



8.5 Identity PSK Feature Deployment Guide

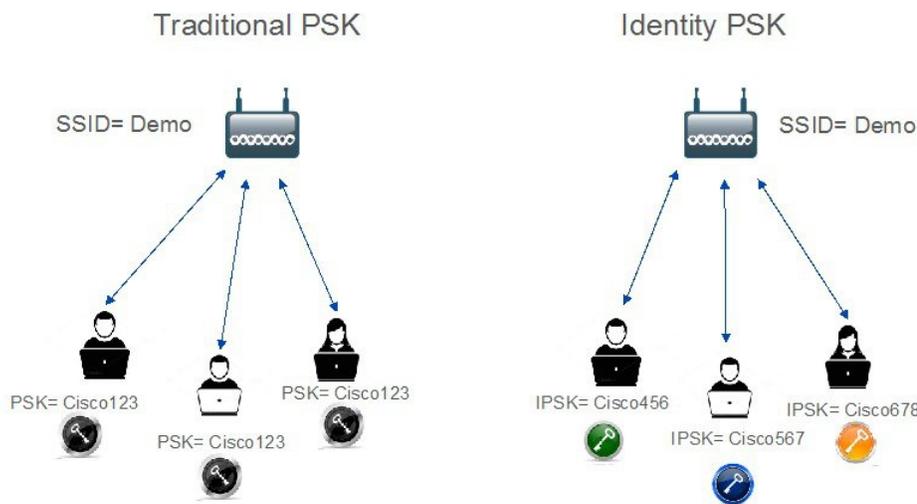
Product or Feature Overview	2
IPSK solution	2
Configurations Steps for IPSK in 8.5 release	3
Controller Configuration Steps	6
WLC Local Policies Combined with IPSK	10
Introduction to Profiling and Policy Engine on the WLC	11
Scope and Objectives	12
Profiling and Policy Configuration	12
Mapping Policy on WLAN	17
Interface Group Override	20
End User Device Setup	21
Conclusion	22
IPSK Configuration through CLI commands	23

Product or Feature Overview

With the advent of internet of things, the number of devices that connect to the internet is increased multifold. Not all of these devices support 802.1x supplicant and need an alternate mechanism to connect to the internet. One of the security mechanisms, WPA-PSK could be considered as an alternative. With the current configuration, the pre-shared-key is the same for all clients that connect to the same WLAN. In certain deployments such as Educational Institutions, this results in the key being shared to unauthorized users resulting in security breach. Therefore, above mentioned and other requirements lead to the need for provisioning unique pre-shared keys for different clients on a large scale.

- Identity PSKs are unique pre-shared keys created for individuals or groups of users on the same SSID.
- No complex configuration required for clients. The same simplicity of PSK, making it ideal for IoT, BYOD, and guest deployments.
- Supported on most devices, where 802.1X may not, enabling stronger security for IoT.
- Easily revoke access, for a single device or individual, without affecting everyone else.
- Thousands of keys can easily be managed and distributed via the AAA server.

Traditional Vs Identity PSK



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As depicted in the above diagram, in the Traditional PSK, for all the clients that connect to a particular SSID, the key would remain same leading to security issues. With Identity PSK, every client connecting to the same SSID can have potentially a different key.

IPSK solution

During client authentication, the AAA server would authorize the client mac address and send the passphrase (if configured) as part of the Cisco-AVPair list. The WLC would receive this as part of the radius response and would process this further for the computation of PSK.

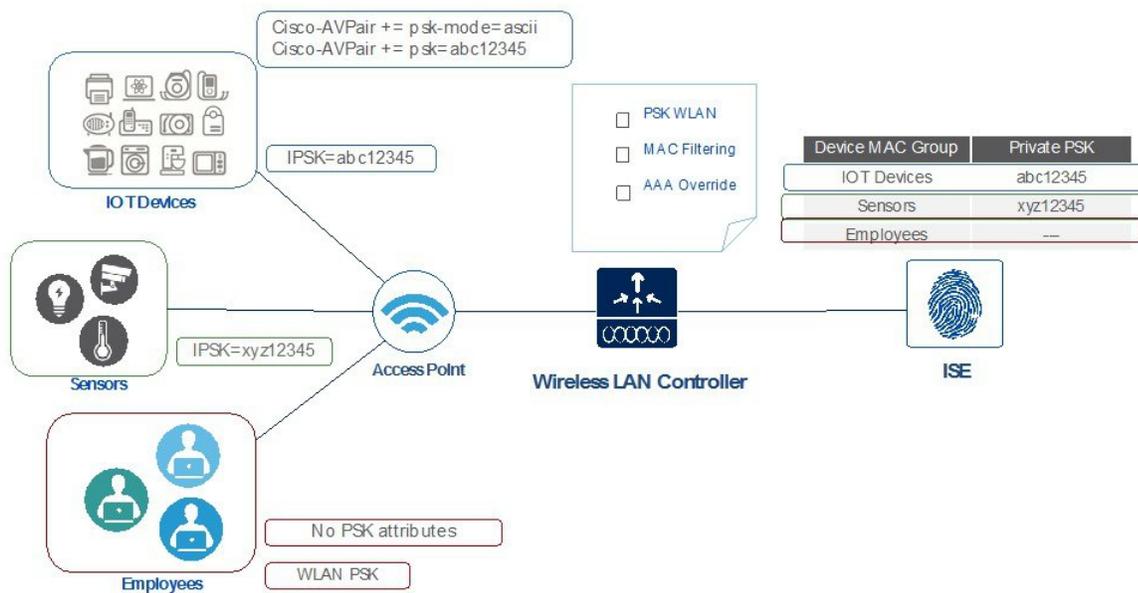
When the client sends association request to the SSID broadcasted by the access point, the Wireless LAN Controller forms the RADIUS request packet with the particular mac address of the client and relays to the RADIUS server.

The RADIUS server performs the authentication and checks whether the client is allowed or not and sends either ACCESS-ACCEPT or ACCESS-REJECT as response to the WLC.

To support Identity PSK, in addition to sending the authentication response, the authentication server would also provide the AV Pair passphrase for this specific client. This is used further for the computation of PSK.

The RADIUS server could also provide additional parameters such as username, VLAN, QoS, etc in the response, that is specific to this client. For multiple devices that is owned by a single user, the passphrase could remain the same.

Private PSK On The same WLAN

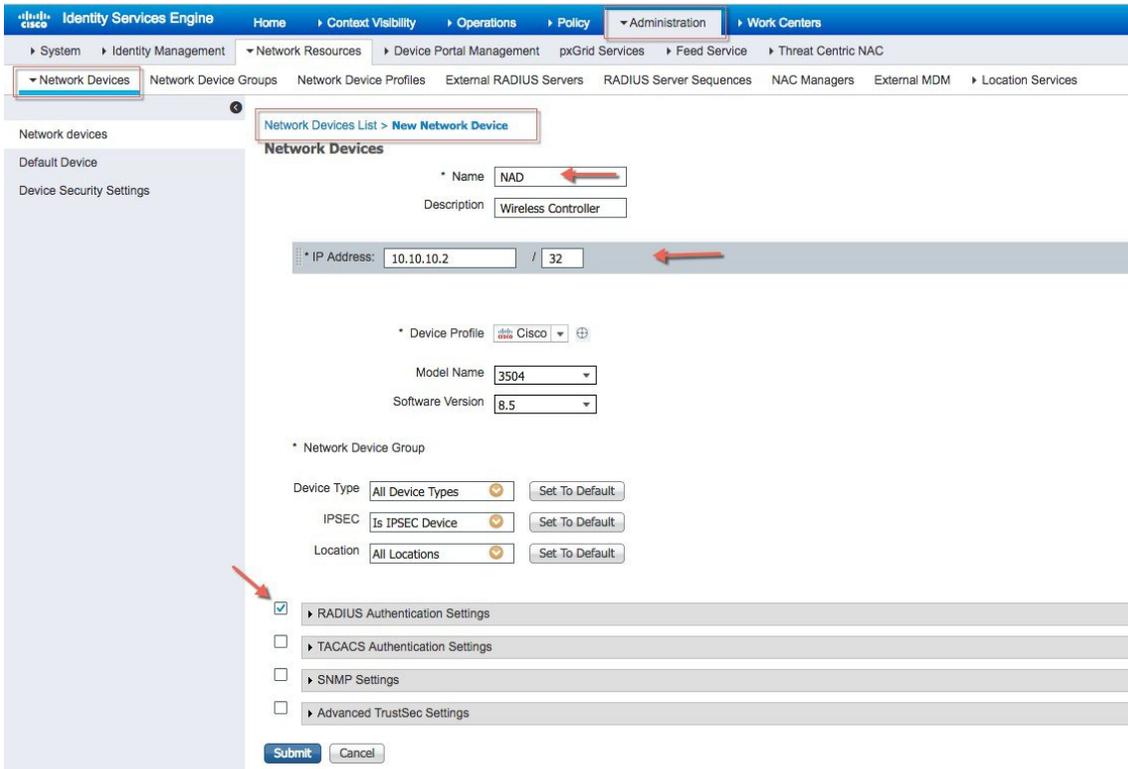
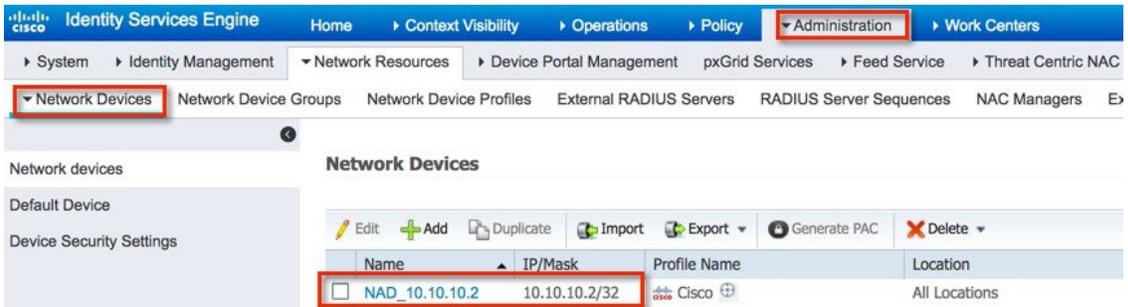


Configurations Steps for IPSK in 8.5 release

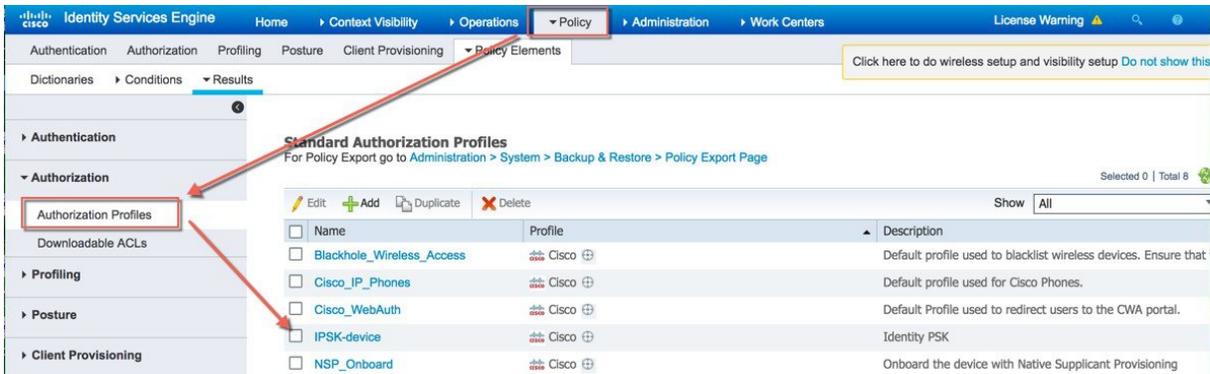
IPSK can be configured on any AAA server that supports Cisco av-pair. In this deployment guide we focus on the configuration on the Cisco Identity Service Engine. ISE 2.2 Configuration Steps

Procedure

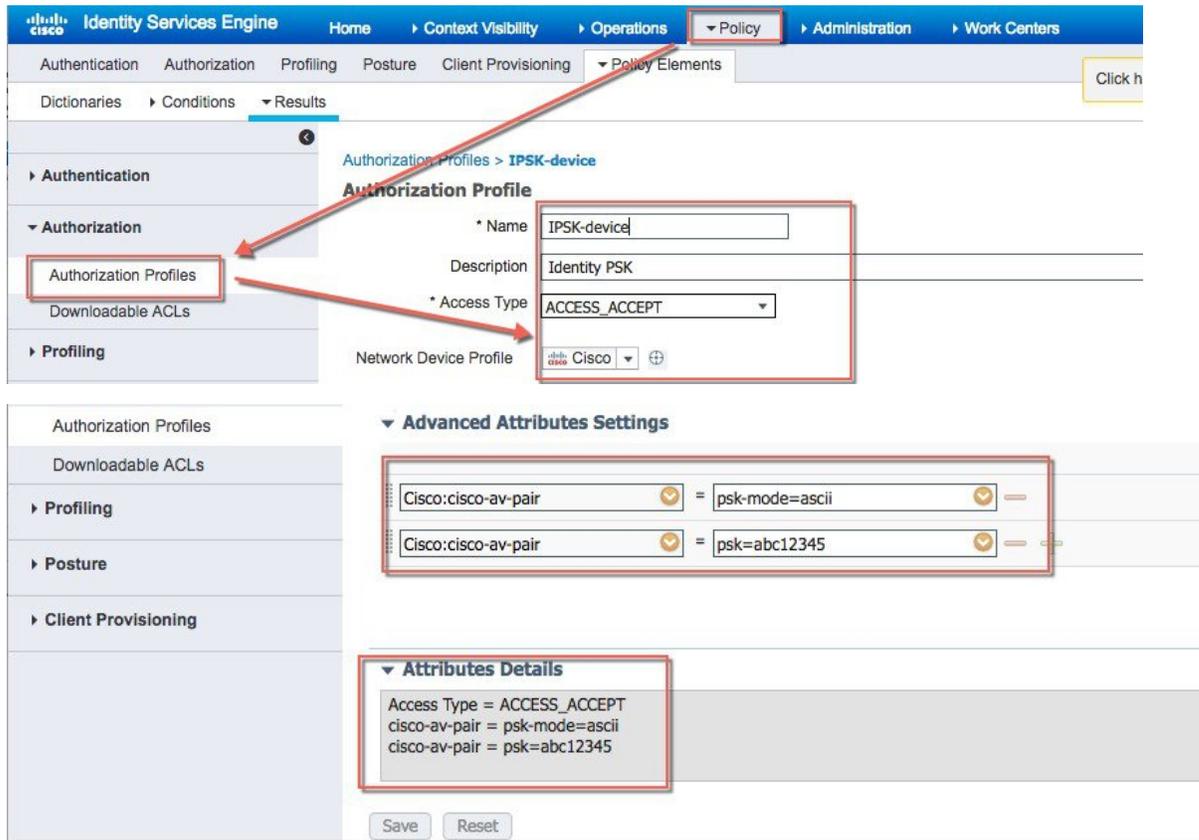
Step 1 Add wireless controller under test on ISE as shown below with a secret password configured in "Radius Authentication Setting" and then Submit the configuration.



Step 2 Create an Authorization Profile and verify it Under Policy>Results>Authorization> Authorization Profiles IPSK-Device as shown in example below.



Step 3 Create Authorization profile With Access Type Access_Accept with cisco-av-pair(s) with psk-mode and psk password as shown in the example below is configured.



Step 4 Under Policy> Authorization Configure Rule for every Device or User MAC address to be used with IPSK as shown in example below. Use as many Mac address entries as you wish.

Note Rule is linked to the Profile created in step 3.

Note Make sure Mac address of the device configured properly. We have configured Apple MacBook laptop Mac address for this Exercise.

Identity Services Engine Home Context Visibility Operations Policy Administration Work Centers

Authentication Authorization Profiling Posture Client Provisioning Policy Elements

Click here to do wireless s

Authorization Policy

Define the Authorization Policy by configuring rules based on identity groups and/or other conditions. Drag and drop rules to change the order. For Policy Export go to Administration > System > Backup & Restore > Policy Export Page

First Matched Rule Applies

Exceptions (0)

Standard

Status	Rule Name	Conditions (identity groups and other conditions)	Permissions
✓	IdentityPSK	if Wireless_MAB AND Radius:Calling-Station-ID EQUALS A0:3B:E3:95:73:4E	then IPSK-device
✓	IdentityPSK_copy	if Wireless_MAB AND Radius:Calling-Station-ID EQUALS f4:5c:89:8f:10:43	then IPSK-device
✓	Wireless Black List Default	if Blacklist AND Wireless_Access	then Blackhole_Wireless_Access
✓	Profiled Cisco IP Phones	if Cisco-IP-Phone	then Cisco_IP_Phones

Status	Rule Name	Conditions (identity groups and other conditions)	Permissions
✓	IdentityPSK	if Any and Wireless_MAB AND Radius:Callin...	then IPSK-device
✓	IdentityPSK_copy	if Wireless_MAB AND Radius: f4:5c:89:8f:10:43	then Non_Cisco_IP_Phones
✓	Wireless Black List Default	if Blacklist AND Wireless_Ad	
✓	Profiled Cisco IP Phones	if Cisco-IP-Phone	
✓	Profiled Non Cisco IP Phones	if Non_Cisco_Profiled_Phones	then Non_Cisco_IP_Phones

Step 5 Verify every step performed above and make sure all configuration are applied and saved.

Controller Configuration Steps

Procedure

Step 1 Create WLAN on your controller as in the shown example Pod1-IPSK.

The screenshot shows the Cisco WLAN configuration interface. The top navigation bar includes 'MONITOR', 'WLANs', 'CONTROLLER', 'WIRELESS', 'SECURITY', and 'MANAGEMENT'. The left sidebar shows 'WLANs' with sub-items 'WLANs' and 'Advanced'. The main content area is titled 'WLANs > Edit 'Identity PSK''. It features several tabs: 'General', 'Security', 'QoS', 'Policy-Mapping', and 'Advanced'. The 'Security' tab is active. The configuration fields are as follows:

Profile Name	Identity PSK
Type	WLAN
SSID	Pod1-IPSK
Status	<input checked="" type="checkbox"/> Enabled
Security Policies	MAC Filtering[WPA2][Auth(PSK)] (Modifications done under security tab will appear)
Radio Policy	All
Interface/Interface Group(G)	management
Multicast Vlan Feature	<input type="checkbox"/> Enabled
Broadcast SSID	<input checked="" type="checkbox"/> Enabled
NAS-ID	none

Step 2 Configure WLAN with Security WPA2/PSK and enable **MAC filtering**. In the example below the PSK key used is **PSK=12345678**.

The screenshot shows the Cisco WLC configuration interface for a WLAN named 'Identity PSK'. The 'WLANs' menu is selected in the top navigation bar. The 'Security' tab is active, and the 'Layer 2' sub-tab is selected. The 'Layer 2 Security' dropdown is set to 'WPA+WPA2', and 'MAC Filtering' is checked. Under 'Fast Transition', 'Fast Transition Over the DS' is checked, and the 'Reassociation Timeout' is set to 20 seconds. Under 'Protected Management Frame', 'PMF' is set to 'Disabled'. The 'WPA+WPA2 Parameters' section shows 'WPA2 Policy' checked, 'WPA2 Encryption' set to 'AES', and 'OSEN Policy' unchecked. Other encryption options like TKIP, CCMP256, and GCMP128 are also visible but unchecked.

Step 3 Configure WLAN with Security WPA2/PSK and configure PSK. In the example below the PSK key used is **PSK=12345678**.

The screenshot shows the 'Authentication Key Management' configuration page. The 'PSK' option is checked and highlighted with a red box. The 'PSK Format' dropdown is set to 'ASCII'. A red arrow points to the PSK key field, which contains six dots representing the masked PSK value.

Step 4 Configure on the WLC the Authentication Server with ISE IP address and apply it to WLAN Pod1-IPSK created in the steps above. In our example, ISE IP address is 10.91.104.106.

The screenshot shows the Cisco WLAN configuration interface. The top navigation bar includes 'MONITOR', 'WLANs', 'CONTROLLER', 'WIRELESS', 'SECURITY', and 'MANAGEMENT'. The left sidebar shows 'WLANs' with sub-items 'WLANs' and 'Advanced'. The main content area is titled 'WLANs > Edit 'Identity-PSK''. Below this are tabs for 'General', 'Security', 'QoS', 'Policy-Mapping', and 'Advanced'. Under the 'Security' tab, there are sub-tabs for 'Layer 2', 'Layer 3', and 'AAA Servers'. The 'AAA Servers' section contains the following text and controls:

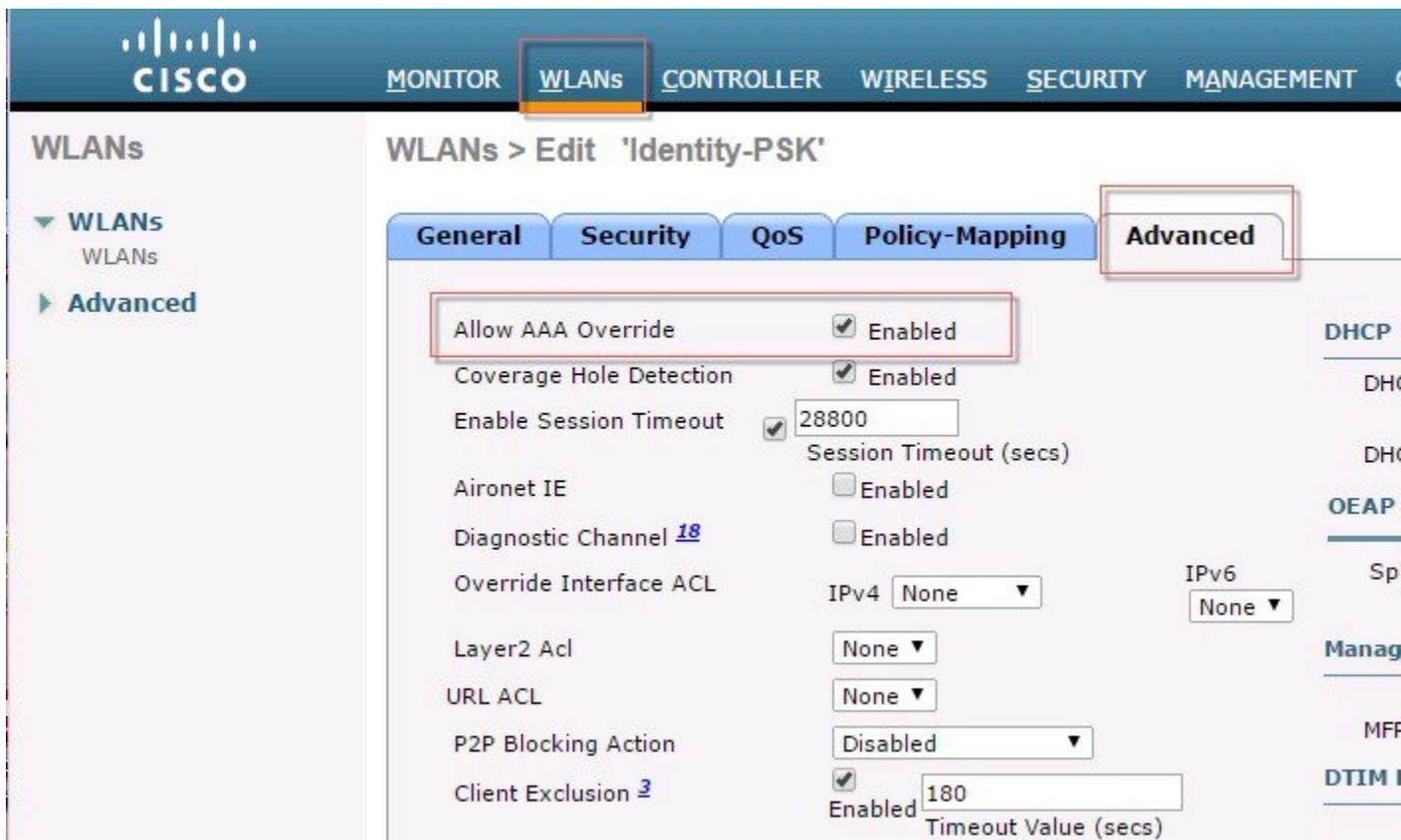
Select AAA servers below to override use of default servers on this WLAN

RADIUS Servers

RADIUS Server Overwrite interface Enabled
Apply Cisco ISE Default Settings Enabled

	Authentication Servers	Accounting Servers
Server 1	<input checked="" type="checkbox"/> Enabled IP:10.91.104.106, Port:1812 ▼	<input checked="" type="checkbox"/> Enabled IP:10.91.104.106, Port:1813 ▼
Server 2	None ▼	None ▼

Step 5 Lastly, under WLAN advanced settings enable AAA Override.



WLC Local Policies Combined with IPSK

Just like AVC, mDNS or Open DNS profile can be mapped to a local policy for a client with a particular device type. IPSK also can be combined with Local policies on the controller and mapped to a specific WLAN. When configuring the AV-pair=PSK-mode and PSK-password on the AAA server such as ISE, admin can easily add another AV-pair=role for example for a teacher or a student group and then configure a Local policy to that specific Role. Each local policy can be configured with a different profile name, ACL, Role, Device Type and even Active Hours based on the AAA override to restrict/permit the policy from being able to use/deny the services not allowed by the profile on the same WLAN.

When combining IPSK and Local Policies on the same WLAN the use cases can be unlimited and open to many different deployment scenarios.

For example on campus admin can configure a use case where students have to login with IPSK and then apply local policy that only those students belonging to the group Students can access specific applications at certain bandwidth on specific device and during specific time. There practically unlimited set of capabilities and tweaks available when combining the two.

The screenshot displays the Cisco WLC configuration interface for a security policy. The left sidebar shows the navigation menu under 'Security', with 'Advanced EAP' selected. The main content area is titled 'Policy > Edit' and shows the following configuration details:

- Policy Name:** IPSK-test
- Policy Id:** 1
- Match Criteria:**
 - Match Role String: (Empty text field, highlighted with a red box)
 - Match EAP Type: none (dropdown)
- Device List:**
 - Device Type: (Dropdown menu, highlighted with a red box)
 - Add: (Button)
- Action:**
 - IPv4 ACL: none (dropdown)
 - URL ACL: none (dropdown)
 - VLAN ID: 0 (text field)
 - Qos Policy: none (dropdown)
 - Average Data Rate(kbps): 0 (text field)
 - Average Real time Data Rate(kbps): 0 (text field)
 - Burst Data Rate(kbps): 0 (text field)
 - Burst Real time Data Rate(kbps): 0 (text field)
 - Session Timeout (seconds): 1800 (text field)
 - Sleeping Client Timeout (min): 720 (text field)
 - Flexconnect ACL: none (dropdown)
 - AVC Profile: none (dropdown)
 - mDNS Profile: none (dropdown)
 - OpenDNS Profile: none (dropdown)
- Active Hours:**
 - Day: Mon (dropdown)
 - Start Time: (Hours) (Mins)
 - End Time: (Hours) (Mins)
 - Add: (Button)

At the bottom of the page, there is a table structure with columns for 'Day', 'Start Time', and 'End Time'.

Introduction to Profiling and Policy Engine on the WLC

Cisco currently offers a rich set of features which provide device identification, on boarding, posture, and policy, through ISE. This new feature on the WLC does the profiling of devices based on protocols such as HTTP, DHCP, and so on to identify the end devices on the network. The user can configure the device-based policies and enforce per user or per device policy on the network. The WLC will also display statistics based on per user or per device end points and policies applicable per device.

With BYOD (Bring your own device), this feature has an impact on understanding the different devices on the network. With this, BYOD can be implemented on a small scale within the WLC itself.

Scope and Objectives

In this section, we will be configuring and implementing Profiling and Policy on a Cisco WLC running AireOS8.5 code.

The profiling and policy enforcement will be configured as two separate components. The configuration on the WLC is based on defined parameters specific to clients joining the network with IPSK security as configured in the previous sections. The policy attributes which are of interest are:

1. Role–Role defines the user type or the user group the user belongs to.
2. PSK-mode ASCII
PSK-password–match of the specific PSK password with the device MAC address
For example: Student or Employee
3. Device–Device defines the type of device.
For example: Windows machine, Smart phone, Apple device such as iPad, iPhone and so on.
4. Time of day–Allows configuration to be defined at what time of the day end-points are allowed on the network.

The above parameters are configurable as policy match attributes. Once the WLC has a match corresponding to the above parameters per end-point, the policy enforcement comes into picture. Policy enforcement will be based on session attributes such as:

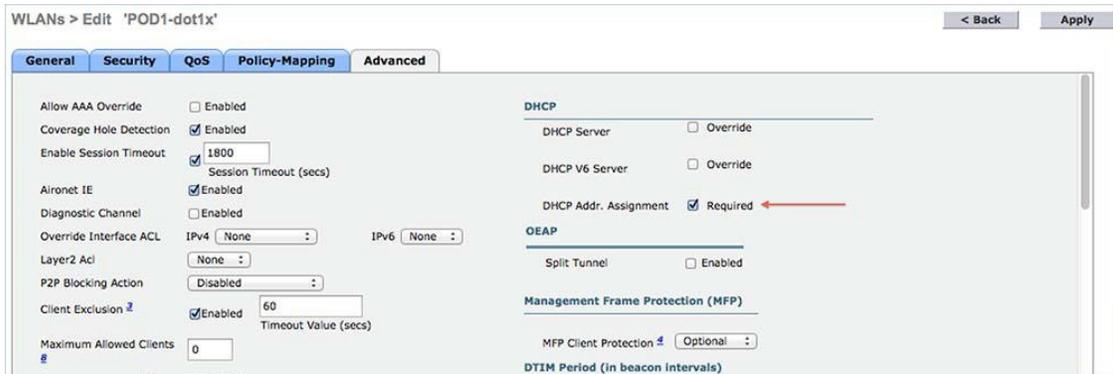
- VLAN
- ACL
- Session Timeout
- QoS
- Sleeping Client
- Flexconnect ACL
- AVC profile
- mDNS profile
- Open DNS profile
- Security Group Tag

The user can configure these policies and enforce end-points with specified policies. The wireless clients will be profiled based on the MAC address, MAC OUI, DHCP, and HTTP user agent (valid Internet required for successful HTTP profiling). The WLC uses these attributes and predefined classification profiles to identify the device.

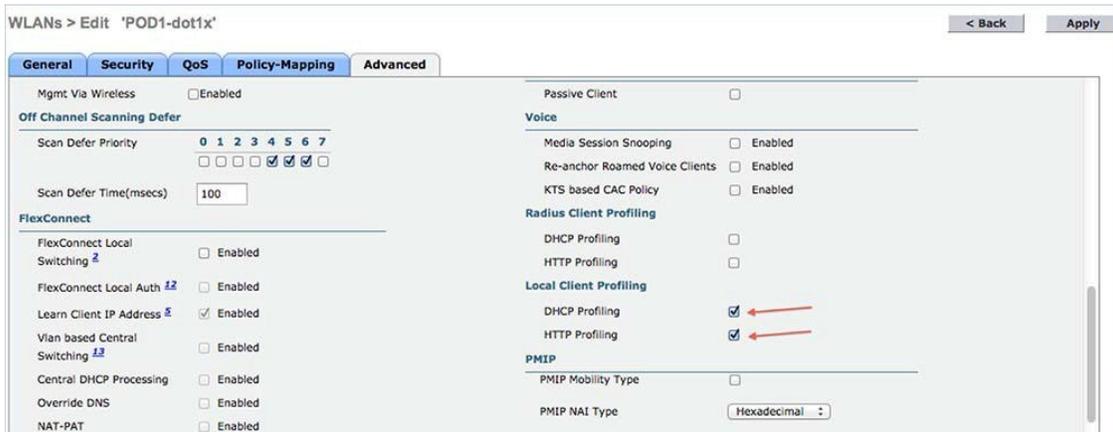
Profiling and Policy Configuration

Procedure

Step 1 To configure device profiling on a WLAN, go to the specific WLAN on which you want to implement Native profiling and policy and click **Advanced**. Disable **Allow AAA Override** if it is enabled. In the **DHCP** area, check the Required check box for **DHCP Addr. Assignment**.



Step 2 After enabling the DHCP required option, scroll down and in the **Local Client Profiling** area, enable DHCP Profiling and HTTP Profiling if they are not enabled and click **Apply**.



Creating Policies on the WLAN from the WLC GUI

Step 3 Once Profiling is configured, we can move on to create Local policies and apply them on the WLAN. On the WLC menu bar, go to **Security > Local Policies**, which will take you to the Policy List.



Step 4 When in the Local Policy List, click **New** to create a Policy Name. In this example, **teacher-LP** is used as a policy name, but you can use any name to define your own policy.



Once policy name is configured, you can create policies to match a Role, EAP Type, and Device Type. Also, you can define the required actions related to the Match criteria.

Here, in our setup we use **User Role** and **Device Type** to Match Criteria, but you can use any other type if required.

Note Make sure Match Role string is the same as AAA defined role name. In this example, it is configured as teacher.

Step 5 Enter User Role and click **Apply**. Here the role name "teacher" is used as an example.

Step 6 To apply the policy based on a user device, in the **Device List** area, from the Device Type drop-down list, choose the **device type** on which you want to enforce the policy and then click **Add**.

Here, we used **Apple-iPad** as a device type for **Match Criteria**. You can add Apple-iPhone and other Apple devices as well from the **Device Type** drop-down list.

Note If you do not want to match any device type then do not configure the **Device Type** option.

Step 7 To apply the appropriate action, choose from the parameters under the **Action** area to enforce the policy. Select the AVC profile that should be defined in the last section.

Security

- AAA
 - General
 - RADIUS
 - Authentication
 - Accounting
 - Fallback
 - DNS
 - Downloaded AVP
 - TACACS+
 - LDAP
 - Local Net Users
 - MAC Filtering
 - Disabled Clients
 - User Login Policies
 - AP Policies
 - Password Policies
- Local EAP
- Advanced EAP
- Priority Order
- Certificate
- Access Control Lists
- Wireless Protection Policies
- Web Auth
- TrustSec
 - Local Policies
- OpenDNS
- Advanced

Policy > Edit

Policy Name: IPSK-test
Policy Id: 1

Match Criteria

Match Role String: teacher
Match EAP Type: none

Device List

Device Type: [dropdown] [Add]

Action

IPV4 ACL: none
URL ACL: none
VLAN ID: 0
Qos Policy: none
Average Data Rate(kbps): 0
Average Real time Data Rate(kbps): 0
Burst Data Rate(kbps): 0
Burst Real time Data Rate(kbps): 0
Session Timeout (seconds): 1800
Sleeping Client Timeout (min): 720
Flexconnect ACL: none
AVC Profile: AUTOQOS-AVC-PROFILE
mDNS Profile: default-mdns-profile
OpenDNS Profile: none

Active Hours

Day: Mon
Start Time: 10 Hours 15 Mins
End Time: 22 Hours 30 Mins
[Add]

Day	Start Time	End Time
-----	------------	----------

Note For additional details on configuring Local Policy please see the link http://www.cisco.com/c/en/us/td/docs/wireless/controller/8-3/config-guide/b_cg83/b_cg83_chapter_01110.html

Step 8 User can create more than one Local policy and apply it for student as “student-LP”.

Note Ensure that the Match Role String is the same as the defined role name on the AAA/Radius Server.

Policy > Edit

Policy Name: student-LP
 Policy Id: 6

Match Criteria

Match Role String: student
 Match EAP Type: none

Device List

Device Type: Android [Add]
 Apple-iPad:

Action

IPv4 ACL: none
 VLAN ID: 0
 Qos Policy: none
 Session Timeout (seconds): 1800
 Sleeping Client Timeout (min): 720
 Flexconnect ACL: none
 AVC Profile: student-AVC
 mDNS Profile: none

Active Hours

Day: Mon
 Start Time: [] Hours [] Mins
 End Time: [] Hours [] Mins
 [Add]

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Step 9 Create a default local policy for any other device.

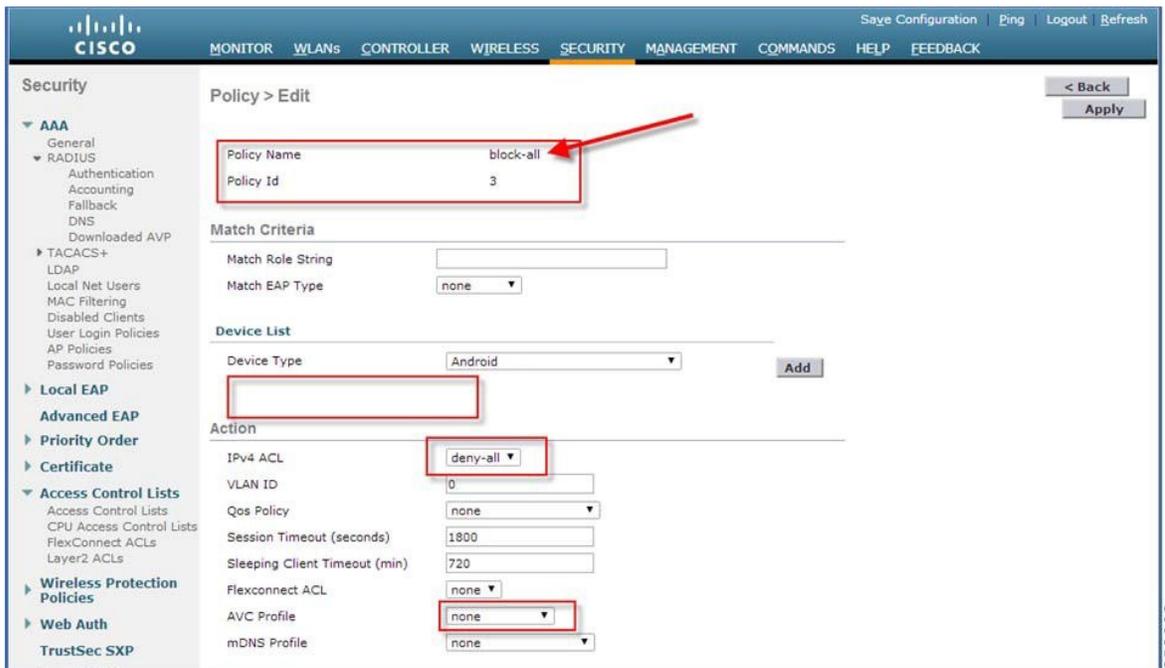
If no other ACL is applied in the Local policy, then any other device, other than Apple-iPad, will be able to access the applications because the final filter function of all policies is **Allow all**.

In order to block all applications on all devices except Apple-iPad, create a **deny all** ACL and apply it on the Local Policy and then apply that policy on the WLAN as the last resort. See the configuration examples in the screenshots below.

Create an ACL to deny all IPv4 flow.



Create a Local Policy **Block-all** and apply the **deny all** ACL to it, do not choose any devices roles or profiles.

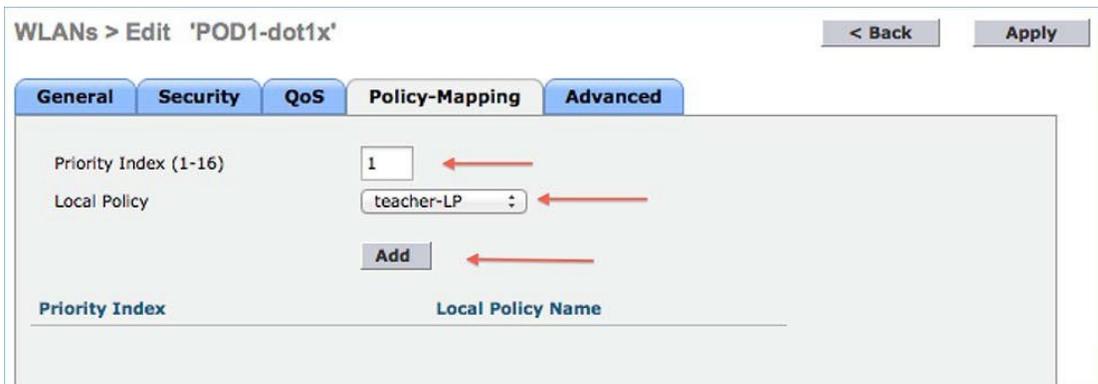


Mapping Policy on WLAN

Procedure

Step 1 Go to **WLANs** from the WLC menu bar and click the **WLAN ID** on which you want the policy to be implemented. From the WLAN edit menu, click the **Policy-Mapping** tab.

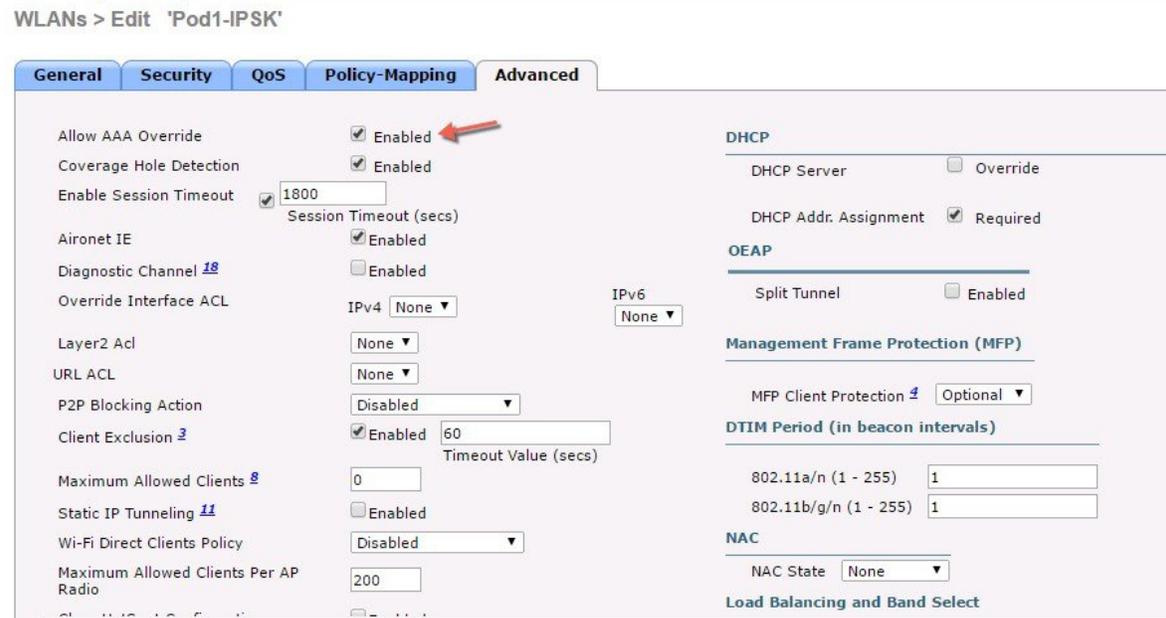
Set the Priority index to any value from 1-16. From the Local Policy drop-down list, choose the policy which you have already created. To apply the policy on the WLAN, click Add. The policy will be added.



Step 2 Add the appropriate policies to **Policy-Mapping** under WLAN.



Step 3 In the **Advanced** tab, disable **Allow AAA Override** if it is enabled as was configured also for IPSK.



Step 4

Check if the AAA role is configured properly, that is, role name on the AAA server should match the role string defined in the local policy. The example below is from the Cisco ISE server configured with cisco-av-pair role=teacher. Same configure for role=students.

The screenshot shows the Cisco Identity Services Engine (ISE) configuration interface. The breadcrumb navigation is: Home > Context Visibility > Operations > Policy > Administration > Work Centers. The main menu includes Authentication, Authorization, Profiling, Posture, Client Provisioning, and Policy Elements. The left sidebar shows a tree view with Authentication, Authorization (selected), Profiling, Posture, and Client Provisioning. Under Authorization, there are sub-items for Authorization Profiles and Downloadable ACLs. The main content area is titled "Authorization Profile" and contains the following fields:

- * Name: IPSK-device
- Description: Identity PSK
- * Access Type: ACCESS_ACCEPT
- Network Device Profile: Cisco
- Service Template:
- Track Movement: (i)
- Passive Identity Tracking: (i)

Below these fields are sections for "Common Tasks" and "Advanced Attributes Settings".

Common Tasks:

- Web Authentication (Local Web Auth)
- Airespace ACL Name
- ASA VPN
- AVC Profile Name

Advanced Attributes Settings:

Cisco:cisco-av-pair	=	psk-mode=ascii	-
Cisco:cisco-av-pair	=	psk=abc12345	-
Cisco:cisco-av-pair	=	role=teacher	- +

A red arrow points to the "role=teacher" attribute in the third row.

Attributes Details:

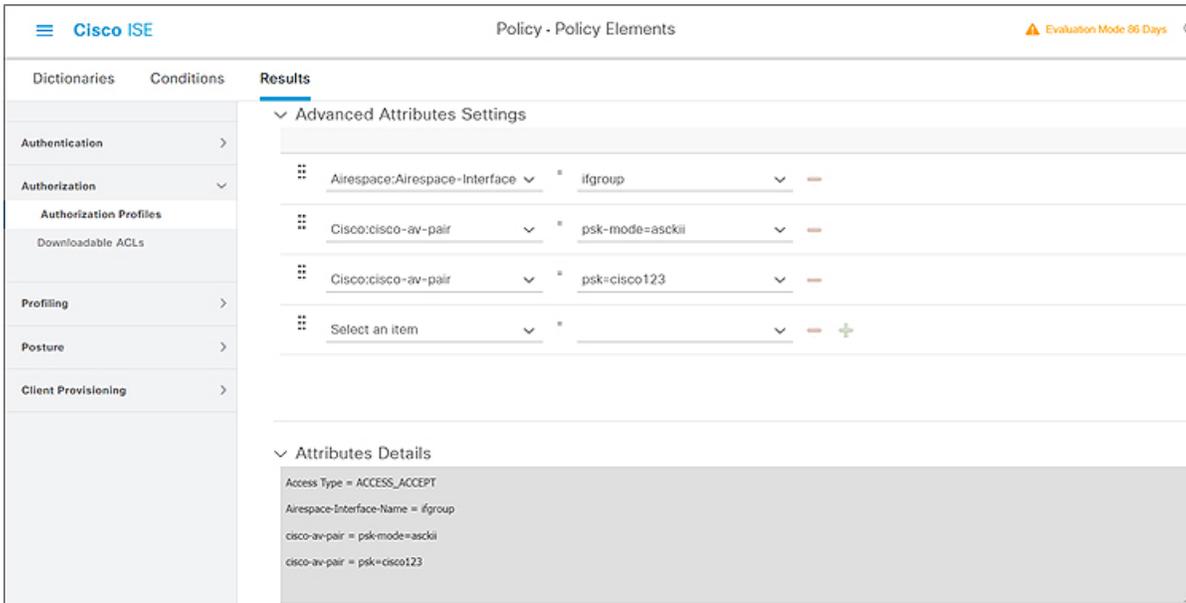
```
Access Type = ACCESS_ACCEPT
cisco-av-pair = psk-mode=ascii
cisco-av-pair = psk=abc12345
cisco-av-pair = role=teacher
```

At the bottom of the configuration area are "Save" and "Reset" buttons.

Interface Group Override

Like VLAN, ACL and QoS returned from AAA to override the policy configuration mapped in WLAN, Interface Group (list of interfaces VLAN) can be overridden from the AAA for a particular client. iPSK combined with the Interface group can allow the iPSK wireless client to obtain IP address from any of the VLANs present in the interface group

Attribute **Airespace: Airespace-Interface-Name** can be used along with the iPSK attributes to override the WLC Interface group.



Sample FreeRadius Configuration for combining iPSK attributes and Interface Group

```
"6c96cff283d0" Cleartext-Password:= "6c96cff283d0"  
293 Cisco-AVPair += "psk-mode=ascii",  
294 Cisco-AVPair += "psk=cisco123",  
295 Airespace-Interface-Name += "ifgroup"
```

Client Debug

Client debugs while returning interface groups along with iPSK and making use of one of the VLANs from the group.

```
*apfReceiveTask: Dec 14 13:25:17.264: [PA] 6c:96:cf:f2:83:d0 Inserting AAA Override struct for mobile  
MAC: 6c:96:cf:f2:83:d0, source 2  
  
*apfReceiveTask: Dec 14 13:25:17.264: [PA] 6c:96:cf:f2:83:d0 Inserting new RADIUS override into chain for  
station 6c:96:cf:f2:83:d0  
*apfReceiveTask: Dec 14 13:25:17.264: [PA] 6c:96:cf:f2:83:d0 Assigned interface 'vlan70' from interface group  
'ifgroup' for the client  
*apfReceiveTask: Dec 14 13:25:17.264: [PA] 6c:96:cf:f2:83:d0 Found an interface name:'vlan70' for interface  
group name received: ifgroup
```

End User Device Setup

Procedure

Step 1 On the End User device with MAC address configured on ISE connect to the WLAN Pod1-IPSK and enter IPSK password **abc12345** for that device or as it was configured on ISE.

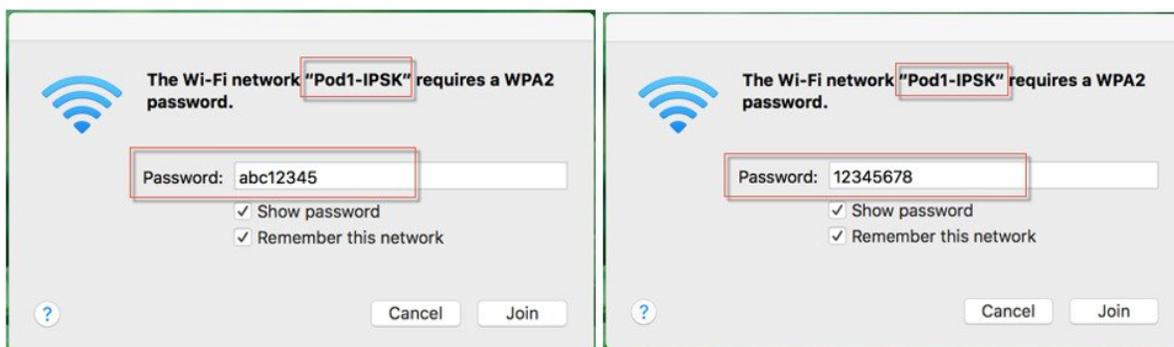
----- Connection **successful**

Step 2 Connect to the same WLAN with PSK **12345678**.

----- connection will be **un-successful**

Step 3 Connect to the same WLAN with device MAC address not configured on ISE with **PSK 12345678**.

----- connection **successful**



Step 4 To verify if the policy is applied from the WLCGUI, go to **Monitor > Clients**, and then click the **Client MAC address**.

Clients > Detail

Max Number of Records 10

General

AVC Statistics

Encryption Cipher	CCMP (AES)
EAP Type	PEAP
SNMP NAC State	Access
Radius NAC State	RUN
CTS Security Group Tag	Not Applicable
AAA Override ACL Name	none
AAA Override ACL Applied Status	Unavailable
AAA Override Flex ACL	none
AAA Override Flex ACL Applied Status	Unavailable
Redirect URL	none
IPv4 ACL Name	none
FlexConnect ACL Applied Status	Unavailable
IPv4 ACL Applied Status	Unavailable
IPv6 ACL Name	none
IPv6 ACL Applied Status	Unavailable
Layer2 ACL Name	none
Layer2 ACL Applied Status	Unavailable
mDNS Profile Name	default-mdns-profile
mDNS Service Advertisement Count	0
AAA Role Type	teacher
Local Policy Applied	teacher-LP

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Conclusion

- Controller that has Mac Filtering and AAA override enabled with ISE configured, will allow IPSK configured devices connect to WLAN with MAC addresses configured on ISE.
- Devices with MAC addresses configured on ISE will not be able to connect to WLAN generic PSK but only with IPSK configured for that device.

- Devices with no-MAC addresses configured on ISE will be able to connect to WLAN with generic PSK only.
- IPSK supports Local Mode and Flexconnect Mode (Central Authentication & Local Switching).
- IPSK supports FSR and key caching is done for faster roams to avoid RADIUS connect on every roam.
- To enable validity of the IPSK at certain scheduled times - the time schedule/validity can be exploited using radius session-timeout attribute in radius response.

IPSK Configuration through CLI commands

The following existing CLIs would be used for this feature:

```
config wlan mac-filtering enable <wlanId>
config wlan aaa-override enable <wlanId>
config wlan security wpa akm psk enable <wlanId>
config wlan security wpa akm psk set-key <ascii/hex> <key> <wlanId>
```

The existing show command would display the configuration of the WLAN and the client.

```
show wlan <wlanId>
show client detail <clientMac>
```



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