# 配置和验证 Wi-Fi 6E 频段操作及客户端连接

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# 简介

本文档介绍 Wi-Fi 6E 频段操作的配置方式以及在不同客户端上的预期运行情况。

# 先决条件

## 要求

Cisco 建议您了解以下主题:

- 思科无线局域网控制器(WLC) 9800
- 支持Wi-Fi 6E的思科接入点(AP)。
- IEEE标准802.11ax。
- 网络工具:Wireshark

## 使用的组件

本文档中的信息基于以下软件和硬件版本:

- 带Cisco IOS® XE 17.9.3的WLC 9800-CL。
- AP C9136、CW9162和CW9166。
- Wi-Fi 6E客户端:
  - Lenovo X1 Carbon Gen11,带英特尔AX211 Wi-Fi 6和6E适配器,带驱动程序版本 22.200.2(1)。
  - ◎ 带驱动程序v1(0.0.108)的Netgear A8000 Wi-Fi 6和6E适配器;
  - Android 13的手机Pixel 6a;
  - 。装有安卓13的手机三星S23。
- Wireshark v4.0.6

本文档中的信息都是基于特定实验室环境中的设备编写的。本文档中使用的所有设备最初均采用原 始(默认)配置。如果您的网络处于活动状态,请确保您了解所有命令的潜在影响。

# 背景信息

需要了解的关键一点是,Wi-Fi 6E并不是一个全新的标准,而是一个扩展。 在其基本上,Wi-Fi 6E是Wi-Fi 6 (802.11ax)无线标准到6 GHz射频频段的扩展。

Wi-Fi 6E基于Wi-Fi 6(最新一代Wi-Fi标准)构建,但只有Wi-Fi 6E设备和应用可以在6-GHz频段运行。

由于6-GHz频谱是新的,只接受Wi-Fi 6E设备,因此它不存在阻塞当前网络的旧问题。

它提供更好的功能:

●容量:在美国由FCC定义,有价值1200 MHz的附加频谱或59个新信道。新的6 GHz频段采用十四 个80 MHz和七个160 MHz信道。其他国家/地区可为WiFi 6E分配不同的频谱数量。请查看<u>国家/地区</u> <u>在6 GHz (Wi-Fi 6E)下启用Wi-Fi</u>,了解有关国家/地区采用WiFi 6E的更新信息。

可靠性●:Wi-Fi 6E提供了一种新的连接可靠性和可预测性标准,缩小了无线和有线连接之间的差距 。6 GHz上不支持从Wi-Fi 1 (802.11b)到Wi-Fi 6 (802.11ax)的设备。

●安全:Wi-Fi保护访问3 (WPA3)是Wi-Fi 6E网络的必备要求,并且比以往任何时候都更好地保护网 络。由于只有Wi-Fi 6产品使用该网络,因此没有遗留的安全问题需要处理。WPA3为网络提供新的 身份验证和加密算法,并针对WPA2遗漏的问题提供修复。它还实施额外的保护层来防御解除身份 验证和解除关联攻击。



有关Wi-Fi 6E的更多背景信息,请查看<u>Wi-Fi白皮书</u>中的"<u>Wi-Fi 6E: The Next Great Chapter"(Wi-</u> <u>Fi 6E:Wi-Fi下一页)。</u>

在Wi-Fi 6E中有各种管理和更改。在本文档的"验证"部分中,我们简要介绍一下这些增强功能以及实际环境中的验证。

Wi-Fi 6E安全

Wi-Fi 6E通过Wi-Fi Protected Access 3 (WPA3)和Opportunistic Wireless Encryption (OWE)提升安全性,并且不与Open和WPA2安全性向后兼容。

WPA3和增强型开放安全现在是Wi-Fi 6E认证的必要条件,并且Wi-Fi 6E还需要在AP和客户端中使用保护管理帧(PMF)。

配置6GHz SSID时,必须满足某些安全要求:

- •WPA3 L2安全,带OWE、SAE或802.1x-SHA256
- 已启用受保护的管理帧;
- 不允许使用任何其他L2安全方法,即不能使用混合模式。

要了解有关Cisco WLAN中WPA3实施的详细信息(包括客户端安全兼容性列表),请随时查看 WPA3部署指南。

### 思科Catalyst Wi-Fi 6E AP



Wi-Fi 6E接入点

# 配置

本部分展示了基本的WLAN配置。本文档后面部分展示了如何配置每个Wi-Fi 6E元素以及如何验证 配置和预期行为。

## 网络图



网络图

## 配置

在本文档中,初始WLAN基本安全配置是采用H2E的WPA3+AES+SAE,如下所示:

## Edit WLAN

ayer2 Layer3 AAA	noed Add 101	Policy Tags		
O WPA + WPA2 O W	PA2 + WPA3	• WPA3	O Static WEP	O None
MAC Filtering O	C		,	
Lobby Admin Access		_		
WPA Parameters	WPA2 O	Fast Tr Status	ansition	Disabled •
GTX D	WPA3 C Policy	Over 1	he DS	0
Transition O Disable		Reaso	ociation Timeout *	20
WPA2/WPA3 Encryption – AES(CCMP128) GCMP128 Protected Management Fran	OCMP256 O OCMP256 O	- Auth K SAE OW 802 SH	ey Mgmt	FT + SAE <b>D</b> FT + 802.1x <b>D</b>
PMF	Required	• Act	Clogging Threshold*	1500
Association Comeback Timer*	1	Max	Retries*	5
SA Query Time*	200	Ret	ansmit Timeout*	400
	-	PSX	Format	ASCI •
		PSX	Туре	Unencrypted •
		Pre-	-Shared Key*	_
		SAL	Password Dement 0	Hash to Element O.T

8

WLAN配置和向AP推送是根据Cisco Catalyst 9800系列无线控制器软件配置指南,Cisco IOS® XE Cupertino 17.9.x中的<u>如何配置WLAN</u>部分中的步骤完成的。

WLAN通过交换和身份验证策略映射到本地交换的策略配置文件,如下所示:

#### **Edit Policy Profile**

A Disabling a Policy or configuring it in 'Enabled' state, will result in loss of connectivity for clients associated with this Policy profile.

×

General	Access Policies C	QOS and AVC Mobility Advan	ced	
Name*		Policy4TiagoHome	WLAN Switching Policy	
Descrip	tion	ProductionPolicy	Central Switching	DISABLED
Status		ENABLED	Central Authentication	DISABLED
Passive	Client	DISABLED	Central DHCP	DISABLED
IP MAC	Binding	ENABLED	Flex NAT/PAT	DISABLED

# 验证

使用本部分可确认配置能否正常运行。

验证部分分为引入的新更改或功能以及每个客户端类型的观察结果(如果适用)。

每个功能都有一个配置和验证部分。

在这些测试和验证中,使用嗅探器模式下的AP执行空中捕获(OTA)。

您可以检查本文找到如何在嗅探器模式下设置AP:<u>在嗅探器模式下设置Catalyst 91xx的AP</u>。

## 信标更改

Wi-Fi 6E上仍然存在信标,默认每100毫秒发送一次,但是它们与Wi-Fi 6(2.4GHz或5GHz)信标 稍有不同。在Wi-Fi 6中,信标包含HT和VHT信息元素,但在Wi-Fi 6E中,这些元素将被删除,并且 只有HE信息元素。

# Legacy HT/VHT Information Element Removed



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



Wi-Fi 6和Wi-Fi 6E信标帧比较

## 确认

## 以下是我们在OTA中看到的内容:



注意:DS参数集是可选字段,不能包含在信标帧中。

## 多个基本服务集标识符(BSSID)

多BSSID最初是在802.11v中指定的功能。它在单个信标帧中组合多个SSID信息,也就是说,它将 发送包含各种BSSID的单个信标,而不是每个SSID的信标。

Wi-Fi 6E中对此进行了规定,主要目标是节省飞行时间。

配置多BSSID配置文件(GUI)

第1步-选择Configuration > Tags & Profiles > Multi BSSID。

第2步-点击添加(Add)。系统将显示Add Multi BSSID Profile页面。

第3步-输入BSSID配置文件的名称和说明。

第4步-启用以下802.11ax参数:

- 下行链路OFDMA
- 上行链路OFDMA
- 下行链路MU-MIMO
- 上行链路MU-MIMO
- 目标唤醒时间
- TWT广播支持

第5步-点击应用到设备。

O Ensert Man, Incore	Edit Multi BSSID Profile	×
- Add X Delete € Cone	Name*	MBSSiDprofile_test
Dashboard Multi BSSID Profile Name	T De	Enter Description
Monitoring MBSSIDprofile_test	Downlink OFDMA	ENABLED
Configuration > default-multi-basid-profile	Det Uplink OFDMA	ENABLED
Administration	Downlink MU-MIMO	ENABLED
C Licensing	Uplink MU-MMO	ENABLED
Troubleshooting	Target Waketime	ENABLED
	TWT Broadcast Support	

## 配置多BSSID配置文件(CLI)

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

## 在射频配置文件(GUI)中配置多BSSID

第1步-选择Configuration > Tags & Profiles > RF/Radio。

第2步-在RF选项卡中,点击添加。系统将显示Add RF Profile页面。

第3步-选择802.11ax选项卡。

第4步-在Multi BSSID Profile字段中,从下拉列表中选择配置文件。

第5步-点击应用到设备。

O. Swinth March James	Config	aration -	> Tags & Profiles * > RF/Radio		Edit RF Profile		×
C OBTONISTIC STORE	RF	Radio			General 802.11 RRM Advanced	802.11ax	
Dashboard		Add	× Dears		6 GHz Discovery Frames ①	None     Eroadcast Probe Response     FLS Discovery	
And summer a		State	T RF Profile Name	T Band			
	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 •	
	0	0	High_Client_Density_rf_5gh	5 GHz	Smattel Deuro		
	O	0	Low_Client_Density_rf_24gh	2.4 GHz	Spatial Reuse		
	O	0	High_Client_Density_rf_24gh	2.4 GHz	OBSS PD	DISABLED	
roubleshooting	O	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	
	24	- 1	⊨ H 10 ▼		SRG OBSS PD	DISABLED	
Welk Me Through 1					SRG OBSS PD Min Threshold (dBm)*	-82	
					SRG OBSS PD Max Threshold (dBm)*	-62	

## 在RF配置文件(CLI)中配置多BSSID

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

## 创建多个SSID

## 要检验MBSSID功能,您必须启用各种SSID并将其推送到AP。在此验证中,使用了三个SSID:

Cisco Ca	talyst 9800-	CL Wireless C	ontroller	Welcome admin	* *		C     Search APs a	nd Clients Q	Feedback e <sup>A</sup> ()
Q. Search Menu Items	Configural	tion • > Tags & Pr	rofiles * > WLANs						
Dashboard	+ Add	× Delete	Clone Enable WI.	AN Disable WLAN					WLAN Wizard
	Selected W	LANs: 1							
	O Stat	Name	т	ID	т	SSID	T	Security	Ŧ
Configuration >	0 0			1		5 00 e		[WPA2][PSK][AES]	
Administration	0 0		•	2				[WPA3][FT + SAE][AES].[F	T Enabled]
~	0 0		•	3				[WPA2][PSK][AES]	
C Licensing	0 0		*	4				[WPA2][PSK][FT + PSK][AB	ES].[FT Enabled]
S. Co. T. March	0 0	wifi6E_test	•	5		wifi6E_test		[WPA3][SAE][AES]	
Troubleshooting	0 0	wifi6E_test_01	•	6		wifi6E_test_01		[WPA3][SAE][AES]	
	0 0	wifi6E_test_02	•	7		wifi6E_test_02		[WPA3][SAE][AES]	

## 确认

要验证配置是否到位,请发出如下所示的命令:

#### <#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#

以下是使用单BSSID时,您在OTA捕获中看到的内容:

Escon, 60Hz, singleSSID.pcapng	
	×
File 588 View Go Castare Analyze Statutics Telephony Wardess Tools Help	
pesiremote	
Dist         Data         Data         Description         Description <th><pre>&gt; Press 1: M&amp; bytes on wire (2064 bits), 306 bytes captured (2064 bits) on interface WorkerWPP_(DATABOB_JOB_ALAGA-COL- ) (thereft Tr, NC: Class, GATAD27 (Wordf:1201742)7), att: Universa, 27:67:66 (Worlswitz) (Mortfordes-JoB_ALAGA-COL- ) thereft Provided Version 4, scr (2016 bits) (Mortfordes) ) use bitgeren Protocol, World 4, scr (2016 bits) ) Use Bits): Holdes Formation ) Hild Bounderson (2016 bits) ) Hild Bounderson (2016 b</pre></th>	<pre>&gt; Press 1: M&amp; bytes on wire (2064 bits), 306 bytes captured (2064 bits) on interface WorkerWPP_(DATABOB_JOB_ALAGA-COL- ) (thereft Tr, NC: Class, GATAD27 (Wordf:1201742)7), att: Universa, 27:67:66 (Worlswitz) (Mortfordes-JoB_ALAGA-COL- ) thereft Provided Version 4, scr (2016 bits) (Mortfordes) ) use bitgeren Protocol, World 4, scr (2016 bits) ) Use Bits): Holdes Formation ) Hild Bounderson (2016 bits) ) Hild Bounderson (2016 b</pre>

以下是使用多个BSSID时,您在OTA捕获中看到的内容:

4	Seacon_6GHz	MSSID.pcaping													- 0
ie.	Edit View	Go Captore A	nalyze Stat	totics Telepho	ny Wireless	Tools H	rip								
ſ.			***	TAT		A III									
1	eekremote														8 <b></b> -
	4 2923-06- 7 3923-06- 8 2923-06- 13 2923-06- 13 2923-06- 15 2923-06- 17 2923-06- 18 2923-06- 22 2923-06- 24 2923-06- 25 2923-06- 27 2923-		0.000000 0 0.182459 0 0.204825 0 0.182325 0 0.182325 0 0.182325 0 0.204300 0 0.204300 0 0.204300 0 0.204300 0 0.382581 0 0.382581 0 0.382581 0 0.382581 0	Clsco_dd:e0:1c Clsco_dd:e0:1c	Broadcast Broadcast Broadcast Broadcast Broadcast Broadcast Broadcast Broadcast Broadcast Broadcast Broadcast Broadcast Broadcast	802.11 802.11 802.11 802.11 802.11 802.11 802.11 802.11 802.11 802.11 802.11 802.11	505 505 505 505 505 505 505 505 505 505	69         -83         Obs           60         -83         Obs           69         -84         Obs           69         -84         Obs           69         -84         Obs           69         -84         Obs           69         -87         Obs           69         -87         Obs           69         -87         Obs           69         -93         Obs           69         -80         Obs           69         -80         Obs           69         -80         Obs           69         -83         Obs           69         -83         Obs           69         -83         Obs           69         -83         Obs           69<-83         Obs         Obs           69<-85         Obs         Obs           69<-85         Obs         Obs	Beacon frame, Beacon frame,	58+213, Flueb, Sin-214, Flueb, Sin-214, Flueb, Sin-218, Flueb, Sin-229, Flueb, Sin-229, Flueb, Sin-224, Flueb, Sin-224, Flueb, Sin-224, Flueb, Sin-225, Flueb, Sin-225, Flueb, Sin-225, Flueb, Sin-225, Flueb, Sin-225, Flueb,	Flagts	100, SID="wif 100, SID="wif	64_best", 550 64_test", 550 64_test", 550 64_test", 550 64_test", 550 64_test", 550 64_test", 550 64_test", 550 64_test", 550 64_test, 550 64_test	なるなななななななななななな	<pre>bitment II, Sec Class_dirth:10 (Medirilander:Dir), Dit: Universig_Profet&amp; (Mellander:Dir(refs)) bitment protects (wrsin 4, sec : 100:346.113, Dit: Universig_Profet&amp; (Mellander:Dir(refs)) Der Derbergum Protocol, Sec Part: 1555, Dit Part: 1686 Derbergum Derberges encossided ISE Ball Derbergum Derberges encossided ISE Ball Ditte Ball i Bach frame, flags:</pre>
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无线客户端的AP发现

发现是指客户端设备开机或进入建筑物时,找到合适的接入点进行连接的过程。

当今大多数客户端设备采用的最简单发现方法是依次通过传输一个或多个探测请求来扫描信道,然 后侦听该区域中接入点的响应,检查探测响应,查看是否有任何SSID与客户端中的配置文件匹配 ,然后转到下一个信道。

这有三个缺点:

- 当无线电离开其服务信道时,它会花费大量时间,从而影响应用性能;
- 在空中需要多个探测请求和响应帧,降低了空时效率;
- 它会影响客户端电池寿命。

该时间(每个非DFS信道约20毫秒,或DFS信道最多100毫秒)在5 GHz频段中已存在问题。 当我 们意识到Wi-Fi 6E客户端必须逐一扫描频段内59个可能的20 MHz信道以发现所有可用接入点时,这 一点变得更为重要。

传统方法(也称为被动扫描和主动扫描)不能在6GHz上扩展。在2.4和5Ghz上,通过被动扫描或主动扫描,它使用"寻线寻道"方法扫描BSSID或AP:



过去,无线设备通过特定信息交换与接入点通信。客户端设备使用活动的"寻线并寻找"方法来扫描 附近的AP。

此主动扫描方法涉及沿2.4 GHz和5 GHz频谱发送探测请求帧。AP将使用探测响应帧进行响应,该 帧包含连接网络所需的基本服务集(BSS)信息。

此信息包括SSID、BSSID、信道宽度和安全信息等。

这种主动的"寻线并寻道"网络连接方法不再必要,实际上在6 GHz频段的Wi-Fi 6E中也不鼓励采用这 种方法,因为现在通过这么多信道广播相同的探测请求效率太低。

Wifi客户端只能在20 MHz信道上发送探测请求,而在6Ghz信道上高达59x20MHz,这意味着客户端 需要扫描总和约为6秒的所有59个信道以被动扫描所有59个信道:



在Wi-Fi 6E上,有新的AP发现机制:



在撰写本文档时,windows/intel和android客户端测试了受支持的FILS和广播探测响应,但不同于 Apple和某些Android客户端,它们可能不支持FILS或广播探测响应。

由于此问题,首选扫描通道(PSC)被认为更具相关性。但是,由于当前不同的无线客户端供应商可 能无法完全兼容wifi 6扫描,因此它不是仅配置6ghz wlan/ssid的理想方法。



注意:如果要确保了解每个客户端支持的发现机制,您必须联系无线客户端供应商支持。

因此,基于无线客户端供应商支持,当前可能与RNR/Reduced Neighbor Report选项启用了 2.4/5Ghz的带外发现相关,其中无线客户端可以通过侦听来自该AP的2.4/5Ghz信标中包含的 RNR信息元素来发现AP上的6Ghz SSID。

您很可能拥有仅提供6GHz WLAN的WLC和AP,并且很可能有其他正在广播的WLAN。考虑到这一 点,建议使用这些传统频段在RNR信息元素中为不支持带内发现机制的客户端设备通告仅6GHz的 WLAN。

最后,由于RNR是Wi-Fi 6E设备已经支持的功能,因此Wi-Fi 6E设备支持该功能,因此不会增加配置负担。

带外

带外发现用于所有3个频段(2.4、5和6 GHz)上的交叉通信。 802.11v中引入的此方法称为精简邻

居报告(RNR)。

实质上,当支持Wi-Fi 6E的AP发送探测响应帧时,它包括(以及2.4或5 GHz频段的基本服务集 (BSS)信息)有关其6 GHz无线电的RNR信息。

此RNR可作为客户端设备在6 GHz和2.4 GHz或5 GHz网络之间漫游的足够信息。

总之:客户端仅使用RNR通过传统频段发现6 GHz频段的WLAN。它们不会直接扫描6 GHz。

如果我们捕获空中2.4或5GHz的流量,并观察探测响应。

例如,在2.4、5和6GHz上广播的SSID的信道1 (2.4GHz)上的探测响应OTA捕获中,将会看到以下 内容:



您可以看到RNR在6GHz信道5和其他2个BSSID上报告相同的SSID。

这是用于同一SSID,但5GHz上的探测响应:

MM 2004-00 401706-0004       6.80000       Class 20.400       Class 20.400       F.80000       F.800000       F.800000       F.8000000       F.800000000000000000000000000000000	No.	. T	me	Delta	Source	Destination	Protocol	Lengti Chi	annei 1	Signal stre	Info	> Frame SEI7: 484 Dytes on wire (1872 Dits), 484 Dytes captured (1872 Dits) on interface \Device\MFF_(D4578985-2998-4456-0)
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11. 2013-04 9 10000.00001 0000000000000000000000000		124. 2	023-06-09 14:38:07.897585	17,1719	71 Cisco 13:00:ef	IntelCor d2:_	802.11	424	64 -	-28 08#	Probe Response, 5N+692, FN+0, Flags+C, 81+100, 551D+"wifi6E test"	> User Datagram Protocol, Src Port: 5555, Ost Port: 5000
11. 2012-4479 10.0105,4444 4.00003 (10.2)10007 (10.2)10017 (10.0)100 (10.2)1007 (10.0)100 (10.2)1007 (10.0)100 (10.2)1007 (10.0)100 (10.2)1007 (10.0)1000		125. 2	023-06-09 14:38:08.063911	0.1663	26 C15C0_13:00:ef	IntelCor_d21_	802.11	454	64 .	-27 088	Probe Response, 5N+693, FN+0, Flags+C, 81+100, SSID+"wifi6E test"	) AiroPeek/OmiPeek encepsulated IEEE 802.11
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<pre>III. 2012-4-09 10108.94428 4.0000 1010_11000 1010_11000 1010_11000 1010_11000 1010_11000 10000 1000 1000 1000 1000 1000 1000 1000 10000 1000 1000 10000</pre>		125. 2	923-86-89 14:32:88.864878	0.0004	34 Clsco_13:00:ef	IntelCor_d2:_	802.11	454	64 -	-25 dim	Probe Response, SN=693, FN=0, Flags=RC, #1=100, SSID="wif16E_test"	> IEEE 802.11 Probe Response, Flags:C
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11. Storberge Stalling. Date of Williem, Jr. Booling and Product Response, Sweids, Fault, Signa, S. S. M., K. (199), J. S., S. M., K. (199), J. S., S. M., K. (199), J. S. M., S. M. (199), J. S. M. (199), Stalling and Product Response, Sweids, Fault, Signa, S. M. (199), J. S. S. M. (199), J. S. M. (		133. 2	023-06-09 14:38:10.729928	0.0010	08 Cisco 13:00:ef	Wistronk b7:_	802.11	484	64 .	-27 d8m	Probe Response, Stud95, Fluid, FlagswC. #I+100, SSID+"wifidE test"	> Tag: SSID parameter set: "wifi66_test"
<pre>114. 3012-06-09 14.39128.727779 #A80208 Cisca_13-08.07 Main result appends, Saudes, Faul, Falges</pre>		133. 2	021-06-09 14:10:10.730449	0.0005	21 Cisco 13:88:ef	wistrony b7:	202.11	454	64 .	-25 dim	Probe Response, Studies, Flue, Flags,	> Tag: Supported Rates 6, 9, 12(8), 18, 24, 36, 48, 54, [Mbit/sec]
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<pre>&gt; Trag 005 Lose Lisert Built COL Version &gt; Trag: Nf Index Constitution &gt; Nf Index Constitution &gt;</pre>												> Tag: RSN Information
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<pre>&gt; 'Tg: #f CaedDilliss (B2.1:6 0.3:0) &gt; Tg: #f CreadDilliss (12 Cites) &gt; Tg: wf CreadDillis &gt; Tg: wf CreadDillis &gt; Tg: wf CreadDillis &gt; Tg: wf CreadDillis &gt; Tg: Not Part Include 'Tg: Note: May Def Not Trait &gt; Tg: Not Part Include 'Tg: Note: State May Def Not (101) Tg: State May Def Not (101) Tg:</pre>												> Tag: RM Enabled Canabilities (6 octets)
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85101 383013867 50-07 5510: 6846/4615												Neighbor AF TETT Offset: 255
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												Short SSID: @xe6ef6415
> @SS Parameters: @x46												> 055 Parameters: 0x46
PSD Subfield: 10.0 dem/Wez												PSD Subfield: 10.0 dBm/NHz

带内发现用于6 GHz设备之间的通信,有三种带内发现方法:

- 快速初始链路建立(FILS)和主动探测响应(UPR)帧是带内发现的两种被动方法。它是FILS或UPR,而不是同时使用两者。只有6 GHz是唯一可正常运行的无线电时,才需要6 GHz发现帧。
- 首选扫描通道(PSC)是带内发现的主动方法。 无线客户端仅探测PSC信道;如果检测到来自 RNR,则扫描非PSC。

请记住,这些是带内发现方法,这意味着这仅适用于连接到6 GHz频段无线网络的Wi-Fi 6E客户端。

文件

FILS是IEEE 802.11ai标准的一部分,可改善网络和BSS发现、身份验证和关联、DHCP和IP地址设置。

FILS使用"发现通告帧",它实际上是紧缩信标帧。在FILS帧中仅发送关键信息:短SSID、BSSID和 信道,供AP决定要连接的AP。

如果配置了FILS,6 GHz AP大约每20毫秒广播一次通告发现帧,这样会消耗更少的无线时间并减 少探测请求开销。



注意:只有在6 GHz是唯一可运行的无线电时,才需要6 GHz发现帧。当其他无线电(2.4/5 GHz)运行正常时,客户端会从RNR IE中检测6 GHz的存在。

在RF配置文件(GUI)中配置FILS发现帧

第1步-选择Configuration > Tags & Profiles > RF/Radio。

第2步-在RF选项卡中,点击添加。系统将显示Add RF Profile页面。

第3步-选择802.11ax选项卡。

第4步-在6 GHz发现帧部分中,点击FILS发现选项。



注意:要在RF配置文件中将发现帧设置为None时阻止传输发现FILS帧,请确保通过切换到 AP上的5-GHz或2.4-GHz频段或通过选择Broadcast Probe Response选项禁用FILS发现帧 。

## 第5步-点击应用到设备。

Saarch Moras heres	Config	uration *	> Tags & Profiles * > RF/Radio		Edit RF Profile	
	RF	Radio			General 802.11 RRM Advanced	802.11ax
Dashboard		Add	× Delite		6 GHz Discovery Frames (1)	O None O Broadcass Probe Response
Monitoring >		State	Y RF Profile Name	▼ Band		FLS Discovery
Configuration >	0	0	default-rf-profile-6ghz	6 GHz	Broadcast Probe Response Interval (msec)*	20
	0	0	Low_Olient_Density_rf_5gh	5 GHz	Multi BSSID Profile	MBSSiDprofile_test •
	0	0	High_Client_Density_rf_5gh	5 GHz	Spatial Bause	
censing	0	0	Low_Client_Density_rf_24gh	2.4 GHz	Speusi neuse	
nubleebooting	0	0	High_Client_Density_rf_24gh	2.4 GHz	OBSS PD	DISABLED
ocureanooung	0	0	Typical_Client_Density_rf_5gh	5 GHz	Nee SDC ODCS DD May Threshold (dDe)+	45
	0	0	Typical_Client_Density_rf_24gh	2.4 GHz	Non-SKG UBSS PD Max (Inteshola (abm))	-62
	1	4 1	10 V		SRG OBSS PD	DISABLED
alk Me Through a					SRG OBSS PD Min Threshold (dBm)*	-82

## 在RF配置文件(CLI)中配置FILS发现帧

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

确认

要验证配置是否到位,请发出show命令,如下所示:

<#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

以下是捕获空中无线流量后我们将会看到的结果:



您可以观察到,帧之间的差值大多数情况下为–20毫秒,但有时您会看到约40毫秒。检查帧序列后 ,发现嗅探器AP偶尔会丢失FILS帧的捕获。

UPR

主动探测响应(UPR)帧包含信标中发送的相同信息,即它携带多个BSSID并包含关联所需的所有信 息。

如果使用,6 GHz AP每20毫秒广播一次完整的探测响应帧,这有助于避免探测风暴。

在6GHz频段,存在新的探测限制:

- 客户端不能进行盲探测,即不允许使用通配符SSID和BSSID的广播目的地址,因为广播探测 请求和带通配符SSID的探测会造成探测风暴,影响性能;
- 客户端必须至少等待最小探测延迟间隔(约20毫秒)的持续时间;
- 始终广播探测响应。

UPR也称为广播探测响应,在下一节中,您可以看到如何启用它。

在RF配置文件(GUI)中配置广播探测响应

第1步-选择Configuration > Tags & Profiles > RF/Radio。

第2步-在RF选项卡中,单击添加。系统将显示Add RF Profile页面。

第3步-选择802.11ax选项卡。

第4步-在6 GHz发现帧部分中,单击广播探测响应选项。

第5步-在Broadcast Probe Response Interval字段中,输入广播探测响应时间间隔(以毫秒为单位)。值范围介于5毫秒和25毫秒之间。默认值为20毫秒。

第6步-点击应用到设备。

south Mary Ineres	Config	uration *	> Tags & Profiles - > RF/Radio		Edit RF Profile	
	RF	Radio			General 802.11 RRM Advanced	802.11ax
lashboard fonitoring			X Delite		6 GHz Discovery Frames ④	None     Broadcast Probe Response     FILS Discovery
		State	T RF Profile Name	▼ Band	Providenza Disko Persona (stan ol (mani)a	
	0	0	default-rf-profile-6ghz	6 GHz	broadcast Probe Response interval (insec)	20
iministration >	0	0	Low_Client_Density_rf_5gh	5 GHz	Multi BSSID Profile	MBSSI0profile_test •
	0	0	High_Client_Density_rf_5gh	5 GHz	Spatial Perree	
	0	0	Low_Client_Density_rf_24gh	2.4 GHz	Spauai reuse	
oubleehooting	0	0	High_Client_Density_rf_24gh	2.4 GHz	OBSS PD	DISABLED
Autoanoanig	0	0	Typical_Client_Density_rf_5gh	5 GHz	New CDC ODCC OD May Threshold (dDe)t	
	0	0	Typical_Client_Density_rf_24gh	2.4 GHz	Non-SKG ODSS PD Max (inteshold (dbm)-	-62
		1	8 NI 10 V		SRG OBSS PD	DISABLED
the Mar Thomas and					SRG OBSS PD Min Threshold (dBm)*	-82
ALL						

## 在RF配置文件(CLI)中配置广播探测响应

```
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
```

#### 确认

要验证配置是否到位,请发出show命令,如下所示:

<#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

### 使用UPR(广播探测响应)时,这是其空中外观:



## PSC

Wi-Fi 6E中的第三个发现方法为首选信道扫描(PSC),此方法处于活动状态。这实际上是Wi-Fi 6E客 户端设备发送探测请求的唯一方法。

如果使用1200 MHz的频谱和59个新的20 MHz信道,每个信道停留时间为100毫秒的站点需要近6秒 才能完成整个频段的被动扫描。

使用PSC,客户端设备只能通过每第四个20 MHz信道发送探测请求。 PSC间隔为80 MHz,因此客 户端只需扫描15个信道,而不是59个信道。

6 GHz PSC信道的完整列表为5、21、37、53、69、85、101、117、133、149、165、181、 197、213和229。



PSC信道

在RF配置文件(GUI)中配置首选扫描信道

第1步-选择Configuration > Tags & Profiles > RF/Radio。

第2步-在RF选项卡中,点击添加。系统将显示Add RF Profile页面。

第3步-选择RRM 选项卡。

第4步-选择DCA选项卡。

第5步-在动态信道分配部分,在DCA信道部分选择所需的信道。

第6步-在PSC实施字段中,点击切换按钮以启用DCA的首选扫描信道实施。

### 第7步-点击应用到设备。

orth Maleus Jaama	Configuration * >	Tags & Profiles * > RF/Radio		Edit RF Profile			
	RF Radio		General 802.11 RRM Advanced 802.11ax				
board		v. Delem	General Coverage TPC	DCA			
nitoring				Dynamic Channel Assignment	_		
fourstion N	State Y	RF Profile Name	T Band	a filmina criminar rangininen			
Jonation >	0 0	default-rf-profile-6ghz	6 GHz	Avoid AP Foreign AP Interference			
Administration	0 0	Low_Client_Density_rf_5gh	5 GHz	Charceal Width	○ 20 MHz ○ 40 MHz ○ 80 MHz ○ 160 MHz		
	0 0	High_Client_Density_rf_5gh	5 GHz	Channe Wool	<ul> <li>Best (DBS)</li> </ul>		
sing	0 0	Low_Client_Density_rf_24gh	2.4 GHz	DBS Channel Width	Min 20 MHz  Max Max Allowed		
lochesting	0 0	High_Client_Density_rf_24gh	2.4 GHz				
asnooung	0 0	Typical_Client_Density_rf_5gh	5 GHz	DCA Channels			
	0 0	Typical_Client_Density_rf_24gh	2.4 GHz				
	<b>1</b>	10 ¥			Q73 Q77 Q81 Q85 Q89 Q93		
					2 97 2 101 2 105 2 109 2 113 2 117 2 121 2 125 2 129 2 133 2 137 2 141		
le Through x					Ø 145 Ø 149 Ø 153 Ø 157 Ø 161 Ø 165		
					Q117 Q221 Q225 Q229 Q233		
				PSC Enforcement	ENABLE		
				PSC Channel List	5,21,37,53,69,85,101,117,133,149,165,181,197,213,229		
				View Control Control Control Control			

在RF配置文件(CLI)中配置首选扫描信道

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

## 确认

要验证配置是否已到位,请发出如下所示的命令:

#### <#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 [...] 在此,我们可以观察在PSC信道5上发送探测请求的Wi-Fi 6E客户端:

## NetGear A8000

	V Frank (5658): Mik huter on ulog (1998 hite): Mik huter rentired (1998 hite) on (standars \Audirs)(MI (Audre))(MI (Audre))(MI (Audre))).
No. Time Delta Source Destination Protocol Lengt Channel Signalistre Info	Fitness Transformed and the stand of the
159_2023-06-09 15:38:48.757226 0.000000 Netgear_48:70:_ Cisco_13:80:_ 802.11 360 5 -47 dBm Probe Request, SN+0, Flags+C, SSID+"wifi66_test"	Teleprost Endersal Meridian 4 Corr 103 102 115 115 105 103 103 131
159_2023-06-09 15:38:48.759693 0.002467 Netgeor_48:701. Cisco_13:801. 802.11 360 5 -47 dbm Probe Request, SN+1, FN+0, Flags+C, SSID+"wifi68_test"	Since Patheness Restored for the Path of the sets of the sets
159_2023-06-09 15:38:40.701562 0.021869 Netgear_48:70:. Cisco_13:80:. 802.11 360 5 -47 dBm Probe Request, SN+2, FN+0, Flags+C, SSID+"wif166_test"	J user belgram Protocol, arc Port: See
159_ 2023-06-09 15:38:49.009330 0.227768 Netgear_48:70:_ Cisco_13:00:_ 802.11 250 5 -47 dBm Association Request, SN=1, FN=0, Flags=C, SSID="wifi6E_test"	> Alroreck/om/Peck enclosulated IEEE 002.11
	> B02.11 redio information
	> IEEE 002.11 Probe Request, Flags:C
	ZEEE D02.11 Wireless Hangement
	<ul> <li>Tagged parameters (270 bytes)</li> </ul>
	<ul> <li>Tag: SSID parameter set: "wifiel_test"</li> </ul>
	Tag Number: SSID parameter set (0)
	Tag length: 11
	SSID: "wifi66_test"
	> Tag: Supported Rates 6(8), 9, 12(8), 18, 24(8), 36, 48, 54, [Mblt/sec]
	> Ext Tag: HE Capabilities
	> Tag: Vendor Specific: Hicrosoft Corp.: WPS
	> Tag: Vendor Specific: wi-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: 0x00 (octet 3)
	> Extended Capabilities: 0x00 (octet 4)
	> Extended Capabilities: 0x00 (octet 5)
	> Extended Capabilities: 0x40 (octet 6)
	> Extended Capabilities: 0x00 (octet 7)
	) Extended Capabilities: 0x00+0 (octets 8 & 9)
	<ul> <li>Extended Capabilities: 0x20 (octet 10)</li> </ul>
	0 = FILS Capable: False
	0. = Extended Spectrum Hanagement Capable: False
	0 = Reserved: 0x0
	Reserved: exe
	ThT Requester Support: True
	.0 This Responder Support: False
	0 0855 Narrow Bandwidth RU in UL OFDHA Tolerance Support: False
	> Ext Tag: HE Capabilities
	Ext Tag: HE 6 GHz Band Capabilities
	Tag Number: Element ID Extension (255)
	Ext Tag length: 2
	Ext Tag Number: HE 6 GHz Band Capabilities (59)
	> Capabilities Information: 0x36b8

## 像素6a

No	Time	Delta	Courses	Destination	Destand	Lanott Channel	Consideration	Info				> Frame 165651: 350 bytes on wire (2000 bits), 350 bytes captured (2000 bits) on interface \Device\NPF (D4570905-2990-4456-8C33-C34)
1740	101C	V018	33 balance day 70.05	Department	P100000	Leigr Charne	Signal Stre	Broke Bennet	D-10/0 D-0	flam. C	CETTS-Philipped?	> Ethernet II, Src: Cisco_dd:7d:37 (00:df:1d:dd:7d:37), Dst: Universa_b7:cf:06 (08:3a:88:b7:cf:06)
134	2013-06-09 16:091	15 FABARA A ANNO	ff hatsaar di balaf	Broadcast	883.33	166	5 - 44 dbs	Broke Requests	FR-1661 FR-0	flage C	ffth-"blitted"	> Internet Protocol Version 4, Src: 192.168.1.15, Ost: 192.168.1.121
134	2022-00-09 20:091	15 550440 0.0007	13 Natana di 30.00	Broadcast	883 33	166	5 -44 488	Brobe Requests	51-1563 51-0	flags. C	SETD-"Blittand"	> User Datagram Protocol, Src Port: SSSS, Dst Port: 5000
124	1011.06.00 16.001	15 551330 0 00007	11 Natasar 48-30-06	Broadcast	002.11	166	5 .44 488	Proba Requesty	SN-1563 EN-8	flags. (	COR."hlimand"	> AiroPeek/OmiPeek encapsulated IEEE 802.11
124	1011.06.00 16-001	10 176341 A 6360	01 Tetalfor 08-58-04	Broadcast	002.11	160	5 .44 48m	Probe Requesty	SN-1801 EN-8	Elasta C	CCTD_Hildrard /8	> 802.11 radio information
124	2023-06-09 16-09-	10 170571 0 0011	12 TetalCor St-151-04	Broadcast	002.11	168	5 .45 454	Probe Requesty	Sh-1002, Filed,	Elast- C	CCTD-Wildcard (8	> IEEE 802.11 Probe Request, Flags:C
1.77	2023-00-09 10:09:	12 021017 2 2462	A Tatalcor Stitliof	Broadcast	882.11	168	5 . 51 dbs	Probe Requests	Sh-1100 EN-0	flags. C	SSTD-Wildcard (8	✓ IEEE 802.11 Wireless Management
1.11	2013-06-09 16:001	12 025547 0 0017	10 TetalCor Stiffior	Broadcast	882.33	168	5 . 51 dim	Broke Requests	Sh-1101 FR-0	flags. C	SSTD-Wildcard (8	<ul> <li>Tagged parameters (260 bytes)</li> </ul>
1.11	1011-06-09 16:091	34 399968 1 3646	31 Tetal(or SS:58:66	Broadcast	887.11	168	5 -47 dim	Brobe Requests	51-1100 51-0	flatte (	SSTD-Wildcard /8	Tag: SSID parameter set: "wifi66_test"
134	1011-06-09 16-101	15 511210 51 1211	S1 Natagar 48-30-65	Broadcast	002.11	166	5 .45 dim	Probe Requests	Student Stud	flatte (	SSID-"hlimand"	Tag Number: SSID parameter set (0)
134	1011-06-09 16-10-	15 511004 0 0004	St Natasar 48-30-05	Broadcast	002.11	166	5 .45 dbm	Proba Request	51-1655 51-8	Elatta C	SSID, "hlissand"	Tag length: 11
134	2023-06-09 16-10-	15 531735 0 0000	12 Nationar 48-30-05	Broadcast	682.11	166	5 .45 dbm	Probe Requests	SN-1696 EN-8	Elars. C	SSID. "Alissand"	SSID: "wifi66_test"
134	2023-06-09 16:10:	25.525155 0.0016	33 Netgear 41:70:05	Broadcast	882.11	166	5 .45 dbs	Probe Requests	Sh-1697, FN-8	flags.	com."hlippand"	> Tag: Supported Rates 6(8), 9, 12(8), 18, 24(8), 36, 48, 54, [Hbit/sec]
1.0	2023-00-09 10:10:	19.925339 0.0016	US NELGEBE _48178195	Broadcast	002.11	100	5 -45 000	Probe Request,	Sta1077, Filed,	flags. (	SSIDE DILLERO	Tag: Extended Supported Rates SAE Wash to Element Only, [Mbit/sec]
14	2023-00-09 10:11:	15.5611/4 00.0350	15 Netgeer_40170195	Broadcast	002.11	100	5 -45 008	Probe Request,	State20, Free,	flags. (	SSEP Philipped?	Tag Number: Extended Supported Rates (50)
	2023-00-07 10:111 2023-06-09 10:111	15.5620/7 0.0007	13 Netgeer_48170195	Broadcast	002.11	166	5 -45 48m	Probe Request,	State29, Free,	flags. (	COLUMN DILLEN	Tag length: 1
	2023-00-07 20-22-	45.504074 0.0000	15 Netgeer_Net70.95	Broadcast	002.11	166	5 -45 dim	Probe Requesty	Statest, Free,	Flags. C	SSED Thlinged?	Extended Supported Rates: SAE Hash to Element Only (RxFb)
	2023-00-09 20-22-	29.963766 0.0006	as tetal can an think	Broadcast	002.11	100	5 . 54 . 658	Probe Requests	Shabba, Free,	flags. C	STID-Hildcard /8	> Tag: Extended Capabilities (11 octets)
100	2013-00-09 10-11-	FC 005712 00.4990	an Tetal Con States of	Broadcast	883.33	160	5 54 688	Probe Requests	FRANKE FRAN	flags. C	FFTD-Wildcard (8	> Tag: Interworking
100	2023-00-09 10:11:	AT 176171 11 1184	in TetalCor Stiffing	Broadcast	883.11	168	5 - 47 484	Brobe Requests	51-1116 51-0	flags. C	EETh-Wildcard (8	Ext Tag: FILS Request Parameters: Undecoded
101	2022-00-09 10:12:	07 170404 A 0073	33 Tetalfor 98-58-66	Broadcast	002.11	160	5 .50 .000	Probe Requests	51-1317 51-0	flags. (	SSID-Wildcard /8	Tag Number: Element ID Extension (255)
101	3033.06.00 16-11-	15 968793 8 7987	as IntelCor Server	Broadcast	002.11	160	5 -51 dim	Probe Requesty	SN-1100 SN-0	flags. (	SSEPHILIPLET (8	Ext Tag length: 2
101	2023-06-09 10-12-	15 071074 0.7764 15 071074 0.0077	14 TetalCor 08-58-04	Broadcast	002.11	160	5 .54 dbm	Probe Requesty	Su-1101 Sk-0	Flags. C	CCTD-Wildcard (8	Ext Tag Number: FILS Request Parameters (2)
194	2023-06-09 16:12:	19.971026 0.0022	34 IntelCor_98:58:07	Broadcast	882.11	168	5 -54 088	Probe Request,	574-1301, FRe0,	Flagss	SSIDWHILDCORD (8	Ext Tag Data: 00ff
			17 Incluce prover	Broadcast		200	5 50 400	Prove Requests	Startes, 1000,	flags. (	statematical (a	> [Expert Info (Note/Undecoded): Dissector for B02.11 Extension Tag (FILS Request Parameters) code not implemented, Contac
15.	. 2023-00-09 10:12:	23.500402 0.0022	39 Incelcor_99:58:64	Broadcast	002.11	160	5 -50 008	Probe Request,	5741453, 77440,	flags.	SSIDWHILDCARD (0	> Ext Tag: HE Cacabilities
154	- 2023-00-09 10:12:	25.504050 1.7763	ve wetgear_waivelys	Broadcast	002.11	100	5 .44 008	Probe Request,	Sha1962, Franc,	flags.	SSID# DIIZZ#FU	Ext Tag: HE 6 GH2 Band Capabilities
4.54	- 2023-00-09 10:12:	25.505/16 0.0000	So NELEER_Mai/0195	Broducast	002.11	100	5 .44 408	Prove Request,	Star 1963, France,	Flags.	SSEDE ULLEAVU	Tag Number: Element ID Extension (255)
16	1011.06.00 16-11-	15 CAT115 A AAAA	16 Natasar 58-30-05	Broadcast	002.11	166	5 .45 dbm	Probe Requests	SHATSES EN-8	Elasta C	CCID. "hlissand"	Ext Tag length: 2
16.	2023-06-09 16-12-	26,618070 1,1107	to total cor ssits of	Broadcast	882.11	168	5 .52 dbs	Probe Requests	Sh-1574 EN-0	Elasta C	SSTD-Wildrard /8	Ext Tag Number: HE 6 GHz Band Capabilities (59)
15.	2023-06-09 16:12:	26.4166.26 0.0015	47 TotalCor Stitlinf	Broadcast	882.11	168	5 .54 .000	Probe Requests	Sh-1616 FR-0	flags.	SSTD-Wildcard (8	<ul> <li>Capabilities Information: exbibe</li> </ul>
101	1011-06-09 16:11:	10.700676 3.0050	an IntelCor Strikt of	Broadcast	887.11	168	5 -dd dite	Broke Request,	Shalled Flag	flags. C	SSTD-Wildcard (8	110 = Hinimum HPOU Start Spacing: B uS (0x6)
161	1011-06-00 16-11-	19 715971 0 0073	45 Total/or 98-58-66	Broadcast	887.11	168	5 .49 (88	Brohe Request	Sta1507 Etc.8	flatte (	SSTD-Wildcard /8	
164	1011-06-09 16-11-	12 994794 1 2788	1) Total(or 98-58-66	Broadcast	887 11	168	5 .51 /88	Probe Request	51-1651 51-0	Elatta (	SSTD-Wildcard /8	
16	1011-06-09 16-11-	12 997154 8 8871	72 Tetal(or 98-58-04	Broadcast	882.11	160	5 .54 /08	Probe Request	58-1653 58-8	Elatia C	SSTD-wildcard (8	
15	2023-06-09 16-12-	17.061162 4.0660	oc totalcor state	Broadcast	882.11	168	5 .44 dbm	Probe Dequest,	Stu1694 EN-8	Elatia	SSID-wildrand (8	11 = SH Power Save: SH Power Save disabled (0x3)
161	2023-06-09 16:11:	19.734428 42.6712	66 83168162165183166	Broadcast	882.11	132	5 .10 dam	Probe Request,	Shudda, Ehud	flags	STD-"wifile test	@ = RD Responder: Not supported
164	2023-06-09 16:13:	25.521218 5.2882	17 Nataear 41:70:05	Broadcast	887.11	166	5 -45 d8m	Probe Request,	5%-20%6. FN-0	flags.	SSID-"hlizzard"	e = Rx Antenna Pattern Consistency: Not supported
16	2023-06-09 16:13:	25.523982 0.0007	72 Natasar 48:70:95	Broadcast	882.11	166	5 .45 dim	Prohe Request,	SN-2007, EN-0.	flagt.	SSID-"hlizzard"	TX Antenna Pattern Consistency: Not supported
16	1011-06-09 16-11-	15.534998 0.0010	16 Neteen 48-70-95	Broadcast	882.11	166	5 .45 dim	Probe Request,	SN-1010 - EN-0	flatta (	SSID_"hlitrard"	00 = Reserved: 0x0
16	2023-06-09 16-13-	15.526167 0.0011	60 Netterar 48-70-95	Broadcast	882.11	166	5 .45 /88	Probe Request,	SN+1010 EN+0	Elatia	SSID_"hlippand"	✓ Ext Tag: Short SSID
161	2023-06-09 16-13-	12.557265 7.0110	68 Google 72:88:66	Broadcast	882.11	150	5 .18 date	Probe Dequest.	Shall, Dad. D	lars. C. St	The "wifflet Pere"	Tag Number: Element ID Extension (255)
1.81	2023-06-09 16:13:	\$2,428238 19,9129	45 Google 72:88:66	Broadcast	882.11	115	5 .45 dam	Prohe Bequest.	Stable, Flag.	flags	STD-Dulfill test	Ext Tag length: 4
187	2023-06-09 16:14:	05.067397 12.5971	67 IntelCor Stiffief	Broadcast	882.11	168	5 .50 dtm	Probe Request.	SN+1749, FN+8.	flatte	SSID-wildcard (8	Ext Tag Number: Short SSID (58)
187	2023-06-09 16:14:	05.065615 0.0022	18 Intelfor 98:58:6f	Broadcast	882.11	168	5 .51 dim	Probe Request,	SN-1758, FN-8,	Flarts	SSID-wildcard (8	Short 8552D: exbd1c2eb5
191	2023-06-09 16:14:	25.554976 20.4853	61 Netgear 48:70:95	Broadcast	882.11	166	5 .45 dim	Probe Request,	SN-2210, FN-0,	Flatte	SSID_"hlizzard"	> Tag: Vendor Specific: Microsoft Corp.: WPS
191	2023-06-09 16:14:	25.555550 0.0006	14 Netgear 45:70:95	Broadcast	882.11	166	5 .45 dim	Prohe Request,	SN=2211, EN=0.	Flatta	SSIDe"hlizzard"	> Tag: Vendor Specific: Wi-Fi Alliance: P2P
191	2021-06-09 16:14:	25.556509 0.0009	19 Netwar 45:70:95	Broadcast	882.11	166	5 .45 dim	Prohe Bequest,	Sha2212, ENaB.	flatta	SSIDe"hlizzard"	> Tag: Vendor Specific: Wi-Fi Alliance: Hotspot 2.0 Indication
191	2023-06-09 16:14:	25.557345 0.0005	16 Netwear 48170195	Broadcast	882.11	166	5 .45 din	Prohe Bequest.	She2233, FNe0,	flaffa	SSIDe"blizzard"	> Tag: Vendor Specific: Hicrosoft Corp.: Unknown 8
193	2023-06-09 16:141	26.967711 1.4183	66 IntelCor 98:58:0f	Broadcast	882.11	168	5 -47 dim	Probe Request.	SN=1817, FN=0.	Flags	SSID-wildcard (8	> Tag: Vendor Specific: Broadcom
193	2023-06-09 16:14:	26.978276 0.0825	45 IntelCor 98:58:0f	Broadcast	882.11	168	5 -49 dim	Probe Request,	SN=1818, FN=0.	Flagte	SSID-wildcard (8	> Tag: vendor Specific: wi-Fi Alliance: Multi Band Operation - Optimized Connectivity Experience
4.71		ANTINA ANTINA	and a second period of				A	A CONTRACTOR OF CONTRACTOR OFO	and a state of the		Concernance of the second	

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No.	Time	(	leita	Source	Destination	Protocol	Lengti Channel	Signal stre	e Info				> Frame 65924: 164 Dytes on wire (1112 Dits), 164 Dytes captured (1112 Dits) on interface \Device
	620 2023-06-09	16:02:25.542609	0.000000	Netgear_48:70:95	Broadcast	802.11	166	5 -45 dbm	Probe Request, 5	N+622, FN+0,	#lags+C,	SSID+"Blizzard"	> Ethernet II, Src: Cisco_dd:7d:37 (00:df:1d:dd:7d:37), Dst: Universa_b7:cf:06 (00:3a:88:b7:cf:06)
	621 2023-06-09	16102125.543382	0.000773	Netgear_48:70:95	Broadcast	802.11	166	5 -45 dbn	Probe Request, 5	N+623, FN+0,	F1865+	SSID+"blizzard"	Internet Protocol Version 4, Src: 192.168.1.15, Dst: 192.168.1.121
	622 2023-06-09	16:02:25.544166	0.000784	Netgear_48:70:95	Broadcast	802.11	166	5 -45 d8m	Probe Request, 5	N=624, FN=0,	Flags	SSID="blizzard"	> User Datagram Protocol, Src Port: SSSS, Dst Port: S000
	624 2023-06-09	16:02:25.545262	0.001096	Netgear 48:70:95	Broadcast	882.11	166	5 -45 dim	Probe Request, 5	N+625, FN+0.	Flagts	SSID+"blizzard"	> AiroPeek/OmiPeek encapsulated IEEE 002.11
	9421 2023-06-05	16:02:47.759164	2.211982	IntelCor server	Broadcast	882.11	168	5 .44 dbs	Probe Request, 5	Na181, ENaB.	Flatte C	SSTD-wildcard (Bro	> 802.11 radio information
	9472 2023-06-05	16102147.761269	0.002105	Intelcor seistiaf	Broadcast	882.11	168	5 .46 .000	Probe Request, 5	Na182, ENaB.	flatta	SSTD-wildcard (Brow	> IEEE 802.11 Probe Request, Flags:C
	128 2023-06-05	16102151 445605	3 684339	Total Con Stitling	Broadcast	882.11	168	5 .57 .004	Prohe Benuect, 5	1-345 EN-0	flags.	SSTD-Wildrard (Bro-	IEEE 002.11 Wireless Management
	120. 2023-00-07	16.02.51.447000		Total/or series	Repadract		160	5 .54 684	Rocks Request, 5		flags. f	SETD-Mildrard (Ren	<ul> <li>Tagged parameters (74 bytes)</li> </ul>
	120. 2023-00-07	10102131.047003	0.002237	National AB-78-96	Broadcast	002.11	166	5 - 54 000	Probe Request, 5	with the second	flags. (	SSID-Thlissand?	> Tag: SSID parameter set: wildcard SSID
	45. 4943-06-97	101031231345587		werken Teeriataa	Brobblest	004.44	100	5 147 688	Prove Request, 5	14756, Plate,	rangan	SSIDE ULLCRY	> Tag: Supported Rates 6, 9, 12, 18, 24, 36, 48, 54, [Mbit/sec]
	225 2023-06-09	16:03:25.545589	e.000000	verbear_estivetab	Broadcast	802.11	166	5 -47 088	Probe Request, 5	Ne757, Phiet,	F1885*	5510+ 011228rd	Tag: Extended (apabilities (ii octets)
	226 2023-06-09	16:03:25.545589	e.000000	verBear_ea:va:aa	erosocast	802.11	100	5 -48 CBM	Probe Request, 5	Ne/30, Phief,	+18g1+	2210+ 011228r0	Tag Number: Extended Cacabilities (127)
1	226 2023-06-09	16:03:25.545509	e.000000	Netgear_48:70:95	Broadcast	002.11	166	5 -47 dom	Probe Request, 5	No759, File0,	F1885*C,	SSID+"011228rd"	Tag length: 11
	414_ 2023-06-09	16104102.310242	6.764653	IntelCor_98158104	Broadcast	802.11	168	5 -44 008	Probe Request, 5	No409, File0,	V1885*C,	SSID+H11dcard (Brow	> Extended Canabilities: dv0s (octet 1)
	414. 2023-06-09	16104102.312552	0.002310	Intercor_98198164	Broadcast	802.11	168	5 -47 088	Probe Request, 5	Ned10, Phie0,	P18g5+C,	331D+H11dCard (Brow	Extended Canabilities: Audo (octet 2)
	422 2023-06-09	16:04:05.183773	2.871221	IntelCor_98:58:0f	Broadcast	802.11	168	5 -55 d8n	Probe Request, S	N=534, FN=0,	Flags=C,	SSID=Wildcard (Brow	) Extended cambilities: when (ctet 1)
	422 2023-06-09	16:04:05.186047	0.002274	IntelCor_98:58:0f	Broadcast	802.11	168	5 -57 d8n	Probe Request, S	N=535, FN=0,	Flags+C,	SSID+Wildcard (Brow	) Extended Comparison with (rest 2)
	481. 2023-06-09	16:04:25.622592	0.436545	Netgear_48:70:95	Broadcast	802.11	166	5 -46 dbn	Probe Request, 5	N=090, FN=0,	Flags+C,	SSID+"blizzard"	> Extended Constitution and (contact 2)
	481 2023-06-09	16:04:25.623258	0.000000	Netgear_48:70:95	Broadcast	802.11	166	5 -47 dbm	Probe Request, 5	N+891, FN+0,	#1ag5+C,	SSID+"blizzard"	Fridad Construction and Control (Control (Contro) (Control (Contro) (Contro) (Con
	481. 2023-06-09	16104125.624360	0.001102	Netgear_48170195	Broadcast	802.11	166	5 -47 d8m	Probe Request, 5	N+892, FN+0,	#1ags+C,	SSID="blizzard"	> Extended Capabilities: exam (octer a)
	481. 2023-06-09	16:04:25.624869	0.000509	Netgear_48:70:95	Broadcast	802.11	166	5 -46 d8m	Probe Request, S	N=893, FN=0,	Flags+C,	SSID="blizzard"	) Extended Capacilities: exwe (otter /)
	481 2023-06-09	16:04:25.885143	0.260274	IntelCor_98:58:0f	Broadcast	802.11	168	5 -47 d8m	Probe Request, 5	N=578, FN=0,	Flags	SSID-Wildcard (Brow	> Extended Capabilities: extende (ottets 8 6 9)
	659 2023-06-09	16:05:19.040282 1	3.155139	SamsungE_c9:e3:71	Broadcast	802.11	172	5 -60 dön	Probe Request, 5	N+131, FN+0,	FlagisC,	SSID+00	<ul> <li>Extended Capabilities: excl (octet 10)</li> </ul>
	659. 2023-06-09	16:05:19.041579	0.001297	SamsungE_c9:e3:71	Broadcast	802.11	164	5 -60 don	Probe Request, 5	N+132, FN+0,	FlagisC,	SSID+Wildcard (Brow	= FILS Capable: True
	659. 2023-06-09	16:05:19.042891	0.001312	SamsungE_c9:e3:71	Broadcast	802.11	164	5 -60 dbn	Probe Request, 5	N+133, FN+0,	#lags+C,	SSID+Wildcard (Brow	0. = Extended Spectrum Management Capable: False
	659 2023-06-05	16:05:19.044213	0.001322	SansungE_c91e3171	Broadcast	802.11	164	5 -60 dbn	Probe Request, 5	N+134, FN+0,	Flags+	SSID+Wildcard (Brow	0 * Future Channel Capable: False
	659. 2023-06-09	16:05:19.060095	0.015882	SamsungE_c9:e3:71	Broadcast	802.11	172	5 -59 d8m	Probe Request, 5	N=135, FN=0,	Flags+	SSID+80	e = Reserved: exe
	659. 2023-06-09	16:05:19.060913	0.000315	SamsungE_c9:e3:71	Broadcast	802.11	164	5 -61 d8m	Probe Request, 5	N+136, FN+0,	Flagts	SSID-Wildcard (Brow	Reserved: exe
	659. 2023-06-09	16:05:19.061998	e.ee1ess	SamsungE_c9:e3:71	Broadcast	802.11	164	5 -61 d0m	Probe Request, 5	N+137, FN+0,	FlagisC,	SSID+Wildcard (Brow	This Requester Support: True
	(59. 2023-06-09	16:05:19,063030	0.001032	SamsungE_c9:e3:71	Broadcast	802.11	164	5 -61 008	Probe Request, 5	N+138, FN+0,	F1865+	SSID+Wildcard (Brow	.e = TuT Responder Support: False
	670. 2023-06-09	16:05:23.619198	4,556168	IntelCor 98:58:0f	Broadcast	802.11	168	5 -51 008	Probe Request, 5	N+635, FN+0,	#1865+	SSID-Wildcard (Brow	0 = OBSS Narrow Bandwidth Ru in UL OFDNA Tolerance Support: False
	670. 2023-06-09	16:05:23.621437	0.002239	IntelCor_98:58:0f	Broadcast	802.11	168	5 -54 dbn	Probe Request, 5	N=636, FN=0,	Flags	SSID-Wildcard (Brow	> Extended Capabilities: 0x20 (octet 11)
	672. 2023-06-09	16:05:25.530364	1.908927	Netgear_48:70:95	Broadcast	802.11	166	5 -47 d8m	Probe Request, 5	N=1024, FN=0	. Flags	. SSID-"blizzard"	> Tag: vendor Specific: Hicrosoft Corp.: Unknown 8
	672. 2023-06-09	16:05:25.532117	0.001753	Netgear 48:70:95	Broadcast	882.11	166	5 -47 dilm	Probe Request, 5	N+1025, FN+0	Flags	. SSID+"blizzard"	✓ Ext Tag: HE Capabilities
	672. 2023-06-09	16:05:25.532117	0.000000	Netgear 48:70:95	Broadcast	882.11	166	5 -47 dbn	Probe Request, 5	N+1026, FN+0	Flags	. SSID+"blizzard"	Tag Number: Element ID Extension (255)
	672 2023-06-05	16:05:25.532841	0.000724	Netgear 48:70:95	Broadcast	882.11	166	5 -47 dbm	Probe Request, 5	N+1027, FN+0	Flags	. SSID+"blizzard"	Ext Tag length: 32
	(87 2023-06-05	16105132.250692	6.717851	Canculate (Stell/21	Broadcast	882.11	172	5 .66 dbs	Probe Request, 5	Na157, ENall.	flats	SSTD_888	Ext Tag Number: HE Capabilities (35)
	687. 2023-06-05	16:05:32.251661	0.000161	Santunge c9:e3:71	Broadcast	882.11	164	5 .64 dbs	Probe Request, S	Na158, FNaB.	Flags	SSTD-willdcard (Bro	> HE MAC Capabilities Information: 0x0040da10010f
	687. 2023-06-05	16:05:12.252934	0.001273	SantungE (9:e3:71	Broadcast	882.11	164	5 -64 dim	Probe Request, S	N=159, FN=0.	Flagta	SSID-Wildcard (Bro	> HE PHY Capabilities Information
	687. 2023-06-05	16:05:12.254216	0.001282	Samtunet (9:e3:71	Broadcast	882.11	164	5 .64 dbs	Probe Request, 5	Na160, ENa0.	Flatta	SSID-wildcard (Bro	> Supported HE-MCS and NSS Set
	687. 2023-06-05	16:05:12.270664	0.016445	Samurat (9:41:71	Broadcast	882.11	172	5 .64 /08	Probe Request, 5	Na161, ENaB.	Flatta	SSTD-DR	> PPE Thresholds
	(87 2023-06-05	16:05:12.271986	0.001242	Cantured (Stal)71	Broadrast	882.11	164	5 .45 .004	Prohe Bequest, 5	N-162 EN-0	flags.	SSTD-Wildrard (Brok	✓ Ext Tag: HE 6 GH2 Band Capabilities
	187 2823-06-05	16:05:32.273048	0.001114	Santungi chiali71	Broadcast	882.11	164	5 .44 000	Probe Request, 5	N=163 EN=0	flatte	SSTD-utildcard (Brow	Tag Number: Element ID Extension (255)
	687 3833-06-05	16:05:32.274031	0.000001	Santunge chralini	Broadcast	882.11	164	5 .44 /84	Brobe Request, S	Nales Ellas	flatte (	SSTD-Wildcard (Bro	Ext Tag length: 2
	107. 2023-05-07	16:05:32.2/9023	A 117663	Sansunge_C9163174	Broadcast	002.11	104	5 -66 000	Probe Request, 5	with the	Flags.	CCTD-TOR-CTD' 108da	Ext Tag Number: HE 6 GHZ Band Capabilities (59)
	104 2023105109	10.05.32.352073	B. 847694	Sansungt_CS.ES.74	Er vervess.	002.11	177	5 . 64 . 654	Prove Request, a	11105, Flore,	Flags. C	SSIDE QUILLS DELLE	<ul> <li>Capabilities Information: dx86bd</li> </ul>
	104. 2023-00-07	10.00.49.299330	0.000000	familiant chieling	Broadcast	002.11	164	5 - 65 - 68m	Probe Request, a	half find	flage. C	FFTD-uildened (new	
	Tel 1823-06-07	16105145.200176	0.000046	familiant chielin	Broadcast	883.11	164	5 -45 CON	Brobe Request, 5	taller, Flore,	flage. (	FETD-uildcard (Brow	
	104. 2023-06-07	16:00:45.20101/	0.000041	famoungs_c9(0)(7)	Broadcast	002.11	164	5 - 65 - 684	Brobe Request, 5	1,107 Filed,	flags. (	SETD-uildcard (arou	10
	/04. 2023-06-09	10:05:45.261948	0.000931	Sensungs_c9(63)71	Broducast	002.11	104	5 -55 088	Prove nequest, 5	**107, FN+0,	*10g3*	2210+H110(SLG (BLO	
	705 2023-06-09	10105145.280295	w.wa8347	Samsunge_c9163171	Broaucast	002.11	172	5 -54 088	Prove nequest, 5	100, FN+0,	*10g3*******	SSID-00	
	705 2023-06-09	10:05:45.281598	w.we1303	Sansungs_c9:03:71	Broadcast	002.11	104	5 -54 008	Probe Request, 5	101107, FNo0,	*10g3*******	SSIDWHILdCard (Brok	0 = KD Responder: Not supported
	/05 2023-06-09	10:09:49.283210	w.ww1612	Samsungs_c9:03:71	erosocast	sec.11	104	5 -54 COR	Probe Request, 5	nelye, Fhield,	* 18g3*	SSIDWHILDCARD (Brow	
	/05 2023-06-09	10:05:45.204052	e.000042	sensungs_catestra	erodocast	002.11	164	> -65 008	Probe Request, 5	ne191, FReD,	***gs*C,	southeningcang (aug	
													00

### 英特尔AX211



6-GHz客户端引导

与现有的2.4 GHz和5 GHz频段相比,6 GHz频段提供更多的信道、更多的带宽,并且网络拥塞更少 。

因此,支持6-GHz的无线客户端可以连接到6-GHz无线电来利用这些优势。

本主题提供有关支持6-GHz频段的AP的6-GHz客户端引导的详细信息。

当控制器收到来自2.4-GHz频段或5-GHz频段的定期客户端统计信息报告时,将发生6-GHz客户端引 导。

客户端引导配置在WLAN下启用,并且仅针对支持6 GHz的客户端进行配置。

如果报告中的客户端支持6-GHz,则触发客户端引导,并将客户端引导到6-GHz频段。

请在文档"Qualcomm Research Band-Steering for Dual-Band Wi-Fi Access Points"中查找有关双频 Wi-Fi接入点的频段控制的更多信息。

转向机构

为了开始引导客户端,AP首先解除与特定频段上的客户端的关联,然后在一段时间内阻止该客户端 在该频段上重新关联。

取消关联后,在扫描其他AP或频段选项之前,客户端会短暂尝试与同一SSID上与上一次关联所在 频段上的AP重新关联。

大多数Wi-Fi客户端通过发送探测请求扫描两个频段,并通过探测响应估计下行链路信号强度,这也 表明无线接入点已准备好重新关联。

由于这种扫描和重新关联行为完全取决于客户端实施,因此某些客户端的引导速度可能比其他客户 端更快。

某些客户端可能没有引导并不断尝试与原始(被阻塞)频段重新关联,或者只是选择完全取消与Wi-Fi的关联,并仅在有数据包要发送时尝试重新关联。

#### 转向警告

需要注意AP,以防止此类操作不友好的客户端在AP处被阻止,在这种情况下,可能需要用户干预 才能恢复Wi-Fi连接。

用户干预可以像开启/关闭Wi-Fi一样简单。显然,这种用户干预是不可取的。因此,设计偏于保守 。

如果客户端无法引导,或者引导尝试失败,则AP会允许客户端与原始频段重新关联,而不是让客户 端在较长的一段时间内被从AP阻止。

由于客户端只在空闲时引导,因此不会中断用户流量。

在全局配置模式(GUI)下配置6 GHz客户端引导

第1步-选择Configuration > Wireless > Advanced。

第2步-点击6 GHz Client Steering选项卡。客户端转向可针对每个WLAN进行配置。

第3步-在6 GHz Transition Minimum Client Count 字段中,输入用于设置客户端控制的最小客户端 数量的值。默认值为3个客户端。值范围介于0和200个客户端之间。

第4步-在6 GHz过渡最小窗口大小字段中,输入用于设置客户端控制的最小窗口大小的值。默认值 为3个客户端。值范围介于0和200个客户端之间。

第5步-在6 GHz过渡最大利用率差异字段中,输入值以设置用于转向的最大利用率差异。值范围介 于0%到100%之间。默认值为 20。

第6步-在6 GHz Transition Minimum 2.4 GHz RSSI Threshold字段中,输入用于设置客户端控制 2.4-GHz RSSI阈值的最小值。

第7步-在6 GHz过渡最小值5 GHz RSSI阈值字段中,输入用于设置客户端调整5 GHz RSSI阈值的 最小值。

第8步-点击应用。



在全局配置模式(CLI)下配置6 GHz客户端引导

```
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
```

在WLAN (GUI)上配置6 GHz客户端引导

第1步-依次选择Configuration > Tags & Profiles > WLANs。 第2步-点击添加(Add)。系统将显示"添加WLAN"(Add WLAN)页面。 第3步-点击高级选项卡。 第4步-选中6 GHz Client Steering复选框以便在WLAN上启用客户端引导。 第5步-点击应用到设备。

Conf	guration *	> Tags & Profiles * > WLANs		Edit WLAN					
		X Delate	Inable WLAN	Changing WLAN p	arameters while it is enabled will	result in loss of conne	ctivity for t	dients conn	ected to it.
Selec	ted WLANs :	0		General Security Adva	nced Add To Policy Ta	35			
0	Status 7	Name	T D	Coverage Hole Detection	Ø	Universal Artmin		2	
, 0	0	9 - 9	N 1		-		<u>ं</u>		
, 0	0		2	Altonet IE O	U	OKC		J	
0	Q		S 3	Advertise AP Name	O	Load Balance	C	0	
0	0	The second se	<b>%</b> 4	P2P Blocking Action	Disabled	Band Select	C	D	
0	0	wifi6E_test	\$ 5				_		
0	0	wihitE_test_01	• 6	Multicast Buffer	DISABLED	IP Source Guard	C	,	
0	O	with58_test_02	• 7	Media Stream Multicast-direct	0	WMM Policy	0	Allowed	•
- 14	- 1	= 10 •		11pc MU-MIMO	Ø	mDNS Mode	ſ	Bridging	•
				WIFI to Cellular Steering	o	Off Channel Sca	nning De	ifer	
				Fastione+ (ASR) 0					
				Deny LAA (RCM) clients	0	Deter Priority	00	01	02
				<u></u>			03	04	Øs
				6 GHz Client Steering			0.	Ω.	
				Max Client Connections			0.	0.	_
						Scan Defer Time	100		
				Per WLAN	0	Assisted Roamin	ng (11k)		
				Per AP Per WLAN	0				
						Prediction Optimiz	ation	0	
				Per AP Radio Per WLAN	200			-	
				11v BSS Transition Support		Neighbor List		U	
						Dual Band Neighb	or List	O	

## 在WLAN (CLI)上配置6 GHz客户端引导

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

确认

要验证配置是否已到位,请发出如下所示的命令:

<#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
6Chz transition minimum client count : 3
6Chz 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

5	wifi6E_test	Enabled	Enabled
6	wifi6E_test_01	Enabled	Enabled
7	wifi6E_test_02	Enabled	Enabled

WLC9800#

show wlan id 5 | i Client Steering

6Ghz Client Steering : Enabled

客户端连接

本部分显示连接到WLAN的每个客户端的进程OTA。

本实验符合以下条件:

- 客户端和AP的视距约为1米,没有障碍物。
- 所有AP广播信道宽度为160MHz、功率级别为1的WLAN。
- 客户端设备与iperf服务器交换在同一个VLAN上。
- 通过1Gbps链路连接的所有AP。

# 6 GHz Radios Total 6 GHz radios : 4

AP Name	:	Slot No	:	Base Radio MAC	÷	Admin Status	1	Operation Status	1	Policy Tag 👃	:	Site Tag	÷	RF Tag	÷	Channel Width	-	Channel	: P	Power Level 0	:
AP9166_0E.6220	Lat	2		7411.b2d2.9740		۲		0		Wifi6E_TestPolicy		TiagoHomePTAPs		default-rf-tag		160 MHz		(69,65,73,77,81,85,89,93)	• •	1/8 (19 dBm)	
AP9162_53.CA50	LM.	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		Wif6E_TestPolicy		TiagoHomePTAPs		default-rf-tag		160 MHz		(53,49,57,61,33,37,41,45)		1/8 (16 dBm)	

### 使用AP 9166进行测试

#### NetGear A8000

WLC中的客户端详细信息:

#### <#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)

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-xxxxxxx Protocol Map : 0x000029 (OUI, DHCP, HTTP) Device OS : Windows NT 10.0; Win64; x64 像素6a WLC中的客户端详细信息: <#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

AAA override passphrase : No

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 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: 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 : 1Absolute-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

#### 三星S23

WLC中的客户端详细信息:

#### <#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 : 0x90000025
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 : 1
Absolute-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)

英特尔AX211

WLC中的客户端详细信息:

#### <#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) [...]

```
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 : 0x90000025
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
```

Policy Type : WPA3

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

在这里,您可以观察每个客户端提供的网络详细信息:



# 故障排除

本文档的故障排除部分旨在提供有关排除WLAN广播问题的一般指导,而不是提供使用本文档中说 明的任何频段操作时可能出现的客户端特定问题。

客户端的故障排除很大程度上取决于客户端操作系统。Windows允许扫描网络并确定笔记本电脑是 否侦听6GHz BSSID。有关协同定位AP的部分向您展示通过RNR报告从相同AP获取了哪些其他 BSSID。

C:\Windows\System32>netsh wlan show networks mode=Bssid

```
Interface name : A8000_NETGEAR
There are 4 networks currently visible.
(...)
SSID 3 : Darchis6
```

Network type	: Intrastructure
Authentication	: WPA3-Personal
Encryption	: CCMP
BSSID 1	: 10:a8:29:30:0d:07
Signal	: 6%
Radio type	: 802.11ax
Band	: 6 GHz
Channel	: 69

```
Hash-to-Element: : Supported
    Bss Load:
        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
                    : 10:a8:29:30:0d:0f
BSSID 2
                      : 57%
    Signal
    Radio type : 802.11ax
    Band
Channel
                     : 5 GHz
                     : 36
    Hash-to-Element: : Supported
    Bss Load:
        Connected Stations:
                                 0
        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
                : 18:f9:35:4d:9d:67
BSSID 3
    Signal
                     : 79%
    Radio type
                   : 802.11ax
    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
```



注意:使用命令之前<u>,请参阅</u>debug有关<u>Debug</u>命令的<u>重要信息</u>。

要排除客户端连接故障,建议使用以下文档:

Catalyst 9800客户端连接问题故障排除流程。

了解Catalyst 9800无线LAN控制器上的无线调试和日志收集。

对于AP故障排除,建议使用以下文档:

排除COS AP故障

有关吞吐量的计算和验证,请参阅本指南:

802.11ac无线吞吐量测试和验证指南。

尽管它是在11ac发布时创建的,但11ax也适用相同的计算。

#### 相关信息

<u>什么是Wi-Fi 6E?</u>

<u>什么是Wi-Fi 6与Wi-Fi 6E?</u>

<u>Wi-Fi 6E概览</u>

<u>Wi-Fi 6E:Wi-Fi下一重要章节(白皮书)</u>

Cisco Live -使用Catalyst Wi-Fi 6E接入点构建下一代无线网络

<u>支持6 GHz Wi-Fi的国家/地区(Wi-Fi 6E)</u>

<u>Cisco Catalyst 9800系列无线控制器软件配置指南17.9.x</u>

<u>WPA3部署指南</u>

## 关于此翻译

思科采用人工翻译与机器翻译相结合的方式将此文档翻译成不同语言,希望全球的用户都能通过各 自的语言得到支持性的内容。

请注意:即使是最好的机器翻译,其准确度也不及专业翻译人员的水平。

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