



# Cisco Hyperlocation

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## Information About Cisco Hyperlocation

Cisco Hyperlocation is an ultraprecise location solution that allows you to track the location of wireless clients. This is possible with the Cisco Hyperlocation radio module in the Cisco Aironet 3600, 3700, and 4800 Series Access Points. The Cisco Hyperlocation module combines Wi-Fi and Bluetooth Low Energy (BLE) technologies to allow beacons, inventory, and personal mobile devices to be pinpointed.

Hyperlocation is also supported in Fabric mode. In particular, when the wireless controller is running on the switch, the controller takes the necessary steps to provision the APs, so that they can generate Hyperlocation VxLAN packets that can traverse the fabric network taking advantage of the fabric infrastructure and be correctly delivered to the destination CMX.

The Hyperlocation VxLAN packets are special packets marked with SGT 0 and using the L3VNID of the APs. For more information, refer to the SDA documentation.

The Cisco Hyperlocation radio module provides the following:

- WSM or WSM2 radio module functions that are extended to:
  - 802.11ac
  - Wi-Fi Transmit
  - 20-MHz, 40-MHz, and 80-MHz channel bandwidth.
- Expanded location functionality:

- Low-latency location optimized channel scanning
- 32-antenna angle of arrival (AoA); available only with the WSM2 module.



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**Note** When using the WSM2 module (includes the WSM module and the antenna add-on), the accuracy of tracking the location of wireless clients can be as close as one meter.

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Cisco Hyperlocation works in conjunction with Cisco Connected Mobile Experiences (CMX). Combining the Cisco Hyperlocation feature on Cisco Catalyst 9800 Series Wireless Controller with a CMX device allows you to achieve better location accuracy, which can result in delivering more targeted content to users. When you use CMX with Cisco CleanAir frequency scanning, it is simple to locate failed, lost, and even rogue beacons.

The Cisco Hyperlocation radio module with an integrated BLE radio allows transmission of Bluetooth Low Energy (BLE) broadcast messages by using up to 5 BLE transmitters. Cisco Catalyst 9800 Series Wireless Controller is used to configure transmission parameters such as interval for the beacons, universally unique identifier (UUID), and transmission power, per beacon globally for all the access points. Also, the controller can configure major, minor, and transmission power value of each AP to provide more beacon granularity.



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**Note** The Cisco Hyperlocation feature must be enabled on the controller and CMX and CMX must be connected for BLE to work.

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In the absence of a Cisco Hyperlocation radio module, Hyperlocation will still work in a modality named *Hyperlocation Local Mode*, which guarantees a slightly lower location accuracy in the range between five meters and seven meters. This is accomplished through CPU cycle stealing.

Using the controller, you can configure Cisco Hyperlocation for APs based on their profile.

### Network Time Protocol Server

Cisco Hyperlocation requires the AP to be synchronized with regard to time. To achieve this, the controller sends network time protocol (NTP) information to the AP. The AP then uses the NTP server to synchronize its clock. Therefore, the AP needs connectivity to the NTP server.

APs can be geographically dispersed. Therefore, it is necessary to provide different NTP servers to different APs. This is achieved by allowing the configuration of NTP server information on a per AP profile basis. If NTP information is not configured on the AP profile, the controller uses one of the global NTP peers defined on its configuration or the management IP address is sent as the NTP server to be used if the controller is acting as an NTP server. If the NTP server is not available, Cisco Hyperlocation will be disabled.



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**Note** In scale setup, the NTP server should be configured on the respective AP profiles, so that the APs and CA servers used for LSC provisioning are time synchronized. If the NTP server is not configured, a few APs would fail in LSC provisioning.

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## Bluetooth Low Energy Configuration

The BLE configuration is split into two parts: per-AP profile and per AP. The BLE feature can be configured partially from the AP profile (by default, the AP profile BLE configuration is applied) and partially per-AP (some or all the attributes are applied).

**Table 1: BLE Configuration Details**

Attribute	BLE Configuration Per AP Profile	BLE Configuration Per AP
Attributes with per-AP granularity (global for all the beacons)	<ul style="list-style-type: none"> <li>Interval</li> <li>Advertised transmission power</li> </ul>	<ul style="list-style-type: none"> <li>Interval</li> <li>Advertised transmission power</li> </ul>
Attributes with per-AP per0-beacon granularity	<ul style="list-style-type: none"> <li>Transmission power</li> <li>UUID</li> <li>Status</li> </ul>	<ul style="list-style-type: none"> <li>Transmission power</li> <li>UUID</li> <li>Status</li> <li>Major</li> <li>Minor</li> </ul>



**Note** The *default-ap-profile* BLE configuration can be considered the default BLE configuration because all the APs will join the *default-ap-profile* AP profile in case the other profiles are removed.

For more information about Cisco Hyperlocation, see the following documents:

- [Cisco Hyperlocation Solution](#)
- [Cisco CMX Configuration Guide to enable Cisco Hyperlocation](#)
- [Cisco CMX Release Notes](#)

## Restrictions on Cisco Hyperlocation

- It is not possible to modify detection, trigger, and reset thresholds while Hyperlocation is in enabled state.
- Changes to the reset threshold are allowed for values in the range of zero to one less than the current threshold value. For example, if the current threshold reset value is 10, changes to the reset threshold are allowed for values in the range of 0 to 9.
- When Cisco Hyperlocation is in use on the Cisco Catalyst 9800 Series Wireless Controller in a non-Fabric deployment, CMX must be reachable through an SVI interface (VLAN). Deployments where CMX is reachable through an L3 port results in an error.
- In Fabric deployments, the wireless management interface (typically loopback interface) must not be in Fabric.

- It is not possible to set the wireless management interface to a loopback interface in non-Fabric deployments.

## Support for IPv6 in Cisco Hyperlocation or BLE Configuration

Until Release 16.12, IPv4 was the only valid configuration. From Release 17.1 onwards, IPv6 is also supported for specific deployments.



**Note** CMX accepts only one IP configuration at a time (either IPv4 or IPv6).

The configuration combinations listed in the following tables are the valid deployments.

**Table 2: Flex Deployment Mode**

Controller Management Interface and AP	CMX
IPv4	IPv4
IPv6	IPv6

**Table 3: Fabric Deployment Mode**

Controller Management Interface and AP	CMX
IPv4	IPv4



**Note** Any other combination of IPv4 or IPv6 is not supported.

## Configuring Cisco Hyperlocation (GUI)

Cisco Hyperlocation is a location solution that allows to track the location of wireless clients with the accuracy of one meter. Selecting this option disables all other fields in the screen, except NTP Server.

### Procedure

- Step 1** In the **Configuration > Tags & Profiles > AP Join** page, click **Add**.  
The **Add AP Join Profile** dialog box appears.
- Step 2** Under the **AP > Hyperlocation** tab, select the **Enable Hyperlocation** check box.
- Step 3** In the **Detection Threshold (dBm)** field, enter a value to filter out packets with low RSSI. You must enter a value between  $-100$  dBm and  $-50$  dBm.

- Step 4** In the **Trigger Threshold (cycles)** field, enter a value to set the number of scan cycles before sending a BAR to clients. You must enter a value between 0 and 99.
- Step 5** In the **Reset Threshold is required** field, enter a value to reset value in scan cycles after trigger. You must enter a value between 0 and 99.
- Step 6** Click **Save & Apply to Device**.

## Configuring Cisco Hyperlocation (CLI)

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 2</b>	<b>ap profile <i>profile-name</i></b>  <b>Example:</b> Device(config)# ap profile <i>profile-name</i>	Configures an AP profile and enters AP profile configuration mode.
<b>Step 3</b>	<b>[no] hyperlocation</b>  <b>Example:</b> Device(config-ap-profile)# [no] hyperlocation	Enables Cisco Hyperlocation feature on all the supported APs that are associated with this AP profile.  Use the <b>no</b> form of the command to disable the Cisco Hyperlocation feature.
<b>Step 4</b>	<b>[no] hyperlocation threshold detection <i>value-in-dBm</i></b>  <b>Example:</b> Device(config-ap-profile)# [no] hyperlocation threshold detection -100	Sets threshold to filter out packets with low RSSI. The <b>no</b> form of this command resets the threshold to its default value. Valid range is between -100 and -50.
<b>Step 5</b>	<b>[no] hyperlocation threshold reset <i>value-btwn-0-99</i></b>  <b>Example:</b> Device(config-ap-profile)# [no] hyperlocation threshold reset 8	Resets the value of scan cycles after a trigger. The <b>no</b> form of this command resets the threshold to its default value.
<b>Step 6</b>	<b>[no] hyperlocation threshold trigger <i>value-btwn-1-100</i></b>  <b>Example:</b> Device(config-ap-profile)# [no] hyperlocation threshold trigger 10	Sets the number of scan cycles before sending a block acknowledgment request (BAR) to clients. The <b>no</b> form of this command resets the threshold to its default value.

	Command or Action	Purpose
<b>Step 7</b>	<p><code>[no] ntp ip ip-address</code></p> <p><b>Example:</b></p> <pre>Device(config-ap-profile)# [no] ntp ip 9.0.0.4</pre>	Sets the IP address of the NTP server. The <b>no</b> form of this command removes the NTP server.

## Configuring Hyperlocation BLE Beacon Parameters for AP (GUI)

### Procedure

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- Step 1** In the **Configuration > Tags & Profiles > AP Join** page, click **Add**.  
The **Add AP Join Profile** dialog box appears.
- Step 2** Under the **AP** tab, click **BLE**.
- Step 3** In the **Beacon Interval (Hz)** field, enter a value.
- Step 4** In the **Advertised Attenuation Level (dBm)** field, enter a value.
- Step 5** Select the check box against each ID and click **Reset**, if required.
- Step 6** Optional, click an ID to edit the values of the following fields, and click **Save**.
- **Status**
  - **Tx Power (dBm)**
  - **UUID**
- Step 7** Click **Save & Apply to Device**.
- 

## Configuring Hyperlocation BLE Beacon Parameters for AP (CLI)

Follow the procedure given below to configure hyperlocation BLE beacon parameters for an AP:

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<p><code>ap name ap-name hyperlocation ble-beacon beacon-id {enable   major major-value   minor minor-value   txpwr value-in-dBm   uuid uuid-value }</code></p> <p><b>Example:</b></p> <pre>Device# ap name test-ap hyperlocation ble-beacon 3 major 65535</pre>	<p>Configures Hyperlocation and related parameters for an AP, and the specified beacon ID:</p> <ul style="list-style-type: none"> <li>• <b>enable</b>—Enables BLE beacon on the AP.</li> <li>• <b>major major-value</b>—Configures BLE beacon's major parameter. Valid value is</li> </ul>

	Command or Action	Purpose
		<p>between 0 and 65535; the default value is 0.</p> <ul style="list-style-type: none"> <li>• <b>minor</b> <i>minor-value</i>—Configures BLE beacon's minor parameter. Valid value is between 0 and 65535; the default value is 0.</li> <li>• <b>txpwr</b> <i>value-in-dBm</i>—Configures BLE beacon attenuation level. Valid value is between -52 dBm and 0 dBm.</li> <li>• <b>uuid</b> <i>uuid-value</i>—Configures a UUID.</li> </ul>
<b>Step 2</b>	<p><b>ap name</b> <i>ap-name</i> <b>hyperlocation ble-beacon advpwr</b> <i>value-in-dBm</i></p> <p><b>Example:</b></p> <pre>Device# ap name test-ap hyperlocation ble-beacon advpwr 90</pre>	Configures BLE beacon's advertised attenuation level for an AP. The valid range for <i>value-in-dBm</i> is between -40 dBm and -100 dBm; the default value is -59 dBm (all values must be entered as positive integers).

## Configuring Hyperlocation BLE Beacon Parameters (CLI)

### Before you begin

For Hyperlocation BLE to be enabled, CMX must be fully joined and enabled for Hyperlocation.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<p><b>ap profile</b> <i>profile-name</i></p> <p><b>Example:</b></p> <pre>Device(config)# ap profile profile-name</pre>	Enables configuration for all the APs that are associated with the specified AP profile name.
<b>Step 2</b>	<p><b>hyperlocation ble-beacon</b> <i>beacon-id</i></p> <p><b>Example:</b></p> <pre>Device(config-ap-profile)# hyperlocation ble-beacon 3</pre>	Specifies the BLE beacon parameters and enters BLE configuration mode.
<b>Step 3</b>	<p><b>enabled</b></p> <p><b>Example:</b></p> <pre>Device(config-halo-ble)# enabled</pre>	Enables BLE for the beacon ID specified.
<b>Step 4</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Device(config-halo-ble)# exit</pre>	Returns to AP profile configuration mode.

	Command or Action	Purpose
<b>Step 5</b>	<b>hyperlocation ble-beacon interval</b> <i>value-in-hertz</i>  <b>Example:</b> Device(config-ap-profile)# hyperlocation ble-beacon interval 1	Configures the BLE beacon interval as 1 Hz for the selected profile.
<b>Step 6</b>	<b>hyperlocation ble-beacon advpwr</b> <i>value-in-dBm</i>  <b>Example:</b> Device(config-ap-profile)# hyperlocation ble-beacon advpwr 40	Configures the BLE beacon-advertised attenuation level. Valid range is between -40 dBm and -100 dBm. The default value is -59 dBm.

## Verifying Cisco Hyperlocation

To display the hyperlocation status values and parameters for all the AP profiles, use the following command:

```
Device# show ap hyperlocation summary
```

```
Profile Name: custom-profile
```

```
Hyperlocation operational status: Down
Reason: Hyperlocation is administratively disabled
Hyperlocation NTP server: 209.165.200.224
Hyperlocation admin status: Disabled
Hyperlocation detection threshold (dBm): -100
Hyperlocation trigger threshold: 10
Hyperlocation reset threshold: 8
```

```
Profile Name: default-ap-profile
```

```
Hyperlocation operational status: Up
Reason: N/A
Hyperlocation NTP server: 209.165.200.224
Hyperlocation admin status: Enabled
Hyperlocation detection threshold (dBm): -90
Hyperlocation trigger threshold: 22
Hyperlocation reset threshold: 8
```

To display both the overall and the per-AP configuration values and operational status, use the following command:

```
Device# show ap hyperlocation detail
```

```
Profile Name: house24
```

```
Hyperlocation operational status: Up
Reason: NTP server is not properly configured
Hyperlocation NTP server: 198.51.100.1
Hyperlocation admin status: Enabled
Hyperlocation detection threshold (dBm): -90
Hyperlocation trigger threshold: 8
Hyperlocation reset threshold: 7
```



AP Name	Radio MAC	Method	CMX IP	AP Profile
APe865.49d9.bfe0	e865.49ea.a4b0	WSM2+Ant	198.51.100.2	house24
APa89d.21b9.69d0	a89d.21b9.69d0	Local	198.51.100.3	house24
APe4aa.5d3f.d750	e4aa.5d5f.3630	WSM	198.51.100.4	house24

To display the overall (profile specific) configuration values and operational status for a given profile, use the following command:

```
Device# show ap profile profile-name hyperlocation summary
```

```
Profile Name: profile-name
Hyperlocation operational status: Up
Reason: N/A
Hyperlocation NTP server: 209.165.200.224
Hyperlocation admin status: Enabled
Hyperlocation detection threshold (dBm): -100
Hyperlocation trigger threshold: 10
Hyperlocation reset threshold: 8
```

To display both the overall (profile specific) and per-AP configuration values and operational status for a given profile, use the following command. The APs listed are only those APs that belong to the specified join profile.

```
Device# show ap profile profile-name hyperlocation detail
```

```
Profile Name: profile-name
Hyperlocation operational status: Up
Reason: N/A
Hyperlocation NTP server: 209.165.200.224
Hyperlocation admin status: Enabled
Hyperlocation detection threshold (dBm): -90
Hyperlocation trigger threshold: 8
Hyperlocation reset threshold: 7
```

AP Name	Radio MAC	Method	CMX IP
APf07f.0635.2d40	f07f.0635.2d40	WSM2+Ant	198.51.100.2
APf07f.0635.2d41	f07f.0635.2d41	Local	198.51.100.3
APf07f.0635.2d42	f07f.0635.2d42	WSM	198.51.100.4

To display configuration values for an AP profile, use the following command:

```
Device# show ap profile profile-name detailed
```

```
Hyperlocation :
Admin State           : ENABLED
PAK RSSI Threshold Detection: -100
PAK RSSI Threshold Trigger : 10
PAK RSSI Threshold Reset : 8
.
.
.
```

To display the Cisco CMXs that are correctly joined and used by hyperlocation, use the following command:

```
Device# show ap hyperlocation cmx summary
```

```
Hyperlocation-enabled CMXs
```

IP	Port	Dest MAC	Egress src MAC	Egress VLAN	Ingress src MAC	Join time
198.51.100.4	2003	aaaa.bbbb.cccc	aabb.ccdd.eeff	2	0000.0001.0001	12/14/18 09:27:14

To display the hyperlocation client statistics, use the following command:

```
Device# show platform hardware chassis active qfp
feature wireless wlclient cpp-client summary
```

```
Client Type Abbreviations:
```

```
RG - REGULAR BL - BLE
HL - HALO LI - LWFL INT
```

```
Auth State Abbreviations:
```

```
UK - UNKNOWN IP - LEARN IP IV - INVALID
L3 - L3 AUTH RN - RUN
```

```
Mobility State Abbreviations:
```

```
UK - UNKNOWN IN - INIT
LC - LOCAL AN - ANCHOR
FR - FOREIGN MT - MTE
IV - INVALID
```

```
EoGRE Abbreviations:
```

```
N - NON EOGRE Y - EOGRE
```

CPP	IF_H	DPIDX	MAC Address	VLAN	CT	MCVL	AS	MS	E	WLAN	POA
0X32	0XF0000001	0000.0001.0001	9	HL	0	RN	LC	N		NULL	

To display the interface handle value statistics, use the following command:

```
Device# show platform hardware chassis active
qfp feature wireless wlclient datapath cpp-if-handle 0x32 statistics start
```

To display the recorded flow, use the following command:

```
Device# show platform hardware chassis active
qfp feature wireless wlclient datapath cpp-if-handle 0X32 statistics
```

	Pkts	Bytes
Rx	26	3628

To stop statistics capture, use the following command:

```
Device# show platform hardware chassis active
qfp feature wireless wlclient datapath cpp-if-handle 0x32 statistics stop
```

To view the APs requested by Cisco CMX with AP groups' support, use the following commands:

```
Device# show nmsp subscription group summary
```

```
CMX IP address: 198.51.100.4
Groups subscribed by this CMX server:
```

```

Group name: CMX_1198.51.100.4

Device# show nmsp subscription group detail ap-list CMX_198.51.100.1 198.51.100.1

CMX IP address: 198.51.100.1
CMX Group name: CMX_198.51.100.1
CMX Group AP MACs:
: aa:bb:cc:dd:ee:01 aa:bb:cc:dd:ee:02 aa:bb:cc:dd:ee:03 aa:bb:cc:dd:ee:03

```

## Verifying Hyperlocation BLE Beacon Configuration

To verify the list of configured BLE beacons, use the following command:

```

Device# show ap profile ap-profile-name hyperlocation ble-beacon
BLE Beacon interval (Hz): 1
BLE Beacon advertised attenuation value (dBm): -59

ID                UUID                TX Power(dBm) Status
-----
0 ffffffff-aaaa-aaaa-aaaa-aaaaaaaaaaaa 0 Enabled
1 ffffffff-bbbb-bbbb-bbbb-bbbbbbbbbbbb 0 Enabled
2 ffffffff-gggg-gggg-gggg-gggggggggggg 0 Enabled
3 ffffffff-dddd-dddd-dddd-dddddddddddd 0 Enabled
4 ffffffff-eeee-eeee-eeee-eeeeeeeeeeee 0 Enabled

```

## Verifying Hyperlocation BLE Beacon Configuration for AP

To verify the Hyperlocation BLE Beacon configuration for an AP, use the following command:

```

Device# show ap name test-ap hyperlocation ble-beacon
BLE Beacon interval (Hz): 1
BLE Beacon advertised attenuation value (dBm): -60

ID Status UUID Major Minor TXPower (dBm)
-----
0 Enabled 99999999-9999-9999-9999-999999999999 8 0 -0
1 Enabled bbbbbbbb-bbbb-bbbb-bbbb-bbbbbbbbbbbb 8 1 -0
2 Enabled 88888888-8888-8888-8888-888888888888 8 2 -0
3 Enabled dddddddd-dddd-dddd-dddd-dddddddddddd 8 3 -0
4 Enabled eeeeeeee-eeee-eeee-eeee-eeeeeeeeeeee 8 4 -0

```

