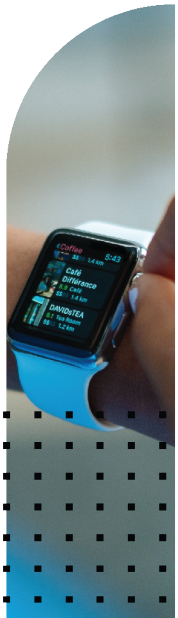
Admin Guide

FortiExtender (Standalone) 7.0.3



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FortiExtender (Standalone) 7.0.3 Admin Guide

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Introduction

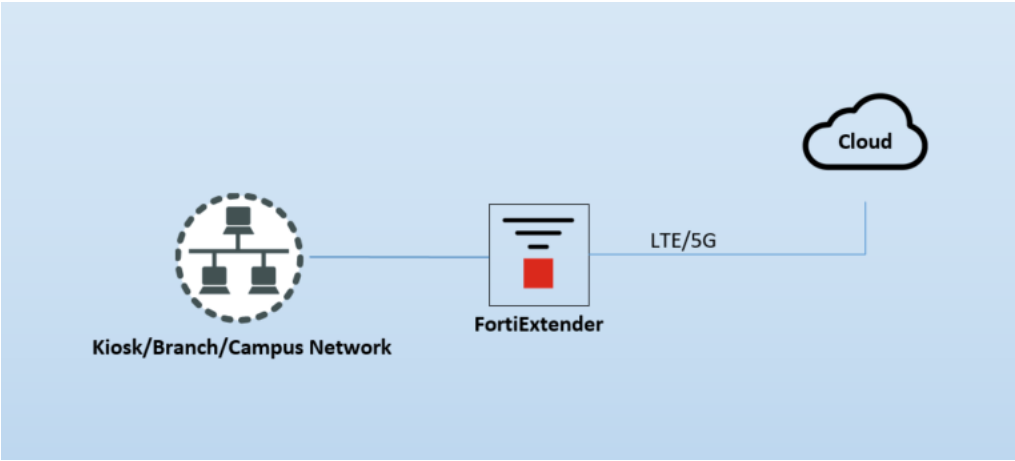
FortiExtender is a plug-and-play customer premises equipment (CPE) device. As a 3G/4G LTE and 5G wireless WAN extender, FortiExtender can provide a primary WAN link for retail POS, ATM, and kiosk systems, or a failover WAN link to your primary Internet connection to ensure business continuity. You can deploy it both indoors and outdoors by choosing the right model and appropriate enclosures.

FortiExtender can be deployed in standalone mode as a wireless router, managed individually or centrally from FortiExtender Cloud, or managed by FortiGate as part of the integrated Fortinet Fabric Solutions.

This *Guide* is for standalone locally managed FortiExtender only. For information about FortiExtender managed by FortiGate or by FortiExtender Cloud, refer to their respective Admin Guides.

Getting started

FortiExtender works as a standalone device when it is not managed by FortiGate or FortiExtender Cloud. A standalone FortiExtender can work in either IP pass-through or NAT mode. You can configure a standalone FortiExtender device from its CLI (Console/SSH) or GUI.



Check current manage mode

You can configure and manage FortiExtender from FortiGate or FortiExtender Cloud. If you are not sure "who" is your FortiExtender's controller, use the following command to find out:

```
FX511F5921000053 # get extender status
Extender Status
    name                  : FX511F5921000053
    mode                  : CLOUD
    fext-addr             : 192.168.237.1
    fext-wan-addr         : 25.75.193.57
    controller-addr       : fortiextender-dispatch.forticloud.com:443
    deployed              : true
    account-id            : 343849
    uptime                : 5 days, 17 hours, 2 minutes, 45 seconds
    management-state      : CWWS_RUN
    base-mac              : E8:ED:D6:03:D2:58
    network-mode          : ip-passthrough
    fgt-backup-mode       : backup
    discovery-type        : cloud
    discovery-interval    : 5
    echo-interval         : 30
    report-interval       : 30
    statistics-interval   : 120
    mdm-fw-server         : fortiextender-firmware.forticloud.com
    os-fw-server          : fortiextender-firmware.forticloud.com
```

Main LTE/5G features

FortiExtender (Standalone) offers the following main LTE/5G features:

- Supported hardware models on page 8
- Cellular capabilities on page 9
- Supported wireless carriers on page 9
- SIM mapping on page 10
- Add a data plan and APN on page 11
- Global SIM with roaming on on page 11
- SIM-switch on page 11
- Get modem status on page 13
- Stopping data traffic on overaged LTE interface on page 14
- OBM management on page 14

To access your FortiExtender device through its console port, you must set the baud rate to 115200.

Supported hardware models

The table below highlights the two FortiExtender hardware models that FortiExtender OS 7.0.0 supports.

Model	Market
FEX-201E	Americas and Europe
FEX-211E	Global coverage
FEX-200F	Global
FEX-511F	Global coverage

FortiExtender unit comes with a Bluetooth button, which is off by default. Bluetooth discovery will be active for 90 seconds after you press the Bluetooth button for more than three seconds. Once connected, as an example, from the FortiExplorer app, you can access the devices via Bluetooth. As a good security practice, we strongly recommend setting your own passwords before deploying FortiExtender in your environment.

Cellular capabilities

FortiExtender 201E uses the CAT6 EM7455 built-in modem to cover countries in Americas and Europe using the following frequencies:

- **LTE/4G Bands**: 1, 2, 3, 4, 5 ,7,12, 13, 20, 25, 26, 29, 30, and 41
- **3G UMTS Bands**: 1, 2, 3, 4, 5, and 8

FortiExtender 211E uses the CAT12 EM7565 built-in modem to cover countries in Americas and Europe using the following frequencies:

- **LTE/4G Bands:** 1, 2, 3, 4, 5, 7, 8, 9, 12, 13, 18, 19, 20, 26, 28, 29, 30, 32, 41, 42, 43, 46, 48, and 66
- **3G UMTS Bands:** 1, 2, 3, 4, 5, 6, 8, 9, and 19

FortiExtender 511F supports 5G using the following frequencies:

- **5G NR:** n1, n3, n5, n7, n8, n20, n28, n38, n40, n41, n77, n78, and n79,
- **LTE-FDD Bands:** 1, 3, 5, 7, 8, 18, 19, 20, 26, 28, and 32
- **LTE-TDD Bands:** 34, 38, 39, 40, 41, 42, and 43
- **WCDMA Bands:** 1, 3, 5, 6, 8, and 19

Supported wireless carriers

By default, FortiExtender (Standalone) supports all major wireless carriers in Europe and North America, including the following:

Region	Carrier
Europe	• A1MobilKom • Bouygues • O2 • Orange • SFR • Swisscom • T-Mobile • Vodafone
North America	• AT&T • Bell • Rogers • Sasktel • Sprint • Telus • T-Mobile • Verizon

If necessary, you can use the following commands to add a new carrier to the list of supported wireless carriers:

```
config lte carrier
edit free
   set firmware SWI9X30C_02.32.11.00.cwe
   set pri SWI9X30C_02.32.11.00_GENERIC_002.064_000.nvu
next
```

FortiExtender (Standalone) also supports other wireless carriers in other parts of the world, depending on the technology and bands used, sometimes requiring specific configuration such as APN, but mostly using the generic modem firmware (see below). Operation of FortiExtender (Standalone) with any unlisted service provider in any country 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 VARs (Value Added Resellers and Distributors) must confirm compatibility prior to placing a customer order.

SIM mapping

A Public Land Mobile Network (PLMN) is a combination of wireless communication services offered by a specific operator in a specific country. A PLMN is identified by a globally unique PLMN code, which consists of a Mobile Country Code (MCC) and a Mobile Network Code (MNC).

FortiExtender (Standalone) uses a PLMN list to identify the carrier of the SIM cards you are using.

You can also use the following commands to add customized entries to the PLMN list to support the SIMs of unlisted carriers, or create a new PLMN list of any listed carrier:

```
FX201E5919000035 # config lte simmap
FX201E5919000035 (simmap) # show
config lte simmap
end
FX201E5919000035 (simmap) # edit 1
FX201E5919000035 (1) <M> # set mcc 332
FX201E5919000035 (1) <M> # set mnc 321
FX201E5919000035 (1) <M> # set carrier <carrier name>
FX201E5919000035 (1) <M> # next
```

FortiExtender (Standalone) automatically switches its modem firmware based on the carrier and technology you are using. If the carrier can't be identified or is unlisted, the generic firmware is used. The generic firmware works with most carriers.

To help FortiExtender (Standalone) recognize the correct carrier name, you can add the MCC and MNC to the configuration file, but this isn't required normally.

Add a data plan and APN

You may need an Access Point Name (APN) to establish a Packet Data Network (PDN) connection with a wireless carrier. An APN may be required for a cellular data plan configuration. In most cases, your SIM card comes with the carrier's APN, which is retrieved automatically at first connection from FortiExtender. If it doesn't or you are not sure what it is, you must find it out from your carrier and add it when creating a data plan.

Use the following commands to create a data plan:

```
config lte plan
edit <plan name>
set modem all
    set type by-default
    set apn <carrier apn>
next
end
```

A PDN sometimes may not be established without a valid APN. Always be aware of the APN of the SIM card that you are using. If you are not sure, contact your network service provider (NSP) for assistance.

Global SIM with roaming on

FortiExtender (Standalone) must always run on the modem firmware compatible with the native wireless operator’s SIM. Most of the providers in the world can work with the "generic" modem firmware included with the FortiExtender (standalone) image. However, this does not apply to roaming operators because roaming agreements require that roaming service providers consider all data service requests. For this reason, there is no need to adjust the configuration for roaming.

SIM-switch

SIM-switching can be configured by data plan, disconnect settings, signal strength, coupled with switch back by time or by timer. All these options are under the “Auto switch” setting.

FortiExtender (Standalone) comes with two SIM-card slots per modem, with the first one (i.e., sim1) being the default. SIM-switch works only when you have two SIM cards installed on a FortiExtender (Standalone) device with the feature enabled on it. SIM-switch is disabled by default, you can enable it using the following commands:

```
config auto-switch
   set by-disconnect disable
   set by-signal disable
   set by-data-plan disable
   set switch-back
end
```

With SIM-switch enabled, FortiExtender (Standalone) automatically switches to sim2 to maintain the current LTE connection when any of the following situations occurs:

- An Internet session gets disconnected. By default, FortiExtender (Standalone) automatically switches to sim2 if sim1 gets disconnected for three times within 600 seconds. You can change the values using the following commands:
```
config lte setting modem1
   config auto-switch
      set by-disconnect enable /*enable the switch by disconnect feature*/
      set disconnect-threshold <3> /*Number of disconnects for sim-switch*/
      set disconnect-period <600> /*Disconnect evaluation period for simswitch*/
   end
end
```
- Data usage has exceeded the set limit of your data plan and overage is disabled. By default, overage is disabled. SIM-switch does not occur if overage is enabled. You can use the following commands to set the capacity of your data plan and enable or disable overage:
```
config lte setting modem1
   config auto-switch
         set by-signal enable /*enable the switch by signal feature*/
         set by-data-plan enable /*enable the switch by data usage feature*/
   end
end
config lte plan
   edit <plan>
      set capacity <data plan in MB>
      set billing-date <billing date>
      set overage {enable | disable}
      set signal-threshold <-100> /*RSSI to be evaluated*/
      set signal-period <600> /*Signal evaluation time in seconds*/
next
```
- The relative signal (RSSI value) stays lower than the specified value for a major part of the time period defined. By default, the RSSI value is -100, and the time period is 600 seconds. This means that SIM-switch occurs if the RSSI value stays below -100 for more than 300 seconds.

RSSI Values and LED State

RSSI	LED-1	LED-2	LED-3	LED-4
0, or N/A, or 'rssi<=-100'	OFF	OFF	OFF	OFF
-90~-81	ON	OFF	OFF	OFF
-80~-71	ON	ON	OFF	OFF
-70~-61	ON	ON	ON	OFF
rssi>=-60	ON	ON	ON	ON

SIM-switch is a feature in data plan configuration which can be configured from FortiExtender Cloud or locally from the FortiExtender GUI. All the aforementioned parameters can be configured from the FortiExtender (Standalone) CLI.

SIM switch-back

Following a fail-over, FortiExtender is able to fail back to the preferred SIM card according to user configuration.

To enable SIM switch-back:

```
FX211E5919000006 (auto-switch) #
     config lte setting modem1 auto-switch
        set switch-back [by-time | by-timer]
     end
```

Parameter	Description
by-time	Switch over to the preferred SIM card/carrier at a specified (UTC) time (in the format of HH:MM).
by-timer	Switch over to the preferred SIM/carrier after the given time (from 3600 to 2147483647 seconds).

Get modem status

You can use the following command to get your modem status:

```
FX201E5919002499 # get modem status
Modem status:
    modem             : Modem1
    usb path          : 2-1.2 (sdk 0)
    vender            : Sierra Wireless, Incorporated
    product           : Sierra Wireless, Incorporated
    model             : EM7455
    SIM slot          : SIM1
    revision          : SWI9X30C_02.32.11.00 r8042 CARMD-EV-FRMWR2 2019/05/15
21:52:20
    imei              : 359073065340568
    iccid             : 8933270100000296108
    imsi              : 208270100029610
    pin status        : enable
    pin code          : 0000
    carrier           : 436627|coriolis|EU
    APN               : N/A
    service           : LTE
    sim pin (sim1)    : 3 attempts left
    sim puk (sim1)    : 10 attempts left
    rssi (dBm)        : -68
    signal_strength   : 64
    ca state          : ACTIVE
    cell ID           : 00A25703
    band              : B7
    band width        : 20
    sinr (dB )        : 7.4
    rsrp (dBm)        : -99
    rsrq (dB )        : -13.1
```

```
plan_name         : coriolis100G
connect_status    : CONN_STATE_CONNECTED
reconnect count   : 0
smart sim switch  : disabled
up time (sec)     : 26670
clock (UTC)       : 20/05/27,20:08:33+08
temperature       : 60
activation_status : N/A
roaming_status    : N/A
Latitude          : 37.376281
Longitude         : -122.010817
```

Stopping data traffic on overaged LTE interface

When an LTE interface has breached its data usage limit, FortiExtender will stop forwarding outgoing traffic (except for management traffic) to that interface. The following types of traffic are affected:

- NATted traffic
- VPN data traffic on IPsec Tunnel based on the overaged LTE interface
- IP-passthrough traffic

OBM management

FortiExtender can be connected to the console port of any device behind it via its USB port, thereby enabling out-of-band management (OBM). This mode requires access to FortiExtender over its WAN interface.

This feature supports multiple OBM console connections with USB to multiple serial console cable/adapter. Once you've logged into FortiExtender, you can access its console port using the following procedures:

1. Log into the FortiExtender device.
2. Connect to the console port of the device.
3. Execute the command:

```
# execute obm-console
Welcome to OBM Console - Serial Redirector.
One device connected with ttyUSB0.
Please choose the baudrate from list below:
1. 9600
2. 19200
3. 38400
4. 57600
5. 115200
6. 921600
7. Other baudrate
Enter to continue & CTRL+X to go back to FortiExtender Console.
```

When USB to multiple serial console cable/adapter is used, execute the following command:

```
# execute obm-console
Welcome to OBM Console - Serial Redirector.
There are 2 devices/ports connected.
Please choose one from list below:
```

```
1. ttyUSB0
2. ttyUSB1
Please choose the baudrate from list below:
1. 9600
2. 19200
3. 38400
4. 57600
5. 115200
6. 921600
7. Other baudrate
Enter to continue & CTRL+X to go back to FortiExtender Console.
```

Make sure that the baud rate you select matches the baud rate of the router which is connected to the serial console via the USB port.

Modes of operation

This section covers the following topics:

- IP pass-through mode on page 16
- NAT mode on page 16

IP pass-through mode

In IP pass-through mode, FortiExtender (Standalone) distributes the WAN IP address provided by the NSP to the device behind it.

Enable IP pass-through mode

FortiExtender (Standalone) can be used as a stand-alone device, without integration with FortiGate or FortiExtender (Standalone) Cloud. In this scenario, all configuration is done locally on the FortiExtender (Standalone) device. We call this mode of operation "local" mode.

You can enable IP pass-through in local mode using the following commands:

```
# config system management
   (management)# set discovery-type local
   (management) <M># config local
   (local)# set mode ip-passthrough
```

There can be only a single device behind FortiExtender (standalone) when in IP-passthrough mode. That device can be either a router that NAT's the traffic behind or a PC, but it cannot be a switch (L2 or L3) without NAT.

Configure a virtual wire pair

A virtual wire pair configuration is necessary to enable the IP Pass-through forwarding between two ports.

```
FX212E5919000009 # config system virtual-wire-pair
FX212E5919000009 (virtual-wire-pair) # set lte1-mapping lan
FX212E5919000009 (virtual-wire-pair)# end
```

NAT mode

The LAN port on FortiExtender (Standalone) can support multiple devices (e.g., PCs, printers, etc.) in NAT mode. In this mode, FortiExtender (Standalone) works as a gateway of the subnet behind it to forward traffic between the LAN and the LTE WAN.

The following features are supported in NAT mode:

- Interface management on page 18
- DHCP configurations on page 29
- System routing on page 34
- Configure PBR routing on page 45
- Firewall on page 49
- VPN on page 53
- SD-WAN on page 62
- Health monitoring on page 66

Interface management

FortiExtender (Standalone) 201E and 211E each come with four LAN Ethernet ports and one WAN Ethernet port. FortiExtender 511F adds another WAN port with 1GigE SFP fiber port. They all can support multiple devices in NAT mode or a single device in IP pass-through mode. FortiExtender works as an extended WAN interface when configured in IP pass-through mode, but functions as a router when in NAT mode.

- port1, port2, and port3 are part of the LAN switch with the static IP address of 192.168.200.99/24; a DHCP server also runs on the LAN switch interface with an IP range from 192.168.200.110 to 192.168.200.210 and the default gateway IP of 192.168.200.99.
- port4/POE port is independent (as a DHCP client).

The table below describes the CLI commands used to configure the system interface.

CLI command	Description
`config system interface`	Enters system interface configuration mode.
`edit <interface_name>`	Specify or edit interface name (lan, lo, lte1 or wan).
`set type <type>`	Select the interface type: • `lan-switch`—LAN interface (Can be edited only). • `physical`—LAN interface (Can be edited only). • `lte`—LTE interface (Can be edited only). • `loopback`—Loopback interface (Can be edited only). • `tunnel`—Tunnel interface (Can be created, edited, or deleted). • `virtual-wan`—Virtual WAN interface (Can be created, edited, or deleted).
`set status {up | down}`	Specify the interface state: • `up`—Enabled. • `down`—Disabled.
`set mode {static | dhcp}`	Set the interface IP addressing mode: • `static`—If selected, FortiExtender (Standalone) will use a fixed IP address. See `set ip <ip>` below. • `dhcp`—If selected, FortiExtender (Standalone) will work in DHCP client mode.
`set ip <ip>`	(Applicable only when IP addressing mode is set to "static".) Specify an IPv4 address and subnet mask in the format: `x.x.x.x/24`
`set gateway <gateway>`	Set an IPv4 address for the router in the format: `x.x.x.x`
`set mtu <mtu>`	Set the interface's MTU value in the range of 512—1500.
`allowaccess {ping | http | https | telnet}`	Select the types of management traffic allowed to access the interface: • `ping`—PING access. • `http`—HTTP access. • `https`—HTTPS access. • `telnet`—TELNET access.

CLI command	Description
	• `ssh`—Secure Shell access. • `snmp`—SNMP access.

Interface configuration guideline

The following are the general guidelines regarding system interface configurations.

Physical interface(s)

FortiExtender (Standalone) LAN interface(s) can be configured in DHCP or static IP addressing mode. When FortiExtender (Standalone) is in NAT mode, you can also configure a DHCP server to distribute IP addresses from the FortiExtender (Standalone) physical Ethernet interface to the devices behind it.

FortiExtender (Standalone) also comes with a WAN physical interface.

LTE interface

The LTE interface only works in DHCP mode and acquires IP addresses directly from wireless NSPs. See Cellular capabilities on page 9.

Tunnel interface

Tunnel interfaces are automatically created when IPsec VPN Tunnels are created. A tunnel interface is a Layer-3 interface which doesn't have an IP address. All traffic sent to the tunnel interface is encapsulated in a VPN tunnel and received from the other end point of the tunnel. It can be used by firewall, routing, and SD-WAN, but cannot be used by VPN.

Virtual-WAN interface

A Virtual-WAN interface is an aggregation of multiple up-links. It works as a common interface because all traffic to it is load-balanced among multiple links.

It can be used by firewall, routing, but cannot be used by SD-WAN or VPN.

LAN interface configuration example:

```
# config system interface
(interface) # edit lan
        (lan) # set type physical
        (lan) # set status up
        (lan) # set mode static
        (lan) # set ip 192.168.2.1/24
        (lan) # set mtu 1400
```

```
(lan) # set allowaccess http ping telnet
(lan) # end
```

WAN interface configuration example:

```
FX211E5919000009 # config system interface
FX211E5919000009 (interface) # edit wan
FX211E5919000009 (wan) # show
edit wan
    set type physical
    set status up
    set mode dhcp
    set mtu-override enable
    set mtu 1500
    set vrrp-virtual-mac enable
    config vrrp
        set status disable
    end
    set allowaccess
next

FX211E5919000009 (wan) # set allowaccess
ping
http
telnet
ssh
https

snmp

FX211E5919000009 (wan) #
```

Access allowance

Both the physical and the LTE interfaces can be configured with access allowance to allow the administrator to access FortiExtender (Standalone) using the following tools:

- SSH
- Telnet
- ping
- HTTP
- HTTPS
- SNMP

Access allowance doesn’t apply to a tunnel or Virtual-WAN interface.

Access from the LTE WAN side is not supported. If you need to manage FortiExtender (Standalone) via LTE, you must use FortiExtender (Standalone) Cloud.

Get interface status

Use the following command to get system interface status:

```
get system interface
        = [ lo ]
        name: lo status: online/up/link up type:
        loopback mac: 00:00:00:00:00:00 mode: static ip:
        127.0.0.1/8 mtu: 65536 gateway: 0.0.0.0
        == [ lte1 ]
        name: lte1 status: online/up/link up type:
        lte mac: d2:82:f4:b7:db:27 mode: dhcp ip:
        10.220.139.33/30 mtu: 1500 gateway: 10.220.139.34 dns:
        172.26.38.1
        == [ lan ]
        name: lan status: online/up/link up type:
        physical mac: 70:4c:a5:fd:1a:da mode: static ip:
        192.168.2.1/24 mtu: 1500 gateway: 0.0.0.0
        == [ vwan1 ]
        name: vwan1 status: online/up/link up type:
        virtual-wan mac: d2:10:5f:ed:71:e8 mode: static ip:
        0.0.0.0/0 mtu: 1364 gateway: 0.0.0.0
        == [ fcs-0-phase-1 ]
        name: fcs-0-phase-1 status: online/up/link up type:
        tunnel mac: 00:00:00:00:00:00 mode: static ip:
        0.0.0.0/0 mtu: 1364 gateway: 0.0.0.0
        == [ fcs-1-phase-1 ]
        name: fcs-1-phase-1 status: online/up/link up type:
        tunnel mac: 00:00:00:00:00:00 mode: static ip:
        0.0.0.0/0 mtu: 1364 gateway: 0.0.0.0
```

Configure LAN switch

FortiExtender (Standalone) comes with four LAN ports (i.e., Ports 1—4) which can be part of the same LAN switch. These ports can also be separated from the LAN switch to run on different IP subnets as well.

To display the current LAN switch configuration:

```
FX211E5919000011 # config system lan-switch
FX211E5919000011 (lan-switch) # config ports
FX211E5919000011 (ports) # show
config system lan-switch ports
    edit port1
    next
    edit port2
    next
    edit port3
    next
    edit port4
    next
end
```

To remove Port 4 from the LAN switch in the example above:

```
FX211E5919000011 (ports) # delete port4
FX211E5919000011 (ports) <M> # next
FX211E5919000011 (ports) # show
config system lan-switch ports
    edit port1
    next
    edit port2
    next
    edit port3
    next
end
```

To add Port 4 back to the LAN switch from the state above:

```
FX211E5919000011 (ports) # edit port4
FX211E5919000011 (port4) <M> # next
FX211E5919000011 (ports) # show
config system lan-switch ports
    edit port1
    next
    edit port2
    next
    edit port3
    next
    edit port4
    next
end
```

Configure switch interface

A software switch is a virtual switch that is implemented at the software or firmware level. It can be used to simplify communication between devices connected to different FortiExtender interfaces. For example, using a software switch, you can place the FortiExtender interface connected to an internal network on the same subnet as your other virtual interfaces, such as VXLAN, aggregate interfaces, and so on.

Similar to a hardware switch, a software switch functions like a single interface. It has an IP address, and all the interfaces in the software switch are on the same subnet. Traffic between devices connected to each interface is not regulated by security policies, while traffic passing in and out of the switch is controlled by the same policy.

When setting up a software switch, consider the following:

- Ensure that you have a backup of your configuration.
- Ensure that you have at least one port or connection, such as the console port, to connect to the FortiExtender unit. This ensures that, if you accidentally combine too many ports, you have a way to undo the error.
- The ports that you include must not have any link or relation to any other aspect of the FortiExtender unit, such as DHCP servers, security policies, and so on.

To create a software switch on the GUI:

1. Go to **Networking > Switch Interface**.
2. Click **Create Switch-Interface**.
3. Configure the name, interface members, and all the other required fields.
4. Click **Save**.

To create a software switch in the CLI:

```
config system switch-interface
    edit <interface>
        set members <interface_list>
        set span enable | disable // enable/disable spanning tree
    next
end
```

Upon execution of the above commands, the following configuration will be automatically generated:

```
config system interface
    edit <interface>
        set type switch
        set status down
    next
end
```

You can update the IP, allowaccess, and the other configurations based on the switch interface. And this interface can also be used in configuring the DHCP server, firewall policies, routes, and some other modules.

Configure VXLAN interface

VXLAN encapsulates OSI Layer-2 Ethernet frames within Layer-3 IP packets using the standard destination Port 4789. VXLAN endpoints, known as VXLAN tunnel endpoints (VTEPs), terminate VXLAN tunnels which can be virtual or physical switch ports.

To add a VXLAN interface from GUI:

1. Go to **Networking>VXLAN.**
2. Click **Create VXLAN.**
3. Configure the name, VNI, remote IP, local IP, and dstport.
4. Click **Save.**

- The local IP must be an IP address of one of your system interfaces.
- The VNI must be unique on every single local IP.
- The destination port is 4789 by default. The valid range is 1—16777215.

To configure VXLAN from the CLI:

```
config system vxlan
    edit <vxlan>
```

```
        set vni <vni>
        set remote-ip <remote ip>
        set local-ip <local ip>
        set dstport 4789
    next
end
```

Upon execution of the above commands, the following configuration will be automatically generated:

```
edit vxlan1
    set type vxlan
    set status down
    set mode static
end
```

You can change the IP, allowaccess, mode, and some other configurations based on this VXLAN interface.

Aggregate interface support with load-balancing

Interfaces of the same type can be aggregated into a virtual aggregate interface as its members. A member of an aggregate interface can be monitored by HMON. A member is considered as healthy if its link is up and marked as ALIVE by HMON. Only a healthy member could be considered as a candidate for sending and receiving packets.

Interfaces are aggregated in either of the following ways:

- Active backup—Only one member of the aggregate interface is active to send and receive packets at a time. One member should be designated as the primary and the others as secondary. If the primary member is healthy, it should be chosen as the active member. Otherwise, another healthy member must be chosen instead. Once the primary member becomes healthy again, it will take over the traffic.
- Load balance—All healthy members are active for sending and receiving packets. Packets are sent over active members based on the round-robin algorithm at the same time. Packets originated from the same source follow the same path.

Once an interface becomes a member of an aggregate interface, it must not be used for firewall and PBR. The aggregate interface must be used instead.

To create an aggregate interface in the GUI:

1. Go to **Networking>Aggregate Interface**.
2. Click **Create Aggregate Interface**.
3. Configure the ID, Mode, and Mapping timeout if mode is set to load balance.
4. Click **Create Member.**
5. Configure the Name, Interface, Weight/Role, HealthCheck, HealthCheckFailCount, and HealthCheckRecoveryCount of each member.

To create an aggregate interface in the CLI:

A table is added to `/config/system` to represent interface aggregations. Each table entry indicates an aggregate interface to be created and one or more interfaces can be aggregated under this aggregate interface.

The following configuration shows two aggregate interfaces in active backup and load-balance mode:

```
config system aggregate-interface
    edit agg1
        set mode loadbalance
        set mapping-timeout 60
        config members
            edit 1
                set interface vx2
                set health-check-event vxlan
                set health-check-fail-cnt 5
                set health-check-recovery-cnt 5
            next
            edit 2
                set interface vx3
                set health-check-event
                set health-check-fail-cnt 5
                set health-check-recovery-cnt 5
            next
        end
    next
    edit agg2
        set mode activebackup
        config members
            edit 1
                set interface wan
                set role primary
                set health-check-event
                set health-check-fail-cnt 5
                set health-check-recovery-cnt 5
            next
            edit 2
                set interface port4
                set role secondary
                set health-check-event
                set health-check-fail-cnt 5
                set health-check-recovery-cnt 5
            next
        end
    next
end
```

Following configuration will be automatically generated:

```
config system interface
    edit agg1
        set type aggregate
        set status down
    next
    edit agg2
        set type aggregate
        set status down
    next
end
```

You can update the IP, allowaccess, and other configurations based on the aggregate interface. And this interface can also be used in configuring the DHCP server, firewall policies, routes, and some other modules.

To get the aggregate interface status:

```
 # get system aggregate-interface status
agg2:
        2(port4): linkdown UNKNOWN aggregated
        1(wan): linkup UNKNOWN aggregated active
agg1:
        2(vx3): linkup UNKNOWN aggregated active
        1(vx2): linkup ALIVE aggregated active
```

Configure a private network

Private network wireless solutions provide seamless, secure access to your corporate network. You can enable private network on your FortiExtender using the following commands:

```
config lte plan
   edit test
   set private-network enable
   end
end
```

Configure Virtual-WAN interface

Step 1: Config VWAN health check

```
config hmon hchk
   edit vw_mb1_hc
      set protocol ping
      set interval 5
      set probe-cnt 1
      set probe-tm 2
      set probe-target 8.8.8.8
      set interface wan
      set src-type none
      set filter rtt loss
   next
   edit vw_mb2_hc
      set protocol ping
      set interval 5
      set probe-cnt 1
      set probe-tm 2
      set probe-target 8.8.8.8
      set interface lte1
      set src-type none
      set filter rtt loss
   next
end
```

Step 2: Configure VWAN members

```
config system vwan-member
   edit mb1
```

```
      set target target.wan
      set priority 1
      set weight 1
      set in-bandwidth-threshold 0
      set out-bandwidth-threshold 0
      set total-bandwidth-threshold 0
      set health-check vw_mb1_hc
      set health-check-fail-threshold 5
      set health-check-success-threshold 5
   next
   edit mb2
      set target target.lte1
      set priority 10
      set weight 1
      set in-bandwidth-threshold 0
      set out-bandwidth-threshold 0
      set total-bandwidth-threshold 0
      set health-check vw_mb2_hc
      set health-check-fail-threshold 5
      set health-check-success-threshold 5
   next
end
```

Step 3: Configure VWAN interface

```
config system interface
   edit vwan1
      set type virtual-wan
      set status up
      set algorithm redundant
      set redundant-by priority
      set FEC source_dest_ip_pair
      set session-timeout 60
      set grace-period 0
      set members mb1 mb2
   next
end
```

Step 4: Confirm the subnet of LAN, and configure a network address instance

```
config network address
   edit lan
      set type ipmask
      set subnet 192.168.2.0/24
   next
end
```

Step 5: Configure firewall policies

```
config firewall policy
   edit vwan_permit_out
      set srcintf any
      set dstintf vwan1
      set srcaddr lan
      set dstaddr all
      set action accept
```

```
      set status enable
      set service ALL
      set nat disable
   next
   edit vw_mb1_nat
      set srcintf any
      set dstintf wan
      set srcaddr lan
      set dstaddr all
      set action accept
      set status enable
      set service ALL
      set nat enable
   next
   edit vw_mb2_nat
      set srcintf any
      set dstintf lte1
      set srcaddr lan
      set dstaddr all
      set action accept
      set status enable
      set service ALL
      set nat enable
   next
end
```

Step 6: Configure router policy

```
config router policy
   edit to_vwan
      set input-device
      set srcaddr lan
      set dstaddr all
      set service ALL
      set target target.vwan1
      set status enable
      set comment
   next
end
```

DHCP configurations

FortiExtender (Standalone) supports DHCP server and DHCP relay. The following sections discuss how to configure the DHCP server and DHCP relay, respectively.

- Configure DHCP server
- Configure DHCP relay

Configure DHCP server

You can configure the DHCP server from FortiExtender (Standalone) Cloud or locally while the device is set in NAT mode.

To configure the DHCP server, change the IP address of the LAN interface to the correct subnet, and then create the DHCP server subnet using commands described in the table below.

CLI command	Description
`config system dhcpserver`	Enters DHCP server configuration mode.
`edit <name>`	Specify the name of the DHCP server.
`set status {enable | disable | backup}`	Set the DHCP server status: • `enable`—Enable the DHCP server. • `disable`—Disable the DHCP server. • `backup`— Enable in VRRP backup mode. (**Note:** The DHCP server is launched only when the VRRP master goes down.)
`set lease-time <lease_time>`	Specify the DHCP address lease time in seconds. The valid range is 300–8640000. 0 means unlimited.
`set dns-service {local | default | specify | wan-dns}`	Select one of the options for assigning a DNS server to DHCP clients: • `local`—The IP address of the interface of the DHCP server that is added becomes clients' DNS server IP address. • `default`—Clients are assigned the FortiExtender (Standalone) configured DNS server. • `specify`—Specify up to three DNS servers in the DHCP server configuration. • `wan-dns`—The DNS of the WAN interface that is added becomes clients' DNS server IP address.
`set dns-server1 <dns_server1>`	Specify the IP address of DNS Server 1.
`set dns-server2 <dns_server2>`	Specify the IP address of DNS Server 2.

CLI command	Description
set dns-server3 <dns_server3>	Specify the IP address of DNS Server 3.
set ntp-service {local | default | specify}	Select an option for assigning a Network Time Protocol (NTP) server to DHCP clients: • local—The IP address of the interface of the DHCP server that is added becomes clients' NTP server IP address. • default—Clients are assigned the FortiExtender (Standalone) configured NTP servers. • specify—Specify up to three NTP servers.
set ntp-server1 <ntp_server1>	Specify the IP address of NTP Server 1.
set ntp-server2 <ntp_server2>	Specify the IP address of NTP Server 2.
set ntp-server3 <ntp_server3>	Specify the IP address of NTP Server 3.
set default-gateway <gateway>	Specify the default gateway IP address assigned by the DHCP server.
set netmask <netmask>	Specify the netmask assigned by the DHCP server.
set interface <interface>	Specify the interface on which the DHCP server is expected to run.
set start-ip <start_ip>	Specify the start IP address of the DHCP IP address range. For example, 192.168.1.100.
set end-ip <end_ip>	Specify the end IP address of the DHCP IP address range. For example, 192.168.1.120.

Example DHCP server configuration:

```
config system dhcpserver
   edit dsl
      set status enable
      set lease-time 8640000
      set dns-service specify
      set dns-server1 8.8.8.8
      set dns-server2 8.8.4.4
      set dns server3
      set ntp-service local
      set default-gateway 192.168.2.1
      set netmask 255.255.255.0
      set interface LAN
      set start-ip 192.168.2.2
      set end-ip 192.168.2.254
      set mtu 1500
      set reserved-address enable
   next
end
```

FortiExtender (Standalone) LAN interface(s) can be configured in static IP address mode locally or from FortiExtender Cloud. By default, the LAN interface has the IP address of 192.168.200.99/24 and runs a DHCP

server serving addresses from 192.168.200.110. You can enable the management of LAN-side capabilities from FortiExtender (Standalone) Cloud.

FortiExtender supports DHCP server with reserved addresses. To take advantage of this feature, you must do the following:

1. Enable the `set reserved-address` option, as shown above.
2. Configure the system DHCP-reserved-address using the following commands:

```
edit 1
   set ip <preferred host IP>
   set mac <mac address of host>
   set action <reserved | blocked>
end
```

- `set action reserved` ensures that the same IP is assigned to the host with a matching MAC address.
- `set action disabled` ensures that the host with a given MAC address is not assigned an IP address.

Configure DHCP relay

FortiExtender supports DHCP relay agent which enables it to fetch DHCP leases from a remote server. It has to be configured per interface. Example below:

```
config system dhcprelay
   edit 1
      set status enable
      set client-interfaces <interface name on which relay agent services are
           offered>
      set server-interface <interface name through which DHCP server can be
           reachable>
      set server-ip <remote dhcp server IP>
```

Network utilities

You can define your network from the following aspects:

- Address on page 32
- Service on page 32
- Target on page 32

Address

Addresses are used to define the networking nodes in your network. An address can be a subnet, a single IP address, or a range of IP addresses. With addresses, you can define the source and destination of network traffic.

Service

Service defines traffic type, such as HTTP, FTP, etc. It consists of a protocol and the destination port.

For example:

```
config network service
   config service-custom
      edit ALL
         set protocol IP
         set protocol-number 0
      next
   end
end
```

Target

Target is the network connected to FortiExtender (Standalone). It is usually an up-link network, such as an NSP network provided by a wireless carrier. A target consists of an outgoing interface and a next hop. Targets are always used in routing systems and SD-WANs to define the destination network to which traffic is sent.

The table below describes the commands for setting a target.

CLI command	Description
`config router target`	Enters target configuration mode.
`edit <name>`	Specify the target network.

CLI command	Description
`set interface <interface>`	Specify the outgoing interface of the gateway.
`set next-hop <next_hop>`	Specify the IP address of the next-hop gateway.

Example target configuration:

```
# get system interface
== [ lo ]
name: lo status: online/up/link up type: loopback mac:
00:00:00:00:00:00 mode: static ip: 127.0.0.1/8 mtu: 65536
gateway: 0.0.0.0
== [ eth1 ]
name: eth1 status: online/up/link up type: lte mac:
9a:fd:56:f1:1a:08 mode: dhcp ip: 10.118.38.4/29 mtu: 1500
gateway: 10.118.38.5 dns: 172.26.38.1
== [ nas1 ]
name: nas1 status: online/up/link up type: physical mac:
70:4c:a5:fd:1b:38 mode: dhcp ip: 172.24.236.22/22 mtu: 1500
gateway: 172.24.239.254 dns: 172.30.1.105, 172.30.1.106
# config router target
(target) # edit target.lte
(target/lte) <M> # abort
(target) # edit target.lte
(target.lte) <M> # set interface eth1
(target.lte) <M> # set next-hop 10.118.38.5
(target.lte) <M> # next
(target) # end
```

A target is automatically created when an LTE is connected, with the LTE as the outgoing interface and the gateway as the next hop. The next hop is not mandatory if the outgoing interface is a tunnel interface or a Virtual-WAN interface. For example:

```
edit target.fcs-1-phase-1
   set interface fcs-1-phase-1
   set next-hop
next
edit target.vwan1
   set interface vwan1
   set next-hop
next
```

System routing

FortiExtender (Standalone) 7.0.3 supports static routing and Policy Based Routing (PBR). Dynamic routing, such as OSPF, ISIS, and EIGRP, is not supported in this release.

Both static routing and PBR apply to NAT mode only.

This section covers the following topics:

- Configure static routing on page 34
- Configure PBR routing on page 45
- View routing configurations on page 46
- Move PBR rules on page 47

Configure static routing

The table below describes the commands for configuring static routing.

CLI command	Description
`config router static`	Enters static route configuration mode.
`edit <name>`	Specify the name of the static route.
`set status {enable | disable}`	Set the status of the static route: • `enable`—Enable the static route. • `disable`—Disable the static route.
`set dst <dst>`	Specify the destination IP address and netmask of the static route in the format: `x.x.x.x/x`
`set gateway <gateway>`	Specify the IP address of the gateway.
`set distance <distance>`	Specify the administrative distance. The range is 1–255. The default is 1.
`set device <device>`	Specify the name of the outgoing interface.
`set comment [comment]`	Enter a comment (optional).

Example static route configuration:

```
config router static
   edit 1
      set status enable
      set dst 0.0.0.0/0
```

```
        set gateway 192.168.2.1
        set distance 5
        set device lan
        set comment
      next
    End
```

Configure dynamic routing — OSPF

Open Shortest Path First (OSPF) is a link state routing protocol and uses the shortest-path-first algorithm to find the best Layer 3 path. It is an Interior Gateway Protocol (IGP) and IP routing information is distributed throughout a single Autonomous System (AS) in an IP network. You can configure OSPF using both the FortiExtender Console (CLI) and GUI.

The current release only supports basic features for point-to-point network type over IPSEC tunnel and Area 0, and static routes and connected routes are allowed to be redistributed into the OSPF routing domain. Other features such as the network type, authentication type, multiple areas, stub areas, and summary-address, etc. are not supported in this release.

- Other dynamic routing protocols such as ISIS, EIGRP, and BGP are not supported in this release.
- Static routing, PBR, and OSPF apply to NAT mode only.

Configure OSPF from Console (CLI)

Below are the general steps you need to follow when configuring OSPF. You can click the topics for more information and instructions for each of the steps:

1. Configure OSPF status on page 35
2. Configure OSPF router-id on page 36
3. Configure OSPF area on page 36
4. Configure OSPF network on page 36
5. Configure OSPF interface on page 37
6. Configure OSPF redistribution on page 37

Configure OSPF status

CLI Command	Description
`set status [enable | disable]`	Set the status of the OSPF: • enable—Enable OSPF • disable—Disable OSPF

Example configuration:

```
ForitExtender# config router ospf
   set status enable | disable
```

Configure OSPF router-id

CLI Command	Description
`set router-id [x.x.x.x ]`	The router-id is a unique identity to the OSPF router. If no router-id is specified, the system will automatically choose the highest IP address as the router-id.

Example configuration:

```
ForitExtender# config router ospf
   set router-id 192.168.100.127
```

Configure OSPF area

CLI Command	Description
`config area` `edit 0.0.0.0`	An area is a logical grouping of contiguous networks and routers in the same area with the same link-state database and topology. **Note:** The current release only supports Area 0 called the backbone area, and does not support multiple areas. All routers inside an area must have the same area ID to become OSPF neighbors. You can add Area 0 by editing Area 0.0.0.0

Example configuration:

```
ForitExtender# config router ospf
   config area
      edit 0.0.0.0
```

Configure OSPF network

CLI Command	Description

`config network`
`edit [id]`
`set prefix [X.X.X.X/Y]`
`set area 0.0.0. Prefix`
	Prefix is used to identify network/subnet address for advertising to the OSPF domain.
	• id—string
	• X.X.X.X—Network prefix
	• Y—Netmask

Example configuration:

```
ForitExtender# config router ospf
   config network
      edit 1
         set prefix 192.168.100.127/32
         set area 0.0.0.0
      next
      edit 2
         set prefix 192.168.100.0/30
         set area 0.0.0.0
```

```
      next
   End
```

Configure OSPF interface

CLI Command	Description

`config ospf-interface`
`edit [id]`
`set status [enable]disable]`
`set interface <ospf-interface name>`
`set mtu-ignore [enable|disbale]`
`set cost <0—65535>`
	Configure the OSPF interface.
	• `id`—string
	• `status`—enable/enable OSPF processing on the said interface.
	• `interface` —must be the VPN tunnel interface as OSPF is built over IPSEC VPN.
	• `mtu-ignore`— enable/disable. `mtu-ignore` prevents OSPF neighbor adjacency failure caused by mismatched MTUs. When `mtu-ignore` is enabled, OSPF will stop detecting mismatched MTUs before forming OSPF adjacency. When `mtu-ignore` is disabled, OSPF will detect mismatched MTUs, and OSPF adjacency is not established if MTU is mismatched.
	• `cost`—Interface cost used to calculate the best path to reach other routers in the same area.

Example configuration:

```
ForitExtender# config router ospf
   config ospf-interface
      edit 1
         set status enable
         set interface opaq
         set mtu-ignore enable
         set cost 5
end
```

Configure OSPF redistribution

The current release allows both connected routes and static routes redistributed into the OSPF Domain.

The following are the summary steps for configuring OSPF redistribution:

1. Configuring prefix-list
2. Configuring route-map
3. Configuring redistribute

Step 1: Configuring redistribute

CLI Command	Description

`config prefix-list`
`edit <prefix-name>`
`config rule edit <id>`
`set action [permit | deny]`
`set prefix <X.X.X.X/Y>`
`set ge 0`
`set le 0`
`next`
	Configure the `prefix-list` which defines the prefix (IP address and netmask) for the filter of redistribution.
	• `prefix-name`— for either static routes or connected routes
	• `id`—rule-id (1-65535)
	• `action`—permit/deny. Permit if it matches prefix network; deny if it does not match the exact prefix network.
	• `le`—(less than or equal to). The `le` parameter can be included to match all more-specific prefixes within a parent prefix up to a certain length. For example, `10.0.0.0/24 le 30` will match 10.0.0.0/24 and all prefixes contained within a length of 30 or less.
	• `ge`— (greater than or equal to) The length specified should be longer than the length of the initial prefix.

Example configuration:

```
ForitExtender# config router
   config prefix-list
      edit local-nets
         config rule
            edit 10
               set action permit
               set prefix 192.168.201.0/24 set ge 0
               set le 0
            next
         end
   next
   edit static-routes
      config rule
         edit 10
            set action deny
            set prefix 192.168.203.0/24 set ge 0
            set le 0
         next
         edit 20
            set action permit
            set prefix 192.168.202.0/24 set ge 0
            set le 0 next
   end
```

Step 2: Configuring route-map

CLI Command	Description

`config route-map`
`edit <route-map name>`
`config rule`
`edit <id>`
	Configure `route-map` which defines the redistributed routes.
	• `route-map name`—defines the route-map name
	• `rule`—routing rule

CLI Command	Description
`set action [permit | deny]` `set match-ip-address <prefix-list>`	• `id`—rule-id (1—65535) • `action`— permit/deny. If set to permit, the system redistributes the permitted prefix-list; if set to deny, the system does not redistribute the permitted prefix-list. • `match-ip-address`—Configure the prefix-list and identifies the prefix list defined in the prefix-list section. **Note:** `Route-maps` are numbered with edit IDs, which are sequential numbers such as 10, 20, etc. We recommend starting with Number 10 to reserve numbering space in case you need to insert new matched/denied condition in the future.

Example configuration:

```
ForitExtender# config router
config route-map
   edit redist-local-connected
      config rule
         edit 10
            set action permit
            set match-ip-address local-nets
end
edit redist-static
   config rule
      edit 10
         set action permit
         set match-ip-address static-routes
```

Step 3: Configuring redistribution

CLI Command	Description

`config router ospf`
`config redistribute`
`config [connected | static]`
`set status [enable | disable]`
`set metric-type [1 | 2]`
`set metric <value>`
`set route-map <route-map name>`
	Configure router OSPF redistribute.
	• `status`—enable/disable redistributing routes.
	• `metric-type`—specify the external link type to be used for the redistributed routes. The options are E1 and E2 (default).
	• `metric value`—used for the redistributed routes. The value range is from 1 to 16777214. The default is 10.
	• `routemap`—defined and configured on the route-map, see Configure route-map for details.

Example configuration:

```
ForitExtender# config router ospf
   config redistribute
      config connected
         set status enable
```

```
        set metric-type 2
        set metric 10
        set routemap redist-local-connected
    end
    config static
      set status enable
      set metric-type 2
      set metric 10
      set routemap redist-static
```

Verify OSPF configurations

Upon completing the OSPF configurations, you may want to double-check to ensure that it works as expected.

- Verify OSPF status on page 40
- Verify OSPF interface on page 41
- Verify OSPF neighbor adjacency on page 41
- Verify OSPF database on page 41
- Verify OSPF routes on page 41
- Verify routing table on page 42

Verify OSPF status

```
FortiExtender# get router info ospf status
OSPF Routing Process, Router ID: 169.254.254.127
Supports only single TOS (TOS0) routes
This implementation conforms to RFC2328
RFC1583Compatibility flag is disabled
OpaqueCapability flag is disabled
Initial SPF scheduling delay 0 millisec(s)
Minimum hold time between consecutive SPFs 50 millisec(s)
Maximum hold time between consecutive SPFs 5000 millisec(s)
Hold time multiplier is currently 1
SPF algorithm last executed 4h47m24s ago
Last SPF duration 75 usecs
SPF timer is inactive
Refresh timer 10 secsArea ID: 0.0.0.0 (Backbone)
Number of interfaces in this area: Total: 1, Active: 1
Number of fully adjacent neighbors in this area: 1

Area has no authentication
SPF algorithm executed 7 times
Number of LSA 2
Number of router LSA 2. Checksum Sum 0x0000e273
Number of network LSA 0. Checksum Sum 0x00000000 Number of summary LSA 0.
     Checksum Sum
0x00000000
Number of ASBR summary LSA 0. Checksum Sum 0x00000000
Number of NSSA LSA 0. Checksum Sum 0x00000000
Number of opaque link LSA 0. Checksum Sum 0x00000000
Number of opaque area LSA 0. Checksum Sum 0x00000000
This router is an ASBR (injecting external routing information)
Number of external LSA 6. Checksum Sum 0x0001faea
```

```
Number of opaque AS LSA 0. Checksum Sum 0x00000000
Number of areas attached to this router: 1
```

Verify OSPF interface

```
FortiExtender# get router info ospf interface
vti1 is up
ifindex 14, MTU 1332 bytes, BW 0 Kbit <UP,POINTOPOINT,RUNNING,NOARP,MULTICAST>
Internet Address 169.254.254.2/30, Area 0.0.0.0
MTU mismatch detection:disabled
Router ID 169.254.254.127, Network Type POINTOPOINT, Cost: 5
Transmit Delay is 1 sec, State Point-To-Point, Priority 1
No designated router on this network
No backup designated router on this network
Multicast group memberships: OSPFAllRouters
Timer intervals configured, Hello 10s, Dead 40s, Wait 40s, Retransmit 5
Hello due in 3.348s
Neighbor Count is 1, Adjacent neighbor count is 1
```

Verify OSPF neighbor adjacency

```
FortiExtender# get router info ospf neighbor
Neighbor ID Pri State Dead Time Address Interface RXmtL RqstL
DBsmL
10.8.8.1 1 Full/DROther 32.647s 169.254.254.1 vti1:169.254.254.2 0 0 0
```

Verify OSPF database

```
FortiExtender # get router info ospf database
OSPF Router with ID (169.254.254.127)
Router Link States (Area 0.0.0.0)
Link ID ADV Router Age Seq# CkSum Link count
10.8.8.1 10.8.8.1 1061 0x80000155 0x05da 3
169.254.254.127 169.254.254.127 1076 0x8000000c 0xdc99 2
AS External Link States
Link ID ADV Router Age Seq# CkSum Route
0.0.0.0 10.8.8.1 321 0x800000e9 0x9c28 E2 0.0.0.0/0 [0x0]
1.1.1.0 169.254.254.127 226 0x8000000b 0x2a6a E2 1.1.1.0/24 [0x0]
2.2.2.0 10.8.8.1 1591 0x80000087 0x1908 E2 2.2.2.0/24 [0x0]
2.2.2.0 169.254.254.127 156 0x8000000b 0x068b E2 2.2.2.0/24 [0x0]
10.7.7.0 10.8.8.1 1121 0x800000e9 0x7834 E2 10.7.7.0/24 [0x0]
192.168.0.0 169.254.254.127 1206 0x8000000b 0x9c91 E2 192.168.0.0/24 [0x0]
```

Verify OSPF routes

```
FortiExtender# get router info ospf route
============ OSPF network routing table ============
N 169.254.254.0/30 [5] area: 0.0.0.0
directly attached to vti1
N 169.254.254.126/32 [105] area: 0.0.0.0
via 169.254.254.1, vti1
============ OSPF router routing table =============
R 10.8.8.1 [5] area: 0.0.0.0, ASBR
```

```
via 169.254.254.1, vti1
============ OSPF external routing table ===========
N E2 0.0.0.0/0 [5/10] tag: 0
via 169.254.254.1, vti1
N E2 2.2.2.0/24 [5/10] tag: 0
via 169.254.254.1, vti1
N E2 10.7.7.0/24 [5/10] tag: 0
via 169.254.254.1, vti1
```

Verify routing table

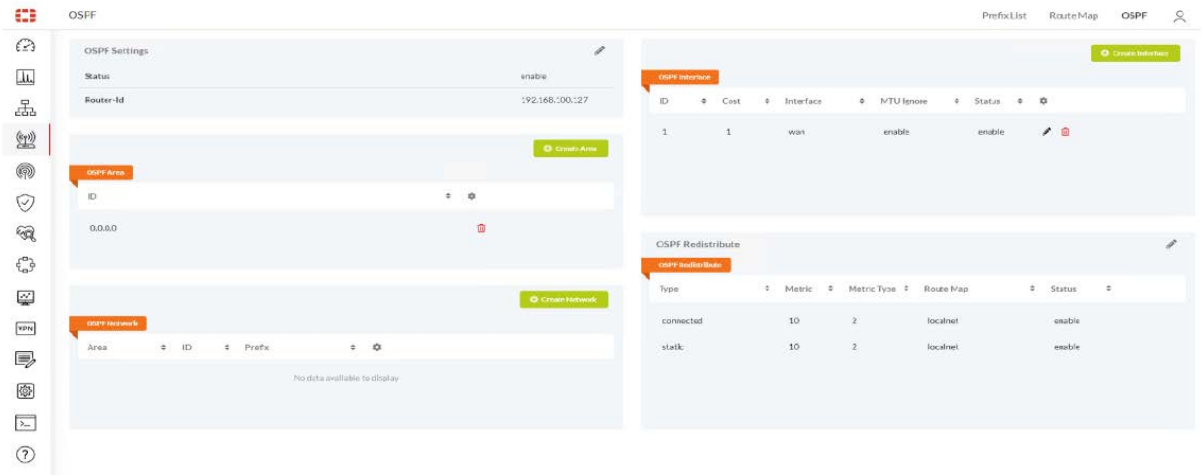
```
FortiExtender# get router info routing-table all
Codes: K - kernel route, C - connected, S - static, R - RIP,
O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel, N - NHRP,
> - selected route, * - FIB route
O>* 0.0.0.0/0 [110/10] via 169.254.254.1, vti1, 04:47:49
S 0.0.0.0/0 [253/0] is directly connected, lte1
S 0.0.0.0/0 [255/0] is directly connected, lte2
S>* 1.1.1.0/24 [1/0] via 10.8.8.1, port1
O 2.2.2.0/24 [110/10] via 169.254.254.1, vti1, 04:47:49
S>* 2.2.2.0/24 [1/0] via 10.8.8.1, port1
S>* 3.3.3.0/24 [1/0] is directly connected, port1
O>* 10.7.7.0/24 [110/10] via 169.254.254.1, vti1, 04:47:49
C>* 10.8.8.0/24 is directly connected, port1
C>* 10.10.10.0/24 is directly connected, wan
C>* 10.38.24.43/32 is directly connected, lte2
C>* 10.224.207.185/32 is directly connected, lte1
C>* 127.0.0.0/8 is directly connected, lo
O 169.254.254.0/30 [110/5] is directly connected, vti1, 05:07:40
C>* 169.254.254.0/30 is directly connected, vti1
O>* 169.254.254.126/32 [110/105] via 169.254.254.1, vti1, 04:47:50
C>* 192.168.0.0/24 is directly connected, port2
C>* 192.168.200.0/24 is directly connected, lan
```

Configure OSPF GUI

Take the following general steps to configure OSPF from the FortiExtender GUI:

1. Go to Router page.
2. Create prefix list.
3. Create route-map.
4. Go to OSPF page:
   - For OSPF settings, enable status and add the router-id.
   - For OSPF Area, create Area "0.0.0.0 ".
   - For OSPF Network, create the network to add the network prefix.
   - For OSPF Interface, create the interface.
   - For OSPF Redistribute, add created the route-maps for redistributing the connected and static routes to the OSPF domain.

Refer to the illustrations below.



Complete OSPF configuration code example

```
FortiExtender#config router prefix-list
   edit static-routes
   config rule
      edit 20
         set action permit
         set prefix 2.2.2.0/24
         set ge 0
         set le 0
      next
      edit 10
         set action permit
         set prefix 1.1.1.0/24
         set ge 0
         set le 0
```

```
        next
      end
      next
        edit local-nets
          config rule
            edit 10
              set action permit set prefix 192.168.0.0/24
              set ge 0
              set le 0
            next
          end
        next
      end

FortiExtender#config router route-map
      edit redist-local-connected
        config rule
          edit 10
            set action permit
            set match-ip-address local-nets
          next
          edit 20
            set action deny
            set match-ip-address
          next
        end
      next
      edit redist-static
        config rule
          edit 20
            set action deny
            set match-ip-address
          next
          edit 10
            set action permit
            set match-ip-address static-routes
          next
      end

FortiExtender#config router ospf
      set status enable
      set router-id 169.254.254.127
      config area
        edit 0.0.0.0
        next
      end
      config network
        edit 1
          set prefix 169.254.254.0/24
          set area 0.0.0.0 next
        edit 2
          set prefix 169.254.254.127/32
          set area 0.0.0.0
        next
      end
        config ospf-interface
          edit 1
```

```
                set status enable
                set interface vti1
                set mtu-ignore enable
                set cost 5
            next
        end
        config redistribute
            config connected
                set status enable
                set metric-type 2
                set metric 10
                set routemap redist-local-connected
            end
            config static
                set status enable
                set metric-type 2
                set metric 10
                set routemap redist-static
            end
        end
    end
```

Configure PBR routing

The table below describes the commands for configuring Policy Based Routing (PBR).

CLI Command	Description
`config router target`	Enters target configuration mode.
`edit <name>`	Specify the name of the target.
`set interface <interface>`	Specify the outgoing interface or tunnel.
`set next-hop <next_hop>`	Specify the IP address of the next-hop gateway .

Example PBR configurations:

config router target

```
    edit target.lan
        set interface lan
            set next-hop 192.168.10.99
        next
        edit target.vwan1
            set interface vwan1
            set next-hop
    next
```

Example PBR policy configuration:

```
    config router policy
        edit vwan1-pbr
```

```
        set input-device /* Incoming interface name.
        size[35] - datasource(s): system.interface.name
        set src 192.168.2.0/24 /* Source IP and mask for
        this policy based route rule.
        set srcaddr /* Source address
        set dst /* Destination IP and mask
        for this policy based route rule.
        set dstaddr /* Destination address
        set service /* Service and service
        group names.
        set target /* This PBR's out-going
        interface and next-hop.
        set status enable /* Enable/disable this
        policy based route rule.
        set comment /* Optional comments. size
        [255]
    next
end
```

View routing configurations

Use the following commands to view routing configurations.

View routing targets:

```
get router info target
== [ target.lo ]
device : lo
next-hop : 0.0.0.0
route type : automatic
routing-table : target.lo.rt.tbl
reference counter : 0

== [ target.lan]
device : lan
next-hop : 192.168.10.99
route type : automatic
routing-table : target.lan.rt.tbl
reference counter : 0

== [ target.vwan1 ]
device : vwan1
next-hop : 0.0.0.0
route type : automatic
routing-table : target.vwan1.rt.tbl
reference counter : 0
```

View PBR configurations:

```
get router info policy
== [ vwan1-pbr ]
seq : 100
status : enable
input-interface :
src : 192.168.2.0/24
```

```
src-addr :
dst :
dst-addr :
service :
target : target.vwan1
routing-table : target.vwan1.rt.tbl
comment :
```

View routing tables:

```
get router info routing-table all
Codes: K - kernel, C - connected, S - static
* - candidate default
```

* 0.0.0.0/0 is the default routing.

Move PBR rules

You can use the `move` command to change the order of the PBR rules you've created.

In the following example, you have created two policy rules:

```
config router policy
   edit one
      set input-device nas1
      set srcaddr
      set dstaddr all
      set service
      set target target.lo
      set status enable
      set comment
   next
   edit two
      set input-device lo
      set srcaddr
      set dstaddr
      set service
      set target target.eth1
      set status enable
      set comment
   next
```

If you want to move policy one after two, you can use either of the following commands:

```
move one after two
```

or

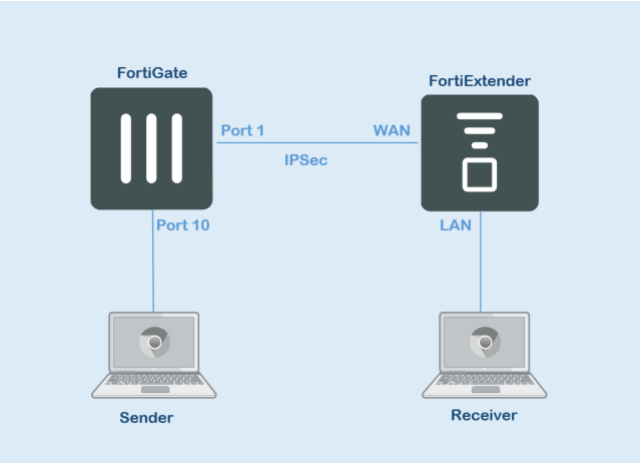
```
move two before one
```

Configure multicast routing

FortiExtender is capable of running PIM-SM to discover terminal devices which can join multicast routing groups accordingly. Other than supporting multicast routing directly on LTE WAN links (mostly for private networks), this feature can also be used to run on top of IPSEC interfaces of FortiExtender to enable private and secure multicast routing.

```
FX201E5919000012 # config router multicast
FX201E5919000012 (multicast) # show
config router multicast
    config pim-sm-global
        set join-prune-interval 60
        set hello-interval 30
        config rp-address
            edit 1
                set address 169.254.254.1
                set group 224.0.0.0/4
            next
        end
    end
    config interface
        edit lan
        next
        edit fex
        next
    end
end
```

Multicasting network topology



Firewall

Firewall allows you to control network access based on Layer-3 or Layer-4 information. Also, SNAT is provided to perform Source Net Address Translation.

Firewall configuration involves the following tasks:

- Configure address/subnet on page 49
- Configure protocol/port range on page 49
- Configure firewall policies on page 50
- Move firewall policies on page 51

Configure address/subnet

Use the following commands to specify the IP address/subnet to which you can apply firewall policies.

CLI command	Description
`config network address`	Enters network IP address configuration mode.
`edit <name>`	Specify the name of the IP address configuration object.
`set type {ipmask | iprange}`	Select either address type: • `ipmask`—IPv4 address/mask in the format: `x.x.x.x/x` • `iprange`—IP addresses range.

Example address/mask configurations:

```
config firewall address
   edit internet
      set type ipmask
      set subnet 0.0.0.0/0
   next
   edit src
      set type iprange
      set start-ip 192.168.2.3
      set end-ip 192.168.2.4
   next
end
```

Configure protocol/port range

Use the following commands to specify the network protocols and ports to which you want to apply firewall policies.

CLI command	Description
`config network service service-custom`	Enters the network service configuration mode.
`edit <name>`	Specify the name of the service configuration object.
`set protocol <Protocol Type>`	Specify the protocol (service).
`set protocol number <0-255> *`	Specify the protocol number (if you are not sure of the name of the protocol).
`set protocol udp-portrange`	Specify the port range for UDP protocol.
`set protocol tcp-portrange`	Specify the port range for TCP protocol.

Example protocol/port range configurations:

```
config network service service-custom
   edit service1
      set protocol tcp
      set tcp-portrange 5000-5555
   next
   edit service2
      set protocol udp
      set udp-portrange 6000-6350
   next
   edit service3
      set protocol icmp
   next
   edit service4
      set protocol ip
      set protocol-number 47
   next
end
```

Configure firewall policies

Once you have completed setting the IP addresses/mask and services (protocols)/port ranges you want to control with firewall policies, you can then use the following commands to impose firewall policies on them.

CLI command	Description
`config firewall policy`	Enters firewall policy configuration mode.
`edit <name>`	Specify the name of the firewall configuration object.
`set srcintf`	Specify the ingress interface.
`set dstintf`	Specify the egress interface.

CLI command	Description
`set srcaddr`	Specify the source IP address, which can be either a single IP address or a range of IP addresses.
`set action {allow | deny}`	Select either of the following actions: • `allow`—Allow access. • `deny`—Deny access.
`set status {enable | disable}`	Set the status of the policy: • `enable`—Enable the policy. • `disable`—Disable the policy.
`set nat {enable | disable}`	Select an option for NAT: • `enable`—Enable NAT. • `disable`—Disable NAT.

Example firewall policy configurations:

```
config firewall policy
   edit filter
      set srcintf any
      set dstintf any
      set srcaddr rec
      set dstaddr internet
      set action deny
      set status enable
      set service service1 service2 service3 service4
      set nat disable
   next
end
```

The FortiExtender (Standalone) firewall is in White List mode, which blocks all traffic by default. You must create a policy to allow traffic into your network.

Move firewall policies

You can use the `move` command to change the order in which your firewall policies are applied.

In the following example, you have created two policy rules:

```
config firewall policy
   edit filter1
      set srcintf any
      set dstintf any
      set srcaddr rec
      set dstaddr internet
      set action deny
      set status enable
      set service service1 service2 service3 service4
      set nat disable
```

```
        next
        edit filter2
           set srcintf lan
           set dstintf wan
           set srcaddr wow
           set dstaddr internet
           set action allow
           set status enable
           set service service1 service2 service3 service4
           set nat disable
        next
     end
```

If you want to move policy one after two, you can use either of the following commands:

```
move filter1 after filter2
```

or

```
move filter2 before filter1
```

VPN

FortiExtender (Standalone) uses IPsec VPN to connect branch offices to each other. It only supports the site-to-site VPN tunnel mode.

An IPsec VPN is established in two phases: Phase 1 and Phase 2.

Several parameters determine how this is done, except for IP addresses, the settings simply need to match at both VPN gateways.

There are defaults that are applicable for most cases.

When a FortiExtender unit receives a connection request from a remote VPN peer, it uses IPsec Phase-1 parameters to establish a secure connection and authenticate that VPN peer. Then, the FortiExtender unit establishes the tunnel using IPsec Phase-2 parameters. Key management, authentication, and security services are negotiated dynamically through the IKE protocol.

To support these functions, the following general configuration steps must be performed on both units:

- Define the Phase-1 parameters that the FortiExtender unit needs to authenticate the remote peer and establish a secure connection.
- Define the Phase-2 parameters that the FortiExtender unit needs to create a VPN tunnel with the remote peer.
- Create firewall policies to control the permitted services and permitted direction of traffic between the IP source and destination addresses.
- Create a route to direct traffic to the tunnel interface.

Currently, FortiExtender only works in VPN client mode, be sure to keep the following limitations in mind when using this feature:

- If both ends of the VPN tunnel are FortiExtender devices, they must operate in NAT mode and use a static public IP address.
- If the remote device is not FortiExtender, it must have a static public IP address and can work in VPN server mode.

This section discusses the following topics:

- Configure VPN on page 53
- Check VPN tunnel status on page 59
- IPsec VPN support for third-party certificates on page 59

Configure VPN

VPN configurations include the following operations:

- Configure phase-1 parameters
- Configure phase-2 parameters
- Configure firewall policies
- Configure route

Configure phase-1 parameters

Use the following commands to configure a VPN tunnel.

CLI command	Description
`ike-version`	Specify the IKE protocol version, 1 or 2.
`keylife`	Specify the time (in seconds) to wait before the Phase-1 encryption key expires. The valid range is 20 –172800.
`proposal`	Specify Phase-1 proposal.
`Dhgrp`	Select one of the following DH groups: • `1` • `2` • `5` • `14`
`*interface`	Use either of the following: • `wan` • `eth1/lte1/lte2`
`type`	Select a remote gateway type: • `static` • `ddns`
`*remote-gw`	Specify the IPv4 address of the remote gateway's external interface.
`*remotegw-ddns`	Specify the domain name of the remote gateway, e.g., xyz.DDNS.com.
`authmethod`	Select an authentication method: • `psk(pre-shared key)` • `signature`
`*psksecret`	Specify the pre-shared secret created when configuring the VPN client.
`*certificate`	`set certificate <local-cert-name>` Specify the name of local signed personal certificates. This entry is only available when authmethod is set to signature. You can enter the names of up to four signed personal certificates for the FortiExtender unit. The certificates must have already been installed on the FortiExtender before you are trying to enter them here.
`*peer`	`set peer <ca-cert-name>` This is the name of the CA certificate used to constrain that the peer certificate is issued by it or its sub-CA. This entry is available only when authmethod is set to signature. The certificates must have already been installed on the FortiExtender before you are trying to enter them here. **Note:** If no peer is set, the peer certificate can still be accepted as long as a CA certificate that can verify the peer certificate exists.
`Localid`	Specify the local ID.
`peerid`	Accept the peer ID.

A Phase-1 interface can be of two categories:

- A static remote VPN gateway with a fixed IP address.
- A DDNS with a dynamic IP address functioning as a dynamic DNS client.

A Phase-1 interface can support the following two authentication methods:

- `psk` (pre-shared key)
- `signature`

When a `psk` is configured, the `psksecret` must be configured as well. When `signature` is chosen, it uses the default Fortinet certs for authentication. Signature mode only supports FortiGate or FortiExtender (Standalone) as a remote gateway.

A tunnel interface is created in the system interface list when an IPSec Phase-1 is successfully created.

Configure phase-2 parameters

Parameter	Description
`phase1name`	The name of Phase-1 which determines the options required for Phase- 2.
`proposal`	Phase-2 proposal.
`pfs`	Select either of the following: • `enable` • `disable`
`Dhgrp`	Phase-2 DH group.
`keylife-type`	Key life type.
`keylifeseconds`	Phase-2 key life time in seconds. **Note:** The valid range is 120—172800.
`encapsulation`	ESP encapsulation mode
`protocol`	Quick mode protocol selector. **Note:** The valid range is 1—255. 0 means for all.
`src-addr-type`	Local proxy ID type. Select one of the following: • `subnet`— IPv4 subnet • `range` —IPv4 range • `ip` —IPv4 IP • `name` — IPv4 network address name
`src-subnet`	Local proxy ID subnet. **Note:** This field is only available when `src-addr-type` is set to `subnet`.
`src-start-ip`	Local proxy ID start. **Note:** This field is only available when `src-addr-type` is set to either `range` or `ip`.
`src-end-ip`	Local proxy ID end. **Note:** This field is only available when `src-addr-type` is set to `range`.

Parameter	Description
src-name	Local proxy ID name. **Note:** This field is only available when src-addr-type is set to name.
src-port	Quick mode source port. **Note:** The valid range is 1—65535. 0 means for all.
dst-addr-type	Remote proxy ID type. Select one of the following: subnet— IPv4 subnet range —IPv4 range ip —IPv4 IP name— IPv4 network address name
dst-subnet	Remote proxy ID subnet. **Note:** The field is only available when dst-addr-type is set to subnet.
dst-start-ip	Remote proxy ID start. **Note:** This field is only available when dst-addr-type is set to either range or ip.
dst-end-ip	Remote proxy ID end. **Note:** This field is only available when dst-addr-type is set to range.
dst-name	Remote proxy ID name. **Note:** This field is only available when dst-addr-type is set to name.
dst-port	Quick mode destination port. **Note:** The valid range is 1—65535. 0 means for all.

Example VPN configuration:

```
FX201E5919002631 # config vpn ipsec phase1-interface
FX201E5919002631 (phase1-interface) #
config phase1-interface
    edit fcs-0-phase-1
        set ike-version 2
        set keylife 8000
        set proposal aes128-sha256 aes256-sha256 3des-sha256
        aes128-sha1 aes256-sha1 3des-sha1
        set dhgrp 14 5
        set interface eth1
        set type static
        set remote-gw 34.207.95.79
        set authmethod psk
        set psksecret HG709!ppA#d
        set localid FX04DA5918004527
        set peerid
    next
end
FX201E5919002631 # config network address
FX201E5919002631 (address) # show
    config network address
        edit local_subnet
```

```
        set type ipmask
        set subnet 192.168.2.0/24
    next
    edit remote_subnet
        set type ipmask
        set subnet 192.168.10.0/24
    next
end
FX201E5919002631 # config vpn ipsec phase2-interface
FX201E5919002631 (phase2-interface) #
    edit fcs-0-phase-2
        set phase1name fcs-0-phase-1
        set proposal aes128-sha1 aes256-sha1 3des-sha1
        aes128-sha256 aes256-sha256 3des-sha256
        set pfs enable
        set dhgrp 14 5
        set keylife-type seconds
        set keylifeseconds 86400
        set encapsulation tunnel-mode
        set protocol 0
        set src-type name
        set src-name local_subnet
        set src-port 0
        set dst-type name
        set dst-name remote_subnet
        set dst-port 0
    next
end
FX201E5919002631 # config firewall policy
FX201E5919002631 (policy) # show
config firewall policy
    edit to_remote
        set srcintf lan
        set dstintf fcs-0-phase-1
        set srcaddr local_subnet
        set dstaddr remote_subnet
        set action accept
        set status enable
        set service ALL
        set nat disable
    next
    edit from_remote
        set srcintf fcs-0-phase-1
        set dstintf lan
        set srcaddr remote_subnet
        set dstaddr local_subnet
        set action accept
        set status enable
        set service ALL
        set nat disable
next
end
FX201E5919002631 # config router static
FX201E5919002631 (static) # show
config router static
    edit to_remote
```

```
        set status enable
        set dst 192.168.10.0/24
        set gateway
        set distance 1
        set device fcs-0-phase-1
        set comment
    next
end
```

Configure firewall policies

You must define two ACCEPT firewall polices to permit communications between the source and destination addresses.

```
config firewall policy
     edit to_remote
         set srcaddr <The address name for the private network behind this
FortiExtender unit>
         set dstaddr <The address name that you defined for the private network
behind the remote peer>
         set service ALL
         set nat disable
         set srcintf <The interface that connects to the private network behind this
FortiExtender unit>
         set dstintf <The VPN Tunnel (IPsec Interface)>
         set status enable
     next
     edit from_remote
         set srcaddr <The address name that you defined for the private network
behind the remote peer>
         set dstaddr <The address name for the private network behind this
FortiExtender unit>
         set service ALL
         set nat disable
         set srcintf <The VPN Tunnel (IPsec Interface)>
         set dstintf <The interface that connects to the private network behind this
FortiExtender unit>
         set status enable
     next
end
```

Configure static routes

All network traffic must have a static route to direct its traffic to the proper destination. Without a route, traffic will not flow even if the firewall policies are configured properly. You may need to create a static route entry for both directions of VPN traffic if your firewall policies allow bi-directional tunnel initiation.

```
config router static
    edit to_remote
        set status enable
        set dst <The address name that you defined for the private network behind the
remote peer>
        set gateway <Leave as default: 0.0.0.0>
```

```
        set distance <Leave this at its default>
        set device <The VPN Tunnel (IPsec Interface)>
        set comment
    next
end
```

If there are other routes on the FortiExtender unit, you may need to set the distance on this route so the VPN traffic will use it as the default route. However, this normally happens by default because this route is typically a better match than the generic default route.

Check VPN tunnel status

Use the following command to check your VPN tunnel status:

```
FX201E5919002631 # get vpn IPSec tunnel details
fcs-0-phase-1: 0000002, ESTABLISHED, IKEv2, 94e21ce630f449a4_i* 07ca3af8b5fb4697_r
  local 'FX04DA5918004433' @ 100.64.126.36[4500]
  remote 'strongswan' @ 34.207.95.79[4500]
  AES_CBC-128/HMAC_SHA2_256_128/PRF_HMAC_SHA2_256/MODP_2048
  established 6850s ago, rekeying in 681s, reauth in 78404s
  fcs-0-phase-2: 0000002, reqid 2, INSTALLED, TUNNEL-in-UDP, ESP:AES_CBC-128/HMAC_
SHA1_96
    installed 6850s ago, rekeying in 72384s, expires in 88190s
    in cc6b72b7 (0x00000002), 704506 bytes, 6034 packets
    out c3e9cb25 (0x00000002), 673016 bytes, 7407 packets, 0s ago
    local 192.168.2.0/24
    remote 192.168.10.0/24
```

IPsec VPN support for third-party certificates

FortiExtender now is able to use third-party CA certificates at phase 1 to verify identity of peers and to establish IPsec VPN tunnels.

Import third-party certificates

Import a third-party CA certificate:

- From the Console: `execute vpn certificate ca import tftp <remote_file> <local_name> <ip>`
- From the GUI: Click **VPN>VPN Certificate>CA Certificate>Import New Certificate**.

Import a third-party Local certificate

- From the console: `execute vpn certificate local import tftp <remote_file> <local_name> <ip> <passwd>`
- From the GUI: Click **VPN>VPN Certificate>Entity Certificate>Import New Certificate.**

Use third-party certificates for IKE authentication

In 4.2.0, two new fields "certificate" and "peer" have been added to the phase1 interface entry. You can use them to reference the imported third-party certificates. It is important to know that these fields are available only when "authmethod" is set to signature.

Certificate

You can reference the datasource "vpn.certificate.local".

For the name of local signed personal certificates, you can enter the names of up to four signed personal certificates for the FortiExtender unit. You must have the certificated already installed on the FortiExtender beforehand to be able to enter them here.

Peer

You can reference the datasource "vpn.certificate.ca".

This is the name of the CA certificate used to constrain that the peer certificate is issued by it or its sub-CA. The certificates must have already been installed on the FortiExtender before you are able to enter them here.

If the peer is not set, the peer certificate can still be accepted as long as a CA certificate that can verify the peer certificate exists.

Example for using third-party certificates for IKE authentication

```
config vpn ipsec phase1-interface
    edit vpn1
        set ike-version 2
        set keylife 86400
        set proposal aes128-sha256 aes256-sha256 3des-sha256 aes128-sha1 aes256-sha1
3des-sha1
        set dhgrp 14 5
        set interface nas1
        set type static
        set remote-gw 192.168.137.106
        set authmethod signature
        set certificate <local_cert_name>   ==> new field
        set peer <ca_cert_name>             ==> new field
        set localid
        set peerid
```

```
        next
    end
```

SD-WAN

FortiExtender supports Software-Defined Wide Area Network (SD-WAN) to provide link load-balancing (LLB) among different links. It provides the following features:

- Virtual interface in system for routing system and firewall.
- Adding targets as members and balancing traffic among them.
- Link Load-balancing (LLB) for WAN interfaces or VPN tunnels.
- LTE interface as members of SD-WAN, or combined with a physical interface as members of SD-WAN.
- Support for multiple LLB algorithms:
  - Redundant
  - Weighted Round Robin (WRR)
- Redundant algorithm using a SD-WAN member for data transmission based on:
  - Priority
  - Cost
- Two LTE interfaces as members of SD-WAN redundant by cost algorithm:
  - The lowest cost target works as primary. When primary fails, the next lowest cost target will take over the primary role (fail-over).
  - When a dead primary comes back to life, it will retake the primary role (fail-back).
  - The cost of LTE interface is calculated based on the capacity and monthly-fee of the LTE plan.
- When the LTE and physical interface(s) are members of SD-WAN redundant by cost algorithm:
  - The physical interface must always be selected as lowest cost target and works as the primary.

This section covers the following topics:

- Configure an SD-WAN on page 62
- Check SD-WAN health on page 63
- Define an SD-WAN member on page 64

Configure an SD-WAN

Use the following commands to configure an SD-WAN.

CLI command	Description
`config system interface`	Enters system interface configuration mode.
`edit <vwan_name>`	Specify the name of the SD-WAN interface.
`set type virtual-wan`	Set the interface type to virtual-wan.
`set status <status>`	Set the status of the interface: • `up`—Enable the interface. • `down`—Disable the interface.

CLI command	Description
`set persistence {source | dest | ip-pair | connection}`	Select a LLB metric to denote how to distribute traffic: • `source`—Traffic from the same source IP is forwarded to the same target. • `dest`—Traffic to the same destination IP is forwarded to the same target. • `ip-pair`—Traffic from the same source IP and to the same destination IP is forwarded to the same target. • `connection`—Traffic with the same 5 tuples (i.e., a source IP address/port number, destination IP address/port number and the protocol) is forwarded to the same target
`set algorithm {redundant | WRR}`	Select the LLB algorithm: • `redundant`—Targets work in primary-secondary mode. • `WRR`—Targets work in Weighted Round Robin mode.
`Set grace-period`	Specify the grace period in seconds to delay fail-back.
`set session-timeout 60`	Specify the session timeout threshold in seconds. The default is 60. This is used to time out a VWAN session. A LLB session is created for each traffic stream. However, when a session times out, it is deleted.
`set members`	Add VWAN members to the VWAN interface.

FortiExtender (Standalone) supports both redundant and Weighted Round Robin (WRR) load-balancing algorithms.

In redundant mode, the link member with the highest priority is selected as the primary member to forward packets. When the primary member is down, the member with the next highest priority is selected.

In WRR mode, traffic is sent to each link member in a round-robin fashion based on the weight assigned to it.

- Weighted Round Robin (WRR)—Traffic is load-balanced based on the weight configured on the underlying link member. The weight value should be based on the available bandwidth of the link member.
- Redundant—If the primary link (determined by priority) goes down, traffic is steered to the secondary link. In the above example, if the algorithm were set to redundant mode, the priorities of the member interfaces (i.e., tunnel0 and tunnel1) must be different. A link with the lowest priority setting gains the primary link status.

Unreliable links can cause bouncing between the primary and the secondary links. Therefore, a grace-period option is provided.

Use persistence to guarantee a specific traffic stream always goes through the same link member. This is useful for a group of traffic streams related to the same application, and there is a time sequence and dependency among them. In this case, a proper persistence should be configured. Current available options are `source_ip`, `dest_ip`, `source_dest_ip_pair`, and `connection`.

Check SD-WAN health

A hmon.hchk is required for VWAN member status checking or health checking. Identify a server on the Internet and determine how the VWAN verifies that FortiExtender can communicate with it.

Example SD-WAN health check configuration:

The following commands are used to define a vwan_health_check and use it to perform health check for the VWAN member, member1.

```
config hmon hchk
    edit vwchk1
        set protocol ping
        set interval 5
        set probe-cnt 1
        set probe-tm 2
        set probe-target 8.8.8.8
        set interface fcs-0-phase-1
        set src-type interfce
        set src-iface nas1
        set filter rtt loss
    next
    edit vwchk2
        set protocol ping
        set interval 5
        set probe-cnt 1
        set probe-tm 2
        set probe-target 8.8.8.8
        set interface fcs-1-phase-1
        set src-type interfce
        set src-iface nas1
        set filter rtt loss
    next
end
```

You can use the "`get hmon hchk vwan.<vwan_member_name>`" command to show the latest statistics that the system has captured.

For every round of measurement, HMON first sends several packets. It then sorts the different round -trip times, and selects the median.

The output shows the following values:

- avg, max, min, now—average, maximum, minimum, current median
- sd—standard deviation of the median
- am/s—ratio of the average median vs. the standard deviation

Example health check output

```
FFX04DA5918000098 # get hmon hchk vwchk1
    median rtt:       avg      max      min      now       sd     am/s
 fcs-0-phase-1:  182.23ms 182.47ms 182.00ms 182.00ms   0.24ms    775.3
   packet loss:       avg      max      min      now
 fcs-0-phase-1:        0%       0%       0%       0%
```

Define an SD-WAN member

An SD-WAN link member is a target with a priority and weight clearly specified.

Use the following commands to define a link member.

CLI command	Description
`set target`	Specify the target to which traffic is forwarded.
`set priority`	Specify the priority of the link member. The valid value range is 1—7.
`set weight`	Specify the weight of the member.
`set health-check`	Specify the link health check of the VWAN.
`set health-check-fail-threshold`	Specify the number of consecutive failed probes before the member is considered dead. **Notes:** The valid value range is 1—10; the default is 5.
`set health-check-success-threshold`	Specify the number of consecutive successful probes before the member is considered alive. Note: The valid value range is 1—10; the default is 5.

Example SD-WAN member configurations:

The following example shows the configuration for two members (`tunnel0` and `tunnel1`) on top of interfaces `fcs-0-phase-1` and `fcs-1-phase-1`, respectively, and prefixed with a target. The same can be attained over any available interface type.

```
config system vwan_member
    edit tunnel0
        set target target.fcs-0-phase-1
        set priority 1
        set weight 1
        set in-bandwidth-threshold 0
        set out-bandwidth-threshold 0
        set total-bandwidth-threshold 0
        set health-check vwchk1
        set health-check-fail-threshold 5
        set health-check-success-threshold 5
    next
    edit tunnel1
        set target target.fcs-1-phase-1
        set priority 1
        set weight 1
        set in-bandwidth-threshold 0
        set out-bandwidth-threshold 0
        set total-bandwidth-threshold 0
        set health-check vwchk2
        set health-check-fail-threshold 5
        set health-check-success-threshold 5
    next
end
```

Health monitoring

This section discusses how to monitor network interface status and perform health check on links. It covers the following topics:

- Monitor interface status on page 66
- Perform link health check on page 67
- Configure health monitoring on page 69

Monitor interface status

Use the following commands to configure traffic monitoring on an interface.

CLI Command	Description
`*set interface <interface_name>`	Specify the interface to be monitored.
`set interval`	Specify the monitoring interval in seconds. The valid range is 1–3600. The default is 30.
`set filter {rx_bytes | tx_bytes | rx_packets | tx_packets | rx_dropped | tx_dropped | rx_bps | tx_bps | rx_pps | tx_pps}`	Set the monitor filters on the interface: • `rx_bytes`—The number of bytes received. • `tx_bytes`—The number of bytes transmitted . • `rx_packets`—The number of packets received. • `tx_packets`—The number of packets transmitted. • `rx_dropped`—The number of incoming packets dropped. • `tx_dropped`—The number of outgoing packets dropped. • `rx_bps`—The number of bytes received per second. • `tx_bps`—The number of bytes transmitted per second. • `rx_pps`—The number of packets received per second. • `tx_pps`—The number of packets transmitted per second.

Example interface monitoring configuration:

```
config hmon interface-monitoring
     edit fcs-0-phase-1-mon
          set interval 30
          set interface fcs-0-phase-1
          set filter rx_bytes tx_bytes
     next
     edit fcs-1-phase-1-mon
          set interval 30
          set interface fcs-1-phase-1
          set filter rx_bytes tx_bytes
     next
     edit ifmon
          set internal 30
```

```
            set interface lte1
            set filter rx_bytes tx_bytes
        next
    end
```

You can monitor the aforementioned configuration using the following commands:

```
X04DA5918004433 # get hmon interface-monitoring fcs-0-phase-1-
mon
                rx_bytes tx_bytes rx_packets tx_
packets rx_dropped tx_dropped rx_bps tx_bps
rx_pps tx_pps
fcs-0-phase-1: 12.76MB 3.40MB 24878 21032
0 0 488b 968b 0 0

X04DA5918004433 # get hmon interface-monitoring ifmon
                rx_bytes tx_bytes rx_packets tx_
packets rx_dropped tx_dropped rx_bps tx_bps
rx_pps tx_pps
lte1: 22.20MB 11.50MB 83137 72281
0 0 101.85Kb 21.14Kb 15 14
0
```

Perform link health check

Health checks can be performed on all types of links. The following example shows a health check configuration on top of two IPSec VPN links, “fcs-0-phase-1” and “fcs-1- phase-1”, respectively.

Use `hmon hchk` to send probes to a specific target to measure:

- The maximum, minimum, or average latency for a given period.
- The maximum, minimum, or average packet loss rate for a given period.
- The latency variation (jitter) for a given period.

Paramerter	Descriptions
`protocol {ping | http | dns}`	The protocol used for status check.
`interval`	The monitoring interval in seconds. The valid value range is 1—3600; the default is 5.
`probe-cnt`	The number of probes sent within the interval. The valid range is 1—10; the default is 1.
`probe-tm`	The timeout for a probe in seconds. The valid value range is 1—10; the default is 2.
`*probe-target`	The target to which a probe is sent.
`port`	The port number used to communicate with the server. The valid value range is 165535; the default is 80.
`http-get`	The URL used to communicate with the server. The default is /.

Paramerter	Descriptions
`*interface`	The outbound interface of probe packets.
`src-type {none | interface | ip}`	Specify the way to set the source address for probes.
`src-iface`	Set the source address as the address derived from the specified interface.
`src-ip`	Set the source address as a specific IP.
`filter {rtt | loss}`	Specify the desired filter.

Example health monitor health check configurations:

```
config hmon hchk
    edit fcs-0-phase-1-chk
        set protocol ping
        set interval 5
        set probe-cnt 1
        set probe-tm 2
        set probe-target 34.207.95.79
        set interface fcs-0-phase-1
        set src-type interfce
        set src-iface lan
        set filter rtt loss
    next
    edit fcs-1-phase-1-chk
        set protocol ping
        set interval 5
        set probe-cnt 1
        set probe-tm 2
        set probe-target 34.207.95.79
        set interface fcs-1-phase-1
        set src-type interfce
        set src-iface lan
        set filter rtt loss
    next
end
```

You can get the health check status for the above configurations using the following command:

```
FX04DA5918004433 # get hmon hchk fcs-0-phase-1
   median rtt:       avg      max      min      now       sd     am/s
fcs-0-phase-1:  141.00ms 151.62ms 127.73ms 132.06ms   7.28ms     19.4
  packet loss:       avg      max      min      now
fcs-0-phase-1:        0%       0%       0%       0%

FX04DA5918004433 # get hmon hchk fcs-1-phase-1
   median rtt:       avg      max      min      now       sd     am/s
fcs-1-phase-1:  121.27ms 133.56ms 108.98ms 115.86ms 8.49ms 14.3
  packet loss:       avg      max      min      now
fcs-1-phase-1:        0%       0%       0%       0%
```

Configure health monitoring

Health Monitoring or HMON is commonly used for monitoring network and system health status, in addition to notifying subscribers of certain conditions which result in reporting collected statistics to FortiExtender cloud or FortiGate, respectively. One instance could involve data overage, another could be probing targets via ping or HTTP, and another could be checking link usability based on RTT or packet loss.

To configure interface monitoring:

```
config hmon
       config interface-monitoring
               edit < interface specific monitor name >
                       set interval <interval size in seconds, default:30>
                       set interface <interfaces to monitor: lte1, lte2>
                       set filter <interested fields: rx_bytes,tx_bytes,rx_packets,tx_packets,rx_
                               dropped,tx_dropped,rx_bps,tx_bps,rx_pps,tx_pps>
               next
       end
```

To configure health check (which can be via ping, http,etc with specific intervals, timeouts and filters on any specific interface or interfaces):

```
config hchk
       edit < health check type name >
               set protocol <ping|http|dns, default: ping>
               set interval <interval size in seconds, default :30>
               set probe-cnt <probes to be sent within an intervalm default:1>
               set probe-tm <probe timeout, default:2>
               set probe-target <target to be probed>
               set interface <uplink interfaces on which probe has to be sent>
               set src-iface <interface whose source IP is to be used>
               set filter <rtt |loss>
       next
       end
end
```

To display interface statistics with a pre-configured filter of choice:

```
get hmon interface-monitoring <interface specific monitor name>
```

To display health check statistics:

```
get hmon hchk <health check type name>
```

To run health check monitor to display all the interface statistics:

```
execute hmon interface-monitoring <interface>
```

To run health check instance on a specific interface:

```
execute hmon hchk protocol ping -I <interface> <probe ip or url>
```

System management

This section discusses system management tasks. It covers the following topics:

- Get system version on page 72
- Upgrade OS firmware on page 73
- Upgrade modem firmware on page 74
- SMS notification on page 75
- Remote diagnostics via SMS on page 76
- Export system logs to remote syslog servers on page 76
- Support for SNMP (read-only) and traps on page 77

Add trusted hosts

FortiExtender OS enables you to add trusted hosts so that administrators of the hosts can connect to it (the FortiExtender device) via the IP/network. You can specify any IPv4 address or subnet address and netmask from which an administrator can connect to the FortiExtedner.

Each administrator can create up to 10 trusted hosts, which can access the device from any IPv4 address by default.

To add trusted hosts:

```
FX201E5919000054 # config system admin
FX201E5919000054 (admin) # edit admin
FX201E5919000054 (admin) # show
edit admin
   set accprofile super_admin
   set password ENC $5$Ht4I..iMtoqzQdJn$tA/wEHn8yAs8Ap19pcBrYE6O92jEI9OnDSY6Y/ujJ9B
   set trusthost1 192.168.1.115
   set trusthost2
   set trusthost3 192.168.2.0/24
   set trusthost4
   set trusthost5
   set trusthost6
   set trusthost7
   set trusthost8
   set trusthost9
   set trusthost10
next
```

Parameter	Description
`edit <usernaem>`	Specify the admin username.
`set accprofile`	Specify the access profile name.

Parameter	Description
`set password`	Specify the admin user password.
`set trusthost1`	Specify the IPv4 address or subnet address/netmask of the host from which the administrator connects to the device.
`set trusthost2`	See "trusthost1" above.
`set trusthost3`	See "trusthost1" above.
`set trusthost4`	See "trusthost1" above.
`set trusthost5`	See "trusthost1" above.
`set trusthost6`	See "trusthost1" above.
`set trusthost7`	See "trusthost1" above.
`set trusthost8`	See "trusthost1" above.
`set trusthost9`	See "trusthost1" above.
`set trusthost10`	See "trusthost1" above.

Activate the default admin account

This feature enables you to activate (i.e., make visible) the admin user account created and hidden in previous versions of your FortiExtender so that you can edit or remove it if needed.

To activate the hidden default admin account:

```
FX201E5919000054 # config system admin
FX201E5919000054 (admin) # show
config system admin
   edit admin
         set accprofile super_admin
         set password ENC
              $5$Ht4I..iMtoqzQdJn$tA/wEHn8yAs8Ap19pcBrYE6O92jEI9OnDSY6Y/ujJ9B
         set trusthost1
         set trusthost2
         set trusthost3
         set trusthost4
         set trusthost5
         set trusthost6
         set trusthost7
         set trusthost8
         set trusthost9
         set trusthost10
   next
end
FX201E5919000054 (admin) #
```

Multiple static access controller addresses or FQDN

FortiExtender enables you to specify multiple access controllers while "`ac-discovery-type`" is static, or specify FQDN (`static-ac-ip-addr` has been changed to `static-ac-addr`).

To configure multiple static access controller or FQDN:

```
config system management fortigate
    set ac-discovery-type static
    config static-ac-addr <=== New table which replaced previous static-ac-ip-addr
        edit 1
            set server 192.168.1.99
        next
        edit 2
            set server fortisase.fortiextender.com
        next
        ...
    end
    set ac-ctl-port 5246
    set ac-data-port 25246
    set discovery-intf wan lan port1 port2 port3 port4
    set ingress-intf
end
```

The "`static-ac-ip-addr`" in pre-7.0.2 releases has now been replaced by "`static-ac-addr`" which is a table that allows you to configure up to 16 entries. For each entry, you can specify the server as in FQDN string or IPv4-address string format.

If you have `static-ac-ip-addr` specified in a pre-7.0.2 version of ForitExtender OS, an entry "1" will be automatically generated and its value of "server" will be the string configured in "static-ac-ip-addr" of old version, after you have upgraded to 7.0.2.

Get system version

Use the following command to find out your system version:

```
FX211E5919000011 # get system version
System version:
    image version   : FXT211E-v4.12-build400
    image type      : Interim
    model           : FortiExtender-211E
    MAC             : 04:d5:90:21:5f:c7
    SN              : FX211E5919000011
    license         : ae30e2902fc1fe8f
    OEM SN          : FX211E5919000011
    REV             : 24258-01
    VERSION         : 00020003
    ROM REV         : FX211E
    Fallback image  : FXT211E-v4.12-build400
    Image type      : Interim
```

Get user session status and force log-out

FortiExtender enables you to get the session status of users currently logged in the system and to log them out if necessary.

To get the session status of current users:

```
FX201E5919000054 # get system admin status
admin accprofile: super_admin
          session: Console start time: 2021-10-27 20:50:36
          session: GUI start time: 2021-10-28 10:13:35 remote: 192.168.1.115

test1 accprofile: super_admin
          session: GUI start time: 2021-10-28 11:33:20 remote: 192.168.1.120
          session: Telnet start time: 2021-10-28 13:42:15 remote: 192.168.1.115
```

To force-log out users:

```
FX201E5919000054 # execute disconnect-admin-session
all All sessions
console Console session
telnet Telnet session
ssh SSH session
gui GUI session
gui-console GUI Console session

FX201E5919000054 # execute disconnect-admin-session all
Usage: disconnect-admin-session <session-type> <logged-in-admin>

FX201E5919000054 # execute disconnect-admin-session all test1
```

Upgrade OS firmware

You can upgrade FortiExtender (Standalone) OS firmware from FortiGate or FortiExtender (Standalone) Cloud. You can also upgrade the OS image directly using the FortiExtender GUI, or any of the following CLI commands, depending on your circumstances::

TFTP

```
execute restore os-image tftp <image name> <tftp server IP address>
```

FTP

```
execute restore os-image ftp <image name> <ftp server IP address> <username>
     <password>
```

USB

1. Configure the OS image name.
```
config system
      set hostname
      set auto-install-image enable
      set default-image-file <OS image name>
end
```
2. Insert the USB and reboot FortiExtender (Standalone).

FortiExtender Cloud

Even when FortiExetnder is managed locally in standalone mode, you can upgrade its OS image by pulling the latest version from the Cloud.

1. Enter this command:
```
execute restore os-image cloud
```
   The available OS images show on FortiExtender (Standalone) Cloud.
2. Select the appropriate option offered in the CLI.
   FortiExtender (Standalone) automatically downloads the images.

GUI

1. From the navigation bar, click **Settings**.
2. On top of the page, click **Firmware.**
3. Select the desired OS firmware to upgrade.

Upgrade modem firmware

The FortiExtender modem firmware can't be upgraded from FortiGate. It must be upgraded from FortiExtender Cloud. The modem firmware is available as a downloadable package from the support site and can be upgraded directly from the FortiExtender CLI or by using the following commands, depending on your circumstances.

TFTP

```
execute restore modem-fw tftp <package name> <tftp server IP address>
```

FTP

```
execute restore modem-fw ftp <package name name> <ftp server IP address>
     <username> <password>
```

USB

```
execute restore modem-fw usb <modem package name>
```

FortiExtender Cloud

Even when FortiExetnder is managed locally in standalone mode, you can upgrade its firmware image by pulling the latest version from the Cloud.

1. Enter this command:
   ```
   execute restore modem-fw cloud
   ```
   The available modem images show on FortiExtender (Standalone) Cloud.
2. Select the appropriate option in the CLI.
   FortiExtender (Standalone) automatically downloads the images.

GUI

1. From the navigation bar, click **Settings**.
2. On top of the page, click **Firmware.**
3. Select the desired modem firmware to upgrade.

SMS notification

FortiExtender-201E and 211E support Simple Message Service (SMS). This enables you to configure multiple mobile phone numbers on the FortiExtender to received SMS alerts.

To create receivers:

```
config system sms-notification
       set notification enable/disable

config receiver
       edit <user1>
               set receiver enable/disable
               set phone-number <mobile phone number, format: +(country code)(phone number)>
               set alert <type of alerts i.e system-reboot,data-exhausted,session-disconnect,etc >
       next
       edit <user2>
               set receiver enable/disable
               set phone-number <mobile phone number, format: +(country code)(phone number)>
               set alert <type of alerts i.e system-reboot,data-exhausted,session-disconnect,etc >
       next
end
```

The following are the types of alerts that are supported:

```
config system sms-notification alert
    set system-reboot system will reboot
```

```
    set data-exhausted data plan is exhausted
    set session-disconnect LTE data session is disconnected
    set low-signal-strength LTE signal strength is too low
    set os-image-fallback system start to fallback OS image
    set mode-switch system networking mode switched
    set fgt-backup-mode-switch FortiGate backup work mode switched
end
```

Remote diagnostics via SMS

FortiExtender supports remote diagnostics by SMS.

To enable remote diagnostics by SMS:

```
FX211E5919000011 # config system sms-remote-diag
FX211E5919000011 (sms-remote-diag) # show
config system sms-remote-diag
    set remote-diag enable
    config allowed-user
        edit user
            set sender disable
            set phone-number 5714515627
            set allowed-command-type factory-reset reboot get-system-status
        next
        edit user2
            set sender enable
            set phone-number 5714515627
            set allowed-command-type reboot get-modem-status get-extender-status
        next
    end
end
```

Export system logs to remote syslog servers

In order for FortiExtender to forward system logs to a remote syslog server, the syslog server and FortiExtender's LAN port must be part of the same subnet.

FortiExtender is able to forward system logs to remote syslog servers based on user configuration.

To enable exporting system logs to a remote syslog server:

```
FX211E5919000011 # config system syslog
FX211E5919000011 (syslog) # show
config system syslog
    set remote-server
    set remote-port 514
end

FX211E5919000011 (syslog) # set
```

```
remote-server    Remote Syslog server IP address
remote-port      Remote Syslog server port
```

Support for SNMP (read-only) and traps

As an SNMP agent, FortiExtender responds to SNMP managers query on v1/v2c and v3 protocol. It supports the following SNMP trap events (which can be configured in both SNMP community and user events):

- system-reboot
- data-exhausted
- session-disconnect
- low-signal-strength
- os-image-fallback
- mode-switch
- fgt-backup-mode-switch

Typical SNMP commands

The following are commands commonly used to configure SNMP in FortiExtender.

```
FX201E5919000054 # config snmp
FX201E5919000054 (snmp) # show
config snmp
   config sysinfo
      set status enable
      set description
      set contact-info
      set location
   end
   config community
      edit fext
         set status enable
         set hosts lan
         set query-v1-status enable
         set query-v1-port 161
         set query-v2c-status enable
         set query-v2c-port 161
         set trap-v1-status enable
         set trap-v1-lport 162
         set trap-v1-rport 162
         set trap-v2c-status disable
         set trap-v2c-lport 162
         set trap-v2c-rport 162
         set events
      next
   end
   config user
   end
   config hosts
      edit lan
         set host-ip 172.30.0.0/16
```

```
        set host-type any
      next
   end
end
```

Sample SNMP commands

```
FX201E5919000054 # config snmp
FX201E5919000054 (snmp) # show
config snmp
   config sysinfo
      set status disable
      set description
      set contact-info
      set location
   end
   config community
   end
   config user
   end
   config hosts
   end
end

FX201E5919000054 (snmp) # config
sysinfo SNMP system info setting
community SNMP v1/v2c community setting
user SNMP v3 user setting
hosts SNMP hosts setting

FX201E5919000054 (snmp) # config sysinfo
FX201E5919000054 (sysinfo) # show
config snmp sysinfo
   set status disable
   set description
   set contact-info
   set location
end

FX201E5919000054 (sysinfo) # set
status Enable/disable SNMP
description System description. size[127]
contact-info Contact information
location System location. size[127]
FX201E5919000054 (sysinfo) # end

FX201E5919000054 # config snmp hosts
FX201E5919000054 (hosts) # edit lan
FX201E5919000054 (lan) <M> # set
*host-ip IPv4 address of the SNMP manager(host), syntax: X.X.X.X/24
host-type Control whether the SNMP manager sends SNMP queries, receives SNMP traps,
      or both
FX201E5919000054 (hosts) # end

FX201E5919000054 # config snmp community
FX201E5919000054 (community) # edit fext
```

```
FX201E5919000054 (fext) <M> # set
status Enable/disable this SNMP community
hosts Configure IPv4 SNMP managers (hosts)
query-v1-status Enable/disable SNMP v1 queries
query-v1-port SNMP v1 query port (default = 161)
query-v2c-status Enable/disable SNMP v2c queries
query-v2c-port SNMP v2c query port (default = 161)
trap-v1-status Enable/disable SNMP v1 traps
trap-v1-lport SNMP v1 trap local port (default = 162)
trap-v1-rport SNMP v1 trap remote port (default = 162)
trap-v2c-status Enable/disable SNMP v2c traps
trap-v2c-lport SNMP v2c trap local port (default = 162)
trap-v2c-rport SNMP v2c trap remote port (default = 162)
events SNMP trap events
FX201E5919000054 (community) # end


FX201E5919000054 # config snmp user
FX201E5919000054 (user) # edit lan
FX201E5919000054 (lan) <M> # set
status Enable/disable this SNMP user
notify-hosts SNMP managers to send notifications (traps) to
trap-status Enable/disable traps for this SNMP user
trap-lport SNMPv3 local trap port (default = 162)
trap-rport SNMPv3 trap remote port (default = 162)
queries Enable/disable SNMP queries for this user
query-port SNMPv3 query port (default = 161)
events SNMP trap events
security-level Security level for message authentication and encryption
FX201E5919000054 (user) # end
```

Executable SNMP commands

```
FX201E5919000054 # execute snmpmibs
download Export SNMP MIBs to tftp server
FX201E5919000054 # execute snmpmibs download
tftp download through TFTP.
FX201E5919000054 # execute snmpmibs download tftp
FORTINET-CORE-MIB.mib download FORTINET-CORE-MIB.mib
FORTINET-FORTIEXTENDER-MIB.mib download FORTINET-FORTIEXTENDER-MIB.mib
FX201E5919000054 # execute snmpmibs download tftp FORTINET-CORE-MIB.mib
Usage: snmpmibs export mib_file tftp tftp_server
<mpmibs download tftp FORTINET-FORTIEXTENDER-MIB.mib
Usage: snmpmibs export mib_file tftp tftp_server
FX201E5919000054 #
```

Get MIB2 interface statistics via SNMP

FortiExtender supports MIB2 interface, which enables you to get interface statistics directly from the device via SNMP.

It supports the OID range from 1.3.6.1.2.1.2.2.1.1 to .1.3.6.1.2.1.2.2.1.22. Below are some examples:

```
OID: .1.3.6.1.2.1.2.2.1.16.3
Value: 29002
Type: Integer

OID: .1.3.6.1.2.1.2.2.1.16.4
Value: 10614
Type: Integer

OID: .1.3.6.1.2.1.2.2.1.16.5
Value: 0
Type: Integer

OID: .1.3.6.1.2.1.2.2.1.16.6
Value: 2794
Type: Integer
```

Dual modems

Dual modem means that a FortiExtender unit comes with two LTE interfaces for internet connectivity. These two LTE interfaces can be used for link load balancing.

- Dual-modem in IP pass-through mode on page 91
- Dual modems in NAT mode on page 92

Dual modems in NAT mode

In NAT mode, FortiExtender functions as a gateway with two LTE interfaces. You can use either a virtual WAN interface or a policy-based route to do link-load balancing.

For more information, refer to Interface configuration guideline on page 19 for Virtual-WAN interface and System routing on page 34 for policy-based route configurations.

Troubleshooting, diagnostics, and debugging

This section discusses system troubleshooting, diagnostics, and debugging. It covers the following topics:

- Troubleshooting on page 82
- Status, diagnostics, and debugging commands on page 83
- Diagnose FortiExtender

Troubleshooting

Below are some common error situations with their suggested solutions.

Can’t manage the FortiExtender (Standalone) from FortiExtender (Standalone) Cloud

Upgrade the FortiExtender (Standalone) to OS version 3.3.0 or higher.

Can’t start an Internet session

1. Type `execute debug-mode ati` to enter debug mode.
2. Troubleshoot in the following sequence:

Step	Task	CLI command to use
1	**Check the SIM card** If the SIM is accessible, output the SIM IMSI number, for example, 311480420284429. If the SIM can’t be read, reinsert it into the SIM slot until it clicks into place.	`AT+CIMI`
2	**Check the modem firmware compatibility** The current firmware and the preferred firmware for the inserted SIM card must be the same, or else the output will indicate a mismatch error.	`AT!IMPREF?` `AT!GOBIIMPREF?`
3	**Check the signal availability** Ensure that the FortiExtender has good signal strength to derive good speeds and prevent time-outs.	`AT!GSTATUS?`
4	**Check Internet connectivity** Check to see if the APN is configured correctly. Although the modem in FortiExtender (Standalone) can negotiate the APN, it might run into issues with some wireless providers.	`AT+CGDCONT?`

Status, diagnostics, and debugging commands

FortiExtender (Standalone) supports the following CLI commands for system status checking, diagnostics, and debugging.

Task	CLI command/action
Check connectivity to FortiGate	`get extender status`
Check connectivity to FortiExtender (Standalone)Cloud	`get cpm status`
Check the status of modems	`get modem status`
Perform health checks and monitoring	`get hmon hchk vwan.<vwan_member name>` (The member can be tunnel0 or tunnel1.)
Logs on telnet/ssh	`execute debug log-to-console on`
Perform modularized debugging	**1.** Select the module. **2.** Turn the log level on/off as needed.
Debug	`execute debug <module> <log level> on/off`
	`SYSTEM,MONITORD, EXTD, MDMD, CONNMGR,NETD,CLI,GUI CPM,CONFIG,JCLI,HMON,IPSecD,FIREWALLD`
Applicable log levels	`error, info, dbg, fatal, warning, trace`

Diagnose from Telnet

1. From the Windows Command prompt, type `cmd`.
2. Type `telnet [modem ip address]`. (The default IP address is 192.168.100.20/24.)
3. Enter your user name and password as required.
4. Enter the command you want.

Collect complete diagnostics information

FortiExtender (Standalone) now supports collecting all diagnostics information in a compressed package. The package contains all details, including system software, hardware, configuration, CPU usage, memory usage,

modem status, interfaces, routing tables, IP tables, VPN, session tables, and kernel logs.

Use the following command to collect all diagnostics information:

```
execute debuginfo export tftp <filename.tgz> <tftp server ip address>
```

Appendix A: Configure LTE settings

- Add a new carrier profile on page 85
- Add a new operator/carrier on page 85
- Activate a SIM card on page 87
- Configure start session timeout on page 88
- Check the recorded SIM card IMSI number on page 89
- Delete the recorded SIM card IMSI number on page 89
- Set the default SIM on page 89
- Enable SIM-switch on page 90
- Dual modems on page 91

Add a new carrier profile

Default carrier profiles are included in modem firmware package. You can check the default carriers using the following commands:

```
get extender lte-carrier-list <FEX SN>
   show
   end
```

If your carrier is not in the list of profiles, you can create a customized carrier profile using the following commands:

```
config lte carrier
edit <carrier>
   set firmware <firmware name>
   set pri <pri name>
next
```

Add a new operator/carrier

An SIM map entry is used to get the carrier from the PLMN. Most PLMNs are supported in the default configuration. You can always check if your SIM PLMN is supported using the following command:

```
get extender lte-carrier-by-mcc-mnc <FEX SN> <MCC> <MNC>
```

If you cannot find the carrier of your SIM card, you can add a customized SIM using the following commands:

```
execute extender lte-simmap add <FEX SN> <MCC> <MNC> <Carrier_Name>
edit <carrier>
   set mcc <first 3 digits of the IMSI number>
   set mnc <next 2 digits the IMSI number>
   set carrier <carrier name from the newly created carrier profile>
next
```

The new operator/carrier requires at least one matched carrier profile entry from "`get extender lte-carrier-list <FEX SN>`" to take effect.

Create a data plan

You can configure a data plan on the FortiGate with the below parameters:

```
config extender-controller dataplan
    edit Verizon
        set modem modem1
        set type by-carrier
        set carrier Verizon
        set apn WE01.VZWSTATIC
        set auth NONE
        set user
        set pwd
        set pdn ipv4-only
        set signal-threshold 0
        set signal-period 0
        set capacity 0
        set monthly-fee 0
        set billing-date 0
        set overage disable
        set preferred-subnet 32
        set private-network disable
    next
end
```

When "`private network`" is enabled, FortiExtender allows the flow of non-NAT'ed IP traffic on to an LTE interface. Otherwise, it does not.

Parameter	Description
modem	Choose “modem1”, “modem2”, or “all”.
type	Choose the way for the modem to select the SIM card: • carrier— Assign by SIM carrier. • slot— Assign to SIM slot 1 or 2. • iccid— Assign to a specific SIM by its serial number (18 to 22 digits). • generic— Compatible with any SIM. Assigned if no other data plan matches the chosen SIM.
iccid	The serial number of the SIM, mandatory for “set type by-iccid”.
carrier	The SIM card carrier, mandatory for “set type by-carrier”.
slot	The SIM card slot, mandatory for “set type by-slot”

Parameter	Description
apn	Set the APN of the SIM card.
auth-type	Choose the Authorization mode.
username	Set the username.
password	Set the password.
pdn	Choose the Packet Data Network (PDN) IP address family.
signal-threshold	Set the signal-strength threshold beyond which SIM switch will occur. **Note:** Enter an integer value from <50> to <100> (default = <100>).
signal-period	Set the length of time (from 600 to 18000 seconds) for SIM switch to occur when signal strength remains below the set signal threshold for more than half of the set period.
capacity	Set data capacity per month (from 0 to 102400000 MB).
monthly-fee	Set the monthly fee for the data plan (from 0 to 1000000).
billing-date	Set the billing date of the month.
preferred-subnet	DHCP subnet.
private-network	Enable/disable blocking all non-NAT'ed traffic.

Activate a SIM card

A new SIM card must be activated to connect to the ISP network. Activating a SIM card generally takes about 10 seconds to complete, but it might take minutes or longer in some rare cases.

The "`set sim-activation-delay 300`" command comes into play when a new SIM card fails to be activated within 10 seconds. It has a default value of 300 seconds to activate a SIM, and the configurable range is from 5 seconds to 600 seconds.

To activate a SIM card:

```
FX201E5919000035 # config lte setting
   FX201E5919000035 (setting) # show
   config lte setting
       config controller-report
           set status disable
       end
       config modem1
           set cert-mode disable
           set default-sim sim1
           set session-down-detection 3
           set gps enable
           set sim1-pin disable
```

```
            set sim2-pin disable
            config auto-switch
                set by-disconnect disable
                set by-signal disable
                set by-data-plan disable
                set switch-back
            end
        end
        set advanced enable <==new, default is disable
        config advanced-settings <==new, display only when "set advanced enable"
            set sim-activation-delay 300 <==(5 - 600 sec, default = 300 sec)"
        end
    end
```

Configure start session timeout

Generally, the "`set session-dial-timeout 0`" command has a default value of 0, meaning "disabled".

In some case, it may take time for the modem to establish a session, so you may need to set it to a larger value to ensure that the modem has enough time to connect.

To set up a timeout for start session:

```
 FX201E5919000035 (plan) # edit 1
    FX201E5919000035 (1) <M> # show
    edit 1
        set modem all
        set type by-default
        set apn
        set auth NONE
        set user
        set pwd
        set pdn ipv4-only
        set signal-threshold -100
        set signal-period 3600
        set capacity 0
        set monthly-fee 0
        set billing-date 1
        set overage disable
        set preferred-subnet 0
        set private-network disable
        set session-dial-timeout 0 <=== new, default is 0, means no special wait,
keep the previous design. range": "0-180"
    next

    FX511F5919000000 # execute modem delete-sim-record modem1
    all delete all the IMSI for modem1
    imsi delete one IMSI for modem1
```

Check the recorded SIM card IMSI number

When a SIM card is activated, FortiExtender records the IMSI number of the card. You can use the following command to check the records.

To check the recorded SIM card IMSI number:

```
FX201E5919000035 # get lte sim-imsi-record
      Modem1:
      ***No-record!***
      End
    FX201E5919000035 #

    FX201E5919000035 # get lte sim-imsi-record
      Modem1:
      Index IMSI
      1: 310260888228819
      End
```

Delete the recorded SIM card IMSI number

FortiExtender records the IMSI number of a SIM card when the card is activated. The following command enables you to remove the IMSI number from the record.

To delete the recorded SIM card IMSI number:

```
FX511F5919000000 # execute modem delete-sim-record
    modem1 Print latest modem log
    modem2 Print previous modem log
```

Set the default SIM

When installing two SIM cards in one modem, you can configure the default SIM to use.

You can set the default SIM by

- Set the default SIM by preferred carrier on page 89
- Set the default SIM by low cost on page 90
- Set the default SIM by SIM slot on page 90

Set the default SIM by preferred carrier

Use this option to set the default SIM if you have SIM cards from different carriers.

```
config extender-controller extender
    edit <FEX_SN>
        set authorized enable
        config modem1
            set ifname <fext-wan>
            set default-sim carrier
            set preferred-carrier <carrier name>
        end
    next
end
```

Set the default SIM by low cost

This option applies when you need to choose the low-cost SIM over a more expensive one.

You must configure two entries under "`config lte plan`" for the two SIM cards separately. The system will calculate the cost based on the "`set capacity`" and "`monthly-fee`".

```
config extender-controller extender
    edit <FEX SN>
        set authorized enable
        config modem1
            set ifname <fext-wan>
            set default-sim cost
        end
    next
end
```

Set the default SIM by SIM slot

The default SIM is sim1. You can change it to sim2 using the following commands:

```
config extender-controller extender
    edit <FEX SN>
        set authorized enable
        config modem1
            set ifname <fext-wan>
            set default-sim sim1|2
        end
    next
end
```

Enable SIM-switch

```
config extender-controller extender
    edit <FEX SN>
        set authorized enable
        config modem1
            set ifname <fext-wan>
            config auto-switch
                set by-disconnect enable
```

```
                set by-signal disable
                set by-data-plan disable
                set disconnect-threshold 1
                set disconnect-period 600
                set switch-back by time by-timer set switch-back-by-time 00:01
                set switch-back-by-timer 3600
            end
        end
    next
end
```

SIM-switching can be configured by data plan, disconnect settings, signal strength, coupled with switch back by time or by timer. All these options are under the “Auto switch” setting.

Parameter	Description
by-disconnect	The SIM card switches when the active card gets disconnected according to the 'disconnect-threshold' and 'disconnect-period'.
by-signal	The SIM card switches when the signal strength gets weaker than the signal-threshold.
by-data-plan	The SIM card switches when 'capacity' is overrun and 'overage' is enabled.
disconnect-threshold	The number (1 - 100) of disconnects for SIM switch to take place.
disconnect-period	The evaluation period (600 - 18000) in seconds for SIM switch.
switch-back	Enables switching back to the preferred SIM card.
switch-back-by-time	Switches over to the preferred SIM /carrier at a specified (UTC) time (HH:MM).
switch-back-by-timer	Switches over to the preferred SIM/carrier after a given time (3600-2147483647) in seconds.

Dual modems

Dual modem means that a FortiExtender unit comes with two LTE interfaces for internet connectivity. These two LTE interfaces can be used for link load balancing.

- Dual-modem in IP pass-through mode on page 91
- Dual modems in NAT mode on page 92

Dual-modem in IP pass-through mode

Dual modems mean that a FortiExtender unit comes with two LTE interfaces for internet connectivity. These two LTE interfaces can be used for link load balancing. FortiExtender works in local IP pass-through mode, as an

extended modem of any router. In this mode, FortiExtender must be connected directly to the WAN port of the router and the router WAN port must be in DHCP mode.

Enable local IP pass-through mode

To enable local IP pass-through mode:

```
FX212E5919000009 # config system management local
FX212E5919000009 (local) # set mode ip-passthrough
FX212E5919000009 (local) # end
FX212E5919000009 # config system management
FX212E5919000009 # set discovery-type local
FX212E5919000009 # end
```

Configure a virtual Wire Pair

A virtual wire pair configuration is necessary to enable the IP Pass-through forwarding between two ports.

To configure a virtual pair:

```
FX212E5919000009 # config system virtual-wire-pair
FX212E5919000009 (virtual-wire-pair) # set lte1-mapping lan
FX212E5919000009 (virtual-wire-pair)# end
```

Dual modems in NAT mode

In NAT mode, FortiExtender functions as a gateway with two LTE interfaces. You can use either a virtual WAN interface or a policy-based route to do link-load balancing.

For more information, refer to Interface configuration guideline on page 19 for Virtual-WAN interface and System routing on page 34 for policy-based route configurations.

Change Log

Date	Change Description
December 17, 2021	FortiExtender (Standalone) 7.0.3 Admin Guide.

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