# Assisted GPS

This an overview of the Assisted GPS feature.

## Assisted GPS versus Standalone GPS

Assisted GPS (A-GPS) helps improve the GPS feature in two ways:

■ Faster Time to First Fix (TTFF)

■ Provide a reference/cellular tower location when there is a weak or no satellite visible

The differences in GPS modes are shown in Table 1

**Table 1    Standalone Vs. Assisted GPS**

| Standalone GPS | Assisted GPS (A-GPS) |
|---|---|
| Data network required: No | Data network required: Yes |
| GPS antenna required: Yes | GPS antenna required: Yes |
| Minimal visible satellite: 4 | Minimal visible satellite: 2 |

## Secure User Plane Location (SUPL) Protocol

■ The SUPL Protocol is an IP based protocol for Assisted GPS to receive information about GPS satellites quickly via IP.

■ The modem uses a SUPL server to download almanac and/or ephemeris data and obtain cellular tower reference location to speed up Time To First Fix (TTFF).

■ There are 2 type of SUPL servers; Google's SUPL server or Carrier based SUPL server. The Cisco A-GPS feature uses the one from Google.

■ Google's SUPL server can be used on an encrypted or unencrypted TCP port. The way Cisco implemented the A-GPS feature uses an encrypted TCP port.

■ Using the OEM PRI update for A-GPS will enable standard type SUPL certificate (GeoTrust Global CA) on the modem and configure the modem for correct SUPL settings to reach Google SUPL server.

## Assisted GPS Requirements on Cisco Routers

Your particular router/modem needs to meet the following requirements:

■ Modem needs to have OEM PRI version that supports SUPL/A-GPS.

— Later factory released routers/modems may already come with supported SUPL OEM PRI version. See Table 2 and Table 3 for OEM PRI version that supports SUPL/A-GPS for each modem model.

— SUPL OEM PRI files can be downloaded at:
https://software.cisco.com/download/navigator.html?mdfid=286288566&flowid=76022

— For MC7354MNA and MC7304 modems, SUPL OEM PRI upgrade will need to be done in 2 firmware upgrade processes.

— There is no SUPL OEM PRI for MC7330 modem since it is EOS/EOL.

■ On the ISR4K router, the appxk9 license is needed for A-GPS feature to be available for configuration.

The following tables list the OEM PRI versions that support SUPL/A-GPS.

**Table 2    MC73XX Modems**

| Modem | OEM PRI Version | File Name | Link |
|---|---|---|---|
| MC7304 | 005.012 | MC7304_1102029_05.05.58.00_00_TELSTRA_005.012_000.spk | https://software.cisco.com/download/release.html?mdfid=286288632&flowid=76082&softwareid=284285628&release=5.5.58.00&relind=AVAILABLE&rellifecycle=&reltype=latest |
| MC7350 | 005.007 | MC7350_1102036_05.05.58.01_00_VZW_005.007_000.spk | https://software.cisco.com/download/release.html?mdfid=286288645&flowid=76022&softwareid=284285628&release=5.5.58.01&relind=AVAILABLE&rellifecycle=&reltype=latest |
| MC7354 | 005.010 | MC7354_1102037_05.05.58.00_00_ATT_005.010_000.spk | https://software.cisco.com/download/release.html?mdfid=286288645&flowid=76022&softwareid=284285628&release=5.5.58.01&relind=AVAILABLE&rellifecycle=&reltype=latest <br><br>**Note**: Under 5.5.58.00 |
| MC7354MNA | 005.003 | MC7354MNA_1102407_05.05.58.01_00_VZW_005.003_000.spk | https://software.cisco.com/download/release.html?mdfid=286288645&flowid=76022&softwareid=284285628&release=5.5.58.01&relind=AVAILABLE&rellifecycle=&reltype=latest |

**Table 3    74XX Modems**

| Modem | OEM PRI Version | File Name | Link |
|---|---|---|---|
| EM7430 | 000.007 | EM7430_1102682_02.20.03.01_00_Cisco_000.007_000.nvu | https://software.cisco.com/download/release.html?mdfid=286311403&flowid=81043&softwareid=286311808&release=EM7430_000.007&relind=AVAILABLE&rellifecycle=&reltype=latest |

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| Modem | OEM PRI Version | File Name | Link |
|---|---|---|---|
| EM7455 | 000.007 | EM7455_1102526_02.20.03.22_00_Cisco_000.007_000.nvu | https://software.cisco.com/download/release.html?mdfid=286311429&flowid=81802&softwareid=286311808&release=MC7455MOBILE_000.005&relind=AVAILABLE&rellifecycle=&reltype=latest<br><br>**Note**: Under EM7455_000.007 |
| MC7430 | 000.010 | MC7430_1102644_02.20.03.01_00_Cisco_000.010_000.nvu | https://software.cisco.com/download/release.html?mdfid=286311403&flowid=81043&softwareid=286311808&release=EM7430_000.007&relind=AVAILABLE&rellifecycle=&reltype=latest<br><br>**Note**: Under MC7430_000.010 |
| MC7455B Mobile | 000.005 | MC7455MOBILE_1103084_02.20.03.22_00_Cisco_000.005_000.nvu | https://software.cisco.com/download/release.html?mdfid=286311429&flowid=81802&softwareid=286311808&release=MC7455MOBILE_000.005&relind=AVAILABLE&rellifecycle=&reltype=latest |

# Modem Upgrades

For the 74xx series modems, SUPL OEM PRI upgrade uses a .nvu file. This can be accomplished with the current firmware on the modem.

The following example shows EM7455 modem:

```
router# sh cellular 0/1/0 hardware
Modem Firmware Version = SWI9X30C_02.20.03.00
Modem Firmware built = 2016/06/30 10:54:05
Hardware Version = 1.0
Device Model ID: EM7455
International Mobile Subscriber Identity (IMSI) = 310410819528409
International Mobile Equipment Identity (IMEI) = 356129070050692
Integrated Circuit Card ID (ICCID) = 89014103278195284099
Mobile Subscriber Integrated Services
Digital Network-Number (MSISDN) = 14082216639
Modem Status = Modem OnlineCurrent Modem Temperature = 36 deg C
PRI SKU ID = 1102526, PRI version = 002.020_000, Carrier = AT&T
OEM PRI version = 007 Only this value will change as a result of the SUPL OEM PRI FW upgrade
router#
```

For MC73xx modems, SUPL OEM PRI upgrade uses a .spk file. This type of file changes the following:

- Firmware

- Carrier

- OEM PRI

For the MC7350 and MC7354 modems, the SUPL OEM PRI upgrade is a one step process. Choose the .spk file for the modem currently in the router.

For the MC7354MNA and MC7304 modems, the SUPL OEM PRI upgrade requires a 2 step process, (depending on which carrier you want to use).

1. SUPL OEM PRI firmware upgrade with .spk file. (This would have the modem changed to default carrier.)

2. Firmware upgrade the modem to desire carrier.

   Note: For the MC7354MNA the default carrier is Verizon. For the MC7304 the default carrier is Telstra.

### MC7354MNA Example

To upgrade the OEM PRI to a version that supports A-GPS and with the desired carrier (AT&T), use the following example:

The CLI to change the OEM PRI (same as FW upgrade) is **microcode reload cellular 0 <*slot*> modem-provision flash:<*oem_pri_folder*>**

Example before SUPL OEM PRI upgrade:

```
Router#sh cellular 0 hardware
Modem Firmware Version = SWI9X15C_05.05.58.00
PRI SKU ID = 1102407, PRI version = 005.026_000, Carrier = AT&T
OEM PRI version = 05.01
Router#
```

Example after SUPL OEM PRI upgrade:

- Firmware file: MC7354MNA_1102407_05.05.58.01_00_VZW_005.003_000.spk

- OEM PRI version got changed (05.03) and carrier got changed to default carrier (Verizon).

```
Router#sh cellular 0 hardware
Modem Firmware Version = SWI9X15C_05.05.58.01
PRI SKU ID = 1102407, PRI version = 005.029_001, Carrier = Verizon
OEM PRI version = 05.03
Router#
```

Example after switching to desire carrier (AT&T):

- Firmware file: MC7354MNA_9999999_9902196_05.05.58.00_00_ATT_005.026_000.spk

```
Router#sh cellular 0 hardware
Modem Firmware Version = SWI9X15C_05.05.58.00
PRI SKU ID = 1102407, PRI version = 005.026_000, Carrier = AT&T
OEM PRI version = 05.03
Router#
```

# Assisted GPS Configuration

To enable or disable Assisted GPS, use the l**te gps mode ms-based** command.

For example:

```
router# controller Cellular 0
router# lte gps mode ms-based (to enable)
router# no lte gps mode ms-based (to disable)
router# lte gps nmea ip
```

**Note**: NMEA configuration is the same as Standalone GPS feature.

## Assisted GPS Command Outputs

```
Router#sh cellular 0 gps
GPS Info
-------------
GPS Feature: enabled
GPS Port Selected: Dedicated GPS port
GPS Status: GPS coordinates acquired
GPS auto tracking status: active
GPS auto tracking config: enabled
GPS Mode Configured: ms-based
Last Location Fix Error: Not Available [0x0]
Latitude: 37 Deg 24 Min 59.0141 Sec North
Longitude: 121 Deg 55 Min 7.2450 Sec West
Timestamp (GMT): Mon Aug 14 20:52:53 2017

Fix type index: 0, Height: 13 m
Satellite Info
----------------
Satellite #5, elevation 54, azimuth 84, SNR 31 *
Satellite #12, elevation 33, azimuth 164, SNR 25 *
Satellite #20, elevation 50, azimuth 172, SNR 24 *
Satellite #21, elevation 23, azimuth 253, SNR 18 *
Satellite #25, elevation 62, azimuth 206, SNR 24 *
Satellite #26, elevation 3, azimuth 322, SNR 21
Satellite #29, elevation 60, azimuth 331, SNR 30 *
Satellite #31, elevation 12, azimuth 286, SNR 28 *
Satellite #66, elevation 30, azimuth 142, SNR 25
Satellite #65, elevation 39, azimuth 68, SNR 28
Satellite #88, elevation 41, azimuth 47, SNR 18
Router#

Router#sh controller cellular 0 | inc GPS
GPS Feature: enabled
GPS Status: GPS coordinates acquired
GPS Mode: ms-based
GPS Port selected: Dedicated GPS port
GPS LED     : Amber (LEDs discussed later in this guide)
GPS NMEA port = Enabled   (Stream ON)
Router#
```

## Assisted GPS Output for Reference/Cell Tower Location

Use the **show cellular 0 gps** command:

```
Router#sh cellular 0 gps

GPS Info
-------------
GPS Feature: enabled
GPS Port Selected: Dedicated GPS port
GPS Status: GPS acquiring                    <- Modem is still trying to acquire GPS coordinates
GPS auto tracking status: active
GPS auto tracking config: enabled
GPS Mode Configured: ms-based
Last Location Fix Error: Not Available [0x0]
Last known good GPS coordinates              <- This message is seen
-----------------------------
Latitude: 37 Deg 25 Min 13.4370 Sec North    <- Reference/Cellular Tower location
Longitude: 121 Deg 55 Min 3.2077 Sec West
Timestamp (GMT): Sun Mar  8 21:31:44 1908    <- Date is not correct

Fix type index: 0, Height: 0 m
Satellite Info
----------------
Router#
```

# Assisted GPS LEDs

Different routers have individual ways of indicating assisted GPS via their LEDs.

Here are some examples:

**C800 Routers**

- Off = GPS feature is disabled
      = GPS feature is enabled without GPS mode and NMEA configuration

- Amber (Blinking) = GPS is acquiring

- Amber (Solid) = GPS coordinates are acquired

**IR829 Routers**

- Off = GPS feature is disabled
      = GPS feature is enabled without GPS mode and NMEA configuration

- Green (Fast Blink) = GPS is acquiring

- Green (Solid) = GPS coordinates are acquired

**4G LTE EHWIC on C1900, C2900, or C3900 Routers**

- Off = GPS feature is disabled
      = GPS feature is enabled without GPS mode and NMEA configuration
      = GPS is acquiring

- Green (Solid) = GPS coordinates are acquired

**Note**: LED color/behavior is reflective of which GPS mode is configured. This applies even when the modem falls back to GPS Standalone mode.

# Assisted GPS Scenarios

The following scenarios describe the expected behavior when using assisted GPS.

**Scenario A**

Modem obtained GPS fix via A-GPS, then loses GPS signal.

**Detail**: Router/modem able to obtain GPS fix via A-GPS. Then the device moves to an area where there's no or weak GPS/satellite signal, but still has Data network.

**Expected Result:** Router/Modem will not be able to update GPS coordinates. Like Standalone GPS mode, GPS/satellite signal is still required to continue updating GPS location and timestamp.

**Scenario B**

No GPS signal, but has Data network. A-GPS is then configured.

**Detail**: Router/modem cannot see any satellites or satellite signal is very weak. However, router/modem has Data network and router is then configured for A-GPS feature.

**Expected Result**: If a satellite fix cannot be obtained within the fix timeout period (255 sec or less), the modem will display the Reference/Cellular Tower location. This is not the current location of the router/modem. Also, timestamp will be displayed incorrectly.

**Note:** For the same scenario but modem is attached to 3G network, the Reference/Cellular Tower location can only be seen for 3G GSM/UMTS network. For 3G CDMA/EVDO, no GPS coordinates will be displayed. This is due to the Google SUPL server only supporting RRC protocol.

**Scenario C**

No Data network, but has GPS signal. A-GPS is then configured.

**Detail**: Router/modem can get a good satellite signal but is not attached to a Data network. Then the device is configured for A-GPS feature.

**Expected Result**: Modem will fallback to Standalone GPS mode.

**Note**: The modem will also fallback to Standalone GPS if:

- The modem cannot reach Google SUPL server.

- The certificate expires. Current certificate (GeoTrust Global CA) expires on May 21, 2022.