



# OmniAccess Stellar Wireless

## Fine-Tuning Best Practices

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# OmniAccess Stellar Wireless Fine-Tuning Guidelines Introduction

The purpose of this document is to provide specific **OmniAccess Stellar Wireless LAN** (WLAN) parameters to fine-tune the Stellar WLAN access points in Enterprise mode. This document does not replace any existing user guides or solution guides; for more detailed feature and functionality descriptions refer to the appropriate documentation. In some cases where detail explanations and configuration examples are needed, those documents will be referenced throughout this document. **OmniAccess Stellar WLAN Access Point** (AP) lineup described in this document support the most recent ratified IEEE 802.11ax standard or also known as **Wi-Fi 6** and they are backwards compatible with the Wi-Fi 5 (802.11ac) APs.

These APs have the capability to operate in Express or Enterprise modes; in Enterprise mode **OmniVista** provides a unified **network management system** (NMS) for both wired **OmniSwitch** and **Stellar WLAN** networking devices for provisioning, management, and monitoring capabilities from a single unified NMS interface. The configuration **fine tuning best practices** and recommendations are based on the Enterprise deployment mode.

The Stellar WLAN family of APs offers ease of management and provisioning via its support for a distributed architecture in clusters in Express mode and management via its web interface for clusters of up to 256 APs per cluster. Or via AP groups of up to 4000 APs in Enterprise mode to be centrally provisioned, managed and monitored via OmniVista NMS.

# RF Management, Capacity and Smart Load Balance

## RF Management

The goal of **Radio Frequency (RF)** spectrum management is to configure and calibrate radio settings for the wireless network; after the radio network is operational, the goal of RF spectrum management changes to that of tuning and adjusting radio parameters to maintain a high degree of performance. With Stellar WLAN, RF management is mostly automatic, requiring little configuration or intervention from the administrator.

Stellar WLAN provides a set of functions to **simplify WLAN operations and provide the relevant support for normal to dense 802.11ac/ax environments** in addition to being backwards compatible with legacy 802.11n and b/g devices.

The key parameters of the **Stellar RF management solution**, as described in more detail in our Voice over WLAN Design Guide and OmniAccess Stellar Wireless User Guide is summarized in the Calibration and Optimization, is as follows:

**Calibration:** Used continuously throughout the life of a wireless network; calibration functions allow network administrators to optimize power and sensitivity settings of the network on an antenna by antenna basis.

**Optimization:** Including **DRM (Dynamic Radio Manager)** which provides a channel list setting per radio that defines a perimeter for automatic channel assignment. Auto Radio Resource Allocation which allows individual access points to monitor for RF changes and in conjunction with calibration information to make appropriate channel assignment changes.

**Note:** *A complete description of these RF management parameters and setting options, refer to the VoWLAN Design Guide and OAW Stellar-AP User Guide.*

As stated above, the RF management functions operate automatically and are recommended for them to interact and automatically adjust based on the airspace environment, these settings are enabled by default and should remain enabled with minor adjustments based on the quality of connectivity user experience (QoE) scores that external monitoring tools can analyze. For example, deploying OmniVista Cirrus 10.x where one can graphically view reports showing the channel distribution information combined with channel utilization metrics to check that there is a fair distribution of wireless communications among all channels.

Additional points under this optimization fine tuning parameters to check; for example, adjacent APs need to use different radio channels to prevent interference between them. APs within range of each other should always be set to non-interfering channels to maximize the capacity and performance of the wireless infrastructure.

To avoid mutual interference with adjacent APs, **ACS (auto channel selection)** can be used to make the AP check and select the best channel under the radio environment automatically. The algorithm will help the AP to find the channel with the best radio performance available. And when working on 5G radios, the Radio Dynamic Adjustment™ (RDA) technology can be used to define a “channel list” for the AP to select its channels from that recommended list.

Background scanning is the basis for some advanced features such as: wIDS, wIPS, RDA (ACS/APC) etc. When it's turned OFF, the foreign AP detection and rogue suppression will stop, and the RDA technology will drop its precision. By default, background scanning is enabled, it is recommended to stay enabled. RDA is also used by Stellar WLAN to adjust the radio working channel and transmitting power according to the wireless environment around it. It includes **ACS**, as referenced above, and **Auto Power Control (APC) functions**.

When RDA is disabled there is more risk that the manually defined values will create channel interference for new applications or roaming clients. In some cases, an administrator is tempted to set wide channels, but concerns and some design guidelines need to be exercised when widening channels. For instance, as stated through an Ekahau blog:

802.11ac or .11ax which allows for 80MHz and 160MHz wide channels... These **wide Wi-Fi channels** are created by bonding 20MHz channels together, using the center frequency to denote the channel. For example, channels 36 and 40 (each 20MHz) are bound together to make 40MHz channel 38, etc. This wide channel implementation sounds good for better throughput; however, as also referenced in the Ekahau blog, that implementation introduces the **Co-Channel Interference (CCI)**, plus the introduction of an extra 3dB of noise to the channel, doubling the noise. That scenario introduces more noise and no gain in signal. It equates to a lower SNR (Signal-to-Noise ratio), which will in turn force a lower Modulation Coding Scheme (MCS) rate, shrinking the throughput. This means that clients now take longer to transmit, driving up airtime utilization.

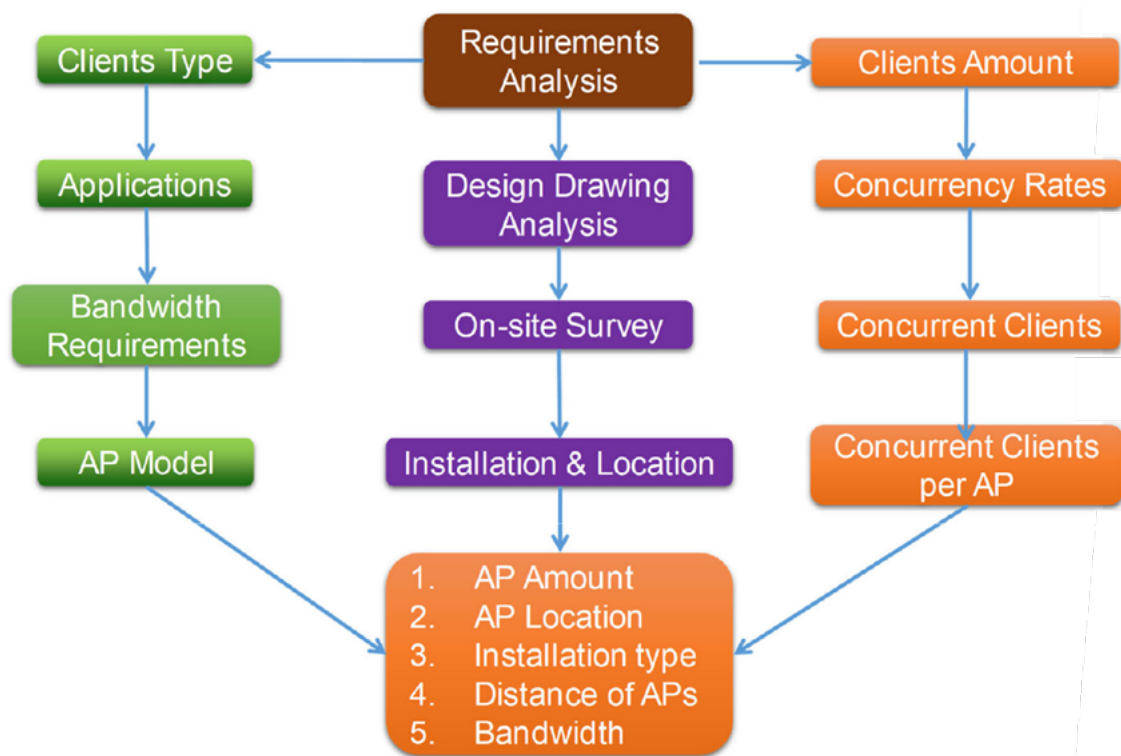
To avoid any of these possible 'pitfalls' keep the RDA enabled for Stellar APs and let it's algorithm determine the best channels and transmitting power to help with this fine-tuning.

## Capacity versus Coverage

Competitor’s recommendations point to two main Wi-Fi design guidelines to offer **coverage** with less access points deployed versus **capacity** with more Access Points deployed to handle the larger client connectivity for throughput capabilities instead of simply connectivity for coverage purposes. ALE recommends the capacity designs for a higher density of APs to **provide the optimal performance**; however, radio management needs to be at the forefront to help with the channel interference when APs are closer to each other.

To properly plan and deploy a capacity design, one needs to understand the principles of deployment. For instance, for the optimal placement of the APs throughout the building or campus, a site survey is required this will provide planning information that is required for proper capacity planning designs.

Capacity planning involves knowing or anticipating how the network is going to be used. The most important part is providing for the expected number and mix of clients connecting to the network. There are industry standard capacity numbers, and maximum client numbers per AP that are known, but other factors need to be considered. Refer to **Figure 1: Capacity and deployment planning workflows**.



**Figure 1:** Capacity and deployment planning

## Stellar AP deployment principles in capacity design scenarios

Use fixed objects to isolate APs and improve channel reuse; for example, in a large open floor office environment, people are better signal isolation objects, installing the APs on the side walls and vertical structural pillars with directional antennas pointing towards the cubicles and office areas are the recommended best practices.

In open areas, such as warehouse manufacturing floors where not much isolated objects are available and there is an open environment for the clients, one can also choose directional antennas to improve the isolation between APs and increase the signal strength to those the mobile Wi-Fi devices.

## Key Wi-Fi 6 feature benefits addressing the ‘Principles of Deployment’

Wi-Fi 6 inherits the advanced MIMO features of Wi-Fi 5 and offers some new features which is optimal for capacity-based network deployments. These include the following key features:

- **Orthogonal frequency division multiple access (OFDMA)** which more efficiently shares channels to increase network efficiency and lower latency for both uplink and downlink traffic in high demand environments
- **Multi-user multiple input, multiple output (MU-MIMO)** which allows more downlink data to be transferred at once and enables an access point to handle a larger number of concurrent clients
- **160 MHz channel utilization** capability which increases bandwidth to deliver greater performance with low latency
- **1024-QAM** which enables throughput increases by encoding more data in the same amount of spectrum
- **Target wake time (TWT)** which enables scheduled sleep and wake times for better network efficiency and longer device battery life
- **Transmit beam forming** which improves signal power resulting in significantly higher rates at a given range.

## Capacity Wi-Fi design with a balancing approach

To avoid mutual interference in a capacity design with adjacent APs, the ACS is used to make the APs check and select the best channel under the radio environment automatically. For 5GHz radio, the Radio **Dynamic Adjustment™ technology** (sometimes referenced in the documentation as RDA) in Stellar WLAN can be used to define a “Channel List” to make the AP select the channels from a specified list. By default, the working channel and transmitting power are automatically managed by the RDA technology. One can specify a channels list/power range applicable for auto selection, which reduces the risk of low power transmitting or channel conflict.

The background scanning functionality is used in multiple functions to examine the radio frequency environment in which the wireless network is operating, discovering neighbor APs, while identifying interference, and attacks. Background scanning is the basis of some advanced features such as, wireless IDS/IPS and the RDA technology which in turn leverages the ACS and APC mechanisms.

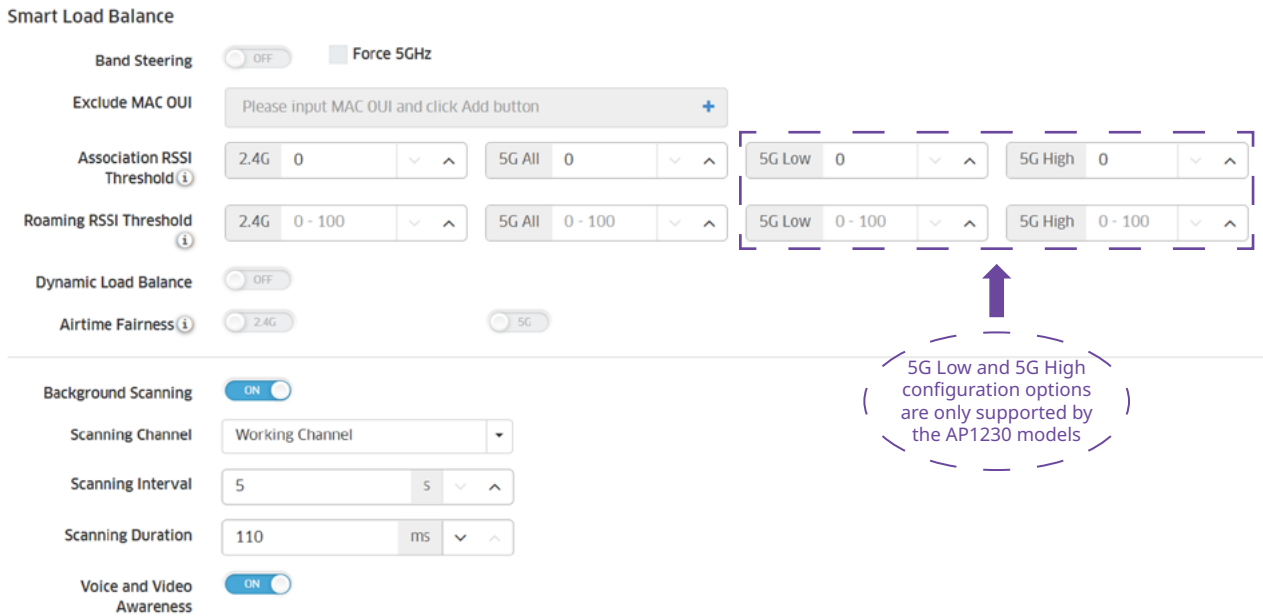
The ACS is recommended for the AP to check and select best channel for the client communications. And the APC checks and selects the best power settings so they does not interfere with other APs, especially for this recommended capacity design where more APs have overlapping coverage and they must control and keep its signal to noise ratio at lower levels.

In the case of a coverage network design, fewer APs are deployed and spaced significantly apart from each other. The APs operate at a **higher transmit power** and therefore **cover larger areas**. However, in a balanced AP design, which leans towards the capacity-based network design, more APs are deployed operating at a lower transmit power to keep the cell size smaller. Through this deployment, devices within these cells associate at higher rates and experience better performance.

It is recommended to deploy OmniAccess Stellar WLAN in a balanced-based design or also called ‘capacity design’ for new deployments to offer better capacity, especially for networks that uses wireless as a primary medium to access the network. The Stellar WLAN RF management algorithm will configure and calibrate the radio settings for the wireless network to leverage the Wi-Fi Fine Tuning of the AP’s radio parameters to maintain a high degree of performance.

# Smart Load Balance

The **Smart Load Balance (SLB)** configuration features improves the user experience when accessing wireless connectivity by guiding a user’s client device to connect to a free wireless channel or AP and denying access to APs with weak signal. These SLB features default settings and recommended best practice adjustments are explained in the following sections. Refer to **Figure 2**, below for configuration options.



**Figure 2:** Smart Load Balance Fine Tuning Configurable Options

**Note:** The 5G Low and 5G High configuration options displayed in **Figure 2** are only supported in the AP1230 models. These configuration options are referenced later in the “Voice and Multimedia Controls” section.

## Optimize Channel Utilization

One important factor affecting network capacity is channel utilization. If the channel utilization reaches 50% or greater before deployment the WLAN capacity will be significantly impacted. Channel utilization is driven by the following factors:

- **Interference** from other WLAN systems such as ad-hoc personal Wi-Fi hotspots
- **Non-Wi-Fi signal interference** such as Bluetooth or other wireless technologies
- **Optimization** of low transmission rate data frames and management frames. It is difficult to optimize AP configurations in the above points 1 & 2 which makes it very important to optimize the channel utilization point. In capacity-based scenarios, it is recommended that the data frames and management frames be optimized separately, and the transmission rates for those frames must be increased, appropriately.

To help illustrate an ‘over-the-top’ **wireless SSID** overhead case, we used an external tool planning called Revolution Wi-Fi Capacity Planner with multiple SSIDs operating on the same channel, refer to **Figure 3**:



Legend	
Low Overhead	0 - 10%
Medium Overhead	10 - 20%
High Overhead	20 - 50%
Very High Overhead	50 - 100%

Note: Configure data rates and SSIDs on the Capacity Plan worksheet.

Number of Access Points On The Same Channel	Number of SSIDs											
	1	2	3	4	5	6	7	8	9	10	11	12
1	0.42%	0.83%	1.25%	1.67%	2.08%	2.50%	2.92%	3.34%	3.75%	4.17%	4.59%	5.00%
2	0.83%	1.67%	2.50%	3.34%	4.17%	5.00%	5.84%	6.67%	7.51%	8.34%	9.17%	10.01%
3	1.25%	2.50%	3.75%	5.00%	6.25%	7.51%	8.76%	10.01%	11.26%	12.51%	13.76%	15.01%
4	1.67%	3.34%	5.00%	6.67%	8.34%	10.01%	11.68%	13.34%	15.01%	16.68%	18.35%	20.02%
5	2.08%	4.17%	6.25%	8.34%	10.42%	12.51%	14.59%	16.68%	18.76%	20.85%	22.93%	25.02%
6	2.50%	5.00%	7.51%	10.01%	12.51%	15.01%	17.51%	20.02%	22.52%	25.02%	27.52%	30.02%
7	2.92%	5.84%	8.76%	11.68%	14.59%	17.51%	20.43%	23.35%	26.27%	29.19%	32.11%	35.03%
8	3.34%	6.67%	10.01%	13.34%	16.68%	20.02%	23.35%	26.69%	30.02%	33.36%	36.70%	40.03%
9	3.75%	7.51%	11.26%	15.01%	18.76%	22.52%	26.27%	30.02%	33.78%	37.53%	41.28%	45.04%
10	4.17%	8.34%	12.51%	16.68%	20.85%	25.02%	29.19%	33.36%	37.53%	41.70%	45.87%	50.04%
11	4.59%	9.17%	13.76%	18.35%	22.93%	27.52%	32.11%	36.70%	41.28%	45.87%	50.46%	55.04%
12	5.00%	10.01%	15.01%	20.02%	25.02%	30.02%	35.03%	40.03%	45.04%	50.04%	55.04%	60.05%
13	5.42%	10.84%	16.26%	21.68%	27.10%	32.53%	37.95%	43.37%	48.79%	54.21%	59.63%	65.05%
14	5.84%	11.68%	17.51%	23.35%	29.19%	35.03%	40.87%	46.70%	52.54%	58.38%	64.22%	70.05%
15	6.25%	12.51%	18.76%	25.02%	31.27%	37.53%	43.78%	50.04%	56.29%	62.55%	68.80%	75.06%
16	6.67%	13.34%	20.02%	26.69%	33.36%	40.03%	46.70%	53.38%	60.05%	66.72%	73.39%	80.06%
17	7.09%	14.18%	21.27%	28.36%	35.44%	42.53%	49.62%	56.71%	63.80%	70.89%	77.98%	85.07%
18	7.51%	15.01%	22.52%	30.02%	37.53%	45.04%	52.54%	60.05%	67.55%	75.06%	82.56%	90.07%
19	7.92%	15.85%	23.77%	31.69%	39.61%	47.54%	55.46%	63.38%	71.31%	79.23%	87.15%	95.07%
20	8.34%	16.68%	25.02%	33.36%	41.70%	50.04%	58.38%	66.72%	75.06%	83.40%	91.74%	100.00%
21	8.76%	17.51%	26.27%	35.03%	43.78%	52.54%	61.30%	70.05%	78.81%	87.57%	96.33%	100.00%
22	9.17%	18.35%	27.52%	36.70%	45.87%	55.04%	64.22%	73.39%	82.56%	91.74%	100.00%	100.00%
23	9.59%	19.18%	28.77%	38.36%	47.95%	57.54%	67.14%	76.73%	86.32%	95.91%	100.00%	100.00%
24	10.01%	20.02%	30.02%	40.03%	50.04%	60.05%	70.05%	80.06%	90.07%	100.00%	100.00%	100.00%
25	10.42%	20.85%	31.27%	41.70%	52.12%	62.55%	72.97%	83.40%	93.82%	100.00%	100.00%	100.00%
26	10.84%	21.68%	32.53%	43.37%	54.21%	65.05%	75.89%	86.73%	97.58%	100.00%	100.00%	100.00%
27	11.26%	22.52%	33.78%	45.04%	56.29%	67.55%	78.81%	90.07%	100.00%	100.00%	100.00%	100.00%
28	11.68%	23.35%	35.03%	46.70%	58.38%	70.05%	81.73%	93.41%	100.00%	100.00%	100.00%	100.00%
29	12.09%	24.19%	36.28%	48.37%	60.46%	72.56%	84.65%	96.74%	100.00%	100.00%	100.00%	100.00%
30	12.51%	25.02%	37.53%	50.04%	62.55%	75.06%	87.57%	100.00%	100.00%	100.00%	100.00%	100.00%

**Figure 3: Revolution Wi-Fi Capacity Planner Output**

The model results in **Figure 3** contain forty percent (40%) of the clients operating based on the 802.11ac standard and the other sixty percent (60%) are a mixture of legacy .11n and .11g devices. This table illustrates the number of SSIDs as to the number of Access Points operating on the same channel. As you can see from these results, as one increases the number of SSIDs it **contributes to the Wi-Fi network** overhead based on the added beacons and probe response frames. Again, this is just an extreme case where no competent engineer would design their WLAN in this manner, but we are making this point to illustrate the overhead caused when a congested channel is selected and when the load balancing algorithm is disabled.

The percentage figures shown in the above table is the airtime overhead caused by the number SSIDs enabled in that Wi-Fi environment, to determine what the actual client serving airtime is offered, the overhead is subtracted from the available airtime that can be used by the clients to transmit and receive data. For example, based on this analysis, if one configures ten SSIDs on twelve Access Points operating on the same channel this will consume 50% of the available airtime. The obvious key point here is that **all APs are on the same channel**, this is where the **Auto Channel Selection (ACS) and Auto Power Control (APC)** functions in Stellar WLAN come into light to help distribute these overhead beacons and probe response frames into multiple non-interfering channels. This is a great reason to keep the Dynamic Radio Adjustment technology enabled. The analysis for the 2.4Ghz band shows worse results, there is over 50% overhead for just three SSIDs for eight APs on the same channel. The point is, be careful and do not go overboard in trying to fine-tune certain parameters, the Wi-Fi environment will be better served when enabling most of its auto functionality to allow its mechanisms to **better load balance**.

## Band Steering

Although most clients support 5GHz connection there are still some clients that select the 2.4GHz band. **Band steering technology** enables clients that support 5GHz to connect to 5GHz first. For newer Wi-Fi device deployments, this attribute is recommended to be enabled.

**Note:** Apple ios devices can have issues with the 'band steering' variable when enabled where it may blacklist the SSID for a few minutes. Caution when enabling for heavy Apple ios device deployments.

## Force 5G

When the "Force 5G" parameter is enabled (disabled by default), it forces **dual band capable wireless** clients to **connect** to 5GHz and does not allow them to connect at 2.4GHz. This functionality is recommended stay disabled for environments where the client population has a mixture of 2.4GHz and 5GHz clients. When enabled it will reject all association requests from 2.4GHz clients.

## Association & Roaming Received Signal Strength Indicator (RSSI)

The **Association RSSI Threshold setting** is used to set thresholds at the RF Profile level for optimizing connectivity when associating with an AP by denying client access with a weak signal. Clients with a signal strength value lower than the association signal threshold will not be allowed to connect to the AP. By default, the RSSI threshold is disabled (0). These thresholds can be applied to 2.4G or 5G bands separately; or for newer (802.11ax and .11ac) capable devices, the association parameters can also be set per SSID basis through the "**Minimum Client Data Rate Controller**" for both bands.

Before we get into more details of these types of RSSI Thresholds, let's clarify how Stellar Wireless Received Signal Strength Indicator is converted to decibel to milliwatt measurements. The RSSI recommendations listed below can be converted to decibels in relation to a milliwatt or also referred as to dBm. The mathematical formula used for this calculation is based on the RSSI value (in a range from 0 through 99 supported in Stellar WLAN), the RSSI value is subtracted from -96 dBm which is the base noise floor for this calculation to obtain the desired value in dBm's to support the VoIP and streaming video applications, as illustrated in **Figure 4**, below. This reference for "Acceptable Signal Strengths" table comes from various industry sources.

Signal Strength	Signal Rating	Applications Supported
-30dBm	Outstanding – Not typical since the Wi-Fi client is only a few feet away from the Access Point to achieve this signal strength.	N/A
-67 dBm	Very good – Minimum signal strength for applications that require time-sensitive communications.	VoIP / VoWLAN, Video streaming
-70 dBm	Minimum signal strength for non-sensitive packet-delay delivery.	Email, web
-80 dBm	Minimum signal strength for device connectivity. Packet delivery is unreliable.	N/A

**Figure 4:** Acceptable Signal Strengths

For the **Stellar WLAN**, we are using -96 dBm as the base noise floor less the RSSI threshold value of (29) it provides the value of -67 dBm's for a minimum very good signal strength converted to decibels to a milliwatt representation to support good QoE for VoIP and video streaming applications.

These fine-tuning recommendation parameters help with issues related to “time-to-connect” and “unsuccessful connectivity attempts” and the overall QoE for a positive Wi-Fi connectivity experience. The recommended minimum “Association RSSI Threshold” setting is (22) for both 2.4G and 5G bands. This threshold allows clients to associate to the Access Point at minimum signal strength of **-74 dBm** using the **-96 dBm** as the base noise floor for conversion from the RSSI value.

Another mechanism support for client association to Access Points is via the **Minimum Client Data Rate** parameters, this option is enabled in the SSID configuration level through the minimum data rate controller parameters for each of the bands. For example, for the 2.4GHz Minimum Client Data Rate the recommended minimum rate is (12), which means 12 Mbps, and the way this mechanism works is when a client's data speed is lower than those settings, the client will be denied association to that SSID. A similar process happens for the 5Ghz clients, the recommended minimum associating data rate is **24 Mbps**.

For device roaming purposes, minimal adjusting of parameters is required since the Stellar Access Points support 802.11r, 802.11k and 802.11v supplemental standards which are better mechanisms to handle roaming decisions. However, for this functionality to work the client side needs to support those supplemental standards, as well. The roaming RSSI thresholds can be used in conjunction with .11k and .11v standards for the devices that support them. These options will be discussed further in a separate section when addressing the sticky-client issue.

But first, let's address the Roaming RSSI Threshold recommendations based on RSSI values in the same manner as discussed for the **association mechanism**. When the client's RSSI value is lower than the threshold value that client will be guided to roam to another AP with a stronger signal. By default, the Roaming RSSI is disabled with a value of zero. This functionality is also applied to the 2.4G or 5G bands separately.

These roaming decisions can best be enabled for coverage-based network designs since there will be less Access Points deployed and weaker signals at the coverage edges; however, for ALE's best design practices, the capacity-based design is recommended with a higher AP density to eliminate most weak signals between APs. With this scenario minimal fine-tuning of those thresholds is required. Nevertheless, for those legacy devices that still need the system control then the Roaming RSSI threshold is recommended to be (25) for both 2.4G and 5G bands to trigger roaming at **-71 dBm** to an AP that can deliver better signal strength to maintain the best QoE connectivity.

**Note:** *In certain time-sensitive applications supported by Stellar WLAN, the roaming thresholds need to be more aggressive on a per band basis. For instance, at one of our customer deployments we configured roaming RSSI thresholds of 34 for 2.4G and 28 for 5G bands. Those thresholds will trigger roaming at 62 dBm for 2.4G and at 68 dBm for 5G clients with those minimum signal strength thresholds.*

The “**Minimum MGMT Rate Controls**” parameters can also help with roaming decisions when working with or without the 802.11k and 11v standards. The recommended minimum MGMT rate setting is also **12 Mbps** for the 2.4G and **24 Mbps** for the 5G bands. These controller fields can be enabled or disabled for each of the radio bands through the “Minimum MGMT Rate Controller” settings.

The higher the value means less coverage; the lower value means larger coverage, but since ALE recommends the capacity-based design there will be more Access Points to serve, offering stronger signals to minimize roaming. But once devices need to roam, they will maintain their high-performance based on those minimum rate requirements.

**Note:** *The association Minimum Client Data Rate setting needs to be equal or higher than the Minimum MGMT Rate. These configuration options can be set at the SSID configuration level (as referenced in Appendix C).*

## Airtime Fairness

The airtime fairness attribute enables or disables (disabled by default) the airtime fairness functionality on 2.4G and 5G bands. The airtime fairness feature provides equal access to all wireless clients, regardless of client type, capability (802.11ax, 802.11ac, 802.11n, 802.11a, 802.11g, 802.11b), thus delivering uniform performance to all clients. This feature prevents the clients from monopolizing resources. When enabled or disabled, its status change requires a reboot of the AP for the change to take effect. This parameter is recommended to be enabled, this functionality provides equal time slices in the air to all clients, and since the latest 802.11ax/ac standards in devices supporting faster processors will be able to take advantage of those airtime slices in a more efficient manner than the legacy devices.

## Background Scanning

The **Background Scanning** configurable parameters are under the umbrella of the Smart Load Balancing features, it contains the enablement options for some advanced features such as, the Radio Dynamic Adjustment (RDA) technology; Auto Channel Selection/Auto Power Control (ACS/APC), wireless Intrusion detection and prevention systems (wIDS & wIPS), and among other functionality that may be required to be adjusted to present the best quality of connectivity experience. When background scanning is turned OFF, the rogue AP detection and suppression will stop and the Radio Dynamic Adjustment™ technology will drop its precision. By default, background scanning is Enabled, and it is recommended to stay that way.

For the RF fine-tuning purposes, let's look at the Radio Dynamic Adjustment technology and how Stellar wireless architecture implements it. RDA technology adjusts the radio working channel and transmitting power according to the wireless environment around it. It includes Auto Channel Selection (ACS) and Auto Power Control (APC) functions. RDA is Enabled by default. The scanning interval of **Background Scanning** can be configured from 5 seconds to 3 hours. For highly sensitive packet delay use cases, it is recommended to increase the setting to 20 seconds. Keep in mind that an interval longer than 60 seconds loses RDA accuracy, and it affects the wIPS functionality, it recommended to keep it under 40 seconds.

The Radio Dynamic Adjustment technology is also controlling adjacent APs, so they use different radio channels to prevent interference. APs within range of each other should always be set to non-interfering channels to maximize the capacity and performance. And this where the auto channel selection setting can be used to make the AP check and select the best channel under its radio environment automatically. The algorithm will help the AP find the channel with the least overhead.

In relation to the **Band Steering** and Force 5G variables that were discussed, previously, these RDA, ACS, and APC features work together to reduce the co-channel interference and increase available bandwidth for the connected devices.

# Roaming Functionality & Sticky-client Avoidance

## Roaming Functionality

There are two options to handle device roaming more efficiently; for example, one is through the Roaming RSSI Threshold, as discussed in the previous section, which sets thresholds to deny clients access to Access Points with weak wireless signals. The Roaming RSSI variables are used in conjunction with the supplemental standards 802.11k and 802.11v. Clients that support those standards will be informed to which AP to roam to when the threshold is reached, this functionality is addressed later in the solution to avoid the sticky-client problem (more details in the next section).

The Layer 2 roaming parameter is recommended to always be enabled; similarly, for L3 Roaming it is recommended to be enabled. The functionality of Layer 3 roaming is that it allows clients to move between APs with access to other subnets and VLANs. We recommend for this parameter to also be enabled; this will assist the wired side of the network to enforce the routing for better controls via policies and ACLs through higher performing Layer 3 switches.

One may be asking what does the **Forwarding Database (FDB) Update on Association** attribute have to do with roaming, well, when enabled and when a client roams to a new AP, the new associated AP will send ARP packets to the uplink switch to notify the switch to change the downstream forwarding port for the wireless client's traffic. Therefore, to keep the network's forwarding tables, the client's location and network path updated this parameter is recommended to be **enabled**.

The Opportunistic Key Caching (OKC) is also related to roaming, when enabled it triggers a cached Pairwise Master Key (PMK) to be used when the client roams to a new Access Point. This also helps with the Sticky-Client avoidance functionality. If re-authentication happened every time a client roamed it would defeat the purpose for device mobility while using the wireless environment, this OKC functionality allows for faster roaming of clients without the need for a complete 802.1x re-authentication.

## Sticky-client Avoidance with IEEE 802.11k & 802.11v Standard Amendments

The sticky-client issue happens when Wi-Fi clients attempt to roam; those clients tend to hang on to the original access point they associated with, rather than moving to a nearby AP that has better signal strength. Clients must monitor indicators of the health of their wireless connection, such as the signal strength (RSSI), their signal to noise ratio, and the number of errors/retries they are experiencing on that connection. Once these indicators start to degrade, they must start to probe for alternative access points, ready to make the jump to a new access point that will provide a better quality connection. The IEEE 802.11k and 802.11v standard amendments forces roaming when connection speeds hit low rates.

It is recommended to have the 802.11k and 11v controls enabled. These advanced controls include mechanisms for performing various measurements of the WLAN station's environment; for example, the 802.11k controls allow a client to request information about that environment. One of the most useful mechanisms from a client's roaming perspective is the neighbor report. A neighbor report is requested by a client which contains a list of the APs the APs each of the knows about. Since the client has this information, it improves its ability to make the roaming decision. However, keep in mind that use of 802.11k functionality is dependent on the client's support for that feature.

The 802.11v defines a service that allows stations on WLAN devices to exchange data that provides them with awareness of the network conditions. One of the mechanisms provided in 802.11v is 'BSS Transition Management'. This mechanism allows an access point to request that a client roam to a specific AP, or it provides a set of preferred APs. This mechanism also provides the client with better data to improve its roaming decisions.

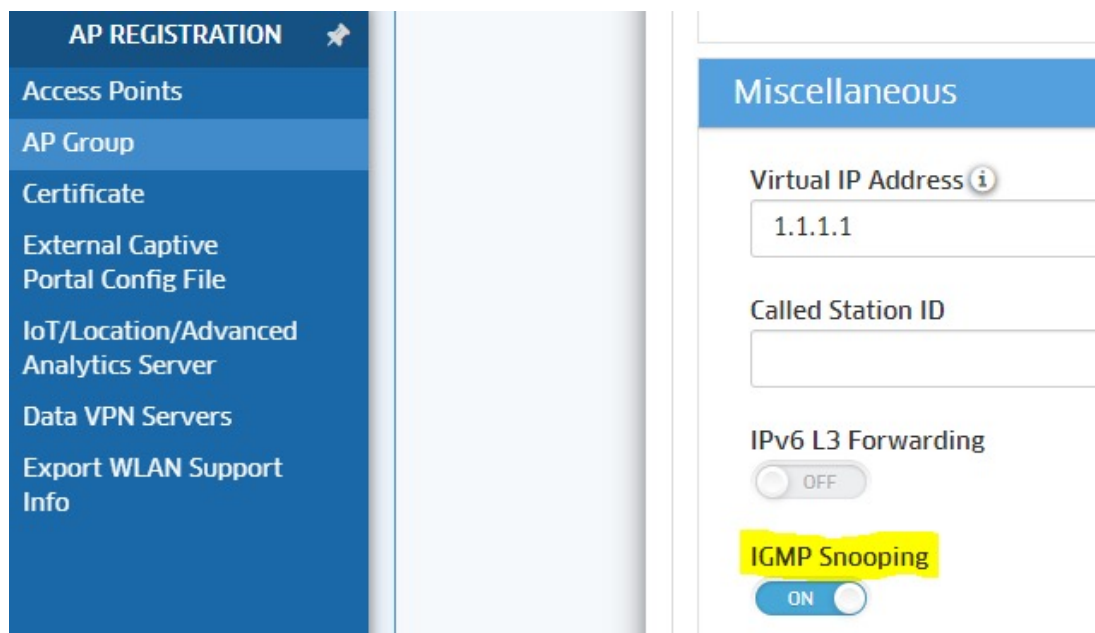
In addition to the .11k and .11v parameters, the 802.11r is also recommended to be enabled to support the Fast BSS Transition mechanism to minimize the delay when a client transitions from one BSS to another within the same group.

Even though, when the load balancing algorithm is enabled supporting band steering, RSSI thresholds for client's connections, and client count based load balancing among neighboring APs; none of that functionality solves the problem of sticky clients or guarantees that the Wi-Fi network is providing optimal performance to all its connected clients. Therefore, the enabling of the 802.11k / 802.11v supplemental standards to force roaming when connection speeds reach low rates is a requirement to avoid the 'sticky-client' issues. But keep in mind the lowest common denominator is that the client needs to support those standard amendments to force the roaming gracefully and to avoid those issues.

# Multicast Optimization and Broadcast Filter Controls

## Multicast Optimization

In a networking environment where IP multicast traffic is used, destination hosts signal their intent to receive a specific IP multicast stream by sending an **Internet Group Management Protocol (IGMP)** request to a nearby networking switch and Access Point. This process is referred to as IGMP Snooping. This functionality is very important for large subnets and for layer 2 roaming functionality because of the limited airspace for data transmission. Before we begin with the fine-tuning of the broadcast and multicast optimization recommendations for the broadcast key rotation and filters, the IGMP snooping parameters needs to be enabled per AP Group basis, see **Figure 5**, below:



**Figure 5:** Turning 'ON' IGMP Snooping

The Multicast Optimization parameter per SSID is enabled by default and the “Number of Clients” attribute is defaulted to six clients to support high throughput via the multicast services. This number is configurable under the QoS section settings on a per SSID basis. The “Multicast Based Channel Utilization” attribute is used to configure the based channel utilization optimization percentage; the range is (0 – 100) and the **default is (90)**. For the limited number of devices supporting multicast services, these defaults are the recommended with minor adjustments depending on the increase or decrease of the number of multicast clients joining the multicast services over the WLAN.

In reference to the “**Broadcast Key Rotation**” attribute, this is used to enable/disable (**disabled** by default) the broadcast key rotation function. When enabled, the broadcast key will be rotated after every interval time. The key rotation time interval is defined in minutes; the rotation key range is (1 – 1440), the default is 15 minutes (when **enabled**). This parameter is recommended to be enabled to assist in the multicast optimization and fine-tuning options.

## Broadcast Filter ARP

The “**Broadcast Filter ARP**” enables/disables broadcast filtering. When enabled, all broadcast frames are dropped, except DHCP and ARP frames. The Broadcast Filter ARP attribute is recommended to be **enabled** so the AP can act as an “ARP Proxy”. If the ARP-request packet requests a client’s MAC address and the Stellar AP knows the client’s MAC and IP address, the AP will respond to the ARP-request but not forward the ARP-request (broadcast) to all broadcast domains. This reduces ARP broadcast packet forwarding and significantly improves network performance. The APs do not act as ARP proxy for gratuitous ARP packets. When the device gets an IP from DHCP or IP release/ renew, the station will send gratuitous ARP packets; the AP will not respond to those special ARP packets, but will broadcast them normally.

The Broadcast Filter ARP attribute while enabled **helps alleviate issues with Wi-Fi devices** (such as, iPhones & Chromebooks) which do not play well in some cases with dynamic frequency selected channels. These problems may cause iPhones and Chromebooks to have issues when roaming, sticky-client, and randomness poor performance. Apple and Google design documents recommend 5GHz only SSIDS to support these devices; therefore, enabling band steering and force 5G are requirements for these types of devices which fall in line with ALE’s recommendations from an earlier section when those parameters were discussed.



# Voice and Multimedia Controls for best QoE

The **Voice and Video Awareness** attribute is used to enable/disable (**disabled** by default) voice and video awareness services. This functionality is used in conjunction with background scanning, this function allows it to be aware of existing traffic on the APs. If there is an ongoing voice/video service, scanning should not be performed to ensure uninterrupted traffic; scanning resumes once there are no active voice/video sessions and this is controlled via this attribute.

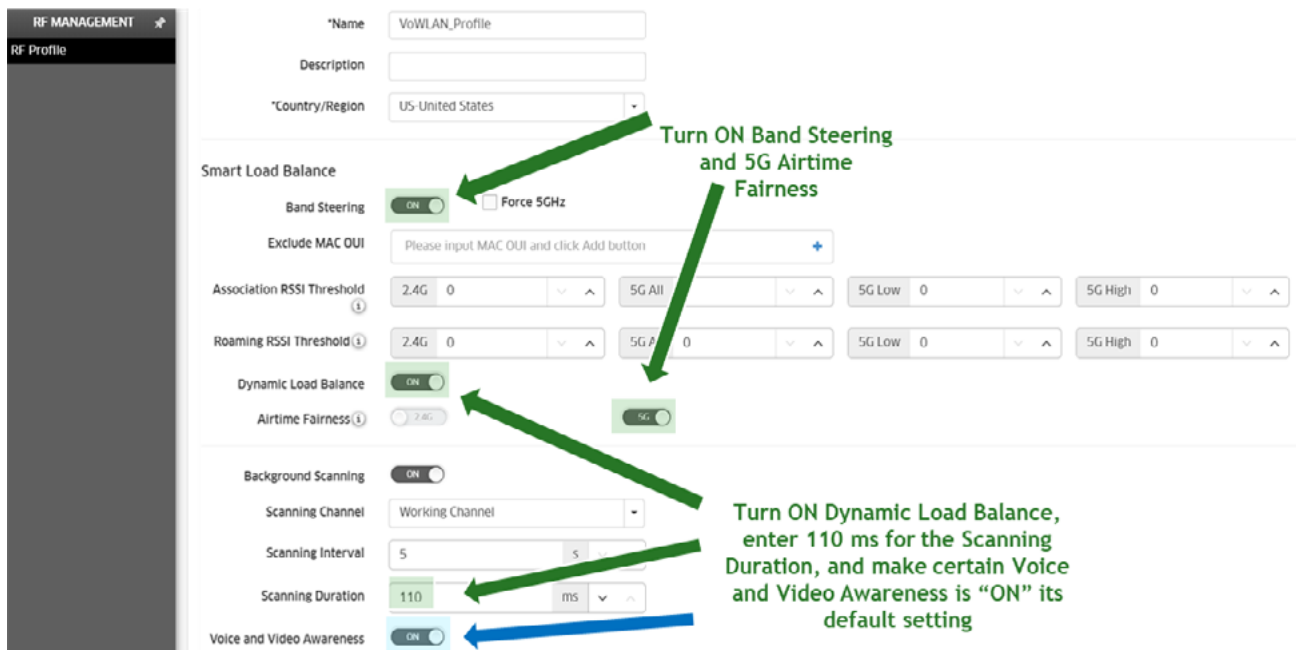
Refer to the “vowlan-guidelines-stellar-awos4.0.2” design guide for detailed configuration options for the QoS parameter settings to handle the voice and multimedia applications over an OmniAccess Stellar WLAN network, below are specific settings that we would like to highlight in this document, but a explained in greater detail in the VoWLAN guide.

## RF Management Tested Recommendations for Voice over WLAN

The key settings for the voice and video awareness are at the RF Profile level by enabling **Band Steering** and **5G AirTime Fairness**, these are the basic prerequisites for guaranteeing QoE for these types of applications.

While Band Steering is a useful feature allowing APs to recommend users to use the 5GHZ instead of the 2.4 GHz band, the experience shows that for Time Sensitive applications, (like Voice over WLAN) we should dedicate a SSID with only the 5 GHz enabled and no Band Steering. Such configuration improves the quality of experience for voice users Wi-Fi optimizing the band usage, the roaming, and the compatibility with some devices (like Apple which recommends such configuration).

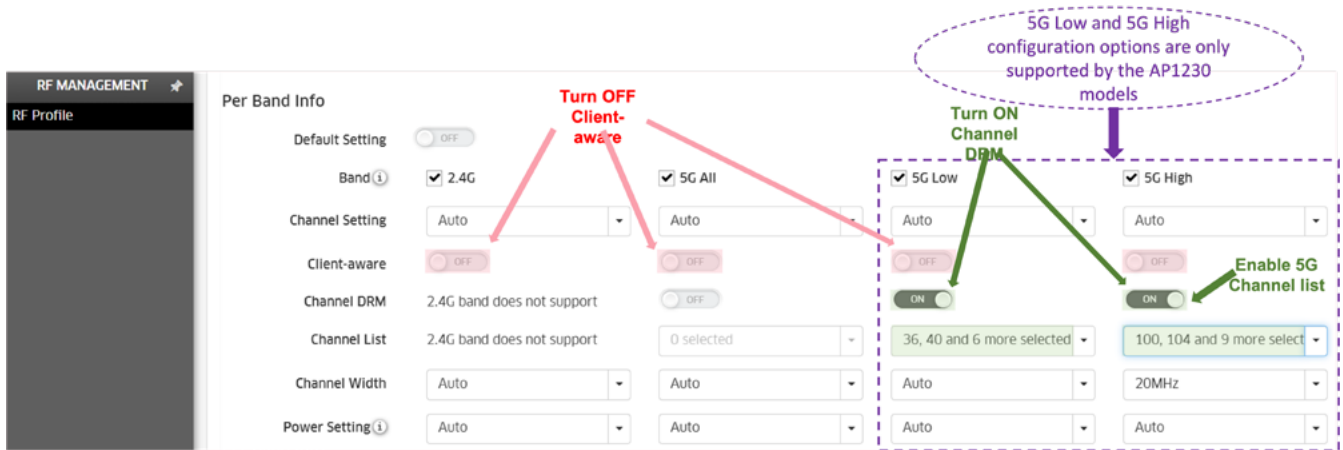
The other prerequisites include Background Scanning and Voice and Video Awareness buttons which are already enabled by default. Make certain the background scanning duration is configured for 110 milli seconds, as denoted in **Figure 6**.



**Figure 6:** RF Management for VoWLAN

# Dynamic Radio Management (DRM) settings

Dynamic Radio Management (DRM) settings are configured through the 'RF Profile' menu on a per AP Group basis, refer to **Figure 7** for the configuration recommendations. As referenced previously, the 5G Low and 5G High configuration options displayed in the **Figure 7** are only supported in the AP1230 models. In most cases, selecting 20MHz channel width for the 5G band is recommended for this application.



**Figure 7:** RF Management for VoWLAN & DRM

When configuring the 5G Low and 5G High options, do the following: 1) select all 8 channels for the 5G Low and once again, 2) leave the channel width and power setting on Auto for both options; and 3) then select 11 channels to have sufficient isolation between them for the 5G High option, change the channel width from Auto to 20MHz, but leave the power setting on Auto; and leave the Multi-MIMO (MU-MIMO) setting as factory default which is already enabled.

## QoS and Prioritizing Mapping Recommendations

In the SSID configuration options, under the “Advanced WLAN Service Configuration”, one can configure the 802.1p Mapping and the DSCP Mapping attributes. The 802.1p Mapping attribute is used to configure the uplink and downlink mapping mechanism between Wi-Fi Multimedia (WMM) access categories and 802.1p priority. The uplink traffic can only be mapped to a single value; however, the downlink traffic can be mapped to multiple values. The fields are already populated with the default values but can be changed based the application requirements.

The DSCP Mapping attribute is used to configure the uplink and downlink mapping mechanism between Wi-Fi Multimedia (WMM) access categories and DSCP priority. The uplink traffic can only be mapped to a single value; however, the downlink traffic can be mapped to multiple values. The fields are already populated with the default values but can be changed based on the required mapping value.

The Trust Original DSCP attribute, if enabled, the original DSCP mapping for uplink traffic is trusted (disabled by default).

Mapping ranges and default values:

- **Video - WMM Video** will be mapped to the 802.1p value.

- Uplink - Maps uplink traffic (from AP to network), default = 32.
- Downlink - Maps downlink traffic (from network to AP), default = 32, 40)

- **Voice - WMM Voice** will be mapped to the 802.1p value.

- Uplink - Maps uplink traffic (from AP to network), default = 48
- Downlink - Maps downlink traffic (from network to AP), default = 48, 56)

For the detailed configuration guidelines and explanations for fine tuning voice and WMM parameters for these Stellar WLAN attributes please refer to the latest VoWLAN Design Guide for the OmniAccess Stellar Wireless.

# Wi-Fi Fine-tuning Evolution Under OmniVista Cirrus

## Analytical Results Fine Tuning Stellar Wi-Fi Solution

**OmniVista Cirrus 10.1** is the first phase of this Artificial Intelligence driven tool to simplify monitoring and troubleshooting of a Stellar Wireless network through detailed QoE measurements and Wi-Fi Analytics in an easy-to-read dashboard displays.

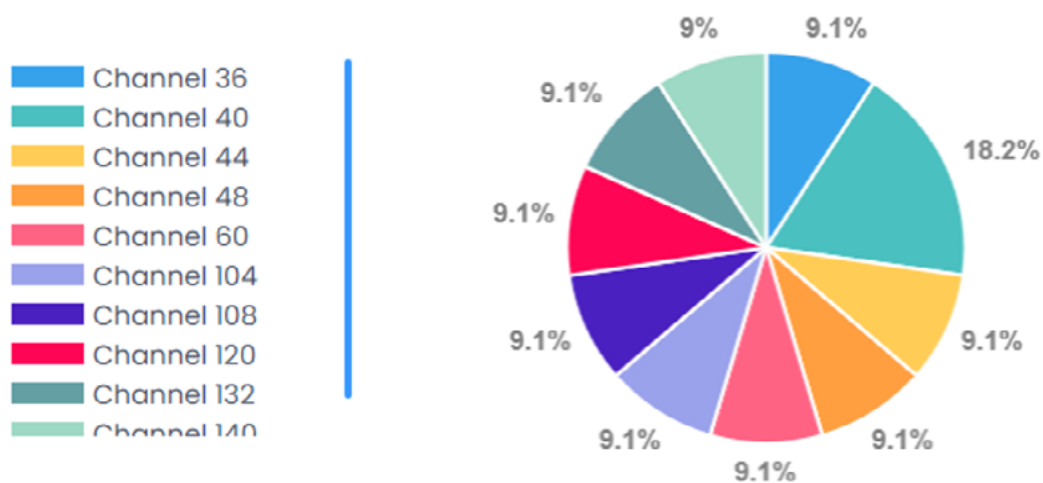
- **OmniVista Cirrus** provides advanced data analytics powered by its Cloud Analytics Engine that processes raw data and presents it in useful information for the various stakeholders to provide insights for proactive service assurance.
- **QoE** encompasses many connectivity factors from successful connectivity attempts, to time-to-connect, to roaming, to capacity availability; airtime-fairness, and among other key QoE attributes which help influence the quality of the user’s experience while securely connecting and roaming on a Stellar wireless network.

This **NMS** tool aids with the “Successful Connects” metrics, this functionality helps track failures during Wi-Fi device: **Association, Authorization, DHCP phases and Captive Portal**.

All the fine-tuning recommendations discussed in this document can serve as a great training tool for OmniVista Cirrus 10.x. The evolution of this tool will provide self-provisioning decisions to fine-tune the network in the future; however, for today, we can help it by fine-tuning parameters based on the analytics data collected by OmniVista Cirrus and converted to information through its AI-driven Cloud Analytics Engine to be presented via usable widgets (refer to the [OmniVista Cirrus 10.x documentation](#) for a complete explanation about this evolving NMS tool. For instance, in reference to the Revolution SSIDs overhead capacity planning tool that we referenced earlier when dealing with a single channel overhead problem. OmniVista Cirrus 10.x provides us with widgets to see the Channel Distribution under the Network Analytics Dashboard section. As shown in **Figure 8**, these widgets show the 2.4GHz and 5GHz frequency bands with the channels that are being used within each frequency band; for example, **Figure 8** illustrates the 5GHz distribution.

### 5GHz

Channel distribution in the frequency band 5GHz. [Learn more.](#)



**Figure 8:** Channel distribution and utilization Sample

If the **QoE scores** are low, then the administrator can use this information combined with the Channel Utilization metrics to check and adjust to accomplish a fair distribution of the wireless communications among all the channels. As illustrated in **Figure 8**, all the clients are well distributed, utilizing 9.1% of each of the 5GHz channels except for channel 40 which is being utilized by more clients than the other channels.

## Conclusion

ALE understands that there are many Wi-Fi parameters that can be adjusted or simply left as defaults, so they can operate according to the standard's thresholds. The purpose of this document is to address specific parameters that are recommended to be fine-tuned based on the application and the device requirements.

Refer to the following appendices for the Wi-Fi configuration fine-tuning options referenced throughout the document. These appendices provide a more structured reference of the parameter setting, the default state, and the recommended fine-tuning guidelines to help deliver the best quality of connectivity experience in the same order as displayed through configuration screen options in OmniVista 2500 4.6R1 and OmniVista Cirrus 4.6.1 versions.

# Appendix A

## Stellar WLAN Fine-Tuning Under the RF Profile Configuration Workflow

### Per Band Info

Settings	Default	Guidelines Reasons to Enable/Disable
Band Steering	Disabled "OFF"	For newer Wi-Fi device deployment, this attribute is recommended to be enabled.
Force 5GHz	Disabled	This functionality is recommended stay disabled for environments where the client population has a mixture of 2.4GHz and 5GHz clients. When enabled it will reject all association requests from 2.4Ghz clients.
Exclude MAC OUI	Disabled	When enabled, the MACs OUI entered in the list and when matched, those MACs will be excluded from the Band Steering algorithm.
Association RSSI Threshold	Disabled "0"	Recommended to be enabled for both bands and set a minimum RSSI threshold of 22 which translates to -74 dBm (using -96 dBm as base noise floor).
Roaming RSSI Threshold	Disabled "0"	Recommended to be enabled for both bands and set the RSSI threshold of 25 which translates to -71 dBm (using -96 dBm as base noise floor), when signal strength drops to -71 dBm roaming is triggered.
Dynamic Load Balance	Disabled "OFF"	Recommended to be enabled.
Airtime Fairness	Disabled "Both Bands"	Recommended to be enabled, the newer devices will take advantage of these advanced features through the support of the new standards in a fair manner since they will have equal airtime while using faster processors, new Wi-Fi standards, etc.
Background Scan-ning	Enabled "ON"	Recommended to stay enabled: Background scanning is used to examine the radio frequency environment in which the wireless network is operating, discover neighbor APs, and identify inter-ferece and attacks. Background scanning is the basis of some advanced features such as: WIPS, Radio Dynamic Adjustment (ACS/APC) etc.
Scanning Channel	"Working Channel"	This setting is modifiable to be for "Working channel" or both "Working channel and Non-working Channel" options; recommended to leave as default.
Scanning Interval	"20" sec	Recommended to leave as default.
Scanning Duration	Enabled "50" ms	Recommended to leave as <i>default</i> .
Voice and Video Awareness	Enabled "ON"	Recommended to leave as default. Background scanning must be aware of existing traffic on APs. If there is an ongoing voice/video service, scanning should not be performed to ensure uninterrupted traffic; and scanning should resume there is no active voice/video session.


# Stellar WLAN Fine-Tuning Under the RF Profile Configuration Workflow

## Per Band Info

Settings	Default	Guidelines Reasons to Enable/Disable
Default Setting	Disabled "OFF"	Disable to set custom bandwidth settings. Enable to reset bandwidth settings to default values. Recommended to stay <b>disabled "OFF"</b> for the APs to be configured with minimum and maximum TX power since there will be a mixture of AP models with different radio capacities.
Band	Enabled "All bands are checked"	Recommended for all bands to stay checked. Regarding the "5G High" and "5G Low" options, they are exclusively used to set the 5.8G and 5.2G radios on Stellar AP-1230 series. The "5G All" is used to set the full band 5G radio on the other AP series. When "Default Setting is "ON" all Bands are enabled.
Channel Setting	Enabled "Auto" for all bands	Recommended to stay on default "Auto". When "Default Setting is "ON" all Bands are on "Auto" and they cannot be changed.
Client-aware	Enabled "ON" for all bands	Recommended to stay on default "ON". When "Default Setting is "ON" all Bands are on "ON" and they cannot be changed.
Channel DRM	Disabled "OFF"	Only supported for 5G bands. Recommended to stay "OFF" to allow the Radio Dynamic Adjustment technology to automatically set the ACS based on its algorithm.
Channel List	Disabled	Only supported when "Channel DRM" for 5G bands is enabled.
Channel Width	Enabled "Auto"	Recommended to stay on "Auto" for most or 20MHz for most WLAN applications.
Power Setting	Enabled "Auto"	Recommended for this setting to stay on Auto, but the 'Minimum TX' and "Maximum TX' power parameters below need to be adjusted.  Note: The maximum transmitting power varies from different models on each band. If manually configured, and when the setting value exceeds the capability of the model, the AP will work with a maximum transmitting power rather than the setting value.

# Stellar WLAN Fine-Tuning Under the RF Profile Configuration Workflow

## Per Band Info

Settings	Default	Guidelines Reasons to Enable/Disable
Maximum TX Power (dBm)	Disabled "configurable range from 3-40 dBm"	For most applications, this parameter is recommended to be set at maximum Tx power at "15" dBm for 2.4GHz and "18" dBm for 5GHz bands.   Note: For this parameter be configurable, the "Default Setting" button at the top of the configuration screen needs to stay "OFF".
External Antennas Gain (dBi)	Enabled "configurable range from 1-16 dBm"	Only applicable to APs supporting external antennas. It is recommended that these types of APs be divided into several AP Groups when using different types of external antenna (e.g., Group A with an antenna gain value of 3-dBi, and Group B with an antenna gain value of 6-dBi).
Beacon Interval (ms)	Enabled "100" ms	This indicates how often the 802.11 beacon management frames are transmitted by the AP, the configurable range is from 60-500 milli seconds (ms). It is recommended to keep at the default of 100 ms.
Short Guard Interval	Enabled "ON"	Recommended to remain <b>enabled</b> .
MU-MIMO	Enabled "ON"	Recommended to remain <b>enabled</b> .
High Efficiency	Enabled "ON"	Recommended to remain <b>enabled</b> for High-Efficiency (HE) 802.11ax APs; when disabled, HE 802.11ax capable APs will downgrade to VHT (Very High Throughput) mode.



# Appendix B

## AP Group

The IGMP Snooping parameter is recommended to be enabled to work with the Multicast Optimization parameter as configured in the SSIDs Configuration section. To enable IGMP Snooping, open the AP Group configuration screen, scroll down to the bottom of the screen to enable this parameter.

### Enabling IGMP Snooping

Settings	Default	Guidelines Reasons to Enable/Disable
IGMP Snooping	Disabled "OFF"	Recommended to be <b>Enabled</b> when the Multicast Optimization parameter is enabled in the SSIDs Configuration section.

# Appendix C

## SSID Configuration Workflow and Expert Mode options

### Advanced WLAN Service Configuration

To minimize radio interference in these today's high-performing Wi-Fi Access Point deployments, minimal AP settings (mostly handled via the OV-2500 NMS Stellar RF management on a per AP group basis). However, the initial deployment needs to be configured and adjusted as per the physical site survey recommendations and based on the applications, performance requirements, and types of devices connecting to this wireless network.

Settings	Default	Guidelines Reasons to Enable/Disable
<b>SSID Setting</b>		
Hide SSID	Disabled	
UAPSD	Enabled	When <b>enabled</b> , the MACs OUI entered in the list and when matched, those MACs will be excluded from the Band Steering algorithm.
<b>Security</b>		
Classification Status	Disabled	When enabled, traffic will be classified to a role based on the configured classification rules. Note that the precedence of role assignment methods is important. Classification Rules are only used if 802.1x/MAC authentication does not return a role, or the returned role is not matched with any configured roles in the device.
Client Isolation	Disabled	Recommended to be <b>Enabled</b> , this adds another layer of security.
Protected Management Frame	Optional	Configures whether connections are accepted from clients supporting Protected Management Frame for certain Security Levels/Encryption Types (Enterprise - WPA2_AES/WPA3_AES256/ WPA3AES).
<b>Roaming Controls</b>		
L3 Roaming	Disabled	Recommended to be <b>Enabled</b> . This will help keeping the FDB updated.
FDB Update on Association	Disabled	Recommended to be <b>enabled</b> . Allows the switch to update the downstream forwarding port based on the new generated ARP. This option will help to keep the switches' forwarding table updated.
802.11r	Disabled	Recommended to be enabled to assist with device roaming decisions when this standard is supported end-to-end.
OKC	Disabled	Recommended to be <b>enabled</b> to allow for faster roaming for Windows clients without a complete 802.1x re-authentication.
802.11k Status	Disabled	Recommended to be <b>enabled</b> , helps to resolve the Sticky-Client issue. Works with these standards' compliant clients to help deliver excellent QoE scores.

802.11v Status	Disabled	Recommended to be enabled to help eliminate the Sticky-Client issue through the support of Fast BSS.
Protected Management Frame	Optional	Configures whether connections are accepted from clients supporting Protected Management Frame for certain Security Levels/Encryption Types (Enterprise - WPA2_AES/WPA3_AES256/ WPA3AES).
<b>Client Controls</b>		
Max Number of Clients Per Band	"64"	
802.11b Support	Enabled	Can only stay enabled when the 802.11a/g setting is enabled. Recommended to be <b>disabled</b> by default.
802.11a/g Support	Enabled	
<b>Minimum Client Data Rate Controls</b>		
2.4GHz Minimum Client Data Rate Controller	Disabled	Recommended to be <b>enabled</b> .
2.4GHz Minimum Client Data Rate	Disabled	Recommended to be <b>enabled</b> , setting the value at 12 Mbps.
5GHz Minimum Client Data Rate Controller	Disabled	Recommended to be <b>enabled</b> .
5GHz Minimum Client Data Rate	Disabled	Recommended to be <b>enabled</b> , setting the value at 24 Mbps.
<b>Minimum MGMT Rate Controls</b>		
2.4GHz Minimum MGMT Rate Controller	Disabled	Recommended to be <b>enabled</b> .
2.4GHz Minimum MGMT Rate	Disabled	Recommended to be <b>enabled</b> , setting the value at <b>12 Mbps</b> , working with the IEEE 802.11k and .11v supplemental standards.
5GHz Minimum MGMT Rate Controller	Disabled	Recommended to be <b>enabled</b> .
5GHz Minimum MGMT Rate	Disabled	Recommended to be <b>enabled</b> , setting the value at <b>24 Mbps</b> , working with the IEEE 802.11k and .11v supplemental standards for time-sensitive applications over WLAN.
<b>Power Save Controls</b>		
DTIM Interval	Default is "1"	The Delivery Traffic Indication Message (DTIM) period in beacons. Note: Recommended for Apple interoperability to be set at a value of 3.

# SSID Configuration Workflow and Expert Mode options

## QoS Setting

Settings	Default	Guidelines Reasons to Enable/Disable
<b>Bandwidth Contract</b>		
Upstream Bandwidth	Disabled	Configurable in 'Kbits/s' from 0-2621440 (Based on application parameters)
Downstream Bandwidth	Disabled	Configurable in 'Kbits/s' from 0-2621440 (Based on application parameters)
Upstream Burst	Disabled	Configurable in 'Kbits/s' from 0-2621440 (Based on application parameters)
Downstream Burst	Disabled	Configurable in 'Kbits/s' from 0-2621440 (Based on application parameters)
<b>Broadcast/Multicast Optimization</b>		
Broadcast Key Rotation	Disabled	For security purposes and for broadcast handling optimization, this attribute recommended to be <b>enabled</b> .
Broadcast Filter All	Disabled	Recommended to be <b>enabled</b> to help alleviate issues with certain devices that have issues with dynamic frequency selected channels. Apple and Google design documents recommend 5GHz only SSIDS to support these devices.
Broadcast Filter ARP	Disabled	Recommended to be <b>enabled</b> . Refer to the "Broadcast Filter ARP" section in this document for additional details.
Multicast Optimization	Enabled	Recommended to keep <b>enabled</b> .
Multicast Based Channel Utilization	"90"	Configures based channel utilization optimization percentage. (Range = 0 - 100, Default = 90)
Number of Clients	"6"	Configure the threshold for multicast optimization. This is the maximum number of high throughputs.