

# Wi-Fi 6E: benefícios, status da tecnologia e considerações de design e implementação



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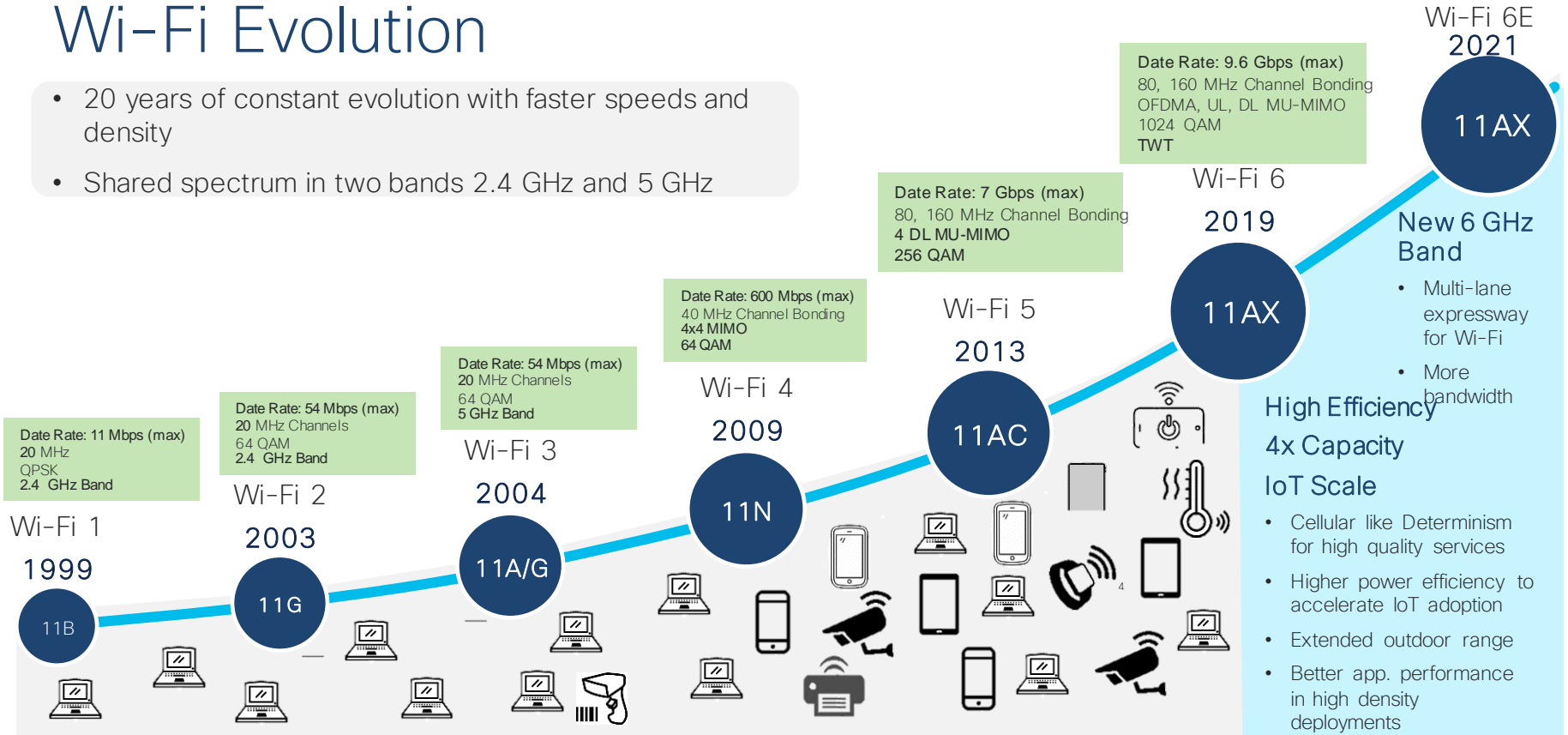
# Agenda



- Evolução do Wi-Fi e do Wi-Fi6
- Status do Wi-Fi6E
- Produtos disponíveis
- Considerações de design
- 6 GHz AP Discovery
- Security in Wi-Fi 6E World
- Client Ecosystem
- DNA Center Wi-Fi6E Integration

# Wi-Fi Evolution

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



# Experience: Wi-Fi 6 (802.11ax)

## What is the big deal?



### Higher data rates

- 1024-QAM for up to 9.6 Gbps per radio and single-antenna speeds of 1.2 Gbps
- 8x8:8SS
- Enables next-generation 4K/8K and AR/VR video



### Increase in overall network capacity

- 3x to 4x more throughput than 802.11ac via OFDMA
- Up to 4x capacity gain in dense scenarios with BSS coloring
- Multiuser MIMO gains on all client types



### Reduced latency and greater reliability

- Scheduled uplink and downlink OFDMA for deterministic “cellular-like” latency, reliability, and QoS
- Optimized for IoT scale with hundreds of devices per AP



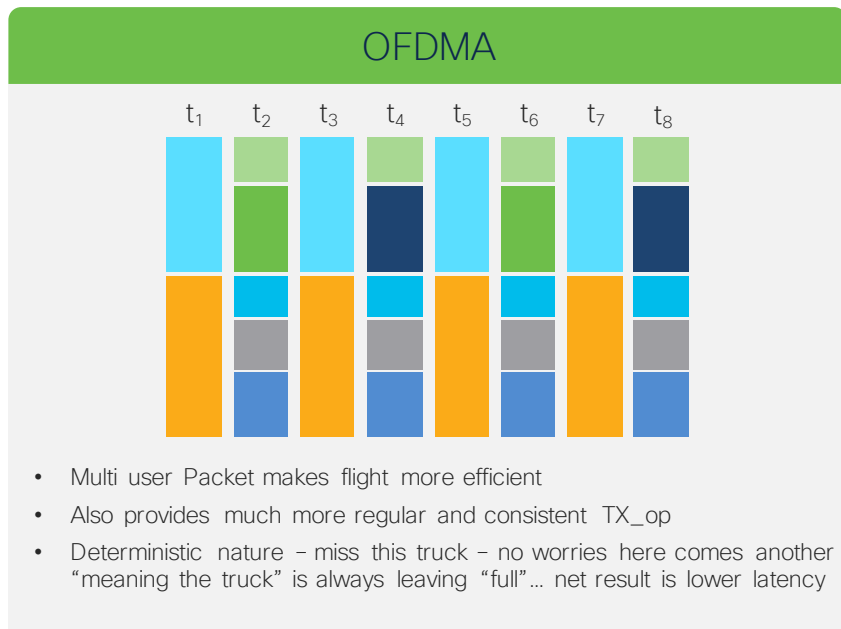
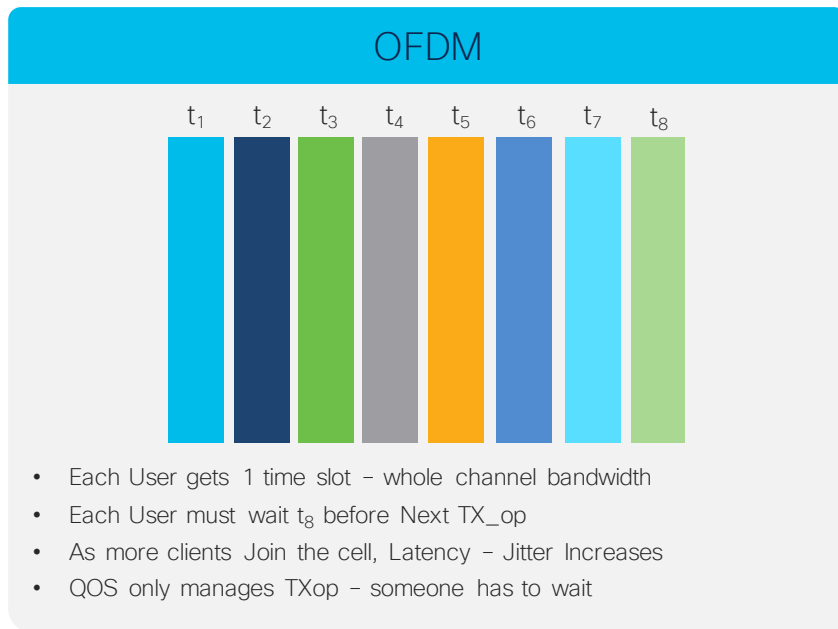
### Improved power efficiency

- Up to 3x better battery life with Target Wake Time (TWT)
- New coding structure and signaling procedures for better transmit and receive efficiency

For more information, see: <https://www.cisco.com/c/en/us/products/collateral/wireless/white-paper-c11-740788.html>

# OFDMA – Using subcarriers more efficiently

## Maximizing client count – lowering latency



■ User 1 - Telemetry ■ User 2 - Voip ■ User 3 - Video ■ User 4 - Voip ■ User 5 - Data ■ User 6 - IoT ■ User 7 - Data ■ User 8 - Voip

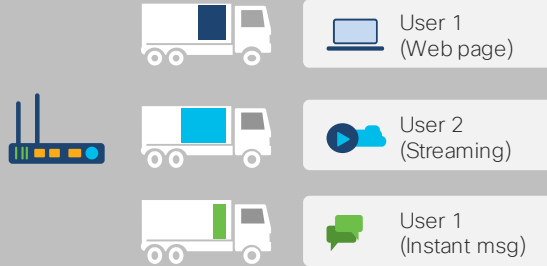
Each subcarrier is a transport – Latency goes up when subcarriers go out “half empty”...  
OFDMA solves this by allowing **multi-user packets to go out on one subcarrier**

# Device only improvements vs whole cell/network: OFDM vs. OFDMA and sub-carriers

## Introduction of OFDMA

Orthogonal Frequency-Division Multiple Access

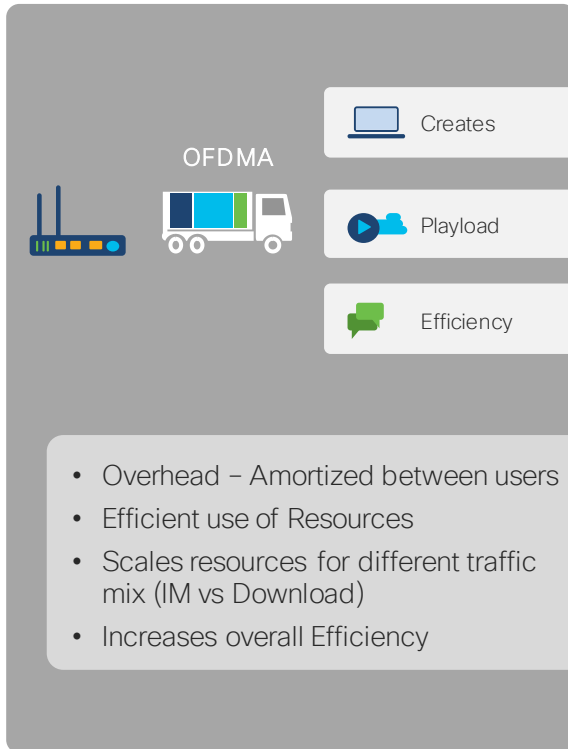
### OFDM



- Fixed overhead – Independent of payload size
- Uses full channel bandwidth – Per user

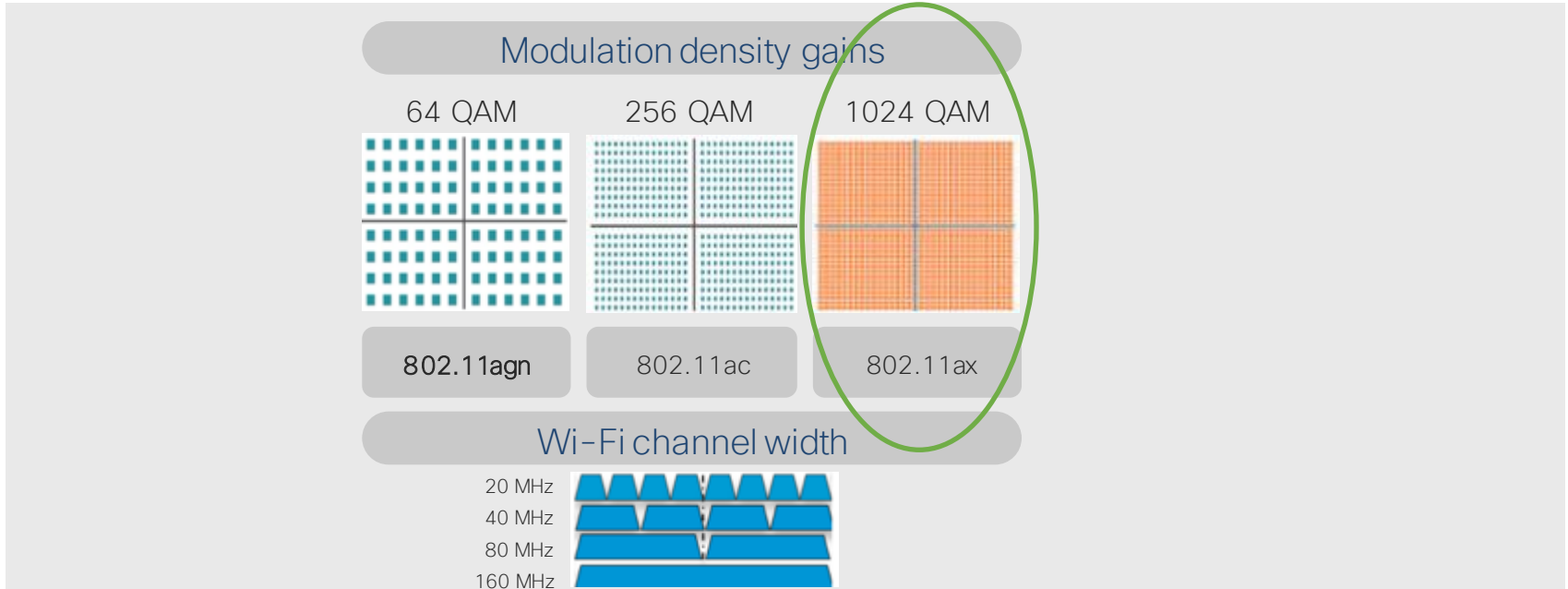


# Device only improvements vs Whole cell/network: OFDM vs. OFDMA and sub-carriers



# 802.11ax is all about high efficiency wireless

These improvements are Wi-Fi 6 enhancements to make every microsecond “On THE AIR” matter.



Note: Channel Bonding reduces range as the power is spread out with each additional 20 MHz adding a 3 dB penalty in SNR and the greater the QAM the harder it is for the receiver to decode therefore it is more sensitive to noise.

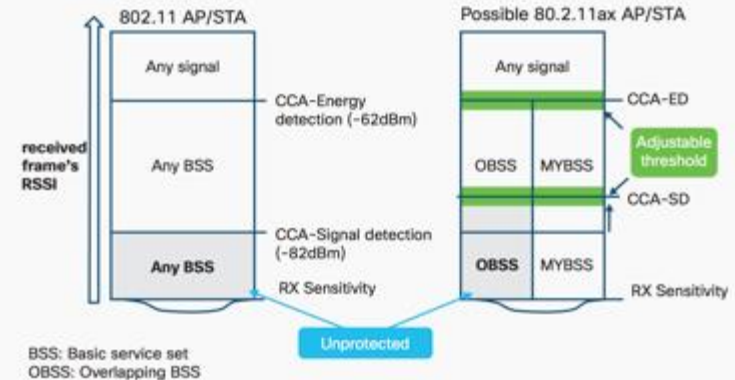
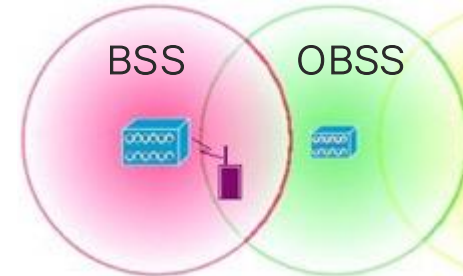


# BSS Coloring – Spatial reuse and addressing interference

## Basic service set “BSS” and overlapping basic service set “OBSS”

- BSS Color – All devices within a BSS send the same value (color), which will be different than other nearby BSSs (or OBSSs)
  - Each BSS (AP) uses a different “color” (6 bits in the preamble)
  - Each user (station) learns its BSS color upon association, allowing it to identify other BSS’s as OBSS
  - Stations detecting the same BSS color (intra-BSS) use a lower RSSI threshold for deferral which reduces Intra BSS collisions
  - Stations detecting a different BSS color (Inter-BSS) use a higher RSSI threshold, which allows more simultaneous transmissions
- OBSS Packet detection is dynamic and managed by the AP
- If a station reduces its TX power, the device **can** raise its **inter**-BSS CCA thresholds and transmit
  - TX Power reduction is based on sounding packets
  - Effectively RF locating the client within the cell
  - The closer the client is to the AP, THE LOWER it’s transmitted power can be

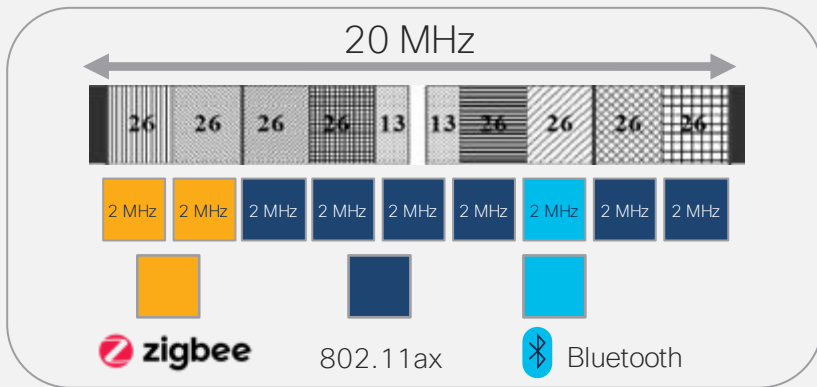
Benefit - Overcomes the problem of Clear channel assessment limitations



# 802.11ax RU and target wake time benefits for IoT

## Better battery life and co-existence via RF efficiency improvements

- 802.11ax RUs and TWT available in 2.4/5G GHz for IoT
- Thanks to 2 MHz channels, Coexistence with other 2.4 GHz IOT technologies is much more effective
- Any channel can be left blank (no 802.11ax) to allow other technologies to operate



### Target wake time



Target Wake Time (TWT) provides an effective mechanism to schedule transmissions in time.

Phones and IoT devices can sleep conserving battery life and then wake to take advantage of multi-user transmissions, and coexist in high-density RF environments with ease.

# Wi-Fi 6 - Enhancements



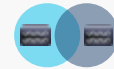
For your reference

**Uplink and Downlink Orthogonal Frequency Division Multiple Access (OFDMA):** Increases network efficiency and lowers latency for high demand environments



Packet latency improvements

**Multi-User Multiple Input Multiple Output (MU-MIMO):** allows more data to be transferred at once and enables an access point to transmit to a larger number of concurrent clients at once



Channel Reuse With BSS Color

**Parallel processing:** enables greater capacity by allowing MU-MIMO and OFDMA to function in UPLINK and DOWNLINK mode



Parallel transmissions

**1024 Quadrature Amplitude Modulation Mode (1024-QAM):** increases throughput in Wi-Fi devices by encoding more data in the same amount of spectrum



Faster Speed more Radios and 1024 QAM

**Target Wake Time (TWT):** significantly improves battery life in Wi-Fi devices, such as Internet of Things (IoT) devices

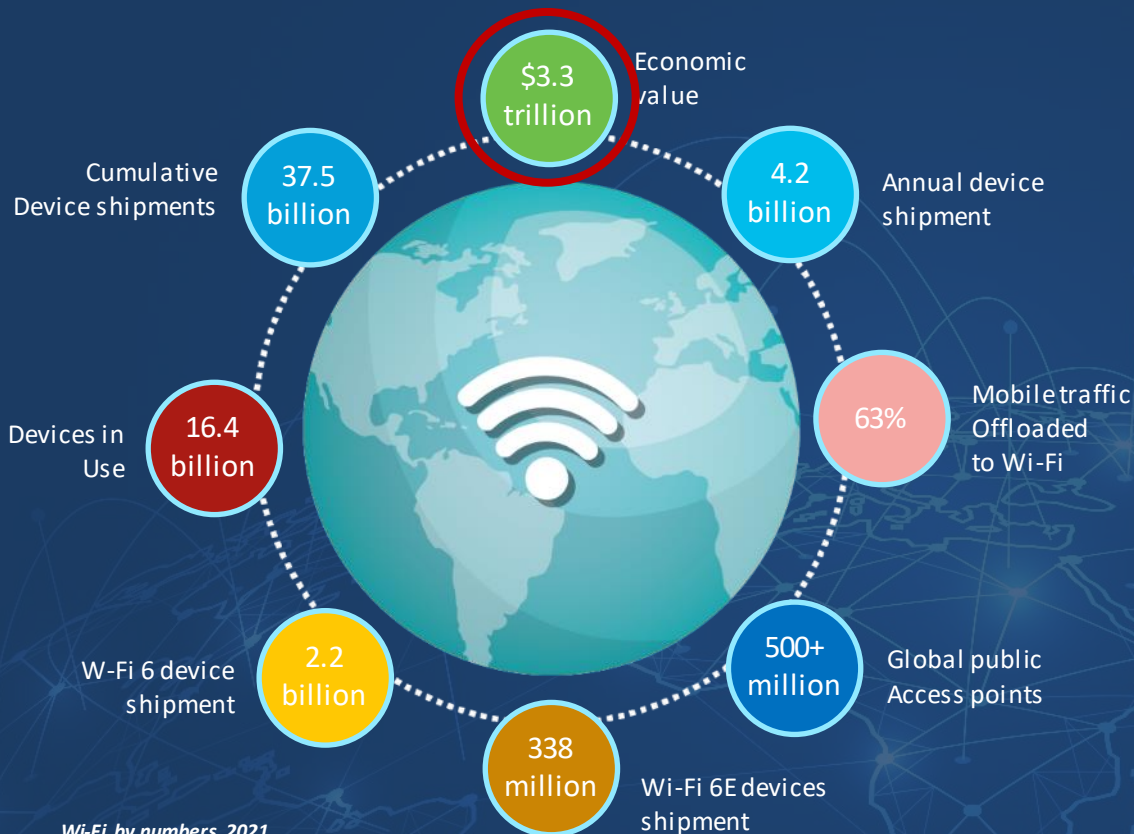


Better Battery Life



# Wi-Fi 6E – O renascimento do Wi-Fi

# Global Economic Value of Wi-Fi



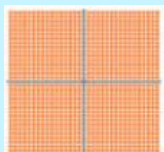
- The world runs on Wi-Fi
- Wi-Fi has proven to be a key driver of digital innovation
- Wi-Fi is foundational to consumer, enterprise networks, as well as the Internet of Things (IoT).
- Wi-Fi is also recognized as an essential part of delivering 5G service
- And in this pandemic, Wi-Fi has been critical in building social and economic resilience

# Wi-Fi 6E

Wi-Fi 6 and 6GHz are friends

802.11ax

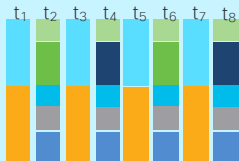
1024 QAM



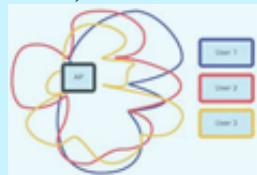
BSS Coloring



OFDMA



DL, UL MU-MIMO



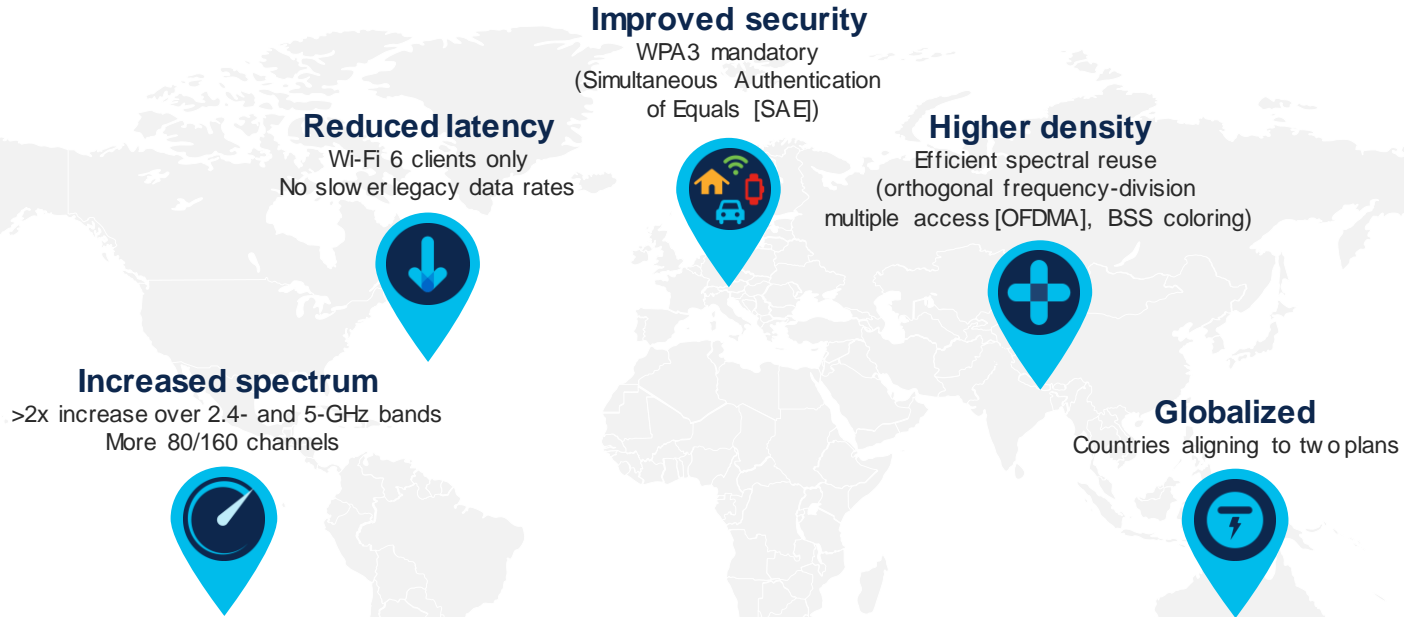
TWT



## Additional Spectrum

- 1200MHz (5.925 GHz to 7.125 GHz) in US
- 500 MHz (5.925 GHz to 6.425 GHz) in Europe
- Wider Channels
- Clean RF
- No Slow Devices
- Security Upgrade
- 6 GHz WLAN Discovery

# Wi-Fi 6E: Enabling new mobile experiences today



Extended spectrum | Realized capacity | Improved experience



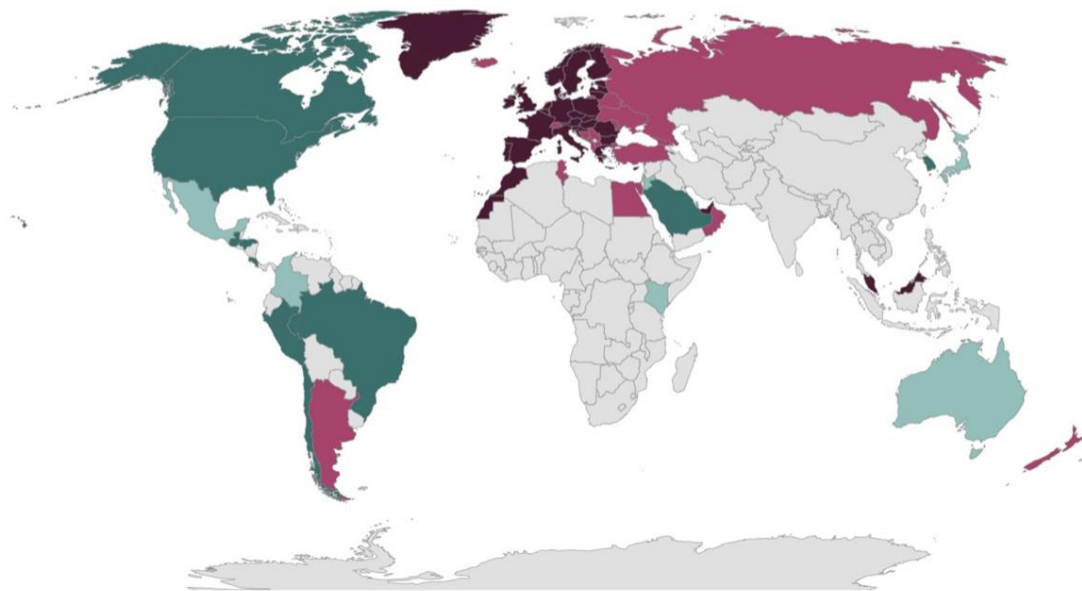
# Countries Enabling Wi-Fi6E in LATAM

Adopted 5925-6425 MHz

Adopted 5925-7125 MHz

Considering 5925-6425 MHz

Considering 5925-7125 MHz



Country	Status	Spectrum
Argentina	Considering	5925-6425 MHz
Brazil	Adopted	5925-7125 MHz
Chile	Adopted	5925-7125 MHz
Colombia	Considering	5925-7125 MHz
Costa Rica	Adopted	5925-7125 MHz
Guatemala	Adopted	5925-7125 MHz
Honduras	Adopted	5925-7125 MHz
Mexico	Considering	5925-7125 MHz
Peru	Adopted	5925-7125 MHz

Country

Status

Spectrum

<https://www.wi-fi.org/countries-enabling-wi-fi-6e>



## Process 53500.027376/2020-49

### Board Decision at 25th February 2021

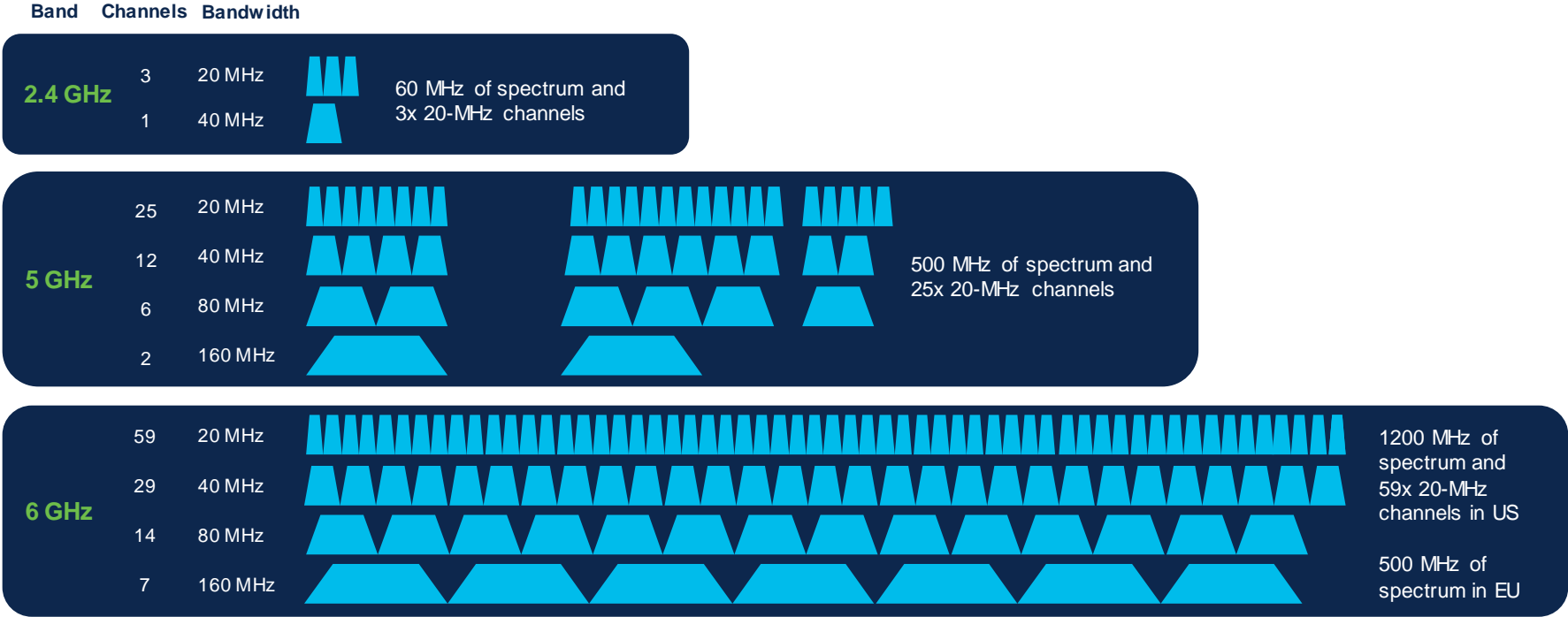
- Approved the Act nr. 1,306, of 26th Feb 2021, updating Act nr.14,448 with technical and operational characteristics of Wireless Access System (WAS, including RLAN) operating in the band 5,925 – 7,125 MHz.
- This Act entered into force in 1st of March 2021, with its publication in Anatel's Service Bulletin.

**Now, anyone can submit an Wi-Fi6E product for certification**

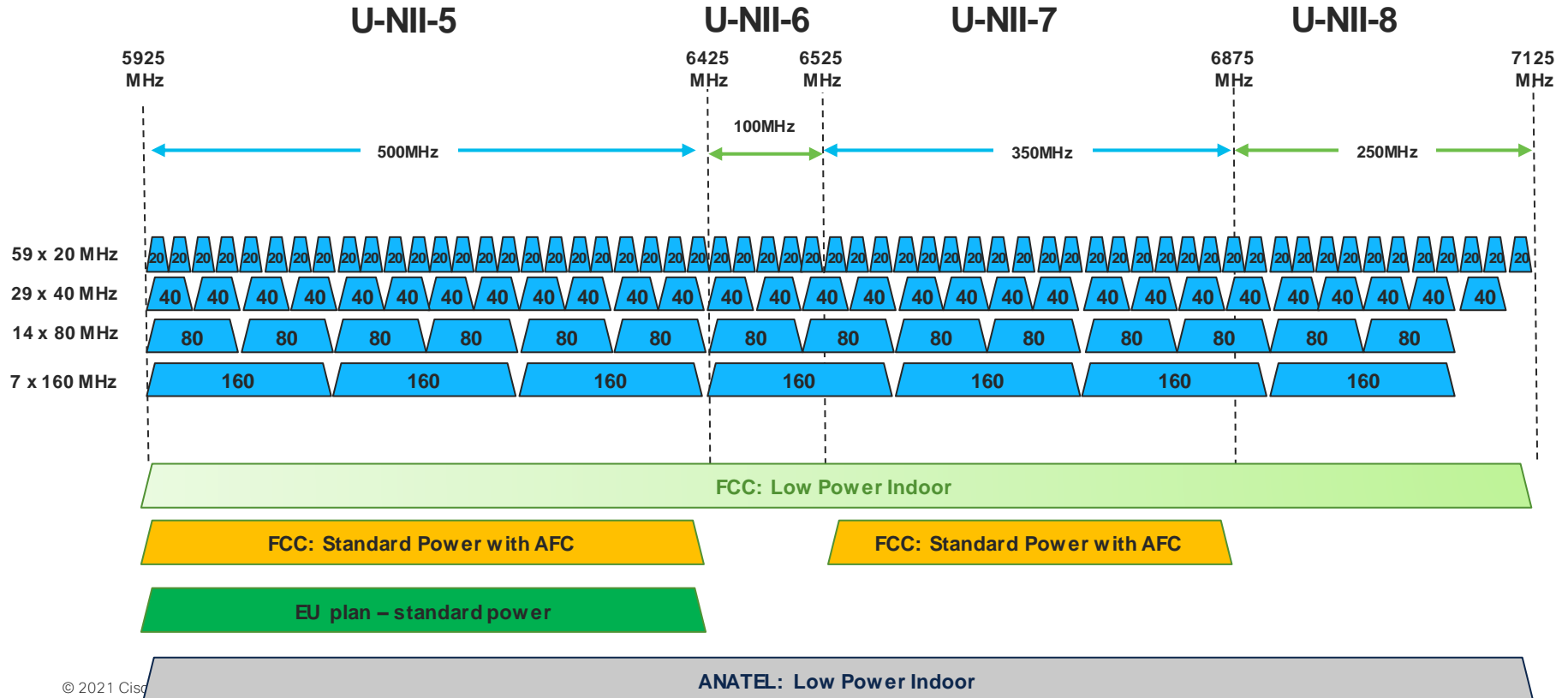
TCB ~ 1 week + Anatel ~ 1 week

**In 2 weeks it's possible to have the certification process completed in Brazil**

# 6 GHz is the biggest Wi-Fi spectrum expansion ever







# 6 GHz Spectrum Availability



# 6 GHz – New Device Classes

- Wi-Fi 6E introduces new device classes for optimized capability
- Regulations vary by country

 <p>Low Power Indoor AP</p>	 <p>Standard Power AP</p>	 <p>Very Lower Power AP</p>	 <p>Client Devices</p>
<ul style="list-style-type: none"><li>• Indoor Only</li><li>• Integrated Antenna Required</li><li>• Can use the full 1200 MHz</li><li>• Wired Power</li></ul>	<ul style="list-style-type: none"><li>• Indoor or Outdoor</li><li>• Integrated or External Antenna</li><li>• UNII-5 and UNII-7 Only (US)</li><li>• Requires AFC</li></ul>	<ul style="list-style-type: none"><li>• Mobile Indoor or Outdoor</li><li>• Limited Range</li><li>• UNII-5 and UNII-7 Only (US)</li><li>• Does not require AFC</li></ul>	<ul style="list-style-type: none"><li>• Indoor or Outdoor</li><li>• Only Indoor under control of LPI AP</li><li>• 6 dBm lower power than AP</li></ul>

# .11ax Data-rate Chart for 1 Spatial Stream

Complex Modulation, Guard Interval and channel bonding is key to single radio performance.

Modulation and coding schemes for single spatial stream

MCS index <sup>[a]</sup>	Modulation type	Coding rate	Data rate (in Mb/s) <sup>[b]</sup>							
			20 MHz channels		40 MHz channels		80 MHz channels		160 MHz channels	
			1600 ns GI <sup>[c]</sup>	800 ns GI	1600 ns GI	800 ns GI	1600 ns GI	800 ns GI	1600 ns GI	800 ns GI
0	BPSK	1/2	4(?)	8.6	8(?)	17.2	17(?)	36	34(?)	36(?)
1	QPSK	1/2	16	17	33	34	68	72	136	144
2	QPSK	3/4	24	26	49	52	102	108	204	216
3	16-QAM	1/2	33	34	65	69	136	144	272	282
4	16-QAM	3/4	49	52	98	103	204	216	408	432
5	64-QAM	2/3	65	69	130	138	272	288	544	576
6	64-QAM	3/4	73	77	146	155	306	324	613	649
7	64-QAM	5/6	81	86	163	172	340	360	681	721
8	256-QAM	3/4	98	103	195	207	408	432	817	865
9	256-QAM	5/6	108	115	217	229	453	480	907	961
10	1024-QAM	3/4	122	129	244	258	510	540	1021	1081
11	1024-QAM	5/6	135	143	271	287	567	600	1134	1201



**Up to 1.2Gb with 1 radio, up to 11 Gb\* with 8 radios @ 160 MHz**

**\*Devices were presented at CES 2018 with a top speed of 11Gbit/s**

Source [https://en.wikipedia.org/wiki/IEEE\\_802.11ax](https://en.wikipedia.org/wiki/IEEE_802.11ax)

# Cisco Meraki and Cisco DNA

Select based on architecture requirement

Simple and streamlined  
Full Stack Cloud Management



Meraki MS Switches



Meraki MR APs



Meraki MX Appliances



Meraki Camera



LTE WAN



Endpoint Management

Flexible and full-featured  
On Prem Management

Cisco DNA

Catalyst 



 viptela



Catalyst 9k  
switching



Catalyst 9k  
Wireless



SD-WAN and  
branch routers

# Leading the industry with Wi-Fi innovations

For every major change in WLAN over the last 20+ years

Autonomous access



1999

Cisco CleanAir®:  
Interference detection  
and mitigation



2011

Application  
Visibility  
and Control



2014

Flexible Radio  
Assignment (FRA)  
(dual 5 GHz)



2016

Intelligent Capture  
and real-time  
telemetry



2018

Software  
Defined  
Antenna



2019

2021



Controller and  
coordinated  
access points



Connected  
Mobile  
Experiences



Hyperlocation



Software-Defined  
Access



Cisco RF ASIC



First 8x8  
WiFi6E  
AP

Cisco® next-generation wireless stack

802.11b/g

Aironet®  
3500 Series



802.11n

Aironet  
3600 Series



802.11ac Wave 1

Aironet  
3700 Series



802.11ac Wave 2

Aironet  
3800 Series



Aironet  
4800  
Series



802.11ax (Wi-Fi 6)

Catalyst®  
9100



# MR57 in detail

The flagship Meraki 6E access point



## Feature highlights:

Wi-Fi 6E tri band, 4x4; 2.4/5/6 GHz

- Seven times more 80 MHz channels (14) vs 5 GHz(2)
- Up to 6 Gbps of combined throughput (tri-band)

Dual 5 GHz support for high density

Expanded IoT support with Bluetooth® Low Energy and USB port

Dual PoE 5 Gbps ports for high availability

Simple deployment with Cisco universal mount

NEW



Cisco universal mount support  
Use an existing Cisco universal mount to reduce deployment time

**Expand IoT use cases**  
Support for additional IoT use cases with Bluetooth® Low Energy and USB

Dual PoE provides redundancy for zero down time use cases




# Enhanced Catalyst Wi-Fi 6/6E Product Line

Purpose-built for Immersive Experiences


## Catalyst 9136 Series

Industry-leading Wi-Fi 6E AP, with hexa-radio architecture and concurrent tri-radio with 16SS for client serving

 Powered by Cisco's AI/ML-Driven Scanning Radio


## Catalyst 9130 Series

Industry-leading Wi-Fi 6 AP with 8x8, tri-radio architecture

 Powered by Cisco RFASIC


## Catalyst 9124 Series

Delivering best-in-class connectivity in outdoor and challenging environments

 Powered by Cisco RFASIC

## Catalyst 9120 Series

For mission-critical deployments using dual 5 GHz and integrated IoT radio

 Powered by Cisco RFASIC

## Catalyst 9115 Series

For small to medium-sized deployments with dual radios

## Catalyst 9105 Series

Perfect for teleworkers, and smaller branch sites



# Cisco Catalyst 9136 Series access point

## 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

- 2 x 5 Multigigabit (mGig) PoE Ports
- 802.3 Link Aggregation > up to 10 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 DNA Spaces

# Best mobile user experience for high-density networks

Higher throughput in a dense environment

## Cisco Wi-Fi 5 Dual 5GHz Innovation

Some radios are overloaded, while others underloaded  
→ Throughput uneven depending on the radio connected

## Improvements with Cisco Wi-Fi 6

Better workload distribution between the radios → Higher, more consistent throughput on connected devices



# Introducing CleanAir Pro\*

15 Years of Innovations and Excellence Carried Forward



## CleanAir

RF-ASIC Based

Excellence

Purpose built for 2.4 and 5 GHz  
Wireless



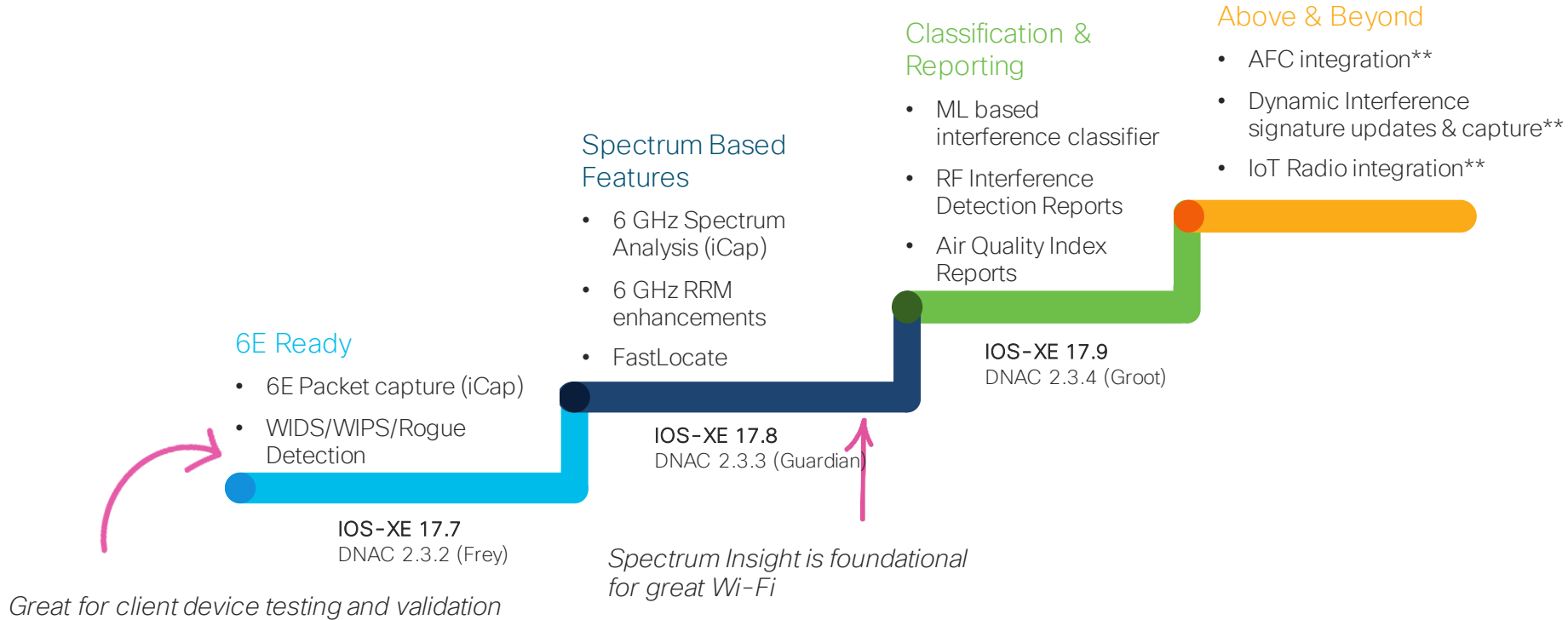
## CleanAir

Pro  
Evolving Wi-Fi Excellence into 6 GHz

- Full 2.4, 5, 6 GHz Band Support
- Multi-Radio Architecture
- AI/ML-Driven Scanning Radio Decoding HE frames
- ML Based Interferer Classification, On-AP

# Cisco CleanAir Pro\*

## Evolving Wi-Fi Excellence into 6 GHz



# Catalyst 9136I has Three-Built in Environmental Sensors with Full DNA Spaces Integration



## Air Quality

The built-in Gas Sensor Module will enable the reading of TVOC concentration, IAQ rating, and CO2 levels.



## Humidity

The built-in module is a fully calibrated sensor with the ability to measure the 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 AQI reading

# IoT Enhanced Hybrid Work Experience

## C9136I Integrates with DNA Spaces for Back-to-Office Use Cases

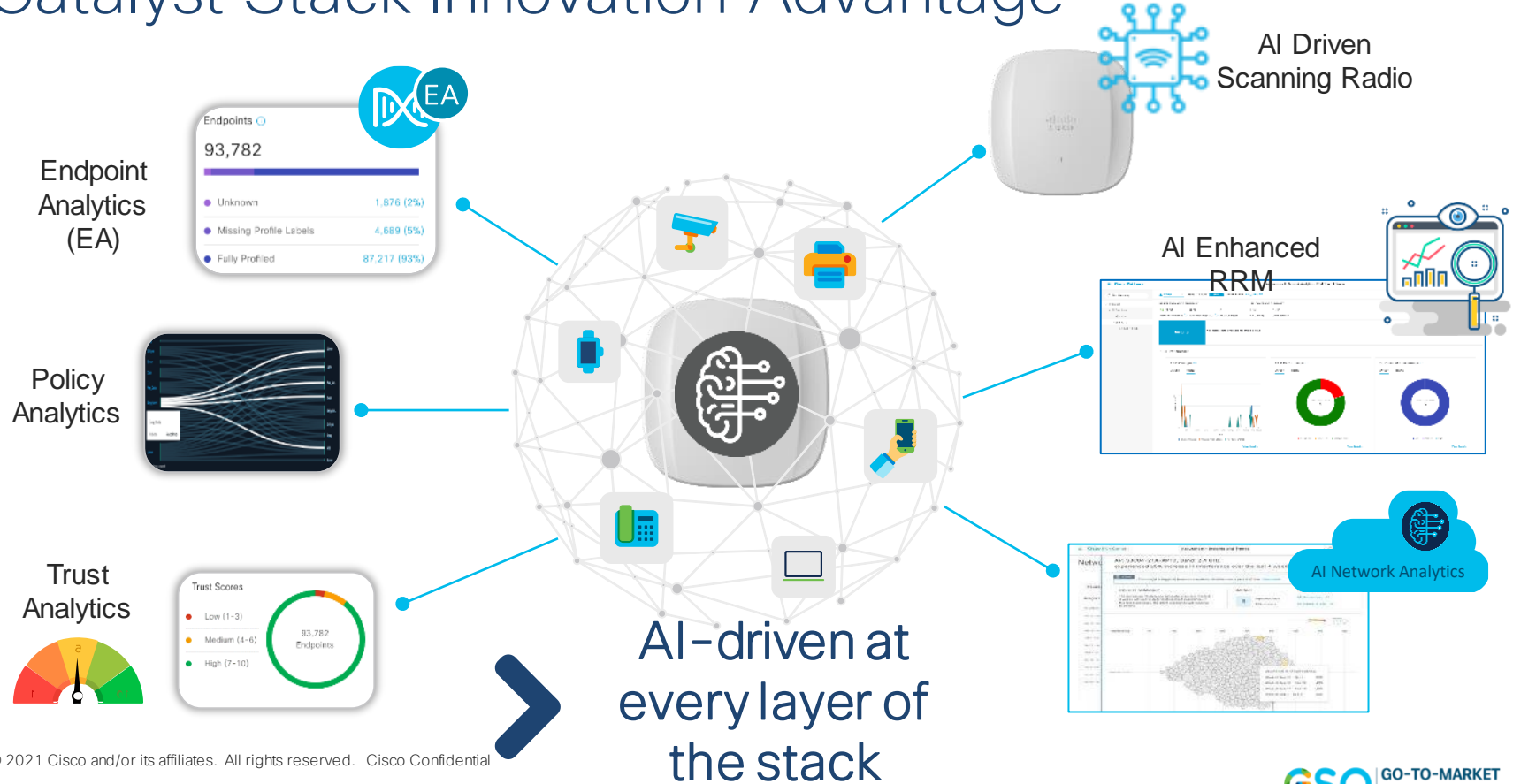


DNA Spaces will support Rich Maps for an Immersive Experience

Network Experience and BLE IoT Integration to Drive Business Outcomes

C9136I has built-in environmental sensors that feeds DNA Spaces Data

# Catalyst Stack Innovation Advantage

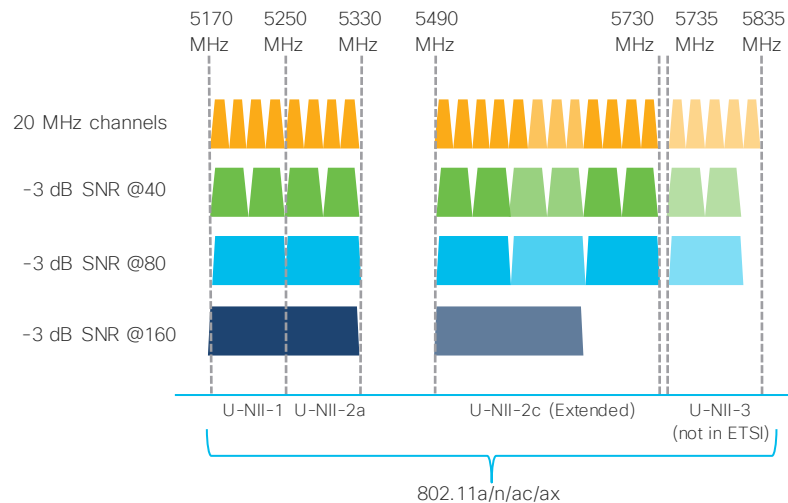




# *Deploying and migrating to Wi-Fi 6 and 6E*

# Bonded Channels and Noise 5 GHz vs 6 GHz

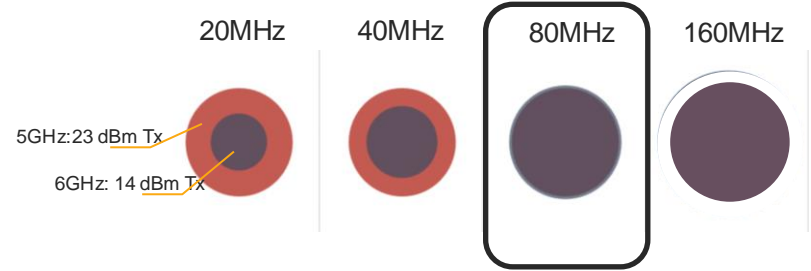
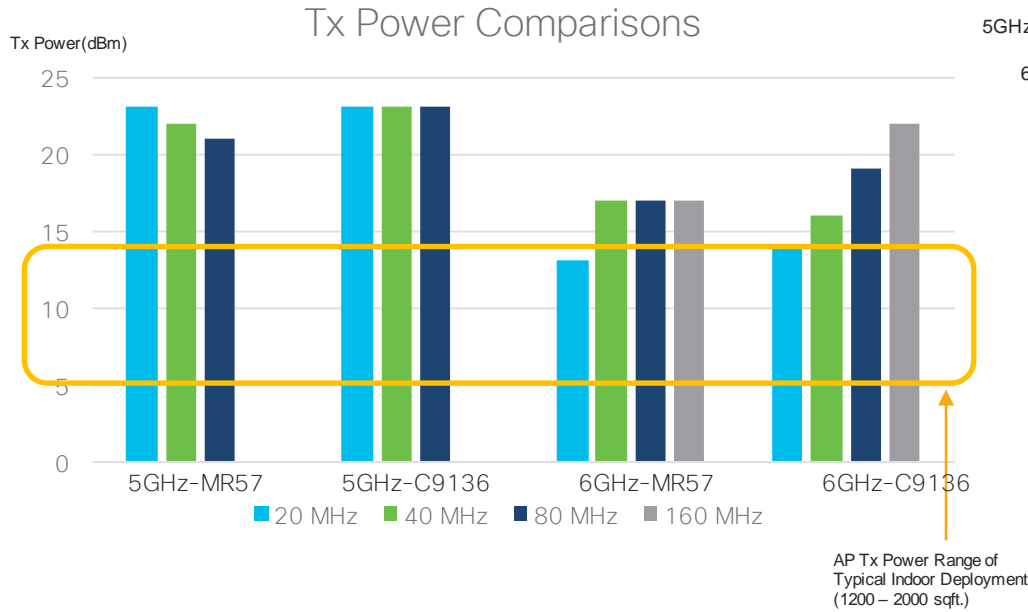
- A wider channel creates more noise
- Increased noise – decreases SNR
- In 5 GHz, every doubling of a channel width takes a corresponding 3 dB hit in SNR,
- A 3 dB reduction in SNR is equivalent to a 3 dB decrease in the RSSI performance wise
- Wi-Fi 6 E power rules in PSD of 5 dBm/MHz increases the EIRP as the channel gets wider
- This off-sets the corresponding SNR loss
- Comparing Effective EIRP – 6 GHz favors wider channels



	Effective EIRP Improves as needed			
	20 MHz	40 MHz	80 MHz	160 MHz
5 GHz, U-NII-1	23 dBm	20 dBm	17 dBm	14 dBm
6 GHz, U-NII-5	18 dBm	21 dBm	24 dBm	27 dBm

# 5GHz vs. 6GHz Coverage Planning

Wider is Better!  
No SNR Penalty for wider channels



- Tx Power difference between 5GHz and 6GHz LPI are getting narrower by increasing Channel Width
- In 6 GHz, 80 MHz is the sweet spot from both coverage as well as throughput point of view
- Worst case, 6GHz radio might requires 10 % additional APs is needed if every deployed AP uses maximum power. While in most of normal deployment, 110 to 185 sq meters. coverage per AP, 5GHz coverage will be comparable to 6GHz

# Wi-Fi6 with External Antenna for Outdoor and special indoor deployments. Wi-Fi6E is not an option today.



- Due to potential interference with incumbent in 6GHz frequency, it cannot be done without AFC.
- FCC & Wi-Fi Alliance is working on AFC Test Plan
- Continue to propose and use Wi-Fi 6 Outdoor/Connectorized Product
- As always check your local regulatory body!

AFC still not available in LATAM.

# Wi-Fi6 Access Points Ethernet Speeds



9115 & 9120 **4x4**  
**Multigigabit 2.5**



9130 **8x8**  
**Multigigabit 5.0**

But do I really need more than  
1Gbps?

# Conclusion – Yes, you will need an mGIG Switch

It will be even more important in Wi-Fi6E and Wi-Fi7 due to wider channels

Wi-Fi6 tests:

**THROUGHPUT 1.537 Gbps**

**38% more Datagrams!**

**Datagrams Sent 11,927,836**

Wi-Fi 6 Performance with **mGIG Switch**

**THROUGHPUT 872.14 Mbps**

**Datagrams Sent 6,952,461**

Wi-Fi 6 Performance with **Gigabit Switch**

2.4 GHz @ 20 MHz w 3x2ss Intel AX200 / 5 GHz @ 80 MHz w 15x2ss Intel AX200



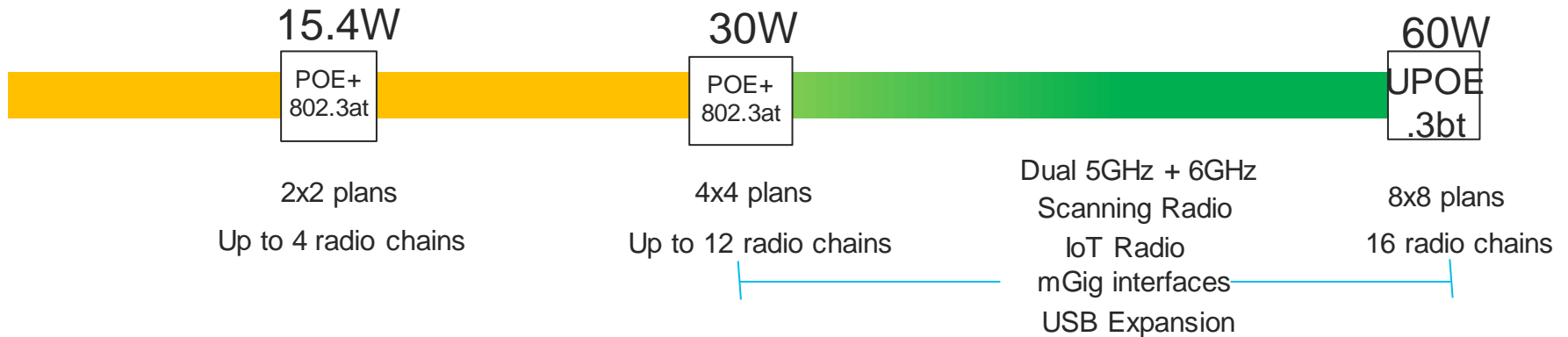
The bridge to possible

# Wi-Fi 6E Speed Test Demo



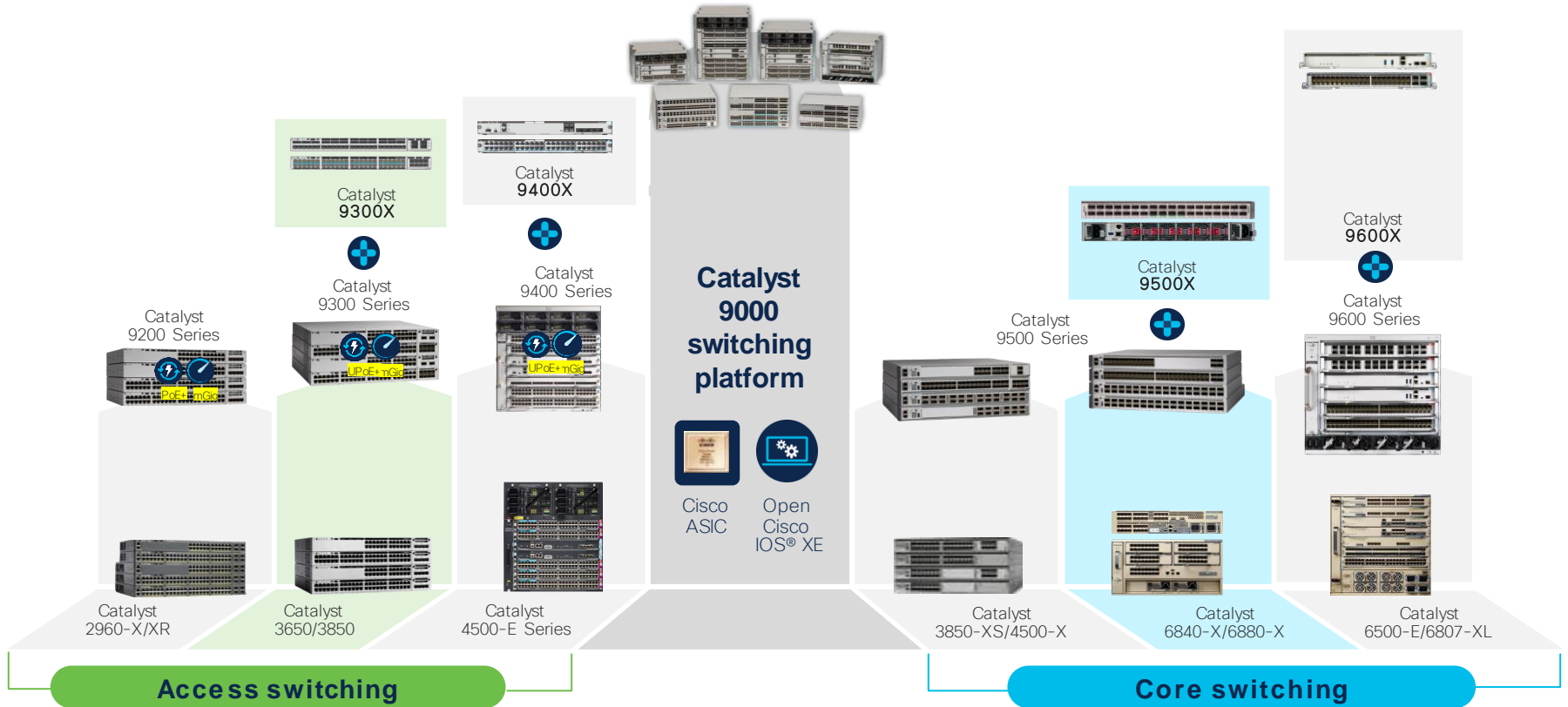
# How much power will it need?

- It will vary model by model but in general. Check model specific power table
- UPOE .3bt can get you ready for top WiFi6/6E and WiFi7
- POE+ .3at can get you most of the Wi-Fi6 and 6E capabilities

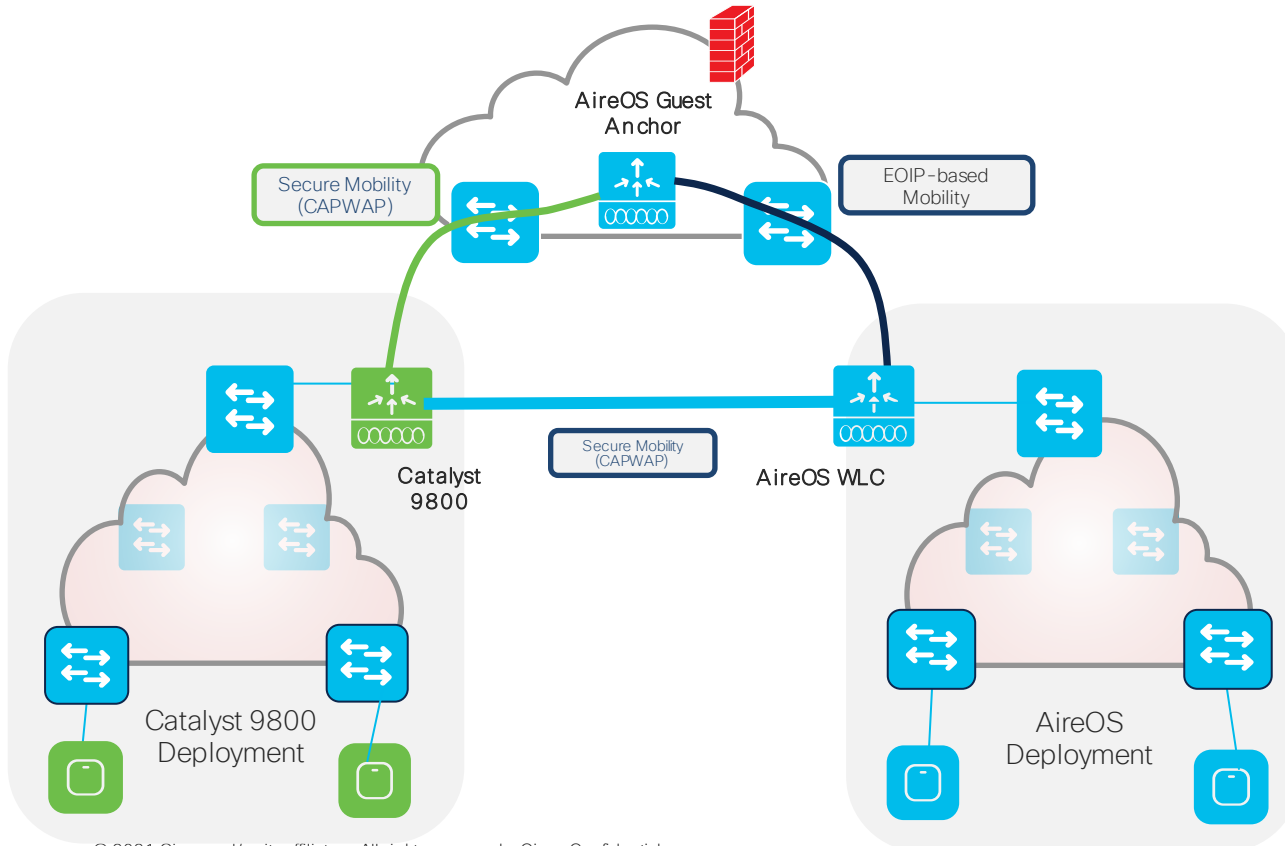




# Catalyst 9000 Switching Portfolio



# AireOS WLCs to C9800 WLCs Refresh



- Start a parallel 9800 Catalyst based cluster
- OPTIONAL: Build a Secure Mobility communication between them. If same are is covered or sharing same Guest Anchoring
- Add APP to 9800 or migrate APs to 9800 as required.

# Deploying and migrating to Wi-Fi 6E

## Summary of recommendations, tips, and tricks

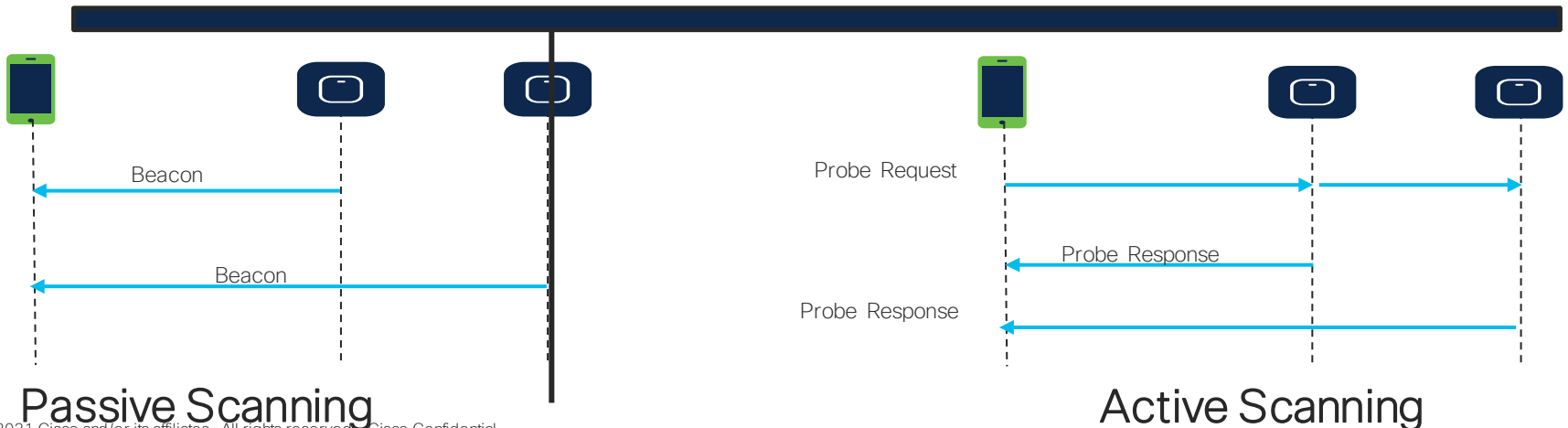
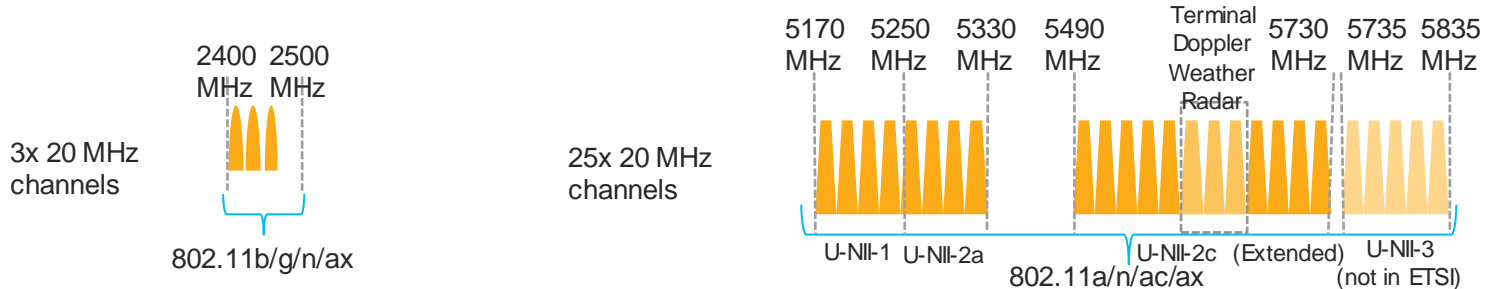
<p><b>Migrating to 6 GHz</b></p> <p><b>Top of mind:</b> For brownfield, 1:1 AP replacement. For greenfield, coverage area per AP is now 1500 to 2000 sq ft / 110 to 185 sq m.</p> <p>Legacy clients must still be considered. Shorter distance = Better data rate</p>	<p><b>Power considerations</b></p> <p><b>Recommendation:</b> 802.3bt (Cisco UPOE®) is the suggested power input.</p> <p>802.3at (PoE+) and 802.3af (PoE) are also supported by the Catalyst and Meraki Wi-Fi6E APs.</p>	<p><b>Security requirements</b></p> <p><b>Mandatory:</b> WPA3 is required for Wi-Fi 6E networks to be enabled.</p> <p>WPA3 was not required for prior Wi-Fi generations; hence, it must be top of mind.</p>	<p><b>Wireless coverage</b></p> <p><b>Recommendation:</b> Use Ekahau and iBwave to analyze 6-GHz AP coverage.</p> <p>The 9136 / MR57 are available on Ekahau; as well as a generic 6-GHz AP.</p>
<p><b>Spectrum considerations</b></p> <p><b>Note:</b> Wi-Fi 6Es wider spectrum enables 80/160-MHz channel widths to be viable.</p> <p>Increased spectrum provides better data rates with less co-channel interference.</p>	<p><b>Multigigabit switching</b></p> <p><b>Recommendation:</b> Use a Multigigabit switch with 2.5/5Gbps capability.</p> <p>Better user experiences with speeds beyond 1 Gbps on existing cabling</p>	<p><b>Cisco DNA Center migration</b></p> <p><b>Note:</b> Use AP refresh workflow to replace existing APs managed by Cisco DNA Center.</p> <p>Access point refresh workflow can be found on Cisco DNA Center's guide.</p>	<p><b>WLAN considerations</b></p> <p><b>Note:</b> 8 Wi-Fi 6E SSIDs per AP can be created in Cisco IOS XE Release 17.7.1. Will be raised to 16 SSIDs in a future release.</p> <p>This differs from the 16 SSIDs allowed for the 2.4- and 5-GHz bands.</p>



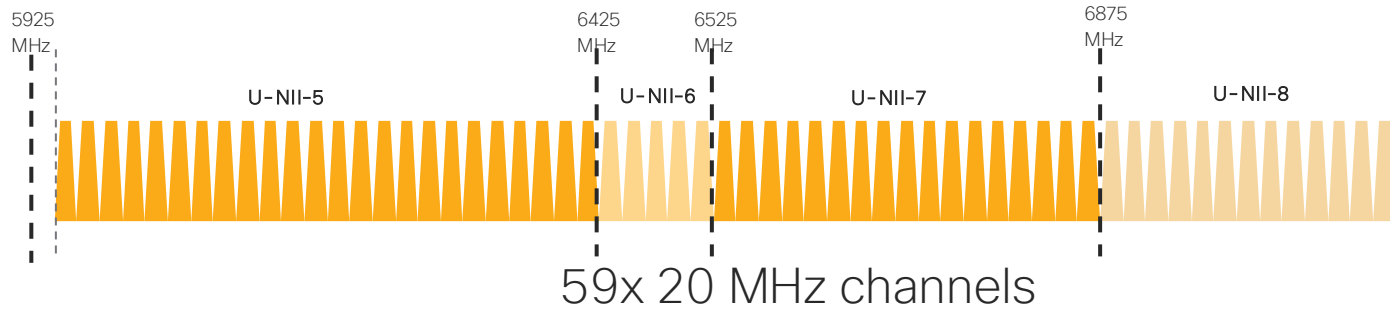
# *Wi-Fi 6E – AP Discovery*

# AP Discovery by Wireless Clients – Legacy Methods

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



# Why Legacy Scanning Methods won't 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  
*(Preferred Method)*  
*Co-located Discovery*

## In Band



Multiple BSSID Beacon Frames

Passive Scan:

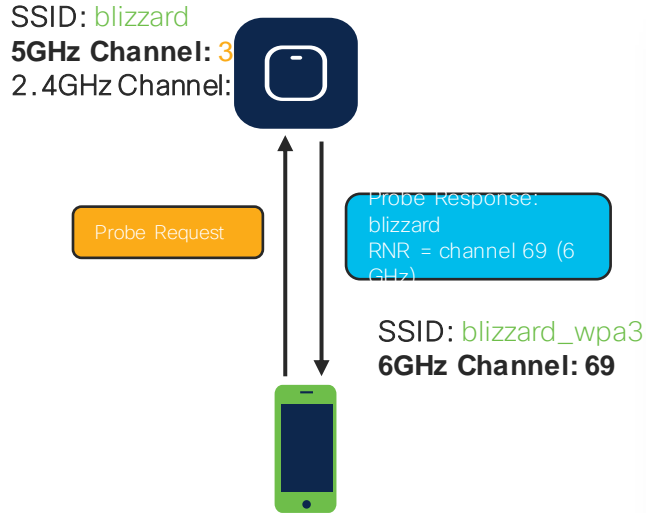
- Fast Link Setup (FILS) Discovery Announcement Frames
- Unsolicited Probe Response Frames

Active Scan:

- Preferred Scanning Channels (PSC)

# Reduced Neighbor Report

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



```
wlan.fc.type_subtype == 5
```

No.	Time	Source	Destination	Protocol	Length	Signal	Strength	Authentication	Info
5	14:31:03.851	68:7d:b4:5e:5f:4f	68:2c:7b:cb:42:d6	802.11	525	-35dBm			Probe Response, SN=9, Flags=.....C, BI=100, SSID=voice
8	14:31:03.871	68:7d:b4:5e:5f:4f	68:2c:7b:cb:42:d6	802.11	525	-35dBm			Probe Response, SN=10, Flags=.....C, BI=100, SSID=voice
10	14:31:03.910	68:7d:b4:5e:5f:4f	98:01:a7:ec:5f:b6	802.11	525	-34dBm			Probe Response, SN=11, Flags=.....C, BI=100, SSID=voice
11	14:31:03.912	68:7d:b4:5e:5f:4f	98:01:a7:ec:5f:b6	802.11	525	-34dBm			Probe Response, SN=11, Flags=.....C, BI=100, SSID=voice
12	14:31:03.913	68:7d:b4:5e:5f:4f	98:01:a7:ec:5f:b6	802.11	525	-34dBm			Probe Response, SN=11, Flags=.....C, BI=100, SSID=voice
13	14:31:03.913	68:7d:b4:5e:5f:4f	98:01:a7:ec:5f:b6	802.11	525	-35dBm			Probe Response, SN=11, Flags=.....C, BI=100, SSID=voice
14	14:31:03.914	68:7d:b4:5e:5f:4e	98:01:a7:ec:5f:b6	802.11	514	-34dBm			Probe Response, SN=5, Flags=.....C, BI=100, SSID=cal-psk
15	14:31:03.915	68:7d:b4:5e:5f:4e	98:01:a7:ec:5f:b6	802.11	514	-35dBm			Probe Response, SN=5, Flags=.....C, BI=100, SSID=cal-psk
16	14:31:03.916	68:7d:b4:5e:5f:4e	98:01:a7:ec:5f:b6	802.11	514	-34dBm			Probe Response, SN=5, Flags=.....C, BI=100, SSID=cal-psk
17	14:31:03.917	68:7d:b4:5e:5f:4e	98:01:a7:ec:5f:b6	802.11	514	-35dBm			Probe Response, SN=5, Flags=.....C, BI=100, SSID=cal-psk

Tag: Reduced Neighbor Report  
Tag Number: Reduced Neighbor Report (201)

Channel Number: 69

TBTT Information  
Neighbor AP TBTT Offset: 255  
BSSID: 687db45e5f40  
Short SSID: 0x4f27e7b9  
BSS Parameters: 0x4e

TBTT Information  
Neighbor AP TBTT Offset: 255  
BSSID: 687db45e5f40  
Short SSID: 0x4f27e7b9  
BSS Parameters: 0x4e

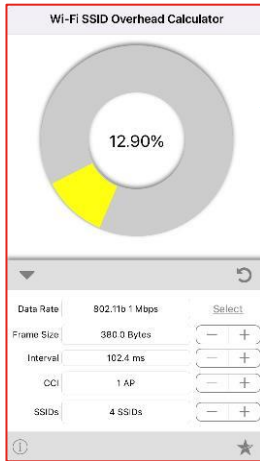
- 0 = OCT Recommended: False
- 1 = Same SSID: True
- 1 = Multiple BSSID: True
- 0 = Transmitted BSSID: True
- 0 = Member of ESS with
- 0 = Unsolicited Probe Responses: False
- 1 = Co-located AP: True
- 0 = Reserved: 0x0

PSD Subfield: 254dBm/MHz



# Multiple BSSID

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



13% Overhead for 4 SSIDs with 1 AP



SSID: wpa3-owe  
SSID: wpa3-SuiteB-GCMP256  
SSID: wpa3-SuiteB-GCMP128



- Conserves Air Time
- Mandated in Wi-Fi 6E

wlan.fc.type\_subtype == 8

No.	Time	Source	Destination	Protocol	Length	Signal	st	Authentication	Info
2	16:57:45.339	68:7d:b4:5e:5f:41	ff:ff:ff:ff:ff:ff	802.11	680	-43dBm			Beacon Frame, SN=3949, Flags=.....C, BI=100, SSID=wpa3-owe, S...
7	16:57:45.441	68:7d:b4:5e:5f:41	ff:ff:ff:ff:ff:ff	802.11	680	-43dBm			Beacon Frame, SN=3953, Flags=.....C, BI=100, SSID=wpa3-owe, S...
12	16:57:45.543	68:7d:b4:5e:5f:41	ff:ff:ff:ff:ff:ff	802.11	680	-43dBm			Beacon Frame, SN=3958, Flags=.....C, BI=100, SSID=wpa3-owe, S...
17	16:57:45.646	68:7d:b4:5e:5f:41	ff:ff:ff:ff:ff:ff	802.11	680	-43dBm			Beacon Frame, SN=3963, Flags=.....C, BI=100, SSID=wpa3-owe, S...

802.11 radio information

802.11 Beacon Frame, Flags=.....C, BI=100, SSID=wpa3-owe, S...

Tag: SSID parameter set: wpa3-owe  
Tag Number: SSID parameter set (0)  
Tag length: 8  
SSID: wpa3-owe

Transmitted BSSID

Tag: Multiple BSSID  
Tag Number: Multiple BSSID (71)  
Tag length: 121  
MaxBSSID Indicator: 4

- Sub-Element: Nontransmitted BSSID Profile  
Subelement ID: 0  
Subelement Length: 58
  - Tag: Non Transmitted BSSID Capability: 0x1511
  - Tag: SSID parameter set: wpa3-SuiteB-GCMP256
  - Tag: Multiple BSSID Index: 11
  - Tag: RSN Information
- Sub-Element: Nontransmitted BSSID Profile  
Subelement ID: 0  
Subelement Length: 58
  - Tag: Non Transmitted BSSID Capability: 0x1511
  - Tag: SSID parameter set: wpa3-SuiteB-GCMP128
  - Tag: Multiple BSSID Index: 12
  - Tag: RSN Information

Non Transmitted BSSID 1

Non Transmitted BSSID 2

# Wi-Fi 6E – Deployment Considerations



Out of Band Discovery  
Only Through RNR  
FILS and UBPR Disabled

Most likely Deployment



In Band Discovery  
Discovery through FILS or UBPR  
Default: FILS

Least likely Deployment

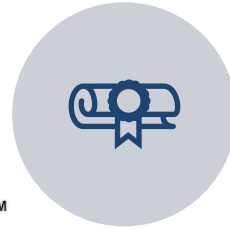


# *Wi-Fi 6E – Security*

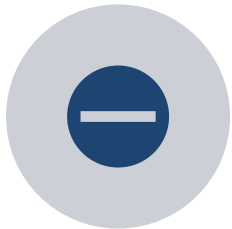
# Wi-Fi 6E Security



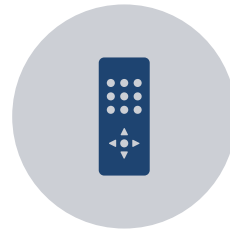
Wi-Fi 6E up levels security with WPA3 and OWE



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.

# Wi-Fi 6E Security Deployment Considerations

- Layers of Wi-Fi Security
  - Clients with WPA2/WPA/Open continue to operate in 2.4 and 5 GHz bands.
  - 6 GHz operates exclusively with WPA3 and Enhanced Open Security
- Use of different SSIDs for 6 GHz band

2.4 & 5 GHz Bands

SSID: employees

(WPA2-Enterprise)

SSID: employees-wpa3

(WPA3-Enterprise)

SSID: guest

(WPA2-Personal)



6 GHz Band

SSID: employees-wpa3

(WPA3-Enterprise)

SSID: guest-wpa3

(WPA3-Personal/H2E \*)

*\*Note: Only H2E is the supported SAE in 6GHz Band*



# *Wi-Fi 6E – Client Eco System*

# Wi-Fi 6E Client Device Eco System

*Wide range of client support ..*



Samsung Galaxy Ultra S21 Samsung Galaxy Z Fold

Google Pixel 6 /Pro



XIAOMI



Xiaomi Mi 11 /Ultra



ASUS Zenfone 8 and 8 Flip



Motorola Edge (2021)

Laptops with Intel AX210 Chipset



Wi-Fi 6E Chipsets



*with more coming soon .....*

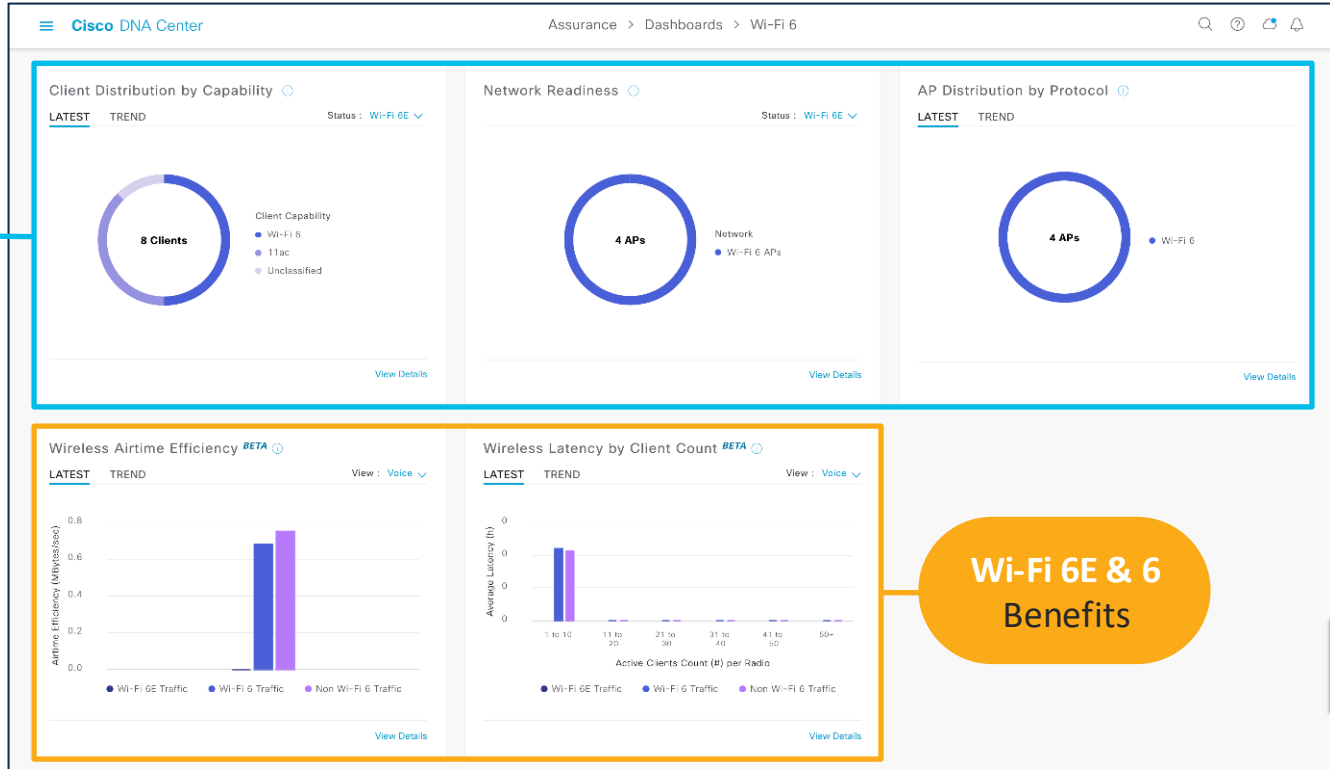
# Wi-Fi 6E Cisco DNA Center Integration



# Wi-Fi 6E integrated into Wi-Fi 6 Dashboard

## Observe the Readiness and Benefits of 6 GHz

Wi-Fi 6E & 6  
Readiness

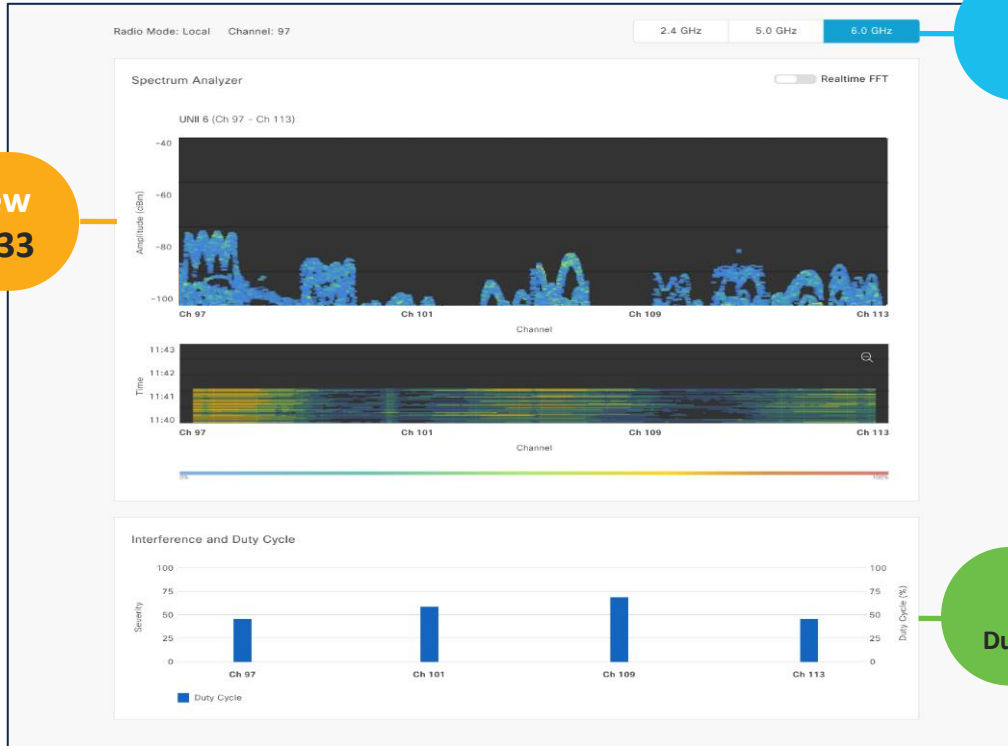


Wi-Fi 6E & 6  
Benefits

# Intelligent Capture's Spectrum Analysis to Capture 6 GHz

Enhanced with C9136I's AI/ML-Driven Scanning Radio

Capable to View  
Channel 1 to 233



Toggle to View  
6 GHz Spectrum

Capture 6 GHz  
Duty Cycle & Interference

# Intelligent Capture's to Support Packet Capture in 6GHz

## Data, Live and Anomaly Packet Capture Inline on the Serving Radio

3 View Unencrypted 6 GHz Data Packets

1 Enable Globally

2 Download Packets

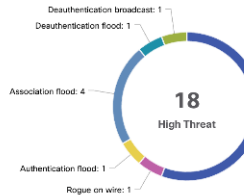
The screenshot displays the Cisco DNA Center interface for Intelligent Capture. At the top, it shows 'Cisco DNA Center' and 'Assurance - Dashboards - Health - User 360'. The main heading is 'Intelligent Capture: Grace.Smith'. Below this, there are controls for 'Run Data Packet Capture', 'Download', and 'Start Live Capture'. A timeline shows 'PCAP' activity on 'Nov 15' from 1:31p to 1:50p. A 'Data Packet Captures' table is visible, listing captures with columns for 'First Packet Time', 'Last Packet Time', 'Type', 'Duration (h:m:s)', 'Size', and 'Download'. The table contains two entries: one for 'Wired' (10 MB) and one for 'Wireless' (15 MB). A large, rounded rectangular window in the foreground shows a detailed view of captured data packets, with alternating blue and orange rows. At the bottom, there is a signal waveform graph and a status bar indicating 'Authentication Done' at 1:52:23 pm.

First Packet Time	Last Packet Time	Type	Duration (h:m:s)	Size	Download
Nov 15, 2020, 11:53:23 am	Nov 15, 2020, 12:26:43 pm	Wired	00:33:20	10 MB	<a href="#">Download</a>
	Nov 15, 2020, 11:53:23 am	Wireless	00:33:20	15 MB	<a href="#">Download</a>

# Rogue Management and aWIPS on Wi-Fi 6E

## Abolish your 6 GHz Network Vulnerabilities

High Threats  
by Category



Threat Level  
Details

Threats (73)

Filter

Threat Level	Threat MAC address	Type
High	00:FE:CB:2E:13:20	Association flood
High	00:FE:CB:2E:13:21	Association flood
High	00:FE:CB:2E:13:22	Association flood
High	00:FE:CB:2E:13:23	Association flood
High	00:FE:CB:2E:13:24	Rogue on wire

Assurance · Dashboards · Rogue and aWIPS

Threat 360: Mac 00:FE:CB:2E:13:22

Threat Level	Threat Type	Vendor	Count	Last Reported
High	Association flood	XEROX CORPORATION	1	Jan 24, 2021 10:15 am

Threat  
Location



Threat Count  
Trend

Detections (1)

Filter

Export

Detecting AP	Detecting AP Site	Last Updated
PLS06-AP3800-01	Global/North America/USA/California/Pleasanton/PLS06/Fr-PLS06-1	Jan 24, 2021 10:15 am

# Cisco partners with major manufacturers to provide the best device experience



**SAMSUNG**



## Best Wi-Fi 6 standards solution

- Client & network interoperability
- Up to 4x performance increase
- Consistent
- Improved power efficiency

## Differentiation through standards +

- Client network analytics providing a client-centric view to DNAC Assurance
- Improve Wi-Fi roaming
- Performance: 5x faster Wi-Fi & cellular handoff

## Open Partner Framework

- Enable partners to integrate with Cisco autonomously
- Promote standards+ features across multiple client devices

# Measure Wi-Fi6 Benefits with Wi-Fi 6 Analytics Dashboard

Cisco DNA Assurance

## Insights

18% of clients in the network are Wi-Fi 6 capable. Your AP Infrastructure is 25% ready for Wi-Fi 6.

Consider the following changes: (1) Upgrade your controller OS version to **AireOS 8.10** or **IOS-XE 16.12** to enjoy the benefits of Wi-Fi 6 network (2) Consider upgrading your AP hardware to **Catalyst 9100 Series** Wi-Fi 6 APs for better client experience

### Client Distribution by Capability

LATEST TREND

18% Wi-Fi 6 clients are associated to a Wi-Fi 6 network



[View Details](#)

### Wi-Fi 6 Network Readiness

LATEST TREND

Your network is 12% Wi-Fi 6 enabled

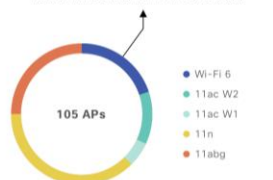


[View Details](#)

### AP Distribution by Protocol

LATEST TREND

10% of APs are on a Wi-Fi 6 network



[View Details](#)

### Wireless Airtime Efficiency

LATEST TREND

View: Voice

Voice is 40% more efficient on a Wi-Fi 6 network

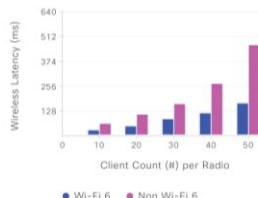


### Wireless Latency by Client Count

LATEST TREND

View: Voice

Voice latency is 40% less on a Wi-Fi 6 network

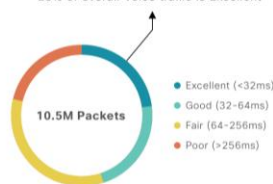


### Wireless Latency by Traffic

LATEST TREND

View: Voice

23% of overall Voice traffic is Excellent



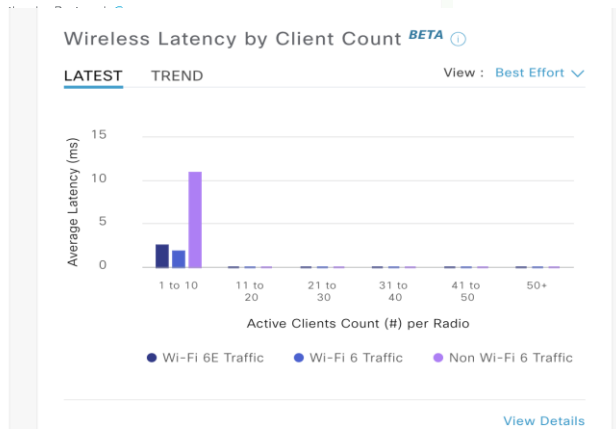
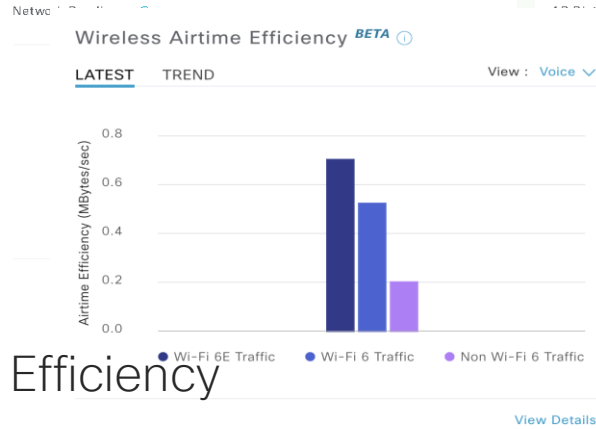
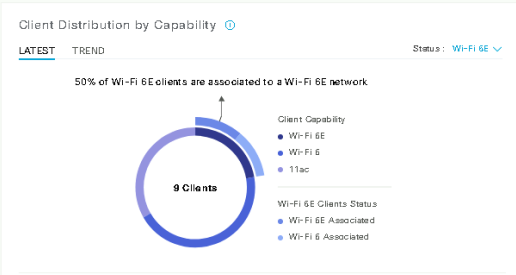
- Analytics on W-Fi 6 APs and devices
- Wi-Fi 6 readiness and benefits analytics
- Advanced wireless performance troubleshooting

# Wi-Fi 6E Visibility

**Insights**

22.22% of clients in the network are Wi-Fi 6E capable. 15.38% of your AP Infrastructure is Wi-Fi 6E ready.

66.67% of clients in the network are Wi-Fi 6 capable. 100% of your AP Infrastructure is Wi-Fi 6 ready.



## Wi-Fi 6E Readiness and Efficiency

# 3D maps integration with DNA Spaces/CMX

- ❖ Integration of DNA Spaces/CMX data to show clients on 3D maps
- ❖ Clients indicated by “Ball” icon
- ❖ Client details on to which AP it is connected and hyperlink to Client 360 for more details

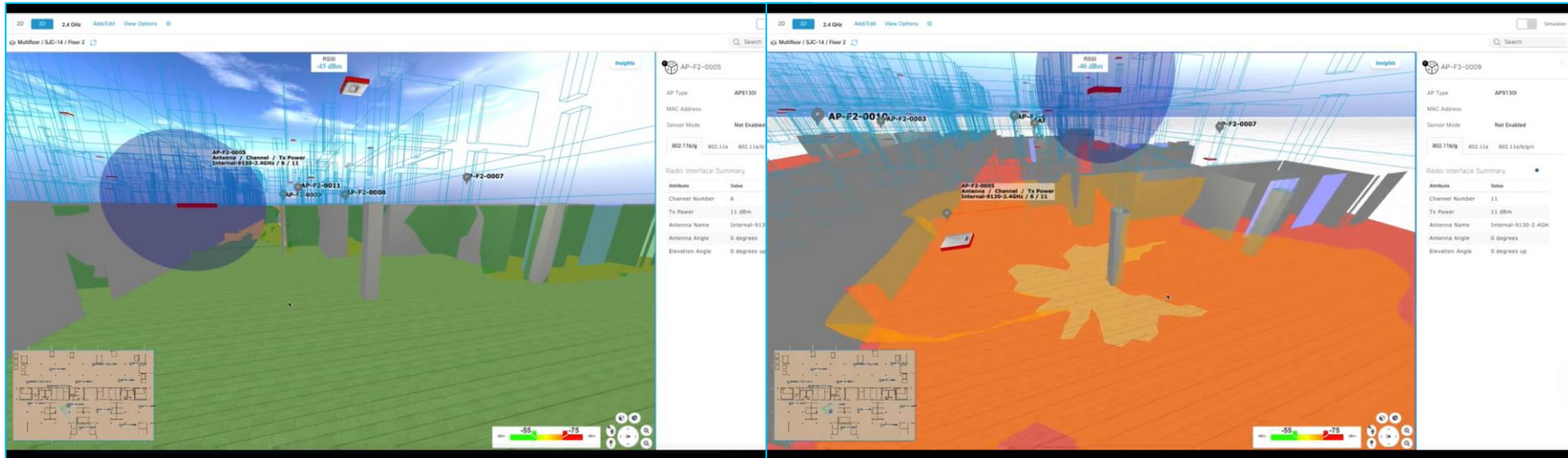
The screenshot displays the Cisco DNA Center interface in the 'Design / Network Hierarchy' view. The main area shows a 3D map of a building with a green 'Ball' icon representing a client. A popup window provides detailed information for Client 360, including its IP address (20.162.1.3), associated AP (DC\_AP9136\_1304), and various performance metrics like RSSI (-13 dBm) and SNR (83 dB). The interface also features a search hierarchy on the left, a top navigation bar with '2D' and '3D' tabs, and a right-hand panel for 'Devices and Clients' with filters for APs, Planned APs, Sensors, and Clients.

Client 360	
IP Address	20.162.1.3
IPv6 Address	fd0d:20:162:0:1984:cfb9:a7da:a430
	fd0d:20:162:0:4c9:80a:83ee:37af
	fd0d:20:162:0:6c0c:2e27:9e78:699f
	fd0d:20:162:0:d1f8:578:81d:ee9a
	fd0d:20:162:0:e119:5ba:1b8d:e0e0
	fd0d:20:162:0:f110:d92a:71a9:357f
	fd0d:20:162:0:f99c:ce07:52f6:5dc0
	fe80::1430:46bc:dd08:29b8
RSSI	-13 dBm
SNR	83 dB
SSID	open
Band	5 GHz
Data Rate	6.0 Mbps
Associated AP	DC_AP9136_1304
Issue Count	0
Status	associated



# Multi-Floor Penetration

- ❖ Ability to Visualize energy penetration alongside Contributing floors
- ❖ Heatmap metrics shown for RSSI, SNR, Interference and Leakage





- Evolução do Wi-Fi e do Wi-Fi6
- Status do Wi-Fi6E
- Produtos disponíveis
- Considerações de design
- 6 GHz AP Discovery
- Security in Wi-Fi 6E World
- Client Ecosystem
- DNA Center Wi-Fi6E Integration

# Muito Obrigado!