Cellular Pluggable Interface Module Configuration Guide

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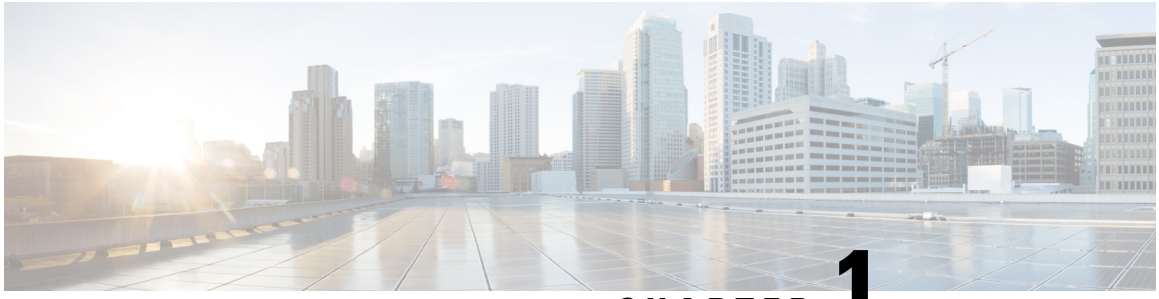


CHAPTER 1

Cellular Background

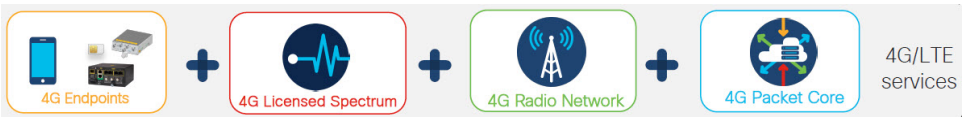
This chapter contains the following sections:

- What Is Cellular?, on page 1
- Cisco Cellular Overview, on page 1

What Is Cellular?

Cellular refers to different generation of cell-based wireless network technologies that connects end devices, for example, mobile phone, routers, and tablets to the Internet as specified in 3GPP architecture (https://www.3gpp.org) summarized in the following figure:

Figure 1: 4G/LTE Services



This section differentiates the types of cellular service that Cisco routers might use.

- Public Cellular Service — Public carrier service in countries, with frequency bands allocated to the carrier in country, and a service subscription done by customer who obtain SIM card from the mobile carrier.
- Private Cellular Network — Infrastructure and frequency band dedicated to a customer in a given location, with private SIM card managed by the owner of the network.
- Private APN — A public mobile network service where the APN is dedicated to an organization, for example, a Utility
- Public Safety Service — Dedicated to some customers, using specific bands and SIM subscription with products that may need to be certified for the services, for example, Firstnet on band 14.

Cisco Cellular Overview

Cisco Cellular Pluggable Interface Modules operate over 5G Sub-6 GHz, Fourth-Generation Long-Term Evolution (4G LTE) cellular networks and Third-Generation (3G) cellular networks.

The Cisco Cellular PIMs may support one or more of the below cellular technologies, dependent of the PIM mode:

5G Sub-6 GHz

Fifth generation of cellular technology. It uses new technologies and methods end to end—from new transmission frequencies to cloud-based radio network access and edge solutions—to achieve better speed, latency, capacity, resiliency, and coverage.

5G is available with dual network modes. NSA (Non-Standalone Access) and SA (Standalone Access) are the two 5G network modes.

- NSA relies on the 4G network facilities to provide more speed and higher data bandwidth.
- SA is the true 5G network, where the 5G network has its dedicated 5G facilities to provide enormous speed improvements and minimal network latency (delay). The 5G SA network is independent of the 4G network.

4G LTE

4G LTE mobile specification provides multi-megabit bandwidth, more efficient radio network, latency reduction, and improved mobility. LTE solutions target new cellular networks. There are different LTE categories that are described in the following table:

Table 1: LTE Categories

UE Category	3GPP Release	Uplink/Downlink Data Rate (Mbs)
NB1	13	HD: DL: 27kbs, UL:62kbs
M1	13	HD: DL: 300kbs, UL: 375kbs FD: DL/UL: 1
1	8	DL: 10, UL: 5
3	8	DL: 100, UL: 50
4	8	DL: 150, UL: 50
6	10	DL: 300, UL: 50
18	14	DL: 1200, UL: 150 (cat 13)

Note Categories specified over releases of 3GPP as LTE, LTE Advanced and LTE Advanced Pro. This led to the Cisco PIM names LTEA, LTEAP.

LTE 450MHz Category 4

The P-LTE-450 is a 450MHz Category-4 LTE PIM, which addresses LTE use cases primarily targeting Utility, public safety and critical infrastructure maintained by public organizations in Europe and other world regions.

The module supports only Band 31 and 72 for LTE 450MHz networks. Support for the module is available with Cisco IOS XE release 17.10.1.

The P-LTE-450 is configured differently from the rest of the Cisco Cellular Pluggable Interface Modules. Complete details can be found in the 450MHz Category-4 LTE PIM, on page 111 chapter.

3G Evolution High-Speed Packet Access (HSPA/HSPA+)

HSPA is a UMTS-based 3G network. It supports High-Speed Downlink Packet Access (HSDPA) and High-Speed Uplink Packet Access (HSUPA) data for improved download and upload speeds. Evolution High-Speed Packet Access (HSPA+) supports Multiple Input/Multiple Output (MIMO) antenna capability.

3G Evolution-Data Optimized (EVDO or DOrA) Mode

EVDO is a 3G telecommunications standard for the wireless transmission of data through radio signals, typically for broadband Internet access. DOrA refers to EVDO Rev-A. EVDO uses multiplexing techniques including Code Division Multiple Access (CDMA), as well as Time Division Multiple Access (TDMA), to maximize both individual users' throughput and the overall system throughput.

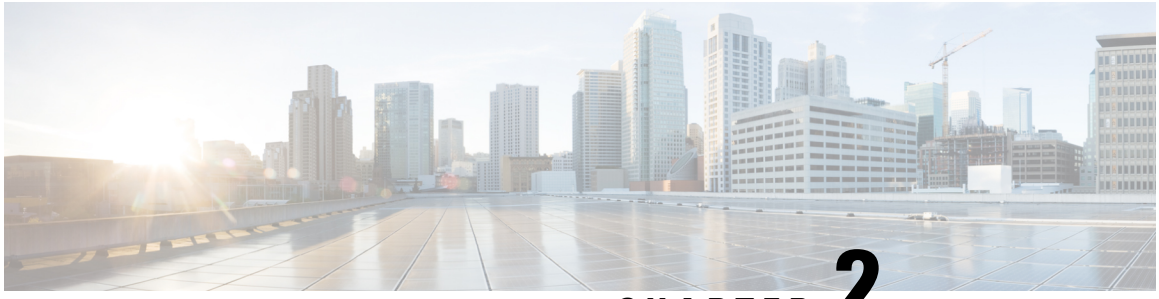
2G

This was the first generation of 3GPP specifications adding Data support on cellular networks. Today, it is still used for M2M communications in several countries, but the technology sunset is now scheduled. See the following note:

Important Information about 2G and 3G Sunset

Important Please read this information about 2G and 3G networks!

Important This configuration guide supports multiple products and is written as generically as possible. Throughout this document, the controller will be referred to as the generic term *slot*. The *slot* will take the form of *x/x/x* in this guide. When configuring the controller on your particular router/pluggable, use the information available in your product documentation, or the tables below.



CHAPTER 2

Pluggable Module Overview

This chapter contains the following sections:

- Supported Cellular PIMs in Routers, on page 5
- Supported Modem Technology, on page 8
- LTE Bands, on page 10
- 5G Bands, on page 12
- Cellular Pluggable Module Firmware, on page 13
- Cellular Pluggable Module Dimensions, on page 15
- Cellular PIM LEDs, on page 15
- Verifying the Cellular Pluggable Interface Module Information on the Router, on page 21

Supported Cellular PIMs in Routers

Note Always check the IOS-XE release notes to understand the minimum software release supporting a given PIM on a given platform.

Important The Pluggable Module is not hot swappable. The router must be reloaded after a new module is installed.

This section describes which cellular pluggable modules are supported in each router.

ESR6300

- P-LTE-MNA (WP7610)
- P-LTEA-LA (EM7430)
- P-LTEA-EA (EM7455)
- P-LTEAP18-GL (LM960AP18)

IR1101

- P-LTE-VZ (WP7601-G)
- P-LTE-US (WP7603-G)
- P-LTE-JN (WP7605-G)
- P-LTE-GB (WP7607-G)
- P-LTE-IN (WP7608-G)
- P-LTE-MNA (WP7610-G)
- P-LTEA-LA (EM7430)
- P-LTEA-EA (EM7455)
- P-LTEAP18-GL (LM960AP18)
- P-5GS6-GL (FN980)

IR1800

- P-LTE-VZ (WP7601-G)
- P-LTE-US (WP7603-G)
- P-LTE-GB (WP7607-G)
- P-LTE-IN (WP7608-G)
- P-LTE-JN (WP7605-G)
- P-LTE-MNA (WP7610-G)
- P-LTEA-LA (EM7430)
- P-LTEA-EA (EM7455)
- P-LTEAP18-GL (LM960AP18)
- P-5GS6-GL (FN980)

IR8140

Note In this section you will see the module names MNA/EA and MNA900/EA900. MNA/EA900 are modules permitting the PIM to be installed in conjunction with a WPAN 902-928MHz Wi-SUN module.

- IRMH-LTE-MNA (WP7610)
- IRMH-LTE-MNA-900 (WP7610)
- IRMH-LTEA-EA (EM7455)
- IRMH-LTEA-EA-900 (EM7455)

- IRMH-LTEA-LA (EM7430)
- IRMH-LTEAP18-GL (LM960AP18)
- IRMH-5GS6-GL (FN980)

IR8340

- P-LTE-MNA (WP7610)
- P-LTEA-LA (EM7430)
- P-LTEA-EA (EM7455)
- P-LTEAP18-GL (LM960)
- P-5GS6-GL (FN980)

ISR1000

- ISR1100-4GLTENA (WP7610)
- ISR1100-4GLTEGB (WP7610)
- P-LTEAP18-GL (LM960A18)
- P-LTEA-EA (EM7455)
- P-LTEA-LA (EM7430)
- P-LTE-MNA (WP7610)
- P-LTE-GB (WP7607)
- P-LTE-US (WP7603)
- P-LTE-VZ (WP7601)
- P-LTE-IN (WP7608)
- P-LTE-JN (WP7605)

8200 Series

- P-5GS6-GL (FN980)
- P-LTEA-LA (EM7430)
- P-LTEA-EA (EM7455)
- P-LTEAP18-GL (LM960)

8300 Series

- P-5GS6-GL (FN980)
- P-LTEAP18-GL (LM960)

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

8200 UCPE

- P-LTEAP18-GL (LM960)
- P-LTEA-LA (EM7430)
- P-LTEA-EA (EM7455)

Supported Modem Technology

This section describes the details of each modem used in the cellular pluggable modules.

The cellular PIMs use Sierra Wireless series modems, and Telit modems. The software download page can be found here:

https://software.cisco.com/download/navigator.html?mdfid=286288566&flowid=76082

Table 2: Modem Technology Supported

SKU ID	Modem Used	Description	Cellular Technology Supported	GPS Support
P-LTE-VZ	WP7601-G	U.S. (Verizon)	LTE CAT4: B4, B13	Yes
P-LTE-US	WP7603-G	North America (AT&T)	LTE CAT4:B2,B4,B5,B12 3G UMTS DC-HSPA+, HSPA+, HSPA, WCDMA: B2,B4, B5	Yes
P-LTE-JN	WP7605-G	Japan	LTE CAT4: B1, B3, B8, B11, B18, B19, B21 3G UMTS HSPA+	Yes
P-LTE-GB	WP7607-G	Europe	LTE CAT4: B1,B3, B7, B8, B20, B28 3G UMTS DC-HSPA+, HSPA+, HSPA, WCDMA GPRS/EDGE: 900/1800	Yes
P-LTE-IN	WP7608-G	India and China	LTE CAT4: B1, B3, B5, B8, B40, B41* 3G UMTS DC-HSPA+ * B41 supported frequency range: (2535–2655 MHz)	No

SKU ID	Modem Used	Description	Cellular Technology Supported	GPS Support
P-LTE-MNA	WP7610-G	North America	LTE CAT4: B2, B4, B5, B12, B13, B14, B17, B66 3G UMTS DC-HSPA+, HSPA+, HSPA, WCDMA	Yes
P-LTEA-LA	EM7430	APAC	LTE CAT6 LTE: B1, B3, B5, B7, B8, B18, B19, B21, B28, B38-B41 Carrier Aggregation: 1+(8,18,19,21); 3+(5,7,19,28); 7+(5,7,28); 19+21, 38+38, 39+39,40+40, and 41+41 3G: B1, B5, B6, B8, B9, B19	Yes
P-LTEA-EA	EM7455	USA, Canada, Europe, Latin America	LTE CAT6 LTE: bands 1-5, 7, 12, 13, 20, 25, 26, 29, 30, and 41 Carrier Aggregation: 1+8; 2+(2,5,12,13,29); 3+(7,20); 4+(4,5,12,13,29); 7+(7,20); 12+30, 5+30, and 41+41 3G: B1, B2, B3, B4, B5, B8	Yes
P-LTEAP18-GL, Cisco LTE Advanced Pro Pluggable 3GPP Category 18	LM960AP18	United States, Europe, Canada, Japan, Australia, and New Zealand.	LTE CAT18 LTE FDD: B1, B3, B25(B2), B66(B4), B26(B5/B18/B19), B7, B8, B12(17), B13, B14(FirstNet), B20, B28, B29, B30, B32, B7 LTE TDD: B38, B39, B40, LB41, B42, B43, B46, B48 (CBRS) UMTS:B1, B2, B4, B5(B19), B8	No
P-5GS6-GL	FN980	United States, Europe, Canada, APJC, Japan, Australia, and New Zealand.	5G FR1 - n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79 LTE bands 1-5, 7-8, 12-14, 17-20, 25, 26, 28-30, 32, 34, 38-43, 46(LAA), 48(CBRS), 66 and 71 3G WCDMA bands 1,2,3,4,5,6,8,9,19 **Note** 3G is not available on all region's firmware.	Yes

LTE Bands

The following table shows a snapshot of LTE Bands when deploying Globally.

Table 3: LTE Bands

Band	Uplink/Downlink (MHz)	Pluggable Support
1	UL:1920-1980 DL: 2110-2170	P-LTExx
2	UL:1850-1910 DL:1930-1990	P-LTExx
3	UL:1710-1785 DL:1805-1880	P-LTExx
4	UL:1710-1755 DL:2110-2155	P-LTExx
5	UL: 824-849 DL: 869-894	P-LTExx
7	UL:2500-2570 DL:2620-2690	P-LTExx
8	UL:880-915 DL:925-960	P-LTExx
12	UL:699-716 DL:729-746	P-LTExx
13	UL:777-787 DL:746-756	P-LTExx
14 (Firstnet)	UL:788-798 DL:758-768	P-LTEA-MNA P-LTEAP18-GL
17	UL:704-716 DL:734-746	P-LTEA-MNA
18	UL:815-830 DL:860-875	P-LTExx
19	UL:830-845 DL:875-890	P-LTExx

Band	Uplink/Downlink (MHz)	Pluggable Support
20	UL:832- 862 DL:791-821	P-LTExx
21	UL:1447.9-1462.9 DL:1495.9-1510.9	P-LTExx
25	UL:1850-1915 DL:1930-1995	P-LTExx
26	UL:1850-1915 DL:1930-1995	P-LTExx
28	UL:703-748 DL:758-803	P-LTExx
29	DL only DL:717-728	P-LTExx
30	UL:2305- 2315 DL:2350-2360	P-LTExx
31 (450 MHz)	UL:452.5-457.5 DL:462.5-467.5	Unsupported
32	DL only DL:1452-1496	P-LTEAP18-GL
38	TDD 2570-2620	P-LTExx
39	TDD 1880-1920	P-LTExx
40	TDD 2300-2400	P-LTExx
41	TDD 2496-2690	P-LTExx
42	TDD 3400-3600	P-LTEAP18-GL
43 (P-LTE)	TDD 3600-3800	P-LTEAP18-GL

Band	Uplink/Downlink (MHz)	Pluggable Support
46	TDD unlicensed 5150-5925	P-LTEAP18-GL
48 (CBRS)	TDD 3550-3700	P-LTEAP18-GL
66	UL:1710-1780 DL:2110-2200	P-LTEAP18-GL P-LTEA-MNA
71	UL:663-698 DL:617-652	P-LTEAP18-GL
72	UL: 451-456 DL: 461-466	Unsupported

5G Bands

The following table shows a snapshot of 5G Bands when deploying Globally.

Table 4: 5G Bands sub-6GHz (FR1)

FR1 Band	Uplink/Downlink (MHz)	Pluggable Support
n1	UL:1920-1980 DL: 2110-2170	P-5GS6-GL
n2	UL:1850-1910 DL:1930-1990	P-5GS6-GL
n3	UL:1710-1785 DL:1805-1880	P-5GS6-GL
n5	UL: 824-849 DL: 869-894	P-5GS6-GL
n7	UL:2500-2570 DL:2620-2690	P-5GS6-GL
n8	UL:880-915 DL:925-960	P-5GS6-GL
n12	UL:699-716 DL:729-746	P-5GS6-GL

FR1 Band	Uplink/Downlink (MHz)	Pluggable Support
n13	UL:777-787 DL:746-756	Unsupported
n14	UL:788-798 DL:758-768	Unsupported
n18	UL:815-830 DL:860-875	Unsupported
n20	UL:832- 862 DL:791-821	P-5GS6-GL
n25	UL: 1850 – 1915 DL: 1930 – 1995	P-5GS6-GL
n28	UL: 703 – 748 DL: 758 – 803	P-5GS6-GL
n38	2570 – 2620	P-5GS6-GL
n40	2300 – 2400	P-5GS6-GL
n41	2496 – 2690	P-5GS6-GL
n48	3550 – 3700	P-5GS6-GL
n66	UL: 1710 – 1780 DL: 2110 – 2200	P-5GS6-GL
n71	UL: 663 – 698 DL: 617 – 652	P-5GS6-GL
n77	3300 – 4200	P-5GS6-GL
n78	3300 – 3800	P-5GS6-GL
n79	4400 – 5000	P-5GS6-GL

Cisco pluggable modules do not support mmW (FR2) bands at this time.

Cellular Pluggable Module Firmware

The following command is the most common one used for updating the modem firmware.

```
Router#microcode reload cellular <subinterface> <slot> modem-provision flash:<modem firmware
 version>
```

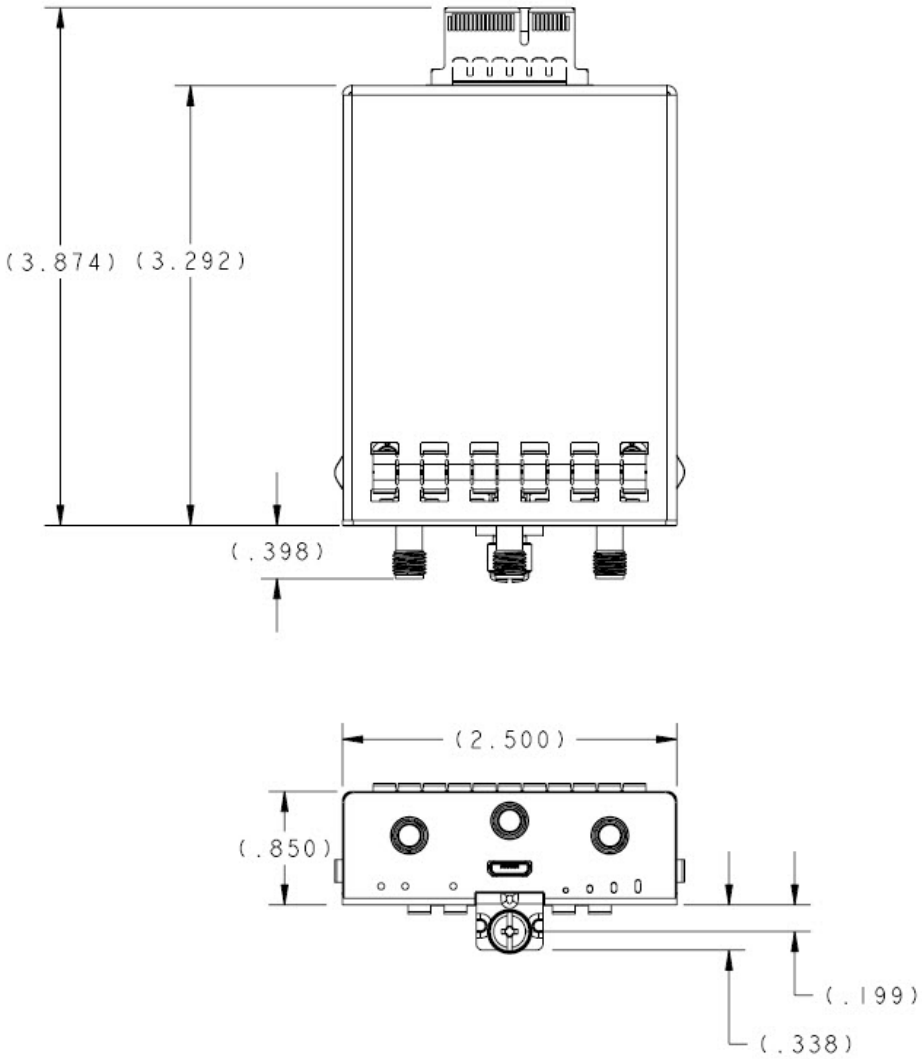
Note This command may not be appropriate for your particular modem. Consult the Cisco Firmware Upgrade Guide for 4G LTE and 5G Cellular Modems before updating.

The following table lists the modem and firmware for the pluggable modules.

Modem	Download Link
7430	Wireless WAN 7430 Cellular Interface
7430 for Australia Telstra	Wireless WAN 7430 Cellular Interface for Australia Telstra
7430 for Japan	Wireless WAN 7430 Cellular Interface for Japan
7455	Wireless WAN 7455 Cellular Interface
7455 for Canada	Wireless WAN 7455 Cellular Interface for Canada
7455 for Europe	Wireless WAN 7455 Cellular Interface for Europe
7455 for North America ATT	Wireless WAN 7455 Cellular Interface for North America ATT
7455 for North America Sprint	Wireless WAN 7455 Cellular Interface for North America Sprint
7455 for North America Verizon	Wireless WAN 7455 Cellular Interface for North America Verizon
7455 for US Cellular	Wireless WAN 7455 Cellular Interface for US Cellular
FN980	Wireless WAN FN980 Cellular Interface
LM960 for Global Carriers	Wireless WAN LM960 Cellular Interface for Global Carriers
LM960 for North America	Wireless WAN LM960 Cellular Interface for North America
WP7502 for Europe	Wireless WAN WP7502 Cellular Interface for Europe
WP7504 for North America	Wireless WAN WP7504 Cellular Interface for North America
WP7601	Wireless WAN WP7601 Cellular Interface for North America Verizon
WP7603	Wireless WAN WP7603 Cellular Interface for North America ATT
WP7605	Wireless WAN WP7605 Cellular Interface for Japan
WP7607	Wireless WAN WP7607 Cellular Interface for Europe
WP7608	Wireless WAN WP7608 Cellular Interface for India and Asia
WP7609	Wireless WAN WP7609 Cellular Interface for Australia and Brazil
WP7610	Wireless WAN WP7610 Cellular Interface for North America

Cellular Pluggable Module Dimensions

The physical dimensions of the PIM are shown in the following graphic. All values are in inches.



Cellular PIM LEDs

Cellular PIM LED status can be obtained through the show led CLI, or visually on the pluggable modem card. The following is an example of the **show led** CLI from an IR1800:

```
Router#show led
SYSTEM LED : Green

GigabitEthernet0/0/0 LED : On
GigabitEthernet0/1/0 LED : Off
```

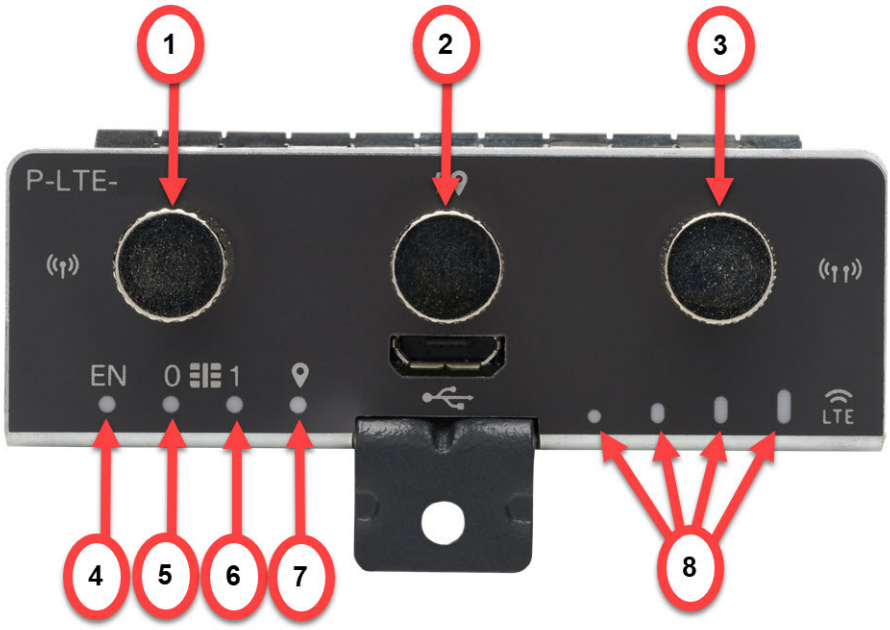
```
GigabitEthernet0/1/1 LED : Off
GigabitEthernet0/1/2 LED : Off
GigabitEthernet0/1/3 LED : Off

*Cellular 0/4*
LTE module Enable LED : Green
LTE module SIM 0 LED : Green
LTE module SIM 1 LED : Yellow
LTE module GPS LED : Off
LTE module RSSI 0 LED : On
LTE module RSSI 1 LED : On
LTE module RSSI 2 LED : On
LTE module RSSI 3 LED : On

*Cellular 0/5*
LTE module Enable LED : Green
LTE module SIM 0 LED : Green
LTE module SIM 1 LED : Off
LTE module GPS LED : Off
LTE module RSSI 0 LED : On
LTE module RSSI 1 LED : On
LTE module RSSI 2 LED : On
LTE module RSSI 3 LED : Off
```

P-LTE-x Pluggable Interface Module

Figure 2: P-LTE-x Pluggable Interface Module



Item	Description
1	Cellular-Main SMA

Item	Description
2	GPS SMA
3	Cellular-Div SMA
4	Enable LED
5	SIM 0 LED
6	SIM 1 LED
7	GPS LED
8	RSSI LEDs

The following table describes the LED behavior on the pluggable module.

Table 5: LED Indicators

LED	Color/Bar and Description	
Cellular SIM(0) & SIM(1)	Green (Solid)	Modem up, SIM installed and active
	Off	No SIM is present
	Amber (Solid)	Modem up, SIM installed but not active
EN	Off	Pluggable is powered off.
	Amber (Solid)	Module power is on, but the module is not functioning correctly.
	Green (Solid)	Module power is on
RSSI - Uses Bars for LED Indication	See the RSSI LED description in the next table.	
GPS	Green (Solid)	GPS coordinates are obtained.
	Off	GPS is disabled, GPS is enabled without GPS mode and NMEA configuration, or GPS is acquiring

Table 6: RSSI LED Description

Color	RSSI	Service
Off	No Service	No Service
One Green	< -110 dBm	LTE
Two Green	-99dBm <> -90dBm	LTE

Color	RSSI	Service
Three Green	-89dBm <> -70dBm	LTE
Four Green	>= -69dBm	LTE
One Yellow	< -110 dBm	3G
Two Yellow	-99dBm <> -90dBm	3G
Three Yellow	-89dBm <> -70dBm	3G
Four Yellow	>= -69dBm	3G

P-LTEA18-GL Cellular PIM

Figure 3: P-LTEA18-GL Pluggable Interface Module

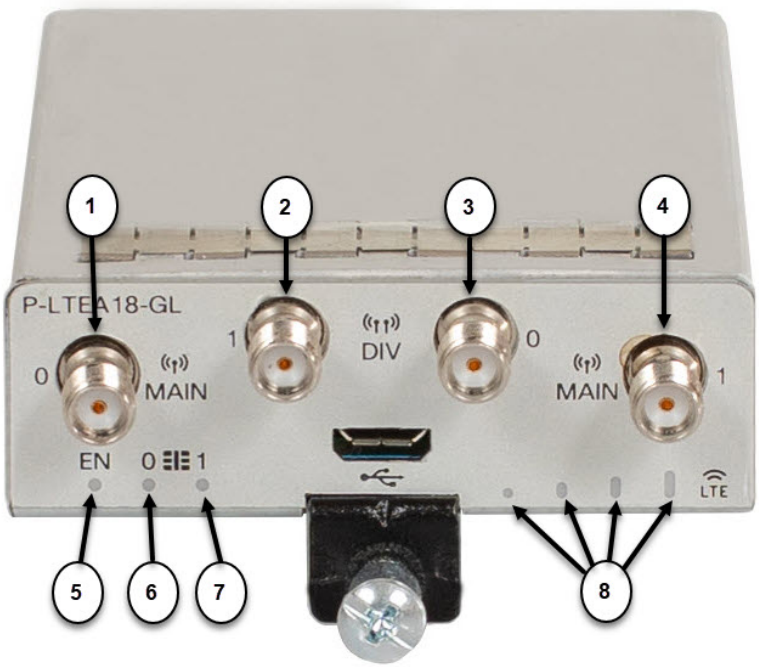


Table 7:

Item	Description
1	Main 0 Antenna
2	Diversity 1 Antenna
3	Diversity 0 Antenna
4	Main 1 Antenna
5	Enable LED

Item	Description
6	SIM 0 LED
7	SIM 1 LED
8	RSSI LEDs

The following table describes the LED behavior on the pluggable module.

Table 8: LED Indicators

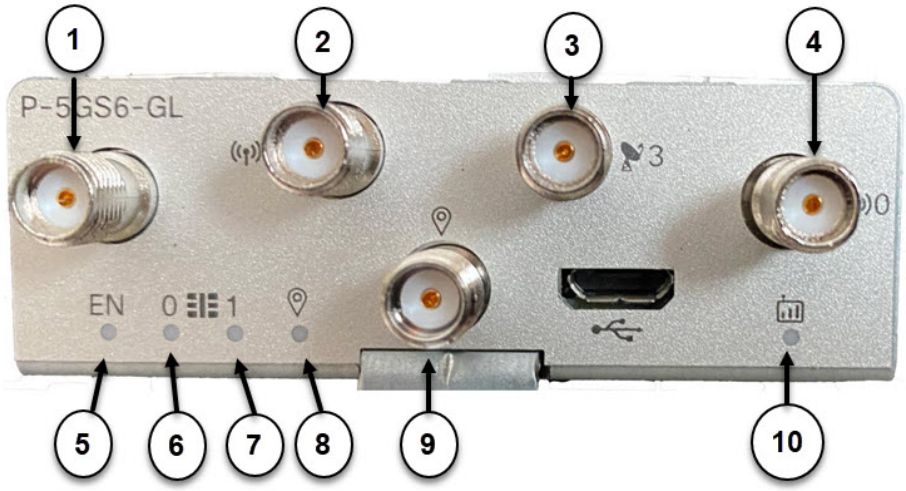
LED	Color/Bar and Description	
Cellular SIM(0) & SIM(1)	Green (Solid)	Modem up, SIM installed and active
	Off	No SIM is present
	Amber (Solid)	Modem up, SIM installed but not active
EN	Off	Pluggable is powered off.
	Amber (Solid)	Module power is on, but the module is not functioning correctly.
	Green (Solid)	Module power is on
RSSI - Uses Bars for LED Indication	See the RSSI LED description in the next table.	

Table 9: RSSI LED Description

Color	RSSI	Service
Off	No Service	No Service
One Green	< -110 dBm	LTE
Two Green	-99dBm <> -90dBm	LTE
Three Green	-89dBm <> -70dBm	LTE
Four Green	>= -69dBm	LTE
One Yellow	< -110 dBm	3G
Two Yellow	-99dBm <> -90dBm	3G
Three Yellow	-89dBm <> -70dBm	3G
Four Yellow	>= -69dBm	3G

P-5GS6-GL Cellular PIM:

Figure 4: 5G Cellular Pluggable Interface Module



Item	Description
1	Antenna 2 (SMA)
2	Antenna 1 (SMA)
3	Antenna 3 (SMA)
4	Antenna 0 (SMA)
5	Enable LED
6	SIM 0 LED
7	SIM 1 LED
8	SIM 1 LED
9	GPS (SMA)
10	Service LED

LED	Color	Function
EN	Green, Yellow	**Enable LED** • Pluggable enable LED • Off: System power is off • Yellow: Module power is not functioning correctly • Green: Module power is on

LED	Color	Function
SIM0	Green, Yellow	**SIM0 LED/Activity** • SIM0 LED status and WWAN activity • Off: SIM0 is not installed • Yellow: SIM0 is installed, but not active • Green: SIM0 installed and active • Green Flash: Cellular data activity
SIM1	Green, Yellow	**SIM1 LED/Activity** • SIM1 LED status and WWAN activity • Off: SIM1 is not installed • Yellow: SIM1 is installed, but not active • Green: SIM1 installed and active • Green Flash: Cellular data activity
GPS	Green, Yellow	**GPS LED** • Off: GPS not configured • Yellow: Software defined • Green: GPS configured • Green Flash: GPS acquiring (flashing done by SW)
Service	Green, Yellow, Blue	**Service Indication LED** • Yellow: 3G • Green: 4G • Blue: 5G

Verifying the Cellular Pluggable Interface Module Information on the Router

You can verify the configuration by using the following show commands:

Note These examples are from an IR1831 router

show version

```
Router#show version
Cisco IOS XE Software, Version 17.08.01
Cisco IOS Software [Cupertino], ISR Software (ARMV8EL_LINUX_IOSD-UNIVERSALK9_IOT-M), Version
 17.8.1, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2022 by Cisco Systems, Inc.
Compiled Sat 09-Apr-22 00:42 by mcpre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GPL code under the terms of GPL Version 2.0. For more details, see the
documentation or "License Notice" file accompanying the IOS-XE software,
or the applicable URL provided on the flyer accompanying the IOS-XE
software.


ROM: 4.1(REL)

IR1831 uptime is 2 days, 15 hours, 35 minutes
Uptime for this control processor is 2 days, 15 hours, 37 minutes
System returned to ROM by reload at 13:48:15 UTC Tue Apr 19 2022
System restarted at 17:52:26 UTC Sun Apr 24 2022
System image file is "bootflash:ir1800-universalk9.17.08.01.SPA.bin"
Last reload reason: Critical software exception, check
bootflash:IR1831_crashinfo_RP_00_00_20220424-174335-UTC



This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.


Technology Package License Information:

-----------------------------------------------------------------
Technology Type Technology-package Technology-package
Current Next Reboot
-----------------------------------------------------------------
Smart License Perpetual network-advantage network-advantage
Smart License Subscription None None

The current throughput level is 250000 kbps


Smart Licensing Status: Smart Licensing Using Policy
```

```
cisco IR1831-K9 (1RU) processor with 425374K/6147K bytes of memory.
Processor board ID FCW2530P5BJ
Router operating mode: Autonomous
MCU bootloader version: 0x23
MCU application version: 0x4d
1 Virtual Ethernet interface
6 Gigabit Ethernet interfaces
2 Serial interfaces
1 terminal line
4 Cellular interfaces
32768K bytes of non-volatile configuration memory.
3987572K bytes of physical memory.
2887679K bytes of Bootflash at bootflash:.

Configuration register is 0x2102
```

show platform

```
router# sh platform
Chassis type: IR1833-K9

Slot       Type               State                  Insert time (ago)
--------- ------------------- --------------------- -----------------
0         IR1833-K9           ok                    00:04:03
0/0       IR1833-1x1GE        ok                    00:01:22
0/1       IR1833-ES-4         ok                    00:01:22
0/3       WP-WIFI6-B          ok                    00:01:22
0/4       P-LTEA-LA           ok                    00:01:21
0/5       P-LTEA-LA           ok                    00:01:21
R0        IR1833-K9           ok, active            00:04:03
F0        IR1833-K9           ok, active            00:04:03
P0        PWR-12V             ok                    00:02:00
GE-POE    IR1800-I-POE        ok                    00:02:00
```

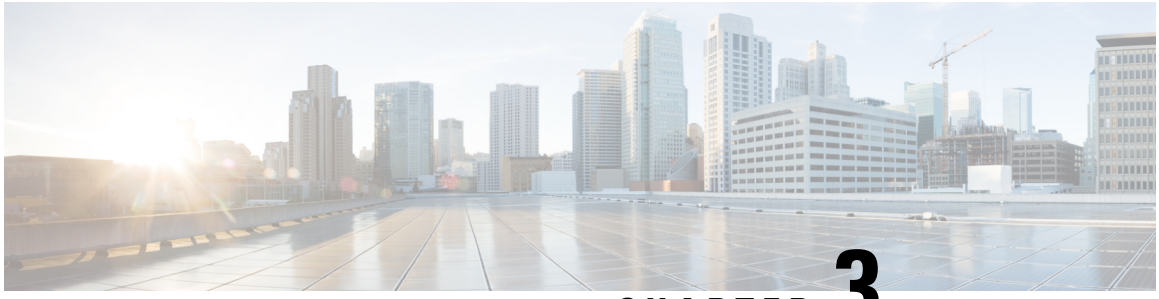
show interfaces

```
router#sh interface cellular 0/4/0
Cellular0/4/0 is up, line protocol is up
  Hardware is LTE Adv CAT6 - Europe/North America Multimode LTE/DC-HSPA+/HSPA+/HSPA/UMTS/
  Internet address is 10.14.162.11/32
  MTU 1500 bytes, BW 50000 Kbit/sec, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set
  Keepalive not supported
  DTR is pulsed for 1 seconds on reset
  Last input never, output 00:00:42, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     5 packets input, 460 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     21 packets output, 1692 bytes, 0 underruns
     0 output errors, 0 collisions, 8 interface resets
     0 unknown protocol drops
     0 output buffer failures, 0 output buffers swapped out
```

```
     0 carrier transitions
router#
```

show inventory

```
router# show inventory
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
INFO: Please use "show license UDI" to get serial number for licensing.
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

NAME: "Chassis", DESCR: "Cisco Catalyst IR1833 Rugged Series Router"
PID: IR1833-K9 , VID: V00 , SN: FCW2447P0EB

NAME: "Power Supply Module 0", DESCR: "Cisco IR1800 DC Power Supply"
PID: PWR-12V , VID: , SN:

NAME: "GE-POE Module", DESCR: "POE Module for On Board GE for Cisco IR183X"
PID: IR1800-I-POE , VID: V00 , SN: FOC24382K4W

NAME: "module 0", DESCR: "Cisco IR-1833-K9 Built-In NIM controller"
PID: IR1833-K9 , VID: , SN:

NAME: "NIM subslot 0/3", DESCR: "Cisco Wide Pluggable Form Factor WIFI6 AP Module"
PID: WP-WIFI6-B , VID: V00 , SN: FOC24490FEP

NAME: "NIM subslot 0/4", DESCR: "P-LTEA-LA Module"
PID: P-LTEA-LA , VID: V01 , SN: FOC22287JMC

NAME: "Modem on Cellular0/4/0", DESCR: "Sierra Wireless EM7430"
PID: EM7430 , VID: 1.0 , SN: 355813070165276

NAME: "NIM subslot 0/5", DESCR: "P-LTEA-LA Module"
PID: P-LTEA-LA , VID: V01 , SN: FOC22287JLZ

NAME: "Modem on Cellular0/5/0", DESCR: "Sierra Wireless EM7430"
PID: EM7430 , VID: 1.0 , SN: 355813070165524

NAME: "NIM subslot 0/0", DESCR: "Front Panel 1 port Gigabitethernet Module"
PID: IR1833-1x1GE , VID: V01 , SN:

NAME: "NIM subslot 0/1", DESCR: "IR1833-ES-4"
PID: IR1833-ES-4 , VID: V01 , SN:

NAME: "module R0", DESCR: "Cisco IR1833-K9 motherboard"
PID: IR1833-K9 , VID: V00 , SN: FOC24384177

NAME: "module F0", DESCR: "Cisco IR1833-K9 Forwarding Processor"
PID: IR1833-K9 , VID: , SN:
```



CHAPTER 3

Prerequisites and Restrictions for Configuring the Cisco Cellular Pluggable Interface Module (PIM)

This chapter contains the following sections:

- Prerequisites for Configuring a Cellular PIM, on page 25
- Restrictions for Configuring a Cellular PIM, on page 26
- Features Not Supported, on page 26
- Cellular PIM Major Features, on page 26

Prerequisites for Configuring a Cellular PIM

Note You must have the appropriate antennas and antenna accessories to complete your installation. Consult the Cisco Industrial Routers and Industrial Wireless Access Points Antenna Guide for suggestions on possible solutions.

- If the signal is not good at the router, place the antenna away from router in a better coverage area. Please refer to the RSSI/SNR values as displayed through **show cellular <x/x/x> all** or the LED of the pluggable modem.
- You must have cellular network coverage where your router is physically placed. For a complete list of supported carriers.
- You must subscribe to a service plan with a wireless service provider and obtain a Subscriber Identity Module (SIM) card. Only micro SIMs are supported.
- You must install the SIM card before configuring the Cellular PIM or router.
- The standalone antenna that supports GPS capabilities must be installed for the GPS feature to work when available on the PIM.

Restrictions for Configuring a Cellular PIM

- Currently, cellular networks support only user initiated bearer establishment.
- Due to the shared nature of wireless communications, the experienced throughput varies depending on the radio network capabilities, number of active users or congestion in a given network.
- Cellular bandwidth is asymmetric with the downlink data rate being greater than the uplink data rate, while on private cellular with TDD frequency band(s), it may be symmetrical.
- Cellular networks have higher latency compared to wired networks. Radio latency rates depend on the technology and carrier. Latency also depends on the signal conditions and can be higher because of network congestion.
- CDMA-EVDO, CDMA-1xRTT, and GPRS technology modes are not supported. 2G is only supported on the P-LTE-GB.
- Any restrictions that are part of the terms of service from your carrier.
- SMS—Only one text message up to 160 characters to one recipient at a time is supported. Larger texts are automatically truncated to the proper size before being sent.

Features Not Supported

The following features are not supported:

- On Cisco IOS-XE, TTY support or Line is not available on cellular interface as it was on IOS classic.
- On Cisco IOS-XE, explicit Chat script /Dialer string doesn't need to be configured for the cellular interface as it was on IOS classic.
- DM log output to USB flash is not supported
- Voice services

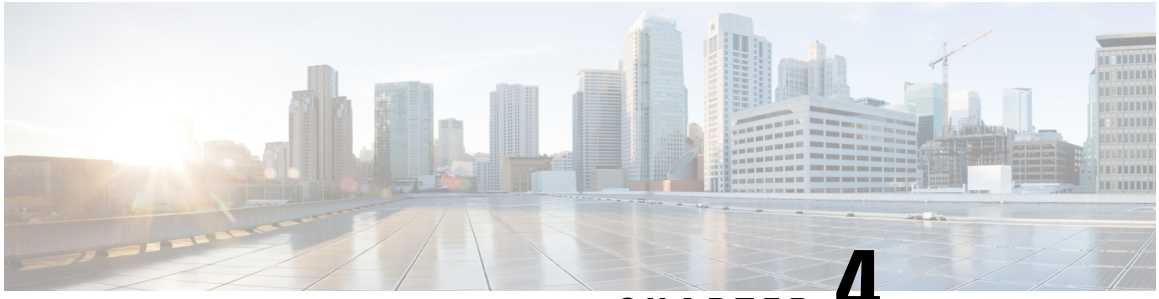
Cellular PIM Major Features

The PIM supports the following major features:

Feature	Description
SIM lock and unlock capabilities	SIM card with security mechanism requiring a PIN code is supported, see SIM Cards on the Cellular Pluggable Interface Module (PIM), on page 29 for details.

Feature	Description
Dual SIM **Note** Not supported on the P-LTE-VZ pluggable	For backup purpose, a cellular PIM may support two SIM cards, enabling auto-switch failover between primary and backup (backup only) mobile carrier' services from a single Cellular PIM, see SIM Cards on the Cellular Pluggable Interface Module (PIM), on page 29 for details.
Auto SIM	Cisco IOS-XE feature enabling a Cellular PIM to activate the appropriate firmware associated to a SIM card from a mobile carrier, see SIM Cards on the Cellular Pluggable Interface Module (PIM), on page 29 for details.
Public Land Mobile Network (PLMN) selection	By default, a Cellular PIM will attach to its default network associated to the installed SIM card. In case of private Cellular network or to avoid roaming, a cellular interface can be configured to only attach to a given PLMN. See PLMN Search and Selection, on page 80 for details.
Private LTE **Note** Private 4G and private 5G networks are leveraging spectrum that can be obtained by enterprises to deploy the private cellular infrastructure. It can either be a subset of SP spectrum or a frequency band dedicated to private network in countries, for example 4G band 48 (CBRS) in U.S., 5G band n78 in Germany,	On appropriate Cellular PIM modules, for example, P-LTEAP18-GL and P-5GS6-GL, frequency bands allowing connectivity to private LTE and/or private 5G infrastructure are supported. See Cellular Band Lock, on page 84.
Two active PDN profiles	On Cellular interface, up to 16 PDN profiles can be defined, while two could be active, dependent of the SIM subscription and services, see Using Data Profiles, on page 52 for details.
IPv6	IPv6 data traffic is fully supported over Cellular network. See Configuring Cellular IPv6 Address, on page 74.
Mobile Network IPv6 **Note** Not available on all mobile carriers.	Cellular attachment to an APN on a mobile network can be performed through IPv4 and IPv6, or IPv6 only.
Cellular serviceability	On Cisco IOS-XE, several features such as LTE Link recovery, firmware upgrade, DM logs collection can be configured to ease the operations and offer better serviceability, see Cellular Serviceability, on page 135 for details.

Feature	Description
Short Message Service (SMS)	A text message service with messages exchanged between a modem's device and a SMS service center in a store and forward mechanism. On Cisco IOS-XE router, outgoing SMS may be used to send dying gasp message to a management solution or operators. SMS on dying gasp is available on some cellular PIMs such as P-LTEA-EA, P-LTEA-LA and P-LTEAP18-GL. See Short Message Service (SMS) and Dying Gasp, on page 143 for details
3G/4G Simple Network Management Protocol (SNMP) MIB	Cellular WAN MIBs and Traps sending management information through SNMP to a Management solution, see Management Information Base, on page 88 for details
GPS **Note** See Supported Modem Technology, on page 8 for GPS support.	Global Navigation Satellite System (GNSS) (requires a GNSS compliant antenna) and National Marine Electronics Association (NMEA) streaming.



CHAPTER 4

SIM Cards on the Cellular Pluggable Interface Module (PIM)

This chapter contains the following sections:

- Using a SIM Card, on page 29
- Inserting a SIM into a Cellular Pluggable Interface Module, on page 30
- Changing the PIN, on page 32
- Locking and Unlocking a SIM Card Using a PIN, on page 32
- Configure Card Holder Verification Level 1 for Unencrypted Levels, on page 32
- Configure Card Holder Verification Level 7 for Unencrypted Levels, on page 33
- Dual SIM Card, on page 34
- SIM Security, on page 37
- Example: SIM Configuration, on page 41

Using a SIM Card

Modem support for the pluggable modules is accomplished through the use of a SIM. With two SIM cards inserted into one pluggable interface module, the cellular radio still only connects to one active SIM at a time. By default, the SIM in slot0 is primary SIM. Using IOS-XE CLI the user can make SIM in slot1 as primary.

Note DUAL Modem is for mission-critical IoT applications, while DUAL SIM is for non-mission-critical IoT applications.

If the primary SIM network connectivity fails, the secondary SIM network connectivity will be established (if properly configured). Switching back to the Primary SIM network will be performed either when the Secondary SIM network connectivity fails, or the router reboots, or the modem is reset or by forcing the Primary SIM switch back through WANmon feature or other EEM script.

If a router is configured with two PIM modules, this dual modem configuration allows simultaneous connectivity through two different carriers, which provides multiple benefits:

- The WAN redundancy for mission-critical applications allows automatic switch from one carrier to the other to occur in mere seconds.

- Both modems can be active at the same time, allowing for more bandwidth, but through two different cellular networks.
- Load balancing done on IP routing.
- For SDWAN and data usage optimization.

Auto-SIM automatically configures a modem carrier based on detected SIM. This simplifies the configuration process and reduces setup time , as well as reducing inventory complexity and simplifying deployment.

The PIM needs an active SIM card provided by a service provider. The SIM cards are usually provided in an unlocked state so that it can be used without a Personal Identification Number (PIN). If the SIM is unlocked, it can be inserted into a PIM and used without an authorization code.

The SIM can be initially locked with a PIN code (4 to 8 digits s long) defined by the service provider. Contact your service provider for the PIN code.

The SIM-Lock feature allows a SIM to be locked or unlocked with a PIN code so that it is used only in an authorized device. Perform the SIM lock and unlock procedures using the Cisco IOS CLI through a console or Telnet/SSH to the router.

After the SIM is locked, it cannot initiate a call unless authentication is done using the same PIN. Authentication is done automatically by Cisco IOS through configuration of the PIN. This mandatory configuration for automatic SIM authentication is done using the Cisco IOS CLI as part of the router startup configuration.

After the Cisco IOS configuration is in place, the router can initiate a cellular connection. The router uses the configured PIN to authenticate prior to the cellular connection. If the Cisco IOS PIN configuration is missing or if the PIN is incorrect, the SIM authentication will fail, and the connection will not be initiated.

If the locked SIM is moved to a different router or to another device, or if the PIM in which the locked SIM resides is moved to a different slot in the same router, the router configuration should be changed. The configuration is associated with the cellular controller that is specific to a router cellular slot number. This will ensure that the SIM card will not be used in any unauthorized device, or, if there are multiple PIMs in a single router, that the appropriate PIN is applied to each SIM. An authentication command (with the same PIN used to lock the SIM) must be defined on the new device or on the new cellular controller slot to successfully initiate the cellular connection.

The following procedures are used to configure a SIM:

Caution It is very important to use the correct PIN after it is configured. The SIM card will be blocked if the wrong PIN is entered three consecutive times on a locked SIM during authentication or when trying to unlock a locked SIM. You can unblock a blocked SIM card using the PUK code. Contact your service provider for the PUK code. Use the **cellular** *<slot>* **lte sim unblock** *<PUK code> <new PIN code>* command to unblock the SIM.

Inserting a SIM into a Cellular Pluggable Interface Module

This section gives an overview of installing the SIMs in a PIM.

Note Details on installing the pluggable module and additional information on SIMs can be found in your products Hardware Installation Guide.

Refer to the figure that follows the steps for details.

Step 1 Place the Cellular PIM on its bottom side. Remove the SIM door screw using a #1 Philips screwdriver, and then carefully remove the Micro-SIM cover from the pluggable module.

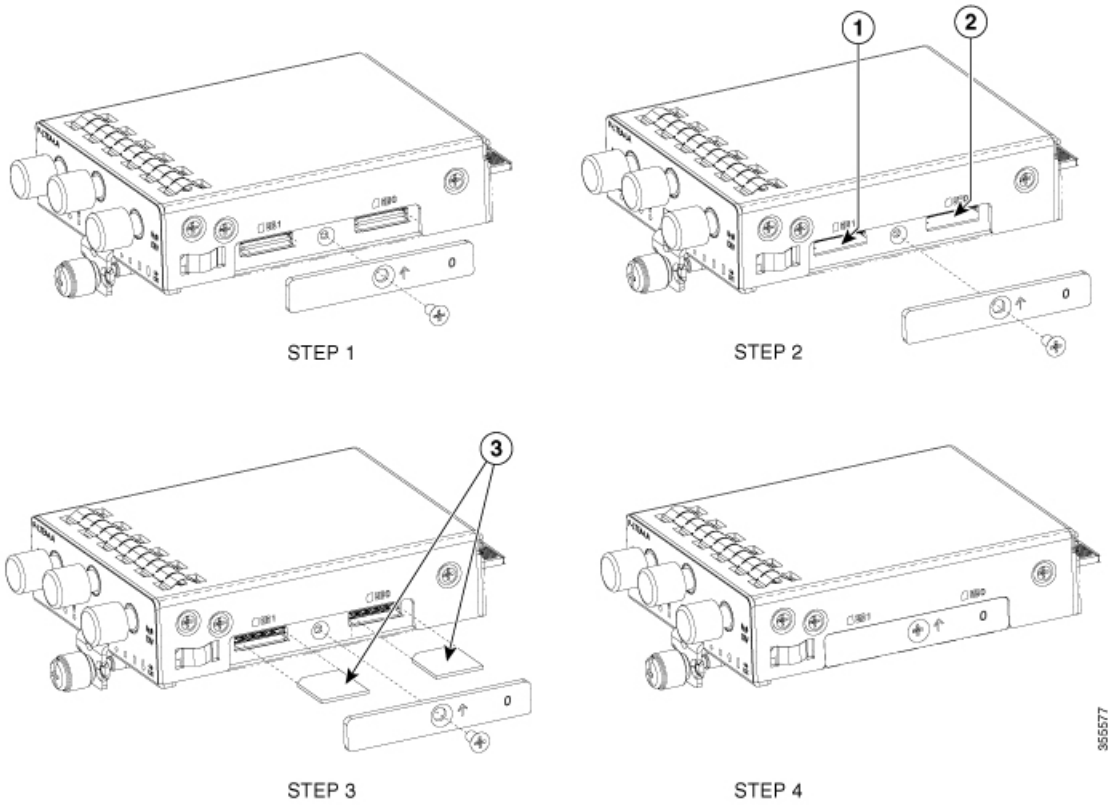
Caution Do not touch any part of the exposed PCB circuit area when the Micro-SIM cover is removed.

Step 2 Slot 1 and slot 0 are the Micro-SIM slots. See items 1 and 2 in step 2.

Step 3 Install SIM 0 and SIM 1 in their respective slots. SIM 0 or SIM 1 is marked on the pluggable interface module above the Micro-SIM cover. The SIM icons show the correct orientation required to install the SIM into each respective connector (SIM connectors are a push-push type). To install, insert the SIM card in the connector until you feel it click, then let go and the SIM is locked to the connector. To remove the SIM card, depress the SIM in the connector slot again until you feel the same click and let it go, the SIM connector should eject part way out of the connector. The SIM card can then be grabbed and removed). See item 3 in step 3.

Step 4 Secure the Micro-SIM cover with a screw, use a number 1 Philips screwdriver to secure the screw on the Micro-SIM cover. The recommended torque is 2.8 - 3.8 inch LBF. See step 3 and 4.

Figure 5: SIM Installation



Changing the PIN

Ensure to enter the correct PIN, the SIM card gets blocked if the wrong PIN is entered three consecutive times.

Procedure

	Command or Action	Purpose
Step 1	**cellular** *interface* **lte sim change-pin** *current-pin new-pin* **Example:** `Router# cellular x/x/x lte sim lock 1111 1234`	Locks or unlocks the SIM card using a PIN code. **Note** Locks or unlocks the SIM card using a PIN code. *pin*—A code (4 to 8 digits long) provided by your service provider to lock or unlock the SIM card. **Note** SIM should be in locked state when the PIN is being changed.

Locking and Unlocking a SIM Card Using a PIN

Perform this task to lock or unlock a SIM card given by your service provider. Make sure you enter the correct PIN, the SIM card gets blocked if the wrong PIN is entered three consecutive times.

Procedure

	Command or Action	Purpose
Step 1	**cellular** *<slot>* **lte sim** *{lock | unlock} <pin>* **Example:** `Router# cellular x/x/x lte sim lock 1111`	Locks or unlocks the SIM card using a PIN code. **Note** PIN is a code (4 to 8 digits long) provided by your service provider to lock or unlock the SIM card.

Configure Card Holder Verification Level 1 for Unencrypted Levels

Use either of these commands:

- lte sim authenticate 0 pin
- lte sim authenticate 0 pin slot {0 | 1}

Procedure

	Command or Action	Purpose

Step 1	**controller cellular** *slot*
	Example:
	`Router# controller cellular x/x/x`
	`lte sim authenticate 7 1111 slot 0`
		Enters the cellular controller configuration mode.

Configure Card Holder Verification Level 7 for Unencrypted Levels

To configure an encrypted PIN, the scrambled value of the PIN must be obtained. To get the scrambled Level 7 PIN and to configure the SIM CHV1 code for verification using this encrypted PIN, enter the following commands in the EXEC mode. When obtaining the encrypted PIN for a SIM, a username and password are created by configuring password encryption, defining the username and associated password, copying the resulting scrambled password, and using this scrambled password in the SIM authentication command.

Note After the scrambled PIN has been obtained and used in SIM authentication, the username created can be deleted from the Cisco IOS configuration. A SIM should be locked for SIM authentication to work

Procedure

	Command or Action	Purpose
Step 1	**service password-encryption** **Example:** `Router (config)# service password-encryption`	Enables password encryption.
Step 2	**username** *username* **privilege** *var password pin* **Example:** `Router (config)# username SIM privilege 0 password 1111`	**Note** Creates username and password. name - specifies the username. *pin* - 4 to 8 digit PIN code.
Step 3	**do show run | i name** **Example:** `Router(config)# do show run | i SIM`	Shows the username configuration line with the encrypted level 7 PIN for the username created in Step 3 (user “SIM” in the example shown). Copy the scrambled password for use in Step 6 (as the PIN).
Step 4	**controller cellular** *x/x/x* **Example:** `Router(config)# controller cellular x/x/x`	Enters the cellular controller configuration mode.

	Command or Action	Purpose
Step 5	**lte sim authenticate 7** *pin* `OR` **lte sim authenticate 7 pin slot {0 | 1}** **Example:** `Device(config-controller)# lte sim authenticate 7 055A575E70`	Authenticates the SIM CHV1 code by using the encrypted keyword 7 and the scrambled PIN from Step 4. The PIN is sent to the modem for authentication with each subsequent cellular connection. If authentication passes based on the configured PIN, the data call is allowed. If authentication fails, the modem does not initiate the data call. **Note** The slot keyword and its options are available only on platforms that supports Dual-SIM feature.
Step 6	**exit** **Example:** `Router(config-controller)# exit`	(Optional) Exits the cellular controller configuration mode.
Step 7	**no username** *name* **Example:** `Router(config-controller)# no username SIM`	(Optional) Removes the username and password created in Step 3
Step 8	**no service password-encryption** *name* **Example:** `Router(config-controller)# no service password-encryption`	(Optional) Removes the username and password created in Step 3

Dual SIM Card

Note The P-LTE-VZ pluggable that provides Verizon support is a single SIM.

SIM card primary slot is selected when router boots up or when PIM reloads. The default slot is 0. If SIM card is not present in the primary slot, select the alternative slot if SIM card is present.

```
controller cellular x/x/x
lte sim primary slot <slot-number>
```

If the primary SIM network connectivity fails, the secondary SIM network connectivity will be established (if properly configured). Switching back to the Primary SIM network will be performed either when the Secondary SIM network connectivity fails, or the router reboots, or the modem is reset or by forcing the Primary SIM switch back through WANmon feature or other EEM script.

By default, the failover timer is 3 minutes. The failover timer can be set from 3 to 7 minutes.

```
controller cellular x/x/x
lte failovertimer <3-7>
```

You can also manually switch the SIM slot via the command line interface.

```
cellular x/x/x lte sim activate slot <0-1>
```

Auto SIM

The Auto SIM feature detects the SIM and loads the corresponding firmware. Auto-SIM is done on modem that supports multiple carrier/firmware. Therefore, if you install an AT&T SIM, it loads the AT&T firmware. If the SIM card is switched, i.e. Verizon, it reloads the Verizon firmware. Older generation of PIMs were dedicated to a carrier.

When Auto-SIM is enabled, it is said to be in Auto-SIM mode and when disabled, it is known as Manual mode. In Auto-SIM mode, the modem selects the right carrier firmware from the list of firmware's available. When in manual mode, you can select the firmware manually. Modem resets every time you make a config change from Auto-SIM enabled to disabled or vice-versa.

Note Auto SIM is always enabled by default.

Enable Auto SIM

Use the **cellular <slot> lte firmware-auto-sim command** to enable Auto SIM, if previously disabled.

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**controller cellular** *<slot>*	
Step 3	**lte firmware auto-sim** **Example:** `Router(config)# lte firmware auto-sim`	Enables Auto-SIM feature if previously disabled.

Example: List the firmware when Auto-SIM is Enabled

```
Router# show cellular x/x/x firmware
Idx Carrier FwVersion PriVersion Status
3 AT&T M0H.030200-B016 0910 Active

Firmware Activation mode = Auto

Modem image running: Main
Mobile Network Operator: AT&T
Number of MNO's = 14
Index MNO ID MNO NAME
1 0 Generic GCF
2 1 Generic PTCRB
3 10 AT&T
4 11 T-Mobile
```

```
5 12 Verizon
6 14 Bell
7 15 Rogers
8 16 Telus
9 20 SK Telecom
10 21 SK Telecom Dongle
11 30 NTT Docomo
12 31 KDDI
13 40 Telstra
14 50 Anatel
```

Disable Auto SIM

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**controller cellular** *slot* **Example:** `Router(config)# controller cellular x/x/x`	Specifies the controller interface.
Step 3	**no lte firmware auto-sim** **Example:** `Router(config-controller)# no lte firmware auto-sim`	Disable auto SIM.

Example: List the Firmware when Auto-SIM is Disabled

```
Router# show cellular x/x/x firmware
Idx Carrier FwVersion PriVersion Status
1 ATT 02.37.00.00 002.098_000 Inactive
2 GENERIC 02.37.03.00 002.095_000 Active
3 KDDI 02.37.03.00 001.048_000 Inactive
4 SOFTBANK 02.37.03.00 001.050_000 Inactive
5 TELUS 02.37.03.00 001.017_000 Inactive
6 VERIZON 02.37.03.00 002.104_000 Inactive
7 VODAFONE 02.37.03.00 000.011_000 Inactive

Firmware Activation mode  =  Manual
```

Manual Firmware Selection

This section describes how to force the firmware selection when set to manual.

First, Auto SIM has to be turned off.

```
Router(config)# controller cellular x/x/x
Router(config-controller)# no lte firmware auto-sim
```

Second, select the appropriate firmware, for example, private LTE or private 5G by selecting it through CLI.

```
Router# cellular 0/4/0 lte mno-activate ?
<1-100> mno index
```

The mno index is seen from the **show cellular x/x/x firmware** index column. For example, this output shows AT&T as active, that is listed as Index 3:

```
Router# show cellular x/x/x firmware
Idx Carrier FwVersion PriVersion Status
3 AT&T M0H.030200-B016 0910 Active

Modem image running: Main
Mobile Network Operator: AT&T
Number of MNO's = 14
Index MNO ID MNO NAME
1 0 Generic GCF
2 1 Generic PTCRB
3 10 AT&T
4 11 T-Mobile
5 12 Verizon
6 14 Bell
7 15 Rogers
8 16 Telus
9 20 SK Telecom
10 21 SK Telecom Dongle
11 30 NTT Docomo
12 31 KDDI
13 40 Telstra
14 50 Anatel
```

Use the **cellular 0/4/0 lte mno-activate** <*number*> command to choose your mno associated with the firmware you wish.

SIM Security

Locking and Unlocking a SIM Card Using a PIN Code

Perform this task to lock or unlock a SIM card given by your service provider.

Note The SIM card gets blocked if the wrong PIN is entered three consecutive times. Make sure you enter the correct PIN the SIM is configured with. If your SIM card gets blocked, contact your service provider for a PUK code. Using the PUK code, you can unblock the SIM card.

Procedure

	Command or Action	Purpose
Step 1	**cellular** *slot* **lte sim** *{lock | unlock} pin* **Example:**	Locks or unlocks the SIM card using a PIN code.

	Command or Action	Purpose
	`Router# cellular x/x/x lte sim lock 1111`	*pin*—A code (4 to 8 digits long) provided by your carrier to lock or unlock the SIM card.

Changing the PIN Code

Perform this task to change the PIN code of a SIM.

Procedure

	Command or Action	Purpose
Step 1	**cellular** <*slot*> **lte sim change-pin** <*pin*> <*new-pin*> **Example:** `Router# cellular x/x/x lte sim change-pin 1111 1234`	Changes the assigned PIN code. SIM should be in locked state when the PIN is being changed.

Verifying the Security Information of a Modem

Perform this task to verify the security information of a modem.

Procedure

	Command or Action	Purpose
Step 1	**show cellular slot security** **Example:** `Router# show cellular x/x/x security`	Shows the security information of the modem, including the SIM lock status.

Example

The following is from an IR1821 with SIM 1 activated:

```
IR1821#show cell 0/4/0 security
Active SIM = 1
SIM switchover attempts = 0
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
IR1821#
```

Configuring Automatic Authentication for a Locked SIM

An unencrypted PIN can be configured to activate the Card Holder Verification (CHV1) code that authenticates a modem.

The SIM card gets blocked if the wrong PIN is entered three consecutive times. Make sure you enter the correct PIN the SIM is configured with. If your SIM card gets blocked, contact your service provider for a PUK code.

Follow these procedures when using an unencrypted Level 0 PIN to configure CHV1. For instructions on how to configure CHV1 using an encrypted Level 7 PIN, see the Configuring an Encrypted PIN for a SIM, on page 39.

A SIM should be locked for SIM authentication to work. To verify the SIM's status, use the **show cellular slot security** command.

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**controller cellular** *<slot>* **Example:** `Router(config)# controller cellular x/x/x`	Enters the cellular controller configuration mode.
Step 3	**lte sim authenticate 0 pin**	Authenticates the SIM CHV1 code by using an unencrypted (**0**) keyword and PIN. This PIN is sent to the modem for authentication with each subsequent cellular connection. If authentication passes based on the configured PIN, the data call is allowed. If authentication fails, the modem does not initiate the data call. **Note** This command is valid only when an unencrypted PIN is used. To configure CHV1 code using an encrypted PIN, see the Configuring an Encrypted PIN for a SIM, on page 39.

Configuring an Encrypted PIN for a SIM

To configure an encrypted PIN, the scrambled value of the PIN must be obtained. To get the scrambled Level 7 PIN and to configure the SIM CHV1 code for verification using this encrypted PIN, enter the following commands in the EXEC mode.

Note When obtaining the encrypted PIN for a SIM, a username and password are created by configuring password encryption, defining the username and associated password, copying the resulting scrambled password, and using this scrambled password in the SIM authentication command. After the scrambled PIN has been obtained and used in SIM authentication, the username created can be deleted from the Cisco IOS configuration.

A SIM should be locked for SIM authentication to work. To verify the SIM's status, use the **show cellular slot security** command.

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**service password-encryption** **Example:** `Router(config)# service password-encryption`	Enables password encryption.
Step 3	**username name privilege 0 password** *pin* **Example:** `Router(config)# username SIM privilege 0 password 1111`	Creates username and password. • *name*—Specifies the username. • *pin* —Specifies the four- to eight-digit PIN code.
Step 4	**do show run | i name** **Example:** `Router(config)# do show run | i SIM`	Shows the username configuration line with the encrypted level 7 PIN for the username created in Step 3 (user "SIM" in the example shown). Copy the scrambled password for use in Step 6 (as the PIN).
Step 5	**controller cellular** *slot* **Example:** `Router(config)# controller cellular x/x/x`	Enters the cellular controller configuration mode.
Step 6	**lte sim authenticate** *{0 | 7} pin* **Example:** `Router(config)# lte sim authenticate 7 1234`	Authenticates the SIM CHV1 code by using the encrypted keyword 7 and the scrambled PIN from Step 4. The PIN is sent to the modem for authentication with each subsequent cellular connection. If authentication passes based on the configured PIN, the data call is allowed. If authentication fails, the modem does not initiate the data call.
Step 7	**exit** **Example:** `Router(config-controller)# exit`	(Optional) Exits the cellular controller configuration mode.
Step 8	**no username** *name* **Example:** `Router(config)# no username SIM`	(Optional) Removes the username and password created in Step 3.
Step 9	**no service password-encryption** **Example:** `Router(config)# no service password-encryption`	(Optional) Disables password encryption.

Example: SIM Configuration

This section provides examples:

Locking the SIM Card

The following example shows how to lock the SIM. The italicized text in this configuration example is used to indicate comments and is not seen when normal console output is viewed.

```
Router# sh cellular x/x/x security
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
!! SIM is in unlocked state.!


Router# cellular x/x/x lte sim lock 1111
!!!WARNING: SIM will be locked with pin=1111(4).
Do not enter new PIN to lock SIM. Enter PIN that the SIM is configured with.
Call will be disconnected!!!
Are you sure you want to proceed?[confirm]<enter>
Router#

Apr 26 19:35:28.339: %CELLWAN-2-MODEM_DOWN: Modem in NIM slot 0/2 is DOWN
Apr 26 19:35:59.967: %CELLWAN-2-MODEM_UP: Modem in NIM slot 0/2 is now UP
Router#

Router# sh cellular x/x/x security
Card Holder Verification (CHV1) = Enabled
SIM Status = Locked
SIM User Operation Required = Enter CHV1
Number of CHV1 Retries remaining = 3
!! SIM is in locked state.!
Router#
```

Unlocking the SIM Card

The following example shows how to unlock the SIM.

```
Router# show cellular x/x/x security
Card Holder Verification (CHV1) = Enabled
SIM Status = Locked
SIM User Operation Required = Enter CHV1
Number of CHV1 Retries remaining = 3
!! SIM is in locked state.!
Router#

Router# cellular x/x/x lte sim unlock 1111
!!!WARNING: SIM will be unlocked with pin=1111(4).
Do not enter new PIN to unlock SIM. Enter PIN that the SIM is configured with.
Call will be disconnected!!!
Are you sure you want to proceed?[confirm]<enter>
Router#

Router# show cellular x/x/x security
```

```
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
!! SIM is in locked state.!
Router#
```

Automatic SIM Authentication

The following example shows how to configure automatic SIM authentication. The italicized text throughout this configuration example is used to indicate comments and will not be seen when a normal console output is viewed.

```
Router# show cellular x/x/x security
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
!! SIM is in unlocked state.!


Router# cellular x/x/x lte sim lock 1111
!!!WARNING: SIM will be locked with pin=1111(4).
Do not enter new PIN to lock SIM. Enter PIN that the SIM is configured with.
Call will be disconnected!!!
Are you sure you want to proceed?[confirm]<enter>
Router#

Apr 26 21:22:34.555: %CELLWAN-2-MODEM_DOWN: Modem in NIM slot 0/2 is DOWN
Apr 26 21:23:06.495: %CELLWAN-2-MODEM_UP: Modem in NIM slot 0/2 is now UP
Router#

Router# sh cellular x/x/x security
Card Holder Verification (CHV1) = Enabled
SIM Status = Locked
SIM User Operation Required = Enter CHV1
Number of CHV1 Retries remaining = 3
!SIM is in locked state. SIM needs to be in locked state for SIM authentication to work!

Router#
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# controller cellular x/x/x
Router(config-controller)# lte sim authenticate 0 1111
CHV1 configured and sent to modem for verification
Router(config-controller)# end
Router#

Apr 26 21:23:50.571: %SYS-5-CONFIG_I: Configured from console by console
Router#

Router# sh cellular x/x/x security
Card Holder Verification (CHV1) = Enabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
!SIM is now in locked state but it can be used for connectivity since authentication
is good. Authentication can be saved in the router configuration so that when you boot
up the router with the same locked SIM, connection can be established with the
correct Cisco IOS configuration.!
Router#
```

Changing the PIN Code

The following example shows how to change the assigned PIN code.

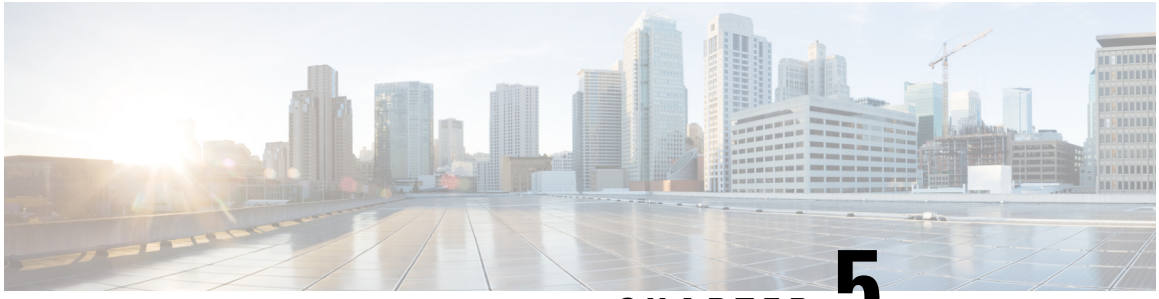
```
Router# show cellular x/x/x security
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
!!SIM is in unlocked state.!
Router#

Router# cellular x/x/x lte sim lock 1111
!!!WARNING: SIM will be locked with pin=1111(4).
Do not enter new PIN to lock SIM. Enter PIN that the SIM is configured with.
Call will be disconnected!!!
Are you sure you want to proceed?[confirm]<enter>
Router#

Apr 26 21:58:11.903: %CELLWAN-2-MODEM_DOWN: Modem in NIM slot 0/2 is DOWN
Apr 26 21:58:43.775: %CELLWAN-2-MODEM_UP: Modem in NIM slot 0/2 is now UP
Router#

Router# show cellular x/x/x security
Card Holder Verification (CHV1) = Enabled
SIM Status = Locked
SIM User Operation Required = Enter CHV1
Number of CHV1 Retries remaining = 3
!! SIM is in locked state. SIM needs to be in locked state to change its PIN.!
Router#

Router# cellular x/x/x lte sim change-pin 1111 0000
!!!WARNING: SIM PIN will be changed from:1111(4) to:0000(4)
Call will be disconnected. If old PIN is entered incorrectly in 3 attempt(s), SIM will be
blocked!!!
Are you sure you want to proceed?[confirm]<enter>
Resetting modem, please wait...
CHV1 code change has been completed. Please enter the new PIN in controller configuration
for verification
Router#

Apr 26 21:59:16.735: %CELLWAN-2-MODEM_DOWN: Modem in NIM slot 0/2 is DOWN
Apr 26 21:59:48.387: %CELLWAN-2-MODEM_UP: Modem in NIM slot 0/2 is now UP
Router#

Router# show cellular x/x/x security
Card Holder Verification (CHV1) = Enabled
SIM Status = Locked
SIM User Operation Required = Enter CHV1
Number of CHV1 Retries remaining = 3
Router#

Router# cellular x/x/x lte sim unlock 0000
!!!WARNING: SIM will be unlocked with pin=0000(4).
Do not enter new PIN to unlock SIM. Enter PIN that the SIM is configured with.
Call will be disconnected!!!
Are you sure you want to proceed?[confirm]<enter>
Router#

Router# show cellular x/x/x security
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
```

```
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
! Unlock with new PIN is successful. Therefore, changing the PIN was successful.!
Router#
```

Configuring an Encrypted PIN

The following example shows how to configure automatic SIM authentication using an encrypted PIN. The italicized text throughout this configuration example is used to indicate comments and will not be seen when a normal console output is viewed.

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# service password-encryption
Router(config)# username SIM privilege 0 password 1111
Router(config)# do sh run | i SIM
username SIM privilege 0 password 7 055A575E70.
!!Copy the encrypted level 7 PIN. Use this scrambled PIN in the SIM authentication command.

Router(config)# controller cellular x/x/x
Router(config-controller)# lte sim authenticate 7 055A575E70
CHV1 configured and sent to modem for verification
Router(config-controller)# exit
Router(config)# no username SIM
Router(config)# end
May 14 20:20:52.603: %SYS-5-CONFIG_I: Configured from console by console
```



CHAPTER 5

Configuring the Cellular Pluggable Interface Module (PIM)

This chapter contains the following sections:

- Before You Begin, on page 45
- Verifying Modem Signal Strength and Service Availability, on page 47
- Using Data Profiles, on page 52
- Data Call Setup, on page 58
- Configuring Cellular Modem Link Recovery , on page 69
- Configuring Cellular IPv6 Address, on page 74
- PLMN Search and Selection, on page 80
- Modem Settings for North America and Carriers Operating on 700 MHz Band, on page 83
- Cellular Band Lock, on page 84
- Cellular Band 30, on page 85
- Radio Power Mode, on page 87
- Management Information Base, on page 88

Before You Begin

Important This configuration guide supports multiple products and is written as generically as possible. Throughout this document, the controller will be referred to as the generic term *slot*. The *slot* will take the form of *x/x/x* in this guide. When configuring the controller on your particular router/pluggable, use the information available in your product documentation, or the tables below.

For information on supported antennas and accessories, see the Cisco Industrial Routers and Industrial Wireless Access Points Antenna Guide.

Multiple PDN Contexts

This feature enables the router to connect to multiple (currently two) packet data networks. This allows users to enable different features independently on each PDN. For instance, the first PDN can be used for public Internet access and the second one for VPN connectivity; each PDN has its own set of IP addresses and QoS

characteristics. It assumes the dual PDN is supported on SIM subscription and services plan from your single mobile carrier.

During the initialization of the router, two cellular interfaces corresponding to the two PDNs are created:

- cellular 0/x/0
- cellular 0/x/1

These interfaces can be viewed as two logical interfaces using the same radio resources. For the rest of this guide, the interface cellular 0/x/0 is referred as the first PDN, and cellular 0/x/1 as the second PDN.

The first step, in bringing up the two PDNs, is applying the configuration on both the cellular interfaces and their corresponding lines, in order to make two simultaneous data calls.

The next step is associating the data-bearer profile with its corresponding cellular interface or PDN. It is sufficient to associate the profile for just the first PDN under the controller cellular configuration. Note that the second PDN assumes a profile that is just one above the profile used for the first PDN. For example, if the first PDN uses profile 1, the second PDN uses profile 2 automatically when the call is initiated for the second one.

After the interesting traffic is routed through these cellular interfaces, data calls are initiated, and each interface is assigned its own IP and DNS addresses provided by the cellular network. Note that both PDNs share radio resources. Therefore, any throughput measurement needs to take into account the aggregate throughput on both PDNs, instead of just one.

Router Cellular Architecture

The SIM numbering is always 0/1 if the pluggable supports dual SIM, or 0 if the pluggable is a single SIM (P-LTE-VZ).

The configuration commands used are **controller cellular** and **interface cellular**.

- Controller cellular — Configures all of the parameters related to LTE.
- Interface cellular — Configures all of the parameters related to the interface (not PDN) such as IPv4, IPv6, and dialer-xxx.

Note The controller and the interface have the same numbering convention.

The following table helps to illustrate these relationships.

Router	Controller/Interface	Slot
ESR6300	0/3/0	0/3 (location up to the integrator)
IR1101 series	0/1/x	Base Unit
	0/3/x	Expansion module top (EM) side
	0/4/x	Expansion module bottom (CM) side

Router	Controller/Interface	Slot
IR1800 series	0/4/x	0/4 (left side)
	0/5/x	0/5 (right side)
IR8100 series	0/2/x	Dependent on the slot configuration. See the Cisco Catalyst IR8140 Heavy Duty Router Installation Guide.
	0/3/x	Dependent on the slot configuration. See the Cisco Catalyst IR8140 Heavy Duty Router Installation Guide.
IR8300 series	0/4/x	Left side
	0/5/x	Right side
ISR1000 series	0/2/x	Back side right
ISR8200 series	0/2/x	Back side center
ISR8300 series	0/2/x	Dependent on module and configuration. See the Hardware Installation Guide for Cisco Catalyst 8300 Series Edge Platforms.
	0/3/x	Dependent on module and configuration. See the Hardware Installation Guide for Cisco Catalyst 8300 Series Edge Platforms.
ISR8200 UCPE	0/2/x	Back side center

Verifying Modem Signal Strength and Service Availability

Procedure

	Command or Action	Purpose
Step 1	**show cellular** *slot* **network** **Example:** `Router# show cellular x/x/x network`	Displays information about the carrier network, cell site, and available service.
Step 2	**show cellular** *slot* **radio details** **Example:**	Shows the radio signal strength.

	Command or Action	Purpose
	`Router# show cellular x/x/x radio details`	**Note** The RSSI should be better than –90 dBm for steady and reliable connection.
Step 3	**show cellular** *slot* **profile** **Example:** `Router# show cellular x/x/x profile`	Shows information about the modem data profiles created.
Step 4	**show cellular** *slot* **security** **Example:** `Router# show cellular x/x/x security`	Shows the security information for the modem, such as SIM and modem lock status.
Step 5	**show cellular** *slot* **all** **Example:** `Router# show cellular x/x/x all`	Shows consolidated information about the modem, profiles created, radio signal strength, network security, and so on.

Example

The following is the output of **show cellular 0/1/0 all** on an IR1101 with a P-LTEAP18-GL.

```
IR1101#show cellular 0/1/0 all
Hardware Information
====================
Modem Firmware Version = 32.00.116
Host Firmware Version = 32.00.007
Device Model ID = LM960A18
International Mobile Subscriber Identity (IMSI) = 310170205101138
International Mobile Equipment Identity (IMEI) = 356299100001310
Integrated Circuit Card ID (ICCID) = 89011702272051011382
Mobile Subscriber Integrated Services
Digital Network-Number (MSISDN) =
Modem Status = Modem Online
Current Modem Temperature = 39 deg C
PRI version = 1026, Carrier = Generic
OEM PRI version = 32101006

Profile Information
====================

Profile 1 = ACTIVE* **
--------
PDP Type = IPv4
PDP address = 10.52.50.241
IPv4 PDP Connection is successful
Access Point Name (APN) = m2m.com.attz
Authentication = None
Primary DNS address = 8.8.8.8
Secondary DNS address = 8.8.4.4

Profile 2 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = m2m.com.attz
Authentication = None

Profile 3 = INACTIVE
```

```
--------
PDP Type = IPv4
Access Point Name (APN) = mmsbouygtel.com
Authentication = None

Profile 5 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = orange
Authentication = None

Profile 16 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = test
Authentication = None

* - Default profile
** - LTE attach profile


Configured default profile for active SIM 0 is profile 1.


Data Connection Information
===========================
Profile 1, Packet Session Status = ACTIVE
Cellular0/1/0:
Data Packets Transmitted = 26 , Received = 24
Data Transmitted = 1900 bytes, Received = 2311 bytes
IP address = 10.52.50.241
Primary DNS address = 8.8.8.8
Secondary DNS address = 8.8.4.4
Profile 2, Packet Session Status = INACTIVE
Profile 3, Packet Session Status = INACTIVE
Profile 4, Packet Session Status = INACTIVE
Profile 5, Packet Session Status = INACTIVE
Profile 6, Packet Session Status = INACTIVE
Profile 7, Packet Session Status = INACTIVE
Profile 8, Packet Session Status = INACTIVE
Profile 9, Packet Session Status = INACTIVE
Profile 10, Packet Session Status = INACTIVE
Profile 11, Packet Session Status = INACTIVE
Profile 12, Packet Session Status = INACTIVE
Profile 13, Packet Session Status = INACTIVE
Profile 14, Packet Session Status = INACTIVE
Profile 15, Packet Session Status = INACTIVE
Profile 16, Packet Session Status = INACTIVE


Network Information
===================
Current System Time = Wed Apr 27 8:48:13 2022
Current Service Status = Normal
Current Service = Packet switched
Current Roaming Status = Roaming
Network Selection Mode = Automatic
Network = F-Bouygues Telecom
Mobile Country Code (MCC) = 208
Mobile Network Code (MNC) = 20
Packet switch domain(PS) state = Attached
LTE Carrier Aggregation state = Deconfigured
Registration state(EMM) = Registered
EMM Sub State = Normal Service
```

```
Tracking Area Code (TAC) = 30440
Cell ID = 128697859
Negotiated network MTU = 1430

Radio Information
=================
Radio power mode = Online
LTE Rx Channel Number(PCC) = 3175
LTE Tx Channel Number(PCC) = 21175
LTE Band = 7
LTE Bandwidth = 15 MHz
Current RSSI = -60 dBm
Current RSRP = -91 dBm
Current RSRQ = -14 dB
Current SNR = 14.8 dB
Physical Cell Id = 378
Number of nearby cells = 1
Idx PCI (Physical Cell Id)
--------------------------------
1 378
Radio Access Technology(RAT) Preference = AUTO
Radio Access Technology(RAT) Selected = LTE
Network Change Event = unknown


LTE bands supported by modem:
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 38 39 40 41 42 43 46 48 66 71.
LTE band Preference settings for the active sim(slot 0):
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 38 39 40 41 42 43 46 48 66 71.

3G bands supported by modem:
Index:
23 - UMTS Band 1: 2100 MHz (IMT)
24 - UMTS Band 2: 1900 MHz (PCS A-F)
26 - UMTS Band 4: 1700 MHz (AWS A-F)
27 - UMTS Band 5: US 850 MHz (CLR)
50 - UMTS Band 8: 900 MHz (E-GSM)
51 - UMTS Band 9: Japan 1700 MHz
61 - UMTS Band 19: 800 MHz (800 Japan)
3G band Preference settings for the active sim(slot 0):
Index:
23 - UMTS Band 1: 2100 MHz (IMT)
24 - UMTS Band 2: 1900 MHz (PCS A-F)
26 - UMTS Band 4: 1700 MHz (AWS A-F)
27 - UMTS Band 5: US 850 MHz (CLR)
50 - UMTS Band 8: 900 MHz (E-GSM)
51 - UMTS Band 9: Japan 1700 MHz
61 - UMTS Band 19: 800 MHz (800 Japan)

==========================================

Band index reference list:

For LTE and 5G, indices 1-128 correspond to bands 1-128.

For 3G, indices 1-64 maps to the 3G bands mentioned against each above.


Modem Security Information
==========================
Active SIM = 0
SIM switchover attempts = 0
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
```

```
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3

Cellular Firmware List
==========================
Idx Carrier FwVersion PriVersion Status
1 Generic 32.00.116 1026 Active
2 Verizon 32.00.126 2022 Inactive
3 ATT 32.00.147 4024 Inactive
4 TMUS 32.00.156 5005 Inactive

Firmware Activation mode = MANUAL

FOTA Information
=================
FOTA Server is not configured

SMS Information
===============
Incoming Message Information
----------------------------
SMS stored in modem = 0
SMS archived since booting up = 0
Total SMS deleted since booting up = 0
Storage records allocated = 25
Storage records used = 0
Number of callbacks triggered by SMS = 0
Number of successful archive since booting up = 0
Number of failed archive since booting up = 0


Outgoing Message Information
----------------------------
Total SMS sent successfully = 0
Total SMS send failure = 0
Number of outgoing SMS pending = 0
Number of successful archive since booting up = 0
Number of failed archive since booting up = 0
Last Outgoing SMS Status = SUCCESS
Copy-to-SIM Status = 0x0
Send-to-Network Status = 0x0
Report-Outgoing-Message-Number:
Reference Number = 0
Result Code = 0x0
Diag Code = 0x0 0x0 0x0 0x0 0x0

SMS Archive URL =

Mobile app service = Not Available

Modem Crashdump Information
===========================
Modem crashdump logging = off

Dying Gasp Information
==========================
Dying Gasp Detach = Disabled
SMS = Disabled


Packet drop stats
=================

Source IP violation stats:
```

```
Total dropped IPv4 packets: 0
Recently violated IPv4 addresses (Max 4):

Total dropped IPv6 packets: 0
Recently violated IPv6 addresses (Max 4):

IR1101#
```

Using Data Profiles

Customized profiles, Access Point Name (APN) in mobile networks, can be created and used on the cellular pluggable module. Maximum number of profiles that can be created are 16.

Each profile is created for a given firmware, for example, AT&T. If you switch to a different firmware, for example, Generic PTCRB, you must create a profile. When two active PDN are supported by the SIM card subscription, each interface for example, cellular 0/x/0 and 0/x/1, should have its dedicated profile created.

When the profile is created, using global or config mode, it is stored in the PIM itself. This means you can create a profile, write erase your configuration to allow PnP process to work, since it requires no configuration on the router.

In cases where profile configurations are not available, separate profiles should be created with required parameters.

Guidelines for Creating, Modifying, or Deleting Modem Data Profiles

Follow these guidelines when you configure a data profile using EXEC mode or Config mode:

- You do not have to make any profile-related changes if your modem comes with a data profile, for instance, AT&T, Sprint, and Verizon.
- If any profile parameter changes are required for a connection type, the changes will likely be carried out in the default profiles.
- To configure different profile types and use them for a different connection, you can create separate profiles with different parameters (for instance, APN names). Note that only one profile is active at a given time.
- Use the **show cellular <slot> profile** command to view the data profile. An asterisk(*) symbol is displayed against the data profile. Double asterisk(**) symbol is displayed against the attach profile.
- The data profile is used to set up a data call. If you want to use a different profile, that profile needs to be made the default one. Use the **lte sim data-profile <number>** command to change the default profile under controller cellular x/x/x.

Creating, Modifying, or Deleting Data Profiles Using EXEC Mode

Customized profiles Access Point Name (APN) in mobile networks can be created and used on the cellular pluggable interface module. Maximum number of profiles that can be created are 16.

Cisco SKU's shipping with specific carrier provisioning file default profiles are already populated and can be deployed readily. These can be found in carrier label under the **show cellular slot hardware** command.

Procedure

	Command or Action	Purpose
Step 1	**cellular** *slot* **lte profile [create | delete]** *profile-number [apn [authentication [username password [bearer-type]]]]* **Example:** `Router# cellular x/x/x lte profile create 2 apn.com pap username pwd ipv4`	Creates, modifies, or deletes a modem data profile in the privileged EXEC mode. • The profile-number argument specifies the profile number created for the modem. • (Optional) The apn argument specifies an Access Point Name (APN). An APN is provided by your service provider. Only a single APN can be specified for a single profile. • (Optional) The authentication parameter specifies the authentication type used. Acceptable parameters are chap, none (no authentication), pap, and pap_chap (PAP or CHAP authentication). • (Optional) The username and password arguments are given by a service provider. These are mandatory when an authentication type other than none is used. • (Optional) The PDN type parameter specifies the type of packet data session established with mobile network using this profile. Acceptable parameters are ipv4, ipv6, and ipv4v6 (IPv4 and IPv6). The **show cellular slot profile** command displays configured profile list. **Note** Single asterisk(*) displayed against data profile. Double asterisk(**) displayed against attached profile.

Example

```
router# show cellular x/x/x profile
Profile 1 = INACTIVE **
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwims
Authentication = None

Profile 2 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwadmin
Authentication = None

Profile 3 = ACTIVE*
--------
PDP Type = IPv4v6
PDP address = 100.119.136.44
```

```
PDP IPV6 address = 2600:1010:B00E:1E11:192D:3E20:199B:3A70/64  Scope: Global
Access Point Name (APN) = VZWINTERNET
Authentication = None
        Primary DNS address = 198.224.173.135
        Secondary DNS address = 198.224.174.135
        Primary DNS IPV6 address = 2001:4888:68:FF00:608:D:0:0
        Secondary DNS IPV6 address = 2001:4888:61:FF00:604:D:0:0

Profile 4 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwapp
Authentication = None

Profile 5 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzw800
Authentication = None

Profile 6 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = CISCO.GW4.VZWENTP
Authentication = None

  * - Default profile
 ** - LTE attach profile
```

```
#show cellular x/x/x profile
Profile 1 = INACTIVE **
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwims
Authentication = None

Profile 2 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwadmin
Authentication = None

Profile 3 = ACTIVE*
--------
PDP Type = IPv4v6
PDP address = 100.86.69.19
PDP IPV6 address = 2600:1010:B040:DA58:1C27:D97:321E:18C4/64  Scope: Global
Access Point Name (APN) = VZWINTERNET
Authentication = None
 Primary DNS address = 198.224.173.135
 Secondary DNS address = 198.224.174.135
 Primary DNS IPV6 address = 2001:4888:68:FF00:608:D:0:0
 Secondary DNS IPV6 address = 2001:4888:61:FF00:604:D:0:0

Profile 4 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwapp
Authentication = None

Profile 5 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzw800
Authentication = None
```

```
Profile 6 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwclass6
Authentication = None

  * - Default profile
 ** - LTE attach profile


Configured default profile for active SIM 0 is profile 3.
```

Note If data and attach profile bindings need modification, use the **controller cellular slot** command.

```
router(config-controller)# lte sim data-profile 3 attach-profile 2 slot slot


Router#show cellular x/x/x profile
Profile 1 = INACTIVE
--------------------------------------------------
PDP Type = IPv4v6
Access Point Name (APN) = test
Authentication = None

Profile 2 = INACTIVE **
--------
PDP Type = IPv4
Access Point Name (APN) = internet
Authentication = PAP or CHAP
Username =  user@solution.com
Password =  cisco

Profile 3 = INACTIVE*
--------
PDP Type = IPv4v6
Access Point Name (APN) = basic
Authentication = None

  * - Default profile
 ** - LTE attach profile
Configured default profile for active SIM 0 is profile 2.
```

Creating, Modifying, or Deleting Data Profiles Using Configuration Mode

Procedure

	Command or Action	Purpose
Step 1	**profile id** *id-number* **apn** *apn-name* **authentication** *username-password* **pdn-type** *pdn-type* **no-overwrite** **Example:** `Router(config-controller) profile id 1 apn apn_internet authentication none pdn-type ipv4 no-overwrite`	Configures a cellular profile in the configuration mode. • The *id* argument specifies the profile number created for the modem. The maximum number of profiles that can be created for each modem is 16. • (Optional) The *apn* argument specifies an Access Point Name (APN) in the profile. An APN is provided by

	Command or Action	Purpose
		your service provider. Only a single APN can be specified in a single profile. • (Optional) The *authentication* parameter specifies the authentication type used. Acceptable parameters are **chap**, **none** (no authentication), **pap**, and **pap_chap** (PAP or CHAP authentication). • (Optional) The *username* and *password* arguments are provided by a service provider. These are mandatory when an authentication type is used other than none. • (Optional) The *PDN-type* parameter specifies the type of packet data session established with mobile network using this profile. Acceptable parameters are: **ipv4**, **ipv6** and **ipv4v6** (IPv4 and IPv6). • (Optional) *No-overwrite* action to be taken when a profile already exists in modem for the profile id. If there is a profile already exists in the modem for this profile id and no-overwrite option is specified, this configuration will not overwrite existing profile. Default is *overwrite*.

Example: Changing a Default Profile

The following example shows how to change a default profile:

```
router(config-controller)# lte sim data-profile 2 attach-profile 1 slot slot
```

The following example shows the output of the **show cellular** command for Verizon network service:

```
router# show cellular x/x/x profile
Profile 1 = INACTIVE **
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwims
Authentication = None

Profile 2 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwadmin
Authentication = None

Profile 3 = ACTIVE*
--------
PDP Type = IPv4v6
PDP address = 100.119.136.44
PDP IPV6 address = 2600:1010:B00E:1E11:192D:3E20:199B:3A70/64  Scope: Global
Access Point Name (APN) = VZWINTERNET
Authentication = None
        Primary DNS address = 198.224.173.135
        Secondary DNS address = 198.224.174.135
```

```
        Primary DNS IPV6 address = 2001:4888:68:FF00:608:D:0:0
        Secondary DNS IPV6 address = 2001:4888:61:FF00:604:D:0:0

Profile 4 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwapp
Authentication = None

Profile 5 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzw800
Authentication = None

Profile 6 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = CISCO.GW4.VZWENTP
Authentication = None

  * - Default profile
 ** - LTE attach profile
```

Example: Cellular Profile Configuration

The following is an example configuration under cellular profile:

```
router(config-controller)# profile id 1 apn apn_internet authentication none pdn-type ipv4
 no-overwrite
```

Controller Cellular Running Configuration

```
Router #show running-config controller cellular <slot>
Building configuration...

Current configuration : 330 bytes
!
controller Cellular x/x/x
profile id 1 apn apn_internet authentication none pdn-type ipv4 no-overwrite
end



 ** This will override exec mode profile configuration
 ** If for a profile ID, configuration CLI exists, exec mode configuration cannot be
performed.

Router #show cellular <slot> profile 5
Profile 5 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = apn_old
Authentication = None

TSN1#cellular <slot> lte profile create 5 apn_new
Warning: You are attempting to create Profile 5
 Profile 5 was configured through controller configuration 'profile id <profile #>'
 Please execute command under controller configuration using '[no] profile id <profile #>'
 for profile 5 to create
 Profile 5 NOT written to modem
```

```
** As part of this enhancement, any attach and/or data profile changes will immediately
trigger a connection reset and take effect. Below warning message will be displayed.

Warning: You are attempting to modify the data/attach profile.
Connection will be reset
```

Applying a Modem Profile in a SIM Configuration

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters the global configuration mode.
Step 2	**controller cellular** *<slot>* **Example:** `Router(config)# controller cellular x/x/x`	Enters the cellular controller configuration mode.
Step 3	**lte sim data-profile** *data-profile-number attach-profile number slot*	Applies the configured profile number to the SIM and its slot number. The default (primary) slot is 0. The attach profile is the profile used by the modem to attach to the cellular network. The data profile is the profile used to send and receive data over the cellular network. The slot number helps specify different data and attach profiles for two different carrier SIMs.

Data Call Setup

To set up a data call, use the following procedures:

Configuring the Cellular Interface

Note A NAT configuration may be needed to get full IP connectivity. See the example below.

To configure the cellular interface, enter the following commands starting in EXEC mode.

If a tunnel interface is configured with **ip unnumbered cellular x/x/x**, it is necessary to configure the actual static IP address under the cellular interface, in place of **ip address negotiated** assuming your mobile carrier allows it.

Note As a best practice, you should not use the cellular interface IP address for the tunnel.

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**interface cellular** *slot* **Example:** `Router(config)# interface cellular x/x/x`	Specifies the cellular interface.
Step 3	**ip address negotiated** **Example:** `Router(config-if)# ip address negotiated`	Specifies that the IP address for a particular interface is dynamically obtained.
Step 4	**dialer in-band** **Example:** `Router(config-if)# dialer in-band`	Enables DDR and configures the specified serial interface to use in-band dialing.
Step 5	**dialer watch-group** *<group-number>* **Example:** `Router(config-if)# dialer watch-group 1`	Specifies the number of the dialer access group to which the specific interface belongs.
Step 6	**exit** **Example:** `Router(config-if)# exit`	Enters the global configuration mode.
Step 7	**ip route** *<network-number> <network-mask> {<ip-address> | <interface>} [<administrative distance>]* [**name** *<name>*] **Example:** `Router(config)# ip route 209.165.200.225 255.255.255.224 cellular x/x/x`	Establishes a floating static route with the configured administrative distance through the specified interface. **Note** A higher administrative distance should be configured for the route through the backup interface so that it is used only when the primary interface is down.
Step 8	**dialer-list** *<dialer-group>* **protocol** *<protocol-name>* **permit | deny | list** *access-list-number | access-group* **Example:** `Router(config)# dialer-list 1 protocol ip list 1`	Creates a dialer list for traffic of interest and permits access to an entire protocol.

Example

```
unicast-routing
ipv6
interface Cellular0/2/0
ip address negotiated
ip nat outside
dialer in-band
dialer idle-timeout 0
dialer watch-group 1
ipv6 enable
no shutdown

interface GigabitEthernet0/0/0
 ip address 192.168.60.1 255.255.255.0
 ip nat inside
 ipv6 address autoconfig

ip nat inside source list 1 interface Cellular0/1/0 overload
ip route 0.0.0.0 0.0.0.0 Cellular0/1/0
ipv6 route ::/0 Cellular0/1/0

ip access-list standard 1
 10 permit 192.168.60.0 0.0.0.255
dialer watch-list 1 ip 5.6.7.8 255.255.255.255
dialer-list 1 protocol ip permit
```

Configure Cellular Interface with dialer watch-group

A dialer watch-group allows you to define a group of routes based on IP address and mask and assign that group to a group-number. If no routes to these networks are in the routing table, the router dials a backup connection.

To configure the cellular interface with dialer watch-group, enter the following commands starting in EXEC mode.

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**interface cellular** *slot* **Example:** `Router(config)# interface cellular x/x/x`	Specifies the cellular interface.
Step 3	**ip address negotiated** **Example:** `Router(config-if)# ip address negotiated`	Specifies that the IP address for a particular interface is dynamically obtained.

	Command or Action	Purpose
Step 4	**dialer in-band** **Example:** `Router(config-if)# dialer in-band`	Enables DDR and configures the specified serial interface to use in-band dialing.
Step 5	**ip address negotiated** **Example:** `Router(config-if)# ip address negotiated`	Specifies that the IP address for a particular interface is dynamically obtained.
Step 6	**dialer idle-timeout** *<seconds>* **Example:** `Router(config-if)# dialer idle-timeout 30`	Specifies the duration of idle time, in seconds, after which a line has no outbound traffic. “0” second means no idle timeout. The default idle timeout is 120 seconds if there is no idle timer specified.
Step 7	**dialer watch-group** *<group-number>* **Example:** `Router(config-if)# dialer watch-group 1`	Enables Dialer Watch on the specific interface.
Step 8	**exit** **Example:** `Router(config-if)# exit`	Enters the global configuration mode.
Step 9	**dialer-list** *<dialer-group>* **protocol** *<protocol-name>* {**permit | deny | list**} *<access-list-number>* *<group-number>* **Example:** `Router(config)# dialer-list 1 protocol ip list 1`	Creates a dialer list for traffic of interest and permits access to an entire protocol.
Step 10	**access-list** *<access-list-number>* **permit** *<ip-source-address>* **Example:** `Router(config)# access-list 1 permit any`	Defines traffic of interest.
Step 11	**dialer watch-list** *<watch-group number>* *<ip>* *<ip mask>* **Example:** `Router(config)# dialer watch-list 1 ip 5.6.7.8 255.255.255.255`	Defines traffic of interest.
Step 12	**dialer watch-list** *<watch-group number>* **delay route-check initial** *<time in seconds>* **Example:** `Router(config)# dialer watch-list 1 delay route-check initial 60`	Defines traffic of interest.
Step 13	**dialer watch-list** *<watch-group number>* **delay connected** *<seconds>*	Defines traffic of interest.

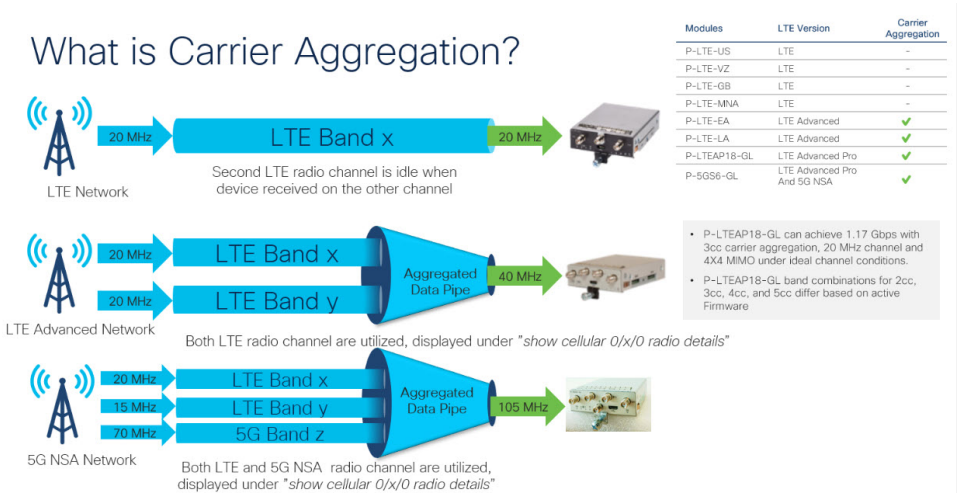
	Command or Action	Purpose
	Example: `Router(config)# dialer watch-list 1 delay connect 1`	

Carrier Aggregation

Carrier aggregation makes it possible for carriers to transmit data to a device like a wireless router over multiple network bands at once, through a single "aggregated data pipe." LTE Advanced with carrier aggregation utilizes multiple frequency bands at once, devices switch frequency bands in just a few milliseconds. Additionally, even if one band drops, the device stays connected via the second band in the aggregated data pipe.

Refer to the following figure for an example:

Figure 6: Carrier Aggregation



Carrier aggregation can be monitored by using the show cellular 0/x/0 radio details command:

```
IR1821#show cell 0/4/0 radio details
 Modem Radio is Online
 Main Antenna details:
 RSSI = -51 dBm
 RSRP = 75 dBm
 Diversity Antenna details:
 RSSI = -54 dBm
 RSRP = 81 dBm
 SCC information available
 SCC[0]:
 PCI = 27
 State = Deactivated
 Band = 3
 Rx Channel Number = 1850
 Bandwidth = 20 MHz
 SCC[1]:
 PCI = 27
 State = Deactivated
 Band = 1
 Rx Channel Number = 251
```

```
 Bandwidth = 10 MHz
 SCC[2]:
 PCI = 27
 State = Deactivated
 Band = 7
 Rx Channel Number = 3175
 Bandwidth = 15 MHz
 SCC[3]: Not Available

PCC CA information:
 LTE band class = Band 20
 E-UTRA absolute radio frequency channel number of the serving cell = 6200
 Bandwidth = 10 MHz
 Physical Cell Id = 27
 Current RSRP in 1/10 dBm as measured by L1 = -75
 Current RSSI in 1/10 dBm as measured by L1 = -49
 Current RSRQ in 1/10 dBm as measured by L1 = -10
 Measured SINR in dB = 136
 Tracking area code information for LTE = 30440

 SCC 0 CA information:
 LTE band class = Band 3
 E-UTRA absolute radio frequency channel number of the serving cell = 1850
 Bandwidth = 20 MHz
 Physical Cell Id = 27
 Current RSRP in 1/10 dBm as measured by L1 = -89
 Current RSSI in 1/10 dBm as measured by L1 = -64
 Current RSRQ in 1/10 dBm as measured by L1 = -5
 Measured SINR in dB = 0
 Current SCC state = Configured
```

Example: Showing Carrier Aggregation

The following are examples of an IR1101 showing carrier aggregation (CA) for both 4G/LTE and 5G NSA.

First is **show cellular 0/1/0 all** Notice the radio section only contains details on the Primary Channel that is also used for Control Plane.

```
Router#show cell 0/1/0 all
Hardware Information
====================
Modem Firmware Version = M0H.030200-B012
Host Firmware Version = A0H.000300-B012
Device Model ID =  FN980
International Mobile Subscriber Identity (IMSI) = 208018903906177
International Mobile Equipment Identity (IMEI) = 359661100035944
Integrated Circuit Card ID (ICCID) = 89330120410034176680
Mobile Subscriber Integrated Services
Digital Network-Number (MSISDN) =
Modem Status = Modem Online
Current Modem Temperature = 42 deg C
PRI version = 0880-109, Carrier = Generic GCF
OEM PRI version = 0880-109

Profile Information
====================

Profile 1 = ACTIVE* **
--------
PDP Type = IPv4
PDP address = 10.44.198.163
IPv4 PDP Connection is successful
Access Point Name (APN) = orange
```

```
Authentication = None
       Primary DNS address = 192.168.10.110

Profile 2 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = ims
Authentication = None

Profile 15 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = Broadband
Authentication = None

  * - Default profile
 ** - LTE attach profile


Configured default profile for active SIM 0 is profile 1.

Data Connection Information
===========================
Profile 1, Packet Session Status = ACTIVE
       Cellular0/1/0:
       Data Packets Transmitted = 9249463 ,  Received = 9382548
       Data Transmitted = 2289007661 bytes, Received = 3415239855 bytes
        IP address = 10.44.198.163
       Primary DNS address = 192.168.10.110
Profile 2, Packet Session Status = INACTIVE
Profile 3, Packet Session Status = INACTIVE
Profile 4, Packet Session Status = INACTIVE
Profile 5, Packet Session Status = INACTIVE
Profile 6, Packet Session Status = INACTIVE
Profile 7, Packet Session Status = INACTIVE
Profile 8, Packet Session Status = INACTIVE
Profile 9, Packet Session Status = INACTIVE
Profile 10, Packet Session Status = INACTIVE
Profile 11, Packet Session Status = INACTIVE
Profile 12, Packet Session Status = INACTIVE
Profile 13, Packet Session Status = INACTIVE
Profile 14, Packet Session Status = INACTIVE
Profile 15, Packet Session Status = INACTIVE
Profile 16, Packet Session Status = INACTIVE

Network Information
===================
Current System Time = Wed Apr 20 12:29:50 2022
Current Service Status = Normal
Current Service = Packet switched
Current Roaming Status = Home
Network Selection Mode = Automatic
Network = Orange F
Mobile Country Code (MCC) = 208
Mobile Network Code (MNC) = 1
Packet switch domain(PS) state = Attached
Registration state(EMM) = Registered
EMM Sub State = Normal Service
Tracking Area Code (TAC) = 50443
Cell ID = 24246021
Negotiated network MTU = 1500

Radio Information
=================
```

```
Radio power mode = Online
LTE Rx Channel Number(PCC) =  6400
LTE Tx Channel Number(PCC) =  24400
LTE Band =  20
LTE Bandwidth = 10 MHz
Current RSSI = -57 dBm
Current RSRP = -87 dBm
Current RSRQ = -13 dB
Current SNR = 13.2  dB
Physical Cell Id = 48
Number of nearby cells = 2
Idx      PCI (Physical Cell Id)
--------------------------------
1              48
2              242
Radio Access Technology(RAT) Preference = AUTO
Radio Access Technology(RAT) Selected = LTE
Network Change Event = activated 5G ENDC


LTE bands supported by modem:
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 34 38 39 40 41 42 43 46 48 66
 71.
LTE band Preference settings for the active sim(slot 0):
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 34 38 39 40 41 42 43 46 48 66
 71.

NR5G bands supported by modem:
- Bands 1 2 3 5 7 8 12 20 25 28 38 40 41 48 66 71 77 78 79.
NR5G band Preference settings for the active sim(slot 0):
- Bands 1 2 3 5 7 8 12 20 25 28 38 40 41 48 66 71 77 78 79.

3G bands supported by modem:
Index:
  23 - UMTS Band 1: 2100 MHz (IMT)
  24 - UMTS Band 2: 1900 MHz (PCS A-F)
  26 - UMTS Band 4: 1700 MHz (AWS A-F)
  27 - UMTS Band 5: US 850 MHz  (CLR)
  50 - UMTS Band 8: 900 MHz  (E-GSM)
  51 - UMTS Band 9: Japan 1700 MHz
  61 - UMTS Band 19: 800 MHz (800 Japan)
3G band Preference settings for the active sim(slot 0):
Index:
  23 - UMTS Band 1: 2100 MHz (IMT)
  24 - UMTS Band 2: 1900 MHz (PCS A-F)
  26 - UMTS Band 4: 1700 MHz (AWS A-F)
  27 - UMTS Band 5: US 850 MHz  (CLR)
  50 - UMTS Band 8: 900 MHz  (E-GSM)
  51 - UMTS Band 9: Japan 1700 MHz
  61 - UMTS Band 19: 800 MHz (800 Japan)

==========================================

Band index reference list:

For LTE and 5G, indices 1-128 correspond to bands 1-128.

For 3G, indices 1-64 maps to the 3G bands mentioned against each above.


Modem Security Information
==========================
Active SIM = 0
SIM switchover attempts = 0
```

```
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3

Cellular Firmware List
==========================
 Idx Carrier              FwVersion        PriVersion   Status
 1   Generic GCF          M0H.030200-B012  0880         Active

Firmware Activation mode  =  MANUAL

Modem image running: Main
Mobile Network Operator: Generic GCF
Number of MNO's = 14
 Index MNO ID  MNO NAME
 1     0       Generic GCF
 2     1       Generic PTCRB
 3     10      AT&T
 4     11      T-Mobile
 5     12      Verizon Wireless
 6     14      Bell
 7     15      Rogers
 8     16      Telus
 9     20      SK Telecom
 10    21      SK Telecom Dongle
 11    30      NTT Docomo
 12    31      KDDI
 13    40      Telstra
 14    50      Anatel

FOTA Information
=================
FOTA Server is not configured

GPS Information
==========================
GPS Feature =  enabled
GPS Mode Configured =  standalone
GPS Port Selected =  Dedicated GPS port
GPS Status =  GPS acquiring
Last Location Fix Error =  Offline [0x0]
Latitude =  0 Deg 0 Min 0 Sec North
Longitude =  0 Deg 0 Min 0 Sec East
Timestamp (GMT) =  Sun Jan  6 00:00:00 1980

Fix type =  2D, Height =  0 m
HDOP =  , GPS Mode Used =  not configured

Satellite Info
----------------

SMS Information
===============
Incoming Message Information
----------------------------
SMS stored in modem = 1
SMS archived since booting up = 0
Total SMS deleted since booting up = 0
Storage records allocated = 25
Storage records used = 1
Number of callbacks triggered by SMS = 0
Number of successful archive since booting up = 0
Number of failed archive since booting up = 0
```

```
Outgoing Message Information
----------------------------
Total SMS sent successfully = 0
Total SMS send failure = 0
Number of outgoing SMS pending = 0
Number of successful archive since booting up = 0
Number of failed archive since booting up = 0
Last Outgoing SMS Status = SUCCESS
Copy-to-SIM Status =     0x0
Send-to-Network Status = 0x0
Report-Outgoing-Message-Number:
  Reference Number =     0
  Result Code =          0x0
  Diag Code =            0x0 0x0 0x0 0x0 0x0

SMS Archive URL =

Mobile app service = Not Available

Modem Crashdump Information
===========================
Modem crashdump logging = off

Dying Gasp Information
==========================
 Dying Gasp Detach =  Disabled
 SMS =  Disabled


Packet drop stats
=================

Source IP violation stats:
 Total dropped IPv4 packets: 0
 Recently violated IPv4 addresses (Max 4):

 Total dropped IPv6 packets: 0
 Recently violated IPv6 addresses (Max 4):
#Router
```

Next, the **`show cellular 0/1/0 radio details`** displays all Secondary Channels (SCC) for both 4G/LTE and 5G NSA (ENDC). Each channel displays its band and channel bandwidth, for example, 5G channel is band n78 and 90MHz bandwidth, as well as Radio signal quality.

```
Router#show cell 0/1/0 radio details
 Modem Radio is Online
 Main 0 Antenna details:
 RSSI = -57 dBm
 RSRP = 87 dBm
 Diversity 0 Antenna details:
 RSSI = -59 dBm
 RSRP = 89 dBm

 SCC information available
 SCC[0]:
 PCI = 48
 State = Deactivated
 Band = 3
 Rx Channel Number = 1300
 Bandwidth = 20 MHz
 SCC[1]:
 PCI = 48
 State = Deactivated
```

```
 Band = 7
 Rx Channel Number = 3000
 Bandwidth = 20 MHz
 SCC[2]:
 PCI = 48
 State = Deactivated
 Band = 1
 Rx Channel Number = 524
 Bandwidth = 15 MHz
 SCC[3]: Not Available

 5G CC information:
 ENDC active band = 78
 ENDC Bandwidth (MHz) = 90
 ENDC active downlink channel = 650400
 ENDC active uplink channel = 650400
 ENDC Physical Cell Id = 99
 Current ENDC RSRP in 1/10 dBm as measured by L1 = -111
 Current ENDC RSSI in 1/10 dBm as measured by L1 = -100
 Current ENDC RSRQ in 1/10 dBm as measured by L1 = -11
 Measured ENDC SINR in dB = 95

PCC CA information:
 LTE band class = Band 20
 E-UTRA absolute radio frequency channel number of the serving cell = 6400
 Bandwidth = 10 MHz
 Physical Cell Id = 48
 Current RSRP in 1/10 dBm as measured by L1 = -87
 Current RSSI in 1/10 dBm as measured by L1 = -58
 Current RSRQ in 1/10 dBm as measured by L1 = -12
 Measured SINR in dB = 163
 Tracking area code information for LTE = 50443

 SCC 0 CA information:
 LTE band class = Band 3
 E-UTRA absolute radio frequency channel number of the serving cell = 1300
 Bandwidth = 20 MHz
 Physical Cell Id = 48
 Current RSRP in 1/10 dBm as measured by L1 = -98
 Current RSSI in 1/10 dBm as measured by L1 = -74
 Current RSRQ in 1/10 dBm as measured by L1 = -4
 Measured SINR in dB = 0
 Current SCC state = Configured

 SCC 1 CA information:
 LTE band class = Band 7
 E-UTRA absolute radio frequency channel number of the serving cell = 3000
 Bandwidth = 20 MHz
 Physical Cell Id = 48
 Current RSRP in 1/10 dBm as measured by L1 = -115
 Current RSSI in 1/10 dBm as measured by L1 = -95
 Current RSRQ in 1/10 dBm as measured by L1 = -3
 Measured SINR in dB = 0
 Current SCC state = Configured

 SCC 2 CA information:
 LTE band class = Band 1
 E-UTRA absolute radio frequency channel number of the serving cell = 524
 Bandwidth = 15 MHz
 Physical Cell Id = 48
 Current RSRP in 1/10 dBm as measured by L1 = -101
 Current RSSI in 1/10 dBm as measured by L1 = -76
 Current RSRQ in 1/10 dBm as measured by L1 = -6
 Measured SINR in dB = 0
```

```
 Current SCC state = Configured
Router#
```

Configuring Cellular Modem Link Recovery

The cellular modem link recovery feature is disabled by default, and it is recommended to enable the link recovery feature.

Note No manual operations or automated scripts interacting with 4G modems may be possible until and unless the modems have come fully in-service. Modems may take a few minutes after platform bootup and CLI available to be able to allow full interaction and establish IP connectivity. A typical modem power-cycle may also take approximately 4 minutes before any interaction is possible. Modems are in-service after the console displays the following message:

%CELLWAN-2-MODEM_RADIO: Cellularx/x/x Modem radio has been turned on

To enable or disable the cellular modem link recovery feature, if required, perform the following steps:

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**controller cellular** *<slot>* **Example:** `Router(config)# controller cellular x/x/x`	Enters cellular controller configuration mode.

Step 3	**{lte | no lte} modem link-recovery disable**
	Example:
	`Router(config-controller)#lte modem link-recovery disable`
	
	`Router(config-controller)# no lte modem link-recovery disable`
	
	`Router#show run | sec controller Cellular x/x/x`
	`lte modem link-recovery rssi onset-threshold -110`
	`lte modem link-recovery monitor-timer 20`
	`lte modem link-recovery wait-timer 10`
	`lte modem link-recovery debounce-count 6`
	
	`Example:`
	`Router#configure terminal`
	`Router(config)#controller Cellular x/x/x`
	`Router(config-controller)#lte modem link-recovery monitor-timer 30`
		Enables or disables the cellular modem link recovery feature.
		Enables or disables the cellular modem link recovery feature.
		Once we enable link-recovery, the default Cisco recommended values for link-recovery parameters are populated.
		We can change the values of link-recovery parameters from the default Cisco recommended values, by using cli for each parameter like in example.
		Note Changing the default recommended cisco values is not advised as it will impact ideal performance of link-recovery feature.

	Command or Action	Purpose

	`Router(config-controller)#lte modem wait-timer 15`
	`Router(config-controller)#lte modem debounce-count 8`
	`Router(config-controller)#lte modem rssi onset-threshold -100`	

Step 4	**end** **Example:** `Router(config)# end`	Exits the configuration mode and returns to the privileged EXEC mode.

Cellular Modem Link Recovery Parameters

There are four configurable parameters to adjust the behavior of cellular link recovery. The default values optimized for the best performance of the feature and changing it is not recommended unless advised by Cisco.

The following table explains the link recovery parameters.:

Table 10: Link Recovery Parameters

Parameter	Description
rssi onset-threshold	This parameter defines the RSSI value below which the link recovery feature triggers additional scrutiny to look for potential issues and act if needed. The range of this parameter can be set from -90 dBm to -125 dBm. The recommended and default value is -110 dBm.
monitor-timer	This parameter determines how often link recovery looks for potential issues. The default value for this parameter is 20 seconds meaning that link recovery feature will be triggered every 20 seconds and look at certain parameters to determine if there is a potential issue. You can configure the monitor-timer range between 20 to 60 seconds. Increasing the monitor timer value above 20 seconds will increase the response time of the feature.

Parameter	Description
wait-timer and debounce-count	The wait-timer parameter is used in conjunction with the debounce-count parameter to perform more frequent, additional checks, once the link recovery feature has identified a potential issue that needs to be recovered from, with a modem power-cycle. The default value for wait-timer is 10 seconds and the default value for debounce- count is 6. With this setting, once link recovery has identified an inoperative modem state, it performs additional checks every 10 seconds, up to 6 times, to determine if the issue has been resolved without a modem power-cycle. Reducing the debounce-count and the wait-timer makes faster link recovery, while reducing them may increase the time for recovery. The configurable range for wait-timer is 5-60 seconds. The configurable range for debounce-count is 6-20 seconds.

Verifying the Cellular Modem Link Recovery Configuration

To determine if the cellular modem link recovery is enabled, use the **show controller cellular slot** command.

```
Router# show controller cellular 0/4/0

Interface Cellular0/4/0
5G Advanced Pro CAT-18 pluggable-Global Multimode LTE/LTE-A/LTE-AP/DC-HSPA+/HSP unit 4

Cellular Modem Configuration
==============================
Modem is recognized as valid
Power save mode is OFF
manufacture id = 0x00001BC7 product id = 0x00001050
Telit Wireless Direct IP FN980 modem
Modem Uplink Speed = 542000 kbit.
Modem Downlink Speed = 3800000 kbit.

GPS Feature = enabled
GPS Status = NMEA Disabled
GPS Mode = standalone
GPS Port selected = Dedicated GPS port

Cellular Dual SIM details:
---------------------------
SIM 0 is not present
SIM 1 is present
SIM 1 is active SIM

Module OIR Details
-----------------------------------------------
Module type : P-5GS6-GL
Module Serial Number : FOC25031VY2
Module Last Inserted on : Tue Apr 19 17:44:45 2022
-----------------------------------------------

Module Reload Statistics
-------------------------
Soft OIR reloads = 0
```

```
Hard OIR reloads = 0
-------------------------

Modem Management Statistics
---------------------------
Modem resets = 4
Modem timeouts = 0
Link recovery is ON

Registration check is ON
RSSI threshold value is -110 dBm
Monitor Timer value is 20 seconds
Wait Timer value is 10 seconds
Debounce Count value is 6

Link recovery count is 0
User initiated Modem Commands
---------------------------------
Modem user initiated power-cycles = 0
Successful Modem Power Cycles = 0
Failed Modem Power Cycles = 0
Modem user initiated resets = 0
Successful Modem Resets = 0
Failed Modem Resets = 0
Last known modem state = 'application' mode
AT Command Port = /dev/cwan_ttyUSB5
NMEA Port = /dev/cwan_ttyUSB4
DM Port = /dev/cwan_ttyUSB3

DIP MDM link status retry count = 0 pdp context = 0
DIP MDM link up pending = 0 pdp context = 0
DIP MDM link status retry count = 0 pdp context = 1
DIP MDM link up pending = 0 pdp context = 1
DIP MDM link status retry count = 0 pdp context = 2
DIP MDM link up pending = 0 pdp context = 2
IDB with pending DIP call = Cellular0/4/0
IDB Cellular0/4/0: DIP profile id = 1
IDB Cellular0/4/1: DIP profile id = 255
PDN 0 Channel rate (bps) tx = 542000000, rx = 3800000000
Max rate (bps) tx = 542000000, rx = 3800000000
PDN 1 Channel rate (bps) tx = 542000000, rx = 3800000000
Max rate (bps) tx = 542000000, rx = 3800000000
GPS NMEA port = Disabled (Stream OFF)
NMEA queue depth = 0
NMEA packet count = 0
NMEA Stream no: 1 Not Configured
NMEA Stream no: 2 Not Configured
NMEA Stream no: 3 Not Configured
NMEA Stream no: 4 Not Configured
NMEA Stream no: 5 Not Configured
NMEA Stream no: 6 Not Configured
DM port = Disabled


Modem Callback Statistics
---------------------------
PacketServiceCallback_count 1
DataBearerCallback_count 0
DormancyStatusCallback_count 0
PowerCallback_count 0
ByteTotalsCallback_count 0
iByteTotalsCallback_count 0
PacketsCountCallback_count 0
iPacketsCountCallback_count 0
```

```
ActivationStatusCallback_count 0
MobileIPStatusCallback_count 0
RoamingIndicatorCallback_count 0
DataCapabilitiesCallback_count 0
SignalStrengthCallback_count 0
iSignalStrengthCallback_count 0
RFInfoCallback_count 0
LURejectCallback_count 0
NewSMSCallback_count 8
SLQSSMSEventCallback_count 0
NMEACallback_count 0
PDSStateCallback_count 0
CATEventCallback_count 0
iCATEventCallback_count 0
DeviceStateChangeCbk_count 7
FwDldCompletionCbk_count 0
SLQSOMADMAlertCallback_count 0
OMADMStateCallback_count 0
SLQSServingSystemCallback_count 0
SLQSBandPreferenceCbk_count 0
USSDReleaseCallback_count 0
USSDNotificationCallback_count 0
SLQSSignalStrengthsCallback_count 0
iSLQSSignalStrengthsCallback_count 0
SLQSSDKTerminatedCallback_count 0
SLQSTransLayerInfoCallback_count 0
SLQSTransNWRegInfoCallback_count 0
SLQSSysSelectionPrefCallBack_count 0
NotifySessionStateDisconnect_count 0
WdsEventCallback_count 87
HeartbeatModemStatisticsCallback_count 0

idb at 0xFFFF6EA094A8, driver data structure at 0xFFFF6EA0B0A0


Cellular Linux F/W Info
-----------------------

Firmware Version = A0H.000300-B016

Modem SDK and Driver Information
--------------------------------

The Current Modem SDK Version is SDK Lite Telit sdk 1.0.29.0
Modem USB-Serial Driver Version is GobiSerial
Modem USB-Net Driver Version is GobiNet
```

When the cellular modem link recovery occurs and modem is power cycled, you can see the %CELLWAN-2-MODEM_DOWN message on the console logs and additionally there is a %CELLWAN-2-LINK_RECOVERY message which indicates that action has been taken by the cellular modem link recovery feature.

Whenever the cellular modem link recovery has occurred, it updates the Modem timeouts counter under the Modem Management Statistics section of the **show controller cellular slot** command output. Modem parameters at the last timeout section has information that helps to identify the cause of the issue that triggered link recovery

In the following example log, the messages, modem time out counter, and modem parameters at the last time out are highlighted.

***Jul 19 17:15:18.980 PDT: %CELLWAN-2-LINK_RECOVERY: Cellular x/x/x: Cellular Modem has been power cycled**

Configuring Cellular IPv6 Address

Cellular IPv6 Address

IPv6 addresses are represented as a series of 16-bit hexadecimal fields separated by colons (:) in the format: x:x:x:x:x:x:x:x. Following are two examples of the same IPv6 address:

- 2001:CDBA:0000:0000:0000:0000:3257:9652
- 2001:CDBA::3257:9652 (zeros can be omitted)

IPv6 addresses commonly contain successive hexadecimal fields of zeros. Two colons (::) may be used to compress successive hexadecimal fields of zeros at the beginning, middle, or end of an IPv6 address (the colons represent successive hexadecimal fields of zeros). The table below lists compressed IPv6 address formats.

An IPv6 address prefix, in the format ipv6-prefix/prefix-length, can be used to represent bit-wise contiguous blocks of the entire address space. The ipv6-prefix must be in the form documented in RFC 2373 where the address is specified in hexadecimal using 16-bit values between colons. The prefix length is a decimal value that indicates how many of the high-order contiguous bits of the address comprise the prefix (the network portion of the address). For example, 2001:cdba::3257:9652 /64 is a valid IPv6 prefix.

IPv6 Unicast Routing

An IPv6 unicast address is an identifier for a single interface, on a single node. A packet that is sent to a unicast address is delivered to the interface identified by that address.

The Router supports the following address types:

Link-Local Address

A link-local address is an IPv6 unicast address that can be automatically configured on any interface using the link-local prefix FE80::/10 (1111 1110 10) and the interface identifier in the modified EUI-64 format. A link-local address is automatically configured on the cellular interface when an IPv6 address is enabled.

After the data call is established, the link-local address on the cellular interface is updated with the host generated link-local address that consists of the link-local prefix FF80::/10 (1111 1110 10) and the auto-generated interface identifier from the USB hardware address. The figure below shows the structure of a link-local address.

Global Address

A global IPv6 unicast address is defined by a global routing prefix, a subnet ID, and an interface ID. The routing prefix is obtained from the PGW. The Interface Identifier is automatically generated from the USB hardware address using the interface identifier in the modified EUI-64 format. The USB hardware address changes after the router reloads.

Configuring Cellular IPv6 Address

To configure the cellular IPv6 address, perform these steps:

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 unicast-routing** **Example:** `Router# ipv6 unicast-routing`	Enable IPv6 routing globally on the router.
Step 3	**interface cellular** <*slot/port/interface*> **Example:** `Router(config)# interface cellular 0/1/0`	Specifies the cellular interface.
Step 4	**description** <*text*> **Example:** `Router(config-if)# description text`	Provides a description for the cellular interface, if desired.
Step 5	**ipv6 address** <*options*> **Example:** `Router(config-if)# ipv6 address negotiated`	Specifies that the IP address for a particular interface is dynamically obtained.
Step 6	**load-interval** <*seconds*> **Example:** `Router(config-if)# load-interval 30`	Specifies the length of time for which data is used to compute load statistics.
Step 7	**dialer in-band** **Example:** `Router(config-if)# dialer in-band`	Enables DDR and configures the specified serial interface to use in-band dialing.
Step 8	**dialer idle-timeout** <*seconds*> **Example:** `Router(config-if)# dialer idle-timeout 0`	Specifies the dialer idle timeout period.
Step 9	**dialer watch-group** <*group number*> **Example:** `Router(config-if)# dialer watch-group 1`	Specifies the number of the dialer access group to which the specific interface belongs.
Step 10	**ipv6 enable** **Example:** `Router(config-if)# ipv6 enable`	Enables IPv6.
Step 11	**pulse time** <*seconds*> **Example:** `Router(config-if)# pulse-time 1`	Define pulse time

	Command or Action	Purpose
Step 12	**ip virtual-reassembly** **Example:** `Router(config-if)# ip virtual-reassembly`	Enable Virtual Fragment Reassembly (default is 'in' only).
Step 13	**no shutdown** **Example:** `Router(config-if)#no shutdown`	No shutdown the interface
Step 14	**exit** **Example:** `Router(config-if)#exit`	Exit from the interface configuration.
Step 15	**access-list 1 permit any** **Example:** `Router(config)#access-list 1 permit any`	Defines traffic of interest.
Step 16	**dialer watch-list 1** <*ipaddress*> < *mask*> **Example:** `Router(config)#dialer watch-list 1 ip 5.6.7.8 255.255.255.255`	Defines IP and mask for a watch list.
Step 17	**dialer watch-list 1 delay route-check initial 60** **Example:** `Router(config)#dialer watch-list 1 delay route-check initial 60`	Defines delay for a route check.
Step 18	**dialer watch-list 1 delay connect 1** **Example:** `Router(config)#dialer watch-list 1 delay connect 1`	Defines delay for connect.
Step 19	**dialer-list 1 protocol ip permit** **Example:** `Router(config)#dialer-list 1 protocol ip permit`	Defines a dial-on-demand routing (DDR) dialer list for dialing by protocol or by a combination of a protocol and a previously defined access list.
Step 20	**dialer-list 1 protocol ipv6 permit** **Example:** `Router(config)#dialer-list 1 protocol ipv6 permit`	Permits IPv6 on the dialer list.
Step 21	**ipv6 route** <*destination ipv6 prefix*> / <*destination mask*> *{forwarding router address | interface | other options}* **Example:** `Router(config)#ipv6 route ::/0 Cellular0/1/0`	Defines the route.

	Command or Action	Purpose
Step 22	**end** **Example:** `Router(config)#end`	Exits to global configuration mode.

Examples

The following example shows the Cellular IPv6 configuration .

```
lte sim data-profile 1 attach-profile 1 slot 0
 lte sim data-profile 1 attach-profile 1 slot 1
 lte interface 0 64 1111:2222:3333:0001
 lte gps mode standalone
 lte modem dm-log size 2
 lte modem dm-log filesize 1
 lte modem dm-log rotation
 lte modem link-recovery disable
!
!
interface Loopback0
 ip address 1.1.1.1 255.255.255.255
!
!
interface Cellular0/1/0
 description Cell-to-CMW
 ip address negotiated
 load-interval 30
 dialer in-band
 dialer idle-timeout 0
 dialer watch-group 1
 ipv6 enable
 pulse-time 1
 ip virtual-reassembly
!
interface Cellular0/1/1
 no ip address
 shutdown
!
…
ip route 0.0.0.0 0.0.0.0 Cellular0/1/0
ipv6 route ::/0 Cellular0/1/0
…
!
access-list 1 permit any
dialer watch-list 1 ip 5.6.7.8 255.255.255.255
dialer watch-list 1 delay route-check initial 60
dialer watch-list 1 delay connect 1
dialer-list 1 protocol ip permit
dialer-list 1 protocol ipv6 permit
!
```

Configuring a Deterministic IPv6 Host Address

Deterministic IPv6 addresses allow a user to configure a static, user-specified IPv6 address host portion for the interface. While IPv6 address network and subnet parts may be assigned by the ISP, the host part remains unchanged using this configuration. This allows devices to have known, pre-determined IPv6 addresses in their network.

To configure a deterministic IPv6 host address, perform these steps:

Procedure

	Command or Action	Purpose
Step 1	**config terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**ipv6 unicast-routing** **Example:** `Router(config)# ipv6 unicast-routing`	Enable IPv6 routing.
Step 3	**interface cellular** *<slot>* **Example:** `Router(config)# interface Cellular 0/1/0`	Specifies the cellular interface.
Step 4	**enable ipv6** **Example:** `Router(config-if)# enable ipv6`	Enables IPv6.
Step 5	**ipv6 address autoconfig** **Example:** `Router(config-if)# ipv6 address autoconfig`	Enables automatic configuration of IPv6 addresses using stateless autoconfiguration on an interface and enables IPv6 processing on the interface.
Step 6	**no shut** **Example:** `Router(config-if)#no shut`	Shutdown Interface.
Step 7	**controller cellular** *<slot>* **Example:** `Router(config)# controller cellular 0/1/0`	Configure the controller.
Step 8	**lte interface** *<interface number> <address length 48-80> <deterministic address suffix>* **Example:** `Router(config)# lte interface 0 64 1111:2222:3333:1234`	Specify in controller config the deterministic IPv6 address for cellular interface.
Step 9	**end**	

	Command or Action	Purpose
	Example: `Router# end`	
Step 10	**clear int cellular 0/1/0** **Example:** `Router# clear int cellular 0/1/0`	Clears the cellular interface and forces the cellular interface to reacquire IP address.

Example

The following example shows the configuration:

```
controller Cellular 0/1/0
 lte sim data-profile 1 attach-profile 1 slot 0
 lte sim data-profile 1 attach-profile 1 slot 1
 no lte firmware auto-sim
 lte interface 0 64 1111:2222:3333:0001
 lte gps mode standalone
 lte modem dm-log size 2
 lte modem dm-log filesize 1
 lte modem dm-log rotation
 lte modem link-recovery disable
!
!
…
!
interface Loopback0
 ip address 1.1.1.1 255.255.255.255
!
!
interface Cellular0/1/0
 description Cell-to-CMW
 ip address negotiated
 load-interval 30
 dialer in-band
 dialer idle-timeout 0
 dialer watch-group 1
 dialer-group 1
 ipv6 enable
 pulse-time 1
 ip virtual-reassembly
!
interface Cellular0/1/1
 no ip address
 shutdown
!
…
ip route 0.0.0.0 0.0.0.0 Cellular0/1/0
ipv6 route ::/0 Cellular0/1/0
…
!
access-list 1 permit any
dialer watch-list 1 ip 5.6.7.8 255.255.255.255
dialer watch-list 1 delay route-check initial 60
dialer watch-list 1 delay connect 1
dialer-list 1 protocol ip permit
dialer-list 1 protocol ipv6 permit
!
…
```

PLMN Search and Selection

This feature allows you to search for available Public Land Mobile Network (PLMN) and connect to one of the PLMN.

PLMN Commands

Use the following commands for PLMN feature:

- **cellular** < *unit* > **lte plmn search**
- **cellular** < *unit* > **lte plmn select** < *mode* > < *mcc* > < *mnc* > < *rat* > < *duration* >
- **show cellular** < *unit* > **network**

Searching the Network

You can use the **cellular 0 lte plmn search** command to search for available PLMNs. This example shows how to search for networks:

```
router#cellular 0 lte plmn search
Searching for available PLMNs.This may take up to 3 minutes.
Please wait.........................
PLMN search done. Please use "show cellular 0 network" to see available PLMNS
```

After the search, use the s**how cellular 0 network** command to see the available networks:

```
router#show cellular 0 network
Current System Time = Fri Sep 18 18:49:24 2015
Current Service Status = Normal
Current Service = Packet switched
Current Roaming Status = Roaming
Network Selection Mode = Manual
Network = O2 - UK
Mobile Country Code (MCC) = 234
Mobile Network Code (MNC) = 10
Packet switch domain(PS) state = Attached
Location Area Code (LAC) = 4931
Cell ID = 34319
Available PLMNs:
Idx MCC MNC RAT     Desc
1   234 10  umts    O2 - UK
2   234 10  gsm     O2 - UK
3   234 20  umts    3 UK
4   234 30  umts    EE
5   234 15  gsm     voda UK
6   234 33  gsm     EE
7   234 20  lte     3 UK
8   234 30  gsm     EE
9   234 15  umts    voda UK
10  234 30  lte     EE
11  234 10  lte     O2 - UK
12  234 15  lte     voda UK
```

Selecting the Network

There are three ways you can select an available network: Auto mode, Force Mode, and Manual mode. In Auto mode, your router will connect automatically to a network preferred by the SIM. In Force mode, the router is forced to select an available or known network without performing a network search. If a network is not available or the router is unable to attach to a network, then the router will remain in a 'Not attached' state. You can use the **cellular x lte plmn select auto** command to attach the router to a network preferred by the SIM. In Manual mode, you can select an available network from your search result.

This example shows how to select a network manually:

```
router#cellular 0 lte plmn select manual ?
  <0-999>  Mobile Country Code (MCC)
router#cellular 0 lte plmn select manual 234 ?
  <0-999>  Mobile Network Code (MNC)
router#cellular 0 lte plmn select manual 234 10 ?
  gsm   GSM
  lte   LTE
  umts  UMTS
router#cellular 0 lte plmn select manual 234 10 gsm ?
  permanent    PERMANENT
  power-cycle  POWER_CYCLE
router#cellular 0 lte plmn select manual 234 10 gsm power-cycle ?

  <cr>
router#cellular 0 lte plmn select manual 234 10 gsm power-cycle
```

This example shows how to force a network selection:

```
router#cellular 0 lte plmn select force ?
  <0-999>  Mobile Country Code (MCC)
router#cellular 0 lte plmn select force 310 ?
  <0-999>  Mobile Network Code (MNC)
router#cellular 0 lte plmn select force 310 410 ?
  <2-3>  MNC Digits Ex 23 means 2 Digits, 023 Means 3 Digits
router#cellular 0 lte plmn select force 310 410 2 ?
  gsm   GSM
  lte   LTE
  umts  UMTS

router#cellular 0 lte plmn select force 310 410 2 lte ?
  permanent    PERMANENT
  power-cycle  POWER_CYCLE
Router#cellular 0 lte plmn select force 310 410 2 lte power-cycle ?
  <cr>
Router#cellular 0 lte plmn select force 310 410 2 lte power-cycle
```

Verifying PLMN Selection

Use **show cellular 0 network** command to verify the PLMN selection:

```
router#show cellular 0 network
Current System Time = Fri Sep 18 18:53:25 2015
Current Service Status = Normal
Current Service = Packet switched
Current Roaming Status = Roaming
Network Selection Mode = Manual
Network = O2 - UK
```

```
Mobile Country Code (MCC) = 234
Mobile Network Code (MNC) = 10
Packet switch domain(PS) state = Attached
Location Area Code (LAC) = 4931
Cell ID = 34319
Available PLMNs:
Idx MCC MNC RAT     Desc
1   234 10  umts    O2 - UK
2   234 10  gsm     O2 - UK
3   234 20  umts    3 UK
4   234 30  umts    EE
5   234 15  gsm     voda UK
6   234 33  gsm     EE
7   234 20  lte     3 UK
8   234 30  gsm     EE
9   234 15  umts    voda UK
10  234 30  lte     EE
11  234 10  lte     O2 - UK
12  234 15  lte     voda UK
router#show cellular 0 radio
Radio power mode = ON
Channel Number = 122
Current Band = GSM 900 Extended
Current RSSI = -48 dBm
Current ECIO = -127 dBm
Radio Access Technology(RAT) Preference = GSM
Radio Access Technology(RAT) Selected = EDGE
```

Note Some networks may not allow the router to connect. In such cases, you have to choose a different network.

Note Restart your modem if the router is not able to connect to any network.

Example: PLMN Search

This example shows the output of a PLMN search without SIM card on a P-LTEAP18-GL.

Without a SIM card:

```
IR1101#show cell 0/1/0 ha
Modem Firmware Version = 32.00.116
Host Firmware Version = 32.00.007
Device Model ID =  LM960A18
International Mobile Subscriber Identity (IMSI) =
International Mobile Equipment Identity (IMEI) = 356299100001310
Integrated Circuit Card ID (ICCID) =
Mobile Subscriber Integrated Services
Digital Network-Number (MSISDN) =
Modem Status = Modem Online
Current Modem Temperature = 37 deg C
PRI version = 1026, Carrier = Generic
OEM PRI version = 32101006
IR1101#

IR1101#show cell 0/1/0 secu
Active SIM = NONE
IR1101#
```

Performing a PLMN search:

```
IR1101#cell 0/1/0 lte plmn search
Searching for available PLMNs...Please wait...
This may take up to 5 minutes.............
PLMN search done. Please use "show cellular x/x/x network" to see available PLMNS
```

Showing the PLMN display:

```
IR1101#show cell 0/1/0 net
Current System Time = Sun Jan 6 0:14:39 1980
Current Service Status = No service
Current Service = Unknown
Current Roaming Status = Roaming
Network Selection Mode = Automatic
Network =
Mobile Country Code (MCC) = 208
Mobile Network Code (MNC) = 10
Packet switch domain(PS) state = Not attached
LTE Carrier Aggregation state = Deconfigured
Registration state(EMM) = Searching/Not Registered
EMM Sub State = Limited Service
Tracking Area Code (TAC) = 0
Cell ID = 0
Available PLMNs at  =  08:21:25 UTC Thu May 5 2022
Idx MCC MNC RAT     Desc
1   208 10  lte     SFR
2   208 16  lte     Free
3   208 1   lte     Orange
4   208 20  lte     BYTEL
5   208 15  lte     Free

Network MTU = Not Available
IR1101#
```

Modem Settings for North America and Carriers Operating on 700 MHz Band

For deployments in North America, and carriers operating in the 700 MHz band, the following changes to the modem settings are required to prevent long network attach times.

To change the modem settings to force the modem to scan different technologies, use the following Cisco IOS command:

```
Router# cellular 0/0/0 lte technology ?
auto         Automatic LTE Technology Selection
cdma-1xrtt   CDMA 1xRTT
cdma-evdo    CDMA EVDO Rev A
cdma-hybrid  HYBRID CDMA
gsm          GSM
lte          LTE
umts         UMTS
```

To select "LTE only", then use the configuration term command under controller cellular x/x/x.

```
Router(config-controller)#lte modem band-select all-lte-only
```

Cellular Band Lock

With private cellular networks, customers have a single frequency band to run their private network, for example band 48 (CBRS) in U.S. In this case, the customer can lock the cellular band to the one allocated to the private network.

Note Bands reporting and locking is dependent from the PIM module.

The cellular PIMs support different 3G, 4G or 5G frequency bands, which can be displayed by the **show cellular x/x/x radio band** CLI.

```
Router#show cell x/x/x radio band

LTE bands supported by modem:
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 38 39 40 41 42 43 46 48 66 71.
LTE band Preference settings for the active sim(slot 0):
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 38 39 40 41 42 43 46 48 66 71.

3G bands supported by modem:
Index:
  23 - UMTS Band 1: 2100 MHz (IMT)
  24 - UMTS Band 2: 1900 MHz (PCS A-F)
  26 - UMTS Band 4: 1700 MHz (AWS A-F)
  27 - UMTS Band 5: US 850 MHz  (CLR)
  50 - UMTS Band 8: 900 MHz  (E-GSM)
  51 - UMTS Band 9: Japan 1700 MHz
  61 - UMTS Band 19: 800 MHz (800 Japan)
3G band Preference settings for the active sim(slot 0):
Index:
  23 - UMTS Band 1: 2100 MHz (IMT)
  24 - UMTS Band 2: 1900 MHz (PCS A-F)
  26 - UMTS Band 4: 1700 MHz (AWS A-F)
  27 - UMTS Band 5: US 850 MHz  (CLR)
  50 - UMTS Band 8: 900 MHz  (E-GSM)
  51 - UMTS Band 9: Japan 1700 MHz
  61 - UMTS Band 19: 800 MHz (800 Japan)
```

For reference, the bands listed above map as follows:

- For 4G and 5G, indices 1-128 correspond to bands 1-128.
- For 3G, indices 1-64 maps to the 3G bands mentioned against each above.

Dependent of the country and service providers, one or more bands may be used to attach the device to the service provider radio network. This is done automatically since all bands are valid. Therefore, Cisco does not recommend changing the configuration

With private cellular networks, customers have a single frequency band to run their private network, for example band 48 (CBRS) in U.S. In this case, the customer can lock the cellular band to the one allocated to the private network.

This is accomplished with the following command syntax:

```
Router(config-controller)#lte modem band-select indices umts3g none ?
  lte4g  Specify the LTE indices

Router(config-controller)#lte modem band-select indices umts3g none lte4g 48 ?
```

```
  nr5g  Specify the 5g indices
  slot  primary SIM slot

Router(config-controller)#lte modem band-select indices umts3g none lte4g 48 slot 0

Router(config-controller)#lte modem band-select indices umts3g ?
  WORD  Band index(es) in string format "<band index#>, <band index#>, ...".
        (supported 3G band indices are listed under 'show cellular radio
        band'.)
        Enter "none" for no bands or "all" for all supported 3G bands.

Router(config-controller)#lte modem band-select indices umts3g none lte4g ?
  WORD  Band index(es) in string format "<band index#>, <band index#>, ...".
        (supported LTE band indices are listed under 'show cellular radio
        band'.)
        Enter "none" for no bands or "all" for all supported LTE bands.
```

The result should be as follows:

```
Router#show cell x/x/x radio band

LTE bands supported by modem:
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 38 39 40 41 42 43 46 48 66 71.
LTE band Preference settings for the active sim(slot 0):
- Bands 48.
```

Cellular Band 30

Caution Some of the cellular PIMs support LTE FDD Band 30 transmitter. When a cellular PIM supports LTE FDD band 30 in a U.S. based deployment, activated with an AT&T subscription, then some customers (location dependent) may be at risk of FCC violation in a transportation or roadway scenario. In this case, disabling band 30 is recommended.

Use the following procedure in order to disable Band 30.

Display all bands as set-up by default.

```
Router#show cell x/x/x radio band

LTE bands supported by modem:
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 34 38 39 40 41 42 43 46 48 66
 71.
LTE band Preference settings for the active sim(slot 0):
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 34 38 39 40 41 42 43 46 48 66
 71.

NR5G bands supported by modem:
- Bands 1 2 3 5 7 8 12 20 25 28 38 40 41 48 66 71 77 78 79.
NR5G band Preference settings for the active sim(slot 0):
- Bands 1 2 3 5 7 8 12 20 25 28 38 40 41 48 66 71 77 78 79.

3G bands supported by modem:
Index:
  23 - UMTS Band 1: 2100 MHz (IMT)
  24 - UMTS Band 2: 1900 MHz (PCS A-F)
  26 - UMTS Band 4: 1700 MHz (AWS A-F)
  27 - UMTS Band 5: US 850 MHz  (CLR)
  50 - UMTS Band 8: 900 MHz  (E-GSM)
```

```
  51 - UMTS Band 9: Japan 1700 MHz
  61 - UMTS Band 19: 800 MHz (800 Japan)
3G band Preference settings for the active sim(slot 0):
Index:
  23 - UMTS Band 1: 2100 MHz (IMT)
  24 - UMTS Band 2: 1900 MHz (PCS A-F)
  26 - UMTS Band 4: 1700 MHz (AWS A-F)
  27 - UMTS Band 5: US 850 MHz  (CLR)
  50 - UMTS Band 8: 900 MHz  (E-GSM)
  51 - UMTS Band 9: Japan 1700 MHz
  61 - UMTS Band 19: 800 MHz (800 Japan)

==========================================

Band index reference list:

For LTE and 5G, indices 1-128 correspond to bands 1-128.

For 3G, indices 1-64 maps to the 3G bands mentioned against each above.

Router#
```

In order to disable band 30, you have to setup all of the supported bands, omitting the band you do not want. There is no disable function. In this example, band 30 is omitted.

```
Router#conf term
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#controller cellular x/x/x
Router(config-controller)#
Router(config-controller)#lte modem band-select indices ?
  umts3g
Specify the 3g indices
Router(config-controller)#lte modem band-select indices umts3g all lte4g
1,2,3,4,5,7,8,12,13,14,17,18,19,20,25,26,28,29,32,34,38,39,40,41,42,43,46,48,66,71 nr5g all
 slot 0
Router(config-controller)#exit
Router(config)#exit
Router#
```

Verify that the omitted band is not showing on the "preference setting for the active slot". See the following example.

```
Router#show cell x/x/x radio band

LTE bands supported by modem:
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 34 38 39 40 41 42 43 46 48 66
 71.
Notice band 30 shows in the "bands supported by modem".

LTE band Preference settings for the active sim(slot 0):
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 32 34 38 39 40 41 42 43 46 48 66 71.
Notice band 30 is not available in the "band Preference settings for the active sim(slot
0)"

NR5G bands supported by modem:
- Bands 1 2 3 5 7 8 12 20 25 28 38 40 41 48 66 71 77 78 79.
NR5G band Preference settings for the active sim(slot 0):
- Bands 1 2 3 5 7 8 12 20 25 28 38 40 41 48 66 71 77 78 79.

3G bands supported by modem:
Index:
  23 - UMTS Band 1: 2100 MHz (IMT)
  24 - UMTS Band 2: 1900 MHz (PCS A-F)
  26 - UMTS Band 4: 1700 MHz (AWS A-F)
```

```
  27 - UMTS Band 5: US 850 MHz  (CLR)
  50 - UMTS Band 8: 900 MHz  (E-GSM)
  51 - UMTS Band 9: Japan 1700 MHz
  61 - UMTS Band 19: 800 MHz (800 Japan)
3G band Preference settings for the active sim(slot 0):
Index:
  23 - UMTS Band 1: 2100 MHz (IMT)
  24 - UMTS Band 2: 1900 MHz (PCS A-F)
  26 - UMTS Band 4: 1700 MHz (AWS A-F)
  27 - UMTS Band 5: US 850 MHz  (CLR)
  50 - UMTS Band 8: 900 MHz  (E-GSM)
  51 - UMTS Band 9: Japan 1700 MHz
  61 - UMTS Band 19: 800 MHz (800 Japan)

==========================================

Band index reference list:

For LTE and 5G, indices 1-128 correspond to bands 1-128.

For 3G, indices 1-64 maps to the 3G bands mentioned against each above.
```

Radio Power Mode

The power to the radio can be turned on and off manually. See the following examples.

To tun the power off:

```
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#controller cell
Router(config)#controller cellular 0/1/0
Router(config-controller)#lte radio off
Warning: Not all PDP contexts are in shutdown state
Please shutdown all the interfaces manually and re-enter this command.

Router(config-controller)#inter cell 0/1/0
Router(config-if)#shut
Router(config)#inter cell 0/1/1
Router(config-if)#shut
Router(config-if)#controller cellular 0/1/0
Router(config-controller)#lte radio off
WARNING(Controller cellular 0/1): Radio power OFF setting will NOT persists if router
or modem resets. Save to startup configuration.Use "no lte radio off" to turn radio power
ON
Router(config-controller)#end

Router#show cell 0/1/0 radio
Radio power mode = OFF, Reason = User Request
Channel Number = 0
Current Band = Unknown
Current RSSI = -128 dBm
Current ECIO = -65531 dBm
Radio Access Technology(RAT) Preference = AUTO
Radio Access Technology(RAT) Selected = AUTO
Network Change Event = unknown
```

To tun the power on:

```
Router#conf term
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#controller cellular 0/1/0
```

```
Router(config-controller)#no lte radio off
Router(config-controller)#inter cell 0/1/0
Router(config-if)#no shut
Router(config-if)#inter cell 0/1/1
Router(config-if)#no shut
Router(config-if)#end

Router#show cell 0/1/0 radio
Radio power mode = Online
LTE Rx Channel Number(PCC) =  9385
LTE Tx Channel Number(PCC) =  27385
LTE Band =  28
LTE Bandwidth = 5 MHz
Current RSSI = -48 dBm
Current RSRP = -76 dBm
Current RSRQ = -15 dB
Current SNR = 6.2  dB
Physical Cell Id = 27
Number of nearby cells = 2
Idx      PCI (Physical Cell Id)
--------------------------------
1              27
2              378
Radio Access Technology(RAT) Preference = AUTO
Radio Access Technology(RAT) Selected = LTE
Network Change Event = unknown
```

Management Information Base

A Management Information Base (MIB) is a database of the objects that can be managed on a device. The managed objects, or variables, can be set or read to provide information on the network devices and interfaces.

You can find complete information on MIBS and the MIB locator here: https://mibs.cloudapps.cisco.com/ITDIT/MIBS/servlet/index

Note For better security, it is recommended that you configure SNMP V3 with authentication/privacy when implementing SNMP SET operation.

Refer to the SNMP Configuration Guide.

The following Simple Management Network Protocol (SNMP) MIBs are supported on the cellular PIM:

- IF-MIB
- ENTITY-MIB
- CISCO-WAN-3G-MIB
- CISCO-WAN-CELL-EXT-MIB

For the CISCO-WAN-CELL-EXT-MIB, the following tables and sub-tables are supported:

- ciscoWanCellExtMIB(817)
- ciscoWanCellExtMIBNotifs(0)
- ciscoWanCellExtMIBObjects(1)

- ciscoWanCellExtLte(1)
- cwceLteRadio(1)
- cwceLteProfile(2)

You can download the MIBs from the Cisco MIB Locator at http://www.cisco.com/go/mibs.

Example: Cellular PIM SNMP Configuration

The following example describes how to configure a MIB trap on the router:

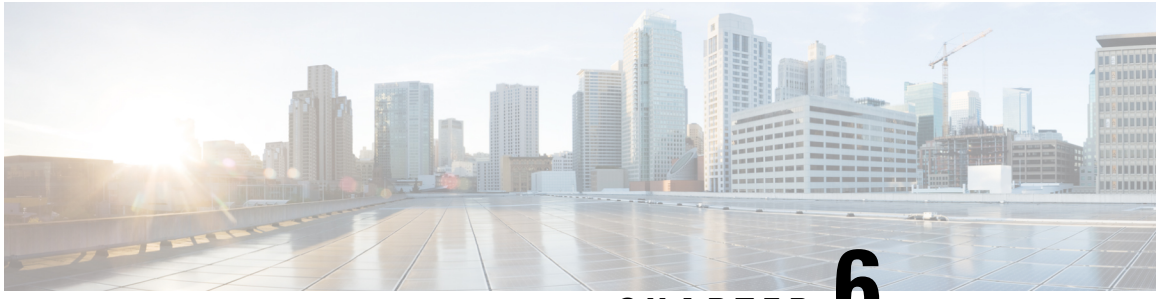
```
controller Cellular x/x/x
 lte event rssi onset mib-trap All-lte
 lte event rssi onset threshold -100
 lte event rssi abate mib-trap All-lte
 lte event rssi abate threshold -90
 lte event temperature onset mib-trap
 lte event temperature onset threshold 55
 lte event temperature abate mib-trap
 lte event temperature abate threshold 50
 lte event modem-state mib-trap all
 lte event service mib-trap
 lte event network mib-trap
 lte event connection-status mib-trap All-lte
 lte event rsrp onset mib-trap All-lte
 lte event rsrp onset threshold -85
 lte event rsrp abate mib-trap All-lte
 lte event rsrp abate threshold -80
 lte event rsrq onset mib-trap All-lte
 lte event rsrq onset threshold -8
 lte event rsrq abate mib-trap All-lte
 lte event rsrq abate threshold -6
```

The following example describes how to configure SNMP capability on the router:

```
snmp-server group neomobilityTeam v3 auth notify 3gView
snmp-server view 3gView ciscoWan3gMIB included
snmp-server community neomobility-test RW snmp-server community public RW
snmp-server enable traps c3g
snmp server enable traps LTE
snmp-server host 172.19.153.53 neomobility c3g snmp-server host 172.19.152.77 public c3g
snmp-server host 172.19.152.77 public udp-port 6059
```

The following example describes how to configure an external host device to communicate with the router through SNMP:

```
setenv SR_MGR_CONF_DIR /users/<userid>/mibtest
setenv SR_UTIL_COMMUNITY neomobility-test
setenv SR_UTIL_SNMP_VERSION -v2c
setenv SR_TRAP_TEST_PORT 6059
```



CHAPTER 6

Configuring GPS

This chapter contains the following sections:

- GPS Overview, on page 91
- Configuring LTE GPS, on page 93
- Enabling NMEA Data Streaming, on page 95
- Debug Cellular-Based GPS, on page 97
- NTP Clock Sync with GPS, on page 97
- National Marine Electronics Association (NMEA) IOx Support, on page 100
- Example: Connecting to a Server Hosting a GPS Application, on page 101

GPS Overview

Satellite navigation is a system of satellites that provide autonomous geo-spatial positioning with global coverage and allow small electronic receivers to determine location (longitude, latitude, and altitude/elevation) using time signals transmitted from satellites. Often times the terms “GNSS” and “GPS” are used interchangeably but there are key differences between the two:

- The United States’ Global Positioning System (GPS) consists of up to 31 medium Earth orbit satellites in six different orbital planes, with the exact number of satellites varying as older satellites are retired and replaced. Operational since 1978 and globally available since 1994, GPS is currently the world’s most utilized satellite navigation system. A GPS receiver can only use signals from the 31 satellites in the Global Positioning System, and if too many of these signals are blocked, the receiver becomes useless until it can find a signal again.

- GNSS stands for Global Navigation Satellite System, and is the standard generic term for satellite navigation systems that provide autonomous geo-spatial positioning with global coverage. This term includes GPS, GLONASS, Galileo, Beidou and other regional systems. GNSS is a term used worldwide The advantage to having access to multiple satellites is accuracy, redundancy and availability at all times. Though satellite systems don’t often fail, if one fails GNSS receivers can pick up signals from other systems. Also, if line of sight is obstructed, having access to multiple satellites is also a benefit. Common GNSS Systems are GPS, GLONASS, Galileo, Beidou and other regional systems. A GNSS receiver can use signals from any positioning satellite, not just the ones in the GPS system. This means that even if all of the GPS signals are blocked, it can pick up signals from any of the other satellite systems worldwide. This flexibility makes GNSS receivers much more accurate and reliable than GPS technology alone. With GNSS, you can be confident that you are getting the best result possible, wherever and whenever you need it.

Note A GNSS antenna is required for proper reception of GNSS constellation signal. Most Cisco antennas are GPS only, your antenna SKU must explicitly state it supports GNSS.

Note For the purposes of this document, we will be referring only to Cellular Modem based GPS.

Cellular GPS Use Cases

The following are descriptions of some of the use cases for GPS:

- Geo-Fencing — Geo-fencing is the concept of controlling a device's operation based on where it is located. One use may be to only allow a device to operate if it is located in an area it is authorized to be. For example, if a router inside a store, kiosk or ATM was taken to a location other than where it should be, the router could disable itself. Or if the device is programmed to send (or polled) for its location, and the cloud/host application finds it outside the authorized area, the application may stop allowing communications to the devices behind the router.
- Asset Tracking — Asset tracking is the concept of knowing where equipment or devices are currently, and their condition/operation. The condition/operation can be gleaned by cloud/host applications, or by network management tools. The location of the specific device/equipment however can be important to an organization's operations. For example, a transportation enterprise may need to know the location of each of its trucks, train cars and ships in order to coordinate the on-time shipment and delivery of cargo. This may allow for the best selection of transport means and specific vehicles for a particular expedited shipment.
- Time Synchronization — Accurate time on a router can be important, for having exact time stamps of logs, or for accurate execution of tasks via automated/scheduled router functions. There may be times that the router requires synchronization of its internal clock with a highly accurate time source. Inability to sync the time may occur with deployments in vehicles or movable installations that are out of signal range for long periods, or where the deployment used a connection to an isolated private network with no NTP server.
- GPS streaming to Apps and IOx — When a modem has GPS enabled, the NMEA stream can be forwarded to IOx from the ngiolite module. This is accomplished by create a tunnel between Linux and IOx and then forward all NMEA messages over the tunnel to IOx.

Cellular GPS Parameters

Refer to the following table:

Parameters	Cellular Modem Based GPS
Type	Cellular Modem based GPS
PIDs Supported	See the Supported Modem Technology, on page 8 section for modules that support GPS.
Configuration Modes	Standalone mode

Parameters	Cellular Modem Based GPS
Number of satellites needed for co-ordinates	Standalone mode – 4
Satellites Supported in show command	Co-ordinates seen in show commands output is based only on GPS.
Initial Calibration Required	No
Co-ordinates in Absence of Satellite	No Co-ordinates will be acquired, and it stays in acquiring status.
Device Name of Controller to use for Configuration	controller cellular <slot>
CLI to enable feature	**lte gps enable** **lte gps mode standalone** **Note** A modem power cycle is required after enabling the configuration.
CLI to configure nmea	**lte gps nmea**
CLI to configure nmea udp socket	**lte gps nmea ip udp** *<source_ip> <destination_ip> <destination_port>*
CLI to verify configuration under show running-config	**show run | sec controller cellular***<slot>*
Show commands to verify gps output	**show cellular** *<slot>* **gps** **show controller cellular** *<slot>* **| inc GPS**
Access to GPS nmea traffic on IOx side	Supported
Debug Command	**debug cellular***<slot>* **messages gps** **debug cellular***<slot>* **messages nmea**
Yang Model Support	Yes

Configuring LTE GPS

Follow these steps to configure the LTE cellular modem for GPS in Standalone mode.

Note For a 4G LTE-Advanced, the *slot* argument identifies the router slot, module slot, and the port, and is separated by slashes (0/4/0).

Note Starting with IOS XE 17.9.1, GPS will be enabled by default.

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters the configuration mode.
Step 2	**controller cellular** *slot* **Example:** `Router(config)# controller cellular 0/4/0`	Enters the controller cellular configuration mode.
Step 3	**lte gps enable** **Example:** `Router(config-controller)# lte gps enable`	(Optional) GPS is enabled by default. Use this command to enable the GPS feature if GPS has been disabled for any reason.
Step 4	**lte gps mode standalone** **Example:** `Router(config-controller)# lte gps mode standalone`	Enables the standalone GPS mode.
Step 5	**end** **Example:** `Router(config-controller)# end`	Exits the controller configuration mode and returns to the privileged EXEC mode.
Step 6	**test cellular** *slot* **modem-power-cycle** **Example:** `Router# test cellular 0/4/0 modem-power-cycle`	GPS can take effect only after modem power cycle.

Step 7	**show cellular** *slot* **gps**
	Example:
	`Router# show cellular 0/4/0 gps`
	`  GPS Feature = enabled`
	`GPS Mode Configured = standalone`
	`GPS Port Selected = Dedicated GPS port`
	`GPS Status = GPS coordinates acquired`
	`Last Location Fix Error = Offline [0x0]`
	`Latitude = 37 Deg 25 Min 4.8915 Sec North`
	`Longitude = 121 Deg 55 Min 8.5627 Sec West`
	`Timestamp (GMT) = Wed Nov 7 21:54:18 2018`
	
	`Fix type index = 0, Height = 8 m`
	`Satellite Info`
	`----------`
	`Satellite #1, elevation 45, azimuth 303, SNR 20 *`
	`Satellite #3, elevation 15, azimuth 296, SNR 21`
	`Satellite #8, elevation 9, azimuth 227, SNR 27 *`
	`Satellite #11, elevation 41, azimuth 270, SNR 27 *`
	`Satellite #18, elevation 64, azimuth 258, SNR 29 *`
	`Satellite #22, elevation 35, azimuth 303, SNR 22 *`
	`Satellite #31, elevation 51, azimuth 140, SNR 24`
		Displays a summary of the following GPS data:
		• GPS state information (GPS disabled, GPS acquiring, GPS enabled)
		• GPS mode configured (standalone)
		• GPS location and timestamp information
		• GPS satellite information
		• GPS feature (enabled or disabled)
		• GPS port selected (Dedicated GPS and GPS port with voltage-no-bias)

	Command or Action	Purpose

	`*`
	`Satellite #32, elevation 46, azimuth 43, SNR 22 *`
	`Satellite #10, elevation 25, azimuth 97, SNR 0`
	`Satellite #14, elevation 68, azimuth 26, SNR 0`
	`!!... truncated ....!!`
	`Router#`	

Step 8	**show cellular** *slot* **gps detail**
	Example:
	`Router# show cellular 0/4/0 gps detail`
	`GPS Feature = enabled`
	`GPS Mode Configured = standalone`
	`GPS Port Selected = Dedicated GPS port`
	`GPS Status = GPS coordinates acquired`
	`Last Location Fix Error = Offline [0x0]`
	`Latitude = 37 Deg 25 Min 4.9282 Sec North`
	`Longitude = 121 Deg 55 Min 8.5209 Sec West`
	`Timestamp (GMT) = Wed Nov 7 21:53:52 2018`
	
	`Fix type index = 0, Height = 7 m`
	`HDOP = 1.5, GPS Mode Used = standalone`
	
	`Satellite Info`
	`----------`
	`Satellite #8, elevation 9, azimuth 227, SNR 31 *`
	`Satellite #11, elevation 41, azimuth 270, SNR 32`
	`*`
	`Satellite #18, elevation 64, azimuth 258, SNR 33`
	`*`
	`Satellite #22, elevation 35, azimuth 303, SNR 26`
	`*`
	`Satellite #31, elevation 51, azimuth 140, SNR 27`
	`*`
	`Satellite #32, elevation 46, azimuth 43, SNR 22`
	`Satellite #1, elevation 45, azimuth 303, SNR 0`
	`Satellite #3, elevation 14, azimuth 296, SNR 0`
	`!!!...truncated!!!`
	`Router#`
		Displays detailed GPS data.

Enabling NMEA Data Streaming

GPS NMEA data streaming to external NMEA 2.0-compliant GPS plotter applications can be enabled on Cisco 4G LTE Advanced.

Note This assumes you have already configured and enabled LTE GPS.

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:**	Enters the configuration mode.

	Command or Action	Purpose
	`Router# configure terminal`	
Step 2	**controller cellular** *slot* **Example:** `Router(config)# controller cellular 0/4/0`	Enters the controller cellular configuration mode.

Step 3	**lte gps nmea {ip | udp** [*source address*][*destination address*][*destination port*] }
	Example:
	`Router(config-controller)# lte gps nmea ip`
	or
	`Router(config-controller)# lte gps nmea`
		Enables NMEA. Cisco 4G LTE Advanced supports only IP NMEA. Therefore, the IP interface and serial interface options are unavailable.

Step 4	**end** **Example:** `Router(config-controller)# end`	Exits the controller configuration mode and returns to the privileged EXEC mode.
Step 5	**test cellular** *slot* **modem-power-cycle** **Example:** `Router# test cellular 0/4/0 modem-power-cycle`	GPS can take effect only after modem power cycle.

Step 6	**show cellular** *slot* **gps**
	Example:
	`Router# show cellular 0/4/0 gps`
	`GPS Feature = enabled`
	`GPS Mode Configured = standalone`
	`GPS Port Selected = Dedicated GPS port`
	`GPS Status = GPS coordinates acquired`
	`Last Location Fix Error = Offline [0x0]`
	`Latitude = 37 Deg 25 Min 4.8915 Sec North`
	`Longitude = 121 Deg 55 Min 8.5627 Sec West`
	`Timestamp (GMT) = Wed Nov 7 21:54:18 2018`
	
	`Fix type index = 0, Height = 8 m`
	`Satellite Info`
	`----------`
	`Satellite #1, elevation 45, azimuth 303, SNR 20 *`
	`Satellite #3, elevation 15, azimuth 296, SNR 21`
	`Satellite #8, elevation 9, azimuth 227, SNR 27 *`
	`Satellite #11, elevation 41, azimuth 270, SNR 27 *`
	`Satellite #18, elevation 64, azimuth 258, SNR 29 *`
	`Satellite #22, elevation 35, azimuth 303, SNR 22 *`
	`Satellite #31, elevation 51, azimuth 140, SNR 24 *`
	`Satellite #32, elevation 46, azimuth 43, SNR 22 *`
	`Satellite #10, elevation 25, azimuth 97, SNR 0`
	`Satellite #14, elevation 68, azimuth 26, SNR 0`
	`!!... truncated ....!!`
	`Router#`
		Displays a summary of the following GPS data:
		• GPS state information (GPS disabled, GPS acquiring, GPS enabled)
		• GPS mode configured (standalone)
		• GPS location and timestamp information
		• GPS satellite information
		• GPS feature (enabled or disabled)
		• GPS port selected (Dedicated GPS and GPS port with voltage-no-bias)

	Command or Action	Purpose

Step 7	**show cellular** *slot* **gps detail**
	Example:
	`Router# show cellular 0/4/0 gps detail`
	`GPS Feature = enabled`
	`GPS Mode Configured = standalone`
	`GPS Port Selected = Dedicated GPS port`
	`GPS Status = GPS coordinates acquired`
	`Last Location Fix Error = Offline [0x0]`
	`Latitude = 37 Deg 25 Min 4.9282 Sec North`
	`Longitude = 121 Deg 55 Min 8.5209 Sec West`
	`Timestamp (GMT) = Wed Nov 7 21:53:52 2018`
	
	`Fix type index = 0, Height = 7 m`
	`HDOP = 1.5, GPS Mode Used = standalone`
	
	`Satellite Info`
	`----------`
	`Satellite #8, elevation 9, azimuth 227, SNR 31 *`
	`Satellite #11, elevation 41, azimuth 270, SNR 32 *`
	`Satellite #18, elevation 64, azimuth 258, SNR 33 *`
	`Satellite #22, elevation 35, azimuth 303, SNR 26 *`
	`Satellite #31, elevation 51, azimuth 140, SNR 27 *`
	`Satellite #32, elevation 46, azimuth 43, SNR 22`
	`Satellite #1, elevation 45, azimuth 303, SNR 0`
	`Satellite #3, elevation 14, azimuth 296, SNR 0`
	`!!!...truncated!!!`
	`Router#`
		Displays detailed GPS data.

Debug Cellular-Based GPS

Use the following commands to debug Cellular-Based GPS issues.

- **debug cellular** <*slot*> **messages gps**
- **debug cellular** <*slot*> **messages nmea**

NTP Clock Sync with GPS

This feature enables GPS time as the time source for NTP from LTE modems (except LM960) on the router.

GPS time will act as a stratum 0 source and IOS NTP server will act as a stratum 1 device, which in turn provides clock information to its NTP clients (stratum 2 and 3).

In order to use the NTP clock sync feature, you must first enable cellular modem GPS. See the command examples in the following section.

Command Line Interface

To enable LTE GPS time to NTP feature, the following CLI is available and needs to be configured. If the CLI is not configured, LTE time acquired by the GPS over the LTE modem will not be the time source.

The following example uses the CLI to select the interface/modem as time source:

Note Make sure the LTE modems are present on the slot you are trying to configure.

```
Route(config)# ntp refclock gps interface <Cellular Interface>

Router(config)# ntp refclock gps interface ?
  Cellular     Cellular WAN interface
```

Once the above CLIs are configured, all NTP CLI show commands shall reflect the time from the LTE modems.

Example Output

Using Cellular Interface 0/1/0

Make sure that the interface is configured for GPS.

```
Router#show cellular 0/1/0 gps
GPS Feature =  enabled
GPS Mode Configured =  standalone
GPS Port Selected =  Dedicated GPS port
GPS Status =  GPS coordinates acquired
Last Location Fix Error =  Offline [0x0]
Latitude =  37 Deg 25 Min 5.1159 Sec North
Longitude =  121 Deg 55 Min 8.4338 Sec West
Timestamp (GMT) =  Thu Apr 22 02:03:07 2021

Fix type index =  0, Height =  28 m
Satellite Info
----------------
Satellite #5, elevation 39, azimuth 49, SNR 29 *
Satellite #10, elevation 1, azimuth 212, SNR 22
Satellite #12, elevation 2, azimuth 164, SNR 22
Satellite #15, elevation 23, azimuth 130, SNR 25
Satellite #16, elevation 7, azimuth 323, SNR 26
Satellite #18, elevation 51, azimuth 286, SNR 32 *
Satellite #20, elevation 73, azimuth 188, SNR 29 *
Satellite #23, elevation 30, azimuth 206, SNR 28 *
Satellite #25, elevation 29, azimuth 189, SNR 25 *
Satellite #26, elevation 25, azimuth 305, SNR 29 *
Satellite #29, elevation 75, azimuth 53, SNR 31 *
Satellite #2, elevation 0, azimuth 74, SNR 0
Satellite #13, elevation 15, azimuth 94, SNR 0
Satellite #78, elevation 21, azimuth 309, SNR 31 *
Satellite #77, elevation 26, azimuth 250, SNR 14
Satellite #76, elevation 4, azimuth 203, SNR 24
Satellite #65, elevation 19, azimuth 170, SNR 24
Satellite #88, elevation 19, azimuth 299, SNR 29 *
Satellite #87, elevation 47, azimuth 337, SNR 30 *
Satellite #71, elevation 38, azimuth 50, SNR 28 *
Satellite #72, elevation 49, azimuth 125, SNR 24
Satellite #70, elevation 0, azimuth 0, SNR 0
```

```
Satellite #86, elevation 31, azimuth 70, SNR 0
Satellite #1, elevation 13, azimuth 185, SNR 0
Satellite #7, elevation 19, azimuth 53, SNR 0
Satellite #19, elevation 16, azimuth 157, SNR 0
Satellite #24, elevation 28, azimuth 300, SNR 0
Satellite #31, elevation 40, azimuth 239, SNR 0
Satellite #33, elevation 64, azimuth 12, SNR 0  **
```

Configure the interface to use GPS as a time source.

```
Router#config term
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ntp refclock gps interface Cellular0/1/0
Router(config)#end
```

Verify the action.

```
Router#show run | sec ntp
ntp refclock gps interface Cellular0/1/0
```

```
Router#show ntp associations

  address         ref clock       st   when   poll reach  delay  offset   disp
 ~127.127.5.1     .GPS.            0      -     16     0  0.000   0.000 16000.
 * sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured
```

```
Router#show ntp status
Clock is synchronized, stratum 1, reference is .GPS.
nominal freq is 250.0000 Hz, actual freq is 249.8750 Hz, precision is 2**10
ntp uptime is 393200 (1/100 of seconds), resolution is 4016
reference time is E42B582E.00022760 (02:04:30.000 UTC Thu Apr 22 2021)
clock offset is -0.0328 msec, root delay is 0.00 msec
root dispersion is 7939.08 msec, peer dispersion is 7937.98 msec
loopfilter state is 'CTRL' (Normal Controlled Loop), drift is 0.000499999 s/s
system poll interval is 64, last update was 6 sec ago.
```

Yang Model Support

YANG model support is available for the CLI below:

Note Make sure the LTE modems are present on the slot you are trying to configure.

Use the following command to configure Cellular interface timestamp as the NTP source.

ntp refclock gps interface *<cellular 0/x/0>*

Use the following command to disable the Cellular interface timestamp as the NTP source.

[no] ntp refclock gps interface *<cellular 0/x/0>*

Note A model file, Cisco-IOS-XE-ntp.yang, is available for the configuration model.

Yang Model Examples

Cellular Slot 1

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="101">
  <edit-config>
```

```
    <target>
      <running/>
    </target>
    <config>
      <native xmlns="http://cisco.com/ns/yang/Cisco-IOS-XE-native">
        <ntp>
          <refclock xmlns="http://cisco.com/ns/yang/Cisco-IOS-XE-ntp">
            <gps>
              <interface>Cellular0/1/0</interface>
            </gps>
          </refclock>
        </ntp>
      </native>
    </config>
  </edit-config>
</rpc>
```

Get the configuration

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="101">
  <get-config>
    <source>
      <running/>
    </source>
    <filter>
      <native xmlns="http://cisco.com/ns/yang/Cisco-IOS-XE-native">
        <ntp>
          <refclock xmlns="http://cisco.com/ns/yang/Cisco-IOS-XE-ntp"
xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0" nc:operation="delete"/>
        </ntp>
      </native>
    </filter>
  </get-config>
</rpc>
```

Delete the configuration

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="101">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <native xmlns="http://cisco.com/ns/yang/Cisco-IOS-XE-native">
        <ntp>
          <refclock xmlns="http://cisco.com/ns/yang/Cisco-IOS-XE-ntp"
xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0" nc:operation="delete"/>
        </ntp>
      </native>
    </config>
  </edit-config>
</rpc>
```

National Marine Electronics Association (NMEA) IOx Support

From linux or the IOx container, the following tty is available for NMEA traffic:

- /dev/ttyTun9
- /dev/ttyS2

Example: Connecting to a Server Hosting a GPS Application

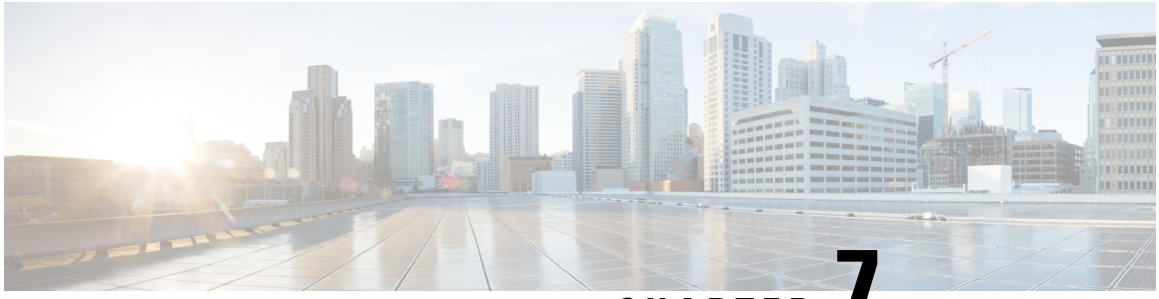
You can feed the NMEA data to a remote server that hosts the GPS application. The server can be connected to the router either directly using an Ethernet cable or through a LAN or WAN network. If the application supports serial port, run a serial port emulation program to create a virtual serial port over the LAN or WAN connection.

Note Microsoft Streets & Trips is a licensed software that you can download from the Microsoft website.

To connect a Cisco 4G LTE-Advanced through IP to a PC running Microsoft Streets & Trips, perform the following steps:

1. Connect the PC to the router using an Ethernet cable.
2. Ensure that the PC and router can ping.
3. Launch the serial port redirector on the PC.
4. Create a virtual serial port that connects to the NMEA port on the router.
5. Launch **Microsoft Streets & Trips** on your PC.
6. Select the GPS Menu.
7. Click Start Tracking.
8. If you have acquired a location fix from the **show cellular 0/4/0 gps** command output on the router, the current location is plotted on the graph, and a reddish brown dotted cursor with a circle around it is seen on the map.

Note If you have not acquired a location fix, the Microsoft application times out and disconnects.



CHAPTER 7

5G Sub-6 GHz Pluggable Interface Module

This chapter contains the following sections:

- 5G Sub-6 GHz Support on IoT Routing, on page 103
- 5G Pluggable Interface Module Overview, on page 104
- LED Behaviors, on page 105
- RF Band and Port Mapping for the P-5GS6-GL Antenna, on page 106
- Thermal Mitigation, on page 107
- Attaching an Antenna, on page 109

5G Sub-6 GHz Support on IoT Routing

The 5G Sub-6 GHz Pluggable Interface Module offers 5G capability to the IoT Industrial Router family. The product ID for the pluggable module is P-5GS6-GL. The P-5GS6-GL uses the FN980 Telit modem.

Note IOS XE release 17.7.1 is the first software release to provide support for the P-5GS6-GL.

Features and Limitations

The following features and limitations apply across all IoT routing platforms unless specifically mentioned:

- IoT routing platforms support a maximum of two pluggable modules, with a combination of 5G and 4G PIMs.
- The pluggable module can be started or stopped through the CLI under exec mode. Also, it can be configured to power off the module to reduce power consumption as needed.
- The capability to disable FDD Band 30 for vehicular applications is available.
- GPS functionality is not supported on the P-5GS6-GL.

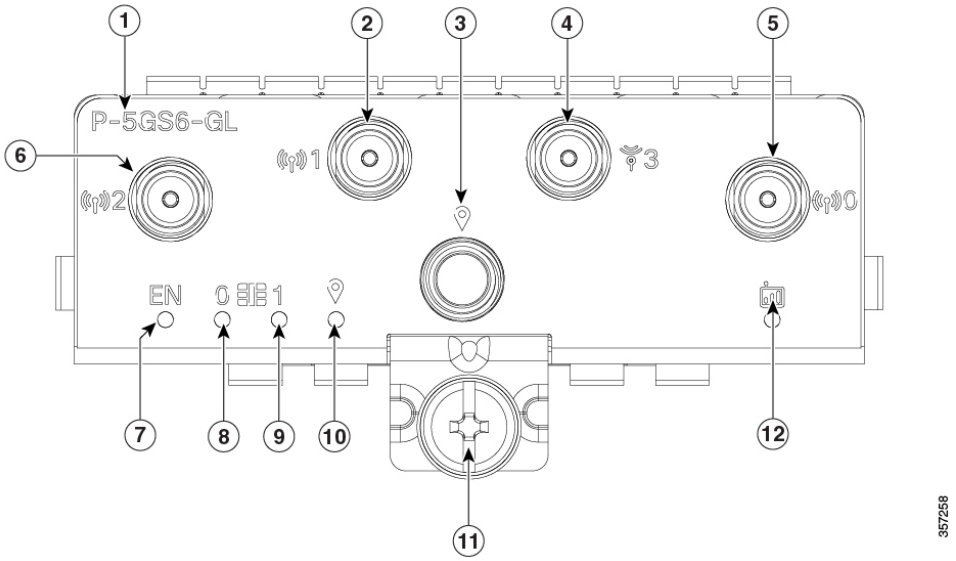
The following are product specific:

- On the IR1101, when plugged into the base, the module is accessible via Cellular 0/1/0, 0/1/1.
- On the IR1101, the module is not supported on the expansion module.
- On the IR1800, the cellular modems are accessible via Cellular 0/4/0, 0/4/1, 0/5/0, 0/5/1.

5G Pluggable Interface Module Overview

The following figure shows the P-5GS6-GL pluggable module:

Figure 7: 5G Pluggable Interface Module - P-5GS6-GL



1	PID
2	Antenna 1 (SMA)
3	GPS (SMA)
4	Antenna 3 (SMA)
5	Antenna 0 (SMA)
6	Antenna 2 (SMA)
7	Enable LED
8	SIM 0 LED
9	SIM 1 LED
10	GPS LED
11	M3.5 thumb-screw
12	Service LED

LED Behaviors

The following table lists the LED indicators and their behavior. The LEDs provide a visual indication of the status and the currently selected services.

LED Indicators:

LED	Color	Function
EN	Green, Yellow	**Enable LED** • Pluggable enable LED • Off: System power is off • Yellow: Module power is not functioning correctly • Green: Module power is on
SIM0	Green, Yellow	**SIM0 LED/Activity** • SIM0 LED status and WWAN activity • Off: SIM0 is not installed • Yellow: SIM0 is installed, but not active • Green: SIM0 installed and active • Green Flash: LTE data activity
SIM1	Green, Yellow	**SIM1 LED/Activity** • SIM1 LED status and WWAN activity • Off: SIM1 is not installed • Yellow: SIM1 is installed, but not active • Green: SIM1 installed and active • Green Flash: LTE data activity
GPS	Green, Yellow	**GPS LED** • Off: GPS not configured • Yellow: Software defined • Green: GPS configured • Green Flash: GPS acquiring (flashing done by SW)
Service	Green, Yellow, Blue	**Service Indication LED** • Yellow: 3G

LED	Color	Function
		• Green: 4G LTE • Blue: 5G

RF Band and Port Mapping for the P-5GS6-GL Antenna

The following table lists the RF band mapping for antenna ports.

RF Band Mapping for Antenna Ports:

Antenna Port	Technology	TX	RX
ANT 0	3G WCDMA	B1, B2, B3, B4, B5, B6, B8, B9, B19	B1, B2, B3, B4, B5, B6, B8, B9, B19
	4G LTE	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B30, B34, B38, B39, B40, B41, B66, B71	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B32, B34, B38, B39, B40, B41, B42, B43, B46, B48, B66, B71
	5G NR FR1	n1, n2, n3, n5, n7, n8, n12, n20, n28, n38, n40, n41, n66, n71	n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79
ANT 1	3G WCDMA	—	B1, B2, B3, B4, B5, B6, B8, B9, B19
	4G LTE	B5, B20, B42, B43, B48, B71	B1, B2, B3, B4, B5, B7, B8, B12, B13, B14, B17, B18, B19, B20, B25, B26, B28, B29, B30, B32, B34, B38, B39, B40, B41, B42, B43, B46, B48, B66, B71
	5G NR FR1	n5, n48, n77, n78, n79	n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79
ANT 2	3G WCDMA	—	—
	4G LTE	B1, B2, B3, B4, B7, B41, B66	B1, B2, B3, B4, B7, B25, B30, B32, B34, B38, B39, B40, B41, B42, B43, B46, B48, B66
	5G NR FR1	n1, n2, n3, n7, n25, n41, n66, n77, n78, n79	n1, n2, n3, n7, n25, n38, n40, n41, n48, n66, n77, n78, n79

Antenna Port	Technology	TX	RX
ANT 3	3G WCDMA	—	—
	4G LTE	—	B1, B2, B3, B4, B7, B25, B30, B32, B34, B38, B39, B40, B41, B42, B43, B46, B48, B66
	5G NR FR1	—	n1, n2, n3, n7, n25, n38, n40, n41, n48, n66, n77, n78, n79

Port Mappings for 5G-ANTM-0-4-B on the P-5GS6-GL PIM

The following table lists the port mappings using the 5G-ANTM-O-4-B antenna as an example, mapping to the ports on the P-5GS6-GL pluggable module.

5G-ANTM-O-4-B	P-5GS6-GL
MAIN 0 (LTE1)	ANT 0
MAIN 1 (LTE3)	ANT 1
DIV 0 (LTE2)	ANT 2
DIV 1 (LTE4)	ANT 3
GNSS	GPS

The following link contains the antenna specifications and installation instructions for 5G NR (5G-ANTM-O-4-B):

https://www.cisco.com/c/en/us/td/docs/routers/connectedgrid/antennas/installing-combined/b-cisco-industrial-routers-and-industrial-wireless-access-points-antenna-guide/m-5g-antm-04b.html#Cisco_Generic_Topic.dita_e780a6fe-fa46-4a00-bd9d-1c6a98b7bcb9

Thermal Mitigation

The following tables provide a description of thermal mitigation levels and throughput performance across all IoT industrial routers.

This applies to both the 4G LTE and 5G NR FR1 operation of the P-5GS6-GL.

Table 11: Thermal Mitigation Levels

Level	Description
Level 0	Normal mode, no thermal throttling.
Level 1	Uplink throttling, via reduced UL TX duty cycle.

Level	Description
Level 2	May include the following: • DL throughput capability reduction, such as 4 RX > 2 RX paths. • Drop Secondary Cells (SCells) all, or one by one. • 5G NR > 4G LTE fall back. • MTPL backoff or reduced TX power. • Reduced UL communication range.
Level 3	Limited service. **Note** Limited service typically means emergency calls only. The P-5GS6-GL does not support emergency call mode, therefore limited service means “no service” for the P-5GS6-GL .
Thermal Shutdown	This occurs after Level 3.

Note Cisco does not recommend operation deep into level 2 as this may affect communication range via MTPL backoff.

Table 12: Thermal Mitigation Table - IR1101

Hardware	Maximum Ambient Temperature (C/F)	Airflow (LFM)	Throughput Performance
IR1101 plus 2x IRM-1100 Single P-5GS6-GL	60°/140°	0	Normal, Level 0
	65°/149°	40	Throttled, Level 2
	70°/158°	40	Throttled, Level 3
	70°/158°	200	Throttled, Level 1
	75°/167°	200	Throttled, Level 2

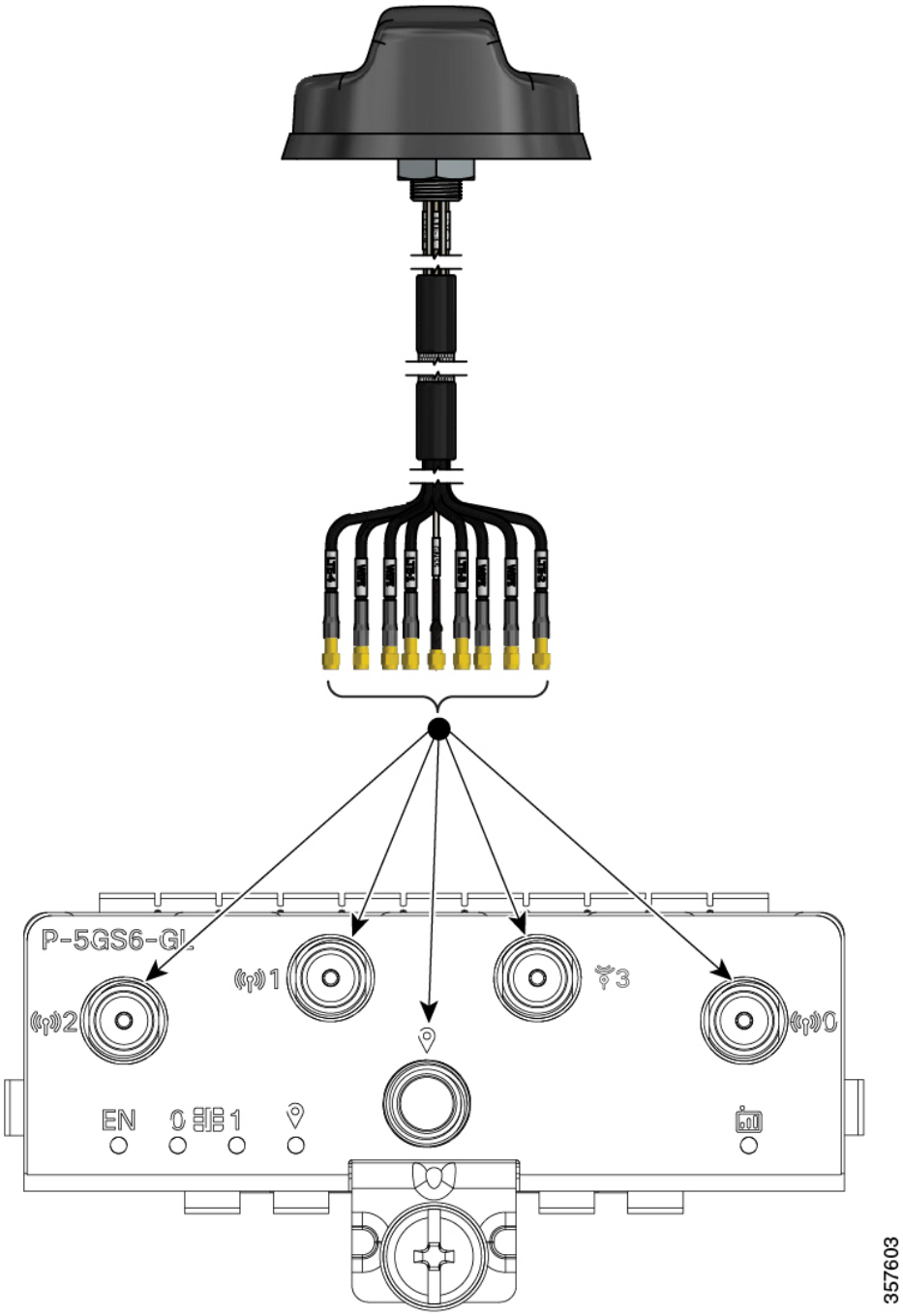
Table 13: Thermal Mitigation Table - IR1835

Hardware	Maximum Ambient Temperature (C/F)	Airflow (LFM)	Throughput Performance
IR1835 plus WP-WIFI6 Dual P-5GS6-GL	60°/140°	0	Normal, Level 0
	65°/149°	40	Normal, Level 0
	70°/158°	40	Throttled, Level 1
	70°/158°	200	Normal, Level 0
	75°/167°	200	Throttled, Level 1

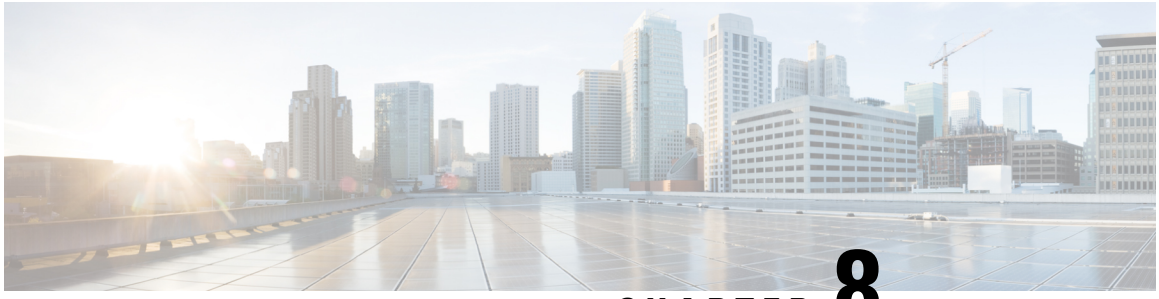
Attaching an Antenna

To attach the antenna in the Pluggable Interface Module, perform the below steps:

Figure 8: Attaching 5G NR Antenna (5G-ANTM-O4-B) to P-5GS6-GL PIM



1. Attach each SMA cable to the ports as indicated in the table mappings.
2. Ensure that you tighten and secure each SMA cable into the SMA connector on the PIM.



CHAPTER 8

450MHz Category-4 LTE PIM

This chapter contains the following sections:

- Overview, on page 111
- Showing the P-LTE-450 Installed in the Router, on page 115
- Gigabit Ethernet Configuration for the P-LTE-450, on page 117
- Configuring the Router Interface for the P-LTE-450 Module, on page 118
- Example Topology, on page 121
- Configuring Minimum P-LTE-450 Parameters through Cisco IOS-XE, on page 121
- Managing the P-LTE-450 Through the WebUI, on page 122
- Additional CLI Support for the P-LTE-450, on page 127
- Troubleshooting, on page 132

Overview

The P-LTE-450 is a 450 MHz Category-4 LTE PIM, which addresses LTE use cases primarily targeting Utility, public safety and critical infrastructure maintained by public organizations in Europe and other world regions. The module supports only LTE 450MHz networks with a bandwidth of 1.4, 3, and 5 MHz. Support for the module is available with Cisco IOS XE release 17.12.1.

Figure 9: P-LTE-450 Pluggable Module

Note Throughout the documentation, you will see the module referred to as P-LTE-450, which is the Cisco product name. The module is by Intelliport, which refers to it as the IPS-701. Both names will be present in documentation.

Unlike regular LTE modules, there are some differences with regards to the P-LTE-450 MHz on IOS-XE platform. Some of the key differences are:

- IP pass through will be on the Gigabit Ethernet interfaces rather than the cellular interface.
- Minimum P-LTE-450 cellular configuration may be done through Cisco IOS-XE config mode under Gigabit Ethernet 0/x/0 interface through **lte 450 xxx** commands.
- Troubleshooting commands are from the IPS-701 web interface from Intelliport.

See the Intelliport product website for more information.

For additional information, see the LTE 450 MHz Alliance.

P-LTE-450 Hardware Features Overview

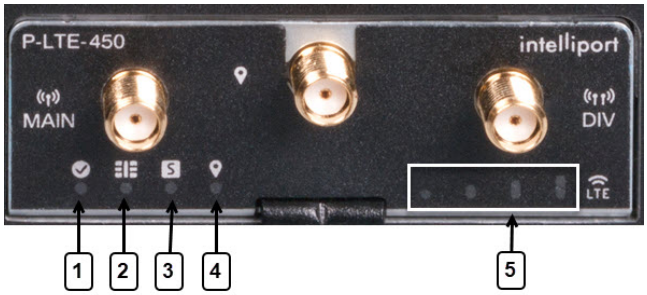
The P-LTE-450 Pluggable Interface Module offers the following features:

- Available only on the IR1101 with Cisco IOS XE release 17.12.1 and later.
- LTE 450 MHz band 31 and 72 with supported bandwidths of 1.4, 3, and 5 MHz only. For modem details see UNI450 ML620EU modem.
- The P-LTE-450 can be installed in the IR1101 Base or in the IRM-1100 Expansion Module attached through the Compute module slot (bottom side of the IR1101 Base). The IRM-1100 Expansion Module can NOT be installed on the Expansion module side (top side of the IR1101 Base). See the following figure that shows the Expansion and Compute Module locations.
- One SIM card – 3FF format.
- Two RF ports of cellular module (main and diversity) via SMA(f) connectors.
- GPS connectivity via SMA(f) connector. No Cisco IOS-XE support equivalent to Cellular PIM for GPS features.

LED Description

The following image shows the P-LTE-450 Pluggable Interface Module LEDs.

Figure 10: LED Description



1	Enabled	Green — Module power is on. Off — System power is off.
2	SIM	Green — SIM inserted. Off — No SIM.
3	Status	Green — Boot completed and connected to mobile internet. Off — Has not booted.
4	GPS	Green — Enabled and has a valid location. Off — Disabled.

5	RSSI	Signal Strength — See the Intelliport documentation for an exact description.

Thermal Considerations

The host router and the P-LTE-450 module is able to boot up and operate at a lower temperature than the radio module on the P-LTE-450. The radio module will not operate at a temperature below -30° C (-22° F).

P-LTE-450 Software Features Overview

The P-LTE-450 Pluggable Interface Module offers the following features:

- Joint development by Cisco (IOS XE software) and Intelliport (Modem firmware).
- The P-LTE-450 requires Network Advantage license to be recognized under Cisco IOS-XE. Refer to the Smart Licensing Using Policy (SLP).
- The P-LTE-450 acts similarly to the Catalyst Cellular Gateway.
  - The modem is an IP passthrough for both IPv4 and IPv6 traffic.
  - The management interface, GigabitEthernet 0/1/0 (Base chassis), or GigabitEthernet 0/4/0 (Expansion Module), must be configured under Cisco IOS-XE.

Note The configuration CLI applicable to the LTE-450 is under this interface.

  - Data traffic passes through GigabitEthernet 0/1/0.n or GigabitEthernet 0/4/0.n.
- The P-LTE-450 is managed by a Web User Interface (WebUI) designed by Intelliport. Access to the Intelliport WebUI is gained through the Cisco WebUI. Requires IP routing for the management IP subnet.
- GPS details will be shown only on the Intelliport modem IPS701 WebUI, not the IOS XE CLI.
- Supports Multi PDN; each PDN is associated with the GigabitEthernet 0/x/0.n sub-interface.

The Intelliport Web User Interface is referred to as IPS701. This WebUI controls all configuration of the Pluggable Interface.

LTE 450 MHz Details

Channel bandwidth is variable at 1.4 MHz, 3 MHz, and 5 MHz . The maximum achievable is:

- Bandwidth => 5 MHz
- UL => 12.5 Mbps
- DL => 37.5 Mbps

Additional information available at the LTE 450 MHz Alliance.

Showing the P-LTE-450 Installed in the Router

P-LTE-450 installed in the IR1101 Base chassis

Within the IR1101 base module, the interface enumerated will be GigabitEthernet 0/1/0 under the running configuration. The PIM module will reflect the respective sub-slot under **show inventory**.

The following example shows the P-LTE-450 installed in the IR1101 Base chassis:

```
IR1101#show inventory
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
INFO: Please use "show license UDI" to get serial number for licensing.
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

NAME: "Chassis", DESCR: "IR1101 Base Chassis"
PID: IR1101-K9   , VID: V01, SN: FCW2252007Y

NAME: "Module 0 - Mother Board", DESCR: "Cisco IR1101 motherboard"
PID: IR1101-K9   , VID: V01, SN: FOC22500RGS

NAME: "module subslot 0/0", DESCR: "IR1101-ES-5"
PID: IR1101-ES-5  , VID: V01, SN:

NAME: "subslot 0/0 transceiver 0", DESCR: "10/100/1000BaseTX SFP"
PID: SFP-VADSL2+-I  , VID: V01, SN: MET20230010

NAME: "module subslot 0/1", DESCR: "P-LTE-450 Module"
PID: P-LTE-450   , VID: V03, SN: S62EG000014
IR1101#
```

The following example shows the P-LTE-450 Ethernet configuration in the IR1101 Base chassis.

- GI0/1/0 IP address is the P-LTE-450 management address.

  GI0/1/0.1 IP address is one received from the cellular network.

```
IR1101#show ip inter brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   unassigned      YES NVRAM  administratively down down
FastEthernet0/0/1      unassigned      YES unset  down                  down
FastEthernet0/0/2      unassigned      YES unset  down                  down
FastEthernet0/0/3      unassigned      YES unset  down                  down
FastEthernet0/0/4      unassigned      YES unset  down                  down
GigabitEthernet0/1/0   192.168.200.128   YES DHCP   up                    up
GigabitEthernet0/1/0.1 192.168.2.15    YES DHCP   up                    up
Async0/2/0             unassigned      YES unset  up                    down
Loopback0              1.1.1.1         YES NVRAM  up                    up
VirtualPortGroup1      192.168.30.1    YES NVRAM  up                    up
Vlan1                  192.168.20.1    YES NVRAM  up                    down

IR1101#
```

The following shows the physical interface enumerated:

```
Router#sh interface gigabitEthernet 0/1/0
 GigabitEthernet0/1/0 is up, line protocol is up
   Hardware is P-LTE-450, address is ac3a.677f.a888 (bia ac3a.677f.a888)
   Internet address is 192.168.200.128
   MTU 1500 bytes, BW 1000000 Kbit/sec, DLY 10 usec,
    reliability 255/255, txload 1/255, rxload 1/255
   Encapsulation 802.IQ Virtual LAN, Vlan ID 1., loopback not set
```

```
  Keepalive not supported
  Full Duplex, 1000Mbps, link type is force-up, media type is RJ45
  output flow-control is on, input flow-control is on
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 03:30:21, output 00:00:06, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    821 packets input, 115274 bytes, 0 no buffer
    Received 24 broadcasts (0 IP multicasts)
    0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
    0 watchdog, 0 multicast, 0 pause input
    21279 packets output, 8622685 bytes, 0 underruns
```

The P-LTE-450 installed in the IR1101 Base chassis is connected through Gigabit Ethernet 0/1/0 and sub-interface.

P-LTE-450 installed in the IR1101 Expansion Module

Within the IR1101 expansion module connected on the Compute side, the interface enumerated will be GigabitEthernet 0/4/0 under running configuration and PIM module will reflect to respective sub-slot under **show inventory**.

The following example shows the P-LTE-450 installed in the IR1101 Expansion Module installed on the Compute (bottom) side:

```
IR1101#show inventory
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
INFO: Please use "show license UDI" to get serial number for licensing.
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
NAME: "Chassis", DESCR: "IR1101 Base Chassis"
PID: IR1101-K9         , VID: V01  , SN: FCW2252007Y

NAME: "Module 0 - Mother Board", DESCR: "Cisco IR1101 motherboard"
PID: IR1101-K9         , VID: V01  , SN: FOC22500RGS

NAME: "module subslot 0/0", DESCR: "IR1101-ES-5"
PID: IR1101-ES-5       , VID: V01  , SN:

NAME: "subslot 0/0 transceiver 0", DESCR: "10/100/1000BaseTX SFP"
PID: SFP-VADSL2+-I       , VID: V01  , SN: MET20230010

NAME: "module subslot 0/4", DESCR: "P-LTE-450 Module"
PID: P-LTE-450         , VID: V03  , SN: S62EG000014

NAME: "Module 2 - Compute Module", DESCR: "IR1100 expansion module with Pluggable slot,
SFP, mSATA SSD slot and Digital GPIO"
PID: IRM-1100-SPMI     , VID: V01  , SN: FCW2329001L
IR1101#
```

The following example shows the P-LTE-450 Ethernet configuration in the IR1101 Expansion Module connected through Gigabit Ethernet 0/4/0 and sub-interface:

```
IR1101#show ip inter brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   unassigned      YES NVRAM  administratively down down
FastEthernet0/0/1      unassigned      YES unset  down                  down
FastEthernet0/0/2      unassigned      YES unset  down                  down
```

```
FastEthernet0/0/3      unassigned      YES unset  down                  down
FastEthernet0/0/4      unassigned      YES unset  down                  down
Cellular0/1/0          10.41.96.60     YES IPCP   up                    up
Cellular0/1/1          unassigned      YES NVRAM  administratively down down
GigabitEthernet0/4/0   192.168.200.128    YES DHCP   up                    up
GigabitEthernet0/4/0.1 192.168.2.15   YES DHCP   up                    up
Async0/2/0             unassigned      YES unset  up                    down
Loopback0              1.1.1.1         YES NVRAM  up                    up
VirtualPortGroup1      192.168.30.1    YES NVRAM  up                    up
Vlan1                  192.168.20.1    YES NVRAM  up                    down
```

The following shows the physical sub-interface enumerated:

```
Router#show interface gigabitEthernet 0/4/0
GigabitEthernet0/4/0 is up, line protocol is up
   Hardware is P-LTE-450, address is ac3a.677f.a888 (bia ac3a.677f.a888)
   Internet address is 192.168.200.128
   MTU 1500 bytes, BW 1000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
   Encapsulation 802.IQ Virtual LAN, Vlan ID 2.
   ARP type: ARPA, ARP Timeout 04:00:00
   Keepalive not supported
   Last clearing of "show interface" counters never
```

Gigabit Ethernet Configuration for the P-LTE-450

The router needs to have a basic Ethernet configuration in order for the P-LTE-450 to work. The Gigabit Ethernet 0/x/0 interface and the Gigabit Ethernet 0/x/0.x sub-interface need to be configured. There must be one sub-interface per PDN. The P-LTE-450 supports up to three PDNs, each on a different sub-interface.

The following are the requirements:

- Gigabit Ethernet 0/x/0 interface is used for management of the P-LTE-450.
  - IPv4 address is learnt through DHCP, IPv6 address learnt through stateless autoconfiguration from the P-LTE-450.
- Gigabit Ethernet 0/x/0.x sub-interface get its IP address from the Cellular network, once a SIM card is installed and Cellular attachment is done.
  - LTE 450 MHz PIM acts as IP passthrough.
  - NAT rules to be properly defined according to the network.
- Default IP route to be configured according to the network.
- Dot1Q Encapsulation for sub-interface.
- NTP must be configured, enabling the P-LTE-450 to sync-up its clock with the router.

The following is an example of the minimum configuration needed:

```
interface GigabitEthernet0/1/0
 description Management Interface
 ip dhcp client lease 0 0 2
 ip address dhcp
 ip nat inside
 negotiation auto
 ipv6 address dhcp
 ipv6 enable
```

```
!
interface GigabitEthernet0/1/0.1
 description LTE450 Interface
 encapsulation dot1Q 2
 ip address dhcp
 ip dhcp client lease 0 0 2
 ipv6 address autoconfig
 ipv6 enable
 ntp broadcast

ntp master
```

Configuring the Router Interface for the P-LTE-450 Module

LTE 450 MHz network IP pass through will be on the physical interface that is enumerated based on where module is connected, and address allocation is accomplished using DHCP either on IPv4 or IPv6. To connect to web-interface of P-LTE-450 MHz PIM module, need to have a sub-interface associated to the main physical interface with encapsulation dot1q.

The following steps are needed to configure the router to accept the P-LTE-450 Module. The module configuration can only be accomplished through the Intelliport WebUI.

Procedure

	Command or Action	Purpose

Step 1	**enable**
	Example:
	`Router> enable`
	`Router#`
		Enables privileged EXEC mode.
		• Enter your password if prompted.

Step 2	**configure terminal**
	Example:
	`Router> configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enables privileged EXEC mode.
		• Enter your password if prompted.

Step 3	**interface GigabitEthernet <slot>**
	Example:
	`Router(config)# interface GigabitEthernet0/1/0`
	`Router(config-if)#`
		Enter interface configuration mode either 0/1/0 or 0/4/0 based on connection.

Step 4	**ip address dhcp**
	Example:
	`Router(config-if)#ip address dhcp`
	`Router(config-if)#`
		DHCP configuration for IPv4 for main interface to retrieve the management address.

Step 5	**ip nat inside**
	Example:
	`Router(config-if)#ip nat inside`
	`Router(config-if)#`
		NAT configuration to connect to management WebUI.

	Command or Action	Purpose

Step 6	**negotiation auto**
	Example:
	`Router(config-if)#negotiation auto`
	`Router(config-if)#`
		To handle different speeds on hardware.

Step 7	**ipv6 enable**
	Example:
	`Router(config-if)#ipv6 enable`
	`Router(config-if)#`
		Enable IPv6 configuration for interface level.

Step 8	**no shutdown**
	Example:
	`Router(config-if)#no shutdown`
	`Router(config-if)#`
		Remove “admin” shutdown on the interface.

Configuring the Router Sub-Interface for the P-LTE-450 Module

The following is an example of the sub-interface configuration to connect to WebUI of third party PIM module.

Procedure

	Command or Action	Purpose

Step 1	**enable**
	Example:
	`Router> enable`
	`Router#`
		Enables privileged EXEC mode.
		• Enter your password if prompted.

Step 2	**configure terminal**
	Example:
	`Router> configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enables privileged EXEC mode.
		• Enter your password if prompted.

Step 3	**ipv6 unicast-routing**
	Example:
	`Router(config)# ipv6 unicast-routing`
	`Router(config)#`
		IPv6 unicast-routing to be enabled.

Step 4	**interface GigabitEthernet**<*slot*>
	Example:
	`Router(config)# interface GigabitEthernet0/1/0.1`
	`Router(config-if)#`
		Creates a sub-interface associated to physical interface.

Step 5	**Encapsulation dot1q** <*VLAN_ID*> **Example:**	Enables encapsulation VLAN ID for the sub-interface.

	Command or Action	Purpose
	`Router(config-if)#encapsulation dot1q 2` `Router(config-if)#`	

Step 6	**ip address dhcp**
	Example:
	`Router(config-if)#ip address dhcp`
	`Router(config-if)#`
		Obtains the cellular network IP address.

Step 7	**ip nat inside**
	Example:
	`Router(config-if)#ip nat inside`
	`Router(config-if)#`
		NAT configuration to connect to WebUI.

Step 8	**no shutdown**
	Example:
	`Router(config-if)#no shutdown`
	`Router(config-if)#`
		Remove “admin” shutdown on the interface.

Configuration Example

The following is a configuration example on the IR1101 Base unit.

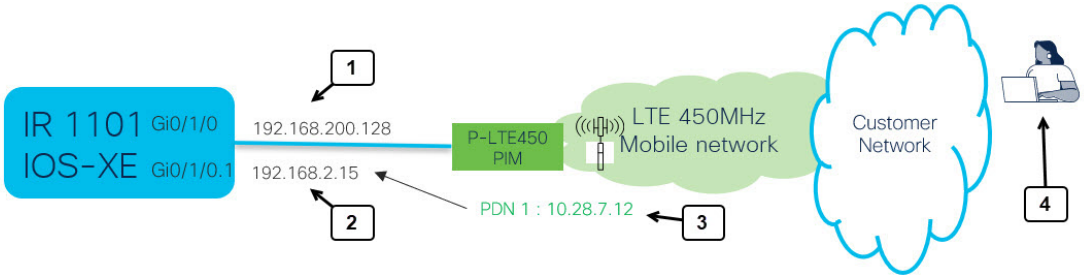
```
Router#show running-config interface GigabitEthernet 0/1/0
Building configuration...

Current configuration : 105 bytes
!
interface GigabitEthernet0/1/0
ip address dhcp
negotiation auto
ipv6 address dhcp
ipv6 enable
end

Router#show running-config interface GigabitEthernet 0/1/0.1
Building configuration...

Current configuration : 112 bytes
!
interface GigabitEthernet0/1/0.1
encapsulation dot1Q 2
ip address dhcp
ipv6 address dhcp
ipv6 enable
end

# No VLAN 2 required for dot1q 2 above
```

Note The default WebUI IP address can only be changed through the WebUI once the initial configuration is done, since you need IP access to the module.

Example Topology

The WebUI connection for the P-LTE-450 MHz module can be dependent on network topology based on the following diagram:

Figure 11: WebUI Connection for P-LTE-450 MHz Module Topology



Refer to the following table for details on the topology.

1	The GI 0/1/0 (or GI0/4/0) interface is used for management. It communicates between IOS XE and the P-LTE-450.
2	The IP address from the cellular network is passed through from the modem to GI0/1/0.n subinterface. There is one per active PDN.
3	GI0/1/0.1 Cellular interface PDN1. The LTE450MHz carrier assigns an IP address to the LTE 450 modem that is passed through to GI0/1/0.1 sub-interface.
4	P-LTE450 WebUI access: 1 ping 192.168.200.1 2 open WebUI

These are the possible connections:

1. Connection using Local-PC
2. Connection using Remote-PC

With connection using Local-PC (1), there is no need for **ip nat configuration**.

With connection using Remote-PC (2), **nat configuration is required** based on the network topology.

In either case, you enter the URL of the Management IP address for the P-LTE-450 MHz module (192.168.200.1 is the default) or re-direct to the IP address from the Cisco WebUI.

Configuring Minimum P-LTE-450 Parameters through Cisco IOS-XE

There is an IOS-XE configuration command line under the Gigabit Ethernet 0/x/0 interface that provides a subset of LTE 450 configuration that allows a management solution to set template.

This subset includes the following:

- Band
- DHCP default gateway
- Profile (including the following)
  - APN
  - Mode
  - Authentication
  - VLAN

The following are command examples:

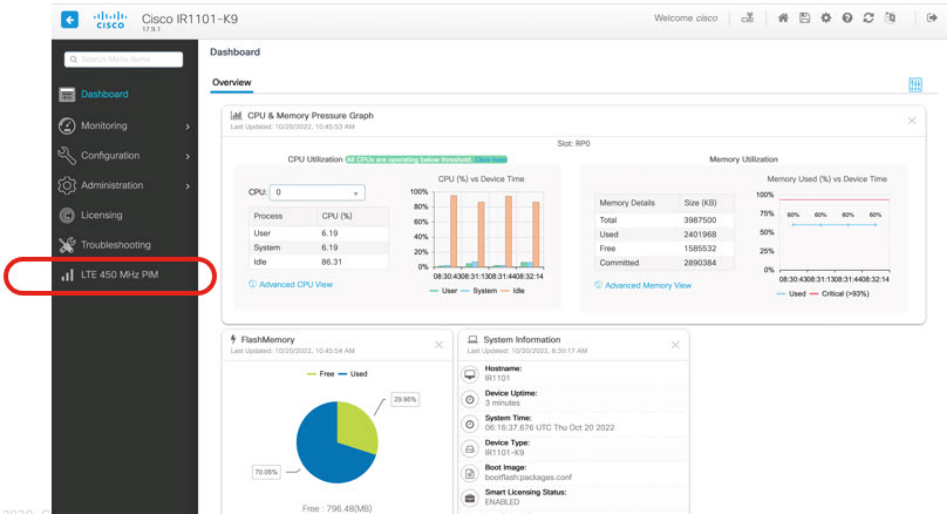
```
IR1101#conf term
Enter configuration commands, one per line.  End with CNTL/Z.

IR1101(config)#inter gi0/4/0

IR1101(config-if)#lte450 ?
  band                  select band <31|72>
  dhcp_default_gateway  select <Assign|Don't assign>
  profile               LTE Profile management commands

IR1101(config-if)#lte450 profile id 1 apn TEST authentication ?
  chap  CHAP authentication only
  none  No authentication
  pap   PAP authentication only

IR1101(config-if)#lte450 profile id 1 apn TEST authentication none pdn-type ?
  ipv4    IPv4 type bearer
  ipv4v6  IPV4V6 type bearer
  ipv6    IPV6 type bearer

IR1101(config-if)#lte450 profile id 1 apn TEST authentication none pdn-type ipv4 vlan ?
  <1-4094>  ltebridge profile VLAN ID
  <cr>      <cr>

IR1101(config-if)#lte450 profile id 1 apn TEST authentication none pdn-type vlan 2 ?
  disable  disable Profile
  enable   enable profile
  <cr>     <cr>

IR1101(config-if)#lte450 profile id 1 apn TEST authentication none pdn-type vlan 2 enable
```

Managing the P-LTE-450 Through the WebUI

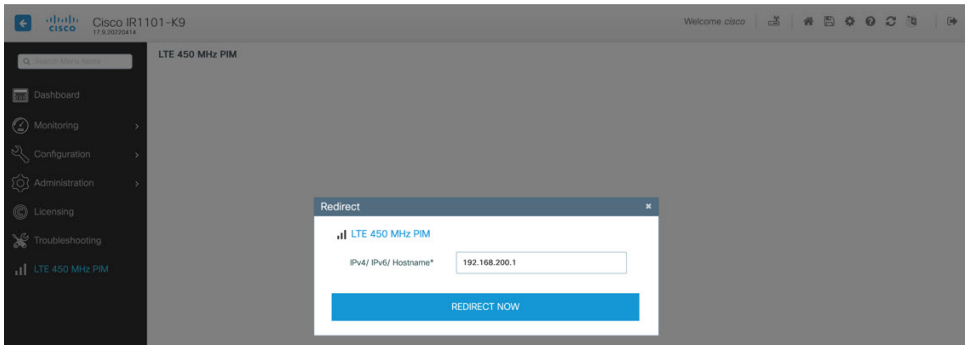
The P-LTE-450 is managed by the Web User Interface designed by Intelliport. Access to the Intelliport WebUI is gained through the Cisco WebUI.

Cisco WebUI to Intelliport WebUI Redirection

Launch the Cisco WebUI and log in with your IOS XE credentials (privilege 15).



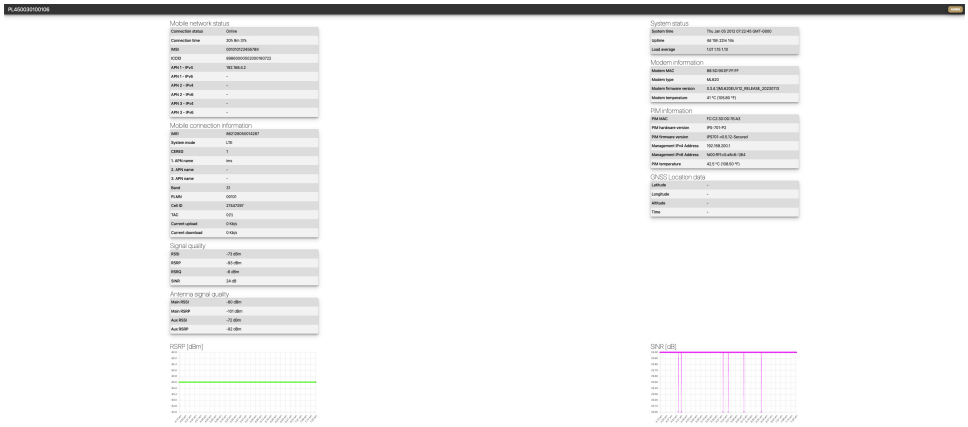
Click on **LTE 450 MHz PIM** along the left side. The Redirect window appears.



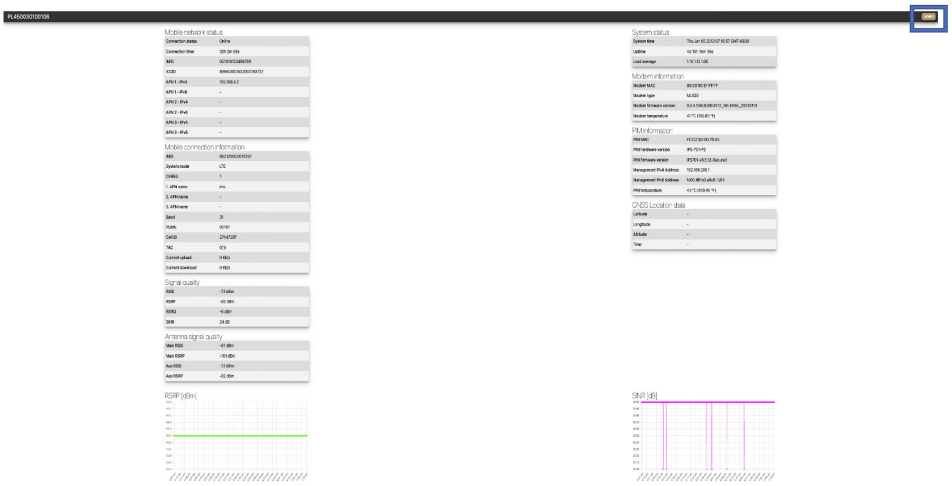
Enter the IP address of the LTE PIM. This address must be pingable by your laptop. Then click **REDIRECT NOW**. The Intelliport WebUI, referred to as the IPS701, landing page appears.

IPS701 WebUI Landing Page

The landing page shows all of the status information as well as radio signal graphs.



To log into the WebUI as Administrator, click on the **ADMIN** button on the top right corner.



Log in with the default credentials:

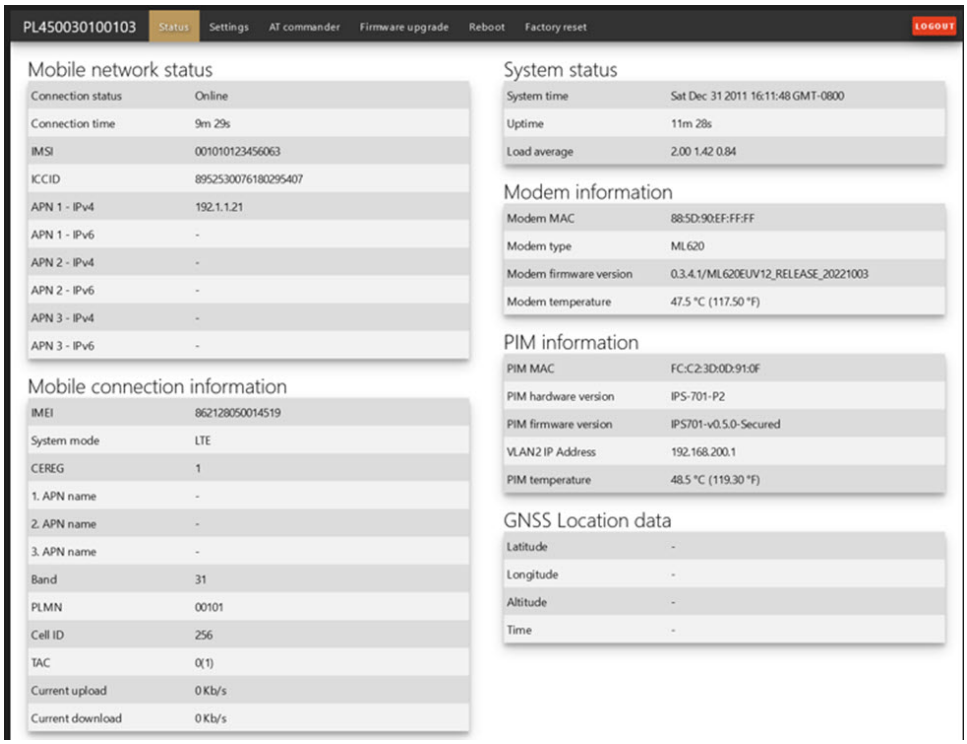
- Username — admin
- Password — admin

Note Changing the default credentials is not supported for the current release of firmware from IPS701.

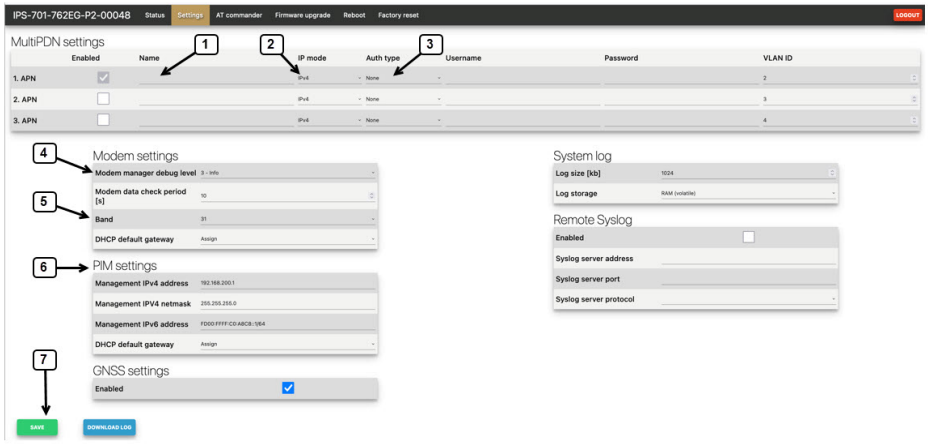
Then click on **SUBMIT**.

Configuring the IPS701

The Intelliport WebUI (IPS-701) appears when you log in as admin.



Click on the **Settings** tab to set the IPS701 parameters.



The following settings apply:

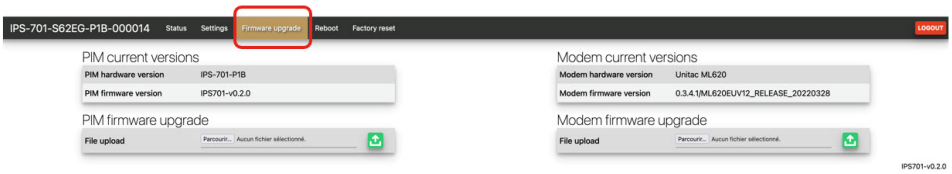
1	Select APN and enter an APN name.
2	Select IPv4, IPv6, or both.
3	Select Authentication. PAP, CHAP, or None.

4	Modem Manager debug level: 1 — error 2 — debug 3 — info
5	Select LTE 450 MHz band B31 or B72.
6	IPv4 and IPv6 address and subnet for Management.
7	Click SAVE to save the configuration. Reboot the P-LTE-450.

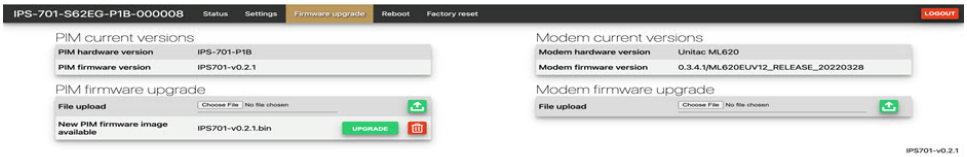
Note Settings will be applied after saving the configuration, however, you must do an additional **shut** and **no shut** on the physical interface on the router.

Other Functions

If new IPS701 firmware becomes available, it can be upgraded from the IPS701 WebUI. Click on the **Firmware upgrade** tab.



Choose the appropriate PIM or Modem firmware and upload it. Once the new firmware is uploaded click on the **UPGRADE** button.



The Reboot option in the IPS701 WebUI reloads the modem (not the PIM in IOS XE).

The P-LTE-450 module can also be rebooted through Cisco IOS-XE by performing a power-cycle of the module. Use the **hw-module subslot <slot> shutdown unpowered** command.

```
IR1101#conf term
Enter configuration commands, one per line. End with CNTL/Z.
IR1101(config)#hw-module subslot 0/1 shutdown unpowered
IR1101(config)#no hw-module subslot 0/1 shutdown unpowered
```

If the IPS701 needs to be reset to factory defaults, it should be done through the WebUI.

Enter the admin password and then click **FACTORY RESET**.

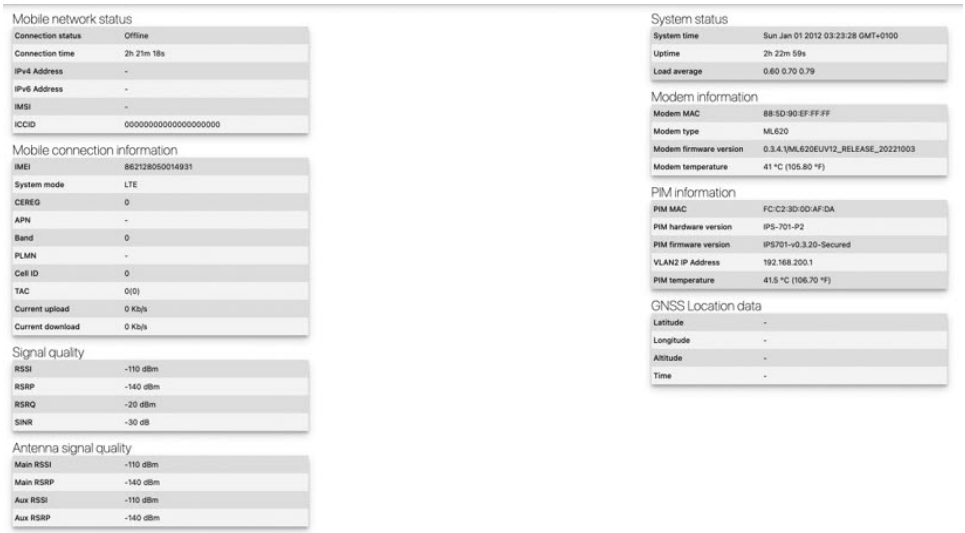
Additional CLI Support for the P-LTE-450

Management of the module is from a WebUI by Intelliport, which refers to it as the IPS-701. There is a subset of CLI commands available that are in the IPS-701 WebUI..

P-LTE-450 Monitoring

The CLI will show the module status information which is available from the IPS-701 WebUI minus the signal radio graphs.

Figure 12: IPS-701 Landing Page



The **show** commands will either display all sections or based on the qualifier matching each section.

```
Router# show lte450 0/1/0 ?
  all        Display all LTE450 information
  hardware   Display LTE450 hardware information
  network    Display LTE450 network information
  radio      Display LTE450 radio information
```

```
Router#show lte450 0/1/0 all

System Status
=============
System time = Tue Jul 11 19:59:59 2023
Uptime = 9d 0h 27m 46s
Load Average = 3.14 3.05 3.04
```

```
Modem information
=================
Modem MAC = 88:5D:90:EF:FF:FF
Modem hardware version = ML620EU
Modem firmware version = 0.3.4.1/ML620EUV12_RELEASE_20230424
Modem temperature = 50.0 deg C

PIM information
===============
PIM MAC = FC:C2:3D:0D:7E:82
PIM hardware version = IPS-701-P3
PIM firmware version = IPS701-v1.1.0-Secured
PIM serial number = 762EG000085
Management IPv4 Address = 192.168.200.1
Management IPv6 Address = fd00:ffff:c0:a8c8::1/64
PIM temperature = 52.0 deg C

GNSS Location Data
==================
Latitude = 37.4183466
Longitude = -121.9192633
Altitude = 18.30 m
Time = 2023-07-11T20:02:43.000Z

Watchdog Statistics
===================
Hardware watchdog counter = 0
Modem watchdog counter = 2

Mobile network status
=====================
Connection Status = Online
Connection time = 3d 1h 44m 7s
IMSI = 123456700004864
ICCID = 8949001508130014864
MSISDN =
APN-1 IPv4 address = 192.168.168.19
APN-1 IPv6 address =
APN-2 IPv4 address =
APN-2 IPv6 address =
APN-3 IPv4 address =
APN-3 IPv6 address =

Mobile connection information
=============================
IMEI = 862128050014592
System mode = LTE
EPS State = ATTACHED
RRC State = RRC CONNECTED
CEREG = 5
APN-1 APN name = cmw500
APN-2 APN name =
APN-3 APN name =
Band = 31
PLMN = 00101
Cell ID = 256
TAC = 0(1)
PCI = 0
TX power = -15
Bandwidth = 5MHz
LTE RX channel = 9895
LTE TX channel = 27785
Current upload = 1501.0 Kbps
Current download = 1655.0 Kbps
```

```
Signal quality
==============
RSSI = -64 dBm
RSRP = -91 dBm
RSRQ = -13 dBm
SINR = 30 dB

Antenna signal quality
======================
Main RSSI = -64 dBm
Main RSRP = -91 dBm
Aux RSSI = -63 dBm
Aux RSRP = -90 dBm
```

```
Router#show lte450 0/1/0 hardware

System Status
=============
System time = Tue Jul 11 20:00:28 2023
Uptime = 9d 0h 28m 15s
Load Average = 3.31 3.09 3.05

Modem information
=================
Modem MAC = 88:5D:90:EF:FF:FF
Modem hardware version = ML620EU
Modem firmware version = 0.3.4.1/ML620EUV12_RELEASE_20230424
Modem temperature = 50.0 deg C

PIM information
===============
PIM MAC = FC:C2:3D:0D:7E:82
PIM hardware version = IPS-701-P3
PIM firmware version = IPS701-v1.1.0-Secured
PIM serial number = 762EG000085
Management IPv4 Address = 192.168.200.1
Management IPv6 Address = fd00:ffff:c0:a8c8::1/64
PIM temperature = 52.0 deg C

GNSS Location Data
==================
Latitude = 37.4183466
Longitude = -121.9192633
Altitude = 18.30 m
Time = 2023-07-11T20:03:06.000Z

Watchdog Statistics
===================
Hardware watchdog counter = 0
Modem watchdog counter = 2
```

```
Router#show lte450 0/1/0 network

Mobile network status
=====================
Connection Status = Online
Connection time = 3d 1h 45m 18s
IMSI = 123456700004864
ICCID = 8949001508130014864
MSISDN =
APN-1 IPv4 address = 192.168.168.19
```

```
APN-1 IPv6 address =
APN-2 IPv4 address =
APN-2 IPv6 address =
APN-3 IPv4 address =
APN-3 IPv6 address =

Mobile connection information
============================
IMEI = 862128050014592
System mode = LTE
EPS State = ATTACHED
RRC State = RRC CONNECTED
CEREG = 5
APN-1 APN name = cmw500
APN-2 APN name =
APN-3 APN name =
Band = 31
PLMN = 00101
Cell ID = 256
TAC = 0(1)
PCI = 0
TX power = -15
Bandwidth = 5MHz
LTE RX channel = 9895
LTE TX channel = 27785
Current upload = 1577.0 Kbps
Current download = 1739.0 Kbps


Router#show lte450 0/1/0 radio

Signal quality
==============
RSSI = -64 dBm
RSRP = -91 dBm
RSRQ = -13 dBm
SINR = 30 dB

Antenna signal quality
======================
Main RSSI = -64 dBm
Main RSRP = -91 dBm
Aux RSSI = -63 dBm
Aux RSRP = -90 dBm
```

P-LTE-450 Configuration

Command line options are available for the following parameters:

- Band
- DHCP Default Gateway
- APN Profile

Configuration options are shown by the **lte450 ?** command.

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
(config)#interface GigabitEthernet 0/1/0
(config-if)#lte450 ?
band                  select band <31|72>
dhcp_default_gateway  select <Assign|Don't assign>
profile               LTE Profile management commands
```

The following are examples of the CLI options.

Table 14: CLI Options for Band and DHCP Default Gateway

Option	Command	Purpose
Band	**lte450 band** *<31 | 72>*	Assigns the modem band.
DHCP Default Gateway	**lte450 dhcp_default_gateway** *<assign | dont-assign>*	Assigns/Unassigns DHCP default gateway.

CLI options for the APN Profile are broken down in the following table:

Table 15: CLI Options for APN Profile

Profile Parameter	Command	Options
APN Name	**lte450 profile id** *<1-3>* **apn** *<apn-name>*	Assigns a name to the apn belonging to a particular profile. • <1-3> Profile number • <apn-name> Name of access point
Authentication	**lte450 profile id** *<1-3>* **authentication** *<chap | none | pap>* **username** *<Username>* **password** *<Password>*	Specifies the type of authentication to be used for a particular profile. If the authentication type is chap/pap, username and password fields will be required. If the authentication type is none, username and password fields will not be required. • <chap> CHAP authentication only • <none> No authentication • <pap> PAP authentication only
IP Mode	**lte450 profile id** *<1-3>* **pdn-type** *<ipv4/ipv4v6/ipv6>*	Specifies the IP mode for a particular profile. • <ipv4> IPv4 type bearer • <ipv4v6> IPV4V6 type bearer • <ipv6> IPV6 type bearer

Profile Parameter	Command	Options
VLAN	**lte450 profile id** *<1-3>* **vlan** *<1-4094> <disable | enable>*	VLAN: Assigns a VLAN ID to a particular lte bridge profile. • <1-4094> ltebridge profile VLAN ID

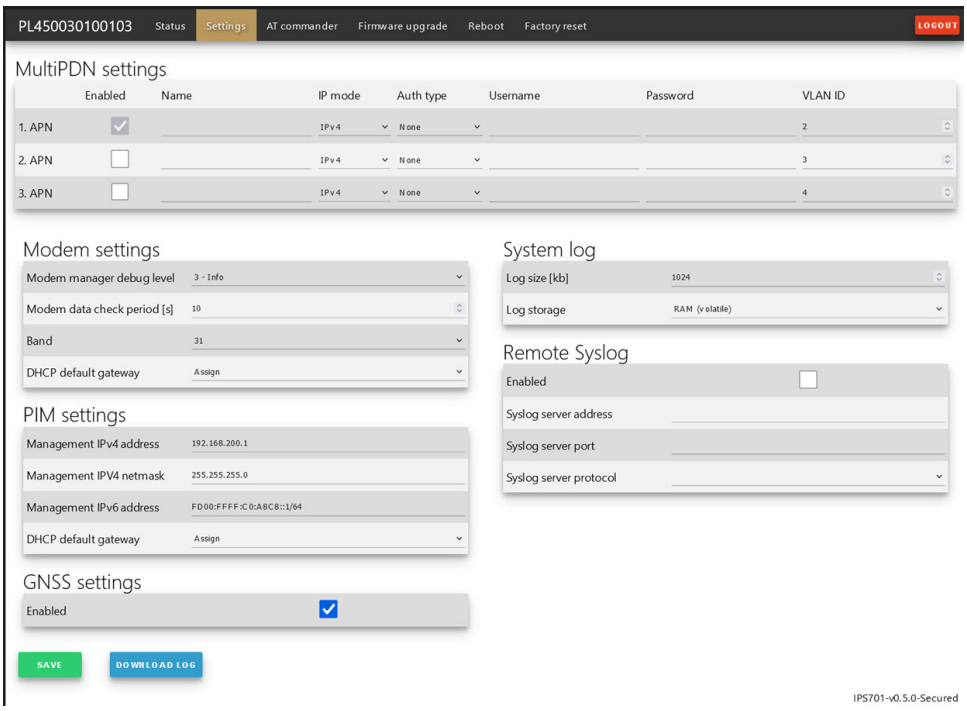
Troubleshooting

When troubleshooting with a private LTE Network, the router software configuration is limited. In order to troubleshoot the module, you need to download a log from the IPS-701 module for third party evaluate of the state of the connection.

In order to download the log from the IPS-701 webpage, navigate to the **Settings** tab. Click on **DOWNLOAD LOG**. If you want to increase the logging buffer you can do the same on the webpage.

Refer to the following:

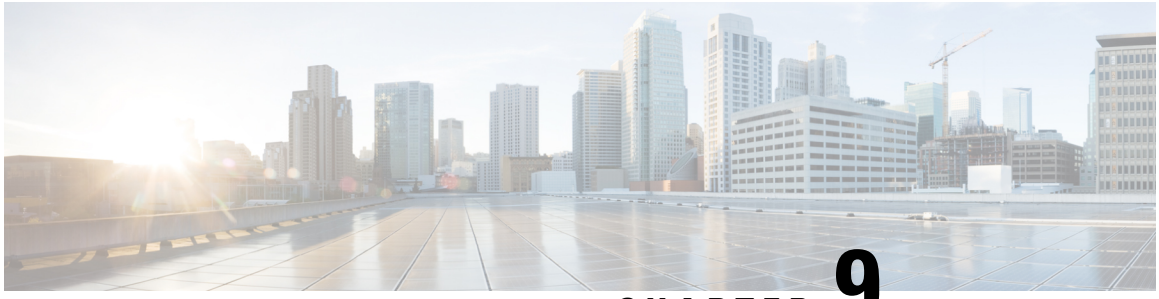
Figure 13: Download Log



To reload the module, use the **hw-module sublot <slot>** command with reload option:

```
Router#hw-module subslot 0/1 ?
maintenance Maintenance mode
oir Spa OIR
reload Restart the target subslot
start Activate the target subslot
stop Deactivate the target subslot
```

```
Router#hw-module subslot 0/1 reload
```



CHAPTER 9

Cellular Serviceability

This chapter contains the following sections:

- Configuring Modem DM Log Collection, on page 135
- Example: DM Log Configuration, on page 137
- Example: Configuring dm-log to Utility Flash, on page 138
- Enabling Modem Crashdump Collection, on page 139
- Displaying Modem Log Error and Dump Information, on page 140
- Example: Sample Output for the show cellular logs dm-log Command, on page 140
- Example: Sample Output for the show cellular logs modem-crashdump Command, on page 141

Configuring Modem DM Log Collection

Diagnostic Monitor (DM) Log is a modem's feature that captures data transactions between the modem and the network over the radio frequency interface. This feature is a useful tool for troubleshooting 3G and 4G data connectivity or performance issues.

Once a DM log file is captured, diagnostic software tools, such as Sierra Wireless SwiLog and Qualcomm QXDM, can be used to decode the DM log file to understand the issues. A member of Cisco TAC can help with decoding the DM log files.

To configure DM log collection, enter the following commands, starting in privileged EXEC mode.

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**controller cellular** *<slot>* **Example:** `Router(config)# controller cellular x/x/x`	Enters cellular controller configuration mode.
Step 3	**lte modem dm-log enable** **Example:**	Configures DM logging for LTE modem.

	Command or Action	Purpose
	`Router(config-controller)# lte modem dm-log enable`	• autostop—Automatically stops DM log capturing based on: link-down—cellular interface link down event timertimer—amount of time in minutes • enable—Starts DM log capturing. • filesize <size>—Specifies the maximum log file size, in MB for each DM log file before creating another DM log file. Range is from 1 to 64. Default is 20. • filter location: <filename>—Specifies the DM log filter to use from the following locations: —bootflash:file —flash:file **Note** Bootflash and flash are the only valid locations to store the DM log filter file. **Note** If the DM log filter file is not specified, the generic filter file, which comes with the router will be used. **Note** The DM log filter file needs to be in .sqf format. • rotation—Enables continuous DM log capturing by replacing the oldest DM log files with the latest. • size <log-size>—Specifies the maximum total size in MB of all DM log files that can be allowed in the bootflash or flash before modem stops capturing DM log files. If rotation is enabled, the oldest DM files is replaced with the latest DM file to meet this size configuration.
Step 4	**end** **Example:** `Router(config-controller)# end`	Returns to privileged EXEC mode.

Step 5	**show cellular** <*slot*> **logs dm-log**
	Example:
	`Router# show cellular x/x/x logs dm-log`
	`Integrated DM logging is on`
	`output path = Utility Flash`
	`filter = MC74xx generic - v11026_Generic_GSM_WCDMA_LTE_IP-no-data-packets.sqf`
	`maximum log size = 0`
	`maximum file size = 0`
	`log rotation = disabled`
		(Optional) Displays DM log configuration and statistics.

	Command or Action	Purpose
	33 packets sent to the modem, 4663 bytes, 0 errors 28521 packets received from the modem, 13500758 bytes, 0 input drops 28521 packets stored in utility flash, 13500758 bytes current file size = 13500758 current log size = 13500758 total log size = 13500758 Utility Flash DM log files = (1) files	

Example: DM Log Configuration

The following example shows how to:

- Specify the maximum size of all DM log files that can be stored in bootflash or flash to 512 MB
- Specify the maximum size of each DM log file to 32 MB
- Use MC7xxx_GPS_Log.sqf DM log filter in the flash
- Enable rotation
- Enable DM log capturing

```
Router(config-controller)# controller cell x/x/x
Router(config-controller)# lte modem dm-log size 512

Router(config-controller)# controller cell x/x/x
Router(config-controller)# lte modem dm-log filesize 32

Router(config-controller)# controller cell x/x/x
Router(config-controller)# lte modem dm-log filter flash:MC7xxx_GPS_Log.sqf

Router(config-controller)# controller cell x/x/x
Router(config-controller)# lte modem dm-log rotation

Router(config-controller)# controller cell x/x/x
Router(config-controller)# lte modem dm-log enable

Router(config-controller)# controller cell x/x/x
Router(config-controller)# end

Router(config-controller)# controller cell x/x/x
Router(config-controller)# lte modem dm-log size 1024

Router#show running-config | section controller
controller Cellular x/x/x
 lte modem dm-log filter flash:MC7xxx_GPS_Log.sqf
 lte modem dm-log size 512
 lte modem dm-log filesize 32
 lte modem dm-log rotation
 lte modem dm-log enable
 lte modem dm-log size 1024

Router#show cellular x/x/x logs dm-log
Integrated DM logging is on
output path = Utility Flash
filter = flash:MC7xxx_GPS_Log.sqf
maximum log size = 536870912
maximum file size = 33554432
```

```
log rotation = enabled

32 packets sent to the modem, 3879 bytes, 0 errors
158324 packets received from the modem, 75971279 bytes, 0 input drops
158324 packets stored in utility flash, 75971279 bytes

current file size = 8863042
current log size = 75971279
total log size = 75971279
Utility Flash DM log files =  (3) files
end

Router#dir flash:dmlog*
Directory of bootflash:/dmlog*

Directory of bootflash:/

   27  -rw-    33554069   Jun 7 2020 18:08:46 -08:00  dmlog-slot4-20200921-172930.bin
2885718016 bytes total (521891840 bytes free)
lte modem dm-log size 1024

Router(config)#controller cellular x/x/x
Router(config-controller)#no lte modem dm-log enable
Router(config-controller)#end
```

Example: Configuring dm-log to Utility Flash

```
Router(config)#controller cellular x/x/x
Router(config-controller)#lte modem dm-log enable
Router(config-controller)#
*May 8 17:57:09.905: %SYS-5-CONFIG_I: Configured from console by console
Router#
Router#show cellular x/x/x log dm-log
Integrated DM logging is off
Output path = bootflash:
Filter Type = Default
Filter Name = v11026_Generic_GSM_WCDMA_LTE_IP-no-data-packets.sqf
Maximum log size = 0 MB
Maximum file size = 0 MB
Log rotation = Disabled

Router#show cellular x/x/x log dm-log details
Integrated DM logging is off
Output path = bootflash:
Filter Type = Default
Filter Name = v11026_Generic_GSM_WCDMA_LTE_IP-no-data-packets.sqf
Maximum log size = 0 MB
Maximum file size = 0 MB
Log rotation = Disabled

0 Packets sent to the modem, 0 Bytes, 0 Errors
0 Packets received from the modem, 0 Bytes, 0 Input drops
0 Packets stored in file system, 0 Bytes, 0 Errors, 0 Aborts
0 Max rcv queue size

Current file size = 0 MB
Current log size = 0 MB
Total log size = 0 MB
Router#
```

Enabling Modem Crashdump Collection

Modem crashdump collection is useful in debugging firmware crash. To collect crash data, the modem has to be pre-configured so that it will stay in memdump mode after a crash. Memdump mode is a special boot-and-hold mode for the memdump utility to collect crash data.

To enable modem crashdump collection, perform the following steps.

Note The integrated modem crashdump collection feature is supported only on 3G HSPA and 4G based cellular modems.

Before you begin

The device will need to be in boot-and-hold mode.

```
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#controller cel x/x/x
Router(config-controller)#lte modem crash-action ?
boot-and-hold Remain in crash state

Router(config-controller)#lte modem crash-action boot-and-hold
```

This ensures that whenever the router crashes, it will stay in that state and will not try to recover. By default, the crash-action is reset which means the modem will reset and try to recover itself whenever it crashes. The above boot-and-hold command is used to keep the modem in a crashed state so that you can capture crashdump using the following command:

```
Router#test cell-cwan x/x/x modem-crashdump ?
off Disable Modem firmware crash dump
on Enable Modem firmware crash dump

Router#test cell-cwan x/x/x modem-crashdump on
```

This will capture the crashdump and store it in flash.

Procedure

	Command or Action	Purpose
Step 1	**test** *{ cell-cwan }* <*slot*> **modem-crashdump** { **on** <*location*> | **off** } **Example:** `Router# test cell-host x/x/x modem-crashdump on local_uf`	Enables or disables modem crashdump collection. • **cell-host** —Keyword for fixed platform. • **cell-cwan** — Keyword for cellular on a PIM. • *slot* —For the PIM, this is the router slot, module slot, and port separated by slashes (for example, x/x/x). For fixed platform, this is the number 0.

	Command or Action	Purpose
		• **on** —Enables crashdump log collection. • *location* —Specifies the destination URL where the modem crashdump logs will be stored. • **off** —Disables crashdump log collection.

Displaying Modem Log Error and Dump Information

As part of the 3G serviceability enhancement, commands strings (**at!err** and **at!gcdump**) can be sent to the modem using Cisco IOS CLI rather than setting up a reverse telnet session to the cellular modem to obtain log error and dump information.

To obtain log error and dump information, perform the following steps.

Note The modem log error and dump collection feature is supported only on 3G SKUs.

Procedure

	Command or Action	Purpose
Step 1	**show cellular** <*slot*> **log error** **Example:** `Router# show cellular x/x/x log error`	Shows modem log error and dump information.
Step 2	**test cellular** <*slot*> **modem-error-clear** **Example:** `Router# test cellular x/x/x modem-error-clear`	(Optional) Clears out the error and dump registers. By default, error and dump registers are not cleared out after a read. This command changes the operation so that registers are cleared once they are read. As a result, the AT command strings are changed to "**at!errclr=–1**" for CDMA and "**at!err=0**" for GSM modems.

Example: Sample Output for the show cellular logs dm-log Command

The following shows a sample output of the **show cellular logs dm-log** command:

```
Router# show cellular x/x/x logs dm-log
```

```
Integrated DM logging is on
filter = generic
maximum log size = 67108864
maximum file size = 20971520
log rotation = disabled
7 packets sent to the modem, 3232 bytes, 0 errors
75 packets received from the modem, 57123 bytes, 0 input drops
75 packets stored in file system, 57123 bytes, 0 errors, 0 aborts
2 max rcv queue size
current file size = 57123
current log size = 57123
total log size = 57123
DM log files: (1 files)
```

Example: Sample Output for the show cellular logs modem-crashdump Command

The following shows a sample output of the **show cellular logs modem-crashdump** command:

```
Router# show cellular x/x/x logs modem-crashdump
Modem crashdump logging: off
Progress = 100%
Last known State = Getting memory chunks
Total consecutive NAKs = 0
Number of retries = 0
Memory Region Info:
1: Full SDRAM [Base:0x0, Length:0x2000000]
2: MDSP RAM A region [Base:0x91000000, Length:0x8000]
3: MDSP RAM B region [Base:0x91200000, Length:0x8000]
4: MDSP RAM C region [Base:0x91400000, Length:0xC000]
5: MDSP Register region [Base:0x91C00000, Length:0x28]
6: ADSP RAM A region [Base:0x70000000, Length:0x10000]
7: ADSP RAM B region [Base:0x70200000, Length:0x10000]
8: ADSP RAM C region [Base:0x70400000, Length:0xC000]
9: ADSP RAM I region [Base:0x70800000, Length:0x18000]
10: CMM Script [Base:0x6A350, Length:0x310]
Router#
```

CHAPTER 10

Short Message Service (SMS) and Dying Gasp

This chapter contains the following sections:

- SMS WARNING, on page 143
- Short Message Service (SMS) Capabilities, on page 143
- Configuring 4G SMS Messaging, on page 144
- Dying-Gasp SMS Notification for Supported Modems, on page 145

SMS WARNING

SMS may be used by customers willing to leverage the Dying gasp feature (outgoing SMS) for their management solution. Any other SMS use, for example incoming SMS, is not recommended. Please read the following warning.

Warning Use of SMS on devices may create a security risk by permitting uncontrolled and/or unauthenticated access through the modem via SMS commands, if incoming SMS are allowed and associated with any active script. SMS are issued with commands issued in clear text and may also be subject to denial of services attacks.

As security best practices, Cisco strongly advises against the use of SMS for cellular accounts associated with LTE ports on IoT routers, particularly on critical infrastructure or where there may be safety implications for human life or property.

For better security, Cisco recommends that you ask your service provider to **DISABLE** SMS services on existing LTE accounts associated with networking devices. For new LTE accounts, please specify **NO SMS** services for the LTE service at the time the service is ordered.

Short Message Service (SMS) Capabilities

Some of the modems used on the cellular pluggable interface support receiving, transmitting, archiving, and deleting of SMS messages. This support includes the ability to view up to 25 received texts and archive more messages in a custom file location. SMS is supported on multiple carriers.

A sending device behind a cellular pluggable interface transmits an SMS text message over the cellular link through cellular towers until it the message reaches the recipient's router, which then notifies the recipient device, such as a cell phone. The receiving device uses the same process to return a reply to the sending device.

For SMS transmission to work, end users must have a text-capable device, and optionally, a text plan. If end users do not have a text plan, standard SMS rates apply to their text transmissions.

Configuring 4G SMS Messaging

Note For an 4G LTE Advanced, the *unit* argument identifies the router slot, module slot, and the port, and is separated by slashes (0/4/0).

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters the configuration mode.
Step 2	**controller cellular** *<unit>* **Example:** `Router(config)# controller cellular 0/4/0`	Enters the controller cellular configuration mode.

Step 3	**lte sms archive path** *<FTP-URL>*
	Example:
	`Router(config-controller)# lte sms archive path ftp://username:password@172.25.211.175/SMS-LTE`
		Specifies an FTP server folder path to send all the incoming and outgoing SMS messages. After the folder path is identified, it is appended automatically with outbox and inbox folders for the path to which SMS messages are sent and received, for example:
		`ftp://172.25.211.175/SMS-LTE/outbox`
		`ftp://172.25.211.175/SMS-LTE/inbox`

Step 4	**cellular** *unit* **lte sms view** { *all* | *ID* | *summary* }
	Example:
	`Router# cellular 0/4/0 lte sms view summary`
	`ID FROM YY/MM/DD HR:MN:SC SIZE CONTENT`
	`0 4442235525 12/05/29 10:50:13 137 Your entry last month has...`
	`2 5553337777 13/08/01 10:24:56 5 First`
	`3 5553337777 13/08/01 10:25:02 6 Second`
		Displays the message contents of incoming texts received by a modem.
		• **all**—Displays the message contents of up to 255 incoming text messages received by the modem.
		• **ID** —Displays the message contents for a specified ID (0-255) of an incoming text message.
		• **summary**—Displays a summary of the incoming text messages received by the modem.

Step 5	**end** **Example:** `Router# end`	Exits the configuration mode and returns to the privileged EXEC mode.
Step 6	**show cellular** *unit* **sms** **Example:**	Displays all the information in the text messages sent and received. Message information includes text messages sent successfully, received, archived, and messages pending to

	Command or Action	Purpose
	Router#**show cellular 0/4/0 sms** Incoming Message Information ---------- SMS stored in modem = 20 SMS archived since booting up = 0 Total SMS deleted since booting up = 0 Storage records allocated = 25 Storage records used = 20 Number of callbacks triggered by SMS = 0 Number of successful archive since booting up = 0 Number of failed archive since booting up = 0 Outgoing Message Information ---------- Total SMS sent successfully = 0 Total SMS send failure = 0 Number of outgoing SMS pending = 0 Number of successful archive since booting up = 0 Number of failed archive since booting up = 0 Last Outgoing SMS Status = SUCCESS Copy-to-SIM Status = 0x0 Send-to-Network Status = 0x0 Report-Outgoing-Message-Number: Reference Number = 0 Result Code = 0x0 Diag Code = 0x0 0x0 0x0 0x0 0x0 SMS Archive URL = ftp://lab:lab@1.3.150.1/outbox	be sent. LTE-specific information on errors in case of a FAILED attempt may also be displayed.
Step 7	**cellular** *unit* **lte sms send** *number SMS_Text* **Example:** Router# **cellular 0/4/0 lte sms send 15554443333** *<sms text>*	Enables a user to send a 4G LTE band SMS message to other valid recipients, provided they have a text message plan. The *number* argument is the telephone number of the SMS message recipient. **Note** 10-digit or 11-digit (phone) numbers are the proper numerical format for sending a text. For example, ########## or 1##########. Seven digits are not supported.
Step 8	**cellular** *unit* **lte sms delete** [**all** | *id*] **Example:** Router# **cellular 0/4/0 lte sms delete** *[all | id]*	(Optional) Deletes one message ID or all of the stored messages from memory.

Dying-Gasp SMS Notification for Supported Modems

Prerequisites:

- A modem that supports dying gasp
- Cisco Network-advantage license

Pluggable Interface Modules (PIMs) using the EM7430, EM7455, or P-LTEA18-GL modem have extra capacitors to supply power to the modem in case of loss of power to the module. This allows a graceful power

off of the modem. When loss of power is detected, the modem is expected to send out dying gasp SMS when configured.

The following is an example of configuring dying gasp with a phone number and SMS message:

```
#controller Cellular 0/4/0
#lte dyinggasp sms send 9119110911 "Losing Power"
Warning: Enabling Dying Gasp SMS configuration completed successfully.
Please reset Modem for the changes to take effect
```

Configuration Steps

Step	Command	Purpose
1	**configure terminal**	Enters the global configuration mode.
2	**controller Cellular** *<slot>*	Enters the interface command mode for the cellular module controller slot.
3	**lte dyinggasp detach enable**	Enable dying-gasp feature with send detach request
4	**lte dyinggasp sms send**&# *<phone number> <SMS message>;*	Configure the phone number to receive SMS text message and the content of text message to be sent by the modem when platform or module powered down.
5	**exit**	Exit configuration
6	**write mem**	Save changes to the router configuration

Configuration Example

The following example shows how to enable dying-gasp feature on cellular module in slot 0/1/0, specify phone number receiving the SMS, and the specific SMS text message to be sent by modem upon power failure.

```
router# configure terminal

router(config)# controller cellular 0/4/0
router (config-controller)# lte dyinggasp detach enable
router (config-controller)# lte dyinggasp sms send 4081112222
 IR1800-#999_EM7455_powered_off!
```

CHAPTER 11

Troubleshooting

This chapter contains the following sections:

- Verifying Data Call Setup , on page 147
- Checking Signal Strength, on page 148
- Verifying Service Availability, on page 148
- Sample Command Output, on page 151

Verifying Data Call Setup

To verify the data call setup, follow these steps:

1. After you create a modem data profile using the cellular profile create command and configuring DDR on the cellular interface, send a ping from the router to a host across the wireless network.
2. If the ping fails, capture the following show commands:
   - show version
   - show cellular 0/x/0 all
   - show controller cellular 0/x/0 all
   - show interface cellular 0/x/0
   - show dialer
   - show ip route
   - show running-config
3. For more detailed troubleshooting, capture traces from debug commands:
   - debug cellular all — All debugging
   - debug cellular async — Cellular async debugging
   - debug cellular callback — Cellular data callback debugging
   - debug cellular callcontrol — Cellular Direct IP call control debugging
   - debug cellular data — Data path debugging

- debug cellular dm— DM debugging
- debug cellular dualsim — Cellular dual SIM debugging
- debug cellular fota — Cellular Fota debugging
- debug cellular fw — Cellular modem firmware upgrade debugging
- debug cellular gps — Cellular gps debugging
- debug cellular ipc — Cellular IPC debugging
- debug cellular linkrecovery — Cellular Link Recovery debugging
- debug cellular management — Mgmt path debugging
- debug cellular mobile-app — Cellular mobile app debugging
- debug cellular nas — Cellular NAS log debugging
- debug cellular nmea — GPS NMEA messages debugging
- debug cellular sms — SMS messages debugging
- debug cellular snmp — Cellular snmp debugging

Checking Signal Strength

If the Received Signal Strength Indication (RSSI) level is very low (for example, if it is less than –110 dBm), follow these steps:

1. Ensure at least one antenna is connected to the 'MAIN' RF port on the 4G module. Preferably both MAIN and DIV RF ports should be connected to antenna for better RF signal. Check to ensure the antenna are threaded and tightened.
2. If you are using a remote antenna, move the antenna cradle and check if the RSSI has improved.
3. Contact your wireless service provider to verify if there is service availability in your area.

Verifying Service Availability

The following is a sample output for the **show cellular** *slot* **all** command.

```
Router# show cellular x/x/x all
Hardware Information
====================
Modem Firmware Version = 32.00.116
Host Firmware Version = 32.00.007
Device Model ID = LM960A18
International Mobile Subscriber Identity (IMSI) = 310170205101138
International Mobile Equipment Identity (IMEI) = 356299100001310
Integrated Circuit Card ID (ICCID) = 89011702272051011382
Mobile Subscriber Integrated Services
Digital Network-Number (MSISDN) =
Modem Status = Modem Online
```

```
Current Modem Temperature = 39 deg C
PRI version = 1026, Carrier = Generic
OEM PRI version = 32101006

Profile Information
====================

Profile 1 = ACTIVE* **
--------
PDP Type = IPv4
PDP address = 10.54.25.215
IPv4 PDP Connection is successful
Access Point Name (APN) = m2m.com.attz
Authentication = None
Primary DNS address = 8.8.8.8
Secondary DNS address = 8.8.4.4

Profile 2 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = m2m.com.attz
Authentication = None

Profile 3 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = mmsbouygtel.com
Authentication = None

Profile 5 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = orange
Authentication = None

* - Default profile
** - LTE attach profile


Configured default profile for active SIM 0 is profile 1.


Data Connection Information
===========================
Profile 1, Packet Session Status = ACTIVE
Cellular0/1/0:
Data Packets Transmitted = 30 , Received = 30
Data Transmitted = 2160 bytes, Received = 3000 bytes
IP address = 10.54.25.215
Primary DNS address = 8.8.8.8
Secondary DNS address = 8.8.4.4
Profile 2, Packet Session Status = INACTIVE
Profile 3, Packet Session Status = INACTIVE
Profile 4, Packet Session Status = INACTIVE
Profile 5, Packet Session Status = INACTIVE
Profile 6, Packet Session Status = INACTIVE
Profile 7, Packet Session Status = INACTIVE
Profile 8, Packet Session Status = INACTIVE
Profile 9, Packet Session Status = INACTIVE
Profile 10, Packet Session Status = INACTIVE
Profile 11, Packet Session Status = INACTIVE
Profile 12, Packet Session Status = INACTIVE
Profile 13, Packet Session Status = INACTIVE
Profile 14, Packet Session Status = INACTIVE
```

```
Profile 15, Packet Session Status = INACTIVE
Profile 16, Packet Session Status = INACTIVE

Network Information
===================
Current System Time = Mon Apr 25 9:16:36 2022
Current Service Status = Normal
Current Service = Packet switched
Current Roaming Status = Roaming
Network Selection Mode = Automatic
Network = F-Bouygues Telecom
Mobile Country Code (MCC) = 208
Mobile Network Code (MNC) = 20
Packet switch domain(PS) state = Attached
LTE Carrier Aggregation state = Deconfigured
Registration state(EMM) = Registered
EMM Sub State = Normal Service
Tracking Area Code (TAC) = 30440
Cell ID = 128697859
Negotiated network MTU = 1430

Radio Information
=================
Radio power mode = Online
LTE Rx Channel Number(PCC) = 3175
LTE Tx Channel Number(PCC) = 21175
LTE Band = 7
LTE Bandwidth = 15 MHz
Current RSSI = -67 dBm
Current RSRP = -96 dBm
Current RSRQ = -11 dB
Current SNR = 6.0 dB
Physical Cell Id = 378
Number of nearby cells = 1
Idx PCI (Physical Cell Id)
--------------------------------
1 378
Radio Access Technology(RAT) Preference = AUTO
Radio Access Technology(RAT) Selected = LTE
Network Change Event = unknown


LTE bands supported by modem:
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 38 39 40 41 42 43 46 48 66 71.
LTE band Preference settings for the active sim(slot 0):
- Bands 1 2 3 4 5 7 8 12 13 14 17 18 19 20 25 26 28 29 30 32 38 39 40 41 42 43 46 48 66 71.


3G bands supported by modem:
Index:
23 - UMTS Band 1: 2100 MHz (IMT)
24 - UMTS Band 2: 1900 MHz (PCS A-F)
26 - UMTS Band 4: 1700 MHz (AWS A-F)
27 - UMTS Band 5: US 850 MHz (CLR)
50 - UMTS Band 8: 900 MHz (E-GSM)
51 - UMTS Band 9: Japan 1700 MHz
61 - UMTS Band 19: 800 MHz (800 Japan)
3G band Preference settings for the active sim(slot 0):
Index:
23 - UMTS Band 1: 2100 MHz (IMT)
24 - UMTS Band 2: 1900 MHz (PCS A-F)
26 - UMTS Band 4: 1700 MHz (AWS A-F)
27 - UMTS Band 5: US 850 MHz (CLR)
50 - UMTS Band 8: 900 MHz (E-GSM)
```

```
51 - UMTS Band 9: Japan 1700 MHz
61 - UMTS Band 19: 800 MHz (800 Japan)

==========================================

Band index reference list:

For LTE and 5G, indices 1-128 correspond to bands 1-128.

For 3G, indices 1-64 maps to the 3G bands mentioned against each above.


Modem Security Information
==========================
Active SIM = 0
SIM switchover attempts = 0
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3

Cellular Firmware List
==========================
Idx Carrier FwVersion PriVersion Status
1 Generic 32.00.116 1026 Active
2 Verizon 32.00.126 2022 Inactive
3 ATT 32.00.147 4024 Inactive
4 TMUS 32.00.156 5005 Inactive

Firmware Activation mode = MANUAL
```

Sample Command Output

The following examples show samples of command output:

```
router# debug cellular 0/0/0 messages profile
PROFILE_3GPP2 debugging is on
router#

router #show cellular 0/0/0 profile
Profile 1 = INACTIVE **
--------
PDP Type = IPv6
Access Point Name (APN) = vzwims
Profile 2 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwadmin
Profile 3 = ACTIVE*
--------
PDP Type = IPv4v6
PDP address = 10.187.130.3
Access Point Name (APN) = VZWINTERNET
        Primary DNS address = 198.224.173.135
        Secondary DNS address = 198.224.174.135
Profile 4 = INACTIVE
--------
PDP Type = IPv4v6
Access Point Name (APN) = vzwapp
3GPP2 Profiles:
==============
Profile 1 = INACTIVE
```

```
--------
PDN Type = IPv6
Access Point Name (APN) = vzwims
Profile 2 = INACTIVE
--------
PDN Type = IPv4v6
Access Point Name (APN) = vzwadmin
Profile 3 = INACTIVE*
--------
PDN Type = IPv4v6
Access Point Name (APN) = VZWINTERNET
Profile 4 = INACTIVE
--------
PDN Type = IPv4v6
Access Point Name (APN) = vzwapp

Profile 5 = INACTIVE
--------
PDN Type = IPv4v6
Access Point Name (APN) =
Profile 6 = INACTIVE
--------
PDN Type = IPv4v6
Access Point Name (APN) =
  * - Default profile
 ** - LTE attach profile
```

Dual SIM

The following example shows there are two SIMs present:

```
router# show controller cellular 0
Interface Cellular0
4G WWAN Modem - Global Multimode LTE/DC-HSPA+/HSPA+/HSPA/UMTS/EDGE/GPRS
Cellular modem configuration
=====================================
Modem is recognized as valid
manufacture id:  0x00001199     product id: 0x000068A2
Power status: Active
Sierra Wireless Direct IP MC7710 modem
:
:
Cellular Dual SIM details:
---------------------------
SIM 0 is present
SIM 1 is present
SIM 0 is active SIM
```

The following example shows how to display the status of the active SIM:

```
router# show cellular 0/x/0 security
Active SIM = 0
SIM switchover attempts = 0
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
router#
```