Configure Enhanced Open SSID with Transition Mode - OWE

Contents

Introduction

This document describes how to configure and troubleshoot Enhanced Open with Transition Mode on Catalyst 9800 Wireless LAN Controller (9800 WLC).

Prerequisites

Requirements

Cisco recommends that you have knowledge of these topics:

- Cisco Wireless Lan Controllers (WLC) 9800.
- Cisco Access Points (APs) that support WPA3.
- IEEE Standard 802.11ax.
- Wireshark.

Components Used

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

- WLC 9800-CL with IOS® XE 17.9.3.
- APs C9130, C9136, CW9162, CW9164 and CW9166.
- Wi-Fi 6 Clients:
  - iPhone SE3rd gen on IOS 16
  - MacBook on Mac OS 12.
- Wi-Fi 6 Clients:

- Lenovo X1 Carbon Gen11 with Intel AX211 Wi-Fi 6 and 6E Adapter with driver version 22.200.2(1).
- Netgear A8000 Wi-Fi 6 and 6E Adapter with driver v1(0.0.108);
- Mobile Phone Pixel 6a with Android 13;
- Mobile Phone Samsung S23 with Android 13.

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

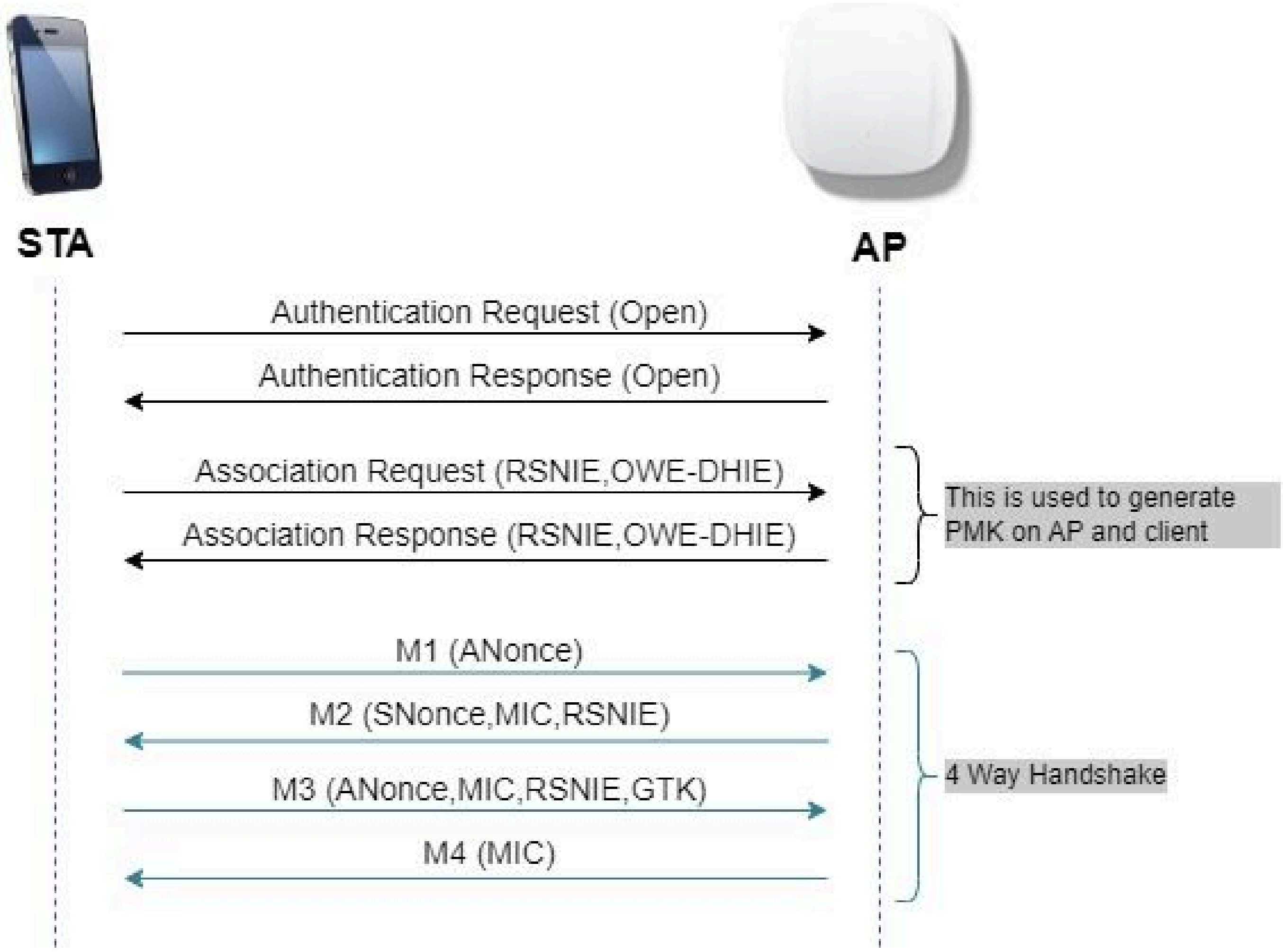
Background Information

The Enhanced Open is a certification provided by WiFi alliance as part of the WPA3 wireless security standard. It uses Opportunistic Wireless Encryption (OWE) on Open (unauthenticated) networks to prevent passive sniffing and prevent simple attacks as compared to a public PSK wireless network.

With Enhanced Open, clients and the WLC (in case of Central Authentication) or the AP (in case of FlexConnect Local Authentication) perform a Diffie-Hellman key exchange during the association process and use the pairwise master key secret (PMK) with the 4-way handshake.

OWE

Opportunistic Wireless Encryption (OWE) is an extension to IEEE 802.11 that provides encryption of the wireless medium (IETF RFC 8110). The purpose of OWE based authentication is avoid open unsecured wireless connectivity between the AP’s and clients. The OWE uses the Diffie-Hellman algorithms based Cryptography to setup the wireless encryption. With OWE, the client and AP perform a Diffie-Hellman key exchange during the access procedure and use the resulting pairwise master key (PMK) secret with the 4-way handshake. The use of OWE enhances wireless network security for deployments where Open or shared PSK based networks are deployed.


STA
AP
Authentication Request (Open)
Authentication Response (Open)
Association Request (RSNIE,OWE-DHIE)
Association Response (RSNIE,OWE-DHIE)
This is used to generate PMK on AP and client
M1 (ANonce)
M2 (SNonce,MIC,RSNIE)
M3 (ANonce,MIC,RSNIE,GTK)
M4 (MIC)
4 Way Handshake

OWE frame exchange

Transition Mode

Typically enterprise networks only have one unencrypted guest SSID and prefer to have both older clients that do not support enhanced open and newer clients with enhanced open to co-exist. Transition Mode is introduced specifically to cater to this scenario.

This requires configuration of two SSIDs - one hidden SSID to support OWE and a second SSID that is Open and is broadcasted.

The Opportunistic Wireless Encryption (OWE) transition mode enables OWE and non-OWE STAs to connect to the same SSID simultaneously. When all the OWE STAs see an SSID in OWE transition mode, they connect with the OWE.

Both the open WLAN and the OWE WLAN transmit beacon frames. Beacon and probe response frames from the OWE WLAN include the Wi-Fi Alliance vendor IE to encapsulate the BSSID and SSID of the open WLAN, and similarly, the open WLAN also includes for OWE WLAN.

An OWE STA shall only display to the user in the list of available networks the SSID of the Open BSS of an OWE AP operating in OWE Transition Mode, and shall suppress the display of the OWE BSS SSID of that OWE AP.

Guidelines and Restrictions:

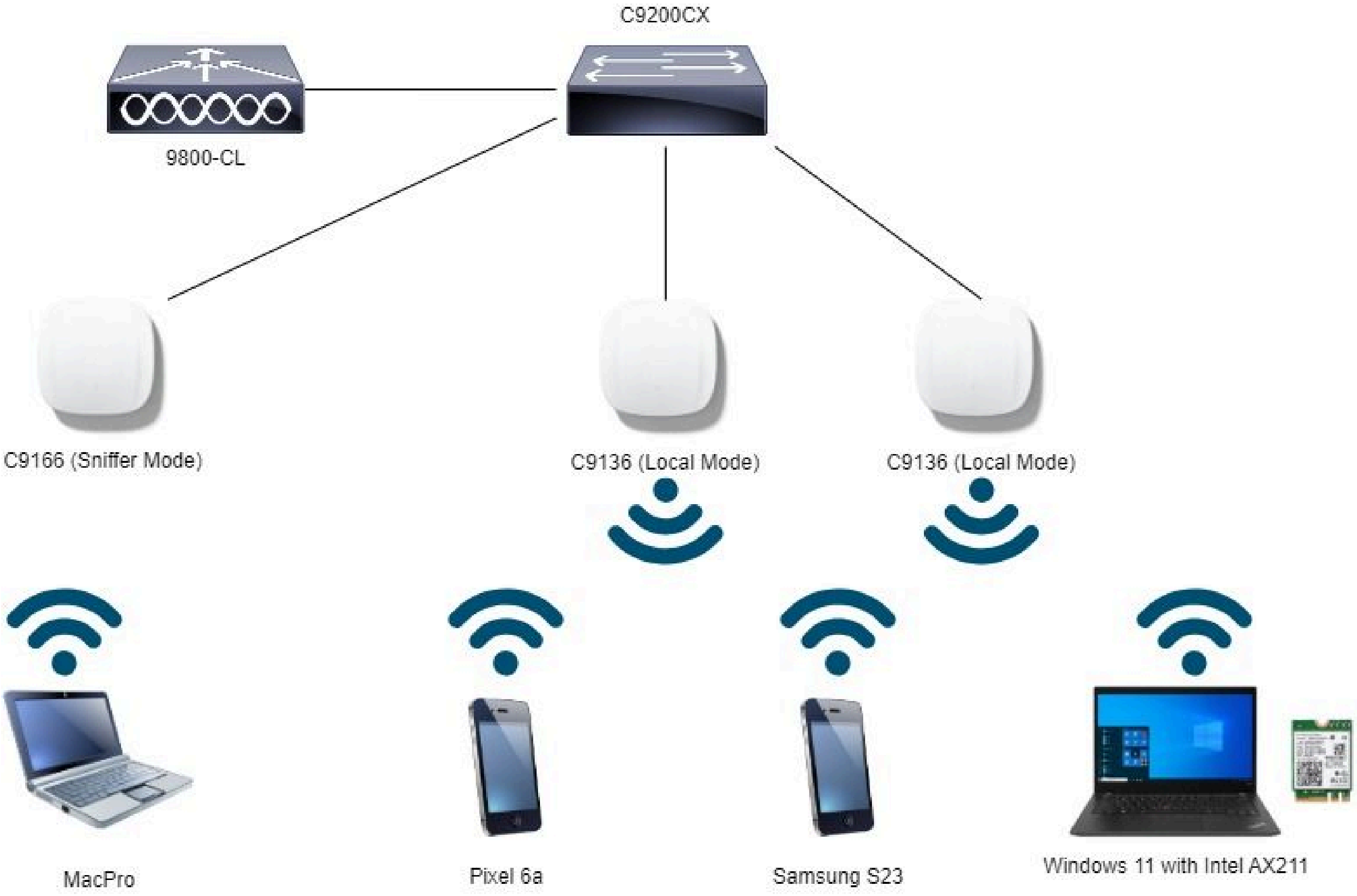
- Enhanced open requires WPA3 only Policy. WPA3 is not supported in Cisco Wave 1 (Cisco IOS®-

based) APs.
- Protected Management Frame (PMF) must be set to Required. This is set by default with WPA3 only Layer 2 Security.
- Enhanced Open only works on end clients that run the newer versions that support Enhanced Open.
- Wi-Fi Enhanced Open Transition Mode is not allowed on 6GHz band. As per the [WPA3™ Specification v3.4]: there are these constraints related to 6GHz and Wi-Fi 7 (EHT - Extremely High Throughput or MLO - Multi Link Operation):
    - "When an AP is operating a BSS in the 6 GHz band: [...] The AP's BSS Configuration shall not allow Wi-Fi Enhanced Open Transition Mode (i.e., where the OWE Transition Mode element is included in Beacons and Probe responses)".
    - "When an AP is operating a BSS with EHT or MLO enabled [...]: The AP's BSS Configuration shall not allow Wi-Fi Enhanced Open Transition Mode (i.e., where the OWE Transition Mode element is included in Beacons and Probe responses).

Configure

Typical use case where the administrator wants to configure Enhanced Open but still allow for older clients to be able to connect to the guest SSID.

Network Diagram



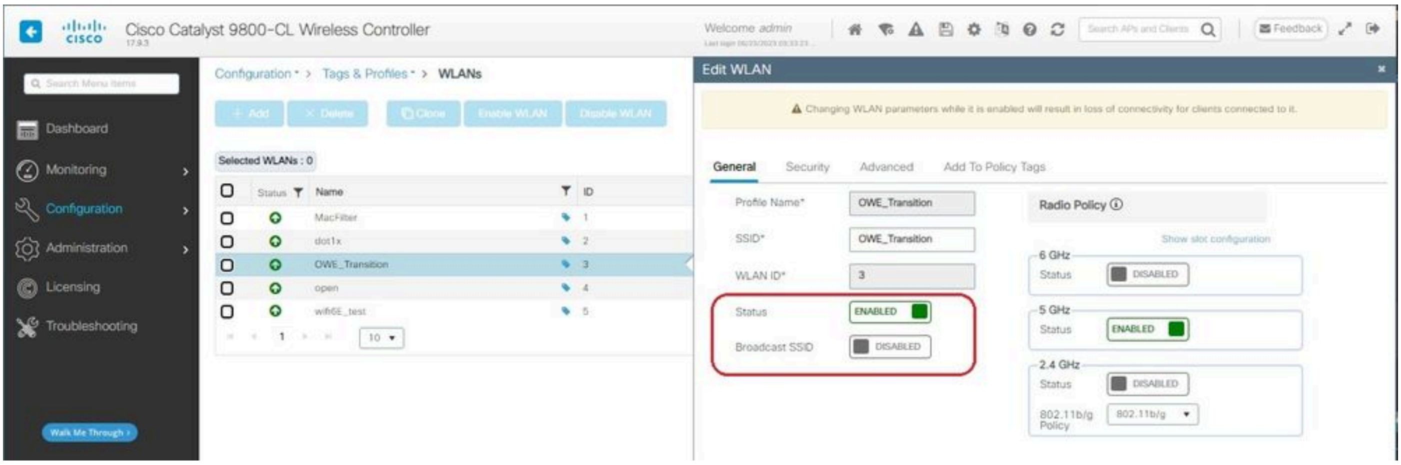
Network Topology

Configuration steps for GUI:

Create first SSID, hereby called “OWE_Transition”. In this example WLAN ID 3, and ensure it is hidden with the option “Broadcast SSID” disabled:

Step 1 Choose **Configuration** > **Tags & Profiles** > **WLANs** to open the WLANs page.

Step 2 Click **Add** to add new WLAN > add WLAN name "OWE_Transition" > change **Status** to **Enable** > ensure **Broadcast SSID** is **Disabled.**



Status	Name	ID
●	MacFilter	1
●	dot1x	2
●	OWE_Transition	3
●	open	4
●	wifi6E_test	5

Edit WLAN

⚠ Changing WLAN parameters while it is enabled will result in loss of connectivity for clients connected to it.

General | Security | Advanced | Add To Policy Tags

Profile Name*	OWE_Transition
SSID*	OWE_Transition
WLAN ID*	3
Status	ENABLED
Broadcast SSID	DISABLED

Radio Policy ⓘ

Show slot configuration

6 GHz	Status	DISABLED
5 GHz	Status	ENABLED
2.4 GHz	Status	DISABLED
	802.11b/g Policy	802.11b/g

OWE Transition Enhanced Open SSID hidden

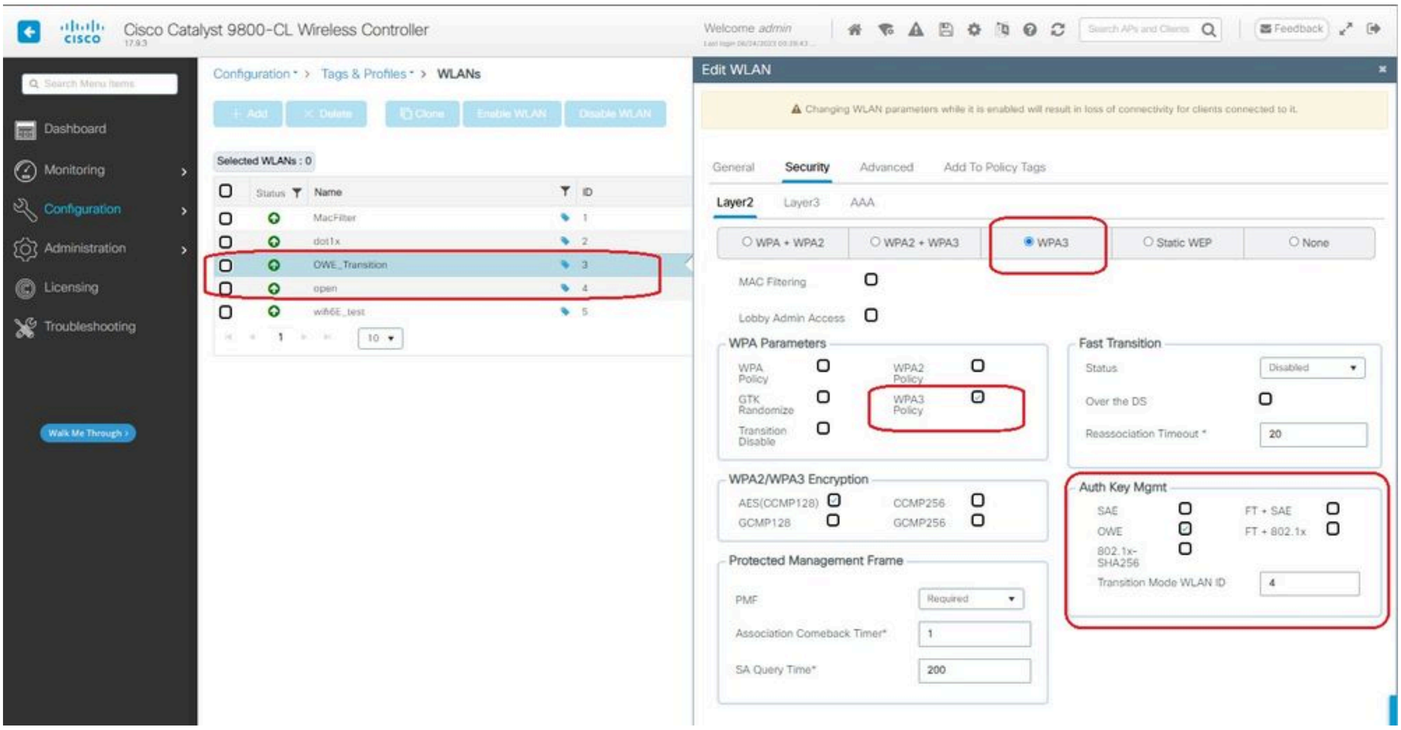
Step 3 Choose the **Security** > **Layer 2** tab > Select **WPA3**.

Step 4 Set Protected Management Frame **(PMF)** to **Required.**

Step 5 Under **WPA Parameters** > Check the WPA3 Policy. Select **AES(CCMP128)** Encryption and **OWE** Auth Key Management.

Step 6 Add WLAN ID 4 (open WLAN) to "**Transition Mode WLAN ID**" box.

Step 7 Click **Apply to Device**.



Status	Name	ID
●	MacFilter	1
●	dot1x	2
●	OWE_Transition	3
●	open	4
●	wifi6E_test	5

Edit WLAN

⚠ Changing WLAN parameters while it is enabled will result in loss of connectivity for clients connected to it.

General | Security | Advanced | Add To Policy Tags

Layer2 | Layer3 | AAA

○ WPA + WPA2 ○ WPA2 + WPA3 ● WPA3 ○ Static WEP ○ None

MAC Filtering □

Lobby Admin Access □

WPA Parameters

WPA Policy □ WPA2 Policy □

GTK Randomize □ WPA3 Policy ☑

Transition Disable □

WPA2/WPA3 Encryption

AES(CCMP128) ☑ CCMP256 □

GCMP128 □ GCMP256 □

Protected Management Frame

PMF	Required
Association Comeback Timer*	1
SA Query Time*	200

Fast Transition

Status	Disabled
Over the DS	□
Reassociation Timeout *	20

Auth Key Mgmt

SAE □ FT + SAE □

OWE ☑ FT + 802.1x □

802.1x-SHA256 □

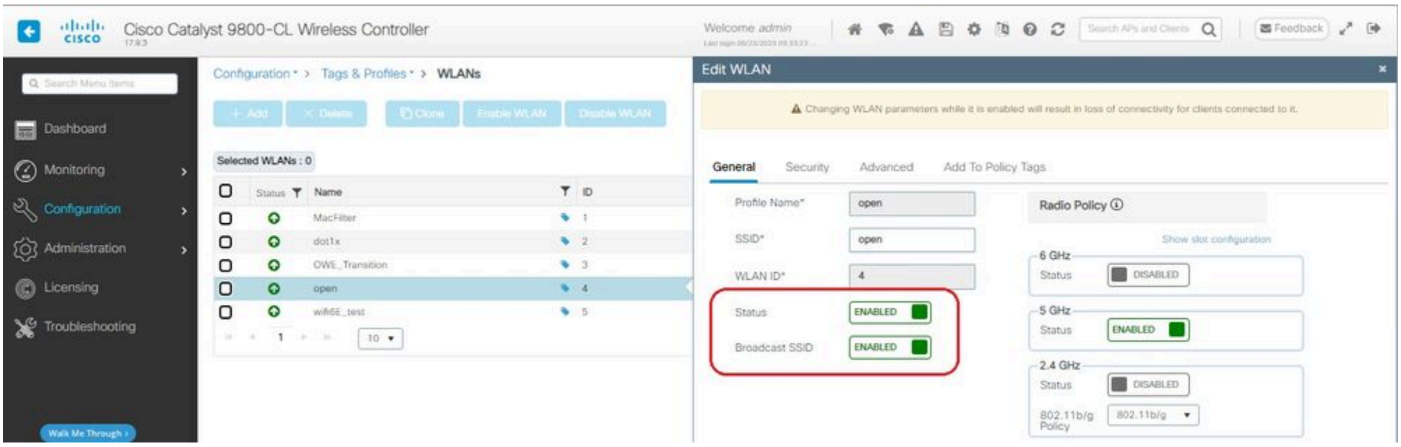
Transition Mode WLAN ID 4

OWE Transition Mode - OWE SSID

Create second SSID, call it “open” in this example WLAN ID 4, and ensure you enable “Broadcast SSID”:

Step 1 Choose **Configuration** > **Tags & Profiles** > **WLANs** to open the WLANs page.

Step 2 Click **Add** to add new WLAN > add WLAN name "open" > change **Status** to **Enable** > ensure **Broadcast SSID** is **Enabled.**



Selected WLANs : 0

Status	Name	ID
●	MacFilter	1
●	dot1x	2
●	OWE_Transition	3
●	open	4
●	wifi6E_test	5

Profile Name* open

SSID* open

WLAN ID* 4

Status ENABLED

Broadcast SSID ENABLED

6 GHz Status DISABLED

5 GHz Status ENABLED

2.4 GHz Status DISABLED

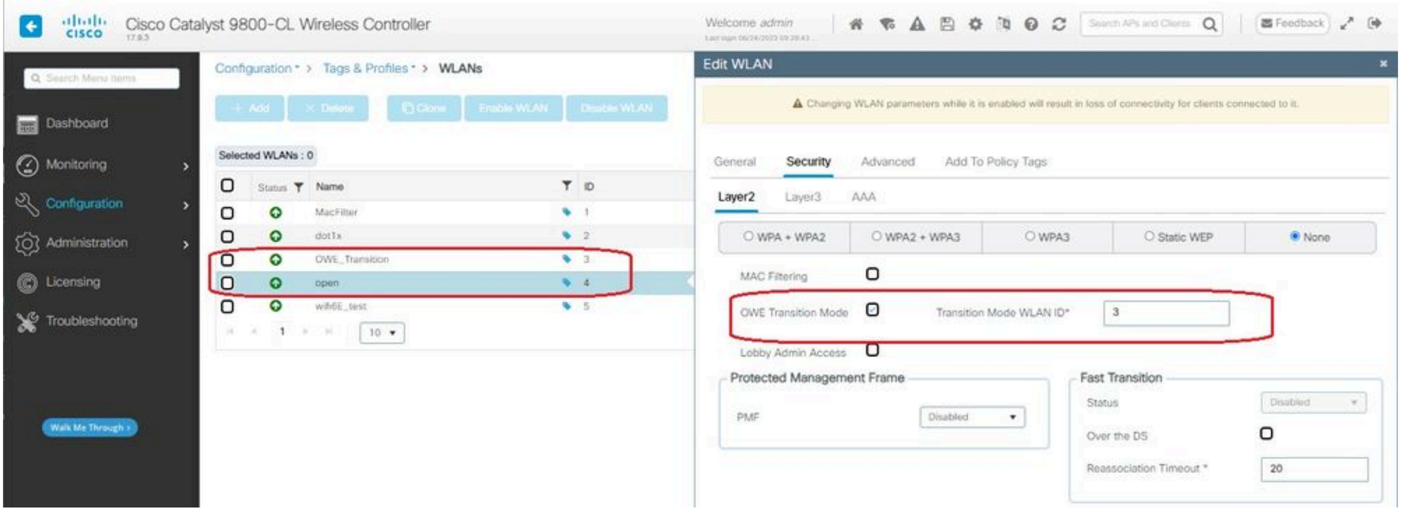
802.11b/g Policy 802.11b/g

OWE Transition Open SSID

Step 3 Choose the **Security** > **Layer 2** tab > Choose **None**.

Step 4 Add WLAN ID 3 (OWE_Transition) to "**Transition Mode WLAN ID**" box.

Step 5 Click **Apply to Device**.



Selected WLANs : 0

Status	Name	ID
●	MacFilter	1
●	dot1x	2
●	OWE_Transition	3
●	open	4
●	wifi6E_test	5

○ WPA + WPA2 ○ WPA2 + WPA3 ○ WPA3 ○ Static WEP ● None

MAC Filtering □

OWE Transition Mode ☑ Transition Mode WLAN ID* 3

Lobby Admin Access □

Protected Management Frame

PMF Disabled

Fast Transition

Status Disabled

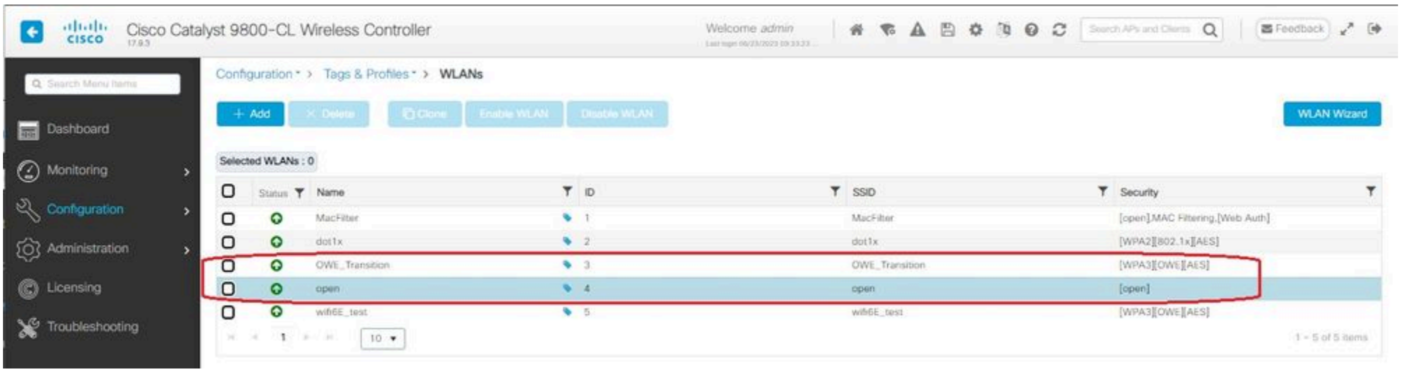
Over the DS □

Reassociation Timeout * 20

OWE Transition Mode Open WLAN Security

Caution: In case you had a previous open WLAN using the same SSID of the OWE WLAN, Windows clients appends “2” to the SSID name. To overcome this, navigate to “Network & Internet > Wi-Fi > Manage known networks” and delete the old connection.

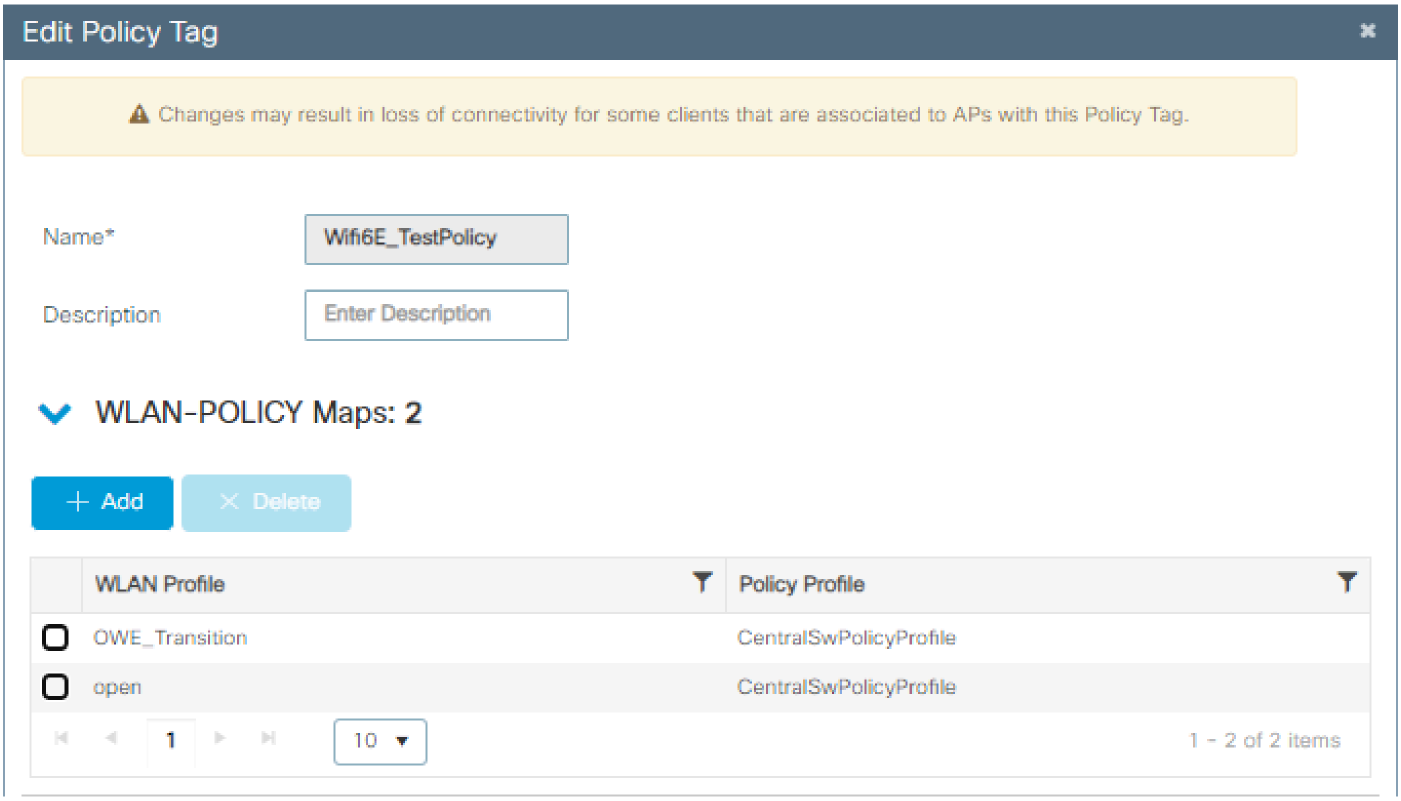
This screenshot shows the final result: one WLAN is secured and configured for WPA3+OWE+WPA3 named "OWE_Transition" and the other is a fully open SSID named "open". Only the fully open SSID called “open” has its SSID broadcasted in the beacons while "OWE_Transition" is hidden.



☐	Status	Name	ID	SSID	Security
☐	●	MacFilter	1	MacFilter	[open],MAC Filtering,[Web Auth]
☐	●	dot1x	2	dot1x	[WPA2][802.1x][AES]
☐	●	OWE_Transition	3	OWE_Transition	[WPA3][OWE][AES]
☐	●	open	4	open	[open]
☐	●	wifi6E_test	5	wifi6E_test	[WPA3][OWE][AES]

OWE Transition Mode WLANs

Step 6 Map the **WLANs** created to the desired **Policy Profiles** into the **Policy Tag** and apply it to the APs.



⚠ Changes may result in loss of connectivity for some clients that are associated to APs with this Policy Tag.

Name* Wifi6E_TestPolicy

Description Enter Description

WLAN-POLICY Maps: 2

	WLAN Profile	Policy Profile
□	OWE_Transition	CentralSwPolicyProfile
□	open	CentralSwPolicyProfile

Policy Tag

Configure for CLI:

Enhanced Open SSID:

```
Device# conf t
Device(config)# wlan OWE_Transition 3 OWE_Transition
Device(config)# no broadcast-ssid
Device(config)# no security ft adaptive
Device(config)# no security wpa wpa2
Device(config)# no security wpa akm dot1x
Device(config)# security wpa akm owe
Device(config)# security wpa transition-mode-wlan-id 4
Device(config)# security wpa wpa3
Device(config)# security pmf mandatory
Device(config)# no shutdown
```

Open SSID:

```
Device# conf t
Device(config)# wlan open 4 open
Device(config)# no security ft adaptive
Device(config)# no security wpa
Device(config)# no security wpa wpa2
Device(config)# no security wpa wpa2 ciphers aes
Device(config)# no security wpa akm dot1x
Device(config)# security wpa transition-mode-wlan-id 3
Device(config)# no shutdown
```

Policy Profile:

```
Device(config)# wireless tag policy Wifi6E_TestPolicy
Device(config-policy-tag)# wlan open policy CentralSwPolicyProfile
Device(config-policy-tag)# wlan OWE_Transition policy CentralSwPolicyProfile
```

Verify

This is the verification section.

Verify the WLANs configuration on CLI:

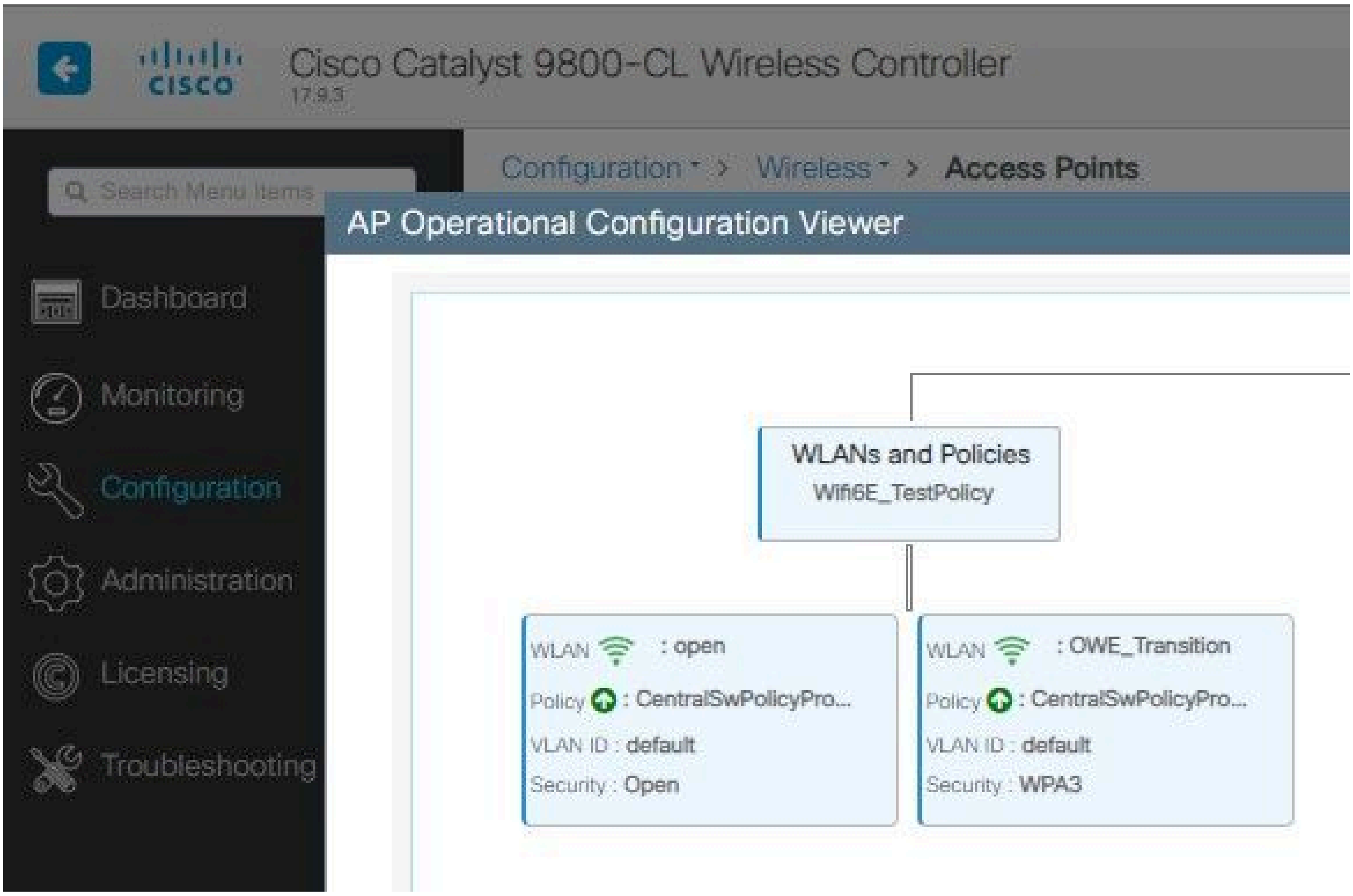
<#root>

```
Device#show wlan id 3
WLAN Profile Name : OWE_Transition
================================================

Identifier : 3


Description :

Network Name (SSID) : OWE_Transition


Status : Enabled

Broadcast SSID : Disabled


[...]
Security

802.11 Authentication : Open System


Static WEP Keys : Disabled

Wi-Fi Protected Access (WPA/WPA2/WPA3) : Enabled


WPA (SSN IE) : Disabled
WPA2 (RSN IE) : Disabled

WPA3 (WPA3 IE) : Enabled



AES Cipher : Enabled


CCMP256 Cipher : Disabled
```

```
GCMP128 Cipher : Disabled
GCMP256 Cipher : Disabled
Auth Key Management
802.1x : Disabled
PSK : Disabled
CCKM : Disabled
FT dot1x : Disabled
FT PSK : Disabled
FT SAE : Disabled
Dot1x-SHA256 : Disabled
PSK-SHA256 : Disabled
SAE : Disabled

OWE : Enabled


SUITEB-1X : Disabled
SUITEB192-1X : Disabled
SAE PWE Method : Hash to Element, Hunting and Pecking(H2E-HNP)

Transition Disable : Disabled


CCKM TSF Tolerance (msecs) : 1000

OWE Transition Mode : Enabled



OWE Transition Mode WLAN ID : 4


OSEN : Disabled
FT Support : Disabled
FT Reassociation Timeout (secs) : 20
FT Over-The-DS mode : Disabled

PMF Support : Required


PMF Association Comeback Timeout (secs): 1
PMF SA Query Time (msecs) : 200
[...]
#show wlan id 4
WLAN Profile Name : open
================================================

Identifier : 4


Description :

Network Name (SSID) : open



Status : Enabled



Broadcast SSID : Enabled


[...]
Security
802.11 Authentication : Open System
Static WEP Keys : Disabled
```

```
Wi-Fi Protected Access (WPA/WPA2/WPA3) : Disabled


OWE Transition Mode : Enabled



OWE Transition Mode WLAN ID : 3


OSEN : Disabled
FT Support : Disabled
FT Reassociation Timeout (secs) : 20
FT Over-The-DS mode : Disabled
PMF Support : Disabled


PMF Association Comeback Timeout (secs): 1
PMF SA Query Time (msecs) : 200
[...]
```

In the WLC you can go to the AP Configuration and verify that both WLANs are active on the AP:


Cisco Catalyst 9800-CL Wireless Controller
17.9.3
Search Menu Items
Dashboard
Monitoring
Configuration
Administration
Licensing
Troubleshooting
Configuration > Wireless > Access Points
AP Operational Configuration Viewer

WLANs and Policies
Wifi6E_TestPolicy

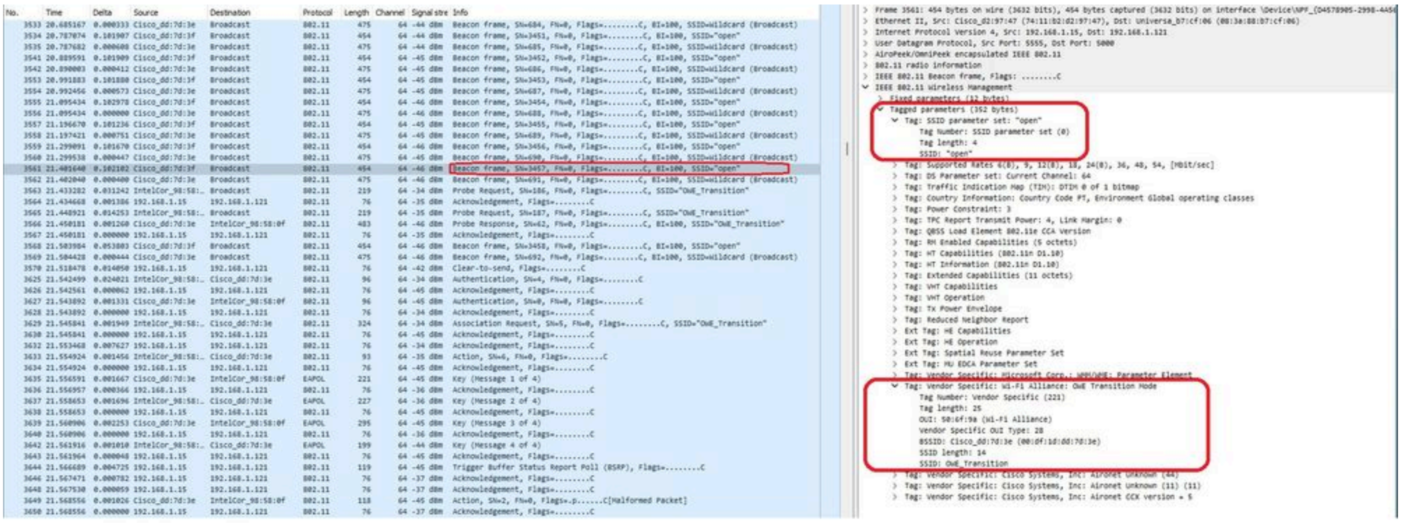
WLAN : open
Policy : CentralSwPolicyPro...
VLAN ID : default
Security : Open

WLAN : OWE_Transition
Policy : CentralSwPolicyPro...
VLAN ID : default
Security : WPA3

OWE Transition Mode AP Operational Configuration Viewer

When enabled, the AP only beacons with Open SSID but carry an OWE Transition Mode Information Element (IE). When a client capable of enhanced open connects to this SSID, it automatically uses OWE to encrypt all traffic post association.

Here is what you can observe over the air (OTA):



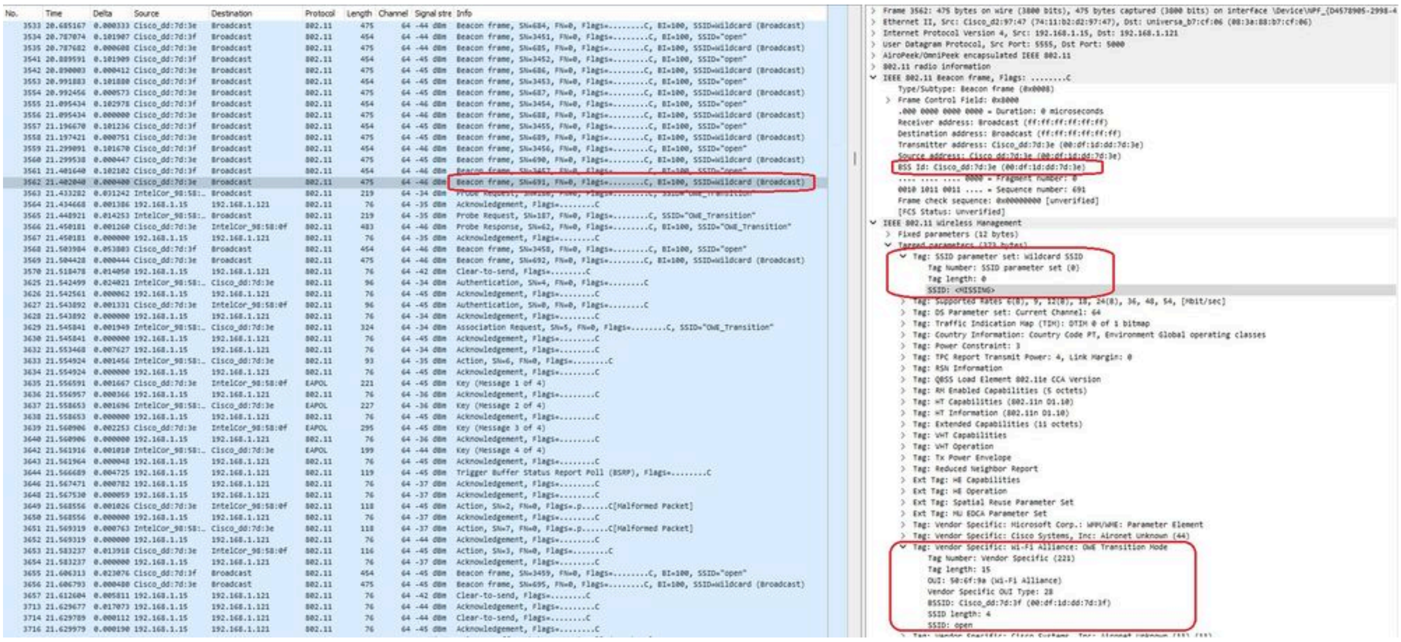
```
No.     Time      Delta    Source              Destination         Protocol Length Channel Signal stre Info
   3533 20.685167 0.000333 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -44 dBm  Beacon frame, SN=684, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3534 20.787074 0.101907 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -44 dBm  Beacon frame, SN=3451, FN=0, Flags=........C, BI=100, SSID="open"
   3535 20.787682 0.000608 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -44 dBm  Beacon frame, SN=685, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3541 20.889591 0.101909 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -45 dBm  Beacon frame, SN=3452, FN=0, Flags=........C, BI=100, SSID="open"
   3542 20.890003 0.000412 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -45 dBm  Beacon frame, SN=686, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3553 20.991883 0.101880 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -45 dBm  Beacon frame, SN=3453, FN=0, Flags=........C, BI=100, SSID="open"
   3554 20.992456 0.000573 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -45 dBm  Beacon frame, SN=687, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3555 21.095434 0.102978 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -46 dBm  Beacon frame, SN=3454, FN=0, Flags=........C, BI=100, SSID="open"
   3556 21.095434 0.000000 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -46 dBm  Beacon frame, SN=688, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3557 21.196670 0.101236 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -45 dBm  Beacon frame, SN=3455, FN=0, Flags=........C, BI=100, SSID="open"
   3558 21.197421 0.000751 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -45 dBm  Beacon frame, SN=689, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3559 21.299091 0.101670 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -46 dBm  Beacon frame, SN=3456, FN=0, Flags=........C, BI=100, SSID="open"
   3560 21.299538 0.000447 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -45 dBm  Beacon frame, SN=690, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3561 21.401640 0.102102 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -46 dBm  Beacon frame, SN=3457, FN=0, Flags=........C, BI=100, SSID="open"
   3562 21.402040 0.000400 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -46 dBm  Beacon frame, SN=691, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3563 21.433282 0.031242 IntelCor_98:58:…    Broadcast           802.11   219    64 -34 dBm  Probe Request, SN=186, FN=0, Flags=........C, SSID="OWE_Transition"
   3564 21.434668 0.001386 192.168.1.15        192.168.1.121       802.11   76     64 -35 dBm  Acknowledgement, Flags=........C
   3565 21.448921 0.014253 IntelCor_98:58:…    Broadcast           802.11   219    64 -35 dBm  Probe Request, SN=187, FN=0, Flags=........C, SSID="OWE_Transition"
   3566 21.450181 0.001260 Cisco_dd:7d:3e      IntelCor_98:58:0f   802.11   483    64 -46 dBm  Probe Response, SN=62, FN=0, Flags=........C, BI=100, SSID="OWE_Transition"
   3567 21.450181 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -35 dBm  Acknowledgement, Flags=........C
   3568 21.503984 0.053803 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -46 dBm  Beacon frame, SN=3458, FN=0, Flags=........C, BI=100, SSID="open"
   3569 21.504428 0.000444 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -46 dBm  Beacon frame, SN=692, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3570 21.518478 0.014050 192.168.1.15        192.168.1.121       802.11   76     64 -42 dBm  Clear-to-send, Flags=........C
   3625 21.542499 0.024021 IntelCor_98:58:…    Cisco_dd:7d:3e      802.11   96     64 -34 dBm  Authentication, SN=4, FN=0, Flags=........C
   3626 21.542561 0.000062 192.168.1.15        192.168.1.121       802.11   76     64 -45 dBm  Acknowledgement, Flags=........C
   3627 21.543892 0.001331 Cisco_dd:7d:3e      IntelCor_98:58:0f   802.11   96     64 -45 dBm  Authentication, SN=0, FN=0, Flags=........C
   3628 21.543892 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -34 dBm  Acknowledgement, Flags=........C
   3629 21.545841 0.001949 IntelCor_98:58:…    Cisco_dd:7d:3e      802.11   324    64 -34 dBm  Association Request, SN=5, FN=0, Flags=........C, SSID="OWE_Transition"
   3630 21.545841 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -45 dBm  Acknowledgement, Flags=........C
   3632 21.553468 0.007627 192.168.1.15        192.168.1.121       802.11   76     64 -34 dBm  Acknowledgement, Flags=........C
   3633 21.554924 0.001456 IntelCor_98:58:…    Cisco_dd:7d:3e      802.11   93     64 -35 dBm  Action, SN=6, FN=0, Flags=........C
   3634 21.554924 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -45 dBm  Acknowledgement, Flags=........C
   3635 21.556591 0.001667 Cisco_dd:7d:3e      IntelCor_98:58:0f   EAPOL    221    64 -45 dBm  Key (Message 1 of 4)
   3636 21.556957 0.000366 192.168.1.15        192.168.1.121       802.11   76     64 -36 dBm  Acknowledgement, Flags=........C
   3637 21.558653 0.001696 IntelCor_98:58:…    Cisco_dd:7d:3e      EAPOL    227    64 -36 dBm  Key (Message 2 of 4)
   3638 21.558653 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -45 dBm  Acknowledgement, Flags=........C
   3639 21.560906 0.002253 Cisco_dd:7d:3e      IntelCor_98:58:0f   EAPOL    295    64 -45 dBm  Key (Message 3 of 4)
   3640 21.560906 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -36 dBm  Acknowledgement, Flags=........C
   3642 21.561916 0.001010 IntelCor_98:58:…    Cisco_dd:7d:3e      EAPOL    199    64 -44 dBm  Key (Message 4 of 4)
   3643 21.561964 0.000048 192.168.1.15        192.168.1.121       802.11   76     64 -45 dBm  Acknowledgement, Flags=........C
   3644 21.566689 0.004725 192.168.1.15        192.168.1.121       802.11   119    64 -45 dBm  Trigger Buffer Status Report Poll (BSRP), Flags=........C
   3646 21.567471 0.000782 192.168.1.15        192.168.1.121       802.11   76     64 -37 dBm  Acknowledgement, Flags=........C
   3648 21.567530 0.000059 192.168.1.15        192.168.1.121       802.11   76     64 -37 dBm  Acknowledgement, Flags=........C
   3649 21.568556 0.001026 Cisco_dd:7d:3e      IntelCor_98:58:0f   802.11   118    64 -45 dBm  Action, SN=2, FN=0, Flags=.p......C[Malformed Packet]
   3650 21.568556 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -37 dBm  Acknowledgement, Flags=........C
```

```
> Frame 3561: 454 bytes on wire (3632 bits), 454 bytes captured (3632 bits) on interface \Device\NPF_{D4578905-2998-445
> Ethernet II, Src: Cisco_d2:97:47 (74:11:b2:d2:97:47), 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
> AiroPeek/OmniPeek encapsulated IEEE 802.11
> 802.11 radio information
> IEEE 802.11 Beacon frame, Flags: ........C
v IEEE 802.11 Wireless Management
  > Fixed parameters (12 bytes)
  v Tagged parameters (352 bytes)
    v Tag: SSID parameter set: "open"
        Tag Number: SSID parameter set (0)
        Tag length: 4
        SSID: "open"
    > Tag: Supported Rates 6(B), 9, 12(B), 18, 24(B), 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: 4, Link Margin: 0
    > Tag: QBSS Load Element 802.11e CCA Version
    > Tag: RM 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 EDCA Parameter Set
    > Tag: Vendor Specific: Microsoft Corp.: WMM/WME: Parameter Element
    v Tag: Vendor Specific: Wi-Fi Alliance: OWE Transition Mode
        Tag Number: Vendor Specific (221)
        Tag length: 25
        OUI: 50:6f:9a (Wi-Fi Alliance)
        Vendor Specific OUI Type: 28
        BSSID: Cisco_dd:7d:3e (00:df:1d:dd:7d:3e)
        SSID length: 14
        SSID: OWE_Transition
    > 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 CCX version = 5
```

OWE Transition Open SSID Beacon

The beacon send with SSID "open" contains the OWE Transition Mode IE with the enhanced open SSID details inside, like BSSID and SSID name "OWE_Transition".

There are also beacons OTA with the SSID hidden and if we filter by bssid, the frames are sent to the BSSID **00:df:1d:dd:7d:3e** which is the BSSID inside the OWE Transition Mode IE:



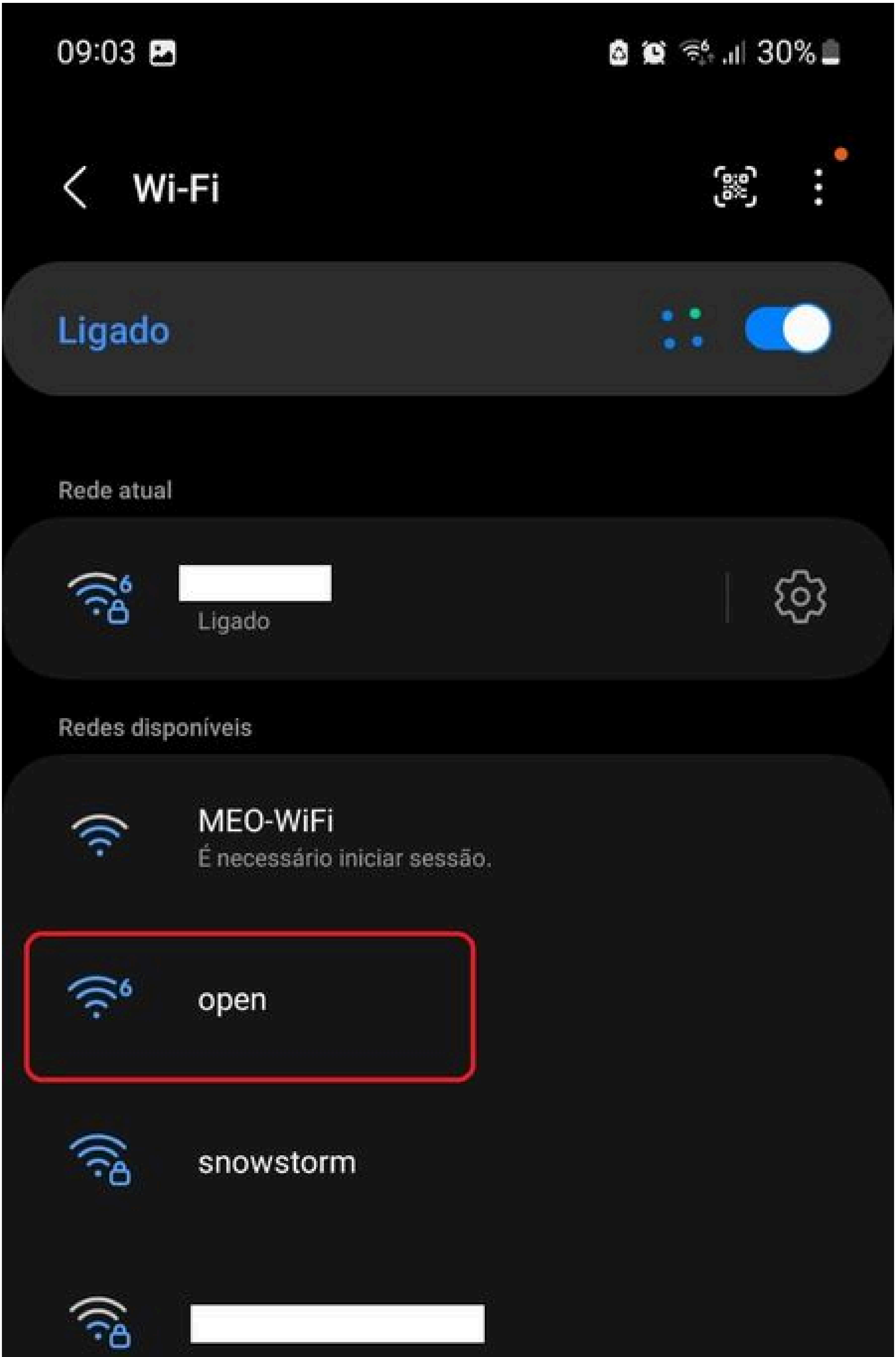
```
No.     Time      Delta    Source              Destination         Protocol Length Channel Signal stre Info
   3533 20.685167 0.000333 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -44 dBm  Beacon frame, SN=684, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3534 20.787074 0.101907 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -44 dBm  Beacon frame, SN=3451, FN=0, Flags=........C, BI=100, SSID="open"
   3535 20.787682 0.000608 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -44 dBm  Beacon frame, SN=685, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3541 20.889591 0.101909 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -45 dBm  Beacon frame, SN=3452, FN=0, Flags=........C, BI=100, SSID="open"
   3542 20.890003 0.000412 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -45 dBm  Beacon frame, SN=686, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3553 20.991883 0.101880 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -45 dBm  Beacon frame, SN=3453, FN=0, Flags=........C, BI=100, SSID="open"
   3554 20.992456 0.000573 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -45 dBm  Beacon frame, SN=687, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3555 21.095434 0.102978 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -46 dBm  Beacon frame, SN=3454, FN=0, Flags=........C, BI=100, SSID="open"
   3556 21.095434 0.000000 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -46 dBm  Beacon frame, SN=688, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3557 21.196670 0.101236 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -45 dBm  Beacon frame, SN=3455, FN=0, Flags=........C, BI=100, SSID="open"
   3558 21.197421 0.000751 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -45 dBm  Beacon frame, SN=689, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3559 21.299091 0.101670 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -46 dBm  Beacon frame, SN=3456, FN=0, Flags=........C, BI=100, SSID="open"
   3560 21.299538 0.000447 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -45 dBm  Beacon frame, SN=690, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3561 21.401640 0.102102 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -46 dBm  Beacon frame, SN=3457, FN=0, Flags=........C, BI=100, SSID="open"
   3562 21.402040 0.000400 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -46 dBm  Beacon frame, SN=691, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3563 21.433282 0.031242 IntelCor_98:58:…    Broadcast           802.11   219    64 -34 dBm  Probe Request, SN=186, FN=0, Flags=........C, SSID="OWE_Transition"
   3564 21.434668 0.001386 192.168.1.15        192.168.1.121       802.11   76     64 -35 dBm  Acknowledgement, Flags=........C
   3565 21.448921 0.014253 IntelCor_98:58:…    Broadcast           802.11   219    64 -35 dBm  Probe Request, SN=187, FN=0, Flags=........C, SSID="OWE_Transition"
   3566 21.450181 0.001260 Cisco_dd:7d:3e      IntelCor_98:58:0f   802.11   483    64 -46 dBm  Probe Response, SN=62, FN=0, Flags=........C, BI=100, SSID="OWE_Transition"
   3567 21.450181 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -35 dBm  Acknowledgement, Flags=........C
   3568 21.503984 0.053803 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -46 dBm  Beacon frame, SN=3458, FN=0, Flags=........C, BI=100, SSID="open"
   3569 21.504428 0.000444 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -46 dBm  Beacon frame, SN=692, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3570 21.518478 0.014050 192.168.1.15        192.168.1.121       802.11   76     64 -42 dBm  Clear-to-send, Flags=........C
   3625 21.542499 0.024021 IntelCor_98:58:…    Cisco_dd:7d:3e      802.11   96     64 -34 dBm  Authentication, SN=4, FN=0, Flags=........C
   3626 21.542561 0.000062 192.168.1.15        192.168.1.121       802.11   76     64 -45 dBm  Acknowledgement, Flags=........C
   3627 21.543892 0.001331 Cisco_dd:7d:3e      IntelCor_98:58:0f   802.11   96     64 -45 dBm  Authentication, SN=0, FN=0, Flags=........C
   3628 21.543892 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -34 dBm  Acknowledgement, Flags=........C
   3629 21.545841 0.001949 IntelCor_98:58:…    Cisco_dd:7d:3e      802.11   324    64 -34 dBm  Association Request, SN=5, FN=0, Flags=........C, SSID="OWE_Transition"
   3630 21.545841 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -45 dBm  Acknowledgement, Flags=........C
   3632 21.553468 0.007627 192.168.1.15        192.168.1.121       802.11   76     64 -34 dBm  Acknowledgement, Flags=........C
   3633 21.554924 0.001456 IntelCor_98:58:…    Cisco_dd:7d:3e      802.11   93     64 -35 dBm  Action, SN=6, FN=0, Flags=........C
   3634 21.554924 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -45 dBm  Acknowledgement, Flags=........C
   3635 21.556591 0.001667 Cisco_dd:7d:3e      IntelCor_98:58:0f   EAPOL    221    64 -45 dBm  Key (Message 1 of 4)
   3636 21.556957 0.000366 192.168.1.15        192.168.1.121       802.11   76     64 -36 dBm  Acknowledgement, Flags=........C
   3637 21.558653 0.001696 IntelCor_98:58:…    Cisco_dd:7d:3e      EAPOL    227    64 -36 dBm  Key (Message 2 of 4)
   3638 21.558653 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -45 dBm  Acknowledgement, Flags=........C
   3639 21.560906 0.002253 Cisco_dd:7d:3e      IntelCor_98:58:0f   EAPOL    295    64 -45 dBm  Key (Message 3 of 4)
   3640 21.560906 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -36 dBm  Acknowledgement, Flags=........C
   3642 21.561916 0.001010 IntelCor_98:58:…    Cisco_dd:7d:3e      EAPOL    199    64 -44 dBm  Key (Message 4 of 4)
   3643 21.561964 0.000048 192.168.1.15        192.168.1.121       802.11   76     64 -45 dBm  Acknowledgement, Flags=........C
   3644 21.566689 0.004725 192.168.1.15        192.168.1.121       802.11   119    64 -45 dBm  Trigger Buffer Status Report Poll (BSRP), Flags=........C
   3646 21.567471 0.000782 192.168.1.15        192.168.1.121       802.11   76     64 -37 dBm  Acknowledgement, Flags=........C
   3648 21.567530 0.000059 192.168.1.15        192.168.1.121       802.11   76     64 -37 dBm  Acknowledgement, Flags=........C
   3649 21.568556 0.001026 Cisco_dd:7d:3e      IntelCor_98:58:0f   802.11   118    64 -45 dBm  Action, SN=2, FN=0, Flags=.p......C[Malformed Packet]
   3650 21.568556 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -37 dBm  Acknowledgement, Flags=........C
   3651 21.569319 0.000763 IntelCor_98:58:…    Cisco_dd:7d:3e      802.11   118    64 -37 dBm  Action, SN=7, FN=0, Flags=.p......C[Malformed Packet]
   3652 21.569319 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -44 dBm  Acknowledgement, Flags=........C
   3653 21.583237 0.013918 Cisco_dd:7d:3e      IntelCor_98:58:0f   802.11   116    64 -45 dBm  Action, SN=3, FN=0, Flags=........C
   3654 21.583237 0.000000 192.168.1.15        192.168.1.121       802.11   76     64 -37 dBm  Acknowledgement, Flags=........C
   3655 21.606313 0.023076 Cisco_dd:7d:3f      Broadcast           802.11   454    64 -45 dBm  Beacon frame, SN=3459, FN=0, Flags=........C, BI=100, SSID="open"
   3656 21.606793 0.000480 Cisco_dd:7d:3e      Broadcast           802.11   475    64 -45 dBm  Beacon frame, SN=695, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
   3657 21.612604 0.005811 192.168.1.15        192.168.1.121       802.11   76     64 -42 dBm  Clear-to-send, Flags=........C
   3713 21.629677 0.017073 192.168.1.15        192.168.1.121       802.11   76     64 -44 dBm  Acknowledgement, Flags=........C
   3714 21.629789 0.000112 192.168.1.15        192.168.1.121       802.11   76     64 -44 dBm  Clear-to-send, Flags=........C
   3716 21.629979 0.000190 192.168.1.15        192.168.1.121       802.11   76     64 -45 dBm  Acknowledgement, Flags=........C
```

```
> Frame 3562: 475 bytes on wire (3800 bits), 475 bytes captured (3800 bits) on interface \Device\NPF_{D4578905-2998-4
> Ethernet II, Src: Cisco_d2:97:47 (74:11:b2:d2:97:47), 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
> AiroPeek/OmniPeek encapsulated IEEE 802.11
> 802.11 radio information
v IEEE 802.11 Beacon frame, Flags: ........C
    Type/Subtype: Beacon frame (0x0008)
  > Frame Control Field: 0x8000
    .000 0000 0000 0000 = Duration: 0 microseconds
    Receiver address: Broadcast (ff:ff:ff:ff:ff:ff)
    Destination address: Broadcast (ff:ff:ff:ff:ff:ff)
    Transmitter address: Cisco_dd:7d:3e (00:df:1d:dd:7d:3e)
    Source address: Cisco_dd:7d:3e (00:df:1d:dd:7d:3e)
    BSS Id: Cisco_dd:7d:3e (00:df:1d:dd:7d:3e)
    .... .... .... 0000 = Fragment number: 0
    0010 1011 0011 .... = Sequence number: 691
    Frame check sequence: 0x00000000 [unverified]
    [FCS Status: Unverified]
v IEEE 802.11 Wireless Management
  > Fixed parameters (12 bytes)
  v Tagged parameters (373 bytes)
    v Tag: SSID parameter set: Wildcard SSID
        Tag Number: SSID parameter set (0)
        Tag length: 0
        SSID: <MISSING>
    > Tag: Supported Rates 6(B), 9, 12(B), 18, 24(B), 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: 4, Link Margin: 0
    > Tag: RSN Information
    > Tag: QBSS Load Element 802.11e CCA Version
    > Tag: RM 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 EDCA Parameter Set
    > Tag: Vendor Specific: Microsoft Corp.: WMM/WME: Parameter Element
    > Tag: Vendor Specific: Cisco Systems, Inc: Aironet Unknown (44)
    v Tag: Vendor Specific: Wi-Fi Alliance: OWE Transition Mode
        Tag Number: Vendor Specific (221)
        Tag length: 15
        OUI: 50:6f:9a (Wi-Fi Alliance)
        Vendor Specific OUI Type: 28
        BSSID: Cisco_dd:7d:3f (00:df:1d:dd:7d:3f)
        SSID length: 4
        SSID: open
    > Tag: Vendor Specific: Cisco Systems, Inc: Aironet Unknown (11) (11)
```

OWE Beacon

You can see that also the OWE hidden beacon contains the OWE Transition Mode IE with the open ssid BSSID and SSID name "open".

These screenshots show an Android phone that supports Enhanced Open: it only displays the open SSID with no lock icon (a lock icon would make the user believe it requires a password to connect), but once connected the security shows Enhanced Open security is used.



09:03

30%

Wi-Fi

Ligado

Rede atual

[redacted]

Ligado

Redes disponíveis

MEO-WiFi

É necessário iniciar sessão.

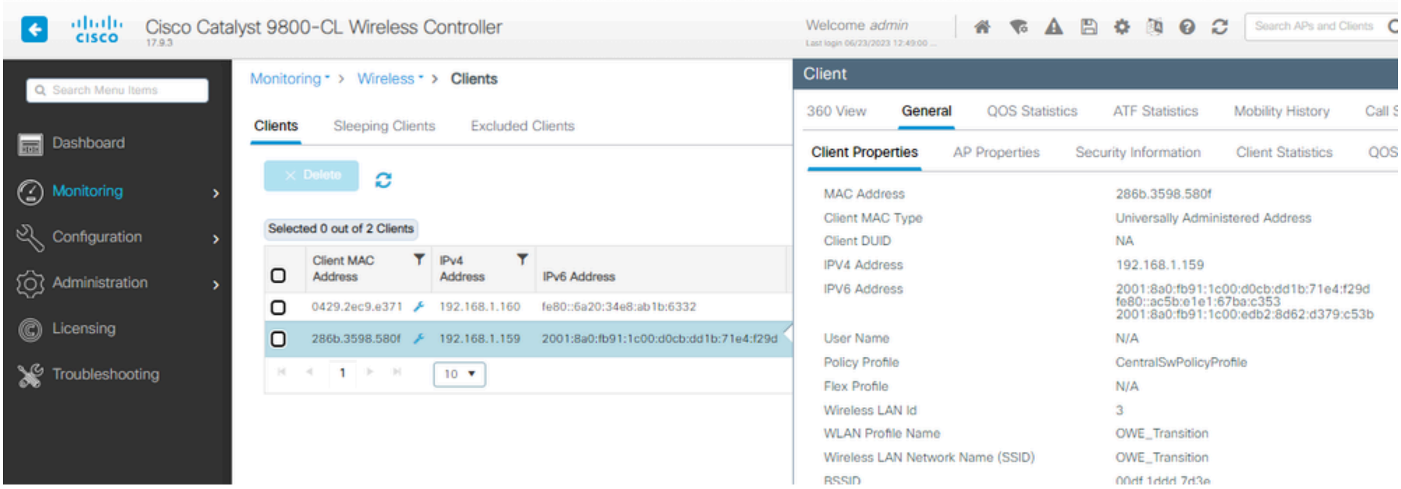
open

snowstorm

[redacted]

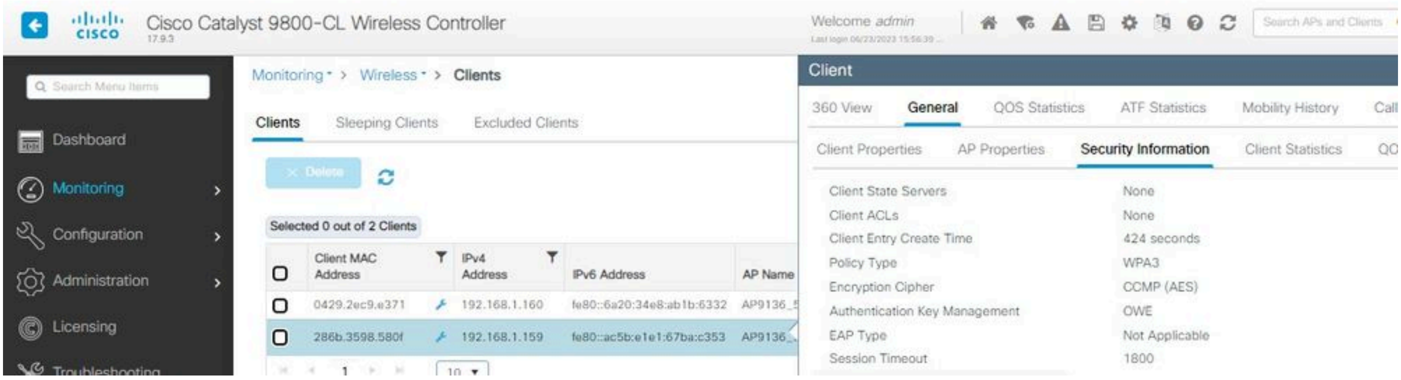
```
Client MAC Address : 286b.3598.580f
[...]
AP Name: AP9136_5C.F524
AP slot : 1
Client State : Associated
Policy Profile : CentralSwPolicyProfile
Flex Profile : N/A
Wireless LAN Id: 3

WLAN Profile Name: OWE_Transition


Wireless LAN Network Name (SSID): OWE_Transition


BSSID : 00df.1ddd.7d3e
Connected For : 682 seconds
Protocol : 802.11ax - 5 GHz
Channel : 64
Client IIF-ID : 0xa0000003
Association Id : 2

Authentication Algorithm : Open System


Idle state timeout : N/A
[...]

Policy Type : WPA3


Encryption Cipher : CCMP (AES)


Authentication Key Management : OWE


Transition Disable Bitmap : None
User Defined (Private) Network : Disabled
User Defined (Private) Network Drop Unicast : Disabled
Encrypted Traffic Analytics : No

Protected Management Frame - 802.11w : Yes


EAP Type : Not Applicable
```

And we can observe the same in the WLC GUI:



□	Client MAC Address	IPv4 Address	IPv6 Address
□	0429.2ec9.e371	192.168.1.160	fe80::6a20:34e8:ab1b:6332
□	286b.3598.580f	192.168.1.159	2001:8a0:fb91:1c00:d0cb:dd1b:71e4:f29d

MAC Address	286b.3598.580f
Client MAC Type	Universally Administered Address
Client DUID	NA
IPV4 Address	192.168.1.159
IPV6 Address	2001:8a0:fb91:1c00:d0cb:dd1b:71e4:f29d fe80::ac5b:e1e1:67ba:c353 2001:8a0:fb91:1c00:edb2:8d62:d379:c53b
User Name	N/A
Policy Profile	CentralSwPolicyProfile
Flex Profile	N/A
Wireless LAN Id	3
WLAN Profile Name	OWE_Transition
Wireless LAN Network Name (SSID)	OWE_Transition
BSSID	00df 1ddd 7d3e

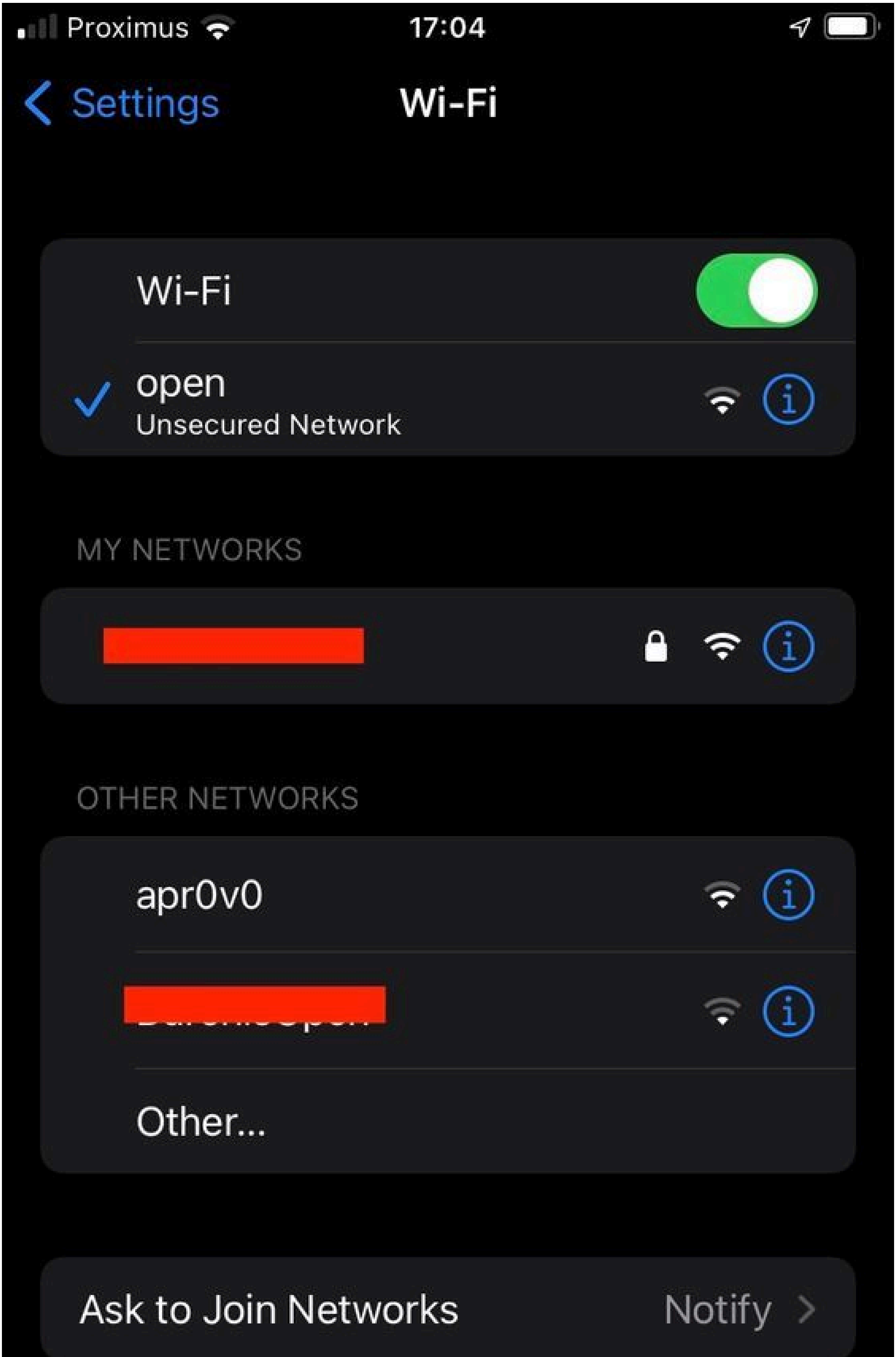


□	Client MAC Address	IPv4 Address	IPv6 Address	AP Name
□	0429.2ec9.e371	192.168.1.160	fe80::6a20:34e8:ab1b:6332	AP9136_5
□	286b.3598.580f	192.168.1.159	fe80::ac5b:e1e1:67ba:c353	AP9136_.

Client State Servers	None
Client ACLs	None
Client Entry Create Time	424 seconds
Policy Type	WPA3
Encryption Cipher	CCMP (AES)
Authentication Key Management	OWE
EAP Type	Not Applicable
Session Timeout	1800

For clients that do not support Enhanced Open, they only see and connect to the open SSID, with no encryption.

As illustrated here, these are clients that do not support Enhanced Open (respectively an iPhone on IOS 15 and a MacBook on Mac OS 12) and only see the open guest SSID and do not use encryption.



Proximus 17:04

< Settings Wi-Fi

Wi-Fi

✓ open
Unsecured Network

MY NETWORKS

[redacted]

OTHER NETWORKS

apr0v0

[redacted]

Other...

Ask to Join Networks Notify >

```
Client MAC Address : b44b.d623.a199
[...]
AP Name: AP9136_5C.F524
AP slot : 1
Client State : Associated
Policy Profile : CentralSwPolicyProfile
Flex Profile : N/A
```

```
Wireless LAN Id: 4
```

```
WLAN Profile Name: open
```

```
Wireless LAN Network Name (SSID): open
```

```
BSSID : 00df.1ddd.7d3f
[...]
```

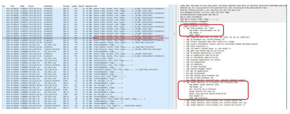
```
Authentication Algorithm : Open System
```

```
[...]
```

```
Protected Management Frame - 802.11w : No
```

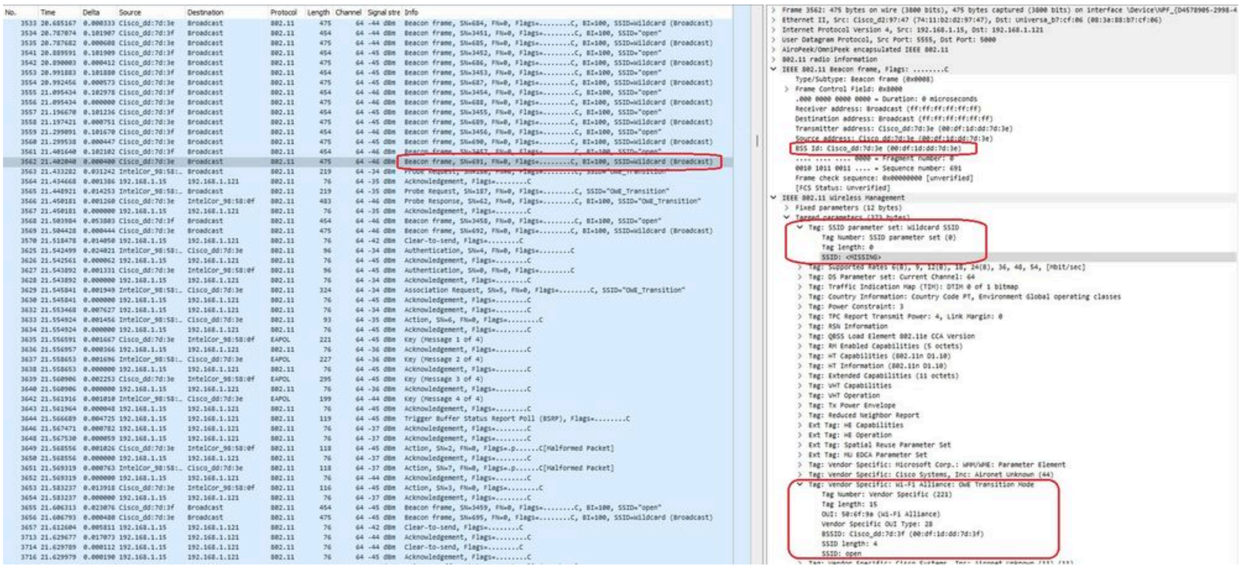
```
EAP Type : Not Applicable
```

Troubleshoot

1. Ensure that client supports OWE, as not all clients support it. Check the client vendor documentation, for example Apple documented the support for their devices here.
2. Some older clients possibly do not even accept the Open ssid beacons due to the presence of the OWE Transition Mode IE and not present the SSID in the networks in range. If your client cannot see the Open SSID, remove the Transition VLAN (set to 0) from the WLAN configuration and check if it sees the WLAN then.
3. If clients see open SSID, support OWE, but they still connect without WPA3, then verify if the transition VLAN id is correct and being broadcasted in the beacons of both WLANs. You can use AP in sniffer mode to capture OTA traffic. Please execute these steps to configure an AP in sniffer mode: APs Catalyst 91xx in Sniffer Mode .
    - The beacon is sent with SSID "open" contains the OWE Transition Mode IE with the enhanced open SSID details inside, like BSSID and SSID name "OWE_Transition": 

      OWE Transition Open SSID Beacon

    - There are also beacons OTA with the SSID hidden and if we filter by bssid, the frames are sent to the BSSID **00:df:1d:dd:7d:3e** which is the BSSID inside the OWE Transition Mode IE:



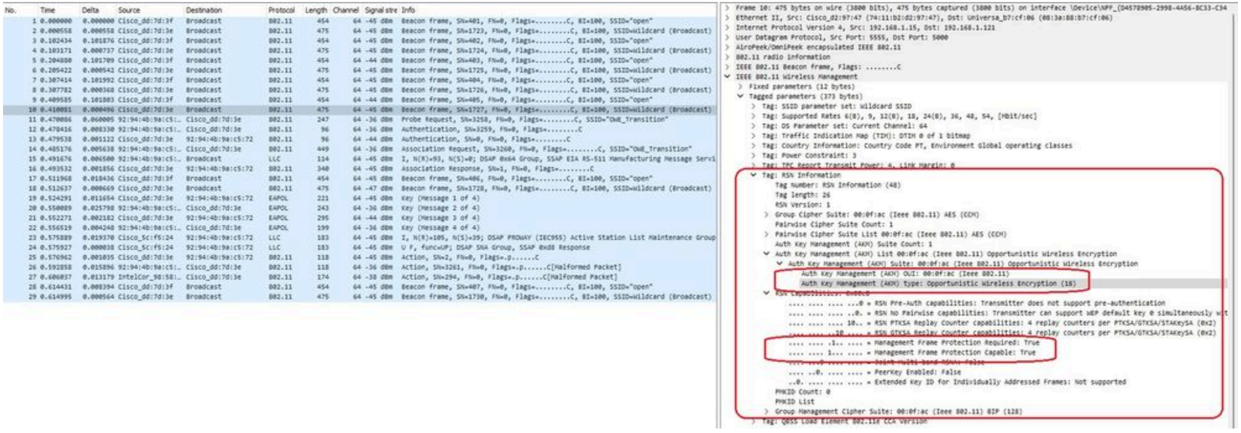
```
No.  Time      Delta    Source              Destination          Protocol Length Channel Signal stre Info
3533 20.685167 0.000333 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -44 dBm Beacon frame, SN=684, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
3534 20.787074 0.101907 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -44 dBm Beacon frame, SN=3451, FN=0, Flags=........C, BI=100, SSID="open"
3535 20.787682 0.000608 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -44 dBm Beacon frame, SN=685, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
3541 20.889591 0.101909 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -45 dBm Beacon frame, SN=3452, FN=0, Flags=........C, BI=100, SSID="open"
3542 20.890003 0.000412 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -45 dBm Beacon frame, SN=686, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
3553 20.991883 0.101880 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -45 dBm Beacon frame, SN=3453, FN=0, Flags=........C, BI=100, SSID="open"
3554 20.992456 0.000573 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -45 dBm Beacon frame, SN=687, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
3555 21.095434 0.102978 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -46 dBm Beacon frame, SN=3454, FN=0, Flags=........C, BI=100, SSID="open"
3556 21.095434 0.000000 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -46 dBm Beacon frame, SN=688, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
3557 21.196670 0.101236 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -45 dBm Beacon frame, SN=3455, FN=0, Flags=........C, BI=100, SSID="open"
3558 21.197421 0.000751 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -45 dBm Beacon frame, SN=689, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
3559 21.299091 0.101670 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -46 dBm Beacon frame, SN=3456, FN=0, Flags=........C, BI=100, SSID="open"
3560 21.299538 0.000447 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -45 dBm Beacon frame, SN=690, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
3561 21.401640 0.102102 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -46 dBm Beacon frame, SN=3457, FN=0, Flags=........C, BI=100, SSID="open"
3562 21.402040 0.000400 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -46 dBm Beacon frame, SN=691, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
3563 21.433282 0.031242 IntelCor_98:58:...  Broadcast            802.11   219    64 -34 dBm Probe Request, SN=186, FN=0, Flags=........C, SSID="OWE_Transition"
3564 21.434668 0.001386 192.168.1.15        192.168.1.121        802.11   76     64 -35 dBm Acknowledgement, Flags=........C
3565 21.448921 0.014253 IntelCor_98:58:...  Broadcast            802.11   219    64 -35 dBm Probe Request, SN=187, FN=0, Flags=........C, SSID="OWE_Transition"
3566 21.450181 0.001260 Cisco_dd:7d:3e      IntelCor_98:58:0f    802.11   483    64 -46 dBm Probe Response, SN=62, FN=0, Flags=........C, BI=100, SSID="OWE_Transition"
3567 21.450181 0.000000 192.168.1.15        192.168.1.121        802.11   76     64 -35 dBm Acknowledgement, Flags=........C
3568 21.503984 0.053803 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -46 dBm Beacon frame, SN=3458, FN=0, Flags=........C, BI=100, SSID="open"
3569 21.504428 0.000444 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -46 dBm Beacon frame, SN=692, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
3570 21.518478 0.014050 192.168.1.15        192.168.1.121        802.11   76     64 -42 dBm Clear-to-send, Flags=........C
3625 21.542499 0.024021 IntelCor_98:58:...  Cisco_dd:7d:3e       802.11   96     64 -34 dBm Authentication, SN=4, FN=0, Flags=........C
3626 21.542561 0.000062 192.168.1.15        192.168.1.121        802.11   76     64 -45 dBm Acknowledgement, Flags=........C
3627 21.543892 0.001331 Cisco_dd:7d:3e      IntelCor_98:58:0f    802.11   96     64 -45 dBm Authentication, SN=0, FN=0, Flags=........C
3628 21.543892 0.000000 192.168.1.15        192.168.1.121        802.11   76     64 -34 dBm Acknowledgement, Flags=........C
3629 21.545841 0.001949 IntelCor_98:58:...  Cisco_dd:7d:3e       802.11   324    64 -34 dBm Association Request, SN=5, FN=0, Flags=........C, SSID="OWE_Transition"
3630 21.545841 0.000000 192.168.1.15        192.168.1.121        802.11   76     64 -45 dBm Acknowledgement, Flags=........C
3632 21.553468 0.007627 192.168.1.15        192.168.1.121        802.11   76     64 -34 dBm Acknowledgement, Flags=........C
3633 21.554924 0.001456 IntelCor_98:58:...  Cisco_dd:7d:3e       802.11   93     64 -35 dBm Action, SN=6, FN=0, Flags=........C
3634 21.554924 0.000000 192.168.1.15        192.168.1.121        802.11   76     64 -45 dBm Acknowledgement, Flags=........C
3635 21.556591 0.001667 Cisco_dd:7d:3e      IntelCor_98:58:0f    EAPOL    221    64 -45 dBm Key (Message 1 of 4)
3636 21.556957 0.000366 192.168.1.15        192.168.1.121        802.11   76     64 -36 dBm Acknowledgement, Flags=........C
3637 21.558653 0.001696 IntelCor_98:58:...  Cisco_dd:7d:3e       EAPOL    227    64 -36 dBm Key (Message 2 of 4)
3638 21.558653 0.000000 192.168.1.15        192.168.1.121        802.11   76     64 -45 dBm Acknowledgement, Flags=........C
3639 21.560906 0.002253 Cisco_dd:7d:3e      IntelCor_98:58:0f    EAPOL    295    64 -45 dBm Key (Message 3 of 4)
3640 21.560906 0.000000 192.168.1.15        192.168.1.121        802.11   76     64 -36 dBm Acknowledgement, Flags=........C
3642 21.561916 0.001010 IntelCor_98:58:...  Cisco_dd:7d:3e       EAPOL    199    64 -44 dBm Key (Message 4 of 4)
3643 21.561964 0.000048 192.168.1.15        192.168.1.121        802.11   76     64 -45 dBm Acknowledgement, Flags=........C
3644 21.566689 0.004725 192.168.1.15        192.168.1.121        802.11   119    64 -45 dBm Trigger Buffer Status Report Poll (BSRP), Flags=........C
3646 21.567471 0.000782 192.168.1.15        192.168.1.121        802.11   76     64 -37 dBm Acknowledgement, Flags=........C
3648 21.567530 0.000059 192.168.1.15        192.168.1.121        802.11   76     64 -37 dBm Acknowledgement, Flags=........C
3649 21.568556 0.001026 Cisco_dd:7d:3e      IntelCor_98:58:0f    802.11   118    64 -45 dBm Action, SN=2, FN=0, Flags=.p......C[Malformed Packet]
3650 21.568556 0.000000 192.168.1.15        192.168.1.121        802.11   76     64 -37 dBm Acknowledgement, Flags=........C
3651 21.569319 0.000763 IntelCor_98:58:...  Cisco_dd:7d:3e       802.11   118    64 -37 dBm Action, SN=7, FN=0, Flags=.p......C[Malformed Packet]
3652 21.569319 0.000000 192.168.1.15        192.168.1.121        802.11   76     64 -44 dBm Acknowledgement, Flags=........C
3653 21.583237 0.013918 Cisco_dd:7d:3e      IntelCor_98:58:0f    802.11   116    64 -45 dBm Action, SN=3, FN=0, Flags=........C
3654 21.583237 0.000000 192.168.1.15        192.168.1.121        802.11   76     64 -37 dBm Acknowledgement, Flags=........C
3655 21.606313 0.023076 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -45 dBm Beacon frame, SN=3459, FN=0, Flags=........C, BI=100, SSID="open"
3656 21.606793 0.000480 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -45 dBm Beacon frame, SN=695, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
3657 21.612604 0.005811 192.168.1.15        192.168.1.121        802.11   76     64 -42 dBm Clear-to-send, Flags=........C
3713 21.629677 0.017073 192.168.1.15        192.168.1.121        802.11   76     64 -44 dBm Acknowledgement, Flags=........C
3714 21.629789 0.000112 192.168.1.15        192.168.1.121        802.11   76     64 -44 dBm Clear-to-send, Flags=........C
3716 21.629979 0.000190 192.168.1.15        192.168.1.121        802.11   76     64 -45 dBm Acknowledgement, Flags=........C
```

```
> Frame 3562: 475 bytes on wire (3800 bits), 475 bytes captured (3800 bits) on interface \Device\NPF_{D4578905-2998-4
> Ethernet II, Src: Cisco_d2:97:47 (74:11:b2:d2:97:47), 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
> AiroPeek/OmniPeek encapsulated IEEE 802.11
> 802.11 radio information
v IEEE 802.11 Beacon frame, Flags: ........C
    Type/Subtype: Beacon frame (0x0008)
  > Frame Control Field: 0x8000
    .000 0000 0000 0000 = Duration: 0 microseconds
    Receiver address: Broadcast (ff:ff:ff:ff:ff:ff)
    Destination address: Broadcast (ff:ff:ff:ff:ff:ff)
    Transmitter address: Cisco_dd:7d:3e (00:df:1d:dd:7d:3e)
    Source address: Cisco_dd:7d:3e (00:df:1d:dd:7d:3e)
    BSS Id: Cisco_dd:7d:3e (00:df:1d:dd:7d:3e)
    .... .... .... 0000 = Fragment number: 0
    0010 1011 0011 .... = Sequence number: 691
    Frame check sequence: 0x00000000 [unverified]
    [FCS Status: Unverified]
v IEEE 802.11 Wireless Management
  > Fixed parameters (12 bytes)
  v Tagged parameters (373 bytes)
    v Tag: SSID parameter set: Wildcard SSID
        Tag Number: SSID parameter set (0)
        Tag length: 0
        SSID: <MISSING>
    > Tag: Supported Rates 6(B), 9, 12(B), 18, 24(B), 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: 4, Link Margin: 0
    > Tag: RSN Information
    > Tag: QBSS Load Element 802.11e CCA Version
    > Tag: RM 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 EDCA Parameter Set
    > Tag: Vendor Specific: Microsoft Corp.: WMM/WME: Parameter Element
    > Tag: Vendor Specific: Cisco Systems, Inc: Aironet Unknown (44)
    v Tag: Vendor Specific: Wi-Fi Alliance: OWE Transition Mode
        Tag Number: Vendor Specific (221)
        Tag length: 15
        OUI: 50:6f:9a (Wi-Fi Alliance)
        Vendor Specific OUI Type: 28
        BSSID: Cisco_dd:7d:3f (00:df:1d:dd:7d:3f)
        SSID length: 4
        SSID: open
    > Tag: Vendor Specific: Cisco Systems, Inc: Aironet Unknown (11) (11)
```

OWE Beacon

You can see that also the OWE hidden beacon contains the OWE Transition Mode IE with the open ssid BSSID and SSID name "open".

- You can as well see AKM info and verify that MFP is advertised as Required and Capable:



```
No. Time     Delta    Source              Destination          Protocol Length Channel Signal stre Info
 1  0.000000 0.000000 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -45 dBm Beacon frame, SN=401, FN=0, Flags=........C, BI=100, SSID="open"
 2  0.000558 0.000558 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -45 dBm Beacon frame, SN=1723, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
 3  0.102434 0.101876 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -45 dBm Beacon frame, SN=402, FN=0, Flags=........C, BI=100, SSID="open"
 4  0.103171 0.000737 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -45 dBm Beacon frame, SN=1724, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
 5  0.204880 0.101709 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -44 dBm Beacon frame, SN=403, FN=0, Flags=........C, BI=100, SSID="open"
 6  0.205422 0.000542 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -45 dBm Beacon frame, SN=1725, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
 7  0.307414 0.101992 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -45 dBm Beacon frame, SN=404, FN=0, Flags=........C, BI=100, SSID="open"
 8  0.307782 0.000368 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -45 dBm Beacon frame, SN=1726, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
 9  0.409585 0.101803 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -44 dBm Beacon frame, SN=405, FN=0, Flags=........C, BI=100, SSID="open"
10  0.410081 0.000496 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -45 dBm Beacon frame, SN=1727, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
11  0.470086 0.060005 92:94:4b:9a:c5:...  Cisco_dd:7d:3e       802.11   247    64 -36 dBm Probe Request, SN=3258, FN=0, Flags=........C, SSID="OWE_Transition"
12  0.478416 0.008330 92:94:4b:9a:c5:...  Cisco_dd:7d:3e       802.11   96     64 -36 dBm Authentication, SN=3259, FN=0, Flags=........C
13  0.479538 0.001122 Cisco_dd:7d:3e      92:94:4b:9a:c5:72    802.11   96     64 -44 dBm Authentication, SN=0, FN=0, Flags=........C
14  0.485176 0.005638 92:94:4b:9a:c5:...  Cisco_dd:7d:3e       802.11   449    64 -36 dBm Association Request, SN=3260, FN=0, Flags=........C, SSID="OWE_Transition"
15  0.491676 0.006500 92:94:4b:9a:c5:...  Broadcast            LLC      114    64 -45 dBm I, N(R)=93, N(S)=0; DSAP 0x64 Group, SSAP EIA RS-511 Manufacturing Message Servi
16  0.493532 0.001856 Cisco_dd:7d:3e      92:94:4b:9a:c5:72    802.11   340    64 -45 dBm Association Response, SN=1, FN=0, Flags=........C
17  0.511968 0.018436 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -45 dBm Beacon frame, SN=406, FN=0, Flags=........C, BI=100, SSID="open"
18  0.512637 0.000669 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -47 dBm Beacon frame, SN=1728, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
19  0.524291 0.011654 Cisco_dd:7d:3e      92:94:4b:9a:c5:72    EAPOL    221    64 -45 dBm Key (Message 1 of 4)
20  0.550089 0.025798 92:94:4b:9a:c5:...  Cisco_dd:7d:3e       EAPOL    243    64 -36 dBm Key (Message 2 of 4)
21  0.552271 0.002182 Cisco_dd:7d:3e      92:94:4b:9a:c5:72    EAPOL    295    64 -44 dBm Key (Message 3 of 4)
22  0.556519 0.004248 92:94:4b:9a:c5:...  Cisco_dd:7d:3e       EAPOL    199    64 -36 dBm Key (Message 4 of 4)
23  0.575889 0.019370 Cisco_5c:f5:24      92:94:4b:9a:c5:72    LLC      183    64 -45 dBm I, N(R)=105, N(S)=39; DSAP PROWAY (IEC955) Active Station List Maintenance Group
24  0.575927 0.000038 Cisco_5c:f5:24      92:94:4b:9a:c5:72    LLC      183    64 -45 dBm U F, func=UP; DSAP SNA Group, SSAP 0xd8 Response
25  0.576962 0.001035 Cisco_dd:7d:3e      92:94:4b:9a:c5:72    802.11   118    64 -45 dBm Action, SN=2, FN=0, Flags=.p......C
26  0.592858 0.015896 92:94:4b:9a:c5:...  Cisco_dd:7d:3e       802.11   118    64 -36 dBm Action, SN=3261, FN=0, Flags=.p......C[Malformed Packet]
27  0.606037 0.013179 IntelCor_98:58:...  Cisco_dd:7d:3e       802.11   174    64 -38 dBm Action, SN=294, FN=0, Flags=.p......C[Malformed Packet]
28  0.614431 0.008394 Cisco_dd:7d:3f      Broadcast            802.11   454    64 -45 dBm Beacon frame, SN=407, FN=0, Flags=........C, BI=100, SSID="open"
29  0.614995 0.000564 Cisco_dd:7d:3e      Broadcast            802.11   475    64 -45 dBm Beacon frame, SN=1730, FN=0, Flags=........C, BI=100, SSID=Wildcard (Broadcast)
```

```
> Frame 10: 475 bytes on wire (3800 bits), 475 bytes captured (3800 bits) on interface \Device\NPF_{D4578905-2998-4A56-8C33-C34
> Ethernet II, Src: Cisco_d2:97:47 (74:11:b2:d2:97:47), 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
> AiroPeek/OmniPeek encapsulated IEEE 802.11
> 802.11 radio information
> IEEE 802.11 Beacon frame, Flags: ........C
v IEEE 802.11 Wireless Management
  > Fixed parameters (12 bytes)
  v Tagged parameters (373 bytes)
    > Tag: SSID parameter set: Wildcard SSID
    > Tag: Supported Rates 6(B), 9, 12(B), 18, 24(B), 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: 4, Link Margin: 0
    v Tag: RSN Information
        Tag Number: RSN Information (48)
        Tag length: 26
        RSN Version: 1
      > Group Cipher Suite: 00:0f:ac (Ieee 802.11) AES (CCM)
        Pairwise Cipher Suite Count: 1
      > Pairwise Cipher Suite List 00:0f:ac (Ieee 802.11) AES (CCM)
        Auth Key Management (AKM) Suite Count: 1
      v Auth Key Management (AKM) List 00:0f:ac (Ieee 802.11) Opportunistic Wireless Encryption
        v Auth Key Management (AKM) Suite: 00:0f:ac (Ieee 802.11) Opportunistic Wireless Encryption
            Auth Key Management (AKM) OUI: 00:0f:ac (Ieee 802.11)
            Auth Key Management (AKM) type: Opportunistic Wireless Encryption (18)
      v RSN Capabilities: 0x00e8
          .... .... .... ...0 = RSN Pre-Auth capabilities: Transmitter does not support pre-authentication
          .... .... .... ..0. = RSN No Pairwise capabilities: Transmitter can support WEP default key 0 simultaneously wit
          .... .... .... 10.. = RSN PTKSA Replay Counter capabilities: 4 replay counters per PTKSA/GTKSA/STAKeySA (0x2)
          .... .... ..10 .... = RSN GTKSA Replay Counter capabilities: 4 replay counters per PTKSA/GTKSA/STAKeySA (0x2)
          .... .... .1.. .... = Management Frame Protection Required: True
          .... .... 1... .... = Management Frame Protection Capable: True
          .... ...0 .... .... = Joint Multi-band RSNA: False
          .... ..0. .... .... = PeerKey Enabled: False
          ..0. .... .... .... = Extended Key ID for Individually Addressed Frames: Not supported
        PMKID Count: 0
        PMKID List
      > Group Management Cipher Suite: 00:0f:ac (Ieee 802.11) BIP (128)
    > Tag: QBSS Load Element 802.11e CCA Version
```

-

OWE Beacon AKM

4. Collect RadioActive traces based on client mac address and you see similar logs as this:

2023/06/23 15:08:58.567933 {wncd_x_R0-0}{1}: [client-keymgmt] [14854]: (note): MAC: xxxx.xxxx.xxxx EAP Key management successful. AKM:OWE Cipher:CCMP WPA Version: WPA3

2023/06/23 15:10:06.971651 {wncd_x_R0-0}{1}: [client-orch-state] [14854]: (note): MAC: xxxx.xxxx.xxxx Client state transition: S_CO_IP_LEARN_IN_PROGRESS -> S_CO_RUN

References

[Cisco Catalyst 9800 Series Wireless Controller Software Configuration Guide 17.9.x](#)

[WPA3 Deployment Guide](#)

[Wi-Fi Alliance® WPA3™ Specifications v3.4](#)