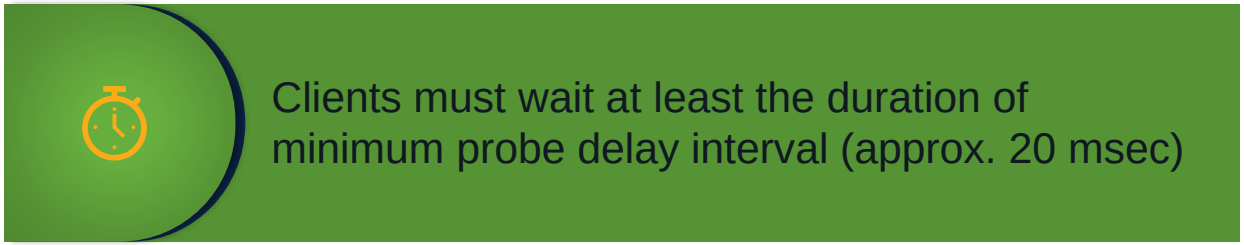
In-Band (passive)




- Broadcast frames
- Transmitted every 20ms
- Carry Multiple BSSID
- Contains all information needed for association

# New Probe Restrictions in 6 GHz Band



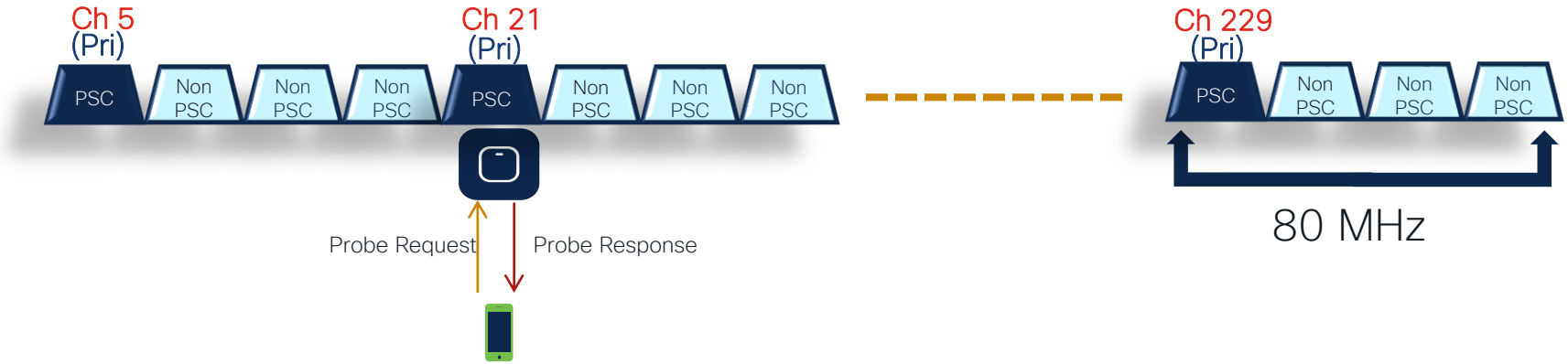





Broadcast probe requests and probes with wildcard SSID create probe storm and impacts performance

# Preferred Scanning Channels (PSC)

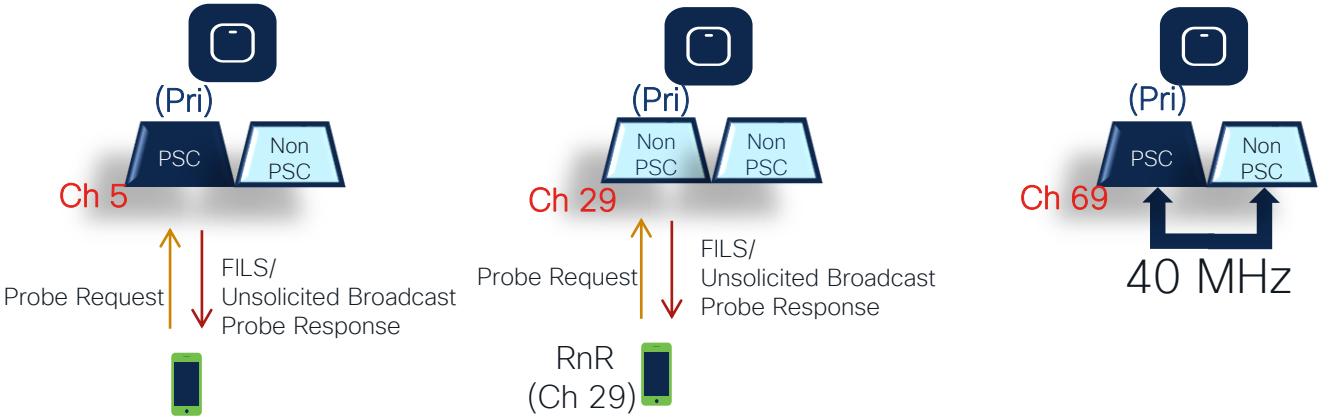
- Every fourth 20MHz channel designated for active probing by Wi-Fi 6E Clients; restricts scanning to 15 channels, instead of 59.
- PSC channels serve as the primary channel for channel bonding in 80 MHz




PSC Channel List:
5, 21, 37, 53, 69, 85, 101, 117, 133, 149, 165, 181, 197, 213 and 229

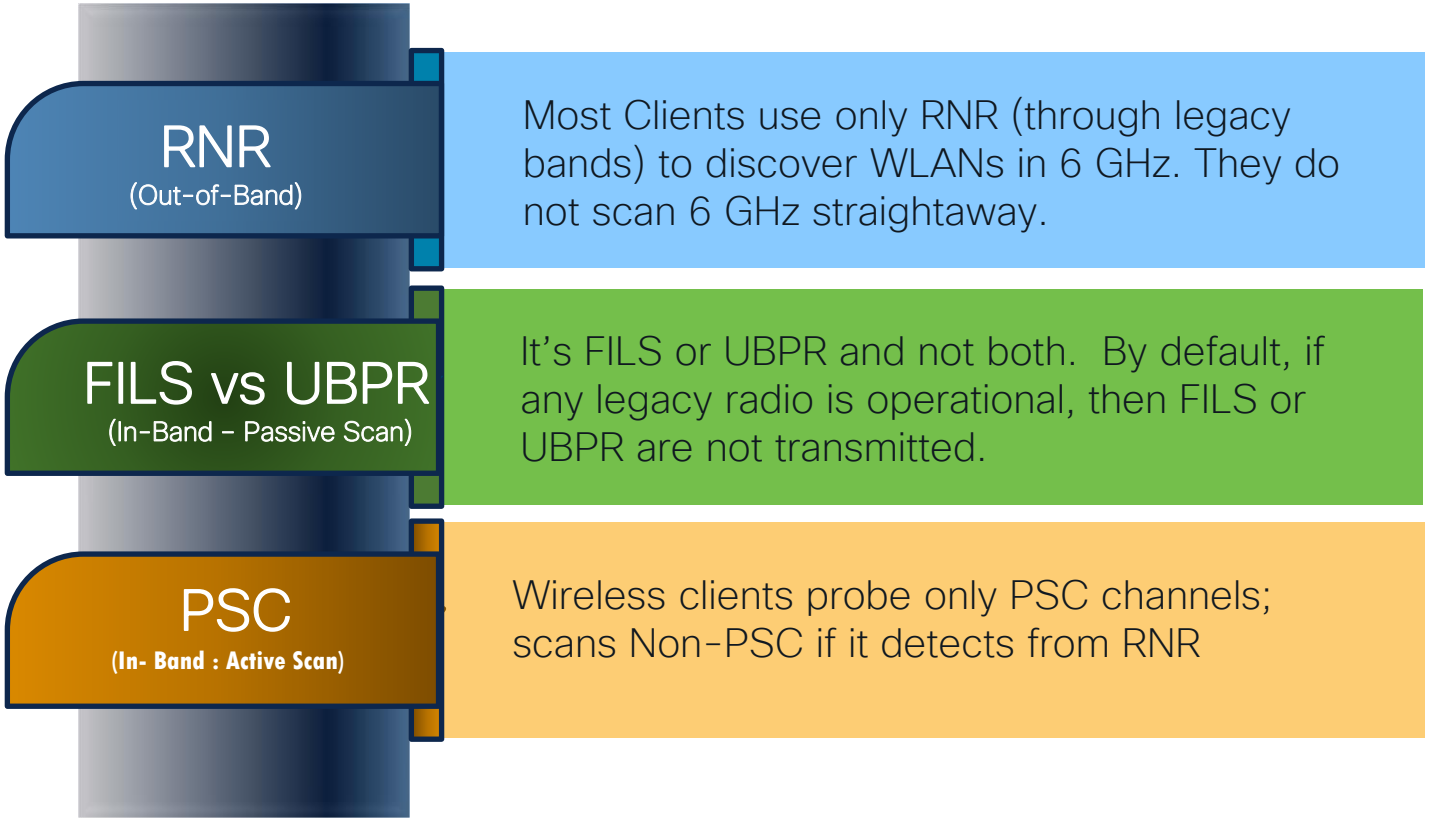
# Preferred Scanning Channels with 40 MHz Channel

- 40 MHz Channel Width is reality in Countries with 500 MHz Spectrum.
- RRM algorithm allocates 40 MHz Channel Width




Clients do not scan Non-PSC

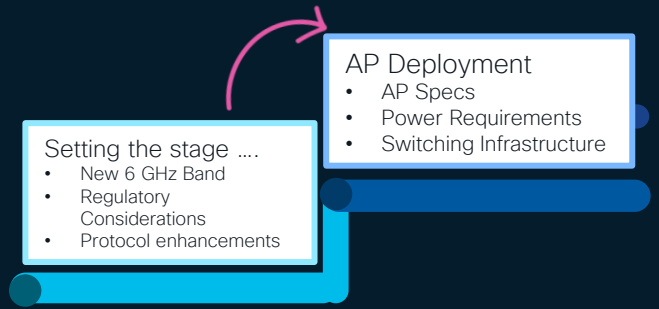
# Key Takeaways



# Section Summary

1. New 6 GHz Band: (5925 – 7125 MHz) 1200 MHz or 500 MHz
2. Device Classes: Low Power Indoor AP, Standard Power AP and Very Low Power AP
3. Protocol Optimizations: Reduced Beacon Size, Multiple BSSID (MBSSID)
4. AP Discovery: RnR (Out-of-Band), FILS, UBPR & PSC (In-Band)

# AP Deployment



# Catalyst Wi-Fi 6E Access Points

# Cisco Catalyst 9136 Series Access Points
## Mission-critical Wi-Fi 6E technology starting from Cisco IOS® XE 17.7.1

### Cisco® Catalyst® 9136 Series
Concurrent tri-radio with 16 spatial streams


### Hexa-radio architecture
1. 2.4-GHz serving radio (slot 0): 4x4:4SS
2. 5-GHz serving radio (slot 1 + slot 2): 8x8:8SS
3. Dual 5-GHz serving radio (slot 1 or slot 2*): 4x4:4SS
4. 6-GHz serving radio (slot 3): 4x4:4SS
5. Dedicated AI/ML-driven scanning radio
6. 2.4-GHz IoT radio

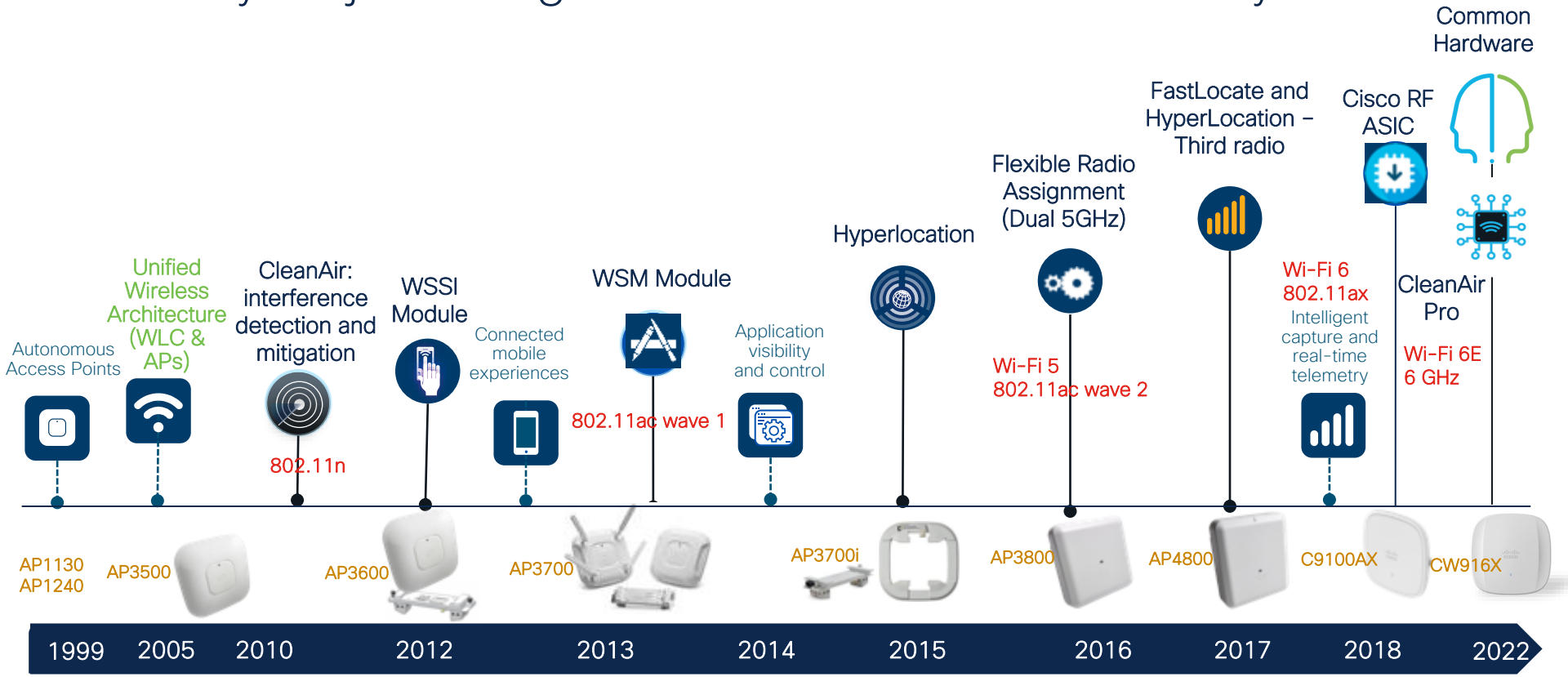
### Dual PoE for power redundancy
- 2x 5 Multigigabit (mGig) PoE ports
- 802.3 Link Aggregation – up to 5-Gbps uplink

### Internet of Things capabilities
- Built-in environmental sensors
- Application hosting technology
- USB port with 9W power output

Analytics with Cisco DNA Center 2.3.2 | Extending Cisco's intent-based network | Location and IoT with Cisco Spaces

*The slot 2 radio in 4x4 will be supported in a future software release.

# Cisco Wi-Fi innovations
## For every major change in WLAN over the last 20+ years



# One Product – Two Management Modes

Cisco DNA **Management Mode**
C9800 & DNAC Stack

Meraki **Management Mode**
MR Dashboard Stack

# Cisco Wi-Fi 6E Portfolio

## Common Platforms will have CW PIDs

MR and C series APs are not convertible

### One Product – Two Management Modes

#### CW9162

- 2x2 + 2x2 + 2x2
- 2.5 Gbps mGig
- Power Options: PoE, DC Power
- Scanning Radio
- IoT ready + Bluetooth 5.x
- Standard Bracket

#### CW9164

- 2x2, 4x4, 4x4
- 2.5 Gbps mGig
- Power Options: PoE, DC Power
- Scanning Radio
- IoT Ready + Bluetooth 5.x
- Standard Bracket

#### CW9166

- 4x4 + 4x4, 4x4 (XOR 5/6)
- 5 Gbps mGig
- Power Options: PoE, DC Power
- IoT ready + Bluetooth 5.x
- Scanning Radio
- Environmental Sensor
- Common XOR Architecture
- Standard Bracket

### MR57

- 4x4 + 4x4, 4x4 (XOR 5/6)
- Dual 5 Gbps mGig with failover
- Power Options: PoE, DC Power
- IoT ready + Bluetooth 5.x
- Scanning Radio
- XOR Architecture (High/Low band)
- Standard Bracket

### C9136

- 4x4 + 8x8 + 4x4 or 4x4+4x4+4x4+4x4
- Dual 5 Gbps mGig with failover
- Power Options: PoE, DC Power
- IoT ready + Bluetooth 5.x
- Scanning Radio
- Environmental Sensor
- XOR Architecture (macro/meso)
- Standard Bracket

# Cisco Catalyst Wireless 6E Access Points

Ideal for Small to Medium-sized deployments

Best In Class, Flexibility

Mission Critical, Performance


## CW9162

- 2x2 + 2x2 + 2x2
- 2.5 Gbps mGig
- Power Options: PoE, DC Power
- IoT ready + Bluetooth 5.x
- Partial iCAP
- USB – 4.5 W


## CW9164

- 2x2, 4x4, 4x4
- 2.5 Gbps mGig
- Power Options: PoE, DC Power
- IoT Ready + Bluetooth 5.x
- Partial iCAP
- USB- 4.5 W


## CW9166

- 4x4 + 4x4 + 4x4 (XOR 5/6)
- 5 Gbps mGig
- Power Options: PoE, DC Power
- IoT ready + Bluetooth 5.x
- Environmental Sensor
- Full Packet Capture (iCAP)
- Zero-Wait DFS*
- USB – 4.5W

## C9136

- 4x4, 8x8, 4x4 (or) 4x4, 4x4+4x4, 4x4
- Dual 5 Gbps mGig, active fail over
- PoE Redundancy
- IoT ready
- Bluetooth 5.x
- Environmental Sensor
- Full Packet Capture (iCAP)
- Zero-Wait DFS*
- USB – 9W

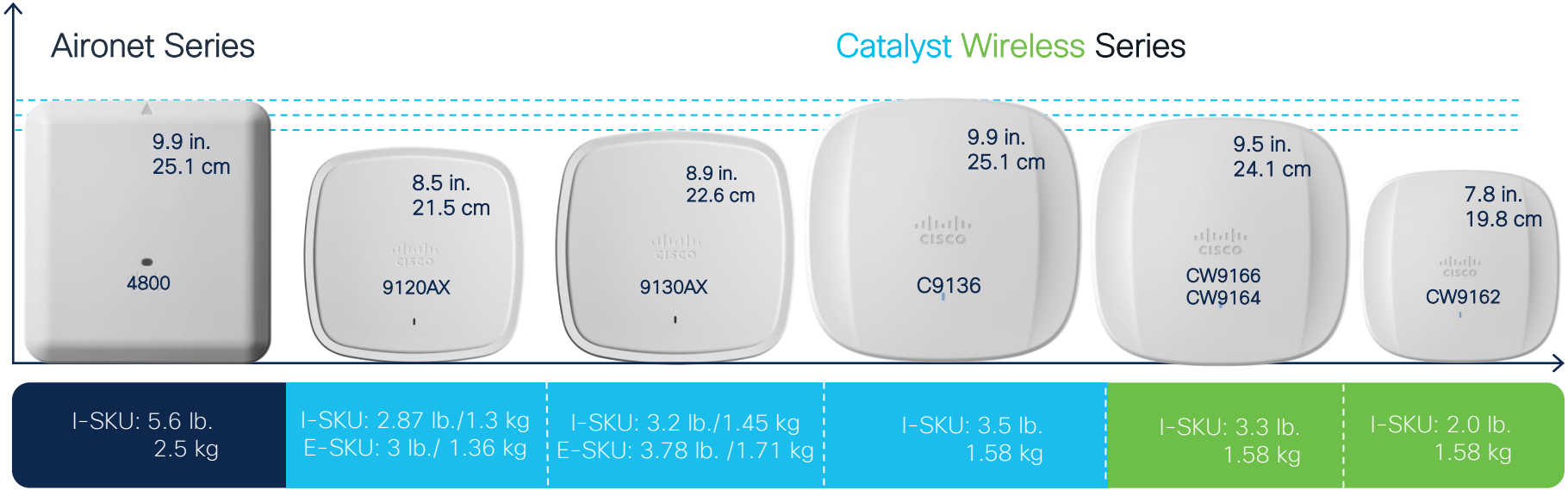
Available with IOS-XE 17.9.2

*Available in Future

**Full radio capability (6 GHz @ LPI) on single 30W PoE+**

Dedicated Radio for CleanAir Pro | Same Bracket, Industrial Design | AP Power Optimization | USB

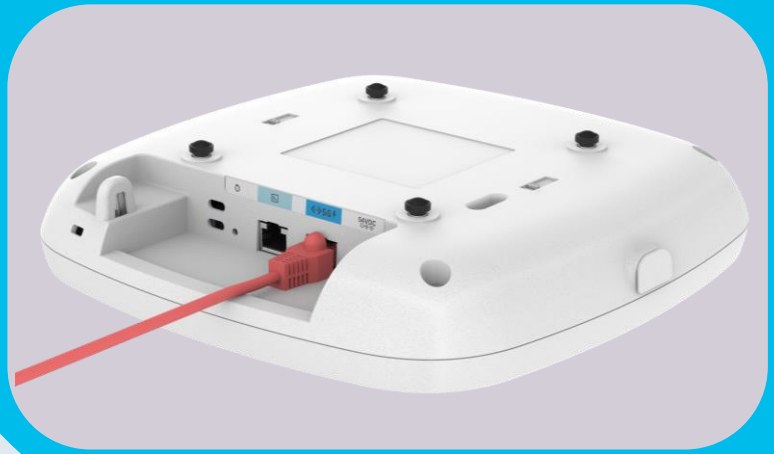
# Indoor Access Point Dimensions
## Wi-Fi 6E – Similar in size but significantly more capabilities



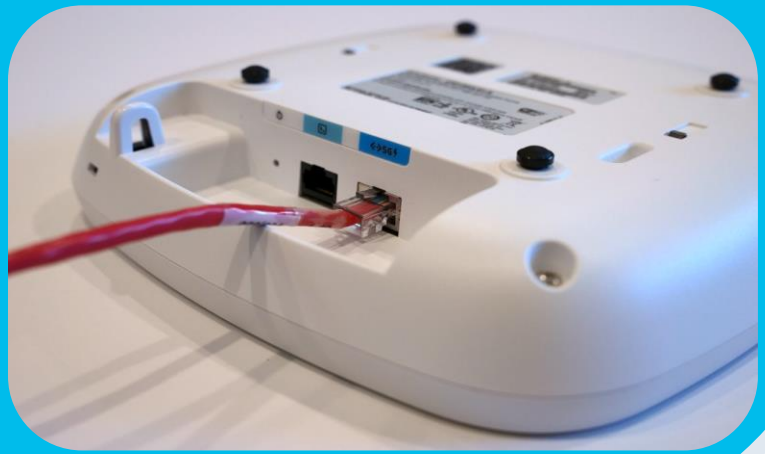
# Catalyst C9136/CW9166/9164/9162

## Enhanced cabling experience

C9136/CW66/64/62– Lowered Edge



C9130 – Higher Edge and Smaller Area

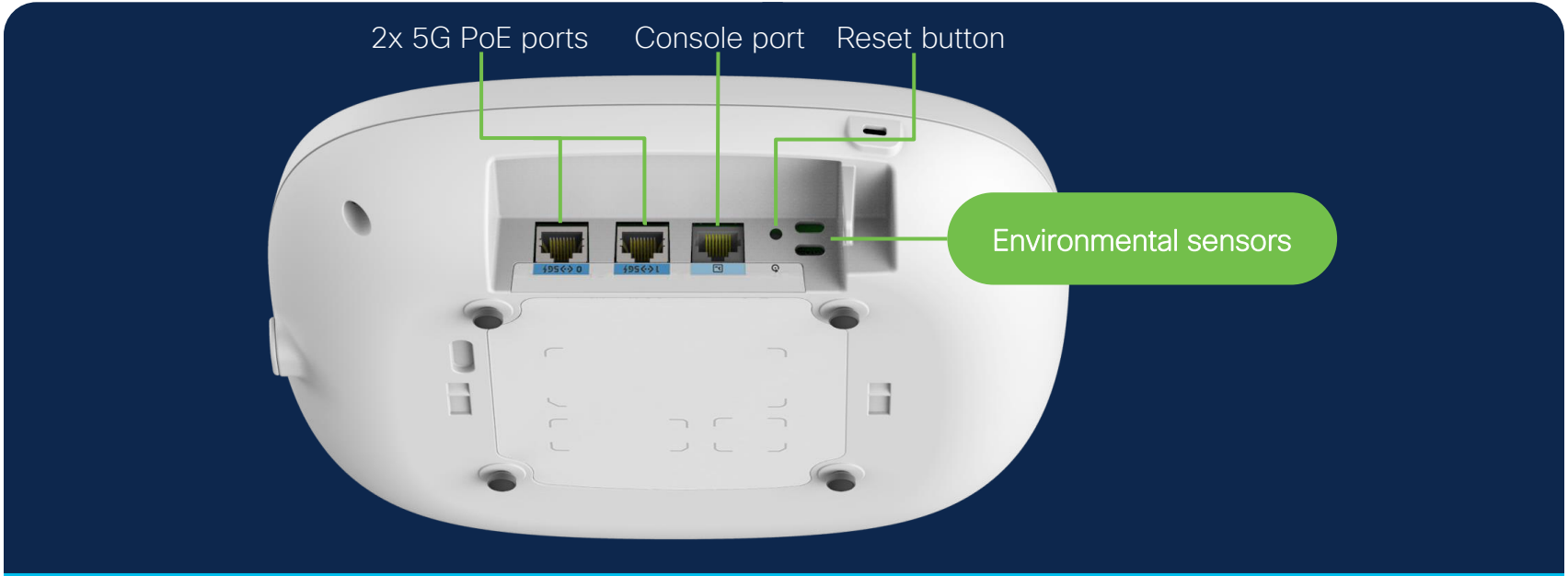


**Larger Recessed Area**
Allow Wires not to be Bent During Connection

**More Easily Accessible Port**
Allow for Better Deployment Experience

# Catalyst 9136 ports

## Ports and connections

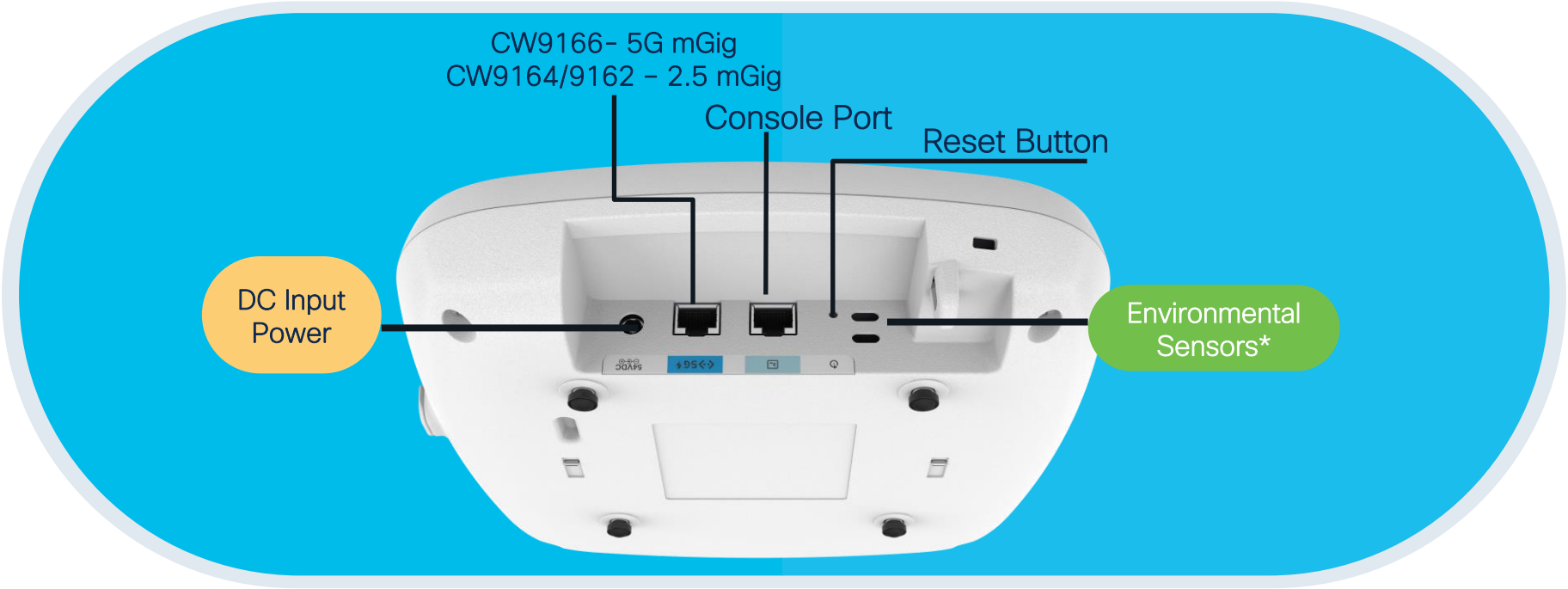



**Dual PoE ports for hitless PoE:**
No reboot required if a port loses power

**Uplink ports support:**
802.3 link aggregation for increased throughput resiliency

# Catalyst CW9166/64/62

## Ports and connections




* Environmental Sensors Available only in CW9166

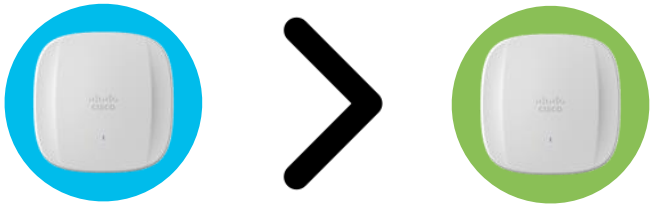
# AIR-AP-BRACKET-1 photos

| Front side | AP mounted | Back side |
|---|---|---|

# AIR-AP-BRACKET-2 photos

| Front side | AP mounted | Back side |
|---|---|---|

# Conversion overview



Done from C9800 WLC

Call Meraki Support
(Needs license)

# Cisco Catalyst 9800-CL Wireless Controller

17.9.20220502

Welcome *admin*

Search APs and Clients

Feedback

Search Menu Items

- Dashboard
- Monitoring
- Configuration
- Administration
- Licensing
- Troubleshooting

## Dashboard

| Network | | Wireless LANs | | Access Points | | Clients | | Rogues | | Interferers | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 GHz | ↑ | | 4 | | 3 | Active | 1 | APs | 190 | 5 GHz | 0 |
| 5 GHz | ↑ | | 0 | | 0 | Excluded | 0 | Clients | 59 | 2.4 GHz | 5 |
| 2.4 GHz | ↑ | | | Not Joined | 0 | Sleeping | 0 | Ad-Hoc | 1 | | |

## Overview

### Radios

Last Updated: 5/2/2022, 4:20:30 PM

Up Down Radio Role Hide


### Top Access Points

Last Updated: 5/2/2022, 4:20:30 PM

Sort by: APs With Highest Client Count

| Ad... Sta... | AP Name | AP MAC | Clients | Data Usage | Throughput |
|---|---|---|---|---|---|
| ✓ | CW9166I-1 | 10f9.20fe.1ea0 | 1 | 215 MB | 2.9 Kbps |

### Top WLANs

Last Updated: 5/2/2022, 4:20:30 PM

Sort by: WLANs With Highest Client Count

| WLAN Name | ID | Clients | Data Usage |
|---|---|---|---|
| dot1x1 | 2 | 1 | 215 MB |
| dot1x2 | 3 | 0 | 52 KB |

### Client Device Types

Last Updated: 5/2/2022, 4:20:29 PM

### System Information

Last Updated: 5/2/2022, 4:20:30 PM

Hostname: C9800-CL

Device Uptime: 6 hours, 18 minutes

System Time: 16:17:31.084 Pacific Mon May 2 2022

Device Type: C9800-CL

# IoT & Environmental Sensors

# Catalyst 9136/9166I have three built-in environmental sensors with full Cisco Spaces integration


| AP Product | IOS-XE Release |
|---|---|
| Catalyst 9136I | 17.7.1 |
| Catalyst 9166I | 17.9.1 |

**Air quality**

The built-in Gas Sensor Module will enable the reading of Total Volatile Organic Compound (TVOC) concentration and Indoor Air Quality (IAQ) rating.

**Humidity**

The built-in module is a fully calibrated sensor with the ability to measure the relative humidity in the air.

**Temperature**

The built-in module can also capture the temperature to provide a reading of the environment remotely.

**Note:** The temperature generated by the AP will be considered during temperature and IAQ readings.

# Catalyst 9100 Series Access Points have a built-in IoT radio which integrates with Cisco Spaces

| AP Product | IOS-XE Release |
|---|---|
| Catalyst 9136I | 17.7.1 |
| Catalyst 9164I/9166I | 17.9.1 |
| Catalyst 9162I | 17.9.2/17.10.1 |

**Configure as a BLE Gateway** — Enable Catalyst 9100 Access Points as a Base or Advanced AP Gateway

**Enable Scan and/or Transmit Mode** — Scan for information from nearby BLE devices and stream that data to Cisco Spaces and/or transmit BLE signals from Catalyst 9100 Access Points

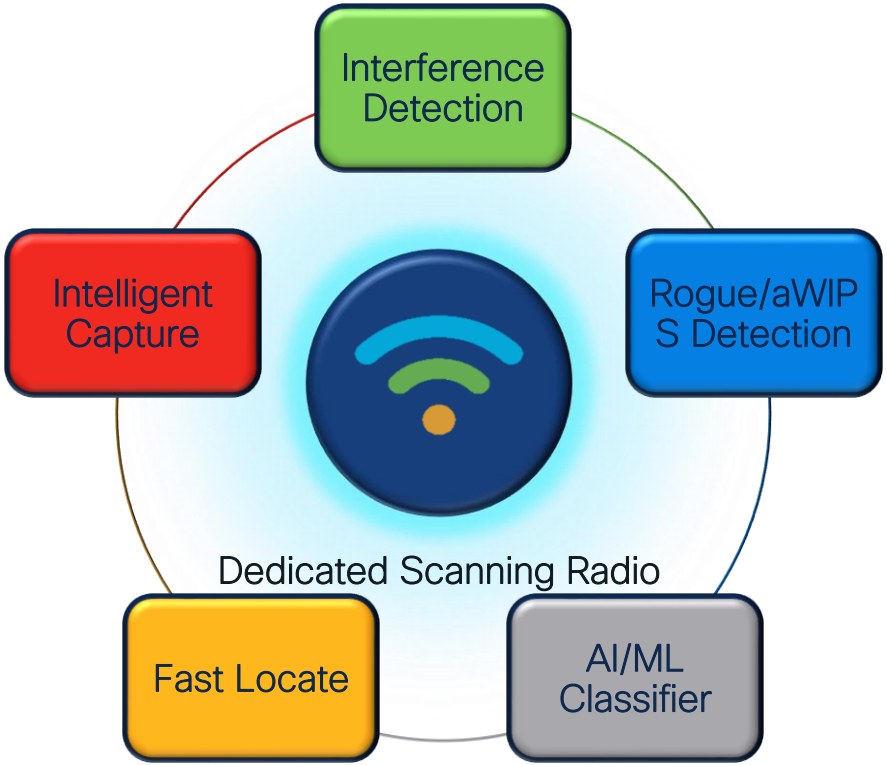
**BLE Device Configuration** — Configure the BLE devices from Cisco Spaces and remove the need for multiple Gateways

# CleanAir™ Pro

## RF Excellence


cisco Live!

# CleanAir Pro
## AI/ML Driven Dedicated Scanning Radio



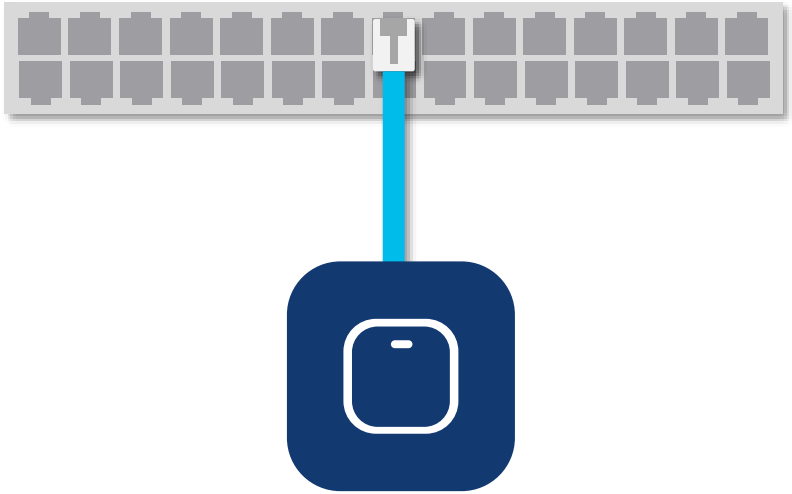

Full 2.4, 5 and 6 GHz Band Support

AI/ML Based Interference classification on the AP

Off-loads Monitoring functions from client serving radios

# Network Infrastructure

# Catalyst AP to Switch connection



AP negotiates power, speed and duplex at boot time via CDP/LLDP

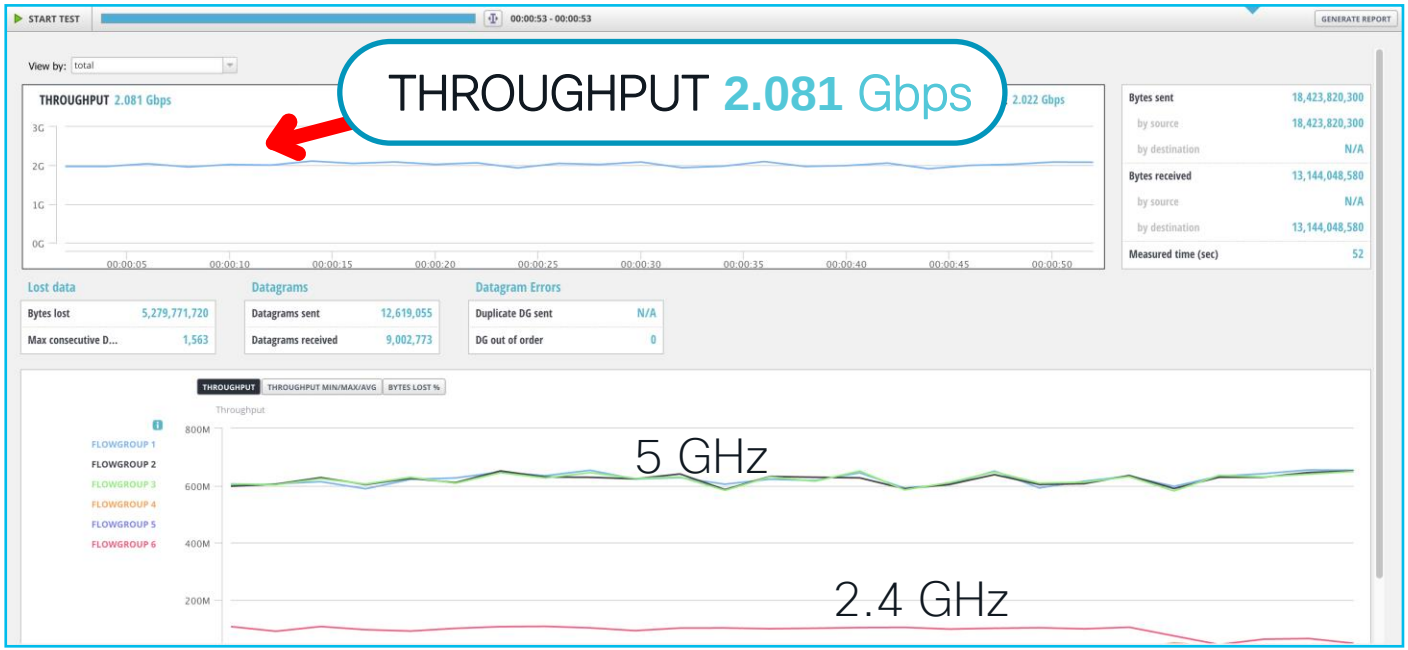
MGig switchport is recommended as Wi-Fi 6/6E speed may exceed 1 Gbps

Cabling: Cat 6/6A recommended. Cat 5e can support up to 5Gbps

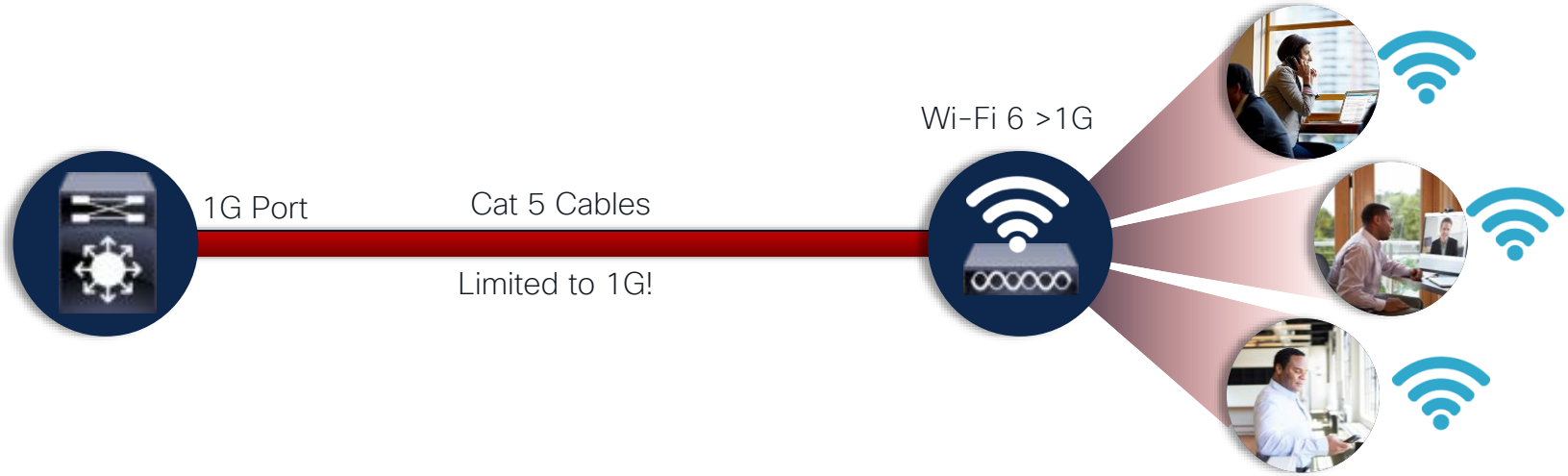
CDP = Cisco Discovery Protocol
LLDP = Link Layer Discovery Protocol
Cat = Category (of ethernet cable)

# Wi-Fi 6 needs 80 MHz for + 1 Gbps

3x Intel AX200 on 2.4 GHz @20 MHz and 3 x Intel AX200 on 5 GHz at 80 MHz



# The Problem – Gigabit Bottleneck



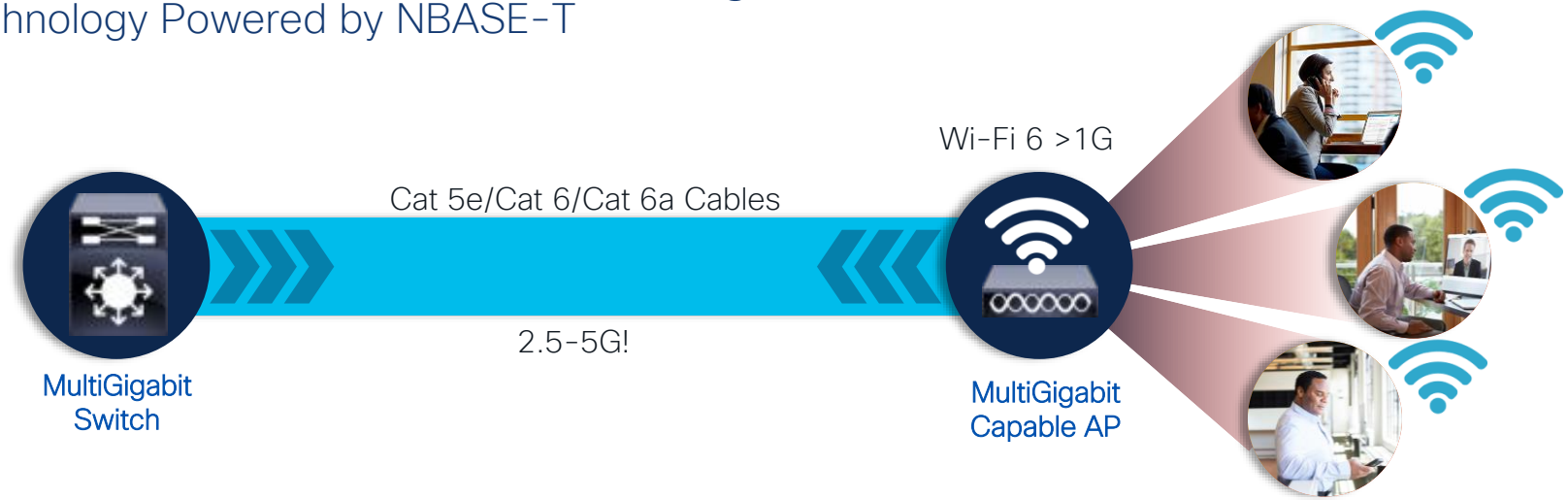

Existing Gigabit infrastructure is insufficient to handle .11ax growth beyond 1Gbps

Gigabit Ethernet has been around since 1999 and had become the bottleneck for next gen access

Market needed an innovative technology to support >1Gbps over existing cables

# The Solution – Cisco MultiGigabit

## Technology Powered by NBASE-T




Is a game-changing innovation allowing enterprise networks to evolve beyond 1G

Enables 2.5 and 5* Gbps up to 100m on legacy cables; Fully 802.3bz compliant

** When bundled 30-50m length*

Supports all PoE standards up to 90W

**Delivers up to 5X Speeds in Enterprise without replacing Cabling Infrastructure**

# MultiGigabit Cabling Investment Protection


**Auto-negotiable** Speeds – Interoperates with legacy ports at 100 Mbps and higher

**Brownfield** Deployments can leverage existing Cat5e cables, extending ROI, and supporting speeds at 2.5G and 5G at a distance of 100m

**Greenfield** Deployments with Cat6a Will Support 10G – They can also support speeds at 2.5G and 5G at a distance of 100m

| Cable Type | 1G | 2.5G | 5G | 10G |
|---|---|---|---|---|
| Cat5e | ✓ | ✓ | ✓ | NA |
| Cat6 | ✓ | ✓ | ✓ | 55 m |
| Cat6a | ✓ | ✓ | ✓ | ✓ |

# Catalyst AP C9136 to Switch connection


AP C9136

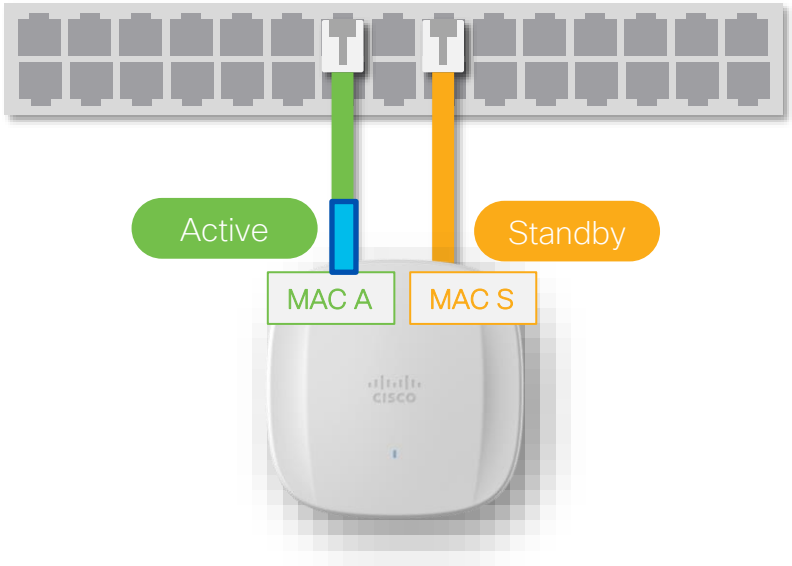
C9136 has two mGig uplink ports

Dual port is for PoE power and uplink redundancy with hitless failover

Switchport and AP can be configured for LAG or standalone ports (default)

mGig = multi gigabit ethernet
PoE = Power over Ethernet
LAG = Link Aggregation Group

# Catalyst AP C9136 to Switch connection

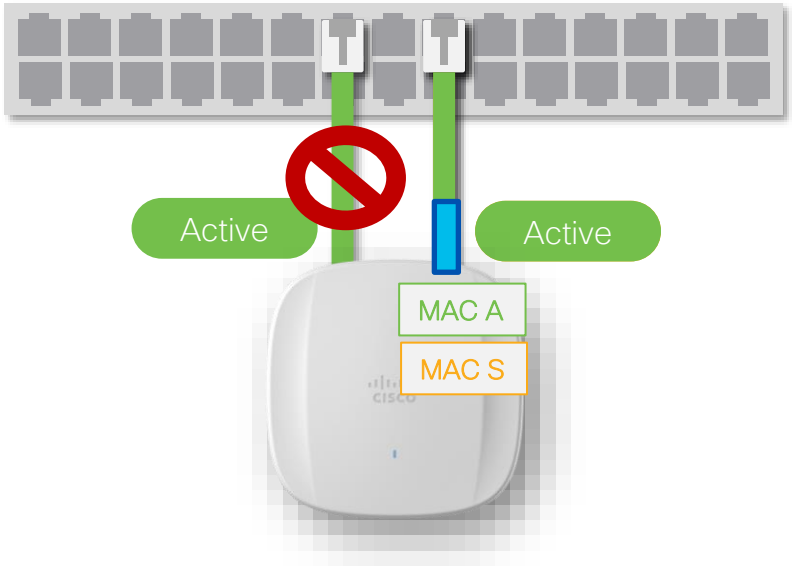



AP C9136

- When configured as standalone ports, one becomes active and the other one standby
  - If power is equal on both ports, Port 0 becomes active. Otherwise, the one with more power
- Traffic is exchanged on active port using active MAC A (CAPWAP, ARP, etc.)
- Standby port only exchanges CDP/LLDP messages with its own MAC S, no other traffic

MAC = Media Access Control
ARP = Address Resolution Protocol
CAPWAP = Control and Provisioning of Wireless Access Points

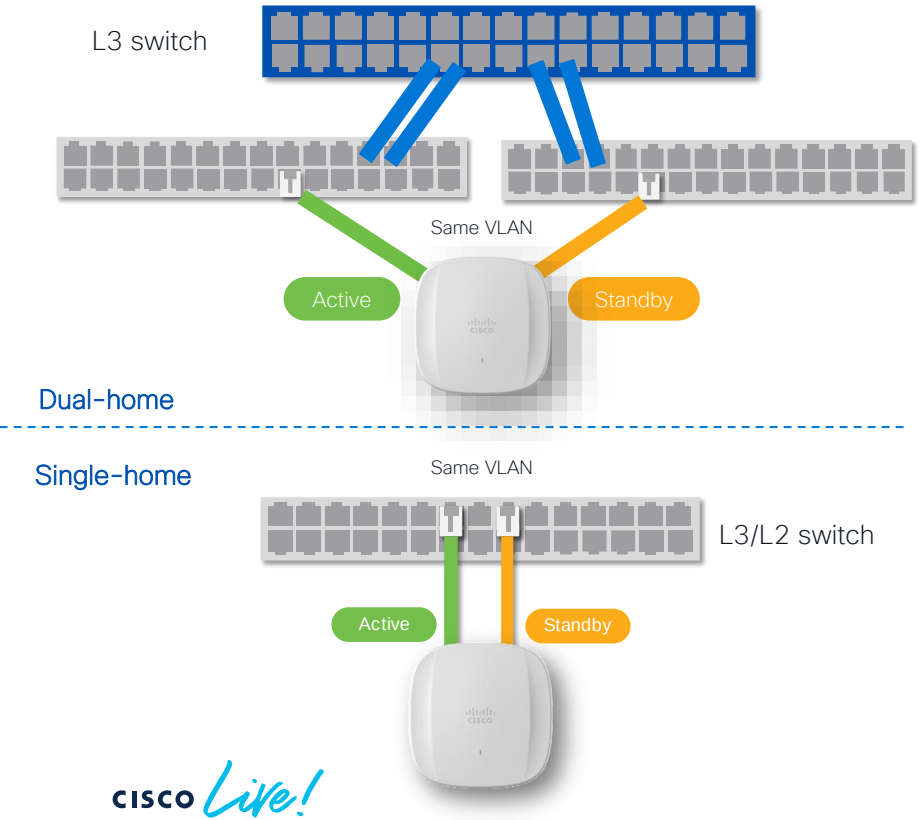
# Catalyst AP C9136 to Switch connection




AP C9136

- When configured as standalone ports, one becomes active and the other one standby
  - If power is equal on both ports, Port 0 becomes active. Otherwise, the one with more power
- Traffic is exchanged on active port using active MAC A (CAPWAP, ARP, etc.)
- Standby port only exchanges CDP/LLDP messages with its own MAC S, no other traffic
- In case of active port failure, standby becomes active and exchanges traffic using MAC A. Minimal to zero traffic interruption

# Catalyst AP C9136 to Switch connection




- When configured with standalone ports, you have two options…
- Dual-home to two different switches
  - Recommend to connect to switches in different IDF, whenever possible
- Single-home to one logical switch (Stack Wise, vPC, Multi-layer switch, etc.)
  - Recommend to connect to two different members of the stack or line-cards
- In both scenario, the switchports must be configured in the same VLAN

VLAN = Virtual Local Area Network
IDF = Intermediate Distribution Frame
vPC = virtual Port Channel

# Catalyst AP C9136 to Switch connection

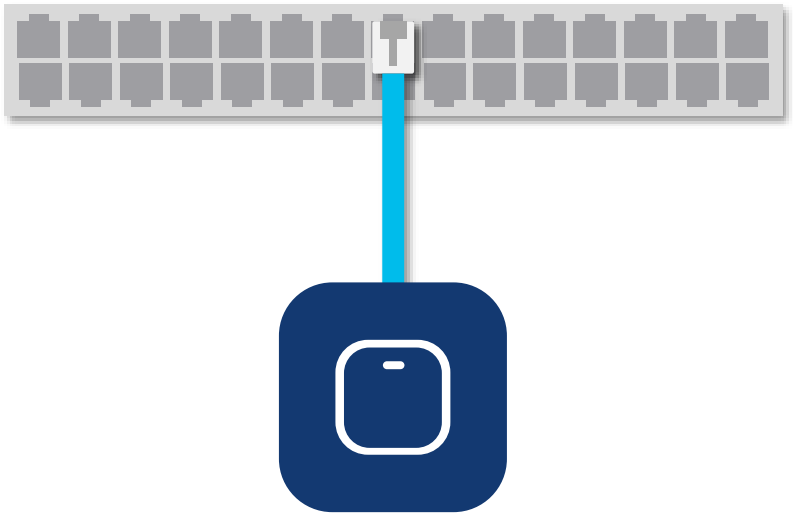

AP C9136

- When configured with LAG, both ports are Active
- LAG must be configured on both AP and switchport side.
- AP supports static LAG config (mode on) or dynamic with LACP
- Traffic is load balanced across the two links using src-dst-port algorithm. CAPWAP uses random source UDP ports
- LAG must be connected to one single (physical or logical) switch

LACP = Link Aggregation Control Protocol
src-dst-port = source-destination-port

# Power considerations

# AP Power Consumption



| Power Allocated | Power Consumed |
| --- | --- |
| 48.3 W | 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

# Catalyst CW9162 Power over Ethernet

## Default Configuration (Fixed Power profile)

| Power Source | Number of Spatial Stream | 2.4 GHz Radio | 5 GHz Radio | 6 GHz Radio | mGig Link Speed | USB | AI/ML Driven Scanning Radio |
|---|---|---|---|---|---|---|---|
| 802.3af | 2 | Disabled | 1x1 | 1x1 | 1G | Disabled | Y |
| 802.3at | 6 | 2x2 | 2x2 | 2x2 | 2.5G | Y/4.5 W | Y |
| 802.3bt | 6 | 2x2 | 2x2 | 2x2 | 2.5G | Y/4.5 W | Y |
| DC Power | 6 | 2x2 | 2x2 | 2x2 | 2.5G | Y/4.5 W | Y |

Note:

1. AIR-PWRINJ7/AIR-PWRINJ6 is C9162I's official 802.3bt Power Injector

USB = universal serial bus
AI = Artificial Intelligence
ML = Machine Learning

# Catalyst CW9164 Power over Ethernet

## Default Configuration (Fixed Power profile)

| Power Source | Number of Spatial Stream | 2.4 GHz Radio | 5 GHz Radio | 6 GHz Radio | mGig Link Speed | USB | AI/ML Driven Scanning Radio |
|---|---|---|---|---|---|---|---|
| 802.3af | n.a. | Disabled | Disabled | Disabled | 1G | Disabled | Y |
| 802.3at | 10 | 2x2 | 4x4 | 4x4 | 2.5G | Disabled | Y |
| 802.3bt | 10 | 2x2 | 4x4 | 4x4 | 2.5G | Y/4.5 W | Y |
| DC Power | 10 | 2x2 | 4x4 | 4x4 | 2.5G | Y/4.5 W | Y |

Note:
1. AIR-PWRINJ7 is C9164I's official 802.3bt Power Injector

USB = universal serial bus
AI = Artificial Intelligence
ML = Machine Learning

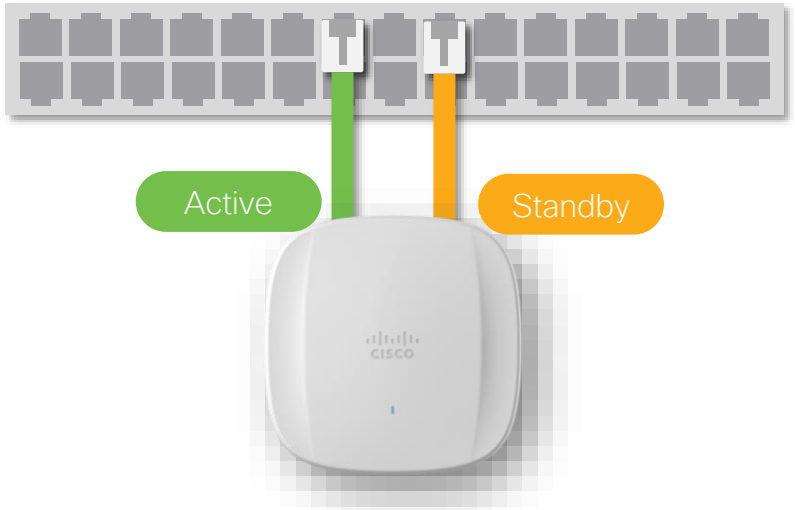
# Catalyst CW9166 Power over Ethernet

## Default Configuration (Fixed Power profile)

| Power Source | Number of Spatial Stream | 2.4 GHz Radio | 5 GHz Radio | 5 GHz /6 GHz Radio (LPI) | mGig Link Speed | USB | Env Sensors | AI/ML Driven Scanning Radio |
|---|---|---|---|---|---|---|---|---|
| 802.3af | n.a. | Disabled | Disabled | Disabled | 1G | Disabled | Y | Y |
| 802.3at | 12 | 4x4 | 4x4 | 4x4 | 5G | Disabled | Y | Y |
| 802.3bt | 12 | 4x4 | 4x4 | 4x4 | 5G | Y/4.5 W | Y | Y |
| DC Power | 12 | 4x4 | 4x4 | 4x4 | 5G | Y/4.5 W | Y | Y |

Note:
1. AIR-PWRINJ7 is C9166I's official 802.3bt Power Injector

# Catalyst 9136 Power Consumption (dual port)




| | Power Allocated | Power Consumed |
|---|---|---|
| Port 0 | 48.3 W | 16.5 W |
| Port 1 | 48.3 W | 0.5 W |

Both ports negotiate power and need to be considered for budget

If no-LAG, Standby port consumes very little power

If LAG, both ports are active, and they both draw power

# Catalyst 9136I Power over Ethernet

## Default Configuration (Fixed Power profile)

| Power source | Number of spatial streams | 2.4-GHz radio (slot 0) | Primary 5-GHz radio (slot 1) | Secondary 5-GHz radio (slot 2) | 6-GHz radio (slot 3) | mGig PHY 0 link speed | mGig PHY 1 link speed | USB | AI/ML-driven scanning radio | Env. sensors | Max power draw |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.3af (PoE) | 0 | Disabled | Disabled | | Disabled | 1G | Disabled | Disabled | Y | Y | 14W |
| 802.3at (PoE+) | 8 | 2x2 | **4x4** | Disabled | **2x2** | 2.5G | 2.5G (Standby) | Disabled | Y | Y | 24.4W |
| 802.3bt (UPOE) | 16 | 4x4 | 8x8 or dual 4x4 | | 4x4 | 5G | 5G | Yes/9W | Y | Y | 47.3W |

Note:

1. Slot 2 can operate only together with slot 1 in 8x8 mode. Independent slot 2 operation is not supported until a future software release.
2. AIR-PWRINJ7 is the 9136I's official 802.3bt power injector.

PHY = Physical layer
PoE = Power over Ethernet
UPoE = Universal Power over Ethernet

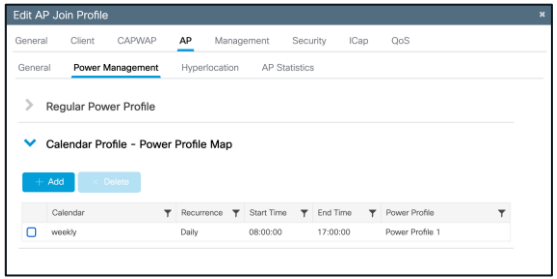
# AP Power Optimizations Feature Suite

## Save Power, Reallocate Power, and Visibility into Savings

### AP Power Save Mode

Lower AP Power Usage

- Create a calendar profile for off-peak hours.
- Create a power profile to lower the power consumption budget during off-peak hours.
- Power Profile: Shut AP Radio or lower spatial Stream, lower port speed, disable USB port.

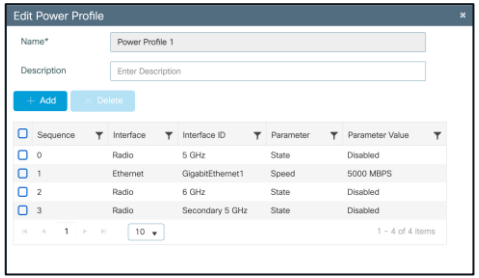



IOS-XE 17.8

### AP Power Distribution

Control over how power is used

- Reallocate extra AP Power to different radios while operating on PoE+ (30W).
- Customization of your PoE power budget.
- Example: Disable 2.4 GHz radio -> use extra power for 6 GHz radio.




IOS-XE 17.10

### AP Power Savings Insight

- Cisco DNA Center PoE dashboard integration.
- Power Savings, Money Savings, Emissions Reductions.
- Visibility into trends and insights.
- Both site level and AP level view.


Supported on 9115, 9120, 9130, 9136, 9166, 9164, 9162

Note: Cisco DNA Center integration is on the roadmap

# Section Summary

1. Catalyst Wi-Fi 6E Access Point Portfolio:
   CW9162, CW9164, CW9166 & C9136
   (Low Power Indoor AP)
2. Common Hardware and Migration
   CleanAir Pro & IoT Capabilities
3. Switch Port Speed ( > 1 G)
   Cabling : Cat 5e, Cat 6, Cat 6A and above
4. PoE Requirements
   Power Optimizations
5. Catalyst 9136 Dual mGig Link and PoE Redundancy Options

# RF Design

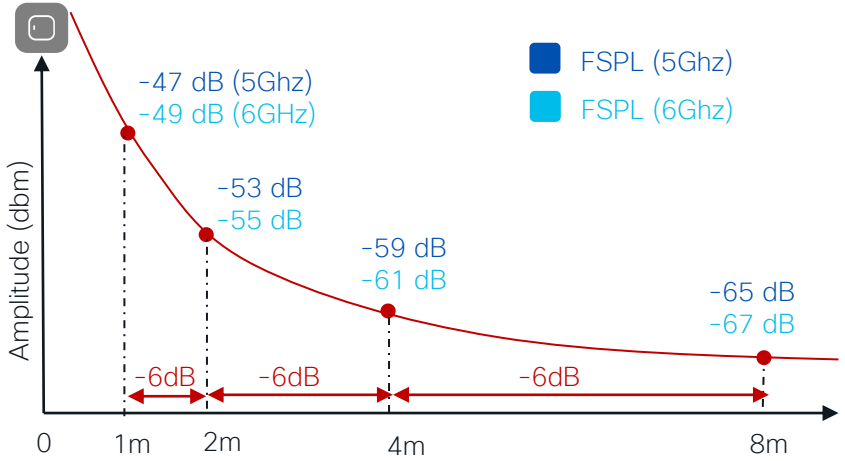

**Setting the stage ….**
- New 6 GHz Band
- Regulatory Considerations
- Protocol enhancements

**AP Deployment**
- AP Specs
- Power Requirements
- Switching Infrastructure

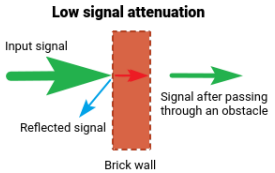
**RF Design**
- AP Coverage
- AP Density
- Site Survey Mode

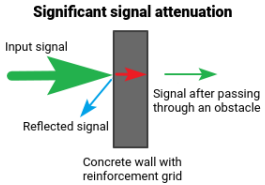
# What you need to consider?

- Path Loss (FSPL)* – Path loss in the first meter is on average 2dB higher at 6GHz vs. 5GHz. After that, the 6 dB rule applies: doubling the distance results in a 6 dB loss, regardless of the frequency
- Cell Size – At 6 GHz @ same power level cell is smaller vs. cell size at 5 GHz




- Absorption/Reflectance – 6 GHz will be attenuated more through wall or other surface
- Noise floor at 6 GHz is much lower than 5 GHz, at least for some time ☺
- Coverage type: Today 6GHz is indoor only



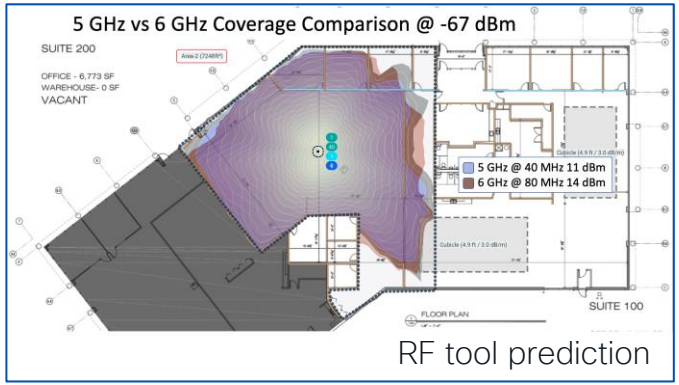




(*) FSPL = Free Space Path Loss: https://en.wikipedia.org/wiki/Free-space_path_loss

https://help.keenetic.com/hc/en-us/articles/213968869-Wi-Fi-signal-attenuation-coefficients-when-passing-through-different-materials

# RF Design considerations

- AP antenna patterns at 6GHz are similar to 5GHz
- AP coverage between 5GHz and 6GHz will be similar, especially in open spaces BUT it does require to compensate with power > 3dB higher in 6GHz



RF tool prediction

5GHz @40 MHz 11dbm

6GHz @80 MHz 14 dbm

- With brick walls, elevator and other environments, you would probably need to measure and add few APs

# Where are we then on 5 and 6 GHz assumptions?

Q1: Can a co-resident 6 GHz radio provide the same coverage as the 5 GHz cell while dramatically increasing performance?

A1: Yes!

Q2: Can a one for one replacement of Wi-Fi 6/5 APs with Wi-Fi 6E APs be achieved?

A2: Yes!

*Assuming 1.2 – 2k $f^2$ (140-190 $m^2$) of average AP density, carpeted office normal ceiling (3 m /10 ft)

- 5 GHz network with RRM operating at power levels 3-4? >then equal 5 and 6 GHz coverage is possible with a one for one AP replacement in both ETSI and FCC. Assuming 80 MHz channel in FCC and 40 MHz channel in ETSI/UK
- If the power level is in 1-2, then you may need around 10 to 20% additional access points.

# To get an in-depth understanding of RF Design ….

## Advanced RF Tuning for Wi-Fi6E with Catalyst Wireless: Become an Expert, While Getting a Little Help from AI - BRKEWN-3413

Jim Florwick, Technical Marketing Engineering Technical Leader, Cisco Systems, Inc. - **Distinguished Speaker**

Participants will learn the RF design and implementation guidelines necessary to plan, configure, and implement Wi-Fi networks that meet the evolving regulatory (6 GHz) and customers RF demands. Wi-Fi is changing and there has never been a more exciting time to be in RF technologies. In this session you will learn about Cisco's newest Catalyst Wireless Access Points and Antenna's including the latest Wi-Fi 6E Access Point and the new Wi-Fi 6 stadium antennas. Participants will learn and understand the current coverage and design best practices as well as what this means to the evolving RF landscape around the world. Everything we know is evolving.

This session will provide a deep dive on how to think about and manage Wi-Fi6e, RRM, Spectrum Intelligence and the evolution of Multi Band Operations within the infrastructure. The evolution to Wi-Fi 6e brings amazing RF capacity gains. Wi-Fi6e also means new pressures on the wired infrastructures capacity and power that supports it. Attendees will learn what to expect and how to manage and plan the future needs now. Session attendees will be able to successfully use the information to navigate and understand todays fluid RF and Mobility landscapes and to articulate the benefits to their customers enabling the Best wireless and mobility experiences yet.

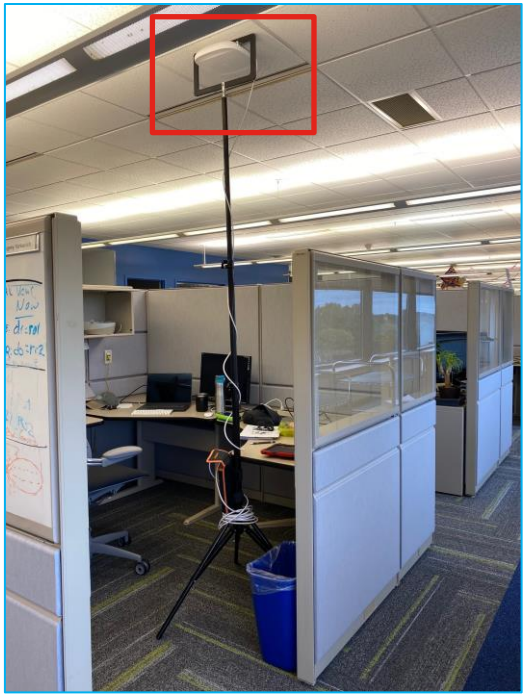
**Technical Level:** Advanced

**Technology:** Wifi 6, Enterprise Mobility

**Wednesday, Feb 8 | 8:30 AM - 10:00 AM CET**

# New Gear!!!  Wi-Fi 6E Measurement !

Ekahau Sidekick 2
- 2.4, 5, 6 GHz
- Ekahau AI Pro
- Ekahau Analyzer

NetAlly Aircheck G3
- 2.4, 5, 6 GHz
- NetAlly Link-Live

- Ekahau Sidekick 1
- 2.4, 5 GHz
- Ekahau AI Pro

# Catalyst Wi-Fi 6E Site Survey Mode


AP in standalone mode, broadcasting SSIDs across all 3 bands
Embedded DHCP server provides Client IP

WebUI access for easy configuration and viewing of various RF metrics for RF coverage and planning

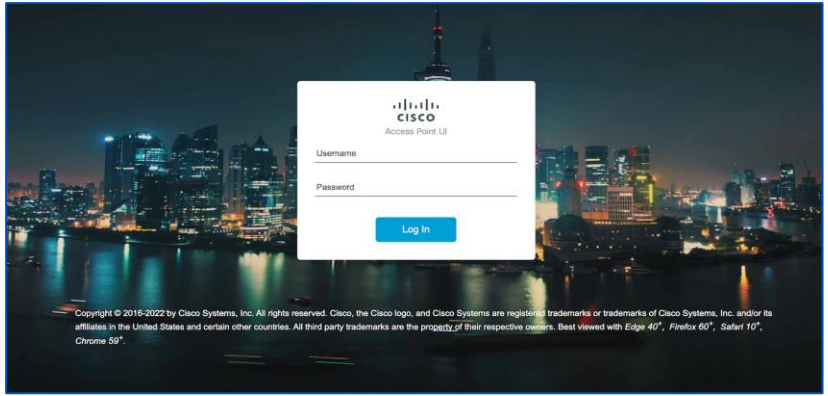
Supports configuration of channel number, channel width, Tx power, SSID, and data rates

# Site survey mode configuration steps

1. Change AP to site survey mode > Enter command “ap site-survey”

```
C9136#ap ?
  capwap       Switch to CAPWAP AP type
  site-survey  Switch to Site Survey AP type
```

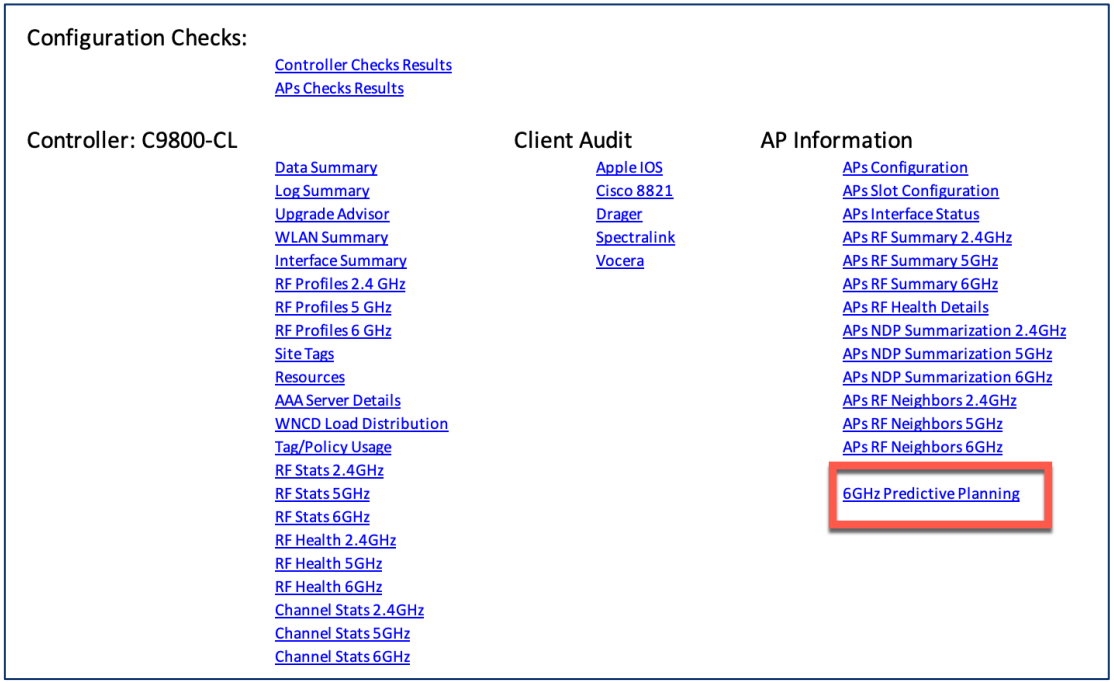
2. After bootup, the AP is automatically assigned a static IP of 10.0.23.1.
3. AP will start broadcasting the **`C9136_site_survey`** with Open/OWE authentication security
4. Connect your wireless client with the site survey SSID and it’ll receive an IP from 10.0.23.0/24
5. Access the Catalyst 9136 Site Survey WebUI via 10.0.23.1




# 6 GHz Predictive view with WCAE Tool

## Get a taste of how the network would look, without adding any Aps!

WCAE Version: 0.9.11 or later



# Get to Know Average Power Level with WCAE Tool

| Summarization Level | Name | Channel | APs | Clients | Average Power | Average Power dBm |
|---|---|---|---|---|---|---|
| Controller | 9800-a | 48 | 42 | 17 | 1.81 | 14.57 |
| Controller | 9800-a | 64 | 257 | 20 | 1.58 | 16.25 |
| Controller | 9800-a | 132 | 173 | 12 | 2.1 | 19.6 |
| Controller | 9800-a | 36 | 311 | 16 | 1.36 | 15.92 |
| Controller | 9800-a | 100 | 213 | 30 | 2.2 | 19.34 |
| Controller | 9800-a | 112 | 90 | 9 | 2.8 | 17.57 |
| Controller | 9800-a | 56 | 11 | 2 | 1.36 | 16.91 |
| Controller | 9800-a | 108 | 16 | 0 | 2.12 | 19.62 |
| Controller | 9800-a | 52 | 115 | 11 | 1.89 | 15.34 |
| Controller | 9800-a | 40 | 9 | 0 | 1.44 | 15.67 |
| Controller | 9800-a | 44 | 49 | 4 | 2.12 | 13.63 |
| Controller | 9800-a | 104 | 8 | 0 | 1.88 | 20 |
| Controller | 9800-a | 60 | 16 | 4 | 1.19 | 17.44 |
| Controller | 9800-a | 136 | 34 | 3 | | |
| Controller | 9800-a | 116 | 1 | 0 | | |

*Example of site with Low 5 GHz coverage*

1. Check Channel Stats 5 GHz
2. Presents summary per channel at Controller or Site-tag level of average power levels

| | | | | | | |
|---|---|---|---|---|---|---|
| Controller | 9800-b | 36 | 82 | 20 | 5.63 | 2.79 |
| Controller | 9800-b | 52 | 26 | 3 | 5.62 | 2.62 |
| Controller | 9800-b | 64 | 53 | 11 | 5.42 | 3.13 |
| Controller | 9800-b | 132 | 68 | 12 | 7.15 | 3.53 |
| Controller | 9800-b | 100 | 49 | 11 | 7.04 | 3.82 |
| Controller | 9800-b | 112 | 45 | 17 | 7.16 | 3.53 |
| Controller | 9800-b | 48 | 20 | 2 | 5.95 | 2.05 |
| Controller | 9800-b | 44 | 21 | 6 | 6.24 | 0.24 |
| Controller | 9800-b | 104 | 4 | 1 | 6 | 7.75 |
| Controller | 9800-b | 108 | 1 | 0 | 4 | 14 |
| Controller | 9800-b | 56 | 13 | 4 | 5.54 | 2.69 |
| Controller | 9800-b | 40 | 2 | 0 | 3 | 12 |
| Controller | 9800-b | 136 | 3 | 0 | 6.33 | 7 |

*Example of site with Good 5 GHz coverage*

https://developer.cisco.com/docs/wireless-troubleshooting-tools/#%21wireless-config-analyzer-express

# 6 GHz Predictive view with WCAE Tool

6GHz predictive" view of how the power distribution, Nearby relationships, and RSSI for clients would look.

| Name | Radio Mac | Slot | Country | 5GHz Power Level | 5GHz Power dBm | 6GHz Predicted Level | 6GHz Predicted dBm | 5GH | Effective Neighbors | Predicted 6GHz Neighbors |
|---|---|---|---|---|---|---|---|---|---|---|
| AP1 | 08-4F-A9-9C-E3-00 | 1 | US | 5 | 8 | 4 | 8 | | 15 | 2 |
| AP2 | 08-4F-A9-9C-E3-01 | 1 | US | 3 | 14 | 2 | 14 | | 11 | 8 |
| AP3 | 08-4F-A9-9C-E3-02 | 1 | US | 4 | 11 | 3 | 11 | | 12 | 9 |
| AP4 | 08-4F-A9-9C-E3-03 | 1 | US | 4 | 11 | 3 | 11 | | 8 | 6 |
| AP5 | 08-4F-A9-9C-E3-04 | 1 | US | 4 | 11 | 3 | 11 | | 19 | 14 |
| AP6 | 08-4F-A9-9C-E3-05 | 1 | US | 3 | 14 | 2 | 14 | | 10 | 8 |
| AP7 | 08-4F-A9-9C-E3-06 | 1 | US | 3 | 17 | 1 | 17 | | 11 | 7 |
| AP8 | 08-4F-A9-9C-E3-07 | 1 | US | 4 | 11 | 3 | 11 | | 16 | 10 |
| AP9 | 08-4F-A9-9C-E3-08 | 1 | US | 2 | 17 | 1 | 17 | | 4 | 4 |
| AP10 | 08-4F-A9-9C-E3-09 | 1 | US | 4 | 11 | 3 | 11 | | 13 | 12 |
| AP11 | 08-4F-A9-9C-E3-10 | 1 | US | 1 | 20 | 1 | 17 | | 4 | 3 |
| AP12 | 08-4F-A9-9C-E3-11 | 1 | US | 5 | 8 | 4 | 8 | | 22 | 13 |
| AP13 | 08-4F-A9-9C-E3-12 | 1 | US | 4 | 11 | 3 | 11 | | 10 | 8 |
| AP14 | 08-4F-A9-9C-E3-13 | 1 | US | 3 | 14 | 2 | 14 | | 11 | 8 |
| AP15 | 08-4F-A9-9C-E3-14 | 1 | US | 4 | 11 | 3 | 11 | | 24 | 16 |
| AP16 | 08-4F-A9-9C-E3-15 | 1 | US | 5 | 8 | 4 | 8 | | 12 | 9 |
| AP17 | 08-4F-A9-9C-E3-16 | 1 | US | 5 | 11 | 3 | 11 | | 23 | 16 |
| AP18 | 08-4F-A9-9C-E3-17 | 1 | US | 5 | 8 | 4 | 8 | | 10 | 10 |
| AP19 | 08-4F-A9-9C-E3-18 | 1 | US | 5 | 8 | 4 | 8 | | 16 | 12 |
| AP20 | 08-4F-A9-9C-E3-19 | 1 | US | 4 | 11 | 3 | 11 | | 16 | 10 |
| AP21 | 08-4F-A9-9C-E3-20 | 1 | US | 4 | 11 | 3 | 11 | | 11 | 9 |
| AP22 | 08-4F-A9-9C-E3-21 | 1 | US | 5 | 8 | 4 | 8 | | 11 | 9 |
| AP23 | 08-4F-A9-9C-E3-22 | 1 | US | 5 | 11 | 3 | 11 | | 18 | 9 |
| AP24 | 08-4F-A9-9C-E3-23 | 1 | US | 4 | 11 | 3 | 11 | | 17 | 10 |
| AP25 | 08-4F-A9-9C-E3-24 | 1 | US | 1 | 20 | 1 | 17 | | 1 | 1 |
| AP26 | 08-4F-A9-9C-E3-25 | 1 | US | 4 | 11 | 3 | 11 | | 11 | 6 |
| AP27 | 08-4F-A9-9C-E3-26 | 1 | US | 2 | 17 | 1 | 17 | | 9 | 8 |
| AP28 | 08-4F-A9-9C-E3-27 | 1 | US | 1 | 20 | 1 | 17 | | 1 | 1 |
| AP29 | 08-4F-A9-9C-E3-28 | 1 | US | 5 | 11 | 3 | 11 | | 24 | 13 |
| AP30 | 08-4F-A9-9C-E3-29 | 1 | US | 5 | 11 | 3 | 11 | | 24 | 17 |
| AP31 | 08-4F-A9-9C-E3-30 | 1 | US | 4 | 11 | 3 | 11 | | 11 | 10 |
| AP-HOS-SON-2001 | 08-4F-A9-9D-B1-C0 | | US | 4 | 14 | 2 | 14 | | 16 | 10 |

Matches FCC or ETSI regulatory requirements.

# Site Survey Recommendations

Q1: What is Cisco's recommendation for Site Survey?

A1: For Greenfield Deployment –Yes!.

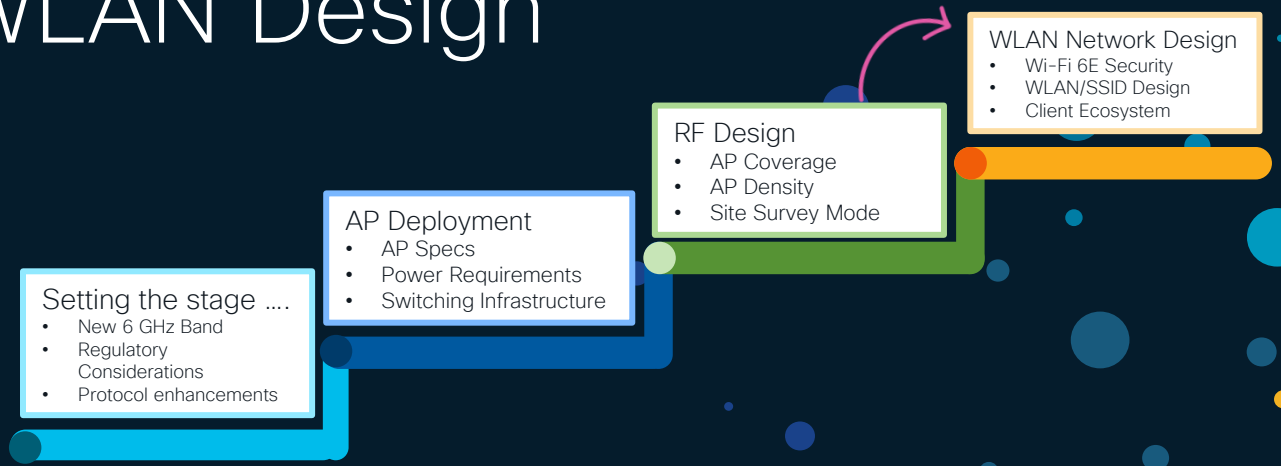
Leverage the new "Site Survey Mode" on Cisco Wi-Fi 6E APs.

For Brownfield, start with a predictive site survey.
Review the power levels of your 5GHz network.
Leverage "WCAE tool" to get a preview.

Q2: Can I mix Wi-Fi 6E APs with existing APs ?

A2: Mixing APs is not recommended. Avoid "Salt & Pepper" design if you can.

# WLAN Design


Setting the stage ….
• New 6 GHz Band
• Regulatory Considerations
• Protocol enhancements
AP Deployment
• AP Specs
• Power Requirements
• Switching Infrastructure
RF Design
• AP Coverage
• AP Density
• Site Survey Mode
WLAN Network Design
• Wi-Fi 6E Security
• WLAN/SSID Design
• Client Ecosystem

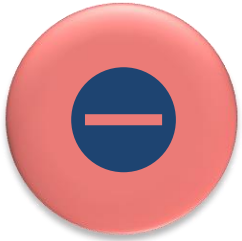
# Wi-Fi 6E – Security

# Wi-Fi 6E Security

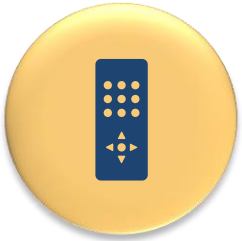
Wi-Fi 6E uplevels security.

WPA3 L2 Security: OWE, SAE*, 802.1x-SHA256

WPA3 and Enhanced Open Security made mandatory for Wi-Fi 6E certification.



No backward compatibility with Open and WPA2 Security.



Requires Protected Management Frame (PMF) in both AP and Clients.

*Only SAE-H2E (Hash to Element) Method Supported.
SAE (Hunting N Pecking) – Not Supported

AKM = Authentication and Key Management
OWE = Opportunistic Wireless Encryption
SAE = Simultaneous Authentication of Equals
SHA-256 = Secure Hash Algorithm (SHA) 256 bit

# WLAN/SSID Design

# 6GHz WLAN Design Considerations

## What options would you have?

1. "All-In" Option: Reconfigure the existing WLAN to WPA3, one SSID for all radio policies (2.4/5/6 GHz) – Most unlikely
2. "One SSID" Option: Configure multiple WLANs with same SSID name, different security settings – Most conservative
3. "Multiple SSIDs" Option: Redesign your SSIDs, adding specific SSID/WLAN with specific security settings – Most flexible

Most likely your current SSID configuration would prevent it from being broadcasted on 6GHz
Note: as 17.9.2, there is a limit of 8 SSIDs broadcasted on 6GHz radio

# Option 1

## Pros

- Cleanest and simplest option
- No new WLAN and SSID to be managed
- Most secure with WPA3 everywhere

## Cons

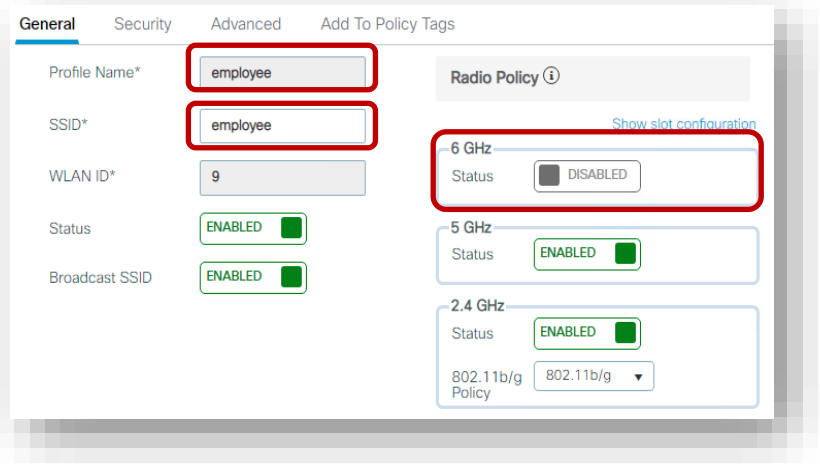
- Breaks support for existing clients that don't support WPA3 and PMF in 2.4 and 5GHz
- Requires full control on client devices and drivers

# Option 2

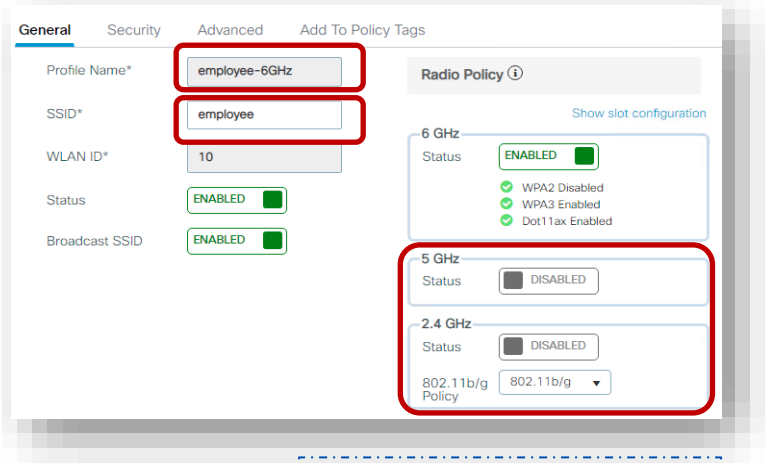
# WLAN design considerations

- Option 2: Single SSID but different AKM per band. For Cisco today, this means creating an additional WLAN for 6GHz, with same SSID name but different WLAN profile name and security settings (AKM):

Existing WLAN serving 2.4 and 5GHz




New WLAN, same SSID name serving 6GHz




AKM = Authentication and Key Management

# Option 2 sub-options for 2.4/5 GHz

Two options for WLAN security settings in 2.4/5GHz band:

a) WPA3 Transition mode

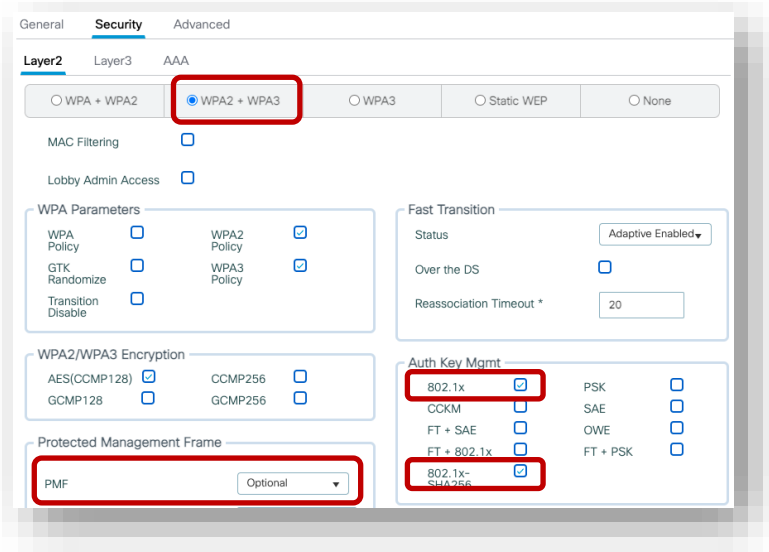
b) WPA/WPA2

Things to keep in mind:

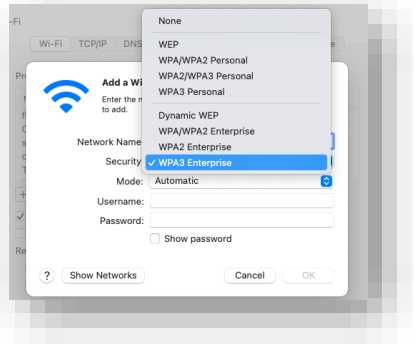
- From the initial testing done, some older drivers clients may have issues in connecting to a WPA3 transition mode
- Today Cisco doesn't support seamless roaming across WLANs, so for both options it will be a hard roam across bands.

# Option 2a (dot1x SSID)

WLAN security configuration for 2.4/5GHz > Enable WPA3-Enterprise Transition mode (a.k.a. mixed mode):




- L2 Security would be WPA2+ WPA3. AKM should be set to **802.1x-SHA256** and **802.1x** (SHA1). PMF as **Optional**
- How to configure the client side?
  - For clients that don't support 6 GHz, configure a **WPA2 profile**
  - For clients that support 6 GHz, configure **WPA3 Enterprise**. They will use these settings to connect to both 2.4/5 GHz and 6GHz



# Option 2a

## Pros

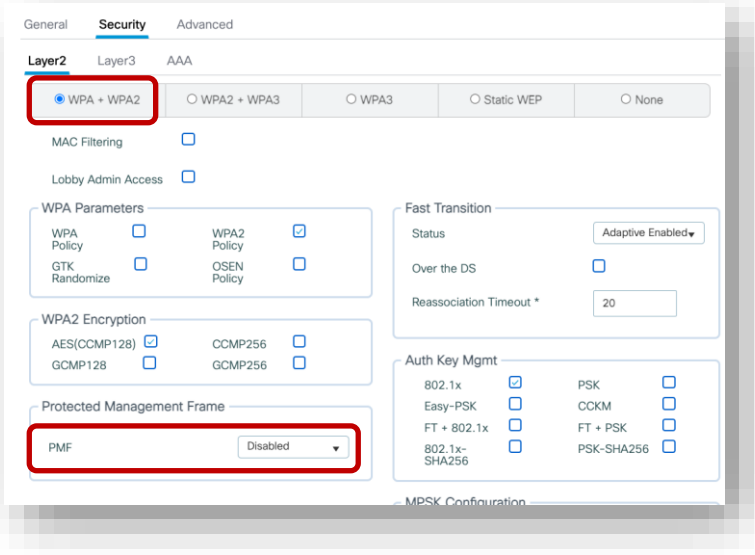
- Provide an adoption path to more secure Wi-Fi via WPA3 Transition mode
- No new SSID profile to be managed on the client side

## Cons

- Older clients may have issues connecting to an SSID with WPA3 Transition mode
- Roaming across different WLANs (same SSID) is not supported
- Not supported by Cisco DNA Center Automation

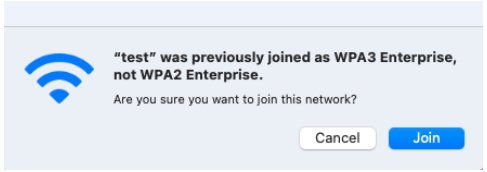
# Option 2b (dot1x SSID)

## WLAN security configuration on 2.4/5GHz:




- L2 Security would be **WPA+WPA2**. AKM should be set to **802.1x-SHA1**. PMF **Disabled**
- Make sure you don't have WFA "**Transition Disable**" feature turned on on the **6GHz WLAN**

- How to configure the client side?
  - For legacy clients just keep the existing **WPA2 profile**
  - For clients that are configured for 6GHz with a WPA3 profile, connecting to the 2.4/5GHz WLAN could be seen as a security downgrade attack. **Note**: MacOS gives you a warning:




**Important**: This option should only be recommended if planning for a full coverage at 6GHz.
In this case, 6GHz capable clients would not need to connect to 2.4/5GHz.

WFA = Wi-Fi Alliance

# Option 2b

## Pros

- Maintain support for older clients using WPA/WPA2.
- No new SSID profile to be managed on the client side

## Cons

- WPA2 only for 2.4/5GHz > not as secure as using WPA3
- Clients may complain going from a WPA3 SSID to a lower security
- Roaming across different WLANs (same SSID) is not supported
- Not supported by Cisco DNA Center Automation

# Option 3

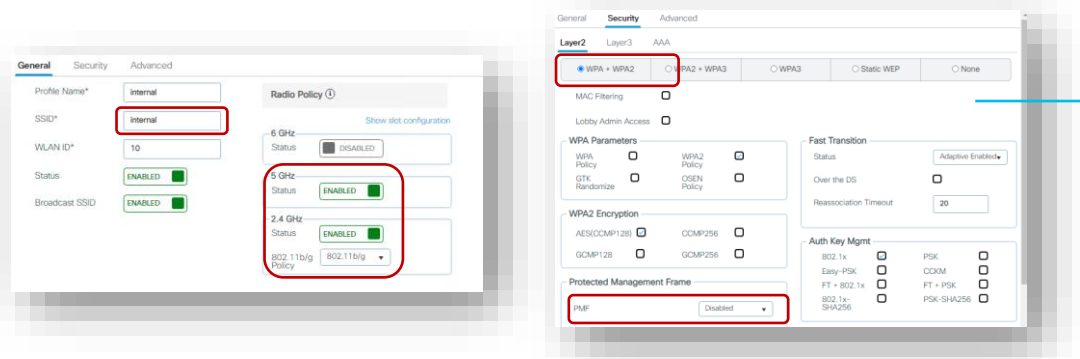
# Option 3 - WLAN design considerations

- Option 3: Redesign the SSIDs. This entails adding a WPA3 separate SSID for 6GHz and then decide which bands to enable to address different customer use cases.
  - Example 1: customer wants to adopt 6GHz without touching the existing SSIDs > add a separate SSID with WPA3 and broadcast it in all bands.
  - Example 2: Customer wants to redesign the SSIDs dedicating each band for a specific device/use case

# Option 3 > Example 1

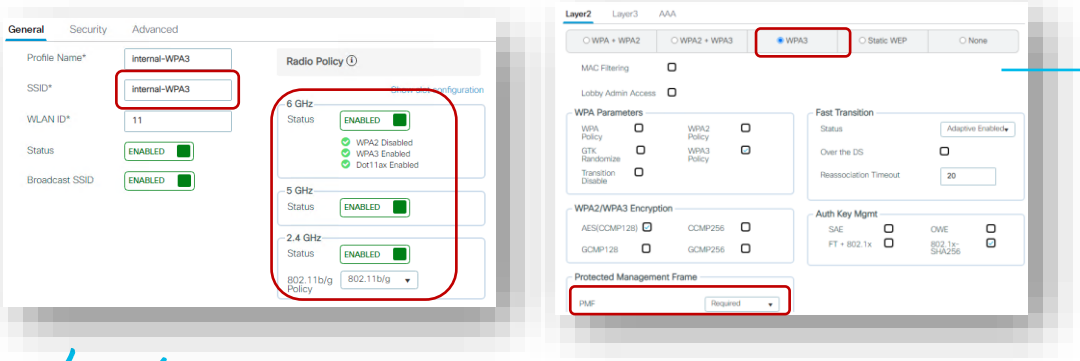
Add a separate WLAN with different SSID name for WPA3 and broadcast it in all bands. Leave the existing WLAN/SSID untouched.

Legacy SSID




Existing WPA/WPA2 SSID in 2.4 and 5GHz for legacy clients

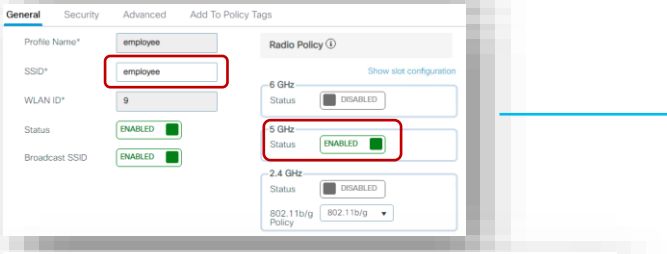
New SSID

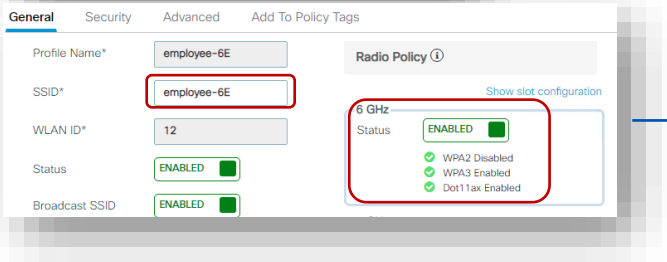



Dedicated SSID for WPA3 (new name) capable clients in all bands. This is the SSID for 6GHz

# Option 3 > Example 2

## Redesign the WLANs, reserving each band for a specific device/use case


2.4GHz dedicated to specifc devices. These could be legacy devices or IoT devices. If IoT will be mostly PSK

5GHz dedicated to majority of existing clients

WPA3 on 6GHz band only, for the newest clients

# Option 3

## Pros

- Cleanest option from a client compatibility point of view
- Most secure options as clients can adopt WPA3 security
- WPA3 clients can roam across different bands
- Automated via DNA Center

## Cons

- Additional SSIDs to configure & manage on WLC
- Need to manage additional SSID profiles on clients

# *Wi-Fi 6E – Client Eco System*

# Wi-Fi 6E Client Device Eco System

*Wide range of client support ..*

Upgrade to Windows 11!
Update the Wi-Fi driver and Bios!!

Samsung Galaxy Ultra S21/S22 &Up

Samsung Galaxy Z Fold

Google Pixel 6 /Pro & Up

Xiaomi Mi 11 /Ultra

MacBook Pro M2 Pro/Max

Mac Mini M2

iPad Pro 6th Generation

ASUS Zenfone 8 and 8 Flip
ROG Phones*

Samsung Galaxy Tab S8 series

Chromebook

Redmagic 6s Pro & Up

Zebra TC53/58

Motorola Edge (2021 & up)

Wi-Fi 6E Chipsets

Laptops **with Intel AX210/AX211/AX411 Chipset**

*And more getting added…..*

# Getting clients to join 6E - from bad to better

## Bad: Early days of 6E

6E Capable clients *always* preferred 5 GHz

Working closely with client device vendors

## Better: Now

More of 6E-capable clients join 6 GHz*

**Recommendations:**

1. Upgrade to the Latest Driver
2. Configure Client Steering Feature

(to move 6 GHz capable clients to 6 GHz Radio)

* Assuming latest driver

# Wi-Fi 6E/WPA3 Client Security Matrix
(Local Mode)

Reference

| Protocol | Encryption | AKM | FT-OTA | FT-ODS | Intel AX210 | Qualcomm HSPv2 WCN6855 | Samsung / Google Android | Apple iPhone (11,12,13) (6GHz Not Supported) | Apple iPad (iPad OS 16.3- 6 GHz Supported) | Apple MacBook (6 GHz Not supported) | Zebra TC58 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OWE | AES-CCMP128 | OWE | N/A | N/A | Supported | Supported | Supported | Not Supported | Supported | Not Supported | Supported |
| SAE | AES-CCMP128 | SAE<br><br>6GHz: H2E Only | Supported | Supported | Supported: H2E only SAE-FT: Windows does not support. SAE-FT: Linux supports it.<br><br>*(No limitation on AX210)* | Supported | Supported: H2E only<br><br>SAE-FT: Galaxy S21 Ultra, Galaxy Z Fold 3 has capable to support, but currently it is disabled. C an be enabled by usermode fw on protos only. | Supported H2E – iOS 16 | Supported (FT-SAE Supported) | Supported | Supported |

*Note: Client Security Matrix with AP Mode as Local*

# Wi-Fi 6E/WPA3 Client Security Matrix
(Local Mode)

Reference

| Protocol | Encryption | AKM | EAP Method | FT-OTA | FT-ODS | Adaptive | Intel AX210 | Qualcomm HSPv2 WCN6855 | Samsung / Google Android | Apple (iPhone 11, 12, 13) 6 GHz Not Supported | Apple iPad (iPad OS 16.3- 6 GHz Supported) | Apple MacBook (6 GHz Not Supported) | Zebra TC58 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Enterprise | AES-CCMP128 | 802.1x-SHA256 | PEAP/FAST/TLS | Supported | Supported | Supported | Supported: SHA256 & FT-OTA<br>Not-Supported: EAP-FAST, FT-ODS, | Supported | Supported: SHA256 & FT-OTA<br><br>Not-Supported: EAP-FAST<br>Not-Supported: FT-ODS | Not supported | Supported SHA256, Adaptive & FT-OTA | Not Supported | Supported |
| Enterprise | GCMP128 | SuiteB-1X | PEAP/FAST/TLS | Not Supported | Not Supported | Not Supported | Not-Supported | Not-Supported | Not-Supported | Not Supported | Not Supported | Not Supported | Not Supported |
| Enterprise | GCMP256 | SuiteB-192 | TLS | Not Supported | Not Supported | Not Supported | Supported: GCMP256<br><br>Not-Supported: EAP-FAST & FT(both FT-OTA & FT-ODS) | Supported: GCMP256 | Supported: GCMP256 FT-OTA *<br>Not-Supported: FT-ODS | Supported | | Only supported on M1 | Supported |

*Note: Client Security Matrix with AP Mode as Local*

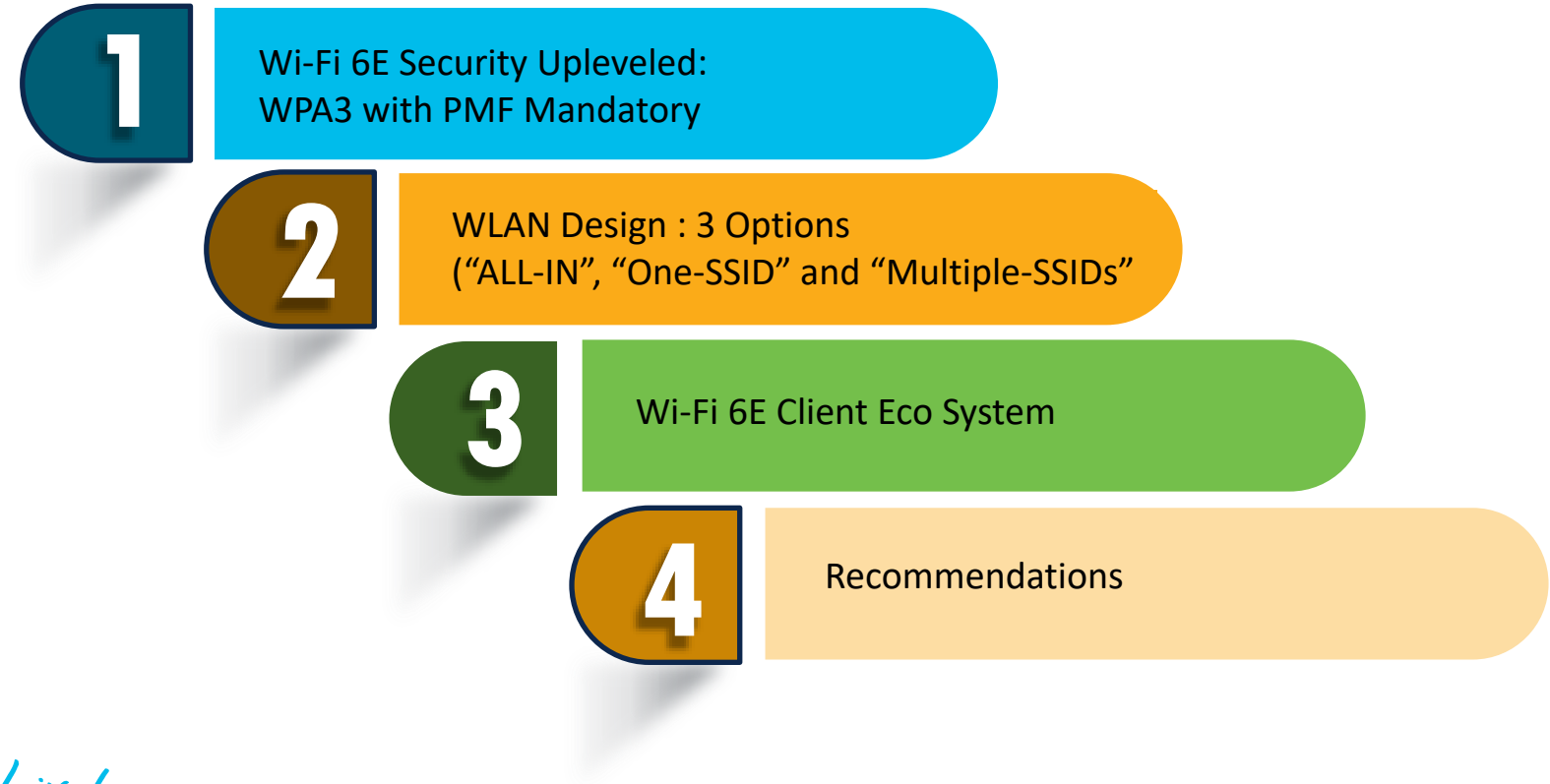
# Wi-Fi 6E/WPA3 Client Security Matrix (FlexConnect – Central Auth)

| WPA3 protocol | Encryption | AKM | EAP Method | FT-OTA | FT-ODS | Intel AX210 | QCA | Samsung S21 |
|---|---|---|---|---|---|---|---|---|
| OWE | AES-CCMP128 | OWE | | N/A | N/A | Supported: OWE auth | Supported | Supported |
| SAE | AES-CCMP128 | SAE | | Not supported | Not supported | Supported: H2E only & FT-OTA<br><br>Not Supported: FT-ODS | Supported | Supported: H2E only |
| Enterprise | AES-CCMP128 | 802.1x-SHA256 | | Supported | Supported | Supported: SHA256 & FT-OTA<br>Not-Supported: FT-ODS | Supported | Supported |
| Enterprise (Not supported) | GCMP128 | SuiteB-1X | Not supported(none of the radios) | Not supported | Not supported | Not-Supported: GCMP128 & FT-OTA & FT-ODS | Not-Supported: GCMP128 & FT-OTA & FT-ODS | Not-Supported: GCMP128 & FT-OTA & FT-ODS |
| Enterprise (Not supported) | GCMP256 | SuiteB-192 | Not supported(none of the radios) | Not supported | Not supported | Supported: GCMP256<br>Not-Supported: FT(both FT-OTA & FT-ODS) | Supported: GCMP256 | Supported: GCMP256 & FT-OTA & FT-ODS |

# Wi-Fi 6E/WPA3 Client Security Matrix (FlexConnect – Local Auth)

| WPA3 protocol | Encryption | AKM | EAP Method | FT-OTA | FT-ODS | Intel AX210 | QCA | Samsung S21 |
|---|---|---|---|---|---|---|---|---|
| OWE | AES-CCMP128 | OWE | | N/A | N/A | Supported: OWE auth | Supported | Supported |
| SAE | AES-CCMP128 | SAE | | Not supported | Not supported | Supported: H2E only & FT-OTA<br><br>Not Supported: FT-ODS | Supported | Supported: H2E only |
| Enterprise | AES-CCMP128 | 802.1x-SHA256 | | Supported | Supported | Supported: SHA256 & FT-OTA<br>Not-Supported: FT-ODS | Supported | Supported |
| Enterprise (Not supported) | GCMP128 | SuiteB-1X | Not supported(none of the radios) | Not supported | Not supported | Not-Supported: GCMP128 & FT-OTA & FT-ODS | Not-Supported: GCMP128 & FT-OTA & FT-ODS | Not-Supported: GCMP128 & FT-OTA & FT-ODS |
| Enterprise (Not supported) | GCMP256 | SuiteB-192 | Not supported(none of the radios) | Not supported | Not supported | Supported: GCMP256<br>Not-Supported: FT(both FT-OTA & FT-ODS) | Supported: GCMP256 | Supported: GCMP256 & FT-OTA & FT-ODS |

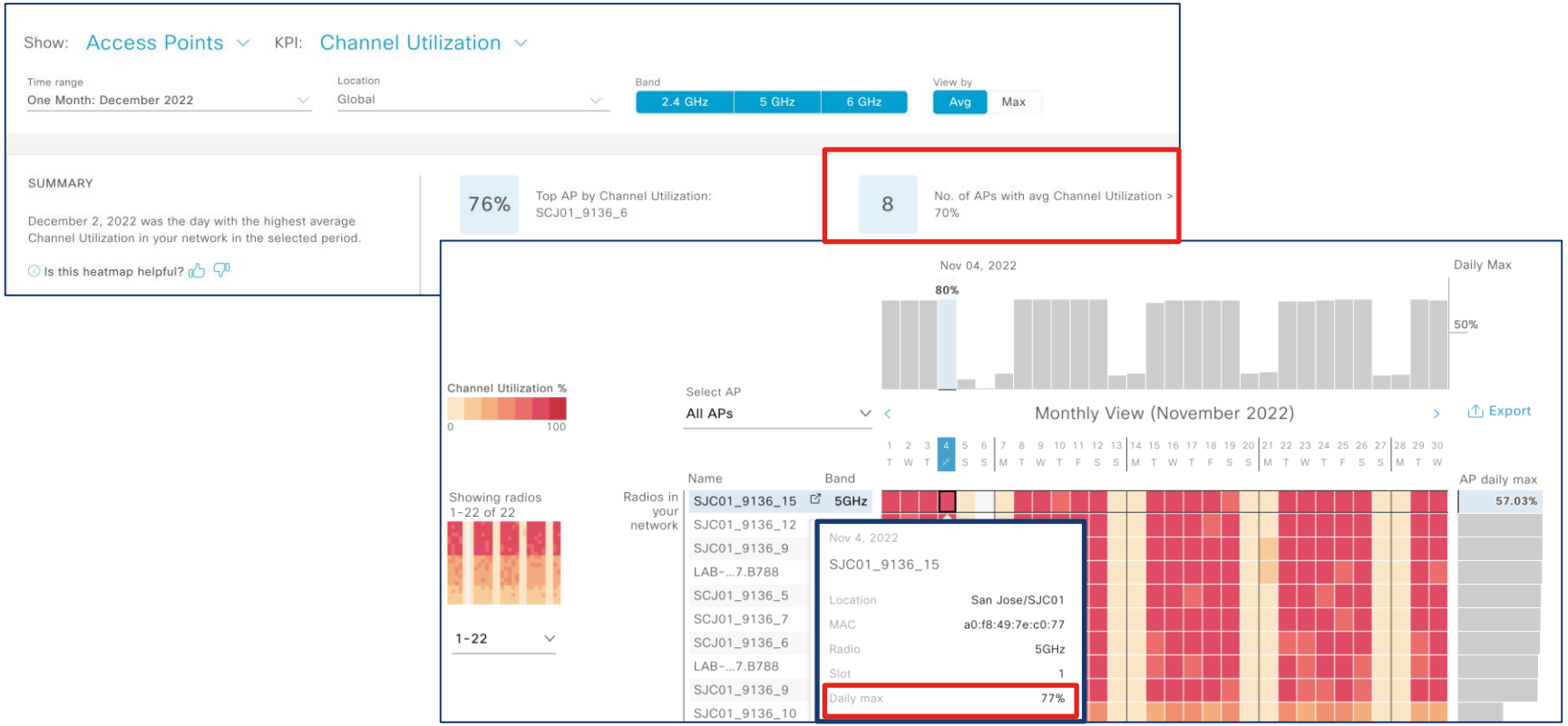
# Section Summary



# Wi-Fi Network Design

# Start with Use Cases

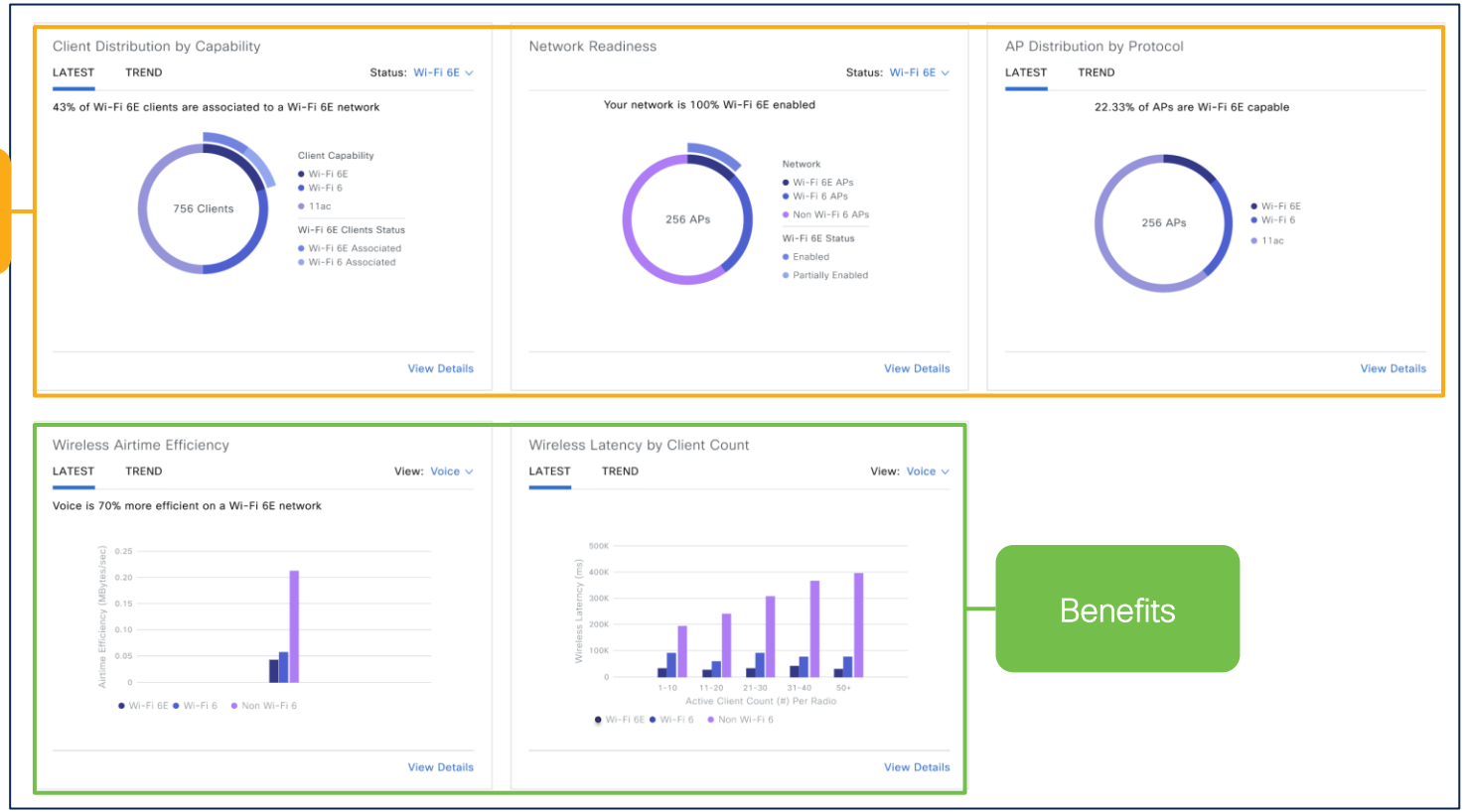
# Observe Channel Utilization in your Network



# Observe the Client Types in your Network

## Readiness and benefits of 6 GHz from Cisco DNAC 2.3.2

Readiness




Benefits

# Wi-Fi 6/6E runs on Cisco Catalyst Wireless


Catalyst 9800
Wireless LAN Controller (WLC)

## Supported Access Points

Wi-Fi 6/6E

C9136 | CW9166/64 | CW9162

Wi-Fi 6

9130 | 9124 | 9120 | 9115 | 9105

# Legacy AireOS based Controllers (Recap)

Wi-Fi 6E APs are NOT supported in AireOS Controllers

## Gen 1 (with IRCM)

1

- 5508 and 8510
- Supported on AireOS 8.5
- Allows IRCM with C9800 (IOS-XE)
- Supports both Wave 1 & Wave 2 Access Points

## Gen 2

2

- 3504, 5520 and 8540
- Supported on AireOS 8.10
- Allows IRCM with C9800 (IOS-XE)
- Supports Wi-Fi 6 APs (9100 series)

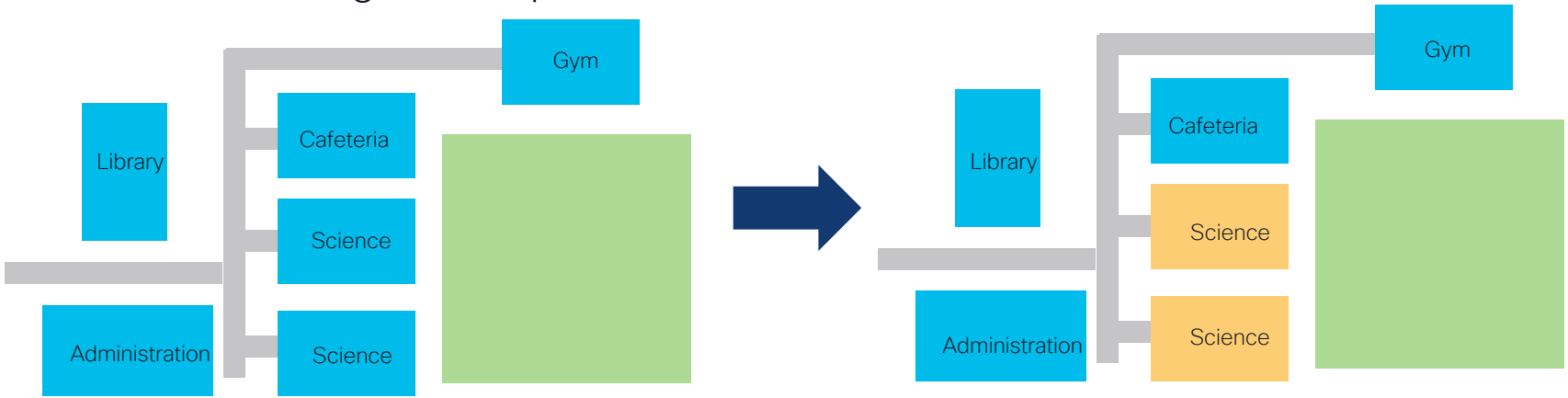
## Gen 1 (without IRCM)

3

- 2504, WiSM2, vWLC and 7510
- No mobility with C9800 (IOS-XE)
- Additional steps needed for migration

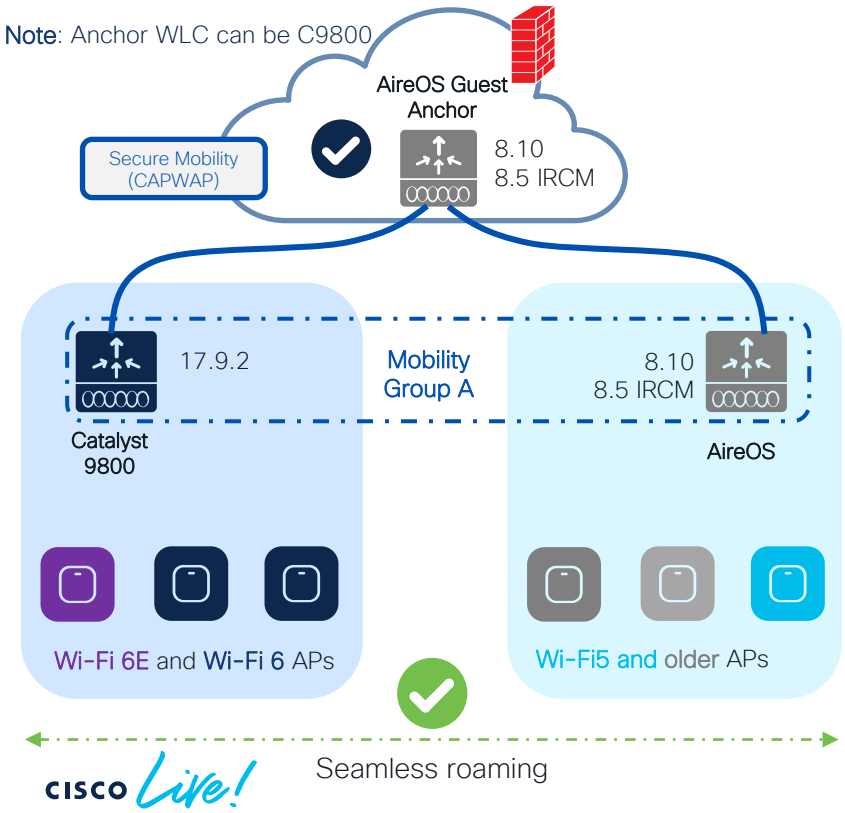
# Migration Scenarios

- Move “per RF blocks”
- Move a building or complete floor into the new hardware and software




Avoid “Sale & Pepper” Deployments. Do not mix APs on different controllers at

# How do I start adopting 6GHz?
## Answer: Inter Release Controller Mobility (IRCM)

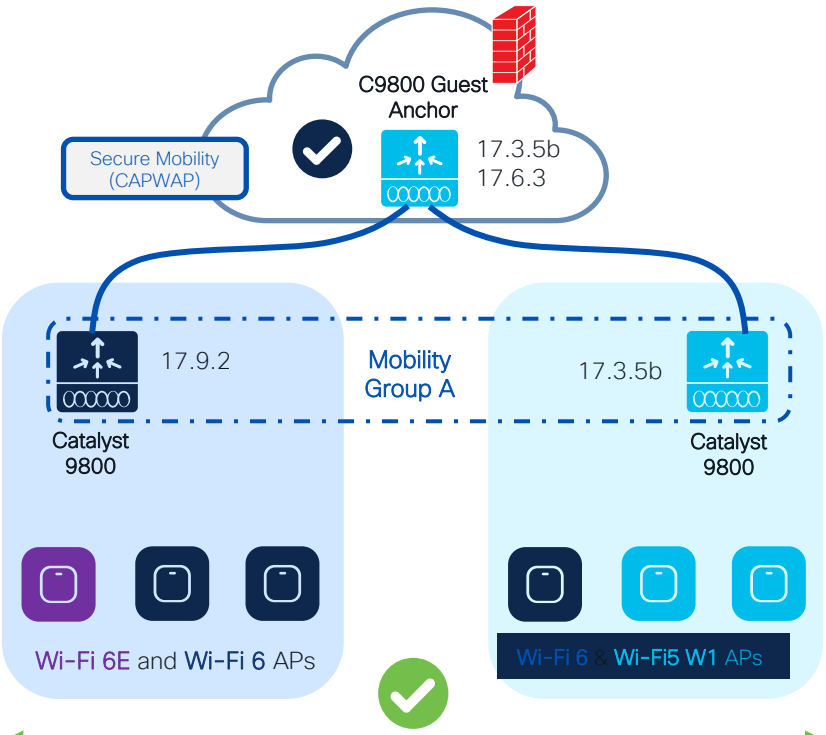



## Scenario 1: Legacy Controller Supports IRCM

- Introduce new 6/6E AP hadware on the new C9800 and support seamless roaming and Guest Anchor with existing networks
- This method allows the smooth coexistence of both controllers, with RF areas migrated as needed, without any overnight switchover.
- Things to consider:
  - If the controller is limited to 8.5 (5508, 8510), we will need a special IRCM version (8.5.182.104), to connect them to IOS-XE
  - Best to split the RF network into different areas, configuring different RF group names between the legacy and IOS-XE controllers.
  - Always configure the primary/secondary controller name in access points. The new controllers will reject unsupported APs, but if any AP could work in both controller types, this will avoid APs joining the wrong one, or flip-flopping between them, until the migration is ready to proceed
- Fast & secure roam will only be supported if the WLAN profile is the same on the two WLCs

(*) https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_c9800_wireless_controller-aireos_ircm_dg.html

# How do I start adopting 6GHz?
## Answer: Inter Release Controller Mobility (IRCM)

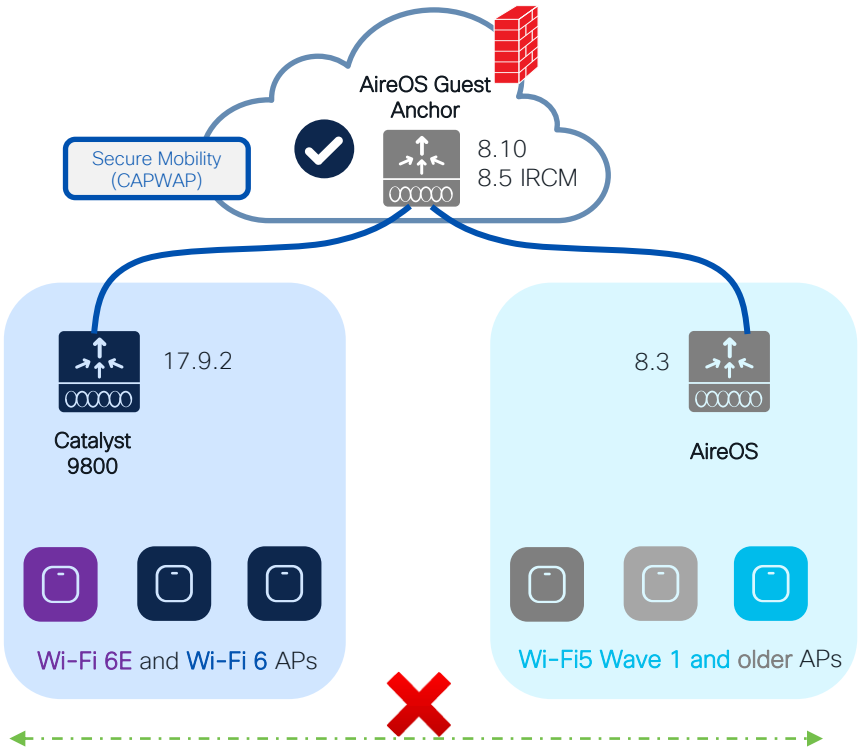



### Scenario 2: AP is supported up to 17.3 but not in later version

- If you have already started your C9800 journey… & Wave 1 Aps are still present (1700/2700/3700).
- Introduce new AP hadware on the new supported IOS XE release and support seamless roaming and Guest Anchor with exsiting C9800 networks
- The release combinations shown have been tested at scale, check IRCM deployment guide*
- Fast & secure roam will only be supported if the WLAN profile is the same on the two WLCs
- Note: Anchor can be on AireOS as well (8.10 or 8.5 IRCM latest

(*) https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_c9800_wireless_controller-aireos_ircm_dg.html

# How do I start adopting 6GHz?
## Answer: Inter Release Controller Mobility (IRCM)




### Scenario 3: Legacy Controller not supporting IRCM

- Not possible to establish IRCM between old controller and new 9800 handling 6E Aps
- Limits options available. Forces more aggressive migration process.
- Migration alternatives:
  - Keep the two networks separated ; migrate physical RF areas as new Aps are added.
  - Roaming is not possible.
  - Avoid migrations “per floor” as in most building types, it is normal to see clients roaming between Aps on different floor.
  - Temporarily, replace the legacy controller with one that supports IRCM.
- The release combinations shown have been tested at scale, check IRCM deployment guide*

(*) https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_c9800_wireless_controller-aireos_ircm_dg.html

# Wi-Fi 6E, are you ready?

# Wi-Fi 6E, are you ready?

**Is this the right time to move to 6 GHz?**

Start with use cases not technology: go with 6GHz if your 2.4/5GHz RF is crowded, if applications are delay sensitive and bandwidth hungry

**Check your infrastructure**

Consider the switch infrastructure
Verify the power budget

**Prepare your wireless**

Evaluate the implications on RF and WLAN design

# Networking

## Catalyst 9800 with Wi-Fi6/6E

Learn from experts on wireless topics such as WiFi6 an WiFi6E standards enhancements. You will understand what you need to know about designing for 6GHz, migrating from AireOS to Catalyst 9800, and what you need to know about 5G and WiFi6E

START

Feb 5 | 16:45
**LABEWN-1528**
9800 Embedded Wireless Controller on Wi-Fi 6 Access Points

Feb 5 | 19:00
**LABEWN-2202**
9800 Wireless Controller Upgrade with Zero Downtime

Feb 7 | 10:00
**BRKEWN-2846**
High Availability Design with Cisco Catalyst 9800 Wireless Controllers

Feb 7 | 11:30
**BRKEWN-2024**
Architecting Next Generation Wireless Network with Catalyst Wi-Fi 6E Access Points

Feb 7 | 14:45
**BRKEWN-1742**
7 Ways to Fail - on Wi-Fi 6(E)

Feb 7 | 16:45
**BRKEWN-2284**
Becoming a Wi-Fi Guest star: Better Practices for Guest Networks on Cisco Catalyst Wireless

Feb 8 | 08:30
**BRKEWN-3413**
Advanced RF Tuning for Wi-Fi6E with Catalyst Wireless: Become an Expert, while getting a little help from AI

Feb 8 | 10:45
**BRKEWN-2926**
Cisco Wi-Fi: how to tune your design and configurations for your most demanding clients and applications

Feb 8 | 14:00
**LTREWN-2034**
9100 Wi-Fi 6E APs Managed from Cloud or On Premises? We've got you Covered!

Feb 8 | 14:00
**LTREWN-2724**
Be My Guest: Designing and Troubleshooting Wireless Guest Networks with Catalyst 9800 Wireless Controller

If you are unable to attend a live session, you can watch it On Demand after the event

CISCO Live!

Feb 8 | 14:45

**BRKOPS-2402**

Automate the Deployment of a Wireless Network with the Help of Cisco DNA Center

Feb 9 | 08:30

**BRKEWN-2338**

Successful Migration and Deployment Best Practices for Catalyst 9800 Wireless Networks

Feb 9 | 10:30

**BRKEWN-2087**

High Density Wi-Fi Design, Deployment and Optimization

Feb 9 | 15:45

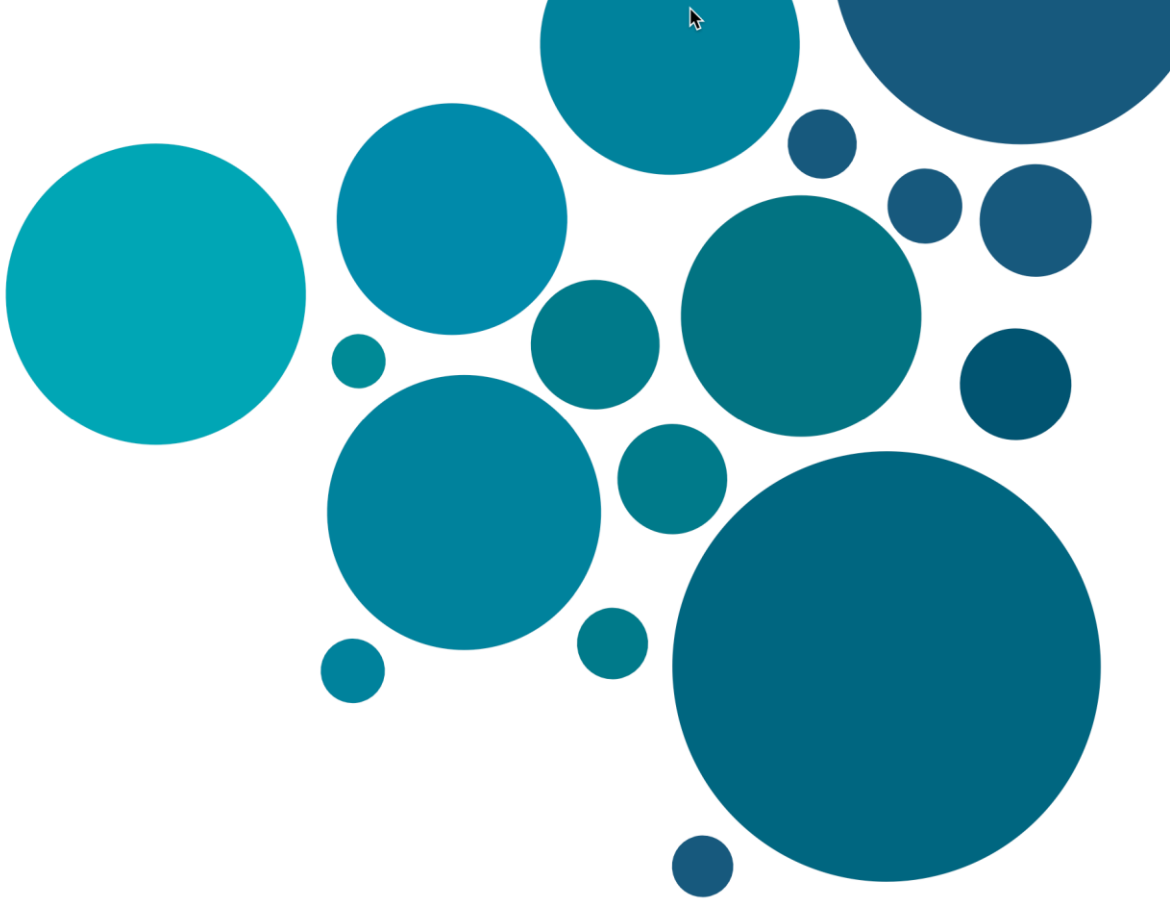
**BRKEWN-2030**

Wi-Fi6/6E and Private 5G for the Enterprise – a 'Better Together' Journey

Feb 9 | 16:00

FINISH **BRKEWN-2094**

Successfully Configuring Catalyst 9800 Wireless on Your First Shot



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