

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[国家/地区在6 GHz \(Wi-Fi 6E\)下启用Wi-Fi](#)，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。

6 GHz Band – Total Spectrum 1200 MHz



5 GHz Band – Total Spectrum 500 MHz (180 MHz without DFS)



2.4 GHz Band – Total Spectrum 80 MHz



比较2.4、5和6 GHz wifi频谱和信道

有关Wi-Fi 6E的更多背景信息，请查看[Wi-Fi白皮书](#)中的“[Wi-Fi 6E：The Next Great Chapter](#)” ([Wi-Fi 6E：Wi-Fi下一页](#))。

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

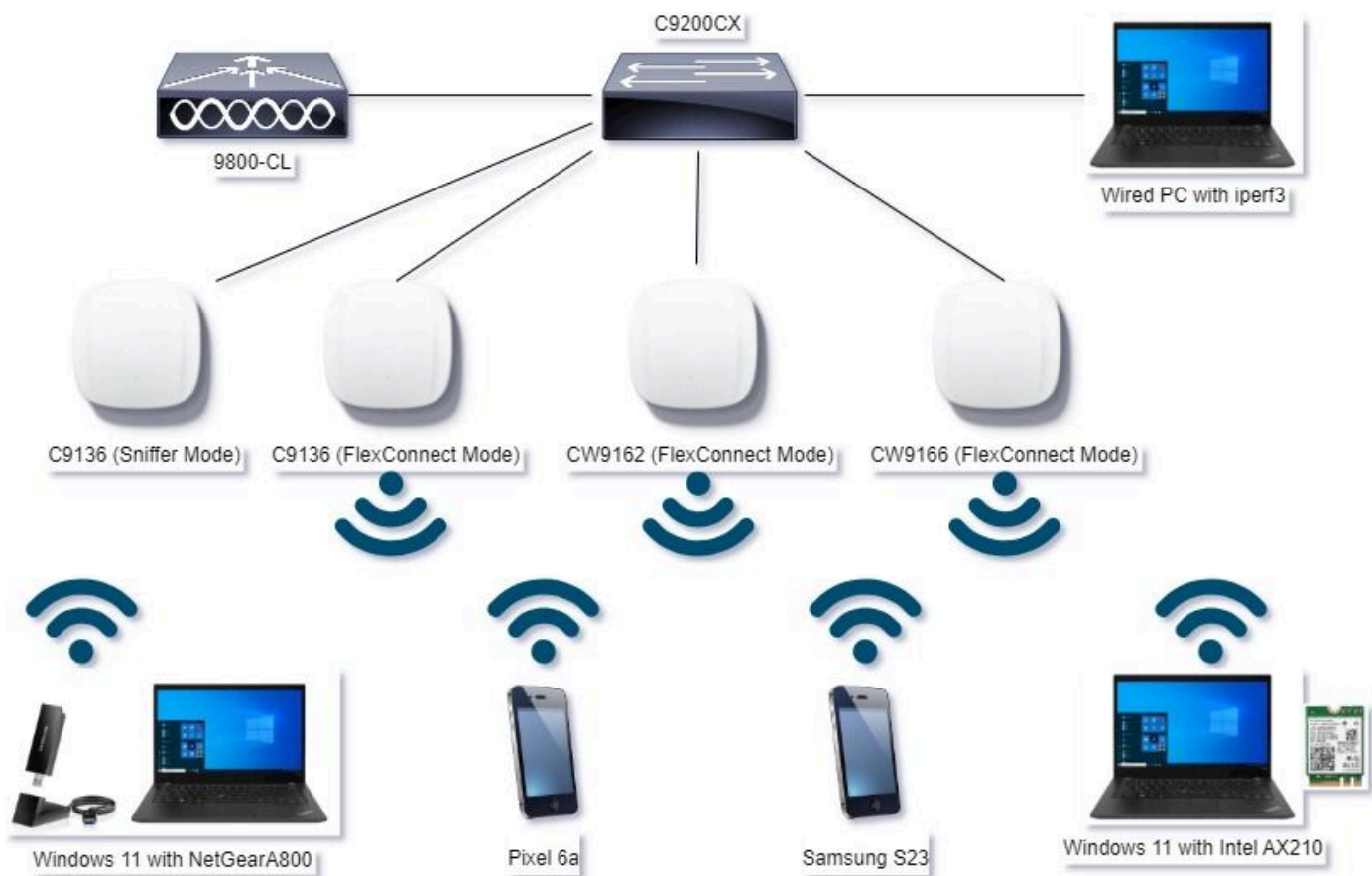
Ideal for Small to Medium-sized deployments	Best In Class, Flexibility		Mission Critical, Performance
 <p>CW9162</p> <ul style="list-style-type: none"> • 2x2 + 2x2 + 2x2 • 2.5 Gbps mGig • Power Options: PoE, DC Power • IoT ready + Bluetooth 5.x • Partial iCAP • USB - 4.5 W <p><small>Available with IOS-XE 17.9.2</small></p>	 <p>CW9164</p> <ul style="list-style-type: none"> • 2x2, 4x4, 4x4 • 2.5 Gbps mGig • Power Options: PoE, DC Power • IoT Ready + Bluetooth 5.x • Partial iCAP • USB- 4.5 W 	 <p>CW9166</p> <ul style="list-style-type: none"> • 4x4 + 4x4 + 4x4 (XOR 5/6) • 5 Gbps mGig • Power Options: PoE, DC Power • IoT ready + Bluetooth 5.x • Environmental Sensor • Full Packet Capture (iCAP) • Zero-Wait DFS* • USB - 4.5W 	 <p>C9136</p> <ul style="list-style-type: none"> • 4x4, 8x8, 4x4 (or) 4x4, 4x4+4x4, 4x4 • Dual 5 Gbps mGig, active fail over • PoE Redundancy • IoT ready • Bluetooth 5.x • Environmental Sensor • Full Packet Capture (iCAP) • Zero-Wait DFS* • USB - 9W <p><small>*Available in Future</small></p>
Full radio capability (6 GHz @ LPI) on single 30W PoE+			
Dedicated Radio for CleanAir Pro	Same Bracket, Industrial Design	AP Power Optimization	USB

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。

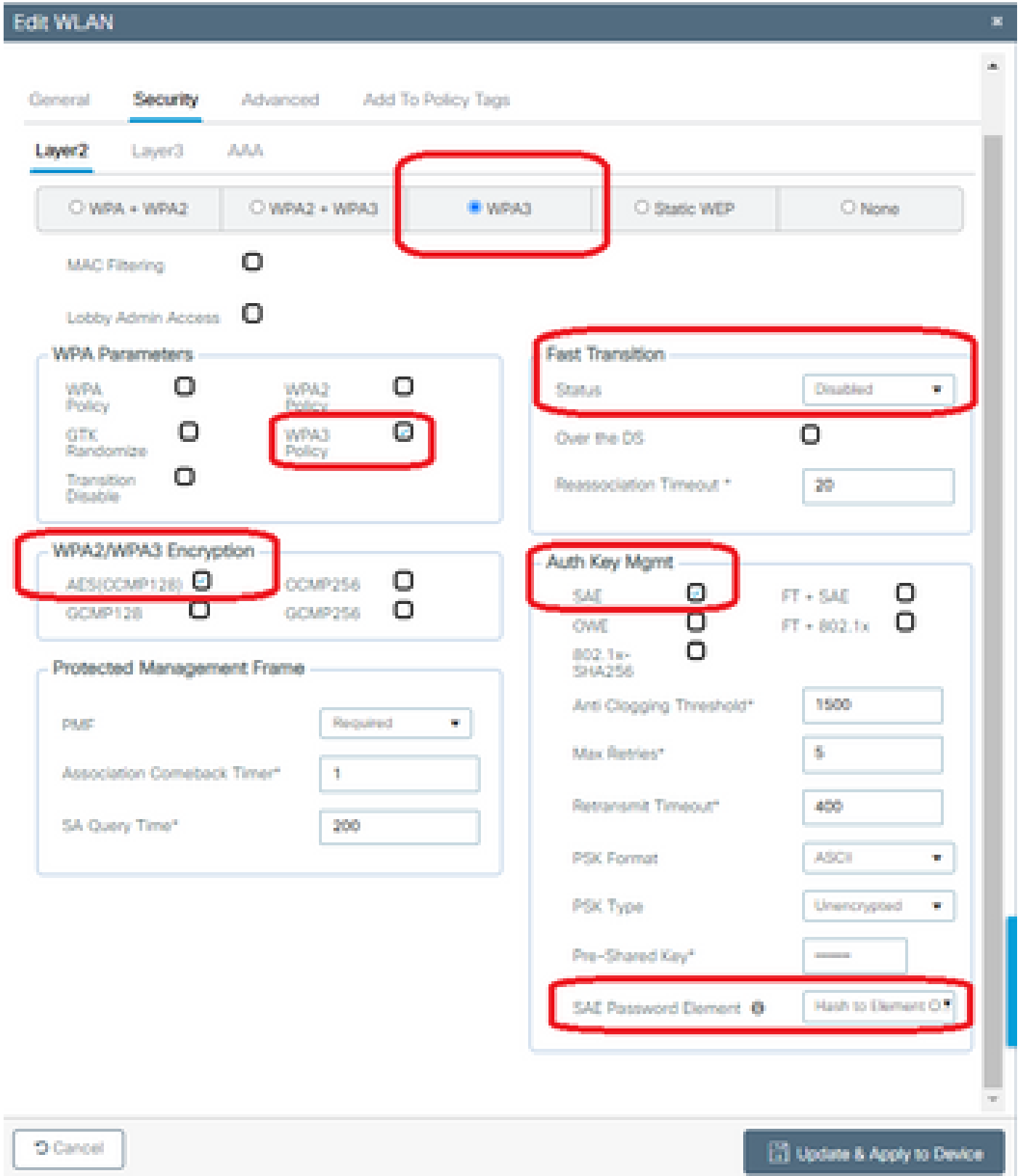
网络图



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：



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[如何配置WLAN](#)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：

⚠ 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 QOS and AVC Mobility Advanced

Name*	<input type="text" value="Policy4TiagoHome"/>	WLAN Switching Policy	
Description	<input type="text" value="ProductionPolicy"/>	Central Switching	<input type="checkbox"/> DISABLED
Status	<input checked="" type="checkbox"/> ENABLED	Central Authentication	<input type="checkbox"/> DISABLED
Passive Client	<input type="checkbox"/> DISABLED	Central DHCP	<input type="checkbox"/> DISABLED
IP MAC Binding	<input checked="" type="checkbox"/> ENABLED	Flex NAT/PAT	<input type="checkbox"/> 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：[在嗅探器模式下设置Catalyst 91xx的AP。](#)

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

Wi-Fi 6 Beacon



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

Wi-Fi 6E Beacon



Reduced Beacon Size

Wi-Fi 6和Wi-Fi 6E信标帧比较

确认

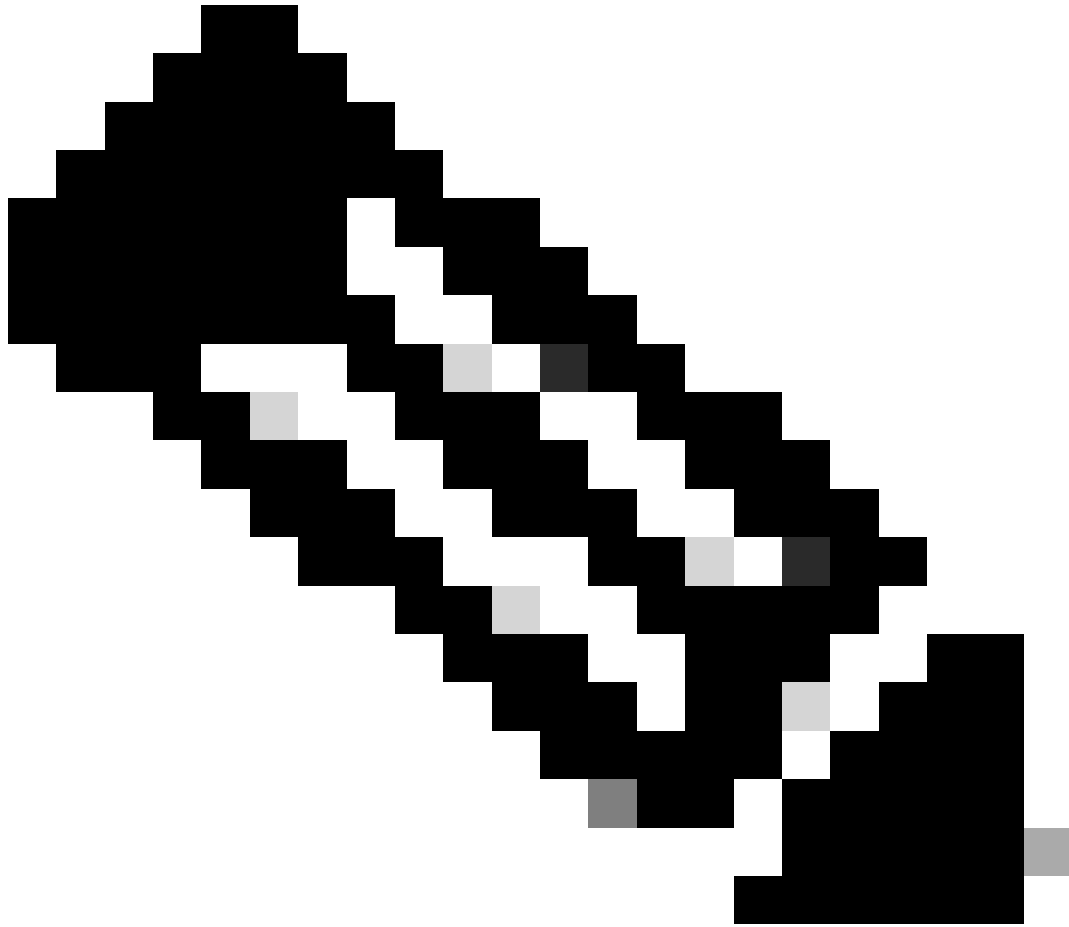
以下是我们在OTA中看到的内容：

```

> Frame 18: 464 bytes on wire (3712 bits), 464 bytes captured (3712 bits) on interface \Device\NPF_{04578985-2998-4A56-8C33-C343166}
> Ethernet II, Src: Cisco_0d:7d:37 (08:0f:1d:dd:7d:37), Dst: Universa_b7:cf:06 (08:3a:88:b7:cf:06)
> Internet Protocol Version 4, Src: 192.168.1.15, Dst: 192.168.1.121
> User Datagram Protocol, Src Port: 5555, Dst Port: 5000
> Airengk/OmniPeek encapsulated IEEE 802.11
< IEEE 802.11 radio information
  PHY type: 802.11a (OFDM) (5)
  Data rate: 12.0 Mb/s
  Channel: 64
  Signal strength (percentage): 67%
  Signal strength (dBm): -28 dBm
  Noise level (percentage): 67%
  Noise level (dBm): -95 dBm
  Signal/noise ratio (dB): 67 dB
  TSF timestamp: 63436667884472
  > [Duration: 292us]
  > IEEE 802.11 Beacon frame, Flags: .....C
  > IEEE 802.11 Wireless Management
  > Fixed parameters (12 bytes)
  > Tagged parameters (362 bytes)
  > Tag: SSID parameter set: "wifi6e_test"
  > Tag: Supported Rates 6, 9, 12(8), 18, 24, 36, 48, 54, [Mbit/sec]
  > Tag: DS Parameter set: Current Channel: 64
  > Tag: Traffic Indication Map (TIM): DTIM 0 of 1 bitmap
  > Tag: Country Information: Country Code PT, Environment Global operating classes
  > Tag: Power Constraint: 3
  > Tag: TPC Report Transmit Power: 18, Link Margin: 0
  > Tag: RSN Information
  > Tag: QSS Load Element 802.11e CCA Version
  > Tag: RH Enabled Capabilities (5 octets)
  > Tag: HT Capabilities (802.11n D1.10)
  > Tag: HT Information (802.11n D1.10)
  > Tag: Extended Capabilities (11 octets)
  > Tag: VHT Capabilities
  > Tag: VHT Operation
  > Tag: Tx Power Envelope
  > Tag: Reduced Neighbor Report
  > Ext Tag: HE Capabilities
  > Ext Tag: HE Operation
  > Ext Tag: Spatial Reuse Parameter Set
  > Ext Tag: MU ECCA Parameter Set
  > Tag: RSN extension (1 octet)
  > Tag: Vendor Specific: Microsoft Corp.: WMM/WME: Parameter Element
  > Tag: Vendor Specific: Cisco Systems, Inc: Aironet Unknown (44)
  > Tag: Vendor Specific: Cisco Systems, Inc: Aironet Unknown (11) (11)
  > Tag: Vendor Specific: Cisco Systems, Inc: Aironet Client MFP Disabled
  > Tag: Vendor Specific: Cisco Systems, Inc: Aironet CCX version = 5
          
```

```

> Frame 5: 358 bytes on wire (2864 bits), 358 bytes captured (2864 bits) on interface \Device\NPF_{04578985-2998-4A56-8C33-C343166}
> Ethernet II, Src: Cisco_0d:7d:37 (08:0f:1d:dd:7d:37), Dst: Universa_b7:cf:06 (08:3a:88:b7:cf:06)
> Internet Protocol Version 4, Src: 192.168.1.15, Dst: 192.168.1.121
> User Datagram Protocol, Src Port: 5555, Dst Port: 5000
> Airengk/OmniPeek encapsulated IEEE 802.11
< IEEE 802.11 radio information
  PHY type: 802.11g (ERP) (6)
  Data rate: 6.0 Mb/s
  Channel: 5
  Signal strength (percentage): 60%
  Signal strength (dBm): -35 dBm
  Noise level (percentage): 60%
  Noise level (dBm): -95 dBm
  Signal/noise ratio (dB): 60 dB
  TSF timestamp: 62165356724611
  > [Duration: 420us]
  > IEEE 802.11 Beacon frame, Flags: .....C
  > IEEE 802.11 Wireless Management
  > Fixed parameters (12 bytes)
  > Tagged parameters (256 bytes)
  > Tag: SSID parameter set: "wifi6e_test"
  > Tag: Supported Rates 6(8), 9, 12(8), 18, 24(8), 36, 48, 54, [Mbit/sec]
  > Tag: Traffic Indication Map (TIM): DTIM 2 of 3 bitmap
  > Tag: Country Information: country code na, Environment Global operating classes
  > Tag: Power Constraint: 6
  > Tag: TPC Report Transmit Power: 17, Link Margin: 0
  > Tag: RSN Information
  > Tag: QSS Load Element 802.11e CCA Version
  > Tag: RH Enabled Capabilities (5 octets)
  > Tag: Extended Capabilities (11 octets)
  > Tag: Tx Power Envelope
  > Tag: Tx Power Envelope
  > Ext Tag: Multiple BSSID Configuration
  > Ext Tag: HE Capabilities
  > Ext Tag: HE Operation
  > Ext Tag: Spatial Reuse Parameter Set
  > Ext Tag: MU ECCA Parameter Set
  > Ext Tag: HE 6 GHz Band Capabilities
  > Tag: RSN extension (1 octet)
  > Tag: Vendor Specific: Atheros Communications, Inc.: Unknown
  > Tag: Vendor Specific: Microsoft Corp.: WMM/WME: Parameter Element
  > Tag: Vendor Specific: Cisco Systems, Inc: Aironet Unknown (44)
  > Tag: Vendor Specific: Cisco Systems, Inc: Aironet Unknown (11) (11)
  > Tag: Vendor Specific: Cisco Systems, Inc: Aironet Client MFP Disabled
  > Tag: Vendor Specific: Cisco Systems, Inc: Aironet CCX version = 5
          
```

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。

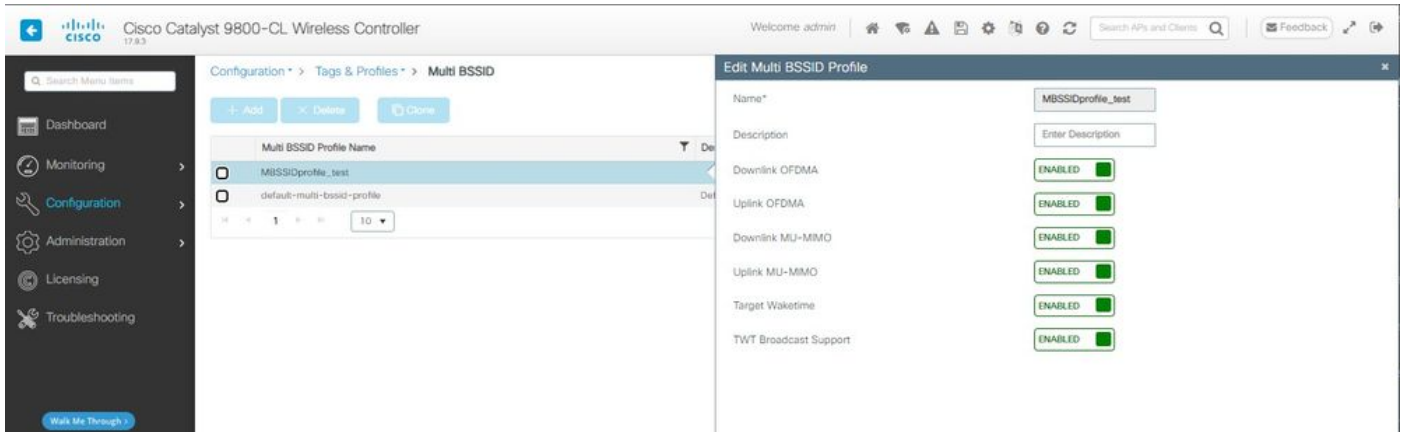
第2步-点击添加(Add)。系统将显示Add Multi BSSID Profile页面。

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。



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

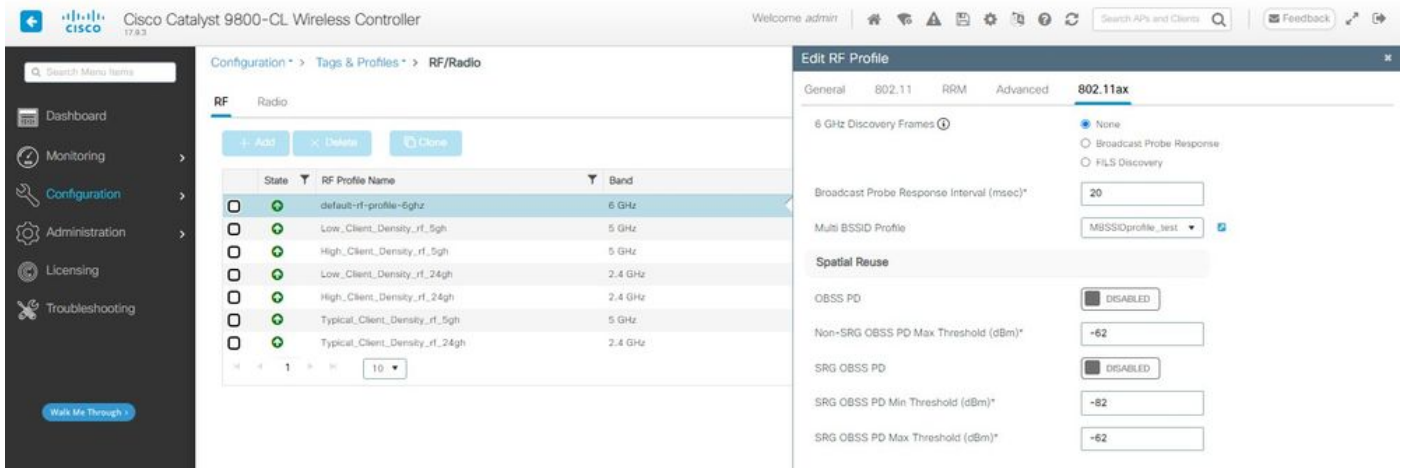
第1步-选择Configuration > Tags & Profiles > RF/Radio。

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。

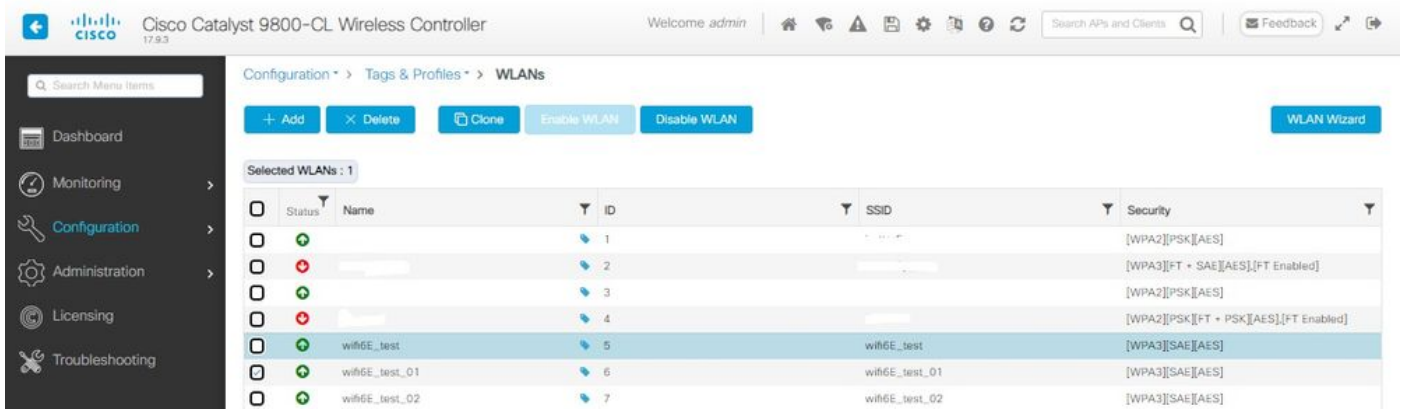


在RF配置文件(CLI)中配置多BSSID

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



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：

The screenshot shows a Wireshark capture of a beacon frame. The packet list pane shows a beacon frame from source 00:00:00:00:00:00 to destination Broadcast. The packet details pane shows the IEEE 802.11ax parameters, including:

- Tag: SSID parameter set (0)
 - Tag length: 11
 - SSID: "wifi6e_test"
- Tag: Traffic Indication Map (TIM): OFDM 2 of 3 bitmap
- Tag: Country Information: Country Code aa, Environment Global operating classes
- Tag: Power Constraint: 6
- Tag: TPC Report Transmit Power: 16, Link Margin: 0
- Tag: RSK Information
- Tag: QSS Load Element 802.11e QCA Version
- Tag: RX Enabled Capabilities (5 octets)
- Tag: TX Power Envelope
- Tag: TX Power Envelope

以下是使用多个BSSID时，您在OTA捕获中看到的内容：

The screenshot displays a Wireshark capture of beacon frames. The packet list on the left shows a series of beacon frames from source 0.20443 to 0.20433. The details pane on the right shows the structure of a beacon frame, including SSID, supported rates, traffic indication map, and various information elements like SSID, RSN, and Extended Capabilities. Red arrows point to specific fields in the details pane, such as 'Tag: SSID parameter set' and 'Tag: Multiple BSSIDs'.

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。

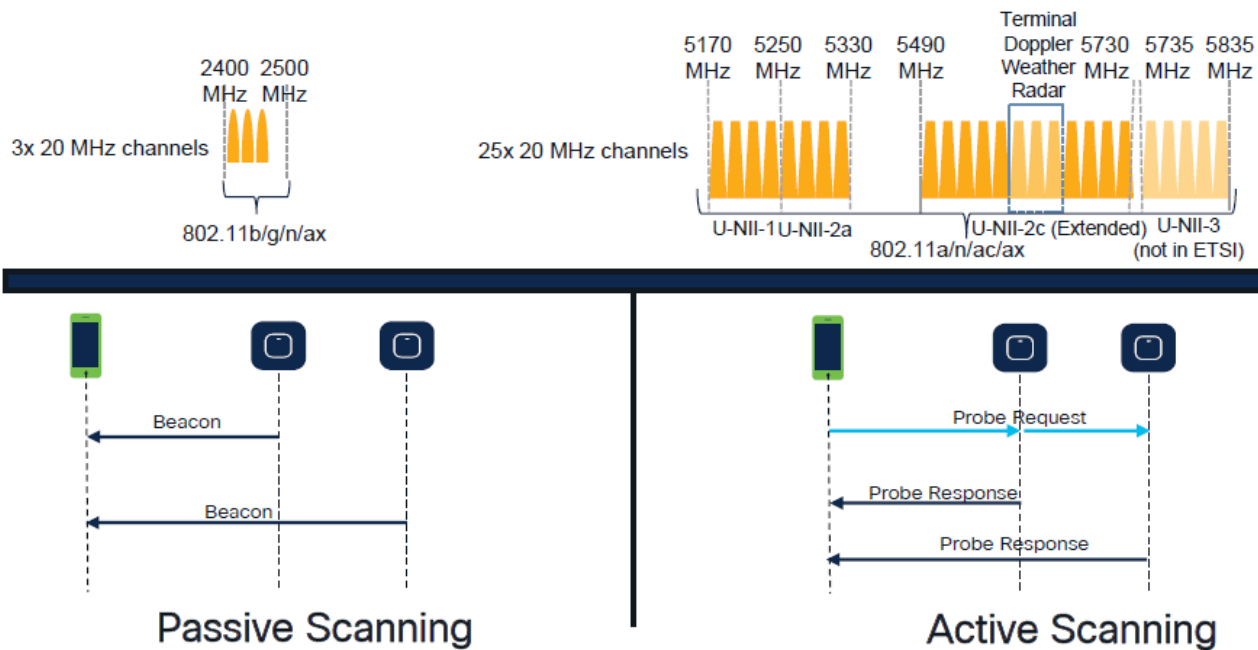
当今大多数客户端设备采用的最简单发现方法是依次通过传输一个或多个探测请求来扫描信道，然后侦听该区域中接入点的响应，检查探测响应，查看是否有任何SSID与客户端中的配置文件匹配，然后转到下一个信道。

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；
- 它会影响到客户端电池寿命。

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：



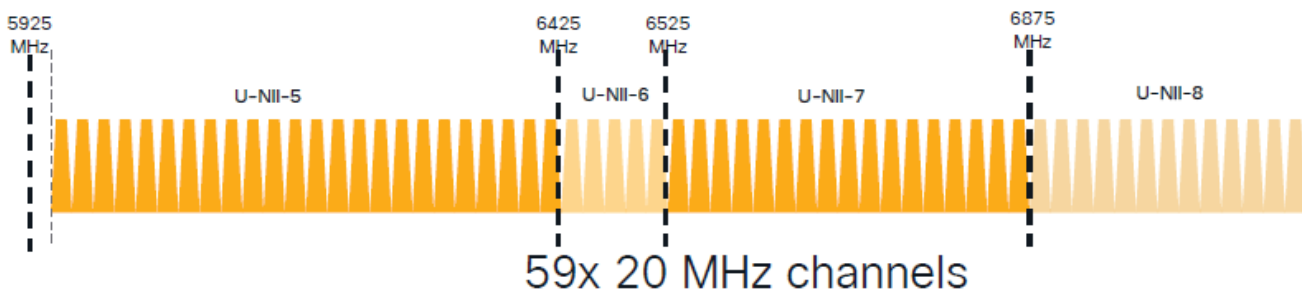
过去，无线设备通过特定信息交换与接入点通信。客户端设备使用活动的“寻线并寻找”方法来扫描附近的AP。

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：

Out of Band

Reduced Neighbor Report

Co-located Discovery



In Band

Passive Scan:

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

Active Scan:

Preferred Scanning Channels (PSC)



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：

The image shows a Wireshark capture of network traffic. The main table displays numerous 'Probe Response' frames from various access points (APs). A red box highlights a 'Reduced Neighbor Report' (RNR) frame from the AP with BSSID '3910713B0E'. This RNR frame contains information about neighboring APs and TWT (Target Wake Time) parameters. Red arrows point to specific fields within the RNR frame, such as 'Neighbor AP Information' and 'TWT Information', indicating the structure of the RNR data.

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：

The image shows a Wireshark capture of network traffic, similar to the previous one. It highlights a 'Reduced Neighbor Report' (RNR) frame from the AP with BSSID '3910713B0E', but this time for channel 6. Red arrows point to the 'Neighbor AP Information' and 'TWT Information' sections within the RNR frame, showing the structure of the RNR data for this specific channel.

带内

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。

The screenshot shows the Cisco Catalyst 9800-CL Wireless Controller configuration interface. The main navigation menu on the left includes Dashboard, Monitoring, Configuration, Administration, Licensing, and Troubleshooting. The current view is 'Configuration > Tags & Profiles > RF/Radio'. The 'Edit RF Profile' window is open, showing the '802.11ax' tab. The '6 GHz Discovery Frames' section is highlighted with a red box, and the 'None' radio button is selected. The 'Spatial Reuse' section shows 'OBSS PD' and 'SRG OBSS PD' set to 'DISABLED'. The 'Broadcast Probe Response Interval (msec)' is set to 20. The 'Multi BSSID Profile' is set to 'MBSSIDprofile_text'. The 'SRG OBSS PD Min Threshold (dBm)*' and 'SRG OBSS PD Max Threshold (dBm)*' are both set to -62.

State	RF Profile Name	Band
<input type="checkbox"/>	default-rf-profile-6ghz	6 GHz
<input type="checkbox"/>	Low_Client_Density_rf_5gh	5 GHz
<input type="checkbox"/>	High_Client_Density_rf_5gh	5 GHz
<input type="checkbox"/>	Low_Client_Density_rf_24gh	2.4 GHz
<input type="checkbox"/>	High_Client_Density_rf_24gh	2.4 GHz
<input type="checkbox"/>	Typical_Client_Density_rf_5gh	5 GHz
<input type="checkbox"/>	Typical_Client_Density_rf_24gh	2.4 GHz

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：

No.	Time	Delta	Source	Destination	Protocol	Length	Channel	Signal	Info
5007	2023-06-09 14:59:17.112446	0.0202985	Cisco_13:100:ec	Broadcast	802.11	115	5 -37 dBm	FILS Discovery, E1-100	> Frame 5007: 115 bytes on wire (920 bits), 115 bytes captured (920 bits) on interface vDevice\NPF_{D4578065-2998-4456-8C13-C...}
5012	2023-06-09 14:59:17.153221	0.040495	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	> Ethernet II, Src: Cisco_00:10:00:00:00:00, Dst: Universa_b7:cf:96 (08:00:00:00:00:00)
5024	2023-06-09 14:59:17.173780	0.020679	Cisco_13:100:ec	Broadcast	802.11	115	5 -37 dBm	FILS Discovery, E1-100	> Internet Protocol version 4, Src: 192.168.1.19, Dst: 192.168.1.121
5027	2023-06-09 14:59:17.194383	0.020333	Cisco_13:100:ec	Broadcast	802.11	115	5 -37 dBm	FILS Discovery, E1-100	> User Datagram Protocol, Src Port: 5555, Dst Port: 5000
5032	2023-06-09 14:59:17.214794	0.020493	Cisco_13:100:ec	Broadcast	802.11	115	5 -37 dBm	FILS Discovery, E1-100	> AirPeek/WinPeak encapsulated IEEE 802.11
5046	2023-06-09 14:59:17.255787	0.040911	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	> IEEE 802.11 Action, Flags: .....C
5049	2023-06-09 14:59:17.276185	0.020458	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	Type/Subtype: Action (0x0000)
5084	2023-06-09 14:59:17.296779	0.020414	Cisco_13:100:ec	Broadcast	802.11	115	5 -35 dBm	FILS Discovery, E1-100	> Frame Control fields: 0x0000
5082	2023-06-09 14:59:17.317181	0.020482	Cisco_13:100:ec	Broadcast	802.11	115	5 -35 dBm	FILS Discovery, E1-100	.....0000000000 = Duration: 0 microseconds
5078	2023-06-09 14:59:17.358875	0.040949	Cisco_13:100:ec	Broadcast	802.11	115	5 -35 dBm	FILS Discovery, E1-100	Receiver address: Broadcast (ff:ff:ff:ff:ff:ff)
5085	2023-06-09 14:59:17.379375	0.020400	Cisco_13:100:ec	Broadcast	802.11	115	5 -35 dBm	FILS Discovery, E1-100	Destination address: Broadcast (ff:ff:ff:ff:ff:ff)
5095	2023-06-09 14:59:17.399321	0.020466	Cisco_13:100:ec	Broadcast	802.11	115	5 -35 dBm	FILS Discovery, E1-100	Transmitter address: Cisco_13:100:ec (18:91:07:13:00:ec)
5184	2023-06-09 14:59:17.419594	0.020473	Cisco_13:100:ec	Broadcast	802.11	115	5 -35 dBm	FILS Discovery, E1-100	Source address: Cisco_13:100:ec (18:91:07:13:00:ec)
5118	2023-06-09 14:59:17.460512	0.040938	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	BSS Id: Cisco_13:100:ec (18:91:07:13:00:ec)
5122	2023-06-09 14:59:17.480915	0.020463	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....0000 = Fragment number: 0
5124	2023-06-09 14:59:17.502561	0.021086	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	0318 1800 9181 = Sequence number: 1649
5131	2023-06-09 14:59:17.522807	0.031476	Cisco_13:100:ec	Broadcast	802.11	115	5 -37 dBm	FILS Discovery, E1-100	Frame check sequence: 0x00000000 [unverified]
5147	2023-06-09 14:59:17.562874	0.040939	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	[FC Status: Unverified]
5190	2023-06-09 14:59:17.583325	0.020493	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	> IEEE 802.11 Wireless Management
5132	2023-06-09 14:59:17.604167	0.020842	Cisco_13:100:ec	Broadcast	802.11	115	5 -37 dBm	FILS Discovery, E1-100	> IEEE 802.11 Wireless Management
5156	2023-06-09 14:59:17.624287	0.020120	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	> IEEE 802.11 Wireless Management
5172	2023-06-09 14:59:17.665387	0.041100	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	Category code: Public Action (4)
5176	2023-06-09 14:59:17.685883	0.020496	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	Public Action: FILS Discovery (0x22)
5179	2023-06-09 14:59:17.706338	0.020495	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	> Frame Control fields, Capability, Short SSID, Length
5187	2023-06-09 14:59:17.727082	0.020664	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....0000 = SSID Length: 0(0)
5201	2023-06-09 14:59:17.767771	0.040769	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....01000000 = Capability: Present
5200	2023-06-09 14:59:17.788384	0.020415	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00000000 = Short SSID: Present
5208	2023-06-09 14:59:17.808714	0.020528	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00000000 = AN: Not Present
5215	2023-06-09 14:59:17.829188	0.020474	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00000000 = ANO: Not Present
5228	2023-06-09 14:59:17.870251	0.041043	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00000000 = Channel Center Frequency Segment 1: Not Present
5231	2023-06-09 14:59:17.890788	0.020339	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00000000 = Primary Channel: Not Present
5236	2023-06-09 14:59:17.911149	0.020559	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00000000 = RSN Info: Not Present
5242	2023-06-09 14:59:17.931615	0.020466	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00000000 = Length: Present
5246	2023-06-09 14:59:17.952142	0.040947	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00000000 = RD: Not Present
5259	2023-06-09 14:59:17.993098	0.020488	Cisco_13:100:ec	Broadcast	802.11	115	5 -35 dBm	FILS Discovery, E1-100	0000000000000000 = Reserved: Not Present
5262	2023-06-09 14:59:18.013608	0.020758	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	Timestamp: 00004617933
5271	2023-06-09 14:59:18.034064	0.020337	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	Reason Interval: 0.000000 [seconds]
5290	2023-06-09 14:59:18.075088	0.041085	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	Short SSID: 0x001c0005
5298	2023-06-09 14:59:18.095351	0.020493	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	Length: 2
5301	2023-06-09 14:59:18.115844	0.020324	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	Capability: 0x0122
5355	2023-06-09 14:59:18.177128	0.040966	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00000000 = ESI: 0(0)
5362	2023-06-09 14:59:18.197639	0.020389	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	.....00000000 = PRRACY: 0(0)
5381	2023-06-09 14:59:18.238728	0.020971	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00000000 = BSS Operating Channel width: 160MHz or 80MHz+80MHz / 2x4, 4x4 or 2x4, 2x4+2x4 (8x)
5384	2023-06-09 14:59:18.259289	0.020496	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00010000 = Maximum number of Spatial Streams: 2 spatial streams (8x)
5393	2023-06-09 14:59:18.280295	0.020436	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	.....00000000 = Reserved: 0(0)
5399	2023-06-09 14:59:18.300925	0.020462	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	.....00000000 = Multiple BSSIDs: 0(4)
5403	2023-06-09 14:59:18.321051	0.020362	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	.....00000000 = Max Tx Power: 0(0)
5417	2023-06-09 14:59:18.362372	0.041159	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	Tagged parameters (4 bytes)
5420	2023-06-09 14:59:18.382583	0.020393	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	> Tag: Tx Power Envelope
5423	2023-06-09 14:59:18.402813	0.020393	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	Tag length: 2
5428	2023-06-09 14:59:18.423192	0.020789	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	> Max Tx Power Envelope
5430	2023-06-09 14:59:18.443617	0.020465	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	Tag length: 2
5438	2023-06-09 14:59:18.464053	0.040966	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	.....000 = Max Tx Power Count: 0
5443	2023-06-09 14:59:18.484583	0.020993	Cisco_13:100:ec	Broadcast	802.11	115	5 -36 dBm	FILS Discovery, E1-100	.....00000000 = Max Tx Power unit Interpretation: Unknown (3)
5457	2023-06-09 14:59:18.525806	0.020714	Cisco_13:100:ec	Broadcast	802.11	115	5 -38 dBm	FILS Discovery, E1-100	0000000000000000 = Reserved: 0

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。

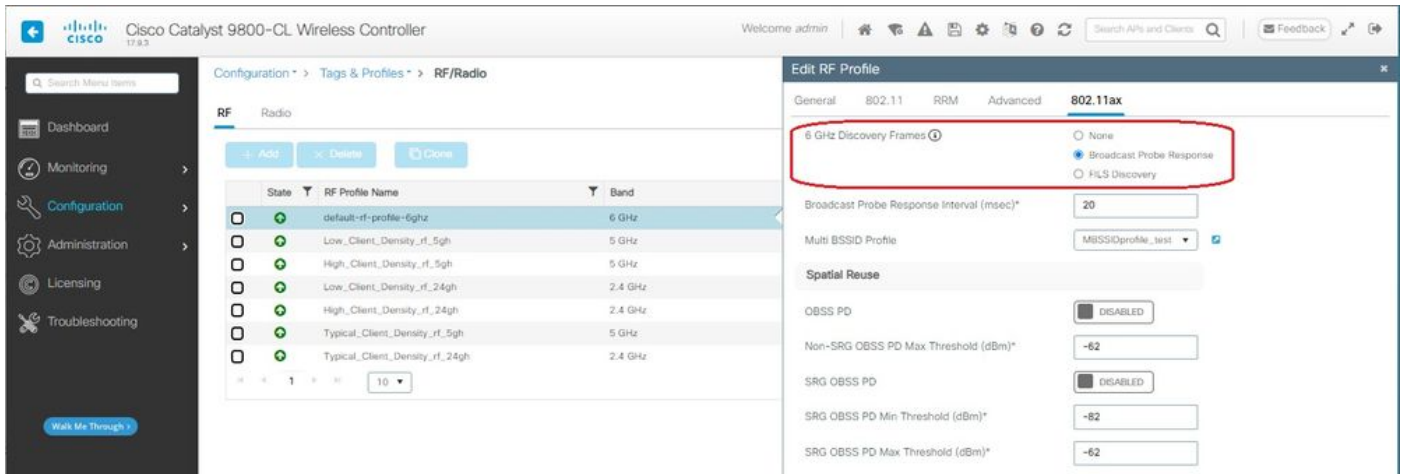
第2步-在RF选项卡中，单击添加。系统将显示Add RF Profile页面。

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。



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 bcst-probe-response
Device(config-rf-profile)# dot11ax bcst-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:

The image displays a Wireshark packet capture of IEEE 802.11 wireless management frames. The left pane shows a list of packets, with several Probe Response frames highlighted in red. The right pane shows the details of a selected Probe Response frame (packet 97), including the SSID parameter set 'wifi_test_01' and various management frame fields like Supported Rates, Country Information, and TPC Report.

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。

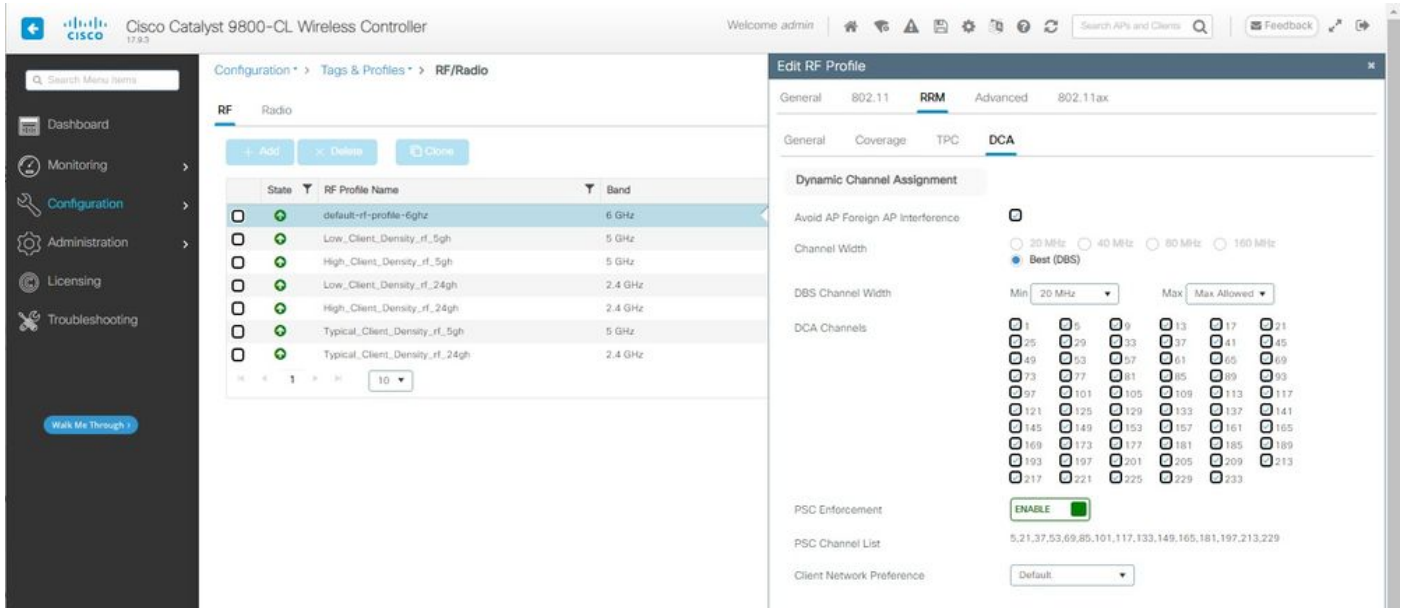
第3步-选择RRM 选项卡。

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。



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
[...]
```

PSC Enforcement : 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

No.	Time	Delta	Source	Destination	Protocol	Length	Channel	Signal	Info
159.	2023-06-09 15:38:48.797236	0.000000	netgear_48:78:1c	Cisco:13:108:...	802.11	368	5 -47 dBm	Probe Request, Srv, Fw, Flags=.....C, SSID="wifi6_test"	> Frame 193580: 368 bytes on wire (2880 bits), 368 bytes captured (2880 bits) on interface l0device\WFP_{D4578965-2998-4A56-8C33-3A43}
159.	2023-06-09 15:38:48.798659	0.000247	netgear_48:78:1c	Cisco:13:108:...	802.11	368	5 -47 dBm	Probe Request, Srv, Fw, Flags=.....C, SSID="wifi6_test"	> Ethernet II, Src: Cisco_08:00:27:00:00:00, Dst: universa_b7:cf:06 (08:1a:8b:b7:cf:06)
159.	2023-06-09 15:38:48.791562	0.021869	netgear_48:78:1c	Cisco:13:108:...	802.11	368	5 -47 dBm	Probe Request, Srv, Fw, Flags=.....C, SSID="wifi6_test"	> Internet Protocol Version 4, Src: 192.168.1.15, Dst: 192.168.1.121
159.	2023-06-09 15:38:49.099338	0.227768	netgear_48:78:1c	Cisco:13:108:...	802.11	250	5 -47 dBm	Association Request, Srv, Fw, Flags=.....C, SSID="wifi6_test"	> User Datagram Protocol, Src Port: 5555, Dst Port: 5000
									> AirPort/OverPeak encapsulated IEEE 802.11
									> IEEE 802.11 Probe Request, Flags: .....C
									> IEEE 802.11 Wireless Management
									> Tagged parameters (276 bytes)
									> Tag: SSID parameter set: "wifi6_test"
									> Tag Number: SSID parameter set (0)
									> Tag Length: 11
									> SSID: "wifi6_test"
									> Tag: Supported Rates 618, 9, 1218, 18, 2418, 36, 48, 54, [Mbit/sec]
									> Tag: Vendor Specific: Microsoft Corp.: WPS
									> Tag: Vendor Specific: Wi-Fi Alliance: Multi Band operation - Optimized Connectivity Experience
									> Tag Number: Extended Capabilities (18 octets)
									> Tag Length: 18
									> Extended Capabilities: 0x01 (octet 1)
									> Extended Capabilities: 0x02 (octet 2)
									> Extended Capabilities: 0x03 (octet 3)
									> Extended Capabilities: 0x04 (octet 4)
									> Extended Capabilities: 0x05 (octet 5)
									> Extended Capabilities: 0x06 (octet 6)
									> Extended Capabilities: 0x07 (octet 7)
									> Extended Capabilities: 0x08 (octets 8 & 9)
									> Extended Capabilities: 0x20 (octet 10)
									> Extended Capabilities: 0x21 (octet 11)
									> Extended Capabilities: 0x22 (octet 12)
									> Extended Capabilities: 0x23 (octet 13)
									> Extended Capabilities: 0x24 (octet 14)
									> Extended Capabilities: 0x25 (octet 15)
									> Extended Capabilities: 0x26 (octet 16)
									> Extended Capabilities: 0x27 (octet 17)
									> Extended Capabilities: 0x28 (octet 18)
									> Extended Capabilities: 0x29 (octet 19)
									> Extended Capabilities: 0x2A (octet 20)
									> Extended Capabilities: 0x2B (octet 21)
									> Extended Capabilities: 0x2C (octet 22)
									> Extended Capabilities: 0x2D (octet 23)
									> Extended Capabilities: 0x2E (octet 24)
									> Extended Capabilities: 0x2F (octet 25)
									> Extended Capabilities: 0x30 (octet 26)
									> Extended Capabilities: 0x31 (octet 27)
									> Extended Capabilities: 0x32 (octet 28)
									> Extended Capabilities: 0x33 (octet 29)
									> Extended Capabilities: 0x34 (octet 30)
									> Extended Capabilities: 0x35 (octet 31)
									> Extended Capabilities: 0x36 (octet 32)
									> Extended Capabilities: 0x37 (octet 33)
									> Extended Capabilities: 0x38 (octet 34)
									> Extended Capabilities: 0x39 (octet 35)
									> Extended Capabilities: 0x3A (octet 36)
									> Extended Capabilities: 0x3B (octet 37)
									> Extended Capabilities: 0x3C (octet 38)
									> Extended Capabilities: 0x3D (octet 39)
									> Extended Capabilities: 0x3E (octet 40)
									> Extended Capabilities: 0x3F (octet 41)
									> Extended Capabilities: 0x40 (octet 42)
									> Extended Capabilities: 0x41 (octet 43)
									> Extended Capabilities: 0x42 (octet 44)
									> Extended Capabilities: 0x43 (octet 45)
									> Extended Capabilities: 0x44 (octet 46)
									> Extended Capabilities: 0x45 (octet 47)
									> Extended Capabilities: 0x46 (octet 48)
									> Extended Capabilities: 0x47 (octet 49)
									> Extended Capabilities: 0x48 (octet 50)
									> Extended Capabilities: 0x49 (octet 51)
									> Extended Capabilities: 0x4A (octet 52)
									> Extended Capabilities: 0x4B (octet 53)
									> Extended Capabilities: 0x4C (octet 54)
									> Extended Capabilities: 0x4D (octet 55)
									> Extended Capabilities: 0x4E (octet 56)
									> Extended Capabilities: 0x4F (octet 57)
									> Extended Capabilities: 0x50 (octet 58)
									> Extended Capabilities: 0x51 (octet 59)
									> Extended Capabilities: 0x52 (octet 60)
									> Extended Capabilities: 0x53 (octet 61)
									> Extended Capabilities: 0x54 (octet 62)
									> Extended Capabilities: 0x55 (octet 63)
									> Extended Capabilities: 0x56 (octet 64)
									> Extended Capabilities: 0x57 (octet 65)
									> Extended Capabilities: 0x58 (octet 66)
									> Extended Capabilities: 0x59 (octet 67)
									> Extended Capabilities: 0x5A (octet 68)
									> Extended Capabilities: 0x5B (octet 69)
									> Extended Capabilities: 0x5C (octet 70)
									> Extended Capabilities: 0x5D (octet 71)
									> Extended Capabilities: 0x5E (octet 72)
									> Extended Capabilities: 0x5F (octet 73)
									> Extended Capabilities: 0x60 (octet 74)
									> Extended Capabilities: 0x61 (octet 75)
									> Extended Capabilities: 0x62 (octet 76)
									> Extended Capabilities: 0x63 (octet 77)
									> Extended Capabilities: 0x64 (octet 78)
									> Extended Capabilities: 0x65 (octet 79)
									> Extended Capabilities: 0x66 (octet 80)
									> Extended Capabilities: 0x67 (octet 81)
									> Extended Capabilities: 0x68 (octet 82)
									> Extended Capabilities: 0x69 (octet 83)
									> Extended Capabilities: 0x6A (octet 84)
									> Extended Capabilities: 0x6B (octet 85)
									> Extended Capabilities: 0x6C (octet 86)
									> Extended Capabilities: 0x6D (octet 87)
									> Extended Capabilities: 0x6E (octet 88)
									> Extended Capabilities: 0x6F (octet 89)
									> Extended Capabilities: 0x70 (octet 90)
									> Extended Capabilities: 0x71 (octet 91)
									> Extended Capabilities: 0x72 (octet 92)
									> Extended Capabilities: 0x73 (octet 93)
									> Extended Capabilities: 0x74 (octet 94)
									> Extended Capabilities: 0x75 (octet 95)
									> Extended Capabilities: 0x76 (octet 96)
									> Extended Capabilities: 0x77 (octet 97)
									> Extended Capabilities: 0x78 (octet 98)
									> Extended Capabilities: 0x79 (octet 99)
									> Extended Capabilities: 0x7A (octet 100)
									> Extended Capabilities: 0x7B (octet 101)
									> Extended Capabilities: 0x7C (octet 102)
									> Extended Capabilities: 0x7D (octet 103)
									> Extended Capabilities: 0x7E (octet 104)
									> Extended Capabilities: 0x7F (octet 105)
									> Extended Capabilities: 0x80 (octet 106)
									> Extended Capabilities: 0x81 (octet 107)
									> Extended Capabilities: 0x82 (octet 108)
									> Extended Capabilities: 0x83 (octet 109)
									> Extended Capabilities: 0x84 (octet 110)
									> Extended Capabilities: 0x85 (octet 111)
									> Extended Capabilities: 0x86 (octet 112)
									> Extended Capabilities: 0x87 (octet 113)
									> Extended Capabilities: 0x88 (octet 114)
									> Extended Capabilities: 0x89 (octet 115)
									> Extended Capabilities: 0x8A (octet 116)
									> Extended Capabilities: 0x8B (octet 117)
									> Extended Capabilities: 0x8C (octet 118)
									> Extended Capabilities: 0x8D (octet 119)
									> Extended Capabilities: 0x8E (octet 120)
									> Extended Capabilities: 0x8F (octet 121)
									> Extended Capabilities: 0x90 (octet 122)
									> Extended Capabilities: 0x91 (octet 123)
									> Extended Capabilities: 0x92 (octet 124)
									> Extended Capabilities: 0x93 (octet 125)
									> Extended Capabilities: 0x94 (octet 126)
									> Extended Capabilities: 0x95 (octet 127)
									> Extended Capabilities: 0x96 (octet 128)
									> Extended Capabilities: 0x97 (octet 129)
									> Extended Capabilities: 0x98 (octet 130)
									> Extended Capabilities: 0x99 (octet 131)
									> Extended Capabilities: 0x9A (octet 132)
									> Extended Capabilities: 0x9B (octet 133)
									> Extended Capabilities: 0x9C (octet 134)
									> Extended Capabilities: 0x9D (octet 135)
									> Extended Capabilities: 0x9E (octet 136)
									> Extended Capabilities: 0x9F (octet 137)
									> Extended Capabilities: 0xA0 (octet 138)
									> Extended Capabilities: 0xA1 (octet 139)

No.	Time	Delta	Source	Destination	Protocol	Length	Channel	Signal	Info
620	2023-06-09 16:02:25.542089	0.00000	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Frame 6924: 164 bytes on wire (1312 bits), 164 bytes captured (1312 bits) on interface UDeviceWIFI_04878985-2998-4A56-8C33-C43464
621	2023-06-09 16:02:25.543282	0.00073	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ethernet II, Src: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)
622	2023-06-09 16:02:25.544566	0.00073	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Internet Protocol Version 4, Src: 192.168.1.15, Dst: 192.168.1.121
623	2023-06-09 16:02:25.545850	0.00109	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> User Datagram Protocol, Src Port: 5555, Dst Port: 5000
624	2023-06-09 16:02:25.547134	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> AirPee/WiFiReq encapsulated IEEE 802.11
625	2023-06-09 16:02:25.548418	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> IEEE 802.11 Probe Request, Flags: .....C
626	2023-06-09 16:02:25.549702	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> IEEE 802.11 Wireless Management
627	2023-06-09 16:02:25.550986	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Tagged parameters (24 bytes)
628	2023-06-09 16:02:25.552270	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Tag: SSID parameter set: Wldcard SSID
629	2023-06-09 16:02:25.553554	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Tag: Supported Rates 6, 9, 12, 18, 24, 36, 48, 54, [Mbit/sec]
630	2023-06-09 16:02:25.554838	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Tag: Extended Capabilities (11 octets)
631	2023-06-09 16:02:25.556122	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Tag Number: Extended Capabilities (127)
632	2023-06-09 16:02:25.557406	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Tag Length: 11
633	2023-06-09 16:02:25.558690	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Extended Capabilities: 0x00 (octet 1)
634	2023-06-09 16:02:25.559974	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Extended Capabilities: 0x00 (octet 2)
635	2023-06-09 16:02:25.561258	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Extended Capabilities: 0x00 (octet 3)
636	2023-06-09 16:02:25.562542	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Extended Capabilities: 0x01 (octet 4)
637	2023-06-09 16:02:25.563826	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Extended Capabilities: 0x01 (octet 5)
638	2023-06-09 16:02:25.565110	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Extended Capabilities: 0x00 (octet 6)
639	2023-06-09 16:02:25.566394	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Extended Capabilities: 0x0000 (octets 7 & 8)
640	2023-06-09 16:02:25.567678	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Extended Capabilities: 0x01 (octet 10)
641	2023-06-09 16:02:25.568962	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Tag: Vendor Specific: Microsoft Corp.: Unknown #
642	2023-06-09 16:02:25.570246	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Tag: Element ID Extension (255)
643	2023-06-09 16:02:25.571530	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ext Tag Length: 2
644	2023-06-09 16:02:25.572814	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ext Tag Number: 0x00 (Reserved: 0x0)
645	2023-06-09 16:02:25.574098	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ext Tag: HE Capabilities
646	2023-06-09 16:02:25.575382	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ext Tag Length: 12
647	2023-06-09 16:02:25.576666	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ext Tag Number: HE Capabilities (35)
648	2023-06-09 16:02:25.577950	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> HE MAC Capabilities Information: 0x000000000000
649	2023-06-09 16:02:25.579234	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> HE MFC Capabilities Information
650	2023-06-09 16:02:25.580518	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Supported HE MCS and NSS Set
651	2023-06-09 16:02:25.581802	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> PPE Thresholds
652	2023-06-09 16:02:25.583086	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ext Tag: HE 6 GHz Band Capabilities
653	2023-06-09 16:02:25.584370	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Tag Number: Element ID Extension (255)
654	2023-06-09 16:02:25.585654	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ext Tag Length: 2
655	2023-06-09 16:02:25.586938	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ext Tag Number: HE 6 GHz Band Capabilities (59)
656	2023-06-09 16:02:25.588222	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Capabilities Information: 0x0000
657	2023-06-09 16:02:25.589506	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	>1801 = Maximum MPOU Start Spacing: 4 US (8x5)
658	2023-06-09 16:02:25.590790	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	>1111 = Maximum A-MPOU Length: Extension: 1 048 576 (8x7)
659	2023-06-09 16:02:25.592074	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	>1111 = Maximum A-MPOU Length: 1 048 576 (8x7)
660	2023-06-09 16:02:25.593358	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	>0000 = Reserved: 0x0
661	2023-06-09 16:02:25.594642	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	>0000 = Reserved: 0x0
662	2023-06-09 16:02:25.595926	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	>1111 = SM Power Save: SM Power Save Disabled (8x7)
663	2023-06-09 16:02:25.597210	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	>0000 = SM Power Save: Dynamic SM Power Save Mode (8x7)
664	2023-06-09 16:02:25.598494	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	>0000 = HD Responder: Not supported
665	2023-06-09 16:02:25.599778	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	>0000 = Rx Antenna Pattern Consistency: Not supported
666	2023-06-09 16:02:25.601062	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	>0000 = Tx Antenna Pattern Consistency: Not supported
667	2023-06-09 16:02:25.602346	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	>0000 = Reserved: 0x0
668	2023-06-09 16:02:25.603630	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> > Tag: FILS Request Parameters: Undecoded
669	2023-06-09 16:02:25.604914	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Tag Number: Element ID Extension (255)
670	2023-06-09 16:02:25.606198	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ext Tag Length: 1
671	2023-06-09 16:02:25.607482	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ext Tag Number: FILS Request Parameters (2)
672	2023-06-09 16:02:25.608766	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Ext Tag Data: 0x00
673	2023-06-09 16:02:25.610050	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> [Expert Info (NotImplemented):] Dissector for IEEE 802.11 Extension Tag (FILS Request Parameters) code not implemented, Contact
674	2023-06-09 16:02:25.611334	0.00129	netgear_48:78:95	Broadcast	802.11	166	5 -45 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Tag: Vendor Specific: Wi-Fi Alliance: Multi Band Operation - optimized connectivity experience

英特尔AX211

No.	Time	Delta	Source	Destination	Protocol	Length	Channel	Signal	Info
9421	2023-06-09 16:02:47.759844	0.00000	netgear_48:78:95	Broadcast	802.11	168	5 -44 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:66 (0e:1a:31:37:c:f:66)	> Frame 9421: 168 bytes on wire (1344 bits), 168 bytes captured (1344 bits) on interface UDeviceWIFI_04878985-2998-4A56-8C33-C43464
9422	2023-06-09 16:02:47.761037	0.00119	netgear_48:78:95	Broadcast	802.11	168	5 -44 dBm	Probe Request, Srv: Cisco_06:76:17 (00:0f:1d:06:76:17), Dst: Univers_37:c:f:	

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。

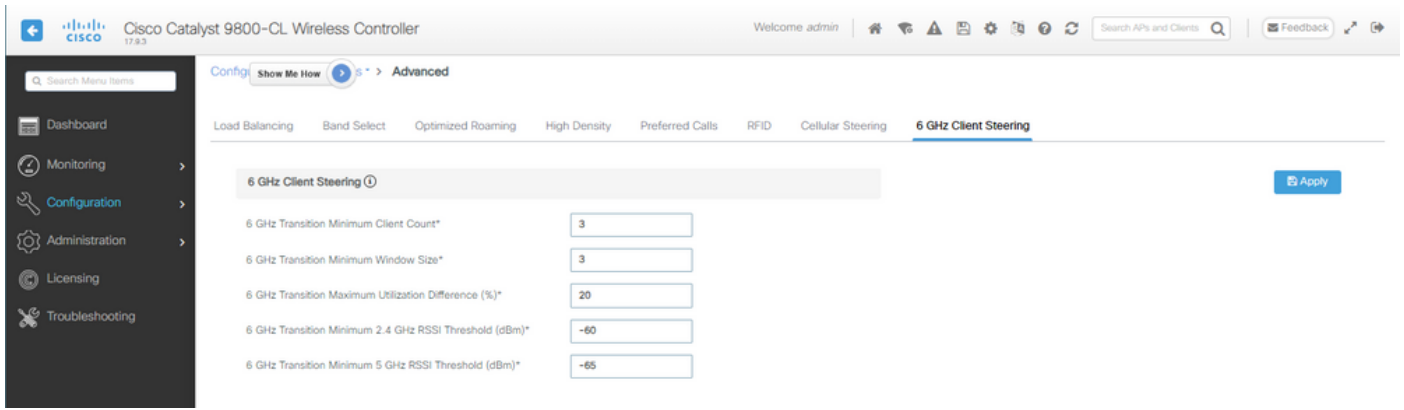
第4步-在6 GHz过渡最小窗口大小字段中，输入用于设置客户端控制的最小窗口大小的值。默认值为3个客户端。值范围介于0和200个客户端之间。

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。



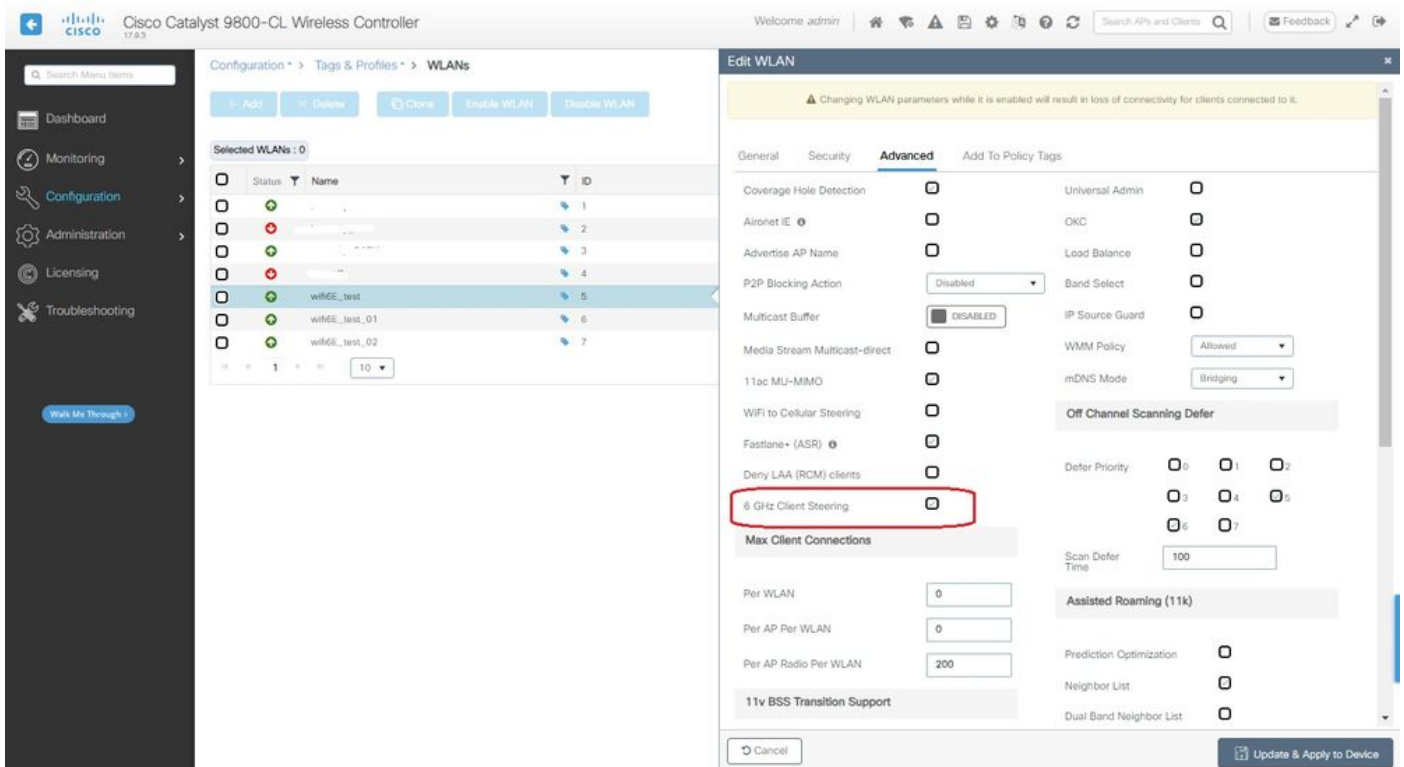
在全局配置模式(CLI)下配置6 GHz客户端引导

```

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。



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
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
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	Operation Status	Policy Tag	Site Tag	RF Tag	Channel Width	Channel	Power Level
AP9166_0E.6220	2	7411.b2d2.9740	✓	✓	W66E_TestPolicy	TiagoHomePTAPs	default-rf-tag	160 MHz	(69,65,73,77,81,85,89,93)*	*1/8 (19 dBm)
AP9162_53.CA50	2	3891.b713.80e0	✓	✓	W66E_TestPolicy	TiagoHomePTAPs	default-rf-tag	160 MHz	(5,1,9,13,17,21,25,29)*	*1/8 (17 dBm)
AP9136_5C.F524	3	00d1.1ddd.7d30	✓	✓	W66E_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)
```

```
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-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_OE.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

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: 000000000000171BC51FF477

Acct Session ID : 0x00000000

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

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_OE.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: 0000000000001713C518E305

Acct Session ID : 0x00000000

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_OE.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 : 0x90000025

Authorized : TRUE

Session timeout : 86400

Common Session ID: 000000000000171CC520478F

Acct Session ID : 0x00000000

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

[...]

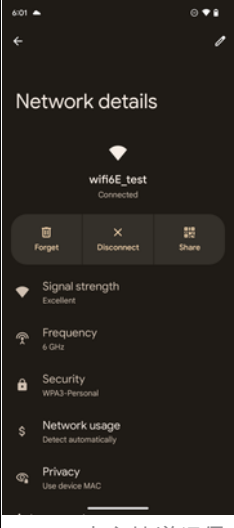
Device Classification Information:

Device Type : LENOVO 21CCS43W0T

Device Name : CSCO-W-xxxxxxxx

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：

NetGearA8000	像素6a	三星S23	英特尔AX211
<pre>Name: A8000_NETGEAR Description: NETGEAR A8000 WiFi 6 & 6E Adapter Physical address (MAC): 94:18:65:48:70:95 Status: Operational Maximum transmission unit: 1500 Link speed (Receive/Transmit): 1201/1201 (Mbps) DHCP enabled: Yes DHCP servers: 192.168.1.254 DHCP lease obtained: Monday, June 19, 2023 6:20:11 PM DHCP lease expires: Tuesday, June 20, 2023 6:20:11 PM IPv4 address: 192.168.1.163/24 IPv6 address: 2001:8a0:fb91:1c00:f6e7:e29c:f0e1:63ea/64, 2001:8a0:fb91:1c00:299c:6c3b:b3c0:59b6/128 IPv4 default gateway: 192.168.1.254 IPv6 default gateway: fe80::5afc:20ff:fe9e:59af%16 DNS servers: 2001:8a0:fb91:1c00:1 (Unencrypted) 192.168.1.254 (Unencrypted) DNS domain name: Home DNS connection suffix: Home DNS search suffix list: Network name: wifif6E_test</pre>			<pre>Name: Wi-Fi Description: Intel(R) Wi-Fi 6E AX211 160MHz Physical address (MAC): 28:6b:35:98:58:0f Status: Operational Maximum transmission unit: 1500 Link speed (Receive/Transmit): 2402/2402 (Mbps) DHCP enabled: Yes DHCP servers: 192.168.1.254 DHCP lease obtained: Monday, June 19, 2023 6:02:34 PM DHCP lease expires: Tuesday, June 20, 2023 6:02:34 PM IPv4 address: 192.168.1.159/24 IPv6 address: 2001:8a0:fb91:1c00:edb2:8d62:d379:c53b/64, 2001:8a0:fb91:1c00:ac5b:e1e1:67ba:c353/64 IPv4 default gateway: 192.168.1.254 IPv6 default gateway: fe80::5afc:20ff:fe9e:59af%8 DNS servers: 2001:8a0:fb91:1c00:1 (Unencrypted) 192.168.1.254 (Unencrypted) DNS domain name: Home DNS connection suffix: Home DNS search suffix list: Network name: wifif6E_test</pre>
NetGearA8000客户端详细信息	Pixel6a客户端详细信息	S23客户端详细信息	AX211客户端详细信息

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 : Infrastructure
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
BSSID 2 : 10:a8:29:30:0d:0f
Signal : 57%
Radio type : 802.11ax
Band : 5 GHz
Channel : 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
BSSID 3 : 18:f9:35:4d:9d:67
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，[请参阅](#) debug 有关 Debug 命令的 [重要信息](#)。

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

[什么是Wi-Fi 6E？](#)

[什么是Wi-Fi 6与Wi-Fi 6E？](#)

[Wi-Fi 6E概览](#)

[Wi-Fi 6E：Wi-Fi下一重要章节（白皮书）](#)

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

[支持6 GHz Wi-Fi的国家/地区\(Wi-Fi 6E\)](#)

[Cisco Catalyst 9800系列无线控制器软件配置指南17.9.x](#)

[WPA3部署指南](#)

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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