Cisco Flexible Radio Assignment

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Flexible radio assignments

A Flexible Radio Assignment (FRA) is a configuration management feature that

- adapts AP radio hardware for multiple roles
- manages various Cisco AP models like Cisco Aironet 2800 Series Access Points, Cisco Aironet 3800 Series Access Points, and other APs in Catalyst series, and
- optimizes client experience by adapting radio roles based on client capabilities

FRA takes advantage of the dual-band radios included in APs. The FRA is a new feature added to the RRM to analyze the Neighbor Discovery Protocol (NDP) measurements, which manages the hardware used to determine the role of the new flexible radio (2.4 GHz, 5 GHz, or monitor) in your network.

Traditional legacy dual–band APs always had 2 radio slots, (1 slot per band) and were organized by the band they were serving, that is slot 0= 802.11b,g,n and slot 1=802.11a,n,ac.

Benefits of the FRA

- Solves the problem of 2.4–GHz over coverage.
- Creates two distinct 5–GHz cells to double available airtime.
- Permits one AP with one Ethernet drop to function like two 5–GHz APs.
- Introduces the concept of macro and micro cells for airtime efficiency.
- Allows more bandwidth to be applied to an area within a larger coverage cell.
- Addresses nonlinear traffic distribution.

- Enhances the High-Density Experience (HDX) with one AP.
- Allows XOR radios to serve client or monitor roles based on configuration.

XOR support in 2.4-GHz or 5-GHz bands

XOR support increases flexibility in AP operations by offering capabilities to serve various frequency bands and monitor radio signals, thereby optimizing network coverage and efficiency.

The flexible radio (XOR) offers the ability to serve the 2.4-GHz or the 5-GHz bands, or passively monitor both bands on the same AP.

- AP models supporting dual 5-GHz band operations:
  - *i* model supports a dedicated Macro/Micro architecture.
  - *e* and *p* models support Macro/Macro architecture.
- FRA with internal antenna (*i* series models) allows two 5-GHz radios in Micro/Macro cell mode.
- FRA with external antenna (*e* and *p* models) enables creation of two separate macro or micro cells for HDX.
- FRA calculates redundancy for 2.4-GHz radios with a metric called COF (Coverage Overlap Factor).
- Feature integration in RRM for mixed environments and AP **AP MODE** selections include:
  - Local Mode
  - Monitor Mode
  - FlexConnect Mode
  - Sniffer Mode
  - Spectrum Connect Mode

Before XOR was introduced, mode changes affected the entire AP (both radio slot 0 and slot 1). The XOR addition allows operation of a single radio interface independently, known as *roles*:

- Client Serving
- Either 2.4 GHz(1) or 5 GHz(2)
- Monitor-Monitor mode (3)

Note

- Mode: Assigned to a whole AP (slot 0 and slot 1)
- Role: Assigned to a single radio interface (slot 0)

Flexible radio assignments

A flexible radio assignment is a configuration management feature that

- adapts AP radio hardware for multiple roles
- manages various Cisco AP models such as Cisco Aironet 2800 series, Cisco Aironet 3800 series, and Catalyst series, and
- optimizes client experience by adapting radio roles based on client capabilities.

Feature history

Release	Feature	Feature Information
Cisco IOS XE 17.11.1	Convert Redundant 2.4-GHz Radios to Monitor Mode	From this release, you can select the redundant dual-band radios in a network to operate in monitor only mode.
Cisco IOS XE 17.9.1	Support for Cisco Catalyst 9166I Series Wi-Fi 6E Access Points	From this release onwards, the dual-band radio in Cisco Catalyst 9166I Series Wi-Fi 6E Access Points offers the ability to serve either in 5-GHz or 6-GHz band, as monitor or sniffer on the same AP.
Cisco IOS XE 16.10.1	Flexible Radio Assignment	This feature was introduced.

FRA role selection by AP model and client capability

FRA performs multiple roles depending on the AP model and capabilities. FRA dynamically adjusts radio roles to optimize client performance and network coverage.

FRA configuration modes

All FRA-capable models support these configuration options:

- Automatic: Allows FRA to manage role selection automatically.
- Client Serving: Manual role selection of 2.4-GHz, 5-GHz, or 6-GHz. FRA is not engaged.
- Monitor: Manual role selection. FRA is not engaged.
- Sniffer: Manual role selection. FRA is not engaged.

2.4-GHz and 5-GHz XOR models

FRA establishes the required 2.4-GHz coverage, identifies redundant radios, and converts them to either 5-GHz or a monitor role.

Tri-radio and 5/6-GHz XOR models

FRA determines the 2.4-GHz coverage, and the redundant radios are converted to a monitor role.

Role selection based on client capabilities

5-GHz Tri-Radio: FRA determines the best operating role for the 5-GHz tri-radio (as either a single 8x8 or a dual 4x4), based on connected client capabilities.

5/6-GHz XOR Radios: For the 5/6-GHz XOR radio, the band that the radios should operate on is based on the availability of 6-GHz client presence in the regulatory domain.

FRA client steering and load balancing

FRA works with client steering to optimize how clients connect across available radios.

FRA also manages the resulting configurations of the radios to optimize client experience across flexible roles. Client Steering is responsible for load balancing client connections. For instance, from Cisco Aironet 2800 APs through Cisco Catalyst 9120 Series APs, all the internal antenna AP models perform dual 5-GHz roles as a Macro-Micro cell (a cell within a cell). The antennas on these models are built to support the directionality needed for the micro cell. FRA client steering helps to steer clients to the appropriate radio based on their position within the cell (closer clients are put on the micro cell).

Macro-macro radio layouts

The FRA APs that support external antennas operate as Macro-Macro, which allows full control over power and channels.

FRA on Cisco Catalyst 9130

In Cisco Catalyst 9130 APs , FRA also manages the operating mode of the band-locked 8x8 5-GHz tri-radio by monitoring client capabilities of connected clients. Mode selection depends on the client types.

Wi-Fi 5 clients: For instance, if the attached clients are largely Wi-Fi 5-capable clients, then, beam forming should be multi-user MIMO (MU-MIMO), ensuring better capacity with dual 4x4 5-GHz cells.

Wi-Fi 6 clients:

FRA on CW9166 AP

AP models and types of hardware managed by FRA

To provide comprehensive details on the AP models and types of hardware managed by Flexible Radio Assignment (FRA) technology, enabling users to identify the appropriate access points for their specific wireless network needs and configurations.

AP Model	FRA Radios	Functions
Cisco Aironet 2800 Series Access Points	2.4/5 XOR	2.4-GHz and 5-GHz or dual 5-GHz operations
Cisco Aironet 3800 Series Access Points	2.4/5 XOR	2.4-GHz and 5-GHz or dual 5-GHz operations

AP Model	FRA Radios	Functions
Cisco Aironet 4800 Series Access Points	2.4/5 XOR	2.4-GHz and 5-GHz or dual 5-GHz operations
Cisco Catalyst 9120 Series Access Points	2.4/5 XOR	2.4-GHz and 5-GHz or dual 5-GHz operations
Cisco Catalyst 9130AX Series Access Points	5-GHz Tri-Radio	2.4-GHz 4x4 and single 5-GHz 8x8, or 2.4-GHz 4x4 and dual 5-GHz 4x4

Configure FRA Radio (CLI)

Procedure

Step 1 Enable privileged EXEC mode

Example:

```
Device# enable
```

Enters privileged EXEC mode.

Step 2 Enter configuration mode

Example:

```
Device# configure terminal
```

Enters global configuration mode.

Step 3 Enable or disable FRA

Example:

```
Device(config)# [no] ap fra
```

Enables or disables FRA on the AP.

Step 4 Configure FRA interval

Example:

```
Device(config)# ap fra interval 3
```

Configures the FRA interval in hours. The range is 1 to 24 hours.

Note
The FRA interval has to be more than the configured RRM interval.

Step 5 Configure the FRA sensitivity

Example:

```
Device(config)# ap fra sensitivity high
```

Configures the FRA sensitivity.

- **high**: Sets the FRA Coverage Overlap Sensitivity to **high**.
- **medium**: Sets the FRA Coverage Overlap Sensitivity to **medium**.
- **low**: Sets the FRA Coverage Overlap Sensitivity to **low**.

Step 6 Exit global configuration mode

Example:

```
Device(config)# end
```

Returns to privileged EXEC mode. Alternatively, you can also press **Ctrl-Z** to exit global configuration mode.

Step 7 Reverts to XOR radio state

Example:

```
Device# ap fra revert all auto
```

Rolls back the XOR Radio state.

- **all**: Reverts all XOR Radios
- **auto-only**: Revert only XOR radios currently in automatic band selection.
- **auto**: Sets the XOR radios in automatic band selection.
- **static**: Sets the XOR radio in static 2.4-GHz band.

Step 8 View the configuration and statistics of 802.11 APs

```
Device# show ap dot11 5ghz summary
```

Shows the configuration and statistics of 802.11 Cisco APs

Step 9 View the current FRA configuration

Example:

```
Device# show ap fra

FRA State                                          : Disabled
FRA Sensitivity                                    : medium (95%)
FRA Interval                                       : 1 Hour(s)

AP Name              MAC Address       Slot ID  Current-Band      COF %      Suggested Mode
-----------------------------------------------------------------------------------------
AP00A6.CA36.295A     006b.f09c.8290    0        2.4GHz             None       2.4GHz

COF : Coverage Overlap Factor

test_machine#
```

Shows the current FRA configuration.

Step 10 View the current 802.11 dual-band parameters

Example:

```
Device# show ap name config dot11 dual-band
```

Shows the current 802.11 dual-band parameters in a given AP.

Configure FRA radio (GUI)

The purpose of configuring the FRA radio is to optimize the radio assignment for overlapping coverage areas, improving network efficiency and performance. This includes enabling the Flexible Radio Assignment (FRA) status, setting intervals, and adjusting sensitivity levels to ensure optimal coverage.

Procedure

Step 1 Choose **Configuration** > **Radio Configurations** > **RRM** > **FRA**.

Step 2 In the **Flexible Radio Assignment** window, enable FRA status and determine the overlapping 2.4 GHz or 5 GHz coverage for each AP, choose **Enabled** in the **FRA Status** field. By default, the FRA status is disabled.

Step 3 Under the From the **FRA Interval** drop-down list, choose the FRA run interval. The interval values range from 1 hour to 24 hours. Choose the FRA run interval value only after you enable the FRA status.

Step 4 From the **FRA Sensitivity** drop-down list, choose the percentage of Coverage Overlap Factor (COF) required to consider a radio as redundant. You can select the supported value only after you enable the FRA status.

The supported values are as follows:

- Low: 100 percent
- Medium (default): 95 percent
- High: 90 percent

The **Last Run** and **Last Run Time** fields will show the time FRA was run last and the time it was run.

Step 5 Check the **Client Aware** check box to take decisions on redundancy.

When enabled, the **Client Aware** feature monitors the dedicated 5-GHz radio and when the client load passes a pre-set threshold, automatically changes the Flexible Radio assignment from a monitor role into a 5-GHz role, effectively doubling the capacity of the cell on demand. Once the capacity crisis is over and Wi-Fi load returns to normal, the radios resume their previous roles.

Step 6 In the **Client Select** field, enter a value for client selection. The valid values range between 0 and 100 percent. The default value is 50 percent.

This means that if the dedicated 5-GHz interface reaches 50% channel utilization, this will trigger the monitor role dual-band interface to transition to a 5-GHz client-serving role.

Step 7 In the **Client Reset** field, enter a reset value for the client. The valid values range between 0 and 100 percent. The default value is 5 percent.

Once the AP is operating as a dual 5-GHz AP, this setting indicates the reduction in the combined radios' overall channel utilization required to reset the dual-band radio to monitor role.

Step 8 Click **Apply** to save the configuration.

After completing the configuration, the FRA system will be active, improving the radio coverage efficiency by managing overlapping frequencies and enhancing redundancy decisions. This results in better utilization of network resources and coverage optimization.

Flexible Radio Assignment (FRA) Action

Flexible radio assignment actions

Flexible Radio Assignment (FRA) evaluates 2.4-GHz radio coverage to identify overlapping coverage causing radio interference. If there is an overlapping coverage, the dual-band radio moves to either 5-GHz client serving or monitor role.

Feature history for flexible radio assignment action

Table 1: Feature history for FRA Action

Release	Feature	Feature information
Cisco IOS XE Dublin 17.10.1	Flexible Radio Assignment (FRA) Action	In Cisco IOS-XE 17.10.1 and earlier releases, the FRA moves the redundant dual-band radios to either 5-GHz client-serving role or monitor role.
Cisco IOS XE Dublin17.11.1	Flexible Radio Assignment (FRA) Action	From Cisco IOS-XE 17.11.1 onwards, you can select the redundant dual-band radios in a network to operate in monitor only mode.

Release Information

In Cisco IOS-XE 17.10.1 and earlier releases, the FRA moves the redundant dual-band radios to either 5-GHz client-serving role or monitor role. From Cisco IOS-XE 17.11.1 onwards, you can set redundant dual-band radios in a network to operate in monitor-only mode.

Note The FRA action feature is disabled by default.

Configure FRA action in default RF profile (CLI)

Configure the FRA action in the default RF profile to optimize radio frequency management.

Procedure

Step 1 Configure terminal

Example:

```
Device# configure terminal
```

Enters global configuration mode.

Step 2 Configure the FRA action

Example:

```
Device(config)# ap dot11 24ghz fra action monitor
```

Configures the FRA action to monitor mode, moving all redundant dual-band APs solely to the monitor role.

Step 3 Exit configuration mode

Example:

```
Device(config)# end
```

Exits configuration mode and returns to privileged EXEC mode.

Upon completion, the FRA action is set, redundancy in dual-band radios is handled efficiently, and the system returns to privileged EXEC mode.

Configure FRA action in 2.4-GHz RF profile (CLI)

Procedure

Step 1 Configure terminal

Example:

```
Device# configure terminal
```

Enters global configuration mode

Step 2 Configure the RF profile name

Example:

```
Device(config)# ap dot11 24ghz rf-profile alpha-rfprofile-24ghz
```

Configures the RF profile name and enters RF profile configuration mode.

Step 3 Configure the FRA action as monitor

Example:

```
Device(config-rf-profile)# fra action monitor
```

Configures the FRA action as monitor, and moves all redundant dual-band radios to monitor role only.

Step 4 Exit configuration mode

Example:

```
Device(config-rf-profile)# end
```

Exits configuration mode and returns to privileged EXEC mode.

Verify FRA action configuration

To view the selected FRA action, use the following command:

```
Device# show ap fra
FRA State              : Enabled
FRA Freeze             : Disabled
FRA Operation State    : Up
FRA Sensitivity        : higher (85%)
FRA Interval           : 1 Hour(s)
Service Priority       : Coverage
Client Aware FRA       : Enabled
  Client Select        : 25%
  Client Reset         : 5%
FRA Action             : 2.4GHz/Monitor
  Last Run             : 3069 seconds ago
```

To view the FRA action details in an AP RF profile, use the following command:

```
Device# show ap rf-profile name madhu-rf-profile-24 detail | sec FRA
Client Aware FRA                 : Disabled
FRA Action                       : 2.4GHz/Monitor
```

To view the radio mode and role in an AP, use the following command:

```
Device# show ap name AP7872.5DED.CB74 config slot 0 | sec Attribute
Attributes for Slot 0
  Radio Type                                    : 802.11n - 2.4/5 GHz
  Radio Mode                                    : Monitor
  Radio Role                                    : Monitor
    Assignment Method                           : Auto
    Monitor Mode Reason                         : Automatically Switched by FRA
```