WLAN Security

Layer 2 Security

This section contains the following subsections:

Prerequisites for Layer 2 Security

WLANs with the same SSID must have unique Layer 2 security policies so that clients can make a WLAN selection based on the information advertised in beacon and probe responses. The available Layer 2 security policies are as follows:

- None (open WLAN)
- Static WEP or 802.1X

Note

- Because static WEP and 802.1X are both advertised by the same bit in beacon and probe responses, they cannot be differentiated by clients. Therefore, they cannot both be used by multiple WLANs with the same SSID.
- WLAN WEP is not supported in Cisco Aironet 1810w Access Points.

- WPA+WPA2

Note

- Although WPA and WPA2 cannot be used by multiple WLANs with the same SSID, you can configure two WLANs with the same SSID with WPA/TKIP with PSK and Wi-Fi Protected Access (WPA)/Temporal Key Integrity Protocol (TKIP) with 802.1X, or with WPA/TKIP with 802.1X or WPA/AES with 802.1X.
- A WLAN configured with TKIP support will not be enabled on an RM3000AC module.

- Static WEP (not supported on Wave 2 APs)

Guidelines and Limitations

- If WLAN is configured with Layer 2 security WEP without an encryption key, you will receive the following XML message:

```
apf_xml_validate_vapStatus: Encryption mode 0 for static WEP does not match encryption
 mode 2 for dynamic WEP
Validation for node ptr_apfCfgData.apfVAPIDData.apfVapStatus failed, indices for node
are 11
```

- If you need Layer 2 protection and prevent MAC spoofing, we recommend that you combine web authentication with Layer 2 security such as WPA2-PSK or WPA2-dot1x.

Configuring Dynamic 802.1X Keys and Authorization (CLI)

Controllers can control 802.1X dynamic WEP keys using Extensible Authentication Protocol (EAP) across access points and support 802.1X dynamic key settings for WLANs.

Note To use LEAP with lightweight access points and wireless clients, make sure to choose **Cisco-Aironet** as the RADIUS server type when configuring the CiscoSecure Access Control Server (ACS).

- Check the security settings of each WLAN by entering this command:

  show wlan *wlan_id*

  The default security setting for new WLANs is 802.1X with dynamic keys enabled. To maintain robust Layer 2 security, leave 802.1X configured on your WLANs.

- Disable or enable the 802.1X authentication by entering this command:

  config wlan security 802.1X {**enable** | **disable**} *wlan_id*

  After you enable 802.1X authentication, the controller sends EAP authentication packets between the wireless client and the authentication server. This command allows all EAP-type packets to be sent to and from the controller.

Note The controller performs both web authentication and 802.1X authentication in the same WLAN. The clients are initially authenticated with 802.1X. After a successful authentication, the client must provide the web authentication credentials. After a successful web authentication, the client is moved to the run state.

- Change the 802.1X encryption level for a WLAN by entering this command:

  config wlan security 802.1X encryption *wlan_id* **[0 | 40 | 104]**

  - Use the **0** option to specify no 802.1X encryption.
  - Use the **40** option to specify 40/64-bit encryption.
  - Use the **104** option to specify 104/128-bit encryption. (This is the default encryption setting.)

RADIUS VSA

The Internet Engineering Task Force (IETF) draft standard specifies a method for communicating vendor-specific information between the network access server and the RADIUS server by using vendor specific attributes (VSA). VSA allow vendors to support their own extended attributes otherwise not suitable for general use. VSA are predefined in an XML file. You need to add the vendor specific attributes to the XML file and this XML file is downloaded to the controller. There is no configuration required on the controller to enable the support. The file contains the RADIUS attributes in a specific format as explained by the XML schema to specify the XML tags.

The XML file with the vendor specific attributes defined can be downloaded from a FTP server. The downloaded file is stored in the flash memory and retained across several reboot processes. The file is parsed upon successful download and each time when the controller boots up. The XML file can be uploaded to RADIUS server for authentication and accounting. Once controller parses these values, it stores the file in a separate data structures meant for vendor specific attributes storage. The controller uses these attributes value in authentication or accounting packets, or both based on specified usage format. If there are any errors in the file, the controller parsing fails, and the attributes are not applied. You should address the errors in the file or download the file from the FTP server again to the controller.

This section contains the following subsections:

Sample RADIUS AVP List XML File

You can use the sample RADIUS AVP list XML file for reference. The sample XML file contains only two attributes, one for authentication and the other for accounting. You can add more number of RADIUS attributes and value pairs but those attributes and value pairs should be appended in the format specified.

Note The maximum number of WLANs that is supported in an AVP download is 32.

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Sample XML file edited by User1-->
```

```
<radiusFile>
<avpList SSID_PROF="test" incAuth="true" incAcct="false">
        <radiusAttributes>
                <attributeName>Idle-Timeout</attributeName>
                <vendorId>9</vendorId>
                <attributeId>21</attributeId>
                <valueType>INTEGER</valueType>
                <attributeValue>100</attributeValue>
        </radiusAttributes>
        <radiusAttributes>
                <attributeName>remote-name</attributeName>
                <vendorId>9</vendorId>
                <attributeId>26</attributeId>
                <valueType>STRING</valueType>
                <attributeValue>TEST</attributeValue>
        </radiusAttributes>
</avpList>
<avpList SSID_PROF="test" incAcct="true">
        <radiusAttributes>
                <attributeName>Idle-Timeout</attributeName>
                <vendorId>9</vendorId>
                <attributeId>21</attributeId>
                <valueType>INTEGER</valueType>
                <attributeValue>100</attributeValue>
        </radiusAttributes>
        <radiusAttributes>
                <attributeName>remote-name</attributeName>
                <vendorId>9</vendorId>
                <attributeId>26</attributeId>
                <valueType>STRING</valueType>
                <attributeValue>TEST</attributeValue>
        </radiusAttributes>
</avpList>
</radiusFile>
```

Downloading RADIUS AVP List (GUI)

Procedure

Step 1 Choose **Commands** > **Download File** to open the Download File to Controller page.

Step 2 From the File Type drop-down list, choose **RADIUS AVP List**.

Step 3 From the Transfer Mode drop-down list, choose from the following options:

- **TFTP**
- **FTP**
- **SFTP**

Step 4 In the IP Address text box, enter the IPv4 or IPv6 address of the server.

Step 5 In the File Path text box, enter the directory path of the RADIUS AVP list.

Step 6 In the File Name text box, enter the name of the RADIUS AVP list.

Step 7 If you are using an FTP server, follow these steps:

a) In the Server Login Username text box, enter the username to log into the FTP server.

b) In the Server Login Password text box, enter the password to log into the FTP server.

c) In the Server Port Number text box, enter the port number on the FTP server through which the download occurs. The default value is 21. For SFTP, the default value is 22.

Step 8 Click **Download** to download the RADIUS AVP list to the controller. A message appears indicating the status of the download.

Step 9 Choose **Security** > **AAA** > **RADIUS** > **Downloaded AVP** to open the Download RADIUS AVP List page.

Step 10 From the WLAN SSID Profile name drop-down list, choose the WLAN SSID profile name.

Step 11 Click the **Auth AVP** tab to view the RADIUS authentication attributes mapped to the AVP list.

Step 12 Click the **Acct AVP** tab to view the RADIUS accounting attributes mapped to the AVP list.

Uploading RADIUS AVP List (GUI)

Procedure

Step 1 Choose **Commands** > **Upload File** to open the Upload File from Controller page.

Step 2 From the File Type drop-down list, choose **RADIUS AVP List**.

Step 3 From the Transfer Mode drop-down list, choose from the following options:

- **TFTP**
- **FTP**
- **SFTP**

Step 4 In the IP Address text box, enter the IPv4 or IPv6 address of the server.

Step 5 In the File Path text box, enter the directory path of the RADIUS AVP list.

Step 6 In the File Name text box, enter the name of the RADIUS AVP list.

Step 7 If you are using an FTP server, follow these steps:

a) In the Server Login Username text box, enter the username to log into the FTP server.
b) In the Server Login Password text box, enter the password to log into the FTP server.
c) In the Server Port Number text box, enter the port number on the FTP server through which the download occurs. The default value is 21. For SFTP, the default value is 22.

Step 8 Click **Upload** to upload the RADIUS AVP list from the controller. A message appears indicating the status of the upload.

Uploading and Downloading RADIUS AVP List (CLI)

Procedure

Step 1 Log on to the controller CLI.

Step 2 Download the RADIUS AVPs in the XML file format from the FTP server to the controller by entering this command:

transfer download datatype radius-avplist

Step 3 Upload the XML file from the controller to the RADIUS server using the command:

transfer upload datatype radius-avplist

Step 4 Display VSA AVPs using the command:

show radius avp-list *ssid-profile-name*

Custom NAS-ID for RADIUS Accounting Using Downloadable RADIUS AVP

This feature addresses the need to have a configurable custom NAS-ID for custom accounting purposes on per WLAN basis. To download the XML file to the Cisco WLC, you can use the FTP (server) method or use the transfer download method. This file is retained in the WLC after the reboot also.

The custom AVP supersedes only the WLAN NAS-ID in the accounting messages. The priority of the other NAS-IDs is not affected.

Note

- The Global WLAN NASID is not used in accounting messages. If no NASID (WLAN/Interface/apgroup) is configured at the WLAN, then the system name is sent as the default NASID.
- The AVP list is only available as an uploaded and downloaded config file. You cannot configure or modify the AVP list on the Cisco WLC using GUI, CLI, or SNMP methods.
- If there are no AVP lists that are downloaded or WLAN specific or interface-specific NAS-ID configured, then the system name is the default NAS-ID.
- The standby controller also receives the AVP list during the XML file is download to the primary controller.

Refer to *RADIUS VSA* section from the *WLC Configuration guide* to create the custom AVP file.

The following are the supported value type for NAS-ID (strictly uppercase):

- SYSNAME
- SYSIP
- SYSMAC
- APIP
- APNAME
- APMAC
- APETHMAC
- APGROUP
- FLEXGROUP
- SSID
- APLOCATION

Note Software downgrade from the 8.6 to older version will not be supported for the new NAS-identifier AVP. If you decide to downgrade to an older version, perform the following steps:

1. Upload the existing RADIUS AVP attribute file.
2. Edit the file to remove the NAS-Identifier AVPs.
3. Downgrade the controller.
4. Download the changed RADIUS AVP file without the NAS-identifier AVP.

Restrictions on Custom NAS-ID for RADIUS Accounting Using Downloadable RADIUS AVP

- The custom NAS-ID string should contain minimum one value type and a maximum of three value type using ":" as the delimiter.
- When a downloaded NAS-ID has multiple custom NAS-ID syntaxes for the same SSID profile, by default the latest syntax is used after overwriting the older one.
- Maximum number of downloadable WLAN SSID profiles are 32.
- The maximum supported length of the custom NAS-IDs that are derived from the syntax is 253.

This section contains the following subsections:

Configuring Custom NAS-ID AVP XML File

Procedure

Step 1 Edit the XML file using a notepad.

Step 2 Update the **SSID_PROF** tag with the WLAN profile name you wish to apply the AVP to.

Step 3 Update the following fields:

- **vendorId** tag to 0
- **attributeId** to 32
- **Valuetype** to "STRING"
- **attributeValue** to attribute tag string with delimiter as ":"

Note It is necessary to set either the **incAuth** or the **incAcct** value to true. The custom NASID is updated for auth and accounting packets. Only the standard **attributeID** value 32 is supported. Other values are sent as a vendor attribute.

Example:

```
<?xml version="1.0" encoding="UTF-8"?>
<radiusFile>
 <avpList SSID_PROF="DocTest_8500_OPEN" incAuth="true" incAcct="true">
  <radiusAttributes>
   <attributeName>SVR-Zip-Code</attributeName>
```

```
 <vendorId>0</vendorId>
 <attributeId>32</attributeId>
 <valueType>STRING</valueType>
 <attributeValue> SYSNAME:APNAME:APLOCATION </attributeValue>
</radiusAttributes>
<radiusAttributes>
 <attributeName>W2BW-NASId</attributeName>
 <vendorId>0</vendorId>
 <attributeId>32</attributeId>
 <valueType>STRING</valueType>
<attributeValue>SYSNAME:APNAME:APLOCATION</attributeValue>
  </radiusAttributes>
  </avpList>
</radiusFile>
```

Step 4 Download the updated AVP XML file to the WLC.

Step 5 When the RADIUS download fails, use **debug option debug radius avp-xml enable** to know more about the error.

Deleting a NAS-ID AVP (GUI)

Procedure

Step 1 Edit the AVP XML file using a text editor and delete the SSID_PROF name.

Step 2 Download the updated NAS-ID AVP XML file to the Cisco WLC.

Step 3 Choose **Security** > **RADIUS** > **Downloaded AVP**. On the **DOWNLOADED RADIUS AVP LIST** page, the Acct tab displays an empty page.

The NAS-ID AVP is successfully deleted.

Note This procedure deletes the selected SSID profile. If multiple AVPs are listed in the XML AVP list file, they continue to function unless deleted using the delete procedure.

Viewing Custom NAS-ID Enhancement Configuration (GUI)

Procedure

Step 1 Choose **WLANs** > **WLAN ID** > **General** to open the **WLAN > Edit** page.

Step 2 In the general tab, view the greyed out NAS-ID field to view the value type.

Check if the format syntax for that file is downloaded and the string is displayed.

Example:

Downloaded NAS-ID syntax	Acct and auth NASID encoded format	Delimiter used
APIP:APNAME:SYSNAME	9.11.12.2:AP_BASEMENT_1:WLC_1	":" Colon

Step 3 Choose **Security** > **RADIUS** > **Downloaded AVP** > **Acct AVP** tab to open the **DOWNLOADED RADIUS AVP LIST** page.

Step 4 Select the **Wlan SSID Profile Name** from the drop-down list.

The AVP details are displayed.

Viewing Custom NAS-ID Enhancement (CLI)

Procedure

- View the downloaded AVP for the NAS-ID by entering this command:

  show radius avp-list *profile-name*

- View detailed information of a client by MAC address by entering this command:

  show client detail *mac-addr*

- View the RADIUS packets by entering this command:

  debug aaa all enable

- Enable the debug log to identify the cause of download failure by entering this command:

  debug aaa avp-xml enable

Identity Networking

In most wireless LAN systems, each WLAN has a static policy that applies to all clients associated with an SSID. Although powerful, this method has limitations because it requires clients to associate with different SSIDs to inherit different QoS and security policies.

However, the Cisco Wireless LAN solution supports identity networking, which allows the network to advertise a single SSID but allows specific users to inherit different QoS or security policies based on their user profiles. The specific policies that you can control using identity networking are as follows:

- ACL—When the ACL attribute is present in the RADIUS Access Accept, the system applies the ACL name to the client station after it authenticates, which overrides any ACLs that are assigned to the interface.
- VLAN—When a VLAN Interface-name or VLAN tag is present in a RADIUS Access Accept, the system places the client on a specific interface.

  Note The VLAN feature only supports MAC filtering, 802.1X, and WPA. The VLAN feature does not support web authentication or IPsec.

- Tunnel Attributes.

Note When any of the other RADIUS attributes (QoS-Level, ACL-Name, Interface-Name, or VLAN-Tag), which are described later in this section, are returned, the Tunnel Attributes must also be returned.

The operating system's local MAC filter database has been extended to include the interface name, allowing local MAC filters to specify to which interface the client should be assigned. A separate RADIUS server can also be used, but the RADIUS server must be defined using the Security menus.

This section contains the following subsection:

RADIUS Attributes Used in Identity Networking

QoS-Level

This section explains the RADIUS attributes used in identity networking.

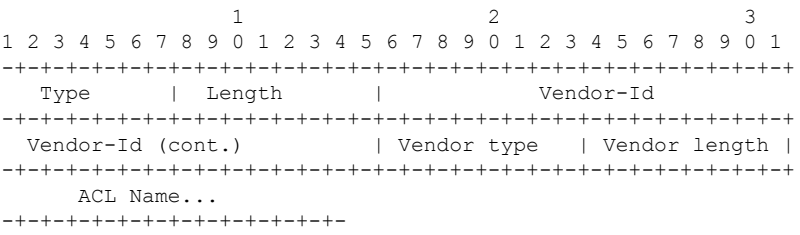
This attribute indicates the QoS level to be applied to the mobile client's traffic within the switching fabric, as well as over the air. This example shows a summary of the QoS-Level Attribute format. The text boxes are transmitted from left to right.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |  Length       |            Vendor-Id
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     Vendor-Id (cont.)          | Vendor type   | Vendor length |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                           QoS Level                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- Type – 26 for Vendor-Specific
- Length – 10
- Vendor-Id – 14179
- Vendor type – 2
- Vendor length – 4
- Value – Three octets:
  - 3 – Bronze (Background)
  - 0 – Silver (Best Effort)
  - 1 – Gold (Video)
  - 2 – Platinum (Voice)

ACL-Name

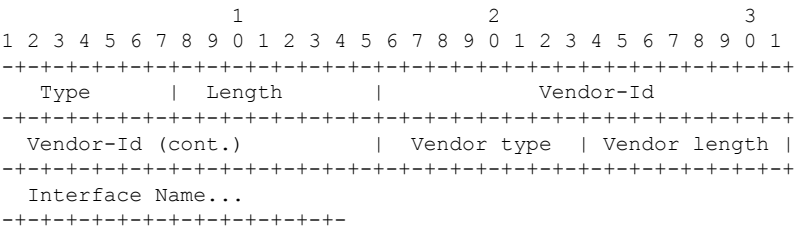
This attribute indicates the ACL name to be applied to the client. A summary of the ACL-Name Attribute format is shown below. The text boxes are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – >7
- Vendor-Id – 14179
- Vendor type – 6
- Vendor length – >0
- Value – A string that includes the name of the ACL to use for the client

Interface Name

This attribute indicates the VLAN Interface a client is to be associated to. A summary of the Interface-Name Attribute format is shown below. The text boxes are transmitted from left to right.



- Type – 26 for Vendor-Specific
- Length – >7
- Vendor-Id – 14179
- Vendor type – 5
- Vendor length – >0
- Value – A string that includes the name of the interface the client is to be assigned to.

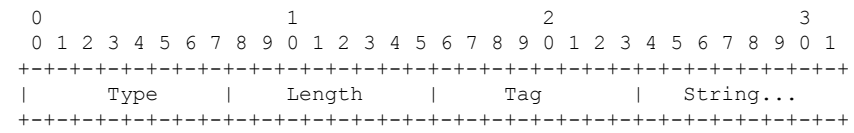
Note This Attribute only works when MAC filtering is enabled or if 802.1X or WPA is used as the security policy.

VLAN Tag

This attribute indicates the group ID for a particular tunneled session and is also known as the Tunnel-Private-Group-ID attribute.

This attribute might be included in the Access-Request packet if the tunnel initiator can predetermine the group resulting from a particular connection and should be included in the Access-Accept packet if this tunnel session is to be treated as belonging to a particular private group. Private groups may be used to associate a tunneled session with a particular group of users. For example, it may be used to facilitate routing of unregistered IP addresses through a particular interface. It should be included in Accounting-Request packets which contain Acct-Status-Type attributes with values of either Start or Stop and which pertain to a tunneled session.

A summary of the Tunnel-Private-Group-ID Attribute format is shown below. The text boxes are transmitted from left to right.



- Type – 81 for Tunnel-Private-Group-ID.
- Length – >= 3
- Tag – The Tag text box is one octet in length and is intended to provide a means of grouping attributes in the same packet which refer to the same tunnel. If the value of the Tag text box is greater than 0x00 and less than or equal to 0x1F, it should be interpreted as indicating which tunnel (of several alternatives) this attribute pertains. If the Tag text box is greater than 0x1F, it should be interpreted as the first byte of the following String text box.
- String – This text box must be present. The group is represented by the String text box. There is no restriction on the format of group IDs.

Note When any of the other RADIUS attributes (QoS-Level, ACL-Name, Interface-Name, or VLAN-Tag) are returned, the Tunnel Attributes must also be returned.

Tunnel Attributes

RFC 2868 defines RADIUS tunnel attributes used for authentication and authorization, and RFC2867 defines tunnel attributes used for accounting. Where the IEEE 802.1X authenticator supports tunneling, a compulsory tunnel may be set up for the Supplicant as a result of the authentication.

In particular, it may be desirable to allow a port to be placed into a particular VLAN, defined in IEEE 8021Q, based on the result of the authentication. This configuration can be used, for example, to allow a wireless host to remain on the same VLAN as it moves within a campus network.

The RADIUS server typically indicates the desired VLAN by including tunnel attributes within the Access-Accept. However, the IEEE 802.1X authenticator may also provide a hint as to the VLAN to be assigned to the Supplicant by including Tunnel attributes within the AccessRequest.

For use in VLAN assignment, the following tunnel attributes are used:

- Tunnel-Type=VLAN (13)
- Tunnel-Medium-Type=802
- Tunnel-Private-Group-ID=VLANID

The VLAN ID is 12 bits, with a value between 1 and 4094, inclusive. Because the Tunnel-Private-Group-ID is of type String as defined in RFC 2868, for use with IEEE 802.1X, the VLANID integer value is encoded as a string.

When Tunnel attributes are sent, it is necessary to fill in the Tag text box. As noted in RFC 2868, section 3.1:

- The Tag text box is one octet in length and is intended to provide a means of grouping attributes in the same packet that refer to the same tunnel. Valid values for this text box are 0x01 through 0x1F, inclusive. If the Tag text box is unused, it must be zero (0x00).
- For use with Tunnel-Client-Endpoint, Tunnel-Server-Endpoint, Tunnel-Private-Group-ID, Tunnel-Assignment-ID, Tunnel-Client-Auth-ID or Tunnel-Server-Auth-ID attributes (but not Tunnel-Type, Tunnel-Medium-Type, Tunnel-Password, or Tunnel-Preference), a tag text box of greater than 0x1F is interpreted as the first octet of the following text box.
- Unless alternative tunnel types are provided, (e.g. for IEEE 802.1X authenticators that may support tunneling but not VLANs), it is only necessary for tunnel attributes to specify a single tunnel. As a result, where it is only desired to specify the VLANID, the tag text box should be set to zero (0x00) in all tunnel attributes. Where alternative tunnel types are to be provided, tag values between 0x01 and 0x1F should be chosen.

MAC Filtering of WLANs

When you use MAC filtering for client or administrator authorization, you need to enable it at the WLAN level first. If you plan to use local MAC address filtering for any WLAN, use the commands in this section to configure MAC filtering for a WLAN.

This section contains the following subsections:

Restrictions for MAC Filtering

- MAC filtering cannot be configured for Guest LANs.
- Central Authentication and Switching—MAC authentication takes priority over MAC filtering if an external RADIUS is configured for the WLAN.
- Local Authentication and Switching—MAC authentication does not work if MAC filtering is not supported on local authentication.
- Interface mapping and profile precedence—MAC filtering for the WLAN set to any WLAN/Interface requires a mandatory profile name, followed by the interface name for the traffic to work properly.

Enabling MAC Filtering

Use these commands to enable MAC filtering on a WLAN:

- Enable MAC filtering by entering the **config wlan mac-filtering enable** *wlan_id* command.
- Verify that you have MAC filtering enabled for the WLAN by entering the **show wlan** command.

When you enable MAC filtering, only the MAC addresses that you add to the WLAN are allowed to join the WLAN. MAC addresses that have not been added are not allowed to join the WLAN.

When a client tries to associate to a WLAN for the first time, the client gets authenticated with its MAC address from AAA server. If the authentication is successful, the client gets an IP address from DHCP server, and then the client is connected to the WLAN.

When the client roams or sends association request to the same AP or different AP and is still connected to WLAN, the client is not authenticated again to AAA server.

If the client is not connected to WLAN, then the client has to get authenticated from the AAA server.

Local MAC Filters

Controllers have built-in MAC filtering capability, similar to that provided by a RADIUS authorization server.

Prerequisites for Configuring Local MAC Filters

You must have AAA enabled on the WLAN to override the interface name.

Configuring Local MAC Filters (CLI)

- Create a MAC filter entry on the controller by entering the **config macfilter add** *mac_addr wlan_id* [*interface_name*] [*description*] [*IP_addr*] command.

  The following parameters are optional:

  - *mac_addr*—MAC address of the client.
  - *wlan_id*—WLAN id on which the client is associating.
  - *interface_name*—The name of the interface. This interface name is used to override the interface configured to the WLAN.
  - *description*—A brief description of the interface in double quotes (for example, “Interface1”).
  - *IP_addr*—The IP address which is used for a passive client with the MAC address specified by the mac addr value above.

- Assign an IP address to an existing MAC filter entry, if one was not assigned in the **config macfilter add** command by entering the **config macfilter ip-address** *mac_addr IP_addr* command.
- Verify that MAC addresses are assigned to the WLAN by entering the **show macfilter** command.

Note For ISE NAC WLANs, the MAC authentication request is always sent to the external RADIUS server. The MAC authentication is not validated against the local database. This functionality is applicable to Releases 8.5, 8.7, 8.8, and later releases via the fix for CSCvh85830.

Previously, if MAC filtering was configured, the controller tried to authenticate the wireless clients using the local MAC filter. RADIUS servers were attempted only if the wireless clients were not found in the local MAC filter.

MAC Authentication Failover to 802.1X Authentication

You can configure the controller to start 802.1X authentication when MAC authentication with static WEP for the client fails. If the RADIUS server rejects an access request from a client instead of deauthenticating the client, the controller can force the client to undergo an 802.1X authentication. If the client fails the 802.1X authentication too, then the client is deauthenticated.

If MAC authentication is successful and the client requests for an 802.1X authentication, the client has to pass the 802.1X authentication to be allowed to send data traffic. If the client does not choose an 802.1X authentication, the client is declared to be authenticated if the client passes the MAC authentication.

Note WLAN with **WPA2 + 802.1X + WebAuth with WebAuth** on MAC failure is not supported.

This section contains the following subsections:

Configuring MAC Authentication Failover to 802.1x Authentication (GUI)

Procedure

Step 1 Choose **WLANs** > **WLAN ID** to open the WLANs > Edit page.

Step 2 In the **Security** tab, click the **Layer 2** tab.

Step 3 Select the **MAC Filtering** check box.

Step 4 Select the **Mac Auth or Dot1x** check box.

Configuring MAC Authentication Failover to 802.1X Authentication (CLI)

Procedure

To configure MAC authentication failover to 802.1X authentication, enter this command:

config wlan security 802.1X on-macfilter-failure {**enable** | **disable**} *wlan-id*

802.11w

Wi-Fi is a broadcast medium that enables any device to eavesdrop and participate either as a legitimate or rogue device. Control and management frames such as authentication/deauthentication, association/disassociation, beacons, and probes are used by wireless clients to select an AP and to initiate a session for network services.

Unlike data traffic which can be encrypted to provide a level of confidentiality, these frames must be heard and understood by all clients and therefore must be transmitted as open or unencrypted. While these frames cannot be encrypted, they must be protected from forgery to protect the wireless medium from attacks. For

example, an attacker could spoof management frames from an AP to tear down a session between a client and AP.

The 802.11w standard for Management Frame Protection is implemented in the 7.4 release.

The 802.11w protocol applies only to a set of robust management frames that are protected by the Management Frame Protection (PMF) service. These include Disassociation, Deauthentication, and Robust Action frames.

Management frames that are considered as robust action and therefore protected are the following:

- Spectrum Management
- QoS
- DLS
- Block Ack
- Radio Measurement
- Fast BSS Transition
- SA Query
- Protected Dual of Public Action
- Vendor-specific Protected

When 802.11w is implemented in the wireless medium, the following occur:

- Client protection is added by the AP adding cryptographic protection (by including the MIC information element) to deauthentication and disassociation frames preventing them from being spoofed in a DOS attack.
- Infrastructure protection is added by adding a Security Association (SA) teardown protection mechanism consisting of an Association Comeback Time and an SA-Query procedure preventing spoofed association request from disconnecting an already connected client.

This section contains the following subsections:

Restrictions for 802.11w

- Cisco's legacy Management Frame Protection is not related to the 802.11w standard that is implemented in the 7.4 release.
- The 802.11w standard is supported on all 802.11n capable APs from Cisco WLC release 7.5.
- The 802.11w standard is not supported on WLC.
- 802.11w cannot be applied on an open WLAN, WEP-encrypted WLAN, or a TKIP-encrypted WLAN.
- PMF is not supported in Cisco Aironet 1810, 1815, 1832, 1852, 1542, and 1800 series APs in FlexConnect mode prior to Release 8.9.

Configuring 802.11w (GUI)

Procedure

Step 1 Choose **WLANs** > WLAN ID to open the WLANs > Edit page.

Step 2 In the **Security** tab, choose the **Layer 2** security tab.

Step 3 From the Layer 2 Security drop-down list, choose **WPA+WPA2**.

The 802.11w IGTK Key is derived using the 4-way handshake, which means that it can only be used on WLANs that are configured for WPA2 security at Layer 2.

Note WPA2 is mandatory and encryption type must be AES. TKIP is not valid.

Step 4 Choose the PMF state from the drop-down list

The following options are available:

- **Disabled**—Disables 802.11w MFP protection on a WLAN
- **Optional**—To be used if the client supports 802.11w.
- **Required**—Ensures that the clients that do not support 802.11w cannot associate with the WLAN.

Step 5 If you choose the PMF state as either **Optional** or **Required**, do the following:

a) In the Comeback Timer box, enter the association comeback interval in milliseconds. It is the time within which the access point reassociates with the client after a valid security association.

b) In the SA Query Timeout box, enter the maximum time before an Security Association (SA) query times out.

Step 6 In the Authentication Key Management section, follow these steps:

a) Select or unselect the **PMF 802.1X** check box to configure the 802.1X authentication for the protection of management frames.

b) Select or unselect the **PMF PSK** check box to configure the preshared keys for PMF. Choose the PSK format as either ASCII or Hexadecimal and enter the PSK.

Step 7 Click **Apply**.

Step 8 Click **Save Configuration**.

Related Topics

Configuring Infrastructure MFP (GUI)

Configuring 802.11w (CLI)

Procedure

- Configure the 802.1X authentication for PMF by entering this command:

  config wlan security wpa akm pmf 802.1x {**enable** | **disable**} *wlan-id*

- Configure the preshared key support for PMF by entering this command:

  config wlan security wpa akm pmf psk {**enable** | **disable**} *wlan-id*

- If not done, configure a preshared key for a WLAN by entering this command:

  config wlan security wpa akm psk set-key {*ascii* | *hex*} *psk wlan-id*

- Configure protected management frames by entering this command:

  config wlan security pmf {**disable** | **optional** | **required**} *wlan-id*

- Configure the association comeback time settings by entering this command:

  config wlan security pmf association-comeback *timeout-in-seconds wlan-id*

- Configure the SA query retry timeout settings by entering this command:

  config wlan security pmf saquery-retrytimeout *timeout-in-milliseconds wlan-id*

- See the 802.11w configuration status for a WLAN by entering this command:

  show wlan *wlan-id*

- Configure the debugging of PMF by entering this command:

  debug pmf events {**enable** | **disable**}

Related Topics

Configuring Infrastructure MFP (CLI)

802.11r Fast Transition

802.11r, which is the IEEE standard for fast roaming, introduces a new concept of roaming where the initial handshake with the new AP is done even before the client roams to the target AP, which is called Fast Transition (FT). The initial handshake allows the client and APs to do the Pairwise Transient Key (PTK) calculation in advance. These PTK keys are applied to the client and AP after the client does the reassociation request or response exchange with new target AP.

802.11r provides two methods of roaming:

- Over-the-Air
- Over-the-DS (Distribution System)

The FT key hierarchy is designed to allow clients to make fast BSS transitions between APs without requiring reauthentication at every AP. WLAN configuration contains a new Authenticated Key Management (AKM) type called FT (Fast Transition).

From Release 8.0, you can create an 802.11r WLAN that is also an WPAv2 WLAN. In earlier releases, you had to create separate WLANs for 802.11r and for normal security. Non-802.11r clients can now join 802.11r-enabled WLANs as the 802.11r WLANs can accept non-802.11r associations. If clients do not support mixed mode or 802.11r join, they can join non-802.11r WLANS. When you configure FT PSK and later define PSK, clients that can join only PSK can now join the WLAN in mixed mode.

How a Client Roams

For a client to move from its current AP to a target AP using the FT protocols, the message exchanges are performed using one of the following two methods:

- Over-the-Air—The client communicates directly with the target AP using IEEE 802.11 authentication with the FT authentication algorithm.

- Over-the-DS—The client communicates with the target AP through the current AP. The communication between the client and the target AP is carried in FT action frames between the client and the current AP and is then sent through the controller.

Figure 1: Message Exchanges when Over the Air client roaming is configured

This figure shows the sequence of message exchanges that occur when Over the Air client roaming is configured.

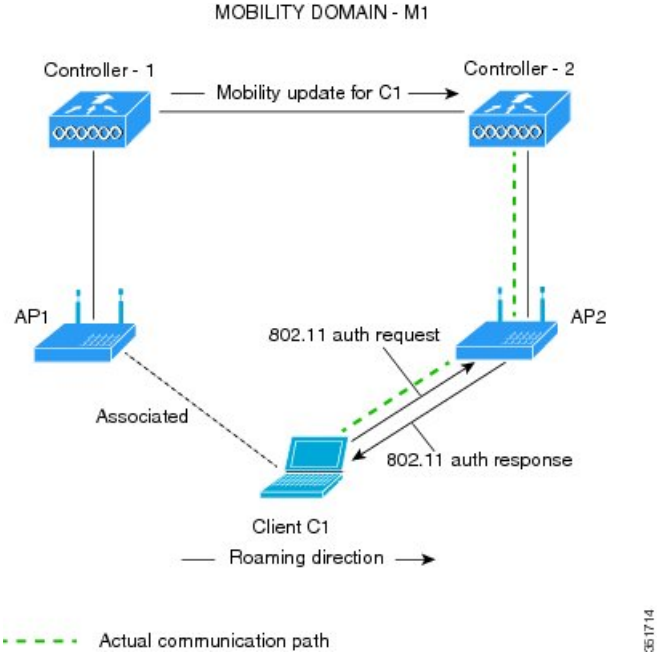
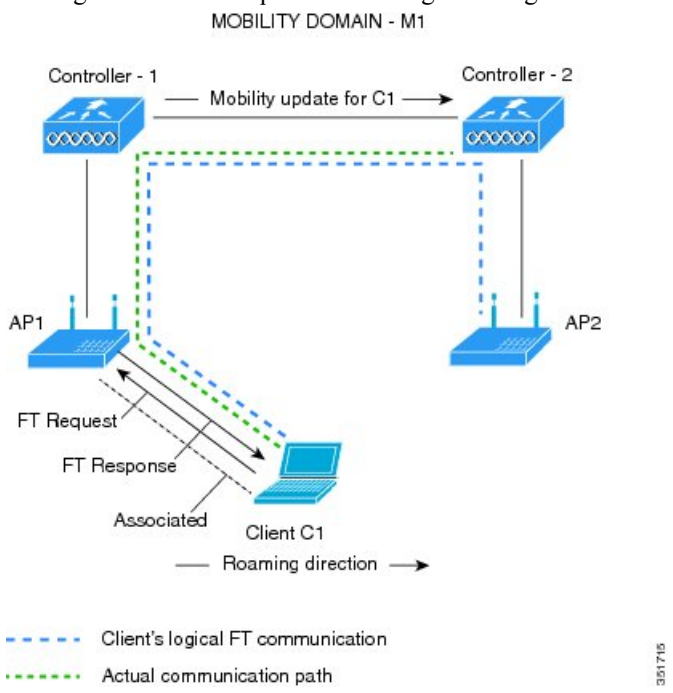


Figure 2: Message Exchanges when Over the DS client roaming is configured

This figure shows the sequence of message exchanges that occur when Over the DS client roaming is configured.



This section contains the following subsections:

Restrictions for 802.11r Fast Transition

- This feature is not supported on mesh access points.
- In 8.1 and earlier releases, this feature is not supported on access points in FlexConnect mode. In Release 8.2, this restriction is removed.
- For APs in FlexConnect mode:
  - 802.11r Fast Transition is supported in central and locally switched WLANs.
  - This feature is not supported for the WLANs enabled for local authentication.
  - 802.11r client association is not supported on access points in standalone mode.
  - 802.11r fast roaming is not supported on access points in standalone mode.
  - 802.11r fast roaming between local authentication and central authentication WLAN is not supported.
  - 802.11r fast roaming works only if the APs are in the same FlexConnect group.
- 802.11r fast roaming is not supported if the client uses Over-the-DS preauthentication in standalone mode.
- EAP LEAP method is not supported. WAN link latency prevents association time to a maximum of 2 seconds.
- The service from standalone AP to client is only supported until the session timer expires.

- TSpec is not supported for 802.11r fast roaming. Therefore, RIC IE handling is not supported.
- If WAN link latency exists, fast roaming is also delayed. Voice or data maximum latency should be verified. The Cisco WLC handles 802.11r Fast Transition authentication request during roaming for both Over-the-Air and Over-the-DS methods.
- This feature is supported on open and WPA2 configured WLANs.
- It is not possible to enable WPA1 encryption along with Fast Transition on a WLAN using the controller GUI. The workaround is to configure it using the controller CLI. For more information, see https://bst.cloudapps.cisco.com/bugsearch/bug/CSCvp05137.
- Legacy clients cannot associate with a WLAN that has 802.11r enabled if the driver of the supplicant that is responsible for parsing the Robust Security Network Information Exchange (RSN IE) is old and not aware of the additional AKM suites in the IE. Due to this limitation, clients cannot send association requests to WLANs. These clients, however, can still associate with non-802.11r WLANs. Clients that are 802.11r capable can associate as 802.11i clients on WLANs that have both 802.11i and 802.11r Authentication Key Management Suites enabled.

  The workaround is to enable or upgrade the driver of the legacy clients to work with the new 802.11r AKMs, after which the legacy clients can successfully associate with 802.11r enabled WLANs.

  Another workaround is to have two SSIDs with the same name but with different security settings (FT and non-FT).
- Fast Transition resource request protocol is not supported because clients do not support this protocol. Also, the resource request protocol is an optional protocol.
- To avoid any Denial of Service (DoS) attack, each Cisco WLC allows a maximum of three Fast Transition handshakes with different APs.
- Non-802.11r capable devices will not be able to associate with FT-enabled WLAN.
- 802.11r FT + PMF is not recommended.
- 802.11r FT Over-the-Air roaming is recommended for FlexConnect deployments.
- In a default FlexGroup scenario, fast roaming is not supported.

Configuring 802.11r Fast Transition (GUI)

Procedure

Step 1 Choose **WLANs** to open the **WLANs** window.

Step 2 Click a WLAN ID to open the **WLANs > Edit** window.

Step 3 Choose **Security** > **Layer 2** tab.

Step 4 From the **Layer 2 Security** drop-down list, choose **WPA+WPA2**.

The Authentication Key Management parameters for Fast Transition are displayed.

Step 5 From the **Fast Transition** drop-down list, choose Fast Transition on the WLAN.

Step 6 Check or uncheck the **Over the DS** check box to enable or disable Fast Transition over a distributed system.

This option is available only if you enable Fast Transition or if Fast Transition is adaptive.

To use 802.11r Fast Transition, Over-the-Air and Over-the-DS must be disabled.

Step 7 In the **Reassociation Timeout** field, enter the number of seconds after which the reassociation attempt of a client to an AP should time out. The valid range is 1 to 100 seconds.

Note This option is available only if you enable Fast Transition.

Step 8 Under Authentication Key Management, choose **FT 802.1X** or **FT PSK**. Check or uncheck the corresponding check boxes to enable or disable the keys. If you check the **FT PSK** check box, from the PSK Format drop-down list, choose **ASCII** or **Hex** and enter the key value.

Note When Fast Transition adaptive is enabled, you can use only **802.1X** and **PSK AKM.**.

Step 9 From the **WPA gtk-randomize State** drop-down list, choose **Enable** or **Disable** to configure the Wi-Fi Protected Access (WPA) group temporal key (GTK) randomize state.

Step 10 Click **Apply** to save your settings.

Configuring 802.11r Fast Transition (CLI)

802.11r-enabled WLAN provides faster roaming for wireless client devices. However, if 802.11r is enabled on a WLAN and advertises fast transition (FT) and non-FT AKMs in Beacon and Probe RSN IE, some of the devices with bad implementation may not recognise FT/WPA2 authentication key-management (AKM) in RSN IE and fails to join. As a result, customers cannot enable 802.11r on the SSID.

To overcome this, Cisco Wireless infrastructure introduces adaptive 802.11r Feature. When FT mode is set to adaptive, WLAN advertises 802.11r Mobility Domain ID on an 802.11i-enabled WLAN. Apple iOS10 client devices identifies the presence of MDIE on a 80211i/WPA2 WLAN and does a proprietary handshake to establish 802.11r association. Once the client completes successful 802.11r association, it will be able to do FT roaming as in a normal 802.11r enabled WLAN.

The FT adaptive is applicable only to selected Apple iOS10 devices. All other clients will continue to have 802.11i association on the WLAN.

Procedure

Step 1 To enable or disable 802.11r fast transition parameters, use the **config wlan security ft** {**adaptive** | **enable** | **disable**} *wlan-id* command.

Fast Transition adaptive option is enabled by default when you create a new WLAN, from Cisco Wireless Controller (WLC), Release 8.3, onwards. However, the existing WLANs will retain its current configuration when Cisco WLC upgrades to Release 8.3 from an earlier release.

Enable Fast SSID feature for allowing client devices a smother switching smoother switching from one WLAN to another. .

Step 2 To enable or disable 802.11r fast transition parameters over a distributed system, use the **config wlan security ft over-the-ds** {**enable** | **disable**} *wlan-id* command.

The Client devices normally prefer fast transition over-the-ds if the capability is advertised in the WLAN. To force a client to perform fast transition over-the-air, disable fast transition over-the-ds.

Step 3 To enable or disable the authentication key management for fast transition using preshared keys (PSK), use the **config wlan security wpa akm ft psk** {**enable** | **disable**} *wlan-id* command.

By default, the authentication key management using PSK is disabled.

Step 4 To enable or disable authentication key management for adaptive using PSK, use the **config wlan security wpa akm psk** {**enable** | **disable**} *wlan-id* command.

Step 5 To enable or disable authentication key management for fast transition using 802.1X, use the **config wlan security wpa akm ft-802.1X** {**enable** | **disable**} *wlan-id* command.

By default, authentication key management using 802.1X is enabled.

Step 6 To enable or disable authentication key management for adaptive using 802.1x, use the **config wlan security wpa akm 802.1x** {**enable** | **disable**} *wlan-id* command.

Note When Fast Transition adaptive is enabled, you can use only 802.1X and PSK AKM.

Step 7 To enable or disable 802.11r fast transition reassociation timeout, use the **config wlan security ft reassociation-timeout** *timeout-in-seconds wlan-id* command.

The valid range is 1 to 100 seconds. The default value of reassociation timeout is 20 seconds.

Step 8 To view the fast transition configuration on a WLAN, use the **show wlan** *wlan-id* command.

Step 9 To view the fast transition configuration on a client, use the **show client detail** *client-mac* command.

Note This command is relevant only for a connected or connecting client station (STA).

Step 10 To enable or disable debugging of fast transition events, use the **debug ft events** {**enable** | **disable**} command.

What to do next

- The tech support command output and xml config will not display fast transition information, when it is disabled.
- The tech support command output and xml config will display Adaptive 802.11r information, when it is enabled.
- To display a comprehensive view of the current Cisco WLC configuration, use the **show run-config all** command.
- The fast transition adaptive mode is not supported on Releases prior to Release 8.3, the fast transition adaptive WLANs default to fast transition disable when Cisco WLC is downgraded from Release 8.3 to a previous release, and the fast transition adaptive configuration is invalidated.

Troubleshooting 802.11r BSS Fast Transition

Symptom	Resolution
Non-802.11r legacy clients are no longer connecting.	Check if the WLAN has FT enabled. If so, non-FT WLAN will need to be created.
When configuring WLAN, the FT setup options are not shown.	Check if WPA2 is being used (802.1x / PSK). FT is supported only on WPA2 and OPEN SSIDs.

Symptom	Resolution
802.11r clients appear to reauthenticate when they do a Layer 2 roam to a new controller.	Check if the reassociation timeout has been lowered from the default of 20 by navigating to **WLANs** > *WLAN Name* > **Security** > **Layer 2** on the controller GUI.

Sticky Key Caching

The controller supports sticky key caching (SKC). With sticky key caching, the client receives and stores a different PMKID for every AP it associates with. The APs also maintain a database of the PMKID issued to the client.

In SKC, the client stores each Pairwise Master Key ID (PMKID) against a Pairwise Master Key Security Association (PMKSA). When a client finds an AP for which it has the PMKSA, it sends the PMKID in the association request to the AP. If the PMKSA is alive in the AP, the AP provides support for fast roaming. In SKC, full authentication is done on each new AP to which the client associates and the client must keep the PMKSA associated with all APs. For SKC, PMKSA is a per AP cache that the client stores and PMKSA is precalculated based on the BSSID of the new AP.

This section contains the following subsections:

Restrictions for Sticky Key Caching

- The controller supports SKC for up to eight APs per client. If a client roams to more than 8 APs per session, the old APs are removed to store the newly cached entries when the client roams. We recommend that you do not use SKC for large scale deployments.
- SKC works only on WPA2-enabled WLANs.
- SKC does not work across controllers in a mobility group.
- SKC works only on local mode APs.

Configuring Sticky Key Caching (CLI)

Procedure

Step 1 Disable the WLAN by entering this command:

config wlan disable *wlan_id*

Step 2 Enable sticky key caching by entering this command:

config wlan security wpa wpa2 cache sticky enable *wlan_id*

By default, SKC is disabled and opportunistic key caching (OKC) is enabled.

Note SKC works only on WPA2 enabled WLANs.

You can check if SKC is enabled by entering this command:

show wlan *wlan_id*

Information similar to the following appears:

```
WLAN Identifier.................................. 2
Profile Name..................................... new
Network Name (SSID).............................. new
Status........................................... Disabled
MAC Filtering.................................... Disabled
Security
   802.11 Authentication:........................ Open System
   Static WEP Keys............................... Disabled
   802.1X........................................ Disabled
   Wi-Fi Protected Access (WPA/WPA2)............. Enabled
      WPA (SSN IE)............................... Disabled
      WPA2 (RSN IE).............................. Enabled
         TKIP Cipher............................. Disabled
         AES Cipher.............................. Enabled
      Auth Key Management
         802.1x.................................. Disabled
         PSK..................................... Enabled
         CCKM.................................... Disabled
         FT(802.11r)............................. Disabled
         FT-PSK(802.11r)......................... Disabled
     SKC Cache Support.......................... Enabled
      FT Reassociation Timeout................... 20
      FT Over-The-Air mode....................... Enabled
      FT Over-The-Ds mode........................ Enabled
CCKM tsf Tolerance............................... 1000
   Wi-Fi Direct policy configured................ Disabled
   EAP-Passthrough............................... Disabled
```

Step 3 Enable the WLAN by entering this command:

config wlan enable *wlan_id*

Step 4 Save your settings by entering this command:

save config

WLAN for Static WEP

You can configure up to four WLANs to support static WEP keys. Follow these guidelines when configuring a WLAN for static WEP:

- When you configure static WEP as the Layer 2 security policy, no other security policies can be specified. That is, you cannot configure web authentication. However, when you configure static WEP as the Layer 2 security policy, you can configure web authentication.

Restrictions for Configuring Static WEP

- The controller software supports CCX versions 1 through 5. CCX support is enabled automatically for every WLAN on the controller and cannot be disabled. The controller stores the CCX version of the client in its client database and uses it to limit client functionality. Clients must support CCXv4 or v5 in order to use CCKM. For more information about CCX, see the Configuring Cisco Client Extensions section.

- In a unified architecture where multiple VLAN clients are supported for a WGB, you also need to configure encryption cipher suite and WEP keys globally, when the WEP encryption is enabled on the WGB. Otherwise, multicast traffic for wired VLAN clients fail.

WPA1 and WPA2

Wi-Fi Protected Access (WPA or WPA1) and WPA2 are standards-based security solutions from the Wi-Fi Alliance that provide data protection and access control for wireless LAN systems. WPA1 is compatible with the IEEE 802.11i standard but was implemented prior to the standard's ratification; WPA2 is the Wi-Fi Alliance's implementation of the ratified IEEE 802.11i standard.

By default, WPA1 uses Temporal Key Integrity Protocol (TKIP) and message integrity check (MIC) for data protection while WPA2 uses the stronger Advanced Encryption Standard encryption algorithm using Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (AES-CCMP). Both WPA1 and WPA2 use 802.1X for authenticated key management by default. However, these options are also available:

- 802.1X—The standard for wireless LAN security, as defined by IEEE, is called 802.1X for 802.11, or simply 802.1X. An access point that supports 802.1X acts as the interface between a wireless client and an authentication server, such as a RADIUS server, to which the access point communicates over the wired network. If 802.1X is selected, only 802.1X clients are supported.
- PSK—When you choose PSK (also known as WPA preshared key or WPA passphrase), you need to configure a preshared key (or a passphrase). This key is used as the pairwise master key (PMK) between the clients and the authentication server.
- CCKM—Cisco Centralized Key Management (CCKM) uses a fast rekeying technique that enables clients to roam from one access point to another without going through the controller, typically in under 150 milliseconds (ms). CCKM reduces the time required by the client to mutually authenticate with the new access point and derive a new session key during reassociation. CCKM fast secure roaming ensures that there is no perceptible delay in time-sensitive applications such as wireless Voice over IP (VoIP), enterprise resource planning (ERP), or Citrix-based solutions. CCKM is a CCXv4-compliant feature. If CCKM is selected, only CCKM clients are supported.

  When CCKM is enabled, the behavior of access points differs from the controller's for fast roaming in the following ways:

  - If an association request sent by a client has CCKM enabled in a Robust Secure Network Information Element (RSN IE) but CCKM IE is not encoded and only PMKID is encoded in RSN IE, then the controller does not do a full authentication. Instead, the controller validates the PMKID and does a four-way handshake.
  - If an association request sent by a client has CCKM enabled in RSN IE but CCKM IE is not encoded and only PMKID is encoded in RSN IE, then AP does a full authentication. The access point does not use PMKID sent with the association request when CCKM is enabled in RSN IE.

- 802.1X+CCKM—During normal operation, 802.1X-enabled clients mutually authenticate with a new access point by performing a complete 802.1X authentication, including communication with the main RADIUS server. However, when you configure your WLAN for 802.1X and CCKM fast secure roaming, CCKM-enabled clients securely roam from one access point to another without the need to reauthenticate to the RADIUS server. 802.1X+CCKM is considered optional CCKM because both CCKM and non-CCKM clients are supported when this option is selected.

On a single WLAN, you can allow WPA1, WPA2, and 802.1X/PSK/CCKM/802.1X+CCKM clients to join. All of the access points on such a WLAN advertise WPA1, WPA2, and 802.1X/PSK/CCKM/ 802.1X+CCKM information elements in their beacons and probe responses. When you enable WPA1 and/or WPA2, you can also enable one or two ciphers, or cryptographic algorithms, designed to protect data traffic. Specifically, you can enable AES and/or TKIP data encryption for WPA1 and/or WPA2. TKIP is the default value for WPA1, and AES is the default value for WPA2.

This section contains the following subsections:

Configuring WPA1+WPA2 (GUI)

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the desired WLAN to open the **WLANs > Edit** page.

Step 3 Choose the **Security** and **Layer 2** tabs to open the **WLANs > Edit (Security > Layer 2)** page.

Step 4 Choose **WPA+WPA2** from the Layer 2 Security drop-down list.

Step 5 Under WPA+WPA2 Parameters, select the **WPA Policy** check box to enable WPA1, select the **WPA2 Policy** check box to enable WPA2, or select both check boxes to enable both WPA1 and WPA2.

Note The default value is disabled for both WPA1 and WPA2. If you leave both WPA1 and WPA2 disabled, the access points advertise in their beacons and probe responses information elements only for the authentication key management method that you choose in Step 7.

Step 6 Select the **WPA2 Policy-AES** check box to enable AES data encryption .

Note Based on guidance from the Wi-Fi alliance (WFA), WPA/TKIP can only be configured on a secondary interface (CLI). Any previously saved TKIP configurations are retained upon upgrade and can be viewed on the CLI. This allows customers with Wi-Fi clients that only support WPA/TKIP to have a planned migration to devices that support AES.

Step 7 Choose one of the following key management methods from the Auth Key Mgmt drop-down list: **802.1X**, **CCKM**, **PSK**, or **802.1X+CCKM**.

Step 8 If you chose PSK in Step 7, choose **ASCII** or **HEX** from the PSK Format drop-down list and then enter a preshared key in the blank text box. WPA preshared keys must contain 8 to 63 ASCII text characters or 64 hexadecimal characters.

Note The PSK parameter is a set-only parameter. The value set for the PSK key is not visible to the user for security reasons. For example, if you selected HEX as the key format when setting the PSK key, and later when you view the parameters of this WLAN, the value shown is the default value. The default is ASCII.

Step 9 Click **Apply** to commit your changes.

Step 10 Click **Save Configuration** to save your changes.

Configuring WPA1+WPA2 (CLI)

Procedure

Step 1 Disable the WLAN by entering this command:

config wlan disable *wlan_id*

Step 2 Enable or disable WPA for the WLAN by entering this command:

config wlan security wpa {**enable** | **disable**} *wlan_id*

Step 3 Enable or disable WPA1 for the WLAN by entering this command:

config wlan security wpa wpa1 {**enable** | **disable**} *wlan_id*

Step 4 Enable or disable WPA2 for the WLAN by entering this command:

config wlan security wpa wpa2 {**enable** | **disable**} *wlan_id*

Step 5 Enable or disable AES or TKIP data encryption for WPA1 or WPA2 by entering one of these commands:

- **config wlan security wpa wpa1 ciphers** {**aes** | **tkip**} {**enable** | **disable**} *wlan_id*
- **config wlan security wpa wpa2 ciphers** {**aes** | **tkip**} {**enable** | **disable**} *wlan_id*

The default values are TKIP for WPA1 and AES for WPA2.

Note From Release 8.0, you cannot configure TKIP as a standalone encryption method. TKIP can be used only with the AES encryption method.

Note You can enable or disable TKIP encryption only using the CLI. Configuring TKIP encryption is not supported in GUI.

When you have VLAN configuration on WGB, you need to configure the encryption cipher mode and keys for a particular VLAN, for example, **encryption vlan 80 mode ciphers tkip**. Then, you need configure the encryption cipher mode globally on the multicast interface by entering the following command: **encryption mode ciphers tkip**.

Step 6 Enable or disable 802.1X, PSK, or CCKM authenticated key management by entering this command:

config wlan security wpa akm {**802.1X** | **psk** | **cckm**} {**enable** | disable} *wlan_id*

The default value is 802.1X.

Step 7 If you enabled PSK in *Step 6*, enter this command to specify a preshared key:

config wlan security wpa akm psk set-key {**ascii** | **hex**} *psk-key wlan_id*

WPA preshared keys must contain 8 to 63 ASCII text characters or 64 hexadecimal characters.

Step 8 Enable or disable authentication key management suite for fast transition by entering this command:

config wlan security wpa akm ft {**802.1X** | **psk**} {**enable** | **disable**} *wlan_id*

Note You can now choose between the PSK and the fast transition PSK as the AKM suite.

Step 9 Enable or disable randomization of group temporal keys (GTK) between AP and clients by entering this command:

config wlan security wpa gtk-random {**enable** | **disable**} *wlan_id*

Step 10 If you enabled WPA2 with 802.1X authenticated key management or WPA1 or WPA2 with CCKM authenticated key management, the PMK cache lifetime timer is used to trigger reauthentication with the client when necessary. The timer is based on the timeout value received from the AAA server or the WLAN session timeout setting. To see the amount of time remaining before the timer expires, enter this command:

show pmk-cache all

If you enabled WPA2 with 802.1X authenticated key management, the controller supports both opportunistic PMKID caching and sticky (or non-opportunistic) PMKID caching. In sticky PMKID caching (SKC), the client stores multiple PMKIDs, a different PMKID for every AP it associates with. Opportunistic PMKID caching (OKC) stores only one PMKID per client. By default, the controller supports OKC.

Step 11 Enable the WLAN by entering this command:

config wlan enable wlan_id

Step 12 Save your settings by entering this command:

save config

Identity PSK

This feature is designed to provide a simple and secured way for the growing number of devices to connect to the network. Some devices such as Internet of Things (IoT) clients may not support the 802.1x security protocol. These devices can connect to the network using the PSK authentication mechanism.

If all the clients are using the same key and if the key is shared with unauthorized users, then it leads to security breach.

The IPSK feature enables the administrator to configure WPA-PSK protocol-based unique pre-shared keys in the same SSID. This pre-shared key can be issued to an individual or group of users for their devices to connect to the network easily and safely. This also helps in identifying and managing a set of devices without affecting the other pre-shared key devices connected to the network. These keys can be configured with rules to authenticate and provide the appropriate level of access in the network.

Here, the AAA RADIUS server key is used to authenticate the client.

For documentation on Cisco ISE configuration, see Cisco ISE 2.2 Administrator Guide.

This section contains the following subsections:

Prerequisites for Identity PSK

The RADIUS server must be configured to return the following Cisco AV pairs in its response to the MAC-filtering authentication request:

- psk-mode=ascii
- psk=cisco123

Key length must be between 8 and 63 characters for ASCII and 64 characters for HEX. If the key configured on the RADIUS server does not meet the length requirement, the client can be authenticated with PSK configured on the WLAN.

Configuring Identity PSK (GUI)

Procedure

Step 1 Choose **WLAN** to open the WLAN page.

Step 2 Create a new WLAN or click an existing WLAN.

Step 3 Select the **Status Enabled** check box.

Step 4 Choose **Security** > **Layer 2** tab.

Step 5 Choose **WPA+WPA2** from the **Layer 2 Security** drop-down list.

Step 6 Select the **MAC Filtering** check box.

Step 7 Select **PSK Enable** check box under Authentication Key Management.

Step 8 Choose **Security** > **AAA Servers** tab.

Step 9 Select the **Authentication Servers Enabled** check box.

Step 10 Select the **Server IP address and port number** from the drop-down list.

If the RADIUS server is not configured, the RADIUS server is selected from the global list.

Step 11 Choose **Advanced** tab.

Step 12 Select the **Allow AAA Override Enabled** check box to enable AAA override. The default value is disabled.

Step 13 Click **Apply**.

Configuring Identity PSK (CLI)

Procedure

- Enable MAC filtering by entering this command:
  config wlan mac-filtering enable *wlan-id*
- Enable AAA-override on a WLAN by entering this command:
  config wlan aaa-override enable *wlan-id*
- Enable RADIUS authentication on a WLAN by entering this command:
  config wlan radius_server auth enable *wlan-id*
- Enable PSK support on a WLAN by entering this command:
  config wlan security wpa akm psk enable *wlan-id*
- Configure the PSK pre-share key by entering this command:
  config wlan security wpa akm psk set-key *ascii/hex psk-key wlan-id*

Web Redirect with 802.1X Authentication

You can configure a WLAN to redirect a user to a particular web page after 802.1X authentication has completed successfully. You can configure the web redirect to give the user partial or full access to the network.

This section contains the following subsections:

Conditional Web Redirect

If you enable conditional web redirect, the user can be conditionally redirected to a particular web page after 802.1X authentication has completed successfully. You can specify the redirect page and the conditions under which the redirect occurs on your RADIUS server. Conditions might include the user's password reaching expiration or the user needing to pay his or her bill for continued usage.

If the RADIUS server returns the Cisco AV-pair "url-redirect," then the user is redirected to the specified URL upon opening a browser. If the server also returns the Cisco AV-pair "url-redirect-acl," the specified access control list (ACL) is installed as a preauthentication ACL for this client. The client is not considered fully authorized at this point and can only pass traffic allowed by the preauthentication ACL.

After the client completes a particular operation at the specified URL (for example, changing a password or paying a bill), the client must reauthenticate. When the RADIUS server does not return a "url-redirect," the client is considered fully authorized and allowed to pass traffic.

Note The conditional web redirect feature is available only for WLANs that are configured for 802.1X or WPA+WPA2 Layer 2 security.

After you configure the RADIUS server, you can then configure the conditional web redirect on the controller using either the controller GUI or CLI.

Splash Page Web Redirect

If you enable splash page web redirect, the user is redirected to a particular web page after 802.1X authentication has completed successfully. After the redirect, the user has full access to the network. You can specify the redirect page on your RADIUS server and the corresponding ACL to allow access to this server in "url-redirect-acl". If the RADIUS server returns the Cisco AV-pair "url-redirect," then the user is redirected to the specified URL upon opening a browser. The client is considered fully authorized at this point and is allowed to pass traffic, even if the RADIUS server does not return a "url-redirect."

Note The splash page web redirect feature is available only for WLANs that are configured for 802.1X or WPA+WPA2 Layer 2 security with 802.1x key management. Preshared key management is not supported with any Layer 2 security method.

Suppose there are backend applications running on the wireless clients and they use HTTP or HTTPS port for their communication. If the applications start communicating before the actual web page is opened, the redirect functionality does not work with web passthrough.

After you configure the RADIUS server, you can then configure the splash page web redirect on the controller using either the controller GUI or CLI.

Configuring the RADIUS Server (GUI)

Note These instructions are specific to the CiscoSecure ACS; however, they should be similar to those for other RADIUS servers.

Procedure

Step 1 From the CiscoSecure ACS main menu, choose **Group Setup**.

Step 2 Click **Edit Settings**.

Step 3 From the Jump To drop-down list, choose **RADIUS (Cisco IOS/PIX 6.0)**.

Step 4 Select the **[009\001] cisco-av-pair** check box.

Step 5 Enter the following Cisco AV-pairs in the [009\001] cisco-av-pair edit box to specify the URL to which the user is redirected and, if configuring conditional web redirect, the conditions under which the redirect takes place, respectively:

url-redirect=http://url

url-redirect-acl=acl_name

Configuring Web Redirect

Configuring Web Redirect (GUI)

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the desired WLAN. The WLANs > Edit page appears.

Step 3 Choose the **Security** and **Layer 2** tabs to open the WLANs > Edit (Security > Layer 2) page.

Step 4 From the Layer 2 Security drop-down list, choose **802.1X** or **WPA+WPA2**.

Step 5 Set any additional parameters for 802.1X or WPA+WPA2.

Step 6 Choose the **Layer 3** tab to open the WLANs > Edit (Security > Layer 3) page.

Step 7 From the Layer 3 Security drop-down list, choose **None**.

Step 8 Check the **Web Policy** check box.

Step 9 Choose one of the following options to enable conditional or splash page web redirect: **Conditional Web Redirect** or **Splash Page Web Redirect**. The default value is disabled for both parameters.

Step 10 If the user is to be redirected to a site external to the controller, choose the ACL that was configured on your RADIUS server from the Preauthentication ACL drop-down list.

Step 11 Click **Apply** to commit your changes.

Step 12 Click **Save Configuration** to save your changes.

Configuring Web Redirect (CLI)

Procedure

Step 1 Enable or disable conditional web redirect by entering this command:

config wlan security cond-web-redir {**enable** | **disable**} *wlan_id*

Step 2 Enable or disable splash page web redirect by entering this command:

config wlan security splash-page-web-redir {**enable** | **disable**} *wlan_id*

Step 3 Save your settings by entering this command:

save config

Step 4 See the status of the web redirect features for a particular WLAN by entering this command:

show wlan *wlan_id*

Information similar to the following appears:

```
WLAN Identifier.................................. 1
Profile Name..................................... test
Network Name (SSID).............................. test
...
Web Based Authentication......................... Disabled
Web-Passthrough.................................. Disabled
Conditional Web Redirect......................... Disabled
Splash-Page Web Redirect......................... Enabled
...
```

Layer 3 Security

This section contains the following subsections:

Information About Web Authentication

WLANs can use web authentication only if VPN passthrough is not enabled on the controller. Web authentication is simple to set up and use and can be used with SSL to improve the overall security of the WLAN.

Using Web Authentication with 802.1x

There are three types of timers that are active when your WLAN uses web authentication along with 802.1x. These timers are based on the timeout value received from the AAA server or the WLAN session timeout:

- Session timer—Client session timeout configured for a WLAN that requires reauthentication. This timer starts after a successful web authentication.
- Reauthentication timer—Timer that is used to trigger client reauthentication for WPA1.
- PMK cache timer—Cache lifetime timer that is used to trigger client reauthentication for WPA2.

This section describes the two scenarios that clients can encounter when a WLAN is configured to use web authentication along with 802.1x.

Client associated to a single controller—In this scenario, when the reauthentication or PMK cache timer expires, the client reauthenticates, updates the reauthentication/PMK cache timer and remains in the run state.

When the client session timer (ST) expires, the client is deauthenticated even if the reauthentication/PMK cache timer is still valid.

Client roams from one controller to another controller—In this scenario, after the client roams the foreign controller triggers an L2 authentication and the anchor controller triggers an L3 authentication. The 802.1x reauthentication/PMK timer runs on the foreign controller and the client session timer runs on the anchor controller. When the reauthentication/PMK timer expires, 802.1x client reauthentication happens and the client is in the run state. Client is deauthenticated only when the client session timer expires.

The session timeout depends on the type of authentication, AAA or local, and the number of users:

- If we have AAA user with AAA override enabled, the session timeout is received from the RADIUS server.
- If we have AAA user with AAA override disabled, the session timeout is taken from the corresponding WLAN.
- If we use local authentication, 802.1x reauthentication/PMK cache timer is the WLAN ST value and web authentication local user remaining lifetime is configured as ST.

Note We can have same or different users for both 802.1x and web authentication.

Prerequisites for Configuring Web Authentication on a WLAN

- To initiate HTTP/HTTPS web authentication redirection, use HTTP URL or HTTPS URL.
- If the CPU ACLs are configured to block HTTP / HTTPS traffic, after the successful web login authentication, there could be a failure in the redirection page.
- Before enabling web authentication, make sure that all proxy servers are configured for ports other than port 53.
- When you enable web authentication for a WLAN, a message appears indicating that the controller forwards DNS traffic to and from wireless clients prior to authentication. We recommend that you have a firewall or intrusion detection system (IDS) behind your guest VLAN to regulate DNS traffic and to prevent and detect any DNS tunneling attacks.
- If the web authentication is enabled on the WLAN and you also have the CPU ACL rules, the client-based web authentication rules take higher precedence as long as the client is unauthenticated (in the webAuth_Reqd state). Once the client goes to the RUN state, the CPU ACL rules get applied. Therefore, if the CPU ACL rules are enabled in the controller, an allow rule for the virtual interface IP is required (in any direction) with the following conditions:
  - When the CPU ACL does not have an allow ACL rule for both directions.
  - When an allow ALL rule exists, but also a DENY rule for port 443 or 80 of higher precedence.
- The allow rule for the virtual IP should be for TCP protocol and port 80 (if secureweb is disabled) or port 443 (if secureweb is enabled). This process is required to allow client's access to the virtual interface IP address, post successful authentication when the CPU ACL rules are in place.

Restrictions for Configuring Web Authentication on a WLAN

- Web authentication is supported only with these Layer 2 security policies: open authentication, open authentication+WEP, and WPA-PSK. With the 7.4 release, web authentication is supported for use with 802.1X.
- Special charecters are not supported in the username field for web-authentication.
- When clients connect to a WebAuth SSID and a preauthorization ACL configured to allow VPN users, the clients will get disconnected from the SSID every few minutes. Webauth SSIDs must not connect without authenticating on the web page.

  You can select the following identity stores to authenticate web-auth user, under **WLANs > Security > AAA servers > Authentication priority** order for web-auth user section:

  - Local
  - RADIUS
  - LDAP

  If multiple identity stores are selected, then the controller checks each identity store in the list, in the order specified, from top to bottom, until authentication for the user succeeds. The authentication fails, if the controller reaches the end of the list and user remains un-authenticated in any of the identity stores.

Default Web Authentication Login Page

If you are using a custom web-auth bundle that is served by the internal controller web server, the page should not contain more than 5 elements (including HTML, CSS, and Images). This is because the internal controller web server implements a DoS protection mechanism that limits each client to open a maximum of 5 (five) concurrent TCP connections depending on the load. Some browsers may try to open more than 5 TCP sessions at the same time if the page contains more elements and this may result in the page loading slowly depending on how the browser handles the DoS protection.

If you do not want users to connect to a web page using a browser that is configured with SSLv2 only, you can disable SSLv2 for web authentication by entering the **config network secureweb cipher-option sslv2 disable command**. If you enter this command, users must use a browser that is configured to use a more secure protocol such as SSLv3 or later releases. The default value is disabled.

Note Cisco TAC is not responsible for creating a custom webauth bundle.

If you have a complex custom web authentication module, it is recommended that you use an external web-auth config on the controller, where the full login page is hosted at an external web server.

This section contains the following subsections:

Choosing the Default Web Authentication Login Page (GUI)

Procedure

Step 1 Choose **Security** > **Web Auth** > **Web Login Page** to open the Web Login page.

Step 2 From the Web Authentication Type drop-down list, choose **Internal (Default)**.

Step 3 If you want to use the default web authentication login page as is, go to Step 8. If you want to modify the default login page, go to Step 4.

Step 4 If you want to hide the Cisco logo that appears in the top right corner of the default page, choose the Cisco Logo **Hide** option. Otherwise, click the **Show** option.

Step 5 If you want the user to be directed to a particular URL (such as the URL for your company) after login, enter the desired URL in the Redirect URL After Login text box. You can enter up to 254 characters.

Step 6 If you want to create your own headline on the login page, enter the desired text in the Headline text box. You can enter up to 127 characters. The default headline is "Welcome to the Cisco wireless network."

Step 7 If you want to create your own message on the login page, enter the desired text in the Message text box. You can enter up to 2047 characters. The default message is "Cisco is pleased to provide the Wireless LAN infrastructure for your network. Please login and put your air space to work."

Step 8 Click **Apply** to commit your changes.

Step 9 Click **Preview** to view the web authentication login page.

Step 10 If you are satisfied with the content and appearance of the login page, click **Save Configuration** to save your changes. Otherwise, repeat any of the previous steps as necessary to achieve your desired results.

Choosing the Default Web Authentication Login Page (CLI)

Procedure

Step 1 Specify the default web authentication type by entering this command:

config custom-web webauth_type internal

Step 2 If you want to use the default web authentication login page as is, go to Step 7. If you want to modify the default login page, go to Step 3.

Step 3 To show or hide the Cisco logo that appears in the top right corner of the default login page, enter this command:

config custom-web weblogo {**enable** | **disable**}

Step 4 If you want the user to be directed to a particular URL (such as the URL for your company) after login, enter this command:

config custom-web redirecturl *url*

You can enter up to 130 characters for the URL. To change the redirect back to the default setting, enter the **clear redirecturl** command.

Step 5 If you want to create your own headline on the login page, enter this command:

config custom-web webtitle *title*

You can enter up to 130 characters. The default headline is "Welcome to the Cisco wireless network." To reset the headline to the default setting, enter the **clear webtitle** command.

Step 6 If you want to create your own message on the login page, enter this command:

config custom-web webmessage *message*

You can enter up to 130 characters. The default message is "Cisco is pleased to provide the Wireless LAN infrastructure for your network. Please login and put your air space to work." To reset the message to the default setting, enter the **clear webmessage** command.

Step 7 To enable or disable the web authentication logout popup window, enter this command:

config custom-web logout-popup {**enable** | **disable**}

Step 8 Enter the **save config** command to save your settings.

Step 9 Import your own logo into the web authentication login page as follows:

a. Make sure that you have a Trivial File Transfer Protocol (TFTP) server available for the file download. Follow these guidelines when setting up a TFTP server:

- If you are downloading through the service port, the TFTP server must be on the same subnet as the service port because the service port is not routable, or you must create static routes on the controller.
- If you are downloading through the distribution system network port, the TFTP server can be on the same or a different subnet because the distribution system port is routable.
- A third-party TFTP server cannot run on the same computer as the Cisco Prime Infrastructure because the Prime Infrastructure built-in TFTP server and the third-party TFTP server require the same communication port.

b. Ensure that the controller can contact the TFTP server by entering this command:

ping ip-address

c. Copy the logo file (in .jpg, .gif, or .png format) to the default directory on your TFTP server. The maximum file size is 30 kilobits. For an optimal fit, the logo should be approximately 180 pixels wide and 360 pixels high.

d. Specify the download mode by entering this command:

transfer download mode tftp

e. Specify the type of file to be downloaded by entering this command:

transfer download datatype image

f. Specify the IP address of the TFTP server by entering this command:

transfer download serverip *tftp-server-ip-address*

Note Some TFTP servers require only a forward slash (/) as the TFTP server IP address, and the TFTP server automatically determines the path to the correct directory.

g. Specify the download path by entering this command:

transfer download path *absolute-tftp-server-path-to-file*

h. Specify the file to be downloaded by entering this command:

transfer download filename {*filename.jpg* | *filename.gif* | *filename.png*}

i. View your updated settings and answer *y* to the prompt to confirm the current download settings and start the download by entering this command:

transfer download start

j. Save your settings by entering this command:

save config

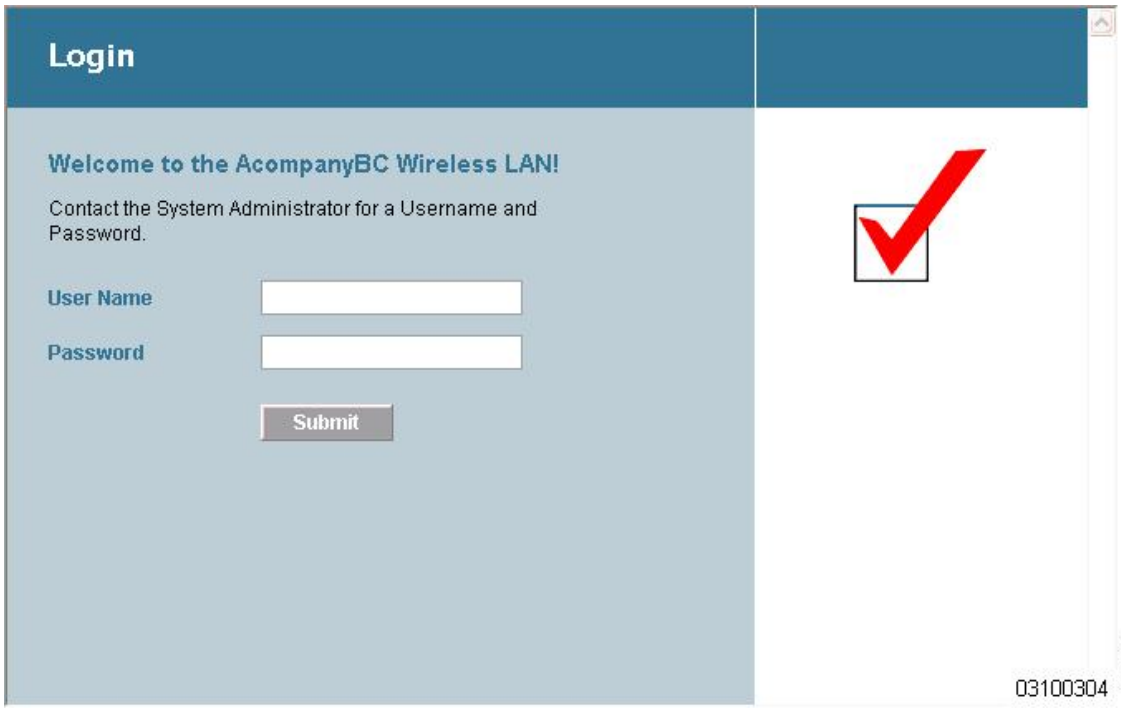
Note If you ever want to remove this logo from the web authentication login page, enter the **clear webimage** command.

Step 10 Follow the instructions in the Verifying the Web Authentication Login Page Settings (CLI), on page 45 section to verify your settings.

Example: Modified Default Web Authentication Login Page Example

Figure 3: Modified Default Web Authentication Login Page Example

This figure shows an example of a modified default web authentication login page.



These CLI commands were used to create this login page:

- **config custom-web weblogo** *disable*
- **config custom-web webtitle** *Welcome to the AcompanyBC Wireless LAN!*
- **config custom-web webmessage** *Contact the System Administrator for a Username and Password.*
- **transfer download** *start*
- **config custom-web redirecturl** *url*

Using a Customized Web Authentication Login Page from an External Web Server

Information About Customized Web Authentication Login Page

You can customize the web authentication login page to redirect to an external web server. When you enable this feature, the user is directed to your customized login page on the external web server.

You must configure a preauthentication access control list (ACL) on the WLAN for the external web server and then choose this ACL as the WLAN preauthentication ACL under **Layer 3 Security > Web Policy** on the **WLANs > Edit** page.

Choosing a Customized Web Authentication Login Page from an External Web Server (GUI)

Procedure

Step 1 Choose **Security** > **Web Auth** > **Web Login Page** to open the Web Login page.

Step 2 From the Web Authentication Type drop-down list, choose **External (Redirect to external server)**.

Step 3 In the Redirect URL after login text box, enter the URL that you want the user to be redirected after a login.

For example, you may enter your company's URL here and the users will be directed to that URL after login. The maximum length is 254 characters. By default, the user is redirected to the URL that was entered in the user's browser before the login page was served. of the customized web authentication login page on your web server. You can enter up to 252 characters.

Step 4 In the External Webauth URL text box, enter the URL that is to be used for external web authentication.

Step 5 Click **Apply**.

Step 6 Click **Save Configuration**.

Choosing a Customized Web Authentication Login Page from an External Web Server (CLI)

Procedure

Step 1 Specify the web authentication type by entering this command:

config custom-web webauth_type external

Step 2 Specify the URL of the customized web authentication login page on your web server by entering this command:

config custom-web ext-webauth-url *url*

You can enter up to 252 characters for the URL.

Step 3 Specify the IP address of your web server by entering this command:

config custom-web ext-webserver {**add** | **delete**} *server_IP_address*

Step 4 Enter the **save config** command to save your settings.

Step 5 Follow the instructions in the Verifying the Web Authentication Login Page Settings (CLI), on page 45 section to verify your settings.

Example: Creating a Customized Web Authentication Login Page

This section provides information on creating a customized web authentication login page, which can then be accessed from an external web server.

Here is a web authentication login page template. It can be used as a model when creating your own customized page:

Note We recommend that you follow the Cisco guidelines to create a customized web authentication login page. If you have upgraded to the latest versions of Google Chrome or Mozilla Firefox browsers, ensure that your webauth bundle has the following line in the *login.html* file:

```
<body onload="loadAction();">
```

For more information about this issue, see CSCvj17640.

```
<html>
<head>
<meta http-equiv="Pragma" content="no-cache">
<meta HTTP-EQUIV="Content-Type" CONTENT="text/html; charset=iso-8859-1">
<title>Web Authentication</title>
<script>

function submitAction(){
 var link = document.location.href;
 var searchString = "redirect=";
 var equalIndex = link.indexOf(searchString);
 var redirectUrl = "";

 if (document.forms[0].action == "") {
  var url = window.location.href;
  var args = new Object();
  var query = location.search.substring(1);
  var pairs = query.split("&");
  for(var i=0;i<pairs.length;i++){
  var pos = pairs[i].indexOf('=');
   if(pos == -1) continue;
    var argname = pairs[i].substring(0,pos);
    var value = pairs[i].substring(pos+1);
    args[argname] = unescape(value);
  }
   document.forms[0].action = args.switch_url;
  }

      if(equalIndex >= 0) {
  equalIndex += searchString.length;
  redirectUrl = "";
  redirectUrl += link.substring(equalIndex);
  }
  if(redirectUrl.length > 255)
  redirectUrl = redirectUrl.substring(0,255);
  document.forms[0].redirect_url.value = redirectUrl;
  document.forms[0].buttonClicked.value = 4;
        document.forms[0].submit();
}

 function loadAction(){
      var url = window.location.href;
      var args = new Object();
```

```
      var query = location.search.substring(1);
      var pairs = query.split("&");
      for(var i=0;i<pairs.length;i++){
          var pos = pairs[i].indexOf('=');
          if(pos == -1) continue;
          var argname = pairs[i].substring(0,pos);
          var value = pairs[i].substring(pos+1);
          args[argname] = unescape(value);
      }
//alert( "AP MAC Address is " + args.ap_mac);
      //alert( "The Switch URL to post user credentials is " + args.switch_url);
      document.forms[0].action = args.switch_url;

      // This is the status code returned from webauth login action
      // Any value of status code from 1 to 5 is error condition and user
      // should be shown error as below or modify the message as it suits
      // the customer
      if(args.statusCode == 1){
        alert("You are already logged in. No further action is required on your part.");
      }
      else if(args.statusCode == 2){
        alert("You are not configured to authenticate against web portal. No further action
 is required on your part.");
      }
      else if(args.statusCode == 3){
        alert("The username specified cannot be used at this time. Perhaps the username is
 already logged into the system?");
      }
      else if(args.statusCode == 4){
        alert("The User has been excluded. Please contact the administrator.");
      }
      else if(args.statusCode == 5){
        alert("Invalid username and password. Please try again.");
      }
      else if(args.statusCode == 6){
        alert("Invalid email address format. Please try again.");
      }
}

</script>
</head>
<body topmargin="50" marginheight="50" onload="loadAction();">
<form method="post" action="https://209.165.200.225/login.html">
<input TYPE="hidden" NAME="buttonClicked" SIZE="16" MAXLENGTH="15" value="0">
<input TYPE="hidden" NAME="redirect_url" SIZE="255" MAXLENGTH="255" VALUE="">
<input TYPE="hidden" NAME="err_flag" SIZE="16" MAXLENGTH="15" value="0">

<div align="center">
<table border="0" cellspacing="0" cellpadding="0">
<tr> <td> </td></tr>

<tr align="center"> <td colspan="2"><font size="10" color="#336699">Web
Authentication</font></td></tr>

<tr align="center">

<td colspan="2"> User Name    <input type="TEXT" name="username" SIZE="25"
MAXLENGTH="63" VALUE="">
</td>
</tr>
<tr align="center" >
<td colspan="2"> Password      <input type="Password" name="password"
 SIZE="25" MAXLENGTH="24">
</td>
```

```
</tr>

<tr align="center">
<td colspan="2"><input type="button" name="Submit" value="Submit" class="button"
onclick="submitAction();">
</td>
</tr>
</table>
</div>

</form>
</body>
</html>
```

These parameters are added to the URL when the user's Internet browser is redirected to the customized login page:

- **ap_mac**—The MAC address of the access point to which the wireless user is associated.
- **switch_url**—The URL of the controller to which the user credentials should be posted.
- **redirect**—The URL to which the user is redirected after authentication is successful.
- **statusCode**—The status code returned from the controller's web authentication server.
- **wlan**—The WLAN SSID to which the wireless user is associated.

The available status codes are as follows:

- Status Code 1: "You are already logged in. No further action is required on your part."
- Status Code 2: "You are not configured to authenticate against web portal. No further action is required on your part."
- Status Code 3: "The username specified cannot be used at this time. Perhaps the username is already logged into the system?"
- Status Code 4: "You have been excluded."
- Status Code 5: "The User Name and Password combination you have entered is invalid. Please try again."

Note For additional information, see the *External Web Authentication with Wireless LAN Controllers Configuration Example* at http://www.cisco.com/c/en/us/support/docs/wireless-mobility/wlan-security/71881-ext-web-auth-wlc.html.

Downloading a Customized Web Authentication Login Page

You can compress the page and image files used for displaying a web authentication login page into a.tar file for download to a controller. These files are known as the webauth bundle. The maximum allowed size of the files in their uncompressed state is 1 MB. When the .tar file is downloaded from a local TFTP server, it enters the controller's file system as an untarred file.

You can download a login page example from Cisco Prime Infrastructure and use it as a starting point for your customized login page. For more information, see the Cisco Prime Infrastructure documentation.

Note If you load a webauth bundle with a .tar compression application that is not GNU compliant, the controller cannot extract the files in the bundle and the following error messages appear: "Extracting error" and "TFTP transfer failed." Therefore, we recommend that you use an application that complies with GNU standards, such as PicoZip, to compress the .tar file for the webauth bundle.

Note Configuration backups do not include extra files or components, such as the webauth bundle or external licenses, that you download and store on your controller, so you should manually save external backup copies of those files or components.

Note If the customized webauth bundle has more than 3 separated elements, we advise you to use an external server to prevent page load issues that may be caused because of TCP rate-limiting policy on the controller.

Prerequisites for Downloading a Customized Web Authentication Login Page

- Name the login page `login.html`. The controller prepares the web authentication URL based on this name. If the server does not find this file after the webauth bundle has been untarred, the bundle is discarded, and an error message appears.
- Include input text boxes for both a username and password.
- Retain the redirect URL as a hidden input item after extracting from the original URL.
- Extract and set the action URL in the page from the original URL.
- Include scripts to decode the return status code.
- Make sure that all paths used in the main page (to refer to images, for example).
- Ensure that no filenames within the bundle are greater than 30 characters.

Downloading a Customized Web Authentication Login Page (GUI)

Procedure

Step 1 Copy the .tar file containing your login page to the default directory on your server.

Step 2 Choose **Commands** > **Download File** to open the Download File to Controller page.

Step 3 From the **File Type** drop-down list, choose **Webauth Bundle**.

Step 4 From the **Transfer Mode** drop-down list, choose from the following options:

- **TFTP**
- **FTP**
- **SFTP** (available in the 7.4 and later releases)

Step 5 In the **IP Address** text box, enter the IP address of the server.

Step 6 If you are using a TFTP server, enter the maximum number of times the controller should attempt to download the .tar file in the Maximum Retries text box.

The range is 1 to 254.

The default is 10.

Step 7 If you are using a TFTP server, enter the amount of time in seconds before the controller times out while attempting to download the *.tar file in the Timeout text box.

The range is 1 to 254 seconds.

The default is 6 seconds.

Step 8 In the **File Path** text box, enter the path of the .tar file to be downloaded. The default value is "/."

Step 9 In the **File Name** text box, enter the name of the .tar file to be downloaded.

Step 10 If you are using an FTP server, follow these steps:

a. In the **Server Login Username** text box, enter the username to log into the FTP server.

b. In the **Server Login Password** text box, enter the password to log into the FTP server.

c. In the **Server Port Number** text box, enter the port number on the FTP server through which the download occurs. The default value is 21.

Step 11 Click **Download** to download the .tar file to the controller.

Step 12 Choose **Security** > **Web Auth** > **Web Login Page** to open the Web Login page.

Step 13 From the Web Authentication Type drop-down list, choose **Customized (Downloaded)**.

Step 14 Click **Apply**.

Step 15 Click **Preview** to view your customized web authentication login page.

Step 16 If you are satisfied with the content and appearance of the login page, click **Save Configuration**.

Downloading a Customized Web Authentication Login Page (CLI)

Procedure

Step 1 Copy the .tar file containing your login page to the default directory on your server.

Step 2 Specify the download mode by entering this command:

transfer download mode {**tftp** | **ftp** | **sftp**}

Step 3 Specify the type of file to be downloaded by entering this command:

transfer download datatype webauthbundle

Step 4 Specify the IP address of the TFTP server by entering this command:

transfer download serverip *tftp-server-ip-address.*

Note Some TFTP servers require only a forward slash (/) as the TFTP server IP address, and the TFTP server automatically determines the path to the correct directory.

Step 5 Specify the download path by entering this command:

transfer download path *absolute-tftp-server-path-to-file*

Step 6 Specify the file to be downloaded by entering this command:

transfer download filename *filename.tar*

Step 7 View your updated settings and answer **y** to the prompt to confirm the current download settings and start the download by entering this command:

transfer download start

Step 8 Specify the web authentication type by entering this command:

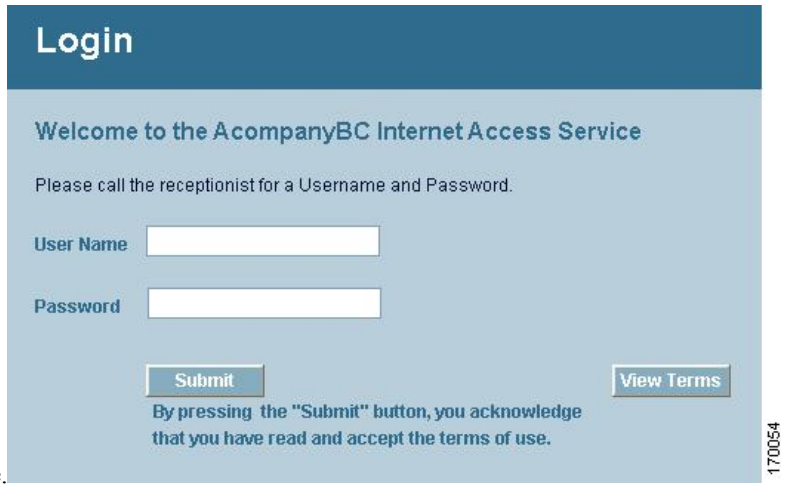
config custom-web webauth_type *customized*

Step 9 Enter the **save config** command to save your settings.

Example: Customized Web Authentication Login Page

Figure 4: Customized Web Authentication Login Page Example

This figure shows an example of a customized web authentication login page.



Verifying the Web Authentication Login Page Settings (CLI)

Verify your changes to the web authentication login page by entering this command:

show custom-web

Assigning Login, Login Failure, and Logout Pages per WLAN

You can display different web authentication login, login failure, and logout pages to users per WLAN. This feature enables user-specific web authentication pages to be displayed for a variety of network users, such as guest users or employees within different departments of an organization.

Different login pages are available for all web authentication types (internal, external, and customized). However, different login failure and logout pages can be specified only when you choose customized as the web authentication type.

This section contains the following subsections:

Assigning Login, Login Failure, and Logout Pages per WLAN (GUI)

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN to which you want to assign a web login, login failure, or logout page.

Step 3 Choose **Security** > **Layer 3**.

Step 4 Make sure that **Web Policy** and **Authentication** are selected.

Step 5 To override the global authentication configuration web authentication pages, select the **Override Global Config** check box.

Step 6 When the Web Auth Type drop-down list appears, choose one of the following options to define the web authentication pages for wireless guest users:

- **Internal**—Displays the default web login page for the controller. This is the default value.
- **Customized**—Displays custom web login, login failure, and logout pages. If you choose this option, three separate drop-down lists appear for login, login failure, and logout page selection. You do not need to define a customized page for all three options. Choose **None** from the appropriate drop-down list if you do not want to display a customized page for that option.

  Note These optional login, login failure, and logout pages are downloaded to the controller as webauth.tar files.

- **External**—Redirects users to an external server for authentication. If you choose this option, you must also enter the URL of the external server in the URL text box.

  You can choose specific RADIUS or LDAP servers to provide external authentication on the WLANs > Edit (Security > AAA Servers) page. Additionally, you can define the priority in which the servers provide authentication.

Step 7 If you chose External as the web authentication type in Step 6, choose **AAA Servers** and choose up to three RADIUS and LDAP servers using the drop-down lists.

Note The RADIUS and LDAP external servers must already be configured in order to be selectable options on the WLANs > Edit (Security > AAA Servers) page. You can configure these servers on the RADIUS Authentication Servers page and LDAP Servers page.

Step 8 Establish the priority in which the servers are contacted to perform web authentication as follows:

Note The default order is local, RADIUS, LDAP.

a. Highlight the server type (local, RADIUS, or LDAP) that you want to be contacted first in the box next to the Up and Down buttons.

b. Click **Up** and **Down** until the desired server type is at the top of the box.

c. Click the < arrow to move the server type to the priority box on the left.

d. Repeat these steps to assign priority to the other servers.

Step 9 Click **Apply** to commit your changes.

Step 10 Click **Save Configuration** to save your changes.

Assigning Login, Login Failure, and Logout Pages per WLAN (CLI)

Procedure

Step 1 Determine the ID number of the WLAN to which you want to assign a web login, login failure, or logout page by entering this command:

show wlan summary

Step 2 If you want wireless guest users to log into a customized web login, login failure, or logout page, enter these commands to specify the filename of the web authentication page and the WLAN for which it should display:

- **config wlan custom-web login-page** *page_name wlan_id—Defines a customized login page for a* given WLAN.
- **config wlan custom-web loginfailure-page** *page_name wlan_id—Defines a customized login* failure page for a given WLAN.

  Note To use the controller's default login failure page, enter the **config wlan custom-web loginfailure-page none** *wlan_id* command.

- **config wlan custom-web logout-page** *page_name wlan_id—Defines a customized logout page for* a given WLAN.

  Note To use the controller's default logout page, enter the **config wlan custom-web logout-page none** *wlan_id* command.

Step 3 Redirect wireless guess users to an external server before accessing the web login page by entering this command to specify the URL of the external server:

config wlan custom-web ext-webauth-url *ext_web_url wlan_id*

Note For the external web authentication URL, the CLI does not accept the *?* character. For example, if the URL is *https://example.com?text*, the CLI saves the URL as *https://example.comtext*. For more information, see CSCvu53350.

Step 4 Define the order in which web authentication servers are contacted by entering this command:

config wlan security web-auth server-precedence *wlan_id* {**local** | **ldap** | **radius**} {**local** | **ldap** | **radius**} {**local** | **ldap** | **radius**}

The default order of server web authentication is local, RADIUS and LDAP.

Note All external servers must be preconfigured on the controller. You can configure them on the RADIUS Authentication Servers page and the LDAP Servers page.

Step 5 Define which web authentication page displays for a wireless guest user by entering this command:

config wlan custom-web webauth-type {**internal** | **customized** | **external**} *wlan_id*

where

- **internal** displays the default web login page for the controller. This is the default value.
- **customized** displays the custom web login page that was configured in *Step 2*.

  Note You do not need to define the web authentication type in *Step 5* for the login failure and logout pages as they are always customized.

- **external** redirects users to the URL that was configured in *Step 3*.

Step 6 Use a WLAN-specific custom web configuration rather than a global custom web configuration by entering this command:

config wlan custom-web global disable *wlan_id*

Note If you enter the **config wlan custom-web global enable** *wlan_id* command, the custom web authentication configuration at the global level is used.

Step 7 Save your changes by entering this command:

save config

Web Authentication Proxy

This feature enables clients that have manual web proxy enabled in the browser to facilitate authentication with the controller. If the user's browser is configured with manual proxy settings with a configured port number as 8080 or 3128 and if the client requests any URL, the controller responds with a web page prompting the user to change the Internet proxy settings to automatically detect the proxy settings so that the browser's manual proxy settings information does not get lost. After enabling this settings, the user can get access to the network through the web authentication policy. This functionality is given for port 8080 and 3128 because these are the most commonly used ports for the web proxy server.

Note The web authentication proxy redirect ports are not blocked through CPU ACL. If a CPU ACL is configured to block the port 8080, 3128, and one random port as part of web authentication proxy configuration, those ports are not blocked because the webauth rules take higher precedence than the CPU ACL rules unless the client is in the webauth_req state.

A web browser has the following three types of Internet settings that you can configure:

- Auto detect
- System Proxy
- Manual

In a manual proxy server configuration, the browser uses the IP address of a proxy server and a port. If this configuration is enabled on the browser, the wireless client communicates with the IP address of the destination proxy server on the configured port. In a web authentication scenario, the controller does not listen to such

proxy ports and the client is not able to establish a TCP connection with the controller. The user is unable to get any login page to authentication and get access to the network.

When a wireless client enters a web-authenticated WLAN, the client tries to access a URL. If a manual proxy configuration is configured on the client's browser, all the web traffic going out from the client will be destined to the proxy IP and port configured on the browser.

- A TCP connection is established between the client and the proxy server IP address that the controller proxies for.
- The client processes the DHCP response and obtains a JavaScript file from the controller. The script disables all proxy configurations on the client for that session.

Note For external clients, the controller sends the login page as is (with or without JavaScipt).

- Any requests that bypass the proxy configuration. The controller can then perform web-redirection, login, and authentication.
- When the client goes out of the network, and then back into its own network, a DHCP refresh occurs and the client continues to use the old proxy configuration configured on the browser.
- If the external DHCP server is used with webauth proxy, then DHCP option 252 must be configured on the DHCP server for that scope. The value of option 252 will have the format http://<virtual ip>/proxy.js. No extra configuration is needed for internal DHCP servers.

Note When you configure FIPS mode with secure web authentication, we recommend that you use Mozilla Firefox as your browser.

- If web authentication redirect to HTTPS is enabled, then both the client HTTPS and client HTTP requests are redirected to HTTPS web authentication.

Note This enhancement was introduced in Release 8.0.

This section contains the following subsections:

Configuring the Web Authentication Proxy (GUI)

Procedure

Step 1 Choose **Controller** > **General**

Step 2 From the **WebAuth Proxy Redirection Mode** drop-down list, choose **Enabled** or **Disabled**.

Step 3 In the **WebAuth Proxy Redirection Port** text box, enter the port number of the web auth proxy.

This text box consists of the port numbers on which the controller listens to for web authentication proxy redirection. By default, the three ports 80, 8080, and 3128 are assumed. If you configured the web authentication redirection port to any port other than these values, you must specify that value.

Step 4 Click **Apply**.

Configuring the Web Authentication Proxy (CLI)

Procedure

- Enable web authentication proxy redirection by entering this command:
  config network web-auth proxy-redirect {**enable** | **disable**}
- Configure the secure web (HTTPS) authentication for clients by entering this command:
  config network web-auth secureweb {**enable** | **disable**}

  The default secure web (HTTPS) authentication for clients is enabled.

Note If you configure to disallow secure web (HTTPS) authentication for clients using the **config network web-auth secureweb disable** command, then you must reboot the Cisco WLC to implement the change.

- Set the web authentication port number by entering this command:
  config network web-auth port *port-number*

  This parameter specifies the port numbers on which the controller listens to for web authentication proxy redirection. By default, the three ports 80, 8080, and 3128 are assumed. If you configured the web authentication redirection port to any port other than these values, you must specify that value.
- Configure secure redirection (HTTPS) for web authentication clients by entering this command:
  config network web-auth https-redirect {**enable** | **disable**}
- See the current status of the web authentication proxy configuration by entering one of the following commands:
  - **show network summary**
  - **show running-config**

Captive Bypassing

WISPr is a draft protocol that enables users to roam between different wireless service providers. Some devices (For example, Apple iOS devices) have a mechanism using which they can determine if the device is connected to Internet, based on an HTTP WISPr request made to a designated URL. This mechanism is used for the device to automatically open a web browser when a direct connection to the internet is not possible. This enables the user to provide his credentials to access the internet. The actual authentication is done in the background every time the device connects to a new SSID.

The client device (Apple IOS device) sends a WISPr request to the controller, which checks for the user agent details and then triggers an HTTP request with a web authentication interception in the controller. After

verification of the IOS version and the browser details provided by the user agent, the controller allows the client to bypass the captive portal settings and provides access to the Internet.

Note The captive portal bypass for IOS7 is supported only with Cisco Wireless LAN Controller, Release 7.6.

This HTTP request triggers a web authentication interception in the controller as any other page requests are performed by a wireless client. This interception leads to a web authentication process, which will be completed normally. If the web authentication is being used with any of the controller splash page features (URL provided by a configured RADIUS server), the splash page may never be displayed because the WISPr requests are made at very short intervals, and as soon as one of the queries is able to reach the designated server, any web redirection or splash page display process that is performed in the background is terminated, and the device processes the page request, thus breaking the splash page functionality.

For example, Apple introduced an iOS feature to facilitate network access when captive portals are present. This feature detects the presence of a captive portal by sending a web request on connecting to a wireless network. This request is directed to http://www.apple.com/library/test/success.html for Apple IOS version 6 and older, and to several possible target URLs for Apple IOS version 7 and later. If a response is received, then the Internet access is assumed to be available and no further interaction is required. If no response is received, then the Internet access is assumed to be blocked by the captive portal and Apple's Captive Network Assistant (CNA) auto-launches the pseudo-browser to request portal login in a controlled window. The CNA may break when redirecting to an ISE captive portal. The controller prevents this pseudo-browser from popping up.

You can now configure the controller to bypass WISPr detection process, so the web authentication interception is only done when a user requests a web page leading to splash page load in user context, without the WISPr detection being performed in the background.

This section contains the following subsections:

Configuring Captive Bypassing (CLI)

Use these commands to configure captive bypassing:

- **config network web-auth captive-bypass** {**enable** | **disable**}—Enables or disables the controller to support bypass of captive portals at the network level.
- **show network summary**—Displays the status for the WISPr protocol detection feature.

Configuring Captive Network Assistant Bypass per WLAN (GUI)

Procedure

Step 1 Login to WLC web UI.

Step 2 For the WLAN, choose either of the two following options:

a) Create a new WLAN by choosing **Create New** from the drop-down list and click **Go**.

The **WLANs** > **New** page appears.

b) Click the ID number of the WLAN for which you want to configure Captive Network Assistant Bypass feature.

The **WLANs** > **Edit** page appears.

Step 3 Choose the **Security** and **Layer 3** tabs to open the WLANs > Edit (Security > Layer 3) page.

Step 4 From the Layer 3 Security drop-down list, choose:

- None - Global Captive Network Assistant Bypass setting is applied
- Enable - Captive Network Assistant Bypass is enabled for this particular WLAN
- Disable - Captive Network Assistant Bypass is disabled for this particular WLAN

Step 5 Click **Apply** to commit your changes.

Step 6 Click **Save Configuration** to save your changes.

Configuring Captive Network Assistant Bypass per WLAN (CLI)

Procedure

Enable, disable or activate global Captive Network Assistant Bypass per WLAN by entering this command:

config wlan security web-auth captive-bypass {**none | enable | disable**} *wlan-id*

Fallback Policy with MAC Filtering and Web Authentication

You can configure a fallback policy mechanism that combines Layer 2 and Layer 3 security. In a scenario where you have both MAC filtering and web authentication implemented, when a client tries to connect to a WLAN using the MAC filter (RADIUS server), if the client fails the authentication, you can configure the authentication to fall back to web authentication. When a client passes the MAC filter authentication, the web authentication is skipped and the client is connected to the WLAN. With this feature, you can avoid disassociations based on only a MAC filter authentication failure.

Restrictions

- MAC filtering does not support passthrough web-authentication. It supports only username and password for web-authentication.

Mobility is not supported for SSIDs with security type configured for Webauth on MAC filter failure.

This section contains the following subsections:

Configuring a Fallback Policy with MAC Filtering and Web Authentication (GUI)

Note Before configuring a fallback policy, you must have MAC filtering enabled.

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to configure the fallback policy for web authentication. The WLANs > Edit page appears.

Step 3 Choose the **Security** and **Layer 3** tabs to open the WLANs > Edit (Security > Layer 3) page.

Step 4 From the Layer 3 Security drop-down list, choose **None.**

Step 5 Select the **Web Policy** check box.

Note The controller forwards DNS traffic to and from wireless clients prior to authentication.

The following options are displayed:

- Authentication
- Passthrough
- Conditional Web Redirect
- Splash Page Web Redirect
- On MAC Filter Failure

Step 6 Click **On MAC Filter Failure**.

Step 7 Click **Apply** to commit your changes.

Step 8 Click **Save Configuration** to save your settings.

Configuring a Fallback Policy with MAC Filtering and Web Authentication (CLI)

Note Before configuring a fallback policy, you must have MAC filtering enabled.

Procedure

Step 1 Enable or disable web authentication on a particular WLAN by entering this command:

config wlan security web-auth on-macfilter-failure *wlan-id*

Step 2 See the web authentication status by entering this command:

show wlan *wlan_id*

```
FT Over-The-Ds mode.............................. Enabled
CKIP ..................................... Disabled
   IP Security.................................... Disabled
   IP Security Passthru........................... Disabled
   Web Based Authentication....................... Enabled-On-MACFilter-Failure
        ACL.......................................... Unconfigured
        Web Authentication server precedence:
```

```
1..................................... local
2..................................... radius
3..................................... ldap
```

Central Web Authentication

In the case of Central Web Authentication (CWA), web authentication occurs on the Cisco ISE server. The web portal in the Cisco ISE server provides a login page to a client. After the credentials are verified on the Cisco ISE server, the client is provisioned. The client remains in the POSTURE_REQD state until a change of authorization (CoA) is reached. The credentials and ACLs are received from the Cisco ISE server.

Note In a CWA and MAC filtering configuration scenario, if a change in VLAN occurs during pre-authentication and post-authentication, dissociation request is sent to clients and the clients are forced to go through DHCP again.

For new clients, the RADIUS access accept message carries redirected URL for port 80 and pre-auth ACLs or quarantine VLAN. Definition of ACL is defined in the controller (IP addresses and ports).

Clients will be redirected to the URL provided in the access accept message and put into a new state until posture validation is done. Clients in this state validate themselves against ISE server and the policies configured on the ISE NAC server.

The NAC agent on the clients initiates posture validation (traffic to port 80): The agent sends HTTP discovery request to port 80, which the controller redirects to the URL provided in the access accept message. Cisco ISE knows that the client is trying to reach and responds directly to the client. This way, the client learns about the Cisco ISE IP address and from now on, the client talks directly with the Cisco ISE.

The controller allows this traffic because the ACL is configured to allow this traffic. In case of VLAN override, the traffic is bridged so that it reaches the Cisco ISE.

ISE NAC

After the client completes the assessment, a RADIUS CoA-Req with reauth service is sent to the controller. This initiates reauthentication of the client (by sending EAP-START). Once reauthentication succeeds, the Cisco ISE sends an access accept message with a new ACL (if any) and no URL redirect, or access VLAN.

The controller has support for CoA-Req and Disconnect-Req as per RFC 3576. The controller needs to support CoA-Req for re-auth service, as per RFC 5176.

Instead of downloadable ACLs, pre-configured ACLs are used on the controller. Cisco ISE sends the ACL name, which is already configured in the controller.

This design should work for both VLAN and ACL cases. In case of VLAN override, the port 80 is redirected and allows (bridge) rest of the traffic on the quarantine VLAN. For the ACL, the pre-auth ACL received in the access accept message is applied.

Here's the workflow:

1. The guest user associates with the controller.
2. The controller sends a MAB Request to ISE.

3. ISE matches the first authorization rules, and sends the redirect parameters (ACL and URL).
4. The controller redirects the GUEST to ISE.
5. After the guest is authenticated, ISE makes a second authorization, which is called RADIUS Change of Authorization (CoA). In this second authorization, a profile must be returned so that the guest is permitted access to the network. We can use usecase: guestflow to easily match this second authorization.

AAA Servers

This section contains the following subsections:

LDAP

An LDAP backend database allows the controller to query an LDAP server for the credentials (username and password) of a particular user. These credentials are then used to authenticate the user. For example, local EAP may use an LDAP server as its backend database to retrieve user credentials.

Note From Release 8.0, IPv6 can also be used to configure the LDAP server on the controller.

Fallback LDAP Servers

The LDAP servers are configured on a WLAN for authentication. You require at least two LDAP servers to configure them for fallback behavior. A maximum of three LDAP servers can be configured for the fallback behavior per WLAN. The servers are listed in the priority order for authentication. If the first LDAP server becomes irresponsive, then the controller switches to the next LDAP server. If the second LDAP server becomes irresponsive, then the controller switches again to the third LDAP server.

The LDAP backend database supports these local EAP methods: EAP-TLS, EAP-FAST/GTC, and PEAPv1/GTC. LEAP, EAP-FAST/MSCHAPv2, EAP-FAST/EAP-GTC and PEAPv0/MSCHAPv2 are also supported, but only if the LDAP server is set up to return a clear-text password.

Controllers support Local EAP authentication against external LDAP databases such as Microsoft Active Directory and Novell's eDirectory. For more information about configuring the controller for Local EAP authentication against Novell's eDirectory, see the Configure Unified Wireless Network for Authentication Against Novell's eDirectory Database whitepaper at http://www.cisco.com/c/en/us/support/docs/wireless/4400-series-wireless-lan-controllers/112137-novell-edirectory-00.html

This section contains the following subsections:

Configuring LDAP (GUI)

Procedure

Step 1 Choose **Security** > **AAA** > **LDAP** to open the LDAP Servers page.

- If you want to delete an existing LDAP server, hover your cursor over the blue drop-down arrow for that server and choose **Remove**.

- If you want to make sure that the controller can reach a particular server, hover your cursor over the blue drop-down arrow for that server and choose **Ping**.

Step 2 Perform one of the following:

- To edit an existing LDAP server, click the index number for that server. The **LDAP Servers > Edit** page appears.
- To add an LDAP server, click **New**. The **LDAP Servers > New** page appears. If you are adding a new server, choose a number from the Server Index (Priority) drop-down list to specify the priority order of this server in relation to any other configured LDAP servers. You can configure up to 17 servers. If the controller cannot reach the first server, it tries the second one in the list and so on.

Step 3 If you are adding a new server, enter the IP address of the LDAP server in the **Server IP Address** text box.

Note From Release 8.0, IPv6 can also be used to configure the LDAP server on the controller.

Step 4 If you are adding a new server, enter the LDAP server's TCP port number in the **Port Number** text box. The valid range is 1 to 65535, and the default value is 389.

Note Only LDAP port 389 is supported on Cisco WLC. No other ports are supported for LDAP.

Step 5 From the **Server Mode (via TLS)** drop-down list, choose **Disabled** to establish LDAP connection (without secure tunnel) between LDAP server and the Cisco WLC using TCP or **Enabled** to establish a secure LDAP connection using TLS.

Step 6 Select the **Enable Server Status** check box to enable this LDAP server or unselect it to disable it. The default value is disabled.

Step 7 From the Simple Bind drop-down list, choose **Anonymous** or **Authenticated** to specify the local authentication bind method for the LDAP server. The Anonymous method allows anonymous access to the LDAP server. The Authenticated method requires that a username and password be entered to secure access. The default value is Anonymous.

Step 8 If you chose **Authenticated** in the previous step, follow these steps:

a) In the Bind Username text box, enter a username to be used for local authentication to the LDAP server. The username can contain up to 80 characters.

Note If the username starts with "cn=" (in lowercase letters), the controller assumes that the username includes the entire LDAP database path and does not append the user base DN. This designation allows the authenticated bind user to be outside the user base DN.

b) In the Bind Username text box, enter a username to be used for local authentication to the LDAP server. The username can contain up to 80 characters.

Step 9 In the User Base DN text box, enter the distinguished name (DN) of the subtree in the LDAP server that contains a list of all the users. For example, ou=organizational unit, .ou=next organizational unit, and o=corporation.com. If the tree containing users is the base DN, type.

o=*corporation*.com

or

dc=*corporation***,dc=com**

Step 10 In the User Attribute text box, enter the name of the attribute in the user record that contains the username. You can obtain this attribute from your directory server.

Step 11 In the User Object Type text box, enter the value of the LDAP objectType attribute that identifies the record as a user. Often, user records have several values for the objectType attribute, some of which are unique to the user and some of which are shared with other object types.

Step 12 In the Server Timeout text box, enter the number of seconds between retransmissions. The valid range is 2 to 30 seconds, and the default value is 2 seconds.

Step 13 Click **Apply** to commit your changes.

Step 14 Click **Save Configuration** to save your changes.

Step 15 Specify LDAP as the priority backend database server for local EAP authentication as follows:

a) Choose **Security** > **Local EAP** > **Authentication Priority** to open the Priority Order > Local-Auth page.
b) Highlight **LOCAL** and click **<** to move it to the left User Credentials box.
c) Highlight **LDAP** and click **>** to move it to the right User Credentials box. The database that appears at the top of the right User Credentials box is used when retrieving user credentials.

Note If both LDAP and LOCAL appear in the right User Credentials box with LDAP on the top and LOCAL on the bottom, local EAP attempts to authenticate clients using the LDAP backend database and fails over to the local user database if the LDAP servers are not reachable. If the user is not found, the authentication attempt is rejected. If LOCAL is on the top, local EAP attempts to authenticate using only the local user database. It does not fail over to the LDAP backend database.

d) Click **Apply** to commit your changes.
e) Click **Save Configuration** to save your changes.

Step 16 (Optional) Assign specific LDAP servers to a WLAN as follows:

a) Choose **WLANs** to open the WLANs page.
b) Click the ID number of the desired WLAN.
c) When the WLANs > Edit page appears, choose the **Security** > **AAA Servers** tabs to open the WLANs > Edit (Security > AAA Servers) page.
d) From the LDAP Servers drop-down lists, choose the LDAP server(s) that you want to use with this WLAN. You can choose up to three LDAP servers, which are tried in priority order.

Note These LDAP servers apply only to WLANs with web authentication enabled. They are not used by local EAP.

e) Click **Apply** to commit your changes.
f) Click **Save Configuration** to save your changes.

Step 17 Specify the LDAP server fallback behavior, as follows:

a) Choose **WLAN** > **AAA Server** to open the Fallback Parameters page.
b) From the LDAP Servers drop-down list, choose the LDAP server in the order of priority when the controller attempts to authenticate management users. The order of authentication is from server.
c) Choose **Security** > **AAA** > **LDAP** to view the list of global LDAP servers configured for the controller.

Configuring LDAP (CLI)

Procedure

- Configure an LDAP server by entering these commands:

- **config ldap add** *index server_ip_address port# user_base user_attr user_type* **secure**— Adds an LDAP server for secure LDAP.
- **config ldap delete** *index*—Deletes a previously added LDAP server.
- **config ldap** {**enable** | **disable**} *index*—Enables or disables an LDAP server.
- **config ldap security-mode enable** *index*—Enables the LDAP server using index with existing commands.
- **config ldap simple-bind** {**anonymous** *index* | **authenticated** *index* **username** *username* **password** *password*}—Specifies the local authentication bind method for the LDAP server. The anonymous method allows anonymous access to the LDAP server whereas the authenticated method requires that a username and password be entered to secure access. The default value is anonymous. The username can contain up to 80 characters.

  If the username starts with "cn=" (in lowercase letters), the controller assumes that the username includes the entire LDAP database path and does not append the user base DN. This designation allows the authenticated bind user to be outside the user base DN.
- **config ldap retransmit-timeout** *index timeout*—Configures the number of seconds between retransmissions for an LDAP server.

• Specify LDAP as the priority backend database server by entering this command:

config local-auth user-credentials ldap

If you enter the **config local-auth user-credentials ldap local command**, local EAP attempts to authenticate clients using the LDAP backend database and fails over to the local user database if the LDAP servers are not reachable. If the user is not found, the authentication attempt is rejected. If you enter the **config local-auth user-credentials local ldap command**, local EAP attempts to authenticate using only the local user database. It does not fail over to the LDAP backend database.

• (Optional) Assign specific LDAP servers to a WLAN by entering these commands:

- **config wlan ldap add** *wlan_id server_index*—Links a configured LDAP server to a WLAN.

  The LDAP servers specified in this command apply only to WLANs with web authentication enabled. They are not used by local EAP.
- **config wlan ldap delete** *wlan_id* {*all* | *index*}—Deletes a specific or all configured LDAP server(s) from a WLAN.

• View information pertaining to configured LDAP servers by entering these commands:

- **show ldap summary**—Shows a summary of the configured LDAP servers.

```
Idx  Server Address   Port  Enabled
---  --------------  ----  -------
1    2.3.1.4          389     No
2    10.10.20.22      389     Yes


Idx      Server Address      Port     Enabled  Secure
---      --------------      -----    ------  -------
1         2.3.1.4            389       No       No
2         2.3.1.5            389       Yes      No
```

- **show ldap** *index*—Shows detailed LDAP server information. Information like the following appears:

```
Server Index..................................... 2
Address.......................................... 10.10.20.22
Port............................................. 389
Enabled.......................................... Yes
User DN.......................................... ou=active,ou=employees,ou=people,

            o=cisco.com
User Attribute................................... uid
User Type........................................ Person
Retransmit Timeout............................... 2 seconds
Bind Method ..................................... Authenticated
Bind Username.................................... user1

Controller# show ldap 1
Server Index..................................... 1
Address.......................................... 9.1.0.100
Port............................................. 389
Server State..................................... Disabled
User DN.......................................... user1
User Attribute................................... user
User Type........................................ user
Retransmit Timeout............................... 2 seconds
Secure (via TLS)................................. Disabled
Bind Method ..................................... Anonymous
```

- **show ldap statistics**—Shows LDAP server statistics.

```
Server Index..................................... 1
Server statistics:
  Initialized OK................................. 0
  Initialization failed.......................... 0
  Initialization retries......................... 0
  Closed OK...................................... 0
Request statistics:
  Received....................................... 0
  Sent........................................... 0
  OK............................................. 0
  Success........................................ 0
  Authentication failed.......................... 0
  Server not found............................... 0
  No received attributes......................... 0
  No passed username............................. 0
  Not connected to server........................ 0
  Internal error................................. 0
  Retries........................................ 0

Server Index..................................... 2
..
```

- **show wlan** *wlan_id*—Shows the LDAP servers that are applied to a WLAN.

- Make sure the controller can reach the LDAP server by entering this command:
  ping *server_ip_address*
- Save your changes by entering this command:
  save config
- Enable or disable debugging for LDAP by entering this command:
  debug aaa ldap {**enable** | **disable**}

Local EAP

Local EAP is an authentication method that allows users and wireless clients to be authenticated locally. It is designed for use in remote offices that want to maintain connectivity to wireless clients when the backend system becomes disrupted or the external authentication server goes down. When you enable local EAP, the controller serves as the authentication server and the local user database, which removes dependence on an external authentication server. Local EAP retrieves user credentials from the local user database or the LDAP backend database to authenticate users. Local EAP supports LEAP, EAP-FAST, EAP-TLS, P EAPv0/MSCHAPv2, and PEAPv1/GTC authentication between the controller and wireless clients.

Note The LDAP backend database supports these local EAP methods: EAP-TLS, EAP-FAST/GTC, and PEAPv1/GTC. LEAP, EAP-FAST/MSCHAPv2, and PEAPv0/MSCHAPv2 are also supported but only if the LDAP server is set up to return a clear-text password.

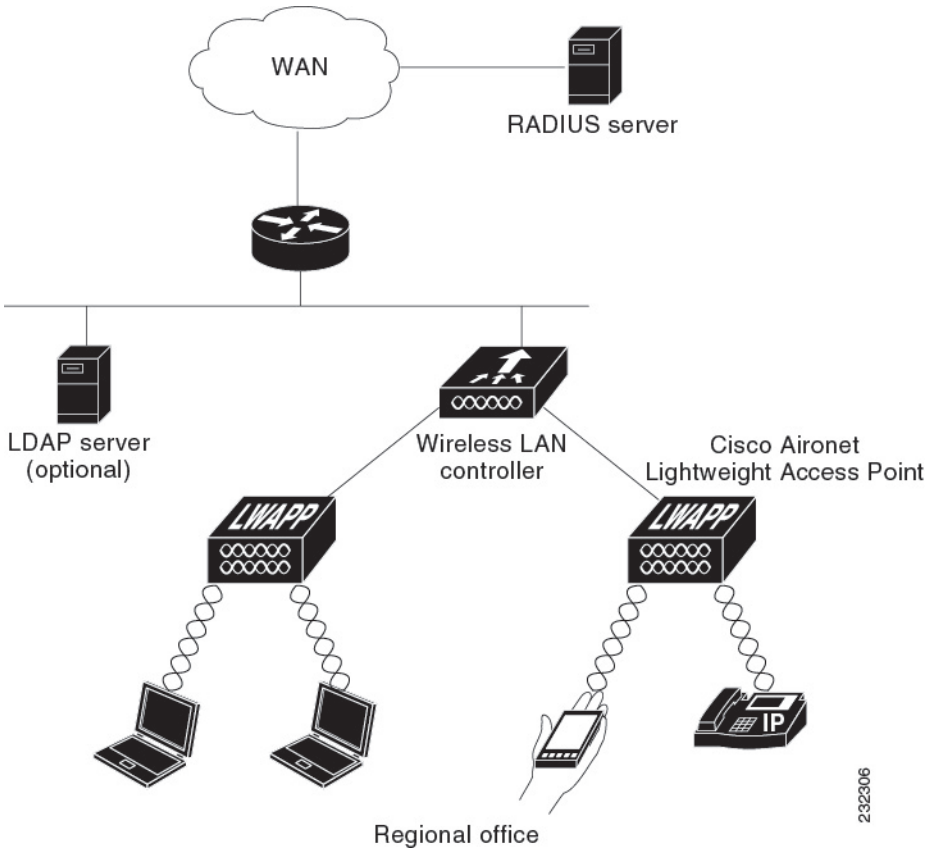
Note Cisco wireless LAN controllers support Local EAP authentication against external LDAP databases such as Microsoft Active Directory and Novell's eDirectory. For more information about configuring the controller for Local EAP authentication against Novell's eDirectory, see the Configure Unified Wireless Network for Authentication Against Novell's eDirectory Database whitepaper at http://www.cisco.com/c/en/us/support/docs/wireless/4400-series-wireless-lan-controllers/112137-novell-edirectory-00.html

Note Local authentication with certificates of second level hierarchy (CA + intermediate CA + device) is not supported.

If any RADIUS servers are configured on the controller, the controller tries to authenticate the wireless clients using the RADIUS servers first. Local EAP is attempted only if no RADIUS servers are found, either because the RADIUS servers timed out or no RADIUS servers were configured. If four RADIUS servers are configured, the controller attempts to authenticate the client with the first RADIUS server, then the second RADIUS server, and then local EAP. If the client attempts to then reauthenticate manually, the controller tries the third RADIUS server, then the fourth RADIUS server, and then local EAP. If you never want the controller to try to authenticate clients using an external RADIUS server, enter these CLI commands in this order:

- **config wlan disable** *wlan_id*
- **config wlan radius_server auth disable** *wlan_id*
- **config wlan enable** *wlan_id*

Figure 5: Local EAP Example



This section contains the following subsections:

Related Topics

Downloading Device Certificates

Restrictions for Local EAP

- In Release 8.6 and later releases, legacy clients that require RC4 or 3DES encryption types are not supported in Local EAP authentication.
- Timer restrictions for local and central authentication using EAP: The EAP timeout cannot be configured on Wave 2 APs. Even though you can configure the EAP timeout on the controller, for Wave 2 APs, the EAP timeout is hardcoded to 30 seconds. This is due to the following reasons:
  - Clients get stuck in 8021X state indefinitely if AP moves from connected to standalone mode while EAP is in process.
  - Controller does not send EAP frames due to some issue, resulting in clients getting stuck indefinitely at AP.

  This has impact on clients, such as Windows clients, that wait for EAP identity request to pop up and are prompted for username and password. This issue is not seen on clients such as Apple, Samsung, Zebra, or WPA supplicants because they take the username and password beforehand.

Configuring Local EAP (GUI)

Before you begin

Note EAP-TLS, P EAPv0/MSCHAPv2, and PEAPv1/GTC use certificates for authentication, and EAP-FAST uses either certificates or PACs. The controller is shipped with Cisco-installed device and Certificate Authority (CA) certificates. However, if you want to use your own vendor-specific certificates, they must be imported on the controller.

Procedure

Step 1 If you are configuring local EAP to use one of the EAP types listed in the note above, make sure that the appropriate certificates and PACs (if you will use manual PAC provisioning) have been imported on the controller.

Step 2 If you want the controller to retrieve user credentials from the local user database, make sure that you have properly configured the local network users on the controller.

Step 3 If you want the controller to retrieve user credentials from an LDAP backend database, make sure that you have properly configured an LDAP server on the controller.

Step 4 Specify the order in which user credentials are retrieved from the backend database servers as follows:

a) Choose **Security** > **Local EAP** > **Authentication Priority** to open the **Priority Order > Local-Auth** page.

b) Determine the priority order in which user credentials are to be retrieved from the local and/or LDAP databases. For example, you may want the LDAP database to be given priority over the local user database, or you may not want the LDAP database to be considered at all.

c) When you have decided on a priority order, highlight the desired database. Then use the left and right arrows and the Up and Down buttons to move the desired database to the top of the right User Credentials box.

Note If both LDAP and LOCAL appear in the right User Credentials box with LDAP on the top and LOCAL on the bottom, local EAP attempts to authenticate clients using the LDAP backend database and fails over to the local user database if the LDAP servers are not reachable. If the user is not found, the authentication attempt is rejected. If LOCAL is on the top, local EAP attempts to authenticate using only the local user database. It does not fail over to the LDAP backend database.

d) Click **Apply** to commit your changes.

Step 5 Specify values for the local EAP timers as follows:

a) Choose **Security** > **Local EAP** > **General** to open the General page.

b) In the **Local Auth Active Timeout** text box, enter the amount of time (in seconds) in which the controller attempts to authenticate wireless clients using local EAP after any pair of configured RADIUS servers fails. The valid range is 1 to 3600 seconds, and the default setting is 300 seconds.

Step 6 Specify values for the Advanced EAP parameters as follows:

a) Choose **Security**> **Advanced EAP**.

b) In the **Identity Request Timeout** text box, enter the amount of time (in seconds) in which the controller attempts to send an EAP identity request to wireless clients using local EAP. The valid range is 1 to 120 seconds, and the default setting is 30 seconds.

c) In the **Identity Request Max Retries** text box, enter the maximum number of times that the controller attempts to retransmit the EAP identity request to wireless clients using local EAP. The valid range is 1 to 20 retries, and the default setting is 2 retries.

d) In the **Dynamic WEP Key Index** text box, enter the key index used for dynamic wired equivalent privacy (WEP). The default value is 0, which corresponds to a key index of 1; the valid values are 0 to 3 (key index of 1 to 4).

e) In the **Request Timeout** text box, enter the amount of time (in seconds) in which the controller attempts to send an EAP request to wireless clients using local EAP. The valid range is 1 to 120 seconds, and the default setting is 30 seconds.

f) In the **Request Max Retries** text box, enter the maximum number of times that the controller attempts to retransmit the EAP request to wireless clients using local EAP. The valid range is 1 to 120 retries, and the default setting is 2 retries.

g) From the **Max-Login Ignore Identity Response** drop-down list, choose **Enable** to limit the number of devices that can be connected to the controller with the same username. You can log in up to eight times from different devices (PDA, laptop, IP phone, and so on) on the same controller. The default value is enabled.

h) In the **EAPOL-Key Timeout** text box, enter the amount of time (in seconds) in which the controller attempts to send an EAP key over the LAN to wireless clients using local EAP. The valid range is 1 to 5 seconds, and the default setting is 1 second.

Note If the controller and access point are separated by a WAN link, the default timeout of 1 second may not be sufficient.

i) In the **EAPOL-Key Max** Retries text box, enter the maximum number of times that the controller attempts to send an EAP key over the LAN to wireless clients using local EAP. The valid range is 0 to 4 retries, and the default setting is 2 retries.

j) In the **EAP-Broadcast Key Interval** text box, enter the interval between the Group Temporal Key (GTK) key rotation for all the stations on a BSSID that is using WPA protocol. The default interval is 3600 seconds.

k) Click **Apply** to commit your changes.

Step 7 Create a local EAP profile, which specifies the EAP authentication types that are supported on the wireless clients as follows:

a) Choose **Security** > **Local EAP** > **Profiles** to open the Local EAP Profiles page.

This page lists any local EAP profiles that have already been configured and specifies their EAP types. You can create up to 16 local EAP profiles.

Note If you want to delete an existing profile, hover your cursor over the blue drop-down arrow for that profile and choose **Remove**.

b) Click **New** to open the **Local EAP Profiles > New** page.

c) In the Profile Name text box, enter a name for your new profile and then click **Apply**.

Note You can enter up to 63 alphanumeric characters for the profile name. Make sure not to include spaces.

d) When the Local EAP Profiles page reappears, click the name of your new profile. The **Local EAP Profiles > Edit** page appears.

e) Select the **LEAP**, **EAP-FAST**, **EAP-TLS,** and/or **PEAP** check boxes to specify the EAP type that can be used for local authentication.

Note You can specify more than one EAP type per profile. However, if you choose multiple EAP types that use certificates (such as EAP-FAST with certificates, EAP-TLS, PEAPv0/MSCHAPv2, and PEAPv1/GTC), all the EAP types must use the same certificate (from either Cisco or another vendor).

Note If you select the **PEAP** check box, both PEAPv0/MSCHAPv2 or PEAPv1/GTC are enabled on the controller.

f) If you chose EAP-FAST and want the device certificate on the controller to be used for authentication, select the **Local Certificate Required** check box. If you want to use EAP-FAST with PACs instead of certificates, leave this check box unselected, which is the default setting.

Note This option applies only to EAP-FAST because device certificates are not used with LEAP and are mandatory for EAP-TLS and PEAP.

g) If you chose EAP-FAST and want the wireless clients to send their device certificates to the controller in order to authenticate, select the **Client Certificate Required** check box. If you want to use EAP-FAST with PACs instead of certificates, leave this check box unselected, which is the default setting.

Note This option applies only to EAP-FAST because client certificates are not used with LEAP or PEAP and are mandatory for EAP-TLS.

h) If you chose EAP-FAST with certificates, EAP-TLS, or PEAP, choose which certificates will be sent to the client, the ones from **Cisco** or the ones from another **Vendor**, from the Certificate Issuer drop-down list. The default setting is Cisco.

i) If you chose EAP-FAST with certificates or EAP-TLS and want the incoming certificate from the client to be validated against the CA certificates on the controller, select the **Check against CA certificates** check box. The default setting is enabled.

j) If you chose EAP-FAST with certificates or EAP-TLS and want the common name (CN) in the incoming certificate to be validated against the Local Net Users configured on the controller, select the **Verify Certificate CN Identity** check box. The default setting is disabled.

k) If you chose EAP-FAST with certificates or EAP-TLS and want the controller to verify that the incoming device certificate is still valid and has not expired, select the **Check Certificate Date Validity** check box. The default setting is enabled.

Note Certificate date validity is checked against the current UTC (GMT) time that is configured on the controller. Timezone offset will be ignored.

l) Click **Apply** to commit your changes.

Step 8 If you created an EAP-FAST profile, follow these steps to configure the EAP-FAST parameters:

a) Choose **Security** > **Local EAP** > **EAP-FAST Parameters** to open the EAP-FAST Method Parameters page.

b) In the Server Key and Confirm Server Key text boxes, enter the key (in hexadecimal characters) used to encrypt and decrypt PACs.

c) In the Time to Live for the PAC text box, enter the number of days for the PAC to remain viable. The valid range is 1 to 1000 days, and the default setting is 10 days.

d) In the Authority ID text box, enter the authority identifier of the local EAP-FAST server in hexadecimal characters. You can enter up to 32 hexadecimal characters, but you must enter an even number of characters.

e) In the Authority ID Information text box, enter the authority identifier of the local EAP-FAST server in text format.

f) If you want to enable anonymous provisioning, select the **Anonymous Provision** check box. This feature allows PACs to be sent automatically to clients that do not have one during PAC provisioning. If you disable this feature, PACS must be manually provisioned. The default setting is enabled.

Note If the local and/or client certificates are required and you want to force all EAP-FAST clients to use certificates, unselect the **Anonymous Provision** check box.

g) Click **Apply** to commit your changes.

Step 9 Enable local EAP on a WLAN as follows:

a) Choose **WLANs** to open the WLANs page.
b) Click the ID number of the desired WLAN.
c) When the **WLANs > Edit** page appears, choose the **Security** > **AAA Servers** tabs to open the **WLANs > Edit (Security > AAA Servers)** page.
d) Unselect the **Enabled** check boxes for Radius Authentication Servers and Accounting Server to disable RADIUS accounting and authentication for this WLAN.
e) Select the **Local EAP Authentication** check box to enable local EAP for this WLAN.
f) From the EAP Profile Name drop-down list, choose the EAP profile that you want to use for this WLAN.
g) If desired, choose the LDAP server that you want to use with local EAP on this WLAN from the **LDAP Servers** drop-down lists.
h) Click **Apply** to commit your changes.

Step 10 Enable EAP parameters on a WLAN as follows:

a) Choose **WLANs** to open the WLANs page.
b) Click the ID number of the desired WLAN.
c) When the **WLANs > Edit** page appears, choose the **Security** > **AAA Servers** tabs to open the **WLANs > Edit (Security > AAA Servers)** page.
d) Select the **Enable** check box to configure EAP parameters for this WLAN.
e) In the **EAPOL Key Timeout (200 to 5000 millisec)** text box, enter the amount of time (in milliseconds) in which the controller attempts to send an EAP key over the WLAN to wireless clients using local EAP. The valid range is 200 to 5000 milliseconds and the default value is 1000 milliseconds.
f) In the **EAPOL Key Retries (0 to 4)** text box, enter the maximum number of times that the controller attempts to send an EAP key over the WLAN to wireless clients using local EAP. The valid range is 0 to 4 retries and the default setting is 2 retries.
g) In the **Identity Request Timeout (1 to 120 sec)** text box, enter the amount of time (in seconds) in which the controller attempts to send an EAP identity request to wireless clients within WLAN using local EAP. The valid range is 1 to 120 seconds and the default value is 30 seconds.
h) In the **Identity Request Retries (1 to 20 sec)** text box, enter the maximum number of times that the controller attempts to retransmit the EAP identity request to wireless clients within WLAN using local EAP. The valid range is 1 to 20 retries, and the default setting is 2 retries.
i) In the **Request Timeout (1 to 120 sec)** text box, enter the amount of time (in seconds) in which the controller attempts to send an EAP parameter request to wireless clients within WLAN using local EAP. The valid range is 1 to 120 seconds, and the default setting is 30 seconds.
j) In the **Request Retries (1 to 20 sec)** text box, enter the maximum number of times that the controller attempts to retransmit the EAP parameter request to wireless clients within WLAN using local EAP. The valid range is 1 to 20 retries, and the default setting is 2 retries.
k) Click **Apply** to commit your changes.

Step 11 Click **Save Configuration** to save your changes.

Configuring Local EAP (CLI)

Before you begin

Note EAP-TLS, P EAPv0/MSCHAPv2, and PEAPv1/GTC use certificates for authentication, and EAP-FAST uses either certificates or PACbs. The controller is shipped with Cisco-installed device and Certificate Authority (CA) certificates. However, if you want to use your own vendor-specific certificates, they must be imported on the controller.

Procedure

Step 1 If you are configuring local EAP to use one of the EAP types listed in the note above, make sure that the appropriate certificates and PACs (if you will use manual PAC provisioning) have been imported on the controller.

Step 2 If you want the controller to retrieve user credentials from the local user database, make sure that you have properly configured the local network users on the controller.

Step 3 If you want the controller to retrieve user credentials from an LDAP backend database, make sure that you have properly configured an LDAP server on the controller.

Step 4 Specify the order in which user credentials are retrieved from the local and/or LDAP databases by entering this command:

config local-auth user-credentials {*local* | *ldap*}

Note If you enter the **config local-auth user-credentials ldap local** command, local EAP attempts to authenticate clients using the LDAP backend database and fails over to the local user database if the LDAP servers are not reachable. If the user is not found, the authentication attempt is rejected. If you enter the **config local-auth user-credentials local ldap command**, local EAP attempts to authenticate using only the local user database. It does not fail over to the LDAP backend database.

Step 5 Specify values for the local EAP timers by entering these commands:

- **config local-auth active-timeout** *timeout*—Specifies the amount of time (in seconds) in which the controller attempts to authenticate wireless clients using local EAP after any pair of configured RADIUS servers fails. The valid range is 1 to 3600 seconds, and the default setting is 100 seconds.
- **config advanced eap identity-request-timeout** *timeout*—Specifies the amount of time (in seconds) in which the controller attempts to send an EAP identity request to wireless clients using local EAP. The valid range is 1 to 120 seconds, and the default setting is 30 seconds.
- **config advanced eap identity-request-retries** *retries*—Specifies the maximum number of times that the controller attempts to retransmit the EAP identity request to wireless clients using local EAP. The valid range is 1 to 20 retries, and the default setting is 20 retries.
- **config advanced eap key-index** *index*—Specifies the key index used for dynamic wired equivalent privacy (WEP). The default value is 0, which corresponds to a key index of 1; the valid values are 0 to 3 (key index of 1 to 4).
- **config advanced eap request-timeout** *timeout*—Specifies the amount of time (in seconds) in which the controller attempts to send an EAP request to wireless clients using local EAP. The valid range is 1 to 120 seconds, and the default setting is 30 seconds.

- **config advanced eap request-retries** *retries*—Specifies the maximum number of times that the controller attempts to retransmit the EAP request to wireless clients using local EAP. The valid range is 1 to 120 retries, and the default setting is 20 retries.
- **config advanced eap eapol-key-timeout** *timeout*—Specifies the amount of time (in seconds) in which the controller attempts to send an EAP key over the LAN to wireless clients using local EAP. The valid range is 1 to 5 seconds, and the default setting is 1 second.

  Note If the controller and access point are separated by a WAN link, the default timeout of 1 second may not be sufficient.

- **config advanced eap eapol-key-retries** *retries*—Specifies the maximum number of times that the controller attempts to send an EAP key over the LAN to wireless clients using local EAP. The valid range is 0 to 4 retries, and the default setting is 2 retries.
- **config advanced eap max-login-ignore-identity-response** {**enable** | **disable**}—When enabled, this command ignores the limit set for the number of devices that can be connected to the controller with the same username through 802.1x authentication. When disabled, this command limits the number of devices that can be connected to the controller with the same username. This is not applicable for web authentication users. You can log in up to eight times from different devices (PDA, laptop, IP phone, and so on) on the same controller. The default value is enabled. Use the command **config netuser maxUserLogin** to set the limit of maximum number of devices per same username.

Step 6 Specify values for the local EAP timers on a WLAN by entering these commands:

- **config wlan security eap-params {enable | disable}** *wlan_id*—Specifies to enable or disable SSID specific EAP timeouts or retries. The default value is disabled.
- **config wlan security eap-params eapol-key-timeout** *timeout wlan_id*—Specifies the amount of time (in milliseconds) in which the controller attempts to send an EAP key over the WLAN to wireless clients using local EAP. The valid range is 200 to 5000 milliseconds, and the default setting is 1000 milliseconds.
- **config wlan security eap-params eapol-key-retries** *retries wlan_id*—Specifies the maximum number of times that the controller attempts to send an EAP key over the WLAN to wireless clients using local EAP. The valid range is 0 to 4 retries, and the default setting is 2 retries.
- **config wlan security eap-params identity-request-timeout** *timeout wlan_id*—Specifies the amount of time (in seconds) in which the controller attempts to send an EAP identity request to wireless clients within WLAN using local EAP. The valid range is 1 to 120 seconds, and the default setting is 30 seconds.
- **config wlan security eap-params identity-request-retries** *retries wlan_id*—Specifies the maximum number of times that the controller attempts to retransmit the EAP identity request to wireless clients within WLAN using local EAP. The valid range is 1 to 20 retries, and the default setting is 2 retries.
- **config wlan security eap-params request-timeout** *timeout wlan_id*—Specifies the amount of time (in seconds) in which the controller attempts to send an EAP parameter request to wireless clients within WLAN using local EAP. The valid range is 1 to 120 seconds, and the default setting is 30 seconds.
- **config wlan security eap-params request-retries** *retries wlan_id*—Specifies the maximum number of times that the controller attempts to retransmit the EAP parameter request to wireless clients within WLAN using local EAP. The valid range is 1 to 20 retries, and the default setting is 2 retries.

Step 7 Create a local EAP profile by entering this command:

config local-auth eap-profile add *profile_name*

Note Do not include spaces within the profile name.

Note To delete a local EAP profile, enter the **config local-auth eap-profile delete** *profile_name* command.

Step 8 Add an EAP method to a local EAP profile by entering this command:

config local-auth eap-profile method add *method profile_name*

The supported methods are leap, fast, tls, and peap.

Note If you choose peap, both P EAPv0/MSCHAPv2 or PEAPv1/GTC are enabled on the controller.

Note You can specify more than one EAP type per profile. However, if you create a profile with multiple EAP types that use certificates (such as EAP-FAST with certificates, EAP-TLS, PEAPv0/MSCHAPv2, and PEAPv1/GTC), all of the EAP types must use the same certificate (from either Cisco or another vendor).

Note To delete an EAP method from a local EAP profile, enter the **config local-auth eap-profile method delete** *method profile_name* command.

Step 9 Configure EAP-FAST parameters if you created an EAP-FAST profile by entering this command:

config local-auth method fast *?*

where *?* is one of the following:

- **anon-prov** {**enable** | **disable**}—Configures the controller to allow anonymous provisioning, which allows PACs to be sent automatically to clients that do not have one during PAC provisioning.
- **authority-id** *auth_id*—Specifies the authority identifier of the local EAP-FAST server.
- **pac-ttl** *days*—Specifies the number of days for the PAC to remain viable.
- **server-key** *key*—Specifies the server key used to encrypt and decrypt PACs.

Step 10 Configure certificate parameters per profile by entering these commands:

- **config local-auth eap-profile method fast local-cert** {**enable** | **disable**} *profile_name*— Specifies whether the device certificate on the controller is required for authentication.

  Note This command applies only to EAP-FAST because device certificates are not used with LEAP and are mandatory for EAP-TLS and PEAP.

- **config local-auth eap-profile method fast client-cert** {**enable** | **disable**} *profile_name*— Specifies whether wireless clients are required to send their device certificates to the controller in order to authenticate.

  Note This command applies only to EAP-FAST because client certificates are not used with LEAP or PEAP and are mandatory for EAP-TLS.

- **config local-auth eap-profile cert-issuer** {**cisco** | **vendor**} *profile_name*—If you specified EAP-FAST with certificates, EAP-TLS, or PEAP, specifies whether the certificates that will be sent to the client are from Cisco or another vendor.
- **config local-auth eap-profile cert-verify ca-issuer** {**enable** | **disable**} *profile_name*—If you chose EAP-FAST with certificates or EAP-TLS, specifies whether the incoming certificate from the client is to be validated against the CA certificates on the controller.
- **config local-auth eap-profile cert-verify cn-verify** {**enable** | **disable**} *profile_name*—If you chose EAP-FAST with certificates or EAP-TLS, specifies whether the common name (CN) in the incoming certificate is to be validated against the CA certificates' CN on the controller.
- **config local-auth eap-profile cert-verify date-valid** {**enable** | **disable**} *profile_name*—If you chose EAP-FAST with certificates or EAP-TLS, specifies whether the controller is to verify that the incoming device certificate is still valid and has not expired.

Step 11 Enable local EAP and attach an EAP profile to a WLAN by entering this command:

config wlan local-auth enable *profile_name wlan_id*

Note To disable local EAP for a WLAN, enter the **config wlan local-auth disable** *wlan_id command.*

Step 12 Save your changes by entering this command:

save config

Step 13 View information pertaining to local EAP by entering these commands:

- **show local-auth config—**Shows the local EAP configuration on the controller.

```
User credentials database search order:
   Primary ..................................... Local DB

Timer:
    Active timeout ............................. 300

Configured EAP profiles:
   Name ........................................ fast-cert
     Certificate issuer ........................ vendor
     Peer verification options:
       Check against CA certificates ........... Enabled
       Verify certificate CN identity .......... Disabled
       Check certificate date validity ......... Enabled
     EAP-FAST configuration:
       Local certificate required .............. Yes
       Client certificate required ............. Yes
     Enabled methods ........................... fast
     Configured on WLANs ....................... 1

   Name ........................................ tls
     Certificate issuer ........................ vendor
     Peer verification options:
       Check against CA certificates ........... Enabled
       Verify certificate CN identity .......... Disabled
       Check certificate date validity ......... Enabled
     EAP-FAST configuration:
       Local certificate required .............. No
       Client certificate required ............. No
     Enabled methods ........................... tls
     Configured on WLANs ....................... 2

EAP Method configuration:
   Low-Cipher Support(TLSv1.0 for local EAP)..... Enabled
   EAP-FAST:
     Server key ................................ <hidden>
     TTL for the PAC ........................... 10
     Anonymous provision allowed ............... Yes
     Accept client on auth prov ................ No
     Authority ID .............................. 436973636f00000000000000000000000
     Authority Information ..................... Cisco A-ID
```

- **show local-auth statistics**—Shows the local EAP statistics.
- **show local-auth certificates**—Shows the certificates available for local EAP.
- **show local-auth user-credentials**—Shows the priority order that the controller uses when retrieving user credentials from the local and/or LDAP databases.
- **show advanced eap**—Shows the timer values for local EAP.

```
EAP-Identity-Request Timeout (seconds)..... 1
EAP-Identity-Request Max Retries.......... 20
```

```
EAP Key-Index for Dynamic WEP..................... 0
EAP Max-Login Ignore Identity Response........... enable
EAP-Request Timeout (seconds)..................... 20
EAP-Request Max Retries........................... 20
EAPOL-Key Timeout (seconds)....................... 1
EAPOL-Key Max Retries........................ 2
```

- **show ap stats wlan** *Cisco_AP*—Shows the EAP timeout and failure counters for a specific access point for each WLAN.
- **show client detail** *client_mac*—Shows the EAP timeout and failure counters for a specific associated client. These statistics are useful in troubleshooting client association issues.

```
...
Client Statistics:
      Number of Bytes Received................... 10
      Number of Bytes Sent....................... 10
      Number of Packets Received................. 2
      Number of Packets Sent..................... 2
      Number of EAP Id Request Msg Timeouts...... 0
      Number of EAP Id Request Msg Failures...... 0
      Number of EAP Request Msg Timeouts......... 2
      Number of EAP Request Msg Failures......... 1
      Number of EAP Key Msg Timeouts............. 0
      Number of EAP Key Msg Failures............. 0
      Number of Policy Errors.................... 0
      Radio Signal Strength Indicator............ Unavailable
      Signal to Noise Ratio...................... Unavailable
```

- **show wlan** *wlan_id*—Shows the status of local EAP on a particular WLAN.

Step 14 (Optional) Troubleshoot local EAP sessions by entering these commands:

- **debug aaa local-auth eap method** {**all** | **errors** | **events** | **packets** | **sm**} {*enable* | *disable*}— Enables or disables debugging of local EAP methods.
- **debug aaa local-auth eap framework** {**all** | **errors** | **events** | **packets** | **sm**} {*enable* | *disable*}— Enables or disables debugging of the local EAP framework.

  Note In these two debug commands, **sm** is the state machine.

- **clear stats local-auth**—Clears the local EAP counters.
- **clear stats ap wlan** *Cisco_AP*—Clears the EAP timeout and failure counters for a specific access point for each WLAN.

```
WLAN      1
   EAP Id Request Msg Timeouts.................... 0
   EAP Id Request Msg Timeouts Failures.......... 0
   EAP Request Msg Timeouts...................... 2
   EAP Request Msg Timeouts Failures............. 1
   EAP Key Msg Timeouts.......................... 0
   EAP Key Msg Timeouts Failures................. 0
WLAN      2
   EAP Id Request Msg Timeouts.................... 1
   EAP Id Request Msg Timeouts Failures.......... 0
   EAP Request Msg Timeouts...................... 0
   EAP Request Msg Timeouts Failures............. 0
```

```
   EAP Key Msg Timeouts.......................... 3
EAP Key Msg Timeouts Failures.............. 1
```

RADIUS Realm

When mobile clients associate to a WLAN, RADIUS realm is received as a part of EAP-AKA identity response request in the authentication request packet. The Network Access Identifier (NAI) format (EAP-AKA) for WLAN can be specified as *0<IMSI>@wlan.mnc<MNC>.mcc<MCC>.3gppnetwork.org*. The realm in the NAI format is represented after the @ symbol, which is specified as *wlan.mnc<MNC>.mcc<MCC>.3gppnetwork.org*. If vendor specific attributes are added for MCC as 311 and MNC as 480 to 489, then the NAI format can be represented as: *0311480999999999@wlan.mnc480.mcc311.3gppnetwork.org*.

For a mobile subscriber, the controller sends the authentication request to the AAA server only when the realm in the NAI format received from the device complies as per the given standards. Apart from authentication, accounting requests are also required to be sent to AAA server based on realm filtering.

In order to support realm filtering on the controller, you need to configure realm on the RADIUS. When a user is connected with a particular SSID, the user is authenticated and authorized using the NAI format received against the realm configured on the RADIUS server.

Realm Support on a WLAN

Each WLAN is configured to support NAI realms. Once the realm is enabled on a particular SSID, the lookup is done to match the realms received in the EAP identity response against the configured realms on the RADIUS server.

Realm Support on RADIUS Server

The RADIUS server needs to redirect the authentication and accounting requests based on configured realms. Each RADIUS server support realms to a maximum of 30 each for authentication and accounting.

- **Realm Match for Authentication**—In WPA2 dot1x with EAP methods (similar to EAP AKA), the username is received as part of EAP identity response. The realm is derived from the username and match with the realms configured in the RADIUS authentication server. If there is a match, then the authentication requests are forwarded to the RADIUS server. If there is a mismatch, then the client is deauthenticated.
- **Realm Match for Accounting**—Username is received in access accept messages. When accounting messages are triggered, the realm is derived from the username and compared against the accounting realms configured on the RADIUS accounting server. If succeeded, accounting requests are forwarded to the RADIUS server. If there is a mismatch, the accounting requests are dropped. For example, if realm is configured as **cisco** on the controller, then the username is authenticated as **xyz@cisco** on the RADIUS server.

Note Even if the NAI realm is enabled on a WLAN and if there is no realm in the username, then the behavior is defaulted to no lookup, and the usual selection of the RADIUS server is followed.

Note When the client uses fast re-authentication identity, the realm name is required from the authentication server in order for the controller to forward corresponding requests to the correct server.

When EAP-AKA is used along with realm, fast re authentication is supported when eap server responds with AT_NEXT_REAUTH_ID attribute having both the username portion and realm portion. Purpose of the realm is received controller picks up the right server for the subsequent fast re authentication requests. eg host apd server which supports eap aka does not support realm portion. So Cisco WLC supports fast re authentication only with those eap servers which have this compatibility.

This section contains the following subsections:

Prerequisites for Configuring RADIUS Realm

RADIUS authentication or accounting server has to be disabled before adding realm and enabled after adding realm on the controller.

Restrictions for Configuring RADIUS Realm

- You can configure a maximum of 17 RADIUS authentication and accounting servers to one controller.
- The total number of realms that you can configure for one RADIUS authentication and accounting server is 30.

Configuring Realm on a WLAN (GUI)

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the desired WLAN to open the WLANs > Edit page.

Step 3 Choose the **Advanced** tab to open the WLANs > Edit (Advanced) page.

Step 4 Select the **RADIUS NAI-Realm** check box to enable realm on the WLAN.

Step 5 Click **Apply** to commit your changes.

Step 6 Click **Save Configuration** to save your changes.

Configuring Realm on a WLAN (CLI)

Procedure

Step 1 Enable or disable realm on a WLAN by entering this command:

config wlan *radius_server* **realm** {**enable** | **disable**} *wlan-id*

Step 2 View the realm configuration on a WLAN by entering this command:

show wlan *wlan-id*

Configuring Realm on a RADIUS Authentication Server (GUI)

Procedure

Step 1 Choose **Security** > **AAA** > **RADIUS** > **Authentication** to open RADIUS Authentication Servers > Edit page.

Step 2 Click the Realm List link to open the Authentication Server Index page.

Step 3 Enter the realm name in the Realm Name text box.

Step 4 Click **Add**.

Configuring Realm on a RADIUS Authentication Server (CLI)

Procedure

Step 1 Add realm to a RADIUS authentication server by entering this command:
config radius auth realm add *radius_index realm_string*

Step 2 Delete realm from a RADIUS authentication server by entering this command:
config radius auth realm delete *radius_index realm_string*

Step 3 View RADIUS authentication server information by entering this command:
show radius auth detailed *radius_index*

Configuring Realm on a RADIUS Accounting Server (GUI)

Procedure

Step 1 Choose **Security** > **AAA** > **RADIUS** > **Accounting** to open RADIUS Accounting Servers > Edit page.

Step 2 Click the Realm List link to open the Accounting Server Index page.

Step 3 Enter the realm name in the Realm Name text box.

Step 4 Click **Add**.

Configuring Realm on a RADIUS Accounting Server (CLI)

Procedure

Step 1 Add realm to a RADIUS accounting server by entering this command:
config radius acct realm add *radius_index realm_string*

Step 2 Delete realm from a RADIUS accounting server by entering this command:
config radius acct realm delete *radius_index realm_string*

Step 3 View RADIUS accounting server information by entering this command:
show radius acct detailed *radius_index*

Per-WLAN RADIUS Source Support

The controller sources RADIUS traffic from the IP address of its management interface unless the configured RADIUS server exists on a VLAN accessible via one of the controller Dynamic interfaces. If a RADIUS server is reachable via a controller Dynamic interface, RADIUS requests to this specific RADIUS server will be sourced from the controller via the corresponding Dynamic interface.

By default, RADIUS packets sourced from the controller will set the NAS-IP-Address attribute to that of the management interface's IP Address, regardless of the packet's source IP Address (Management or Dynamic, depending on topology).

When you enable per-WLAN RADIUS source support (Radius Server Overwrite interface) the NAS-IP-Address attribute is overwritten by the controller to reflect the sourced interface. Also, RADIUS attributes are modified accordingly to match the identity. This feature virtualizes the controller on the per-WLAN RADIUS traffic, where each WLAN can have a separate layer 3 identity. This feature is useful in deployments that integrate with ACS Network Access Restrictions and Network Access Profiles.

To filter WLANs, use the callStationID that is set by RFC 3580 to be in the APMAC:SSID format. You can also extend the filtering on the authentication server to be on a per-WLAN source interface by using the NAS-IP-Address attribute.

You can combine per-WLAN RADIUS source support with the normal RADIUS traffic source and some WLANs that use the management interface and others using the per-WLAN dynamic interface as the address source.

This section contains the following subsections:

Prerequisites for Per-WLAN RADIUS Source Support

- You must implement appropriate rule filtering on the new identity for the authentication server (RADIUS) because the controller sources traffic only from the selected interface.

Restrictions for Per-WLAN RADIUS Source Support

Configuring Per-WLAN RADIUS Source Support (GUI)

Before you begin

Ensure that the WLAN is in disabled state. You can enable the WLAN after the configuration is done.

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the WLAN ID.

Step 3 Click the **Security** tab, and then click the **AAA Servers** tab.

Step 4 Check the **RADIUS Server Overwrite interface** check box to enable the per-WLAN RADIUS source support.

Note When enabled, the controller uses the interface specified on the WLAN configuration as identity and source for all RADIUS related traffic on that WLAN. When disabled, the controller uses the management interface as the identity in the NAS-IP-Address attribute. If the RADIUS server is on a directly connected dynamic interface, the RADIUS traffic will be sourced from that interface. Otherwise, the management IP address is used. In all cases, the NAS-IP-Address attribute remains the management interface, unless the feature is enabled.

Step 5 From the **Interface Priority** drop-down list, select either **AP Group** or **WLAN** as the interface for RADIUS packet routing.

Step 6 Ensure that the **Interim Interval** for RADIUS Server Accounting is within the valid range.

Step 7 Save the configuration.

Configuring Per-WLAN RADIUS Source Support (CLI)

Procedure

Step 1 Enter the **config wlan disable** *wlan-id* command to disable the WLAN.

Step 2 Enter the following command to enable or disable the per-WLAN RADIUS source support:

config wlan radius_server overwrite-interface {**enable** | **disable**} *wlan-id*

Note When enabled, the controller uses the interface specified on the WLAN configuration as identity and source for all RADIUS related traffic on that WLAN. When disabled, the controller uses the management interface as the identity in the NAS-IP-Address attribute. If the RADIUS server is on a directly connected dynamic interface, the RADIUS traffic will be sourced from that interface. Otherwise, the management IP address is used. In all cases, the NAS-IP-Address attribute remains the management interface, unless the feature is enabled.

Step 3 Enable either an AP group's interface or a WLAN's interface for RADIUS packet routing by entering these commands:

- AP group's interface—**config wlan radius_server overwrite-interface apgroup** *wlan-id*
- WLAN's interface—**config wlan radius_server overwrite-interface wlan** *wlan-id*

Note Valid WLAN ID range is between 1 and 16.

Step 4 Enter the **config wlan enable** *wlan-id* command to enable the WLAN.

Note You can filter requests on the RADIUS server side using CiscoSecure ACS. You can filter (accept or reject) a request depending on the NAS-IP-Address attribute through a Network Access Restrictions rule. The filtering to be used is the CLI/DNIS filtering.

Monitoring the Status of Per-WLAN RADIUS Source Support (CLI)

To see if the feature is enabled or disabled, enter the following command:

show wlan *wlan-id*

Example

The following example shows that the per-WLAN RADIUS source support is enabled on WLAN 1.

show wlan *1*

Information similar to the following is displayed:

```
WLAN Identifier.................................. 4
Profile Name..................................... example
Network Name (SSID).............................. example
Status........................................... Enabled
MAC Filtering.................................... Disabled
Broadcast SSID................................... Enabled
AAA Policy Override.............................. Disabled
Network Admission Control
...
Radius Servers
   Authentication................................ Global Servers
   Accounting.................................... Global Servers
   Overwrite Sending Interface................... Enabled
Local EAP Authentication......................... Disabled
```

Uploading PACs

Protected access credentials (PACs) are credentials that are either automatically or manually provisioned and used to perform mutual authentication with a local EAP authentication server during EAP-FAST authentication. When manual PAC provisioning is enabled, the PAC file is manually generated on the controller.

Follow the instructions in this section to generate and load PACs from the controller through the GUI or CLI. However, before you begin, make sure you have a TFTP or FTP server available for the PAC upload. Follow these guidelines when setting up a TFTP or FTP server:

- If you are uploading through the service port, the TFTP or FTP server must be on the same subnet as the service port because the service port is not routable, or you must create static routes on the controller.
- If you are uploading through the distribution system network port, the TFTP or FTP server can be on the same or a different subnet because the distribution system port is routable.

PAC Provisioning and Device Enrolment

Controller device enrollment is initiated by controller as part of Protected Access Credential (PAC) provisioning with the Cisco ISE server. Controller initiates EAP-FAST and gets a PAC. This is accomplished by using the infrastructure of LOCAL-EAP EAP-FAST PAC provisioning. The PAC that is obtained uniquely maps to the device ID. If the device ID changes, the PAC data associated with the previous device ID is removed from the PAC store. PAC provisioning is triggered when a RADIUS server instance is enabled to provision the PAC.

Note Ensure that the Cisco ISE and the controller time are synchronized for PAC to be downloaded on controller appropriately.

In a High Availability (HA) setup, PACs are not shared over redundancy channel; instead, PAC download is reinitiated on a new active controller immediately after switchover.

This section contains the following subsections:

Uploading PACs (GUI)

Procedure

Step 1 Choose **Commands** > **Upload File** to open the Upload File from Controller page.

Step 2 From the File Type drop-down list, choose **PAC (Protected Access Credential)**.

Step 3 In the **User** text box, enter the name of the user who will use the PAC.

Step 4 In the **Validity** text box, enter the number of days for the PAC to remain valid. The default setting is zero (0).

Step 5 In the **Password** and **Confirm Password** text boxes, enter a password to protect the PAC.

Step 6 From the **Transfer Mode** drop-down list, choose from the following options:

- **TFTP**
- **FTP**
- **SFTP** (available in 7.4 and later releases)

Step 7 In the **IP Address (IPv4/IPv6)** text box, enter the IPv4/IPv6 address of the server.

Step 8 In the **File Path** text box, enter the directory path of the PAC.

Step 9 In the **File Name** text box, enter the name of the PAC file. PAC files have a .pac extension.

Step 10 If you are using an FTP server, follow these steps:

a) In the **Server Login Username** text box, enter the username to log into the FTP server.
b) In the **Server Login Password** text box, enter the password to log into the FTP server.
c) In the **Server Port Number** text box, enter the port number on the FTP server through which the upload occurs. The default value is 21.

Step 11 Click **Upload** to upload the PAC from the controller. A message appears indicating the status of the upload.

Step 12 Follow the instructions for your wireless client to load the PAC on your client devices. Make sure to use the password that you entered above.

Uploading PACs (CLI)

Procedure

Step 1 Log on to the controller CLI.

Step 2 Specify the transfer mode used to upload the config file by entering this command:

transfer upload mode {**tftp** | **ftp** | **sftp**}

Step 3 Upload a Protected Access Credential (PAC) by entering this command:

transfer upload datatype pac

Step 4 Specify the identification of the user by entering this command:

transfer upload pac *username validity password*

Step 5 Specify the IP address of the TFTP or FTP server by entering this command:

transfer upload serverip *server-ip-address*

Note The server supports both, IPv4 and IPv6.

Step 6 Specify the directory path of the config file by entering this command:

transfer upload path *server-path-to-file*

Step 7 Specify the name of the config file to be uploaded by entering this command:

transfer upload filename *manual*.pac.

Step 8 If you are using an FTP server, enter these commands:

- **transfer upload username** *username*
- **transfer upload password** *password*
- **transfer upload port** *port*

  Note The default value for the port parameter is 21.

Step 9 View the updated settings by entering the **transfer upload start** command. Answer y when prompted to confirm the current settings and start the upload process.

Step 10 Follow the instructions for your wireless client to load the PAC on your client devices. Make sure to use the password that you entered above.

Disabling Accounting Servers per WLAN (GUI)

Note Disabling accounting servers disables all accounting operations and prevents the controller from falling back to the default RADIUS server for the WLAN.

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN to be modified. The WLANs > Edit page appears.

Step 3 Choose the **Security** and **AAA Servers** tabs to open the WLANs > Edit (Security > AAA Servers) page.

Step 4 Unselect the **Enabled** check box for the Accounting Servers.

Step 5 Click **Apply** to commit your changes.

Step 6 Click **Save Configuration** to save your changes.

Local Network Users on Controller

You can add local network users to the local user database on the controller. The local user database stores the credentials (username and password) of all the local network users. These credentials are then used to authenticate the users. For example, local EAP may use the local user database as its backend database to retrieve user credentials.

Note The controller passes client information to the RADIUS authentication server first. If the client information does not match a RADIUS database entry, the RADIUS authentication server replies with an authentication failure message. If the RADIUS authentication server does not reply, then the local user database is queried. Clients located in this database are granted access to network services if the RADIUS authentication fails or does not exist.

This section contains the following subsections:

Configuring Local Network Users for the Controller (GUI)

Procedure

Step 1 Choose **Security** > **AAA** > **Local Net Users** to open the Local Net Users page.

Note If you want to delete an existing user, hover your cursor over the blue drop-down arrow for that user and choose **Remove**.

When admin modifies the credentials of a local network user, the user gets disassociated from the WLAN. Here, credentials refer to the change in password or wlan profile for that user.

Step 2 Perform one of the following:

- To edit an existing local network user, click the username for that user. The **Local Net Users > Edit** page appears.
- To add a local network user, click **New**. The **Local Net Users > New** page appears.

Step 3 If you are adding a new user, enter a username for the local user in the **User Name** text box. You can enter up to 49 alphanumeric characters.

Note Local network usernames must be unique because they are all stored in the same database.

Step 4 In the **Password** and **Confirm Password** text boxes, enter a password for the local user. You can enter up to 49 alphanumeric characters.

Step 5 If you are adding a new user, select the **Guest User** check box if you want to limit the amount of time that the user has access to the local network. The default setting is unselected.

Step 6 If you are adding a new user and you selected the **Guest User** check box, enter the amount of time (in seconds) that the guest user account is to remain active in the Lifetime text box. The valid range is 60 to 2,592,000 seconds (30 days) inclusive, and the default setting is 86,400 seconds.

Step 7 If you are adding a new user, you selected the **Guest User** check box, and you want to assign a QoS role to this guest user, select the **Guest User Role** check box. The default setting is unselected.

Note If you do not assign a QoS role to a guest user, the bandwidth contracts for this user are defined in the QoS profile for the WLAN.

Step 8 If you are adding a new user and you selected the **Guest User Role** check box, choose the QoS role that you want to assign to this guest user from the Role drop-down list.

Step 9 From the WLAN Profile drop-down list, choose the name of the WLAN that is to be accessed by the local user. If you choose **Any WLAN**, which is the default setting, the user can access any of the configured WLANs.

Note If you are deleting a WLAN associated with network users, then the system prompts you to delete all network users associated with the WLAN before deleting the WLAN itself.

Step 10 In the **Description** text box, enter a descriptive title for the local user (such as "User 1").

Step 11 Click **Apply** to commit your changes.

Step 12 Click **Save Configuration** to save your changes.

Configuring Local Network Users for the Controller (CLI)

Procedure

- Configure a local network user by entering these commands:
  - **config netuser add** *username password* **wlan** *wlan_id userType* **permanent description** *description*—Adds a permanent user to the local user database on the controller.
  - **config netuser add** *username password* {**wlan | guestlan} {***wlan_id* | *guest_lan_id}* **userType guestlifetime** *seconds* **description** *description*—Adds a guest user on a WLAN or wired guest LAN to the local user database on the controller.

Note Instead of adding a permanent user or a guest user to the local user database from the controller, you can choose to create an entry on the RADIUS server for the user and enable RADIUS authentication for the WLAN on which web authentication is performed.

- **config netuser delete** {**username** *username* | **wlan-id** *wlan-id*}
  - *username*—Deletes a user from the local user database on the controller.

Note Local network usernames must be unique because they are all stored in the same database.

- *wlan-id*—Delete all the network users associated with the WLAN ID.

Note When a WLAN associated with network users is deleted, the system prompts to delete all network users associated with the WLAN first. After deleting the network users, you can delete the WLAN.

- See information related to the local network users configured on the controller by entering these commands:
  - **show netuser detail** *username*—Shows the configuration of a particular user in the local user database.
  - **show netuser summary**—Lists all the users in the local user database.

- Save your changes by entering this command:

  save config

Advanced WLAN Security

This section contains the following subsections:

AAA Override

The AAA Override option of a WLAN enables you to configure the WLAN for identity networking. It enables you to apply VLAN tagging, Quality of Service (QoS), and Access Control Lists (ACLs) to individual clients based on the returned RADIUS attributes from the AAA server.

AAA Override for IPv6 ACLs

In order to support centralized access control through a centralized AAA server such as the Cisco Identity Services Engine (ISE) or ACS, the IPv6 ACL can be provisioned on a per-client basis using AAA Override attributes. In order to use this feature, the IPv6 ACL must be configured on the controller and the WLAN must be configured with the AAA Override feature enabled. The client will be de-authenticated if the ACL is not preconfigured on the controller. The actual named AAA attribute for an IPv6 ACL is ***Airespace-IPv6-ACL-Name***, which is similar to the *Airespace-ACL-Name* attribute that is used for provisioning an IPv4-based ACL. The AAA attribute returned contents should be a string equal to the name of the IPv6 ACL as configured on the controller.

Note From Release 7.5, the upstream AAA override rate limiting value is same as the downstream AAA override rate limiting value.

This section contains the following subsections:

Restrictions for AAA Override

- If a client moves to a new interface due to the AAA override and then you apply an ACL to that interface, the ACL does not take effect until the client reauthenticates. To work around this issue, apply the ACL and then enable the WLAN so that all clients connect to the ACL that is already configured on the interface, or disable and then reenable the WLAN after you apply the interface so that the clients can reauthenticate.
- If the ACL returned from the AAA server does not exist on the controller or if the ACL is configured with an incorrect name, then the clients are not allowed to be authenticated.
- With FlexConnect local switching, Multicast is forwarded only for the VLAN that the SSID is mapped to and not to any overridden VLANs. Therefore, IPv6 does not work as expected because Multicast traffic is forwarded from the incorrect VLAN.
- When the interface group is mapped to a WLAN and clients connect to the WLAN, the client does not get the IP address in a round robin fashion. The AAA override with interface group is supported.
- Most of the configuration for allowing AAA override is done at the RADIUS server, where you should configure the Access Control Server (ACS) with the override properties you would like it to return to the controller (for example, Interface-Name, QoS-Level, and VLAN-Tag).
- On the controller, enable the Allow AAA Override configuration parameter using the GUI or CLI. Enabling this parameter allows the controller to accept the attributes returned by the RADIUS server. The controller then applies these attributes to its clients.
- During Layer2 authentication if AAA override is enabled, local policies are not applied and the override takes precedence.
- Cisco TrustSec security group tag is not applied until you enable AAA override on a WLAN.

Updating the RADIUS Server Dictionary File for Proper QoS Values

If you are using a Steel-Belted RADIUS (SBR), FreeRadius, or similar RADIUS server, clients may not obtain the correct QoS values after the AAA override feature is enabled. For these servers, which allow you to edit the dictionary file, you need to update the file to reflect the proper QoS values: Silver is 0, Gold is 1, Platinum is 2, and Bronze is 3. To update the RADIUS server dictionary file, follow these steps:

Note This issue does not apply to the Cisco Secure Access Control Server (ACS).

To update the RADIUS server dictionary file, follow these steps:

1. Stop the SBR service (or other RADIUS service).
2. Save the following text to the `Radius_Install_Directory\Service` folder as `ciscowlan.dct`:

```
##################################################################################
# CiscoWLAN.dct- Cisco Wireless Lan Controllers
#
# (See README.DCT for more details on the format of this file)
##################################################################################
```

```
# Dictionary - Cisco WLAN Controllers
#
# Start with the standard Radius specification attributes
#
@radius.dct
#
# Standard attributes supported by Airespace
#
# Define additional vendor specific attributes (VSAs)
#

MACRO Airespace-VSA(t,s) 26 [vid=14179 type1=%t% len1=+2 data=%s%]

ATTRIBUTE   WLAN-Id                 Airespace-VSA(1, integer)     cr
ATTRIBUTE   Aire-QoS-Level          Airespace-VSA(2, integer)     r
VALUE Aire-QoS-Level Bronze     3
VALUE Aire-QoS-Level Silver     0
VALUE Aire-QoS-Level Gold       1
VALUE Aire-QoS-Level Platinum   2

ATTRIBUTE   DSCP                    Airespace-VSA(3, integer)     r
ATTRIBUTE   802.1P-Tag              Airespace-VSA(4, integer)     r
ATTRIBUTE   Interface-Name          Airespace-VSA(5, string)      r
ATTRIBUTE   ACL-Name                Airespace-VSA(6, string)      r

# This should be last.

##############################################################################
# CiscoWLAN.dct - Cisco WLC dictionary
##############################################################################
```

3. Open the `dictiona.dcm` file (in the same directory) and add the line "@ciscowlan.dct."
4. Save and close the `dictiona.dcm` file.
5. Open the `vendor.ini` file (in the same directory) and add the following text:

```
vendor-product       = Cisco WLAN Controller
dictionary           = ciscowlan
ignore-ports         = no
port-number-usage    = per-port-type
help-id              =
```

6. Save and close the `vendor.ini` file.
7. Start the SBR service (or other RADIUS service).
8. Launch the SBR Administrator (or other RADIUS Administrator).
9. Add a RADIUS client (if not already added). Choose **Cisco WLAN Controller** from the Make/Model drop-down list.

Configuring AAA Override (GUI)

Procedure

Step 1 Choose **WLANs** to open the **WLANs** page.

Step 2 Click the ID number of the WLAN that you want to configure. The **WLANs > Edit** page appears.

Step 3 Choose the **Advanced** tab.

Step 4 Select the **Allow AAA Override** check box to enable AAA override or unselect it to disable this feature. The default value is disabled.

Step 5 Click **Apply**.

Step 6 Click **Save Configuration**.

Configuring AAA Override (CLI)

Procedure

- Configure override of user policy through AAA on a WLAN by entering this command:
  config wlan aaa-override {**enable** | **disable**} *wlan-id*

  For *wlan-id*, enter a value between 1 and 16.
- Configure debugging of 802.1X AAA interactions by entering this command:
  debug dot1x aaa {**enable** | **disable**}
- Configure debugging of AAA QoS override by entering this command:
  debug ap aaaqos-dump {**enable** | **disable**}

Cisco Key Integrity Protocol

Cisco Key Integrity Protocol (CKIP) is a Cisco-proprietary security protocol for encrypting 802.11 media. CKIP improves 802.11 security in infrastructure mode using key permutation, a message integrity check (MIC), and a message sequence number. For this feature to operate correctly, you must enable Aironet information elements (IEs) for the WLAN.

A lightweight access point advertises support for CKIP in beacon and probe response packets by adding an Aironet IE and setting one or both of the CKIP negotiation bits (key permutation and multi-modular hash message integrity check [MMH MIC]). Key permutation is a data encryption technique that uses the basic encryption key and the current initialization vector (IV) to create a new key. MMH MIC prevents bit-flip attacks on encrypted packets by using a hash function to compute message integrity code.

The CKIP settings specified in a WLAN are mandatory for any client attempting to associate. If the WLAN is configured for both CKIP key permutation and MMH MIC, the client must support both. If the WLAN is configured for only one of these features, the client must support only the CKIP feature.

CKIP requires that 5-byte and 13-byte encryption keys be expanded to 16-byte keys. The algorithm to perform key expansion occurs at the access point. The key is appended to itself repeatedly until the length reaches 16 bytes. All lightweight access points support CKIP.

Note CKIP is supported for use only with static WEP. It is not supported for use with dynamic WEP. Therefore, a wireless client that is configured to use CKIP with dynamic WEP is unable to associate to a WLAN that is configured for CKIP. We recommend that you use either dynamic WEP without CKIP (which is less secure) or WPA/WPA2 with TKIP or AES (which are more secure).

Configuring CKIP (GUI)

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the desired WLAN to open the WLANs > Edit page.

Step 3 Choose the **Advanced** tab.

Step 4 Select the **Aironet IE** check box to enable Aironet IEs for this WLAN and click **Apply**.

Step 5 Choose the **General** tab.

Step 6 Unselect the **Status** check box, if selected, to disable this WLAN and click **Apply**.

Step 7 Choose the **Security** and **Layer 2** tabs to open the WLANs > Edit (Security > Layer 2) page.

Step 8 Choose **CKIP** from the Layer 2 Security drop-down list.

Step 9 Under CKIP Parameters, choose the length of the CKIP encryption key from the Key Size drop-down list.The range is Not Set, 40 bits, or 104 bits and the default is Not Set.

Step 10 Choose the number to be assigned to this key from the Key Index drop-down list. You can configure up to four keys.

Step 11 From the Key Format drop-down list, choose **ASCII** or **HEX** and then enter an encryption key in the Encryption Key text box. 40-bit keys must contain 5 ASCII text characters or 10 hexadecimal characters. 104-bit keys must contain 13 ASCII text characters or 26 hexadecimal characters.

Step 12 Select the **MMH Mode** check box to enable **MMH MIC** data protection for this WLAN. The default value is disabled (or unselected).

Step 13 Select the **Key Permutation** check box to enable this form of CKIP data protection. The default value is disabled (or unselected).

Step 14 Click **Apply** to commit your changes.

Step 15 Choose the **General** tab.

Step 16 Select the **Status** check box to enable this WLAN.

Step 17 Click **Apply** to commit your changes.

Step 18 Click **Save Configuration** to save your changes.

Configuring CKIP (CLI)

Procedure

Step 1 Disable the WLAN by entering this command:

config wlan disable *wlan_id*

Step 2 Enable Aironet IEs for this WLAN by entering this command:

config wlan ccx aironet-ie enable *wlan_id*

Step 3 Enable or disable CKIP for the WLAN by entering this command:

config wlan security ckip {**enable** | **disable**} *wlan_id*

Step 4 Specify a CKIP encryption key for the WLAN by entering this command:

config wlan security ckip akm psk set-key *wlan_id* {**40** | **104**} {**hex** | **ascii**} *key key_index*

Step 5 Enable or disable CKIP MMH MIC for the WLAN by entering this command:

config wlan security ckip mmh-mic {**enable** | **disable**} *wlan_id*

Step 6 Enable or disable CKIP key permutation for the WLAN by entering this command:

config wlan security ckip kp {**enable** | **disable**} *wlan_id*

Step 7 Enable the WLAN by entering this command:

config wlan enable wlan_id

Step 8 Save your settings by entering this command:

save config

Disabling Coverage Hole Detection per WLAN

Note Coverage hole detection is enabled globally on the controller.

Note You can disable coverage hole detection on a per-WLAN basis. When you disable coverage hole detection on a WLAN, a coverage hole alert is still sent to the controller, but no other processing is done to mitigate the coverage hole. This feature is useful for guest WLANs where guests are connected to your network for short periods of time and are likely to be highly mobile.

This section contains the following subsections:

Disabling Coverage Hole Detection on a WLAN (GUI)

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the profile name of the WLAN to be modified. The WLANs > Edit page appears.

Step 3 Choose the **Advanced** tab to display the WLANs > Edit (Advanced) page.

Step 4 Uncheck the **Coverage Hole Detection Enabled** check box.

Step 5 Click **Apply**.

Step 6 Click **Save Configuration**.

Disabling Coverage Hole Detection on a WLAN (CLI)

Procedure

Step 1 Disable coverage hole detection on a by entering this command:

config wlan chd *wlan-id* **disable**

Step 2 Save your settings by entering this command:

save config

Step 3 See the coverage hole detection status for a particular WLAN by entering this command:

show wlan *wlan-id*

Information similar to the following appears:

```
WLAN Identifier.................................. 2
Profile Name..................................... wlan2
Network Name (SSID).............................. 2
. . .
CHD per WLAN..................................... Disabled
```

NAC Out-of-Band Integration

The Cisco NAC Appliance, also known as Cisco Clean Access (CCA), is a network admission control (NAC) product that enables network administrators to authenticate, authorize, evaluate, and remediate wired, wireless, and remote users and their machines prior to allowing users onto the network. NAC identifies whether machines are compliant with security policies and repairs vulnerabilities before permitting access to the network.

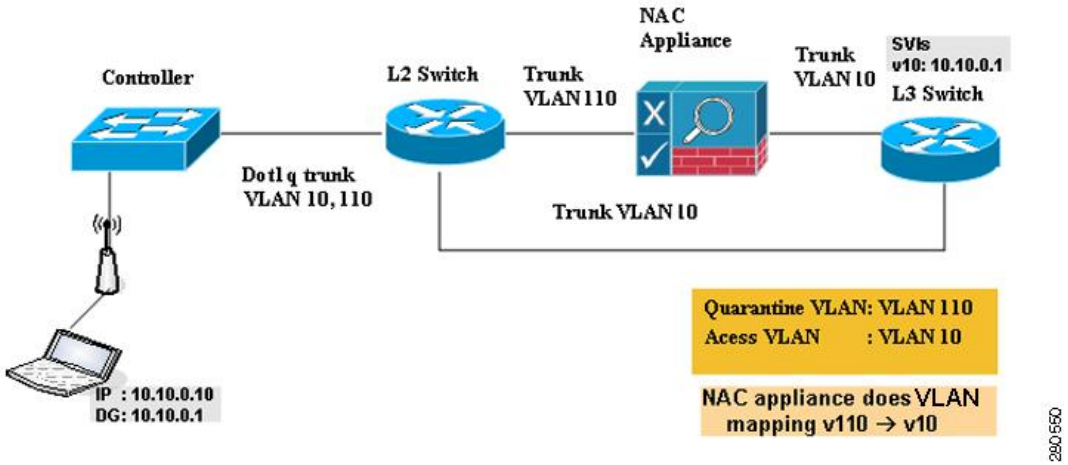
The NAC appliance is available in two modes: in-band and out-of-band. Customers can deploy both modes if desired, each geared toward certain types of access (in-band for supporting wireless users and out-of-band for supporting wired users, for example).

To implement the NAC out-of-band feature on the controller, you must enable NAC support on the WLAN or guest LAN and then map this WLAN or guest LAN to an interface that is configured with a quarantine VLAN (untrusted VLAN) and an access VLAN (trusted VLAN). When a client associates and completes Layer 2 authentication, the client obtains an IP address from the access VLAN subnet, but the client state is Quarantine. While deploying the NAC out-of-band feature, be sure that the quarantine VLAN is allowed only between the Layer 2 switch on which the controller is connected and the NAC appliance and that the NAC appliance is configured with a unique quarantine-to-access VLAN mapping. Client traffic passes into the quarantine VLAN, which is trunked to the NAC appliance. After posture validation is completed, the client is prompted to take remedial action. After cleaning is completed, the NAC appliance updates the controller to change the client state from Quarantine to Access.

Figure 6: Example of NAC Out-of-Band Integration

The link between the controller and the switch is configured as a trunk, enabling the quarantine VLAN (110) and the access VLAN (10). On the Layer 2 switch, the quarantine traffic is trunked to the NAC appliance

while the access VLAN traffic goes directly to the Layer 3 switch. Traffic that reaches the quarantine VLAN on the NAC appliance is mapped to the access VLAN based on a static mapping configuration.



This section contains the following subsections:

Prerequisites for NAC Out Of Band

- CCA software release 4.5 or later releases is required for NAC out-of-band integration.
- Because the NAC appliance supports static VLAN mapping, you must configure a unique quarantine VLAN for each interface that is configured on the controller. For example, you might configure a quarantine VLAN of 110 on controller 1 and a quarantine VLAN of 120 on controller 2. However, if two WLANs or guest LANs use the same distribution system interface, they must use the same quarantine VLAN if they have one NAC appliance deployed in the network. The NAC appliance supports unique quarantine-to-access VLAN mapping.
- For a posture reassessment that is based on a session expiry, you must configure the session timeout on both the NAC appliance and the WLAN, making sure that the session expiry on the WLAN is greater than that on the NAC appliance.
- When a session timeout is configured on an open WLAN, the timing out of clients in the Quarantine state is determined by the timer on the NAC appliance. After the session timeout expires for WLANs that use web authentication, clients deauthenticate from the controller and must perform posture validation again.
- All Layer 2 and Layer 3 authentication occurs in the quarantine VLAN. To use external web authentication, you must configure the NAC appliance to allow HTTP traffic to and from external web servers and to allow the redirect URL in the quarantine VLAN.

Note See the Cisco NAC appliance configuration guides for configuration instructions at http://www.cisco.com/c/en/us/support/security/nac-appliance-clean-access/products-installation-and-configuration-guides-list.html.

- If you want to enable NAC on an access point group VLAN, you must first enable NAC on the WLAN. Then you can enable or disable NAC on the access point group VLAN. If you ever decide to disable NAC on the WLAN, be sure to disable it on the access point group VLAN as well.

- The NAC appliance supports up to 3500 users, and the controller supports up to 5000 users. Multiple NAC appliances might need to be deployed.
- If you want to enable NAC on an access point group VLAN, you must first enable NAC on the WLAN. Then you can enable or disable NAC on the access point group VLAN. If you ever decide to disable NAC on the WLAN, be sure to disable it on the access point group VLAN as well.
- The NAC appliance supports up to 3500 users, and the controller supports up to 5000 users. Multiple NAC appliances might need to be deployed.
- In controller software releases prior to 5.1, the controller integrates with the NAC appliance only in in-band mode, where the NAC appliance must remain in the data path. For in-band mode, a NAC appliance is required at each authentication location (such as at each branch or for each controller), and all traffic must traverse the NAC enforcement point. In controller software release 5.1 or later releases, the controller can integrate with the NAC appliance in out-of-band mode, where the NAC appliance remains in the data path only until clients have been analyzed and cleaned. Out-of-band mode reduces the traffic load on the NAC appliance and enables centralized NAC processing.
- NAC out-of-band integration is supported only on WLANs configured for FlexConnect central switching. It is not supported for use on WLANs configured for FlexConnect local switching.

Restrictions for NAC Out of Band

- NAC out-of-band integration is not supported for use with the WLAN AAA override feature.
- In controller software releases prior to 5.1, the controller integrates with the NAC appliance only in in-band mode, where the NAC appliance must remain in the data path. For in-band mode, a NAC appliance is required at each authentication location (such as at each branch or for each controller), and all traffic must traverse the NAC enforcement point. In controller software release 5.1 or later releases, the controller can integrate with the NAC appliance in out-of-band mode, where the NAC appliance remains in the data path only until clients have been analyzed and cleaned. Out-of-band mode reduces the traffic load on the NAC appliance and enables centralized NAC processing.
- NAC out-of-band integration is supported only on WLANs configured for FlexConnect central switching. It is not supported for use on WLANs configured for FlexConnect local switching.

Configuring NAC Out-of-Band Integration (GUI)

Procedure

Step 1 Configure the quarantine VLAN for a dynamic interface as follows:

a) Choose **Controller** > **Interfaces** to open the Interfaces page.
b) Click **New** to create a new dynamic interface.
c) In the Interface Name text box, enter a name for this interface, such as “quarantine.”
d) In the VLAN ID text box, enter a nonzero value for the access VLAN ID, such as “10.”
e) Click **Apply** to commit your changes. The **Interfaces > Edit** page appears.
f) Select the **Quarantine** check box and enter a nonzero value for the quarantine VLAN ID, such as “110.”

Note We recommend that you configure unique quarantine VLANs throughout your network. If multiple controllers are configured in the same mobility group and access interfaces on all controllers are in the same subnet, it is mandatory to have the same quarantine VLAN if there is only one NAC appliance in the network. If multiple controllers are configured in the same mobility group and access interfaces on all controllers are in different subnets, it is mandatory to have different quarantine VLANs if there is only one NAC appliance in the network.

g) Configure any remaining text boxes for this interface, such as the IP address, netmask, and default gateway.
h) Click **Apply** to save your changes.

Step 2 Configure NAC out-of-band support on a WLAN or guest LAN as follows:

a) Choose **WLANs** to open the WLANs page.
b) Click the ID number of the desired WLAN or guest LAN. The WLANs > Edit page appears.
c) Choose the **Advanced** tab to open the WLANs > Edit (Advanced) page.
d) Configure NAC out-of-band support for this WLAN or guest LAN by selecting the **NAC State** check box. To disable NAC out-of-band support, leave the check box unselected, which is the default value.
e) Click **Apply** to commit your changes.

Step 3 Configure NAC out-of-band support for a specific access point group as follows:

a) Choose **WLANs** > **Advanced** > **AP Groups** to open the AP Groups page.
b) Click the name of the desired access point group.
c) Choose the **WLANs** tab to open the AP Groups > Edit (WLANs) page.
d) Click **Add New** to assign a WLAN to this access point group. The Add New section appears at the top of the page.
e) From the WLAN SSID drop-down list, choose the SSID of the WLAN.
f) From the Interface Name drop-down list, choose the interface to which you want to map the access point group. Choose the quarantine VLAN if you plan to enable NAC out-of-band support.
g) To enable NAC out-of-band support for this access point group, select the **NAC State** check box. To disable NAC out-of-band support, leave the check box unselected, which is the default value.
h) Click **Add** to add this WLAN to the access point group. This WLAN appears in the list of WLANs assigned to this access point group.

Note If you ever want to remove this WLAN from the access point group, hover your cursor over the blue drop-down arrow for the WLAN and choose **Remove**.

Step 4 Click **Save Configuration** to save your changes.

Step 5 See the current state of the client (Quarantine or Access) as follows:

a) Choose **Monitor** > **Clients** to open the Clients page.
b) Click the MAC address of the desired client to open the Clients > Detail page. The NAC state appears under the Security Information section.

Note The client state appears as “Invalid” if the client is probing, has not yet associated to a WLAN, or cannot complete Layer 2 authentication.

Configuring NAC Out-of-Band Integration (CLI)

Procedure

Step 1 Configure the quarantine VLAN for a dynamic interface by entering this command:

config interface quarantine vlan *interface_name vlan_id*

Note You must configure a unique quarantine VLAN for each interface on the controller.

To disable the quarantine VLAN on an interface, enter *0* for the VLAN ID.

Step 2 Enable or disable NAC out-of-band support for a WLAN or guest LAN by entering this command:

config {**wlan** | **guest-lan**} **nac** {**enable** | **disable**} {*wlan_id* | *guest_lan_id*}

Step 3 Enable or disable NAC out-of-band support for a specific access point group by entering this command:

config wlan apgroup nac {**enable** | **disable**} *group_name wlan_id*

Step 4 Save your changes by entering this command:

save config

Step 5 See the configuration of a WLAN or guest LAN, including the NAC state by entering this command:

show {**wlan** *wlan_ id* | **guest-lan** *guest_lan_id*}

Information similar to the following appears:

```
WLAN Identifier.................................. 1
Profile Name..................................... wlan
Network Name (SSID).............................. wlan
Status........................................... Disabled
MAC Filtering.................................... Disabled
Broadcast SSID................................... Enabled
AAA Policy Override.............................. Disabled
Network Admission Control

  NAC-State...................................... Enabled
  Quarantine VLAN............................. 110
...
```

Step 6 See the current state of the client (either Quarantine or Access) by entering this command:

show client detailed *client_mac*

Information similar to the following appears:

```
Client's NAC state.............................. QUARANTINE
```

Note The client state appears as "Invalid" if the client is probing, has not yet associated to a WLAN, or cannot complete Layer 2 authentication.

ISE NAC Support

The Cisco Identity Services Engine (ISE) is a next-generation, context-based access control solution that provides the functions of Cisco Secure Access Control System (ACS) and Cisco Network Admission Control (NAC) in one integrated platform.

Cisco ISE was introduced in Cisco Wireless Release 7.0.116.0. Cisco ISE can be used to provide advanced security for your deployed network. It is an authentication server that you can configure on your controller. When a client associates with a controller on a ISE NAC–enabled WLAN with OPEN/Layer 2 + MAC Filtering, the controller forwards the request to the Cisco ISE server without verifying in the local database.

Note ISE NAC was previously known as RADIUS NAC.

This section contains the following subsections:

Device Registration

Device registration enables you to authenticate and provision new devices on the WLAN with RADIUS NAC enabled. When a device is registered on the WLAN, it can use the network based on the configured ACL.

Central Web Authentication

In the case of Central Web Authentication (CWA), web authentication occurs on the Cisco ISE server. The web portal in the Cisco ISE server provides a login page to a client. After the credentials are verified on the Cisco ISE server, the client is provisioned. The client remains in the POSTURE_REQD state until a change of authorization (CoA) is reached. The credentials and ACLs are received from the Cisco ISE server.

Note In a CWA and MAC filtering configuration scenario, if a change in VLAN occurs during pre-authentication and post-authentication, dissociation request is sent to clients and the clients are forced to go through DHCP again.

For new clients, the RADIUS access accept message carries redirected URL for port 80 and pre-auth ACLs or quarantine VLAN. Definition of ACL is defined in the controller (IP addresses and ports).

Clients will be redirected to the URL provided in the access accept message and put into a new state until posture validation is done. Clients in this state validate themselves against ISE server and the policies configured on the ISE NAC server.

The NAC agent on the clients initiates posture validation (traffic to port 80): The agent sends HTTP discovery request to port 80, which the controller redirects to the URL provided in the access accept message. Cisco ISE knows that the client is trying to reach and responds directly to the client. This way, the client learns about the Cisco ISE IP address and from now on, the client talks directly with the Cisco ISE.

The controller allows this traffic because the ACL is configured to allow this traffic. In case of VLAN override, the traffic is bridged so that it reaches the Cisco ISE.

ISE NAC

After the client completes the assessment, a RADIUS CoA-Req with reauth service is sent to the controller. This initiates reauthentication of the client (by sending EAP-START). Once reauthentication succeeds, the Cisco ISE sends an access accept message with a new ACL (if any) and no URL redirect, or access VLAN.

The controller has support for CoA-Req and Disconnect-Req as per RFC 3576. The controller needs to support CoA-Req for re-auth service, as per RFC 5176.

Instead of downloadable ACLs, pre-configured ACLs are used on the controller. Cisco ISE sends the ACL name, which is already configured in the controller.

This design should work for both VLAN and ACL cases. In case of VLAN override, the port 80 is redirected and allows (bridge) rest of the traffic on the quarantine VLAN. For the ACL, the pre-auth ACL received in the access accept message is applied.

Here's the workflow:

1. The guest user associates with the controller.
2. The controller sends a MAB Request to ISE.
3. ISE matches the first authorization rules, and sends the redirect parameters (ACL and URL).
4. The controller redirects the GUEST to ISE.
5. After the guest is authenticated, ISE makes a second authorization, which is called RADIUS Change of Authorization (CoA). In this second authorization, a profile must be returned so that the guest is permitted access to the network. We can use usecase: guestflow to easily match this second authorization.

Local Web Authentication

Local web authentication is not supported for RADIUS NAC.

This table describes the possible combinations in a typical ISE deployment with Device Registration, CWA and LWA enabled:

Table 1: ISE Network Authentication Flow

WLAN Configuration	CWA	LWA	Device Registration
RADIUS NAC Enabled	Yes	No	Yes
L2 PSK	802.1X	PSK, Static WEP, CKIP	No
L3 None	N/A	Internal/External	N/A
MAC Filtering Enabled	Yes	No	Yes

Guidelines and Restrictions on ISE NAC Support

Guidelines

- When either an authentication or accounting RADIUS server fails, the corresponding server in the authentication or accounting server list will be made inactive. This ensures that client authentication and accounting occurs on the same IP authentication and accounting servers. However, the authentication

and accounting servers should be added in the same order while configuring the RADIUS servers if they have to work together.

- When a client moves from one WLAN to another, the Cisco WLC retains the client's audit session ID if it returns to the WLAN before the idle timeout occurs. As a result, when the client associates with the Cisco WLC before the idle timeout session expires, it is immediately moved to Run state. The client is validated if it reassociates with the Cisco WLC after the session timeout.
- If you have two WLANs, and WLAN 1 is configured on a Cisco WLC (WLC1) and WLAN2 is configured on another Cisco WLC (WLC2) and both are ISE NAC enabled, the client first connects to WLC1 and moves to the RUN state after posture validation. Assume that the client now moves to WLC2. If the client connects back to WLC1 before the PMK expires for this client in WLC1, the posture validation is skipped for the client. The client directly moves to Run state by passing posture validation because the Cisco WLC retains the old audit session ID for the client that is already known to Cisco ISE.
- When deploying ISE NAC in your wireless network, do not configure a primary and secondary Cisco ISE server. Instead, we recommend that you configure High Availability (HA) between the two Cisco ISE servers. Having a primary and secondary ISE setup will require posture validation to occur before the clients move to the Run state. If HA is configured, the client is automatically moved to the Run state in the fallback Cisco ISE server.
- Do not swap AAA server indexes in a live network because clients might get disconnected and have to reconnect to the RADIUS server, which might result in log messages to be appended to the ISE server logs.
- Enable AAA override on the WLAN to use ISE NAC.
- ISE NAC is supported with open authentication/Layer 2 (PSK/802.1x) + MAC Filtering security types.
- During slow roaming, clients go through posture validation.
- If the AAA url-redirect-acl and url-redirect attributes are expected from the AAA server, the AAA override feature must be enabled on the controller.

Restrictions

- For ISE NAC WLANs, the MAC authentication request is always sent to the external RADIUS server. The MAC authentication is not validated against the local database. This functionality is applicable to Releases 8.5, 8.7, 8.8, and later releases via the fix for CSCvh85830.
- The ISE NAC functionality does not work if the configured accounting server is different from the authentication (Cisco ISE) server. You should configure the same server as the authentication and accounting server if Cisco ISE functionalities are used. If Cisco ISE is used only for Cisco ACS functionality, the accounting server can be flexible.
- The controller software configured with ISE NAC does not support a CoA on the service port.
- Guest tunneling mobility is supported only for ISE NAC–enabled WLANs.
- VLAN select is not supported.
- Workgroup bridges are not supported.
- The AP Group over NAC is not supported in ISE NAC.
- When ISE NAC is enabled, the RADIUS server overwrite interface is not supported.

- Remote LANs (RLANs) are not supported.
- Audit session ID is not supported across mobility domains if the controller belongs to a different mobility domain.

Configuring ISE NAC Support (GUI)

Procedure

Step 1 Choose **WLANs**.

Step 2 Click the WLAN ID.

The **WLANs > Edit** page appears.

Step 3 Click the **Advanced** tab.

Step 4 From the **NAC State** drop-down list, choose from the following options:

- **None**
- **SNMP NAC**—Uses SNMP NAC for the WLAN.
- **ISE NAC**—Uses ISE NAC for the WLAN.

Note AAA override is automatically enabled when you use ISE NAC on a WLAN.

Step 5 Save the configuration.

Configuring ISE NAC Support (CLI)

Enter the following command:

config wlan nac radius {**enable** | **disable**} *wlan_id*

Enabling ISE NAC on a WPA/WPA2-PSK WLAN

Information About Enabling ISE NAC on a WPA and WPA2-PSK WLAN

It is possible to enable both ISE NAC and WPA and WPA2-PSK on a WLAN.

This enhancement is introduced in Release 8.3. Prior to Release 8.3, it was not possible to enable both these configurations on the same WLAN.

A use case is Web redirect with PSK on Cisco WLCs for the purpose of device onboarding. For example, on-board devices using an SSID with a PSK send the MAC address to Cisco ISE using central web authentication (CWA), and determine if it is registered.

Workflow

To support PSK along with ISE NAC, you must enable MAC filtering to facilitate a communication link to the AAA server to get redirect URL and preauthentication ACLs. The WLAN configuration that is supported is WPA and WPA-2 PSK + MAC filtering + ISE NAC.

1. A client joins the WLAN with Layer 2 authentication method, that is, PSK with the credentials created at the time of creating the WLAN.
2. Cisco WLC looks up the AAA server to check if MAC filtering is enabled. If yes, the AAA server provides the redirect URL and preauthentication ACLs. The client moves to central web authentication (CWA) state.
3. The client should log on via the redirect URL and authenticate using the available credentials. The CoA is then sent from the AAA server to Cisco WLC.
4. As part of the CoA, Cisco WLC triggers DISSOC to the client with the reason as UNSPECIFIED by starting a rejoin timer with 30 seconds.
5. The final authentication is a MAC authentication to which the final authorization results, such as the final VLAN and ACL, are returned.
6. Expecting client to rejoin performing Layer 2 authentication generating PMK and GTK, thus the wireless encrypted link, the Cisco WLC sends ACCESS REQ to the AAA server and related ACCESS RESP in which the Cisco WLC provides the VLAN change or other enforcement attributes in the AAA server. With this attribute enforcement, the client moves to the Run state.

Additional References

- Web Authentication on WLAN Controller—http://www.cisco.com/c/en/us/support/docs/wireless-mobility/wlan-security/115951-web-auth-wlc-guide-00.html#anc17
- Central Web Authentication on the WLC and ISE Configuration Example—http://www.cisco.com/c/en/us/support/docs/security/identity-services-engine/115732-central-web-auth-00.html

Enabling ISE NAC on WPA/WPA2-PSK WLAN (GUI)

Procedure

Step 1 Configure Cisco WLC:

a) Add Cisco ISE as RADIUS server in Cisco WLC with change of authorization (CoA) in Enabled state.

b) Configure a WLAN with Layer 2 security type set to **WPA+WPA2**, MAC filtering in Enabled state, Authentication Key Management set to **PSK**, and NAC state set to **ISE NAC**:

1. Choose **WLANs** and click the WLAN ID.
2. On the **WLANs > Edit** page, choose **Security** > **Layer 2** tab.
3. Set Layer 2 Security to **WPA+WPA2**.
4. Enable **MAC Filtering**.
5. Under **Authentication Key Management**, enable **PSK** and set the PSK format.
6. In the **Advanced** tab, set the **NAC State** to **ISE NAC**.

c) Create a preauthentication ACL to communicate with only the Cisco ISE server. For instructions on how to create an ACL, see (Link to be provided to the Configuring Access Control Lists chapter).

Note
- In addition to ISE traffic, allow other necessary traffic such as DNS, DHCP to be specified to permit DNS and DHCP traffic on the redirect ACL.
- If the APs are in FlexConnect mode, a preauth ACL is irrelevant. FlexConnect ACLs can be used to allow access for clients that have not been authenticated.

Step 2 Configure Cisco ISE:

a) Ensure that Cisco WLC is in Cisco ISE.
b) Add an authentication profile.
c) Add an authorization profile.
d) Add postauthentication policies.
e) Add authorization policy.

Note
1. The first instance is when a user associates with the SSID and when the central web authentication profile is returned (unknown MAC address; therefore, you must set the user for redirection).
2. The second instance is when a user authenticated on the web portal, such that it matches the default rule (internal users) in this configuration (it can be configured to meet your requirements). It is important that the authorization part does not match the central web authentication profile again. Otherwise, there will be a redirection loop.

For instructions on Cisco ISE configuration, see http://www.cisco.com/c/en/us/support/docs/security/identity-services-engine/115732-central-web-auth-00.html#anc6.

Client Exclusion Policies

Configuring Client Exclusion Policies (GUI)

Procedure

Step 1 Choose **Security** > **Wireless Protection Policies** > **Client Exclusion Policies** to open the Client Exclusion Policies page.

Step 2 Select any of these check boxes if you want the controller to exclude clients for the condition specified. The default value for each exclusion policy is enabled.

- **Excessive 802.11 Association Failures**—Clients are excluded on the sixth 802.11 association attempt, after five consecutive failures.
- **Excessive 802.11 Authentication Failures**—Clients are excluded on the sixth 802.11 authentication attempt, after five consecutive failures.
- **Excessive 802.1X Authentication Failures**—Clients are excluded on the fourth 802.1X authentication attempt, after three consecutive failures.
- **IP Theft or IP Reuse**—Clients are excluded if the IP address is already assigned to another device.

- **Excessive Web Authentication Failures**—Clients are excluded on the fourth web authentication attempt, after three consecutive failures.

Step 3 Save your configuration.

Configuring Client Exclusion Policies (CLI)

Procedure

Step 1 Enable or disable the controller to exclude clients on the sixth 802.11 association attempt, after five consecutive failures by entering this command:

config wps client-exclusion 802.11-assoc {**enable** | **disable**}

Step 2 Enable or disable the controller to exclude clients on the sixth 802.11 authentication attempt, after five consecutive failures by entering this command:

config wps client-exclusion 802.11-auth {**enable** | **disable**}

Step 3 Enable or disable the controller to exclude clients on the fourth 802.1X authentication attempt, after three consecutive failures by entering this command:

config wps client-exclusion 802.1x-auth {**enable** | **disable**}

Step 4 Configure the controller to exclude clients that reaches the maximum failure 802.1X authentication attempt with the RADIUS server by entering this command:

config wps client-exclusion 802.1x-auth max-1x-aaa-fail-attempts

You can configure the maximum failure 802.1X authentication attempt from 1 to 3 and the default value is 3.

Step 5 Enable or disable the controller to exclude clients if the IP address is already assigned to another device by entering this command:

config wps client-exclusion ip-theft {**enable** | **disable**}

Step 6 Enable or disable the controller to exclude clients on the fourth web authentication attempt, after three consecutive failures by entering this command:

config wps client-exclusion web-auth {**enable** | **disable**}

Step 7 Enable or disable the controller to exclude clients for all of the above reasons by entering this command:

config wps client-exclusion all {**enable** | **disable**}

Step 8 Use the following command to add or delete client exclusion entries.

config exclusionlist {**add** *mac-addr description* | **delete** *mac-addr* | **description** *mac-addr description*}

Step 9 Save your changes by entering this command:

save config

Step 10 See a list of clients that have been dynamically excluded, by entering this command:

show exclusionlist

Information similar to the following appears:

```
Dynamically Disabled Clients
```

```
----------------------------
  MAC Address             Exclusion Reason        Time Remaining (in secs)
  -----------             ----------------        ------------------------

00:40:96:b4:82:55         802.1X Failure           51
```

Step 11 See the client exclusion policy configuration settings by entering this command:

show wps summary

Information similar to the following appears:

```
Auto-Immune
 Auto-Immune..................................... Disabled

Client Exclusion Policy
  Excessive 802.11-association failures.......... Enabled
  Excessive 802.11-authentication failures....... Enabled
  Excessive 802.1x-authentication................ Enabled
  IP-theft....................................... Enabled
  Excessive Web authentication failure........... Enabled
  Maximum 802.1x-AAA failure attempts............ 3

Signature Policy
  Signature Processing....................... Enabled
```

Wi-Fi Direct Client Policy

Devices that are Wi-Fi Direct capable can connect directly to each other quickly and conveniently to do tasks such as printing, synchronization, and sharing of data. Wi-Fi Direct devices may associate with multiple peer-to-peer (P2P) devices and with infrastructure wireless LANs (WLANs) concurrently. You can use the controller to configure the Wi-Fi Direct Client Policy, on a per WLAN basis, where you can allow or disallow association of Wi-Fi devices with infrastructure WLANs, or disable Wi-Fi Direct Client Policy altogether for WLANs.

This section contains the following subsections:

Restrictions for the Wi-Fi Direct Client Policy

- Wi-Fi Direct Client Policy is applicable to WLANs that have APs in local mode only.
- Cisco APs in FlexConnect mode (even in central authentication and central switching) is not supported.
- We do not recommend enabling this feature in a mixed AP mode deployment (some APs in FlexConnect mode and some APs in local mode). Such types of deployment is not supported or tested in FlexConnect mode.
- If WLAN applied client policy is invalid, the client is excluded with the exclusion reason being 'Client QoS Policy failure'.

Configuring the Wi-Fi Direct Client Policy (GUI)

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the WLAN ID of the WLAN for which you want to configure the Wi-Fi Direct Client Policy. The **WLANs > Edit** page appears.

Step 3 Click the **Advanced** tab.

Step 4 From the **Wi-Fi Direct Clients Policy** drop-down list, choose one of the following options:

- **Disabled**—Ignores the Wi-Fi Direct status of clients thereby allowing Wi-Fi Direct clients to associate
- **Allow**—Allows Wi-Fi Direct clients to associate with the WLAN
- **Not-Allow**—Disallows the Wi-Fi Direct clients from associating with the WLAN
- **Xconnect-Not-Allow**—Enables AP to allow a client with the Wi-Fi Direct option enabled to associate, but the client (if it works according to the Wi-Fi standards) will refrain from setting up a peer-to-peer connection

Step 5 Save the configuration.

Configuring the Wi-Fi Direct Client Policy (CLI)

Procedure

Step 1 Configure the Wi-Fi Direct Client Policy on WLANs by entering this command:

config wlan wifidirect {**allow** | **disable** | **not-allow**} *wlan-id*

The syntax of the command is as follows:

- **allow**—Allows Wi-Fi Direct clients to associate with the WLAN
- **disable**—Ignores the Wi-Fi Direct status of clients thereby allowing Wi-Fi Direct clients to associate
- **not-allow**—Disallows the Wi-Fi Direct clients from associating with the WLAN
- **xconnect-not-allow**—Enables AP to allow a client with the Wi-Fi Direct option enabled to associate, but the client (if it works according to the Wi-Fi standards) will refrain from setting up a peer-to-peer connection
- *wlan-id*—WLAN identifier

Step 2 Save your configuration by entering this command:

save config

Monitoring and Troubleshooting the Wi-Fi Direct Client Policy (CLI)

Procedure

- Monitor and troubleshoot the Wi-Fi Direct Client Policy by entering theses commands:
  - **show wlan wifidirect** *wlan-id*—Displays status of the Wi-Fi Direct Client Policy on the WLAN.
  - **show client wifiDirect-stats**—Displays the total number of clients associated and the number of clients rejected if the Wi-Fi Direct Client Policy is enabled.

Limit Clients per WLAN per AP Radio

Limit Clients per WLAN per AP Radio (GUI)

- With the AP in Local mode, Cisco WLC validates the association request of all clients. Cisco WLC drops a client association request if the configured limit has been reached.
- With the AP in FlexConnect mode, both connected (local or central switching, local or central authentication) and standalone mode (local switching, local authentication), the AP validates the client admission in the authentication or reassociation phase.

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the WLAN ID.

Step 3 On the **WLANs > Edit** page, click the **Advanced** tab.

Step 4 In the **Maximum Allowed Clients** field, enter the maximum number of clients that can be allowed to join the WLAN.

Note If you enter a value of 0, this means that there is no restriction on the number of clients that are allowed to join the WLAN.

Step 5 In the **Maximum Allowed Clients Per AP Radio** field, enter the maximum number of clients that can be allowed to join the WLAN per AP radio.

Valid range is between 1 to 200 clients.

Step 6 Save the configuration.

Limit Clients per WLAN per AP Radio (CLI)

- With the AP in Local mode, Cisco WLC validates the association request of all clients. Cisco WLC drops a client association request if the configured limit has been reached.
- With the AP in FlexConnect mode, both connected (local or central switching, local or central authentication) and standalone mode (local switching, local authentication), the AP validates the client admission in the authentication or reassociation phase.

Procedure

Step 1 Configure the maximum number of clients that can be allowed to join the WLAN per AP radio by entering this command:

config wlan max-radio-clients *max-clients wlan-id*

Step 2 View the client information by entering these commands:

- On the Cisco WLC console—**show client summary**
- On the Cisco Wave 2 AP console—**show dot11 clients**

Step 3 Enable debugging on the Cisco Wave 2 AP console by entering these commands:

- Enable 802.11 event level debugging—**debug dot11 events**
- Enable 802.11 information level debugging—**debug dot11 info**

Peer-to-Peer Blocking

Peer-to-peer blocking is applied to individual WLANs, and each client inherits the peer-to-peer blocking setting of the WLAN to which it is associated. Peer-to-Peer enables you to have more control over how traffic is directed. For example, you can choose to have traffic bridged locally within the controller, dropped by the controller, or forwarded to the upstream VLAN.

Peer-to-peer blocking is supported for clients that are associated with local and central switching WLANs.

Per WLAN, peer-to-peer configuration is pushed by the controller to FlexConnect AP. In controller software releases prior to 4.2, peer-to-peer blocking is applied globally to all clients on all WLANs and causes traffic between two clients on the same VLAN to be transferred to the upstream VLAN rather than being bridged by the controller . This behavior usually results in traffic being dropped at the upstream switch because switches do not forward packets out the same port on which they are received.

This section contains the following subsections:

Restrictions on Peer-to-Peer Blocking

- Peer-to-peer blocking does not apply to multicast traffic.
- In FlexConnect, solution peer-to-peer blocking configuration cannot be applied only to a particular FlexConnect AP or a subset of APs. It is applied to all FlexConnect APs that broadcast the SSID.
- Cisco controller with central switching clients supports peer-to-peer upstream-forward. However, this is not supported in the FlexConnect solution. This is treated as peer-to-peer drop and client packets are dropped.
- Cisco controller with central switching clients supports peer-to-peer blocking for clients associated with different APs. However, this solution targets only clients connected to the same AP. FlexConnect ACLs can be used as a workaround for this limitation.

Configuring Peer-to-Peer Blocking (GUI)

Procedure

Step 1 Choose **WLANs** to open the WLANs page.

Step 2 Click the ID number of the WLAN for which you want to configure peer-to-peer blocking.

Step 3 Choose the **Advanced** tab to open the WLANs > Edit (Advanced) page.

Step 4 Choose one of the following options from the P2P Blocking drop-down list:

- **Disabled**—Disables peer-to-peer blocking and bridges traffic locally within the controller whenever possible. This is the default value.

  Note Traffic is never bridged across VLANs in the controller.

- **Drop**—Causes the controller to discard the packets.
- **Forward-UpStream**—Causes the packets to be forwarded on the upstream VLAN. The device above the controller decides what action to take regarding the packets.

  Note To enable peer-to-peer blocking on a WLAN configured for FlexConnect local switching, select **Drop** from the P2P Blocking drop-down list and select the **FlexConnect Local Switching** check box.

Step 5 Click **Apply** to commit your changes.

Step 6 Click **Save Configuration** to save your changes.

Configuring Peer-to-Peer Blocking (CLI)

Procedure

Step 1 Configure a WLAN for peer-to-peer blocking by entering this command:

config wlan peer-blocking {**disable** | **drop** | **forward-upstream**} *wlan_id*

Step 2 Save your changes by entering this command:

save config

Step 3 See the status of peer-to-peer blocking for a WLAN by entering this command:

show wlan *wlan_id*

Information similar to the following appears:

```
WLAN Identifier.................................. 1
Profile Name..................................... test
Network Name (SSID).............................. test
Status........................................... Enabled
...
...
```

```
...
Peer-to-Peer Blocking Action..................... Disabled
Radio Policy..................................... All
Local EAP Authentication..... Disabled
```

Local Policies

Controller can do profiling of devices based on protocols such as HTTP, DHCP, and so on to identify the clients. You can configure the device-based policies and enforce per-user or per-device policy on the network. The controller also displays statistics that are based on per-user or per-device end points and policies that are applicable per device. The maximum number of policies that you can configure is 64.

The policies are defined based on the following attributes:

- User group or user role
- Device type such as Windows clients, smartphones, tablets, and so on
- Service Set Identifier (SSID)
- Location, based on the access point group that the end point is connected to
- Time of the day
- Extensible Authentication Protocol (EAP) type, to check what EAP method that the client is getting connected to

When these policy attributes match, you can define the following actions:

- Virtual local area network (VLAN)
- Access control list (ACL)
- Quality of Service (QoS) level
- Session timeout value
- Sleeping client timeout value
- Select either AVC profile or role, or both based on local policy attributes defined in the AAA server.

  The following are the different ways by which local policies are applied based on a combination of AVC profile and role defined in the AAA server:

  - Both AVC profile and role are derived from the AAA server, the following options are available:
    - If AAA override is enabled, then AVC profile is prioritized and is applied.
    - If AAA override is disabled, then role matching is applied.
  - Only role is derived from the AAA server and role matching takes place, the following options are available:
    - If profile is defined in the policy, then role policy is applied.
    - If profile is not defined in the policy, then AVC profile defined in WLAN is applied.

- Only AVC profile is derived from the AAA server, the following options are available:
  - If AAA override is enabled, then AVC profile received from the AAA server is applied.
  - If AAA override is disabled, then AVC profile defined on the WLAN is applied.

This section contains the following subsections:

Guidelines and Restrictions for Local Policy Classification

- If you enable AAA override and there are AAA attributes other than the role type from the AAA server, the configured policy action is not applied. The AAA override attributes have higher precedence.
- On a WLAN, when local profiling is enabled, RADIUS profiling is not allowed.
- Client profiling uses existing profiles on the controller.
- You cannot create custom profiles.
- Wired clients behind the workgroup bridge (WGB) are not profiled and the policy action is not taken.
- Only the first policy rule which matches with the policy profile is given precedence. Each policy profile has an associated policy rule, which is used to match the policies.
- You can configure up to 64 policies, out of which you can configure up to 16 policies per WLAN.
- Policy action is taken after Layer 2 authentication is complete, or after Layer 3 authentication is complete, or when the device sends HTTP traffic and gets the device profiled. Therefore, profiling and policy actions occur more than once per client.
- Only VLAN, ACL, Session Timeout, and QoS are supported as policy action attributes.
- If you want a local policy session timeout to be applied and overridden for a WLAN, you must enable the session timeout at the WLAN with a value greater than 0.
- Profiling is performed only on IPv4 clients.
- For all the controllers in a mobility group, it is mandatory that the local policy configurations have the same match criteria attributes and action attributes. Otherwise, the local policy configuration becomes invalid when roaming occurs across the controllers.
- When local policy is configured for device type policy match and configured on a WLAN with guest anchor enabled, the AVC profile name from local policy is not applied at anchor.
- Local policies are enforced after profiling using OUI irrespective of DHCP or HTTP profiling. For more information, see CSCvp70783.

Table 2: Differences Between Cisco Identity Services Engine (ISE) and Controller Profiling Support

ISE	Controller
Supports profiling using RADIUS probes, DHCP probes, HTTP, and other protocols used to identify the client type.	Supports MAC OUI, DHCP, and HTTP-based profiling.

ISE	Controller
Supports multiple different attributes for the policy action and has an interface to pick and select each of the attributes.	Supports VLAN, ACL, Session Timeout, and QoS as policy action attributes.
Supports customization of profiling rules with user-defined attributes.	Supports only default profiling rules.

Configuring Local Policies (GUI)

Procedure

Step 1 Choose **Security** > **Local Policies**.

Step 2 Click **New** to create a new policy.

Step 3 Enter the policy name and click **Apply**.

Step 4 On the **Policy List** page, click the policy name to be configured.

Step 5 On the **Policy > Edit** page, follow these steps:

a) In the **Match Criteria** area, enter a value for **Match Role String**. This is the user type or user group of the user, for example, student, teacher, and so on.

b) From the **Match EAP Type** drop-down list, choose the EAP authentication method used by the client.

c) From the **Device Type** drop-down list, choose the device type.

d) Click **Add** to add the device type to the policy device list.

The device type you choose is listed in the **Device List**.

e) In the **Action** area, specify the policies that are to be enforced. From the **IPv4 ACL** drop-down list, choose an IPv4 ACL for the policy.

f) Enter the **VLAN ID** that should be associated with the policy.

g) From the **QoS Policy** drop-down list, choose a QoS policy to be applied.

h) Enter a value for **Session Timeout**. This is the maximum amount of time, in seconds, after which a client is forced to reauthenticate.

i) Enter a value for **Sleeping Client Timeout**, which is the timeout for sleeping clients.

Sleeping clients are clients with guest access that have had successful web authentication that are allowed to sleep and wake up without having to go through another authentication process through the login page.

This sleeping client timeout configuration overrides the WLAN-specific sleeping client timeout configuration.

j) From the **AVC Profile** drop-down list, choose an AVC profile to be applied based on the role defined in AAA.

k) In the **Active Hours** area, from the **Day** drop-down list, choose the days on which the policy has to be active.

l) Enter the **Start Time** and **End Time** of the policy.

m) Click **Add**.

The day and start time and end time that you specify is listed.

n) Click **Apply**.

What to do next

Apply a local policy that you have created to a WLAN by following these steps:

1. Choose **WLANs**.
2. Click the corresponding WLAN ID.

   The **WLANs > Edit** page is displayed.
3. Click the **Policy-Mapping** tab.
4. Enter the **Priority Index** for a policy.
5. From the **Local Policy** drop-down list, choose the policy that has to be applied for the WLAN.
6. Click **Add**.

   The priority index and the policy that you choose is listed. You can apply up to 16 policies for a WLAN.

Configuring Local Policies (CLI)

Procedure

- Create or delete a local policy by entering this command:

  config policy *policy-name* {**create** | **delete**}
- Configure a match type to a policy by entering these commands:
  - **config policy** *policy-name* **match device-type** {**add** | **delete**} *device-type*
  - **config policy** *policy-name* **match eap-type** {**add** | **delete**} {**eap-fast** | **eap-tls** | **leap** | **peap**}
  - **config policy** *policy-name* **match role** {*role-name* | *none*}
- Configure an action that has to be enforced as part of a policy by entering these commands:
  - ACL action to a policy—**config policy** *policy-name* **action acl** {**enable** | **disable**} *acl-name*
  - QoS average data rate—**config policy** *policy-name* **action average-data-rate** {**enable** | **disable**} *rate*
  - QoS average real-time data rate—**config policy** *policy-name* **action average-realtime-rate** {**enable** | **disable**} *rate*
  - QoS burst data rate—**config policy** *policy-name* **action burst-data-rate** {**enable** | **disable**} *rate*
  - QoS burst real-time data rate—**config policy** *policy-name* **action burst-realtime-rate** {**enable** | **disable**} *rate*
  - QoS action—**config policy** *policy-name* **action qos** {**enable** | **disable**} {**bronze** | **gold** | **platinum** | **silver**}
  - Session timeout action—**config policy** *policy-name* **action session-timeout** {**enable** | **disable**} *timeout-in-seconds*
  - Sleeping client timeout action—**config policy** *policy-name* **action sleeping-client-timeout** {**enable** | **disable**} *timeout-in-hours*
  - Enable AVC profile—**config policy** *policy-name* **action avc-profile-name enable** *avc-profile-name*

- Disable AVC profile—**config policy** *policy-name* **action avc-profile-name disable**
- VLAN action—**config policy** *policy-name* **action vlan** {**enable** | **disable**} *vlan-id*

Note Ensure that you configure the Average Data Rate before you configure the Burst Data Rate.

- Configure the active time for a policy by entering this command:

  config policy *policy-name* **active** {**add** | **delete**} **hours start-time end-time days** {*mon* | *tue* | *wed* | *thu* | *fri* | *sat* | *sun* | *daily* | *weekdays*}

- Apply a local policy to a WLAN by entering this command:

  config wlan policy {**add** | **delete**} *priority-index policy-name wlan-id*

- Enable or disable client profiling in local mode for a WLAN, based on HTTP, DHCP, or both by entering this command:

  config wlan profiling local {**dhcp** | **http** | **all**} {**enable** | **disable**} *wlan-id*

- Apply a local policy to an AP group of a WLAN by entering this command:

  config wlan apgroup policy {**add** | **delete**} *priority-index policy-name ap-group-name wlan-id*

- View information about a policy by entering this command:

  show policy {**summary** | *policy-name*} **statistics**

- View local device classification profile summary by entering this command:

  show profiling policy summary

- View all the clients with a type of device by entering this command:

  show client wlan *wlan-id* **device-type** *device-type*

- View a client profiling status that includes profiling done by the RADIUS server and the controller by entering this command:

  show wlan *wlan-id*

- View the policy details for AP groups by entering this command:

  show wlan apgroups

- Configure the task of debugging of policies by entering this command:

  debug policy {**error** | **event**} {**enable** | **disable**}

Updating Organizationally Unique Identifier List

Updating Organizationally Unique Identifier List (GUI)

Procedure

Step 1 Copy the latest OUI list available at http://standards.ieee.org/develop/regauth/oui/oui.txt to the default directory on your server.

Step 2 Choose **Commands** > **Download File**.

The **Download file to Controller** page is displayed.

Step 3 From the **File Type** drop-down list, choose **OUI Update**.

Step 4 From the **Transfer Mode** drop-down list, choose the server type.

The server details are displayed on the same page.

Step 5 Click **Download**.

Step 6 After the download is complete, reboot the Cisco WLC by choosing **Commands** > **Reboot**.

Step 7 If prompted to save your changes, click **Save and Reboot**.

Step 8 Click **OK**.

Updating Organizationally Unique Identifier List (CLI)

Procedure

Step 1 Copy the latest OUI list available at http://standards.ieee.org/develop/regauth/oui/oui.txt to the default directory on your server.

Step 2 Specify the server type by entering this command:

transfer download mode {**tftp** | **ftp** | **sftp**}

Step 3 Specify the file type by entering this command:

transfer download datatype oui-update

Step 4 Begin the download of the file by entering this command:

transfer download start

Note Follow the on-screen instructions to complete the download process.

Step 5 Reboot the Cisco WLC by entering this command:

reset system

Step 6 See the updated OUI list by entering this command:

show profiling oui-string summary

Note HA support for OUI update: HA link must be up while downloading the OUI file to the Active controller, so that the OUI update gets applied to the Standby controller as well.

Updating Device Profile List

Updating Device Profile List (GUI)

Procedure

Step 1 Copy the latest device profile list file to the default directory on your server.

Step 2 Choose **Commands** > **Download File**.

The **Download file to Controller** page is displayed.

Step 3 From the **File Type** drop-down list, choose **Device Profile**.

Step 4 From the **Transfer Mode** drop-down list, choose the server type.

The server details are displayed on the same page.

Step 5 Click **Download**.

Step 6 After the download is complete, reboot the Cisco WLC by choosing **Commands** > **Reboot**.

Step 7 If prompted to save your changes, click **Save and Reboot**.

Step 8 Click **OK**.

Updating Device Profile List (CLI)

Procedure

Step 1 Copy the latest device profile list file to the default directory on your server.

Step 2 Specify the server type by entering this command:
transfer download mode {**tftp** | **ftp** | **sftp**}

Step 3 Specify the file type by entering this command:
transfer download datatype device-profile

Step 4 Specify the file name by entering this command:
transfer download filename *device_profile-xml-file*

Step 5 Begin the download of the file by entering this command:
transfer download start

Note Follow the on-screen instructions to complete the download process.

Step 6 Reboot the Cisco WLC by entering this command:
reset system

Step 7 See the updated OUI list by entering this command:
show profiling policy summary

Wired Guest Access

Wired guest access enables guest users to connect to the guest access network from a wired Ethernet connection designated and configured for guest access. Wired guest access ports might be available in a guest office or through specific ports in a conference room. Like wireless guest user accounts, wired guest access ports are added to the network using the lobby ambassador feature.

Wired guest access can be configured in a standalone configuration or in a dual-controller configuration that uses both an anchor controller and a foreign controller. This latter configuration is used to further isolate wired guest access traffic but is not required for deployment of wired guest access.

Wired guest access ports initially terminate on a Layer 2 access switch or switch port configured with VLAN interfaces for wired guest access traffic. The wired guest traffic is then trunked from the access switch to a controller. This controller is configured with an interface that is mapped to a wired guest access VLAN on the access switch.

Note Although wired guest access is managed by anchor and foreign anchors when two controllers are deployed, mobility is not supported for wired guest access clients. In this case, DHCP and web authentication for the client are handled by the anchor controller.

Note You can specify the amount of bandwidth allocated to a wired guest user in the network by configuring a QoS role and a bandwidth contract.

You can create a basic peer to peer WLAN ACL and apply it to the wired guest WLAN. This will not block peer to peer traffic and the guest users can still communicate with each other.

This section contains the following subsections:

Prerequisites for Configuring Wired Guest Access

To configure wired guest access on a wireless network, you must perform the following:

1. Configure a dynamic interface (VLAN) for wired guest user access
2. Create a wired LAN for guest user access
3. Configure the controller
4. Configure the anchor controller (if terminating traffic on another controller)
5. Configure security for the guest LAN
6. Verify the configuration

Restrictions for Configuring Wired Guest Access

- Wired guest access interfaces must be tagged.
- Wired guest access ports must be in the same Layer 2 network as the foreign controller.
- Up to five wired guest access LANs can be configured on a controller. Also in a wired guest access LAN, multiple anchors are supported.
- Layer 3 web authentication and web passthrough are supported for wired guest access clients. Layer 2 security is not supported.
- Do not trunk a wired guest VLAN to multiple foreign controllers, as it might produce unpredictable results.
- The controller does not use the callStationIDType parameter configured for the Radius server while authenticating wired clients, instead the controller uses the system MAC address configured for the callStationIDType parameter.

Configuring Wired Guest Access (GUI)

Procedure

Step 1 To create a dynamic interface for wired guest user access, choose **Controller** > **Interfaces**. The Interfaces page appears.

Step 2 Click **New** to open the **Interfaces > New** page.

Step 3 Enter a name and VLAN ID for the new interface.

Step 4 Click **Apply** to commit your changes.

Step 5 In the **Port Number** text box, enter a valid port number. You can enter a number between 0 and 25 (inclusive).

Step 6 Select the **Guest LAN** check box.

Step 7 Click **Apply** to commit your changes.

Step 8 To create a wired LAN for guest user access, choose **WLANs**.

Step 9 On the WLANs page, choose **Create New** from the drop-down list and click **Go**. The **WLANs** > **New page** appears.

Step 10 From the Type drop-down list, choose **Guest LAN**.

Step 11 In the **Profile Name** text box, enter a name that identifies the guest LAN. Do not use any spaces.

Step 12 From the WLAN ID drop-down list, choose the ID number for this guest LAN.

Note You can create up to five guest LANs, so the WLAN ID options are 1 through 5 (inclusive).

Step 13 Click **Apply** to commit your changes.

Step 14 Select the **Enabled** check box for the Status parameter.

Step 15 Web authentication (Web-Auth) is the default security policy. If you want to change this to web passthrough, choose the **Security** tab after completing *Step 16* and *Step 17*.

Step 16 From the Ingress Interface drop-down list, choose the VLAN that you created in *Step 3*. This VLAN provides a path between the wired guest client and the controller by way of the Layer 2 access switch.

Step 17 From the Egress Interface drop-down list, choose the name of the interface. This WLAN provides a path out of the controller for wired guest client traffic.

Step 18 If you want to change the authentication method (for example, from web authentication to web passthrough), choose **Security** > **Layer 3**. The **WLANs > Edit (Security > Layer 3)** page appears.

Step 19 From the Layer 3 Security drop-down list, choose one of the following:

- **None**—Layer 3 security is disabled.
- **Web Authentication**—Causes users to be prompted for a username and password when connecting to the wireless network. This is the default value.
- **Web Passthrough**—Allows users to access the network without entering a username and password.

  Note There should not be a Layer 3 gateway on the guest wired VLAN, as this would bypass the web authentication done through the controller.

Step 20 If you choose the Web Passthrough option, an **Email Input** check box appears. Select this check box if you want users to be prompted for their e-mail address when attempting to connect to the network.

Step 21 To override the global authentication configuration set on the Web Login page, select the **Override Global Config** check box.

Step 22 When the Web Auth Type drop-down list appears, choose one of the following options to define the web authentication pages for wired guest users:

- **Internal**—Displays the default web login page for the controller. This is the default value.
- **Customized**—Displays custom web login, login failure, and logout pages. If you choose this option, three separate drop-down lists appear for login, login failure, and logout page selection. You do not need to define a customized page for all three options. Choose **None** from the appropriate drop-down list if you do not want to display a customized page for that option.

  Note These optional login, login failure, and logout pages are downloaded to the controller as webauth.tar files.

- **External**—Redirects users to an external server for authentication. If you choose this option, you must also enter the URL of the external server in the URL text box.

  You can choose specific RADIUS or LDAP servers to provide external authentication on the WLANs > Edit (Security > AAA Servers) page. Additionally, you can define the priority in which the servers provide authentication.

Step 23 If you chose External as the web authentication type in *Step 22*, choose **Security > AAA Servers** and choose up to three RADIUS and LDAP servers using the drop-down lists.

Note You can configure the Authentication and LDAP Server using both IPv4 and IPv6 addresses.

Note The RADIUS and LDAP external servers must already be configured in order to be selectable options on the WLANs > Edit (Security > AAA Servers) page. You can configure these servers on the RADIUS Authentication Servers page and LDAP Servers page.

Step 24 To establish the priority in which the servers are contacted to perform web authentication as follows:

Note The default order is local, RADIUS, LDAP.

a. Highlight the server type (local, RADIUS, or LDAP) that you want to be contacted first in the box next to the Up and Down buttons.

b. Click **Up** and **Down** until the desired server type is at the top of the box.

c. Click the < arrow to move the server type to the priority box on the left.

d. Repeat these steps to assign priority to the other servers.

Step 25 Click **Apply**.

Step 26 Click **Save Configuration**.

Step 27 Repeat this process if a second (anchor) controller is being used in the network.

Configuring Wired Guest Access (CLI)

Procedure

Step 1 Create a dynamic interface (VLAN) for wired guest user access by entering this command:

config interface create *interface_name vlan_id*

Step 2 If link aggregation trunk is not configured, enter this command to map a physical port to the interface:

config interface port *interface_name primary_port* {*secondary_port*}

Step 3 Enable or disable the guest LAN VLAN by entering this command:

config interface guest-lan *interface_name* {**enable | disable}**

This VLAN is later associated with the ingress interface created in *Step 5*.

Step 4 Create a wired LAN for wired client traffic and associate it to an interface by entering this command:

config guest-lan create *guest_lan_id interface_name*

The guest LAN ID must be a value between 1 and 5 (inclusive).

Note To delete a wired guest LAN, enter the **config guest-lan delete** *guest_lan_id command.*

Step 5 Configure the wired guest VLAN's ingress interface, which provides a path between the wired guest client and the controller by way of the Layer 2 access switch by entering this command:

config guest-lan ingress-interface *guest_lan_id interface_name*

Step 6 Configure an egress interface to transmit wired guest traffic out of the controller by entering this command:

config guest-lan interface *guest_lan_id interface_name*

Note If the wired guest traffic is terminating on another controller, repeat *Step 4* and *Step 6* for the terminating (anchor) controller and *Step 1* through *Step 5* for the originating (foreign) controller. Additionally, configure the **config mobility group anchor add** {**guest-lan** *guest_lan_id* | **wlan** *wlan_id} IP_address* command for both controllers.

Step 7 Configure the security policy for the wired guest LAN by entering this command:

config guest-lan security {**web-auth enable guest_lan_id** | **web-passthrough enable** *guest_lan_id*}

Note Web authentication is the default setting.

Step 8 Enable or disable a wired guest LAN by entering this command:

config guest-lan {enable | disable} *guest_lan_id*

Step 9 If you want wired guest users to log into a customized web login, login failure, or logout page, enter these commands to specify the filename of the web authentication page and the guest LAN for which it should display:

- **config guest-lan custom-web login-page** *page_name guest_lan_id—Defines a web login page.*
- **config guest-lan custom-web loginfailure-page** *page_name guest_lan_id—Defines a web login failure* page.

  Note To use the controller's default login failure page, enter the **config guest-lan custom-web loginfailure-page none** *guest_lan_id* command.

- **config guest-lan custom-web logout-page** *page_name guest_lan_id*—Defines a web logout page.

  Note To use the controller's default logout page, enter the **config guest-lan custom-web logout-page none** *guest_lan_id* command.

Step 10 If you want wired guest users to be redirected to an external server before accessing the web login page, enter this command to specify the URL of the external server:

config guest-lan custom-web ext-webauth-url *ext_web_url guest_lan_id*

Step 11 If you want to define the order in which local (controller) or external (RADIUS, LDAP) web authentication servers are contacted, enter this command:

config wlan security web-auth server-precedence *wlan_id* {**local** | **ldap** | **radius**} {**local** | **ldap** | **radius**} {**local** | **ldap** | **radius**}

The default order of server web authentication is local, RADIUS, LDAP.

Note All external servers must be preconfigured on the controller. You can configure them on the RADIUS Authentication Servers page or the LDAP Servers page.

Step 12 Define the web login page for wired guest users by entering this command:

config guest-lan custom-web webauth-type {**internal** | **customized** | **external**} *guest_lan_id*

where

- **internal** displays the default web login page for the controller. This is the default value.
- **customized** displays the custom web pages (login, login failure, or logout) that were configured in *Step 9*.
- **external** redirects users to the URL that was configured in *Step 10*.

Step 13 Use a guest-LAN specific custom web configuration rather than a global custom web configuration by entering this command:

config guest-lan custom-web global disable *guest_lan_id*

Note If you enter the **config guest-lan custom-web global enable** *guest_lan_id* command, the custom web authentication configuration at the global level is used.

Step 14 Save your changes by entering this command:

save config

Note Information on the configured web authentication appears in both the **show run-config** and **show running-config** commands.

Step 15 Display the customized web authentication settings for a specific guest LAN by entering this command:

show custom-web {all | guest-lan guest_lan_id}

Note If internal web authentication is configured, the Web Authentication Type displays as internal rather than external (controller level) or customized (WLAN profile level).

Step 16 Display a summary of the local interfaces by entering this command:

show interface summary

Note The interface name of the wired guest LAN in this example is *wired-guest* and its VLAN ID is 236.

Display detailed interface information by entering this command:

show interface detailed *interface_name*

Step 17 Display the configuration of a specific wired guest LAN by entering this command:

show guest-lan *guest_lan_id*

Note Enter the **show guest-lan summary** command to see all wired guest LANs configured on the controller.

Step 18 Display the active wired guest LAN clients by entering this command:

show client summary guest-lan

Step 19 Display detailed information for a specific client by entering this command:

show client detail *client_mac*

Supporting IPv6 Client Guest Access

The client is in WebAuth Required state until the client is authenticated. The controller intercepts both IPv4 and IPv6 traffic in this state and redirects it to the virtual IP address of the controller. Once authenticated, the user's MAC address is moved to the run state and both IPv4 and IPv6 traffic is allowed to pass.

In order to support the redirection of IPv6-only clients, the controller automatically creates an IPv6 virtual address based on the IPv4 virtual address configured on the controller. The virtual IPv6 address follows the convention of [::ffff:<virtual IPv4 address>]. For example, a virtual IP address of 192.0.2.1 would translate into [::ffff:192.0.2.1]. For an IPv6 captive portal to be displayed, the user must request an IPv6 resolvable DNS entry such as ipv6.google.com which returns a DNSv6 (AAAA) record.

Configuring Network Access Identifier (CLI)

You can configure a network access server identifier (NAS-ID) on each WLAN profile, VLAN interface, or AP group. The NAS-ID is sent to the RADIUS server by the controller through an authentication request to classify users to different groups so that the RADIUS server can send a customized authentication response.

If you configure a NAS-ID for an AP group, this NAS-ID overrides the NAS-ID that is configured for a WLAN profile or the VLAN interface. If you configure a NAS-ID for a WLAN profile, this NAS-ID overrides the NAS-ID that is configured for the VLAN interface.

- Configure a NAS-ID for a WLAN profile by entering this command:

  config wlan nasid {*nas-id-string* | **none**} *wlan-id*

- Configure a NAS-ID for a VLAN interface by entering this command:

  config interface nasid {*nas-id-string* | **none**} *interface-name*

- Configure a NAS-ID for an AP group by entering this command:

  config wlan apgroup nasid {*nas-id-string* | **none**} *apgroup-name*

When the controller communicates with the RADIUS server, the NAS-ID attribute is replaced with the configured NAS-ID in an AP group, a WLAN, or a VLAN interface.

The NAS-ID that is configured on the controller for an AP group, a WLAN, or a VLAN interface is used for authentication. The configuration of NAS-ID is not propagated across controllers.

Note If WLAN interface is overridden at AP group then overridden interface NAS ID will be used. Since Interface NASID is given priority over WLAN NAS ID.