Radio Resource Management Concepts

RRM is a collection of algorithms which together provide a comprehensive management solution- the key algorithmic groups to be discussed here are:

- RF Grouping–The algorithm responsible for determining the RF Group Leader and members
- FRA–Flexible Radio Assignment – a new algorithm charged with identifying redundant radios resources and re-assigning the resource to a better role – strictly applicable to 2800, 3800 series AP's with XOR radio for slot 0.
- DCA–A Global Algorithm, runs on the RF Group leader
- TPC–A Global Algorithm, runs on the RF Group Leader
- CHDM–A Local Algorithm, runs on each individual controller

In addition to RRM, there are several features which manage specific traffic types or client types which can greatly increase the spectral efficiency and assist RRM in providing a better experience for users. These will be discussed in context with the algorithms.

RRM is organized under the following Hierarchy:

RF Group Name ⇒ RF Group leader(s) ⇒ RF Neighborhood(s)

For any RF Group Name, multiple RF group Leaders may exist (a minimum of 2, one for 2.4 GHz and one for 5 GHz will always be present). An RF Group Leader will manage multiple RF Neighborhoods.

Pre-requisites and Assumptions

It is assumed that readers have a detailed knowledge of the following:

- Knowledge of and experience with common WLAN/RF design considerations (knowledge comparable to that of CWNA certification)
- Unified wireless access methodologies and hardware

Key Terms

Readers should fully understand the following terms used throughout this document with regard to Cisco's RRM algorithms:

1. **Signal**: refers to RF emanating from AP's belonging to the same RF group or our AP's.
2. **Interference**: Wi-Fi signals that do not belong to our network (rogues).
3. **Noise**: any signal that cannot be demodulated as an 802.11 signal. This can either be from a non-802.11 source (such as a microwave or Bluetooth device) or from an 802.11 source whose signal is below sensitivity threshold of the receiver or has been corrupted due to collision or interference.
4. **dBm**: an absolute, logarithmic mathematical representation of the strength of an RF signal. dBm is directly correlated to milliwatts, but is commonly used to easily represent output power in the very low values common in wireless networking.
5. **RSSI, or Received Signal Strength Indicator**: an absolute, numeric measurement of the strength of the signal in a channel.
6. **Noise floor**: the ambient RF Noise level (an absolute value expressed in dBm) below which received signals are unintelligible.
7. **SNR**: the ratio of signal strength to noise floor. This value is a relative value and as such is measured in decibels (dB).
8. **RF Group**: The logical container that an instance of RRM is configured through. All devices belonging to a single RF Network will be configured as a member of a particular RF group.
9. **RF Group leader**: The device where the algorithms for the RF group will be run. The RF group leader is either automatically selected through an election process or may be manually assigned through configuration. Two are required – one for each Spectrum band 2.4 and 5 GHz. And more may be present given the equipment and scale being employed.
10. **RF Neighborhood**: A group of AP's that belonging to the same RF group which can hear each other at =/>-80 dBm. This is a physical grouping based on RF proximity.
11. **TPC**: Transmit Power Control is the RRM algorithm that monitors and manages transmit power level for all AP's in the RF group. There are two versions – each with their strenghths – this document will cover both with recommendations.
12. **DCA**: Dynamic Channel Assignment is the RRM algorithm responsible for selecting the operating channel for all AP's in the RF group.
13. **CHDM**: Coverage Hole Detection and Mitigation–consists of the Coverage Hole Detection algorithm and the Coverage Hole Mitigation algorithm – CHD and CHM. This also has intersection with the HDX feature of Optimized Roaming as it relies on the measurements obtained from CHD.
14. **CM**: Cost Metric–an RSSI based metric which combines AP load, Co-channel interference, Adjacent channel interference and non wi-fi sourced interference into a goodness metric used by DCA to evaluate effective channel throughput potential.
15. **COF**: Coverage Overlap Factor – output of FRA algorithm, represents percentage of cell covered to -67 dBm by other 2.4 GHz radios.

16. **FRA**: Flexible radio Assignment – RRM algorithm that manages flexible radios and determines coverage redundancy and best roles for Flexible Radios to play based on coverage requirements and density.

Note

- RRM (and RF Grouping) is a separate function from inter-controller mobility (and Mobility Grouping). Confusion can arise through the default use of a common ASCII string assigned to both group names (RF Group, Mobility Group) during the initial controller configuration wizard. This is done for a simplified setup process and can be changed later.
- It is normal for multiple logical RF Group Leaders to exist. An AP on a given controller will help join their controller with another controller **only** if an AP or AP's from each controller can hear one another. In large Campus environments it is quite normal for multiple RF Neighborhoods to exist, spanning small clusters of buildings.

How Does RRM do and what it does?

The high level view of RRM is quite simple. It is a framework of services used to gather relevant over the air information and store it for analysis. Each AP spends time listening within its environment and collecting a variety of utilization statistics. The information collected drives many algorithms (wIDS and rogue detection are examples outside of RRM's algorithms). Each AP will gather information regarding Neighbors (Neighbor Discovery Protocol) channel conditions - Load, Interference, Noise. This information is collected by the RF Group Leader for the entire RF Group and used to determine the structure of the RF Domain first and break down the domain into RF Neighborhoods. An RF Neighborhood is a group of AP's that can hear one another, and as such must have channel and power solutions calculated together.

So the RF Group Leader is the designated controller that will run RRM Algorithm's on information that it collects from Member controllers. It does this by first identifying groups of AP's that are physically close enough to one another and organizing these into groups of RF Neighborhoods. The RF Group Leader is also the repository for the current RRM configurations (for channel and power) that will be used to configure the Algorithms for the RF Group.