Access Point Location

AP auto location support

Access points auto location support is a wireless network feature that

- automates the identification and assignment of geographic locations to APs
- uses technologies such as the Global Positioning System (GPS) or a Global Navigation Satellite System (GNSS), and
- enhances the accuracy and efficiency of wireless network management.

Feature history for AP auto location support

Table 1: Feature history

Release	Feature information
Cisco IOS XE 17.12.1	The Access Point Auto Location Support feature helps to effectively self-locate APs in a global coordinate by combining various ranging technologies and algorithms.
Cisco IOS XE 17.13.1	The improved Access Point Auto Location Support feature helps wireless clients to leverage Fine Timing Measurement (FTM) and AP GNSS for indoor navigation.
Cisco IOS XE 17.15.2	Ultra Wide Band (UWB) technology uses various methods to determine the position and distance between APs. UWB is supported in the Cisco Wireless 9178I Series Wi-Fi 7 APs, Cisco Wireless 9176I Series Wi-Fi 7 APs, and Cisco Wireless 9176D1 Series Wi-Fi 7 APs to perform AP to AP ranging.

The AP auto location solution mitigates common challenges in enterprise environments where manual AP location entry is often inaccurate or neglected. This system

- automates AP location detection using GNSS and Fine Timing Measurement (FTM) technologies, when accessible
- uses manual anchors to support location determination when GNSS signals are unavailable, and
- requires adequate AP density to ensure inter-AP communication at maximum power for precise geolocation.

Process Overview

Auto location support enhances efficient, precise AP management in settings where traditional GNSS solutions are impractical.

- Segmentation and Labeling: Dividing a large number of APs into smaller, floor-specific segments to determine geolocations.
- Ranging and Geolocation: Leveraging strong GNSS signals to assist APs with weak signals, through inter-AP ranging data and FTM technology.
- Fallback with Manual Anchors: Implementing manual anchors as needed to maintain location accuracy in areas without GNSS reception.

Use Case

Auto location support is effectively applied for self-locating APs within a building or a specific floor, aiding seamless network integration and management.

Supported Access Points

For information about APs that support this feature see https://www.cisco.com/c/en/us/td/docs/wireless/access_point/feature-matrix/ap-feature-matrix.html.

Advanced functionalities in Cisco IOS XE 17.12.1

- Client FTM: It enhances indoor navigation by allowing AP range checks from unassociated clients through designated WLANs on 5-GHz and 6-GHz bands.
- Air Pressure Reporting and Updates: APs send air pressure data to the controller, with RPC and Privileged EXEC mode commands to enable collection. Samples are collected at regular intervals, such as every 30 seconds for 10 minutes.
- Band Filters: Optimizes AP-to-AP ranging by enhancing site-tag efficiency on specified bands like 5 GHz or 6 GHz.
- Ranging Completion Notification: The controller oversees APs for ranging completion, relaying status to Cisco Spaces upon completion.
- AP Movement Alarm: When an AP is disconnected and then reconnected at a new location, the system reports an alarm to the controller, which updates the system with syslog entries and alerts Cisco Spaces.

Ultra-wideband ranging

Ultra-wide band ranging is a technology-based method that

- determines position and distance between APs using a range of techniques
- employs double-sided two-way ranging between UWB-capable APs and UWB-enabled devices to enhance accuracy, and
- differentiates multipath components through short pulse duration and wide bandwidth.

UWB for increased accuracy

UWB technology, combined with precise time measurement, enhances accuracy in environments with heavy multipath conditions, including concrete structures or metallic surfaces. This technology optimizes performance and reliability by reducing signal reflection and interference, thereby enhancing the precision of AP AnyLocate in specific Cisco Wireless AP series.

In particular, UWB radios in Cisco Wireless 9178I Series Wi-Fi 7 APs, 9176I Series Wi-Fi 7 APs, and 9176D1 Series Wi-Fi 7 APs are utilized to conduct AP-to-AP ranging. When combined with Wi-Fi-based ranging, UWB yields superior results in specific environments.

Group ranging

Group ranging is a technique where ranging is exclusively conducted within a group of identified APs.

- These APs can span different site tags.
- A list of AP radio MAC addresses must be provided as input to execute group ranging.

Group ranging does not have CLI support and relies on Network Configuration Protocol (NETCONF) and Remote Procedure Calls (RPC) for implementation.

Global Navigation Satellite System raw data streaming through gRPC

Global Navigation Satellite System (GNSS) data streaming is a feature that

- streams high-volume raw GNSS data from APs directly to Cisco Spaces
- uses the Google Remote Procedure Call (gRPC) protocol for efficient data handling, and
- reduces the load on network controllers.

Supported equipment and features

- Internal GNSS antennas
- External GNSS data through Gypsum USB dongle
- Cisco Catalyst 9120 Series AP, Cisco Catalyst 9130 Series AP, Cisco Catalyst 9136 Series AP, Cisco Catalyst 9162 Series AP, Cisco Catalyst 9164 Series AP, Cisco Catalyst 9166 Series AP, Cisco Catalyst 9166D Series AP, Cisco Wireless 9178 Series AP, and Cisco Wireless 9176 Series AP.

Configuration Information

- There is no configuration on the controller.
- The AP sends GNSS data to Cisco Spaces through gRPC once the connection is established.

GNSS raw data streaming through gRPC

Summary

This process describes how GNSS data is transmitted from APs to Cisco Spaces using gRPC technology.

Workflow

1. The APs receive GNSS data either internally or through the Gypsum module.
2. After the controller is added to the Cisco Spaces connector, the AP establishes a gRPC tunnel to the Cisco Spaces connector.
3. Cisco Spaces pushes the configuration to set the GNSS reporting interval on the AP.
4. The AP sends GNSS data to Cisco Spaces at the configured interval.

Result

The process successfully transfers GNSS data from the APs to Cisco Spaces, ensuring seamless communication.

Restrictions for GNSS raw data streaming through gRPC

- AP Join Profile Preparation: You must create the AP join profile before adding the controller to the Cisco Spaces connector.
- Interval Reset Upon Reload: If the AP reloads, note that the interval duration resets. The AP must then wait for 24 hours for the connector to push the configuration again.
- Data Sending Restriction: Ensure that GNSS raw data streaming cannot be explicitly disabled.

AP commands

Outline the available AP commands executable via the controller for effective network management.

These are the AP commands. These commands can be run from the controller using the **remote** command.

- **show spaces endpoint key access**
- **show spaces endpoint key authentication**
- **show spaces endpoint connection detail**
- **debug spaces <info/debug/error/warning/critical>**

Configure AP geolocation derivation using ranging (GUI)

This task explains how to enable geolocation derivation for access points using ranging to determine their location.

Use these steps to configure access point geolocation derivation using ranging:

Procedure

Step 1 Choose **Configuration** > **Wireless** > **Wireless Global**.

Step 2 In the **AP Geolocation** section, click the **Geolocation Derivation Using Ranging** toggle button to enable geolocation derivation.

Enabling **Geolocation Derivation Using Ranging** allows the AP to participate in location services using ranging for geolocation.

Step 3 Click **Apply**.

Note
Once enabled, **Geolocation Derivation Using Ranging** updates the AP ranging capability on Cisco Spaces within approximately 30 minutes.

The AP is configured for geolocation derivation and is ready for use in location services employing ranging techniques.

Configure AP geolocation derivation using ranging (CLI)

This task allows you to configure geolocation derivation for an access point using ranging, which can improve location accuracy.

Procedure

Step 1 Enter global configuration mode.

Example:

```
Device# configure terminal
```

Step 2 Enable geolocation derivation using ranging.

Example:

```
Device(config)# ap geolocation derivation ranging
```

Note
Use the **no** command to disable the feature.

Geolocation derivation is enabled for AP, which potentially improves its location estimation capabilities. If the configuration fails, verify the commands and check the device logs for errors.

Configure the AP Ranging Parameters through the GUI

This task guides you through configuring the ranging parameters on an access point using the controller's graphical user interface.

Procedure

Step 1 Choose **Configuration** > **Tags & Profiles** > **AP Join**.

Step 2 Click **Add**.

Step 3 In the **General** tab, enter the name and description of the corresponding AP join profile.

Step 4 Click the **Geolocation** tab.

Step 5 In the **Fine Time Management (FTM)** section, complete these steps:

- Click the **FTM** toggle button to allow APs to use FTM for inter AP ranging.
- In the **FTM Initiator Burst Size** field, specify the burst size value. The burst size determines the size of the transmitted frames. The valid range is between two and 31 frames. The default value is 16 frames per burst.
- From the **FTM Initiator Burst Duration** drop-down list, choose a value. The burst duration determines the interval of the transmitted frames. The default value is 32 microseconds.

Step 6 Click **Apply to Device**.

Upon completion, the access point will be configured with the specified ranging parameters, enhancing wireless communication by allowing accurate distance measurements.

Configure AP ranging parameters (CLI)

Set up AP geolocation ranging parameters to enable Fine Timing Measurement (FTM) for precise location tracking.

Procedure

Step 1 Enter global configuration mode.

Example:

```
Device# configure terminal
```

Step 2 Configure an AP profile and enter AP profile configuration mode.

Example:

```
Device(config)# ap profile ap-profile1
```

Step 3 Enable geolocation Fine Timing Measurement (FTM).

Example:

```
Device(config-ap-profile)# geolocation ftm
```

Step 4 Configure the geolocation FTM burst size.

Example:

```
Device(config-ap-profile)# geolocation ftm initiator burst-size 8
```

The burst size values are 4, 8, 16, 32 and 64 frames. The default value is 8 frames per burst.

Step 5 Configure the geolocation FTM burst duration.

Example:

```
Device(config-ap-profile)# geolocation ftm initiator burst-duration 32ms
```

The default value is 32 microseconds.

The AP is configured with the specified geolocation ranging parameters for FTM.

Configure AP location (CLI)

Accurately configure AP with their physical location and floor information for precise network management and location-based services.

Use these steps to configure the AP coordinates and the corresponding floor information.

Note There are no corresponding GUI steps for this configuration.

Procedure

Step 1 Enable privileged EXEC mode.

Example:

```
Device> enable
```

Enter your password, if prompted.

Step 2 Configure the longitude and latitude of the AP.

Example:

```
Device# ap name cisco-ap1 geolocation coordinates 90 45
```

The value range for longitude is from -180 to 180 degrees. The value range for latitude is from -90 to 90 degrees.

Step 3 Configure the floor ID for the AP.

Example:

```
Device# ap name cisco-ap1 floor 2147483647
```

The floor ID range is from -2147483648 to 2147483647.

The AP has updated geographical coordinates and floor information, allowing accurate mapping and integration with location-based services.

Configure on-demand AP ranging (CLI)

Improve the geolocation accuracy of APs through on-demand ranging configuration.

Use these steps to configure on-demand AP ranging:"

Note There are no corresponding GUI steps for this configuration.

Procedure

Step 1 Enable privileged EXEC mode.

Example:

```
Device> enable
```

Enter your password, if prompted.

Step 2 Enable accurate ranging using the 5 GHz or 6 GHz bands on APs under the configured site tag.

Example:

```
Device# ap geolocation ranging site <cite>ap-site-tag</cite> accurate 5ghz
```

Note
Client connections may be disrupted.

Step 3 Enable accurate ranging using the 5 GHz or 6 GHz bands on all APs.

Example:

```
Device# ap geolocation ranging all accurate 5ghz
```

Caution
Client connections may be disrupted.

APs are configured for enhanced geolocation accuracy through on-demand ranging.

Enable fine time measurement (802.11mc) responder (GUI)

Enable the AP to respond to fine time measurement queries for indoor location determination.

Follow these steps to configure the AP to respond to fine time measurement queries:

Procedure

Step 1 Choose **Configuration** > **Tags & Profiles** > **WLANs**.

Step 2 Click **Add**.

The **Add WLAN** window is displayed.

Step 3 In the **General** tab, enter the **Profile Name**, the **SSID**, and the **WLAN ID**.

Step 4 In the **Advanced** tab, under the **Geolocation** section, click the **Fine Time Measurement (FTM) Responder** toggle button to enable the AP to respond to time measurement queries sent from a client.

The client sends time measurement queries to measure its distance to the AP and determine their indoor location.

The **Advertise AP Location** field is displayed.

Step 5 Click the **Advertise AP Location** toggle button to enable the AP to advertise its geolocation coordinates.

Step 6 Click **Apply to Device** to save the configuration.

The AP is configured to respond to fine time measurement queries.

Configure fine time measurement (802.11mc) responder

Configure a fine time measurement (802.11mc) responder to ensure it communicates accurate location information.

Follow these steps to configure a fine time measurement responder:

Procedure

Step 1 Enter global configuration mode.

Example:

```
Device# configure terminal
```

Step 2 Specify the WLAN name and ID.

Example:

```
Device(config)# wlan wlan-profile 36 ssid1
```

- *profile-name* is the WLAN name. Valid WLAN names can contain up to 32 alphanumeric characters
- *wlan-id* is the wireless LAN identifier. The valid range is from 1 to 4096.
- *ssid-name* is the SSID which can contain 32 alphanumeric characters.

Step 3 Configure the FTM responder.

Example:

```
Device(config-wlan)# geolocation ftm-responder
```

Step 4 Configure the advertisement of AP location to clients.

Example:

```
Device(config-wlan)# geolocation ftm-responder advertise-ap-location
```

Step 5 (Optional) Clear the AP geolocation best known FTM report.

Example:

```
Device# clear ap geolocation ranging
```

The fine time measurement responder is configured successfully, allowing communication of accurate location information to compatible devices.

Configure air pressure reporting (CLI)

This task allows the configuration of air pressure data reporting to optimize environmental monitoring.

Procedure

Step 1 Enable privileged EXEC mode.

Example:

```
Device> enable
```

Enter your password if you are prompted.

Step 2 Configure sensor air pressure data collection either for all APs or specifically for APs within a site tag.

Example:

```
Device# ap sensor air-pressure site sitetag1 duration 10
```

The value range of the duration of the air pressure reporting is from 1 minute to 1,440 minutes. The default is 10 minutes.

From Cisco IOS XE 17.15.1, the default air pressure sample interval is changed from 30 seconds to 60 seconds. For example, if the duration is set to 10 minutes, the APs send 10 samples, spaced at 60-second intervals each.

Air pressure data collection is configured for the specified access points, allowing for effective environmental monitoring and reporting.

Configure AP ultra wide band parameters (GUI)

Configure the ultra wide band parameters on an access point using the GUI.

Follow these steps to configure the UWB parameters:

Procedure

Step 1 Choose **Configuration** > **Tags & Profiles** > **AP Join**.

Step 2 Click **Add**.

Step 3 In the **General** tab, enter the name and description of the corresponding AP join profile.

Step 4 Click the **Geolocation** tab.

Step 5 In the **Ultra Wide Band (UWB)** section, complete these steps:

- Click the **UWB** toggle button to allow APs to use UWB for inter AP ranging.
- In the **UWB Burst Size** field, specify the burst size value. The size of the transmitted frames is determined by the burst size. The range is from 10 ro 100 frames. The default value is 32 frames per burst.
- From the **UWB Burst Duration** drop-down list, choose a value. The interval of the transmitted frames is determined by the burst duration. The valid range is from 5 to 30 seconds. The default value is 10 seconds.
- Click **Apply to Device**.

The AP is configured with the specified UWB parameters, allowing for optimized inter AP ranging and communication.

Configure access point ultra wide band parameters (CLI)

This task guides you through configuring ultra wide band (UWB) parameters for an AP, optimizing geolocation accuracy and efficiency.

Procedure

Step 1 Enter global configuration mode.

Example:

```
Device# configure terminal
```

Step 2 Configure an AP profile and enter AP profile configuration mode.

Example:

```
Device(config)# ap profile default-ap-profile
```

Step 3 Enable default.

Example:

```
Device(config-ap-profile)# geolocation uwb
```

Step 4 Configure the geolocation UWB burst size.

Example:

```
Device(config-ap-profile)# geolocation uwb initiator burst-size 32
```

The range of burst size values is from 10 to 100 frames. The default value is 32 frames per burst.

Important
We recommend that you do not alter the burst size and the burst duration.

Step 5 Configure the geolocation UWB burst duration.

Example:

```
Device(config-ap-profile)# geolocation uwb initiator burst-duration 10s
```

The range of burst duration values is from 5 to 30 seconds. The default value is 10 seconds.

The AP has optimized UWB parameters, which enhance its geolocation functionality for improved accuracy.

Verify AP geolocation information

Verify AP geolocation ranging report

To verify the AP geolocation ranging report, run this command:

```
Device# show ap geolocation ranging report
RequestID     AP Name                              NeighborAP(Name/MAC)              Type
Method  Dist(cm)  Channel   Band      Width(MHz)  AOA(elev)     AOA(azim)     RSSIAvg
Frames       Time
-------------------------------------------------------------------------------------------------------------------
1             AP6849-92D3-87E0                     AP6849-92D4-1470                  BEST
FTM     298       36        5 GHz     80          NA            NA            -27
 6/1      04/30/2024 09:44:03 UTC
1             AP6849-92D3-87E0                     AP6849-92D4-1470                  LATEST
FTM     251       36        5 GHz     80          NA            NA            -28
12/3      05/09/2024 12:03:33 UTC
1             AP6849-92D4-1470                     AP6849-92D3-87E0                  BEST
FTM     229       36        5 GHz     80          NA            NA            -32
 5/2      05/06/2024 14:32:28 UTC
1             AP6849-92D4-1470                     AP6849-92D3-87E0                  LATEST
FTM     227       36        5 GHz     40          NA            NA            -37
15/0      05/09/2024 12:03:31 UTC
1             AP6849-92D4-1470                     AP6849-92D3-87E0                  LATEST
FTM     237       36        5 GHz     80          NA            NA            -36
 9/1      05/09/2024 12:03:36 UTC
```

Note AoA which refers to the angle of arrival (azimuth and elevation) is included in the show command output from the Cisco IOS XE 17.15.2 release.

To view an AP geolocation ranging request, run this command:

```
Device# show ap geolocation ranging request
Request ID    SiteTag/Group/All APs             Mode          Method        Band
Requests  Responses  Reports    Start Time                End Time
-------------------------------------------------------------------------------------------------------------------
1             ALL APs                           Accurate      ALL           All       4
      0          0          05/15/2024 14:33:33 UTC
```

Note The method column is introduced from Cisco IOS XE 17.15.2 release.

To view the AP geolocation summary, run this command:

```
Device# show ap geolocation summary
AP Name                Radio MAC          Location  Location Longitude   Latitude
Major-axis Minor-axis Orientation Height Height   Height        Height
                                        Type      Source   (degrees)   (degrees)   (meters)
   (meters)   (degrees)   Type   (meters) Uncertainty   Source

                                           (meters)
-------------------------------------------------------------------------------------------------------------------
APCC9C.3EF1.0F30      10f9.20fd.f640     Ellipse   Manual   90.000000   90.000000    0
      0          0.000000    NA     NA       NA            NA
```

To view the AP geolocation statistics, run this command:

```
Device# show ap geolocation statistics
Num APs with GNSS                  : 1
Num APs with manual height         : 0
Num APs with derived geolocation   : 0
Last geolocation derivation run    : 07/21/2023 08:54:21
```

To view the AP geolocation GNSS-capable summary, run this command:

```
Device# show ap geolocation gnss-capable summary
-------------------------------------------------------------------------------------------------
AP Name                      Radio MAC          GPS Coverage    Antenna Type  Last GPS fix

-------------------------------------------------------------------------------------------------
APCC9C.3EF4.CF00             10f9.20fd.b6e0     No              Internal      NA
```

Note APs do not store the GNSS location. The location is recalculated after a reboot unless it is configured manually.

To view the AP geolocation ranging status, run this commands:

```
Device# show ap geolocation ranging status
```

```
Device# show ap name geolocation ranging status
```

To view the ranging capability of APs, run this command:

```
Device# show ap geolocation ranging capability
AP Name               FTM Responder   FTM Initiator
-----------------------------------------------------------------
AP0001.Cisco.CF00      Yes             Yes
AP0002.Cisco.0F30      Yes             Yes
AP-2800                No              No
AP0003.Cisco.82a0      No              No
```