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Let's go

The bridge to possible

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

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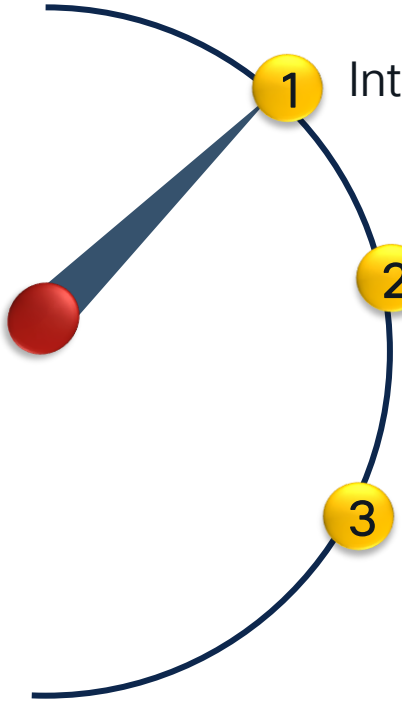
Senior Technical Leader, Technical Marketing

Agenda

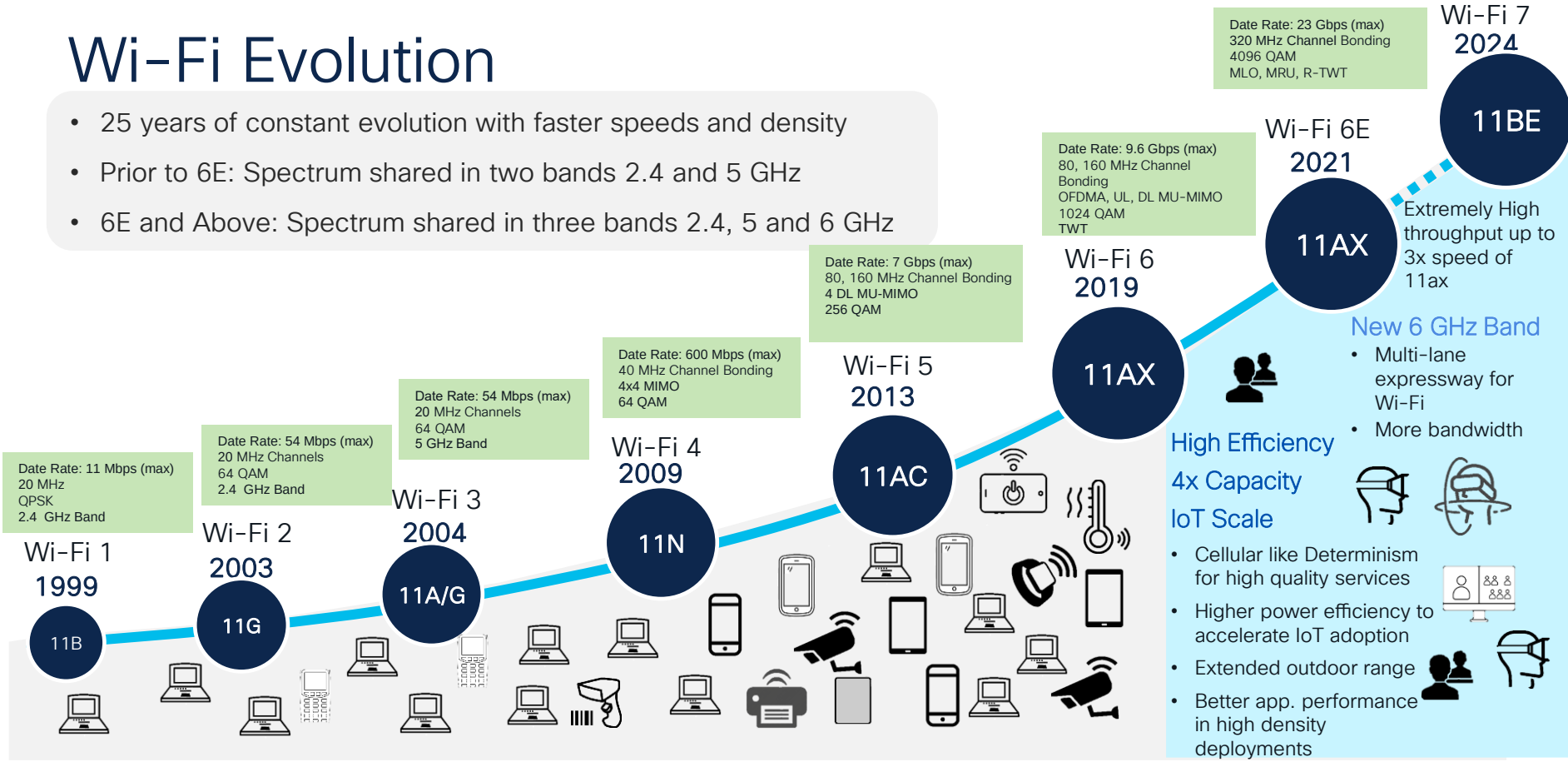


1. Introduction to Wi-Fi 6E
   New 6 GHz spectrum, Device Classes, Power Levels, Protocol Enhancements
2. Cisco Catalyst Wi-Fi 6E Access Points
   Catalyst Wi-Fi 6E Access Point Portfolio, Common Hardware, CleanAir Pro
3. Design, Deployment and Migration Considerations
   Network Infrastructure, RF Design,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


25
YEARS
Wi Fi
ALLIANCE

Wi-Fi Evolution

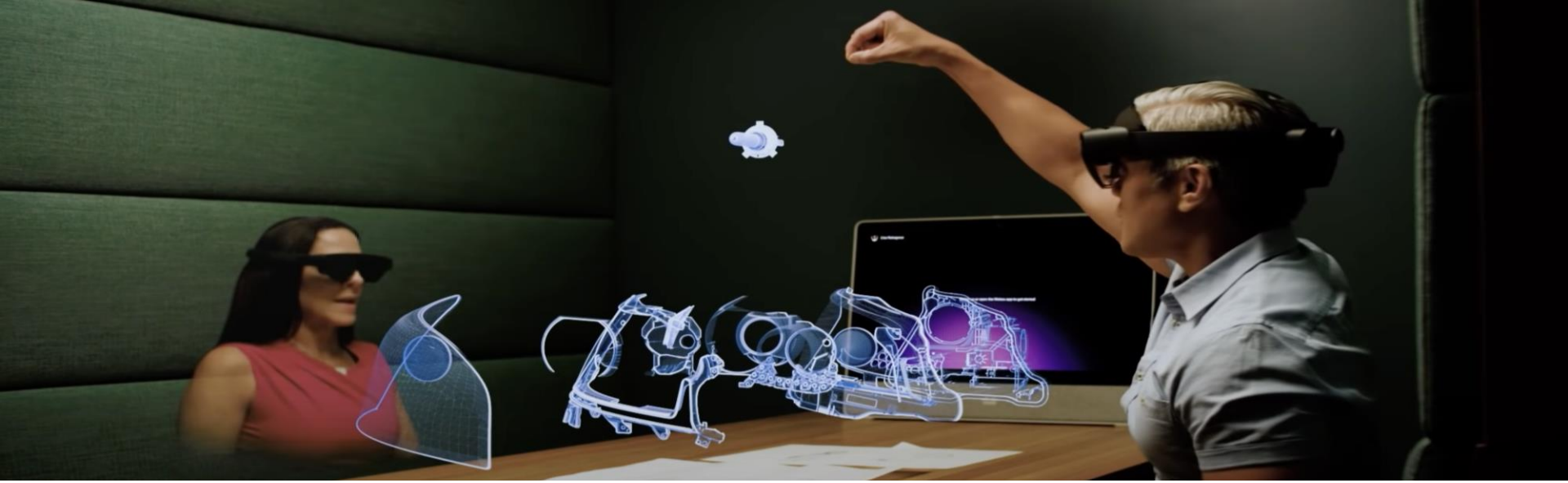
- 25 years of constant evolution with faster speeds and density
- Prior to 6E: Spectrum shared in two bands 2.4 and 5 GHz
- 6E and Above: Spectrum shared in three bands 2.4, 5 and 6 GHz



Why Wi-Fi 6E ?

Primitive applications of the past to ....

Immersive Experiences of Today...

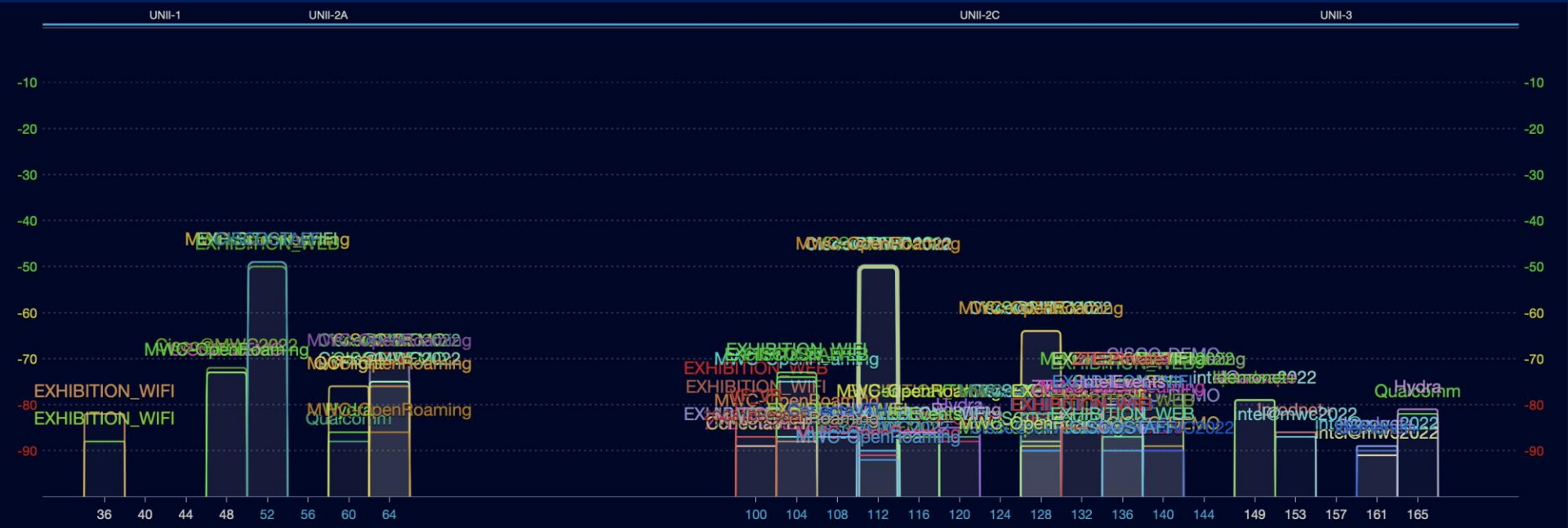


Webex Hologram https://www.youtube.com/watch?v=YEx7h0NKnXE

and Tomorrow...

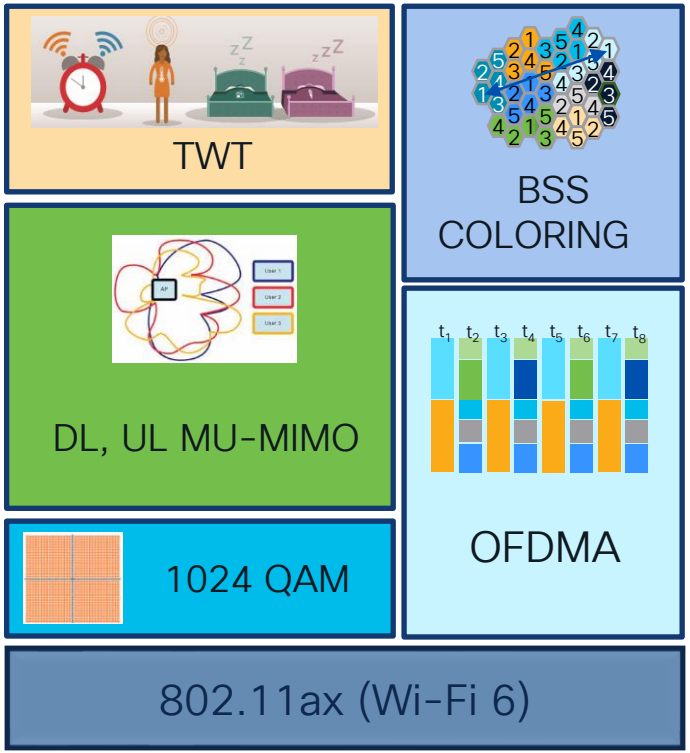
What is the Problem?

- Existing 2.4 GHz and 5 GHz spectrum is congested
- Interference
- Limited re-usable channels
- No way to use 80 or 160 MHz channels



Pre Wi-Fi 6E

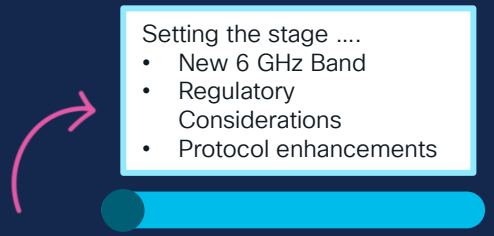
Wi-Fi 6E
Wi-Fi 6 and 6GHz are friends!



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. **Protocol Enhancements**
   Airtime Efficiency
6. **Wider RF Channels**
   80 MHz channels – 1200 MHz
   40 MHz channels – 500 MHz

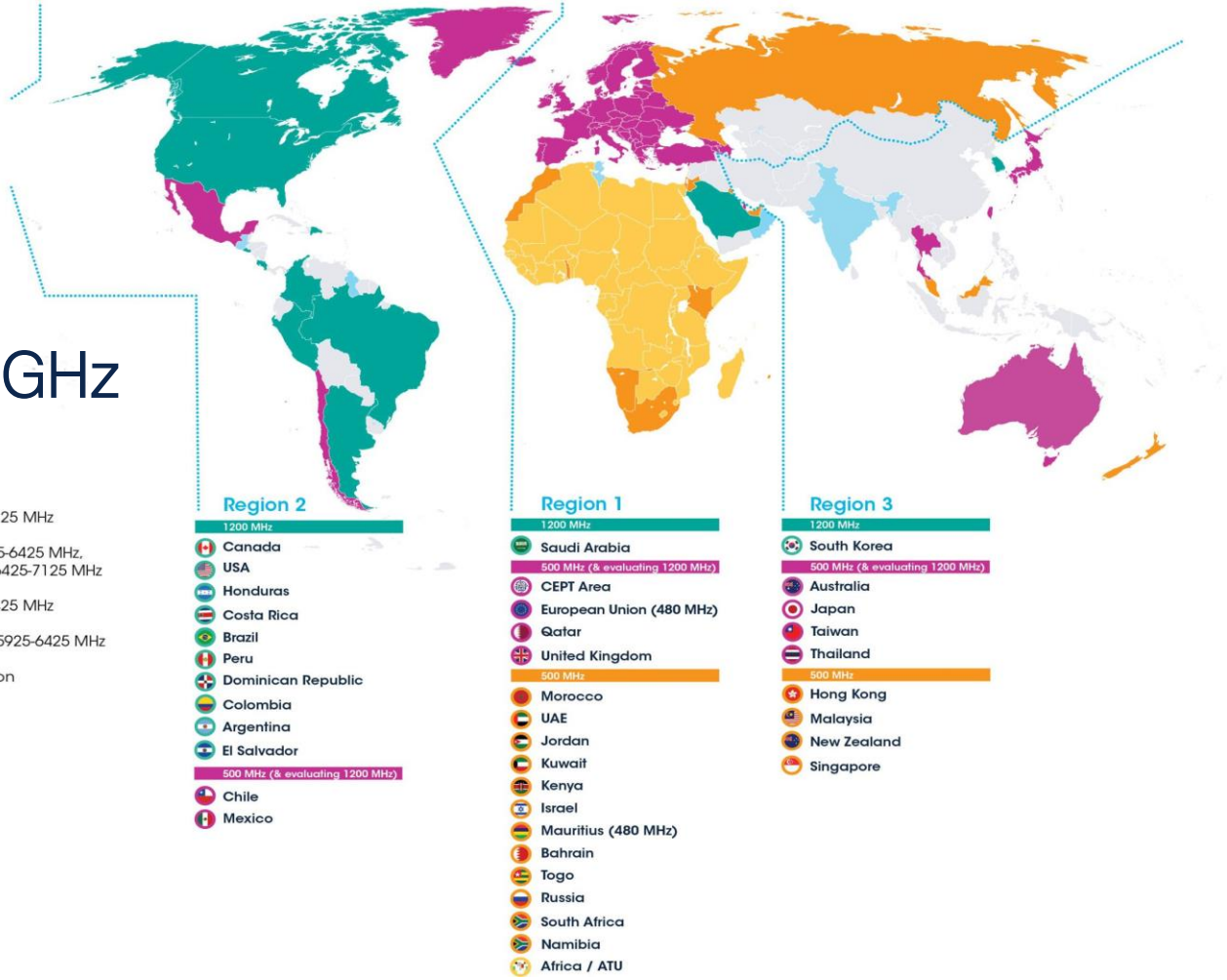
With Wi-Fi 6E ....

Setting the stage ....



Wi-Fi 6E – 6GHz Around the World

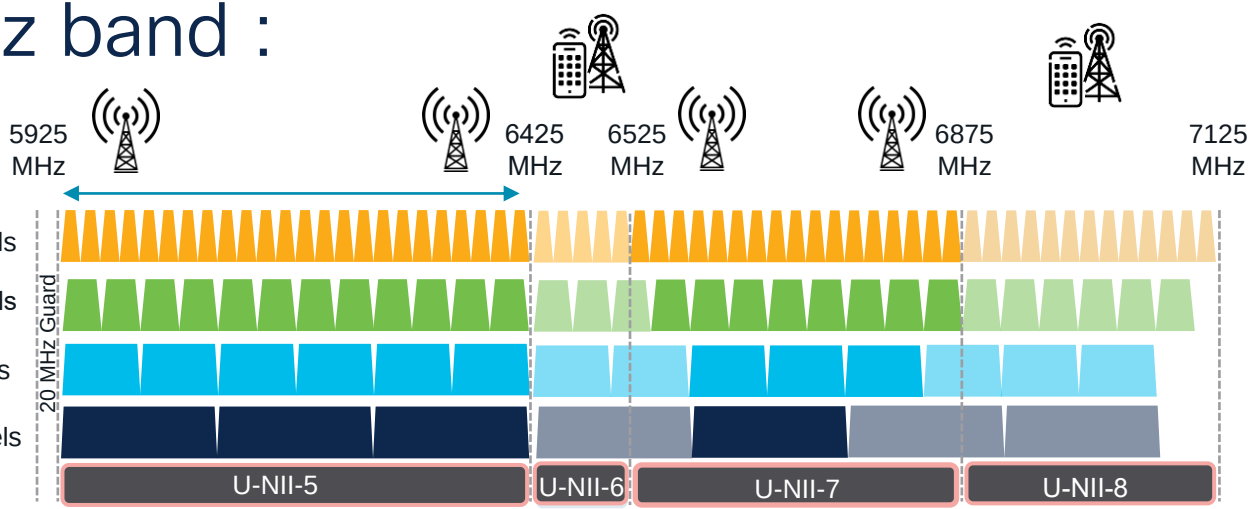
Global availability of 6 GHz band for Wi-Fi



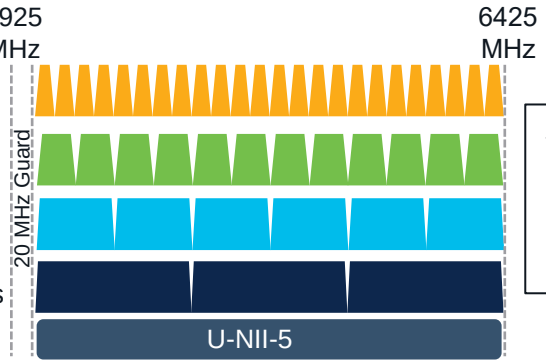
Source: https://6ghz.info

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

Wi-Fi 6E introduces new device classes for optimized capability

Low Power Indoor AP

- Indoor Only
- Integrated Antenna Required
- Can use the full 1200 MHz
- Wired Power

Standard Power AP

- Indoor or Outdoor
- Integrated or External Antenna
- UNII-5 and UNII-7 Only (US)
- Requires AFC

Very Lower Power AP

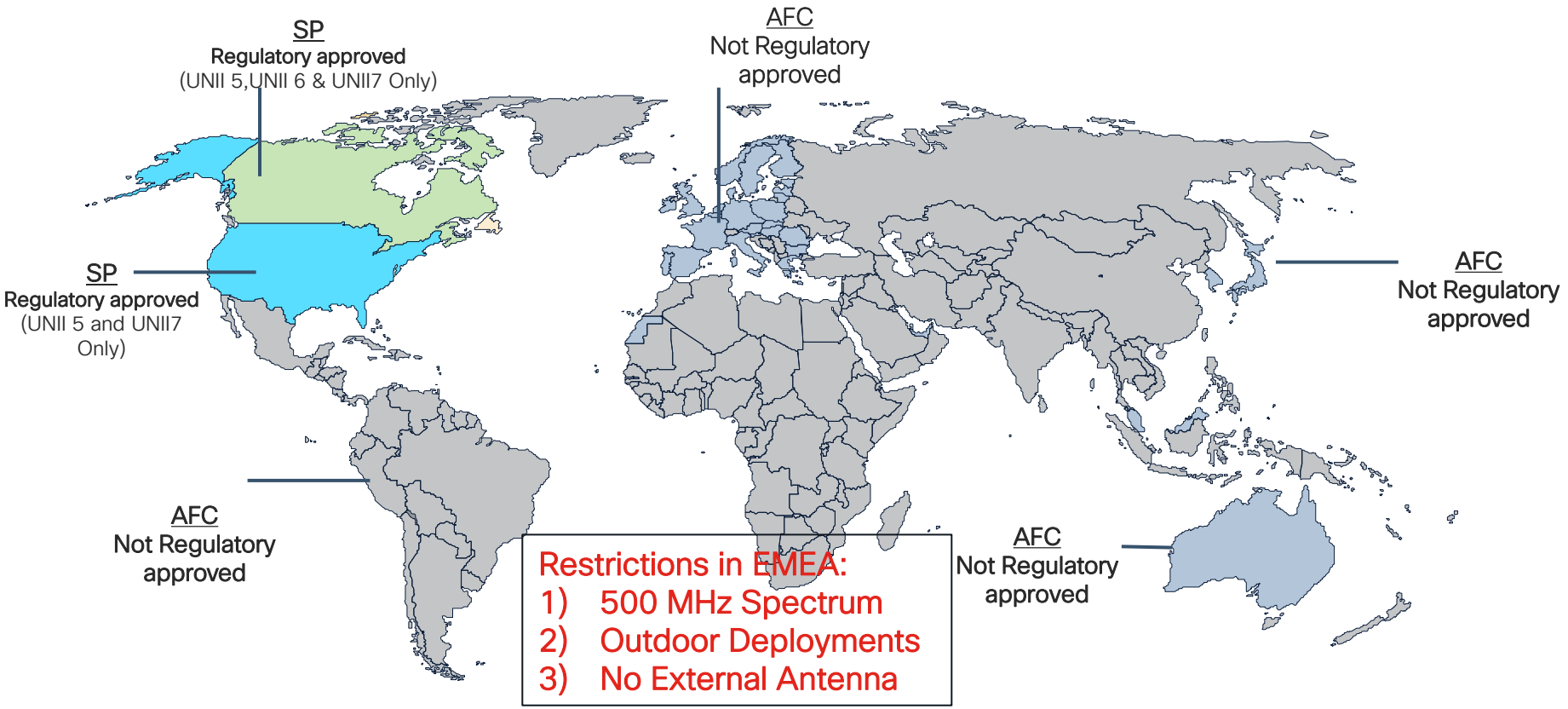
- Mobile Indoor or Outdoor
- Limited Range
- Can use the full 1200 MHz
- Does not require AFC

Client Devices

- Indoor or Outdoor
- Only Indoor under control of LPI AP
- 6 dBm lower power than AP

Regulations vary by country

External(SP)/Outdoor Antenna 6GHz Status

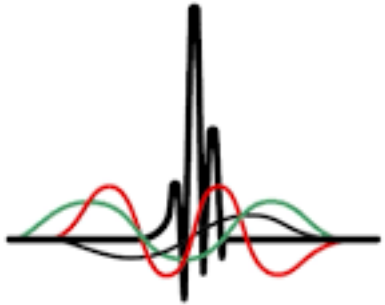


AFC approved in USA & Canada

What's next for spectrum in Europe?

- Equal status to Wi-Fi and 5G in 6425-7125 MHz in Region 1
- Saudi Arabia has allotted 1200 MHz for Indoor & Outdoor; Russia going to allot 100% of spectrum for 5G.
- Rules & Implementation may vary from country to country
- CEPT currently has couple ongoing work items studying 6 GHz use cases.
  - Low Power Indoor (LPI) use in 6425-7125 MHz
  - Outdoor and higher power use in the lower band (5945-6425 MHz)

In the interim ....



- Use of 1200 MHz for outdoor operation on an exceptional or lightly licensed basis.
- Possible applications include football stadiums, hospitals, large factories, mining.
- Cisco is working with regulators to make this opportunity a reality.

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

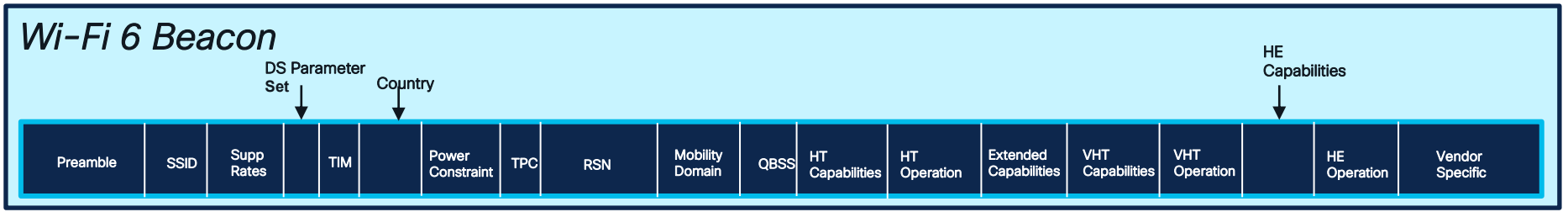
Mode	Country	Max Tx Power EiRP		Max PSD EiRP	
	(Frequency Range MHz)	AP (dBm)	Client (dBm)	AP (dBm)	Client (dBm)
	FCC (5925-7125)	30	24	5	-1
	ETSI (5945-6425)	23	23	10	10
	UK (5925-6425)	24	24	11	11

	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

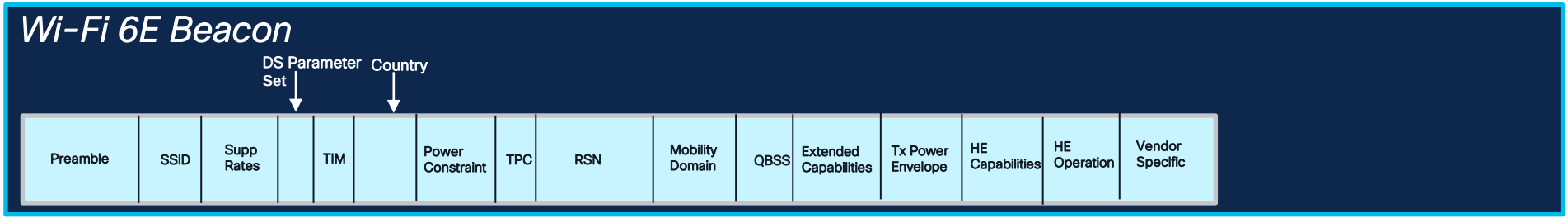
Wi-Fi 6E – Protocol Optimizations

Wi-Fi 6E Beacon Changes

Legacy HT/VHT Information Element Removed



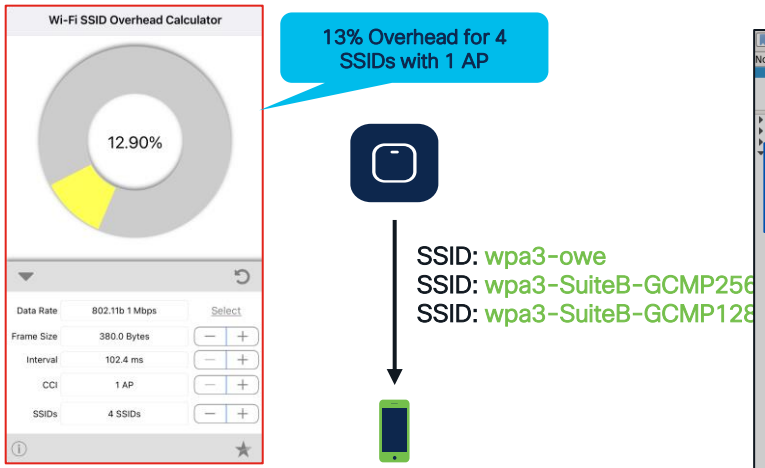
Comparison of Wi-Fi 6 and Wi-FI 6E Beacon Frame

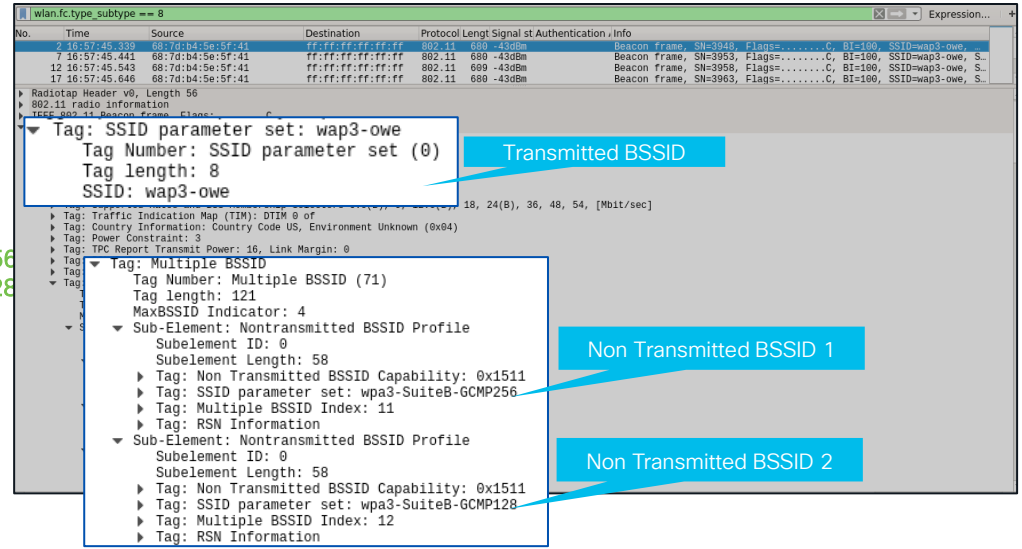


Reduced Beacon Size helps conserve airtime

Multiple BSSID

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





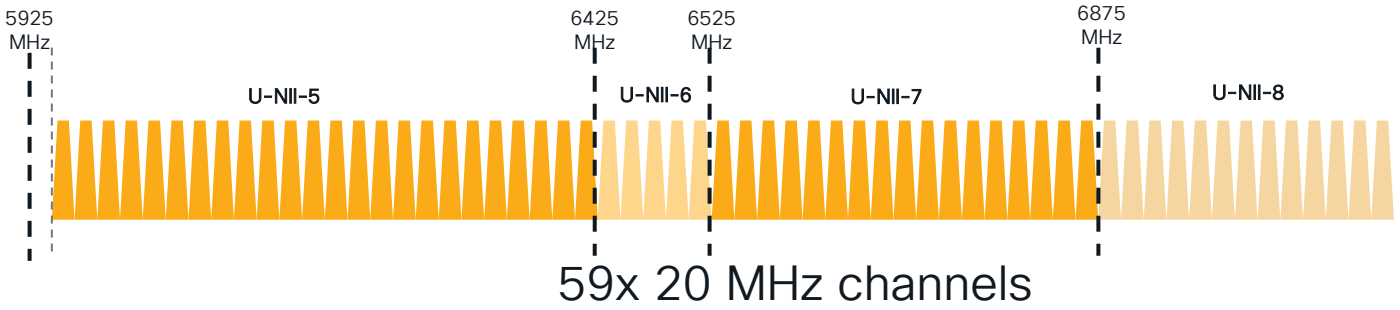
- Conserves Airtime
- Mandated in Wi-Fi 6E

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:

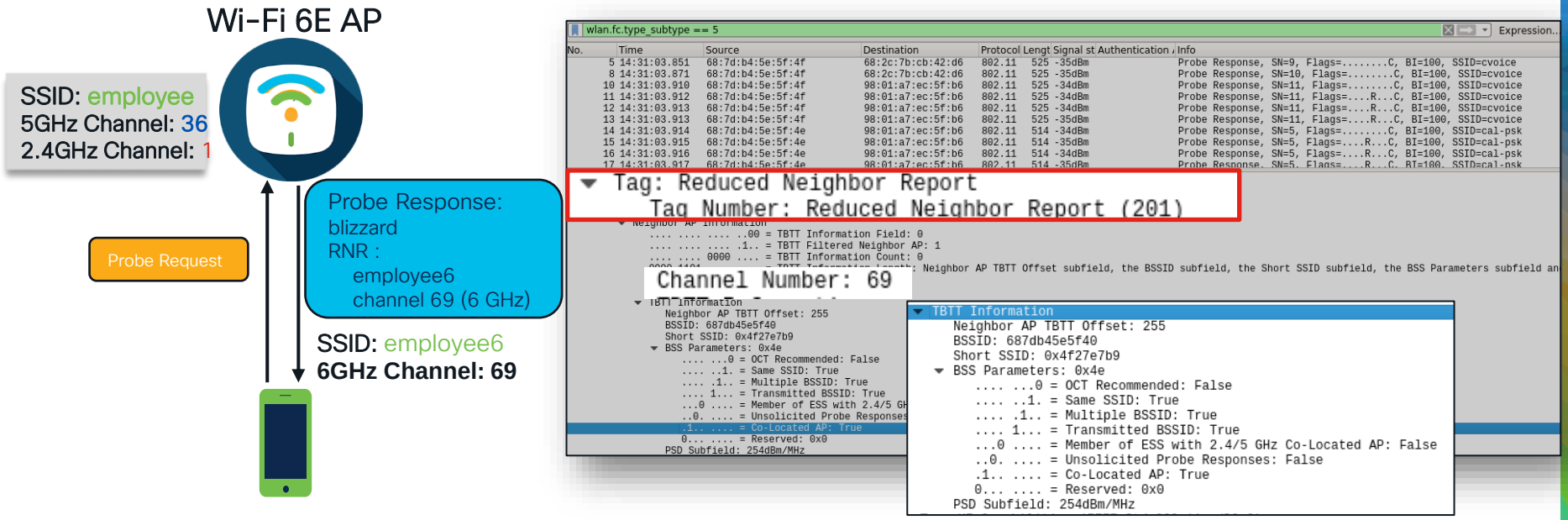
Fast Link Setup (FILS) Discovery Frames
Unsolicited Broadcast Probe Response Frames

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

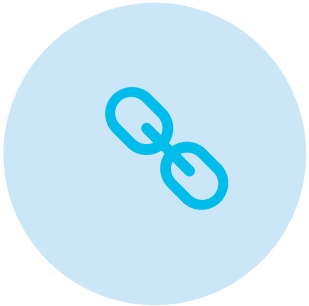
Wi-Fi 6E
Inband AP Discovery

Wireless Clients always Probe!

FILS Discovery Frames helps AP Discovery Faster

Reduces AirTime Utilization by Management Frames

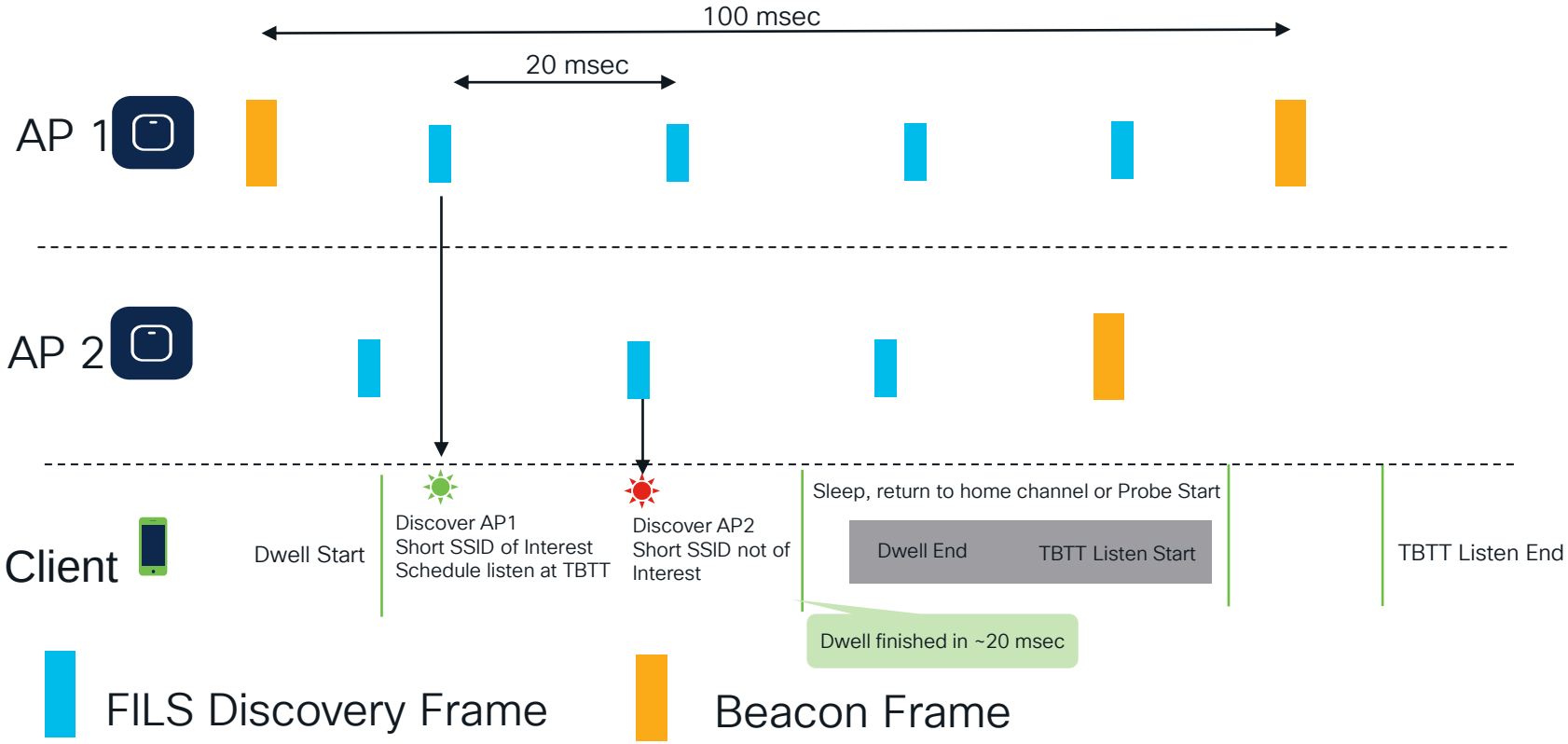
SMALLER BEACONS THAT IS TRANSMITTED MORE FREQUENTLY (APPROX. 20 MSEC), CONSUMES LESS AIR TIME.



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

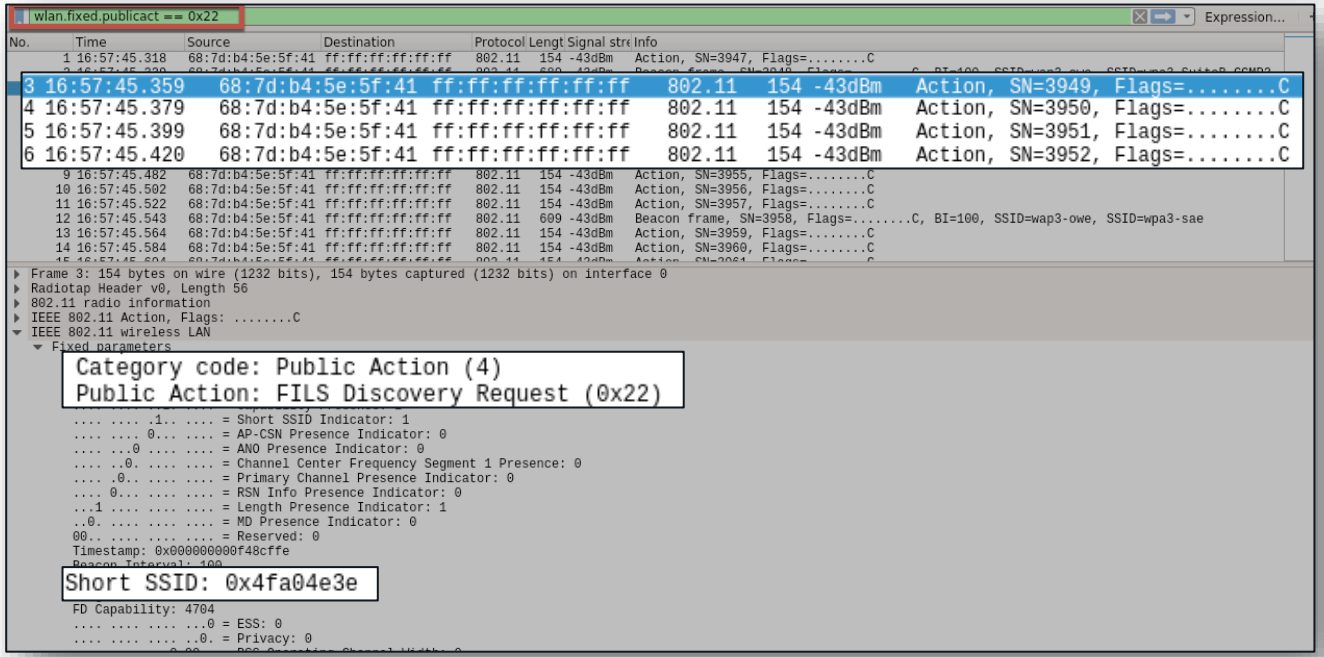
REDUCES PROBE REQUEST OVERHEAD

Fast Initial Link Setup (FILS) Discovery Frames



FILS Discovery Frame – Packet Capture

Wireshark Filter Expression: wlan.fixed.publicact == 0x22



- Broadcast Action Frames
- Contains Short SSID, Channel, TBTT etc
- Transmitted every 20 msec

Unsolicited Broadcast Probe Response

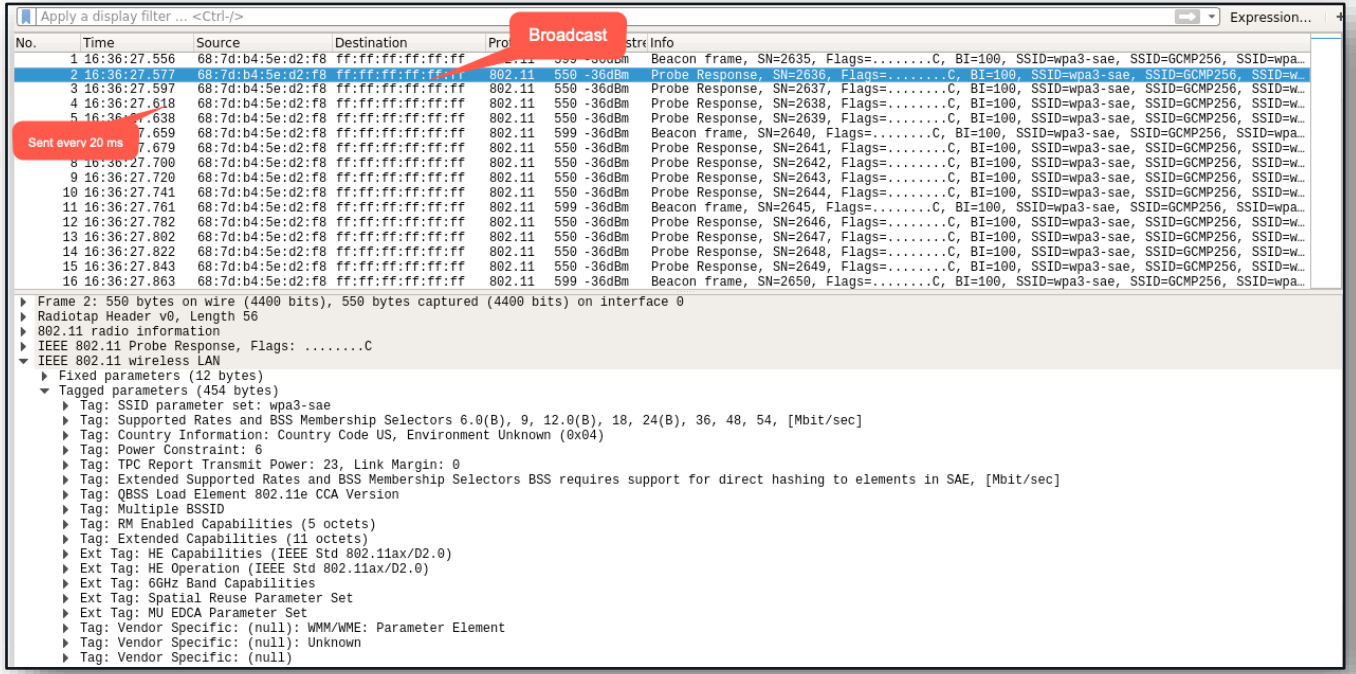
Reduces Probe Request Overhead

Broadcast probe response every 20 msec

Contains detailed information as a Beacon

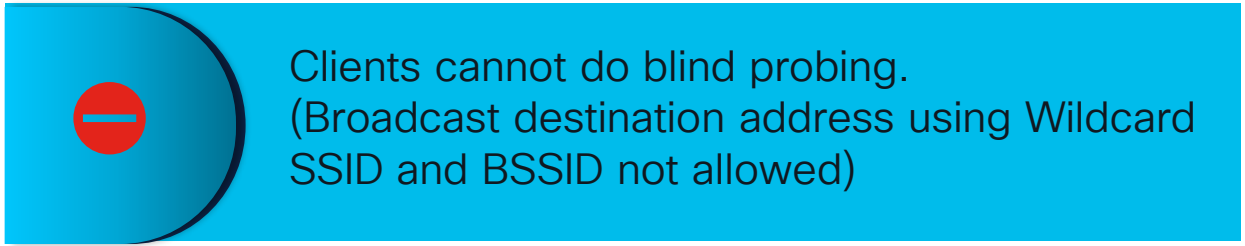
Helps Avoid Probe Storm

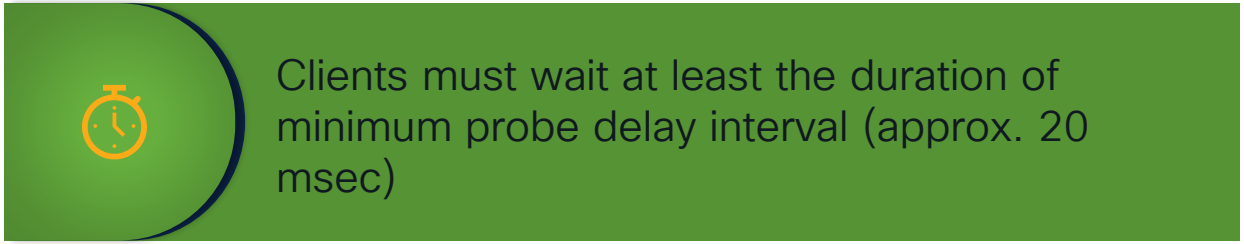
Unsolicited Broadcast Probe Response Packet Capture



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

New Probe Restrictions in 6 GHz Band

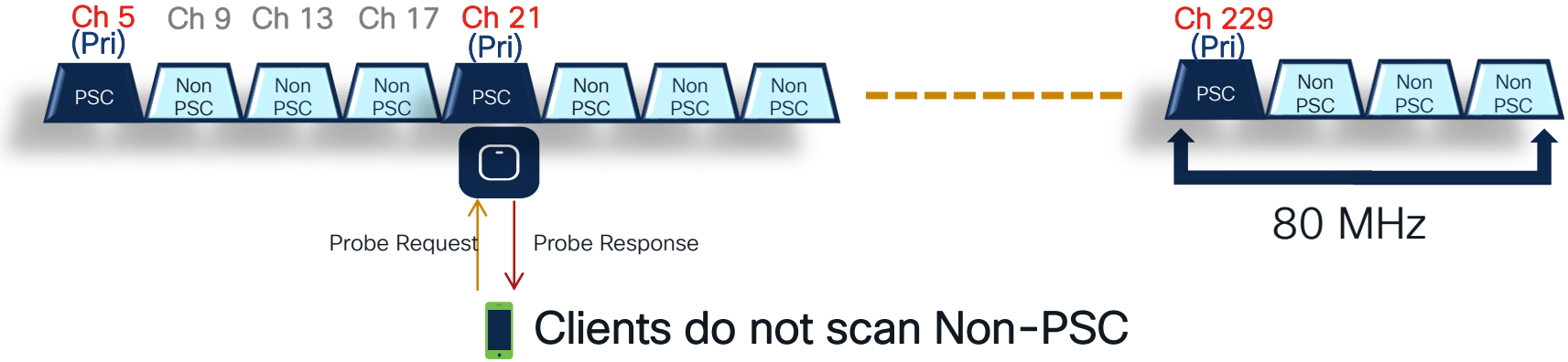




Broadcast probe requests and probes with wildcard SSID create probe storm and impacts performance

Preferred Scanning Channels (PSC)

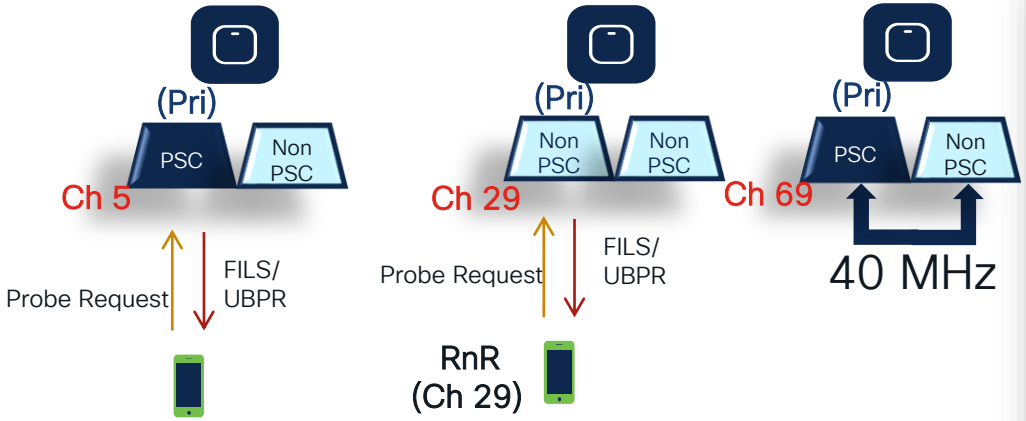
- Every fourth 20MHz channel designated for active probing by Wi-Fi 6E Clients; restricts scanning to 15 channels, instead of 59.
- PSC channels serve as the primary channel for channel bonding in 80 MHz

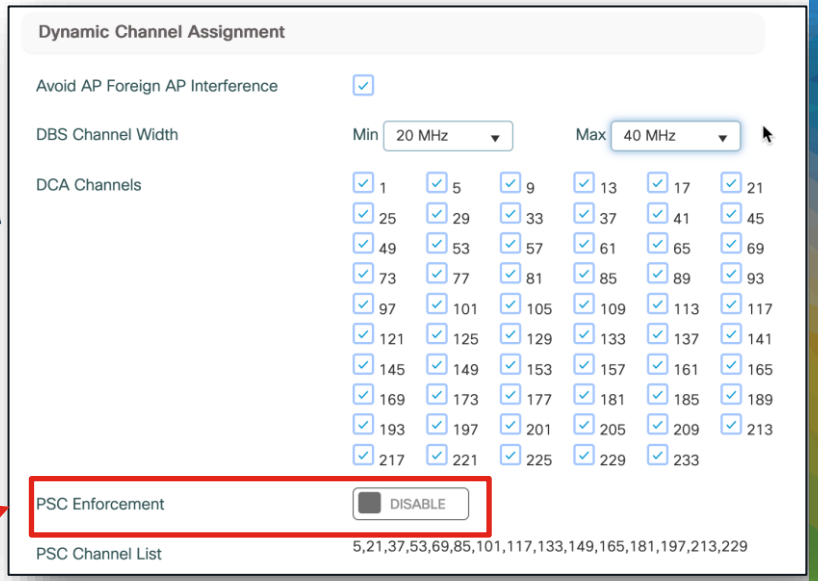


PSC Channel List:
5, 21, 37, 53, 69, 85, 101, 117, 133, 149, 165, 181, 197, 213 and 229

Preferred Scanning Channels with 40 MHz Channel

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

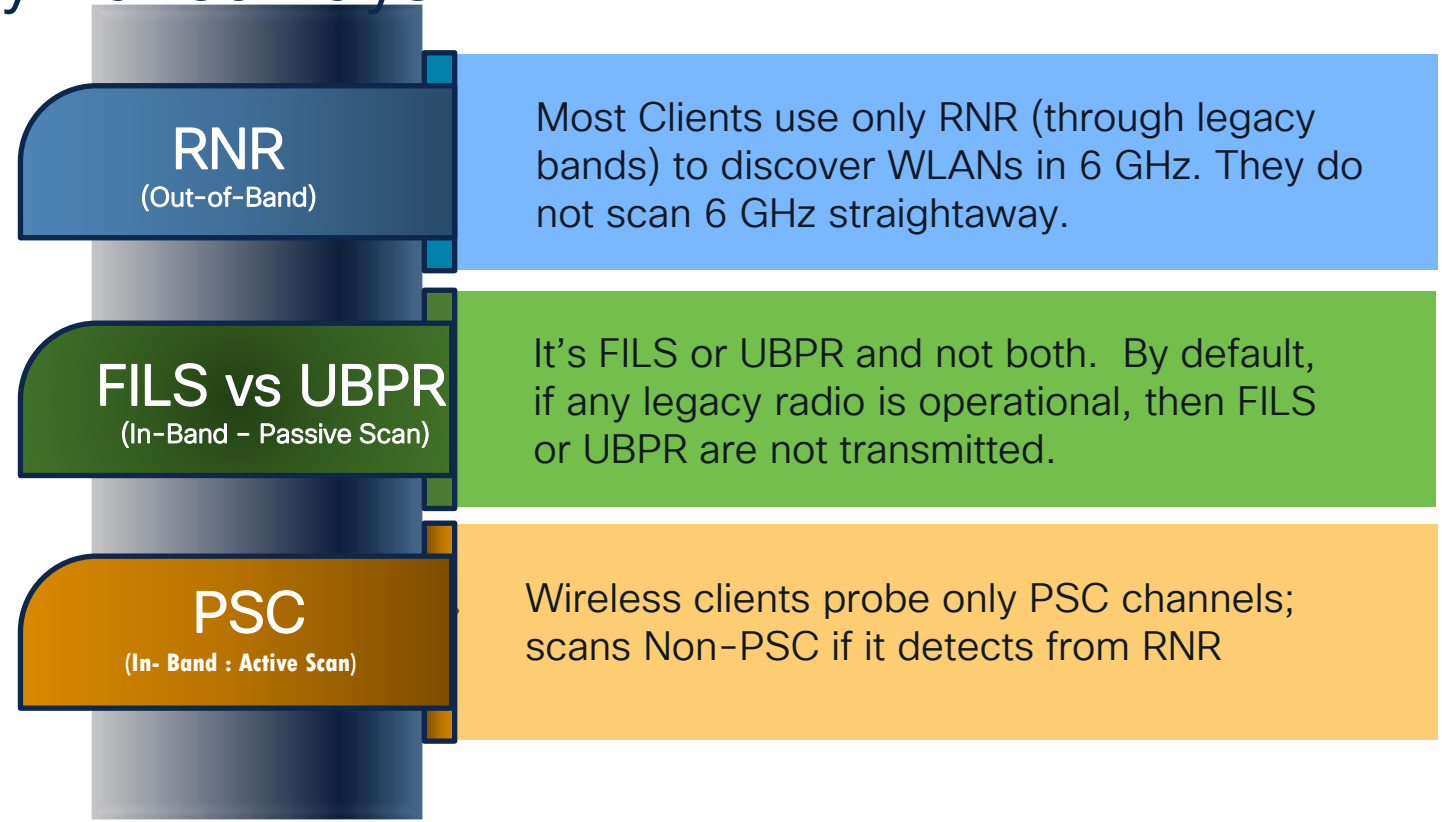




Not recommended

Configuration → Tags & Profiles → RF/Radio

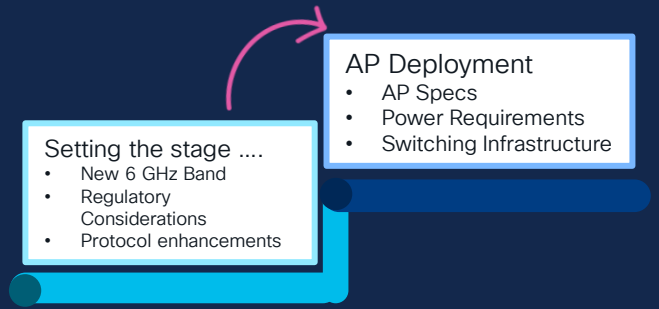
Key Takeaways



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

One Product – Two Management Modes

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

Meraki **Management Mode**
MR Dashboard Stack

Industry’s best & broadest Wi-Fi 6E portfolio

Low End

9162

Mid Size

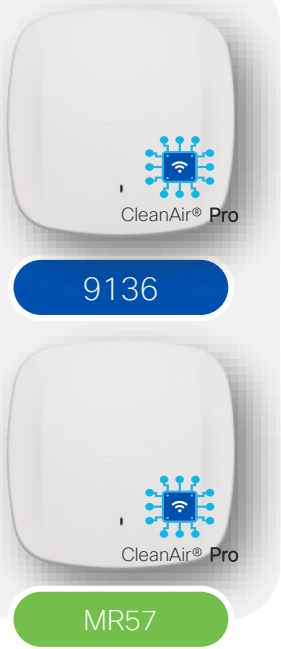
9164

Most Enterprise

9166D1

9166I

Mission Critical & High Density



9136

MR57

Outdoor

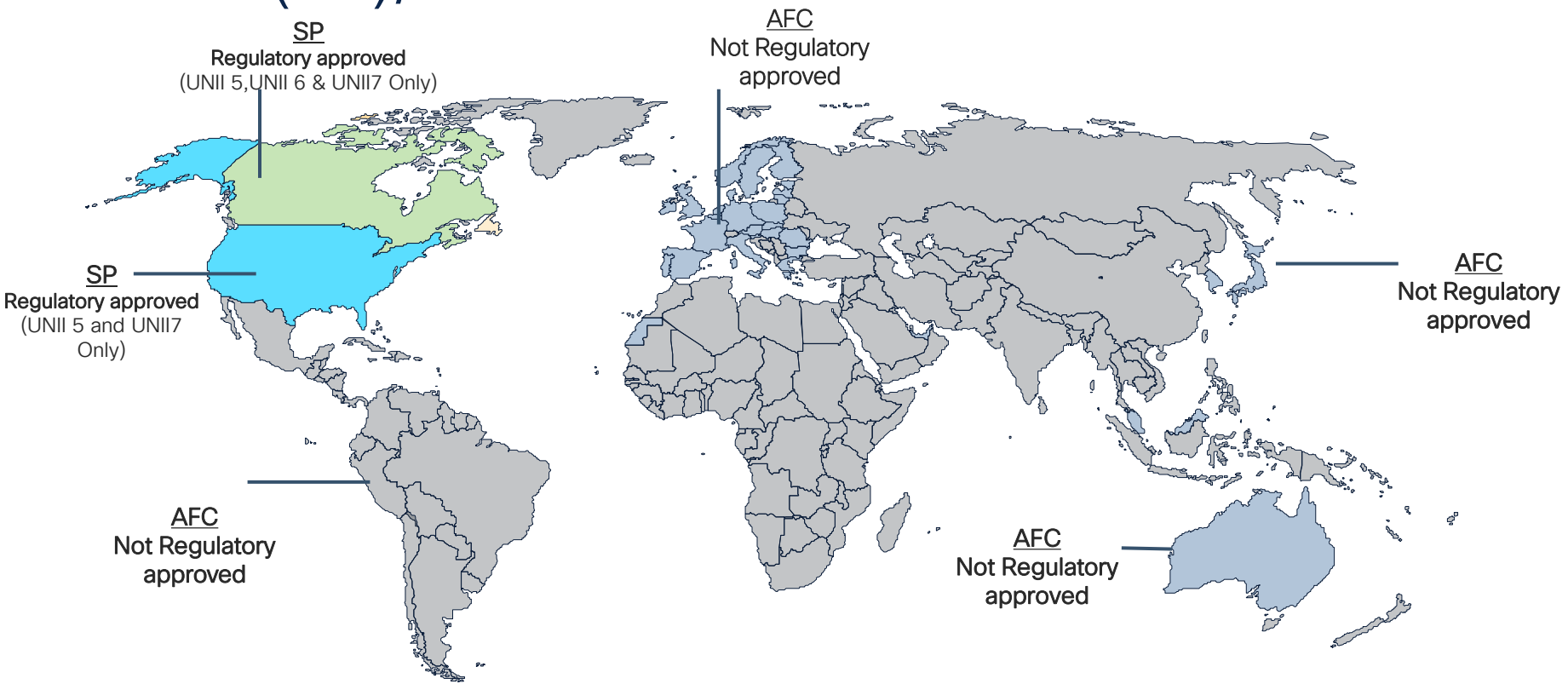
9163E

Indoor Access Points

Outdoor Access Points

Management mode can be changed

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



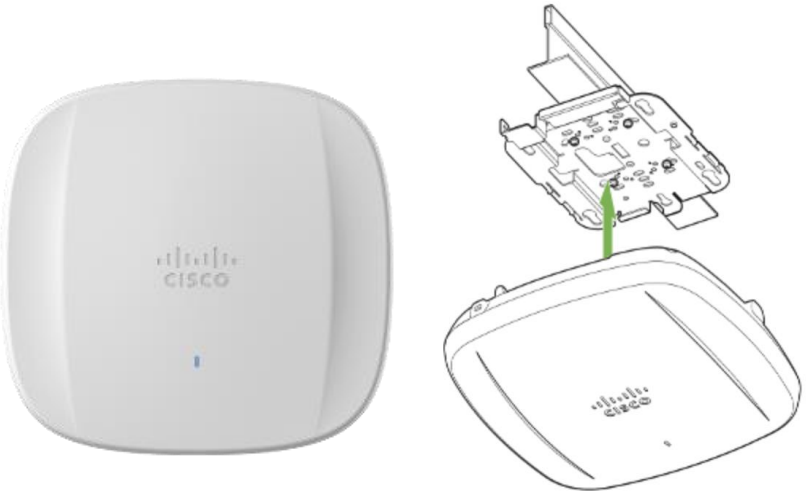
AFC approved in USA & Canada

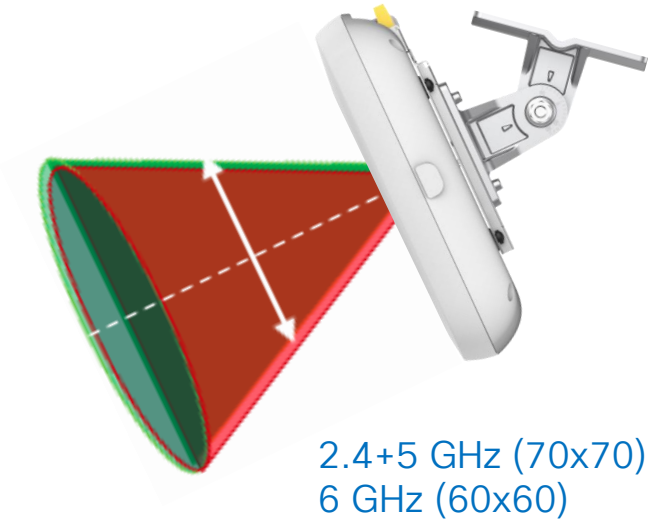
Solution: Add a directional array to the 9166 Series

Introducing the CW9166D1 Series Directional AP

- Simplifies installation costs (less to mount)
- No bulky cables, expensive adapters…
- Similar coverage pattern as previous products using 6 dBi directional antennas
- Solves most popular external antenna cases world-wide irrespective of regulations
- Less components – resulting in a better MTBF – More aesthetically pleasing

Antenna differences between CW9166i and CW9166D1





2.4+5 GHz (70x70)
6 GHz (60x60)

CW9166i designed with an integrated omni-directional antenna ceiling mount for a “360 degree” coverage pattern – ideal for offices, conventional buildings

CW9166D1 designed with an integrated directional antenna allowing the coverage pattern to favor the area the AP is facing - ideal for warehouse, auditoriums etc.

Cisco® Catalyst® 9166D1-x

Directional, Tri-Radio with 12 Spatial Streams!

Available Now!

cisco Live!

9166D1 Wi-Fi 6 Access Point

Penta-Radio Architecture

1. 2.4 GHz Client Radio: 4x4:4SS
2. 5 GHz Client Radio: 4x4:4SS
3. 6 GHz Client Radio 4x4:4SS (XOR to 5GHz)
4. Dedicated tri-band auxiliary radio
5. 2.4 GHz IoT Radio

Directional antenna architecture

- 2.4+5 GHz: 6 dBi gain (70x70 deg), 6 GHz: 8 dBi (60x60)*
- Same X,Y as CW9166I – and only 0.1cm taller!
- Wide support for pan/tilt combinations

Internet of Things Capabilities

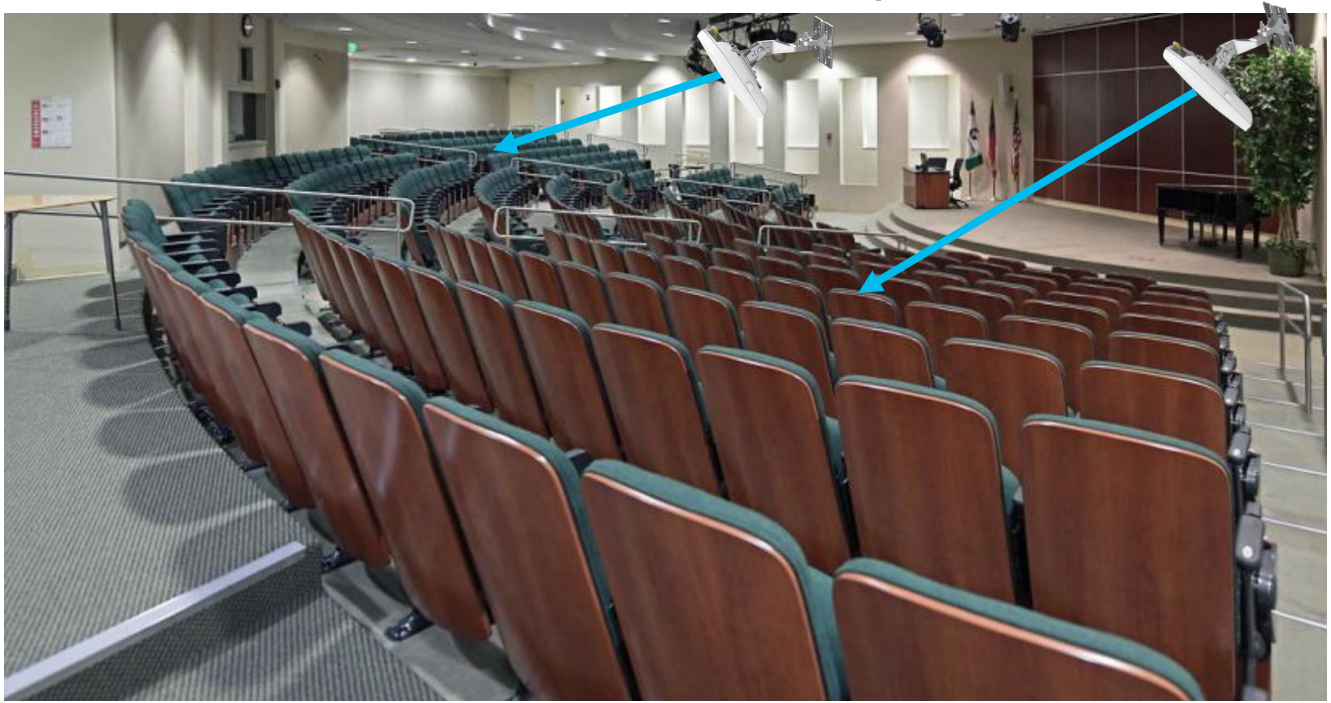
- Built-In Environmental Sensors
- Application Hosting Technology
- USB port with 4.5 W power output

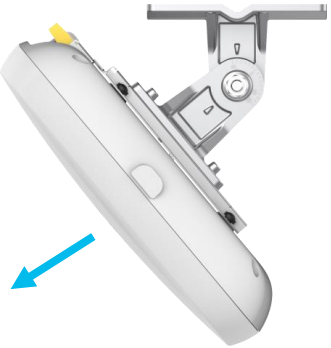
5 Multigigabit (mGig) PoE Port

- Optional DC Power

Subject to change
*2/5/6 mode
† SW support post-FCS

Use cases – Auditoriums (Focused connectivity)



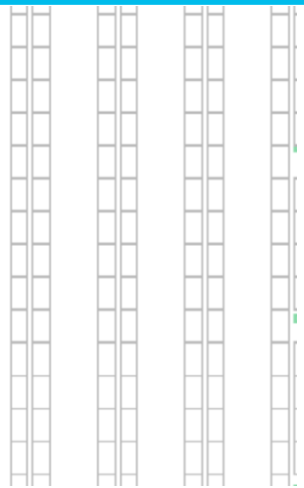


Focusing the direction of the signal improves range, increases signal strength and reduces retries improving overall performance

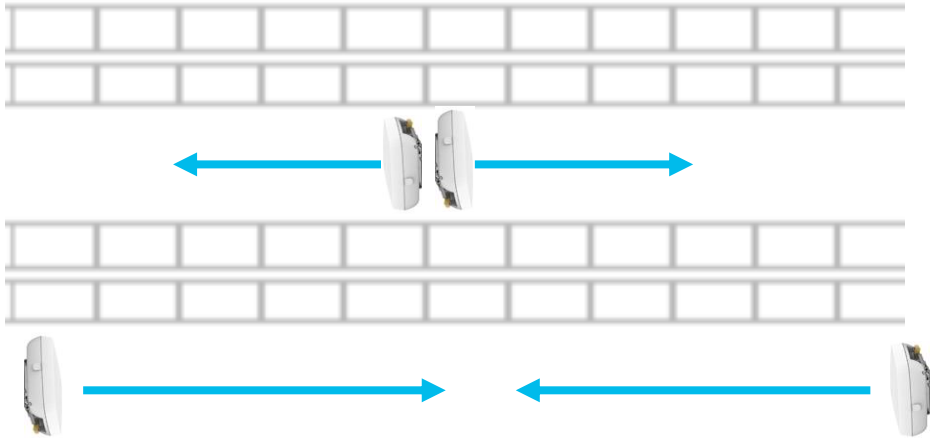
While an Omni-Directional would work, in this fashion, RF connectivity is optimized as each AP is focused into a specific area

Use cases - Warehouse (High ceilings / long aisles)

Warehousing challenges
- High Ceilings
- Long aisles
- Stock material changes (seasonal)
- AP (distance to client) & mounting



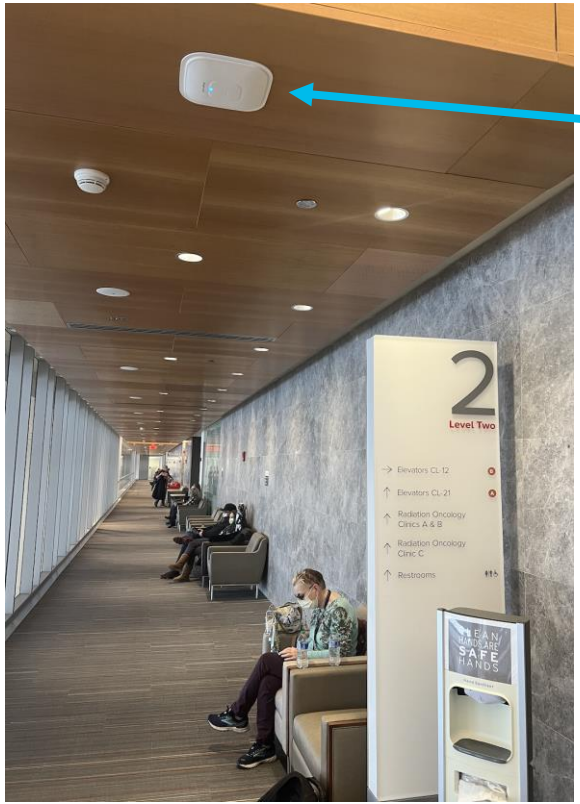
Back-to-Back units in center of aisle covering long aisles (Ability to adjust tilt)



Or perhaps at each end of the aisle shooting down the aisle

Omni-directional pattern is problematic in these areas as AP should be directional and located high to avoid tow motors, changing stock material etc.

Use cases – Healthcare (long hallways)



Long hallways are oftentimes handled with Omni-directional Access Points such as this Cisco Access Point flush mounted to a wooden ceiling.

When it becomes problematic or cost prohibitive to install multiple Access Points, a directional antenna unit can be installed on each end of the hallway assuming there are no metal doors or obstructions in the path

Catalyst CW9166D1

Use cases – Airport Hangars and Bus Garages

Conventional Omni-directional Access Points are not always compatible with high ceilings or areas with a lot of metal.

A directional AP can be mounted on the ceiling or wall allowing the RF energy to be focused where needed

Note: Conventional APs very high on the ceiling and in near proximity to each other, can cause Radio Resource Management (RRM) to hear the AP stronger than the clients. This can result in RRM to believe there is over coverage turning the RF power down on the Access Points causing issues. Directional Access Points help mitigate this issue

Outdoor Access Points

MR78/76/86

- 802.11AX, MU-MIMO, OFDMA
- MR76/78: 2x2 MR86: 4x4
- Integrated Scanning Radio
- Integrated BLE Radio
- Cloud based RF Optimization
- MR76/78: 1G MR86:2.5G (RJ45)
- MR76/78: .3af MR86: .3at
- Integrated L7 Firewall
- Real-time WIDS/WIPS
- Enhanced transmit power and receive sensitivity

6

C9124

- 802.11AX, MU-MIMO, OFDMA
- 4x4 + 4x4:4
- Cisco RF ASIC next-gen Cisco CleanAir
- IoT ready
- 1x 2.5G mGig/SFP/1Gbe PoE-Out
- PoE-In 802.3af/at/bt/UPOE
- DC power input (24 to 56 VDC)
- 30 dBm Transmit Power(Same as 1572 and higher than 1562)
- Centralized, FlexConnect, Bridge, Flex+Bridge & EWC

CW9163E

6E

- 802.11AX, MU-MIMO, OFDMA
- 2x2(2.4GHz) + 2x2(5GHz) + 2x2(6GHz)*
- Tri-band Scanning Radio with next-gen CleanAirPro
- IoT ready
- 1x 2.5G mGig
- In-built GPS module
- PoE-In 802.3af/at

* 6GHz subject to AFC availability

Premier Wi-Fi 6/6E outdoor and industrial access point

6GHz-ready 4x4 outdoor and industrial access point

Catalyst IW9167I/E Heavy Duty Access Point

Wi-Fi 6/6E*

- Tri-radio (2.4GHz, 5GHz, 6GHz), 4x4, integrated omni-directional antennas [5-6 dBi]
- Cast aluminum case, IP66/IP67, -40C to +70C
- Multigigabit 5Gbps, RJ-45, SFP+, optional M12 adapter
- Manage with Catalyst 9800 wireless LAN controllers and Cisco Catalyst Center
- GNSS, scanning radio

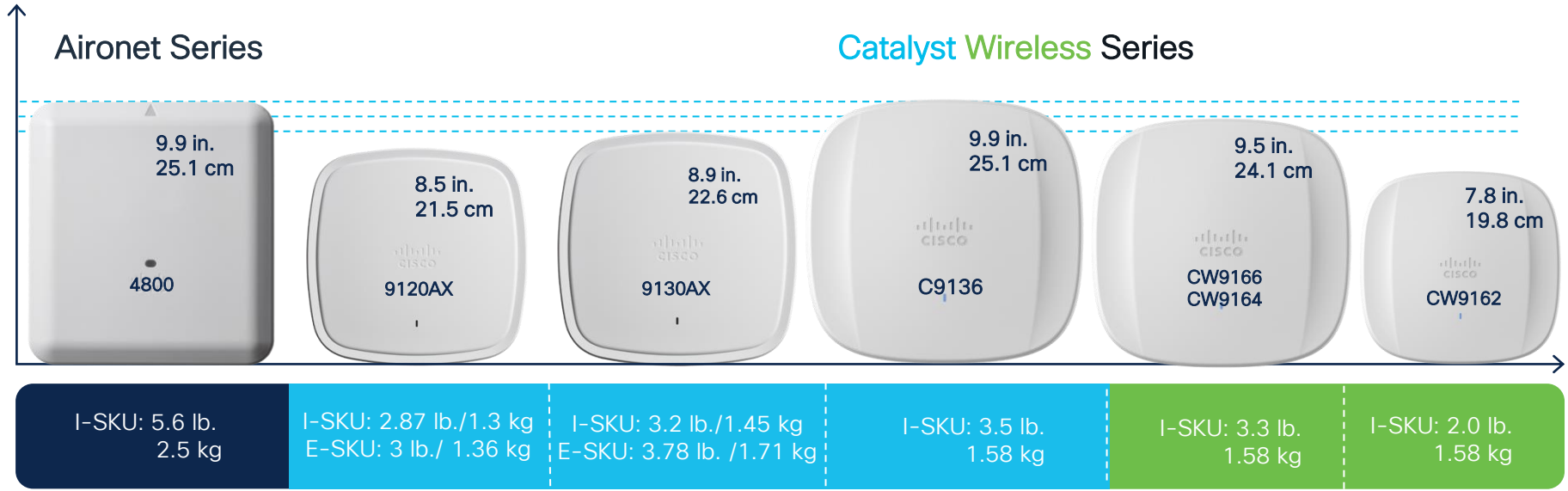
Take your Wi-Fi network wherever you need it today. Be ready for tomorrow. With ease.

*Wi-Fi 6E subject to regulatory agencies' regulations and approvals.

Mechanical Specifications

Indoor Access Point Dimensions

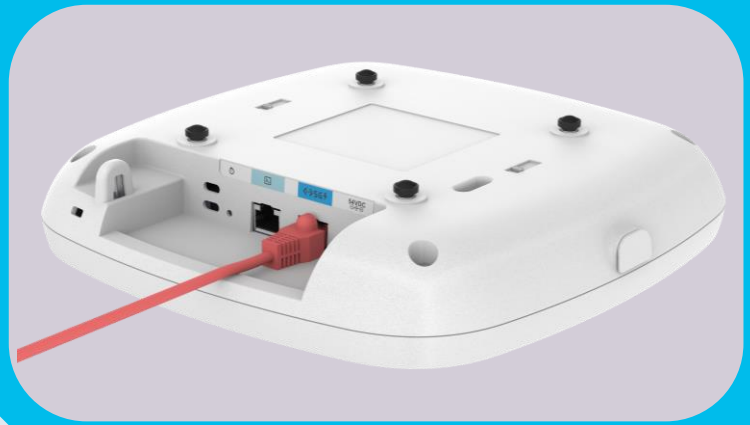
Wi-Fi 6E - Similar in size but significantly more capabilities



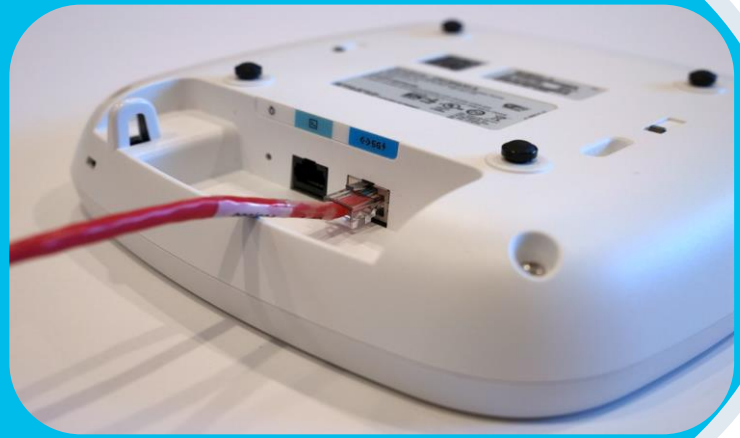
Catalyst C9136/CW9166/9164/9162

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

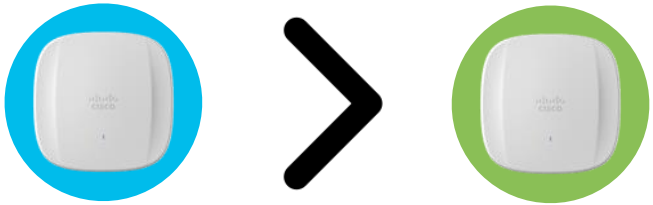
AIR-AP-BRACKET-1 photos

Front side	AP mounted	Back side

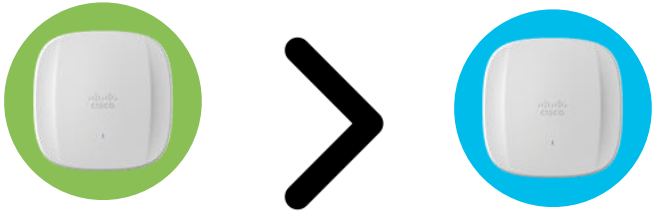
AIR-AP-BRACKET-2 photos

Front side	AP mounted	Back side

Conversion overview



Done from C9800 WLC

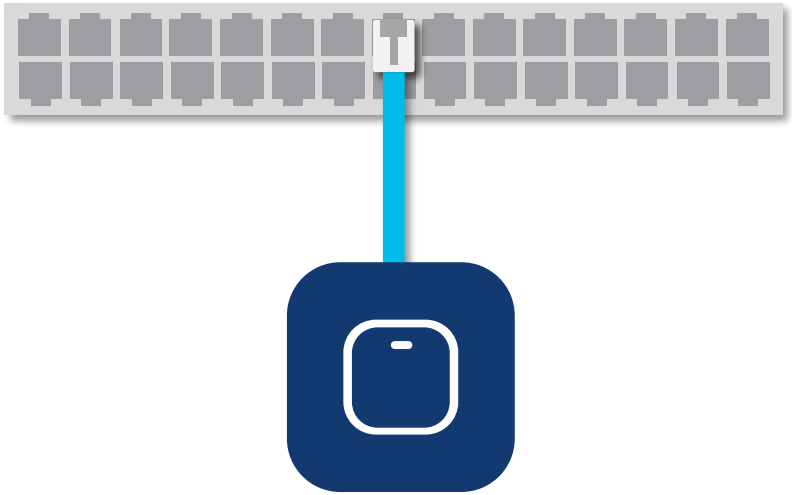


Call Meraki Support
(Needs license)

Migration Guide: https://www.cisco.com/c/en/us/products/collateral/wireless/catalyst-9100ax-access-points/migrating-dna-to-meraki-mgmt-mode.pdf

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 6E Performance Comparison

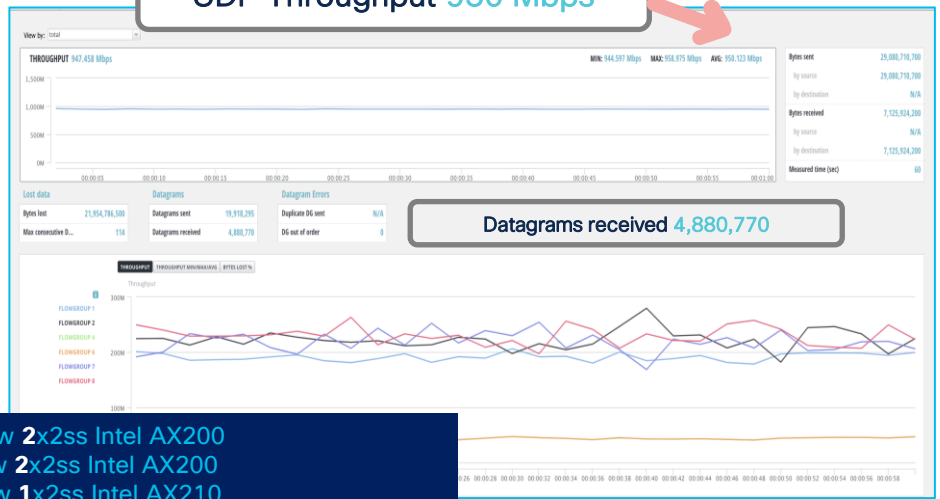
5 Gig (mGig) AP Uplink vs. 1 Gig AP Uplink

Wi-Fi 6E Performance with mGig (5 Gig) Switch

UDP Throughput 2.88 Gbps

Wi-Fi 6E Performance with Gigabit Switch

UDP Throughput 950 Mbps



2.4 GHz @20 MHz w **2**x2ss Intel AX200
5 GHz @80 MHz w **2**x2ss Intel AX200
6 GHz @160 MHz w **1**x2ss Intel AX210

Catalyst AP C9136 to Switch connection

AP C9136

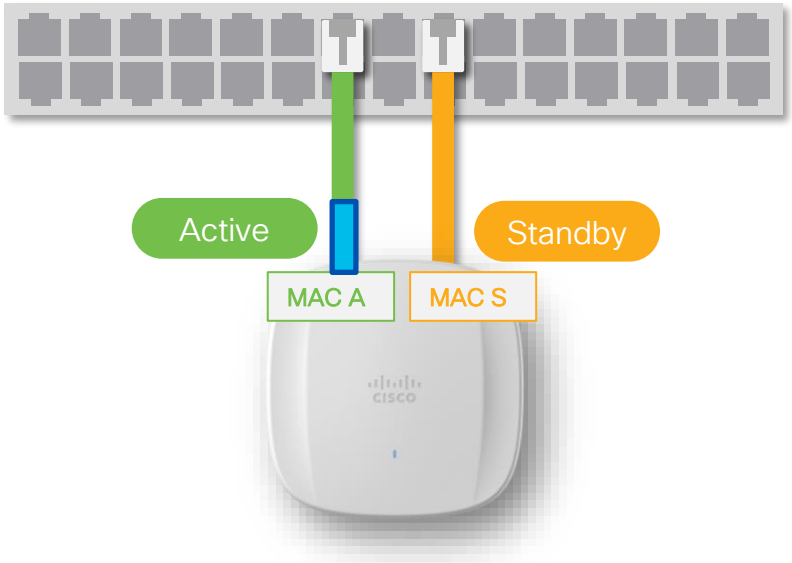
C9136 has two mGig uplink ports

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

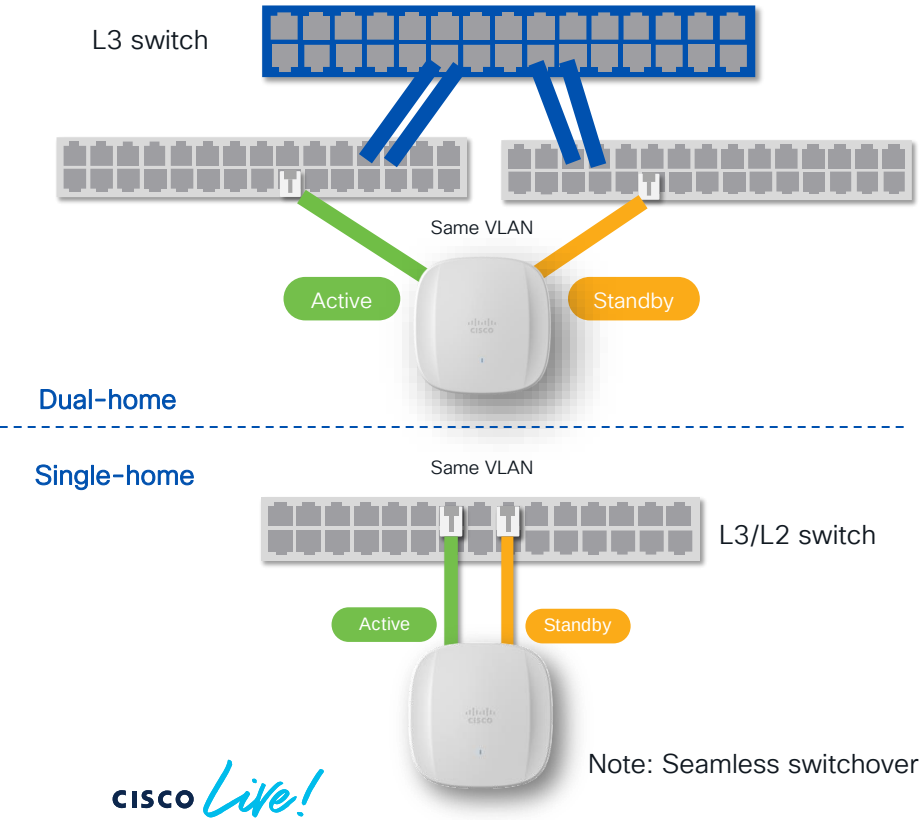
Catalyst AP C9136 to Switch connection

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

Note: Seamless switchover with AP port authentication with dot1x/mab currently not supported

Catalyst AP C9136 to Switch connection

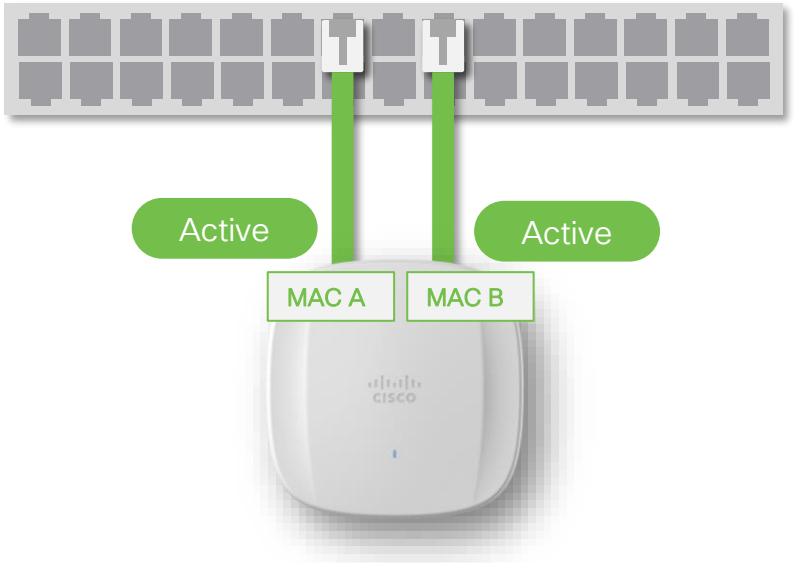


- When configured with standalone ports, you have two options…
- Dual-home to two different switches
  - Recommend to connect to switches in different IDF, whenever possible
- Single-home to one logical switch (Stack Wise, Multi-layer switch, etc.)
  - Recommend to connect to two different members of 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

Note: Seamless switchover in dual home in SDA not supported currently

Catalyst AP C9136 to Switch connection



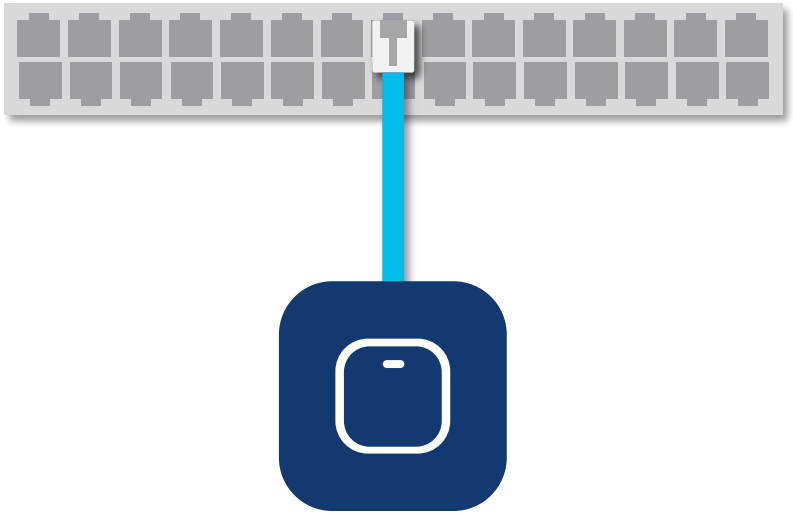
AP C9136

- 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 (LPI)	mGig Link Speed	USB	AI/ML Driven Scanning Radio
802.3af	2	Disabled	1x1	1x1	1G	Disabled	Y
802.3at	6	2x2	2x2	2x2	2.5 G	Y/4.5 W	Y
802.3bt	6	2x2	2x2	2x2	2.5 G	Y/4.5 W	Y
DC Power	6	2x2	2x2	2x2	2.5 G	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 (LPI)	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	2.5 G	Disabled	Y
802.3bt	10	2x2	4x4	4x4	2.5 G	Y/4.5 W	Y
DC Power	10	2x2	4x4	4x4	2.5 G	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)

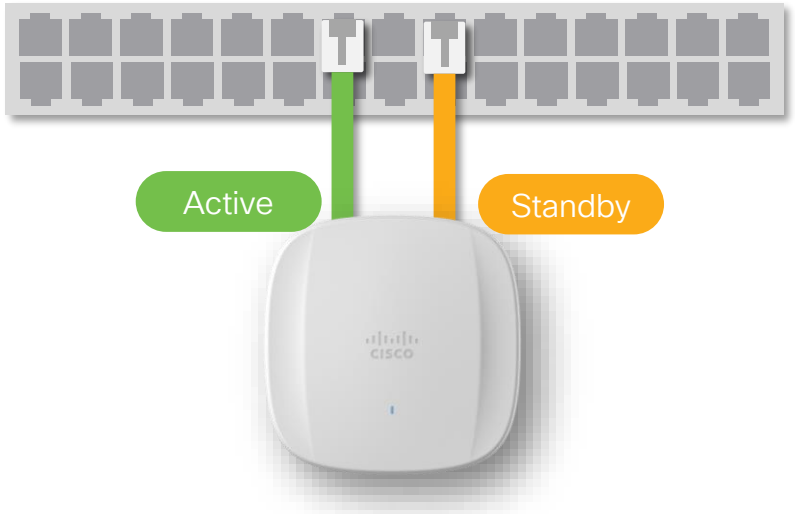
Power Source	Number of Spatial Stream	2.4 GHz Radio	5 GHz Radio	5 GHz / 6 GHz Radio (LPI)	mGig Link Speed	USB	Env Sensors	AI/ML Driven Scanning Radio
802.3af	n.a.	Disabled	Disabled	Disabled	1G	Disabled	Y	Y
802.3at	12	4x4	4x4	4x4	5G	Disabled	Y	Y
802.3bt	12	4x4	4x4	4x4	5G	Y/4.5 W	Y	Y
DC Power	12	4x4	4x4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

Note:

1. AIR-PWRINJ7 is C9166I/D's official 802.3bt Power Injector

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

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

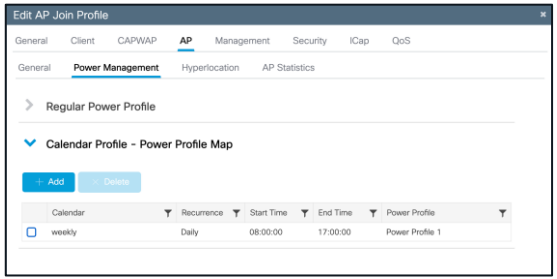
AP Power Optimizations Feature Suite

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.

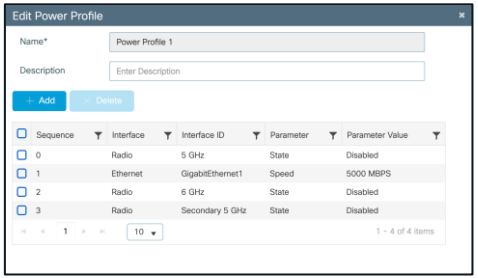


IOS-XE 17.8

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 Catalyst 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

To know more about Wireless Sustainability

Saving Energy and Money with Your Cisco Wireless Network - BRKEWN-2043

Simone Arena, Distinguished TME, Cisco Systems, Inc. - **Distinguished Speaker**

Learn how your Cisco wireless network can accelerate progress toward your sustainability goals and reduce your energy costs. Get answers to these important questions: Why does sustainability matter in networking? Why act now? How do you build an energy-efficient wireless network? Get to know Cisco's commitment to sustainability and what it means for you, and how to start saving energy, emit less CO2, and reduce OpEx today.

Technical Level: Intermediate

Technology: Meraki, Wi-Fi 6E, Enterprise Wireless

Session Type: Breakout

Session Length: 60 Minutes

Percentage of New Content: 25% New

Eligible for Continuing Education Credit: Yes

Thursday, Feb 8 | 1:30 PM - 2:30 PM CET | Session Room A1

Section Summary

1. Catalyst Wi-Fi 6E Access Point Portfolio
2. Common Hardware and Migration
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

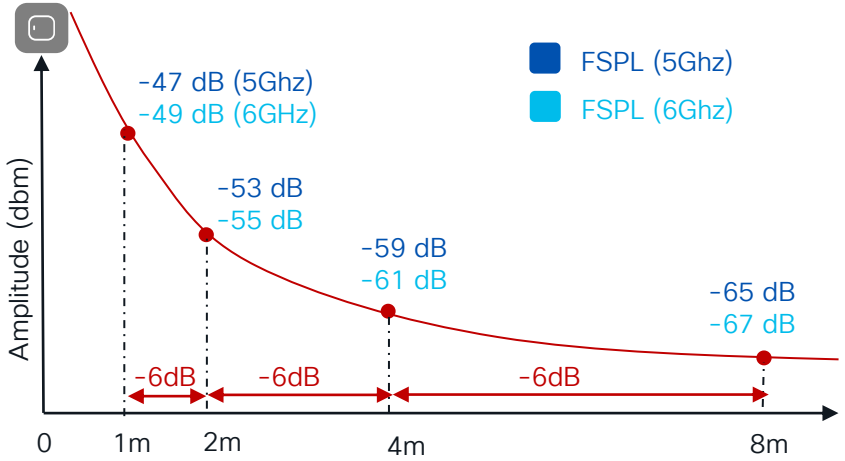
- AP Specs
- Power Requirements
- Switching Infrastructure

RF Design

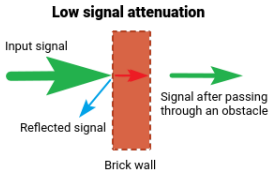
- AP Coverage
- AP Density
- Site Survey Mode

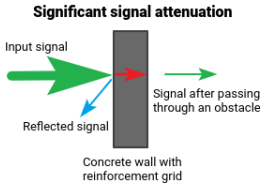
What you need to consider?

- 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



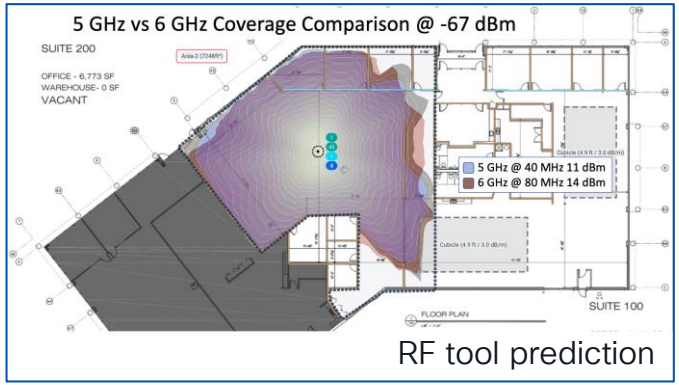


(*) FSPL = Free Space Path Loss: https://en.wikipedia.org/wiki/Free-space_path_loss

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?

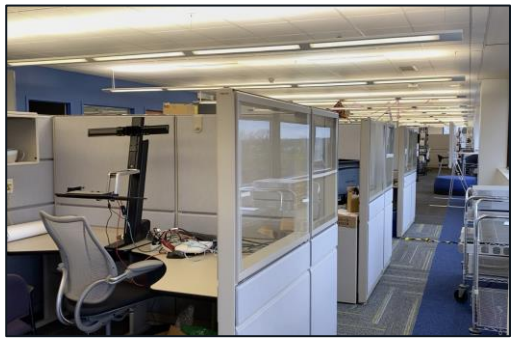
Q1: Can a co-resident 6 GHz radio provide the same coverage as the 5 GHz cell while dramatically increasing performance?

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.

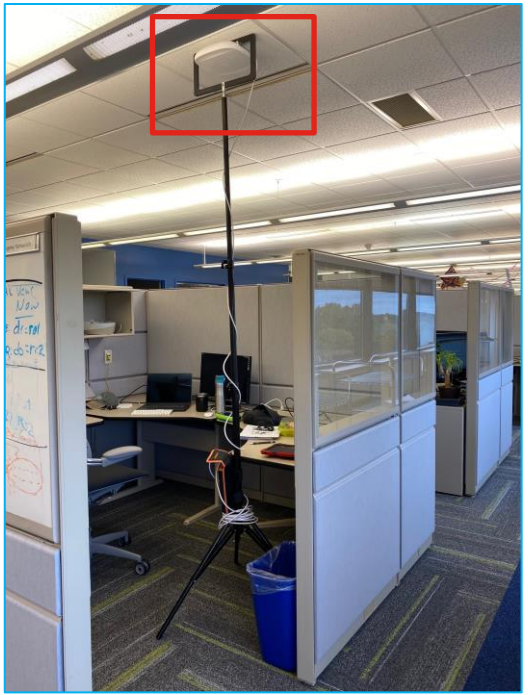
New Gear!!! Wi-Fi 6E Measurement !

Ekahau Sidekick 2

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

NetAlly Aircheck G3 Pro

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



Hamina Integration – Work in progress!

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

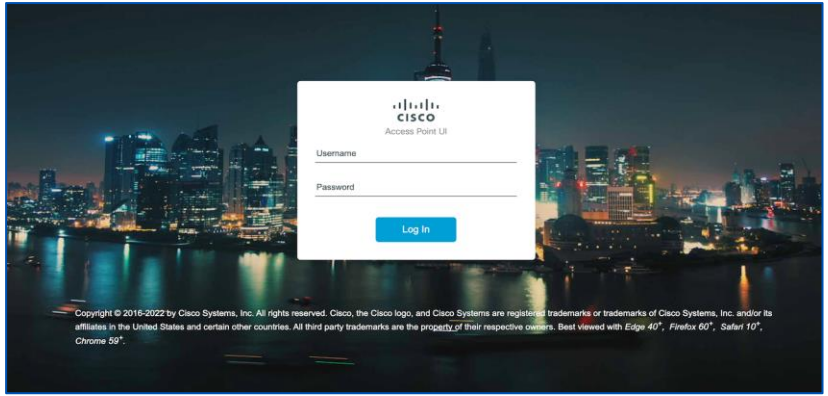
Supports configuration of channel number, channel width, Tx power, SSID, and data rates

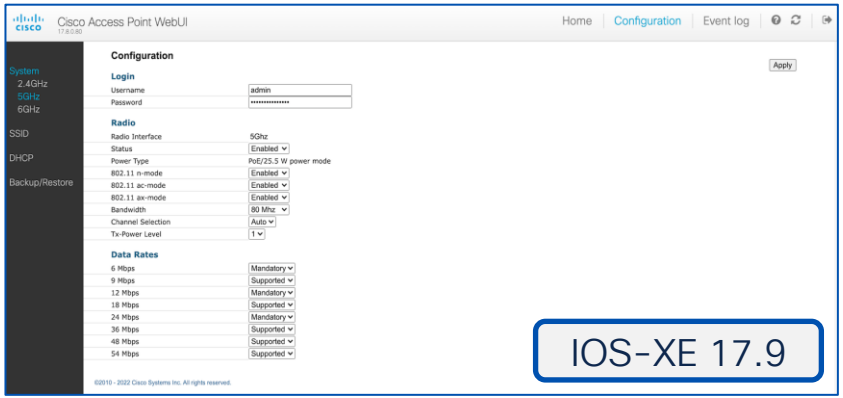
Site survey mode configuration steps

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

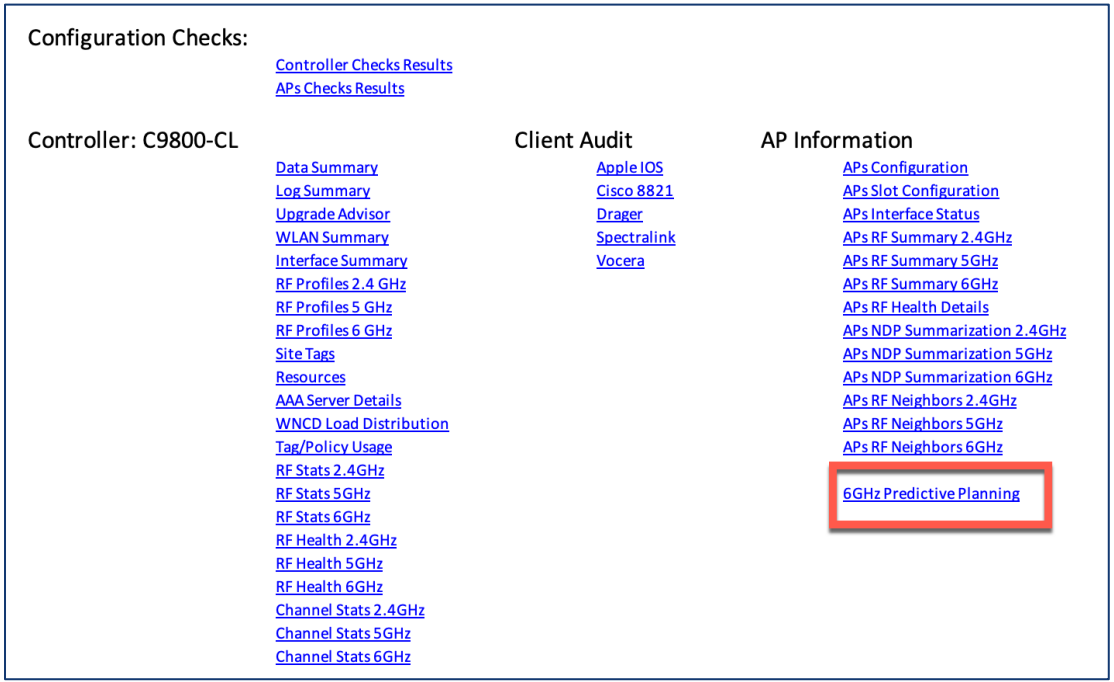




6 GHz Predictive view with WCAE Tool

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

WCAE Version: 0.9.11 or later



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 Predicte	dBm	5GHz 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.

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.

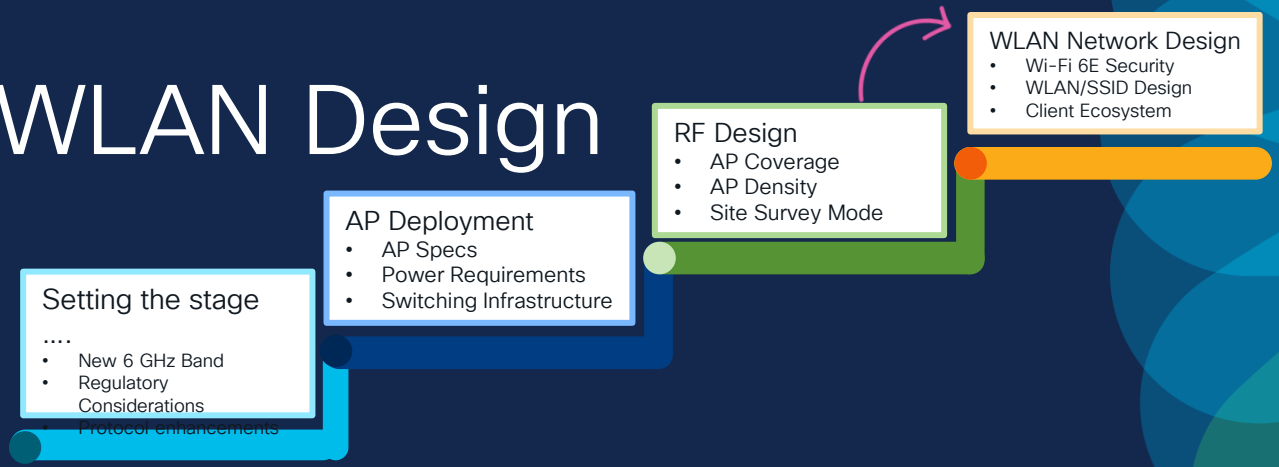
This session will provide a deep dive on how to think about and manage Wi-Fi6e, RRM, Spectrum Intelligence and the evolution of Multi Band Operations within the infrastructure. The evolution to Wi-Fi 6e brings amazing RF capacity gains. Wi-Fi6e also means new pressures on the wired infrastructures capacity 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

Thursday, Feb 8 | 3:00 PM - 4:30 PM CET | Elicium 2

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

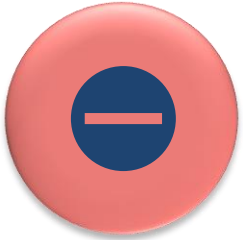
Wi-Fi 6E – Security

Wi-Fi 6E Security

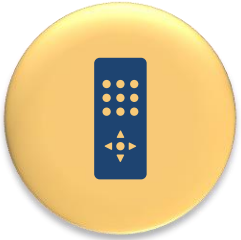
Wi-Fi 6E uplevels security.

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 one 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 of 17.9.4, 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

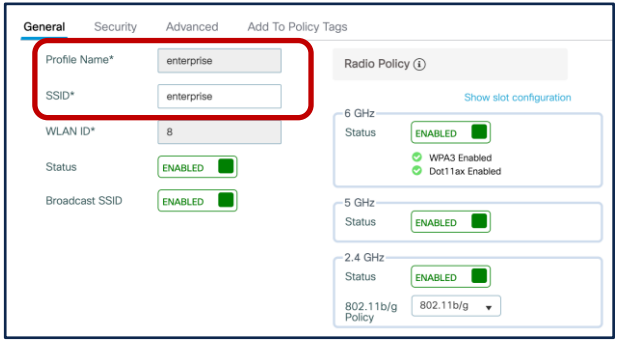
Cons

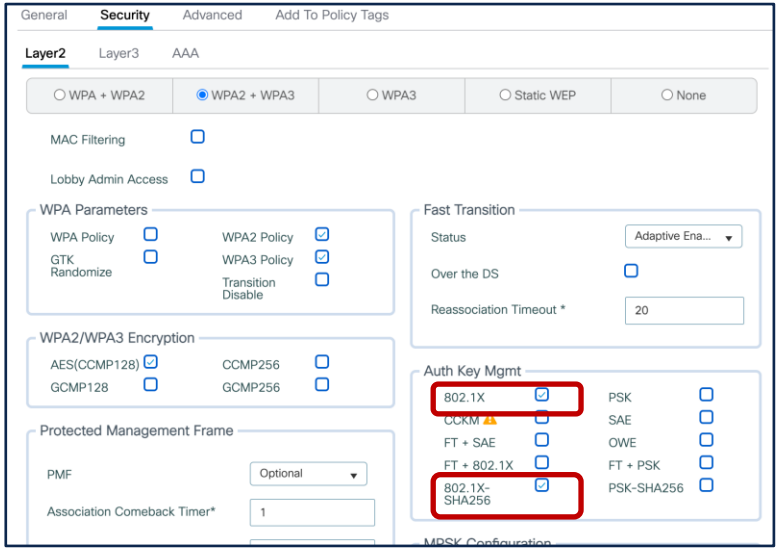
- Breaks support for existing clients that don't support WPA3 and PMF in 2.4 and 5GHz
- Requires full control on client devices and drivers

Option 2

WLAN Design Considerations – IOS-XE 17.12.1

Single WLAN Profile for 2.4/5 and 6 GHz





- L2 Security would be WPA2+ WPA3.
- AKM should be set to **802.1x-SHA256** and **802.1x** (SHA1) for Enterprise; SAE and PSK for Personal.
- PMF as **Optional**

- How to configure the client side?
  - For clients that don't support 6 GHz, configure a **WPA2 profile or WPA3 Enterprise with PMF as Optional** depending on the client support.
  - For clients that support 6 GHz, configure **WPA3 Enterprise**. They will use these settings to connect to both 2.4/5 GHz and 6GHz

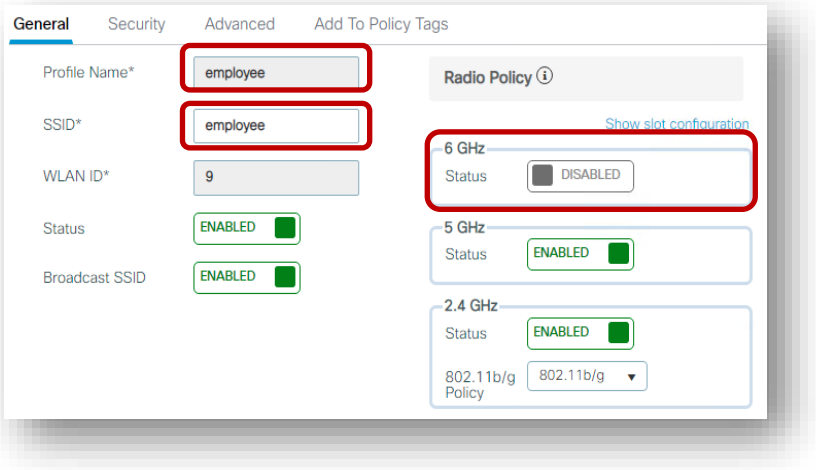
WFA = Wi-Fi Alliance

WLAN design considerations

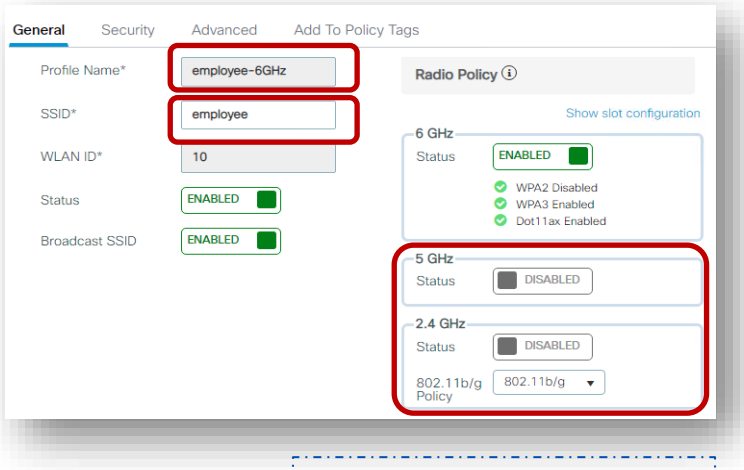
Before 17.12.1

- **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

Before 17.12.1

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

a) WPA3 Transition mode

b) WPA/WPA2

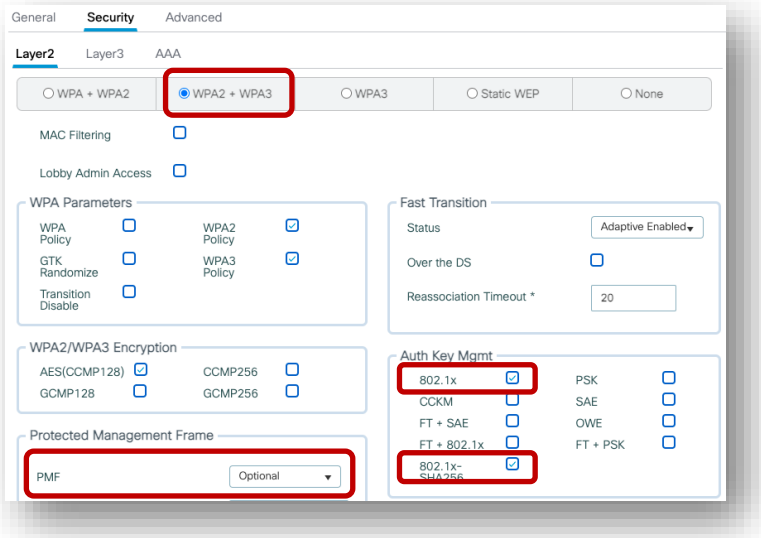
Things to keep in mind:

- 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.

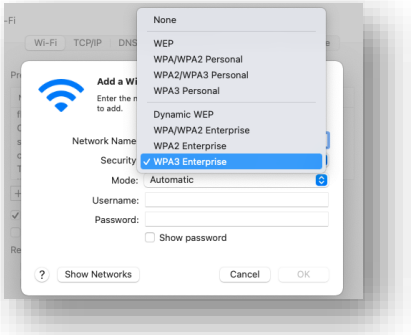
Option 2a (dot1x SSID)

Before 17.12.1

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



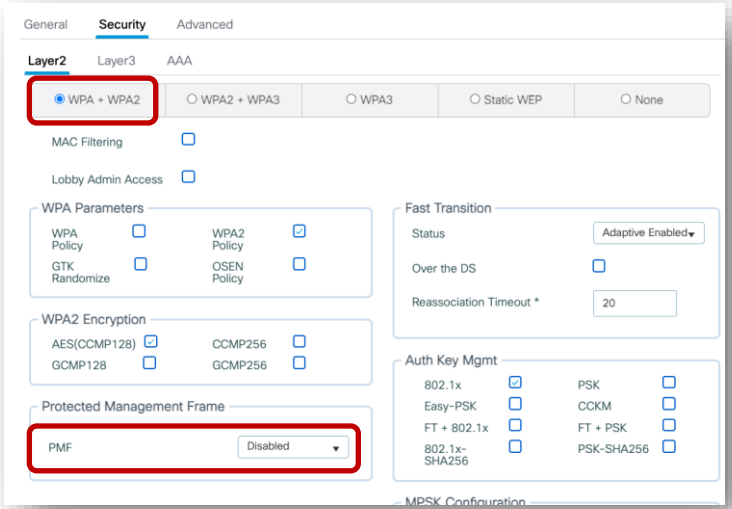
- L2 Security would be WPA2+ WPA3. AKM should be set to **802.1x-SHA256** and **802.1x** (SHA1). PMF as **Optional**
- How to configure the client side?
  - For clients that don't support 6 GHz, configure a **WPA2 profile**
  - For clients that support 6 GHz, configure **WPA3 Enterprise**. They will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



Option 2b (dot1x SSID)

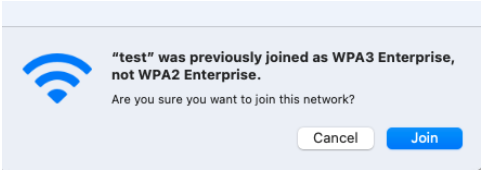
Before 17.12.1

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 3

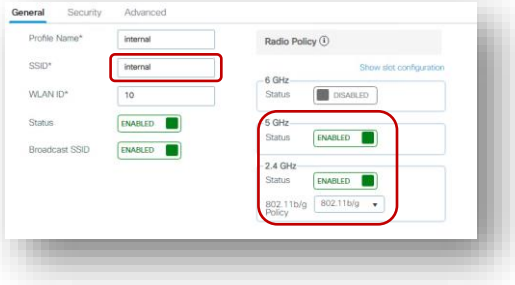
Option 3 – WLAN design considerations

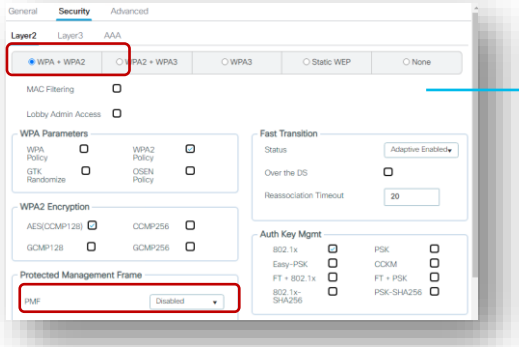
- Option 3: Redesign the SSIDs. This entails adding a WPA3 separate SSID for 6GHz and then decide which bands to enable to address different customer use cases.
  - Example 1: customer wants to adopt 6GHz without touching the existing SSIDs > add a separate SSID with WPA3 and broadcast it in all bands.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

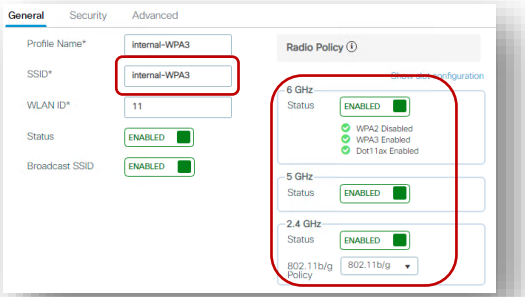
Legacy SSID

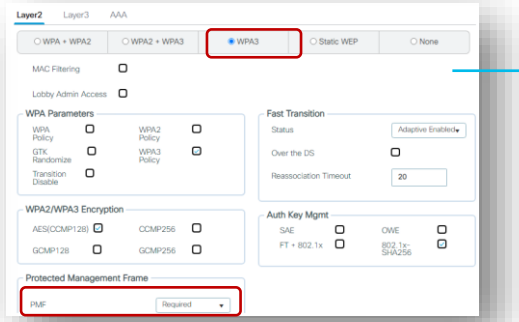




Existing WPA/WPA2 SSID in 2.4 and 5GHz for legacy clients

New SSID

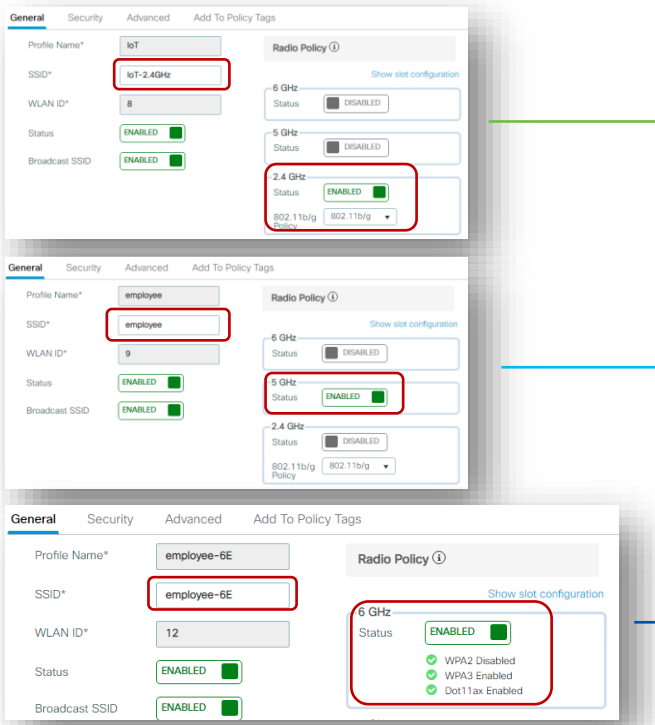




Dedicated SSID for WPA3 (new name) capable clients in all bands. This is the SSID for 6GHz

Option 3 > Example 2

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



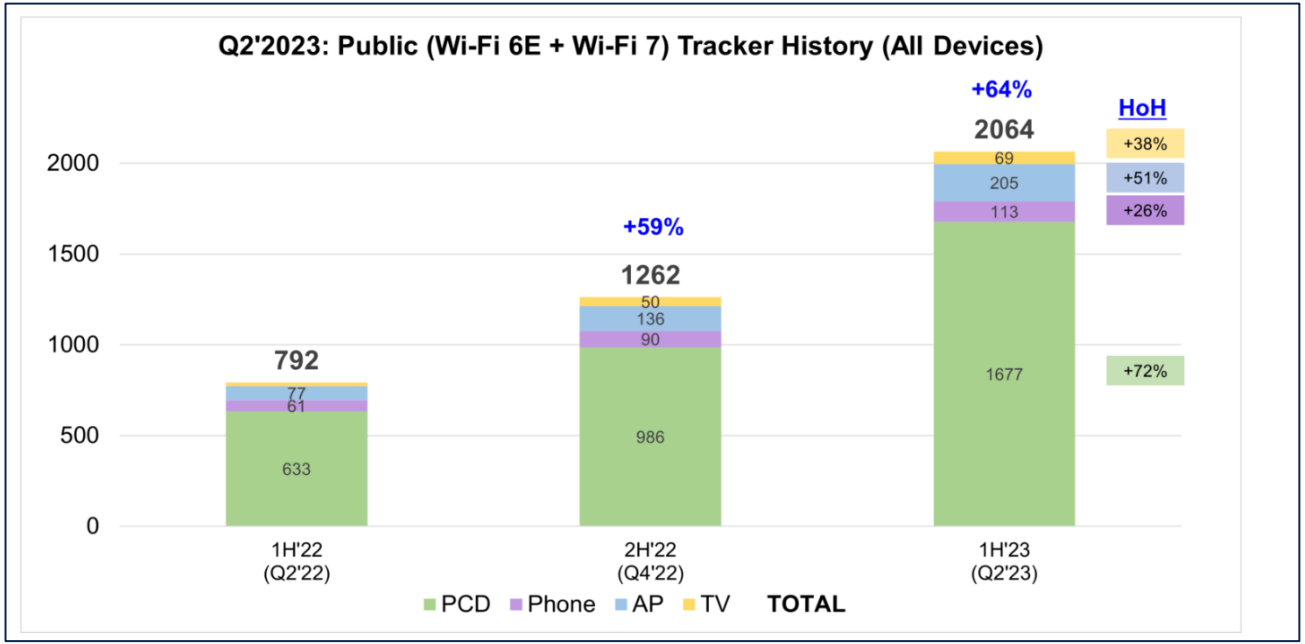
2.4GHz dedicated to specifc devices. These could be legacy devices or IoT devices. If IoT will be mostly PSK

5GHz dedicated to majority of existing clients (WPA2)

WPA3 on on all bands, for the newer clients

Wi-Fi 6E – Client Eco System

Wi-Fi 6E Device Support



Broad range of Wi-Fi 6E Client Set:
Phones, Tablets, Laptops, TVs, Scanners, Desktop

1000+ Laptops
300+ Desktops
100+ Phones

iPhone 15 Pro

Source: https://wifinowglobal.com/news-blog/intel-ecosystem-tracking-2064-wi-fi-6e-devices-now-available-wi-fi-7-reaches-67-devices/

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

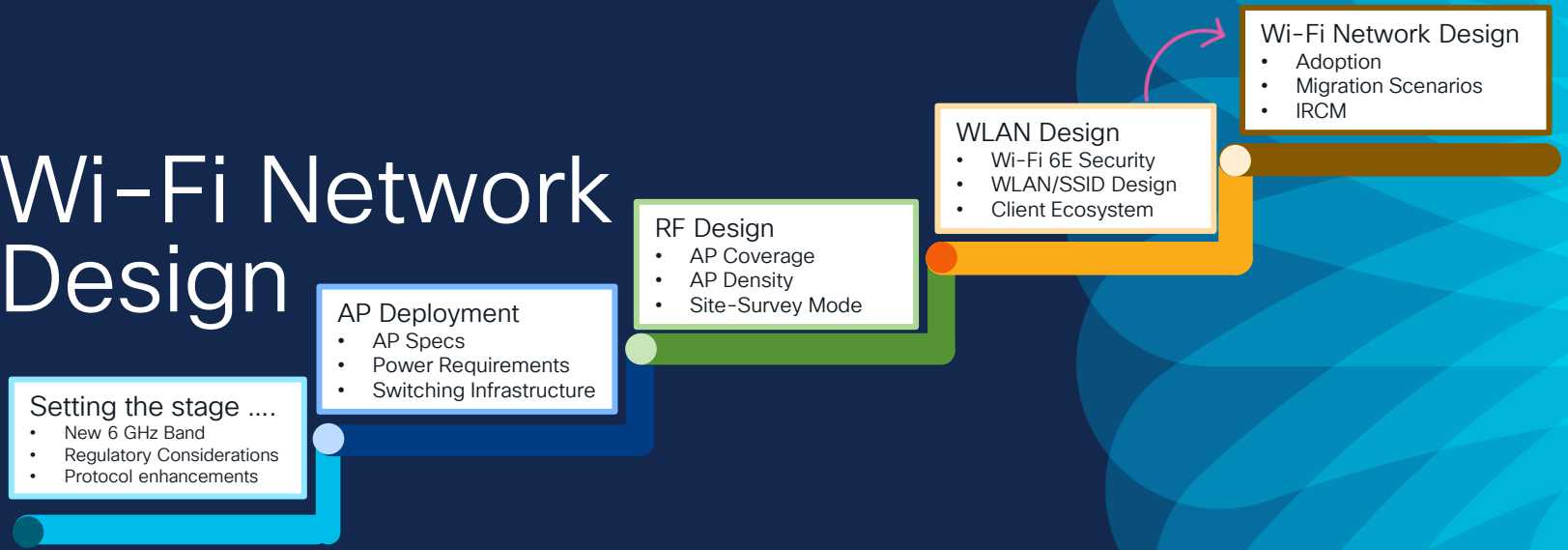
(to move 6 GHz capable clients to 6 GHz Radio)

* Assuming latest driver

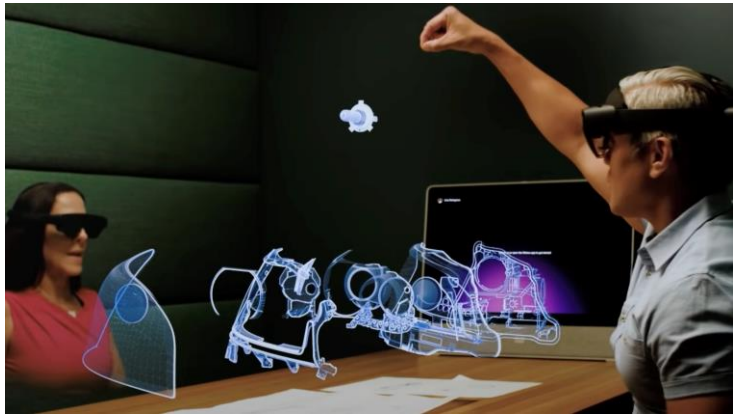
Section Summary

1. Wi-Fi 6E Security Upleveled: WPA3 with PMF Mandatory
2. WLAN Design : 3 Options ("ALL-IN", "One-SSID" and "Multiple-SSIDs")
3. Wi-Fi 6E Client Eco System
4. Recommendations

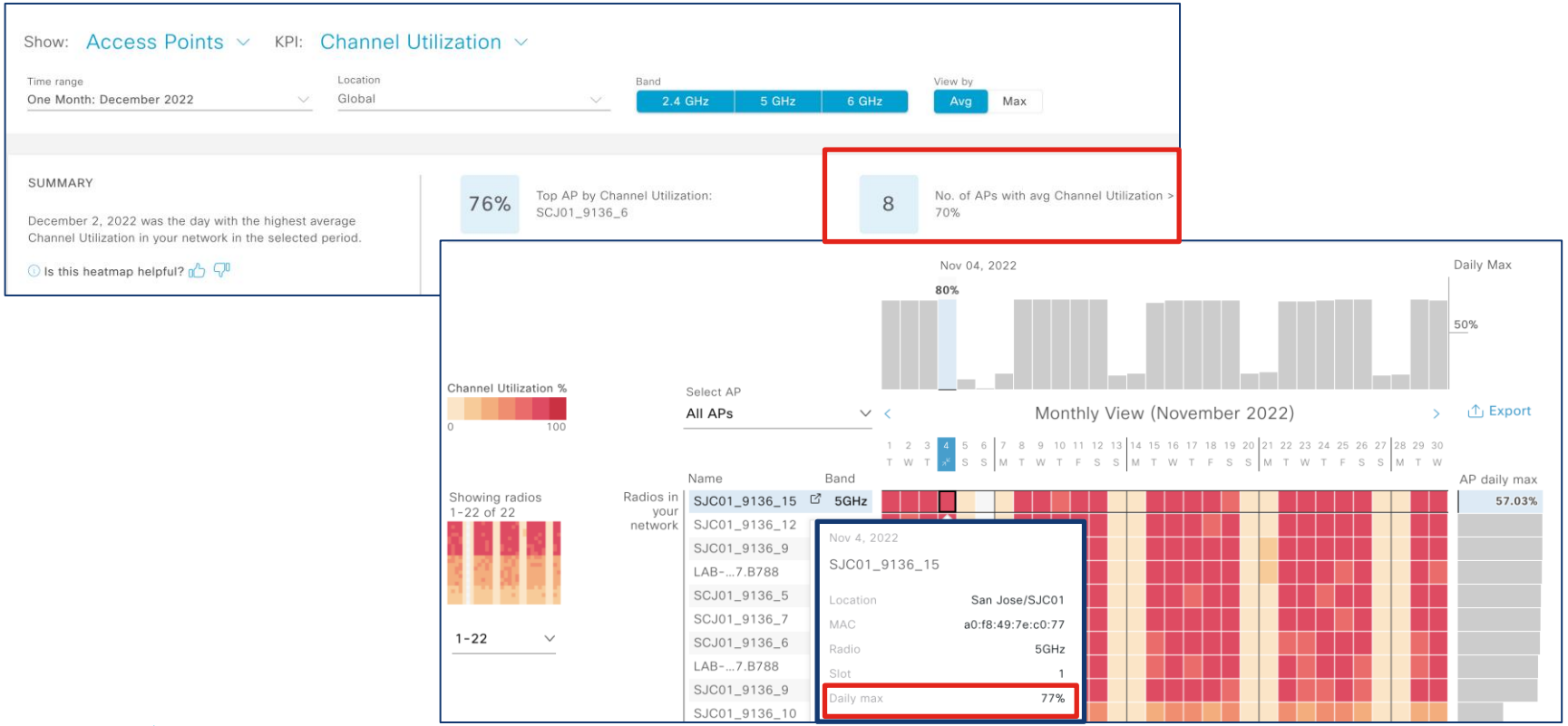
Wi-Fi Network Design



Start with Use Cases



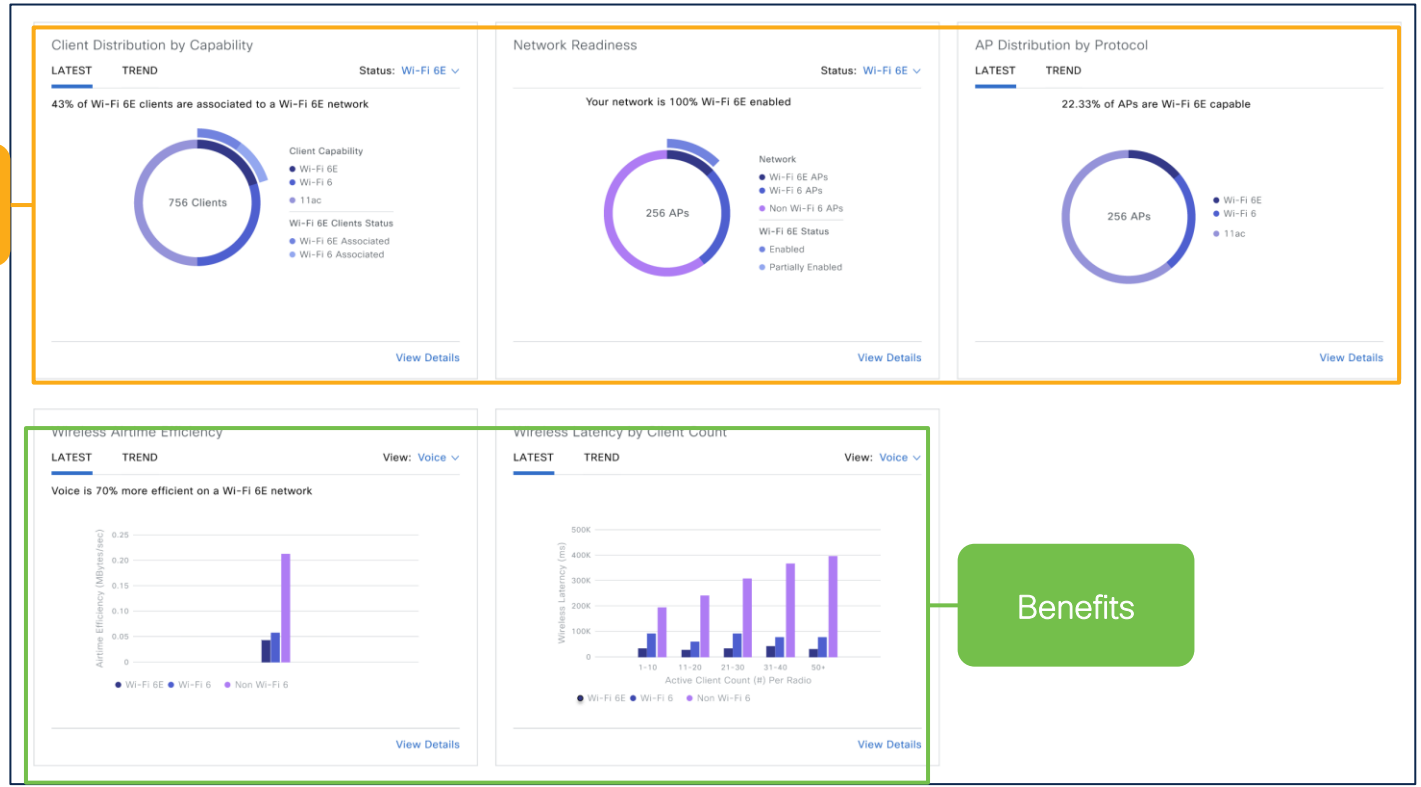
Observe Channel Utilization in your Network



Observe the Client Types in your Network

Readiness and benefits of 6 GHz from Cisco DNAC 2.3.2

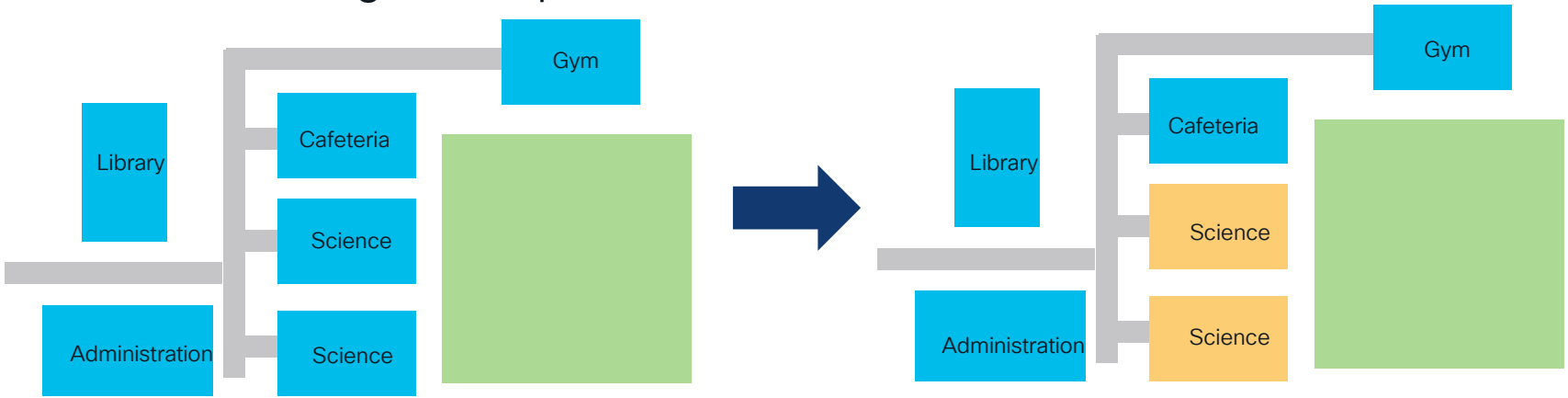
Readiness



Benefits

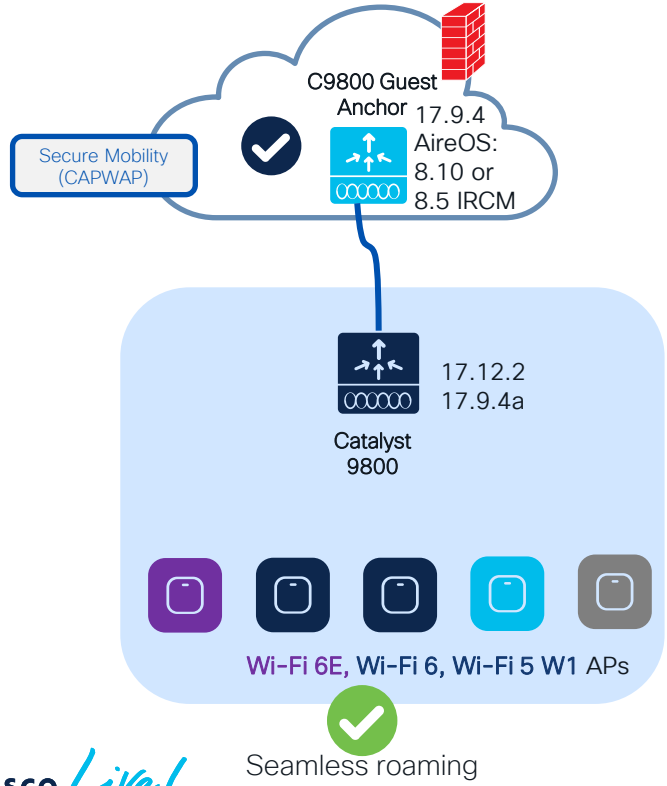
Migration Scenarios

- 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 same time.

How do I start adopting 6GHz?



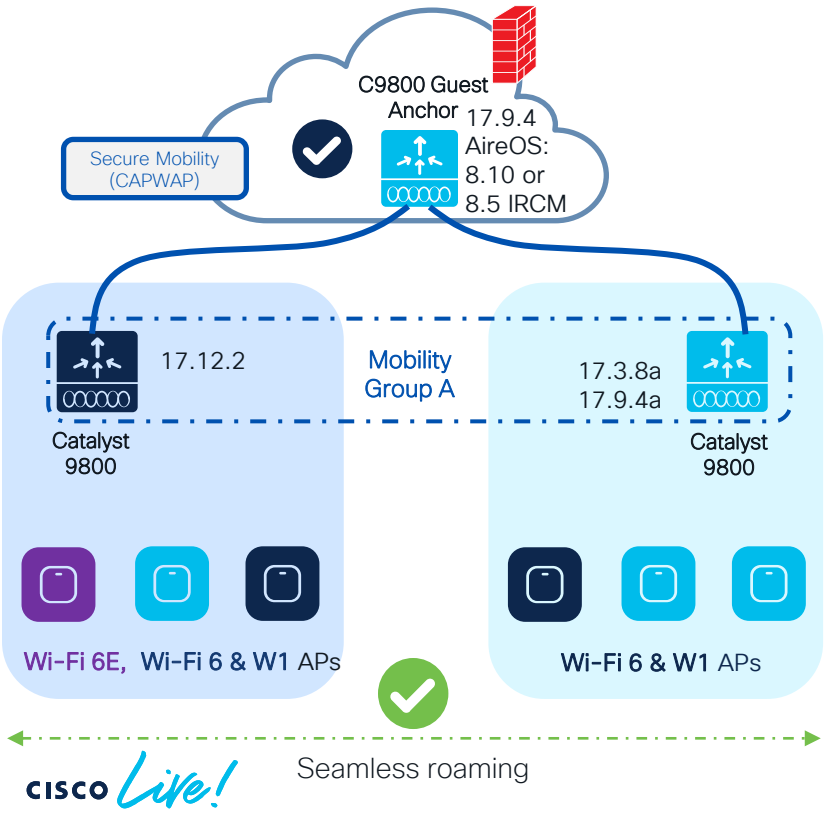
Scenario 1: If you have already started your C9800 journey

- Controller code is 17.12.2
- Wave 1 Aps support added (1700/2700/3700).
- Note: Anchor can be on AireOS as well (8.10 or 8.5 IRCM latest
- Note: 17.12.1 for APJ Countries

(*) 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)



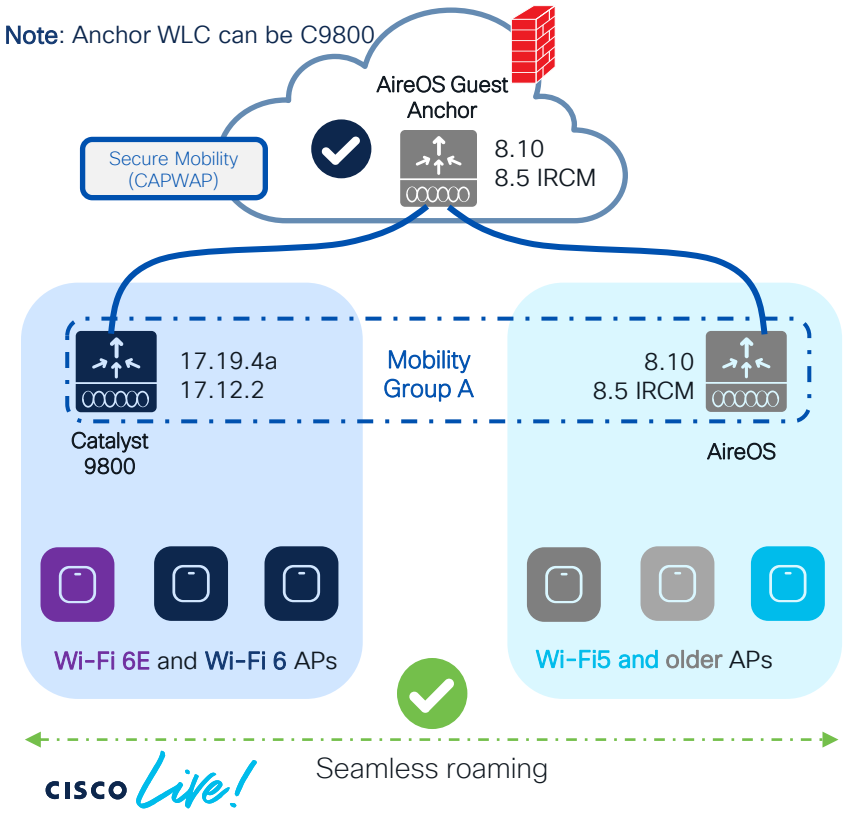
Scenario 2: If you're in IOS-XE 17.3.x, 17.6.x, 17.9.x code

- If you have already started your C9800 journey… & need to introduce CW9166D1
- 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)



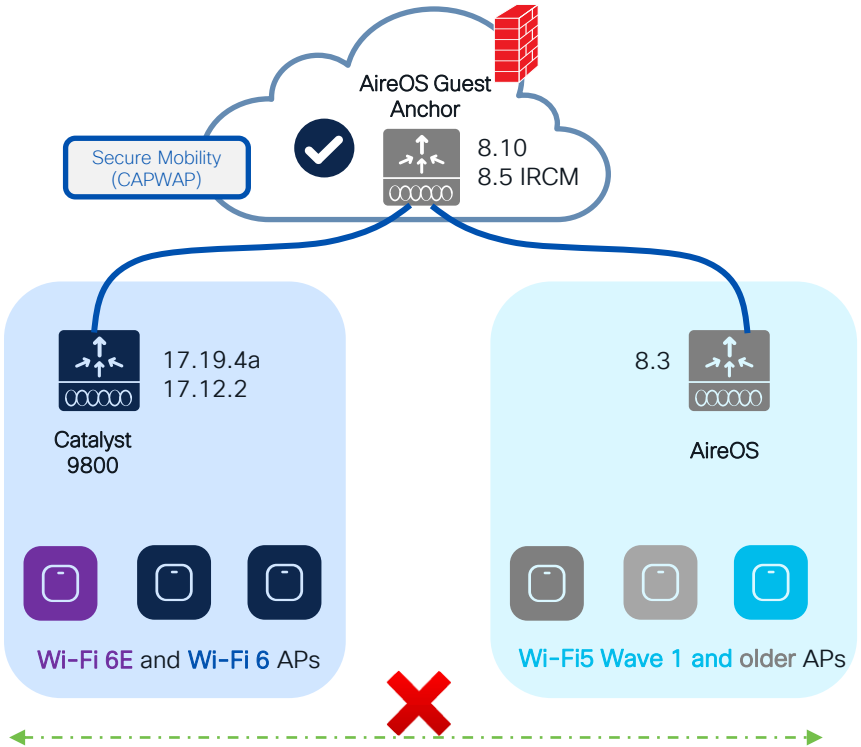
Scenario 1: Legacy Controller Supports IRCM

- 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: 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 is here, are you ready?

Wi-Fi 6E is here, 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


cisco
The bridge to possible
Thank you
cisco Live!


cisco Live!
Let's go