



## Configuring RF Profiles

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## Prerequisites for Configuring RF Profiles

Once you create an AP group and apply RF profiles or modify an existing AP group, the new settings are in effect and the following rules become effective:

- The same RF profile must be applied and present on every controller of the AP group or the action will fail for that controller.
- You can assign the same RF profile to more than one AP group.

## Restrictions for Configuring RF Profiles

- Once you create an AP group and apply RF profiles or modify an existing AP group, the new settings are in effect and the following rules become effective:
  - AP that has a custom power setting applied for AP power is not in global mode configuration, an RF profile has no effect on this AP. For RF profiling to work, all APs must have their channel and power managed by RRM.
  - Within the AP group, changing the assignment of an RF profile on either band causes the AP to reboot.
  - Once you assign an RF profile to an AP group, you cannot make changes to that RF profile. You must change the AP group RF profile settings to none in order to change the RF profile and then

add it back to the AP group. You can also work around this restriction by disabling the network that will be affected by the changes that you will be making either for 802.11a or 802.11b.

- You cannot delete an AP group that has APs assigned to it.
  - You cannot delete an RF profile that is applied to an AP group.
- If you enable Out of Box, save the configuration, and then reboot the Cisco WLC, the status of Out of Box is changed to disabled. This behavior is observed in Cisco WiSM2, Cisco 5500 Series WLC, and Cisco 2500 Series WLC. The workaround is to enable Out of Box again after you reboot the Cisco WLC.

## Information About RF Profiles

RF Profiles allows you to tune groups of APs that share a common coverage zone together and selectively change how RRM will operate the APs within that coverage zone.

For example, a university might deploy a high density of APs in an area where a high number of users will congregate or meet. This situation requires that you manipulate both data rates and power to address the cell density while managing the co-channel interference. In adjacent areas, normal coverage is provided and such manipulation would result in a loss of coverage.

Using RF profiles and AP groups allows you to optimize the RF settings for AP groups that operate in different environments or coverage zones. RF profiles are created for the 802.11 radios. RF profiles are applied to all APs that belong to an AP group, where all APs in that group will have the same profile settings.

The RF profile gives you the control over the data rates and power (TPC) values.

**Note**

The application of an RF profile does not change the AP's status in RRM. It is still in global configuration mode controlled by RRM.

To address high-density complex RF topologies, the following configurations are available:

- High Density Configurations—The following configurations are available to fine tune RF environments in a dense wireless network:
  - Client limit per WLAN or radio—Maximum number of clients that can communicate with the AP in a high-density environment.
  - Client trap threshold—Threshold value of the number of clients that associate with an access point, after which an SNMP trap is sent to the controller and Cisco Prime Infrastructure.
- Stadium Vision Configurations—You can configure the following parameter:
  - Multicast data rates—Configurable data rate for multicast traffic based on the RF condition of an AP.
- Out-of-Box AP Configurations—To create an Out-of-Box AP group that consists of newly installed access points that belong to the default AP group. When you enable this feature:
  - Newly installed access points (assigned to the 'default-group' AP group by default) are automatically assigned to the Out-of-Box AP group upon associating with the controller, and their radios are administratively disabled. This eliminates any RF instability caused by the new access points.

- When Out-of-Box is enabled, default-group APs currently associated with the controller remain in the default group until they reassociate with the controller.
- All default-group APs that subsequently associate with the controller (existing APs on the same controller that have dropped and reassociated, or APs from another controller) are placed in the Out-of-Box AP group.

**Note**


When removing APs from the Out-of-Box AP group for production use, we recommend that you assign the APs to a custom AP group to prevent inadvertently having them revert to the Out-of-Box AP group.

- Special RF profiles are created per 802.11 band. These RF profiles have default settings for all the existing RF parameters and additional new configurations.

**Note**

When you disable this feature after you enable it, only subscription of new APs to the Out of Box AP group stops. All APs that are subscribed to the Out of Box AP Group remain in this AP group. The network administrators can move such APs to the default group or a custom AP group upon network convergence.

- **Band Select Configurations**—Band Select addresses client distribution between the 2.4-GHz and 5-GHz bands by first understanding the client capabilities to verify whether a client can associate on both 2.4-GHz and 5-GHz spectrum. Enabling band select on a WLAN forces the AP to do probe suppression on the 2.4-GHz band that ultimately moves dual band clients to 5-GHz spectrum. You can configure the following band select parameters per AP Group:
  - **Probe response**—Probe responses to clients that you can enable or disable.
  - **Probe Cycle Count**—Probe cycle count for the RF profile. The cycle count sets the number of suppression cycles for a new client.
  - **Cycle Threshold**—Time threshold for a new scanning RF Profile band select cycle period. This setting determines the time threshold during which new probe requests from a client come in a new scanning cycle.
  - **Suppression Expire**—Expiration time for pruning previously known 802.11b/g clients. After this time elapses, clients become new and are subject to probe response suppression.
  - **Dual Band Expire**—Expiration time for pruning previously known dual-band clients. After this time elapses, clients become new and are subject to probe response suppression.
  - **Client RSSI**—Minimum RSSI for a client to respond to a probe.
- **Load Balancing Configurations**—Load balancing maintains fair distribution of clients across APs. You can configure the following parameters:
  - **Window**—Load balancing sets client association limits by enforcing a client window size. For example, if the window size is defined as 3, assuming fair client distribution across the floor area, then an AP should have no more than 3 clients associated with it than the group average.
  - **Denial**—The denial count sets the maximum number of association denials during load balancing.

- Coverage Hole Mitigation Configurations—You can configure the following parameters:
    - Data RSSI—Minimum receive signal strength indication (RSSI) value for data packets received by the access point. The value that you enter is used to identify coverage holes (or areas of poor coverage) within your network.
    - Voice RSSI—Minimum receive signal strength indication (RSSI) value for voice packets received by the access point.
    - Coverage Exception—Minimum number of clients on an access point with an RSSI value at or below the data or voice RSSI threshold to trigger a coverage hole exception.
    - Coverage Level—Percentage of clients on an access point that are experiencing a low signal level but cannot roam to another access point. If an access point has more number of such clients than the configured coverage level it triggers a coverage hole event.
  - DCA—You can configure the following DCA parameters:
    - Avoid foreign AP interference—DCA algorithm bases its optimization on multiple sets of inputs, which include detected traffic and interference from foreign 802.11 traffic access points. Each access point periodically measures interference, noise level, foreign interference, and load and maintains a list of neighbor APs. Foreign AP interference is that which is received from 802.11 non-neighbors (i.e. 802.11 APs which are not in the same RF domain – for instance a foreign 802.11 network). This interference is measured using the same mechanism as the noise level.  
  
Due to being out of the reach of the radio resource management module of the current deployment, such AP's may be disruptive for RRM and hence the user is able to unselect their contribution to DCA in an RF profile to disable this feature.
    - Channel width—You can choose one of the following channel width options to specify the channel bandwidth supported for all 802.11n and 802.11ac radios in the 5-GHz band:
      - 20 MHz—The 20-MHz channel bandwidth (default)
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**Note** The maximum bandwidth allowed for the 2.4-GHz band is 20MHz.

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- 40 MHz—The 40-MHz channel bandwidth
  - 80 MHz—The 80-MHz channel bandwidth
  - DCA channel list—You can choose a channel set used by DCA to assign one of the channels to an access point radio. The channel set selected for an RF profile must be a subset of the DCA global channel list. The available channels are preselected based on the globally configured countries. DCA compares the metrics measured on these channels and selects the most suitable channel. If the bandwidth is larger than 20 MHz, channel bonding takes place in sequential channels. For example, if the bandwidth is 40 MHz, the selected pair is 36 MHz and 40 MHz. For a higher bandwidth such as 80-MHz, the bandwidths selected are 36, 40, 44, and 48 MHz.
  - Auto switch-over on Radar detection—With the enhancements made in DFS architecture, radar trigger on the serving channel AP will move to a new best channel that is conformed by RRM Dynamic Channel Assignment (DCA) list. The channel width applied to such AP will also follow respective DCA channel width settings configured globally or under RF Profiles (if configured).
  - Trap thresholds—The profile threshold for the traps can be configured for the specific AP groups based on the RF profiles.

## Configuring an RF Profile (GUI)

- Step 1** Choose **Wireless > RF Profiles** to open the RF profiles page.
- Step 2** To configure the out-of-box status for all RF profiles, select or unselect the **Enable Out Of Box** check box.
- Step 3** Click **New**.
- Step 4** Enter the RF Profile Name and choose the radio band.
- Step 5** Click **Apply** to configure the customizations of power and data rate parameters.
- Step 6** In the **General** tab, enter the description for the RF profile in the Description text box.
- Step 7** In the **802.11** tab, configure the data rates to be applied to the APs of this profile.
- Step 8** In the **RRM** tab, do the following:
- In the TPC area, configure the Maximum and Minimum Power Level Assignment, that is the maximum and minimum power that the APs in this RF profile are allowed to use.
  - In the TPC area, configure a custom TPC power threshold for either Version1 or Version 2 of TPC.  
**Note** Only one version of TPC can be operable for RRM on a given controller Version 1 and Version 2 are not interoperable within the same RF profile. If you select a threshold value for TPCv2 and it is not in the chosen TPC algorithm for the RF profile, this value will be ignored.
  - In the Coverage Hole Detection area, configure the voice and data RSSI.
  - In the Coverage Exception text box, enter the number for clients.
  - In the Coverage Level text box, enter the percentage.
  - In the Profile threshold for Traps area, enter the interference percentage, number of clients, noise level, and utilization percentage.
  - In the DCA area, select the Avoid Foreign AP interference **Enabled** check box to avoid foreign AP interference.
  - In the High-Speed Roam area, select the HSR mode **Enabled** check box to optimize high-speed roaming.
  - In the High-Speed Roam area, enter the neighbor timeout factor.
  - In the DCA area, choose one of the following channel width options to specify the channel bandwidth supported for all 802.11n and 802.11 ac radios in the 5-GHz band:
    - **20 MHz**—The 20-MHz channel bandwidth (default)
    - **40 MHz**—The 40-MHz channel bandwidth
    - **80 MHz**—The 80-MHz channel bandwidth
  - In the DCA area, the DCA Channels text box shows the channels that are currently selected. To choose a channel, select its check box in the Select column. To exclude a channel, unselect its check box. The channel numbers listed are applicable only for that particular RF profile.  
The ranges are as follows:
    - 802.11a—36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 132, 136, 140, 149, 153, 157, 161, 165, 190, 196
    - 802.11b/g—1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
- The defaults are as follows:
- 802.11a—36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 132, 136, 140, 149, 153, 157, 161

- 802.11b/g—1, 6, 11

**Note** If you are upgrading from a release earlier than Release 8.0, verify that these channels are included in the DCA channel list.

**Step 9** In the **High Density** tab, do the following:

- In the High Density Parameters area, enter the maximum number of clients to be allowed per AP radio and the client trap threshold value.
- In the Multicast Parameters area, choose the data rates from the Multicast Data Rates drop-down list.

**Step 10** In the **Client Distribution** tab, do the following:

- In the Load Balancing area, enter the client window size and the denial count.  
The window size becomes part of the algorithm that determines whether an access point is too heavily loaded to accept more client associations:

*load-balancing window + client associations on AP with the lightest load = load-balancing threshold*

In the group of access points accessible to a client device, each access point has a different number of client associations. The access point with the lowest number of clients has the lightest load. The client window size plus the number of clients on the access point with the lightest load forms the threshold. Access points with more client associations than this threshold is considered busy, and clients can associate only to access points with client counts lower than the threshold.

The denial count sets the maximum number of association denials during load balancing.

- In the Band Select area, select or unselect the **Probe Response** check box.

**Note** The Band Select configurations are available only for the 802.11b/g RF profiles.

- In the Cycle Count text box, enter a value that sets the number of suppression cycles for a new client. The default count is 2.
- In the Cycle Threshold text box, enter a time period in milliseconds that determines the time threshold during which new probe requests from a client from a new scanning cycle. The default cycle threshold is 200 milliseconds.
- In the Suppression Expire text box, enter a time period after which the 802.11 b/g clients become new and are subject to probe response suppression.
- In the Dual Band Expire text box, enter a time period after which the dual band clients become new and are subject to probe response suppression.
- In the Client RSSI text box, enter the minimum RSSI for a client to respond to a probe.

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

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

## Configuring an RF Profile (CLI)

**Step 1** To configure the out-of-box status for all RF profiles, enter this command:  
**config rf-profile out-of-box {enable | disable}**

**Step 2** To create or delete an RF profile, enter this command:  
**config rf-profile {create {802.11a | 802.11b} | delete} profile-name**

- Step 3** To specify a description for the RF profile, enter this command:  
**config rf-profile description** *text profile-name*
- Step 4** To configure the data rates to be applied to the APs of this profile, enter this command:  
**config rf-profile data-rates** {802.11a | 802.11b} {disabled | mandatory | supported} *rate profile-name*
- Step 5** To configure the maximum and minimum power level assignment, that is the maximum and minimum power that the APs in this RF profile are allowed to use, enter this command:  
**config rf-profile** {tx-power-max | tx-power-min} *power-value profile-name*
- Step 6** To configure a custom TPC power threshold for either Version 1 or Version 2 of TPC, enter this command:  
**config rf-profile** {tx-power-control-thresh-v1 | tx-power-control-thresh-v2} *power-threshold profile-name*
- Step 7** To configure the coverage hole detection parameters:
- a) To configure the coverage data, enter this command:  
**config rf-profile coverage data** *value-in-dBm profile-name*
  - b) To configure the minimum client coverage exception level, enter this command:  
**config rf-profile coverage exception** *clients profile-name*
  - c) To configure the coverage exception level percentage, enter this command:  
**config rf-profile coverage level** *percentage-value profile-name*
  - d) To configure the coverage of voice, enter this command:  
**config rf-profile coverage voice** *value-in-dBm profile-name*
- Step 8** To configure the maximum number of clients to be allowed per AP radio, enter this command:  
**config rf-profile max-clients** *num-of-clients profile-name*
- Step 9** To configure the client trap threshold value, enter this command:  
**config rf-profile client-trap-threshold** *threshold-value profile-name*
- Step 10** To configure multicast, enter this command:  
**config rf-profile multicast data-rate** *rate profile-name*
- Step 11** To configure load balancing, enter this command:  
**config rf-profile load-balancing** {window *num-of-clients* | denial *value*} *profile-name*
- Step 12** To configure band select:
- a) To configure the band select cycle count, enter this command:  
**config rf-profile band-select cycle-count** *max-num-of-cycles profile-name*
  - b) To configure the cycle threshold, enter this command:  
**config rf-profile band-select cycle-threshold** *time-in-milliseconds profile-name*
  - c) To configure the expiry of the band select, enter this command:  
**config rf-profile band-select expire** {dual-band | suppression} *time-in-seconds profile-name*
  - d) To configure the probe response, enter this command:  
**config rf-profile band-select probe-response** {enable | disable} *profile-name*
  - e) To configure the minimum RSSI for a client to respond to a probe, enter this command:  
**config rf-profile band-select client-rssi** *value-in-dBm profile-name*
- Step 13** Configure the 802.11n only mode for an access point group base by entering this command:

**config rf-profile 11n-client-only** {enable | disable} *rf-profile-name*

In the 802.11n only mode, the access point broadcasts support for 802.11n speeds. Only 802.11n clients are allowed to associate with the access point

**Step 14** To configure the DCA parameters for an RF profile:

- To configure foreign AP interference, enter this command:  
**config rf-profile channel foreign** { enable | disable } *profile-name*
- To configure channel width, enter this command:  
**config rf-profile channel foreign** { enable | disable } *profile-name*
- To configure a DCA channel list, enter this command:  
**config rf-profile channel** { add | delete } *chan profile\_name*
- To configure trap threshold, enter this command:  
**config rf-profile trap-threshold** { clients | interference | noise | utilization } *profile-name*
  - **clients**—The number of clients on an access point's radio for the trap is between 1 and 200. The default is 12.
  - **interference**—The percentage of interference threshold for the trap is from 0 to 100 percent. The default is 10 percent.
  - **noise**—The noise threshold for the trap is from -127 to 0 dBm. The default is -17 dBm.
  - **utilization**—The percentage of bandwidth being used by an access-point threshold for the trap is from 0 to 100 percent. The default is 80 percent.

## Applying an RF Profile to AP Groups (GUI)

**Step 1** Choose **WLANs > Advanced > AP Groups** to open the AP Groups page.

**Step 2** Click the AP Group Name to open the AP Group > Edit page.

**Step 3** Click the **RF Profile** tab to configure the RF profile details. You can choose an RF profile for each band (802.11a/802.11b) or you can choose just one or none to apply to this group.

**Note** Until you choose the APs and add them to the new group, no configurations are applied. You can save the new configuration as is, but no profiles are applied. Once you choose the APs to move the AP group, the process of moving the APs into the new group reboots the APs and the configurations for the RF profiles are applied to the APs in that AP group.

**Step 4** Click the **APs** tab and choose the APs to add to the AP group.

**Step 5** Click **Add APs** to add the selected APs to the AP group. A warning message displays that the AP group will reboot the APs will rejoin the controller.

**Note** APs cannot belong to two AP groups at once.



**Step 6** Click **Apply**. The APs are added to the AP Group.

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## Applying RF Profiles to AP Groups (CLI)

### What to Do Next

Use this command to apply RF profiles to AP groups:

- **config wlan apgroup profile-mapping {add | delete} *ap-group-name rf-profile-name***

