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Configuration Guide

DynamicSteering in vWLAN

This configuration guide provides an in-depth look at DynamicSteering in ADTRAN Bluesocket virtual wireless local area network (vWLAN) products. Included in this guide are an overview of DynamicSteering, configuration of vWLAN products for DynamicSteering support, and general troubleshooting information.

This guide consists of the following sections:

Overview of DynamicSteering

DynamicSteering is ADTRAN's innovative solution for steering dual-band clients between radios. Using bidirectional steering, DynamicSteering ensures that clients are connected to the best radio based on their signal conditions. Bidirectional band steering includes upgrade steering (2.4 GHz to 5 GHz) and downgrade steering (5 GHz to 2.4 GHz) which allows optimal utilization of both bands.

Traditional band steering is often approached unidirectionally (2.4 GHz to 5 GHz) and steers clients using pre-association steering (upon first connection). The result is an oversaturated 5 GHz spectrum with slow initial associations or connection times, and in some cases, no connection at all. DynamicSteering results in a more balanced spectrum usage and only performs pre-association steering when the load or channel utilization is high. It monitors clients and automatically matches them to the appropriate radio on the appropriate AP, delivering consistent, predictable performance and eliminating sticky clients.

A dual-band AP with DynamicSteering enabled makes steering decisions based on the following input:

- Wireless client capabilities
- Signal Strength on the current band
- Signal Strength on the target band
- Medium utilization on current and target bands
- Steering history

There are three primary types of steering supported in vWLAN and described in the following sections:

- *Pre-association Steering on page 2*
- *Idle-post Association Steering on page 2*
- *Active Post-association Steering on page 4*

Pre-association Steering

Used only during overloaded conditions, pre-association steering aims to connect dual-band clients to a band that is not overloaded. A band is considered overloaded when its average medium utilization over the span of a minute exceeds 70 percent. If the AP sees a dual-band client sending probe requests and the probe requests on the non-overloaded band exceed a threshold (20 dB), a blacklist is installed to deny associations and suppress probe responses on the overloaded band. This is to encourage the client to associate on the non-overloaded band. The steering safety mechanisms, explained in *Steering Safety Mechanisms on page 6*, are applied to ensure that clients being pre-association steered are not orphaned if they persistently try to associate to the blacklisted band on a given AP.

DynamicSteering avoids steering a client too often by incorporating pre-association steering only when high utilization conditions exist. Otherwise, it performs post-association steering, allowing the client to determine the algorithm used to associate to a band.

Idle-post Association Steering

The AP monitors activity for all of its associated clients for a time period (10 seconds). This value was chosen to account for the fact that some clients periodically send packets (such as an Address Resolution Protocol (ARP) every 15 seconds) as a form of keepalive. These keepalive packets can result in a client never being classified as idle and therefore, will not be idle-post association steered.

When a dual-band client does become idle, its uplink signal strength is evaluated to determine if it would be a candidate for steering to a different band. This evaluation is accomplished by comparing the signal strength on the non-serving bands to a set threshold.

A separate threshold is defined for upgrade steering (-65 dBm) and downgrade steering (-90 dBm) in non-overload conditions. The thresholds for non-overload steering effectively disable downgrade steering for two reasons. First, modern Wi-Fi clients generally roam on their own from 5 GHz to 2.4 GHz once the signal becomes sufficiently weak. Secondly, even at relatively weak signal strength, the 5 GHz performance is typically better than 2.4 GHz, especially if a 40 MHz channel width or higher is used in 5 GHz and only a 20 MHz channel width is used in 2.4 GHz.

Once the determination has been made to steer the client, one of the following two mechanisms can be used, Legacy (non Base Service Set (BSS) Transition Management (BTM) compliant) or 802.11v (BTM compliant).

Legacy

The legacy approach first installs a blacklist (denying associations and suppressing probe requests) on the currently serving AP band and then forcibly disassociates the client. Probe responses are withheld on the previously serving AP band until the client associates again on a different band or one of the steering safety mechanisms (explained in *Steering Safety Mechanisms on page 6*) aborts the steering. If the client still tries to authenticate with the previously serving AP band, it is rejected. This is usually sufficient to encourage the client to select a different band.

802.11v

802.11v is a standard defined mechanism that allows an AP to indicate to a client that it should move to a new band and provides a prioritized list of candidate APs. For clients that advertise this capability when associating, the AP attempts to use this mechanism instead of the legacy mechanism. There is significant variation in how well various client implementations respond to 802.11v BTM requests as explained in *Table 1*.

Table 1. 802.11v Condition and Behavior

Condition	Behavior
Idle steering must succeed before attempting active steering	This behavior assumes a client that rejects or otherwise fails to move to the desired band under idle conditions is more likely to do the same when active.
Idle steering fails	If idle BTM steering fails, reverts to legacy steering and considers the device as BTM unfriendly for 600 seconds.
Repeated active steering fails BTM unfriendly timer	If BTM active steering repeatedly fails, active steering is not performed again until both an active steering unfriendliness timer expires (600 seconds) and then a BTM idle steer succeeds.
BTM-based steering operating in best effort case	If the uplink signal strength falls below a threshold (12 dB) on the serving channel, BTM-based steering is used without blacklists, and a failure is not counted against the client.
Clients accepting BTM requests specifying a different BSSID	If the client accepts the BTM request but specifies a different basic service set identifier (BSSID), BTM-based steering is used without blacklists, and a failure is not counted against the client. This helps account for environments with multiple APs operating within the same extended service set (ESS) where a client may see a stronger AP and decides to transition to it.

Not all clients honor BTM requests in the same manner. The AP will use the blacklist and probe response-withholding scheme to improve the reliability of the transition.

Active Post-association Steering

For clients that support 802.11k and 802.11v, DynamicSteering can take advantage of these standards to steer them while they are actively exchanging data. This was not possible with the legacy steering mechanism due to the time it took for a client to re-associate, which often lead to application failures.

By utilizing the 802.11v BSS transition management, the clients that support it are able to transition in a much shorter period of time and applications survive the transition with limited impact. In order for a client to become eligible for active steering, it must first be successfully idle steered using BTM. Once a client is deemed eligible, certain conditions must be met for it to be active steered. These conditions and the necessary triggers are explained in the following sections for *Non-overloaded Active Steering* and *Overloaded Active Steering*.

Non-overloaded Active Steering

Non-overloaded active steering is dependent on the conditions present on the serving band which can be the 2.4 GHz or 5 GHz band since DynamicSteering utilizes bidirectional band steering.

1. While on the 2.4 GHz band, both an uplink signal threshold (40 dB) and a downlink PHY rate threshold (50,000 Kbps) must be exceeded to transition to 5 GHz. Both conditions are required to ensure that the client has both a strong enough signal and is not experiencing a high packet error.
2. For a client currently being served on the 5 GHz band, either the uplink signal threshold (40 dB) or the downlink PHY rate (6,000 Kbps) dropping below the threshold is sufficient to start the active steering evaluation process to 2.4 GHz. This more relaxed policy attempts to account for the fact that the PHY rate may stay relatively high even when the signal threshold has dropped significantly.

Once a trigger has occurred for non-overload steering, the AP estimates the downlink and uplink throughput for that client using the Tx and Rx byte counters (sampled at the beginning and end of a 1-second interval). At the second sample, the last downlink PHY rate is obtained and used to compute an estimated airtime on the currently serving band. The AP then requests the client perform an 802.11k beacon measurement on the candidate band. From this downlink RSSI measurement, the AP attempts to estimate an Modulation and Coding Scheme (MCS) index value (http://mcsindex.com/) that will be achieved by that client (taking into account both the AP and the client's capabilities on the candidate band). From this and the previously measured throughput, an airtime value is computed. This value is then used to determine whether the client can fit on the candidate band without causing an overload. This is accomplished by adding the estimated airtime to the last measured medium utilization and comparing the result against a safety threshold as follows:

- For 2.4 GHz, 50 percent of medium utilization plus the projection
- For 5 GHz, 60 percent medium utilization plus the projection

If this threshold is not exceeded, the steer is allowed to proceed and the estimated airtime is added to a projected airtime increase that is maintained until a new medium utilization measurement is obtained.

Overloaded Active Steering

For overloaded active steering, the trigger is the overload event itself.

1. The AP estimates the airtime of all active steering eligible clients on the overloaded band. This is accomplished using the same technique as described above when a single client measurement is triggered. These values are then sorted by airtime in descending order.
2. Each client is requested in-turn to perform an 802.11k beacon measurement to assess its performance on the candidate band. From this, a decision is made in the same manner as above to either steer the client to that band or not depending on the risk of overload. The estimated rate on the target band must be a configurable amount better than the rate on the current band. Once the handling for one client is completed, consideration then proceeds to the next client with a new 802.11k beacon measurement request.

This process continues until all active steering eligible clients are either exhausted or the medium utilization falls below the safety threshold (after removing the estimated airtime amount from the currently overloaded band).

Any time active steering is performed (either for offloading purposes or due to an individual client's crossing of the thresholds), the medium utilization measurement immediately following the event triggers a steering blackout period (15 minutes). During this period, active upgrade steers are not allowed in an effort to assess more accurately the previous active steers without further active steers adding uncertainty to the data. Active downgrade steers are still permitted to ensure clients can maintain connectivity. Idle steers are also permitted during this blackout because these clients are not currently active and should not impact the utilization measurements until they become active.

Steering Safety Mechanisms

Some safety features implemented with DynamicSteering ensure capable clients do not switch to cellular from Wi-Fi because of steering which helps prevent clients from being steered too frequently. At a high level, the following safety mechanisms exist:

1. Separate timers for legacy and BTM-based steering
   a. When a client is steered, this timer is started, and the AP is prevented from further steering attempts until it expires.
      - Legacy - 300 seconds
      - BTM - 30 seconds
   b. The maximum amount of time the AP allows for a client to re-associate after being steered before declaring a failure is 15 seconds.
2. When using the legacy steering approach or BTM steering, the AP will abort the steering if the client tries to authenticate on the old band too many times (three times within two seconds).

Hardware and Software Requirements and Limitations

DynamicSteering was introduced in software version 2.9.0 and is only available for vWLAN and Bluesocket APs (BSAPs) running software versions 2.9.0 or later. DynamicSteering is supported on all BSAPs, with the exception of the BSAP 1800 Series.

DynamicSteering Configuration

DynamicSteering configuration settings are only applied within the same Service Set Identifier (SSID). For dual-band APs, each radio interface (2.4 GHz and 5 GHz) must have the SSID applied to both radios through the AP template.

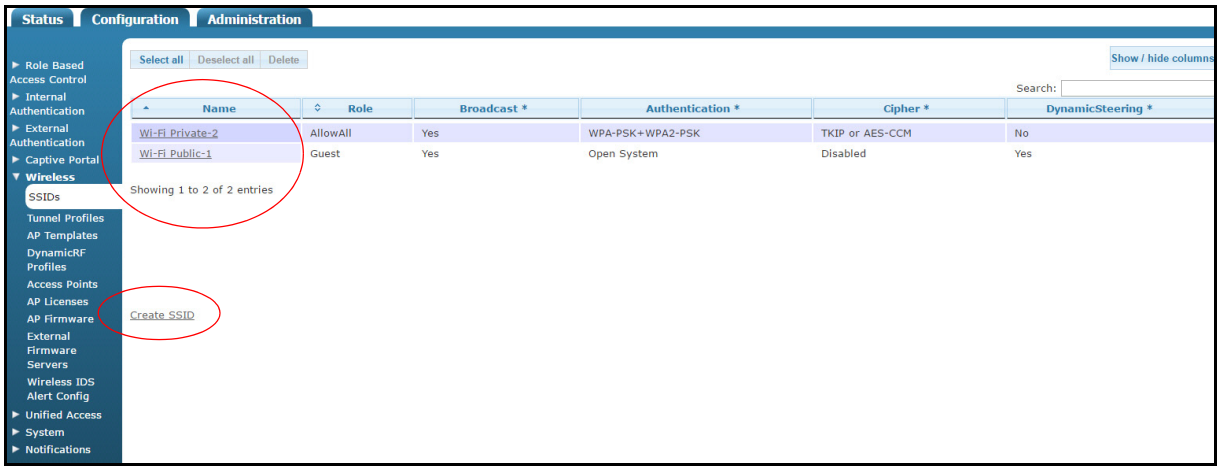
DynamicSteering is configured in vWLAN using the SSID configuration menu. The following section describes the steps necessary to enable and use DynamicSteering. By default, DynamicSteering is disabled.

The steps provided below apply to DynamicSteering configuration only. For more information about configuring SSIDs in general, refer to the vWLAN Administrator's Guide, available online at https://supportforums.adtran.com.

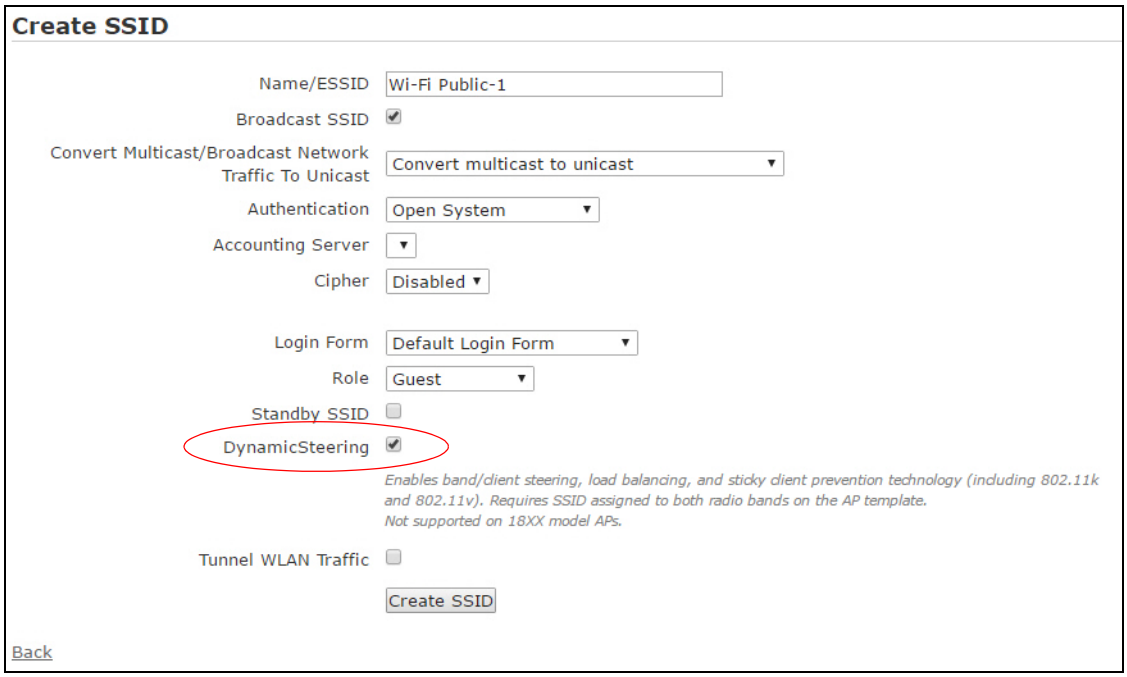
To configure an SSID to use DynamicSteering, connect to the GUI and follow these steps:

1. Navigate to the **Configuration** tab, and select **Wireless** > **SSIDs**. Any previously configured SSIDs are displayed.

2. Select either an existing SSID from the list or create a new SSID by selecting **Create SSID**.



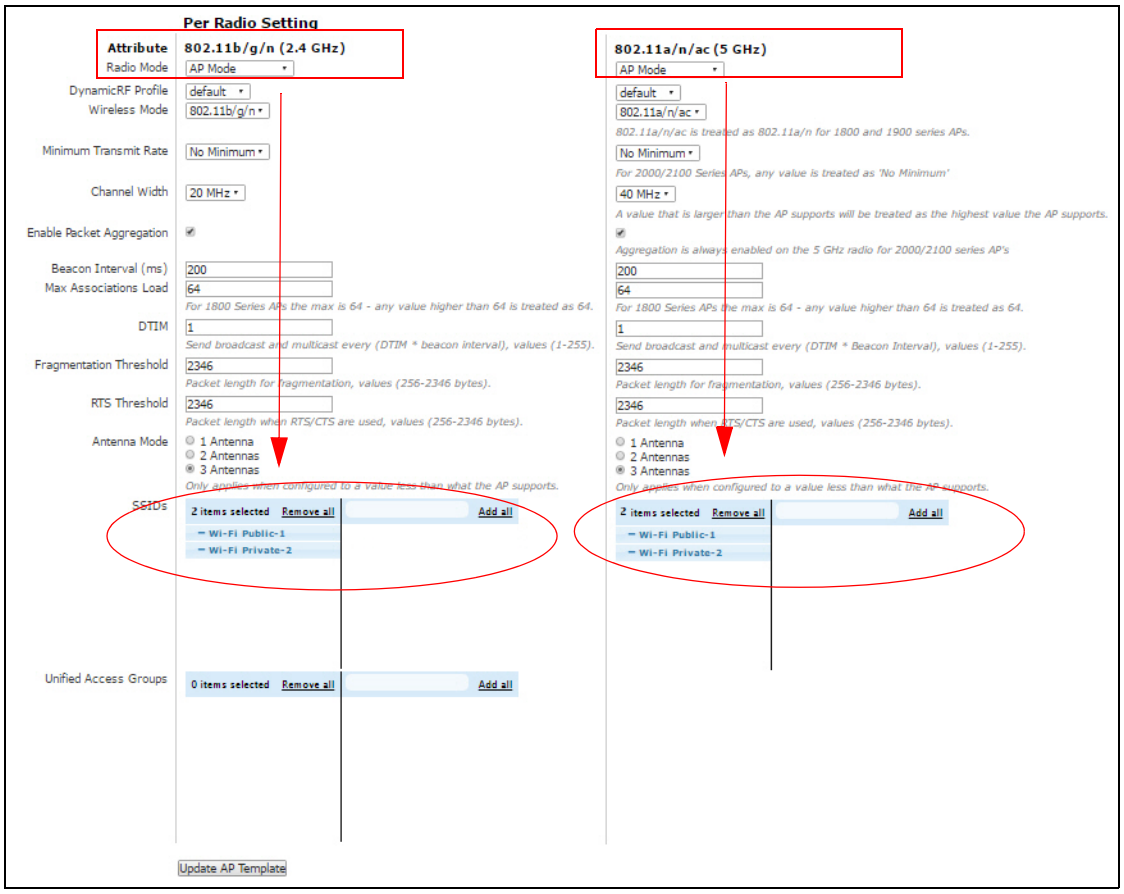
3. Select the **DynamicSteering** option to enable the feature. Make any additional SSIDs setting changes as necessary and select **Update SSID** (or **Create SSID**) to save the settings. A confirmation will display indicating the SSID was successfully created.



> NOTE *The SSID must be applied to both the 2.4 GHz and 5 GHz radios for each AP through the AP template. If DynamicSteering is enabled and the SSID is only used on one band, DynamicSteering will be disabled.*

4. To apply the SSID to both radios on the applicable APs, select **Wireless** > **AP Templates** (from the **Configuration** tab). Select the AP template that provides the configuration settings for your APs (or the default AP template, if applicable). Remember that all APs that use this template will also be updated.

5. Select the SSID on which you enabled DynamicSteering and apply to both the 2.4 GHz and 5 GHz radios. Make any additional changes to the AP template as necessary and select **Update AP Template**.



You have successfully enabled DynamicSteering on your SSID and applied it to the AP. Once the AP template has been applied to your AP, the new configuration settings will take effect.