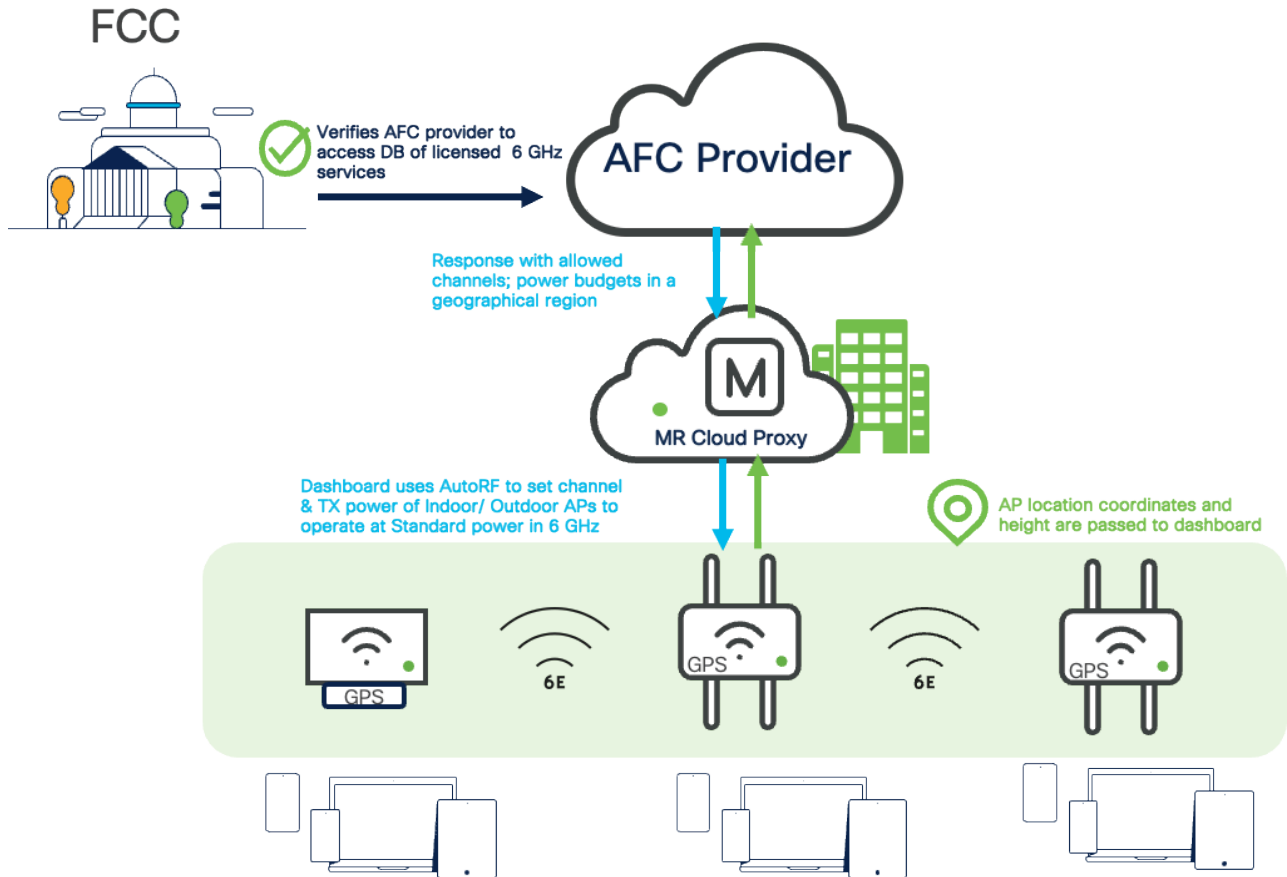


## Automatic Frequency Coordination

### AFC Overview:



With the introduction of Wi-Fi 6E comes a new 6 GHz radio band for which the FCC is opening up 1,200MHz of spectrum for unlicensed usage. This is not a “new” spectrum but a licensed section of spectrum that can now be used for unlicensed Wi-Fi communication. Previously, the 6 GHz band had been reserved only for licensed services such as Fixed Satellite Services (FSS), Satellite Service, Television and Broadcast Services, Microwave P2P links, etc. Automatic Frequency Coordination (AFC ) is a system that protects these licensed services from Wi-Fi interference by coordinating spectrum sharing with these 6 GHz incumbents. In order to effectively coordinate spectrum sharing Wi-Fi 6E APs must operate at either Standard Power or Low Power operation to remain in compliance with the FCC.

#### Scenarios where AFC is required:

- Indoor AP (Internal antenna) operation at Standard Power in 6 GHz
- Outdoor/ External antenna AP operation in 6 GHz

## Lower Power V.S. Standard Power

### Low Power

The Access Points in this device class can operate strictly indoors and must be equipped with only internal antennas. The FCC defines the power level by a Power Spectral Density of 5 dBm/MHz. This allows APs to transmit at 18 dBm for a 20 MHz channel, 21 dBm for 40 MHz channel, 24 dBm for 80 MHz and 27 dBm for 160 MHz channel. These APs can operate in the entire 1200 MHz of spectrum with a max EIRP of 30 dBm.

### Standard Power

The access points in this device class can operate indoors or outdoors with an internal or external antenna. The FCC defines Power Spectral Density at 23 dBm/MHz and a max EIRP of 36 dBm. Since these APs operate at a higher level, they can potentially interfere with the licensed 6 GHz services operating within the spectrum. As a result, they are required to operate under the control of Automatic Frequency Coordination provider. the AFC provider serves as an independent central entity that allocates the channel and power levels based on the geolocation of the access points.

Bandwidth	PSD max for LPI	PSD max for SP	EIRP max for LPI	EIRP max for SP
20 MHz	5 dBm/MHz	23 dBm/MHz	18 dBm	36 dBm
40 MHz	5 dBm/MHz	23 dBm/MHz	21 dBm	36 dBm
80 MHz	5 dBm/MHz	23 dBm/MHz	24 dBm	36 dBm
160 MHz	5 dBm/MHz	23 dBm/MHz	27 dBm	36 dBm

### Client Devices

As per the FCC regulations, the client devices must operate 6 dB lower than the power level of the AP to which it's associated.



**Note:** Spectral density and Max EIRP values will vary based on regional regulatory requirements. Cisco Wireless APs will operate within the defined rules of the region to remain compliant.

## AFC Operation

Automated Frequency Coordination System is a cloud-based operator (Example: Federated Wireless, Open AFC) that has access to FCC's 6 GHz, incumbent database, which stores geolocation coordinates and power of these licensed wireless services operating in the 6 GHz spectrum. In order to avoid interference the access point must present its geolocation coordinates to the AFC provider when powering on and before powering on the 6 GHz radio.

For cloud-based deployments, dashboard will serve as a proxy to the AP by requesting location information to pass to the Meraki AFC provider (Federated Wireless). Upon receiving the request, the AFC provider will query its database to see if there is an overlap of a licensed 6 GHz service in that geolocation. Based on its computed results, the AFC will send a response to the Dashboard on the channels and the power levels the AP can operate at.

AutoRF in Dashboard will then use this information to set the correct transmit power for channels for the AP. Dashboard administrators can also choose channels with knowledge of what power limits the channels have been provided by AFC. For every access point transmitting in the 6 GHz band at Standard power will need to have its AFC data refreshed once a day (every 24 hours) to stay in FCC compliance.

## Event log for access points

**Access point:**  **Client:**

**Before:**   (PDT)

**Event type include:**  **Event type ignore:**

[Reset filters](#)

Download as ▾

[« newer](#) [older »](#)

Time (PDT) ▾	Access point	SSID	Client	Category	Event type	Details
May 13 05:58:06	<a href="#">SJC04-11A-AP11</a>			AutoRF	Auto Tx power change	Tx power increased <a href="#">more »</a>
May 13 05:58:06	<a href="#">SJC04-11A-AP02</a>			AutoRF	Auto Tx power change	Tx power reduced to decrease network interference <a href="#">more »</a>
May 13 05:58:06	<a href="#">SJC04-11A-AP30</a>			AutoRF	Auto Tx power change	Tx power increased <a href="#">more »</a>
May 13 05:37:50	<a href="#">SJC04-11A-AP19</a>			AutoRF	Auto Tx power change	Tx power increased <a href="#">more »</a>
May 13 05:37:50	<a href="#">SJC04-11A-AP11</a>			AutoRF	Auto Tx power change	Tx power increased <a href="#">more »</a>
May 13 05:37:50	<a href="#">SJC04-11A-AP30</a>			AutoRF	Auto Tx power change	Tx power increased <a href="#">more »</a>
May 13 05:37:50	<a href="#">SJC04-11A-AP30</a>			AutoRF	Auto Tx power change	Tx power increased <a href="#">more »</a>
May 13 05:17:48	<a href="#">SJC04-11A-AP01</a>			AutoRF	Auto Tx power change	Tx power increased <a href="#">more »</a>

Indoor access points that fail to renew their AFC status must decrease the TX power of their 6 GHz radio to operate at Indoor Low Power levels. The FCC's regulation on 6 GHz Wi-Fi allows indoor devices to operate in the full 6 GHz band (at 'Indoor Low Power' or ILP) without an active AFC status.

Outdoor access points that fail to renew their AFC status must shut down the 6 GHz radio. Per regulation, the FCC only authorizes outdoor 6 GHz transmission at Standard Power and only under U-NII-5 and U-NII-7 bands.

## AP Geolocation

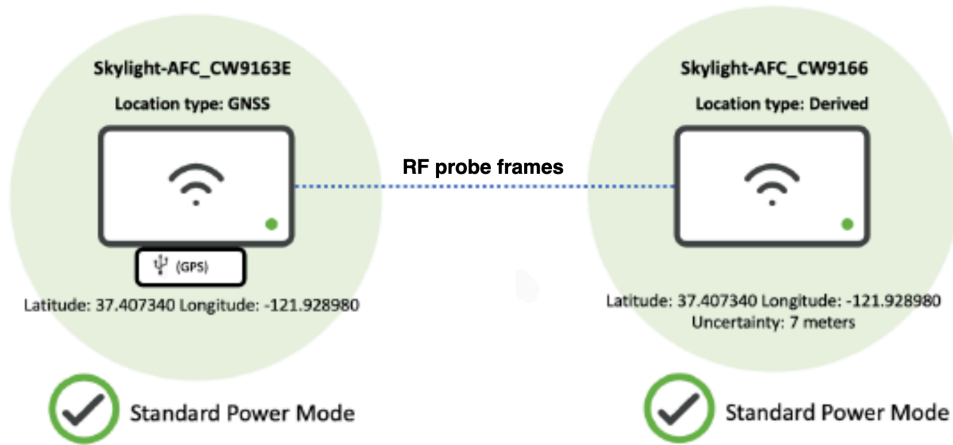
As per the FCC regulation, access points operating at Standard Power must automatically obtain geolocation coordinates using an external or internal GPS module. To automatically obtain the geolocation of an access point, Cisco Wireless has developed a proprietary GPS module that attaches to the USB port of select MR and CW model access points. Once installed, position the access point on the floor of a building near a window with a clear line of sight to the sky. The GPS module will then be able to acquire a satellite signal and share the AP's location with dashboard.

**Note:** The mounting height of the AP is a necessary parameter, this measurement does not have to be auto-generated and can be manually entered in dashboard with a given range of uncertainty.

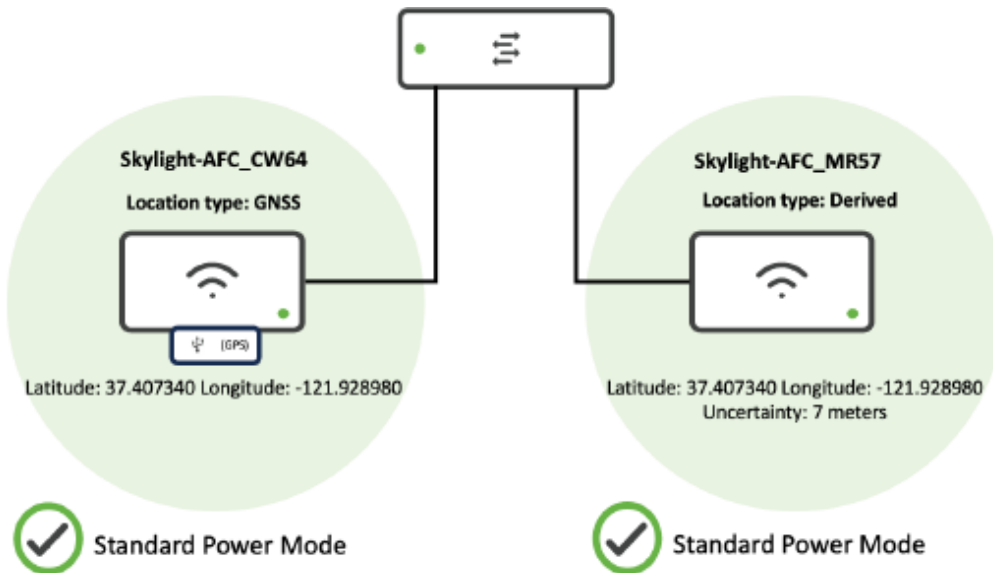
## Geolocation Propagation

Access points enabled for Standard Power do not need an embedded or USB-attached GPS module. If at least one nearby access point has a valid GPS signal, other neighboring access points can leverage the same GPS coordinates with a relative measure of uncertainty. This process is known as geolocation propagation and can be accomplished either through wired proximity on the same layer 2 switch stack or share RF neighborhood up to a calculated distance of up to 400 meters from an AP with a valid GPS signal.

In the two scenarios below, a location algorithm determines the relative position of the access point with a derived GPS location to the access point with a GPS module reporting GPS coordinates to dashboard (anchor AP).



Neighboring AP is able to see an anchor AP as its neighbor and can hear beacon frames on any band/ radio.



Neighboring AP is connected to the same dashboard-managed switch or switch stack as an anchor AP with the GPS module.

## Firmware Requirements

AFC is available in MR30.7+

## Compatible AP Models

### Wi-Fi 6E indoor access points

- MR57
- CW9162
- Cw9164
- CW9166
- CW9166D1



# Live data

## Ports



2. Ensure the USB port is receiving power via dashboard.

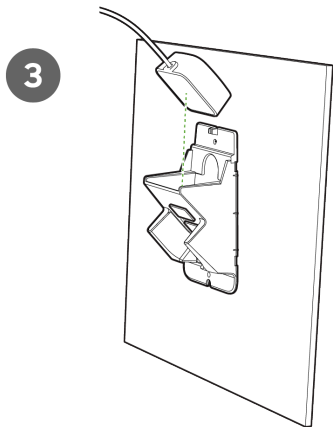
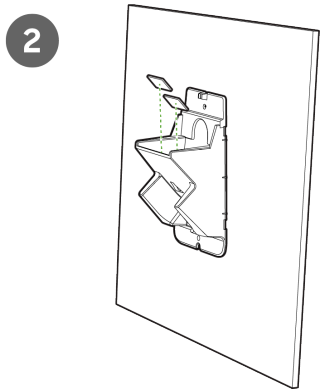
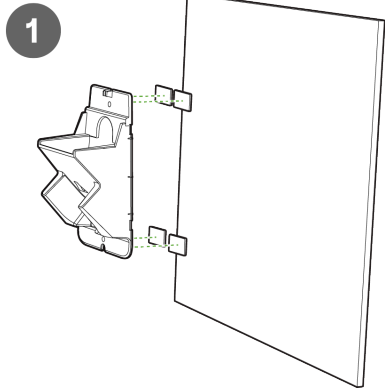
## GNSS Antenna Installation

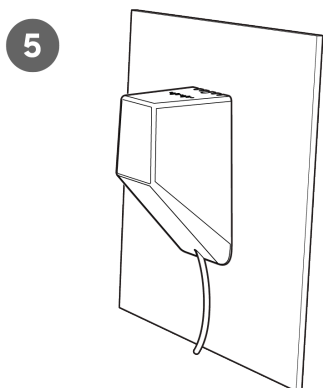
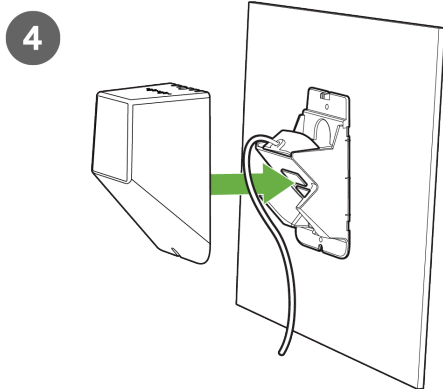
 PID: CW-ANT-GPS1-M-00

APs installed further away from a window can extend satellite reception by 3 meters by utilizing the CW-ANT-GPS1-M-00 GNSS antenna.

1. Insert the CW-ACC-GPS1 GPS module into the USB port of the access point.
2. Remove the covering on the GPS module to reveal the GNSS port and insert the antenna.
3. Determine the desired placement of the antenna bracket on a window pane that allows for a clear line of sight to the sky.
4. Apply the adhesive strips to the top and bottom portions of the bracket.
5. Apply adhesive strips to the inside of the bracket to secure the antenna.
6. Insert the antenna into the bracket and ensure proper adhesion to the strips.
7. Clip the outer casing to the bracket and thread the cabling through the case opening.

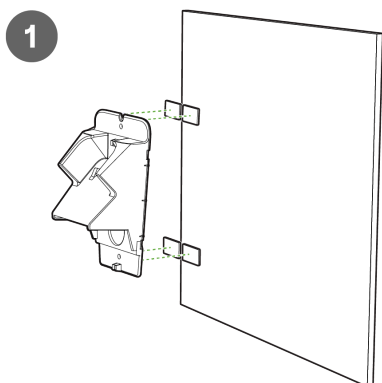
## Indoor Deployment



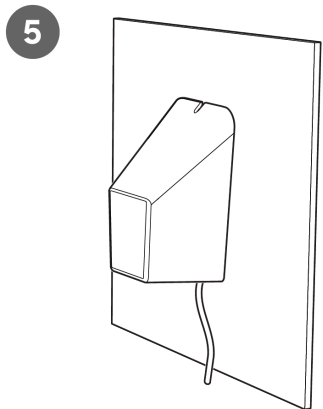
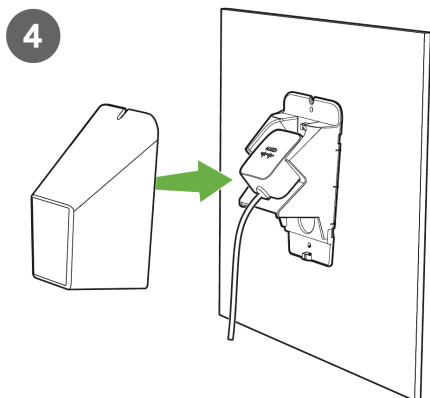
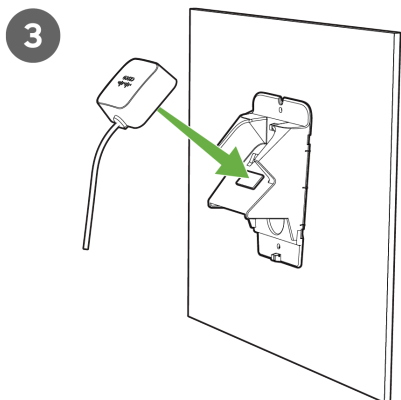
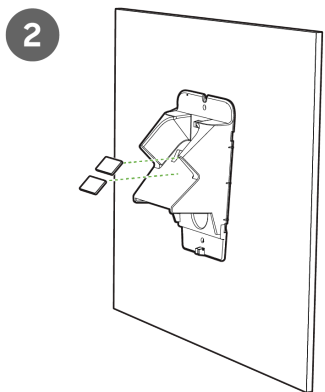


## Outdoor Deployment

**i** Outdoor GPS antenna deployments require a 180-degree rotation of the mounting bracket to allow the antenna to be positioned toward the sky.







## Mounting the AP



1. Ensure the AP is mounted where the GPS module can obtain the satellite signal (e.g., near a window).

## AFC Configuration

### 6 GHz radio settings

Turn off 6 GHz radio

See band selection above.

Standard power service

Enable to allow Dual Mode 6E access points to operate at Standard Power Mode using Automatic Frequency Coordination (AFC) as per FCC requirements. AFC uses location and height of the access point to determine the power limits of each channel, ensuring that it does not interfere with licensed incumbents.


 Check location availability using GNSS USB module for intended access points


On  Off

1. Navigate to **Wireless > Configure > Radio settings > RF profiles**.
2. Edit the default or custom RF profile the APs are assigned to in the network.
3. Under the 6 GHz radio settings, enable Standard Power service.

## Standard power service

Enable to allow Dual Mode 6E access points to operate at Standard Power Mode using Automatic Frequency Coordination (AFC) as per FCC requirements. AFC uses location and height of the access point to determine the power limits of each channel, ensuring that it does not interfere with licensed incumbents.

 Check location availability using GNSS USB module for intended access points

 Height parameters need to be defined for access points to enable AFC on those access points

[Set height for access points...](#)


- Click **Set height for APs** to manually set the height parameter of APs in the network.

[BACK TO RF PROFILE](#)

## Define height for access points

The APs below do not have a height defined. To set the height in bulk, select the APs that are on the same floor and enter a height. As you define the heights, the APs will be removed from this list.

<input type="checkbox"/>	Name	Mac	Floor plan	Tags
<input checked="" type="checkbox"/>	Sunroom	a8:46:9d:00:53:e0	-	JAX
<input type="checkbox"/>	Garage	cc:9c:3e:e8:79:a0	-	Axe IoT

 **Note:** If APs are installed at the same height, you can bulk assign by using filters for AP tags or floor plans. Alternatively, you can select APs individually and set height parameters.

- Click on **Set height**.

## Set height for 1 access point

Enter the height from the ground to the best of your knowledge. Please round to the nearest whole number. If you are fairly confident, choose a lower range of accuracy. If you are unsure of the exact height, choose a wider range of accuracy.

Height from ground

meters

Accuracy range

▼

**i** Having a smaller accuracy range leads to a higher accuracy of power limits reported by AFC. Height is required to be reported accurately.

Cancel

Submit

6. Enter the approximate height from the ground level to the AP's mounting location.
7. Select a height accuracy range from the drop-down menu.

**i** **Note:** The height of the AP should be from the ground level to the AP and not the floor on which the AP is located. FCC guidelines: "antenna height above ground."

**i** **Note:** Having a smaller height accuracy range leads to a higher accuracy of power limits reported by the AFC provider. Height is required to be reported accurately for AFC-enabled APs to remain in compliance with FCC regulations.

**i** **Note:** If an external GPS antenna is used to achieve satellite reception for the AP, the cable length will default to 3 meters. If no external antenna is detected, the cable length will default to 0 meters.

8. Save the configuration

[BACK TO RF PROFILE](#)


## Success


All access points assigned to this RF profile have a defined height.

If you wish to edit any of the heights, you can do so on the individual AP details page, or in bulk on the Radio Settings list view.

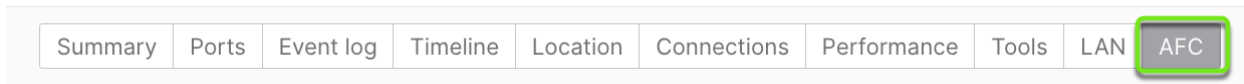
Done

10. Click **Done** once the height is set for all APs assigned to the RF profile.

 **Note:** WiFi 6E requires the clients to support WPA3 as a mandatory mode of encryption. WPA2-WPA3 transition mode is not supported in the 6 GHz frequency. For further information on WPA3 encryption and configuration refer to [this document](#).


 **Note:** After enabling Standard Power within the RF profile, assigned access points will reboot to enable the 6 GHz radio. It is recommended to enable AFC during a planned maintenance window.

## Verify AFC Status




1. Navigate to the Access Point list, and select an AP that is now enabled for AFC.
2. From the AP's overview page, select the **AFC** tab.

### AFC Status

**AFC status**  ✔ Active

**Expiration time:** Oct 14 2023 14:23:07 PDT

**Last response:** Success 

**Last response time:** Oct 13 2023 14:23:08 PDT

[Refresh AFC](#)

The AFC overview page shows the current AFC status of an AP. A status of active means a successful request to the AFC provider along with the associated response. The AFC status page includes the target expiration time at which the current AFC response expires. Per FCC regulation, every AP operating in 6 GHz, AFC status needs to be refreshed once a day (every 24 hours).

## Power Mode

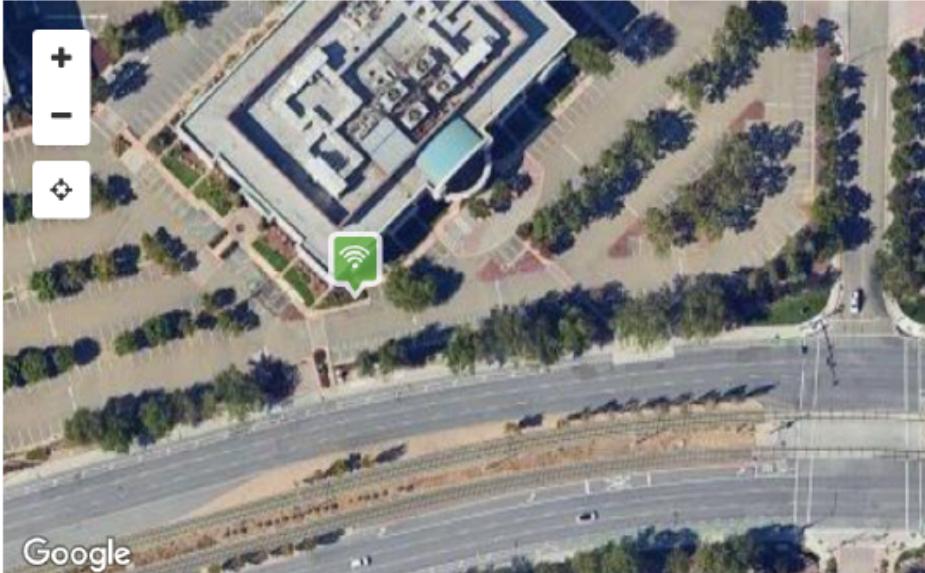
**Power mode**

**6 GHz power mode:** Standard power

After enabling AFC and verifying that Standard Power (SP) operation is permitted on specific 6 GHz channels in the access point's geographic location, the AP will switch its 6 GHz radios to Standard Power (SP) mode. This power mode allows for an Equivalent isotropic radiated power (EIRP) of up to 36 dBm or a max Power Spectral Density (PSD) of 23 dBm/MHz for the FCC regulatory domain on an eligible channel.

## AFC Defined AP Location

**Location type:** GNSS  
**Lat, Long:** (37.413736, -121.933631)  
**Uncertainty:** 10 meters



The **Location type** specifies how the AP's geographical location is determined.

If an AP has a GPS module either internally or externally and it has acquired a signal from a satellite, the Location type will indicate **"GNSS"** (Global Navigation Satellite System), along with the latitude and longitude coordinates of the AP. This indicates that the GPS module has recorded the positioning of the AP locally,

**i** **Note:** Global Navigation Satellite System (GNSS) refers to a constellation of satellites providing signals from space that transmit positioning and timing data to GNSS receivers. The receivers then use this data to determine location.

If the location type is reported as **"Derived"** it means that the location was not obtained locally via a GPS module, but rather through wired or wireless geolocation propagation with a neighboring AP.

If the Location type is empty, AFC operation is not allowed or otherwise impossible as neither GPS nor wired/wireless propagation was successful or invoked (i.e., if AFC is disabled, no valid GPS signal, the USB port is down, etc.).

**i** **Note:** After the AP powers up (or) the USB port registers as enabled, wait 10 minutes for the AP to obtain a GPS signal. If the GPS module can get a satellite signal, the location will be automatically populated with the source as "GNSS".

### AFC defined AP Location

**Location type:** GNSS  
**Lat, Long:** (37.413736, -121.933631)  
**Uncertainty:** 10 meters



**Note:** APs that have their location "Derived" share the same geographical coordinates as the neighbor AP with a satellite signal. Dashboard provides an estimate of the distance between the APs with a level of uncertainty. This uncertainty level is passed to the AFC provider, which regulates a lower power allowance for the derived AP to operate.

### AFC defined AP Location

**Location type:** Derived  
**Lat, Long:** (37.413736, -121.933542)  
**Uncertainty:** 8 meters

## Channel Availability

### Channel availability per bandwidth

Standard Power (SP) operation is only allowed with UNII-5 and UNII-7 channels for this domain



The channel availability is displayed in a chart view showing the power levels assigned by the AFC provider across the 6 GHz spectrum based on the AP's location and installation height. In Dashboard, AutoRF uses these power limits shared by the AFC provider to set the appropriate transmit power of the AP. The power table and channel assignment for the 6 GHz radio needs to be updated dynamically every 24 hours to comply with FCC regulations. This process ensures that APs broadcasting in 6 GHz at Standard Power do not interfere with licensed 6 GHz services (i.e. microwave P2P links, satellite links, etc.).

## Transmit Power Levels

Please note TX power levels listed within the AP details page are the base transmit power levels of the AP's radios and do not include the TX gain from attached antennas.

### RADIO SETTINGS

2.4 GHz: 11 (20 MHz; 5 dBm)

5 GHz: 56 (80 MHz; 23 dBm)

6 GHz: 5 (160 MHz; 18 dBm)

RF profile: [Basic Indoor Profile](#)

## AFC Refresh

Dashboard administrators can refresh the AFC status of selected APs. This tool will queue the AP to issue a new available spectrum inquiry request to the AFC service provider (i.e., Federated Wireless). Within a few moments of selecting this option, the current "afc\_expires\_at" and "afc\_updated\_at" timers should be refreshed and updated once an Available Spectrum Inquiry Response has been received.

The screenshot shows the 'Radio settings' page with a navigation bar at the top containing 'Overview', 'RF profiles', and 'Auto RF'. Below the navigation bar are several filter dropdowns: BAND (All), CHANNEL (All), ACCESS POINT TAG (All), ACCESS POINT MODEL (All), RF PROFILE (All), and REGULATORY DOMAIN (FCC Edit). A search bar contains '96 Radios: 50 checked'. A green box highlights the 'Refresh AFC' button. To the right of the table is a map showing various channel numbers in green callouts.

<input checked="" type="checkbox"/>	Status	Access point name	Channel	Ch. Width (MHz)	Target power (dBm)	Transmit power (dBm)	RF Profile
<input checked="" type="checkbox"/>	●	SJC0...	1 (Auto)	20	5 - 30	14	SJC04-RF-Profile
<input checked="" type="checkbox"/>	●	SJC0...	140 (Auto)	40	8 - 30	8	SJC04-RF-Profile
<input checked="" type="checkbox"/>	●	SJC0...	149 (Auto)	80 (Auto)	8 - 30	9	SJC04-RF-Profile
<input checked="" type="checkbox"/>	●	SJC0...	1 (Auto)	20	5 - 30	6	SJC04-RF-Profile
<input checked="" type="checkbox"/>	●	SJC0...	108 (Auto)	40	8 - 30	8	SJC04-RF-Profile
<input checked="" type="checkbox"/>	●	SJC0...	69 (Auto)	80 (Auto)	8 - 30	9	SJC04-RF-Profile
<input checked="" type="checkbox"/>	●	SJC0...	11 (Auto)	20	5 - 30	6	SJC04-RF-Profile

1. Navigate **Wireless > Configuration > Radio Settings**.
2. Select the checkbox next to one or more AFC-capable APs in the 6 GHz radio list.

The dialog box has a title 'Refresh AFC' and a message: 'Refreshing AFC may change the power limits of 6 GHz channels, and may lead to a change in automatically assigned channels for radios on the 6 GHz band. Do you want to proceed?'. At the bottom right are two buttons: 'Cancel' and 'Yes'.

2. Click the **Refresh AFC** at the top of the page.

**Note:** The specified power limits or channel constraints may or may not have changed based on the results of the new AFC response. Hence, SP mode, transmit power, and/or channel assignment for the 6 GHz radio is also subject to change.



## Monitoring & Troubleshooting



### AFC not configured for this access point

This access point is operating in a RF profile that doesn't have AFC activated. To enable AFC please configure [RF Profiles](#).



### AFC enabled but not configured properly

The following are some considerations and steps to bring up and validate that GPS is working on a given access point:

1. Confirm a secure connection of CW-ACC-GPS1 module to the USB port of the access point's USB port.



*Note:* All Cisco Wireless indoor, 6 GHz capable access points require an external GPS module to operate at Standard Power. Outdoor access point models like the CW9163E have an internal module for GPS.

1. Reboot the access point, and ensure that the AP is fully powered (e.g. 802.3at / PoE)
2. Ensure that AFC is enabled on the RF Profile associated with the AP in question and that the AP height and uncertainty values are accurately configured in Dashboard.
3. Verify that the AP recognizes the GPS module for use with AFC:

### AFC not supported:

1. Firmware does not support SP
2. AP is not SP capable/6GHz capable
3. Network is not set to the correct regulatory domain
4. For APs with flex 5/6 radio, flex radio set to 5 GHz (no 6 GHz radios)

For the above reasons, the AFC tab on the AP details page will not show up

## AP Neighborhood

For best results, the stronger the RF neighborhood, the more consistent the results are likely to be. If the neighborhood is weak and close to the noise floor, then the deployment is likely prone to gaps in neighborhood. They would also be susceptible to other variables at any given time that can hinder performance or limit geolocation propagation from working properly.

Target an RF neighborhood of an RSSI of at least -75 dBm or better on any band (i.e. 2.4 GHz or 5 GHz or 6 GHz) and an SNR of 15-20 or better for optimal and consistent results. Results will vary from one wireless environment to the next.

## AFC Response Event Log

## Event log for access points

Access point:  Client:  Before:   (CDT)

Event type include:  Event type ignore:

[Reset filters](#)

Download as  [< newer](#) [older >](#)

Time (CDT)	Access point	SSID	Client	Category	Event type	Details					
Oct 15 23:20:09	<a href="#">Bk9166j</a>			AFC	AFC response received	last_recorded_at: 2023-10-16 04:20:09 UTC, lat: <input type="text" value=""/> <a href="#">hide</a> location_uncertainty: 5 status: SUCCESS location_type: gps request_type: location change expires_at: 2023-10-17 04:20:09 UTC power_limits_json: {"1":23,"5":23,"9":23,"13":23,"17":23,"21":23,"25":23,"29":23,"33":23,"37":23,"41":23,"45":23,"49":23,"53":23,"57":23,"61":23,"65":23,"69":23,"73":23}					
Oct 15 22:59:09	<a href="#">Bk9166j</a>			AFC	AFC response received	last_recorded_at: 2023-10-16 03:59:09 UTC, lat: 4- <input type="text" value=""/> : -88 <input #"="" type="button" value="7 more &gt;&lt;/a&gt;&lt;/td&gt;&lt;/tr&gt;&lt;tr&gt;&lt;td&gt;Oct 15 22:07:08&lt;/td&gt;&lt;td&gt;&lt;a href="/> Bk9166j			AFC	AFC response received	last_recorded_at: 2023-10-16 03:07:08 UTC, lat: 4 <input type="text" value=""/> 21, lng: -8 <input 336="" 350"="" 473="" 61="" data-label="Text" type="button" value="i4 more &gt;&lt;/a&gt;&lt;/td&gt;&lt;/tr&gt;&lt;/tbody&gt;&lt;/table&gt;&lt;/div&gt;&lt;div data-bbox="/> <p>Admins can verify a response was received from AFC from the Event Logs.</p>

- **AFC response received**- Provides details on the historical list of AFC responses for a specific access point, including the recent update to an AP's AFC status.
- Each AFC response event log contains the power limits passed from the AFC provider to the AP in a JSON file. This configuration file defines the approved channels and transmit power levels allowed by the AFC provider (Federated Wireless) for the AP to operate.

## AFC Status

### AFC status

Connection status: ⚠ Inactive

Response: N/A

Status reason: Height from ground not defined

Last received time: N/A

Expiration time: N/A

### AFC status

Connection status: ! Inactive

Response: Failed

Status reason: AFC System Error

Last received time: Jun 01 2023 11:47:44 PDT

Expiration time: Jun 01 2023 01:35:11 PDT

If the connection status shows inactive, it may be due to:

- AP height is not being configured
- Dashboard failed to receive location information (from either GNSS or propagation)
- An inactive connection status highlighted in red means an AFC request has been sent out but there is no AFC response.

This is due to a connection issue between the Dashboard and the AFC system. This usually occurs when the AFC services are down, and in such cases, it is advised to wait for the services to resume automatically.

## AFC API Endpoints:

Configuration	API Endpoint
AFC Enable/Disable	PUT /networks/{networkId}/wireless/rfProfiles/{rfProfileId}
Height	PUT /devices/{serial}/wireless/radio/afc/positioning
Height Uncertainty	PUT /devices/{serial}/wireless/radio/afc/positioning
Cable Length	PUT /devices/{serial}/wireless/radio/afc/positioning
AFC Refresh	POST /devices/{serial}/wireless/radio/afc/refresh
Monitoring	API Endpoint
AFC Status	GET /devices/{serial}/wireless/radio/afc/powerLimits GET /organizations/{organizationId}/wireless/radio/afc/powerLimits/byDevice
Power Mode	GET /devices/{serial}/wireless/radio/status
Last Response	GET /devices/{serial}/wireless/radio/afc/powerLimits GET /organizations/{organizationId}/wireless/radio/afc/powerLimits/byDevice