



Flexible Radio Assignment (FRA) and Redundant Radios

What does FRA do?

Cisco's Flexible Radio Assignment (FRA) is a new feature introduced in Release 8.2.110.0 to take advantage of the hardware released in the Cisco AP 3800/2800. FRA is a new core algorithm added to RRM to analyze the NDP measurements and manage the hardware used to determine the Role the new Flexible Radio (2.4 GHz, 5 GHz, or Monitor) will play in your network. There are many new and exciting functions integrated into RRM to cover, and we will cover them all here.

Before we start, the Dual-Band radio is a new product concept creating a flexible AP hardware architecture. Traditional legacy dual band APs have always had 2 radio slots, 1 per band and were organized by the band they were serving - slot0= 802.11b,g,n and slot1=802.11a,n,ac. The Dual-Band (XOR) radio offers the ability to serve either the 2.4 or 5 GHz bands or passively monitor both bands on the same AP. The AP models offered are designed to support dual 5 GHz band operations with the I model supporting a dedicated Macro/Micro architecture and the E and P models supporting Macro/Macro. This will be discussed in detail later - for now understand that the model offerings are designed specifically for different use cases which will be covered.

Cisco's FRA does 3 things:

- Calculates and maintains a measurement of redundancy for 2.4 GHz radios and represents this as a new measurement metric called COF (Coverage Overlap Factor)
- Manages radio “role” assignment or re-assignment for interfaces that are marked as redundant interfaces
- For Macro/Micro implementations (2800/3800 I models) FRA Manages Client load balancing across dual 5 GHz interfaces (Macro/Micro Transition)

Before jumping into the detail, a few name changes need to be covered. FRA is tightly integrated into existing RRM and will have to run in mixed environments with legacy AP's. There are some new naming conventions and behaviors to cover conceptually in order to have a clear understanding of the new operations. The AP MODE is an existing concept that required some modification. The Mode selection sets the entire AP (slot 0 and slot1) into one of several operating modes including:

- Local Mode
- Monitor Mode
- Flex Connect Mode
- Sniffer Mode

- Spectrum Connect Mode

Under the new FRA architecture - these "MODES" are still present and function as they always have. Changing an AP's mode - assumes that you will propagate that change to the entire AP, both radio slots 0/1. This changes with the 2800/3800 AP's. With the addition of the Flexible (XOR) radio in the slot0 position - we now have the ability to operate a single radio interface in many of the previous modes. There is no longer a need to place the whole AP into a MODE. When we apply this concept at the single radio level, we will refer to this as a ROLE. There are 3 Roles that can be assigned at the product release.

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



Note Client Serving is the same as Local MODE - in that the radio will support clients in the selected band. The change to Client Serving as a Role is to support post FCS when the Flex Connect MODE will be supported as a role and must be selected for the entire remote AP this will replace using local and remote interface terminology and consolidate under the role of client serving. What's important to remember is:

- A "MODE"–is assigned to a whole AP (slot0/1)
- A "ROLE"–is assigned to a single radio interface (slot0)

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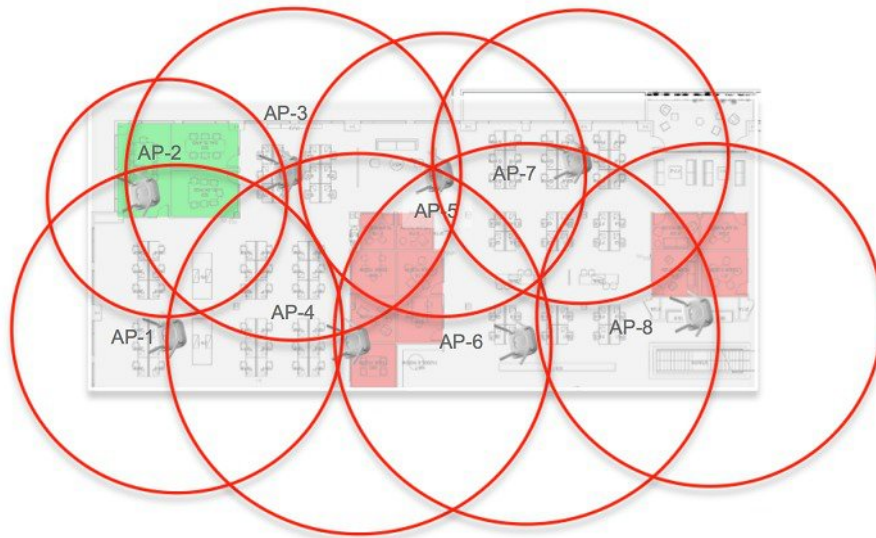
FRA–Coverage Overlap Factor–COF

Lets discuss the operational theory and a little more detail about how FRA does what it does. First and foremost, FRA evaluates 2.4 GHz coverage **only** and determines if there is overlapping coverage creating interference. The AP 3800/2800's initialize by default the same as a Legacy AP with 1x 2.4 GHz interface and 1 x 5 GHz interface. Once FRA completes it's analysis, any radio judged to be redundant - can then be assigned a different and more beneficial role to support the networks goals.

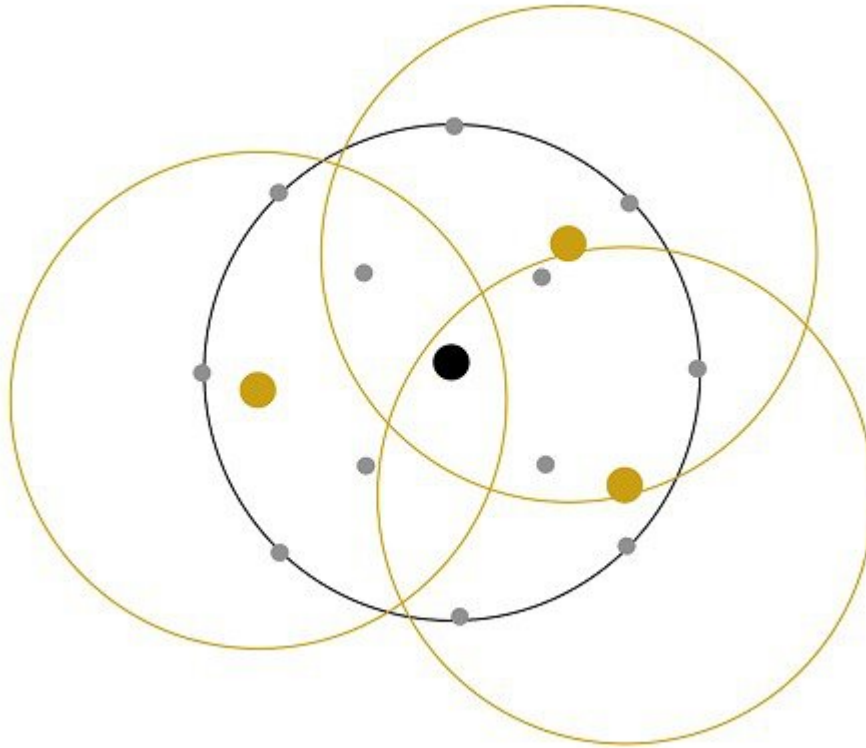
**Note**

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- Customers using AP groups to manage SSID assignments, may have AP's mixed in the same airspace supporting different AP Groups, FRA should be evaluated closely under these scenarios - with the AP's in Manual mode to evaluate the accuracy of COF in a discontinuous grouping. This is the correct way to evaluate complete coverage however - since if an SSID is added to only one AP, then there are no other AP's that can cover for that one AP with the additional or single SSID.

FRA uses the well-established Neighbor Discovery Protocol output from RRM to locate each radio in RF distance and evaluate overlapping coverage by cell. First, using the NDP measurements from the AP's, FRA plots the x and y coordinates relative to every other AP contained in the solution set (AP Group, physical neighbors). The circumference of each cell is calculated based on the present TX power level of each AP. This produces a logical matrix of the AP's coverage intersections.



Based on this understanding, FRA uses a multipoint analysis, to determine the percentage of overlapping coverage for each evaluated AP.



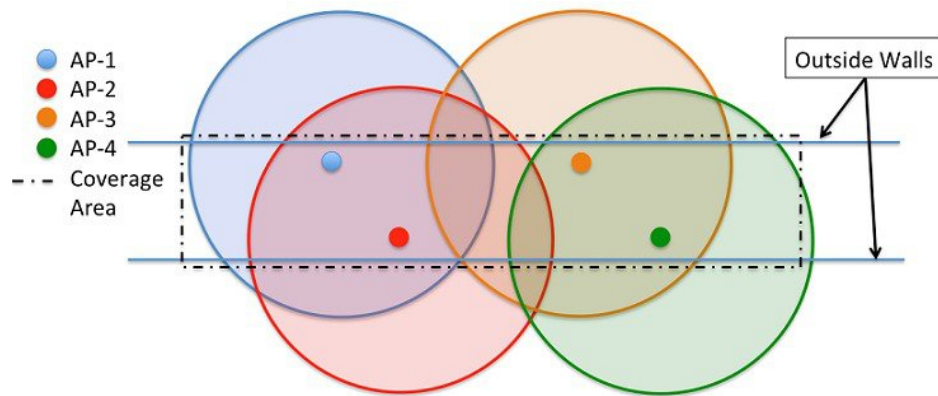
The output of this calculation is the COF (Coverage Overlap Factor %). Coverage Overlap Factor is the percentage of the analyzed cell that is covered at -67 dBm or higher by other - existing radios in service. In the process of calculating this coverage -FRA keeps track of radios that are Coverage Contributors to other radios COF - and will not allow those radios to be marked redundant as long as a radio they are a contributor for is Marked redundant. While FRA is aware of every radio that sends NDP above -80 dBm (system minimum value) it only uses the 4 loudest neighbors to perform the calculation against.



Note In 8.2MR1/8.3 only radios in 2.4 GHz are evaluated for COF. Once a radio is marked redundant, it is available to be assigned another role. Once a radio has been transitioned into another role - COF for that radio will eventually become not available - as it is no longer operating in the 2.4 GHz role where the evaluation is calculated.

RRM and FRA have no knowledge of a map (like Prime Infrastructure has) so the concept of walls, outside coverage, coverage area borders and the like are non-consequential to FRA. We do have a real idea about RF distances as NDP is sent at a known power level - and received packets are reported at actual RSSI so any obstacles show up as RF distance. Here is what's important to understand, COF is telling you the coverage for a theoretical 360 degree cell.

If the AP is in the middle of a large room - then the coverage expectations and what COF reports are likely in alignment. However - if your AP's are distributed down a long hallway with outside walls on the 8th floor, and you don't particularly care if you are covering the outside you can still use COF to evaluate the candidates, but adjust the expectation to the actual coverage area required. See below.



Using the example above, 4 AP's implemented in a staggered fashion in a hallway or similar architectural feature. None of these AP's would likely see 100% COF since:

- AP1 and AP3 are only covering roughly 60% of AP2's calculated cell coverage
- AP2 and AP4 are also only covering about 60% of AP 3's calculated cell

The lines in this drawing represent the outside walls that we know about, and within those lines each AP's required coverage is clear- to us. Each AP is really contributing about 30 % of it's calculated coverage to the actual required coverage area. It is very possible to use the COF as guidance combined with local knowledge to make a good decision here. Very Likely that AP3 should be converted to another role - as AP2 and AP4 cover almost 95% of the required coverage area. AP1, and AP4 extend beyond the center - but with more AP's in this particular hall, we would easily identify more redundant AP's. But this requires YOU to evaluate it as guidance.

Another example would be an enterprise location design where AP's are placed against outside walls. Again - you likely don't care about the coverage beyond those walls. If you do care about the coverage beyond the walls - leave it all alone or consider outdoor AP's. However if you don't and COF does not show 90-100% covered - no worries, If you know you only need 50% of the cell seeing a COF of 65% should send you out to take a quick couple of measurements to be certain before you assign a new role manually.

A Radio is marked as redundant when the calculated coverage meets or exceeds the FRA sensitivity threshold:

- Low–100% COF
- Medium–95% COF
- High–90% COF



Note Before enabling the algorithm, it is highly recommended that you place all your Flexible AP's in FRA Manual Mode. This will prevent any radios from being re-assigned while you are testing or becoming familiar with the commands.

You will need to enable the FRA algorithm. Unless FRA is already enabled - there will be no COF generated until it is - it is disabled by default. On the GUI - Wireless=>Advanced=>Flexible Radio Assignment, CLI > *config advanced fra enable/disable*

The screenshot shows the Cisco Wireless configuration interface. The top navigation bar includes 'MONITOR', 'WLANs', 'CONTROLLER', and 'WIRELESS'. The left sidebar shows the 'Wireless' menu with 'Access Points' expanded to 'Radios', and 'Advanced' expanded to 'RF Management' and 'Flexible Radio Assignment'. The main content area is titled 'Flexible Radio Assignment Configuration' and includes the following settings:

- Flexible Radio Assignment:** Enable Disable
- Sensitivity:** A dropdown menu is open showing 'LOW' (selected), 'MEDIUM', and 'HIGH'.
- Interval:** (Label visible, no value shown)

- Enable and disable the FRA algorithm – it is disabled by default.
- Adjust the FRA Sensitivity Threshold, this sets the percentage of COF required to consider a radio as redundant. Supported values are Low (100%-default) Medium (95%) and High (90%)
- Set the FRA run interval (Valid Choices 1-24 hours must meet or exceed DCA interval)

The FRA run interval is default 1 hour. Selections are available up to 24 hours. However, FRA depends on DCA heavily and the FRA interval cannot be shorter than the DCA interval. See below under role assignment.

FRA–Radio Role Assignment

Once a Radio is marked redundant what happens next is determined by the radio configuration. There are two operational states that the flexible radio can be assigned through - the radio is either FRA-auto (default value) or Manual. In Auto, the radio will be assigned directly by FRA/DCA based on the COF calculated with no user intervention. In Manual, FRA will still produce a COF for the radio - however the user will have complete control over which radios to assign manually.

Radio Role Assignment

Auto Manual

Client Serving Monitor

Band

RF Channel Assignment

Current Channel

Channel Width

Assignment Method Global Custom

Tx Power Level Assignment

Current Tx Power Level

Assignment Method Global Custom



Note

- FRA - Auto or Manual applies only to the assignability of the radio to FRA. RRM, channel and power are separate and users should not confuse the two. In either FRA auto or Manual, the user can still assign channel and power globally (RRM auto) or as a custom setting (no RRM - Manual/custom assignment).
- 2802/3802 models will enforce channel separation of 100 MHz, if attempted less in Dual 5 GHz mode an error message will be displayed.

With the radios in "FRA Auto", FRA then looks to DCA to decide "what" to do with the now redundant radio(s). DCA's priorities are simple:

1. Try to assign the redundant radio in 5 GHz and increase capacity
2. If DCA determines that there is already maximum 5 GHz coverage, it will say so and a Monitor role will be assigned instead

The results of this calculation are shown on the GUI under Monitor=>Access Points=>Dual Band Radios as "suggested mode".

AP Name	Radio Slot#	Base Radio MAC	Coverage Overlap Factor	Suggested Mode	Operational Status	Load Profile	Radio Role
AP00F2.8B26.89D0	0	00:f2:8b:26:ed:d0	84 %	2.4GHz	UP	NA	2.4 GHz * (Local)
3800_e_BC80	0	58:ac:78:df:7e:e0	46 %	2.4GHz	UP	NA	2.4 GHz * (Local)
3802_i_D9A0	0	58:ac:78:df:9c:20	100 %	5GHz	UP	NA	5 GHz * (Local)



Note Suggested mode will report (Static) indicating that the radios are in manual mode if FRA Auto is not selected.

```
Cisco Controller) >show advanced fra
```

```
FRA State..... Enabled
FRA Sensitivity..... high (90)
FAR Interval..... 1 Hour(s)
  Last Run..... 304 seconds ago
  Last Run Time..... 0 seconds
```

AP Name	MAC Address	Slot	Current Band	COF %
Suggested Mode				
-----	-----	-----	-----	-----
3802_i.D9A0 2.4GHz	58:ac:78:df:9c:20	0	2.4GHz	84
AP00F2.8B26.89D0 2.4GHz	00:f2:8b:26:ed:d0	0	2.4GHz	76
3800_e_BC80 2.4GHz	58:ac:78:df:7e:e0	0	2.4GHz	46

COF : Coverage Overlap Factor

Suggested Role's for the Flexible Radio include:

- 2.4 GHz
- 5 GHz
- 5 GHz/Monitor
- (Static)–manual assignment selected at the radio config level



Note The Cisco AP 2802/3802 e and p models do not have a second set of antenna's built into them. For these AP's you will need the DART connector and a second antenna. Neither model will be marked redundant without the insertion of the DART connector it is not available to the Role Selection algorithms.

FRA–Client Network Preference

That takes care of "suggesting" a role. However when that transition is made is governed by another NEW feature in 8.2 MR1 and 8.3 software releases - Client Network Preference. Think of this like a personality adjustment for your network services. It allows an end user to characterize how it wants to prioritize RRM's behaviors. FRA has an entry here.

RRM Algorithm	Connectivity	Throughput	Default
DCA	Higher Bias on current Channel Low Sensitivity for DCA (override in DCA) Prefer current channel when Voice/Video	Less bias on current channel High DCA Sensitivity (override in DCA) All 11n capable clients	No Change from Current DCA behavior
DTPC	DTPC should not reduce power when weak signal clients detected (<-79)	DTPC will not increase power when number of clients is over the configured max threshold	No Change from current TPC behavior
DBS	Prefer Current bandwidth Prefer current Primary channel Lower bias on client type Voice/Video clients increased contribution	Favor Higher Channel Widths Higher bias for high capacity (11n,11ac) client types present	No Change from current DBS behavior
FlexDFS/ED–RRM	Priority on maintaining primary channel Voice/Video client increased contribution	Priority on higher bandwidth channel width	No Change from current flexDFS/ED-RRM behavior
FRA	No Band/Role switching when more than 3 clients exist	Band-switching, regardless of clients	Defaults to connectivity profile

This command is only at the CLI level for now, however it allows customization of processes that different users want to behave differently. Within the context of FRA, what happens to clients connected to the 2.4 GHz interface if it changes to 5 GHz - and do you care? There are 3 options including the default which essentially leaves things as they are today for the customer - except in the case of FRA which by default uses the connectivity setting.

```
(Cisco Controller) >config/show advanced 802.11a/b client-network-preference ?
```

- Connectivity–Preference on Connectivity
- Default–No Client Network Preference Applied
- Throughput–Preference on Throughput

In this case then, the radio would wait to switch roles until the condition (less than 3 clients associated) is met and process the switch on the next DCA run. You can bypass this by selecting the "Throughput" option for Client Network Preference.

A radio will not return to 2.4 GHz unless reverted (through CLI) or manually configured from the GUI/CLI. Automatic reversal only happens in the case of coverage hole alerts on any of the original contributing coverage radios. That means - once a radio is placed in another role - if any of the radios that are contributing to the

coverage to allow an alternate role experience coverage hole alerts, the flexible radio is reverted back to 2.4 GHz immediately.



Note 3802i AP's have two sets of antenna's, a dual band set, and a micro cell antenna for 5 GHz. The 3802i is specifically engineered to support dual 5 GHz as a Macro/Micro cell implementation or operate as a monitor interface. More on this later.

3802e and p models have a single set of external antenna adapters. So there are no built in extra antenna's to support the flexible radio roles. You cannot use the same antenna for two radios operating in the same band simultaneously. For dual 5 GHz operations the Dart connector is needed to support a second antenna that is dedicated to the Flexible (slot0) radio.



Note You do not need a Dart connector to treat the AP as a standard dual band AP - This is only needed support Dual 5GHz and Monitor Roles for the Flexible radio.

These AP's are designed to support Macro/Macro or two full serving cells. Without the Dart connector- no role re-assignment is possible and while it will show COF, it cannot be assigned a different role without the supporting hardware.

FRA—Steady State Operations

FRA is designed in the initial release to evaluate and remediate over population in 2.4 GHz spectrum. In almost all cases - if you are designing a network to optimize 5 GHz, then you will have redundant 2.4 GHz interfaces. It manages the selection, transition, and assignment of redundant radios.

Once it has run, and assuming the network design and number of AP's has not changed, there won't be much for FRA to do but monitor. Keep in mind that while you will not be seeing COF for any AP that's not in the 2.4GHz role, the part about role selection and DCA stays active. What that means - is that if you add AP's or you change the bandwidth you are serving, FRA may choose a different role for your Flexible Radio if 5 GHz is assigned and it becomes challenging to keep that many interfaces in the air peacefully. You may see a 5 GHz interface switch to monitor mode. One sure way to prevent this is lock down the radios by changing them to Manual. That will prevent FRA from taking any more action on their behalf. Keep in mind that if you do this, you could also create issues when making changes that alter the balance of the spectrum - such as Bandwidth Changes which should always be treated as a major upgrade (because - it is).

COF will be "not available" after some time for any Flexible interface not in the 2.4 GHz role in this revision of code. If at any time you wish to reset FRA and re-run the calculations from scratch simply revert the radios:

```
(Cisco Controller) >config advanced fra revert Auto-only/All Static/Auto
```

You can select radios in Auto, or all and revert them to Auto or Static. Reverting to Auto, automatically assigns 2.4 GHz client serving role.

FRA and Dual 5 GHz Operations

Managing a dual 5 GHz cells is one of the most most important things that FRA does. There are two modes of operation for Dual 5 GHz AP's:

- Macro/Micro—A large cell with a smaller cell internal – creating double the capacity within the boundaries of a single cell.
- Macro/Macro—Dual- independent 5 GHz cells, doubling the coverage of a single traditional Dual Band AP.

Macro/Micro is a use case applicable to the Cisco AP 3800/2800 I Models only. The antennas on this AP are designed to support a Cell within a Cell deployment. In order for this to be effective, much design is committed to isolation of the two cells starting at the silicon level, and ending with separation in antenna polarity and frequency separation.

FRA and DCA will enforce many configuration requirements when operating as Dual 5 GHz Macro/Micro:

- Minimum 100 MHz Channel Separation (Frequency Diversity)
- Micro Cell Power is restricted to minimum
- Same SSID's on each cell

Having a Macro/Micro cell architecture is attractive because it solves the problem of having one large cell - in which a very diverse client experience exists. Clients closer to the AP are using higher data rates and enjoy a higher SNR than will clients at the edge of the cell. Macro Micro allows isolation of different clients within the cell that can serve them best and preserves airtime by increasing overall efficiency.

FRA also monitors the two cells and will optimize client connections between the two cells - keeping like performing clients with like performing clients maximize throughput. There are presently three methods by which we move or transition clients between Macro and Micro cells.

- 802.11v BSS Transition
- 802.11k
- Probe Supression

Transition thresholds are configurable by the user - but the defaults are highly recommended and worked well in our testing and Beta.

```
(Cisco Controller) >show advanced client-steering
Client Steering Configuration Information
1 Macro to micro transition threshold..... -55 dBm
2 micro to Macro transition threshold..... -65 dBm
3 micro-Macro transition minimum client count.... 3
4 micro-Macro transition client balancing win.... 3
<snip>
```

Adjustments can be made to these values at the CLI using the commands:

```
(Cisco Controller) >config advanced client-steering transition-threshold ?

balancing-window Configures micro-Macro client load balancing window
macro-to-micro Configures Macro to micro transition RSSI
micro-to-macro Configures micro to Macro transition RSSI
min-client-count Configures micro-Macro minimum client count for transition
802.11v BSS Transition - enabled by default
```

802.11v BSS Transition—Default Enabled

An 802.11v capable client is known to the AP on association. If such a client connects initially to the wrong cell (Macro is most likely, but Micro is possible) on connection the AP will send an 802.11v BSS transition

message with only the BSSID of the target cell as a neighbor. This will be followed by a mandatory De-auth (40 seconds). In testing and beta this method worked for all 802.11v capable clients very well.

802.11k–Default Enabled

Similar to 802.11v, using a site report message with only the target cell's BSSID listed will leave the client little choice. The issue with this method is that ultimately the client needs to request the site report, and in most implementations today - that generally

Probe Suppression–Default Disabled

Non-associated clients usually send probe requests on all channels before using the information in the responses to initiate an association sequence. When both Micro and Macro cell radios receive probe request from non-associated client within a short duration and if the client is within the coverage area of the Micro or Macro cell, the AP can suppress probe responses to the client from the radio we do not want them to join. Since this effectively "hides" the cell from the client, the client is likely to initiate association sequence with the cell that responded. If a client is "sticky" and tries to associate to the other cell even after not receiving a probe response on that channel, depending on the operational mode, the AP can also suppress a single AUTH response on that cell to force the client to try associating to the desired cell.

Similarly associated clients usually send probe requests on all channels before using the information in the responses to move to a radio with higher transmission power. When both radios on the AP receive probe request from a client associated to either cell, in order to prevent the client from prematurely roaming to the other cell due to its higher transmission power, the AP continues to suppress the other cell's probe responses to the client as long as the client is within the coverage area of the target cell.

Like in the other two methods of client steering, we rely on the same client RSSI thresholds to target a coverage cell. Unlike the previous two, this method is disabled by default.

Other than the Micro to Macro and Macro to Micro client thresholds, there is not much that needs or should be configured for 802.11v or k methods. Probe Suppression has some options we will cover here.

- **Operational Mode**–This parameter governs the mode of operation for micro-Macro probe suppression feature on the AP. It supports the following options:
 - **Disable**–Disables micro-macro probe suppression feature on the AP
 - **Probe Only**–Suppresses only probes on Macro cell subject to constraints
 - **Probe And Auth**–Suppresses probes on Macro cell along with a single Auth subject to constraints
- **Probe Validity Window**–This parameter specifies the time interval for which the probe on the micro cell is considered valid in reference to the probe received on the Macro cell
- **Suppress RSSI Threshold**–The client RSSI threshold within which probe responses from the Macro cell are suppressed
- **Enable RSSI Threshold**–The client RSSI threshold beyond which probe responses from the Macro cell are no longer suppressed
- **Probe Aggregate Window**–Clients can sometimes send multiple probe requests in a short span of time. This parameter specifies time interval during which probes from a client are not considered distinct
- **Transition Aggressiveness**–This parameter specifies number of dis-contiguous probe aggregate windows for which probes on the Macro cell are suppressed

```
(Cisco Controller) >config advanced client-steering probe-suppression ?
```

```
disable      Disables micro-Macro probe suppression
enable       Enables micro-Macro probe suppression
hysteresis   Configures hysteresis
transition-aggressiveness Configures probe cycles to be suppressed
```

All of the Macro/Micro transition thresholds can be seen using the *show advanced client-steering* command at the cli:

```
(Cisco Controller) >show advanced client-steering
```

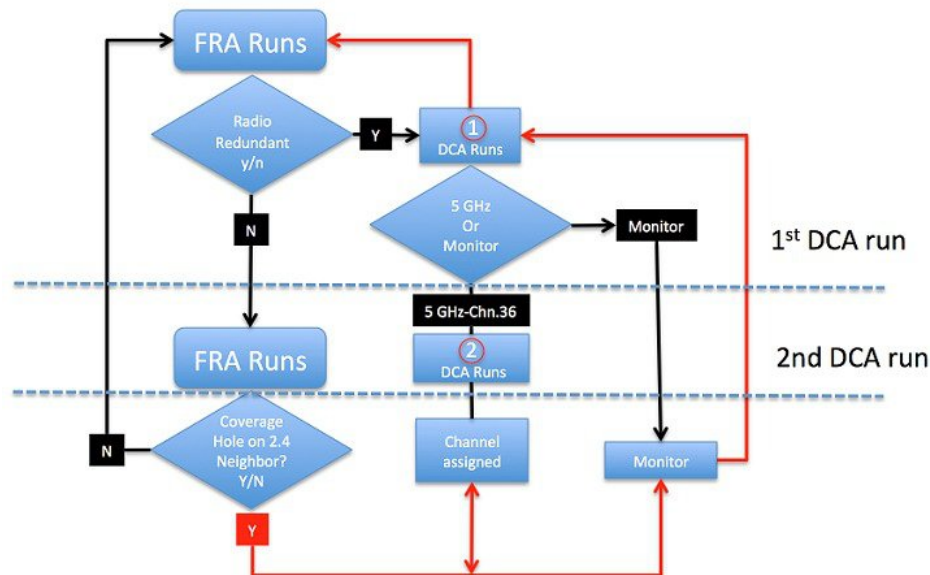
```
Client Steering Configuration Information
```

```
Macro to micro transition threshold..... -55 dBm
micro to Macro transition threshold..... -65 dBm
micro-Macro transition minimum client count... 3
micro-Macro transition client balancing win... 3
Probe suppression mode..... probe-and-auth
Probe suppression validity window..... 100 s
Probe suppression aggregate window..... 200 ms
Probe suppression transition aggressiveness... 3
Probe suppression hysteresis..... -6 dBm
```

FRA–Troubleshooting

FRA is very dependent on DCA, as DCA is used to both evaluate the role selection, and assign channels and band to the radio.

This means that DCA must run at least as often as FRA, and while FRA will make recommendations, it is up to DCA to implement and manage them. This can cause a lot of confusion, unless you know your DCA and FRA configurations, and how they are expected to behave. See the example below, we will walk through the scenarios.



1. FRA Runs and establishes that a Radio is Redundant
2. The Radio now Marked Redundant awaits Role assignment from DCA

3. When DCA runs, we assign it to either 5GHz or monitor based on DCA's assessment of the channel plan/widths/interference and so on
 - a. Because the radio was reverted (running in 2.4 GHz mode, with no 5 GHz channel assigned previously, default channel for 5 GHz is 36, radio is assigned 5 GHz chan 36)
4. Next DCA run, 5 GHz radio has neighbors, and a channel is assigned
5. Any time a neighbor of any of these radios shows a coverage hole at 2.4 GHz being reported FRA will revert any radios that had roles switched back to 2.4 GHz and begin again

If DCA is set for an interval of 12 Hours, FRA must also be set for 12 hours (minimum), the second DCA cycle could be 24 hours

FRA-CLI and Debug Commands

Show Advanced fra shows you the current FRA state (enable/disable), sensitivity, current run interval, last run time, and status and state of all Flexible radios

```
(Cisco Controller) >show advanced fra
```

```
FRA State..... Enabled
FRA Sensitivity..... high (90)
FAR Interval..... 1 Hour(s)
  Last Run..... 620 seconds ago
  Last Run Time..... 0 seconds
```

AP Name Mode	MAC Address	Slot	Current Band	COF %	Suggested
3800_e_BC80	58:ac:78:df:7e:e0	0	2.4GHz	46	2.4GHz
2802_i.89D0	00:f2:8b:26:ed:d0	0	5GHz	84	5G/Monitor
3802_i.D9A0	58:ac:78:df:9c:20	0	5GHz	100	5G/Monitor

COF : Coverage Overlap Factor

Show Advanced 802.11a/b summary will show you all radios in a given band, Flexible radios show up on slot 0 when assigned an 802.11a role. You can also show just the flexible radios with show advanced 802.11-abgn summary

```
(Cisco Controller) >show advanced 802.11-abgn sum
```

```
Member RRM Information
AP Name                MAC Address          Slot Admin   Oper   Channel  TxPower
-----
3800_e_BC80            58:ac:78:df:7e:e0   0  ENABLED  UP     1*       *8/8 (
2 dBm)
2802_i.89D0            00:f2:8b:26:ed:d0   0  ENABLED  UP     (56,52)* *7/7 (
2 dBm)
3802_i.D9A0            58:ac:78:df:9c:20   0  ENABLED  UP     (36,40)* *7/7 (
2 dBm)
```

Config advanced fra revert Can be used to quick flip all or just the flexible radios in auto back to default state of 2.4 GHz client serving and mark them Auto FRA or Manual (very useful for recalculating COF's after adding or moving AP's)

```
(Cisco Controller) >config advanced fra revert all auto
```

```
Reverting XOR radios can cause disruption for associated clients. Are you sure you want to
continue? (y/n)y
```

```
(Cisco Controller) >show advanced fra
```

```
<snip>
```

AP Name	MAC Address	Slot	Current Band	COF %	Suggested Mode
3800_e_BC80	58:ac:78:df:7e:e0	0	2.4GHz	46	2.4GHz
2802_i.89D0	00:f2:8b:26:ed:d0	0	2.4GHz	84	5G/Monitor
3802_i.D9A0	58:ac:78:df:9c:20	0	2.4GHz	100	5G/Monitor

Debug `airewave-director fra enable` will invoke the FRA debug, we'll take this in sections focusing on what's important. There is a lot in this command that's only important to developers so for brevity we'll skip some of the redundant lines.



Warning There is a lot of output in a debug command- debug FRA should never be run on a fully loaded production system against all AP's. You can use the `debug mac addr <mac1,mac2,mac3>` to isolate the debug to just the devices you are concerned with.

The first part of the debug lists all the radios that will be included in the solution set as well as if it is an RRF (Redundant Radio Flexible or a 2800/3800) candidate. Note that the AP's displayed - should be the AP's with 2.4 GHz interfaces. The last column - is extremely useful - NDM (Network Density Metric) this is the number of AP's that each of the indexed AP's have as neighbors they can hear above -67 dBm. The higher that number the denser (AP's closer together) the network is.

```
(Cisco Controller) >debug airewave-director fra enable
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.014: Executing FRA on 802.11bg
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.014: -----
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.014:
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.014: RDCI List :
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.014: -----
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.014: Index          AP                      RRF Candidate
      NDM
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.014: -----
      -----
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.014: 0
      6                      58:AC:78:DF:9C:20(0)    YES
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.014: 1
      6                      00:F2:8B:26:ED:D0(0)    YES
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.014: 2
      6                      F0:7F:06:5E:FD:C0(0)    NO
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.014: 3
      6                      E4:C7:22:AA:38:20(0)    NO
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.015: 4
      6                      E4:C7:22:AA:34:40(0)    NO
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.015: 5
      6                      08:CC:68:B4:20:00(0)    NO
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.015: 6
      5                      58:AC:78:DF:7E:E0(0)    NO
```

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.015: 7
      4                      64:D9:89:46:7F:B0(0)    NO
```


The next step starts the calculation for each RRF Candidate AP in the above list, in this example we will have 2 AP's that are marled Yes. I have 1 3800i, one 2800i, and a 3800 e with NO Dart connector so not currently flexible, the remaining AP's on the list are 3500/3600/3700.

For AP Index 0 (58:AC:78:DF:9C:20) the AP mac address is displayed- and immediately we get the neighborhood list. This is the list of Neighbors to the target AP that will be used in AP index 0's calculation. This is where you see the Neighbors that matter. Only the loudest 4 neighbors will be used- all must be in the same AP group. If an AP is not on this list that you think honestly should be - due to proximity- it is not known as one of the 4 loudest neighbors to the target AP. This could be because it is in a different AP group or that Neighbor information is not yet available (newly powered on).

In the output, you see the first AP on the list selected index 0, and its loudest 4 neighbors displayed along with their neighbor RSSI and their TX power (because of a cosmetic bug, current TX power is incorrect and always displays as max power in release 8.2 MR1, but the algorithm is using current TX power). This establishes the AP's that can be considered for coverage of AP 58:AC:78:DF:9C:20 coverage area.

```
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.015: 58:ac:78:df:9c:20
-----
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.015: 58:ac:78:df:9c:20 Redundancy Iteration 0 , RDCI
0
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.015: 58:ac:78:df:9c:20
-----
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.029: 58:ac:78:df:9c:20 Neighborhood list for AP 0
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.029: 58:ac:78:df:9c:20
-----
Jun 07 16:22:05.029: 58:ac:78:df:9c:20 RDCI Index AP RSSI Tx
Power (dBm)
Jun 07 16:22:05.029: 58:ac:78:df:9c:20 -----
-----
Jun 07 16:22:05.029: 58:ac:78:df:9c:20 0 58:AC:78:DF:9C:20(0) 0
23
Jun 07 16:22:05.029: 58:ac:78:df:9c:20 2 F0:7F:06:5E:FD:C0(0) -14
22
Jun 07 16:22:05.029: 58:ac:78:df:9c:20 7 64:D9:89:46:7F:B0(0) -30
22
Jun 07 16:22:05.029: 58:ac:78:df:9c:20 5 08:CC:68:B4:20:00(0) -31
23
Jun 07 16:22:05.029: 58:ac:78:df:9c:20 4 E4:C7:22:AA:34:40(0) -43
20
Jun 07 16:22:05.029: 58:ac:78:df:9c:20 3 E4:C7:22:AA:38:20(0) -48
20
Jun 07 16:22:05.029: 58:ac:78:df:9c:20 6 58:AC:78:DF:7E:E0(0) -66
23
Jun 07 16:22:05.029: 58:ac:78:df:9c:20
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.029: 58:ac:78:df:9c:20 Neighborhood Path Loss Matrix
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.030: 58:ac:78:df:9c:20 -----
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.030: 58:ac:78:df:9c:20 0 37 52 53 54
66 71 89
<snip> Calculating every AP to every AP's path loss
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.030: 58:ac:78:df:9c:20 Neighborhood Distance Matrix
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.030: 58:ac:78:df:9c:20 -----
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.030: 58:ac:78:df:9c:20 0 0 4 5 5
14 17
<snip>Calculating RF distances between AP's
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.030: 58:ac:78:df:9c:20 Unable to triangulate
neighborhood, assigning single axis coordinates <normal behavior- perfectly fine we are
operating in 2D>
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.030: 58:ac:78:df:9c:20 Computed Coordinates
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.030: 58:ac:78:df:9c:20 -----
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.030: 58:ac:78:df:9c:20 X Y R
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.031: 58:ac:78:df:9c:20 ----
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.031: 58:ac:78:df:9c:20 0 0 18
```

```

<snip> many lines of X, Y positions - and calculated radius of each cell
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.031: 58:ac:78:df:9c:20 Neighborhood Multi-Point Check
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.031: 58:ac:78:df:9c:20 Using 4 neighbors for overlap
computation
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.031: 58:ac:78:df:9c:20 Point Coordinates Coverage
Score
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.031: 58:ac:78:df:9c:20 -----
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.031: 58:ac:78:df:9c:20 0 , 0 2
<snip> Many more lines - deleted for brevity. This is the output and score from the
multipoint overlap calculation.
<comment> followed by the RDCI Overlap Factor for this radio and it's conclusion
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.031: 58:ac:78:df:9c:20 RDCI Overlap Factor : 92 %
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.031: 58:ac:78:df:9c:20 RDCI is redundant
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.032: 00:f2:8b:26:ed:d0 Redundancy Iteration 1 , RDCI
1(00:F2:8B:26:ED:D0(0))
<snip> Redundancy iterations continue for each radio marked as Yes for RRF candidate
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.034: 58:ac:78:df:7e:e0 Redundancy Iteration 2 , RDCI
6(58:AC:78:DF:7E:E0(0))
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.037: Redundancy Identification Complete
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.037: -----
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.037:
<snip> The last entry below - is the output you see in show advanced fra
*RRM-MGR-2_4-GRP: Jun 07 16:22:05.037: RDCI List :
*RRM-MGR-2_4-GRP: Index AP Overlap % Redundant overlap
Contributor
*RRM-MGR-2_4-GRP: -----
*RRM-MGR-2_4-GRP:0 58:AC:78:DF:9C:20(0) 92 YES NO
*RRM-MGR-2_4-GRP:1 00:F2:8B:26:ED:D0(0) 69 NO YES
*RRM-MGR-2_4-GRP:6 58:AC:78:DF:7E:E0(0) 53 N/A NO

```

The debug concludes with the conclusions. Note that AP index 0 is marked as redundant, and is NOT a overlap contributor. The current threshold for FRA is High (90%) and 92% is above 90 %. Had sensitivity been set to medium (85%) it would not have been marked redundant.

Also notice that AP Index 1, is marked as a coverage contributor. This means regardless of the percentage of COF, this AP's 2.4 GHz interface is being counted on to provide coverage for another Radio that has been Marked as Redundant already (AP index 0).

Remember, FRA only identifies a redundant interface and once identified DCA must run to assign a new Role. Things that will prevent a radio from being assigned a new role:

- Client-network-preference–by default for FRA only we use the connectivity profile. This enforces that 3 or more clients associated to the radio – it will not transition. This is evaluated at DCA run time.
- DCA not running–in which case you will not get a suggested role in the show output since it can not be evaluated.

FRA–Best Practices

FRA is new. It has the power to automatically assign 2.4 GHz radios to other roles completely automatic. It is highly recommended that you familiarize yourself with the operations. Operating in Manual Band Selection at the AP is perfectly safe, and will prevent FRA algorithm from acting. This allows you to view the COF, and validate and become familiar with the findings. FRA is conservative by nature.

To Run in Manual Mode:

1. config advanced fra revert all static

2. config advanced fra enable

You can view the COF results and validate without changing bands. Then select the radios you want to change manually later or just turn on auto and let the radios shift.