

Cisco LTE and 5G on Cisco 8100 Series Secure Routers

This chapter provides an overview of the software features and configuration information for Cisco LTE/5G on the Cisco 8100 Series Secure Routers.

For more information on Cisco LTE/5G SKUs, faceplates, and LED descriptions, see the Cisco 8100 Series Secure Routers Hardware Installation Guide.

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Overview of Cisco LTE and 5G

Only the C8151-G2 and C8161-G2 routers support Cisco LTE and 5G using Pluggable Interface Modules (PIMs):

Table 1: Pluggable Modules of the Cisco 8100 Series Secure Routers

Pluggable Interface Modules	Pluggable Interface Modules technology
P-5GS6-R16SA-GL	5G Sub-6 GHz Pluggable Interface Module
P-LTEA7-NA	CAT7 LTE Pluggable for North America
P-LTEA7-JP	CAT7 LTE Advanced PIM for Japan
P-LTEA7-EAL	CAT7 LTE Advanced PIM for EMEA, APAC, LATAM

Table 2: Fixed modules of Cisco 8100 Series Secure Routers

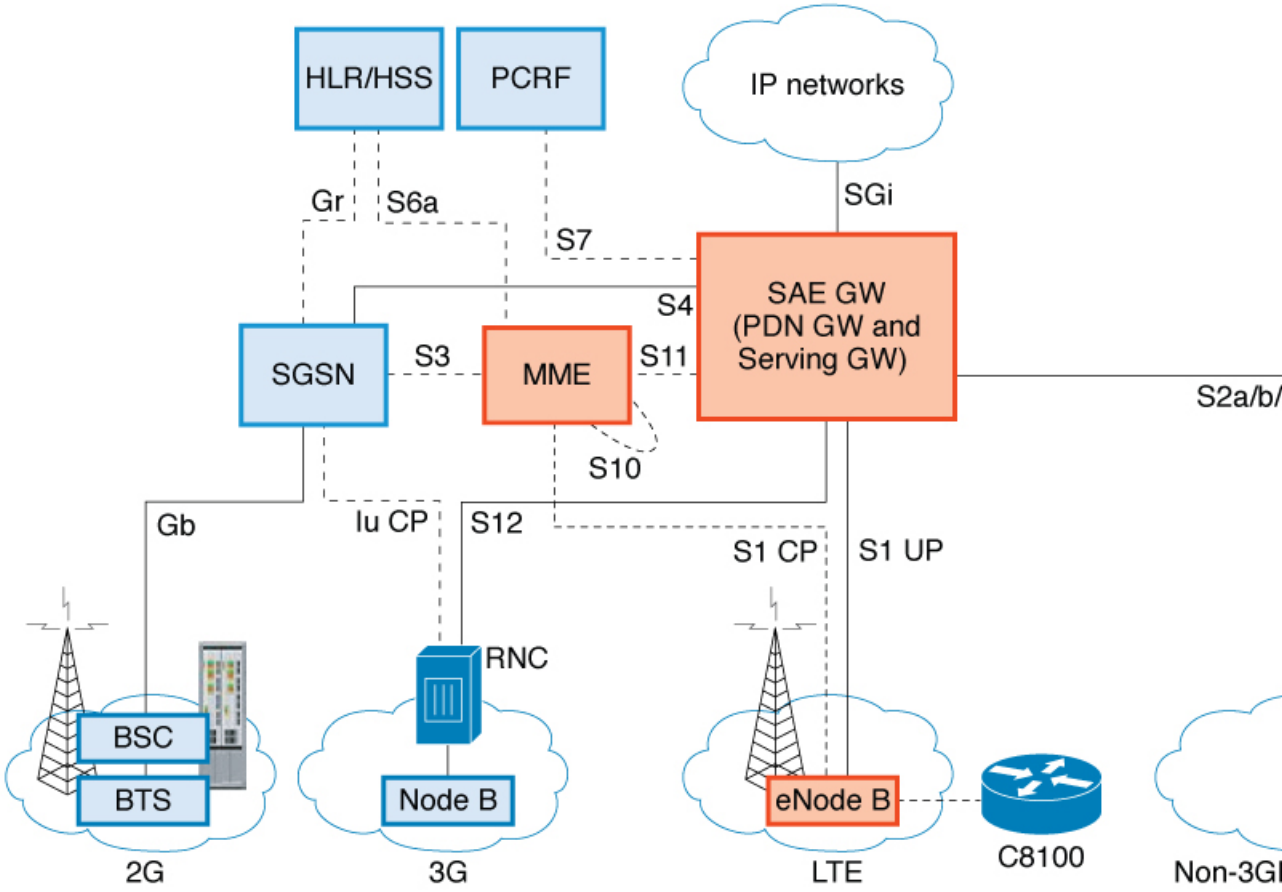
Fixed Module Platforms	Fixed module technology
C8151-CVAP-G2, C8151-CVAI-G2, and C8151H-C-G2	5G Sub-6 (FR1) SA (Standalone)

Cisco LTE/5G supports the following modes:

- **5G** —5G is the next step in the evolution of mobile communications. It is a new global wireless standard after 1G, 2G, 3G, and 4G networks. 5G wireless technology is meant to deliver higher multi-Gbps peak data speeds, ultra low latency, increased availability, massive network capacity, more reliability, and a more uniform user experience to more users.
- **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. These networks initially support up to 300 Mb/s peak rates in the downlink and up to 50 Mb/s peak rates in the uplink.

The following figure explains the 4G LTE packet core network architecture.

Figure 1: 4G LTE Packet Core Network Architecture



Gateways	The Serving Gateway (SGW) routes and forwards user data packets, while also acting as the mobility anchor for the user plane, and is the anchor for mobility between LTE and other 3GPP technologies. The Packet Data Network (PDN) Gateway (PGW) provides connectivity from the User Equipment (UE) to external packet data networks by being the point of exit and entry of traffic for the UE. A UE may have simultaneous connectivity with more than one PGW for accessing multiple PDNs. The PGW performs policy enforcement, packet filtering for each user, charging support, lawful interception, and packet screening. Another key role of the PGW is to act as the anchor for mobility between 3GPP and non-3GPP technologies such as WiMAX and 3GPP2 (CDMA 1X and EvDO). The System Architecture Evolution GW (SAE GW) is the entity that covers the PGW and SGW functionality in the Evolved Packet Core (EPC).
RNC	The Radio Network Controller (RNC) is responsible for controlling the Radio Access Network (RAN) that are connected to it. The RNC carries out radio resource management and some of the mobility management functions and is the point where encryption is done before user data is sent to and from the mobile. The RNC connects to the Circuit-Switched Core Network through the Media Gateway (MGW).
BTS	Base Transceiver Station.
BSC	Base Station Controller.
SGSN	Service GPRS Support Node.

Prerequisites for configuring Cisco LTE and 5G

- If the signal is not good at the router, use the Cisco offered antenna accessories and extension cables to place the antenna away from router in a better coverage area.
- You must have LTE and 5G 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 SIM is supported.
- You must install the SIM card before configuring the LTE/5G on Cisco Cisco 8100 Series Secure Routers.
- The standalone antenna that supports GPS capabilities must be installed for the GPS feature to work. See the Cisco 4G Indoor/Outdoor Active GPS Antenna (GPS-ACT-ANTM-SMA) document for installation information.

Note The GPS Antenna details are not applicable for C8151-CVAI-G2, C8151-CVAP-G2, and C8151H-C-G2.

Restrictions for configuring Cisco LTE and 5G

- Currently, cellular networks support only user initiated bearer establishment.
- Due to the shared nature of wireless communications, the experienced throughput varies depending on the number of active users or congestion in a given network.
- Cellular networks have higher latency compared to wired networks. 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.
- 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.
- It is strongly recommended that you configure SNMP V3 with authentication/privacy.

Cisco LTE and 5G features

Cisco LTE and 5G supports the following major features:

- Global Positioning System (GPS) and National Marine Electronics Association (NMEA) streaming for PIMs.
- Short Message Service (SMS)
- SIM lock and unlock capabilities
- Dual SIM
- Auto SIM
- Public Land Mobile Network (PLMN) selection
- IPv6
- Multiple PDN
- LTE Link Recovery

4G GPS and NMEA

Active GPS is supported on the SubMiniature version A (SMA) port. Active GPS antenna is supported only in the standalone mode. An Active GPS antenna includes a built-in low-noise Amplifier that provides sufficient gain to overcome coaxial cable losses while providing the proper signal level to the GPS receiver. Active GPS antennae require power from the GPS receiver SMA port to operate. See the Connecting to a server hosting a GPS application, on page 5 for more information.

National Marine Electronics Association (NMEA) streams GPS data either from a LTE and 5G through a virtual COM port and a TCP/IP Ethernet connection to any marine device (such as a Windows-based PC) that runs a commercially available GPS-based application.

The following GPS and NMEA features are supported on the Cisco LTE and 5G:

- GPS standalone mode (satellite-based GPS)
- Cisco IOS CLI display coordinates.
- External application displays router map location
- The Cisco LTE/5G only supports NMEA over IP and uses show commands in the platform

Note Assisted GPS mode is not supported.

For instructions on setting up the GPS antenna, see the Cisco 4G Indoor/Outdoor Active GPS Antenna (GPS-ACT-ANTM-SMA) document.

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.

To connect a Cisco LTE/5G through IP to a PC, 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 0/2/0 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.

Dual SIM card

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 0/2/0
lte sim primary slot <slot#>
```

If the active SIM card loses connectivity to the network a failover to the alternative SIM card slot occurs.

By default the failover timer is three minutes. The failover timer can be set from 1 to 7 minutes.

```
controller cellular 0/2/0
lte failovertimer <3-7>
```

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

```
cellular 0/2/0 lte sim activate slot <0-1>
```

Auto SIM

The Auto SIM feature detects the SIM and loads the corresponding firmware.

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

Auto SIM is enabled by default.

Example: List the firmware when auto SIM is enabled

```
Router# show cellular 0/2/0 firmware
firmware          Idx Carrier      FwVersion      PriVersion   Status
 1   ATT          192.0.2.1        002.035_000  Inactive
 2   GENERIC      192.0.2.2        002.035_000  Active
 3   ROGERS       192.0.2.3        001.012_000  Inactive
 4   SPRINT       192.0.2.4        002.012_000  Inactive
 5   VERIZON      192.0.2.5        002.042_000  Inactive

Firmware Activation mode  =  AUTO
```

Disable auto SIM

SUMMARY STEPS

1. **configure terminal**
2. **controller cellular** *slots/sub-slots/interface*
3. **no lte firmware auto-sim**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters configuration mode.
Step 2	**controller cellular** *slots/sub-slots/interface* **Example:** `Router(config)# controller cellular 0/2/0`	Specifies the controller interface.
Step 3	**no lte firmware auto-sim** **Example:** `Router(config-if)# no lte firmware auto-sim`	Disable auto SIM. **Note** Disabling auto SIM resets the modem.

Example: List the firmware when auto SIM is disabled

```
Router# show cellular 0/2/0 firmware
 Idx Carrier      FwVersion    PriVersion   Status
 1   ATT          192.0.2.1  002.035_000  Active
 2   GENERIC      192.0.2.2  002.035_000  Inactive
 3   ROGERS       192.0.2.3  001.012_000  Inactive
 4   SPRINT       192.0.2.4  002.012_000  Inactive
 5   VERIZON      192.0.2.5  002.042_000  Inactive

Firmware Activation mode  =  Manual
```

Firmware activation

Note

- To check the carrier firmwares that are available to be switched to, use the **show cellular slots/sub-slots/interface firmware** command.
- To manually switch the carrier firmware, disable the auto SIM.

SUMMARY STEPS

1. **cellular** *slots/sub-slots/interface* **lte firmware-activate** *firmware-index*

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**cellular** *slots/sub-slots/interface* **lte firmware-activate** *firmware-index* **Example:** `Router# cellular 0/2/0 lte firmware-activate 1`	Activates the firmware index. **Note** For the LTE/5G, the *unit* argument identifies the slot, subslot, and the interface separated by slashes (0/2/0).

Using a SIM Card

Cisco LTE or 5G 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 LTE or 5G 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 an LTE connection. The router uses the configured PIN to authenticate prior to the LTE connection. If the Cisco IOS PIN configuration is missing or if the PIN is incorrect, the SIM authentication fails and the connection is not initiated.

If the locked SIM is moved to a different router or to another device, or if the LTE or 5G in which the locked SIM resides is moved to a different LTE or 5G slot in the same router, the router configuration should be changed. The configuration is associated with the cellular controller that is specific to an router LTE or 5G slot number. This will ensure that the SIM card will not be used in any unauthorized device, or, if there are multiple LTE or 5G in a single router, that the appropriate PIN is applied to each LTE or 5G 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 LTE 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.

Change the PIN

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

SUMMARY STEPS

1. **cellular** *slots subslots interface* **lte sim change-pin** *current-pin new-pin*

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**cellular** *slots subslots interface* **lte sim change-pin** *current-pin new-pin* **Example:** `Router# cellular 0/2/0 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** *unit* **lte sim** {**lock** | **unlock**} *pin* **Example:** `Router# cellular 0/2/0 lte sim lock 1111`	Locks or unlocks the SIM card using a PIN code. **Note** *pin*—A code (4 to 8 digits long) provided by your service provider to lock or unlock the SIM card.

Configure CHV1 for unencrypted level 0

Procedure

	Command or Action	Purpose
Step 1	**cellular** *slots subslots interface* **lte sim lte sim authenticate 0 pin** **Example:**	Enters the cellular controller configuration mode Use either of these commands:**lte sim authenticate 0 pin** or **lte sim authenticate 0 pin slot {0 | 1}**

	Command or Action	Purpose
	`Router# controller cellular 0/0/0`	

Configure CHV1 for unencrypted level 7

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* **privilege** *var password pin* **Example:** `Router(config)# username SIM privilege 0 password 1111`	**Note** Creates username and password. name - specifies the username.*pin*—A 4 to 8 digits 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	*username* **privilege 0** *password pin* **Example:** `Router(config)# controller cellular 0/0/0`	Enters the cellular controller configuration mode.
Step 5	**lte sim authenticate 7***pin* OR**lte sim authenticate 7 pin slot {0 | 1}** **Example:** `Router(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 LTE 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**

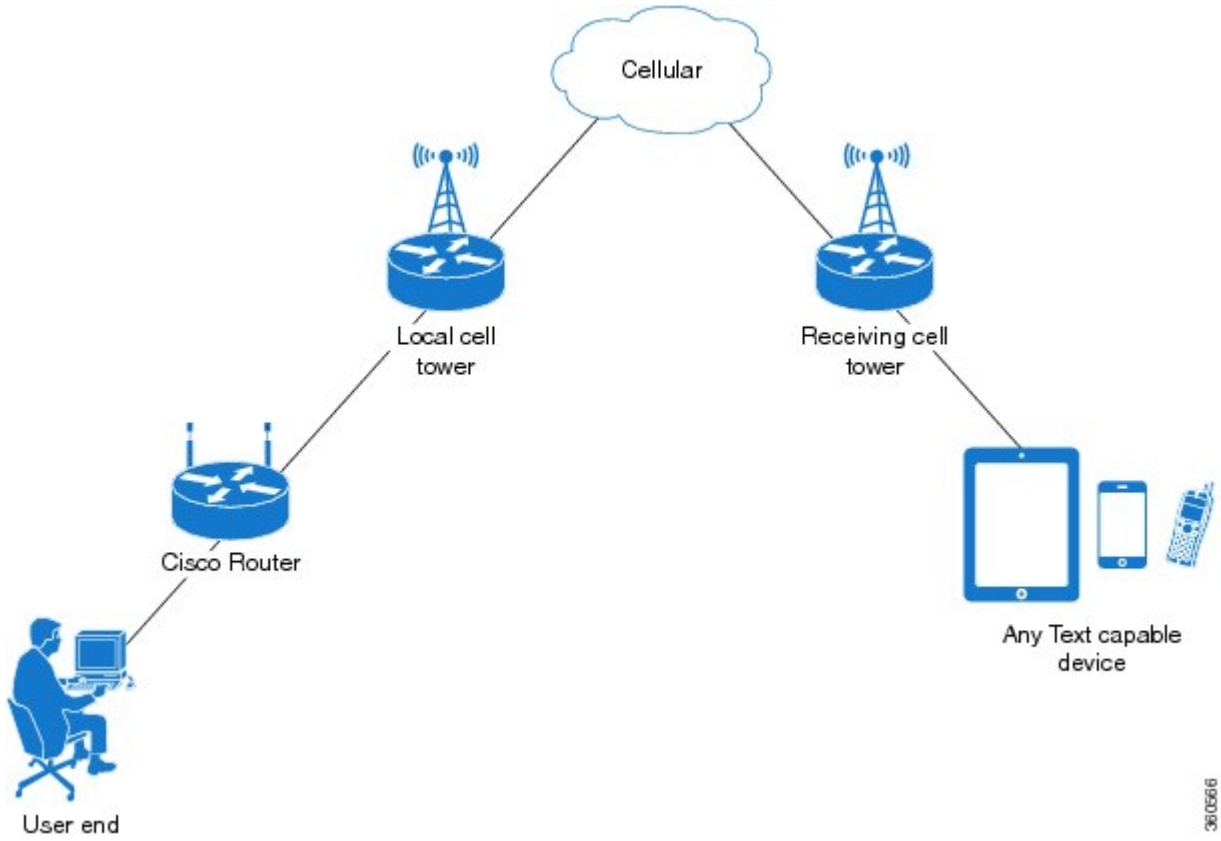
	Command or Action	Purpose
		The slot keyword and its options are available only on platforms that supports Dual-SIM feature.
Step 6	**exit** **Example:** `Router(config-controller)# exit`	(Optional) Exits the cellular controller configuration mode.
Step 7	**no username***name* **Example:** `Router(config-controller)# 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.

Short Message Service capabilities

Cisco LTE/5G support receiving, transmitting, archiving, and deleting of Short Message Service (SMS) messages.

A sending device behind a Cisco LTE/5G transmits an SMS text message over the 4G 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. The following figure describes the flow from a mobile device to a 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.

Figure 2: SMS Network



Provision data account

One or more modem data profiles can be created to provision a modem on a LTE/5G SKU. An active wireless account with a service provider with one or more (dual) SIM cards must be installed. The modem data profile is pre-configured on the modem.

The following tasks are used to verify the signal strength and service availability of the modem and to create, modify, and delete modem data profiles:

IP multimedia subsystem profiles

IP Multimedia Subsystem (IMS) profiles establish a session, and are a part of the modem configuration and are stored in the modem's NVRAM. An IMS network is an access-independent and standard-based IP connectivity service that enables different types of multimedia services to end users using common Internet-based protocols.

LTE and 5G LEDs

The following tables describes the LED behavior in LTE/5G.

Table 3: LTE and 5G LED indicators

LED	Color/Bar and description	
LTE SIM(0) & SIM(1)	Green (Solid)	Modem up, SIM installed and active
	Green Blink	LTE data activity
	Off	Modem not up; or modem up and no SIM
	Amber (Solid)	Modem up, SIM installed but not active
RSSI - Uses Bars for LED Indication	Four Bar	High RSSI >= -69dBm
	Three Bar	Medium RSSI, -89dBm <> -70dBm
	Two Bar	Low RSSI, -99dBm <> -90dBm
	One Bar	RSSI <= -100dBm
	0 or No Bar	No Service
SERVICE - Uses Color Indication	Green(solid)	LTE signal present (RSSI LEDs will be Green)
	Amber(solid)	2G/3G signal present (RSSI LEDs will be Amber)
	No Color	No service detected.
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 4: LTE and 5G LED indicators for C8151-CVAI-G2, C8151-CVAP-G2, and C8151H-C-G2

LED	Color/Bar and description
5G	No colour - No Service
	Green - 4G Service
	Blue - 5G Service

Guidelines for creating, modifying, or deleting modem data profiles

Customized profiles (Access Point Name (APN) in mobile networks) can be created and used on Cisco LTE/5G SKU's. Maximum number of profiles that can be created are 16.

Cisco SKU's shipping with specific carrier provisioning file (Can be found in Carrier label under "show cellular <slot> hardware"), default profiles are already populated and can be deployed readily.

In all other cases where profile configurations are not available, separate profiles should be created with required parameters.The **id** argument specifies the profile number assigned to the modem. The maximum number of profiles that can be created varies depending on the specific modem model.

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 <unit> 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 0/2/0**.
- Profile 1 is reserved for non-network slicing use only. When using Profile 1, only a single slice is supported on Profile 2, and the data-profile CLI configuration is not required. Profiles 2 and above are designated for network slicing (NS) functionality. For these profiles, the data-profile CLI must be configured under **controller cellular 0/x/0**. Each data profile from Profile 2 onwards maps to an individual network slice and corresponding cellular interface.

Create, modify, or delete data profiles using EXEC mode

Customized profiles (Access Point Name (APN) in mobile networks) can be created and used on Cisco LTE/5G SKU's. Maximum number of profiles that can be created are 16.

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

Note For the LTE/5G, the *unit* argument identifies the router slot, module slot, and port separated by slashes (0/2/0).

Procedure

	Command or Action	Purpose
Step 1	**cellular** *unit* **lte profile** *[***create** | **delete***] profile-number [apn [authentication [username password [bearer-type]]]]* **Example:** `Router# cellular 0/2/0 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.

	Command or Action	Purpose
		• (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 displays configured profile list. **Note** Single asterisk(*) displayed against data profile. Double asterisk(**) displayed against attached profile.
Step 2	**cellular** *unit* **lte profile** *[***create** | **delete***] profile-number [apn [authentication [username password [bearer-type [slice-type [slice-differentiator]]]]]]* **Example:** `Router# cellular 0/2/0 lte profile create 2 apn.com pap username pwd ipv4 eMBB 100`	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 displays configured profile list.

	Command or Action	Purpose
		Note Single asterisk(*) displayed against data profile. Double asterisk(**) displayed against attached profile. **Note** The **slice-type** and **slice-differentiator** options are applicable only for P-5GS6-R16SA-GL. • (Optional) Slice-types are identified by 3GPP-defined values. The valid values for slice type are eMBB, URLLC, and MIoT. • (Optional) Slice-differentiator is an optional value that enables the User Equipment (UE) to use multiple slice instances of the same SST.

Example

```
Router# show cellular 0/2/0 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 = 192.0.2.1
PDP IPV6 address = 2600:1010:B00E:1E11:192D:3E20:199B:3A70/64  Scope: Global
Access Point Name (APN) = VZWINTERNET
Authentication = None
        Primary DNS address = 192.0.2.2
        Secondary DNS address = 192.0.2.2
        Primary DNS IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF
        Secondary DNS IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF
```

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

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


Router #show cellular 0/2/0 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.
```

Create, modify, or delete data profiles in configuration mode

Note

- For the LTE/5G NIM, the *unit* argument identifies the router slot, WIC slot, and port separated by slashes (0/1/0).
- The default profile index is 1 and is not allowed to configure the slice type.

Procedure

	Command or Action	Purpose
Step 1	**profile id***id* **apn** *apn name [***authentication** *[username password]***pdn-type** *[pdn type][***slot***slot-number*| *no-overwrite]]]]* **Example:** `Router(config-controller)# profile id 1 apn apn_internet authentication none pdn-type ipv4 slot 0`	Configures a cellular profile in the configuration mode. • The *id* argument specifies the profile number created for the modem. • (Optional) The *apn* argument specifies an Access Point Name (APN) in the profile. An APN is provided by 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

	Command or Action	Purpose
		using this profile. Acceptable parameters are: **ipv4**, **ipv6** and **ipv4v6**. • (Optional) The *slot-number* parameter specifies the slot number. By default, the slot-number is the current active slot-number, if not specified. • (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*.
Step 2	**profile id***id* **apn** *apn name [***authentication** *[username password]***pdn-type** *[pdn type][slice- type][slice-differntiator][***slot***slot-number*| *no-overwrite]]]]* **Example:** `Router(config-controller)# profile id 1 apn apn_internet authentication none pdn-type ipv4 slice-type eMBB slice-differentiator 100 slot 0`	Configures a cellular profile in the configuration mode. • The *id* argument specifies the profile number created for the modem. The **id** argument specifies the profile number assigned to the modem. The maximum number of profiles that can be created varies depending on the specific modem model. • (Optional) The *apn* argument specifies an Access Point Name (APN) in the profile. An APN is provided by 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**. • (Optional) The *slot-number* parameter specifies the slot number. By default, the slot-number is the current active slot-number, if not specified. • (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*. **Note**

	Command or Action	Purpose
		The **slice-type** and **slice-differentiator** options are applicable only for P-5GS6-R16SA-GL. • (Optional) **Slice-type** is identified by 3GPP-defined values. The valid values for slice type are eMBB, URLLC, and MIoT. • (Optional) **Slice-differentiator** is an optional value that enables the User Equipment (UE) to use multiple slice instances of the same slice-type.

Configuration examples

The following example shows how to change a default profile on LTE/5G:

```
Router(config-controller)# lte sim data-profile 3 attach-profile 1 slot <unit>
```

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

```
Router# show cellular 0/2/0 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 = 192.0.2.1
PDP IPV6 address = 2600:1010:B00E:1E11:192D:3E20:199B:3A70/64  Scope: Global
Access Point Name (APN) = VZWINTERNET
Authentication = None
        Primary DNS address = 192.0.2.2
        Secondary DNS address = 192.0.2.3
        Primary DNS IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF
        Secondary DNS IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF

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
```

Configuration example under controller cellular

Example Configuration under Controller Cellular

```
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 0/2/0
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
```

Configure radio band selection

This feature allow users to configure and lock down the modem to a specific RF band, or set of bands. The preference can be set to be equal to, or a sub-set of the capability supported by the modem/carrier combination.

The following examples show the controller configuration commands:

Procedure

Step 1 **conf t**

Example:

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

Step 2 **controller cellular** *interface-number*

Example:

```
Router(config)# controller cellular 0/2/0
```

Step 3 **lte modem band-select indices umts3g indices lte4g indices nr5g-nsa indices nr5g-sa indices slot slot #**

Example:

```
Router(config-controller)# lte modem band-select indices umts3g "none" lte4g "all" nr5g-nsa "78"
nr5g-sa "78" slot 0
```

Example

```
Router#show cellular 0/3/0 radio ?
  band     Show Radio band settings
  history  Show Radio history in graph format
  |        Output modifiers
  <cr>     <cr>
```

```
Router#show cell 0/3/0 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 NSA bands supported by modem:
- Bands 1 2 3 5 7 8 12 13 14 18 20 25 26 28 29 30 38 40 41 48 66 70 71 75 76 77 78 79.
NR5G NSA band Preference settings for the active sim(slot 0):
- Bands 78

NR5G SA bands supported by modem:
- Bands 1 2 3 5 7 8 12 13 14 18 20 25 26 28 29 30 38 40 41 48 66 70 71 75 76 77 78 79.
NR5G SA band Preference settings for the active sim(slot 0):
- Bands 78.

3G/GSM bands supported by modem:
Index:
  23 - WCDMA (Europe, Japan, and China) 2100 band
  24 - WCDMA US PCS 1900 band
  26 - WCDMA US 1700 band
  27 - WCDMA US 850 band
  28 - WCDMA Japan 800 band
  50 - WCDMA Europe and Japan 900 band
  61 - WCDMA Japan 850 band
```

```
3G/GSM band Preference settings for the active sim(slot 0):
Index: <none>

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


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.
```

Multiple PDN contexts

This feature enables 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.

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

cellular 0/2/0 and cellular 0/2/1

These interfaces can be viewed as two logical interfaces using the same radio resources.

The interface cellular 0/2/0 is referred as the first PDN, and cellular 0/2/1 as the second PDN.

To bring up the two PDNs, configuration needs to be applied on both the cellular interfaces in order to make two simultaneous data calls. The next step is to associate 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 Both PDNs share radio resources. Therefore, any throughput measurement needs to take into account the aggregate throughput on both PDNs, instead of just one.

Note For Verizon cellular network, the second PDN uses profile #6 automatically, when the call is initiated for the second data connection.

Configuration examples

The following example shows how to configure multiple PDN on Cisco LTE/5G SKU:

```
interface Cellular0/2/0
ip address negotiated
 dialer in-band
 dialer idle-timeout 0
 dialer-group 1
```

```
 ipv6 enable
 pulse-time 1
!
interface Cellular0/2/1
ip address negotiated
dialer in-band
dialer idle-timeout 0
dialer-group 1
ipv6 enable
pulse-time 1
! dialer-list 1 protocol ipv6 permit
!

ip route 192.0.2.1 255.255.255.0 Cellular0/2/0
ip route 192.0.2.2 255.255.255.255 Cellular0/2/1
!
```

These show commands can be used to verify the status of the multiple PDN calls:

```
Router#sh cellular 0/2/0 profile
Profile 1 = ACTIVE* **
--------
PDP Type = IPv4v6
PDP address = 192.0.2.1
PDP IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF/64  Scope: Global
Access Point Name (APN) = broadband
Authentication = None
        Primary DNS address = 192.0.2.2
        Secondary DNS address = 192.0.2.3
        Primary DNS IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF
        Secondary DNS IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF

.
.
.

Profile 16 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = broadband
Authentication = CHAP
Username: ipv4v6
Password: xxxxxx

  * - Default profile
 ** - LTE attach profile

Configured default profile for active SIM 0 is profile 1.

Router# sh cellular 0/2/0 connection
Profile 1, Packet Session Status = ACTIVE
        Cellular0/2/0:
        Data Packets Transmitted = 9 ,  Received = 9
        Data Transmitted = 900 bytes, Received = 900 bytes
        IP address = 192.0.2.1
        IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF/64  Scope: Global
        Primary DNS address = 192.0.2.2
        Secondary DNS address = 192.0.2.3
        Primary DNS IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF
        Secondary DNS IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF
Profile 2, Packet Session Status = ACTIVE
        Cellular0/2/1:
        Data Packets Transmitted = 7 ,  Received = 2
        Data Transmitted = 700 bytes, Received = 176 bytes
        IP address = 192.0.2.4
```

```
        IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF/64  Scope: Global
        Primary DNS address = 171.70.168.183
        Secondary DNS address = 192.0.2.5
        Primary DNS IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF
        Secondary DNS IPV6 address = 2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF
.
.
.
Profile 16, Packet Session Status = INACTIVE

Router#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0/0   192.0.2.1       YES manual up                    up
GigabitEthernet0/0/1   unassigned      YES unset  administratively down down
GigabitEthernet0/1/0   unassigned      YES unset  administratively down down
GigabitEthernet0/1/1   unassigned      YES unset  administratively down down
GigabitEthernet0/1/2   unassigned      YES unset  administratively down down
GigabitEthernet0/1/3   unassigned      YES u
nset  administratively down down
GigabitEthernet0/1/4   unassigned      YES unset  administratively down down
GigabitEthernet0/1/5   unassigned      YES unset  administratively down down
GigabitEthernet0/1/6   unassigned      YES unset  administratively down down
GigabitEthernet0/1/7   unassigned      YES unset  administratively down down
Wl0/1/8                unassigned      YES unset  administratively down down
Cellular0/2/0          192.0.2.2      YES IPCP   up                    up
Cellular0/2/1          192.0.2.3    YES IPCP   up                    up
Vlan1                  unassigned      YES manual up                    down

Router#
Router# show ip dns view
DNS View default parameters:
DNS Resolver settings:
  Domain lookup is enabled
  Default domain name:
  Domain search list:
  Domain name-servers:
    192.0.2.1
    2001:4860:4860::8888
    192.0.2.2
    2001:DB8:0000:FFFF:FFFF:FFFF:FFFF:FFFF
    192.0.2.3
    8.8.8.8
DNS Server settings:
  Forwarding of queries is enabled
  Forwarder addresses: DNS View default parameters: DNS Resolver settings:
Domain lookup is enabled Default domain name: Domain search list: Domain name-servers:
192.0.2.1
192.0.2.2
192.0.2.3
DNS Server settings:
Forwarding of queries is enabled
Forwarder addresses:
Router#
```

Configure a SIM for data calls

Lock and unlock a SIM card using a PIN code

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

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.

For the LTE/5G, the *unit* argument identifies the router slot, module slot, and port separated by slashes (0/2/0).

Procedure

	Command or Action	Purpose
Step 1	**cellular** *unit* **lte sim** {**lock** | **unlock**} *pin* **Example:** `Router# cellular 0/2/0 lte sim lock 1111`	Locks or unlocks the SIM card using a PIN code. • *pin*—A code (4 to 8 digits long) provided by your carrier to lock or unlock the SIM card.

Change the PIN code

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

For the LTE/5G, the *unit* argument identifies the router slot, module slot, and port separated by slashes (0/2/0).

Procedure

	Command or Action	Purpose
Step 1	**cellular** *unit* **lte sim change-pin** *pin new-pin* **Example:** `Router# cellular 0/2/0 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.



Note For the LTE/5G, the *unit* argument identifies the router slot, module slot, and port separated by slashes (0/2/0).

Procedure

	Command or Action	Purpose
Step 1	**show cellular** *unit* **security** **Example:** `Router# show cellular 0/2/0 security`	Shows the security information of the modem, including the SIM lock status.

Configure 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 Configure an encrypted PIN for a SIM, on page 26.

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

For the LTE/5G, the *unit* argument identifies the router slot, module slot, and port separated by slashes (0/2/0).

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**controller cellular** *unit* **Example:** `Router(config)# controller cellular 0/2/0`	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 LTE 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 Configure an encrypted PIN for a SIM, on page 26.

Configure 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.

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

Note For the 4G LTE SKU, the *unit* argument identifies the router slot, module slot, and port separated by slashes (0/2/0).

SUMMARY STEPS

1. **configure terminal**
2. **service password-encryption**
3. **username** *name* **privilege 0 password** *pin*
4. **do show run** | **i** *name*
5. **controller cellular** *unit*
6. **lte sim authenticate** {**0** | **7**} *pin*
7. **exit**
8. **no username** *name*
9. **no service password-encryption**

DETAILED STEPS

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:**	Creates username and password. • *name*—Specifies the username.

	Command or Action	Purpose
	`Router(config)# username SIM privilege 0 password 1111`	• *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** *unit* **Example:** `Router(config)# controller cellular 0/2/0`	Enters the cellular controller configuration mode.
Step 6	**lte sim authenticate** {**0** | **7**} *pin*	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 LTE 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.

Apply a modem profile in a SIM configuration

SUMMARY STEPS

1. **configure terminal**
2. **controller cellular** *unit*
3. **lte sim data-profile** *number* **attach-profile** *number* **slot** *number*

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters the global configuration mode.
Step 2	**controller cellular** *unit* **Example:** `Router(config)# controller cellular 0/2/0`	Enters the cellular controller configuration mode.
Step 3	**lte sim data-profile** *number* **attach-profile** *number* **slot** *number*	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 LTE network. The **data profile** is the profile used to send and receive data over the cellular network. The**slot** is the optional parameter which distinguishes config for SIM 0 or SIM 1.

Data call setup

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

Configure the cellular interface

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

For the LTE/5G, the *unit* argument identifies the router slot, module slot, and port separated by slashes (0/2/0).

If a tunnel interface is configured with **ip unnumbered cellular 0/2/0**, it is necessary to configure the actual static IP address under the cellular interface, in place of **ip address negotiated**.

SUMMARY STEPS

1. **configure terminal**
2. **interface cellular** unit
3. **ip address negotiated**
4. **dialer in-band**
5. **dialer-group** group-number
6. **exit**
7. **ip route** *network-number network-mask* {*ip-address* | *interface*} [*administrative distance*] [**name** *name*]
8. **dialer-list** dialer-group **protocol** protocol-name {**permit** | **deny** | **list** *access-list-number* | **access-group**}

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**interface cellular** unit **Example:** `Router(config)# interface cellular 0/2/0`	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-group** group-number **Example:** `Router(config-if)# dialer-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 0/2/0`	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.

Configure DDR

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

Note For the LTE/5G, the *unit* argument identifies the router slot, module slot, and port separated by slashes (0/2/0).

SUMMARY STEPS

1. **configure terminal**
2. **interface cellular** *unit*
3. **ip address negotiated**
4. **dialer in-band**
5. **ip address negotiated**
6. **dialer idle-timeout** *seconds*
7. dialer-group group-number
8. **exit**
9. dialer-list dialer-group protocol protocol-name {permit | deny | list *access-list-number* | access-group}
10. access-list access-list-number permit *ip*-source-address

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**interface cellular** *unit* **Example:** `Router(config)# interface cellular 0/2/0`	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.

	Command or Action	Purpose
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-group group-number **Example:** `Router(config-if)# dialer-group 1`	Specifies the number of the dialer access group to which the specific interface belongs.
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* | 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.
Step 10	access-list access-list-number permit *ip*-source-address **Example:** `Router(config)# access-list 1 permit any`	Defines traffic of interest.

Enable 4G GPS and NMEA data streaming

GPS NMEA data streaming to external NMEA 2.0-compliant GPS plotter applications can be enabled on Cisco LTE/5G.

Note For the LTE/5G, the *unit* argument identifies the router slot, module slot, and the port, and is separated by slashes (0/2/0).

SUMMARY STEPS

1. configure terminal
2. controller cellular *unit*
3. lte gps enable

4. lte gps mode standalone
5. lte gps nmea {ip | udp [*source address*][*destination address*][*destination port*] }
6. test cellular *unit* modem-power-cycle
7. end
8. show cellular *unit* gps
9. show cellular *unit* gps detail

DETAILED STEPS

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 0/2/0`	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	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 support only IP NMEA. Therefore, the IP interface and serial interface options are unavailable.

Step 6	test cellular *unit* modem-power-cycle **Example:** `Router# test cellular 0/2/0 modem-power-cycle`	GPS can take effect only after modem power cycle.
Step 7	end **Example:** `Router(config-controller)# end`	Exits the controller configuration mode and returns to the privileged EXEC mode.
Step 8	show cellular *unit* gps	Displays a summary of the following GPS data:

	Command or Action	Purpose

	Example:
	`Router# show cellular 0/2/0 gps`
	
	`GPS Info`
	`-------------`
	`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: 38 Deg 11 Min 22.1939 Sec North`
	`Longitude: 96 Deg 40 Min 48.7066 Sec West`
	`Timestamp (GMT): Thu Jun 29 07:13:42 2017`
	
	`Fix type index: 0, Height: 318 m`
	`Satellite Info`
	`----------------`
	`Satellite #3, elevation 62, azimuth 282, SNR 53`
	`.`
	`.`
	`.`
	`Satellite #28, elevation 0, azimuth 0, SNR 0`
	`Router#`
		• 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)

Step 9	show cellular *unit* gps detail
	Example:
	`Router# show cellular 0 gps detail`
	`GPS Info`
	`-------------`
	`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: 38 Deg 11 Min 22.1939 Sec North`
	`Longitude: 96 Deg 40 Min 48.7066 Sec West`
	`Timestamp (GMT): Thu Jun 29 07:13:42 2017`
	`Fix type index: 0, Height: 0 m`
	`HDOP: , GPS Mode Used: not configured`
	
	`Satellite Info`
	`----------------`
	`Satellite #3, elevation 0, azimuth 0, SNR 53`
	`.`
	`.`
	`.`
	`Satellite #9, elevation 0, azimuth 0, SNR 0`
	`Router#`
		Displays detailed GPS data.

Configure 4G SMS messaging

Note For the LTE/5G, the *unit* argument identifies the router slot, module slot, and the port, and is separated by slashes (0/2/0).

SUMMARY STEPS

1. configure terminal
2. controller cellular *unit*
3. lte sms archive path *FTP-URL*
4. cellular *unit* lte sms view { all | *ID* | summary }
5. end
6. show cellular *unit* sms
7. cellular *unit* lte sms send *number*
8. cellular *unit* lte sms delete [all | *id*]

DETAILED STEPS

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 0/2/0`	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 0/2/0 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.

	Command or Action	Purpose

Step 6	show cellular *unit* sms
	Example:
	`Router# show cellular 0/2/0 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`
		Displays all the information in the text messages sent and received. Message information includes text messages sent successfully, received, archived, and messages pending to 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* **Example:** `Router# cellular 0/2/0 lte sms send 15554443333 <sms text>`	Enables a user to send a LTE/5G 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 0/2/0 lte sms delete [ all | id ]`	(Optional) Deletes one message ID or all of the stored messages from memory.

Configure 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.

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 0/2/0`	Enters cellular controller configuration mode.
Step 3	**lte modem dm-log** {**autoshop** {**link-down** | **timer** *time*} | **enable** | **filesize** *size* | **filter**} **bootflash:***file* | **flash:***file*} **rotation** | **size** *log-size*} **Example:** `Router(config-controller)# lte modem dm-log enable`	Configures DM logging for LTE modem. • **autostop**—Automatically stops DM log capturing based on: **link-down**—cellular interface link down event **timer***timer*—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 locationsto 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

	Command or Action	Purpose
		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** *unit* **logs dm-log**
	Example:
	`Router# show cellular 0/2/0 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`
	`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`
		(Optional) Displays DM log configuration and statistics.

Example

The following example shows how to:

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

```
Router(config-controller)# controller cell 0/2/0
Router(config-controller)# lte modem dm-log filesize 512

Router(config-controller)# controller cell 0/2/0
Router(config-controller)# lte modem dm-log filesize 32
```

The following example shows how to specify the filter file for LTE:

```
Router(config-controller)# controller cell 0/2/0
Router(config-controller)# lte modem dm-log filter flash:MC7xxx_GPS_Log.sqf
```

The following example shows how to enable DM log rotation for LTE:

```
Router(config-controller)# controller cell 0/2/0
Router(config-controller)# lte modem dm-log rotation
```

The following example shows how to specify the maximum log size for LTE:

```
Router(config-controller)# controller cell 0/2/0
Router(config-controller)# lte modem dm-log enable
```

The following example shows how to enable DM log rotation for LTE:

```
Router(config-controller)# controller cell 0/2/0
Router(config-controller)# end
```

The following example shows how to specify the maximum log size for LTE:

```
Router(config-controller)# controller cell 0/2/0
Router(config-controller)# lte modem dm-log size 1024
```

The following example shows how to enable DM log rotation for LTE:

```
Router(config-controller)# controller cell 0/2/0
Router(config-controller)# end
```

The following example shows what was configured on the router for DM log feature:

```
Router#show running-config | section controller
controller Cellular 0/2/0
 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
```

The following displays DM log configuration and statistics

```
Router#show cellular 0/2/0 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
```

The following shows the DM log files created:

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

Directory of bootflash:/

   27  -rw-    33554069   Jun 7 2018 18:08:46 -08:00  dmlog-slot2-20180607-180628.bin
   28  -rw-    33554168   Jun 7 2018 18:11:25 -08:00  dmlog-slot2-20180607-180846.bin
   29  -rw-    14188544   Jun 7 2018 18:12:37 -08:00  dmlog-slot2-20180607-181125.bin
2885718016 bytes total (521891840 bytes free)
lte modem dm-log size 1024
```

The following shows hot to disable/stop DM log capturing:

```
Router(config)#controller cellular 0/2/0
Router(config-controller)#no lte modem dm-log enable
Router(config-controller)#end
```

Enable 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.

For earlier releases, the crashdump collection required the PC to be connected to the router using a USB cable or a special RJ45-USB cable on a non-HSPA+7 3G module.

As part of the 3G and 4G serviceability enhancement, the crashdump collection utility is integrated into Cisco IOS.

To enable modem crashdump collection, perform the following steps.

Note The integrated modem crashdump collection feature is supported only on 3G HSPA and LTE/5G based SKUs.

Before you begin

Ensure that the following prerequisites are met before attempting to enable crashdump logging:

- The modem needs to be provisioned for modem crashdump collection. Contact Cisco TAC for details.
- The modem should be in crash state. Run tests that will result in modem firmware crash. A "MODEM_DOWN" message on the router console or syslog is indicative of modem firmware crash.

Note After the modem firmware crashes, the modem is available for crashdump log collection only. Data calls cannot be made.

Procedure

	Command or Action	Purpose
Step 1	test { cell-cwan } *unit* modem-crashdump { on *location* | off } **Example:** `Router# test cell-host 0/2/0 modem-crashdump on local_uf`	Enables or disables modem crashdump collection. • **cell-host** —Keyword for fixed platform. • **cell-cwan** — Keyword for LTE on a modular inside platform. • *unit*

	Command or Action	Purpose
		—For LTE module, this is the router slot, module slot, and port separated by slashes (for example, 0/2/0). For fixed platform, this is the number 0. • **on** Enables crashdump log collection. • *location* —Specifies the destination URL where the modem crashdump logs will be stored. • **off** —Disables crashdump log collection.

Display 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** *unit* **log error** **Example:** `Router# show cellular 0/2/0 log error`	Shows modem log error and dump information.
Step 2	**test cellular** *unit* **modem-error-clear** **Example:** `Router# test cellular 0/2/0 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.

Verify the LTE or 5G router information

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

show version

```
Router#show version
Cisco IOS XE Software, Version 17.18.01a
Cisco IOS Software [IOSXE], c81g2be Software (ARMV8EL_LINUX_IOSD-UNIVERSALK9-M), Version
17.18.1a, RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2025 by Cisco Systems, Inc.
Compiled Wed 13-Aug-25 07:04 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: 17.18(1r)

Router uptime is 2 hours, 39 minutes
Uptime for this control processor is 2 hours, 40 minutes
System returned to ROM by Reload Command
System image file is "bootflash:c81g2be-universalk9.17.18.01a.SPA.bin"
Last reload reason: Reload Command



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    essentials         essentials

The current crypto throughput level is 250000 kbps (Aggregate)


Smart Licensing Status: Smart Licensing Using Policy

cisco C8161-G2 (1RU) processor with 1901039K/6147K bytes of memory.
Processor board ID FGL2924L2AU
```

```
Router operating mode: Autonomous
1 Virtual Ethernet interface
10 Gigabit Ethernet interfaces
2 Cellular interfaces
32768K bytes of non-volatile configuration memory.
8388608K bytes of physical memory.
18271231K bytes of flash memory at bootflash:.

Configuration register is 0x2102
```

show platform

```
router# show platform
Chassis type: C8161-G2

Slot      Type                State                 Insert time (ago)
--------- ------------------- --------------------- -----------------
0         C8161-G2            ok                    02:40:23
 0/0      C8161-2S            ok                    02:39:45
 0/1      C8161-ES-8          ok                    02:39:44
 0/2      P-LTEA7-NA          ok                    02:26:19
R0        C8161-G2            ok, active            02:40:23
F0        C8161-G2            ok, active            02:40:23
P0        PWR-12V             ok                    02:39:58

Slot      CPLD Version        Firmware Version
--------- ------------------- ----------------------------------------
0         2508050E            17.18(1r)
R0        2508050E            17.18(1r)
F0        2508050E            17.18(1r)
```

show interfaces

```
router#sh interface cellular 0/2/0
Cellular0/2/0 is up, line protocol is up
  Hardware is LTE Advanced CAT-7 pluggable - North America Multimode LTE/DC-HSPA+/HSPA+/HSPA/

  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
  Last input never, output never, 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
     0 packets input, 0 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
     0 packets output, 0 bytes, 0 underruns
     Output 0 broadcasts (0 IP multicasts)
     0 output errors, 0 collisions, 0 interface resets
     0 unknown protocol drops
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
```

Configure cellular modem link recovery

The cellular modem link recovery feature is disabled by default. It is recommended to enable the link recovery feature for improved performance and reliability.

When enabled, the feature monitors specific parameters such as RSSI (Received Signal Strength Indicator), RSRP (Reference Signal Received Power), and RSRQ (Reference Signal Received Quality), one at a time.

These parameters provide information about the strength and quality of the cellular signal.

The modem link recovery feature triggers the modem to reload when any of the configured values (RSSI, RSRP or RSRQ) go beyond the set threshold. Modem link recovery essentially restarts the cellular modem to re-establish a stable connection.

Note This feature does not automatically select the next best carrier network or initiate a SIM switchover based on the RSSI, RSRQ, RSRP values. It only focuses on reloading the modem to resolve potential connectivity problems.

To configure and enable the monitoring parameters for link recovery, perform the **lte modem link-recovery rssi onset-threshold** command for RSSI, **lte modem link-recovery rsrp onset-threshold** for RSRP and **lte modem link-recovery rsrq onset-threshold** for RSRQ.

To disable the link recovery feature, use:

{ lte } modem link-recovery disable | no lte | modem link-recovery disable }

Note The link-recovery feature enables the RSRP (Reference Signal Received Power) and RSRQ (Reference Signal Received Quality) parameters on cellular modems from Cisco IOS XE Dublin 17.11.1a onwards.

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

SUMMARY STEPS

1. **configure terminal**
2. **controller cellular** *unit*
3. For LTE modems, RSSI, RSRP (Reference Signal Received Power) and RSRQ (Reference Signal Received Quality) are recommended indicators of signal quality. Perform the **lte modem link-recovery rssi onset-threshold** command for RSSI, **lte modem link-recovery rsrp onset-threshold** for RSRP and **lte modem link-recovery rsrq onset-threshold** for RSRQ. To disable the link recovery feature, use: {**lte**} **modem link-recovery disable** | **no lte** | **modem link-recoverydisable**}
4. **end**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 2	**controller cellular** *unit* **Example:** `Router(config)# controller cellular 0/2/0`	Enters cellular controller configuration mode.

Step 3	For LTE modems, RSSI, RSRP (Reference Signal Received Power) and RSRQ (Reference Signal Received Quality) are recommended indicators of signal quality. Perform the **lte modem link-recovery rssi onset-threshold** command for RSSI, **lte modem link-recovery rsrp onset-threshold** for RSRP and **lte modem link-recovery rsrq onset-threshold** for RSRQ. To disable the link recovery feature, use: {**lte**} **modem link-recovery disable** | **no lte** | **modem link-recoverydisable**}
	Example:
	`Router(config-controller)# lte modem link-recovery disable`
	`Router(config-controller)# no lte modem link-recovery disable`
	`Router#show run | sec controller Cellular 0/2/0`
	`controller Cellular 0/2/0`
	`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`
	For the RSSI parameter:
	`Router#configure terminal`
	`Router(config)#controller Cellular 0/2/0`
	`Router(config-controller)#lte modem link-recovery`
	`monitor-timer 30`
	`Router(config-controller)#lte modem link-recovery wait-timer 15`
	`Router(config-controller)#lte modem link-recovery debounce-count 8`
	`Router(config-controller)#lte modem link-recovery rssi`
	`onset-threshold -100`
	For the RSRQ parameter:
		Enables or disables the cellular modem link recovery feature (the cellular modem link recovery feature is disabled by default).
		Further enables the RSSI, RSRQ and RSRP parameters recommended for the 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 linkrecovery feature.
		Note
		Only one of the three parameters (RSSI, RSRP, RSRQ) can be configured at a time. If no parameter is explicitly set by the user when link recovery is enabled, the system will fall back to the default value of RSSI.

	Command or Action	Purpose

	`Router#configure terminal`
	`Router(config)#controller`
	`Cellular 0/2/0`
	`Router(config-controller)#lte`
	`modem rsrq onset-threshold -`
	`19`
	For the RSRP parameter:
	`Router#configure terminal`
	`Router(config)#controller`
	`Cellular 0/2/0`
	`Router(config-controller)#lte`
	`modem rsrp onset-threshold -`
	`139`	

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 three 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 5: 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 take action 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 cellularunit** command. In this example, the cellular modem link recovery feature related information is highlighted.

```
Router# show controller cellular 0/2/0Interface Cellular0/2/0
LTE Module - Multimode LTE/DC-HSPA+/HSPA+/HSPA/UMTS/EDGE/GPRS unit 2

Cellular Modem Configuration
============================
Modem is recognized as valid
Power save mode is OFF
manufacture id =  0x00001199     product id = 0x000068C0
Sierra Wireless unknown modem
Modem Uplink Speed = 50000 kbit.
Modem Downlink Speed = 300000 kbit.

GPS Feature = enabled
GPS Status =  NMEA Disabled
GPS Mode = not configured

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

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

Modem Management Statistics
---------------------------
Modem resets = 1
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
```

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 unit 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: Cellular0/1/0: Cellular Modem has been power cycled**

```
Router#show controller Cellular 0/2/0
Interface Cellular0/2/0
LTE Module - Multimode LTE/DC-HSPA+/HSPA+/HSPA/UMTS/EDGE/GPRS unit 2

Cellular Modem Configuration
============================
Modem is recognized as valid
Power save mode is OFF
manufacture id =  0x00001199     product id = 0x000068C0
Sierra Wireless unknown modem
Modem Uplink Speed = 50000 kbit.
Modem Downlink Speed = 300000 kbit.

GPS Feature = enabled
GPS Status =  NMEA Disabled
GPS Mode = not configured

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

Module Reload Statistics
------------------------
Soft OIR reloads = 0
Hard OIR reloads = 0
------------------------
 Modem Management Statistics
---------------------------
Modem resets = 1
Modem user initiated resets = 0
Modem user initiated power-cycles = 0
Modem timeouts = 1
Modem parameters at the last timeout:
         LTE first time attach State was No
         Radio Interface Technology Mode was AUTO
```

```
        Operating Mode was Online
        RSSI was -0 dBm
        Packet switch domain status was Not Attached
        Registration state(EMM) was Not Registered
        Downlink traffic was not present
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
```

Configuration examples for 4G/LTE and 5G serviceability enhancement

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 0/2/0 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 0/2/0 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#
```

Configuration examples for Cisco LTE/5G

The following example shows how to configure Cisco LTE/5G:

```
Router# show running-config
Building configuration...

Current configuration : 6256 bytes
!
! Last configuration change at 11:55:04 UTC Thu Sep 11 2025
!
version 17.18
service timestamps debug datetime msec
service timestamps log datetime msec
platform qfp utilization monitor load 80
!
hostname Router
!
boot-start-marker
boot system bootflash:c81g2be-universalk9.17.18.01a.SPA.bin
! Warning: Booting with bundle mode will be deprecated in the near future. Migration to
install mode is required.
boot-end-marker
!
!
no aaa new-model
!
!
!

Router#show running-config
Building configuration...

Current configuration : 6256 bytes
!
! Last configuration change at 11:55:04 UTC Thu Sep 11 2025
!
version 17.18
service timestamps debug datetime msec
service timestamps log datetime msec
platform qfp utilization monitor load 80
!
hostname Router
!
boot-start-marker
boot system bootflash:c81g2be-universalk9.17.18.01a.SPA.bin
! Warning: Booting with bundle mode will be deprecated in the near future. Migration to
install mode is required.
boot-end-marker
!
!
no aaa new-model
!
!
!
!
```

```
!
!
!
!
!
!
login on-success log
!
!
!
!
!
!
!
subscriber templating
!
!
!
!
!
!
!
!
!
!
!
!
!
!
crypto pki trustpoint TP-self-signed-2631722432
 enrollment selfsigned
 subject-name cn=IOS-Self-Signed-Certificate-2631722432
 revocation-check none
 rsakeypair TP-self-signed-2631722432
 hash sha512
!
crypto pki trustpoint SLA-TrustPoint
 enrollment pkcs12
 revocation-check crl
 hash sha512
!
!
crypto pki certificate chain TP-self-signed-2631722432
 certificate self-signed 01
  30820330 30820218 A0030201 02020101 300D0609 2A864886 F70D0101 0D050030
  31312F30 2D060355 04031326 494F532D 53656C66 2D536967 6E65642D 43657274
  69666963 6174652D 32363331 37323234 3332301E 170D3235 30393131 30393334
  32305A17 0D333530 39313130 39333432 305A3031 312F302D 06035504 03132649
  4F532D53 656C662D 5369676E 65642D43 65727469 66696361 74652D32 36333137
  32323433 32308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201
  0A028201 0100C22A BD9B5FB3 F22B9C03 E2E9CF90 9BF7F7E6 F596A9B5 B1C0117F
  FF0DCFAB 7582906E 18FF4F77 5DC350EF CC09C211 BC0FE3BC 04B9DFB5 E84DDB5C
  997B3DB9 0CB9770C 2E48ED85 2F99BA9D 9F6875DF 63670FAF F62733B8 3286A1F7
  6AB51D18 5D774CA0 43476A66 F35953EB B18A8FB1 F02139E9 90BA9309 14BAF62D
  FF4BDBD7 C2C9D293 8F75412D 8D78DB63 5F861264 7EEAAEEA 067A58FE 8F1C0F06
  C7E5CF52 9E29430E 8A9CA650 F2D98185 C71B6EB9 62783D23 0AC0CFE7 848D67F1
  76AEAA27 86288F31 8E99F8F0 E4BEA406 61EED885 D22A0CDA 8645B49E 11012D40
  0018D148 FFFFB23E D2A16682 C2EF1BA1 8A84FBEC 161DBDE6 4F516810 ECA18902
  921E650E 31630203 010001A3 53305130 1D060355 1D0E0416 0414AF6C 9E98EF87
  6C86D529 2D4693A9 3FB2E815 FEBF301F 0603551D 23041830 168014AF 6C9E98EF
  876C86D5 292D4693 A93FB2E8 15FEBF30 0F060355 1D130101 FF040530 030101FF
  300D0609 2A864886 F70D0101 0D050003 82010100 8BC35481 958BB958 D66B615C
  6902D390 D749BFD8 2CE27737 4002A965 EF141484 8BE093A0 63A8E869 2E447349
```

```
  976051BE 81AC192B 7F6AAAF7 122276B9 32F8D5DC 13B401F4 8AE7B9A4 42284EB6
  FFE4EF1A C218F289 7586B0E8 F347B24D 51FAC24E AF9FAF7F F0E54F2C 6CA7D1D7
  BBE42978 DB21EB26 E025E047 30D64CC3 D067AE02 6FD2F8BA 5C64567E 5B5CE4EE
  585E65D5 FA493B6D A2A6D053 DC4EF3C4 78CD81F1 4EB82678 33C7E51C A67D4C1E
  F9341D5A 0A7AD2EE 888BCCC6 41E1C4DC EDC2CD6F 892C9B2A 203D4DFB 4534DC77
  15AFF68F C94BDC6D AAEB55F3 BA563929 22EF95A8 62B3130C 2DE88DBA 62E51430
  EA812136 FEA032A9 D30C6D28 55FC492D E240D125
        quit
crypto pki certificate chain SLA-TrustPoint
 certificate ca 01
  30820321 30820209 A0030201 02020101 300D0609 2A864886 F70D0101 0B050030
  32310E30 0C060355 040A1305 43697363 6F312030 1E060355 04031317 43697363
  6F204C69 63656E73 696E6720 526F6F74 20434130 1E170D31 33303533 30313934
  3834375A 170D3338 30353330 31393438 34375A30 32310E30 0C060355 040A1305
  43697363 6F312030 1E060355 04031317 43697363 6F204C69 63656E73 696E6720
  526F6F74 20434130 82012230 0D06092A 864886F7 0D010101 05000382 010F0030
  82010A02 82010100 A6BCBD96 131E05F7 145EA72C 2CD686E6 17222EA1 F1EFF64D
  CBB4C798 212AA147 C655D8D7 9471380D 8711441E 1AAF071A 9CAE6388 8A38E520
  1C394D78 462EF239 C659F715 B98C0A59 5BBB5CBD 0CFEBEA3 700A8BF7 D8F256EE
  4AA4E80D DB6FD1C9 60B1FD18 FFC69C96 6FA68957 A2617DE7 104FDC5F EA2956AC
  7390A3EB 2B5436AD C847A2C5 DAB553EB 69A9A535 58E9F3E3 C0BD23CF 58BD7188
  68E69491 20F320E7 948E71D7 AE3BCC84 F10684C7 4BC8E00F 539BA42B 42C68BB7
  C7479096 B4CB2D62 EA2F505D C7B062A4 6811D95B E8250FC4 5D5D5FB8 8F27D191
  C55F0D76 61F9A4CD 3D992327 A8BB03BD 4E6D7069 7CBADF8B DF5F4368 95135E44
  DFC7C6CF 04DD7FD1 02030100 01A34230 40300E06 03551D0F 0101FF04 04030201
  06300F06 03551D13 0101FF04 05300301 01FF301D 0603551D 0E041604 1449DC85
  4B3D31E5 1B3E6A17 606AF333 3D3B4C73 E8300D06 092A8648 86F70D01 010B0500
  03820101 00507F24 D3932A66 86025D9F E838AE5C 6D4DF6B0 49631C78 240DA905
  604EDCDE FF4FED2B 77FC460E CD636FDB DD44681E 3A5673AB 9093D3B1 6C9E3D8B
  D98987BF E40CBD9E 1AECA0C2 2189BB5C 8FA85686 CD98B646 5575B146 8DFC66A8
  467A3DF4 4D565700 6ADF0F0D CF835015 3C04FF7C 21E878AC 11BA9CD2 55A9232C
  7CA7B7E6 C1AF74F6 152E99B7 B1FCF9BB E973DE7F 5BDDEB86 C71E3B49 1765308B
  5FB0DA06 B92AFE7F 494E8A9E 07B85737 F3A58BE1 1A48A229 C37C1E69 39F08678
  80DDCD16 D6BACECA EEBC7CF9 8428787B 35202CDC 60E4616A B623CDBD 230E3AFB
  418616A9 4093E049 4D10AB75 27E86F73 932E35B5 8862FDAE 0275156F 719BB2F0
  D697DF7F 28
        quit
!
!
!
!
!
!
!
!
!
diagnostic bootup level minimal
!
license udi pid C8161-G2 sn FGL2924L2AU
memory free low-watermark processor 62736
!
spanning-tree extend system-id
!
!
!
redundancy
 mode none
!
!
!
!
!
!
controller Cellular 0/2/0
```

```
!
!
vlan internal allocation policy ascending
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface GigabitEthernet0/0/0
 no ip address
 shutdown
 negotiation auto
!
interface GigabitEthernet0/0/1
 no ip address
 shutdown
 negotiation auto
!
interface GigabitEthernet0/1/0
!
interface GigabitEthernet0/1/1
!
interface GigabitEthernet0/1/2
!
interface GigabitEthernet0/1/3
!
interface GigabitEthernet0/1/4
!
interface GigabitEthernet0/1/5
!
interface GigabitEthernet0/1/6
 switchport
!
interface GigabitEthernet0/1/7
 switchport
!
interface Cellular0/2/0
 no ip address
!
interface Cellular0/2/1
 no ip address
!
interface Vlan1
 no ip address
!
ip forward-protocol nd
ip forward-protocol udp
ip http server
ip http authentication local
```

```
ip http secure-server
!
ip ssh bulk-mode 131072
!
!
!
!
control-plane
!
!
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable
!
mgcp profile default
!
!
!
!
!
!
line con 0
 activation-character 13
 stopbits 1
line vty 0 4
 activation-character 13
 login
 transport input ssh
line vty 5 14
 activation-character 13
 login
 transport input ssh
!
!
!
!
!
!
!
end
```

Example: Basic cellular interface configuration Cisco LTE/5G

The following example shows how to configure the cellular interface to be used as a primary and is configured as the default route:

```
Router# show running-config
interface Cellular 0/2/0
ip address negotiated
dialer in-band
dialer-group 1
ip route 172.22.1.10 255.255.255.255 cellular 0/2/0
dialer-list 1 protocol ip permit
```

Cellular back-off example

The following example shows how to configure the cellular back-off feature to stop continuous session activation requests back to the router:

```
Router#show cell 0/2/0 all
Profile 1, Packet Session Status = INACTIVE
Profile 2, Packet Session Status = INACTIVE
Profile 3, Packet Session Status = INACTIVE
.
.
.
Profile 16, Packet Session Status = INACTIVE
Router#
Router#show cell 0/2/0 c n
Current System Time = Sun Jan 6 0:8:37 1980
Current Service Status = Normal
Current Service = Packet switched
Current Roaming Status = Roaming
Network Selection Mode = Automatic
Network = 123 456
Mobile Country Code (MCC) = 123
Mobile Network Code (MNC) = 456
Packet switch domain(PS) state = Attached
LTE Carrier Aggregation state = Deconfigured
Registration state(EMM) = Registered
EMM Sub State = Normal Service
Tracking Area Code (TAC) = 1801
Cell ID = 768001
Network MTU is not Available
Router#
Router#ping 192.0.2.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.192.187.254, timeout is 2 seconds:

*Dec 20 23:22:28.025: %CELLWAN-6-CELLULAR_BACKOFF_START: Cellular0/2/0: Cellular back-off
has started on PDN 0....
Success rate is 0 percent (0/5)
Router#

Router#ping 192.0.2.2
Type escape sequence to abort.
RouterSending 5, 100-byte ICMP Echos to 192.0.2.2, timeout is 2 seconds
.
.
.
Router#show cell 0/2/0
Profile 1, Packet Session Status = INACTIVE
Profile 2, Packet Session Status = INACTIVE
Profile 3, Packet Session Status = INACTIVE
Router Call end mode = 3GPP
Router Session disconnect reason type = 3GPP specification defined(6)
Session disconnect reason = Option unsubscribed(33)
Enforcing cellular interface back-off
Period of back-off = 1 minute(s)
Profile 4, Packet Session Status = INACTIVE
...
Profile 16, Packet Session Status = INACTIVE
Router#
Router#show cell 0/2/0 cn
Sending 5, 100-byte ICMP Echos to 192.0.2.2, timeout is 2 seconds:
Router.....
Success rate is 0 percent (0/5)
Router#
Router#ping 192.0.2.5
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.0.2.5, timeout is 2 seconds:
Router.....
Success rate is 0 percent (0/5)
```

```
Router#show cell 0/2/0 cping 192.0.2.6  Type escape sequence to abort.
RouterSending 5, 100-byte ICMP Echos to 192.0.2.6 , timeout is 2 seconds:
Router.....
RouterSuccess rate is 0 percent (0/5)
Router#ping 192.0.2.6
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.0.2.6 , timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
Router#ping 192.0.2.6
Router#sh cell 0/2/0 c
Profile 1, Packet Session Status = INACTIVE
Profile 2, Packet Session Status = INACTIVE
Profile 3, Packet Session Status = INACTIVE
RouterCall end mode = 3GPP
RouterSession disconnect reason type = 3GPP specification defined(6)
RouterSession disconnect reason = Option unsubscribed(33)
RouterEnforcing cellular interface back-off
 Period of back-off = 1 minute(s)
Profile 4, Packet Session Status = INACTIVE
...
Profile 16, Packet Session Status = INACTIVE
Profile 4, Packet Session Status = INACTIVE
Profile 5, Packet Session Status = INACTIVE
.
.
.
Profile 16, Packet Session Status = INACTIVE
```

Example: GRE tunnel over cellular interface configuration

The following example shows how to configure the static IP address when a GRE tunnel interface is configured with **ip address unnumbered** *cellular interface*:

Note The GRE tunnel configuration is supported only if the service providers provide a public IP address on the LTE interface.

Note For service providers using a private IP address, the point-to-point static GRE tunnel cannot be set up with a private IP address at one end and a public IP address on the other end.

```
interface Tunnel2
ip unnumbered <internal LAN interface GE0/0 etc.>
tunnel source Cellular0/2/0
tunnel destination a.b.c.d
interface Cellular0/2/0
ip address negotiated
no ip mroute-cache
dialer in-band
dialer-group 1
```

Example: LTE/5G as backup with NAT and IPSec

The following example shows how to configure the LTE/5G on the router as backup with NAT and IPsec:

The receive and transmit speeds cannot be configured. The actual throughput depends on the cellular network service.

For service providers using a private IP address, use the **crypto ipsec transform-set esp** command (that is, esp-aes esp-sha256-hmac...).

```
ip dhcp excluded-address 10.4.0.254
!
ip dhcp pool lan-pool
   network 10.4.0.0 255.255.0.0
   dns-server 10.4.0.254
   default-router 10.4.0.254
!
!
crypto isakmp policy 1
 encr 3des
 authentication pre-share
crypto isakmp key  address a.b.c.d
!
!
crypto ipsec transform-set  ah-sha-hmac esp-3des
!
crypto map gsm1 10 ipsec-isakmp
 set peer a.b.c.d
 set transform-set
 match address 103
!
interface ATM0/2/0
 no ip address
 ip virtual-reassembly
 load-interval 30
 no atm ilmi-keepalive
 dsl operating-mode auto
!
interface ATM0/2/0.1 point-to-point
 backup interface Cellular0/2/0
ip address negotiated
ip mtu 1492
ip nat outside
ip virtual-reassembly
encapsulation ppp
load-interval 30
dialer pool 2
dialer-group 2
ppp authentication chap callin
ppp chap hostname cisco@dsl.com
ppp chap password 0 cisco
ppp ipcp dns request
crypto map gsm1

 ip nat outside
 ip virtual-reassembly
 no snmp trap link-status
 pvc 0/35
  pppoe-client dial-pool-number 2
 !
!
interface Cellular0/2/0
```

```
 ip address negotiated
 ip nat outside
 ip virtual-reassembly
no ip mroute-cache
 dialer in-band
 dialer idle-timeout 0
dialer-group 1
 crypto map gsm1
!
interface Vlan1
 description used as default gateway address for DHCP clients
 ip address 10.4.0.254 255.255.0.0
 ip nat inside
 ip virtual-reassembly
!
ip local policy route-map track-primary-if
ip route 0.0.0.0 0.0.0.0 Dialer2 track 234
ip route 0.0.0.0 0.0.0.0 Cellular0/3/0 254
!
!
ip nat inside source route-map nat2cell interface Cellular0/2/0 overload
ip nat inside source route-map nat2dsl overload
!
ip sla 1
 icmp-echo 2.2.2.2 source
 timeout 1000
 frequency 2
ip sla schedule 1 life forever start-time now
access-list 1 permit any
access-list 101 deny ip 10.4.0.0 0.0.255.255 10.0.0.0 0.255.255.255
access-list 101 permit ip 10.4.0.0 0.0.255.255 any
access-list 102 permit icmp any host 2.2.2.2
access-list 103 permit ip 10.4.0.0 0.0.255.255 10.0.0.0 0.255.255.255
dialer-list 1 protocol ip list 1
dialer-list 2 protocol ip permit
!
!
route-map track-primary-if permit 10
 match ip address 102
!
route-map nat2dsl permit 10
 match ip address 101
!
route-map nat2cell permit 10
 match ip address 101
 match interface Cellular0/2/0
!
exec-timeout 0 0
login
 modem InOut
```

Example: SIM configuration

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 are not be seen when a normal console output is viewed.

```
Router# sh cellular 0/2/0 security
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
```

```
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
Router# !! SIM is in unlocked state.!
Router# cellular 0/2/0 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]
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 0/2/0 security
Card Holder Verification (CHV1) = Enabled
SIM Status = Locked
SIM User Operation Required = Enter CHV1
Number of CHV1 Retries remaining = 3
Router# !! SIM is in locked state.!
```

Unlock the SIM card

The following example shows how to unlock the SIM. 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# sh cellular 0/2/0 security
Card Holder Verification (CHV1) = Enabled
SIM Status = Locked
SIM User Operation Required = Enter CHV1
Number of CHV1 Retries remaining = 3
Router# !! SIM is in locked state.!
Router# cellular 0/2/0 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]
Router#
Router# sh cellular 0/2/0 security
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
Router# !! SIM is in unlocked state.!
```

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 0/2/0 security
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
Router# !! SIM is in unlocked state.!Router# cellular 0/2/0 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]
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 0/2/0 security
Card Holder Verification (CHV1) = Enabled
SIM Status = Locked
SIM User Operation Required = Enter CHV1
Number of CHV1 Retries remaining = 3
Router# !! 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 0/2/0
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 0/2/0 security
Card Holder Verification (CHV1) = Enabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
Router#!! 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.!
```

Change the PIN Code

The following example shows how to change the assigned PIN code. 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# sh cellular 0/2/0 security
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
Router#!! SIM is in unlocked state.!Router#
Router# cellular 0/2/0 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]
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# sh cellular 0/2/0 security
Card Holder Verification (CHV1) = Enabled
SIM Status = Locked
SIM User Operation Required = Enter CHV1
Number of CHV1 Retries remaining = 3
Router#!! SIM is in locked state. SIM needs to be in locked state to change its PIN.!Router#
Router# cellular 0/2/0 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]
Resetting modem, please wait...
CHV1 code change has been completed. Please enter the new PIN in controller configuration
```

```
for verfication
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#
Router# sh cellular 0/2/0 security
Card Holder Verification (CHV1) = Enabled
SIM Status = Locked
SIM User Operation Required = Enter CHV1
Number of CHV1 Retries remaining = 3
Router#!! SIM stays in locked state, as expected, but with new PIN.!Router# cellular 0/2/0
 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]
Router#
Router# show cellular 0/2/0 security
Card Holder Verification (CHV1) = Disabled
SIM Status = OK
SIM User Operation Required = None
Number of CHV1 Retries remaining = 3
Router#!! Unlock with new PIN is successful. Hence, changing PIN was successful.!
```

Configure 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 0/2/0
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
```

Upgrade the modem firmware

To upgrade the modem firmware, refer Cisco Firmware Upgrade Guide for 4G LTE and 5G Cellular Modems.

Troubleshooting

This section provides the essential information and resources available for troubleshooting the Cisco LTE/5G feature.

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, debug the failure by using the following debug and show commands:
3. **debug chat**
4. **debug modem**
5. **debug dialer**
6. **show cellular all**
7. **show controller cell***0/2/0*
8. **show interface cellular**
9. **show running-config**
10. **show ip route**
11. **show platform**
12. Save the output from these commands and contact your system administrator.

Check 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:

SUMMARY STEPS

1. Check the antenna connection. Make sure the TNC connector is correctly 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.

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	Check the antenna connection. Make sure the TNC connector is correctly threaded and tightened.	
Step 2	If you are using a remote antenna, move the antenna cradle and check if the RSSI has improved.	
Step 3	Contact your wireless service provider to verify if there is service availability in your area.	

Verify service availability

The following is a sample output for the **show cellular all** command for a scenario where the antenna is disconnected and a modem data profile has not been created.

```
Router# show cellular 0/2/0 all
Hardware Information
====================
Modem Firmware Version = SWI9X30C_02.20.03.00
Modem Firmware built = 2016/06/30 10:54:05
Hardware Version = 1.0
Device Model ID: EM7455
International Mobile Subscriber Identity (IMSI) = 123456000031546
International Mobile Equipment Identity (IMEI) = 356129070052334
Integrated Circuit Card ID (ICCID) = 8949001508130031546
Mobile Subscriber Integrated Services
Digital Network-Number (MSISDN) =
Modem Status = Modem Online
Current Modem Temperature = 42 deg C
PRI SKU ID = 1102526, PRI version = 002.017_000, Carrier = Generic
OEM PRI version = 002

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

Profile 1 = ACTIVE* **
--------
PDP Type = IPv4v6
PDP address = 29.29.29.196
PDP IPV6 address = 2001:2678:2680:5FD7:DDE7:70E1:DC07:CCB7/64  Scope: Global
Access Point Name (APN) = broadband
Authentication = None
        Primary DNS address = 8.0.0.8
        Secondary DNS address = 8.8.4.4
        Primary DNS IPV6 address = 2001:4860:4860:0:0:0:0:8888
        Secondary DNS IPV6 address = 2001:4860:4860:0:0:0:0:8844

Profile 2 = ACTIVE
--------
PDP Type = IPv4v6
PDP address = 21.21.21.206
PDP IPV6 address = 2001:567A:567A:1480:5DD6:18D1:BD63:49DA/64  Scope: Global
Access Point Name (APN) = basic
Authentication = None
        Primary DNS address = 171.70.168.183
        Secondary DNS address = 8.8.8.8
        Primary DNS IPV6 address = 2001:4860:4860:0:0:0:0:8888
        Secondary DNS IPV6 address = 2001:4860:4860:0:0:0:0:8844

Profile 3 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = mpdn
Authentication = None

Profile 4 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = broadband
Authentication = None

Profile 5 = INACTIVE
```

```
--------
PDP Type = IPv4
Access Point Name (APN) = cisco.gw4.vzwentp
Authentication = None

Profile 6 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = mobility-de1
Authentication = None

Profile 7 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = mobility-de2
Authentication = None

Profile 8 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = broadband
Authentication = None

Profile 9 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = mpdndt-qos
Authentication = None

Profile 10 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = mobility-de2
Authentication = None

Profile 11 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = broadband
Authentication = None

Profile 12 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = wfqos
Authentication = CHAP
Username: ipv4v6
Password:

Profile 13 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = broadband
Authentication = CHAP
Username: ipv4v6
Password:

Profile 14 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = mobility-de2
Authentication = CHAP
Username: ipv4v6
Password:
```

```
Profile 15 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = aaaauth
Authentication = CHAP
Username: ipv4v6
Password:

Profile 16 = INACTIVE
--------
PDP Type = IPv4
Access Point Name (APN) = broadband
Authentication = CHAP
Username: ipv4v6
Password:

  * - Default profile
 ** - LTE attach profile


Configured default profile for active SIM 0 is profile 1.


Data Connection Information
===========================
Profile 1, Packet Session Status = ACTIVE
        Cellular0/2/0:
        Data Packets Transmitted = 198 ,  Received = 209
        Data Transmitted = 14410 bytes, Received = 24882 bytes
        IP address = 29.29.29.196
        IPV6 address = 2001:2678:2680:5FD7:DDE7:70E1:DC07:CCB7/64  Scope: Global
        Primary DNS address = 8.0.0.8
        Secondary DNS address = 8.8.4.4
        Primary DNS IPV6 address = 2001:4860:4860:0:0:0:0:8888
        Secondary DNS IPV6 address = 2001:4860:4860:0:0:0:0:8844
Profile 2, Packet Session Status = ACTIVE
        Cellular0/2/1:
        Data Packets Transmitted = 12 ,  Received = 13
        Data Transmitted = 1200 bytes, Received = 1144 bytes
        IP address = 21.21.21.206
        IPV6 address = 2001:567A:567A:1480:5DD6:18D1:BD63:49DA/64  Scope: Global
        Primary DNS address = 171.70.168.183
        Secondary DNS address = 8.8.8.8
        Primary DNS IPV6 address = 2001:4860:4860:0:0:0:0:8888
        Secondary DNS IPV6 address = 2001:4860:4860:0:0:0:0:8844
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 = Tue Jan 8 23:24:22 1980
```

```
 --More--
*Jun 19 06:13:14.665: %IOSXE_OIR-6-INSSPA: SPA inserted in sCurrent Service Status = Normal
Current Service = Packet switched
Current Roaming Status = Roaming
Network Selection Mode = Automatic
Network = 123 456
Mobile Country Code (MCC) = 123
Mobile Network Code (MNC) = 456
Packet switch domain(PS) state = Attached
LTE Carrier Aggregation state = Deconfigured
Registration state(EMM) = Registered
EMM Sub State = Normal Service
Tracking Area Code (TAC) = 1801
Cell ID = 768001
Network MTU is not Available

Radio Information
=================
Radio power mode = online
LTE Rx Channel Number =  2000
LTE Tx Channel Number =  20000
LTE Band =  4
LTE Bandwidth = 10 MHz
Current RSSI = -71 dBm
Current RSRP = -95 dBm
Current RSRQ = -7 dB
Current SNR = 26.4  dB
Physical Cell Id = 12
Number of nearby cells = 1
Idx      PCI (Physical Cell Id)
--------------------------------
1              12
Radio Access Technology(RAT) Preference = LTE
Radio Access Technology(RAT) Selected = LTE

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   ATT          02.20.03.00  002.019_000  Inactive
 2   GENERIC      02.20.03.00  002.017_000  Active
 3   SPRINT       02.20.03.22  002.020_000  Inactive
 4   TELSTRA      02.20.03.00  002.018_000  Inactive
 5   VERIZON      02.20.03.22  002.026_000  Inactive

Firmware Activation mode : AUTO

GPS Information
==========================

GPS Info
-------------
GPS Feature: enabled
GPS Mode Configured: not configured
GPS Status: NMEA Disabled
```

```
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 =

Error Information
=================

This command is not supported on 4G modems.


Modem Crashdump Information
===========================
Modem crashdump logging: off
```

Successful call setup

This is a sample output when a call is set up. It shows a received IP address from the network. Call setup is successful and data path is open.

```
debug dialer
debug cellular 0/2/0 messages callcontrol
```

Modem troubleshooting using integrated modem DM logging

The LTE modem dm-log command can be used in controller cellular configuration mode to configure integrated DM logging to monitor traffic on the modem. See the Cisco 3G and 4G Serviceability Enhancement User Guide for more information on configuring Integrated DM Logging parameters.