3G4G LTE Modem Operator's Manual

FortiGate-FortiWiFi 5.0

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Introduction

The FortiGate/FortiWiFi 30E-3G4G devices come with a built-in 3G/4G LTE modem to provide additional Internet connection and/or redundant WAN link for its customers.

This Manual discusses how to configure the built-in LTE modem as the Internet access interface. It must be noted that, to provide Internet connections to the end devices on your network through the LAN ports, the devices must operate in NAT mode; it does not work in transparent mode. The term "LTE modem" means an LTE-capable modem. It does not mean that the modem is only able to work in LTE mode.

This Manual covers the configuration of the internal LTE modem only. For configuration of the other features of your FortiGate/FortiWiFi devices, refer to the latest FortiGate/FortiOS documentation and FortiWiFi documentation.

We strongly recommend against putting any USB modem into the external USB port because it might confuse the system and cause the built-in LTE modem to malfunction. On the other hand, if you clearly understand what you are doing, you can put a USB modem running the PPP protocol in the external USB port.

This Manual is based on FortiOS 6.0.6 GA release for FortiGate 30E GBL, unless further acknowledged. It is prepared for technical staff of Fortinet Inc. and customers of FortiGate 30E and FortiWiFi 30E devices with the integrated 3G/4G LTE modem.

FortiGate/FortiWiFi variant LTE feature matrix

FortiGate and FortiWiFi have different models with different Sierra LTE modems. So the LTE features may vary with the models of FortiGate or FortiWiFi appliances. The table below highlights the LTE features supported on various FortiGate and FortiWiFi models.

Features	FortiGate/FortiWiFi Models						
	FGT/FWF-30E-NAM	FGT/FWF-30E-INTL	FGT/FWF-30E-GBL	FGT/FWF-4xF-3G4G	FGTRugged-60F-3G4G	FWF-80F-2R-3G4G-DSL (NPI phase)	FWF-81F-2R-3G4G-DSL (NPI phase)
Modem	Sierra EM7355	Sierra EM7355	Sierra EM7565	Sierra EM7565	Sierra EM7565	Sierra EM7565	Sierra EM7565
4G LTE	x	x	x	x	x	x	x
3G	x	x	x	x	x	x	x
4G/3G handover	x	x	x	x	x	x	x
Band restriction	x	x	x	x	x	x	x
Modem firmware upgrade	x	x	x	x	x	x	x
Scheduled firmware upgrade			x	x	x	x	x
Firmware auto-switching			x	x	x	x	x
Carrier firmware selection			x	x	x	x	x
GPS				x	x	x	x
Dual SIM card				x	x	x	x
SIM card auto-switching				x	x	x	x
Dual SIM LED					x		
Billing data	x	x	x	x	x	x	x
Wireless profile configuration	x	x	x	x	x	x	x
Data usage tracking	x	x	x	x	x	x	x
SIM PLMN code lock			x	x	x	x	x

This Manual is written based on FortiGate-30E-3G4G-GBL.

The following paragraphs explain what the aforementioned parameters mean.

4G/3G handover

Our LTE modems support both 4G and 3G connectivity. Because LTE connection is always preferred, the modem will try to switch back to the LTE network whenever the signal is strong enough. Although handover to an LTE network is the default, this behavior is not very explicit sometimes. To make sure the modem always switch back to the LTE network in a prompt manner, FortiOS has the “manual-handover” option which, once enabled, will constantly scanning available LTE signal and send a request to the modem to switch to the LTE network instead of waiting for that modem to act.

Band restriction

You are able to select the allowed radio bands for 3G and LTE services.

LTE modem firmware upgrade

Although the modem is preloaded with firmware for different carriers across the globe, FortiOS supports LTE modem firmware upgrade to meet our customers' needs. You can upgrade your LTE modem either locally or remotely, with local method such as usb/tftp transfer or download it from FortiCloud.

LTE modem firmware scheduled upgrade

In addition to letting you manually upgrade your LTE firmware, FortiOS also enables you to set a download schedule to automatically check for new firmware and to initiate the upgrade process by querying the FortiCloud server routinely. You can simply set a upgrade schedule to let the FortiOS to check for any update weekly, bi-weekly, or monthly. Refer to the LTE firmware upgrade section for more detail.

Modem firmware auto switch

In order to accommodate the different requirements of carrier around the globe, the LTE modem is preloaded with multiple carrier specific firmware. FortiOS will instruct the modem to automatically switch to the corresponding carrier firmware according to the SIM card inserted.

Carrier modem firmware selection

You are also able to manually select a modem firmware to be used instead of letting FortiOS do it automatically.

GPS

The LTE modem possesses GPS location capability. GPS service can be provided by the modem regardless of the inserted SIM cards, as long as there is good GPS satellite signal.

Dual SIM

For SOC4-based LTE models, there are two physical SIM slots available which enable the unit to hold two SIM cards simultaneously. However, only one SIM card will be used at any given time for connection.

SIM card hot-swap

FortiOS is able to choose the valid SIM card to be used regardless of the slot in which the card SIM is inserted. If both SIM card slots are filled, FortiOS will choose the one with connectivity. It automatically monitors the SIM card status to ensure its proper operation. If it detects that the SIM card is in error, absent, or unable to connect to the network, it will switch to the other SIM card.

Dual SIM LED

For certain models, there are LED lights in the front to indicate the active SIM slot the unit is currently using.

Billing data

You are able to view your billing information and set payment notification.

Wireless profile configuration

You are able to construct multiple wireless profiles with different APNs username and authentication settings. FortiOS will match these customized wireless profiles with a network in the air and choose the right one to connect instead of using the default carrier APN. This feature comes in handy for those who would like to join a private network or connect with different credential information.

Data usage tracking

FortiOS keeps track of LTE data usage.

SIM PLMN code lock

FortiOS allows you to set a SIM PLMN code lock which only allows SIM cards with certain PLMN code prefix in its IMSI code for connection.

Regional compatibility

FortiGate 3G4G models support all major wireless carriers in North and South Americas, EMEA, and APAC. For example, all FortiGate 3G4G models for North America are certified for US carriers AT&T and Verizon Wireless.

FortiGate 3G4G models may work well with any wireless carrier in the world, depending on the technology and bands used. In most cases, the generic modem firmware suffices, but sometimes specific configuration such as the APN may be required. Operation of FortiGate 3G4G models with all wireless carriers in the world is not guaranteed. Although the technology and bands may overlap, many variables, such as carrier, SIM card, and certification, must be taken into consideration for reliable operation. Fortinet Value Added Resellers and Distributors (VARs) must confirm compatibility prior to placing a customer order.

Installation

Hardware installation

Follow the instructions below to install your FortiGate 30E.

- The flat antennas are for the 3G/4G LTE modem and must be mounted on both sides.
- The Wi-Fi antennas are on the backside. For a non-Wi-Fi unit, there are no Wi-Fi antennas on the backside.
- If the GPS connector is present, be sure to attach the GPS antenna as well.

1. Attach the Wi-Fi and 3G/4G antennas to the unit. Refer to the notes above.
2. Use the power cable provided in the package to connect the device to a power outlet.
3. Use an Ethernet cable to connect the device to your network.
4. Use another Ethernet cable to connect the device (via any port from port1 through port4) to your PC, hub, or switch.

Check LTE Modem Driver Status and AT command interface

Because the internal LTE Modem is connected to the device via the USB interface, you can check its status via the USB devfs with "fnsysctl cat /proc/bus/usb/devices":

```
T: Bus=02 Lev=02 Prnt=02 Port=01 Cnt=01 Dev#= 5 Spd=5000 MxCh= 0
D: Ver= 3.10 Cls=00(>ifc ) Sub=00 Prot=00 MxPS= 9 #Cfgs= 1
P: Vendor=1199 ProdID=9091 Rev= 0.06
S: Manufacturer=Sierra Wireless, Incorporated
S: Product=Sierra Wireless EM7565 Qualcomm ® Snapdragon  ™ X16 LTE-A
S: SerialNumber=UF00227145031047
```

You can see that the vendor ID of the modem is 1199, the product ID is 9091, and the modem name is EM7565.

Look for the following lines. These descriptors are for the USB interface 0/2/3 and are bound to USB driver qcserial, which means they are USB serial ports. Beware that they are enumerated as /dev/ttyusb0~ttyusb2 in the system. The naming conventions are different in FortiOS from the traditional Linux kernel.

```
I:* If#= 0 Alt= 0 #EPs= 2 Cls=ff(vend.) Sub=ff Prot=ff Driver=qcserial
E: Ad=81(I) Atr=02(Bulk) MxPS=1024 Ivl=0ms
E: Ad=01(O) Atr=02(Bulk) MxPS=1024 Ivl=0ms
I:* If#= 2 Alt= 0 #EPs= 3 Cls=ff(vend.) Sub=00 Prot=00 Driver=qcserial
E: Ad=83(I) Atr=03(Int.) MxPS= 10 Ivl=32ms
E: Ad=82(I) Atr=02(Bulk) MxPS=1024 Ivl=0ms
E: Ad=02(O) Atr=02(Bulk) MxPS=1024 Ivl=0ms
I:* If#= 3 Alt= 0 #EPs= 3 Cls=ff(vend.) Sub=00 Prot=00 Driver=qcserial
E: Ad=85(I) Atr=03(Int.) MxPS= 10 Ivl=32ms
E: Ad=84(I) Atr=02(Bulk) MxPS=1024 Ivl=0ms
E: Ad=03(O) Atr=02(Bulk) MxPS=1024 Ivl=
```

There's an interface 8 in the output which is bound to USB driver qmi_wwan. It is the interface that does the real network data transmission for this modem. It is attached to an Ethernet mode interface wwan in FortiOS.

```
I:* If#= 8 Alt= 0 #EPs= 3 Cls=ff(vend.) Sub=ff Prot=ff Driver=qmi_wwan
```

Interfaces 0/2/3 for this specific modem are DM/GPS/Modem ports. The DM port is reserved for low-level debugging purpose; the GPS port outputs location-related information; the Modem port is also known as the AT Command Interface, to which you can issue AT commands for status and debugging purpose.

```
T: Bus=02 Lev=02 Prnt=02 Port=01 Cnt=01 Dev#= 5 Spd=5000 MxCh= 0
D: Ver= 3.10 Cls=00(>ifc ) Sub=00 Prot=00 MxPS= 9 #Cfgs= 1
P: Vendor=1199 ProdID=9091 Rev= 0.06
S: Manufacturer=Sierra Wireless, Incorporated
S: Product=Sierra Wireless EM7565 Qualcomm ® Snapdragon  ™ X16 LTE-A
S: SerialNumber=UF00227145031047
C:* #Ifs= 4 Cfg#= 1 Atr=a0 MxPwr=224mA
I:* If#= 0 Alt= 0 #EPs= 2 Cls=ff(vend.) Sub=ff Prot=ff Driver=qcserial
E: Ad=81(I) Atr=02(Bulk) MxPS=1024 Ivl=0ms
E: Ad=01(O) Atr=02(Bulk) MxPS=1024 Ivl=0ms
I:* If#= 2 Alt= 0 #EPs= 3 Cls=ff(vend.) Sub=00 Prot=00 Driver=qcserial
E: Ad=83(I) Atr=03(Int.) MxPS= 10 Ivl=32ms
E: Ad=82(I) Atr=02(Bulk) MxPS=1024 Ivl=0ms
E: Ad=02(O) Atr=02(Bulk) MxPS=1024 Ivl=0ms
I:* If#= 3 Alt= 0 #EPs= 3 Cls=ff(vend.) Sub=00 Prot=00 Driver=qcserial
E: Ad=85(I) Atr=03(Int.) MxPS= 10 Ivl=32ms
E: Ad=84(I) Atr=02(Bulk) MxPS=1024 Ivl=0ms
E: Ad=03(O) Atr=02(Bulk) MxPS=1024 Ivl=0ms
I:* If#= 8 Alt= 0 #EPs= 3 Cls=ff(vend.) Sub=ff Prot=ff Driver=qmi_wwan
E: Ad=86(I) Atr=03(Int.) MxPS= 8 Ivl=32ms
E: Ad=8e(I) Atr=02(Bulk) MxPS=1024 Ivl=0ms
E: Ad=0f(O) Atr=02(Bulk) MxPS=1024 Ivl=0ms
```

The following command displays the modem data interface. The interface seems to be already connected and it has got an IP address. If you see no output, then something must be wrong with this modem.

```
FortiWiFi-40F-3G4G # fnsysctl ifconfig wwan

wwan    Link encap:Ethernet  HWaddr 2E:96:91:15:B5:81
        inet addr:10.53.79.115  Bcast:10.53.79.119  Mask:255.255.255.248
        UP BROADCAST RUNNING NOARP MULTICAST  MTU:1430  Metric:1
        RX packets:23863 errors:0 dropped:0 overruns:0 frame:0
        TX packets:23811 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:8056332 (7.7 MB)  TX bytes:2255841 (2.2 MB
```

The DM port is an industrial standard interface. Write a logging filter in a special format, and it will start to output device management logging messages. The DM log is very helpful for the modem vendor to diagnose low-level issues. DM port logging support is not provided in the released version of FortiOS images. The DM log message output might affect the performance of FortiOS. We will discuss how to obtain a DM log with the help of a debug version of FortiOS image later.

The DM port (after filter injection) and the GPS port are read-only.

If the device is at a location without good GPS signal reception, the location information can't be retrieved. The internal GPS daemon, if enabled, polls NMEA messages from the port continuously. With the GPS daemon disabled, you can

use the command "`diagnose system modem com /dev/ttyusb1`" from the console to get NMEA messages displayed on the console, as illustrated below:

```
FortiWiFi-40F-3G4G # dia sys modem com /dev/ttyusb1
Serial port: /dev/ttyusb1
Do not run this command when modem is dialing or connected!
Press Ctrl+W to exit.
$GPGGA,,,,,,0,,,,,,,,*66
$GPGGA,,,,,,0,,,,,,,,*66
$GPVTG,,T,,M,,N,,K,N*2C
$GPVTG,,T,,M,,N,,K,N*2C
$GPRMC,,V,,,,,,,,,,N*53
$GPRMC,,V,,,,,,,,,,N*53
$GPGSA,A,1,,,,,,,,,,,,,,,*32
$GPGSA,A,1,,,,,,,,,,,,,,,*32
```

- Location information does not rely on the data service. Even if you are using a device without a SIM card plugged in, it is possible for you to get the accurate location information.
- The GPS port is disabled by default because some FGT30E_GBL does not have a GPS antenna. The GPS antenna is added back for SOC4 FortiGate LTE variants.

If the GPS daemon is enabled, the above messages will not show up because the GPS port is occupied by the daemon.

To check modem GPS signal information, use the command "`diagnose test app 23`". It will show the available satellites that the modem could use. The more satellites it detects, the better the GPS signal is.

By using command "`diagnose system modem com /dev/ttyusb2`", you will be connected to the Modem interface. Because the LTE modem daemon is running, it issues AT commands to the modem port periodically, so you will see a lot of output from the AT Command interface. So you may want to avoid using the AT command interface directly so that it won't disturb the background work by LTE daemon.

On EM modems, everything that an AT Command can do can be done by some QMI messages. QMI is a binary format protocol for modems. The messages are more compact and much faster because they are in raw format and transferred by USB control messages, while AT commands are limited by the baud rate of the serial port. More important, the QMI protocol is an industrial standard wireless communication protocol. AT commands vary from vendor to vendor. Different vendors have different AT Command sets, which is very inconvenient.

For 30E 3G4G devices, we rely very little on AT Commands. In fact, the AT Commands of EM modems can't even make a connection. We use QMI messages instead.

Check Modem Status

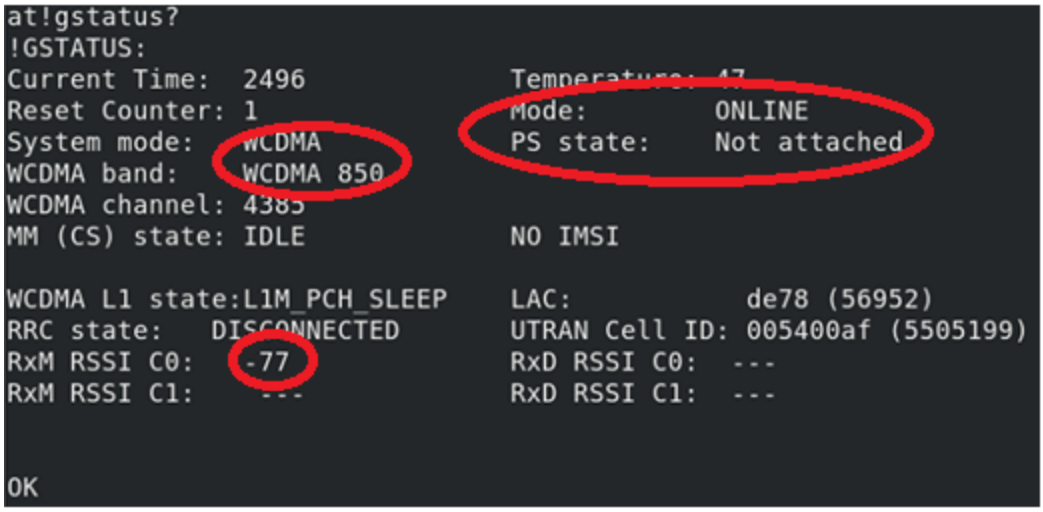
The most straightforward way to check the modem status is to use the command, "`diagnose sys lte-modem modem-details`". If the modem is working properly with the default configuration and recognized by FortiOS, the following information should show up:

```
LTE Modem detailed information:
Modem detected: Yes
Manufacturer: Sierra Wireless, Incorporated
```

```
Model: EM7565
Revision: SWI9X50C_01.07.02.00 6c91bc jenkins 2018/06/13 23:08:16
MSISDN: 16692240893
ESN: 0
IMEI: 353533100752164
MEID:
Hardware revision: 10001
Software revision: T.2.5.1-00478-9655_GENNCH_PACK-1
SKU:
FSN: UF00227145031047
PRL version: 0x0000
Modem FW version: 00.00.00.00
PRI version: 000.000_000
Carrier Abbr: AUTO-SIM
Modem Operation mode: QMI_DMS_OPERATING_MODE_ONLINE
```

The modem firmware version and PRI version are displayed as 0 because the modem is set in AUTO-SIM mode as default as the carrier Abbr indicates. This means the modem is not loaded with firmware for any particular carrier, but it will decide when a SIM card is inserted.

Furthermore, with no SIM card inserted, the modem is in WCDMA mode. To view current modem network parameters, issue "`diagnose test app lted 5`", and you'll see something similar to what is shown below:



Make sure that the modem operation mode is in ONLINE mode. If the modem is in LOW-POWER mode, the modem is not able to connect and you must perform a cold reset using "`exec lte-modem cold-reboot`". If the low-power mode issue persists, new modem firmware may need to be flashed.

For FortiGate 30E-LTE models (GBL/INTL/NAM), upgrading to FortiOS 6.2.4 will cause the unit to stay in low-power mode. This known issue has been fixed in FortiOS 6.2.5 and 6.2.6.

The RxM RSSI C0 value is a good indicator of the signal reception strength. A more comprehensive signal strength overview can be displayed only after a SIM card is inserted. However, this RSSI parameter alone can tell whether the unit is having good signal reception or not. If the value is less than -90 dB, there is a signal problem in most cases, and you must check antenna connection or open the device to inspect the antenna connection to the modem chip.

Use LTE Service

After inspecting the modem and make sure everything looks fine, simply insert a micro SIM card in the SIM slot. The SIM card must be facing down, with the cut corner to the left. Verify that your SIM card is working before inserting it in the device. For models with two SIM slots, it does not matter which slot the SIM card is inserted. With the default configuration, FortiOS constantly scans for available SIM cards and choose the one with connectivity.

If you are using a FortiGate 30E-GBL unit, be sure to choose a nano to micro SIM card adapter of good quality. Bad adapters may cause the SIM card to have loose contact with the card slot, resulting in SIM card reading errors.

Voila! The unit will now automatically connect to the wireless network and an IP will be assigned to its wwan interface:

```
wwan   dhcp   0.0.0.0 0.0.0.0  100.106.224.241 255.255.255.252  up   disable   physical  enable
```

It may take up to a few minutes for the modem to have Internet connection because the modem will switch its firmware according to the SIM card carrier, if auto-sim configuration is enabled (default).

Once the device is connected, use "`diagnose test application lted 5`" to show LTE service information:

```
at!gstatus?
!GSTATUS:
Current Time:  211              Temperature: 47
Reset Counter: 1                Mode:        ONLINE
System mode:   LTE              PS state:    Attached
LTE band:      B66              LTE bw:      15 MHz
LTE Rx chan:   0                LTE Tx chan: 132097
LTE SSC1 state:NOT ASSIGNED
LTE SSC2 state:NOT ASSIGNED
LTE SSC3 state:NOT ASSIGNED
LTE SSC4 state:NOT ASSIGNED
EMM state:     Registered       Normal Service
RRC state:     RRC Idle
IMS reg state: Full Srv         IMS mode:    Normal

PCC RxM RSSI:  -71              PCC RxM RSRP:  -102
PCC RxD RSSI:  -72              PCC RxD RSRP:  -103
Tx Power:      --               TAC:         1f06 (7942)
RSRQ (dB):     -11.9            Cell ID:     007af90c (8059148)
SINR (dB):      4.0


OK
```

Note that the system mode has changed from WCDMA to LTE. A few LTE protocol parameters indicated the modem is now connected to an LTE network and receive full services. Additionally, more signal parameters such as SINR, RSRP and RSRQ are now available for diagnosis.

Configuration

You can configure the 3G/4G LTE modem in your FortiGate 30E in either of the following ways:

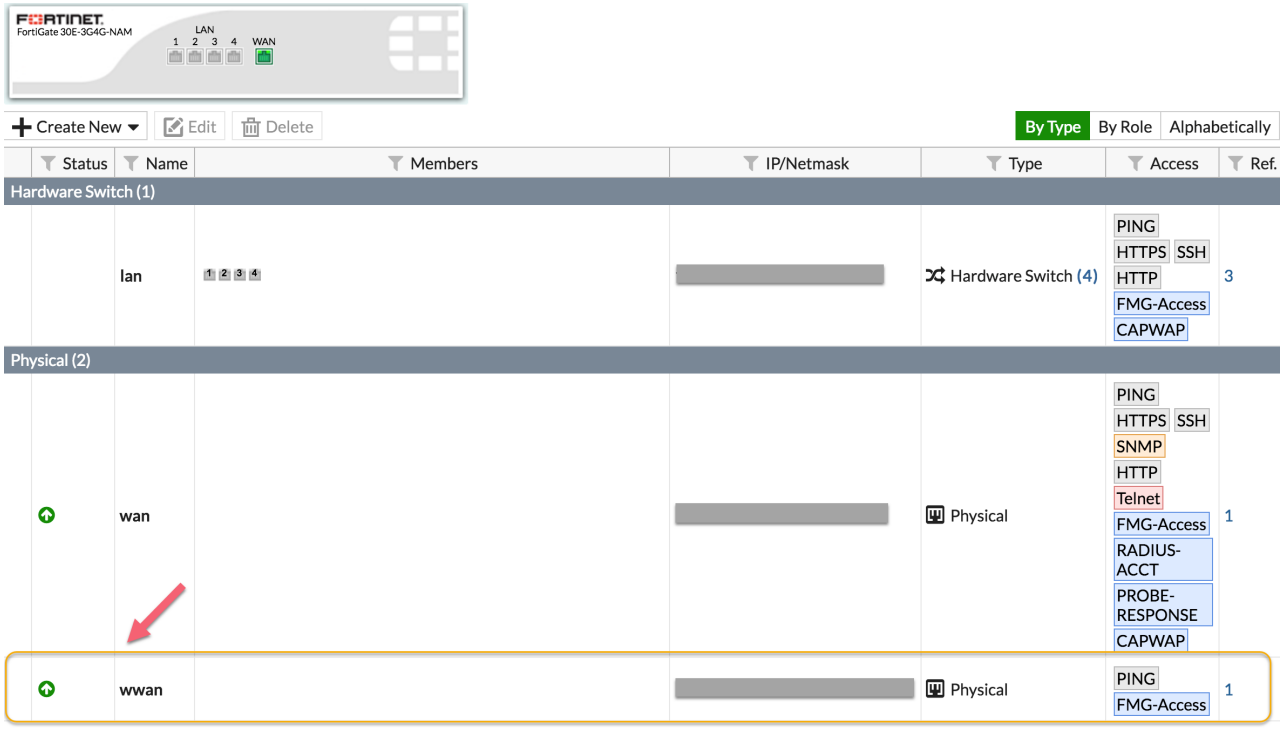
- Configure the modem from FortiGate GUI on page 17
- Configure the modem from FortiGate Console on page 18

Many new features and functions have been added to the Console, but may not have been implemented in the GUI yet. For this reason, we highly recommend configuring the LTE modem via the FortiGate Console.

Configure the modem from FortiGate GUI

Follow these instructions to configure the device from the GUI:

1. Set the Ethernet port on your computer to DHCP mode.
2. Use an Ethernet cable to connect your computer to your FortiGate 30E via any of the Ethernet ports (1 through 4).
3. Start your browser and enter the address of your FortiGate 30E.
4. On the log-in page, enter the default username 'admin' (case-sensitive) in the Username field, leave the Password field blank (no password), and press Login.
   Note: By default, the FortiGate 30E GUI opens to the **Dashboard>Status** page after you log in.
5. Check the status of the modem interface by selecting **Network>Interfaces,** as shown in the following illustration.



6. In the Status column, under Physical (2), make sure that wwan which is the LTE network is up (as indicated by a green up arrow).

A green up arrow in the Status column indicates that the LTE modem is connected and functioning properly, whereas a red down arrow indicates the opposite.

You can double-click this row to view and edit the settings of the interface. Most important of all, make sure that the status of the interface is set to **Enabled.**

Configure the modem from FortiGate Console

Configuring the 3G/4G LTE modem from the FortiGate Console requires the following major steps:

- Connect your server to FortiGate on page 18
- Create wireless profiles
- Configure the LTE modem on page 21

Connect your server to FortiGate

The following instructions show how to access your FortiGate 30E from a server (computer) via its console port.

1. Use the serial cable (included in your product package) to connect the serial port of your computer to the console port of your FortiGate 30E.
2. Start a serial console terminal program from your computer, and set the port to:
   - 9600 baud rate
   - Data bits 8
   - Parity None
   - Stop bits 1
   - Flow control None

We highly recommend setting baud rate to 115200 if we want to capture LTE modem debug information. We also recommend using Telnet or SSH, if possible, to prevent output overflow.

3. Press **Enter** on your keyboard to bring up the command line interface (CLI).
4. Type in the default username "admin", but with no password, and press **Enter** on your Keyboard to log in to the Console.
5. Check the network configuration.
6. Us the following commands to check that the firewall policy allows all traffic from the internal ports to the wwan interface:

```
FortiWiFi-40F-3G4G # sh firewall policy
config firewall policy
   edit 1
      set uuid 92f6165c-e23a-51ea-3694-7a20107fe598
      set srcintf "internal"
      set dstintf "wan"
```

```
        set srcaddr "all"
        set dstaddr "all"
        set action accept
        set schedule "always"
        set service "ALL"
        set nat enable
    next
    edit 2
        set uuid 92f7ac10-e23a-51ea-f648-471c047f588f
        set srcintf "guestwifi"
        set dstintf "wan"
        set srcaddr "all"
        set dstaddr "all"
        set action accept
        set schedule "always"
        set service "ALL"
        set nat enable
    next
```

FortiGate 30E comes with a default firewall policy that allows all traffic from internal ports to the wwan interface. Make sure the policy is in place before moving on to the next step.

Create wireless profiles

A wireless profile contains detailed LTE modem data session settings. Each modem can store up to 16 wireless profiles. Any data connection is initiated using the settings from one of the stored wireless profiles. To make a data connection, you must have at least one wireless profile defined. The following is a sample wireless profile table stored in the internal modem.

```
FortiWiFi-40F-3G4G # exec lte-modem wireless-profile list
ID   Type  Name               APN                  PDP_Type  Authen  Username
 1   0                        broadband            3         0

Profile Type:
    0 ==> QMI_WDS_PROFILE_TYPE_3GPP
    1 ==> QMI_WDS_PROFILE_TYPE_3GPP2
    * ==> Default 3GPP profile, # ==> Default 3GPP2 profile
Profile PDP type:
    0 ==> QMI_WDS_PDP_TYPE_IPV4
    1 ==> QMI_WDS_PDP_TYPE_PPP
    2 ==> QMI_WDS_PDP_TYPE_IPV6
    3 ==> QMI_WDS_PDP_TYPE_IPV4_OR_IPV6

Authentication:
    0 ==> QMI_WDS_AUTHENTICATION_NONE
    1 ==> QMI_WDS_AUTHENTICATION_PAP
    2 ==> QMI_WDS_AUTHENTICATION_CHAP
    3 ==> QMI_WDS_AUTHENTICATION_PAP|QMI_WDS_AUTHENTICATION_CHAP
```

The above is wireless profile of a modem with Verizon firmware. If the APN can be left empty, it indicates a wildcard entry; if the username shows empty, it means that no authentication is not configured.

There is a default wireless table that can be retrieved from the modem firmware. You can list, create, delete, or modify the table with the `exec lte-modem wireless-profile` command. For generic modem firmware, the modem has no wireless table entries pre- installed and the LTE daemon will create a default entry to be used.

It seems that the EM75xx modems do not support either the 3GPP2 or the PPP PDP types of profiles. IPv6 is not supported on this modem yet although you can still specify a profile with PDP type 2 or 3. However, you cannot initiate IPv6 data connection anyway.

When the modem boots up, it automatically scans the network and gets a list of the available candidates for data connection. With the default system configuration, FortiOS sends the start network request to the modem, with no (empty) APN, authentication, or wireless profile entry. Upon receiving the request, the modem scans the wireless profile table, from top to bottom, to find a matching record and make the data call with the settings in that record.

If the APN field is left empty in the wireless profile, the modem make connections to wireless networks with any APN.

It is very important to have a properly configured wireless profile because many carriers run private networks along with their public network. When you have a SIM card for a private network, it can be used to connect to either a public or a private network. If you define a wireless profile without an APN, then it would make connections to any network it scans. When it connects to a unwanted network, it will receive no service. Having a clearly defined profile table can prevent this issue. Assuming that you have a SIM card which can be used for either public network “pn” or private network “prn”, and you want it to connect to private network “prn”. You can make sure that it connects to “prn” by enforcing the profile ID 1 in the LTE modem configuration, as illustrated below. This will ensure that modem always connects to “prn”.

```
ID   Type  Name                APN                 PDP_Type  Authen  Username
 1   0     private_net         prn                 3         0
```

Moreover, instead of letting the modem scan the environment for available networks to connect to, you can also force the modem to always send network connection request with specific APN/authtype/username using the following commands:

```
configure sys lte-modem
   set apn/authtype/username
```

As illustrated below:

```
authtype                              Authentication type for PDP-IP packet data calls.
apn                                   Login APN string for PDP-IP packet data calls.
```

Upon receiving these settings changes, the modem reboots itself to refresh its configuration and re-initiate data connection. The modem will temporarily disconnect during the reboot and shall reconnect once the reboot is completed.

Care must be taken to ensure that there is a wireless profile entry in the modem profile table that matches with the enforced APN settings. Otherwise, the modem will not be able to make network connections because it cannot find a matching profile.

It is also possible to force the modem to dial with a certain wireless profile entry for connection using the following commands:

```
configure sys lte-modem
   set force-wireless-profile
```

As illustrated below:

```
force-wireless-profile                Force to use wireless profile index (1 - 16), 0 if don't force.
```

This configuration must be used with the `set apn` command. Otherwise, it will not work.

Configure the LTE modem

This section introduces the commands for configuring the built-in 3G/4G LTE modem, and discusses in detail how to use each of the commands.

You can start configuring the modem using the `config sys lte-modem` command, and then us the `set`command to configure the various parameters, as illustrated below:

```
FortiWiFi-40F-3G4G (lte-modem) # set
status                                Enable/disable USB LTE/WIMAX device.
extra-init                            Extra initialization string for USB LTE/WIMAX
devices.
manual-handover                       Enable/disable manual handover from 3G to LTE
network.
force-wireless-profile                Force to use wireless profile index (1 - 16), 0 if
don't force.
authtype                              Authentication type for PDP-IP packet data calls.
apn                                   Login APN string for PDP-IP packet data calls.
modem-port                            Modem port index (0 - 20).
network-type                          Wireless network type.
auto-connect                          Enable/disable modem auto connect.
gps-service                           Enable/disable GPS daemon.
data-usage-tracking                   Enable/disable data usage tracking.
gps-port                              Modem GPS port index (0 - 20).
band-restrictions                     Bitmaps for the allowed 3G and LTE bands.Ex:
0000000000000000-0000000000001008 (3G Mask-LTE Mask)
image-preference                      Modem image preference.
allow-modify-wireless-profile-table   Allow LTE daemon to modify wireless profile table, if
running GENERIC firmware.
sim-auto-switch                       Enable/disable SIM card auto detection.
connection-auto-switch                Enable/disable SIM card switch based on connectivity.
```

set status

```
FortiWiFi-40F-3G4G (lte-modem) # set status
enable     Enable USB LTE/WIMA device.
disable    Disable USB LTE/WIMA device.
```

The `set status` command allows you to enable or disable the modem. It acts as the switch of LTE modem daemon. When the LTE modem daemon is switched off, the modem will stop transferring data. You can still use the AT command interface. It is important to note that disabling the LTE modem daemon does not disable GPS and data usage tracking daemons. It does not affect DM port either.

set extra-init

```
FortiWiFi-40F-3G4G (lte-modem) # set extra-init
<string>    please input string value
```

This is a legacy command, which sends an AT command to the modem once the system has detected it.

Do NOT use this command to configure APN. Use the wireless profile or `set apn`instead. Otherwise, the modem may get confused and become unstable.

set manual-handover

```
FortiWiFi-40F-3G4G (lte-modem) # set manual-handover
enable     Enable 3G to LTE manual handover.
```

By default, the network type is set to auto, which means the modem will automatically select a network to connect to, either LTE or 3G (UMTS or CDMA). When LTE signal drops, the modem will switch to the 3G network. If, after a while, the LTE signal comes back to normal, the modem will switch back to the LTE network. This process is called a handover. Handover is supposed to happen automatically, but the modem may fail to do so in some cases. The `set manual-handover` command is used to resolve this issue.

The LTE daemon checks the network type every few seconds. If it is auto and the modem is currently on the 3G network, the LTE daemon checks the signal information. If LTE signal is strong enough (RSRP >= -115), it increases the internal handover counter by 1. If the counter reaches 5, it means the modem is having trouble performing auto handover. When that happens, the LTE daemon will restart the modem to make sure it goes back to the LTE network. If the LTE signal disappears before the counter reaches 5, it is reset to 0.

You must use `set manual-handover enable` to enable this feature.

set apn

```
FortiWiFi-40F-3G4G (lte-modem) # set apn
<string>    please input string value
```

By default, the APN is not set, which means that the modem can connect to any available network it discovers from its automatic network scan. If an APN is set, the modem will only connect to a wireless network with the specific APN.

set force-wireless-profile

```
FortiWiFi-40F-3G4G (lte-modem) # set force-wireless-profile
force-wireless-profile    Enter an integer value from <0> to <16>.
```

When the modem starts a data session, it matches the APN settings, which is either set by the user or from its network scan, against entries in the wireless profile table. If no matching profile is found, it will not send the data connection request and reports an error instead.

It is quite possible that multiple matching profiles with the same APN exist in a profile table, while you want to specify a profile which will not be returned as the matching profile based on our criteria. If you really want to use that profile, you can specify the profile ID in this configuration.

Keep in mind that if the specified wireless profile does not match the parameters in the data connection request such as apn, authtype, etc., an error is reported.

This configuration must be used with `set apn`. Otherwise, it has no effect.

set authtype

```
FortiWiFi-40F-3G4G (lte-modem) # set authtype
none    Username and password not required.
pap     Use PAP authentication.
chap    Use CHAP authentication.
both    Use PAP/CHAP authentication
```

Sometimes, you get a SIM card for a private network which might require authentication. You can set the authentication type, and username and password in the configuration. Whether you use PAP or CHAP authentication, it is OK to set the option to both because the modem knows which algorithm to use.

Once an authentication type is chosen, the hidden username and password options appear, as illustrated below.

```
FortiWiFi-40F-3G4G (lte-modem) # set authtype both

FortiWiFi-40F-3G4G (lte-modem) # set
status                              Enable/disable USB LTE/WIMAX device.
extra-init                          Extra initialization string for USB LTE/WIMAX
devices.
manual-handover                     Enable/disable manual handover from 3G to LTE
network.
force-wireless-profile              Force to use wireless profile index (1 - 16), 0 if
don't force.
authtype                            Authentication type for PDP-IP packet data calls.
username                            Authentication username for PDP-IP packet data calls.
passwd                              Authentication password for PDP-IP packet data calls.
apn                                 Login APN string for PDP-IP packet data calls.
modem-port                          Modem port index (0 - 20).
network-type                        Wireless network type.
auto-connect                        Enable/disable modem auto connect.
gps-service                         Enable/disable GPS daemon.
data-usage-tracking                 Enable/disable data usage tracking.
gps-port                            Modem GPS port index (0 - 20).
band-restrictions                   Bitmaps for the allowed 3G and LTE bands.Ex:
0000000000000000-0000000000001008 (3G Mask-LTE Mask)
image-preference                    Modem image preference.
allow-modify-wireless-profile-table Allow LTE daemon to modify wireless profile table, if
running GENERIC firmware.
sim-auto-switch                     Enable/disable SIM card auto detection.
connection-auto-switch              Enable/disable SIM card switch based on connectivity.
```

set network-type

```
FortiWiFi-40F-3G4G (lte-modem) # set network-type
auto         Automatic detection
umts-3g      UMTS 3G -- For networks use GSM technology
lte          LTE
cdma-hrpd    CDMA and HRPD -- For networks use CDMA technology
```

By default, network-type is set to auto mode. This allows the modem to automatically connect to the LTE network when it's available, or fall back to the 3G mode when LTE signal is lost. The modem is designed to hand over back to the LTE network when the signal comes back.

You can also force the modem to 3G- or LTE-only mode by using the other three commands. Keep in mind that you must not specify umts-3g on a modem with the CDMA network firmware or cdma-hrpd on a modem with the GSM network firmware.

set modem-port

```
FortiWiFi-40F-3G4G (lte-modem) # set modem-port
modem-port    Enter an integer value from <0> to <20> (default = <255>).
```

Almost all modems have a modem port (i.e., the AT Command port). For PPP modems, the modem port is critical because it is the only port to control the modem and to transfer data. For modems such as the EM-series, although the modem port is not used to make or close data sessions, it is still used to get status information from the modem. As discussed earlier, modems expose some USB serial interfaces, and the FortiOS enumerates them as /dev/ttyusbX devices (which is different from /dev/ttyUSBX on standard Linux). Sometimes you might plug some USB device into the USB port on FortiGate 30E 3G/4G. Because the enumeration order of the USB devices varies, it can cause the modem port of the internal EM modem to change. You must also keep in mind that not all modems have a modem port.

By default, the LTE modem daemon keeps a table for a list of the supported modems. There is a default value for the index of the modem port for each modem with a modem port, or nothing if the modem does not have a modem port. This means that, by default, you do not need to specify a modem port for a modem. In case someone has inserted a USB device, causing the modem port to change to a different value, you can use this command to specify the index of the modem port.

You can use the `diagnose system modem com /dev/ttyusbX` command to find out the actual modem port in the system. When you see the AT command interface on the Console, just input `ati` and press **Enter** on your keyboard. If it is a modem port, the device information will appear on the Console. Here `X` is the actual index for the modem port. This is a small tip, but you do not need to try it if you do not have any additional USB devices attached to the system.

The LTE daemon always has a default modem port for all the supported modems. For the internal LTE modem, it is always port index 2. To let the LTE daemon to use the default port index, leave this parameter at the default value 255.

This setting is to be used on an external LTE modem stick only. For FortiGate LTE variants, make sure to keep the default settings and do not modify its port value.

set auto-connect

```
FortiWiFi-40F-3G4G (lte-modem) # set auto-connect
enable     Enable modem auto connect.
disable    Disable modem auto connect
```

By default, you need to send a connect request to get connected to the wireless network and send a disconnect request to get disconnected. If you set the modem to auto-connect mode, it will automatically connect to the network every time the modem is initialized in the system and stays connected. However, there is some drawback to it. For example, you cannot disconnect the modem simply by sending a disconnect request, and some modem commands may not work when the modem is set to automatic connect mode. We recommend disabling the auto-connect mode, which is the default value.

Be careful when using the auto-connect setting. If auto-connect is not enabled, FortiOS issues modem activation commands when the modem is registered to the network. If it is enabled, the modem will randomly connect to any wireless network which matches any profile in its profile table, and it does not wait for input from FortiOS. If there are more than one APN broadcast in the air which matches the profile of the modem, it may end up connected to an unintended APN.

set gps-service

```
FortiWiFi-40F-3G4G (lte-modem) # set gps-service
enable     Enable GPS daemon.
disable    Disable GPS daemon
```

If you have a FortiGate 30E device that comes with a GPS antenna, you can enable this option to get accurate location information if GPS signal is good where the device is deployed.

The GPS module in the latest FortiGate 30E-GBL does not work because the device does not have a GPS connector. For this reason, this option is set to disabled by default.

set data-usage-tracking

```
FortiWiFi-40F-3G4G (lte-modem) # set data-usage-tracking
enable     Enable data usage tracking.
disable    Disable data usage tracking.
```

The modem data usage in a resolution of 1min/10min/30min/hour/day is kept in the system if data-usage-tracking is enabled. This option is disabled by default. A daily bytes in/bytes out record is kept in the flash file system for the past 60 days, and only records with higher resolution are kept in the memory file system. The system is designed to work in this way because the size of flash memory in FortiGate 30E is limited.

Once data-usage-tracking is enabled in the system, it reads data in and out from the modem once every minute and stores it in the memory file system. In the first record, the data usage is always set to 0, so it starts counting from the second record. If the minute can be divided exactly by 10, a 10 min usage record is saved, so on for 30 min and hourly

data. If it is the first minute past midnight, a daily record is saved in the flash file system. The system only keeps a certain maximum number of records for the same type and discards older records. The data-usage-tracking feature can only give an approximate estimation, so it is not accurate. If the device is powered off in the middle of the day, you could lose up to one day's worth of usage data.

set billing-date

```
FortiWiFi-40F-3G4G (lte-modem) # set billing-date
billing-date    Enter an integer value from <1> to <31> (default = <1>).
```

Once data-usage-tracking is enabled, the billing-date option shows up. Billing date means the day of the month when a new statement is generated. A billing cycle means the time frame starts from the last billing day till midnight of the day before the next billing day. In the case 29~31 is set as the billing date, if days in the current month is less than the billing date, the last day of the current month is used, if days in the previous month was less than the billing date, the billing cycle is counted from the first day of the current month. The default billing date is 1.

set data-limit

```
FortiWiFi-40F-3G4G (lte-modem) # set data-limit
data-limit    Enter an integer value from <0> to <100000>.
```

If data-usage-tracking is enabled, data-limit ranging from 1 MB to 100 GB can be set in the system. The default is 0 which means no limit. It can be used as a reminder of how much data you can use in a month. In the future, we can generate an alarm to notify the users that their data limit is approaching.

set gps-port

```
FortiWiFi-40F-3G4G (lte-modem) # set gps-port
gps-port    Enter an integer value from <0> to <20> (default = <255>).
```

For the same reason as the `set modem-port` command, we have this `set gps-port` command. It is /dev/ttyusb1 by default. You can manually set the GPS port index with this command.

A GPS antenna is required to get GPS service. So this command has no effect on FortiGate 30E devices that have no GPS port and/or antenna.

set band-restrictions

```
band-restrictions                       Bitmaps for the allowed 3G and LTE bands.Ex:
0000000000000000-0000000000001008 (3G Mask-LTE Mask)
```

```
band-restrictions                   Bitmaps for the allowed 3G and LTE bands.Ex: 0000000000000000-0000000000001008 (3G Mask-LTE Mask)
```

This command allows you to set the radio bands that modem can use for 3G and LTE service.

set image-preference

```
FortiWiFi-40F-3G4G (lte-modem) # set image-preference
generic      Generic Firmware.
att          AT&T Firmware.
verizon      Verizon Firmware.
telus        Telus Firmware.
docomo       DOCOMO Firmware.
softbank     Softbank Firmware.
sprint       Sprint Firmware.
auto-sim     Auto Select Firmware.
no-change    Do not change.
```

This command enables you to choose the corresponding modem firmware to pair with the inserted SIM card to be used. Certain carriers, such as Verizon, may require special firmware. Otherwise, there could be no service. For carriers not listed in the list, you can use the "generic" firmware instead.

Be sure to select the firmware image that matches your SIM card. The modem will not connect if you set the incorrect firmware preference.

This setting is set to `auto-sim` by default. It enables FortiOS to automatically switch to the proper carrier modem firmware based on the carrier information detected from the SIM card. When a new SIM card is inserted, the modem firmware-switching will take place if the current modem firmware does not match that on the SIM card.

It may take up to five minutes for a modem firmware-switching operation to complete. During this process, the modem could become unstable and may reboot itself for several times. Hence, it is quite common to see the modem disconnected or undetected shortly after a new SIM card is inserted, if `auto-sim` is selected.

set allow-modify-wireless-profile-table

```
allow-modify-wireless-profile-table    Allow LTE daemon to modify wireless profile table, if
running GENERIC firmware.

FortiWiFi-40F-3G4G (lte-modem) # set allow-modify-wireless-profile-table
enable     Allow LTE daemon to modify wireless profile table.
disable    Do not allow LTE daemon to modify wireless profile table.
```

For the "generic" firmware, there are no wireless table entries stored in the modem. This option basically tells the daemon to auto-create a matching wireless profile entry according to the APN setting if the current firmware is set to `generic`, which is the default value of this setting.

set sim-hot-swap

```
FortiWiFi-40F-3G4G (lte-modem) # set sim-hot-swap
enable     Enable SIM card auto detection.
disable    Disable SIM card auto detection
```

For Soc4 LTE platforms such as FGT/FWF 4XF-3G4G units with two physical SIM slots, this configuration is for enabling FortiOS to automatically switch to the slot with an inserted SIM card. If it is enabled, the first inserted SIM card will be used regardless of which slot the card is inserted. If disabled, a SIM card must be inserted to the slot which FortiOS is currently using.

set connection-hot-swap

```
FortiGateRugged-60F-3G4G (lte-modem) # set connection-hot-swap
5-minutes     Perform SIM card hot swapping if current card is not able to connect for 5
minutes.
10-minutes    Perform SIM card hot swapping if current card is not able to connect for 10
minutes.
never         SIM card hot swap based on card presence only.
```

If enabled, FortiOS will chooses the SIM card to be used according to its connectivity rather than mere presence. If no SIM card is connectable, FortiOS will continue scanning both slots until a valid SIM card is in place.

This option is available only when "`sim-hot-swap`" is enabled. Otherwise, it is hidden.

A bug related to this option will render the unit unable to establish an LTE connection in FortiOS 6.2.4 , 6.2.5 and 6.4.2. This issue will be fixed in later FOS releases. A temporary workaround is to disable this option.

set sim-slot

```
FortiWiFi-40F-3G4G (lte-modem) # set sim-slot
sim-slot    Enter an integer value from <1> to <2> (default = <1>).
```

This command enables you to manually set the SIM slot (of the two slots) to be used for connection.

This option is available only when `sim-hot-swap` is disabled so that FortiOS will not perform auto selection.

set sim-lock-passcode

```
FortiGate-30E-3G4G-GBL (lte-modem) # set sim-lock-passcode
<string>    please input string value
```

For platforms with SIM PLMN feature, this option is for you to enter the predefined passcode to unlock the SIM card lock PLMN prefix lock, as illustrated below.

```
FortiGate-30E-3G4G-GBL (lte-modem) # set sim-lock-passcode 123
Pass code incorrect! You have 4 trials remainning.
```

You have five trials to enter the correct passcode. If you fail to enter the correct passcode, you'll have to reboot the system to reset the trials, as illustrated below.

```
FortiGate-30E-3G4G-GBL (lte-modem) # set sim-lock-passcode 2122
All passcode trials used up! Please reboot the unit to try again.
```

Once you have entered the passcode correctly, two more configuration will now be available: "`PLMN-code`" and "`modify-sim-lock-passcode`". They allow you to change unlock passcode and modify the allowed PLMN prefix for the SIM card. Currently, only one PLMN prefix entry can be modified. FortiOS will use this PLMN prefix to match against the one in the IMSI code fetched from the SIM card. If they don't match, FortiOS will not send the connect request to the modem.

```
FortiGate-30E-3G4G-GBL (lte-modem) # set sim-lock-passcode fortinet123!
Pass code correct! Now PLMN setting is available.
```

```
sim-lock-passcode                Enter PLMN setting passcode to unlock PLMN setting.Ex: abc123!
modify-sim-lock-passcode         Modify SIM lock PLMN setting passcode.Ex: abc123!
PLMN-code                        PLMN code allowed for SIM cards.Ex: 310010 for US Verizon, 310030 for US AT&T.
```

The PLMN code prefix is matched literally with the IMSI code from the SIM card. Therefore, any extra strings in the PLMN code setting, such as leading or tailing spaces, may lead to connection failure!

The system default is set as unlock, i.e., the passcode is set as empty, and you can set your own passcode. To lock again, simply unset the sim-lock-passcode configuration and the other two options will be hidden again.

If you have forgotten your set passcode, you can either do a factory reset or contact Fortinet for your admin passcode.

diagnose sys lte-modem

This section introduces the commands for diagnosing the LTE modem. They provide an easy way to check the status of the built-in LTE modem.

```
FortiGateRugged-60F-3G4G # diagnose sys lte-modem
traffic-status       LTE Modem traffic status
modem-details        LTE Modem detailed information
sim-info             LTE Modem SIM card information
signal-info          LTE Modem signal information
data-session-info    LTE Modem data session information
gps-info             LTE Modem GPS information
data-usage           LTE Modem data usage
```

diagnose sys_lte-modem traffic-status

```
FortiWiFi-40F-3G4G # dia sys lte-modem traffic-status
LTE Modem traffic status:
TX packets OK:        24643
RX packets OK:        16392
TX packets error:     0
RX packets error:     0
TX overflows:         0
RX overflows:         0
TX bytes OK:          2323120
RX bytes OK:          5489633
TX packets dropped:   0
RX packets dropped:   0
```

This command shows the data traffic information for the current data connection. The statistics will reset to 0 if the wireless network type changes, such as falling back from the LTE to 3G network, or vice versa, or if the data session is disconnected.

diagnose sys lte-modem modem-details

```
FortiWiFi-40F-3G4G # dia sys lte-modem modem-details
LTE Modem detailed information:
Modem detected:      Yes
Manufacturer:        Sierra Wireless, Incorporated
Model:               EM7565
Revision:            SWI9X50C_01.07.02.00 6c91bc jenkins 2018/06/13 23:08:16
MSISDN:              16692240893
ESN:                 0
IMEI:                353533100752164
MEID:
Hardware revision:   10001
```

```
Software revision:   T.2.5.1-00478-9655_GENNCH_PACK-1
SKU:
FSN:                 UF00227145031047
PRL version:         0x0000
Modem FW version:    00.00.00.00
PRI version:         000.000_000
Carrier Abbr:        AUTO-SIM
Modem Operation mode:      QMI_DMS_OPERATING_MODE_ONLINE
```

This command shows the information of the LTE modem. Not all the firmware revisions carry the software revision and SKU ID. The fields are left blank if no values are assigned to them.

When the auto-sim feature is enabled, the modem firmware version and PRI version will display as 0 instead of their actual values.

diagnose sys lte-modem sim-info

```
FortiWiFi-40F-3G4G # dia sys lte-modem sim-info
LTE Modem SIM card information:
Active Slot:       Slot 2.
SIM state:        QMI_UIM_CARD_STATE_PRESENT
ICCID:            89014103271134616653
IMSI:             310410113461665
Country:          United States
Network:          AT&T Wireless Inc.
```

This command shows status of the SIM card. There are three SIM card detection states:

- QMI_UIM_CARD_STATE_PRESENT
- QMI_UIM_CARD_STATE_ABSENT
- QMI_UIM_CARD_STATE_ERROR

The first two states are quite obvious, but the final state usually indicates the modem has trouble recognizing the inserted SIM card.

In most cases, the error state happens because of loose SIM card contact with the card slot. It can be fixed with a good-quality SIM card adapter.

diagnose sys lte-modem signal-info

```
LTE Modem signal information:
    WCDMA:
         RSSI:       -79
         ECIO:       6
    LTE:
```

```
RSSI:        -51
RSRQ:        -13
RSRP:        -87
SNR:         26
```

This command shows the signal type and strength the modem is able to obtain at the moment. Depending on the firmware that the modem is running, the signal information can be of the following types.

Signal Type	Network	Parameter
CDMA	CDMA	RSSI, ECIO
HDR	CDMA	RSSI, ECIO, SINR, IO
GSM	GSM	GSM
WCDMA	GSM	RSSI, ECIO
LTE	CDMA/GSM	RSSI, RSRP, RSRQ, SNR
TDMA	GSM	TDMA

Signal information is sampled at 1-minute, 10-minute, 30-minute, and 1-hour intervals. Once the GUI implementation is done, you we will be able to get charts for signal strength.

The following chart shows the quality evaluations for modem LTE signal strength.

		RSSI	SINR (dB)	RSQ (dB)	RSRP (dBm)	EC/Io (dB)
	Technology	LTE and 3G	LTE only	LTE only	LTE only	HSPA+ and EVDO
Signal Quality	Excellent	> -65	> 12.5	> -5	> -84	> -2
	Good	-65 to -75	10 to 12.5	-6 to -10	-85 to -102	-2 to -5
	Fair	-75 to -85	7 to 10	-6 to -10	-103 to -111	-5 to -10
	Poor	< -85	< 7	< -11	< -112	< -10

You can use the `diagnose test application 5` command to get a more comprehensive modem signal strength dump.

diagnose sys lte-modem data-session-info

```
LTE Modem data session information:
Interface name:         wwan
Connection status:      QMI_WDS_CONNECTION_STATUS_CONNECTED
Profile ID:             1
```

```
Data profile name:
Profile type:           QMI_WDS_PROFILE_TYPE_3GPP
PDP context type:       QMI_WDS_PDP_TYPE_IPV4
APN name:               broadband
IP family:              QMI_WDS_IP_FAMILY_IPV4
IP:                     10.53.79.115
IP gateway:             10.53.79.116
IP netmask:             255.255.255.248
Primary DNS:            172.26.38.1
Secondary DNS:          0.0.0.0
MTU:                    1430
Auto connect:           QMI_WDS_AUTOCONNECT_DISABLED
Network type:           Unknown WDS Bearer Tech
Network type(last):     Unknown WDS Bearer Tech
Link protocol:          QMI_WDA_LINK_LAYER_PROTOCOL_RAW_IP
```

This command enables you to see the information of the current LTE modem data session. The following table highlights the key parameters in data session information.

Parameter	Description
Interface name	The name of the LTE network interface
Connection status	The status of the connection
Profile ID	The wireless profile used in the current data session
Profile type	The type of wireless profile used in the data session
PDP context type	The PDP types allowed by the wireless profile
APN name	The name of the carrier's APN
IP family	The IP family used in the data connection. It can be either IPv4 or IPv6. **Note:** IPv6 session is not supported for the current release.
IP	**Note:** IP addresses are always acquired through DHCP although some SIM cards offer static IPs.
MTU	The MTU on the wireless front end. **Note:** The MTU on the Ethernet interface wwan can be different. If the wwan runs the link protocol RAW IP, the MTU on the Ethernet interface must be changed to the same as the one on the wireless front end. Otherwise, it will not work.

diagnose sys lte-modem GPS-info

If GPS location information is not retrieved on a device, usually due to poor GPS signal reception, it shows the following result:

```
LTE Modem GPS information:
    GPS daemon enabled:        Yes
```

On a device equipped with GPS antenna, if the location information is retrieved, the latitude, longitude, UTC Ttme are also displayed.

diagnose sys lte-modem data-usage

```
Estimated LTE Modem data usage in this billing cycle:
Bytes in:    0
Bytes out:   0
```

The Console only displays bytes in/out for the current billing cycle.

execute lte-modem

The `execute lte-modem` command allows you access a slew of sub-commands used to manage the LTE mode, as shown in the image below.

```
FortiWiFi-40F-3G4G # exec lte-modem
cold-reboot                  Cold reboot LTE Modem.
get-modem-firmware           get-modem-firmware
get-pri-firmware             get-pri-firmware
plmn-profile                 plmn-profile
power-off                    Power off LTE Modem.
power-on                     Power on LTE Modem.
purge-billing-data           Purge all existing LTE Modem billing data.
reboot                       Warm reboot LTE Modem.
set-operation-mode           Set LTE Modem operation mode.
wireless-profile             wireless-profile
```

execute lte-modem cold-reboot

The `execute lte-modem cold-reboot` command powers off the internal LTE modem for one second and then powers it back on.

```
FortiWiFi-40F-3G4G # exec lte-modem cold-reboot
Are you sure you want to cold reboot the LTE modem?
Do you want to continue? (y/n)
```

execute lte-modem purge-billing-data

The `execute lte-modem purge-billing-data` command allows you to permanently erase and remove billing data from the system to free up memory and storage space.

```
FortiWiFi-40F-3G4G # exec lte-modem purge-billing-data
Are you sure you want to purge all the LTE modem billing data?
Do you want to continue? (y/n)
```

execute lte-modem power-off

The `execute lte-modem power-off` command allows you to power off the internal LTE modem.

```
FortiWiFi-40F-3G4G # exec lte-modem power-off
Are you sure you want to power off the LTE modem?
Do you want to continue? (y/n)
```

execute lte-modem power-on

The `execute lte-modem power-on` command allows you to power on the internal LTE modem.

```
FortiWiFi-40F-3G4G # exec lte-modem power-on
Are you sure you want to power on the LTE modem?
Do you want to continue? (y/n)
```

execute lte-modem reboot

The `execute lte-modem reboot` command allows you to warm-reboot the internal LTE modem.

```
FortiWiFi-40F-3G4G # exec lte-modem reboot
Are you sure you want to reboot the LTE modem?
Do you want to continue? (y/n
```

execute lte-modem set-operation-mode

The `execute lte-modem set-operation-mode` command allows you set the operation mode of the internal LTE modem, which can be either of the options as described below.

```
FortiWiFi-40F-3G4G # exec lte-modem set-operation-mode
( 0, 1)    Operation mode.
 0 - Online
 1 - Low Power
```

Operation Mode	Description
Online	The normal operating mode.
Low Power	The internal LTE modem operates with its RF module turned off.

execute lte-modem wireless-profile-list

The `execute lte-modem wireless-profile-list` command allows you to view all wireless profiles configured in the modem.

```
FortiWiFi-40F-3G4G # exec lte-modem wireless-profile list
ID   Type  Name               APN                  PDP_Type  Authen  Username
 1   0                        broadband            3         0

Profile Type:
    0 ==> QMI_WDS_PROFILE_TYPE_3GPP
    1 ==> QMI_WDS_PROFILE_TYPE_3GPP2
    * ==> Default 3GPP profile, # ==> Default 3GPP2 profile
Profile PDP type:
```

```
    0 ==> QMI_WDS_PDP_TYPE_IPV4
    1 ==> QMI_WDS_PDP_TYPE_PPP
    2 ==> QMI_WDS_PDP_TYPE_IPV6
    3 ==> QMI_WDS_PDP_TYPE_IPV4_OR_IPV6

Authentication:
    0 ==> QMI_WDS_AUTHENTICATION_NONE
    1 ==> QMI_WDS_AUTHENTICATION_PAP
    2 ==> QMI_WDS_AUTHENTICATION_CHAP
    3 ==> QMI_WDS_AUTHENTICATION_PAP|QMI_WDS_AUTHENTICATION_CH
```

A modem can store up to 16 wireless profiles indexed by profile ID from 1 to 16.

The EM73xx modem does not support the 3GPP2 profile. Whether the modem is configured to 3G network UMTS or CDMA, or LTE, the profile type is 3GPP.

The PDP profile limits the types of networks that the modem is able to connect to. On FortiGate 30E 3G4G devices, only IPv4 and IPv6 networks are supported. Usually you can specify PDP type 3 to enable IPv4 and IPv6 at the same time. However, because FortiGate 30E 3G4G devices do not support IPv6 for now, it has not effect if you set PDP type to IPv6 only.

Usually, no authentication is required in a wireless profile. Still, you can enable authentication on a data connection, using either PAP or CHAP. You can always specify authentication type 3 whether the real authentication type is PAP or CHAP, for the modem knows how to handle it.

If authentication is enabled in a wireless profile, username and password will be required. However, when viewing a wireless profile, you are able to see the username only; the password is always hidden.

execute lte-modem wireless-profile create

The `execute lte-modem wireless-profile create` command allows you to create wireless profiles. You can create up to 16 wireless profiles.

When creating a wireless profile, you do not need to specify a profile ID, because the modem automatically assigns one for you. The following image shows the creation of a wireless profile named "profile5".

```
FortiWiFi-40F-3G4G # exec lte-modem wireless-profile create
<name>    Wireless profile name 1 to 16 characters.

FortiWiFi-40F-3G4G # exec lte-modem wireless-profile create profile1
(0, 1)    Wireless profile type.
 0 - 3GPP
 1 - 3GPP2

FortiWiFi-40F-3G4G # exec lte-modem wireless-profile create profile1 0
(0 - 4)    Wireless profile PDP type.
 0 - IPV4
 1 - PPP
 2 - IPV6
 3 - IPV4V6

FortiWiFi-40F-3G4G # exec lte-modem wireless-profile create profile1 0 3
<name>    Wireless profile APN name 0 to 32 characters.
```

```
FortiWiFi-40F-3G4G # exec lte-modem wireless-profile create profile1 0 3 YOUR_APN
(0 - 3)    Wireless profile authentication type.
 0 - None
 1 - PAP
 2 - CHAP
 3 - PAP and CHAP

FortiWiFi-40F-3G4G # exec lte-modem wireless-profile create profile1 0 3 YOUR_APN 0
<name>|<Enter>    Wireless profile user Name 1 to 32 characters, or <Enter> if
authentication is none.

FortiWiFi-40F-3G4G # exec lte-modem wireless-profile create profile1 0 3 YOUR_APN 0
Wireless profile ID 2 created!
FortiWiFi-40F-3G4G # exec lte-modem wireless-profile list
ID   Type  Name               APN                  PDP_Type  Authen  Username
 1   0                        broadband            3         0
 2   0     profile1           YOUR_APN             3
```

execute lte-modem wireless-profile modify

The `execute lte-modem wireless-profile modify` command allows you to modify existing wireless profiles. The following example shows how you can use the command to modify the profile "Profile5" that was created earlier.

```
FortiWiFi-40F-3G4G # exec lte-modem wireless-profile
create    Create a wireless profile.
delete    Delete a wireless profile from the Modem.
list      List all the wireless profiles in the Modem.
modify    Modify a wireless profile.
test      Test wireless profiles.

FortiWiFi-40F-3G4G # exec lte-modem wireless-profile modify
(1-16)    Wireless profile ID.

FortiWiFi-40F-3G4G # exec lte-modem wireless-profile modify 2
<name>    Wireless profile name 1 to 16 characters.

FortiWiFi-40F-3G4G # exec lte-modem wireless-profile modify 2 profile1_modified
(0, 1)    Wireless profile type.
 0 - 3GPP
 1 - 3GPP2

FortiWiFi-40F-3G4G # exec lte-modem wireless-profile modify 2 profile1_modified 0
(0 - 4)    Wireless profile PDP type.
 0 - IPV4
 1 - PPP
 2 - IPV6
 3 - IPV4V6

FortiWiFi-40F-3G4G # exec lte-modem wireless-profile list
ID   Type  Name               APN                  PDP_Type  Authen  Username
 1   0                        broadband            3         0
 2   0     profile1           YOU_APN_2            3         0
```

execute lte-modem wireless-profile delete

The `execute lte-modem wireless-profile delete` command allows you to delete existing wireless profiles. The following example shows the deletion of the profile with "id 5" that we created earlier.

```
FortiWiFi-40F-3G4G # exec lte-modem wireless-profile delete 2
Profile with id 2 deleted!

FortiWiFi-40F-3G4G # exec lte-modem wireless-profile list
ID   Type  Name                APN                  PDP_Type  Authen  Username
 1   0                         broadband            3         0
```

Upgrade modem firmware

The following commands are used for upgrading the firmware of the internal LTE modem, which are discussed in great detail in the Firmware Upgrade Guide.

- `execute lte-modem get-modem-firmware`
- `execute lte-modem get-pri-firmware`
- `execute lte-modem start-upgrade`

Diagnostic test commands

This section introduces the diagnostic test commands for the internal LTE modem. You can use the `diag test app lted` command to access the following list of commands.

```
FortiWiFi-40F-3G4G # diagnose test app lted
1. Show device info
2. Show data session connection status
3. Test connection
4. Test disconnection
5. Get signal strength
6. Get IP address
7. Get IP address and DNS server
8. Get SIM card status
9. Show LTED status
10. Resync LTED status
11. List supported AT commands
12. Get IMEI
13. Get ICCID
14. Get firmware preference
15. Recover firmware preference
16. Set Internal USB Configuration(reboot needed)
17. List stored images
18. Get Msisdn
19. Get SIM State
20. Get RF Band Info
21. Get RF Band Capability
22. Get GPS satellite information
```

Show device information

The `diag test app lted 1` command shows information about the internal LTE modem.

```
FortiWiFi-40F-3G4G # dia test app lted 1
ati
Manufacturer: Sierra Wireless, Incorporated
Model: EM7565
Revision: SWI9X50C_01.07.02.00 6c91bc jenkins 2018/06/13 23:08:16
IMEI: 353533100752164
IMEI SV: 7
FSN: UF002271450310
+GCAP: +CGSM
```

Show data session connection status

The `diag test app lted 2` command shows the data session connection status of the internal LTE modem.

```
FortiWiFi-40F-3G4G # dia test app lted 2
Data connection status: QMI_WDS_CONNECTION_STATUS_CONNECTED
```

Connect and disconnect the modem

The `diag test app lted 3` and `diag test app lted 4` commands let you activate or deactivate the modem.

```
FortiWiFi-40F-3G4G # dia test app lted 3
Modem activation succeeded!
FortiWiFi-40F-3G4G # dia test app lted 4
Modem deactivation done.
```

If the connection activation fails, the cause of the failure will be decoded and displayed onscreen.

Show signal strength

The `diag test app lted 5` command shows the signal strength of the modem, depending on whether LTE service is available or not.

The following shows the screen output when LTE service is available.

```
FortiWiFi-40F-3G4G # dia test app lted 5
at!gstatus?
!GSTATUS:
Current Time: 82609 Temperature: 42
Reset Counter: 3 Mode: ONLINE
System mode: LTE PS state: Attached
LTE band: B2 LTE bw: 20 MHz
LTE Rx chan: 800 LTE Tx chan: 18800
LTE SSC1 state:INACTIVE LTE SSC1 band: B12
LTE SSC1 bw : Unknown LTE SSC1 chan: 5110
LTE SSC2 state:INACTIVE LTE SSC2 band: B30
LTE SSC2 bw : Unknown LTE SSC2 chan: 9820
LTE SSC3 state:NOT ASSIGNED
LTE SSC4 state:NOT ASSIGNED
EMM state: Registered Normal Service
RRC state: RRC Connected
IMS reg state: No Srv

PCC RxM RSSI: -61 PCC RxM RSRP: -96
PCC RxD RSSI: -55 PCC RxD RSRP: -86
SCC1 RxM RSSI: -72 SCC1 RxM RSRP: -94
SCC1 RxD RSSI: -66 SCC1 RxD RSRP: -86
SCC2 RxM RSSI: -87 SCC2 RxM RSRP: -110
SCC2 RxD RSSI: -86 SCC2 RxD RSRP: -113
Tx Power: -- TAC: 8b3f (35647)
RSRQ (dB): -14.1 Cell ID: 0a38ed09 (171502857)
SINR (dB): 7.8
```

The following is the screen output when LTE service is unavailable.

```
FortiGateRugged-60F-3G4G # dia test app lted 5
at!gstatus?
!GSTATUS:
Current Time: 78517 Temperature: 36
Reset Counter: 1 Mode: ONLINE
System mode: WCDMA PS state: Not attached
WCDMA band: WCDMA 850
WCDMA channel: 4385
MM (CS) state: IDLE NO IMSI
WCDMA L1 state:L1M_PCH_SLEEP LAC: de78 (56952)
RRC state: DISCONNECTED UTRAN Cell ID: 005400af (5505199)
RxM RSSI C0: -81 RxD RSSI C0: ---
RxM RSSI C1: --- RxD RSSI C1: ---
```

Show IP address of the modem

The `diag test app lted 6` commands shows the IP address of the internal modem.

```
FortiWiFi-40F-3G4G # dia test app lted 6
at+cgpaddr
+CGPADDR: 1,10.53.79.115
OK
```

The command returns no data if the modem is connected to a 3G network.

Show IP address and DNS server

The `diag test app lted 7` command shows the IP address and DNS server of the LTE modem.

```
FortiWiFi-40F-3G4G # dia test app lted 7
at+cgcontrdp
+CGCONTRDP: 1,5,broadband,10.53.79.115,,172.26.38.1,
```

Show SIM card status

The `diag test app lted 8` command returns SIM card status information.

```
FortiWiFi-40F-3G4G # dia test app lted 8
at$qcsimstat?
$QCSIMSTAT: 0,SIM INIT COMPLETED
```

Internal debugging commands

The `diag test app lted 9` and `diag test app lted 10` commands are used for internal debugging. `The diag test app lted 11` command returns all AT commands.

```
FortiGateRugged-60F-3G4G # dia test app lted 9
admin status: 1
has_usb_lte_dev: 1
monitor_enabled: 1
link/connection status: 0
Interface up/down status: 1
dump_it_cmd: 1
exit_lted: 0
dev type: 1
connect_failed: 0
rssi: 0
last modem offline time jiffies: 0
scheduled hot swap jiffies: 0
current jiffies: 7884153

FortiGateRugged-60F-3G4G # dia test app lted 10
resync status: has_usb_lte_dev:1, admin:1, monitor:1
```

Get modem ID

The `diag test app lted 12` command returns the modem ID.

```
FortiGateRugged-60F-3G4G # dia test app lted 12
ESN=0, IMEI=353533100636565, MEID=
```

Get ICCID

The `diag test app lted 13` command returns the ICCID.

```
FortiWiFi-40F-3G4G # dia test app lted 13
89014103271134616653
```

Get firmware preference

The `diag test app lted 14` command returns the firmware preference from the modem. By checking this information, you can make sure that the firmware is running the firmware of your choice.

```
FortiWiFi-40F-3G4G # dia test app lted 14
Image information from the modem:
Modem image count ==> 2
Image type ==> 0
Modem firmware version ==> 00.00.00.00
```

```
PRI firmware version ==> 000.000_000
Carrier abbr ==> AUTO-SIM
Image type ==> 1
Modem firmware version ==> 00.00.00.00
PRI firmware version ==> 000.000_000
Carrier abbr ==> AUTO-SIM
Modem name ==> EM7565
```

Recover firmware preference

The `diag test app lted 15` command enables you to restore the preferred modem firmware image.

Sometimes you need to change the modem firmware images to work with different carriers. While writing new images to the modem, it is quite possible that something unexpected could happen, causing the modem to stop working. To prevent such accidents from happening, you must always store the original firmware preference in the system before making any changes on the modem. Usually the system is able to automatically restore the original firmware information when the firmware upgrade fails, so you do not need to do anything. However, if you experience something unexpected such as loss of power, you must use this command to restore the modem to its working order after the modem comes back.

```
FortiWiFi-40F-3G4G # dia test app lted 15
No original modem image information found, no need to recover!
Modem will now reboot!
```

Set internal USB configuration

It is possible, though rare, that the USB interface composite and device ID can be changed with certain modem commands, causing the modem to malfunction. If that happens, you can use the `diag test app lted 16` command to reset the USB composite and device ID to what you expect them to be.

```
FortiWiFi-40F-3G4G # dia test app lted 16
Modem USB configuration succeeded! Please reboot the device now.
```

Your must reboot the modem after using this command. This command has become obsolete and is no longer applicable to the internal LTE modem in the latest models of the devices.

Get stored images

The `diag test app lted 17` command allows you to get the stored images in the modem.

There are two types of images in the modem: a modem image and a carrier profile. The former is like a FortiOS image while latter is similar to a configuration file.

The following output shows all the modem images and carrier profiles stored in the modem.

```
FortiWiFi-40F-3G4G # dia test app lted 17
```

```
Image list[0] of 2
Image Type ==> QMI_DMS_FIRMWARE_IMAGE_TYPE_MODEM
Max images ==> 4
Index of running image ==> 2
Sublist[0] of 3 in image list[0]
Storage_indx ==> 1
Failure_count ==> 0
Build id ==> 01.08.04.00_?
Sublist[1] of 3 in image list[0]
Storage_indx ==> 2
<Current running modem image>
Failure_count ==> 0
Build id ==> 01.07.02.00_?
Sublist[2] of 3 in image list[0]
Storage_indx ==> 3
Failure_count ==> 0
Build id ==> 01.09.04.00_?
Image list[1] of 2
Image Type ==> QMI_DMS_FIRMWARE_IMAGE_TYPE_PRI
Max images ==> 50
Index of running image ==> 0
Sublist[0] of 9 in image list[1]
Firmware_indx ==> 0
<Current loaded PRI profile>
Unique id ==> 002.008_004
Build id ==> 01.07.02.00_ATT
Sublist[1] of 9 in image list[1]
Firmware_indx ==> 1
Unique id ==> 002.015_000
Build id ==> 01.09.04.00_DOCOMO
Sublist[2] of 9 in image list[1]
Firmware_indx ==> 2
Unique id ==> 002.011_000
Build id ==> 01.08.04.00_GENERIC
Sublist[3] of 9 in image list[1]
Firmware_indx ==> 3
Unique id ==> 002.018_000
Build id ==> 01.09.04.00_KDDI
```

The images and profiles are grouped and stored in two separate lists:

Modem image

The screenshot above shows two modem images in the list. They are identified with different Build IDs: one is 01.07.02.00 and the other is 01.08.04.00.

PRI profile

A PRI profile contains carrier-specific setup information. The name of a PRI profile is made up of a build ID and the abbreviation of a carrier's name. For instance, 01.07.02.00_ATT means the profile only works with a 1.7.2.0 modem image for AT&T. When the modem boots up, it loads the modem image 01.07.02.00 and the modem is under an AT&T carrier-specific setup. It is mandatory that you use a carrier-specific setup if we know the SIM is from a certain carrier and there is a modem image and carrier profile combination already stored in the modem.

A unique ID identifies the carrier. Each carrier is identified with a unique ID. The carrier abbreviation in a build ID is just for easy identification. If a carrier-specific image and PRI profile cannot be found, the generic firmware can be used

instead. Keep in mind that sometimes a SIM card may not work properly without carrier-specific firmware. In extreme cases involving Verizon SIM cards, both the modem and the SIM card can get locked if they are kept online for an extended period of time without using the Verizon firmware.

There can be different versions of carrier profiles for a certain modem image. For instance, the modem image 1.8.4.0 for Verizon has two versions of profiles: 002.015_000 and 002.015_001. If you have more than one profile for a modem image, you must always use the one with the latest unique ID. There can be only one carrier profile for a single carrier. For example, suppose you have the modem image 1.7.2.0 and the carrier profile 1.7.2.0 generic and later upgrade to the 1.8.4.0 generic firmware, the modem images 1.7.2.0 and 1.8.4.0 will both appear in the list, but the 1.7.2.0 generic profile will disappear and be replaced with the 1.8.4.0 generic profile.

Get MSISDN

MSISDN is short for Mobile Station International Subscriber Directory Number. The `diag test app lted 18` command allows you to retrieve the MSISDN which is used to identify a mobile phone number worldwide.

```
FortiWiFi-40F-3G4G # dia test app lted 18
16692240893
```

Check SIM card state

The "`dia test app lted 19`" command is an alternative command to "`diagnose sys lte-modem sim-info`", but only displays SIM card state.

```
FortiWiFi-40F-3G4G # dia test app lted 19
UIM State ==> QMI_UIM_CARD_STATE_PRESENT
```

Check RF band information

The `diag test app lted 20` command shows the information of the RF band the modem is using.

```
FortiWiFi-40F-3G4G # dia test app lted 20
RF Band[0] Radio Inerface ==> QMI_NAS_RADIO_INTERFACE_LTE
RF Band[0] Active Band Class ==> QMI_NAS_ACTIVE_BAND_EUTRAN_2
RF Band[0] Active Channel ==> 800
```

Get RF band capacity

The `diag test app lted 21` command lists all the RF bands which the modem can use.

```
Band Capability[0] ==> QMI_DMS_BAND_CAPABILITY_WCDMA_2100
Band Capability[1] ==> QMI_DMS_BAND_CAPABILITY_WCDMA_PCS_1900
Band Capability[2] ==> QMI_DMS_BAND_CAPABILITY_WCDMA_1700_US
Band Capability[3] ==> QMI_DMS_BAND_CAPABILITY_WCDMA_850_US
Band Capability[4] ==> QMI_DMS_BAND_CAPABILITY_WCDMA_800
```

```
Band Capability[5] ==> QMI_DMS_BAND_CAPABILITY_WCDMA_900
Band Capability[6] ==> QMI_DMS_BAND_CAPABILITY_WCDMA_1700_JAPAN
Band Capability[7] ==> QMI_DMS_BAND_CAPABILITY_WCDMA_850_JAPAN
LTE Band Capability[0] ==> QMI_DMS_LTE_BAND_CAPABILITY_EUTRAN_1
LTE Band Capability[1] ==> QMI_DMS_LTE_BAND_CAPABILITY_EUTRAN_2
LTE Band Capability[2] ==> QMI_DMS_LTE_BAND_CAPABILITY_EUTRAN_3
LTE Band Capability[3] ==> QMI_DMS_LTE_BAND_CAPABILITY_EUTRAN_4
LTE Band Capability[4] ==> QMI_DMS_LTE_BAND_CAPABILITY_EUTRAN_5
```

Get GPS satellite information

The `diag test app lted 22` command returns GPS satellite information.

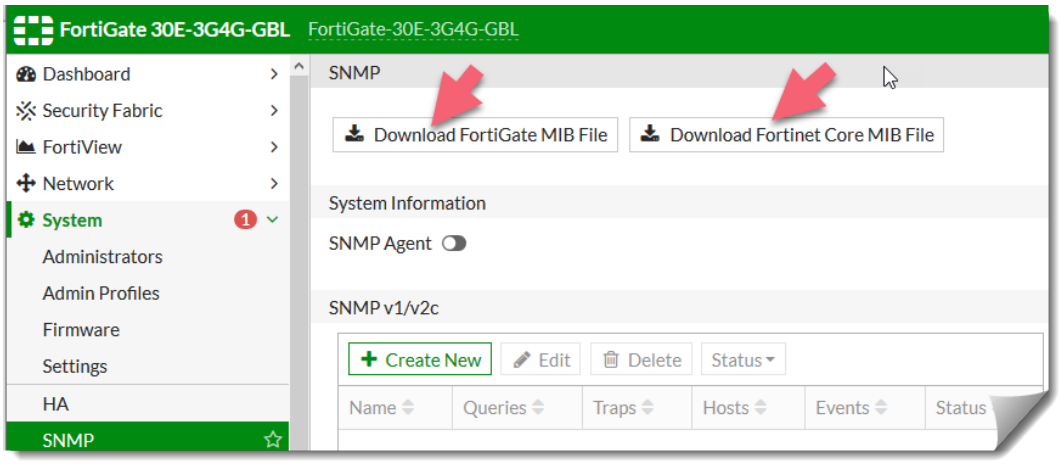
MIBs

All information invoked by the various `diagnose sys lte-modem` commands are available as read-only MIB entries. This section discusses how to access and read the MIB information abput the internal LTE modem.

Download MIB files

FortiGate has two MIB files: FortiGate MIB file and Fortinet Core MIB file. It requires to use the common Fortinet Core MIB (FORTINET-CORE-MIB.mib) for SNMP monitoring.

The following procedures show how to download the MIB files from the FortiGate GUI.

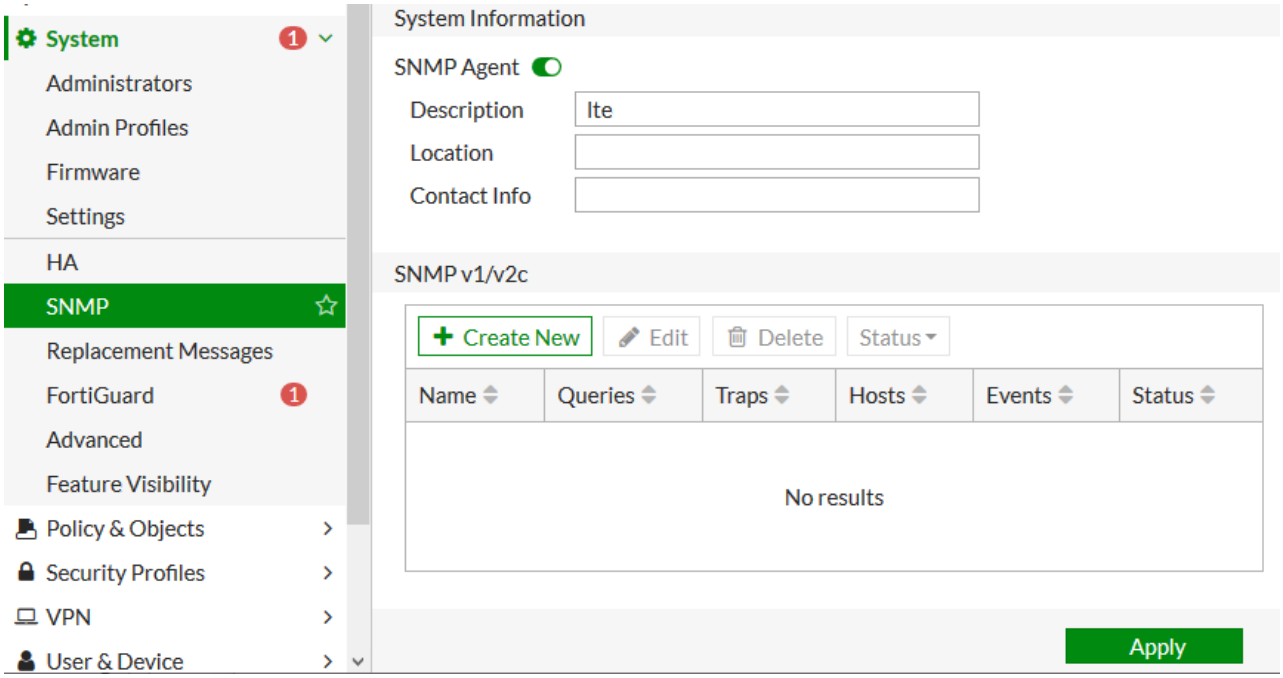
1. From the menu, select **Systems >SNMP**.
2. On the SNMP page, click the download buttons to download the MIB files, as highlighted below.
3. 

Enable SNMP support

The following procedures show how to configure FortiGate 30E-GLB for SNMP support.

1. On the SNMP page (see above), enable **SNMP Agent** to make the FortiGate an SNMP agent.
2. Enter a brief description.

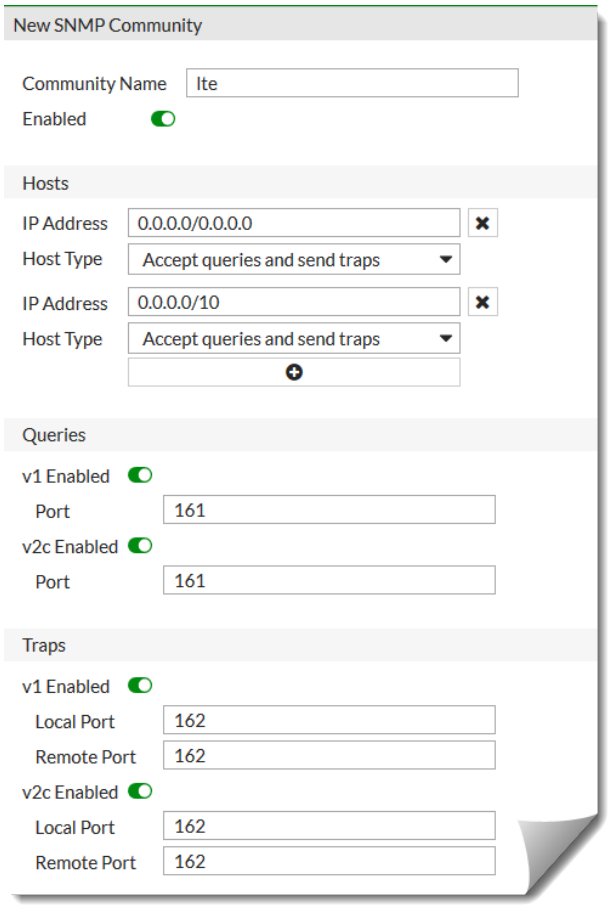
3. Click **Apply**, as illustrated below.

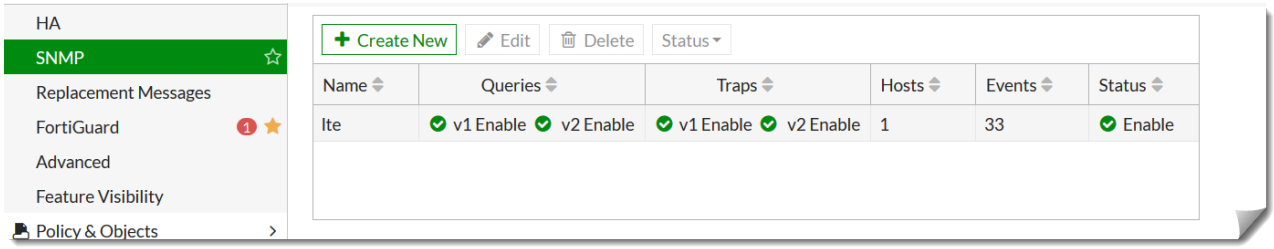


Create SNMP community

1. On the SNMP page, under the SNMPv1/v2c section, click **Create New**.
   The New SNMP Community configuration dialog opens.
2. Specify the Community Name, e.g., lte.
3. Specify the address of the SNMP hosts, and set Host Type to **Accept queries and send traps**.
4. Make the other desired selections.
5. Click **OK.**
   The following illustrations show the configuration of an SNMP community named "lte".

6.



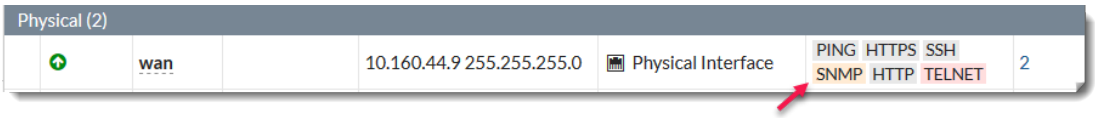


Allow SNMP access

Assume that you use the WAN interface to access MIB information, you must ensure that SNMP is enabled on that interface.

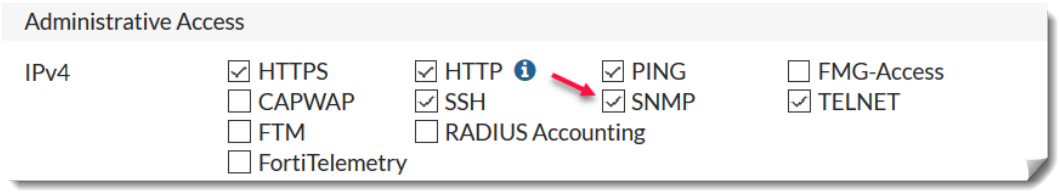
To verify if SNMP is enabled on the WAN interface of the FortiGate device:

1. Click **Network>Interfaces.**
2. Under Physical (2), in the Access column, make sure SNMP is there, as illustrated in the following image.



If for some reason SNMP is not enabled on the wan interface, you can enable it using the following procedures.

1. Double-click the wan interface (refer to the image above) to open its configuration page.
2. Under the Administrative Access, select SNMP, as illustrated below.
3. Click **OK.**

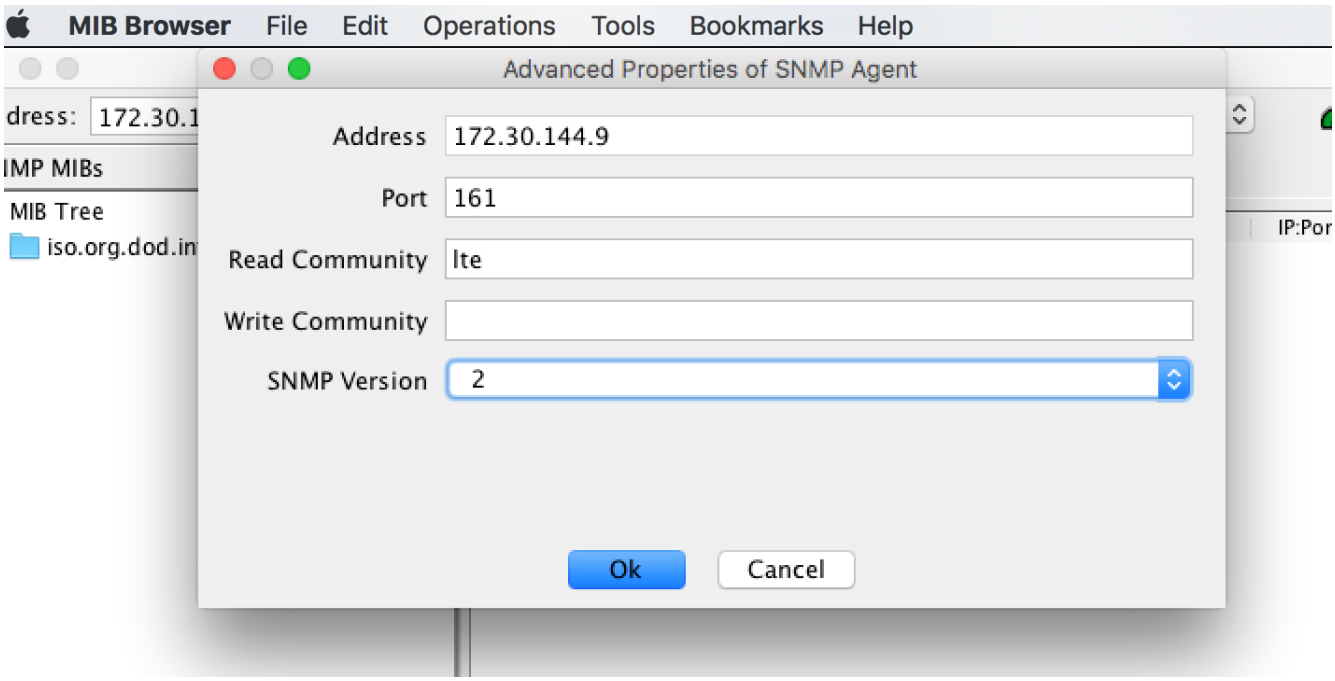


Configure a MIB browser

You need a MIB browser to pull data from SNMP agents such as routers, switches, and servers (FortiGate in this case). In addition, a MIB browser also enables you to retrieve and display MIB data in a human-readable form.

The following example shows the configuration and use of the iReasoning MIB browser.

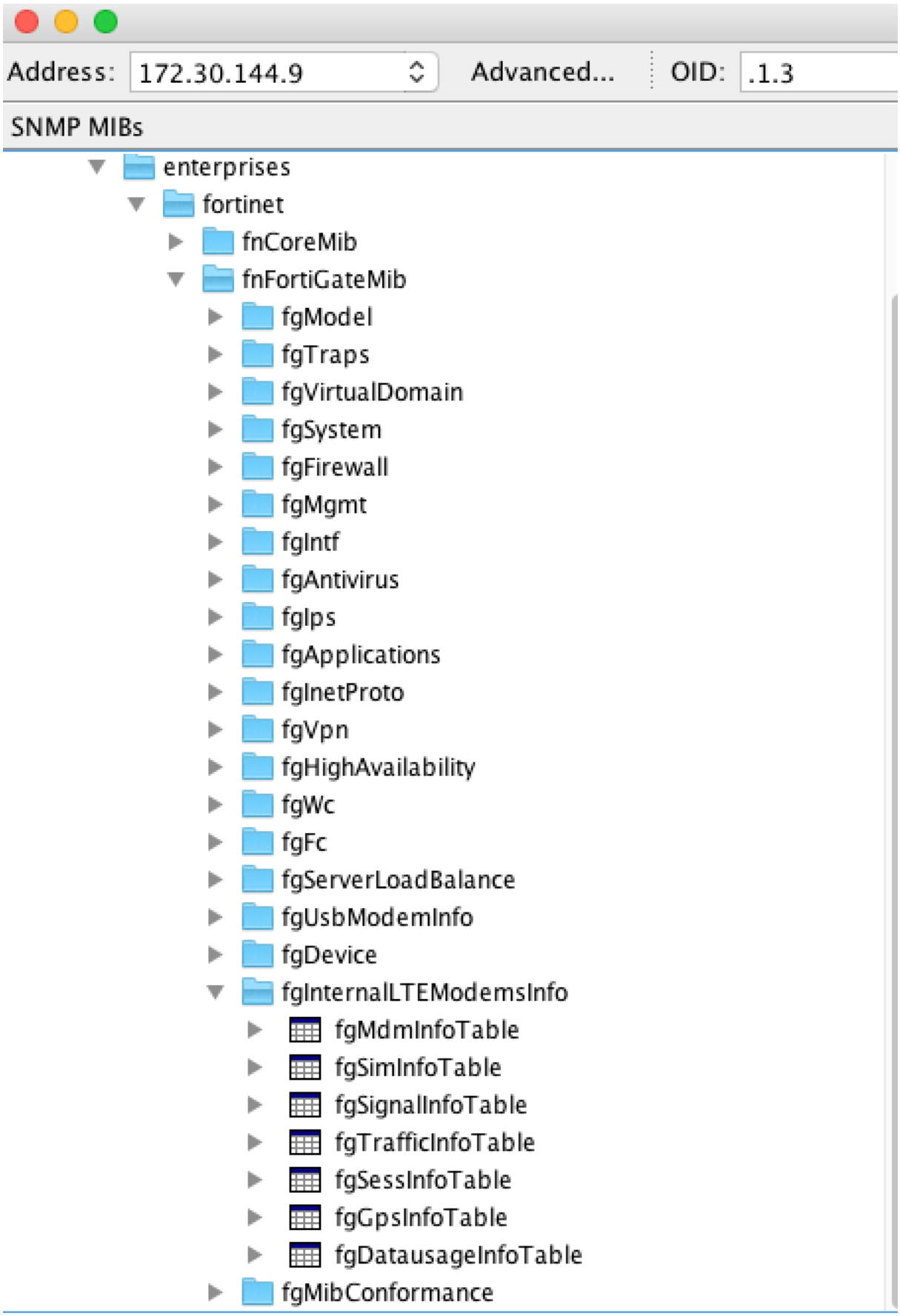
Make sure that the information you enter in the MIB browser matches that on the SNMP agent (FortiGate). Fro more information, see Configure a MIB browser on page 52.



Parameter	Description
Address	The address of the SNMP agent (i.e., the FortiGate device).
Port	The port used for SNMP queries on the SNMP agent.
Read Community	The name of the SNMP Read community.
Write Community	The name of the SNMP Write community. **Note:** Leave this field blank because it is not supported on FortiGate.
SNMP Version	The SNMP version used by the SNMP agent.

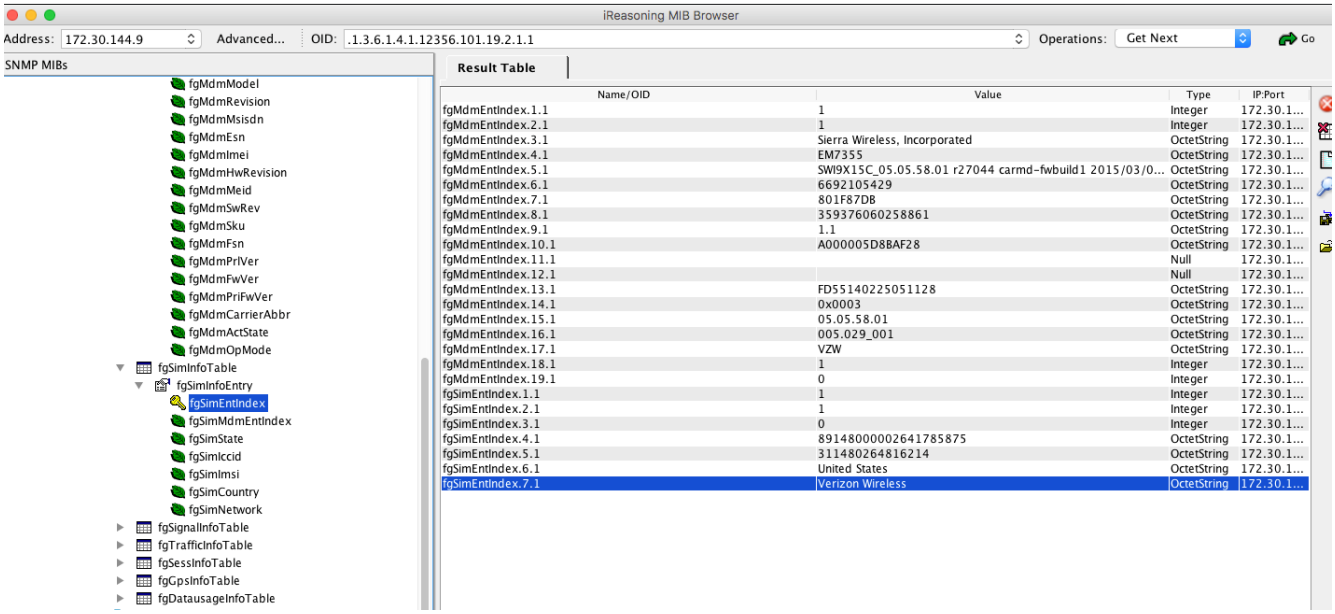
Browse for internal LTE modem MIB entries

The following image shows the path used to browse for MIB information about the internal LTE modem in the FortiGate.


Address: 172.30.144.9
Advanced...
OID: .1.3
SNMP MIBs
enterprises
fortinet
fnCoreMib
fnFortiGateMib
fgModel
fgTraps
fgVirtualDomain
fgSystem
fgFirewall
fgMgmt
fgIntf
fgAntivirus
fgIps
fgApplications
fgInetProto
fgVpn
fgHighAvailability
fgWc
fgFc
fgServerLoadBalance
fgUsbModemInfo
fgDevice
fgInternalLTEModemsInfo
fgMdmInfoTable
fgSimInfoTable
fgSignalInfoTable
fgTrafficInfoTable
fgSessInfoTable
fgGpsInfoTable
fgDatausageInfoTable
fgMibConformance

Drill down to MIB entries

The following image shows the information you'll see when drilling down to a MIB entry.



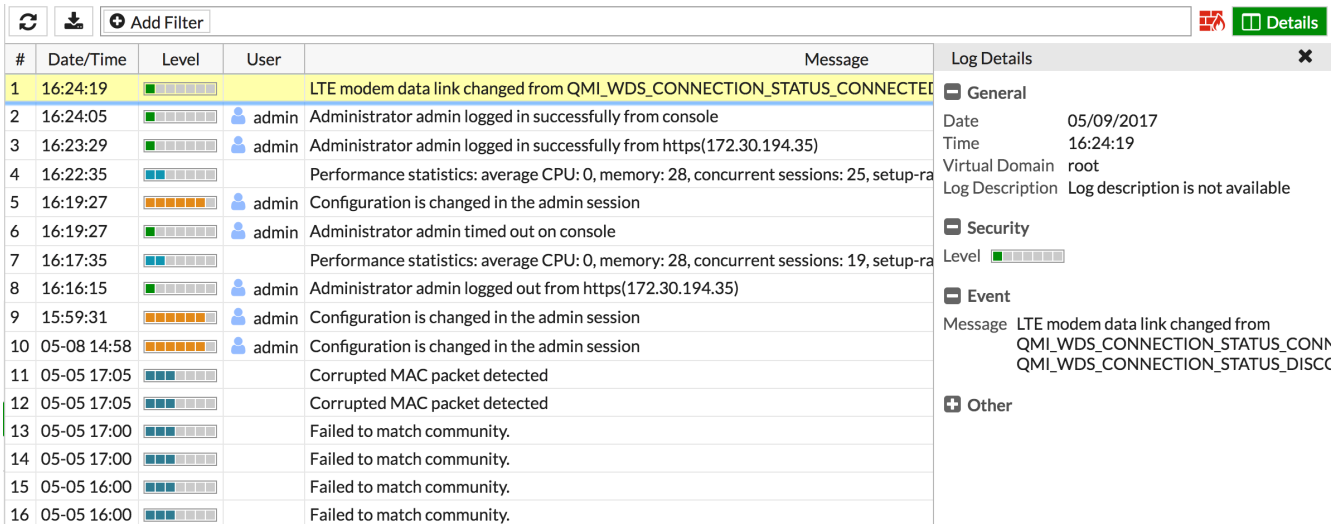
Syslog

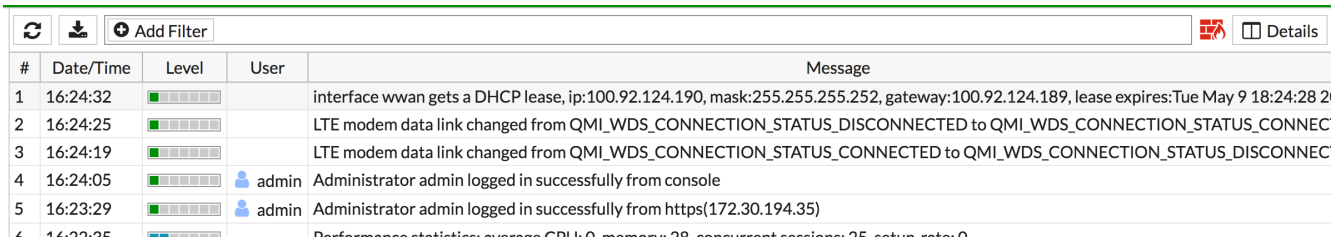
The FortiGate 30E 3G4G device does not come with a log disk. By default, only events with severity level of Warning and higher are logged. To show a quick log sample, you can temporarily lower the memory log severity to Info so that all modem events will be logged. We recommend use the default severity level of Warning for memory log, Otherwise, it will soon use up all system memory.

The following are the logged modem events:

- Modem detection
- GPS daemon up/down
- GPS location acquired/lost
- Data tracking daemon up/down
- Data tracking data purged
- Daily data usage record added
- Modem firmware upgrade
- Modem QDL device detection
- Modem reboot
- Modem operation mode changed
- Modem power on/off
- Modem SIM card state changed
- Modem data link connected/disconnected
- Modem manual handover happened
- Modem IP address changed
- Modem Bearer technology changed

The syslog is only available for the internal LTE modem. Following is an example of syslog for the internal LTE modem.





LTE modem daemon debugging

You can use the `diagnose debug application lted <level>` command to enable or disable LTE modem daemon debugging. We recommend at least using baud rate 115200 on the console port or, if possible, Telnet or SSH because there might be a flood of debug outputs depending on the debug level.

Level 0 disables debugging, Level 1 prints out warning messages, and Levels 2, 4, 8, and 16 print out low volume debugging messages. In most cases, setting the level to 31 to output all the low volume and warning messages is sufficient. Levels 32 and 128 are used to dump QMI-related messages. We recommend using a Tenet client to capture debug messages. Level 64 is for QDL message dumping. which is discussed in the modem firmware Upgrade Guide.

Data usage tracking

You can use the `diagnose debug application qbilld <level>` command to debug the billing daemon. Because this is a low volume debug option, you can always set the level to -1.

Wireless module debugging

This operation requires the debug version of FortiOS image.

You can debug the wireless module if you have the debug version of the FortiOS image installed on your FortiGate.

There's a utility `/bin/swi-dm` and a few DM port filters under `/etc/swi-dm`.

Before starting to capture the DM log, do the following:

1. Use the `/bin/swi-dm /etc/swi-dm/<filter-name> /dev/ttyusb0` command to enable output on the DM port.
2. Use the `cat /dev/ttyusb0 > /tmp/<DM log file>` command to redirect the output to a file.
3. When finished, use Ctrl+C to end debugging and transfer the DM log file to a computer.

When you believe that a problem might be modem-related, you should capture the DM log and send to the vendor, which is Sierra Wireless in this case. for diagnostics.

Connection troubleshooting

This section discusses the known issues and connectivity troubleshooting tips.

Known issues

"QMI_UIM_CARD_STATE_ERROR"

You may encounter this error when issuing the "`diagnose sys sim-info`" command on 30E-GBL devices. This is because the SIM card slot in the device has a design defect, which sometimes could cause the SIM card to be loosely connected. The modem is unable to read from the card due to the loose contact.

Workaround: Usually you can solve the problem by using a good-quality SIM card adapter, but you may file an RMA request if the problem persists.

No location information for 30E-GBL

Even though FortiOS supports GPS function of the modem, the 30E-GBL units do not have GPS antenna equipped. Therefore, it cannot receive GPS information even with the GPS daemon enabled.

“execute sys lte-modem” commands fail to work

This issue occurs when the following message is displayed:

```
Failed to set status to disable because 'wwan' interface is used by other objects.
Please do it in 2 steps: first remove the dependency and commit;
then set status to disable.
attribute set operator error, -651, discard the setting
Command fail. Return code -651
```

```
101: 2019-12-31 16:57:39 Interface wwan has a transmit timeout.
```

This is usually caused by an unfinished configuration left in the system. It happens when FortiOS is in the mid of setting an LTE configuration but gets interrupted. This leaves a lock to the interface in the daemon. As s result, any future operation to the interface would be denied.

Workaround: Reboot the unit.

Unable to establish LTE connection after upgrading to FOS 6.2.5

A backward compatibility issue was discovered in FOS 6.2.4 when the latest FortiGate LTE variant models such as 40F-3G4G were introduced. It could render all older 30E LTE models unable to connect. This issue has been patched in 6.2.5 but we highly recommenced that you stay at FOS 6.2.3 until the FOS 6.2.6 release, which is much more stable.

“diagnose lte-modem sim-info” shows erroneous information

This issue exists in FOS 6.2.4, 6.2.5, 6.4.2 on LTE models with dual SIM slot (40F, 60F, 80F and etc) only.

When issuing the "`diagnose lte-modem sim-info`" command, you may see SIM card information flipping between slot 1 and 2 back and forth, with no LTE connection despite that fact that valid SIM cards are inserted. It started with the default connectivity-based hot swap feature which enables FOS to switch to use the other slot if the current slot (even with a SIM card inserted) is unable to connect for a certain period of time. However, for some carriers, it would take longer to connect than the current waiting period, causing FOS to force-switch to the other slot before the modem has a chance to establish a connection. This issue will be patched in 6.2.6. The current workaround is to manually disable connectivity-based hot swap using the following command:

```
config system lte-modem
   set connection-auto-switch disable
end
```

This ensures that FOS will do hot swapping only based on SIM card presence. You could then insert the SIM card into the slot that FOS is currently monitoring. Or you could use the “`set sim-slot`” command to set the SIM slot for FOS to use.

- The "`connection-auto-switch`” option will be hidden if the “`sim-auto-switch`” option is not ENABLED.
- The “`sim-slot`” option will be hidden if the “`sim-auto-switch`” option is not DISABLED.

“diagnose lte-modem sim-info” shows mixed SIM card info

The “`diagnose lte-modem sim-info`” command sometimes may return mixed SIM card info with some fields belonging to SIM card1 and others related to SIM card2. This is because it takes some time to get SIM card information updated in FOS and the display is lagging behind. It may take a few seconds to for the system to display the correct information after the SIM cards are inserted.

Carrier-provided SIM cards unable to establish LTE connection

Some customers may find their units unable to establish an LTE connection with Fortinet-supported SIM cards from their carrier. This is because currently FGT-3G4G units are preloaded with LTE modem firmware for the following carrier (this information can be obtained using “`diagnose test app lted 17`”):

- ATT
- DOCOMO
- VERIZON
- SOFTBANK

- SIERRA
- SPRINT
- TELUS
- GENERIC

If you are using any of the following carriers, you may need to download their LTE modem firmware and load it onto the internal LTE modem by follow the firmware upgrade guide:

- KDDI
- ROGERS
- TELSTRA

For other carriers, the GENERIC firmware should be good enough and the modem should switch to it automatically.

To check whether the LTE modem recognizes the SIM card:

1. Disable “connection-hot-swap”
2. Insert the card to the current active sim slot.
3. Use “diganose sys lte-modem sim-info” to confirm the card presence.
4. Use “diagnose test app lted 5” to display signal info.
   Note: If the modem stays in WCDMA mode, then the card may not be recognized, and a specific firmware needs to be loaded.

LTE data connectivity and connection stability

LTE data connection stability has the following composition for FortiGate 30E-GBL and other FortiGate LTE variants:

- Sim card validity
- Device registration
- LTE modem signal reception
- LTE modem hardware integrity
- LTE modem firmware carrier match
- Wireless profile, Apn configuration
- FortiOS software integrity
- Fortigate hardware integrity

Quite a few field tickets related to the so-called connection stability issue turn out to be configuration issues rather than FortiOS software/hardware integrity issue.

SIM card validity

Be sure to verify SIM card validity with a computer before using it on FortiGate. You must also make sure the inserted SIM card has good contact with the SIM card slot and no `QMI_UIM_CARD_STATE_ERROR` message occurs with the `diagnose sys lte-modem sim-info` command.

Device registration

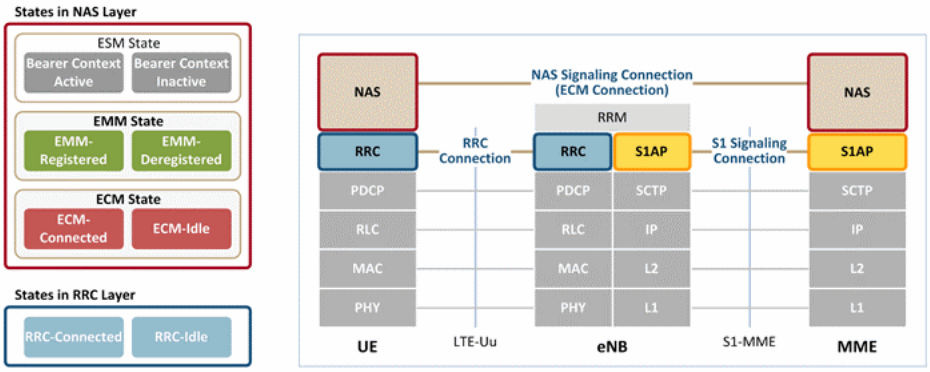
For certain carriers like Verizon, the FortiGate device serial number needs to be registered with the network provider to be recognized. Make sure that your device is registered with the carrier.

LTE network registration

The most straightforward way to check LTE network connection status is to view some of the LTE connection protocol status of the modem. The following snapshot of "`diagnose test application lted 5`" is taken from a connected unit:

```
EMM state: Registered Normal Service
RRC state: RRC Connected
IMS reg state: No Srv
```

These parameters show the current modem registration status with the LTE network. The following figure illustrates EMM, ECM and RRC states associated with the UE and MME. EMM can be in either "EMM-Registered" or "EMM-Deregistered" state depending on whether the UE is attached to, or de-tached from, the network. ECM can have either "ECM-Connected" or "ECM-Idle" depending on whether a NAS signaling connection (i.e., ECM connection) is established or not. Likewise, RRC can be in either "RRC-Connected" or "RRC-Idle" depending on whether an RRC connection is established or not. The following diagram shows the conditions in which a UE stays in a particular state. IMS state is for voice-over-IP service which may not be of interest to us.



The following table describes the meaning of each parameter.

Layer	State	Entity	Description
EMM	EMM-registered	UE, MME	UE has been attached to the LTE network and an IP has been assigned to the UE. An EPS bearer has been established. MME knows the current location of the UE with the accuracy of a cell.
	EEM-deregistered		UE is not attached to any LTE network. MME does know the current location of the UE, but may have the tracking area information last reported by the UE.
RRC	RRC-idle	UE, eNB	No RRC connection is established yet. UE is not connected with the tower.
	RRC-connected		RRC connection has been established.

If a valid SIM card is inserted but the RRC status is not RRC-Connected and there is no connection, it means that the UE has not even established a connection with tower. You may want check the antennas connection to ensure that they are properly connected.

If RRC and EMM status look OK and the device has an IP assigned but is unable to ping out, it may indicate that the SIM card may have already run out of data.

LTE modem signal reception

Make sure that the device is placed at location with good LTE signal reception. Refer to diagnose sys lte-modem signal-info on page 31 for methods to display signal strength and evaluation.

LTE hardware integrity

Check LTE hardware integrity such as antenna installment and LTE module USB connection with the board. If signal reception is poor despite the unit being placed at a premium location, try replacing the antenna.

LTE modem firmware carrier match

The modem firmware must match the carrier of the inserted SIM card. Use the test command mentioned in previous chapters to ensure the two match. If necessary, update the LTE modem firmware.

Wireless profile, APN configuration

This step is very critical as most of connection issues are actually caused by inappropriate wireless profile settings. Be sure to follow wireless profile configuration and APN setting section to avoid any mistakes.

FortiGate hardware integrity

Make sure there is no hardware defect on the FortiGate device.

FortiOS software integrity

Double-check that there is no abnormal behavior in FortiOS and no anomaly in the system log or in diagnostic information.

Enable Verizon 3G/4G service

This section is for customers who choose Verizon for their LTE network service provider. It covers the following topics:

Activate Verizon SIM card

1. Obtain a properly provisioned SIM card from Verizon or a Verizon-reseller.
   Note: SIM card provisioning is done in the same way as USB modem SIM provisioning. The standard plan is "Mobile Broadband". SIM cards come in different sizes. Make sure that you are using a Micro SIM card.
2. On the bottom of the Fortinet device (production units only), locate the IMEI number of the modem.
3. Open the SIM card slot cover, and insert your SIM card into the SIM card slot in the modem.
   Note: You should feel a tactile click for proper fit.
4. Screw on the two included antennas with your fingers.
5. Power on the FortiGate device.
6. On the FortiGate GUI, confirm that the modem is receiving good signal (2+ bars).
7. Confirm that the 3G LED is solid green on the FortiGate (indicating successful activation and router-network connection).

Router pricing plans for B2B customers and M2M small data limits and pooled plans are also available for this product through Verizon only. Contact your Verizon business representative for more information.

Activate Verizon static IP SIM card

The instructions below apply to customers who use Verizon SIM cards with a static IP.

To ensure proper activation of your LTE static IP SIM card with the Verizon network, you must follow these steps the first time you use the product:

1. Confirm with your Verizon representative that your account and SIM card have been properly provisioned with a static IP address on the Verizon network.
   Note: SIM provisioning is done the same way as USB modem SIM provisioning.
2. Open the SIM card slot cover, and insert your SIM card into the slot in the modem.
   Note: You should feel a tactile click for proper fit.
3. Screw on the two included antennas with your fingers.
4. Power on the FortiGate device.
5. On the FortiGate GUI, confirm that the modem is receiving good signal (2+ bars).

6. Wait for up to 60 minutes for the activation process to complete.
   Note: DO NOT POWER OFF THE ROUTER OR UNPLUG THE AER MODEM.
7. Wait until the Internal 3G/4G LED has turned solid green on the FortiGate, indicating completion of modem activation..

Change log

Date	Change description
June 6, 2023	Added "Regional compatibility" in FortiGate/FortiWiFi variant LTE feature matrix on page 7.
March 31, 2022	Initial release.

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