Configure and Verify Wi-Fi 6E Band Operations and Client Connectivity

Contents

Introduction Prerequisites Requirements Components Used **Background Information** Wi-Fi 6E Security Cisco Catalyst Wi-Fi 6E APs Configure Network Diagram Configurations **Verify** Beacon Changes Verification Multiple Basic Service Set Identifier (BSSID) Configure Multi BSSID Profile (GUI) Configure Multi BSSID Profile (CLI) Configure Multi-BSSID in the RF Profile (GUI) Configure Multi-BSSID in the RF Profile (CLI) Creation of Multiple SSIDs Verification AP Discovery by Wireless Clients Out-of-Band In-Band **FILS** Configure FILS Discovery Frames in the RF Profile (GUI) Configure FILS Discovery Frames in the RF Profile (CLI) Verification UPR Configure Broadcast Probe Response in RF Profile (GUI) Configure Broadcast Probe Response in RF Profile (CLI) Verification **PSC** Configure Preferred Scanning Channels in the RF Profile (GUI) Configure Preferred Scanning Channels in the RF Profile (CLI) Verification 6-GHz Client Steering Configuring 6-GHz Client Steering in the Global Configuration Mode (GUI) Configuring 6-GHz Client Steering in the Global Configuration Mode (CLI) Configure 6-GHz Client Steering on the WLAN (GUI) Configure 6-GHz Client Steering on the WLAN (CLI)

Verification

Introduction

This document describes how to configure Wi-Fi 6E Band Operations and what to expect on different clients.

Prerequisites

Requirements

Cisco recommends that you have knowledge of these topics:

- Cisco Wireless Lan Controllers (WLC) 9800
- Cisco Access Points (APs) that support Wi-Fi 6E.
- IEEE Standard 802.11ax.
- Network tools: Wireshark

Components Used

The information in this document is based on these software and hardware versions:

- WLC 9800-CL with Cisco IOS® XE 17.9.3.
- APs C9136, CW9162 and CW9166.
- Wi-Fi 6E Clients:
 - Lenovo X1 Carbon Gen11 with Intel AX211 Wi-Fi 6 and 6E Adapter with driver version 22.200.2(1).
 - Netgear A8000 Wi-Fi 6 and 6E Adapter with driver v1(0.0.108);
 - Mobile Phone Pixel 6a with Android 13;
 - Mobile Phone Samsung S23 with Android 13.
- Wireshark v4.0.6

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Background Information

The key thing to know is that Wi-Fi 6E is not an entirely new standard, but an extension. At its base, Wi-Fi 6E is an extension of the Wi-Fi 6 (802.11ax) wireless standard into the 6-GHz radio-frequency band.

Wi-Fi 6E builds on Wi-Fi 6, which is the latest generation of the Wi-Fi standard, but only Wi-Fi 6E devices and applications can operate in the 6-GHz band.

Since the 6-GHz spectrum is new and accepts only Wi-Fi 6E devices, it does not have any of the old issues that clogg up current networks.

It offers better:

• **Capacity:** In US defined by FCC, there is additional spectrum of 1200 MHz worth or 59 new channels. The new 6-GHz band employs fourteen 80-MHz and seven 160-MHz channels. Other countries can have different spectrum ammount allocated for WiFi 6E. Please check <u>Countries Enabling Wi-Fi in 6 GHz (Wi-Fi 6E)</u> for updated info on country adoption of WiFi 6E.

• **Reliability:**Wi-Fi 6E provides a new standard of reliability and predictability of connection that shortens the gap between wireless and wired connections. Devices from Wi-Fi 1 (802.11b) through Wi-Fi 6 (802.11ax) are not supported on 6 GHz.

• Security:Wi-Fi Protected Access 3 (WPA3) is a mandatory requirement for the Wi-Fi 6E network and secures the network better than ever. And since only Wi-Fi 6 products are to use this network, there are no legacy security issues to deal with. WPA3 provides new authentication and encryption algorithms for networks and furnishes fixes for issues that were missed by WPA2. It also implements an additional layer of protection from deauthentication and disassociation attacks.



Comparizon of 2.4, 5 and 6 GHz wifi spectrum and channels

For additional background information about Wi-Fi 6E, please check our <u>Wi-Fi 6E: The Next Great Chapter</u> in <u>Wi-Fi White Paper</u>.

There are various managements and changes in Wi-Fi 6E. In the Verification section of this document, there is a small description of some of these enhancements accompanied by the verification in the real environment.

Wi-Fi 6E Security

Wi-Fi 6E uplevels security with Wi-Fi Protected Access 3 (WPA3) and Opportunistic Wireless Encryption (OWE) and there is no backward compatibility with Open and WPA2 security.

WPA3 and Enhanced Open Security are now mandatory for Wi-Fi 6E certification and Wi-Fi 6E also requires Protected Management Frame (PMF) in both AP and Clients.

When configuring a 6GHz SSID there are certain security requirements that must be met:

- WPA3 L2 security with OWE, SAE or 802.1x-SHA256
- Protected Management Frame Enabled;
- Any other L2 security method is not allowed, that is, no mixed mode possible.

To know more about detailed information about WPA3 implementation in Cisco WLANs, including client security compatibility matrix, please feel free to check the <u>WPA3 Deployment Guide</u>.

Cisco Catalyst Wi-Fi 6E APs



Wi-Fi 6E Access Points

Configure

In this section, it is shown the basic WLAN configuration. Later in the doc, it is shown how to configure each Wi-Fi 6E elements and how to verify the configuration and expected behavior.

Network Diagram



Network Diagram

Configurations

In this document, the initial WLAN base security configuration is WPA3+AES+SAE with H2E as shown here:

Edit WLAN

eneral Security	Advanced Add To P	Policy Tags		
ayer2 Layer3 /	··· ·		· · · · ·	
O WPA + WPA2	O WPA2 + WPA3	WPA3	O Static WEP	O None
MAC Filtering	o 🗸		,	
Lobby Admin Access	0	_		
WPA Parameters	WPA2 O	Fast Tr Status	ansition	Disabled •
Policy GTX O	WPA3	Over 1	he DS	0
Transition O	PORT	Reaso	ociation Timeout *	20
AES(CCMP128) GCMP128	ocMP256 O ocMP256 O	SAE OW 802 510	E O .1s- O .256	FT + SAE 0 FT + 802.1x 0
PMF	Required	• Art	Clogging Threshold*	5
Association Comeback	Timer* 1	Rev	ansmit Timeout*	400
SA Query Time*	200	PSK	Format	ASCI •
		PSK	Type	Unencrypted •
		Pre-	Shared Key*	—
		SAD	Password Dement 0	Hash to Element O.T
			_	

ж.

The WLAN configuration and push to APs is done as per the steps in the section: <u>How to Configure</u> <u>WLANs</u> from the Cisco Catalyst 9800 Series Wireless Controller Software Configuration Guide, Cisco IOS® XE Cupertino 17.9.x.

The WLAN is mapped to a locally switched policy profile with switching and authentication policy as shown here:

Edit Policy Profile									
A Disabling a Policy or	configuring it in 'Enabled' state, v	will result in loss of connectivity for clients associated with this Policy profile.							
General Access Policies	QOS and AVC Mobilit	ty Advanced							
Name*	Policy4TiagoHome	WLAN Switching Policy							
Description	ProductionPolicy	Central Switching DISABLED							
Status	ENABLED	Central Authentication DISABLED							
Passive Client	DISABLED	Central DHCP DISABLED							
IP MAC Binding	ENABLED	Flex NAT/PAT DISABLED							

Verify

Use this section to confirm that your configuration works properly.

The verification section is divided in new changes or features introduced and observations per client type if applicable.

There is a Configuration and Verification section per feature.

In these tests and verifications, the Over the Air Captures (OTAs) were performed with an AP in sniffer mode.

You can check this article to find how to setup an AP in sniffer mode: <u>APs Catalyst 91xx in Sniffer Mode</u>.

Beacon Changes

Beacons still exist on Wi-Fi 6E, and are sent every 100ms by default, however they are a bit different from the Wi-Fi 6 (2.4GHz or 5GHz) beacons. In Wi-Fi 6 the beacon contains HT and VHT Information Elements, however in Wi-Fi 6E, those elements are removed and there is only HE Information element.

Legacy HT/VHT Information Element Removed



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



Comparison of Wi-Fi 6 and Wi-Fi 6E Beacon Frames

Verification

Here is what we can see in the OTA:

Padiets: 233 · Displayed: 192 (82.4%) Profile: Default	Padiets: 364 - Displayed: 72 (19.8%)
<pre>> User Datagram Protocol, Src Port: S880 > AiroPekt/momentee acceptualed TIEE 882.11 F88.11 radio information FWT type: 182.11a (Orown (15) Data rate: 12.0 Hb/S Channel: 64 Signal Strength (Ben): 23 dem hots: leval (percentage): 67% Signal Strength (Dercentage): 67% Signal</pre>	<pre>> User Datagram Protocol, src Port: SSS, Dat Port: SB00 > Airobeck/miPeck encapsulated TEE B02.11 > B02.11 rdSiD information Prvt type: B02.11g (EBP) (6) Data refet: 6.8 Mo/s Channel: 5 Signal Strength (Dercentage): 66K Noise level (Percentage): 66K Noise level (Strength (Dercentage): 67K Noise Strength (Dercentage): 67K Noise Strengt</pre>
Ethere II, Src Cisco dd:7d:37 (96:df:1d:1d:7d:37), Srt: Universa b7:cf:06 (08:3a:88:b7:cf:06)	> Findle 5. So bytes of while (2000 0113), So bytes taptale (2000 0113) of interinter (act (active (active)(000 0113)))



Note: DS Parameter set is an optional field and can be not included in the beacon frames.

Multiple Basic Service Set Identifier (BSSID)

Multiple BSSID is a capability originally specified in 802.11v. It Combines multiple SSID information in a single beacon frame, that is, instead of a beacon for each SSID, it sends a single beacon that contains various BSSIDs.

This is mandated in Wi-Fi 6E and the main goal is to conserve Air Time.

Configure Multi BSSID Profile (GUI)

- Step 1 Choose Configuration > Tags & Profiles > Multi BSSID.
- Step 2 Click Add. The Add Multi BSSID Profile page is displayed.
- Step 3 Enter the name and the description of the BSSID profile.
- Step 4 Enable the these 802.11ax parameters:

- Downlink OFDMA
- Uplink OFDMA
- Downlink MU-MIMO
- Uplink MU-MIMO
- Target Waketime
- TWT Broadcast Support

Step 5 - Click Apply to Device.

Cisco Cisco Catal	lyst 9800-CL Wireless Controller		Welcome admin 🖌 🌾 🛕 🖺 💠 🕅	Image: Search APs and Clemes Q Image: Search APs and Clemes Q				
Q Search Maria Items	Configuration * > Tags & Profiles * > Multi BSSID	Edit Multi BSSID Profile						
	+ Add X Delots		Name*	MBSSIDprofile_test				
Dashboard	Multi BSSID Profile Name	De	Description	Enter Description				
Monitoring >	MBSSIDprofile_test	<	Downlink OFDMA	ENABLED				
🔾 Configuration 🕠	O default-multi-bssid-profile	Det	Uplink OFDMA	ENABLED				
(ô) Administration	10 ·	-	Downlink MU-MIMO	ENABLED				
C Licensing			Uplink MU-MIMO	ENABLED				
Ye Traubleshooting			Target Waketime	ENABLED				
			TWT Broadcast Support	ENABLED				
Walk Me Through 1								

Configure Multi BSSID Profile (CLI)

```
Device# configure terminal
Device (config)# wireless profile multi-bssid multi-bssid-profile-name
Device (config-wireless-multi-bssid-profile)# dot11ax downlink-mumimo
```

Configure Multi-BSSID in the RF Profile (GUI)

- Step 1 Choose Configuration > Tags & Profiles > RF/Radio.
- Step 2 In the **RF** tab, click **Add.** The Add RF Profile page is displayed.
- Step 3 Choose the **802.11ax** tab.
- Step 4 In the Multi BSSID Profile field, choose the profile from the drop-down list.
- Step 5 Click Apply to Device.

O. Sainth Marris James	Config	uration -	> Tags & Profiles * > RF/Radio		Edit RF Profile				
of parton search and	RF	Radio			General 802.11 RRM Advanced	802.11ax			
Dashboard	-				6 GHz Discovery Frames ①	None			
) Monitoring 💦 🔸			(Cherry)			O FILS Discovery			
		State	Y RF Profile Name	T Band	Broadcart Broke Bernente (stend) (meals	20			
S coniguration >	0	0	default-rf-profile-6ghz	6 GHz		20			
Administration	0	0	Low_Client_Density_rf_5gh	5 GHz	Multi BSSID Profile	MBSSIDprofile_test •			
	0	0	High_Client_Density_rf_5gh	5 GHz	Seatel Davage				
Licensing	0	0	Low_Client_Density_rf_24gh	2.4 GHz	Spatial Reuse				
. Torontal and the second second	0	0	High_Client_Density_rf_24gh	2.4 GHz	OBSS PD	DISABLED			
roubleshooting	0	0	Typical_Client_Density_rf_5gh	5 GHz					
	0	0	Typical_Client_Density_rf_24gh	2.4 GHz	Non-SRG OBSS PD Max Threshold (dBm)*	-62			
	1.1	- 1	ii ii 10 🔻		SRG OBSS PD	DISABLED			
Walk Me Through X					SRG OBSS PD Min Threshold (dBm)*	-82			
					SRG OBSS PD Max Threshold (dBm)*	-62			

Configure Multi-BSSID in the RF Profile (CLI)

```
Device# configure terminal
Device(config)# ap dot11 6ghz rf-profile rf-profile-name
Device(config-rf-profile)# dot11ax multi-bssid-profile multi-bssid-profile-name
```

Creation of Multiple SSIDs

To verify the MBSSID feature, you must have various SSIDs enabled and pushed to the APs. In this verification, three SSIDs are used:

Cisco Cisco Ci	atalyst 98	800-CL	Wireless Co	ontroller		Welcome admin	* *	A 🖹 🌣	O C Search APs	and Clients Q	•
Q. Search Menu Items	Conf	iguration	• > Tags & Pr	ofiles - > WLAN	s						
Dashboard	+	Add	× Delete	Clone		Disable WLAN				WLAN Wiz	ard
	Selec	cted WLAN	is : 1								
2)	0	Status	Name		T ID		T	SSID	7	Security	Ŧ
S Configuration	[^] 0	0			% 1			5 10 m		[WPA2][PSK][AES]	
Administration	, 0	0			• 2					[WPA3][FT + SAE][AES].[FT Enabled]	
	0	0			۹ ک					[WPA2][PSK][AES]	
C Licensing	0	0			۰ ا					[WPA2][PSK][FT + PSK][AES].[FT Enabled]	1
Alle - march	0	0	wifi6E_test		\$ 5			wifi6E_test		[WPA3][SAE][AES]	
X Iroubleshooting	Ø	0	wifi6E_test_01		6			wifi6E_test_0	1	[WPA3][SAE][AES]	
	0	0	wifi6E_test_02		• 7			wifi6E_test_0	2	[WPA3][SAE][AES]	

Verification

To verify if the configuration is in place issue the commands shown here:

<#root> WLC9800# show ap rf-profile name *default-rf-profile-6ghz* detail | b 802.11ax

802.11ax OBSS PD : Disabled Non-SRG OBSS PD Maximum : -62 dBm SRG OBSS PD : Disabled SRG OBSS PD Minimum : -82 dBm SRG OBSS PD Maximum : -62 dBm Broadcast Probe Response : Disabled FILS Discovery : Disabled Multi-BSSID Profile Name : MBSSIDprofile_test

NDP mode : Auto Guard Interval : 800ns PSC Enforcement : Disabled

WLC9800# WLC9800#

show wireless profile multi-bssid detailed MBSSIDprofile_test

Multi bssid profile name :

MBSSIDprofile_test

Description : 802.11ax parameters OFDMA Downlink : Enabled OFDMA Uplink : Enabled MU-MIMO Downlink : Enabled MU-MIMO Uplink : Enabled Target Waketime : Enabled TWT broadcast support : Enabled

WLC9800#

Here is what you can see in the OTA captures when using Single BSSID:



Here is what you can see in the OTA captures when using Multiple BSSIDs:

Eescon, 6GHz, MSSID,pcaping				- 0 X
File Edit View Go Capture Analyze Statistics Telephony	Vireless Tools He	ip.		
# peekremote				⊠⊡•+
No Time Delta Source Dest	nation Protocol	Lengt Changel Signal stre	Info	> Frame 12: 565 bytes on wire (4040 bits), 565 bytes captured (4040 bits) on interface \Device\NFF_(D4578505-2598-4456-8C
4 2023-06-09 13:27:57.051565 0.000000 Cisco dd:00:10 Bros	dcast 802.11	505 69 -38 00m	Beacon frame, SNx213, FNx0, FlagssC, BIx100, SSIDx"wifi68 test", SSIDx"w	> Ethernet II, Src: Cisco_dd:7d:37 (00:df:1d:dd:7d:37), Dst: Universa_b7:cf:06 (00:3a:80:b7:cf:06)
7 2823-06-09 13127157.954024 0.182459 Cisco_ddia0110 Brow	dcast 802.11	505 69 -33 00m	Beacon frame, SN+214, FN+0, Flags+C, 81+100, SSID+"wifi6E_test", SSID+"w	Internet Protocol Version 4, Src: 192.168.1.15, Dst: 192.168.1.121
8 2023-06-09 13:27:58.158867 0.204043 Cisco_dd:a0:1c Bros	dcast 802.11	505 69 -88 d8m	Beacon frame, SN+216, FN+0, Flags+C, BI+100, SSID+"wif166_test", SSID+"w) User Datagram Protocol, Src Port: SSS, DSt Port: Seee Science (State Control State St
12 2823-06-09 13:27:58.363692 0.204825 Cisco_dd:a8:1c Brow	dcast 802.11	505 69 -32 dēn	Beacon frame, SN=218, FN=0, Flags=C, BI=100, SSID="wif166_test", SSID="wi	3 80.11 ratio information
13 2023-06-09 13:27:58.46601/ 0.102325 C15C0_0010011C BF0	dcast 002.11	105 59 -09 20R	Beacon frame, Soully, Field, Flags	> IEEE 802.11 Beacon frame, Flags:C
17 2023-06-09 13:27:50.773268 0.204006 Cisco dd:a0:10 8ros	dcast 802.11	505 65 -05 din	Beacon frame, SN+222, FN+0, Flags+C, 81+100, SSID+"wifi6E test", SSID+"w	✓ IEEE 802.11 wireless Hanagement
18 2023-06-09 13:27:58.978008 0.204740 Cisco_dd:a0:1c 0ros	dcast 802.11	505 69 -09 d8m	Beacon frame, SN+224, FN+0, Flags+C, BI+100, SSID+"wifi6E_test", SSID+"w	> Fixed parameters (12 bytes)
22 2823-06-09 13:27:59.182815 0.204807 Cisco_dd:a0:1c Bros	dcast 802.11	505 69 -88 dBn	Beacon frame, SN+226, FN+0, Flags+C, BI+100, SSID+"wifi66_test", SSID+"w	 Theread consistences (46) prices
23 2023-06-09 13:27:59.285000 0.102265 Cisco_dd:a0:10 Bros	dcast 802.11	505 69 -88 d8m	Beacon frame, SN+227, FN+0, Flags+C, EI+100, SSID+"wifi6E_test", SSID+"wi	> Tar Successary permetter sets maragest
24 2023-06-09 13:27:59.307661 0.102501 C15C0_00:00:10 Bro	dcast 002.11	505 69 -09 ddm	Beacon frame, SHA22B, FNAB, FlagssC, BIA100, SSIDA WIF168_test", SSIDA W	> Tag: Traffic Indication Hap (TDN): DTIN @ of 3 bitmap
27 2823-86-89 13:27:59.592317 8.582272 Cisco dd:a8:1c Bro	dcast 882.11	585 65 -35 dan	Beacon frame, Sha210, Filed, FlagtsC. BIs100, SSIDs"wifi6E tect", SSIDs"wi	> Tag: Country Information: Country Code na, Environment Global operating classes
29 2823-86-89 13:27:59.694784 8.182467 Cisco.dd:a8:1c Bros	dcast 802.11	545 65 -89 dan	Beacon frame, SNu231, Flug, Flags	> Tagi Power Constraint: 6
30 2023-06-09 13:27:59.797104 0.102400 Cisco_dd:a0:1c Bros	dcast 802.11	505 69 -90 dim	Beacon frame, SN+232, FN+0, Flags+C, BI+100, SSID+"wifi66_test", SSID+"w	> Tag: TPC Report Transmit Power: 16, Link Margin: 0
34 2023-06-09 13:20:00.001946 0.204762 Cisco_dd:a0:1c Brok	dcast 002.11	505 69 -09 dBm	Beacon frame, Shk234, FN+0, Flags+C, BI+100, SSID+"wifi66_test", SSID+"wi	> Tag: How Information
38 2823-06-09 13:28:08.104454 0.102508 Clsco_dd:80:1c Brow	dcast 802,11	505 69 -09 dBm	Beacon frame, SN+235, FN+0, Flags+C, BI+100, SSID+"wifi6E_test", SSID+"w	Y Tag: Multiple 65510
39 2823-86-89 13125100,20635 0,182382 C15C0_0018811C Brok	0C#51 802.11	505 69 -55 088	Beacon France, SW236, Field, Flags	Tag Number: Multiple BSSID (71)
42 2023-06-09 13:20:00.411507 0.102444 Cisco dd:a0:10 Bros	dcast 802.11	505 69 -88 dan	Beacon frame, SHu216, Flue, FlagtaC. Bluine, SSIDu"wifi66 test", SSIDu"w	Tag length: 145
43 2023-06-09 13:20:00.514027 0.102440 Cisco_dd:a0:1c Bros	dcast 802.11	505 69 -28 d8m	Beacon frame, SN+239, FN+0, Flags+C, BI+100, SSID+"wifi68_test", SSID+"wi	Hax 85510 Indicator: 4
44 2023-06-09 13:20:00.616332 0.302305 Cisco_dd:00:10 Brow	dcast 802.11	505 69 -59 dBm	Beacon frame, SN+240, FN+0, Flags+C, BI+100, SSID+"wif168_test", SSID+"w	 Subelement: Nontransmitted #SSID Profile
46 2023-06-09 13128:00.718798 0.102466 Cisco_dd:00:1c Brow	dcast 802.11	505 69 -88 d8m	Beacon frame, SN+241, FN+0, Flags+C, BI+100, SSID+"wifi6E_test", SSID+"W	Leafth To Anthenshitted #5510 Profile (4)
47 2023-06-09 13:28:00.821158 0.102360 Cisco_dd:00:1c 8rol	dcast 002.11	505 69 -03 dem	Beacon frame, SN+242, FN+0, Flags+C, BI=100, SSID="WIF166_test", SSID="W	Nontransmitted Profile: 53021115000e776966695645577465737455303155630103003014030000064c04010000
52 2821-06-09 13:28:00.923997 0.102009 C15C0 02:00:10 870	dras# 407.11	105 63 -11 den	Bearing frame, Shu245, Flugs, Flags,	> Tag: Non Transmitted BSSID Capability
54 2023-06-09 13:28:01.333275 0.204885 Cisco_dd:e0:10 Broi	dcast 802.11	505 69 -90 dbn	Beacon frame, SN+247, FN+0, Flags+C, BI+100, SSID+"wif16E_test", SSID+"wi	> Tag: SSID parameter set: "wifi66_test_di"
55 2023-06-09 13:28:01.435564 0.102289 Clsco_dd:a0:1c Bros	dcast 882.11	505 69 -88 dbn	Beacon frame, SN=248, FN=0, Flags=C, BI=100, SSID="wifi6E_test", SSID="wi	> Teg: Multiple #SSID Index
63 2023-06-09 13:28:01.538023 0.102459 Cisco_dd:a0:1c Brow	dcast 802.11	505 69 -89 dBn	Beacon frame, SN+249, FN+0, Flags+C, BI+100, SSID+"wifi6E_test", SSID+"wi	> Tag: #SN Information
64 2023-06-09 13:20:01.640411 0.102305 Cisco_dd:e0:1c Brok	dcast 802.11	505 69 -90 d8m	Beacon frame, SN+250, FN+0, Flagt+C, BI+100, SSID+"wif168_test", SSID+"W) Tag: Non Extended (1 ULEL)) Tag: Vender Sectific: Cisco Systems, Inc: Aironet Uninoum (AA)
56 2023-06-09 13:20:01.742046 0.102435 C15C0_00:00:10 Bro	dcast 802.11	105 69 -88 den	Beacon frame, SHA251, FHAD, FlagsC, BIA100, SSIDA WIF160_test", SSIDA W	> Tag: Vendor Specific: Cisco Systems, Inc: Aironet Unknown (11) (11)
72 2823.06.09 11:28:01.947716 0.182540 Cisco dd:a0:10 8ros	dcast 802.11	505 69 -22 dia	Beacon frame, Shu253, Flug, FlagtsC. ETs100, SSIDs"wifi66 test", SSIDs"wi	✓ Subelement: Nontransmitted #SSID Profile
74 2023-06-09 13:28:02.054159 0.106443 Cisco_dd:a0:1c Bros	dcast 802.11	505 69 -89 dön	Beacon frame, SN=254, FN=0, Flags=C, 81=100, SSID="wifi66_test", SSID="wi	Subelement ID: Nontransmitted BSSID Profile (0)
79 2023-06-09 13:28:02.152422 0.090263 Cisco_dd:e0:1c Bros	dcast 802.11	505 69 -09 dbn	Beacon frame, SN+255, FN+0, Flags+C, BI+100, SSID+"wifi66_test", SSID+"w	Length: 70
81 2823-66-89 13:28:82.254851 0.182429 Cisco_dd:a8:1c Brok	dcast 802.11	505 69 -88 d8m	Beacon frame, SNx256, FNx0, Flags+C, BIx100, SSID+"wif16E_test", SSID+"wi	 There has no rearrently and a SSTD (cambility)
82 2823-06-09 13:28:02.357205 0.182354 C15C0_00:08:1C Bro	dcast 802.11	505 69 -89 dan	Beacon frame, Six257, Flue, FlagsC, BIx100, SSID+"x1f168_test", SSID+"x	> Test: SSID parameter set: "wifief test g2"
47 1011-06-09 11-10-07 561110 & 10160 C1500 M-08-10 Brok	dras# 882.11	545 63 -02 day	Bascon frame Ou-168 Duck Class. / ST-168 SSTD-"u/Did Fat#" CCP-"u	> Tag: Multiple #SSID Index
96 2823-86-89 13:28:82.766882 0.284554 Cisco dd:a8:1c Bros	dcast 902.11	545 69 -89 d8m	Beacon frame, SNx261, FNx0, Flags+C, BIx100, SSIDx"wifi66 test", SSIDx"w	> Tag: RSN Information
97 2823-06-09 13:28:02.869776 0.102894 Cisco_dd:e0:1c Bros	dcast 802.11	505 69 -99 d8m	Beacon frame, SNx262, FNx0, FlagsC, 81x100, SSID+"wifi66_test", SSID+"w	> Tag: RSW eXtension (1 octet)
100 2023-06-09 13:28:02.971656 0.101880 Cisco_dd:e0:1c Brow	dcast 802.11	505 69 -58 00m	Beacon frame, SNv263, FNv0, Flags+C, BI+100, SSID+"wifi66_test", SSID+"w	> Tag: Vendor Specific: Cisco Systems, Inc: Alronet Unknown (44)
105 2023-06-09 13128103.073906 0.102330 Clsco_dd:0011C Brow	dcast 802.11	505 69 -89 dbm	Beacon frame, SN+264, FN+0, Flags+C, BI=100, SSID="wif166_test", SSID="wi	> Tar Bit Could (cantilities (5 ortes) bet Arount One (11) (11)
109 2023-06-09 13:20:03.270876 0.204090 C15C0_00:80:1C Brok	0C851 802.11	505 69 -55 000	Beacon frame, Shi-266, FileD, FileDist	> Tag: Extended Capabilities (11 octets)
112 2023-06-09 13:20:03.403636 0.102297 Cisco dd:a0:1c Bro	dcast 802.11	505 69 -09 dim	Beacon frame, SN+268, FileB, FlagsC, BI+100, SSID+"wifi66 test", SSID+"w	> Tag: Tx Power Envelope
114 2823-06-09 13:28:03.586142 0.102506 Cisco_dd:a0:1c Bros	dcast 002.11	505 69 -88 d8m	Beacon frame, SN+269, FN+0, Flags+C, BI+100, SSID+"wifi66_test", SSID+"w	Tag: Tx Rouse Sensitions
139 2023-06-09 13:28:03.790859 0.204717 Cisco_dd:a0:10 Brow	dcast 802.11	505 69 -88 d8m	Beacon frame, SN+271, FN+0, Flags+C, BI+100, SSID+"wifi6E_test", SSID+"w	Ext Tag: Nultiple #SSID Configuration
142_3623-66-69_13128169-893292_0-382643_C14C0_0814013C_8706	dcest 802.11	505 63 -37 dBa	Beacon frame, Sm-272, Finel, FlagsC, El-LON, SSID-THITLE_TEST, SSID-TH	ext Trag Length 1 ext Trag Length 1 ext Trag Length 1 ext Trag Length 1 Foll Set Trage Addition (S) Foll Trage Addition (S) For Trage Addition (
				> Got Tag: Spatial Ansae Parameter Set > Ext Tag: NJ GOA Parameter Set > Ext Tag: N4 Goa Dana Gapabilitas
Tagged parameters (vian.tagged.all), 403 bytes				Packets: 143 · Displayed: 49 (34.3%) · Dropped: 0 (0.0%) Profile: Default

AP Discovery by Wireless Clients

Discovery is the process where a client device, on power-up or when it enters a building, finds a suitable access point to connect to.

The simplest way to perform discovery, used by most client devices today, is to scan channels in turn by the transmission of one or more probe requests, it then listens for responses from access points in the area, examines the probe responses to see if any of the SSIDs match profiles in the client, then steps to the next channel.

This has three drawbacks:

- it takes significant time, which can affect application performance while the radio is away from its serving channel;
- it requires many probe request and response frames on the air, which reduces airtime efficiency;
- it affects client battery life.

The time – in the order of 20 msec per non-DFS channel or up to 100ms on DFS channel – is already an issue in the 5 GHz band. It becomes more significant when we realize that a Wi-Fi 6E client can have to scan every one of the 59 possible 20 MHz channels in the band to discover all available access points.

The legacy methods aka Passive Scanning and Active Scanning, do not scale on 6GHz. On 2.4 and 5Ghz, it is used the "hunt-and-seek" method to scan BSSIDs or for APs, either by Passive Scanning or Active Scanning:



Traditionally, wireless devices communicate with access points in a specific exchange of information. Client devices use an active "hunt-and-seek" approach to scan for nearby APs.

This active scanning approach involves the send of *probe request* frames along the 2.4 GHz and 5 GHz frequency spectrum. An AP would respond with a *probe response* frame that contains all the necessary basic service set (BSS) information to connect to the network.

This information would consist of SSID, BSSID, channel width, and security information among other things.

This active "hunt-and-seek" approach to network connectivity is no longer necessary and is actually discouraged in Wi-Fi 6E on the 6 GHz band because it is now inefficient to broadcast the same probe requests over so many channels.

Wifi clients can send only Probe Requests on 20 MHz channels, and on 6Ghz there are up to 59x20MHz, which means that the client would need to scan all 59 channels that sums to ~6 seconds to passive scan all 59 channels:



On Wi-Fi 6E, there are new AP Discovery Mechanisms:



At the time of writting this document, the windows/intel and android clients tested supported FILS and broadcast probe responses, however it was not the same across Apple and some Android clients which can possibly not support FILS or broadcast probe responses.

Due to this problem a preferred scanning chanel (PSC) is considered more relevant. However as currently different wireless client vendors are possible to not be fully compatible with wifi 6 scanning, it can not be an ideal approach to configure only 6ghz wlan/ssid.



Note: If you want to make sure to know what discovery mechanism each client supports, you must reach to wireless client vendor support.

So based on wireless client vendor support, currently it is possible to be relevant to have an out-of-band discovery with 2.4/5Ghz enabled for a RNR /Reduced Neighbor Report option wherein wireless clients can discover a 6Ghz SSID on an AP by listening to RNR Information Element included in the 2.4/5Ghz beacons from that AP.

It very unlikely that you have a WLC and AP providing ONLY 6GHz WLAN, and most likely there are other WLANs beeing broadcasted. Taking this into account its recommended to use those legacy bands to advertise the 6GHz only WLANs, in the RNR information element, for client devices that do not support In-Band discovery mechanisms.

In the end there is no added configuration burden because the RNR is a feature already supported by Wi-Fi 6E devices and therefore Wi-Fi 6E devices support it.

Out-of-Band

Out-of-band discovery is used for cross-communication on all 3 frequency bands (2.4, 5, and 6 GHz). This method, introduced in 802.11v is known as Reduced Neighbor Reporting (RNR).

Essentially, when a Wi-Fi 6E-capable AP sends a probe response frame it includes, (along with basic service set (BSS) information for the 2.4 or 5 GHz band) RNR information about its 6 GHz radio.

This RNR serves as enough information for the client device to roam between 6 GHz and 2.4 or 5 GHz networks.

In summary: Clients use only RNR to discover WLANs in 6 GHz through legacy bands. They do not scan 6 GHz straight away.

If we capture the traffic on 2.4 or 5GHz over the air, and observe the Probe Responses.

This is what is expected to be seen for example in an OTA capture of a Probe Response on channel 1 (2.4GHz) for an SSID broadcasted on 2.4, 5 and 6GHz:



You can see the RNR reporting the same SSID on 6GHz channel 5 and 2 other BSSIDs.

This is for the same SSID, but a Probe response on 5GHz:

	ine	Delta	Source	Destination	Protocol	Lengt	Channel Signal	stre Info								
617 :	2023-06-09 14:37:50.724295	8.000000	Cisco_13:80:ef	wistronk_b7:_	802.11	464	64 - 27 di	in Prob	e Response,	Stu698, 1	Fluid,	Flagis	C, 82-100	, SSID	-"wifild_	test"
620 :	2023-06-09 14:37:50.725614	0.001319	Cisco_13:00:ef	WistronN_b7:	802.11	434	64 -27 d	In Prob	e Response,	5%+691,	Flind,	Flags	C, #I×100	P, SSID	"hifi68_	test"
24	2023-06-09 14:38:07.897585	17.171971	Cisco_13:00:ef	IntelCor_d2:_	802.11	434	64 -28 Ø	In Prob	e Response,	58+692,	Thet,	Flag1		, 55ID-	+"wifict_	test"
5.	2023-06-09 14138108.063911	0.166326	Cisco_13:00:ef	IntelCor_d21_	802.11	454	64 -27 0	in Prob	e Response,	55+693, 1	Flind,	#lags+	C, 81+100	, SSID-	-"wifile_	test"
15	2023-06-09 14138:08-064436	0.000525	Cisco_13:80:ef	IntelCor_d2:_	802.11	404	64 -28 di	in Probi	e Response,	5%+693, 1	Flield,	Flags	C, 82-100	, SSID-	-"H1F16E_"	test"
15	2023-06-09 14138108-064870	0.000434	Cisco_13:00:ef	IntelCor_d2:_	802.11	454	64 -28 di	Im Prob	e Response,	5%+693, 1	File0,	Flagt		, SSID.	"hdf16E_	test"
s., :	2023-06-09 14:38:00.065420	0.000550	Cisco_13:D0:ef	IntelCor_d2:_	\$02.11	484	64 -25 di	Im Prob	Response,	SN+693,	File0,	FlagivR.	C, SI+100	, SSID-	"hifics_	test"
a. :	2023-06-09 14:30:10.720409	2.663069	Cisco_13:00:ef	wistronk_b7:_	802.11	454	64 -27 0	in Prob	e Response,	58+694, 1	Plied,	FlaginiR.	C, 0I+100	, SSID	"wifile_	test"
S.;)	2023-06-09 14:38:10.728890	8.000401	Cisco_13:80:ef	wistrons_b7:_	802.11	454	64 -28 0	in Prob	e Response,	58+694,	FN+0,	#1ag1+#.	C, 81=100	, SSID-	"wifife_	test"
a;	2023-06-09 14:38:10.729928	0.001038	Cisco_13:00:ef	wistronk_b7:_	802.11	484	64 -27 d	te Prob	e Response,	5%+695,	Flind,	Flags+		P, 552D-	<pre>"hifife_"</pre>	test"
a. ;	2023-06-09 14:38:10.730449	0.000521	Cisco_13:80:ef	wistronk_b7:_	802.11	454	64 -28 d	in Prob	e Response,	51+695, 1	Eline,	FlagtsR.	C, 82×100	, SSID-	<pre>whities_</pre>	test"
H	2023-06-09 14:38:10.732737	0.002288	Cisco_13:80:ef	wistroni_b7:_	\$82.11	454	64 -27 d	In Prob	e Response,	51+696, 1	Flieft,	Flag1+	C, 83+100	, SSID	-Twifiles_	test"



In-Band

In-band discoveryis used for communication between 6 GHz devices, and there are three methods of in-band discovery:

- **Fast Initial Link Setup** (FILS) and **unsolicited probe response** (UPR) frames are two passive methods of in-band discovery. It's FILS or UPR and not both. 6 GHz Discovery Frames are needed only if 6 GHz is the only radio that is operational.
- **Preferred Scanning Channels** (PSC) is an active method of in-band discovery. Wireless clients probe only PSC channels; scans Non PSC if it detects from RNR.

Remember that these are in-band discovery methods, which means that this only applies to Wi-Fi 6E clients that connect to wireless networks on the 6 GHz band.

FILS

FILS is part of IEEE 802.11ai Standard and addresses improvements in Network and BSS Discovery, Authentication and Association, DHCP and IP address setup.

FILS uses "discovery announcement frames" which are essentially condensed beacon frames. Only crucial information is sent in a FILS frame: Short SSID, BSSID, and channel, for the AP to decide on the AP to connect.

If FILS is configured, the 6 GHz AP broadcasts an announcement discovery frame approximately every 20 milliseconds which consumes less air time and reduces probe request overhead.



Note: 6 GHz Discovery Frames are needed only if 6 GHz is the only radio that is operational. When other radios (2.4/5 GHz) are operational, clients detect 6 GHz presence from RNR IE.

Configure FILS Discovery Frames in the RF Profile (GUI)

- Step 1 Choose Configuration > Tags & Profiles > RF/Radio.
- Step 2 In the **RF** tab, click **Add.** The Add RF Profile page is displayed.
- Step 3 Choose the **802.11ax** tab.
- Step 4 In the 6 GHz Discovery Frames section, click the FILS Discovery option.



Note: To prevent the transmission of discovery FILS frames when the discovery frames are set to **None** in the RF profile, ensure that you disable FILS discovery frames by either switch to the 5-GHz or the 2.4-GHz bands on the AP or by selection of the Broadcast Probe Response option.

Step 5 - Click **Apply to Device**.

Config	guration *	> Tags & Profiles * > RF/Radio		Edit RF Profile				
RF	Radio			General 802.11 RRM Advanced	802.11ax			
, 📜	+ Add	X Delise		6 GHz Discovery Frames ①	O None O Broadcass Probe Response			
ar (10)	State	T RF Profile Name	T Band					
	0	default-rf-profile-6ghz	6 GHz	Broadcast Probe Response Interval (msec)*	20			
, n , O	0	Low_Client_Density_rf_5gh	5 GHz	Multi BSSID Profile	MBSSIDprofile_test •			
0	0	High_Client_Density_rf_5gh	5 GHz	Snatial Darree				
0	0	Low_Client_Density_rf_24gh	2.4 GHz	opena neuse				
. 0	0	High_Client_Density_rf_24gh	2.4 GHz	OBSS PD	DISABLED			
0	0	Typical_Client_Density_rf_5gh	5 GHz	Nee CDC (CDCC DD Max Threshold (dDas)+				
0	0	Typical_Client_Density_rf_24gh	2.4 GHz	Non-Ska USSS PD Max Trieshold (dbm)	-62			
	- 1) II 10 ¥		SRG OBSS PD	DISABLED			
				SRG OBSS PD Min Threshold (dBm)*	-82			
				SDC ORSS DD May Thrashold (dBm)+	-62			

Configure FILS Discovery Frames in the RF Profile (CLI)

```
Device# configure terminal
Device(config)# ap dot11 6ghz rf-profile rf-profile-name
Device(config-rf-profile)# dot11ax fils-discovery
```

Verification

To verify if the configuration is in place issue the **show** command as shown here:

<#root>

WLC9800#

show ap rf-profile name default-rf-profile-6ghz detail | b 802.11ax

```
802.11ax
OBSS PD : Disabled
Non-SRG OBSS PD Maximum : -62 dBm
SRG OBSS PD : Disabled
SRG OBSS PD Minimum : -82 dBm
SRG OBSS PD Maximum : -62 dBm
Broadcast Probe Response : Disabled
```

FILS Discovery : Enabled

Multi-BSSID Profile Name :

MBSSIDprofile_test

NDP mode : Auto Guard Interval : 800ns PSC Enforcement : Disabled

Here is what we expect to see if we capture the wireless traffic over the air:



You can observe that the delta between frames is most of the times \sim 20ms, however sometimes you see \sim 40ms. After checking the frame sequence it was concluded that the sniffer AP was missing the capture of FILS frames sporadically.

UPR

An unsolicited probe response (UPR) frame contains*all*the same information sent in a beacon, that is, it carries multiple BSSIDs and contains all information needed for association.

If used, the 6 GHz AP broadcasts a full probe response frame every 20 milliseconds which helps avoid probe storms.

In 6GHz there are new probe restrictions:

- Clients cannot do blind probe, that is, broadcast destination address using wildcard SSID and BSSID are no allowed because broadcast probe requests and probes with wildcard SSID create probe storm and impacts performance;
- Clients must wait at least the duration of minimum probe delay interval (~20 msec);
- Probe Responses are always broadcast.

UPR is also known as Broadcast Probe Response and in the next section, you can see how to enable it.

Configure Broadcast Probe Response in RF Profile (GUI)

- Step 1 Choose Configuration > Tags & Profiles > RF/Radio.
- Step 2 In the RF tab, click Add. The Add RF Profile page is displayed.
- Step 3 Choose the 802.11ax tab.

Step 4 - In the 6 GHz Discovery Frames section, click the Broadcast Probe Response option.

Step 5 - In the **Broadcast Probe Response Interval** field, enter the broadcast probe response time interval in milli-seconds (ms). The value range is between 5 ms and 25 ms. The default value is 20 ms.

Step 6 - Click **Apply to Device**.

0.0	Config	uration *	> Tags & Profiles - > RF/Radio		Edit RF Profile				
C Search Mend berns	RF	Radio			General 802.11 RRM Advanced	802.11ax			
Dashboard		Add	× Deliste		6 GHz Discovery Frames 3	None Broadcast Probe Response FILS Discovery			
		State	T RF Profile Name	▼ Band					
Connguration >	0	0	default-rf-profile-6ghz	6 GHz	Broadcast Probe Response Interval (Insec)	20			
Administration	0	0	Low_Client_Density_rf_5gh	5 GHz	Multi BSSID Profile	MBSSIDprofile_test V			
~	0	0	High_Client_Density_rf_5gh	5 GHz	Spatial Persea				
C Licensing	0	0	Low_Client_Density_rf_24gh	2.4 GHz	Shangi Kense				
C Traublashanting	0	0	High_Client_Density_rf_24gh	2.4 GHz	OBSS PD	DISABLED			
S Troubleanouning	0	0	Typical_Client_Density_rf_5gh	5 GHz	Non CDC OBSC 00 May Threadedd (dDeale				
	0	0	Typical_Client_Density_rf_24gh	2.4 GHz	Non-SRG ObSS PD Max (infestiold (dbm)-	-62			
		1	i ii 10 ▼		SRG OBSS PD	DISABLED			
Walk Me Through 1					SRG OBSS PD Min Threshold (dBm)*	-82			
					SRG OBSS PD Max Threshold (dBm)*	-62			

Configure Broadcast Probe Response in RF Profile (CLI)

```
Device# configure terminal
Device(config)# ap dot11 6ghz rf-profile rf-profile-name
Device(config-rf-profile)# dot11ax bcast-probe-response
Device(config-rf-profile)# dot11ax bcast-probe-response time-interval 20
```

Verification

To verify if the configuration is in place issue the **show** command as shown here:

<#root>

WLC9800#

show ap rf-profile name default-rf-profile-6ghz detail | b 802.11ax

802.11ax OBSS PD : Disabled Non-SRG OBSS PD Maximum : -62 dBm SRG OBSS PD : Disabled SRG OBSS PD Minimum : -82 dBm SRG OBSS PD Maximum : -62 dBm

Broadcast Probe Response : Enabled Broadcast Probe Response Interval : 20 msec

FILS Discovery : Disabled Multi-BSSID Profile Name :

MBSSIDprofile_test

NDP mode : Auto Guard Interval : 800ns PSC Enforcement : Disabled

When UPR (Broadcast Probe Response) is used this is how it looks over the air:



PSC

The third discovery method in Wi-Fi 6E, which is active, is Preferred Channel Scanning (PSC). This is actually the only method by which Wi-Fi 6E client devices are allowed to send probe requests.

With 1200 MHz of spectrum and 59 new 20 MHz channels, a station with a dwell time of 100 ms per channel would require almost 6 seconds to complete a passive scan of the entire band.

With PSC, client devices are limited to send probe requests on every fourth 20 MHz channel. PSCs are spaced 80 MHz apart, so a client would only need to scan 15 channels instead of 59.

The full list of 6 GHz PSC channels is 5, 21, 37, 53, 69, 85, 101, 117, 133, 149, 165, 181, 197, 213, and 229.



PSC channels

Configure Preferred Scanning Channels in the RF Profile (GUI)

Step 1 - Choose Configuration > Tags & Profiles > RF/Radio.

Step 2 - In the **RF** tab, click **Add.** The Add RF Profile page is displayed.

Step 3 - Choose the **RRM** tab.

Step 4 - Choose the **DCA** tab.

Step 5 - In the **Dynamic Channel Assignment** section, select the required channels in **DCA Channels** section.

Step 6 - In the **PSC Enforcement** field, click the toggle button to enable the preferred scanning channel enforcement for DCA.

Step 7 - Click Apply to Device.

rh Maras hama	Configuration * >	Tags & Profiles * > RF/Radio		Edit RF Profile				
and and the second second	RF Radio			General 802.11 RRM	Advanced 802.11ax			
board -	+ Add >	C Delete		General Coverage TPC	DCA			
toring >	State Y	RF Profile Name	T Band	Dynamic Channel Assignment				
iguration >	0 0	default-rf-profile-6ghz	6 GHz	Avoid AP Foreign AP Interference				
inistration >	0 0	Low_Client_Density_rf_5gh	5 GHz	Chargel Width	O 20 MHz O 40 MHz O 80 MHz O 160 MHz			
	0 0	High_Client_Density_rf_5gh	5 GHz	Contract Tract	 Best (DBS) 			
ising	0 0	Low_Client_Density_rf_24gh	2.4 GHz	D8S Channel Width	Min 20 MHz Max Max Allowed			
aleshooting	0 0	High_Client_Density_rf_24gh	2.4 GHz					
A CONTRACTOR OF CONTRACTOR	0 0	Typical_Client_Density_rf_5gh	5 GHz	DCA Channels				
	0 0	Typical_Client_Density_rf_24gh	2.4 GHz		049 053 057 061 065 069 073 077 081 085 089			
Me Through 1					0.97 0.101 0.105 0.109 0.113 0.117 0.121 0.125 0.129 0.133 0.137 0.141 0.145 0.149 0.153 0.157 0.161 0.165 0.145 0.149 0.153 0.157 0.161 0.165 0.145 0.149 0.153 0.157 0.161 0.165			
					169 173 177 181 185 189 193 197 201 205 209 213 217 221 225 229 233			
				PSC Enforcement	ENABLE			
				PSC Channel List	5,21,37,53,69,85.101,117,133,149,165,181,197,213,229			

Configure Preferred Scanning Channels in the RF Profile (CLI)

```
Device# configure terminal
Device(config)# ap dot11 6ghz rf-profile rf-profile-name
Device(config-rf-profile)# channel psc
```

Verification

To verify if the configuration is in place issue the command as shown here:

<#root>

WLC9800#

show ap rf-profile name default-rf-profile-6ghz detail | b DCA

DCA Channel List : 1,5,9,13,17,21,25,29,33,37,41,45,49,53,57,61,65,69,73,77,81,85,89,93,97,101,105,109, Unused Channel List :

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

DCA Bandwidth : best DBS Min Channel Width : 20 MHz DBS Max Channel Width : MAX ALLOWED DCA Foreign AP Contribution : Enabled [...]

PSC Enforcement : Enabled

Here we can observe Wi-Fi 6E clients that send probe requests on PSC channel 5:

NetGear A8000

Nin	Time	Dalta	Source	Destination	Protocol	Length Change	d Googletre	a tala	10	> Frame 159500: 360 bytes on wire (2000 bits), 360 bytes captured (2000 bits) on interface \Device\WPF_(D4578905-2998-4456-8C33-C343)
100	159 2023-06-09 15:38:48.75722	6 0.00000	B Netzear 45:701	Cisco 13:001	802.11	168	5 -47 dbs	Probe Request, SNu0, FNu0, Flags,	11	Ethernet II, Src: Cisco_dd:7d:37 (00:df:1d:dd:7d:37), Ost: Universa_b7:cf:06 (00:3a:88:b7:cf:06)
	100 2021-04-09 10130-04-75540	3 0.00744	7 hetgear 48:70:	Cisco 13:88:	802.11	168	5 -47 084	Probe Request, Shit, Filed, Flags,	-112	D Internet Protocol Version 4, Src: 192.168.1.15, Dst: 192.168.1.121
	159 1011-06-09 15:18:48 78164	2 0.02184	is hetgen dirth:	Cinco 13:88:	802.11	160	5 -47 das	Probe Request, Sk-1, Ek-8, Flags, C. SSTA-"ulfild test"		User Datagram Protocol, Src Port: 5555, Ost Port: 5000
	159 1011-06-09 15-18-49 00911	0.011110	8 Natesar 48-70-	Circo 13:88:	802.11	158	5 -47 (88	Accordation Research Shut Elanta / SSTD-"widide test"		AiroPeek/OmniPeek encapsulated IEEE 002.11
	1992 1019-00-09 191901-0100999	0 01111/10	a nector _attration	cases_asterns		1.74	3 -47 000	souther adjust, set, new, repetiting, such at the core	112	> 882.11 radio information
										> IEEE 802.11 Probe Request, Flags:C
									1	✓ IEEE 802.11 Wireless Management
										 Tagged parameters (270 bytes)
										✓ Tag: SSID parameter set: "wifi6E_test"
										Tag Number: SSID parameter set (0)
										Tag length: 11
										SSID: "wifi6E_test"
										> Tag: Supported Rates 6(8), 9, 12(8), 18, 24(8), 36, 48, 54, [Nbit/sec]
										> Ext Tag: HE Capabilities
										> Tag: Vendor Specific: Hicrosoft Corp.: WPS
										> Tag: Vendor Specific: Hi-Fi Alliance: Multi Band Operation - Optimized Connectivity Experience
										✓ Tag: Extended Capabilities (10 octets)
										Tag Number: Extended Capabilities (127)
										Tag length: 10
										> Extended Capabilities: 0x01 (octet 1)
										Extended Capabilities: 0x00 (octet 2)
										> Extended Capabilities: 0x08 (octet 3)
										> Extended Capabilities: 0x00 (octet 4)
										> Extended Capabilities: exam (octet 5)
										> Extended Capabilities: exwe (octet 6)
										> Extended Capabilities: example (octet 7)
										> Extended Capabilities: ex0040 (octets 8 6 9)
										 Extended Cabellittes: example (criter 10)
										A characteristic rease
										···· Private interfere important. Frank
										1 _ THT BALANTAR SUBARTS THE
										A - With Respondent Supports from
										A
) But Tarrie Canabilities
										Y BY TWE & GOT BAN CANADILITIES
										Tag Subject Element TD Extension (255)
										fat Tag Length: 2
										Ext Tag humber: W 6 Gut Rand (anabilities (69)
										Canadilitias Televation: dvlibb
1										

Pixel 6a

No.	Time	Delta	Source	Destination	Protocol	ecot Channel	Gonal stre	re tofo		> Frame 165651: 350 bytes on wire (2000 bits), 350 bytes captured (2000 bits) on interface \Device\NFF_(D4578005-2998-4456-8C33-C34)
126	2023-06-09 16:09:25 541710	11.114821	Seferar 45:30:95	Broadcast	882.11	166	5 -44 /08	Probe Request, Shutson, Flues, Flags,		Ethernet II, Src: Cisco_dd:7d:37 (00:df:1d:dd:7d:37), Ost: Universa_b7:cf:06 (08:3a:88:b7:cf:06)
126	2023-04-09 16:09:25 549666	0.00015/	Netgear 41/20/05	Broadcast	882.11	166	5 .44 (88	Probe Request, Shat61, Flug, Flags		Internet Protocol Version 4, Src: 192.168.1.15, Ost: 192.168.1.121
126	2023-04-09 16:09:25 55044	0.000721	Netgear 41:70:95	Broadcast	882.11	166	5 .44 dbm	Probe Request, Shat62, Flug, Flags		User Datagram Protocol, Src Port: 5555, Dst Port: 5000
126	2023-06-09 16:09:25 551320	0.000571	Netgear 41:70:95	Broadcast	882.11	166	5 -44 dim	Probe Request, Sk-1663, FN-8, Flagt		AiroPeek/OmniPeek encapsulated IEEE 802.11
124	1011-06-00 16-00-10 176141	4 636831	Tetal/or 98-59-04	Broadcast	002 11	160	5 .44 48m	Droke Dewart Ch. 1001 Ch0 Elant. / CCTL.Wildrand /0		> 802.11 radio information
126	2023.06.09 16:09:30.178571	0.002233	IntelCor SE-SE-of	Broadcast	882.11	168	5 .45 (00	Probe Request, Skat002, ENaB, Elapia		IEEE 802.11 Probe Request, Flags:C
127	2023-06-09 16:00:37 073037	3.346364	Total Con States of	Broadcast	882.11	168	5 . 51 dbs	Bothe Benuect Stu-1160 Flug Flags		 IEEE 802.11 wireless Management
127	2022-06-09 16:00:32 02647	0.00171/	Total Con Stuttued	Broadcast	882.33	168	5 .51 dia	Booke Request, Smither, Files, Flags, C. SSTD-wildcard (S		 Tagged parameters (260 bytes)
137	1011-06-09 16-09-14 190900	1 364631	Total (or strikt of	Broadcast	883.33	168	5 -47 day	Broke Request, Smither, Files, C. SSTowildcard (Tag: SSID parameter set: "wifi66_test"
135	1013.06.00 16-10-16 531310	61 33336	Netrear 48-30-65	Broadcast	883.33	166	5 .45 /88	Broke Request, Statute, Flag. / SCID_"hitrard"		Tag Number: SSID parameter set (0)
135	1011.06.09 16-10-16 51100	0 000451	Netsear 48-30-05	Broadcast	002.11	166	5 .45 /88	Broke Request Studies ENLB Elast. / SCID."hliviard"		Tag length: 11
135	3033.06.09 16-10-35 \$31750	0.000022	Netsear 41-70-95	Broadcast	882.11	166	5 .45 /08	Donke Denuelt Cluston Elapt. C CCD."histored"		SSID: "wifi66_test"
115	2023.06.09 16:10:26 52516	0.00161	hetgear 41170-05	Broadcast	882.11	166	5 .45 /08	Broke Benuect, Sk-1667, FN-8, Flags		> Tag: Supported Rates 6(8), 9, 12(8), 18, 24(8), 36, 48, 54, [Hbit/sec]
144	2023.04.09 14:11:25 541124	68.835815	Netgear 41170-05	Broadcast	887.11	166	5 .45 .000	Broke Request, Sk-1838, Fa-8, Flags		 Tag: Extended Supported Rates SAE Hash to Element Only, [Hbit/sec]
144	2022-06-09 16:11:25 562020	0.000501	Netgeer 41-70-95	Broadcast	882.11	166	5 .45 dim	Broke Request, Sk-1810, Fa-8, Flags		Tag Number: Extended Supported Rates (50)
	3033 06 00 16-11-26 663001	0.000011	Network 48-38-66	Repadrant	000 11	166	5 .45 484	Broke Remark Ch. 1010 Ch0 Flags- / CCUL-Plinand*		Tag length: 1
	1011 AC AD 10-11-10 50104	0.00001	Netgeer_Net70.95	Broadcast	002.11	166	5 .45 dim	Books Bannack (0-1011 (0-0 flags- / ffth-"blingard"		Extended Supported Rates: SAE Hash to Element Only (RxFb)
	2023 OF 00 10-11-15 00370	10.00004	Tetal Con Distand	Benadicast	002.11	100	s sa des	Bothe Beneart FR-1374 FR-0 Flags. C FFTD-wildcard /		> Tag: Extended Capabilities (11 octets)
100	2023 OF 00 10:11:00 00771	0.00336	Tetal Con Builting	Broadcast	883.33	168	s se dan	Bothe Benard FR-197 FR-8 flags C FFT-411draed //		> Tag: Interworking
140.	. 1013-00-03 10:11:50.003/01	0.002339	Thereacer_personer	Broodcast.		100	5 - 56 - 684	Probe Request, Switzss, Pare, Pargswitting, Salawaladero (Ext Tag: FILS Request Parameters: Undecoded
151.	. 2023-06-09 16:12:07.176171	11.110403	Incelcor_seiserer	Broaucast	002.11	160	5 -4/ 008	Probe Request, SW41316, FRWB, Flags+	:	Tag Number: Element ID Extension (255)
151	. 2023-06-07 16:12:07.170494	0.002323	Intelcor_seiserer	Broadcast	002.11	168	5 -50 000	Probe Request, Swilli, Prive, Plagswilling, SSID-Hildcard (8	:	Ext Teg length: 2
152	. 2023-06-07 16:12:15.766/74	8.796234	Tabalian States	Broadcast	002.11	168	5 -52 088	Probe Request, Swalder, Five, Flagswilling, Silberland (:	Ext Tag Number: FILS Request Parameters (2)
192	. 2023-06-09 16:12:15.9/1020	0.00223	Intelcor_select	Broadcast	802.11	168	5 - 54 088	Probe Request, Swallel, Proe, Flagsw		Ext Tag Data: 00ff
153.	. 2023-06-09 16:12:23.90624	7.93921	IntelCor_99:59:04	Broadcast	002.11	168	5 -48 GBR	Probe Request, Smalesz, Free, Flagse		> [Expert Info (Note/Undecoded): Dissector for B02.11 Extension Tag (FILS Request Parameters) code not implemented, Contac
153.	. 2023-06-09 16:12:23.500403	0.002235	1/telcor_98:58:07	Broadcast	802.11	168	5 -Se dem	Probe Request, SNx1453, FNx0, Flags+C, SSID+Hildcard (B	•	> Ext Tar: HE Cacabilities
154.	. 2023-06-09 16:12:25.504851	1.996370	5 Netgear_48170195	Broadcast	802.11	166	5 -44 GBM	Probe Request, SN#1962, FN#0, Flags*C, SSID*-011218r0-		Y EXT Tag: HE & GH: Band Canabilities
154	. 2023-06-09 16:12:25.505710	0.000051	s netgear_48170195	Broadcast	802.11	166	5 -64 GBR	Probe Request, SN+1963, PN+0, Plags+C, SSID+"011218rd"		Tag Number: Element ID Extension (255)
154	2023-06-09 16:12:25.506499	0.00078	1 Netgear_48170195	Broadcast	882.11	166	5 -45 GER	Probe Request, SN=1964, PR=0, Plags=C, SSID="Dilitard"		Ext Tag length: 2
154.	. 2023-06-09 16:12:25.507325	0.000021	Netgear_40:70:95	Broadcast	802.11	166	5 -45 den	Probe Request, SN+1965, Physe, Plags=C, SSID+ Dilling-		Ext Tag Number: HE 6 GHz Band Capabilities (59)
154.	. 2023-06-09 16:12:26.6180/1	1.110/54	Intelcor_seiserer	Broadcast	002.11	168	5 -52 dem	Probe Request, SN#1524, Fnwe, Flags#,C, SSID+Hildcard (8		Capabilities Information: BxBbbe
154.	. 2023-06-09 16:12:26.619620	0.00154	Intelcor_seiserer	Broadcast	002.11	168	5 -54 dbm	Probe Request, SWH1525, FRWD, Flagswilling, SSIDWH110Card (8		
155.	. 2023-06-09 16:12:29.708620	3,05900	sinteicor_seiseier	Broadcast	802.11	168	5 -46 088	Probe Request, SW#1506, PN#0, Plags#C, SSID#HildCard (8		
155.	. 2023-06-09 16:12:29.715971	0.007345	intelcor_98:58:09	Broadcast	802.11	168	5 -49 GBR	Probe Request, SN#1587, FN#0, Flags*		10 = Maximum MPDU Length: 11 454 (0x2)
156.	. 2023-06-09 16:12:32.994/84	3.27881	1/1CE1COF_98:58:09	Broadcast	882.11	168	5 -51 CBR	Probe Request, SN+1652, PN+8, Plags+,C, SSID+Hildcard (8		
156.	. 2023-06-09 16:12:32.99/150	0.002377	1/101Cor_98158104	Broadcast	842.11	168	5 -54 GER	Probe Request, SN-1653, Prive, Flags		
157.	. 2023-06-09 16:12:37.063164	4.055000	14celcor_98:58:04	Broadcast	002.11	168	5 -46 GBM	Probe Request, Swatere, Priegse		e = RD Responder: Not supported
163.	. 2023-06-09 16:13:19./34420	42.6/120	azieeiezidsiaziee	Broadcast	002.11	132	5 - 39 000	Probe Request, Sweete, Fixe, Flagse	c	
164	. 2023-06-07 16:13:25.523210	5.788784	Netgeer_48170195	Broadcast	002.11	106	5 -45 088	Probe Request, Swatere, Files		TX Antenna Pattern Consistency: Not supported
164	. 2023-06-07 16:13:25.523764	0.000777	inergear_48170195	Broadcast	802.11	100	5 -45 088	Probe Request, Swageyr, Priessenting, State Ulizard		00 = Reserved; 0x0
164	. 2023-06-09 16:13:25.524990	0.001010	s netgear_41:70:95	Broadcast	802.11	166	s ws den	Probe Request, Swappe, Priess. Figs.		¥ Ext Tag: Short SSID
194	. 2023-06-09 16:13:25.52616	0.00110	vietgear_4a:/e.ys	Broadcast	842.11	166	5 -45 GER	Probe Request, Shazerry, Phile, Plagsa		Tag Number: Element ID Extension (255)
105.	. 2023-06-09 16:13:32.55/265	7.031090	Google_/2:08:00	Broadcast	002.11	350	5 -38 088	Proce Request, SHAID, Prive, Plagsa		Ext Tag length: 4
101	. 2023-06-09 16:13:52.4/0230	19.91296	s usegle_/2:ea:06	Broadcast	002.11	135	5 -45 008	Probe Request, Swape, Pixe, Flags		Ext Tag Number: Short SSID (58)
187.	. 2023-06-07 16:14:05.067393	12.59716	Intellor_9615810f	Broducast	002.11	100	5 -50 088	Prove Request, SH#1/47, FRME, FlagS+C, SSID+H110CAFG (Short #SSID: #xbd1c2eb5
187.	. 2023-00-07 16:14:05.069615	0.002211	Anteator_20158101	Broaucast	002.11	100	5 -53 088	Prove Request, Smal/Se, Files, Files	•	> Tag: vendor Specific: Microsoft Corp.; WPS
191	. 2023-00-07 16:14:25.554976	20.405363	vergeer_mai/0:95	Broadcast	002.11	100	s ins den	Prove Request, Smaller, Fine, Flags		> Tag: Vendor Specific: wi-Fi Alliance: P2P
191	. 2023-00-07 16:14:25.555590	0.000614	Netgear_40170195	Broadcast	882.11	100	5 -45 den	Proce Request, Smallsl, Fine, Flags		> Tag: Vendor Specific: wi-Fi Alliance: Hotspot 2.0 Indication
191.	2023-06-07 16:14:25.556505	0.000919	weigear_40:70:95	erosocast	002.11	100	> -45 dBm	Probe Request, SH#2232, FRWD, Flags+C, SSID+"Billiard"		> Tag: Vendor Specific: Hicrosoft Corp.: Unknown 8
191.	2023-06-09 16:14:25.557345	0.000534	Netgear_4s:70:95	prosocast	002.11	166	5 -45 dBR	Probe Request, SN#2233, FN#0, FlagS#C, SSID#"011218rd"		> Tag: vendor Specific: Broadcom
192.	2023-06-07 16:14:26.967711	1.410364	intercor_s815810f	Broadcast	882.11	168	5 -47 den	Probe Request, SN+1817, FN+0, Flags+C, SSID+Hildcard (> Tag: vendor Specific: wi-Fi alliance: multi Band Operation - Optimized Connectivity Experience
192	2023-06-09 16:14:26.970270	0.002565	Turefron 38:28:64	propocast	002.11	365	5 149 GBR	Probe Request, SN+1818, PR+0, F18ES+C, SSID+H11dcard (8)		

Samsung S23

No. Time	Dalta Source	Destination	Destand	Lengt Change	Consel etc	. Info				> Frame 65924: 164 bytes on wire (1312 bits), 164 bytes captured (1312 bits) on interface \Device\NPF_(D4578985-2998-4456-8C33-C]4316
	Dela Dource	Destriction	FIDUDED	cerge charte	agra se	e any	FR. 633 FR. 6	diam.	tern this sector	> Ethernet II, Src: Cisco.dd:7d:37 (00:df:1d:dd:7d:37), Dst: Universa b7:cf:06 (00:3a:88:b7:cf:06)
620 2023-06-09 16:02:25.542	ver eveneee wetgeer_wetrets	Broadcast	002.11	100	5 -45 008	Probe Request,	50+622, 70+0,	flags.	SSIDe Ulizzero	> Internet Protocol Version 4, Src: 192.168.1.15, Dat: 192.168.1.121
621 2023-06-07 16102125-543	saz evenen//s neugear_wai/aiss	Broducast	002.11	100	5 -45 000	Probe Request,	500623, 7000,	flags.	SSIDe Ulizzero	> User Datagram Protocol, Src Port: 5555, Ost Port: 5000
Chi 2023-00-07 101021251544	100 Creeking and 10	Er cepterst	002.11	100	5 45 400	Frobe Request,	succes such	Class. C	CID Thissard	> AiroPeek/OmniPeek encapsulated IEEE 802.11
024 2023-00-07 20102123-345	and an analysis helpest warrants	Broadcast	002.11	100	5 145 088	Probe Request,	500025, 7000,	Flags	SSADE USALLETU	> 802.11 radio information
9421 2023-06-09 16:02:47.759	the a sector relation sector	Broadcast	002.11	100	5 .44 000	Probe Request,	510-101, Filed,	Flags	ssibwalldcard (area	> IEEE 802.11 Probe Request, Flags:C
9422 2023-06-09 16:02:47.761	285 e.vezzes intelcor_seiserer	Broducast	002.11	100	5 -46 000	Probe Request,	500102, FR00,	Pargas	SSIDHHILDCBrD (Brow	V IEEE D02.11 Wireless Management
128. 2023-06-09 16:02:51.445	505 3.664339 IntelCor_98158107	Broadcast	002.11	168	5 -52 008	Probe Request,	55+345, FA+0,	F1885*	SSID+Hildcard (Brow	Tagged parameters (74 bytes)
128. 2023-06-09 16:02:51,447	505 0.002197 IntelCor_98158107	Broadcast	802.11	165	5 -54 con	Probe Request,	55+346, FA+0,	F18g5*	SSID+HILDCARD (Brow	> Tag: SSID parameter set: wildcard SSID
225. 2023-06-09 16:03:25.545	589 34.097784 Netgear_48:70:95	Broadcast	802.11	166	5 -47 088	Probe Request,	55+756, FR+0,	Fiegs+	551D+ 011228rd	> Tag: Supported Rates 6, 9, 12, 18, 24, 36, 48, 54, [Mbit/sec]
225. 2023-06-09 16:03:25-545	erooooo verbes."+e:ve.aa	Broacast	802.11	166	5 -47 GER	Probe Request,	30x757, FRed,	*18g3*	2210+ 011118rd.	Tas: Extended Canabilities (11 octets)
226. 2023-06-09 16:03:25.545	559 0.000000 Netgear_48:70:95	Broadcast	802.11	166	5 -40 dom	Probe Request,	SN#758, FN#0,	F18g1+C,	SSID+"01122ard"	Tar Number: Extended Gasabilities (127)
226. 2023-06-09 16:03:25.545	509 0.000000 Netgear_40:70:95	Broadcast	002.11	166	5 -47 dom	Probe Request,	She759, Flee,	F18g5+C,	SSID+"01122ard"	Tag length: 11
414_ 2023-06-09 16:04:02.310	242 36.764653 IntelCor_98158101	Broadcast	802.11	168	5 -44 008	Probe Request,	She409, Flee,	V1885*C,	SSID+H110card (Brow	> Evtended Canabilities: dvda (oftet 1)
414. 2023-06-09 16104102.312	552 0.002310 IntelCor_98:58:0f	Broadcast	802.11	168	5 -47 088	Probe Request,	SNe410, FNe0,	Flags=C,	SSID=Wildcard (Brow	> Extended Capabilities: dvdb (octet 2)
422. 2023-06-09 16:04:05.183	773 2.871221 IntelCor_98:58:0f	Broadcast	802.11	168	5 -55 d8n	Probe Request,	SN+534, FN+0,	Flags=C,	SSID=Wildcard (Brow) Extended Capabilities: dvda (octat 1)
422. 2023-06-09 16:04:05.106	647 @.002274 IntelCor_98:58:0f	Broadcast	802.11	168	5 -57 dim	Probe Request,	SN+535, FN+0,	Flags+C,	SSID+Wildcard (Brow	Subtracted compatibilities and contact as
481. 2023-06-09 16:04:25.622	592 20.436545 Netgear_48:70:95	Broadcast	802.11	166	5 -46 d0n	Probe Request,	SN+890, FN+0,	FlagiC,	SSID+"blizzard"	> Extended Control Web (Vite 4)
481. 2023-06-09 16:04:25.623	258 0.000666 Netgear_48:70:95	Broadcast	802.11	166	5 -47 dbm	Probe Request,	SN+891, FN+0,	Flags+C,	SSID+"olizzard"	> Exclusion opportunities, while (court of
481., 2023-06-09 16:04:25.624	360 0.001102 Netgear_48:70:95	Broadcast	802.11	166	5 -47 088	Probe Request,	SN+892, FN+0,	Flags+C,	SSID="blizzard"	> stended capacities: exem (otter a)
481. 2023-06-09 16:04:25.624	069 0.000509 Netgear_48:70:95	Broadcast	802.11	166	5 -46 d8m	Probe Request,	SN+893, FN+0,	FlagsC, 1	SSID="blizzard"	> Extended Capabilities: ex40 (offet 7)
481. 2023-06-09 16:04:25.885	143 0.260274 IntelCor_98:58:0f	Broadcast	802.11	168	5 -47 d8m	Probe Request,	SN=578, FN=0,	Flags	SSID=Wildcard (Bro	> Extended Capabilities: existe (cotets 8 & 9)
659 2023-06-09 16:05:19.040	282 53.155139 SamsungE_c9:e3:71	Broadcast	802.11	172	5 -60 d0m	Probe Request,	SN+131, FN+0,	Flagia	SSID+00	 Extended Capabilities: excl (octet 10)
659. 2023-06-09 16:05:19.041	579 0.001297 SamsungE_c9:e3:71	Broadcast	802.11	164	5 -60 don	Probe Request,	SN+132, FN+0,	Flagis	SSID+Wildcard (Brow	1 = FILS Capable: True
659. 2023-06-09 16:05:19.042	091 0.001312 SamsungE_c9:e3:71	Broadcast	802.11	164	5 -68 d88	Probe Request,	SN+133, FN+0,	#lags+C, 1	SSID+Wildcard (Brow	
659., 2023-06-09 16:05:19.044	213 0.001322 SamsungE_c9:e3:71	Broadcast	802.11	164	5 -60 dbn	Probe Request,	SN+134, FN+0,	Flags+	SSID+Wildcard (Brow	
659. 2023-06-09 16:05:19.060	095 0.015882 SamsungE_c9:e3:71	Broadcast	802.11	172	5 -59 d8m	Probe Request,	SN+135, FN+0,	Flags+	SSID+80	0 = Reserved: 0x0
659. 2023-06-09 16:05:19.060	913 0.000018 SamsungE_c9:e3:71	Broadcast	802.11	164	5 -61 d8m	Probe Request,	SN+136, FN+0,	Flag1+	SSID+Wildcard (Brow	# Reserved: 0x0
659. 2023-06-09 16:05:19.061	998 0.001085 SamsungE c9:e3:71	Broadcast	802.11	164	5 -61 d0m	Probe Request.	SN+137, FN+0,	Flags	SSID+Wildcard (Brow	* TwT Requester Support: True
659, 2023-06-09 16:05:19,063	830 0.001032 SamsungE (9:e3:71	Broadcast	802.11	164	5 -61 008	Probe Request.	SN+138, FN+0,	Flatte	SSID+Wildcard (Brow	.0 = TwT Responder Support: False
670, 2023-06-09 16:05:23,619	198 4,556168 IntelCor 98:58:0f	Broadcast	802.11	168	5 -51 008	Probe Request.	SN+635, FN+0,	F1865+	SSID-Wildcard (Brow	0 + OBSS Narrow Bandwidth RU in UL OFDHA Tolerance Support: False
670. 2023-06-09 16:05:23.621	437 0.002239 IntelCor_98:58:0f	Broadcast	802.11	168	5 -54 dbm	Probe Request,	SN=636, FN=0,	F1865+	SSID-Wildcard (Brow	> Extended Capabilities: 0x20 (octet 11)
672. 2023-06-09 16:05:25.530	164 1.900927 Netgear 48:70:95	Broadcast	802.11	166	5 -47 d8m	Probe Request,	5N+1024, FN+0	, Flags	SSID="blizzard"	> Tag: Vendor Specific: Microsoft Corp.: Unknown 8
672. 2023-06-09 16:05:25,532	117 0.001753 Netgear 40:70:95	Broadcast	882.11	166	5 -47 dim	Probe Request.	SN+1025, FN+0	Flatte	SSID+"blizzard"	✓ Ext Tag: HE Capabilities
672. 2023-06-09 16:05:25,532	117 0.000000 Netgear 40:70:95	Broadcast	882.11	166	5 -47 dbn	Probe Request.	SN+1026, FN+0	Flatte	SSID+"blizzard"	Tag Number: Element ID Extension (255)
672 2023-06-09 16:05:25,532	141 0.000724 Netgear 48:70:95	Broadcast	802.11	166	5 -47 dbm	Probe Request.	SN+1027, FN+0	Flags	SSID+"Blizzard"	Ext Tag length: 32
687 2023-06-09 16105132-250	(42 6.717851 Samural (914)171	Broadcast	882.11	172	5 .66 ctm	Probe Request.	SNa157, ENall-	flatta	\$51D+88	Ext Tag Number: HE Capabilities (35)
687. 2023-06-09 16:05:32.251	661 0.000969 Santungi (9:e3:71	Broadcast	882.11	164	5 .64 088	Probe Request.	SNa158, FNa0,	Flatte	SSID-Wildcard (Brow	> HE HAC Capabilities Information: 0x0040da10010f
687. 2023-06-09 16:05:32.252	114 0.001273 SamtuneE c9:e3:71	Broadcast	882.11	164	5 -64 dim	Probe Request.	SN+159, FN+0.	Flatte	SSID-Wildcard (Bro	> HE PMY Capabilities Information
687. 2023-06-09 16:05:32.254	216 0.001282 SamtuneE c9:e3:71	Broadcast	882.11	164	5 -64 dam	Probe Request.	SN+160, FN+0.	Flatte	SSID-wildcard (Bro	> Supported HE-MCS and MSS Set
687 2021-06-09 16:05:12 220	CEA & BIELES CARLINSE (SIA1:71	Broadrast	882.11	172	5 .64 /04	Prohe Benuest	SN-161 EN-0	Elatia C	CCTD-BA	> PPE Thresholds
687 2023-06-09 16:05:32.271	the a datter familie chief171	Broadcast	882.11	164	5 .45 .000	Probe Request,	SN-162, FN-0,	flatte	SSTD-Wildrard (Brow	✓ Ext Tag: HE 6 GH2 Band Capabilities
687 2022-06-09 16:05:32.273	Add & Addible Samural chieling	Broadcast	882.11	164	5 .44 084	Probe Request,	SN-163, FN-0,	flatte	SSTD-Wildcard (Bro	Tag Number: Element ID Extension (255)
687 3833-86-89 16:85:33 334	And Addiest Samural chiral 71	Broadcast	882.11	164	5 -66 084	Brobe Request,	SN-164 EN-R	flatta (SSTD-Wildcard (Bro	Ext Tag length: 2
CET 1011 0C 00 10105111 101	(1) A 112(5) Camping (dira):31	Broadcast	000.11	104	5 . 66 . 684	Broke Requests	51-165 51-0	flagt- (CETD-TOR-STD' SCRAP	Ext Tag Number: HE 6 GHZ Band Capabilities (59)
704 2023 00 00 10 00 10 00	the statest sense chief.	Er OBOCESC.	002.11	177	5 - 64 - 684	Probe Request,	500100, FR00,	Flags. C	South decars because	 Capabilities Information: exemption
704. 2023-00-09 20.09.49.299	the streetest personal contract	Brook ask		4/4	1 10 100	Prove Request,	surger, rare,	show a	sauney	
704. 2023-06-07 16:05:45.200	and a address sensings_coles:/1	Recentract	883.12	164	1 .44 Cm	Booha Request,	FN-105, FR-0,	flagr.	FETD-Wildcard (Brow	
704. 2023-00-07 10:05:45.261	err eveneni sensungs_crid3171	erosocast	002.11	104	2 -00 008	Probe Request,	344100, FRied,	* ang3*	sau-Hildceru (8ro	10
/04. 2023-06-09 16:05:45.261	746 0.000731 SensingE_(9163171	prosocast	002.11	104	5 -65 088	Probe Request,	5%+107, FN+0,	flagsC,	221040110/9/0 (8/0)	
705. 2023-06-09 16:05:45.200	275 W.WIDJ47 SemSUngE_C9163171	Broadcast	002.11	172	5 -64 088	Probe Request,	5%+100, FN+0,	Flagsson C,	SSID-00	
705. 2023-06-09 16:05:45.281	site eventies sensings_c9:03:71	Broadcast	002.11	104	5 -64 088	Probe Request,	30+107, FRe0,	* segs*	samestaceug (euo	e
/05. 2023-06-09 16:05:45.283	zie e.eeloiz samsungs_c9:63:71	erosocast	802.11	164	5 -64 clin	Probe Request,	ane190, Fried,	*segs*	sourweilideard (Broi	
/05. 2023-06-09 16:05:45.284	esz e.ee0042 sansungs_c9:63:71	eroaccast	002.11	164	> -65 088	Probe Request,	ane191, Fried,	*segs*C,	sourweilideaug (Broi	
										00 Reserved: ava
1										

Intel AX211



6-GHz Client Steering

The 6-GHz band provides more channels, more bandwidth, and has less network congestion when compared to the existing 2.4-GHz and 5-GHz bands.

As a result, wireless clients that are 6-GHz capable connect to the 6-GHz radio to take advantage of these benefits.

This topic provides details about 6-GHz client steering for APs supporting 6-GHz band.

The 6-GHz client steering takes place when the controller receives a periodic client statistics report from the 2.4-GHz band or the 5-GHz band.

The client steering configuration is enabled under WLAN, and is configured only for clients that are 6-GHz capable.

If a client in the report is 6-GHz capable, then client steering is triggered, and the client is steered to the 6-GHz band.

Please find more about Band-Steering for Dual-Band Wi-Fi Access Points in the document "Qualcomm Research Band-Steering for Dual-Band Wi-Fi Access Points".

The Steering Mechanism

To start steering a client, the AP first disassociates with the client on a particular band, and then blocks that client from re-associating on that band for a period of time.

Once disassociated, the client briefly tries to reassociate with the AP on the same SSID and on the same band as the last association before scanning for other AP or band options.

Most Wi-Fi clients scan both bands by sending Probe Requests and estimate the downlink signal strength from the Probe Responses which also indicate the AP's readiness to re-associate.

Since this scanning and re-association behavior is completely client implementation dependent, some clients can steer faster than others.

It is possible that some clients do not steer, and keep trying to re-associate with the original (blocked) band or just choose to disassociate from Wi-Fi altogether and attempt to re-associate only when they have packets to send.

Steering Caution

Care needs to be taken at the AP to prevent such steering-unfriendly clients from getting blocked at the AP, in which case user intervention can be needed to restore the Wi-Fi connection.

User intervention can be as simple as toggling the Wi-Fi on/off. Clearly such user interventions are not desirable. Therefore, the design errs on the conservative side.

If a client cannot be steered or a steering attempt fails, the AP lets the client re-associate with the original band as opposed to risking the client being blocked from the AP for an extended period of time.

Since the client is only steered when idle, there is no interruption to the user traffic.

Configuring 6-GHz Client Steering in the Global Configuration Mode (GUI)

Step 1 - Choose Configuration > Wireless > Advanced.

Step 2 - Click the 6 GHz Client Steering tab. Client steering is configurable per WLAN.

Step 3 - In the **6 GHz Transition Minimum Client Count** field, enter a value to set the minimum number of clients for client steering. The default value is three clients. The value range is between 0 and 200 clients.

Step 4 - In the **6 GHz Transition Minimum Window Size** field, enter a value to set the minimum window size of client steering. The default value is three clients. The value range is between 0 and 200 clients. Step 5 - In the **6 GHz Transition Maximum Utilization Difference** field, enter a value to set the maximum utilization difference for steering. The value range is between 0 percent to 100 percent. The default value is 20.

Step 6 - In the **6 GHz Transition Minimum 2.4 GHz RSSI Threshold** field, enter a value to set the minimum value for client steering 2.4-GHz RSSI threshold.

Step 7 - In the **6 GHz Transition Minimum 5 GHz RSSI Threshold** field, enter a value to set the minimum value for client steering 5-GHz RSSI threshold. Step 8 - Click **Apply**.

🕫 🛕 🖺 🏟 🔞 🥹 🎜 Search APs and Clients 🔍 🛛 🖀 Feedback 💒 🗭 Cisco Catalyst 9800-CL Wireless Controller Config Show Me How S* > Advanced Dashboard Load Balancing Band Select Optimized Roaming High Density Preferred Calls 6 GHz Client Steering (2) Monitoring Apply 6 GHz Client Steering (i) 6 GHz Transition Minimum Client Count* 3 6 GHz Transition Minimum Window Size* 3 C Licensing 6 GHz Transition Maximum Utilization Difference (%)* 20 Y Troublesho 6 GHz Transition Minimum 2.4 GHz RSSI Threshold (dBm) -60 6 GHz Transition Minimum 5 GHz RSSI Threshold (dBm)

Configuring 6-GHz Client Steering in the Global Configuration Mode (CLI)

```
Device# configure terminal
Device(config)# client-steering client-count 3
Device(config)# client-steering window-size 5
Device(config)# wireless client client-steering util-threshold 25
Device(config)# wireless client client-steering min-rssi-24ghz -70
Device(config)# wireless client client-steering min-rssi-5ghz -75
```

Configure 6-GHz Client Steering on the WLAN (GUI)

- Step 1 Choose Configuration > Tags & Profiles > WLANs.
- Step 2 Click Add. The Add WLAN page is displayed.
- Step 3 Click the Advanced tab.
- Step 4 Check the 6 GHz Client Steering check box to enable client steering on the WLAN.
- Step 5 Click **Apply to Device**.



Configure 6-GHz Client Steering on the WLAN (CLI)

Device# configure terminal Device(config)# wlan wlan-name *id ssid-name* Device(config-wlan)# client-steering

Verification

To verify if the configuration is in place issue the command as shown here:

<#root>

WLC9800#

show wireless client steering

```
Client Steering Configuration Information
Macro to micro transition threshold : -55 dBm
Micro to Macro transition threshold : -65 dBm
Micro-Macro transition minimum client count : 3
```

```
Micro-Macro transition client balancing window : 3
 Probe suppression mode : Disabled
 Probe suppression transition aggressiveness : 3
 Probe suppression hysteresis : -6 dB
 6Ghz transition minimum client count : 3
 6Ghz transition minimum window size : 3
 6Ghz transition maximum channel util difference : 20%
 6Ghz transition minimum 2.4Ghz RSSI threshold : -60 dBm
 6Ghz transition minimum 5Ghz RSSI threshold : -65 dBm
WLAN Configuration Information
WLAN Profile Name 11k Neighbor Report 11v BSS Transition
_____
                                       _____
    wifi6E_test Enabled
wifi6E_test_01 Enabled
                                    Enabled
5
                                      Enabled
6
7
    wifi6E_test_02 Enabled
                                      Enabled
WLC9800#
show wlan id 5 | i Client Steering
```

```
6Ghz Client Steering : Enabled
```

Client Connectivity

In this section it is shown the process OTA of each client connecting to the WLAN.

The lab was with these conditions:

- Clients and APs were ~1 meter in line of sight without obstructions.
- All APs broadcasting WLAN with Channel Width of 160MHz and power level 1.
- The client devices were switched on the same VLAN as the iperf server.
- All APs connected via 1Gbps link.

✓ 6 GHz Radios																			
Total 6 GHz radios : 4 🖸																			
AP Name	1	Slot No		Base Radio MAC	÷	Admin Status	1	Operation Status	1	Policy Tag 👃	÷	Site Tag	:	RF Tag	÷	Channel Width	Channel :	Power Level 0	:
AP9166_0E.6220	Let	2		7411.b2d2.9740		•		0		Wifi6E_TestPolicy		TiagoHomePTAPs		default-rf-tag		160 MHz	(69,65,73,77,81,85,89,93)*	*1/8 (19 dBm)	
AP9162_53.CA50	Lett.	2		3891.b713.80e0		•		0		Wifi6E_TestPolicy		TiagoHomePTAPs		default-rf-tag		160 MHz	(5,1,9,13,17,21,25,29)*	*1/8 (17 dBm)	
AP9135_5C.F524	Lat	3		00df.1ddd.7d30		0		0		Wih6E_TestPolicy		TiagoHomePTAPs		default-rf-tag		160 MHz	(53,49,57,61,33,37,41,45)*	*1/8 (16 dBm)	

Tests with AP 9166

NetGear A8000

Client details in WLC:

<#root>

#show wireless client mac-address 9418.6548.7095 detail

```
Client MAC Address : 9418.6548.7095
[...]
Client IPv4 Address : 192.168.1.163
[...]
```

AP MAC Address : 7411.b2d2.9740 AP Name: AP9166_0E.6220 AP slot : 2 Client State : Associated Policy Profile : Policy4TiagoHome Flex Profile : TiagoHomeFlexProfile Wireless LAN Id: 5 WLAN Profile Name: wifi6E_test Wireless LAN Network Name (SSID): wifi6E_test BSSID : 7411.b2d2.9747 Connected For : 1207 seconds Protocol : 802.11ax - 6 GHz Channel : 69 [...] Current Rate : m11 ss2 Supported Rates : 54.0 [...] Policy Type : WPA3 Encryption Cipher : CCMP (AES) Authentication Key Management : SAE AAA override passphrase : No SAE PWE Method : Hash to Element(H2E) [...] Protected Management Frame - 802.11w : Yes EAP Type : Not Applicable [...] [...] FlexConnect Data Switching : Local FlexConnect Dhcp Status : Local FlexConnect Authentication : Local Client Statistics: Number of Bytes Received from Client : 1026751751 Number of Bytes Sent to Client : 106125429 Number of Packets Received from Client : 793074 Number of Packets Sent to Client : 184944 Number of Policy Errors : 0 Radio Signal Strength Indicator : -44 dBm

Signal to Noise Ratio : 49 dB

[...] Device Classification Information:

```
Device Type : Microsoft-Workstation
```

Device Name : CSCO-W-xxxxxx

Protocol Map : 0x000029 (OUI, DHCP, HTTP) Device OS : Windows NT 10.0; Win64; x64

Pixel 6a

Client details in WLC:

<#root>

#show wireless client mac-address 2495.2f72.8a66 detail Client MAC Address : 2495.2f72.8a66 [...] Client IPv4 Address : 192.168.1.162 [...] AP MAC Address : 7411.b2d2.9740 AP Name: AP9166_0E.6220 AP slot : 2 Client State : Associated Policy Profile : Policy4TiagoHome Flex Profile : TiagoHomeFlexProfile Wireless LAN Id: 5 WLAN Profile Name: wifi6E_test Wireless LAN Network Name (SSID): wifi6E_test BSSID : 7411.b2d2.9747 Connected For : 329 seconds Protocol : 802.11ax - 6 GHz Channel : 69 Client IIF-ID : 0xa000000a Association Id : 33 Authentication Algorithm : Open System [...] Current Rate : 6.0 Supported Rates : 61.0 [...] Policy Type : WPA3 Encryption Cipher : CCMP (AES) Authentication Key Management : SAE AAA override passphrase : No

[...] Protected Management Frame - 802.11w : Yes EAP Type : Not Applicable [...] Session Manager: Point of Attachment : capwap_90000025 IIF ID : 0x9000025 Authorized : TRUE Session timeout : 86400 Common Session ID: 0000000000171BC51FF477 Acct Session ID : 0x0000000 Auth Method Status List Method : SAE Local Policies: Service Template : wlan_svc_Policy4TiagoHome (priority 254) VLAN : default Absolute-Timer : 86400 Server Policies: **Resultant Policies:** VLAN Name : default VLAN : 1 Absolute-Timer : 86400 [...] FlexConnect Data Switching : Local FlexConnect Dhcp Status : Local FlexConnect Authentication : Local Client Statistics: Number of Bytes Received from Client : 603220312 Number of Bytes Sent to Client : 72111916 Number of Packets Received from Client : 461422 Number of Packets Sent to Client : 107888 Number of Policy Errors : 0 Radio Signal Strength Indicator : -45 dBm Signal to Noise Ratio : 48 dB [...] Device Classification Information: Device Type : Android-Google-Pixel Device Name : Pixel-6a Protocol Map : 0x000029 (OUI, DHCP, HTTP) Device OS : X11; Linux x86_64

SAE PWE Method : Hash to Element(H2E)

Samsung S23

Client details in WLC:

<#root>

#show wireless client mac-address 0429.2ec9.e371 detail Client MAC Address : 0429.2ec9.e371 [...] Client IPv4 Address : 192.168.1.160 [...] AP MAC Address : 7411.b2d2.9740 AP Name: AP9166_0E.6220 AP slot : 2 Client State : Associated Policy Profile : Policy4TiagoHome Flex Profile : TiagoHomeFlexProfile Wireless LAN Id: 5 WLAN Profile Name: wifi6E_test Wireless LAN Network Name (SSID): wifi6E_test BSSID : 7411.b2d2.9747 Connected For : 117 seconds Protocol : 802.11ax - 6 GHz Channel : 69 Client IIF-ID : 0xa0000002 Association Id : 33 Authentication Algorithm : Open System [...] Current Rate : 6.0 Supported Rates : 54.0 [...] Policy Type : WPA3 Encryption Cipher : CCMP (AES) Authentication Key Management : SAE AAA override passphrase : No SAE PWE Method : Hash to Element(H2E) [...] Protected Management Frame - 802.11w : Yes EAP Type : Not Applicable [...] Session Manager: Point of Attachment : capwap_90000025 IIF ID : 0x9000025 Authorized : TRUE

Session timeout : 86400

Common Session ID: 00000000001713C518E305 Acct Session ID : 0x0000000 Auth Method Status List Method : SAE Local Policies: Service Template : wlan_svc_Policy4TiagoHome (priority 254) VLAN : default Absolute-Timer : 86400 Server Policies: **Resultant Policies:** VLAN Name : default VLAN : 1Absolute-Timer : 86400 [...] FlexConnect Data Switching : Local FlexConnect Dhcp Status : Local FlexConnect Authentication : Local Client Statistics: Number of Bytes Received from Client : 550161686 Number of Bytes Sent to Client : 5751483 Number of Packets Received from Client : 417388 Number of Packets Sent to Client : 63427 Number of Policy Errors : 0 Radio Signal Strength Indicator : -52 dBm Signal to Noise Ratio : 41 dB [...] Device Classification Information: Device Type : Android-Device Device Name : Galaxy-S23 Protocol Map : 0x000029 (OUI, DHCP, HTTP) Intel AX211 Client details in WLC: <#root>

#show wireless client mac-address 286b.3598.580f detail Client MAC Address : 286b.3598.580f [...] Client IPv4 Address : 192.168.1.159 [...] AP MAC Address : 7411.b2d2.9740 AP Name: AP9166_0E.6220 AP slot : 2 Client State : Associated Policy Profile : Policy4TiagoHome Flex Profile : TiagoHomeFlexProfile Wireless LAN Id: 5 WLAN Profile Name: wifi6E_test Wireless LAN Network Name (SSID): wifi6E_test BSSID : 7411.b2d2.9747 Connected For : 145 seconds Protocol : 802.11ax - 6 GHz Channel : 69 Client IIF-ID : 0xa0000001 Association Id : 35 Authentication Algorithm : Open System [...] Current Rate : 6.0 Supported Rates : 54.0 AAA QoS Rate Limit Parameters: QoS Average Data Rate Upstream : (kbps) QoS Realtime Average Data Rate Upstream : (kbps) QoS Burst Data Rate Upstream : (kbps) QoS Realtime Burst Data Rate Upstream : (kbps) QoS Average Data Rate Downstream : (kbps) QoS Realtime Average Data Rate Downstream : (kbps) QoS Burst Data Rate Downstream : (kbps) QoS Realtime Burst Data Rate Downstream : (kbps) [...] Policy Type : WPA3 Encryption Cipher : CCMP (AES) Authentication Key Management : SAE AAA override passphrase : No SAE PWE Method : Hash to Element(H2E) [...] Protected Management Frame - 802.11w : Yes [...] Session Manager: Point of Attachment : capwap_90000025 IIF ID : 0x9000025 Authorized : TRUE Session timeout : 86400 Common Session ID: 0000000000171CC520478F Acct Session ID : 0x0000000 Auth Method Status List Method : SAE Local Policies: Service Template : wlan_svc_Policy4TiagoHome (priority 254) VLAN : default Absolute-Timer : 86400 Server Policies: Resultant Policies: VLAN Name : default VLAN : 1 Absolute-Timer : 86400 [...] FlexConnect Data Switching : Local FlexConnect Dhcp Status : Local FlexConnect Authentication : Local Client Statistics: Number of Bytes Received from Client : 335019921 Number of Bytes Sent to Client : 3315418 Number of Packets Received from Client : 250583 Number of Packets Sent to Client : 38960 Number of Policy Errors : 0 Radio Signal Strength Indicator : -54 dBm Signal to Noise Ratio : 39 dB [...] Device Classification Information: Device Type : LENOVO 21CCS43W0T Device Name : CSCO-W-xxxxxxx

```
Protocol Map : 0x000429 (OUI, DOT11, DHCP, HTTP)
Device OS : Windows 10
```

Here you can observe the network details provided by each client:

NetG	earA8000	P	ixel 6	a	Samsu	ng S23	Intel AX211			
Name:	A8000_NETGEAR	A101 🌢		0	18:01 🛋 🎯	15 A 99%∎				
Description: Physical address (MAC):	NETGEAR A8000 WiFi 6 & 6E Adapter	€		,	<		Name:	Wi-Fi		
Status:	Operational	Network details			wifi6E	E_test	Description: Physical address (MAC):	Intel(R) Wi-Fi 6E AX211 160MHz 28:6b:35:98:58:0f		
Maximum transmission unit: Link speed (Receive/Transmit):	1500 1201/1201 (Mbps)	netwo			line in the	lu.	Status: Maximum transmission unit:	Operational 1500		
DHCP enabled: DHCP servers:	Yes 192.168.1.254	wifi6E_test			Conn	ected	Link speed (Receive/Transmit): DHCP enabled:	2402/2402 (Mbps) Yes		
DHCP lease obtained:	Monday, June 19, 2023 6:20:11 PM	Ū	×		Network speed Security	2.2 Gbps WPA3-Personal	DHCP servers: DHCP lease obtained:	192.168.1.254 Monday, June 19, 2023 6:02:34 PM		
IPv4 address:	192.168.1.163/24	Forget	Disconnect	Share			DHCP lease expires: IPv4 address:	Tuesday, June 20, 2023 6:02:34 PM 192.168.1.159/24		
IPv6 address:	2001:8a0:fb91:1c00:f6e7:e29c:f0e1:63ea/64, 2001:8a0:fb91:1c00:299c:6c3b:b3c0:59b6/12	Excellent	auengur		Auto reconnect		IPv6 address:	2001:8a0:fb91:1c00:edb2:8d62:d379:c53b/64, 2i fe80::ac5b:e1e1:67ba:c353%8/64		
IPv4 default gateway: IPv6 default gateway:	192.168.1.254 fe80::5afc:20ff:fe9e:59af%16	Freque 6 GHz	ency		Quick Share Share this network with a n	earby Galaxy user. They's	IPv6 default gateway:	fe80::5afc:20ff:fe9e:59af%8		
DNS servers:	2001:8a0:fb91:1c00::1 (Unencrypted) 192.168.1.254 (Unencrypted)	WPA3-Pe	ty nsonal		Manage router		DNS domain name:	192.168.1.254 (Unencrypted)		
DNS domain name:	Home	\$ Netwo Detect au	rk usage tomatically		 View more 		DNS connection suffix: DNS search suffix list:	Home		
DNS search suffix list:	nome	Privacy Use device	e MAC		GR code	1 Forget	Network name:	wifi6E_test		
Network name: NetGearA8000 Client	Pixel6a	a Client	Details	S23 Client D	etails	AX211 Client Deta	tils			

Troubleshoot

The troubleshooting section of this document is aimed to provide general guidance on troubleshooting WLAN broadcasting issues rather then client specific problems that can occur when using any of the band operations explained in this document.

Troubleshooting on the client-side depends a lot on the client operating system. Windows allows to scan for networks and identify if the 6GHz BSSIDs are being heard by the laptop. The section about colocated APs show you what other BSSID from the same APs were learned through RNR report.

```
C:\Windows\System32>netsh wlan show networks mode=Bssid
Interface name : A8000_NETGEAR
There are 4 networks currently visible.
(...)
    ) 3 : Darcruss
Network type : Intrastruct
Authentication : WPA3-Personal
: CCMP
SSID 3 : Darchis6
                               : Infrastructure
                               : 10:a8:29:30:0d:07
    BSSID 1
          Signal : 6%
Radio type : 802.11ax
          Band : 6 GHz
Channel : 69
          Hash-to-Element: : Supported
          Bss Load:
               Connected Stations:
                                                0
               Connected Stations: 0
Channel Utilization: 2 (0 %)
               Medium Available Capacity: 23437 (749984 us/s)
          Colocated APs:
                              : 3
              BSSID: 10:a8:29:30:0d:01, Band: 2.4 GHz, Channel: 1
              BSSID: 10:a8:29:30:0d:0f, Band: 5 GHz , Channel: 36
              BSSID: 10:a8:29:30:0d:0e, Band: 5 GHz , Channel: 36
          Basic rates (Mbps) : 6 12 24
          Other rates (Mbps) : 9 18 36 48 54

      2
      : 10:a8:29:30:0d:0f

      Signal
      : 57%

      Radio type
      : 802.11ax

    BSSID 2
          Band
Channel
                               : 5 GHz
                               : 36
          Hash-to-Element: : Supported
          Bss Load:
               Connected Stations: 0
Channel Utilization: 9 (3 %)
               Medium Available Capacity: 23437 (749984 us/s)
          Colocated APs:
                              : 1
              BSSID: 10:a8:29:30:0d:07, Band: 6 GHz , Channel: 69
          Basic rates (Mbps) : 6 12 24
          Other rates (Mbps) : 9 18 36 48 54

      3
      : 18:f9:35:4d:9d:67

      Signal
      : 79%

      Radio type
      : 802.11ax

    BSSID 3
          Band : 6 GHz
Channel : 37
          Hash-to-Element: : Supported
          Bss Load:
               Connected Stations:
                                                0
```

Channel Utilization: 2 (0 %) Medium Available Capacity: 23437 (749984 us/s) Colocated APs: : 3 BSSID: 18:f9:35:4d:9d:6f, Band: 5 GHz , Channel: 52 BSSID: 18:f9:35:4d:9d:6e, Band: 5 GHz , Channel: 52 BSSID: 18:f9:35:4d:9d:61, Band: 2.4 GHz, Channel: 11 Basic rates (Mbps) : 6 12 24 Other rates (Mbps) : 9 18 36 48 54



Note: Refer to Important Information on Debug Commands before you usedebugcommands.

To troubleshoot client connectivity issues, it is recommended to use these documents:

Troubleshoot Catalyst 9800 Client Connectivity Issues Flow .

<u>Understand Wireless Debugs and Log Collection on Catalyst 9800 Wireless LAN Controllers</u>.

For AP troubleshooting it is recommended to use this document:

Troubleshoot COS APs

For throughput calculation and validation, please check this guide:

802.11ac wireless throughput testing and validation guide .

Even though it was created when 11ac was released, the same calculations apply for 11ax.

Related Information

What is Wi-Fi 6E?

What Is Wi-Fi 6 vs. Wi-Fi 6E?

Wi-Fi 6E At-a-Glance

Wi-Fi 6E: The Next Great Chapter in Wi-Fi White Paper

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

Countries Enabling Wi-Fi in 6 GHz (Wi-Fi 6E)

Cisco Catalyst 9800 Series Wireless Controller Software Configuration Guide 17.9.x

WPA3 Deployment Guide