Configuring Layer2 Security

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)
- WPA2+WPA3
- Enhanced Open

Configuring Static WEP Keys (CLI)

Controllers can control static WEP keys across access points. Use these commands to configure static WEP for WLANs:

- Disable the 802.1X encryption by entering this command:

  config wlan security 802.1X *disable wlan_id*

- Configure 40/64-bit or 104/128-bit WEP keys by entering this command:

  config wlan security static-wep-key encryption *wlan_id* {**40** | **104**} {**hex** | **ascii**} **key** *key_index*

  - Use the **40** or **104** option to specify 40/64-bit or 104/128-bit encryption. The default setting is 104/128.
  - Use the **hex** or **ascii** option to specify the character format for the WEP key.
  - Enter 10 hexadecimal digits (any combination of 0-9, a-f, or A-F) or five printable ASCII characters for 40-bit/64-bit WEP keys or enter 26 hexadecimal or 13 ASCII characters for 104-bit/128-bit keys.
  - Enter a key index (sometimes called a *key slot*). 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).

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.)

Configuring 802.11r BSS Fast Transition

Restrictions for 802.11r Fast Transition

- This feature is not supported on mesh access points.
- 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.
- This feature is not supported on Linux-based APs such as Cisco 600 Series OfficeExtend Access Points.
- 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.
- 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.

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).

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.

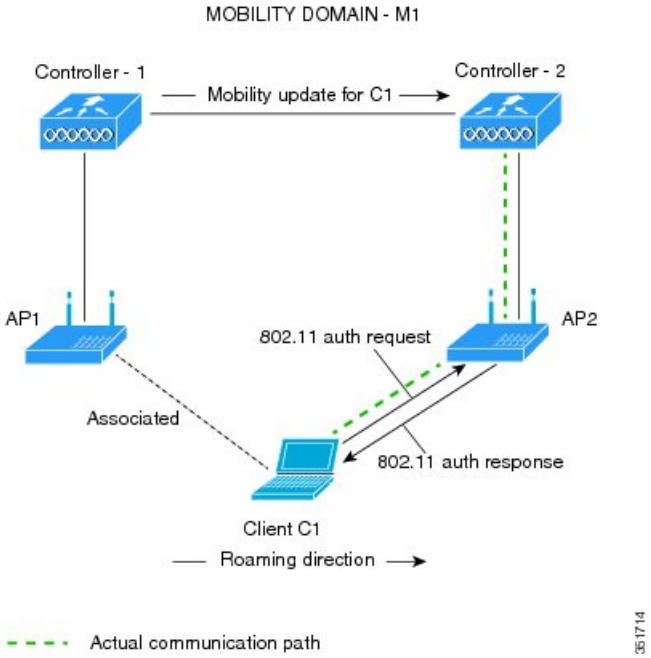
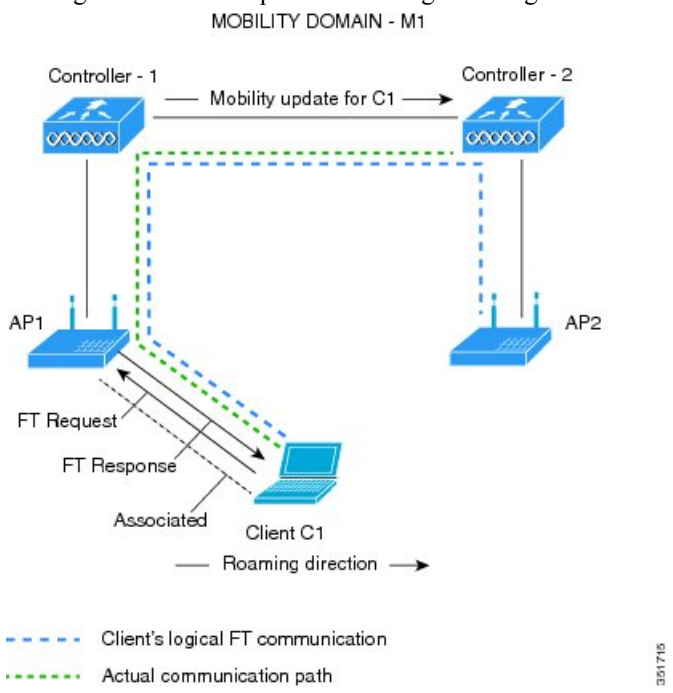


Figure 2: Message Exchanges when Over the DS client roaming is configured

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



This section contains the following subsections:

Configuring 802.11r Fast Transition (GUI)

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)

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

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.

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.
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.

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)

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)

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

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

Configuring 802.11w

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 supported on Cisco 2504, 5508, 8510, and WiSM2 WLCs.

  The 802.11w standard is not supported on Flex 7510 WLC and WLC.
- When 802.11w is set to optional and the keys are set, the AKM suite still shows 802.11w as disabled; this is a Wi-Fi limitation.
- 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.

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:

Configuring 802.11w (GUI)

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**.

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**}