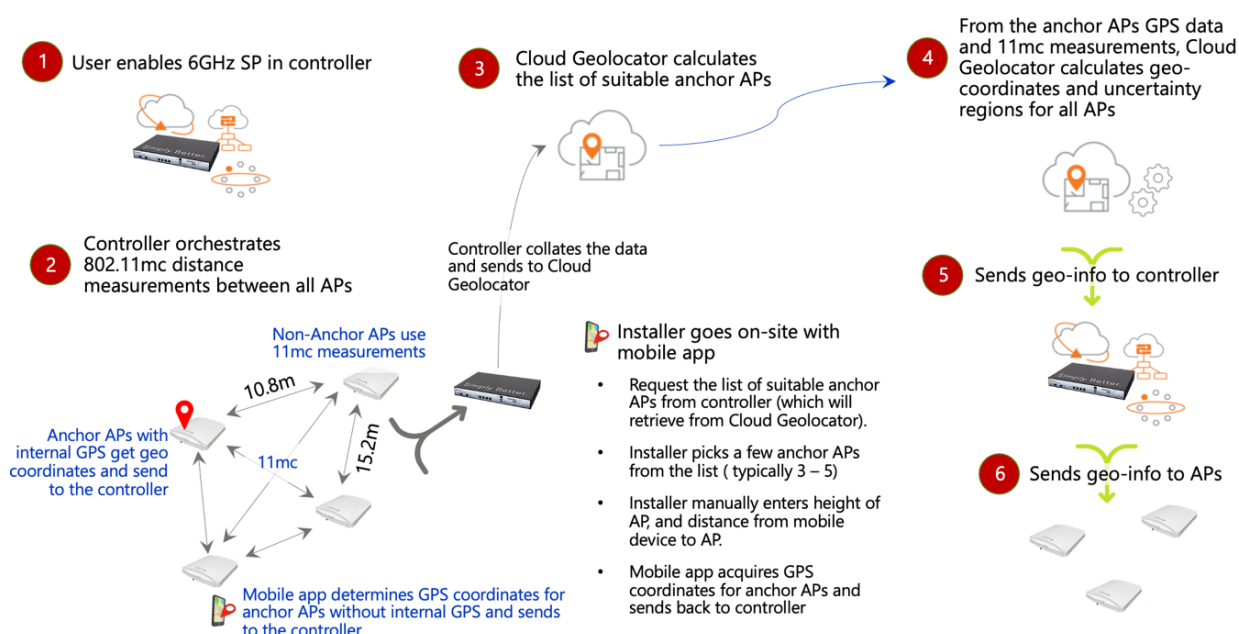


Geolocation General Description¹

This document provides a general overview of how RUCKUS Access Points automatically determine their geographic coordinates. The high-level geolocation workflow is shown in the diagram below. This method will work for both indoor and outdoor standard power APs. The diagram depicts several steps which are also described below.

RUCKUS Geolocation Workflow



The overall flow involves multiple RUCKUS components: the Access Point (AP), Controller, Cloud Geolocator, and mobile app. These geolocation steps will be performed daily.

Step 1: User enables 6 GHz SP in Controller

User ensures the Controller is configured to support 6 GHz standard power operation.

Step 2: Controller orchestrates 802.11mc distance measurements among all APs

The geolocation flow is initiated by the Controller orchestrating distance measurements based on 802.11mc² (11mc) between all the APs in the cluster (e.g., inside a building). The pairwise 11mc distances between the APs are cached in the Controller.

Within the AP cluster, anchor APs are identified as the APs with a good GPS signal, either through the internal GPS in the APs or through the installer using a mobile device app that is within close proximity (generally a few feet) from the AP in cases where the AP does not

¹ Please also refer to our Geolocation System Overview for additional details on our geolocation methodology.

² 802.11mc is an IEEE standard with a mechanism that enables the calculation of precise distance measurements (round-trip time) between Wi-Fi devices.

have an internal GPS or there is not a good GPS signal. The coordinates (lat/long) of anchor APs are also sent to the Controller. The non-anchor APs (which are essentially APs without GPS or without a good GPS signal) depend on the 11mc measurements and the geolocations of the anchor APs for estimating their locations.

Once this step is completed, the Controller has all the necessary data to initiate the Cloud Geolocator process, which includes the lat/long of anchor APs and pairwise 11mc measurements between all APs.

Step 3: Cloud Geolocator calculates the list of suitable anchor APs

Upon getting the coordinates for at least a few anchor APs (e.g., 3 to 5) and the 11mc measurements among all the APs, the Controller sends all the data to the Cloud Geolocator.³

Step 4: Cloud Geolocator calculates geo-coordinates and uncertainty regions for all APs

The Cloud Geolocator then calculates the coordinates (lat/long) and location uncertainty (majorAxis and minorAxis of the ellipse) in meters for all the APs (both anchor and non-anchor APs). The Cloud Geolocator applies different proprietary techniques to estimate the location uncertainty such that the true location of the APs is within the estimated uncertainty region to comply with FCC regulations. We attest that the location uncertainty will be provided with a 95% confidence level.

Steps 5 & 6: Cloud Geolocator sends location information to the APs via the Controller

The Cloud Geolocator sends the results back to all the APs through the Controller. As mentioned earlier, the Geolocator will estimate the locations of the non-anchor APs using the 11mc distance measurements and the geolocations of the anchor APs. Once the Geolocator flow is completed, the APs can now contact the AFC system with its geolocations and uncertainty regions. The communication between AP – Controller and the AFC system is handled by an AFC proxy service hosted by RUCKUS.

Height Determination

Height range input is entered manually by the installer through the mobile phone app or the controller UI. A height range (minimum and maximum heights above ground in meters) can be applied to all APs in a venue, or a subset of the APs. The height is taken as the average of the minimum and maximum values and the vertical uncertainty is equal to half the absolute difference between the two.

Geolocation After Power Cycle

In the event of a power cycle, the AP will contact the Cloud Geolocator to reacquire the geolocation automatically as required by FCC regulations. When contacted by the AP after a power cycle, the Geolocator will first determine whether the device has been physically moved by using the 11mc distance measurements. If not, it will return the previously estimated/cached geolocation and uncertainty data. If yes, the AP will be required to initiate the entire geolocation process again.

³ The Cloud Geolocator is a cloud-based geolocation service that allows us to estimate the geolocations of APs and the associated uncertainty regions through a set of RUCKUS-proprietary algorithms and methods.