



Configure Geofencing

Table 1: Feature History

Feature Name	Release Information	Description
Geofencing	Cisco IOS XE Catalyst SD-WAN Release 17.6.1a Cisco vManage Release 20.6.1	This feature provides a way to restrict a device's location to an operational geographical boundary, and to identify a device's location and report any violations of the configured boundary. If the device is identified to be in violation, you can restrict network access to the device using Cisco SD-WAN Manager operational commands. In the CLI or a CLI template, configure geofencing coordinates for establishing the location of the device. You can also register for SMS alerts.
Added Support for Configuring Geofencing Using a Cisco System Feature Template	Cisco IOS XE Catalyst SD-WAN Release 17.7.1a Cisco vManage Release 20.7.1	This feature adds support for configuring the geographical boundary of a device using a Cisco System feature template. With this feature, you can also configure automatic geolocation detection, where the device determines its own location, while configuring geofencing. A new parameter auto-detect-geofencing-location is added to the geolocation (system) command.
Added Support for LTE Advanced NIM Modules	Cisco IOS XE Catalyst SD-WAN Release 17.8.1a	Added support for Long-Term Evolution (LTE) Advanced Network Interface Modules (NIMs) for Cisco ISR 4000 routers.

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Information About Geofencing

Geofencing allows you to define a geographical boundary within which a device can be deployed. When devices are detected outside of the boundary, SMS alerts as well as critical-event alarms can be generated to Cisco SD-WAN Manager.

Global Positioning System (GPS) within a Long-Term Evolution Pluggable Interface Module (PIM) is used for device detection and monitoring in Cisco IOS XE Catalyst SD-WAN devices.

On the device CLI or through a Cisco SD-WAN Manager CLI template, you can configure the following settings:

- Base location (latitude and longitude) and a geofence range for device detection
- Short-message service (SMS) alert registration for sending SMS messages to a mobile number
- GPS enablement on a Long-Term Evolution PIM in the controller cellular 0/x/0 section



Note You can also enable GPS on a Long-Term Evolution PIM using a feature template.

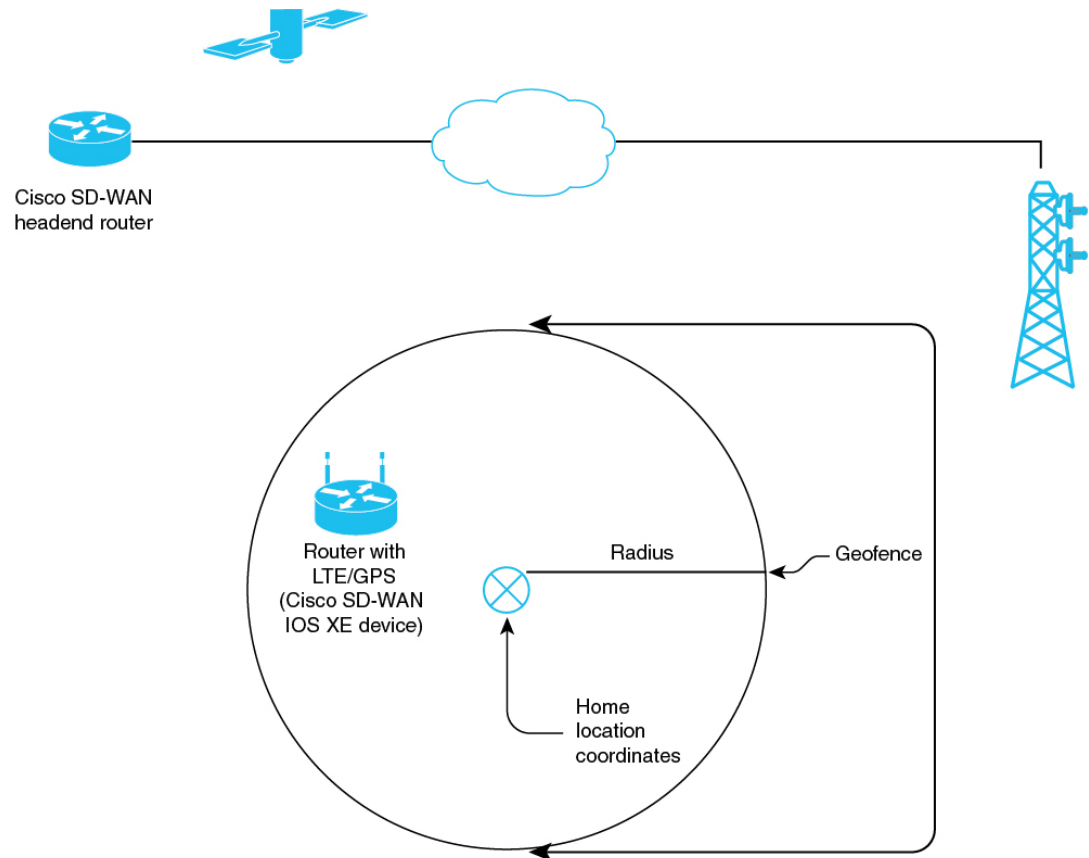
Starting from Cisco vManage Release 20.7.1, you can configure geofencing using a **Cisco System** feature template. You can also enable automatic geolocation detection of a device where the device determines its own base location.

In Cisco SD-WAN Manager, you can use operational commands for restricting network access if a device exceeds its geographical boundary.

For more information on the operational commands for restricting network access, see the [Cisco Catalyst SD-WAN Monitor and Maintain Configuration Guide](#).

Geofencing status alerts are sent to Cisco SD-WAN Manager upon detection of device boundary violations.

Figure 1: Overview of Geofencing



Benefits of Geofencing

- Protects against inappropriate access to an organization's network if a device is beyond its geographical boundary
- Notifies end users of any displaced devices
- Supports a geofence radius for specifying the target location of the device
- Supports SMS alerts for mobile phone alerts

Supported Devices for Geofencing

Supported Devices:

- Cisco ISR 1000 with Long-Term Evolution (fixed and pluggable)
- Cisco Catalyst 8K with Long-Term Evolution Pluggable Interface Module (PIM)
- Cisco ISR 4000 with Long-Term Evolution Advanced Network Interface Modules (NIMs)

Supported Long-Term Evolution PIMs:

- P-LTE-VZ(WP7601)
- P-LTE-US(WP7603)
- P-LTE-JN(WP7605)
- P-LTE-MNA(WP7610)
- P-LTE-GB(WP7607)
- P-LTE-IN(WP7608)
- P-LTE-AU(WP7609)
- P-LTEA-EA(EM7455)
- P-LTEA-LA(EM7430)

Supported Long-Term Evolution Advanced NIMs:

- NIM-LTEA-EA(EM7455)
- NIM-LTEA-LA(EM7430)

Prerequisites for Geofencing

- Ensure that your Cisco IOS XE Catalyst SD-WAN C1100 series router has a built-in Long-Term Evolution interface.
- Enable geofencing using the CLI or a CLI template. From Cisco vManage Release 20.7.1, you can also enable geofencing using a feature template.

For more information, see [Cisco IOS XE SD-WAN Qualified Command Reference](#).

- A SIM card is mandatory in the Long-Term Evolution PIM for receiving SMS alerts.

Restrictions for Geofencing

- Geofencing can be used only in Cisco Catalyst SD-WAN controller mode.

Configure Geofencing Using a Cisco System Template

1. From the Cisco SD-WAN Manager menu, choose **Configuration > Templates**.
2. Click **Feature Templates**.



Note In Cisco vManage Release 20.7.x and earlier releases, **Feature Templates** is titled **Feature**.

3. Click **Add Template**.
4. Choose a device.
5. In the **Select Template > Basic Information** section, click **Cisco System**.
6. In the **Template Name** field, enter a name for the template.
The name can be up to 128 characters and can contain only alphanumeric characters.
7. In the **Template Description** field, enter a description of the template.
The description can be up to 2048 characters and can contain only alphanumeric characters.
8. In the **Basic Configuration** section of the **Cisco System** template, choose a value from the drop-down list for **Console Baud Rate (bps)**.
Console Baud Rate (bps) is a mandatory field for configuring geofencing.
9. Click **GPS** or navigate to the **GPS** section of the **Cisco System** template.
10. In the **Latitude** field, leave the field set to **Default** for automatic detection of a device.
The following are the allowed values: -90.0 - 90.0.
11. In the **Longitude** field, leave the field set to **Default** for automatic detection of a device.
The following are the allowed values: -180.0 - 180.0.



Caution If you manually specify **Latitude** and **Longitude** coordinates, you disable automatic detection of a device. Automatic detection of a device can fail if a device does not have a last-known valid location.

12. In the **Geo Fencing Enable** field, change the scope from **Default** to **Global**, and click **Yes** to enable geofencing.
The **Geo Fencing Enable** field is not enabled by default.
13. (Optional) In the **Geo Fencing Range in meters** field, specify a geofencing range unit in meters.
The geofencing range specifies the radius from the base target location in meters.
The default geofencing range is 100 meters. You can configure a geofencing range of 100 to 10,000 meters.
14. (Optional) In the **Enable SMS** drop-down list, change the scope to **Global**, and click **Yes** to enable SMS alerts.
An SMS alert is delivered when a device is determined to be outside the configured geofencing radius of its target location.



Note The presence of a SIM card is mandatory in the Long-Term Evolution PIM for receiving SMS alerts.

15. (Optional) In the **Mobile Number 1** field, add a mobile number for receiving SMS alerts.



Note Mobile numbers must start with a + sign, include a country code, an area code, with no spaces between the country code and the area code, and the remaining digits.

The following is a sample mobile number: +12344567236.

You can configure additional mobile phone numbers by clicking the + icon.

You can configure up to a maximum of four mobile numbers.

16. Click **Save**.

Configure Geofencing Using the CLI

Configure Latitude, Longitude, a Geofence Range, and Enable SMS Alerts

This section provides example CLI configurations for the following:

- Configure a base location, latitude and longitude.
- Enable automatic detection of a device where the device determines its own location.
- Enable, configure, and specify a geofence range.



Note

- Geofencing range unit is in meters.
- Geofencing range is an optional configuration parameter, and if not configured, it takes the default value of 100 meters.

- Add mobile numbers for receiving SMS alerts.

1. Configure a base location:

```
Device(config)# system
Device(config-system)# gps-location latitude 37.317342 longitude -122.218170
```

2. Enable automatic detection of a device:

```
Router(config)# system
Router(config-system)# no gps-location latitude
Router(config-system)# no gps-location longitude
Router(config-system)# gps-location auto-detect-geofencing-location
```



Note Do not configure latitude and longitude coordinates when using the auto-detect-geofencing-location parameter. You can choose to either configure a base location using latitude and longitude coordinates, or you can enable automatic detection of a device.

3. Enable, configure, and specify a geofence range:

```
Device(config-system)# gps-location geo-fencing-enable
Device(config-system)# gps-location geo-fencing-config
Device(conf-geo-fencing-config)# geo-fencing-range 1000
```

4. Set up an SMS alert by adding the cell phone numbers for the users of the device:

```
Device(config-geo-fencing-config)# sms

Device(config-sms)# sms-enable
Device(config-sms)# mobile-number +12344567234
Device(config-mobile-number-+12344567234)# exit
Device(config-mobile-number-+12344567234)# mobile-number +12344567235
Device(config-mobile-number-+12344567235)# exit
Device(config-mobile-number-+12344567235)# mobile-number +12344567236
Device(config-mobile-number-+12344567236)# exit
Device(config-mobile-number-+12344567236)# mobile-number +12344567237
Device(config-mobile-number-+12344567237)# exit
Device(config-sms)# commit
```

5. Commit your changes.

Enable GPS on a Long-Term Evolution PIM in the Controller Cellular Section

This section provides sample CLI configurations for enabling GPS on the Long-Term Evolution PIM in the 0/x/0 section of the configuration.

1. Enable GPS on a Long-Term Evolution PIM in the controller cellular section:

```
Device(config)# controller Cellular 0/2/0
Device(config-Cellular-0/2/0)# lte gps enable
```

2. Enable ms-based mode with a SIM card present in a Long-Term Evolution PIM. We recommend that you use ms-based with a SIM card present.

Mobile station-based assistance refers to the case where the Global Navigation Satellite System (GNSS-enabled) mobile device computes its own position locally.

```
Device(config-Cellular-0/2/0)# lte gps mode ms-based
```

3. Enable National Marine Electronics Association (NMEA) streaming:

```
Device(config-Cellular-0/2/0)# lte gps nmea
```

4. Commit your changes.

Verify Geofencing Configuration

The following is a sample output from the **show sdwan geofence-status** command:

```
Device# show sdwan geofence-status
geofence-status
Geofence Config Status =           Geofencing-Enabled
Target Latitude =                 37.317342
Target Longitude =                -122.218170
Geofence Range(in m) =           100
Current Device Location Status =   Location-Valid
Current Latitude =                37.317567
Current Longitude =               -122.218170
Current Device Status =           Within-defined-fence
Distance from target location(in m) = 30
```

```
Last updated device location timestamp = 2021-05-06T22:58:34+00:00
Auto-Detect Geofencing Enabled = true
```

In this output, Geofence Config Status = Geofencing-Enabled, so geofencing is enabled.

In this output, Auto-Detect Geofencing Enabled = true. Therefore, automatic detection of the device is enabled. If automatic detection of the device is not enabled, Auto-Detect Geofencing Enabled = false is displayed in the output.

The following is a sample output from the **show cellular 0/x/0 gps** command:

```
Device# show cellular 0/2/0 gps
GPS Feature = enabled
GPS Mode Configured = ms-based
GPS Port Selected = Dedicated GPS port
GPS Status = GPS coordinates acquired
Last Location Fix Error = Offline [0x0]
=====
GPS Error Count = 0
NMEA packet count = 17899
NMEA unknown packet count = 0

Per talker traffic count =
    US-GPS = 5982
    GLONASS = 2560
    GALILEO = 3505
    BEIDOU = 0
    GNSS = 3409
    Unknown talker = 2443
=====
Speed over ground in km/hr = 0
=====

Latitude = 31 Deg 19 Min 14.6203 Sec North
Longitude = 122 Deg 58 Min 32.8164 Sec West
*Apr 15 23:58:45.298: GPS Mode Configured =Timestamp (GMT) = Thu Apr 15 23:57:21 2021

Fix type index = 0, Height = 18 m
Satellite Info
-----
Satellite #2, elevation 51, azimuth 42, SNR 24 *
Satellite #5, elevation 36, azimuth 144, SNR 34 *
Satellite #6, elevation 14, azimuth 45, SNR 24 *
Satellite #12, elevation 72, azimuth 146, SNR 33 *
Satellite #25, elevation 60, azimuth 305, SNR 25 *
=====
Total Satellites in view = 5
Total Active Satellites = 5
GPS Quality Indicator = 1
Total satellites from each constellation:
    US-GPS = 3
    GLONASS = 1
    GALILEO = 1
    BEIDOU = 0
=====
```

In this output, GPS Feature = enabled and GPS Mode Configured = ms-based. Therefore, GPS for controller cellular is enabled, and ms-based is configured.

The following is a sample output from the **show sdwan notification stream viptela** command:

```
Device# show sdwan notification stream viptela
notification
  eventTime 2021-04-13T23:05:02.881093+00:00
```



```

system-logout-change
severity-level minor
host-name pm5
system-ip 172.16.255.15
user-name admin
user-id 0
!
!
notification
eventTime 2021-04-14T00:36:31.344117+00:00
geo-fence-alert-status
severity-level major
host-name pm5
system-ip 172.16.255.15
alert-type device-location-inside
alert-msg Device Locking started for Geofencing Mode and device is within range

```

Monitor Geofencing Alarms

You can monitor geofencing alarms based on severity or based on time.

The following are the types of geofencing alarms.

Table 2: Geofencing Alarm Types

Type	Severity	Description
Device Location Outside	Critical	This notification is sent when the device location is outside the defined geofencing range.
Device Location Inside	Major	This notification is sent when the device location is determined to be inside the defined geofence range when it was previously determined to be outside the defined geofence range, or the device location could not be obtained due to a GPS signal outage.
Device Location Lost	Major	This notification is sent when the device location cannot be determined due to a GPS outage.
Device Location Update	Major	This notification is sent when the device location changes by more than 20 meters either when geofencing is enabled or not. If geofencing is not enabled, this notification is sent only if the device location is available.

You can monitor geofencing alarms using Cisco SD-WAN Manager.

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Logs**.

Cisco vManage Release 20.6.1 and earlier: From the Cisco SD-WAN Manager menu, choose **Monitor > Alarms**.

2. If there are geofencing alarms, the alarms display in the form of a chart, followed by a table.

You can filter the data for a specified time range: (1h, 3h, 6h, and so on), or click **Custom** to define a time range.

3. To view the alarm details, click ... and choose **Alarm Details** to view information about the device.

Configuration Example for Geofencing

End-to-End Configuration for Geofencing and Controller Cellular

The following is an end-to-end sample output that displays the configuration process for geofencing and controller cellular when configuring automatic detection of a device:

```
system
  gps-location auto-detect-geofencing-location
  gps-location geo-fencing-enable
  gps-location geo-fencing
    geo-fencing-range 1000
  sms
    sms-enable
    mobile-number +112312345676
    !
    mobile-number +112312345677
    !
    mobile-number +112312345678
    !
    mobile-number +112312345679
    !
    !
  !
  system-ip          10.1.1.35
  site-id            273
  admin-tech-on-failure
  organization-name  LTE-Test
  vbond vbond-dummy.test.info port 12346
  !
  controller Cellular 0/2/0
  lte gps enable
  lte gps mode ms-based
  lte gps nmea
  !
```

The following is an end-to-end sample output that displays the configuration process for geofencing and controller cellular when manually configuring latitude and longitude coordinates:

```
system
  gps-location latitude 37.317342
  gps-location longitude -122.218170
  gps-location geo-fencing-enable
  gps-location geo-fencing-config
    geo-fencing-range 1000
  sms
    sms-enable
    mobile-number +112312345676
    !
    mobile-number +112312345677
```

```
!  
mobile-number +112312345678  
!  
mobile-number +112312345679  
!  
!  
!
```

