FortiGate Firewall

FortiGate Firewall

Practical Guidance and Hands-On Labs

Hamid Talebi

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Preface

Firewall technologies are growing very fast and knowing how to protect the network is vital for network administrators. A firewall is a network security device that monitors incoming and outgoing network traffic and decides whether to allow or block specific traffic based on a defined set of security rules. Firewalls have been the first line of defense in network security for over 25 years.[1] The lack of materials available for students to learn is part of our issue.

Since I have been teaching Enterprise Security at BCIT, I have received a lot of feedback from my students. Then, I have decided to collect all labs and make them as a book for students. This book is part of the Enterprise Security Course and is based on the practical labs in the class. Each chapter begins with a learning objective and step-by-step explanations in GNS3 to beginners on how to build different security scenarios from scratch.

The book is divided into ten chapters as following:

- **Chapter 1. Basic Settings** of FortiGate firewall and how to work with CLI or GUI to configure the firewall.
- **Chapter 2. Policy:** We will focus on firewall policy and how firewall pass the traffic from one port to another port.
- **Chapter 3. NAT:** We will use Source NAT and Destination NAT. You will learn how to use port forwarding when you are using DNAT.
- **Chapter 4. VPN:** This is very important chapter focus on SSL VPN and IPsec VPN. You will learn how to set site-to-site VPN.
- **Chapter 5. Authentication:** This chapter will focus on Captive Portal and FSSO. You will learn how to install FSSO Agent in the server and monitor Active Directory.
- **Chapter 6. High Availability:** This chapter will focus on High Availability (Active-Passive) in FortiGate firewalls.
- **Chapter 7. Security:** This chapter will focus on security profile, DDoS prevention and VLANs configuration.
- **Chapter 8. VDOM** or Virtual Domain is a feature in FortiGate firewalls to manage resources and access. You will learn how to enable VDOM and how to use it.
- **Chapter 9. SD-WAN:** This chapter will focus on SD-WAN and how to use this feature.
- **Chapter 10. Cloud Technologies:** This chapter will focus on how to deploy FortiGate in the cloud.
- **Appendix:** We will cover basic GNS3 settings you need during this book.

As we know “a picture is worth 1000 words” and that is why this book is based on snapshots and

1. What is a Firewall? (https://www.cisco.com/c/en_ca/products/security/firewalls/what-is-a-firewall.html)

screen-capture all the steps and configurations. This will be useful for fast-tracking. This book will be a practical resource/guide that can be used by BCIT students, and students at other institutions as well as IT professionals.

Hamid Talebi

Dedication

This book is dedicated to those looking to further their knowledge of next-generation firewalls.

Chapter 1. Basic Settings

1.1 Basic Settings

Learning Objectives

- Create a basic configuration in FortiGate
- Identify CLI commands in FortiGate
- Create an IP access in FortiGate
- Create a DHCP server in FortiGate
- Restore previous configurations in FortiGate using backups

Scenario: This exercise will access a FortiGate device using the command-line interface (CLI). Setup your GNS3 and try to connect to FortiGate through WebTerm.

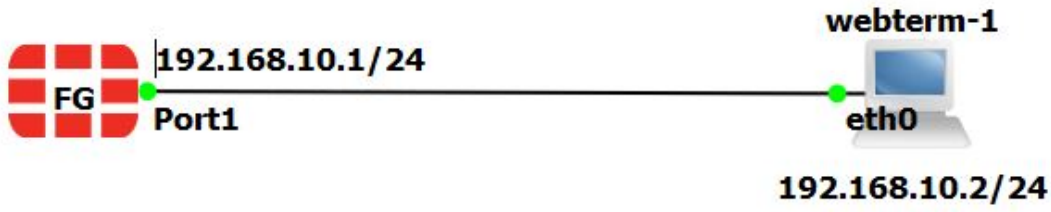


Figure 1.1: Main scenario

Explore the CLI

To explore the CLI, from the GNS3 double click on FortiGate to open the console. In the Password field, type **<the default password is blank>**, and then press enter.

Enter the following command:

get system status

```
FortiGate-VM64-KVM # get system status
Version: FortiGate-VM64-KVM v7.0.1,build0157,210714 (GA)
Virus-DB: 1.00000(2018-04-09 18:07)
Extended DB: 1.00000(2018-04-09 18:07)
Extreme DB: 1.00000(2018-04-09 18:07)
AV AI/ML Model: 0.00000(2001-01-01 00:00)
IPS-DB: 6.00741(2015-12-01 02:30)
IPS-ETDB: 6.00741(2015-12-01 02:30)
APP-DB: 6.00741(2015-12-01 02:30)
INDUSTRIAL-DB: 6.00741(2015-12-01 02:30)
IPS Malicious URL Database: 1.00001(2015-01-01 01:01)
Serial-Number: FGVMEVYCVRJ7IIE1
License Status: Valid
Evaluation License Expires: Wed Mar 23 20:32:13 2022
VM Resources: 1 CPU/1 allowed, 997 MB RAM/2048 MB allowed
Log hard disk: Available
Hostname: FortiGate-VM64-KVM
Operation Mode: NAT
Current virtual domain: root
Max number of virtual domains: 1
Virtual domains status: 1 in NAT mode, 0 in TP mode
Virtual domain configuration: disable
FIPS-CC mode: disable
Current HA mode: standalone
Branch point: 0157
Release Version Information: GA
FortiOS x86-64: Yes
System time: Tue Mar  8 20:35:58 2022
Last reboot reason: warm reboot
```

Figure 1.2: Get system status output

This command displays basic status information about FortiGate. The output includes FortiGate's serial number, operation mode, and a lot of useful information. When the More prompt appears on the CLI, do one of the following:

- To continue scrolling, Space bar.

- To scroll one line at a time, Enter.
- Enter the following command: get ?

> The ? character is not displayed on the screen.

This command shows all of the options that the CLI will accept after the # get command. Depending on the command, you may need to enter additional words to completely specify a configuration option.

- Enter the following command: **execute ?**
- This command lists all options that the CLI will accept after the execute command.
- Type exe, and then press the Tab key. Notice that the CLI completes the current word.
- Press the space bar and then press the Tab key three times.
- Each time you press the Tab key, the CLI replaces the second word with the next possible option for the execute command, in alphabetical order.

> You can abbreviate most commands. In this book, many of the commands that you see will be in abbreviated form. For example, instead of typing execute, you can type exe.
>
> Use this technique to reduce the number of keystrokes that are required to enter a command. Often, experts can configure FortiGate faster using the CLI than the GUI.

Configuration

Table 1.1: Check configuration CLI

Action	Command
Check configuration	# show # show | grep xxxx # show full-configuration # show full-configuration | grep XXXX # show full-configuration | grep -f XXXX ← display with tree view

Network

Table 1.2: Routing and firewall policy CLI

Action	Command
Check Routing	# get router info routing-table detail # show router static# config router static (static) # show (static) # end
Check Firewall Policy	# show firewall policy # show firewall policy XXXX# config firewall policy (policy) # show

Hardware

Table 1.3: Hardware CLI

Action	Command
Check Hardware Information	# get hardware status
Check Version, BIOS, Firmware, etc.	# get system status
Check version	# get system status
Display CPU / memory / line usage	# get system performance status
Display of NTP server	# get system ntp
Display the current time and the time of synchronization with the NTP server	# execute time
Check interfaces status, Up or Down	# get system interface physical
Check interfaces	# config system interface (interface) # show (interface) # end
Display of ARP table	# get system arp

High Availability (HA)

Table 1.4: High Availability CLI

Action	Command
Check HA Status	# get system ha status
Check HA Configuration	# get system ha # show system ha

Network Time Protocol (NTP)

Table 1.5: NTP CLI

Action	Command
Check NTP	# execute time # get system ntp # diagnose sys ntp status

On a fresh line, enter the following command to view the port3 interface configuration:

```
show system interface port3
```

```
FGVM01TM19008000 # show system interface port3
config system interface
    edit "port3"
        set vdom "root"
        set type physical
        set snmp-index 3
    next
end
```

Figure 1.3: Configuration of port3

Enter the following command:

```
show full-configuration system interface port3
```

```
FGVM01TM19008000 # show full-configuration system interface port3
config system interface
    edit "port3"
        set vdom "root"
        set vrf 0
        set fortilink disable
        set mode static
        set dhcp-relay-interface-select-method auto
        set dhcp-relay-service disable
        set ip 0.0.0.0 0.0.0.0
        unset allowaccess
        set fail-detect disable
        set pptp-client disable
        set arpforward enable
        set broadcast-forward disable
        set bfd global
        set l2forward disable
        set icmp-send-redirect enable
        set icmp-accept-redirect enable
        set vlanforward disable
        set stpforward disable
        set ips-sniffer-mode disable
        set ident-accept disable
        set ipmac disable
        set subst disable
```

Figure 1.4: Show full-configuration of port3

Enter the following command:

```
show system interface
```

For setting an IP address on the port1:

```
config system interface
edit port1
set mode static
set ip 192.168.10.1 255.255.255.0
set allowaccess ping ssh http https
end
```

Now you should be able to reach the firewall from port1. In browser, type http://192.168.10.1 and enter username and password.

> In the licensed devices, you should type https://192.168.10.1 and then enter username and password.

Configuring Administrator Accounts

FortiGate offers many options for configuring administrator privileges. For example, you can specify the IP addresses that administrators are allowed to connect from. In this exercise, you will work with administrator profiles and administrator user accounts. An administrator profile is a role that is assigned to an administrator user that defines what the user is permitted to do on the FortiGate GUI and CLI.

Configure a User Administrator Profile

1. Click **System > Admin Profiles**.
2. Click **Create New**.
3. In the Name field, type **Security_Admin_Profile**.
4. In the permissions table, set Security Profile to **Read-Write**, but set all other permissions to Read.
5. Click **OK** to save the changes.

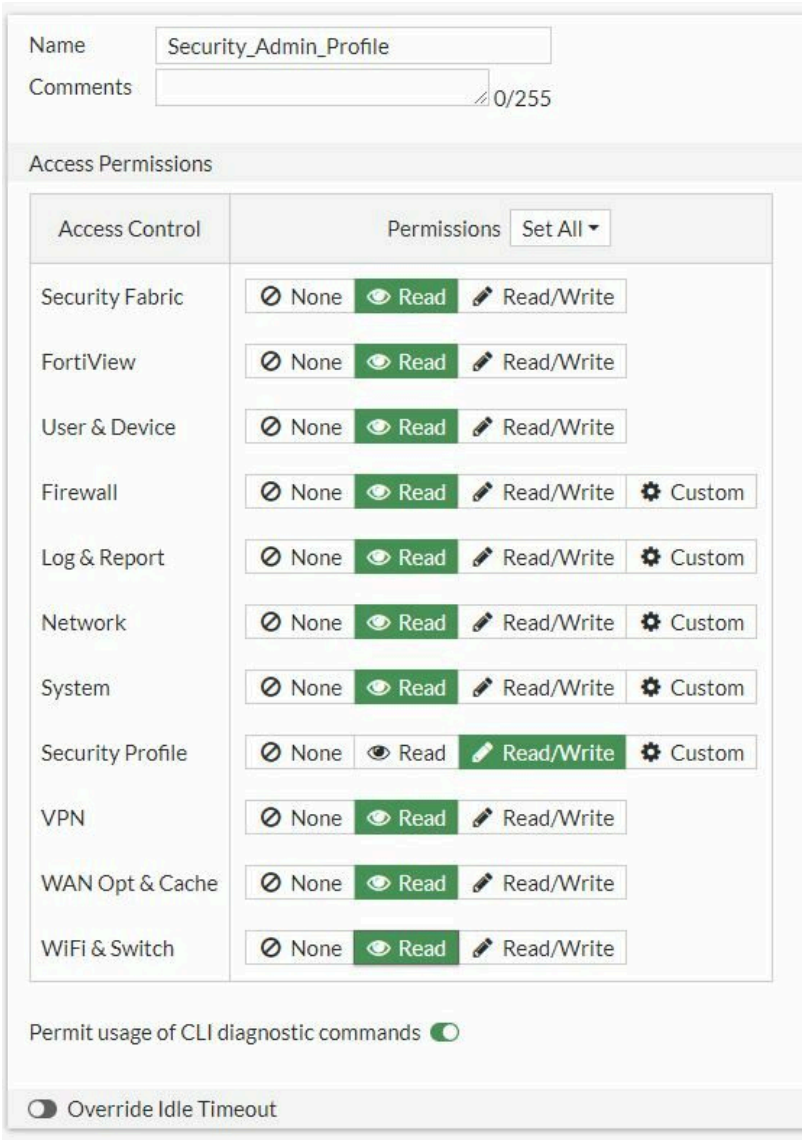


Figure 1.5: Create a custom profile

Create an Administrator Account

Now, you will create a new administrator account. You will assign the account to the administrator profile you created previously. The administrator will have read-only access to most of the configuration settings. To create an administrator account Continuing on the Local-FortiGate GUI, click **System > Administrators**. Click Create New and then click Administrator to add a new administrator account and assign the previous profile you have created to the administrator.

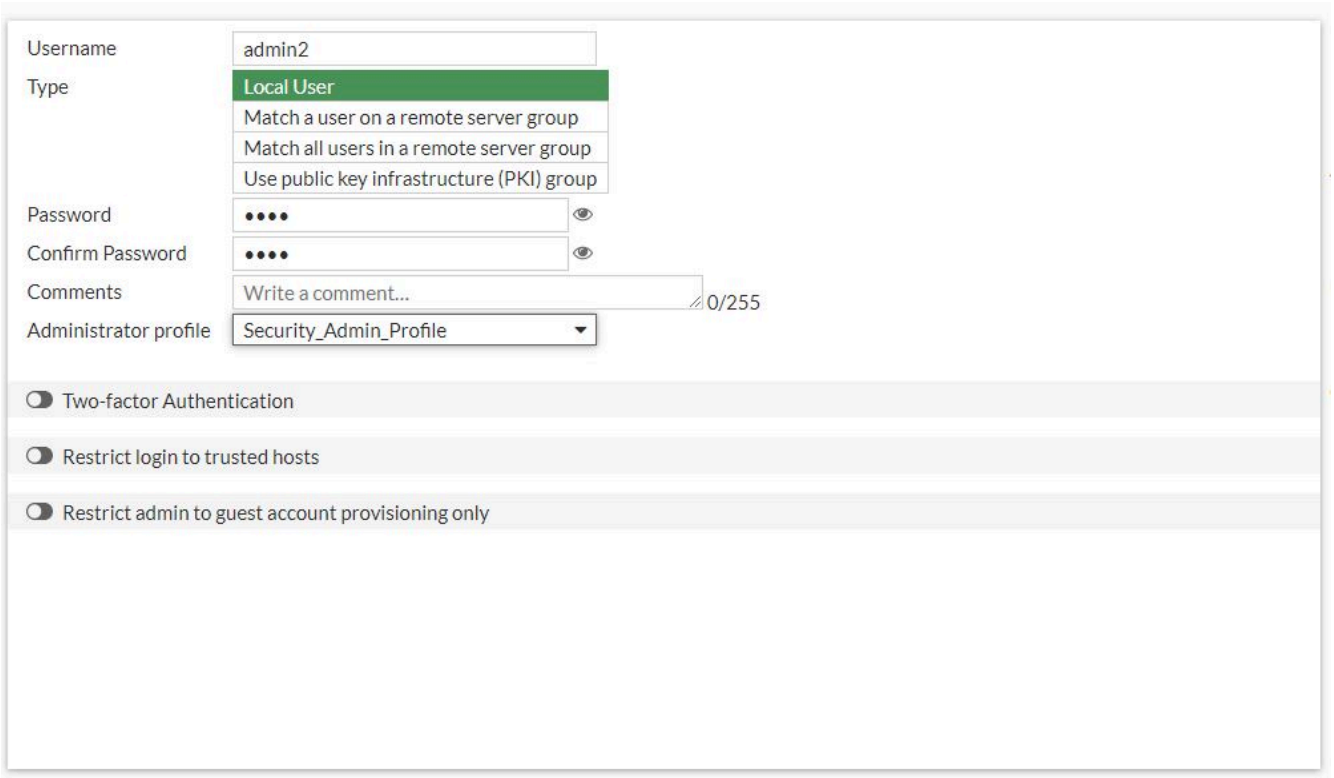


Figure 1.6: Create a local user

Test the New Administrator Account

In this procedure, you will confirm that the new administrator account has read-write access to only the security profiles configuration.

To test the new administrator account Continuing on the Local-FortiGate GUI, click username (in my case, it's admin2) and then Logout to log out of the admin account's GUI session.

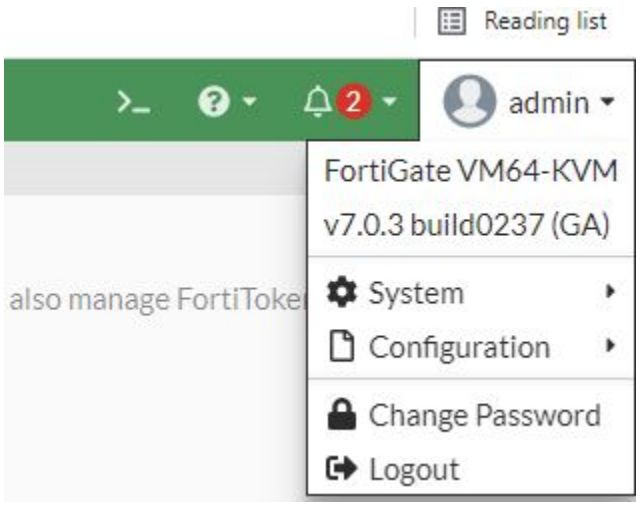


Figure 1.7: Logout option

Explore the permissions that you have in the GUI. You should see that this account can configure only security profiles. Log out of the GUI once done.

Restrict Administrator Access

Now, you will restrict access for FortiGate administrators. Only administrators connecting from a trusted subnet will be allowed access. This is useful if you need to restrict the access points from which administrators connect to FortiGate. To restrict administrator access.

1. Click **System > Administrators**. Edit the admin account.
2. Enable Restrict login to trusted hosts, and set **Trusted Host 1** to the address **192.168.10.100/32**.
3. Click **OK** to save the changes.

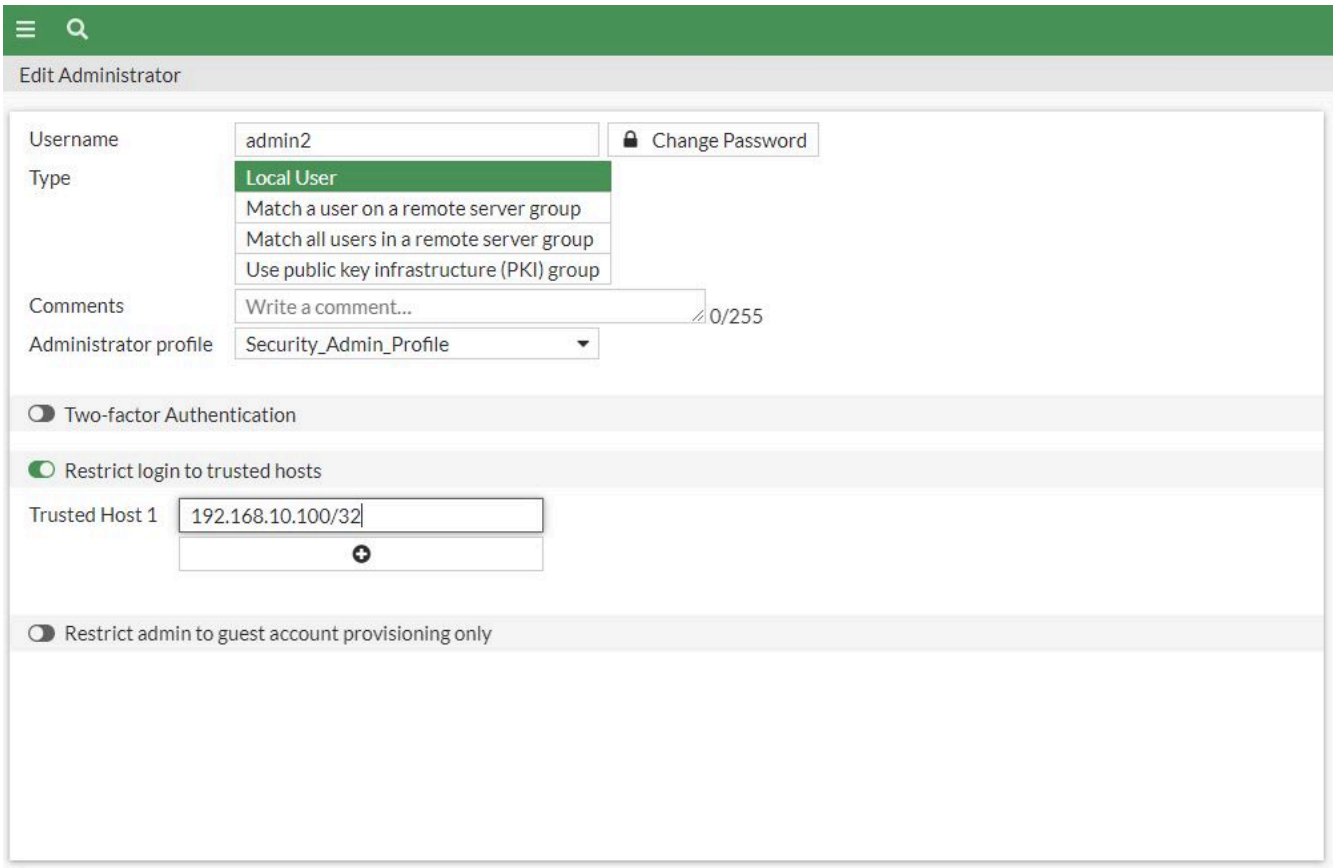


Figure 1.8: Create a trusted host for the user

To test the restricted access

1. Continuing on Local-Windows, log out of the Local-FortiGate GUI session as the admin user.
2. Try to log in to the admin2 account again with password < Your password>. Because you are trying to connect from the 192.168.10.101 address, you shouldn't be able to connect.
3. Log in as admin with password <Your password>. Enter the following CLI commands to add

192.168.10.101/32 as the second trusted IP subnet (Trusted Host 2) to the admin account:

```
config system admin
edit admin
set trusthost2 192.168.10.101/32
end
```

4. Try to log in to the Local-FortiGate GUI at <IP address> with the username admin and password <Your password>. You should be able to log in. (**Hint:** add the IP address 192.168.10.101 to WebTerm and try to reach to the firewall.)

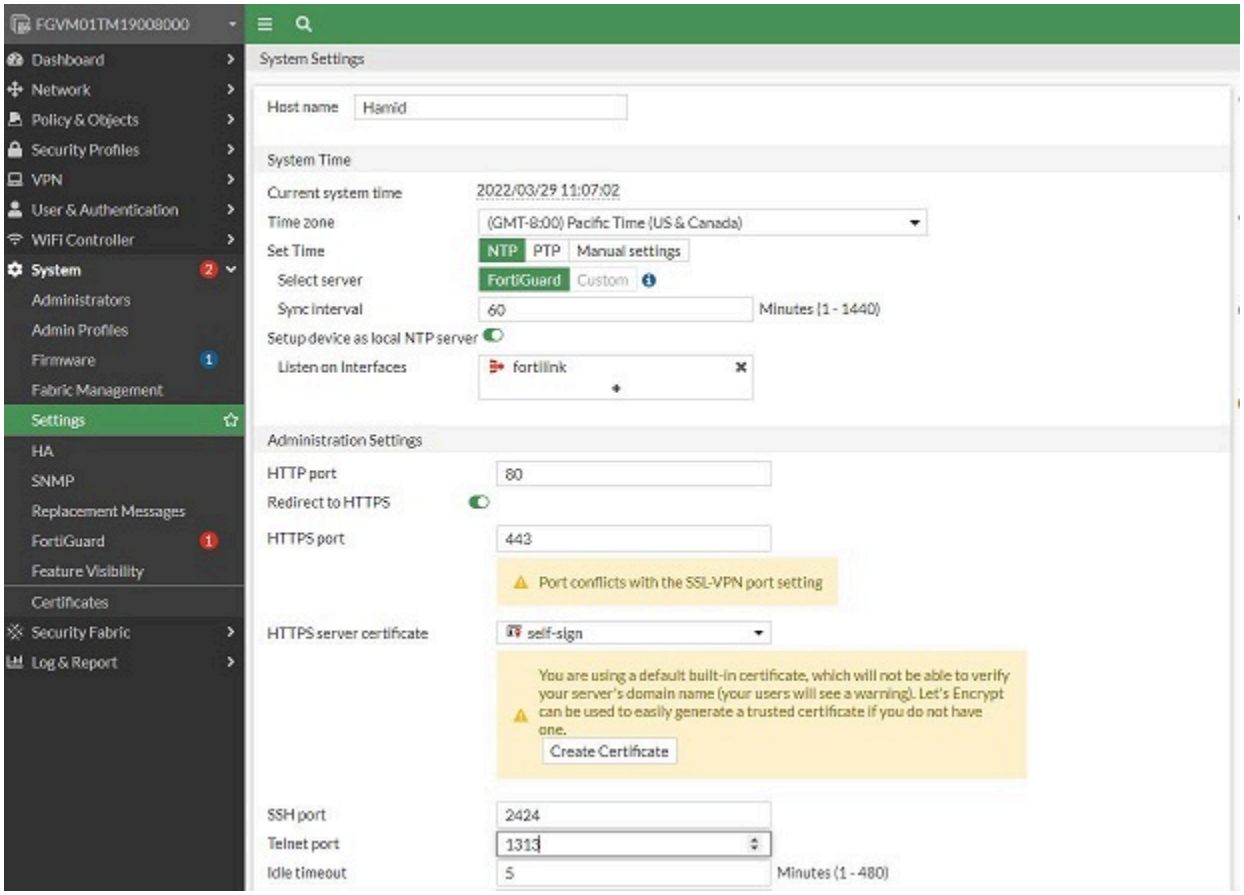


Figure 1.9: System settings

Configuration Backups

The configuration files produced by backups allow you to restore to an earlier FortiGate configuration.

Backup & Restore

Always back up the configuration file before making changes to FortiGate (even if the change seems

minor or unimportant). There is no undo. You should carefully consider the pros and cons of an encrypted backup before you begin encrypting backups. While your configuration, including things like private keys, remains private, an encrypted file hampers troubleshooting because Fortinet support cannot read the file. Consider saving backups in plain-text and storing them in a secure place instead. Now, you will create an encrypted file with the backup of the FortiGate's current configuration.

To save an encrypted configuration backup

Continuing on the Local-FortiGate GUI, in the upper-right corner, click **admin**, and then click **Configuration > Backup**. On the Backup System Configuration page, enable Encryption. In the Password field, enter **fortigate** and repeat in the Confirm password field.

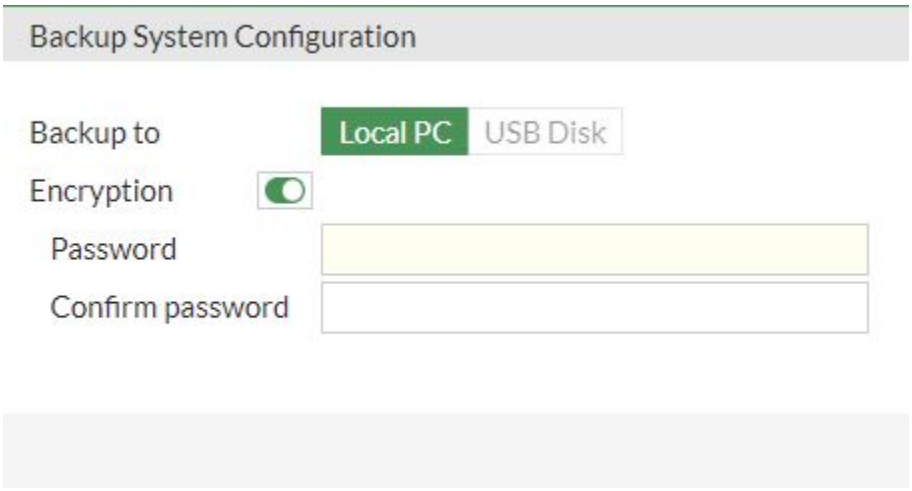


Figure 1.10: Backup System Configuration

Click **OK**.

Select **Save File** and click **OK**.

To restore an encrypted configuration backup

Continuing on the Local-FortiGate GUI, in the upper-right corner, click admin, and then click **Configuration > Restore**. On the Restore System Configuration page, click Upload. Browse to your **Downloads** folder and select the configuration file that you created in the previous procedure. In the Password field, type **fortigate**, and then click **OK.**

DHCP (Dynamic Host Configuration Protocol)

You can configure one or more DHCP servers on any FortiGate interface. A DHCP server dynamically assigns IP addresses to hosts on the network connected to the interface. The host computers must be configured to obtain their IP addresses using DHCP.

Configure DHCP on the FortiGate

To add a DHCP server on the GUI:

1. Go to **Network > Interfaces**.
2. Edit an interface.
3. Enable the DHCP Server option and configure the settings.

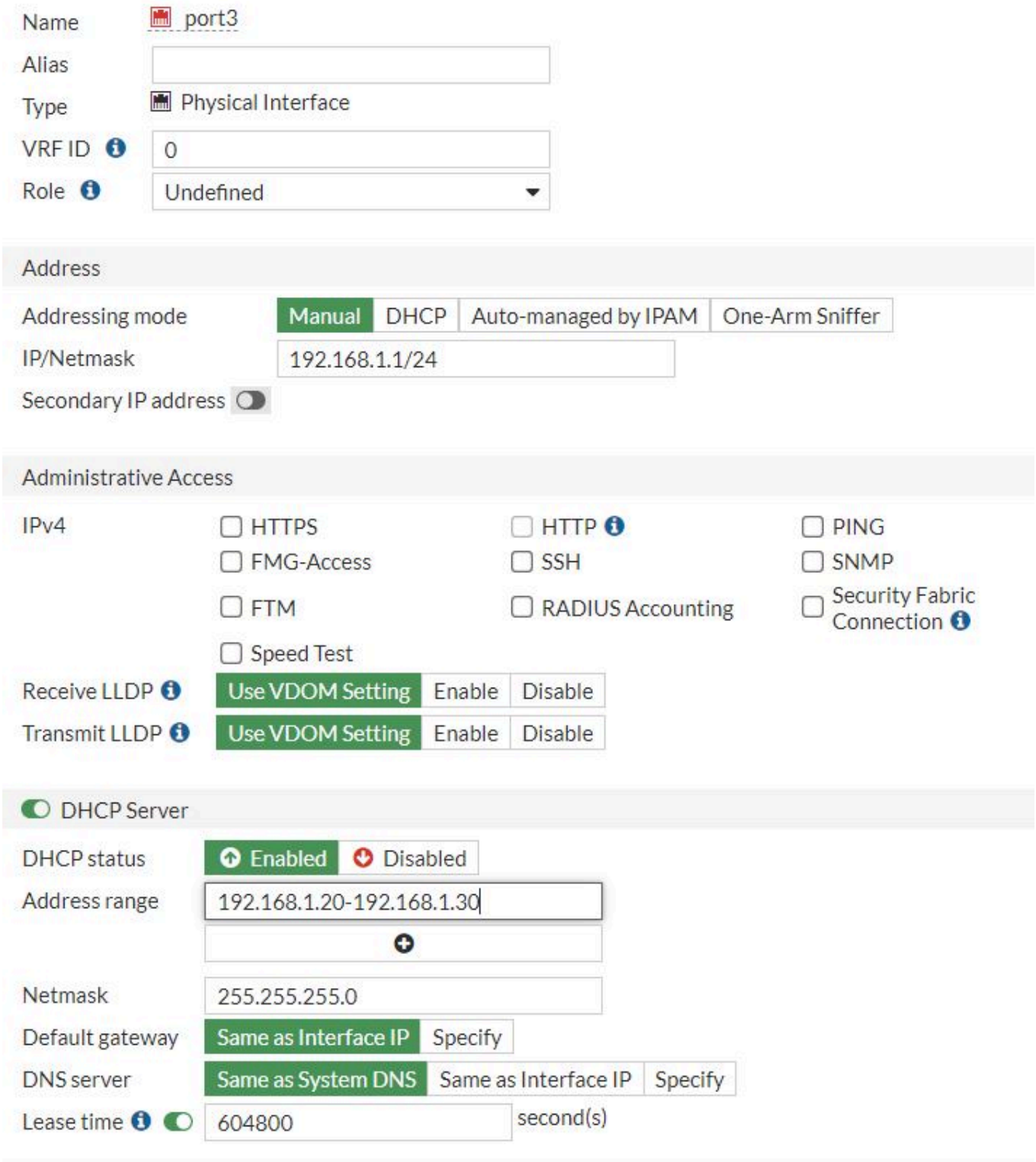


Figure 1.11: Enable DHCP Server

To do it through command line, use following commands:

```
FGVM01TM19008000 # config system dhcp server
FGVM01TM19008000 (server) # edit 1
FGVM01TM19008000 (1) # set dns-service default
FGVM01TM19008000 (1) # set netmask 255.255.255.0
FGVM01TM19008000 (1) # config ip-range
FGVM01TM19008000 (ip-range) # edit 1
FGVM01TM19008000 (1) # set start-ip 192.168.1.1
FGVM01TM19008000 (1) # set end-ip 192.168.1.1
FGVM01TM19008000 (1) # next
FGVM01TM19008000 (ip-range) # edit 2
new entry '2' added
FGVM01TM19008000 (2) # set start-ip 192.168.1.20
FGVM01TM19008000 (2) # set end-ip 192.168.1.30
FGVM01TM19008000 (2) # next
FGVM01TM19008000 (ip-range) # end
FGVM01TM19008000 (1) # next
FGVM01TM19008000 (server) # end
```

If you are looking for a specific configuration or CLI, the FortiGate document library (https://docs.fortinet.com/product/fortigate) has full resources.

Resources

- Fortinet Fortigate CLI Commands (https://cmdref.net/hardware/fortigate/index.html)
- FortiGate document library (https://docs.fortinet.com/product/fortigate/7.2)

Chapter 2. Policy

2.1 Security Policy

Learning Objectives

- Create a Security Policy in FortiGate
- Reorder Firewall Policies and Firewall Policy Actions

Scenario: We are going to allow traffic from the local network to the Internet. We will set Security Policy that allows the traffic from Port 2 to Port 3. Then, WebTerm1 will be able to reach the Internet.

Security Policy

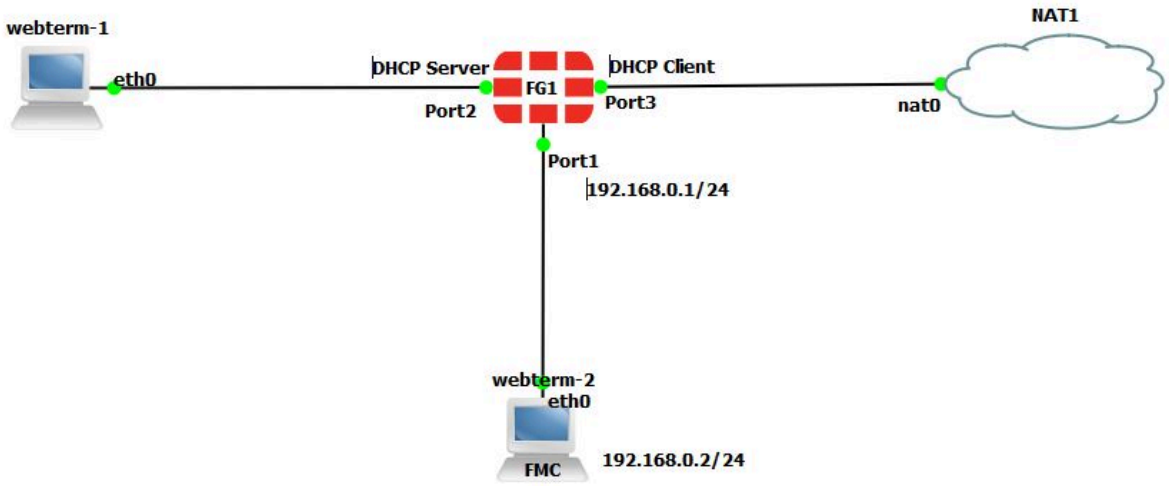


Figure 2.1: Main scenario

Table 2.1: Devices configuration

Device	Configuration
FortiGate	Port 2: DHCP Server Port 3: DHCP Client
WebTerm	DHCP Client

Configuration of port1 of the firewall in CLI is as follows:

```
FGVM01TM19008000 # config system interface
FGVM01TM19008000 (interface) # edit port1
FGVM01TM19008000 (port1) # set mode static
FGVM01TM19008000 (port1) # set ip 192.168.0.1/24
FGVM01TM19008000 (port1) # set allowaccess http https
FGVM01TM19008000 (port1) # end
```

Figure 2.2: Configuration of port1

1. Open the browser in WebTerm2 and type https://192.168.0.1. You should be able to access the firewall.

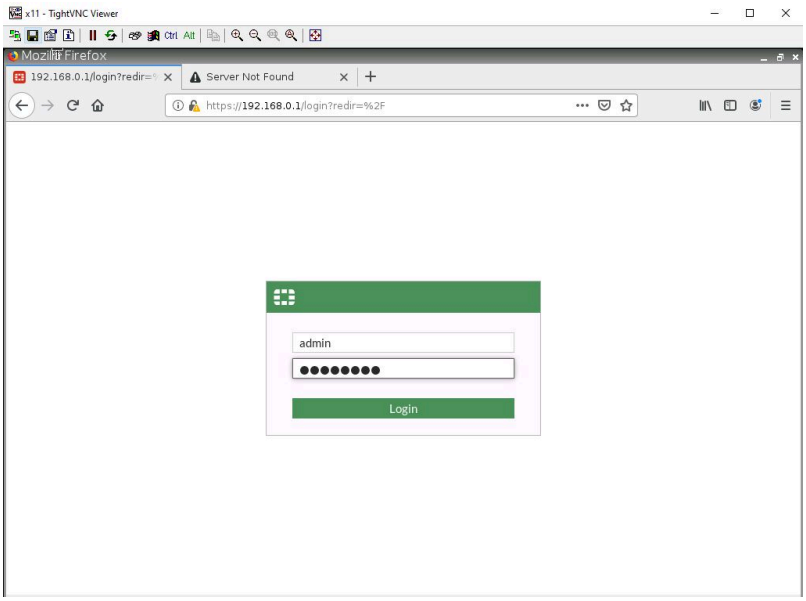


Figure 2.3: Log in to the FortiGate

2. Go to **Network** > **Interfaces** > **Port2**, set the interface IP address as **192.168.1.1/24** and configure DHCP server on interface port2 (Range of IP addresses should be: 192.168.1.20 to

192.168.1.30, DNS: 4.2.2.4) and **Enable Device Detection** under Port2.

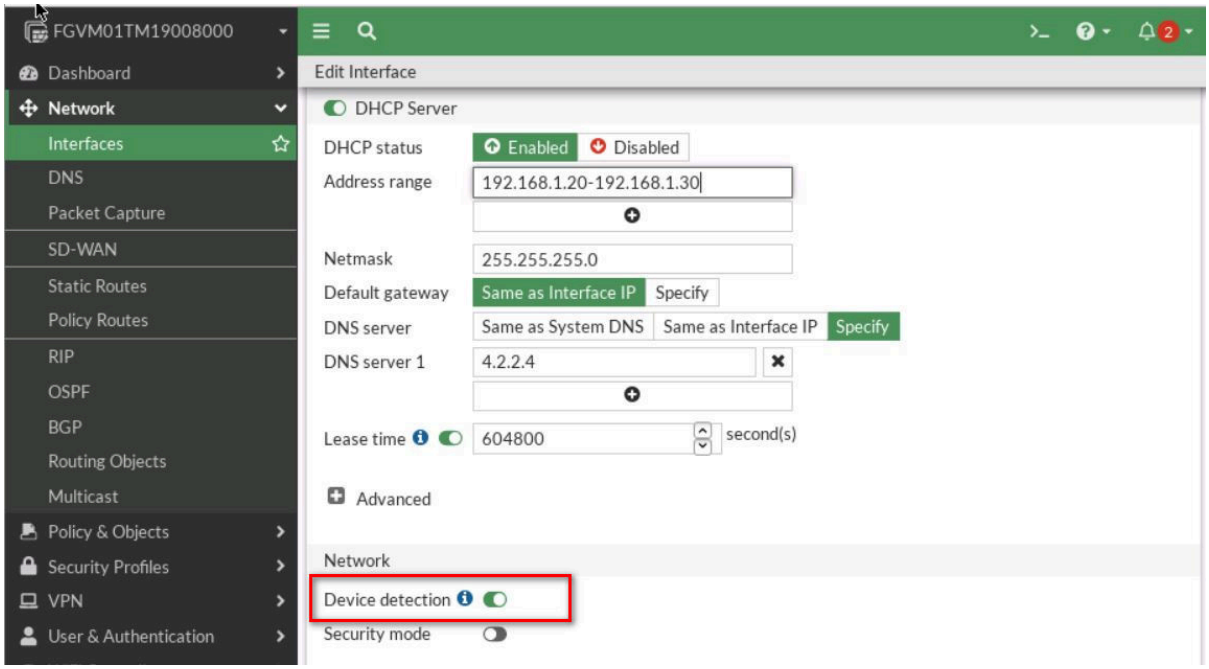


Figure 2.4: Enable DHCP Server

3. Set a port3 as a DHCP client and enable **Device Detection** under Port3.

Figure 2.5: Enable DHCP Client

4. Set a Static route in the firewall to reach the NAT object. Go to **Network > Static Route > Create a new**.

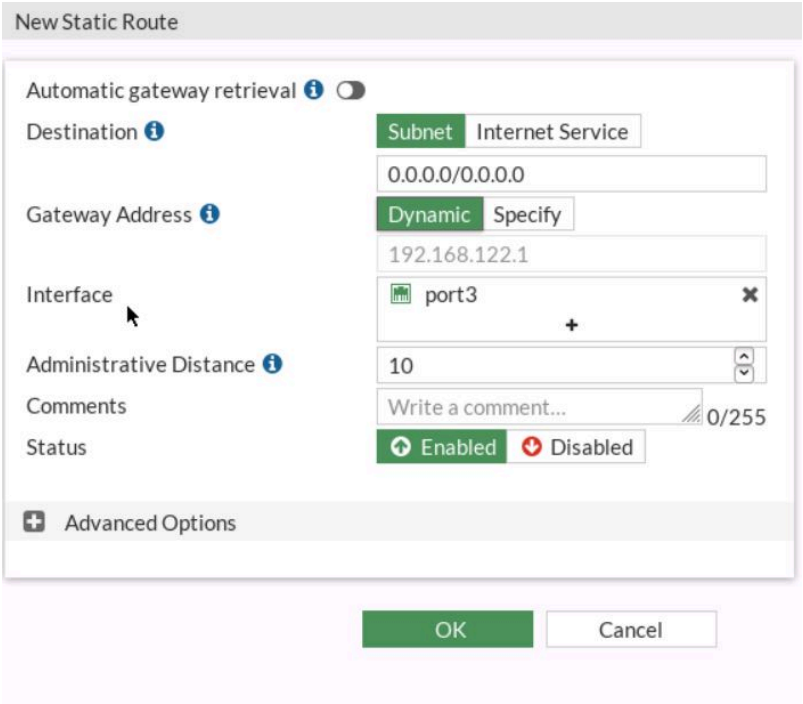


Figure 2.6: Configure a static route

5. Go to **Policy & Objects > Firewall Policy** section, click **Create New** to add a new firewall policy, and configure the following settings:

    - Name: **LocalToInternet**
    - From **inside** to **outside (port2 to port3)**
    - Source: **Create an address for local network (Subnet: 192.168.1.0/24)**
    - Destination: **all**
    - Schedule: **Always**
    - Service: Only **HTTP, HTTPS, DNS, Ping**
    - Action: **Accept**

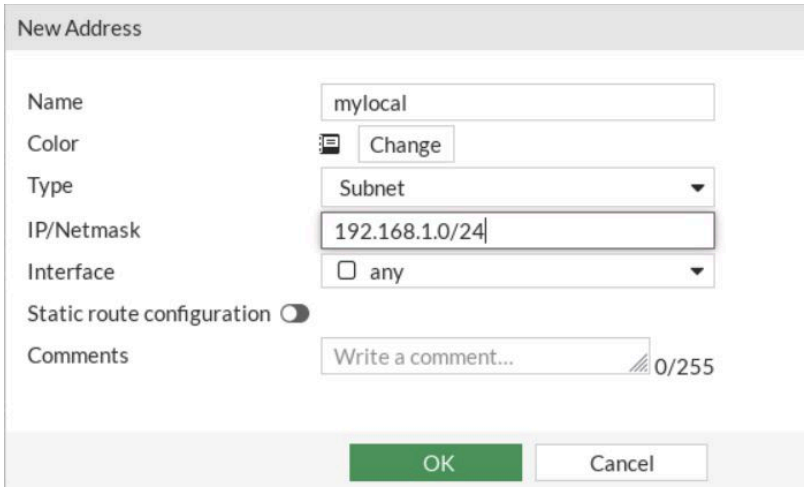


Figure 2.7: Set local subnet

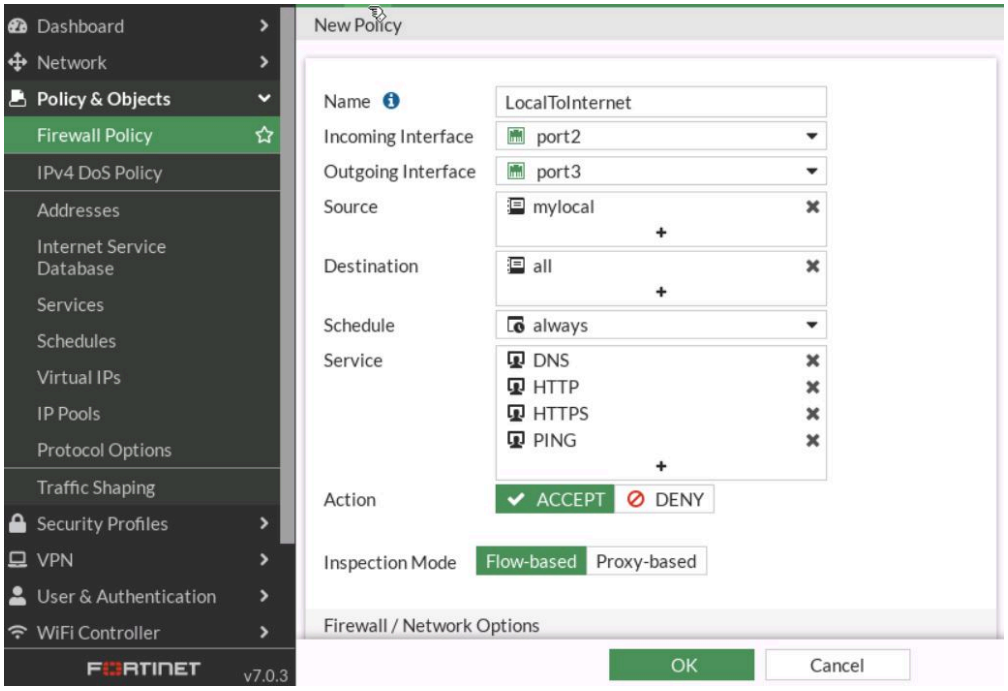


Figure 2.8: Set firewall policy

6. Go to **WebTerm1**, Set interface as DHCP and then open the browser, you should be able to access the internet.

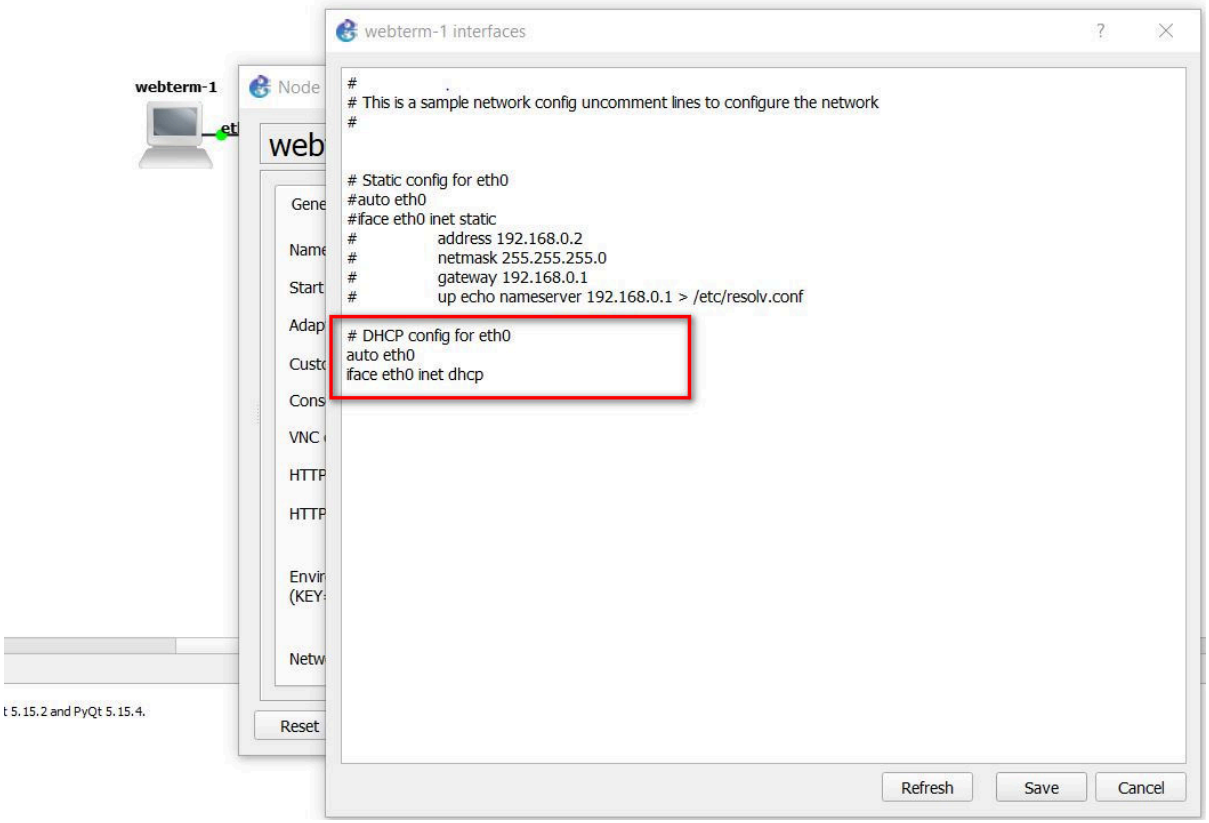


Figure 2.9: Enable DHCP Client on WebTerm1

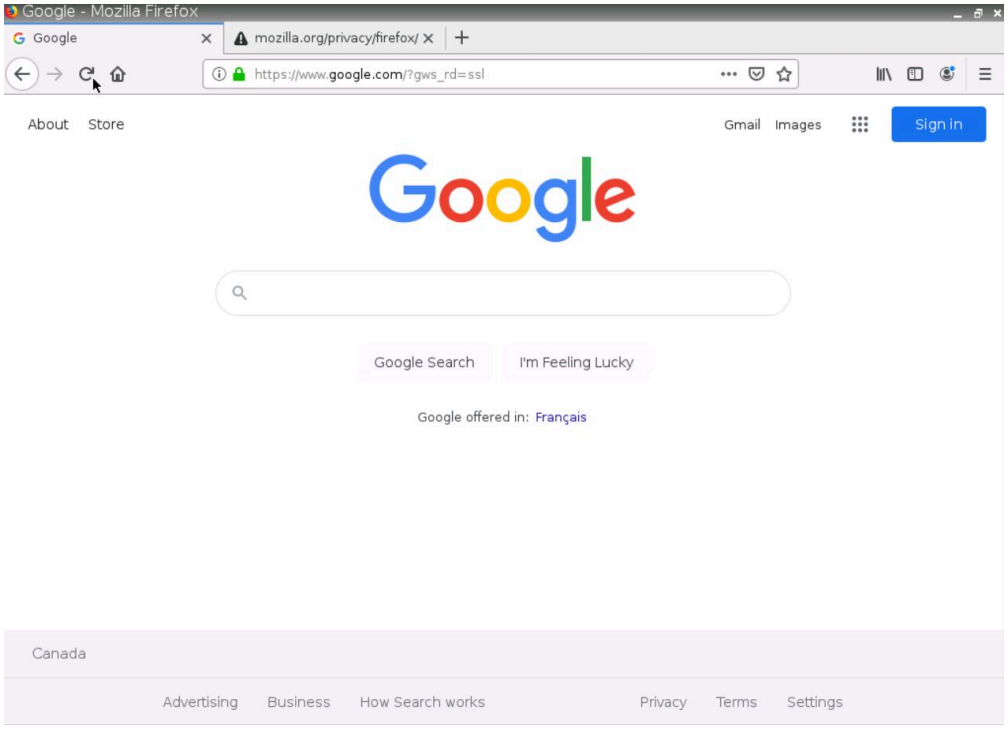


Figure 2.10: Verify your configuration by testing Google.com

Verify Your Configuration

- Go to **Dashboard** > **FortiView Sessions**. You should be able to see the traffic.

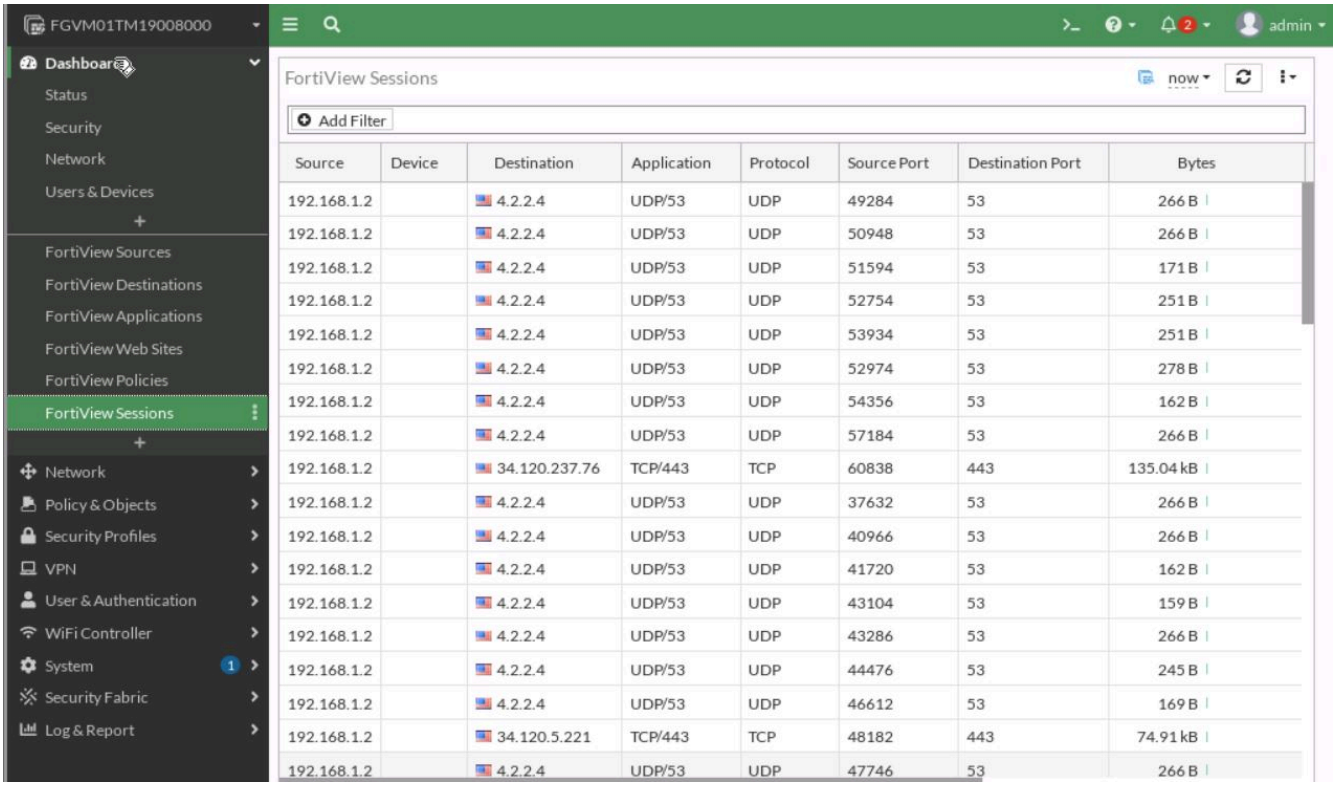


Figure 2.11: FortiView Sessions

- Go to Firewall Policy and on the right side of the screen, you should be able to see **Hit count.**

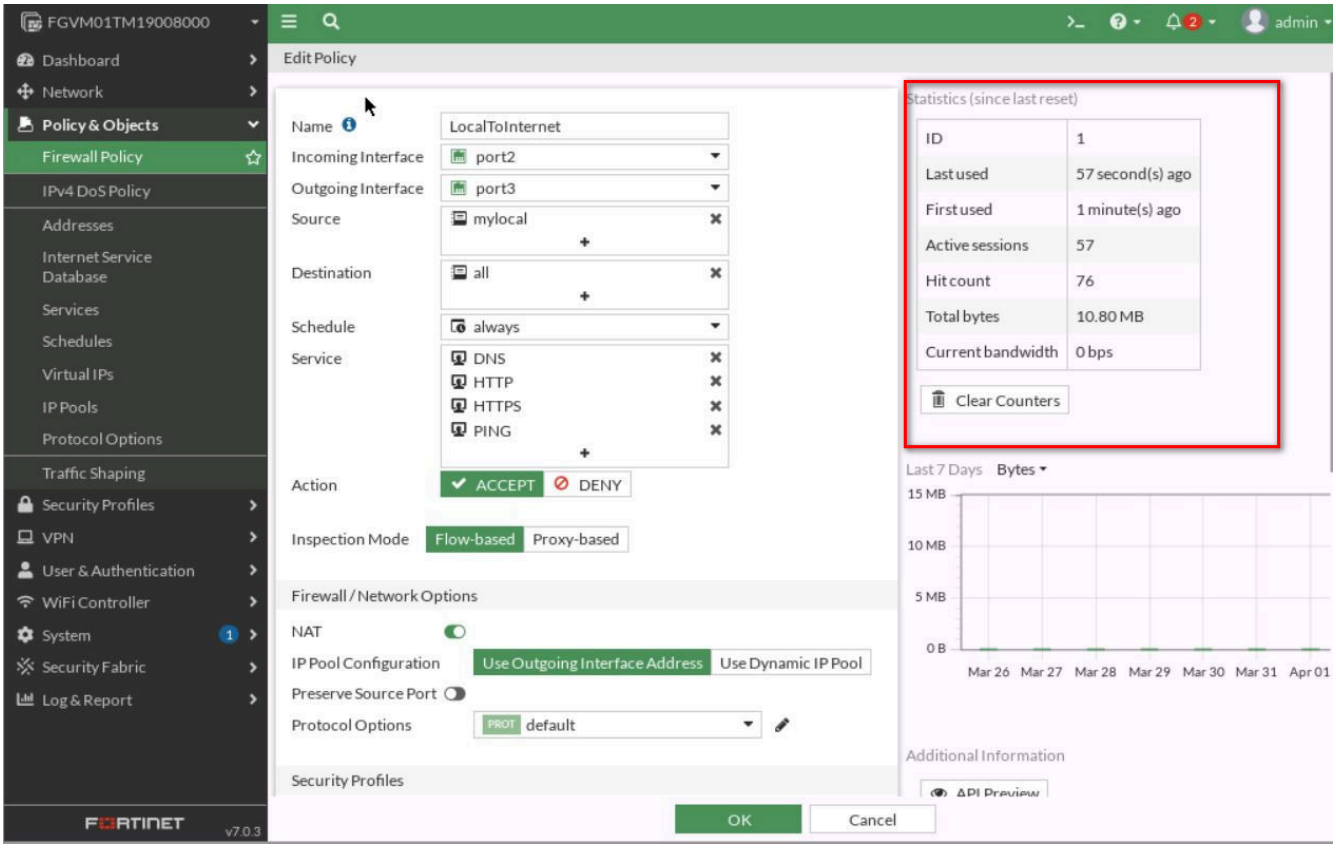


Figure 2.12: Hit count in the Firewall Policy

- Go to **Dashboard** > **Users & Devices** > **Device Inventory** and verify the IP and Mac address of the device.

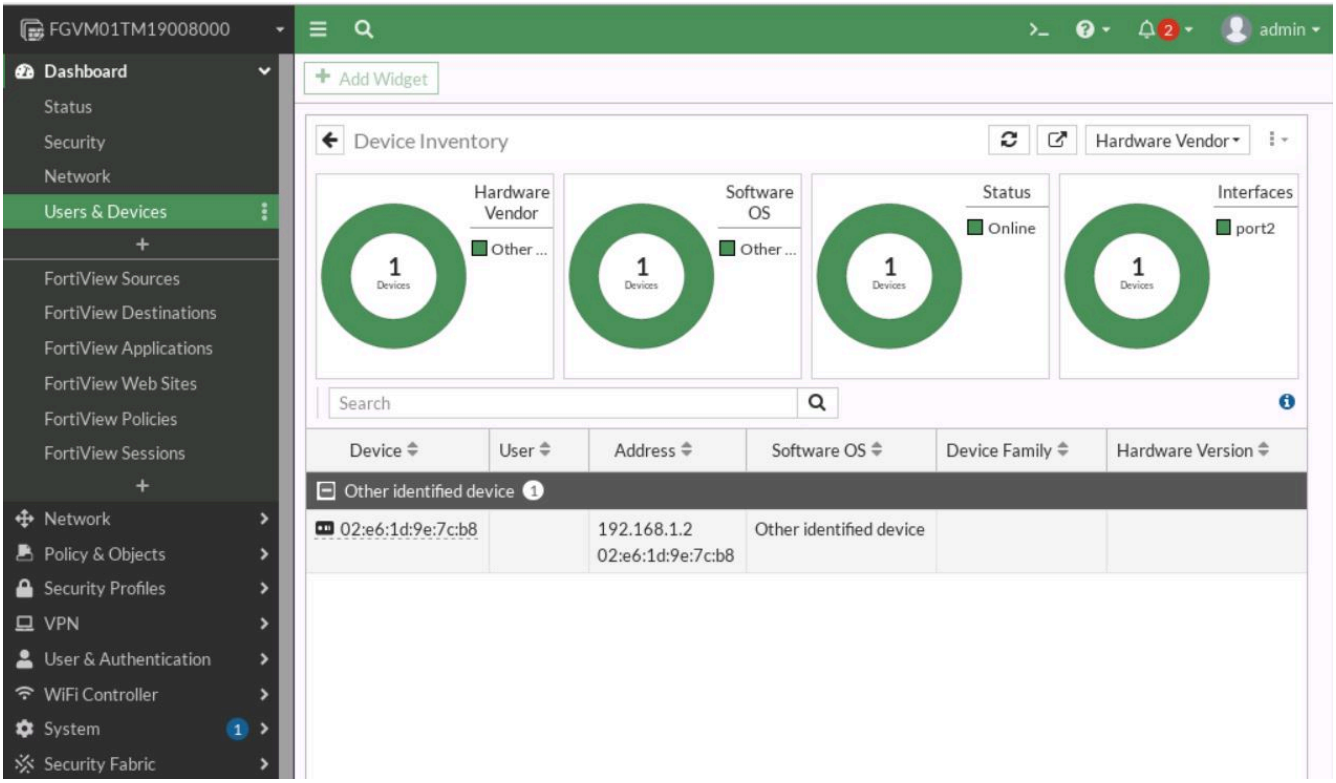


Figure 2.13: Device Inventory

Reordering Firewall Policies and Firewall Policy Actions

FortiGate will look for a matching policy, beginning at the top. Usually, you should put more specific policies at the top; otherwise, more general policies will match the traffic first, and your more granular policies will never be applied.

You will create a new firewall policy with more specific settings such as source, destination, service, and action set to **DENY**. Then, you will move this firewall policy above the existing firewall policies and observe the behaviour of firewall policy reordering.

Create a firewall policy

You will create a new firewall policy to match a specific source, destination, service, and action set to **DENY**.

Table 2.2: Firewall policy configuration

Field	Value
Name	Block_Ping
Incoming Interface	Port2
Outgoing Interface	Port3
Source	LOCAL_SUBNET
Destination	All
Schedule	Always
Service	PING
Action	DENY
Log Violation Traffic	<enable>
Enable this policy	<enable>

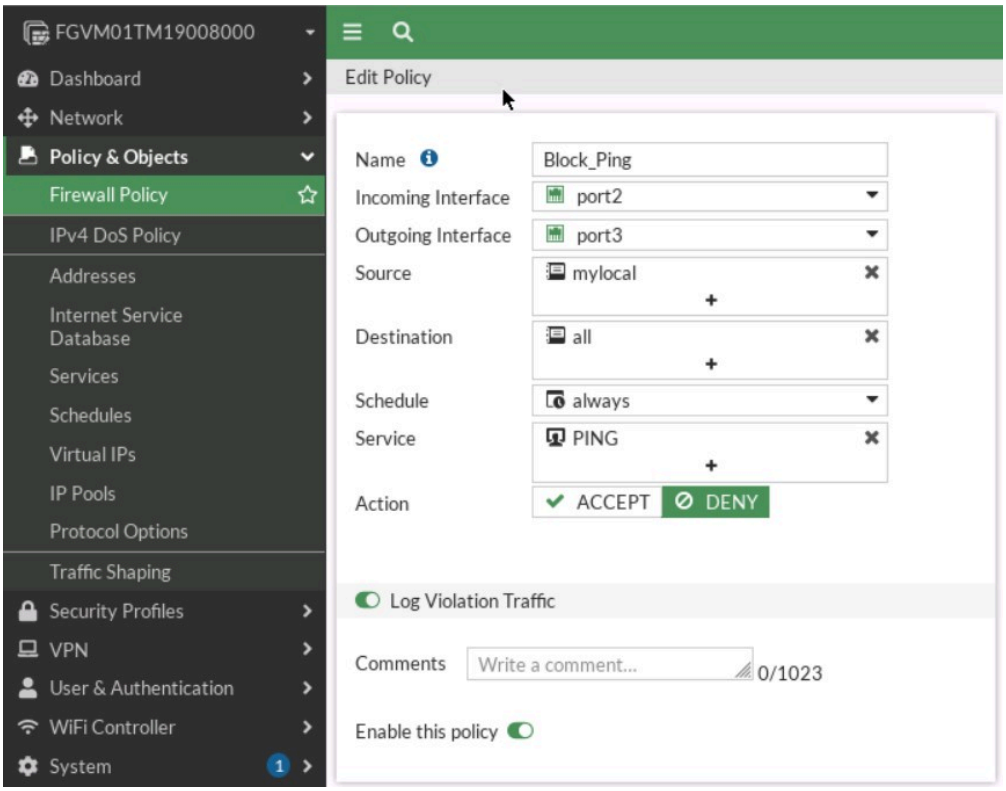


Figure 2.14: Set firewall policy to block ping

Click **OK** to save the changes. Add this policy on top of the previous policy.

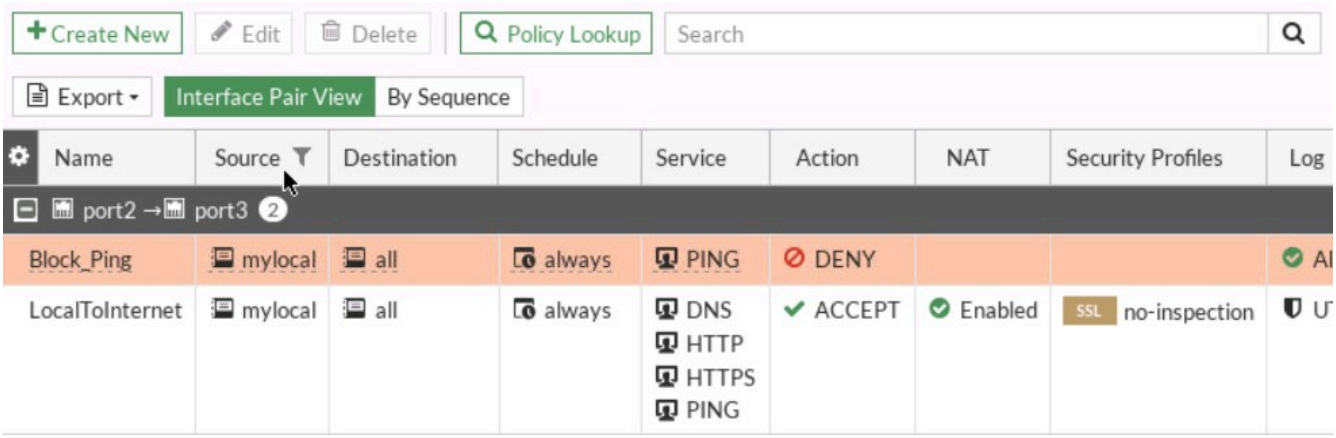


Figure 2.15: Priority of Block_Ping should be higher than LocalToInternet

Go to **Webterm1** and ping **4.2.2.4**. You shouldn't be able to ping!

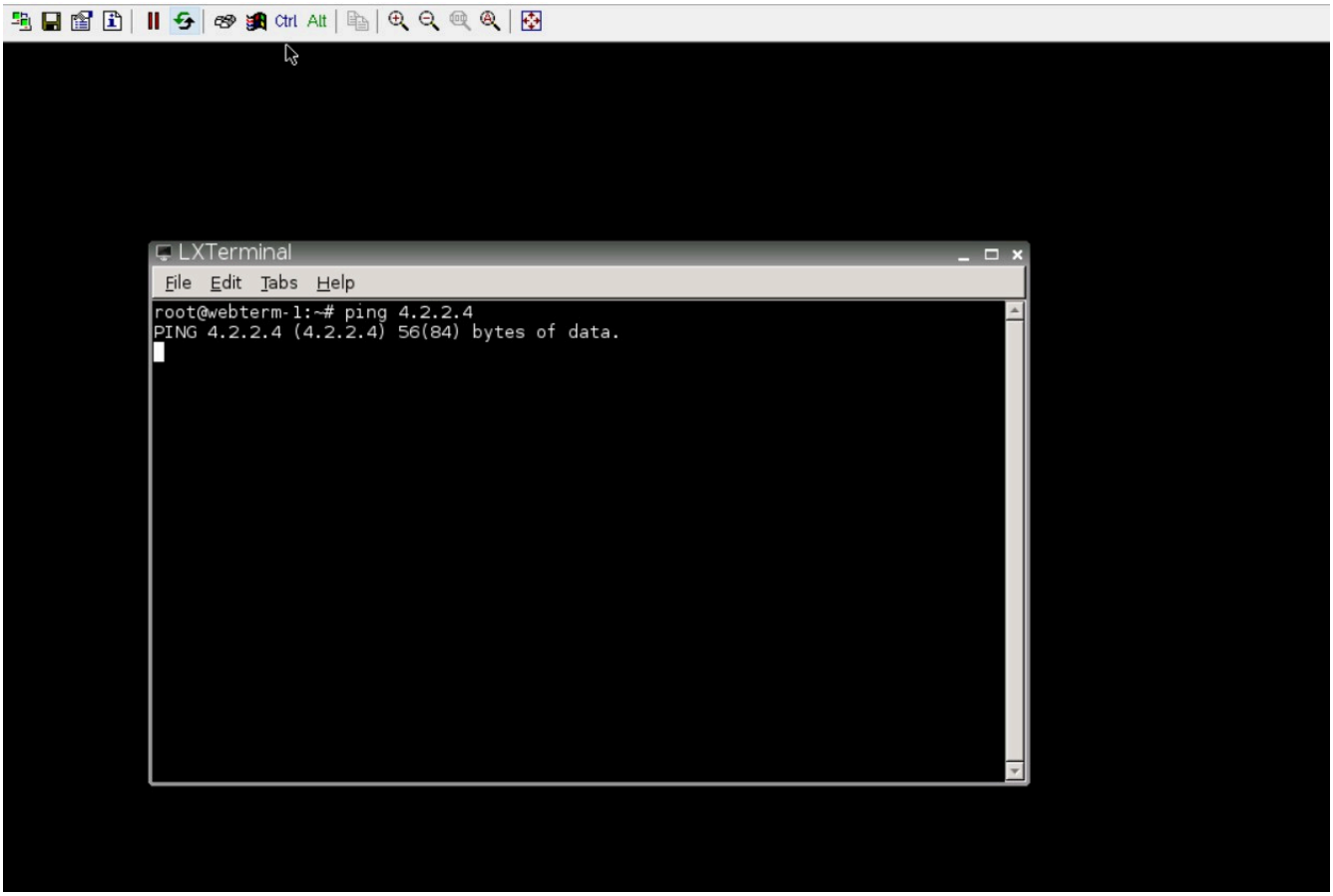


Figure 2.16: Verify ping in the WebTerm1

2.2 Application Profile

Learning Objectives

- Work with application profile in FortiGate
- Create a Traffic Shaper
- Apply Traffic Shaping to the traffic

Scenario: Application control uses IPS protocol decoders that can analyze network traffic to detect application traffic, even if the traffic uses non-standard ports or protocols. We are going to block social networks in the first example and then we are going to set Traffic Shaper for the local PCs in the second example. Finally, we will try to verify the connection speed in both PCs in the local network and compare them together.

Working with Application Profile

1. Go to **Policy & Objects** > **Firewall Policy** section, select **LocalToInternet** policy you have created in the previous section. Click on Edit.
2. Go to **Security Profile section** > **Application Control**.
    - Create a new Application Control
    - Name: **Ban-SocialNetwork**
    - In Categories **Block** Social Media, Video/Audio

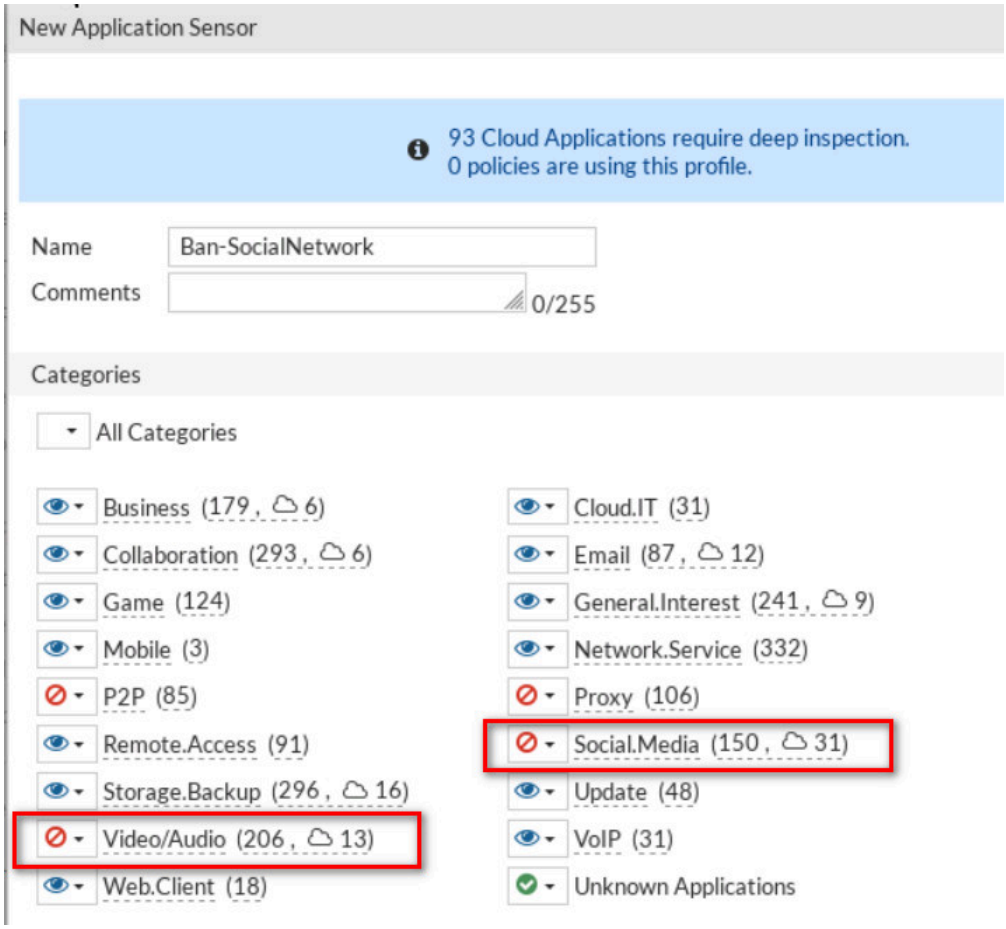


Figure 2.17: Block Social.Media and Video/Audio

For Application and Filter Overrides. Because a filter override is configured to block applications that use excessive bandwidth, it will block all applications using excessive bandwidth, regardless of categories that allow these applications.

3. In **Application and Filter overrides** > **Create a new**.
    1. Select **Application**
    2. Action: **Block**
    3. Application: **YouTube**

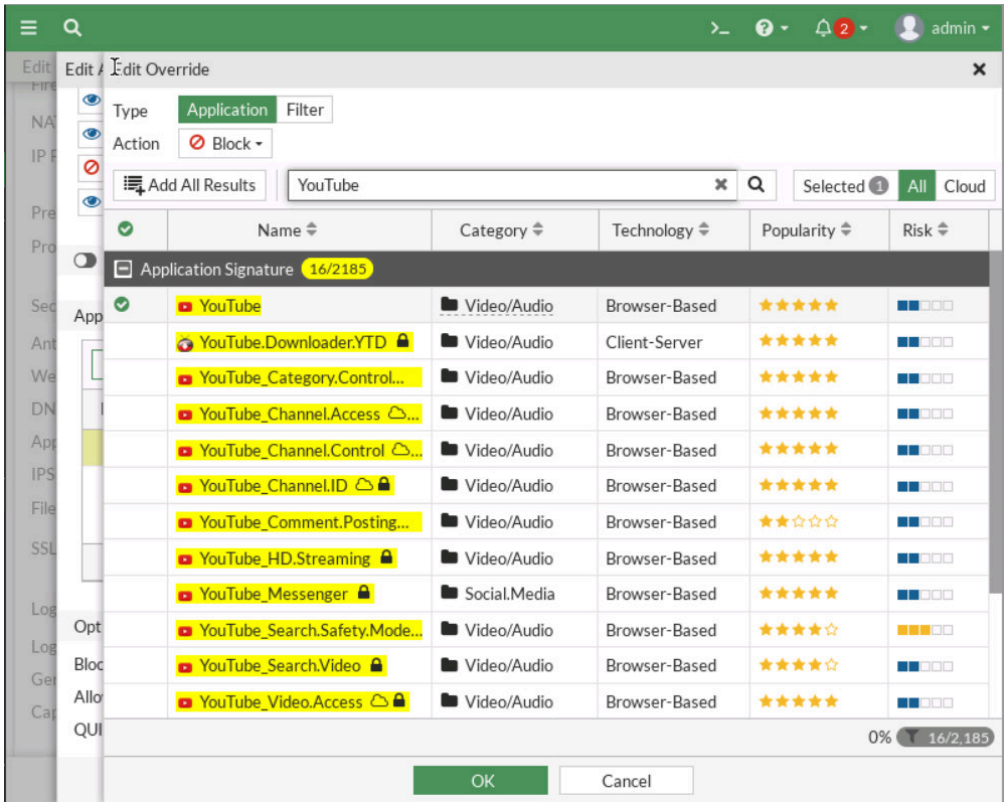


Figure 2.18: Block YouTube

4. In **Application and Filter overrides** > **Create a new**.
    1. Select **Application**
    2. Action: **Block**
    3. Application: **Facebook_Chat**

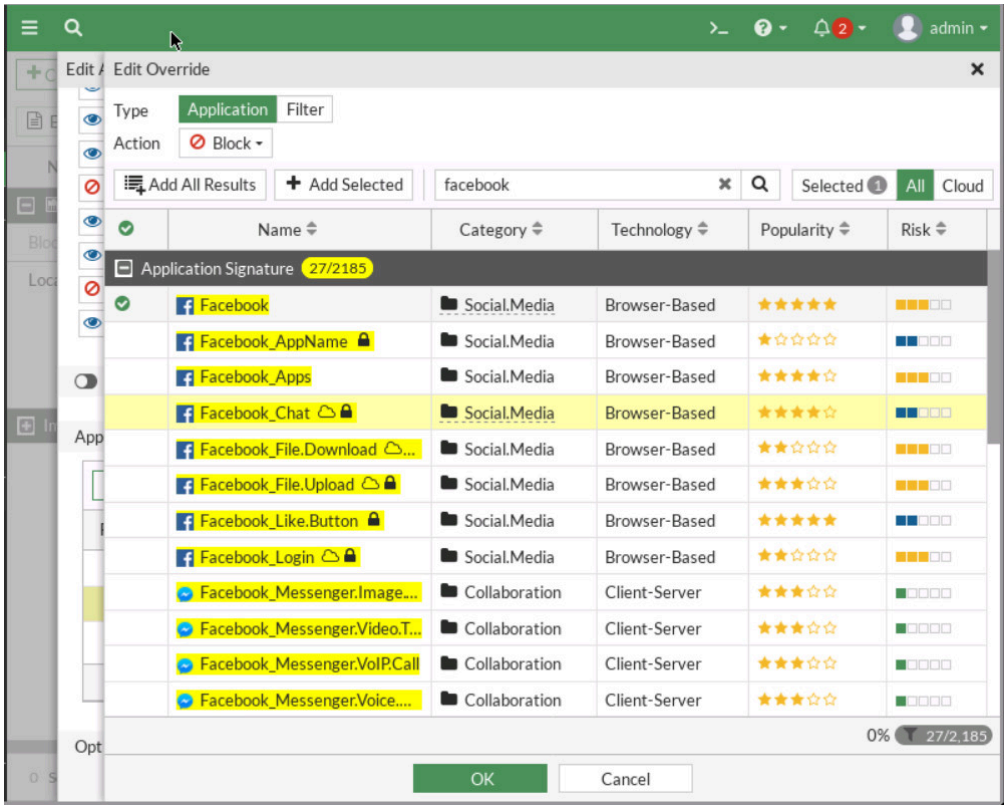


Figure 2.19: Block Facebook

5. **OK** all and now open the browser and go to **Twitter.com** or **YouTube.com** and try to search for a video and you should receive an application block page.

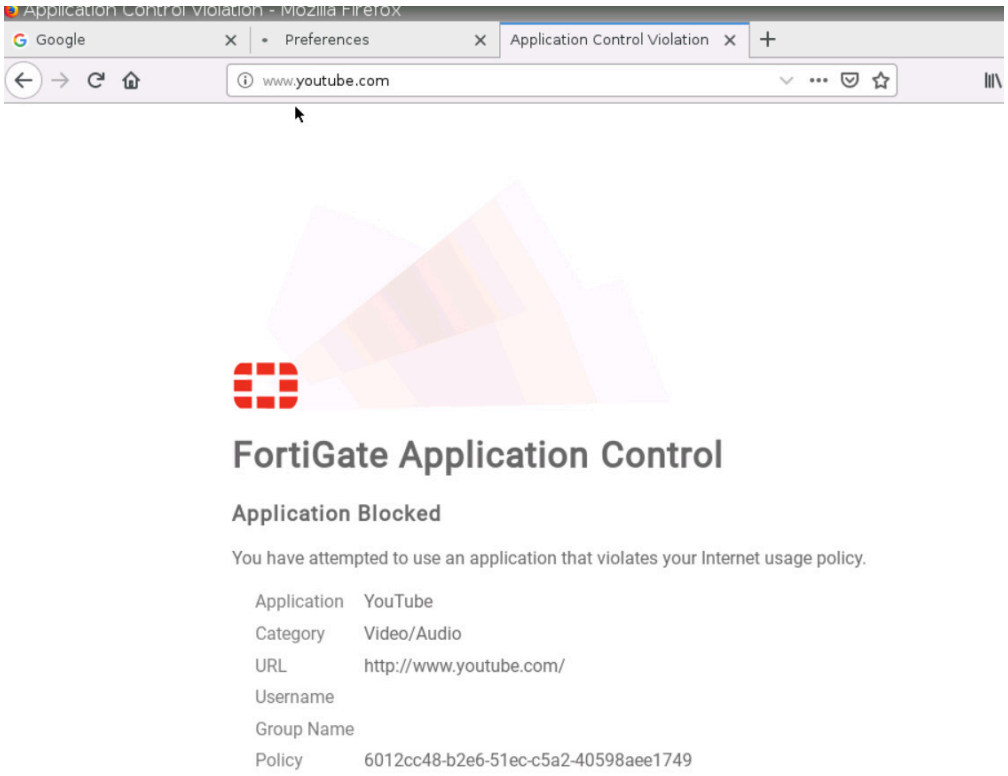


Figure 2.20: Application Control Blocked page

6. Go to **Log & Report** > **Application Control** and try to find the logs related to the previous step.

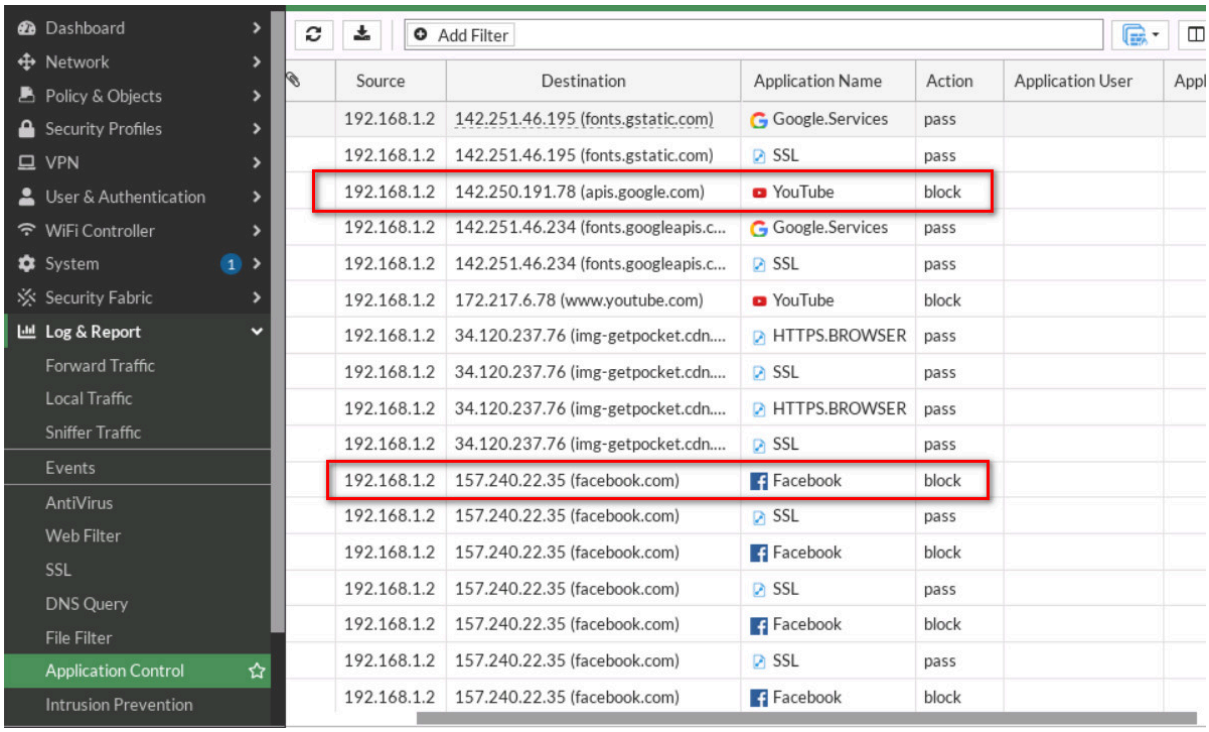


Figure 2.21: Application Control logs

Working with Application Profile: Part 2

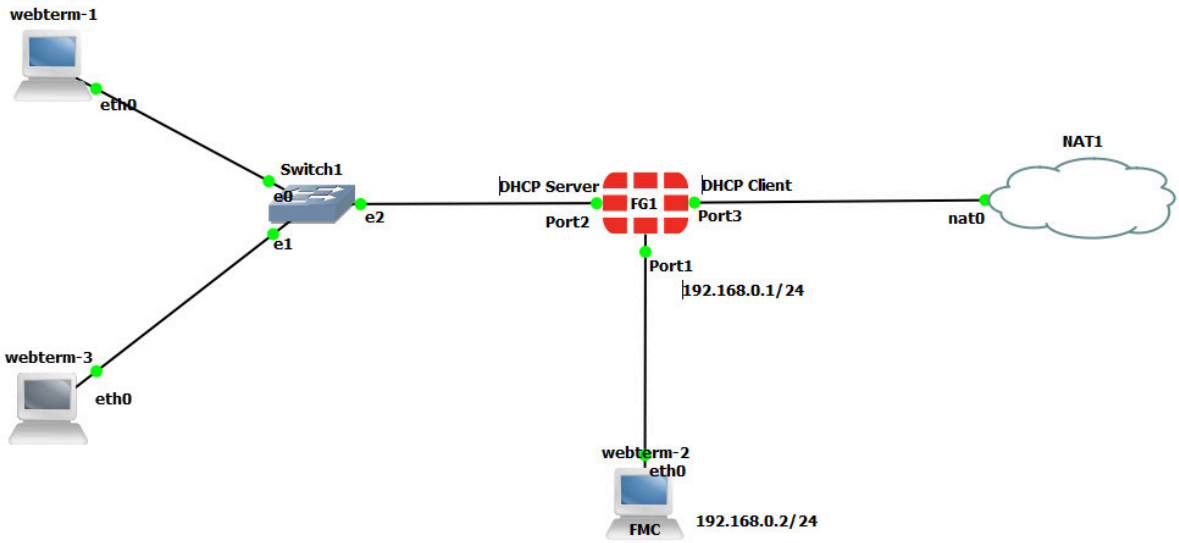


Figure 2.22: Main scenario

Table 2.3: Devices Configuration

Device	Configuration
FortiGate	Port 2: DHCP Server (192.168.1.20 – 192.168.1.30) Port 3: DHCP Client
WebTerm1	DHCP Client
WebTerm3	DHCP Client

1. Remove the application control you have set for policies in the previous step.
2. Add Ethernet Switch and **WebTerm3** to your GNS3. WebTerm3 should receive an IP address from DHCP.

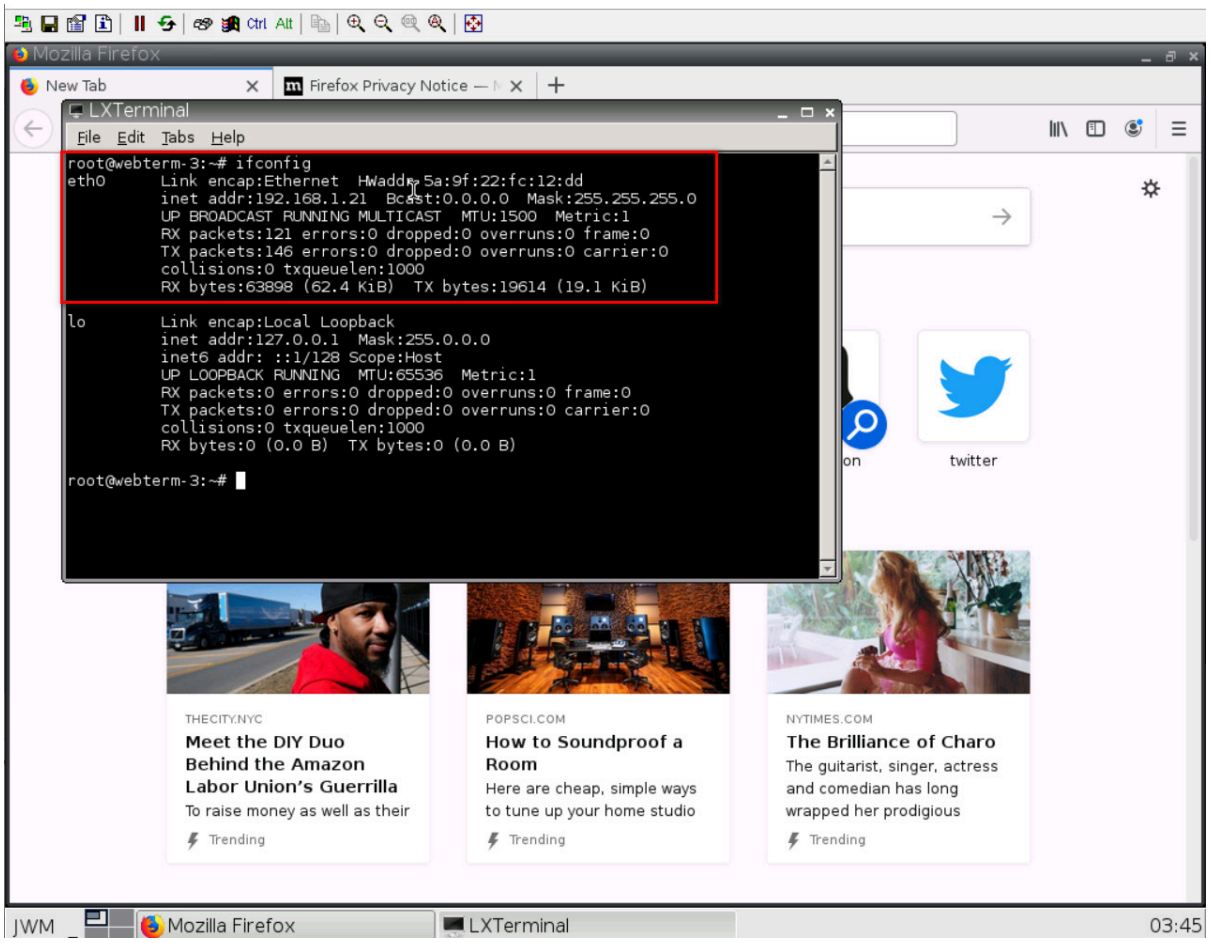


Figure 2.23: Verify DHCP address in WebTerm3

3. Set traffic shaping for WebTerm3 to save the bandwidth.
    - Create an Address object for WebTerm3. Go to **Addresses** > **Create a new Address** with the following information:

Table 2.4: Create a new Address for WebTerm3

Field	Value
Name	WebTerm3
Type	Subnet
Subnet/IP Range	192.168.1.21/32 (Check your IP in WebTerm3)
Interface	any

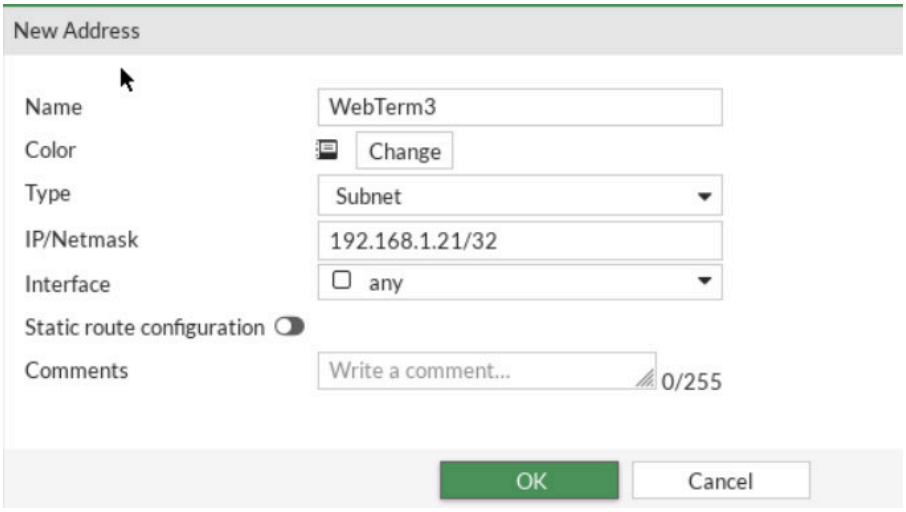


Figure 2.24: WebTerm3 IP address

4. Go to **Policy & Objects** > **Traffic Shapers** and create a new Per-IP traffic shaper. Shared affects upload speed while Per-IP affects download and upload speed.

Table 2.5: Traffic Shaper Configuration

Field	Value
Type	Per-IP
Name	WebTerm3
Max Bandwidth	10000
Max Concurrent Connections	5000

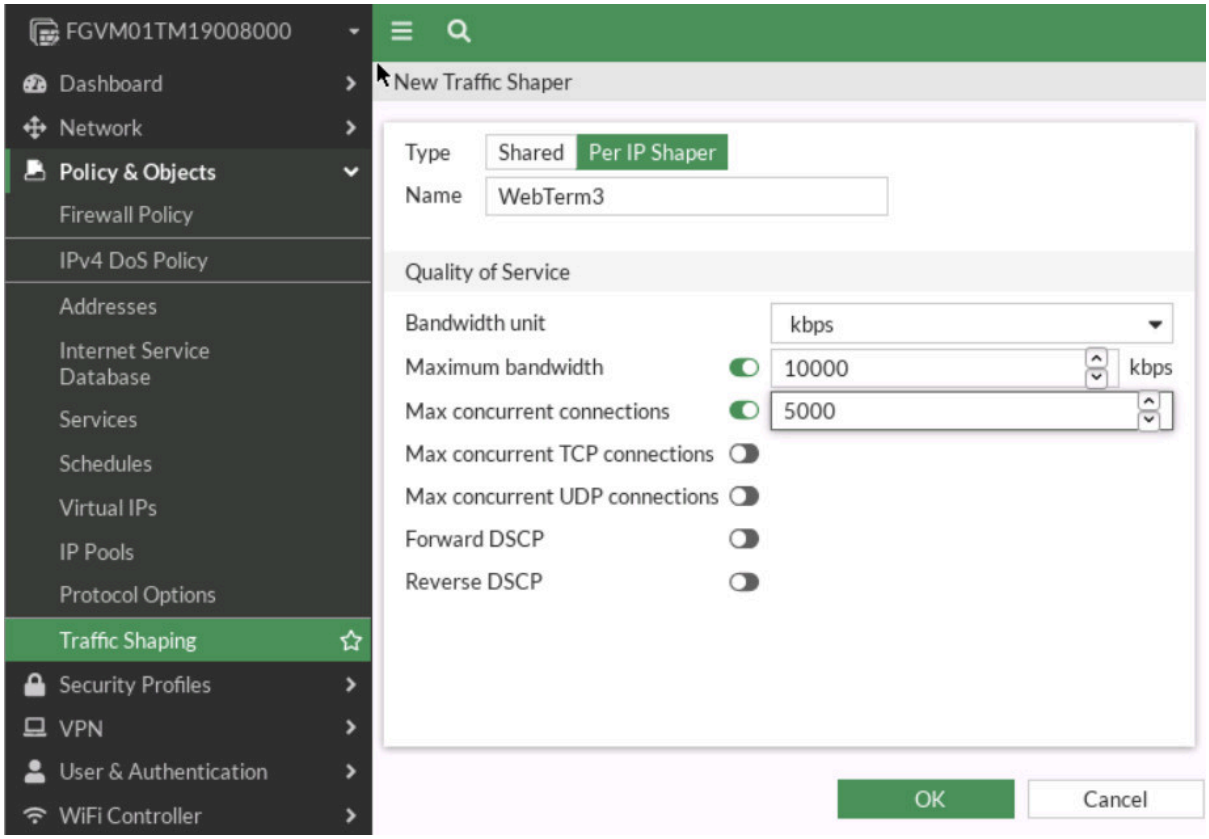


Figure 2.25: Set traffic shaping

5. Go to **Policy & Objects > Traffic Shaping Policy** and create a new Policy.

Table 2.6: Traffic Shaping Policy Configuration

Field	Value
Source	WebTerm3
Destination	ALL
Service	ALL
Outgoing interface	Port3
Per-IP Shaper	WebTerm3

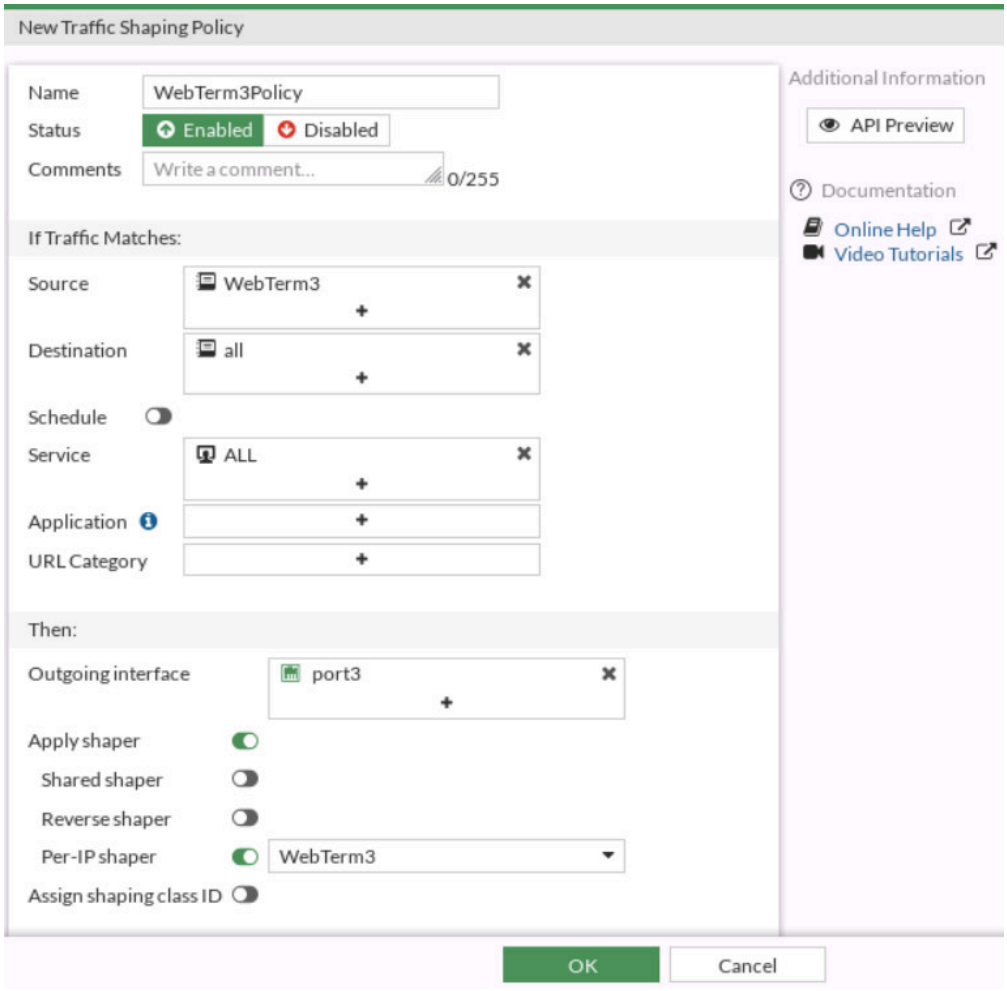


Figure 2.26: Set traffic shaping policy

6. To verify open the browser in the WebTerm3 and go to **Fast.com**.

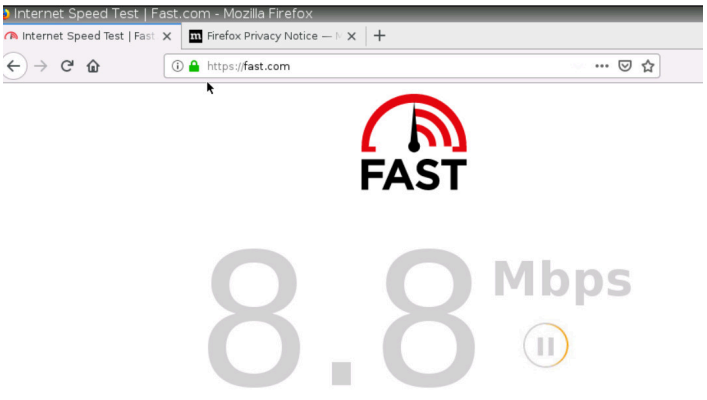


Figure 2.27: WebTerm3 speed test

7. Now, open the browser in WebTerm1 and go to **Fast.com.**

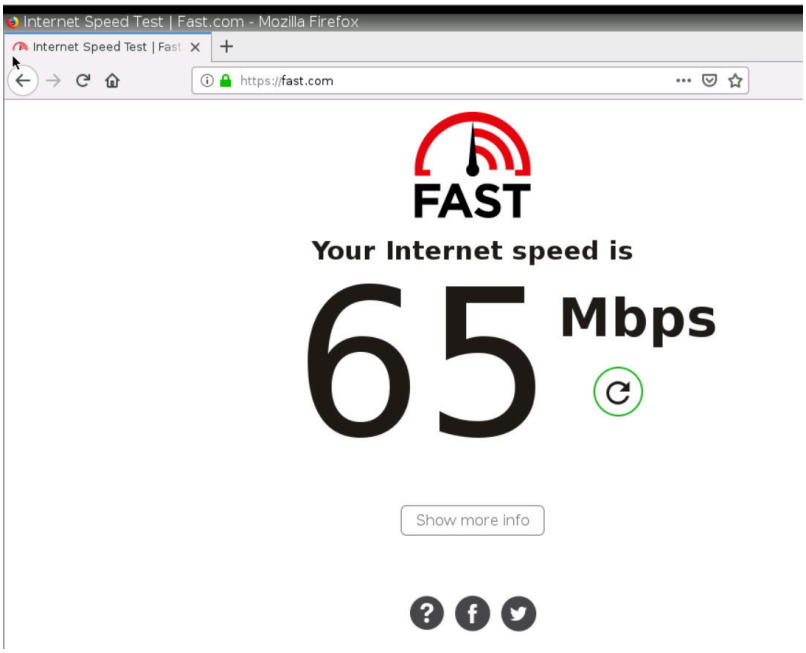


Figure 2.28: WebTerm1 speed test

8. We are going to allow only twitter Applications in WebTerm3. Other applications should be blocked. To do:

    1. Add a new Policy from port2 to port3.

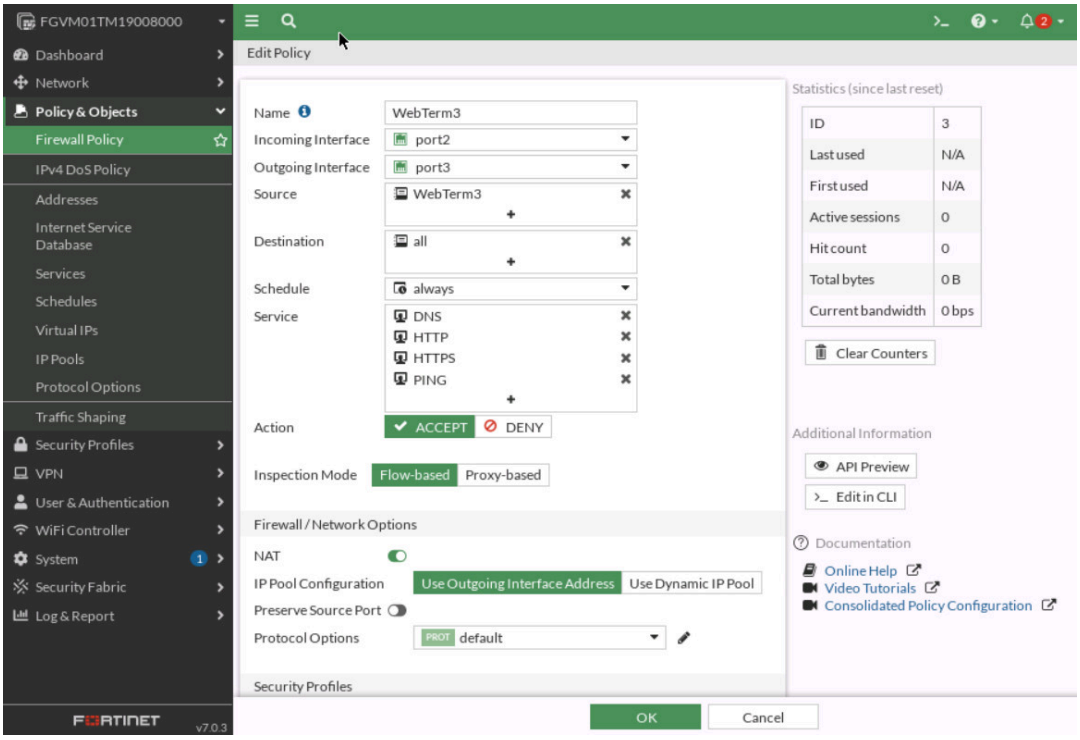


Figure 2.29: Set Firewall Policy

    2. Add and Application Control and Block all applications except Twitter. Then, assign the WebTerm3 profile to Application Control.

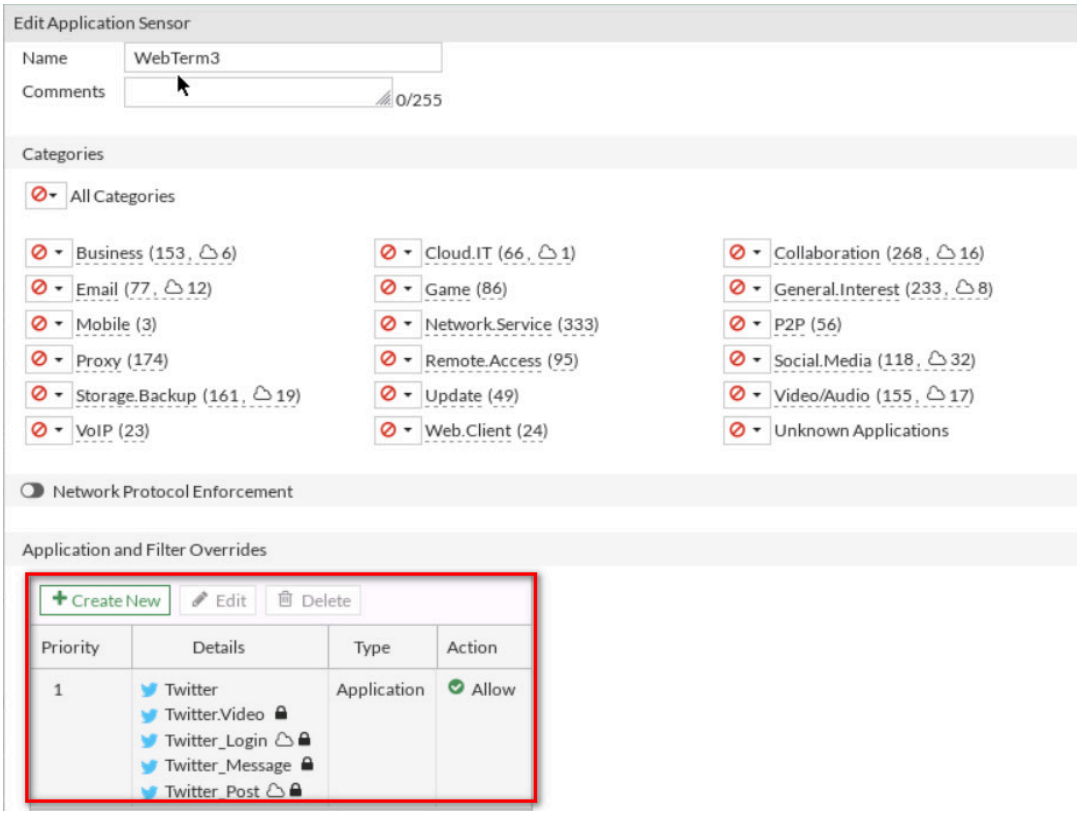


Figure 2.30: WebTerm3 Application Control Settings

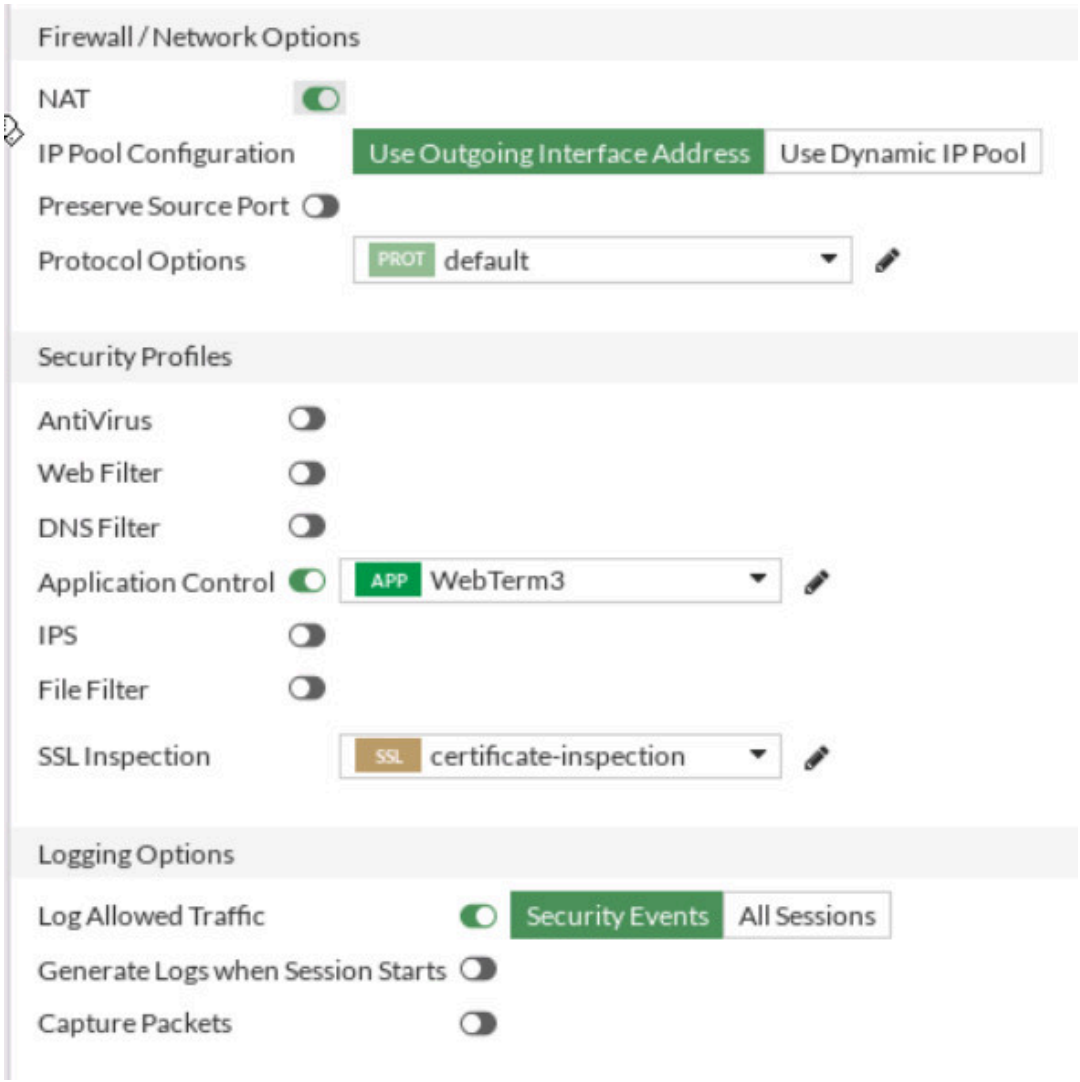


Figure 2.31: Set Application Control

3. Then, put the policy you have created above LocalToInternet Policy.

Name	Source	Destination	Schedule	Service	Action	NAT	Security Profiles	Log
port2 → port3 3								
Block_Ping	mylocal	all	always	PING	DENY			All
WebTerm3	WebTerm3	all	always	DNS HTTP HTTPS PING	ACCEPT	Enabled	APP WebTerm3 SSL certificate-inspection	UTM
LocalToInternet	mylocal	all	always	DNS HTTP HTTPS PING	ACCEPT	Enabled	SSL certificate-inspection	UTM
Implicit 1								

Figure 2.32: Priority of policies

4. Verify: in WebTerm1, you should be able to reach any websites.

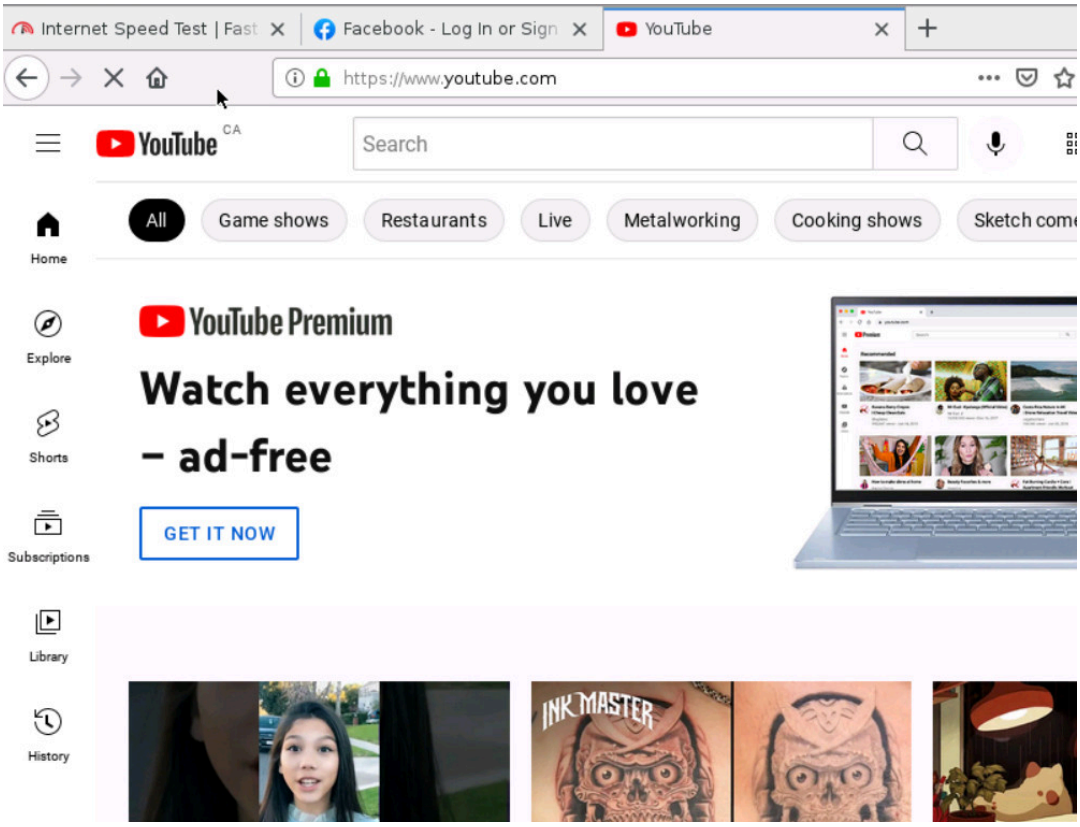


Figure 2.33: Verify the result in WebTerm1

Chapter 3. NAT

3.1 Source NAT

Learning Objectives

- Configure a NAT policy in FortiGate
- Identify source NAT

Scenario: We are going to enable Source NAT (SNAT) to reach the Internet from Kali. That means that all traffic from the local network to the Internet should be allowed.

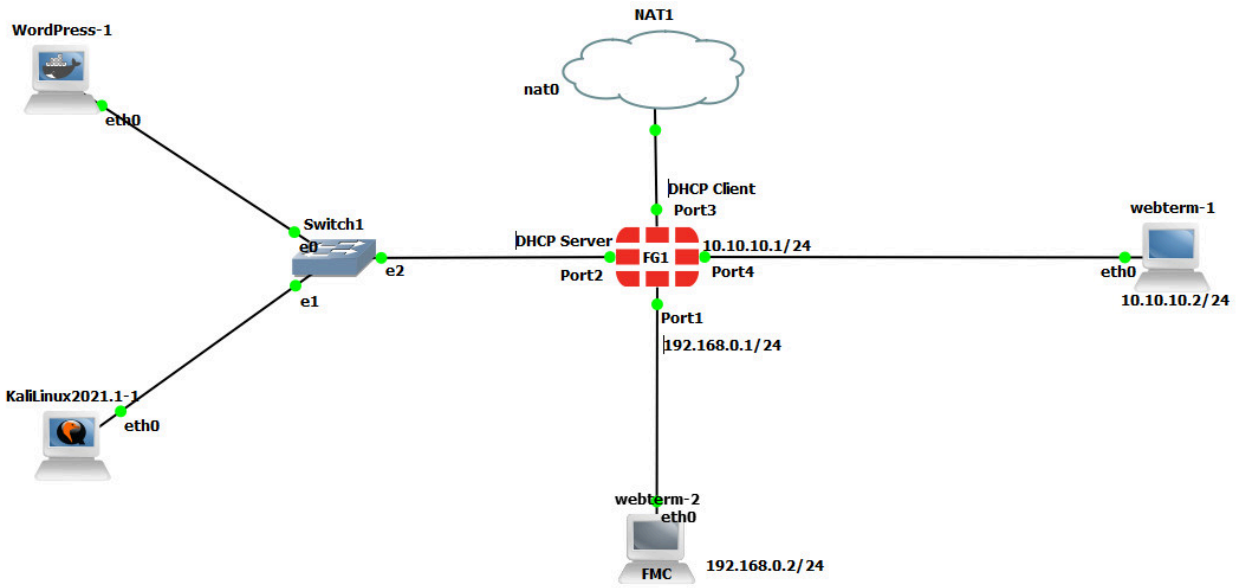


Figure 3.1: Main scenario

Source NAT

Table 3.1: Devices configuration

Device	IP address	Access
Kali	DHCP Client	–
WordPress/Kali	DHCP Client	–
Ethernet Switch	–	–
FortiGate	Port 2 – (192.168.1.1/24) – DHCP Server (192.168.1.10 to 192.168.1.20) Port 3 – DHCP Client Port 4 – 10.10.10.1/24	ICMP-HTTP-HTTPS
WebTerm	10.10.10.2/24	–

Basic Configuration

1. Port configuration in the firewall as follows:

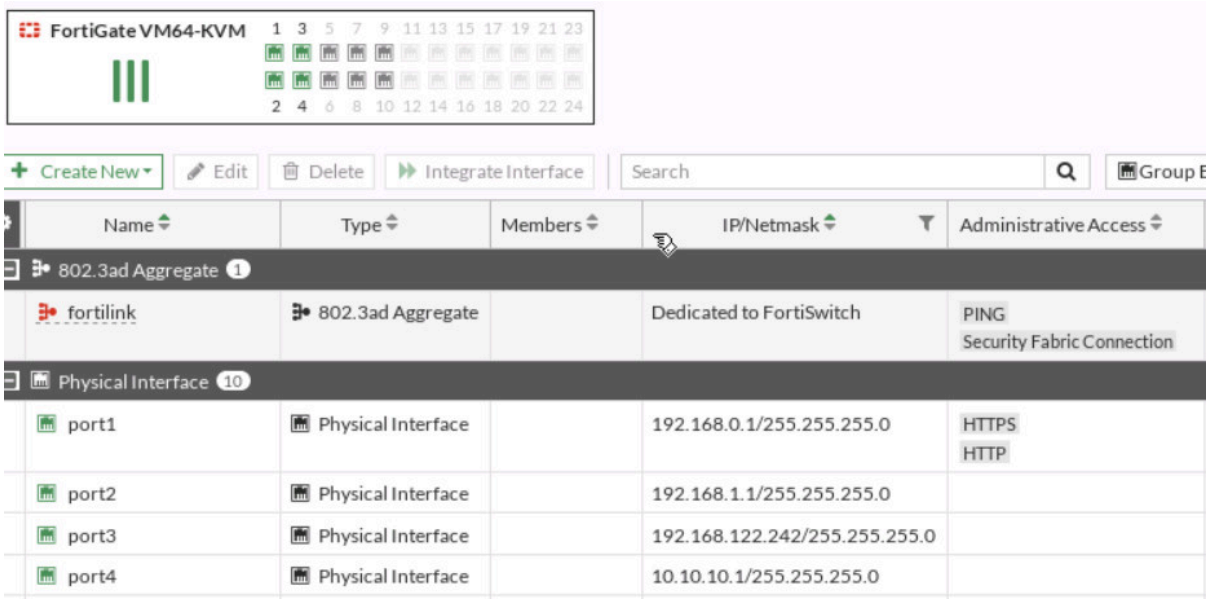


Figure 3.2: Ports configuration in the firewall

2. Set a DHCP server on interface port2 (Range of IP address should be: 192.168.1.10 to 192.168.1.20, DNS: 4.2.2.4).

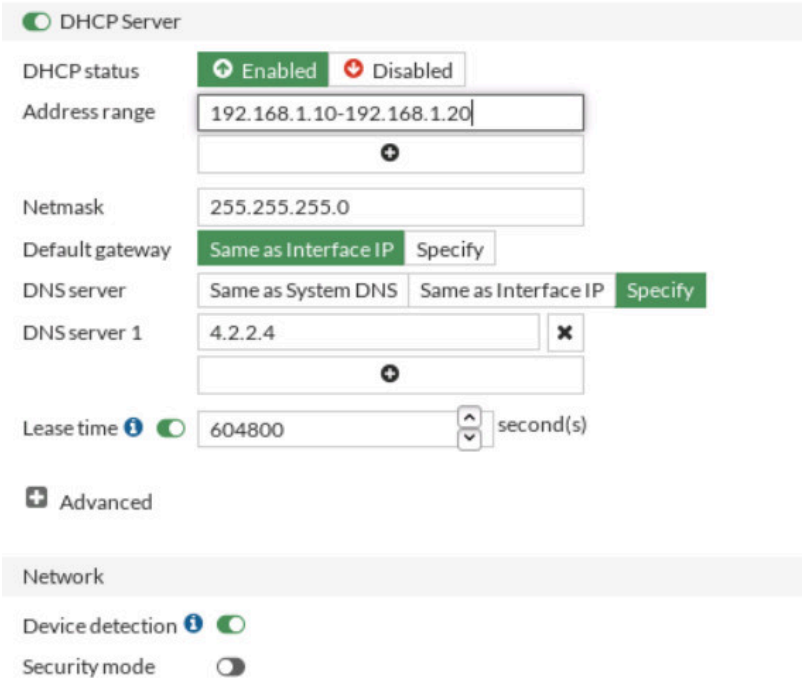


Figure 3.3: DHCP Server configuration

3. Set port3 as a DHCP client and connect to the NAT.

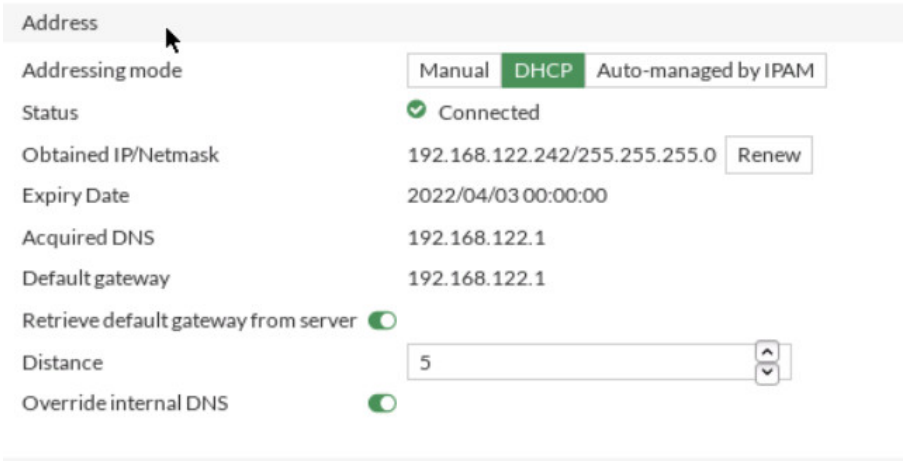


Figure 3.4: DHCP client configuration

4. Set a static route in the firewall to reach to NAT object.

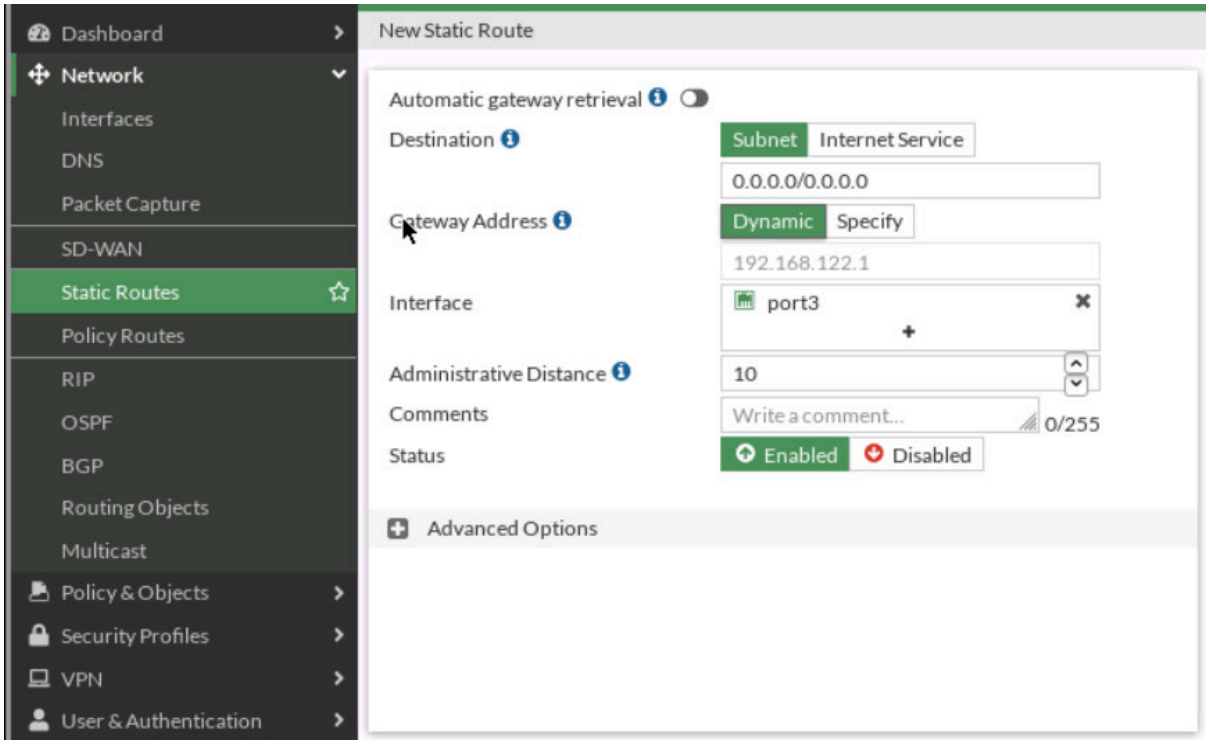


Figure 3.5: Set a static route

5. Go to **Policy & Objects > Firewall Policy** section, click **Create New** to add a new firewall policy, and configure the following settings:

    - Name: **LocalToInternet**
    - From **inside to outside (port2 to port3)**
    - Source: **Create an address for the local network** (Subnet: 192.168.1.0/24)
    - Destination: **all**
    - Schedule: **Always**
    - Service: **Only HTTP, HTTPS, and DNS**
    - Action: **Accept**

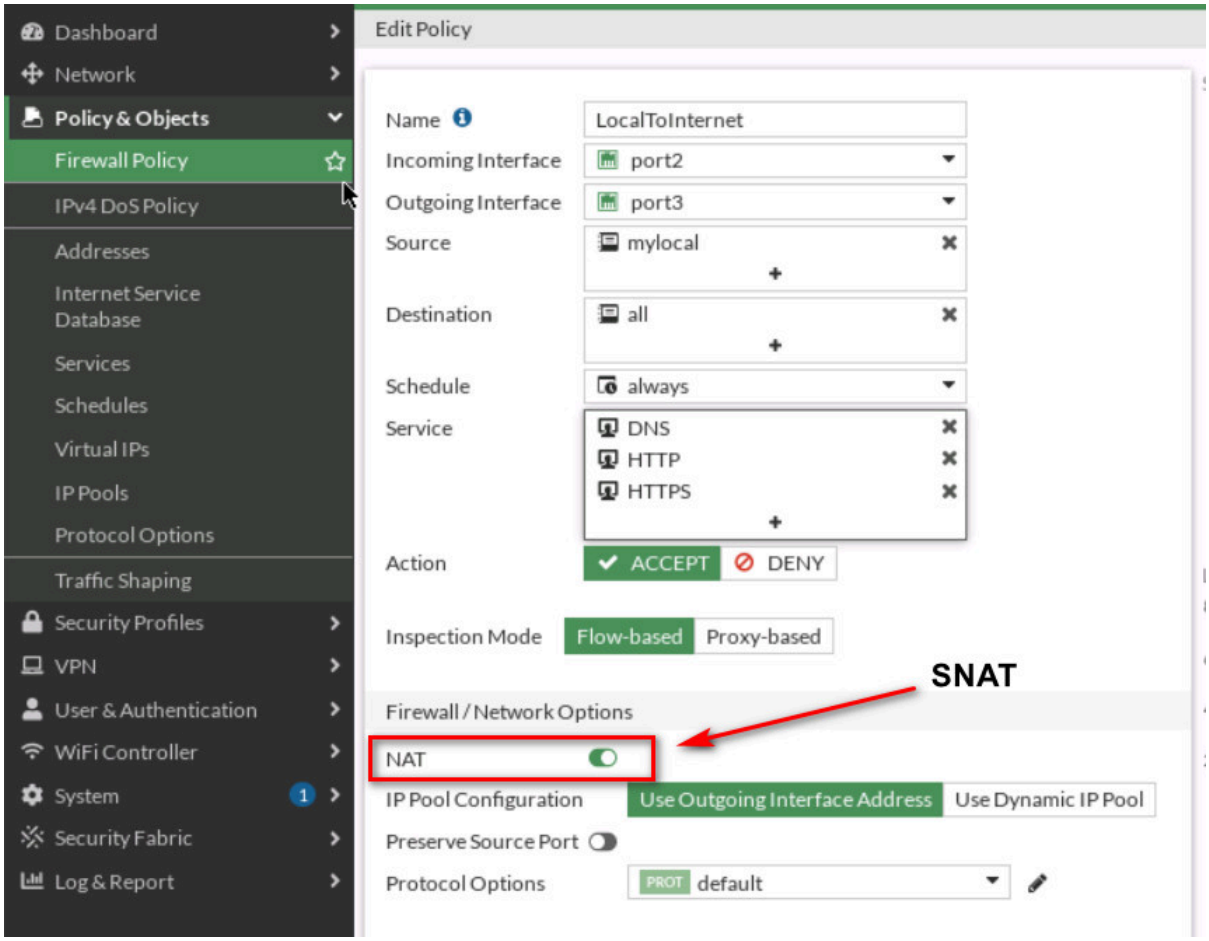


Figure 3.6: Configure Firewall Policy and enable Source NAT

6. Open the browser in Kali, you should be able to access the internet.

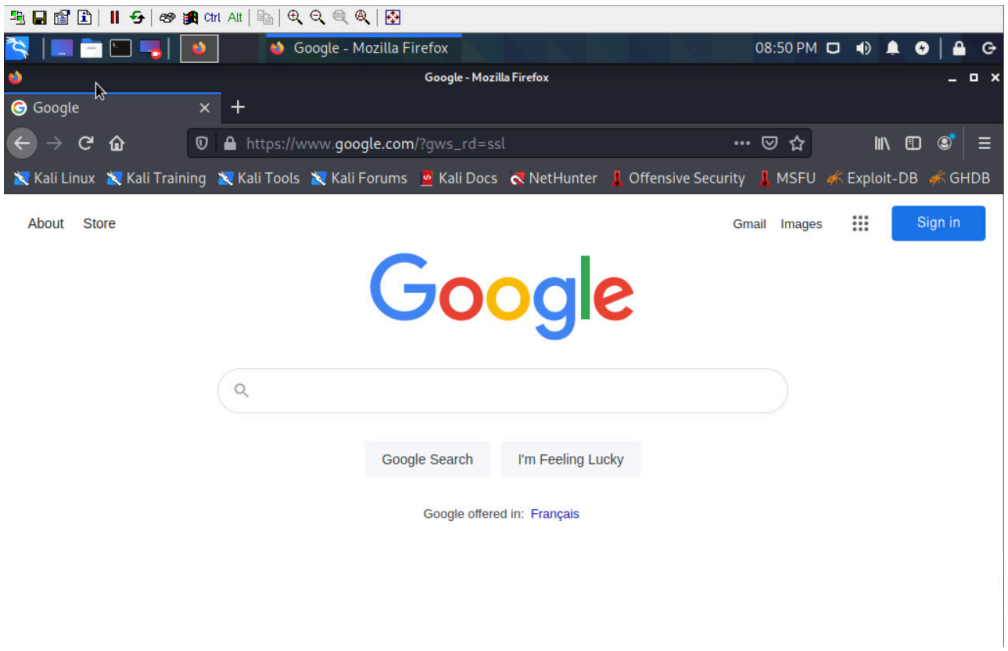


Figure 3.7: Verify your configuration

3.2 Destination NAT

Learning Objectives

- Create a virtual IP address
- Create a Destination NAT
- Create a Port Forwarding

Scenario: We are going to enable Destination NAT (DNAT) and able to reach WordPress from WebTerm1. That means if someone from WebTerm1 opens the browser and types http://10.10.10.1 should be able to reach WordPress.

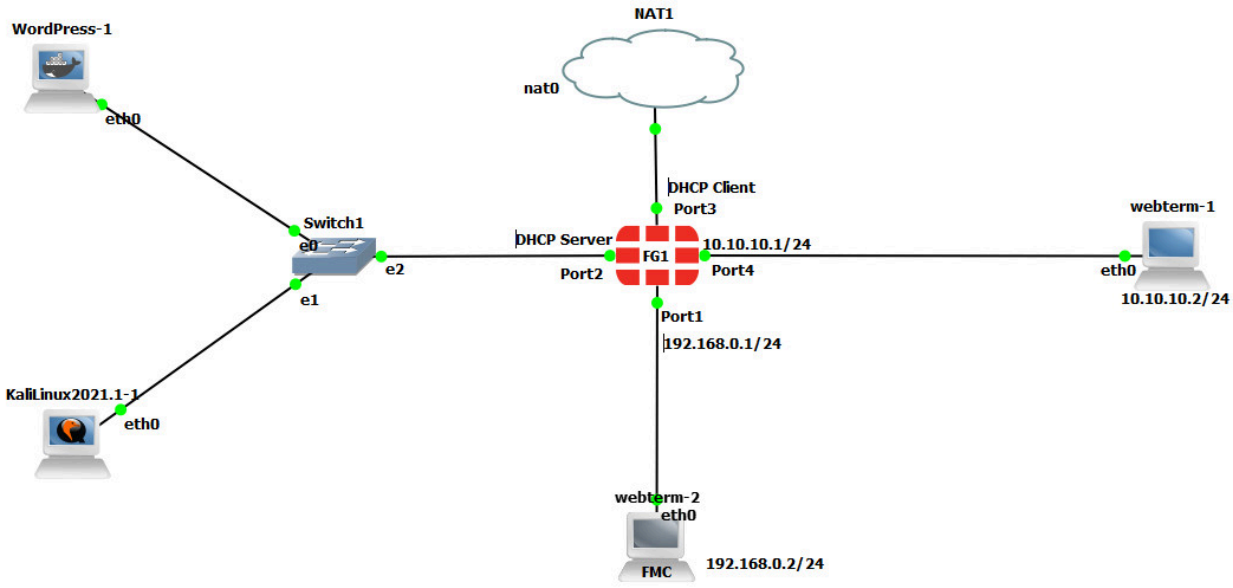


Figure 3.8: Main scenario

VIP (Virtual IP address)

Go to **Policy Objects** > **Virtual IPs** and Create a new Virtual IP:

- Name: **outsideToDMZ**
- Interface: **Port 4**
- External IP address: **10.10.10.1**
- Mapped IP address: **192.168.1.X** (Find the local IP address of your WordPress)
- Enable Port Forwarding:
    - External Service Port: **TCP 80**
    - Map to Port: **TCP 80**

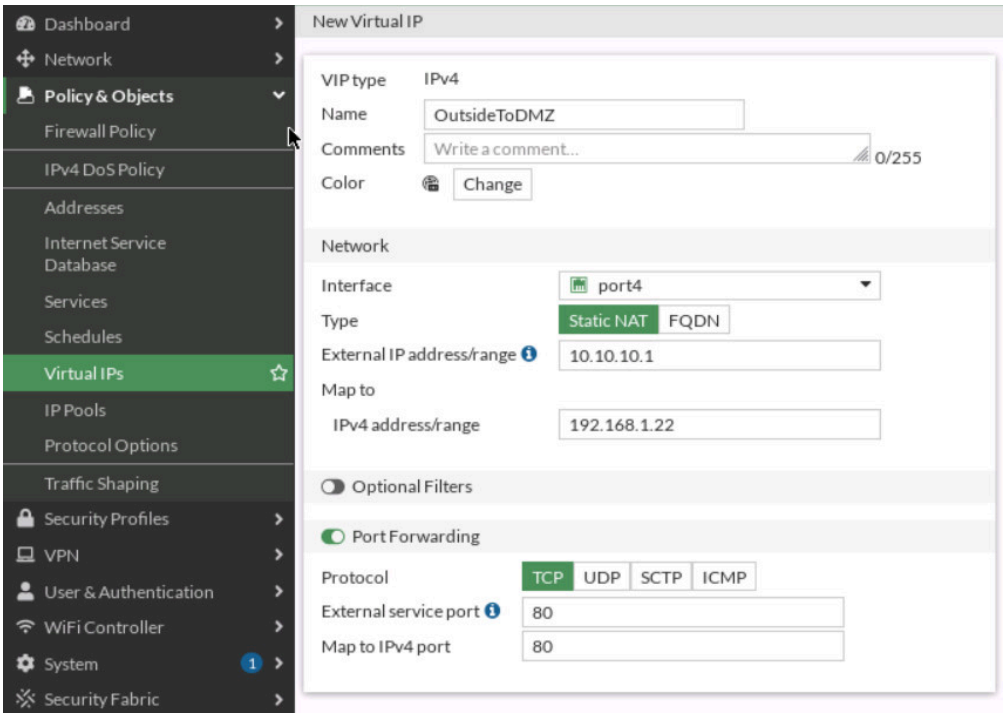


Figure 3.9: Configure Virtual IP

Create a Firewall Policy

You will create a new firewall policy to match a specific source, destination, service, and action set to Accept.

Table 3.2: Firewall policy configuration

Field	Value
Name	Outside-DMZ
Incoming Interface	Port 4
Outgoing Interface	Port 2
Source	All
Destination	Select your VIP Name (outsideToDMZ)
Schedule	Always
Service	HTTP
Action	ACCEPT
Log Violation Traffic	<enable>
Enable this policy	<enable>

Click **OK** to save the changes.

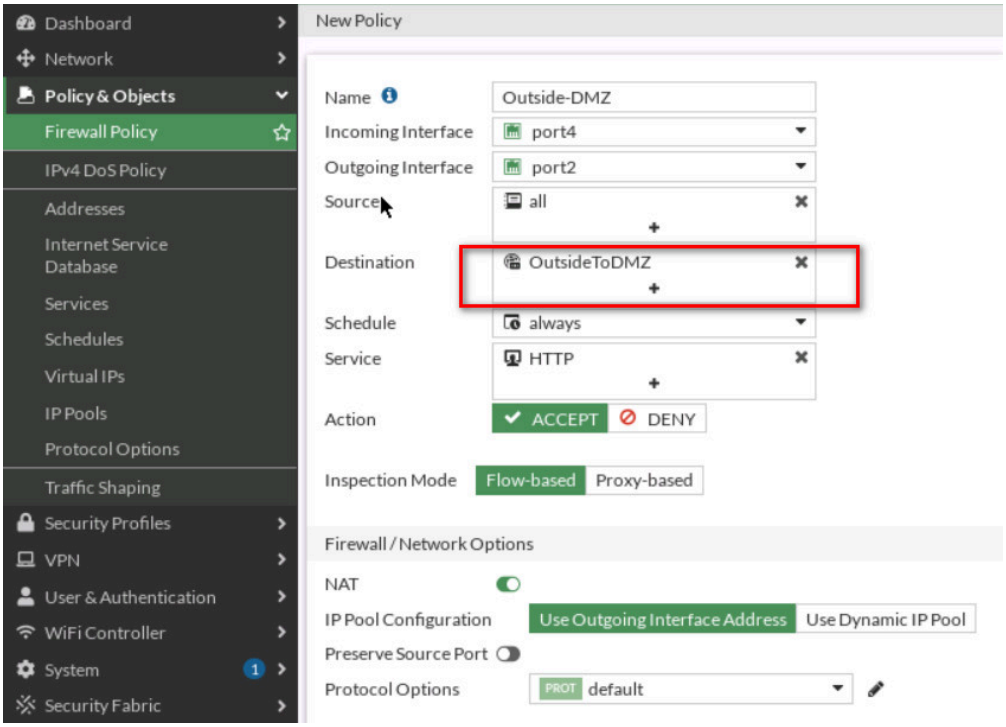


Figure 3.10: Set Firewall Policy

To confirm traffic matches, go to WebTerm1, open the browser and type http://10.10.10.1 in the browser. You should be able to reach WordPress.

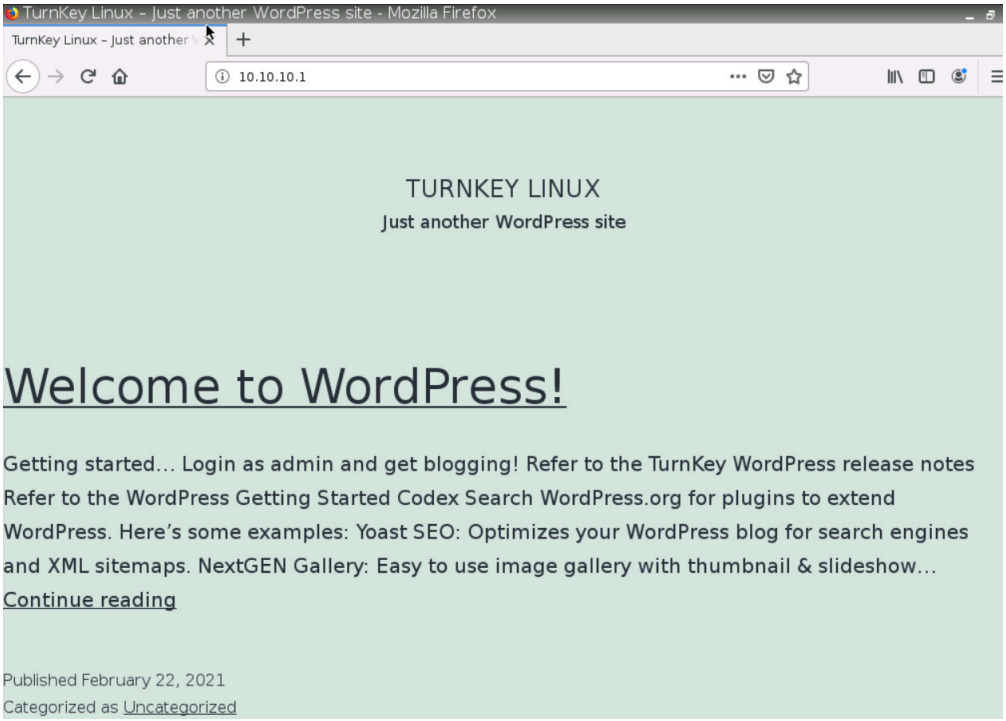


Figure 3.11: Verify configuration

Port Forwarding

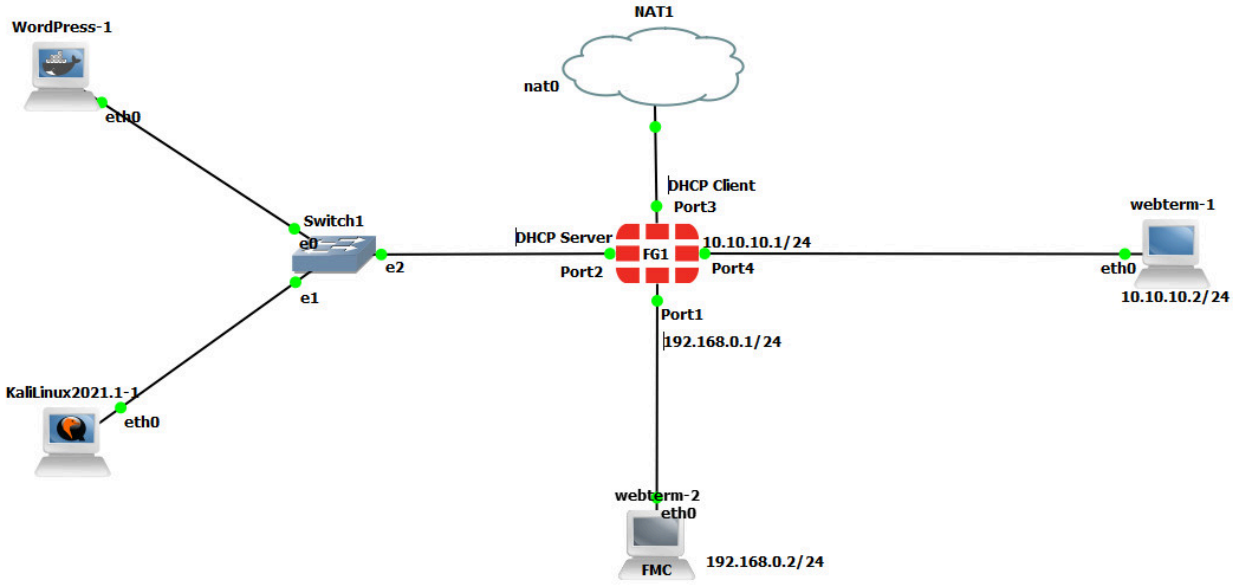


Figure 3.12: Main scenario

1. Set the interface of Kali as a DHCP client and enable SSH in Kali. To enable SSH in Kali type Figure 3.13 command:

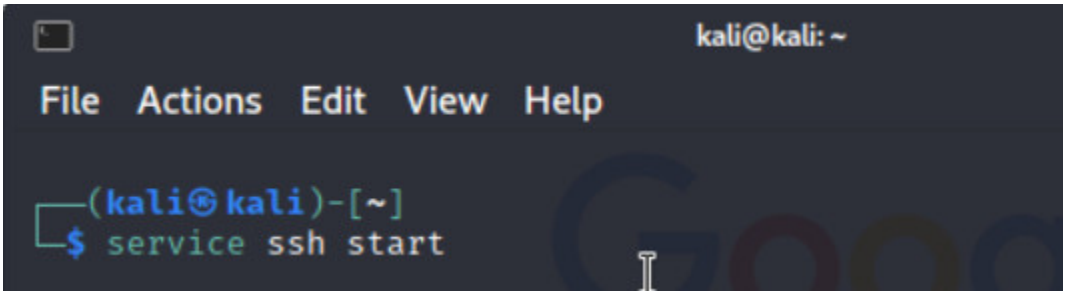


Figure 3.13: Enable SSH service in Kali

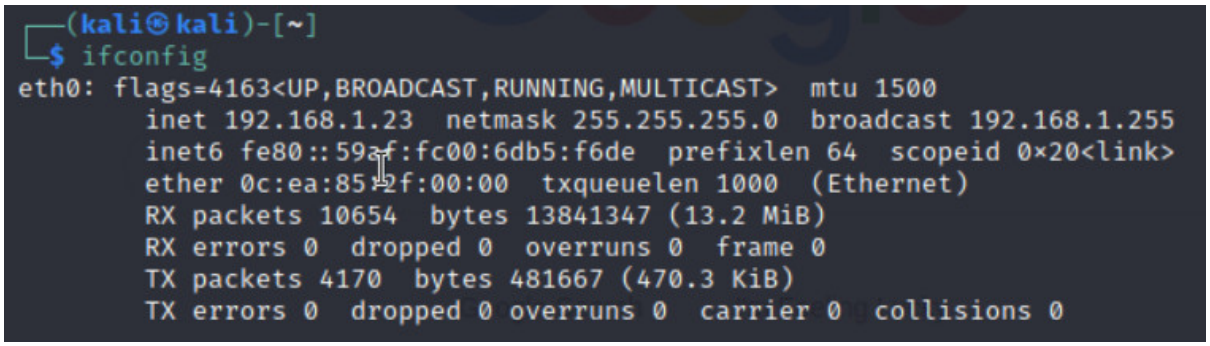


Figure 3.14: Verify you've received an IP address from DHCP

2. Repeat the previous steps we have done for DNAT and try to reach Kali from port 8080 (Port Forwarding: 8080 → 22)

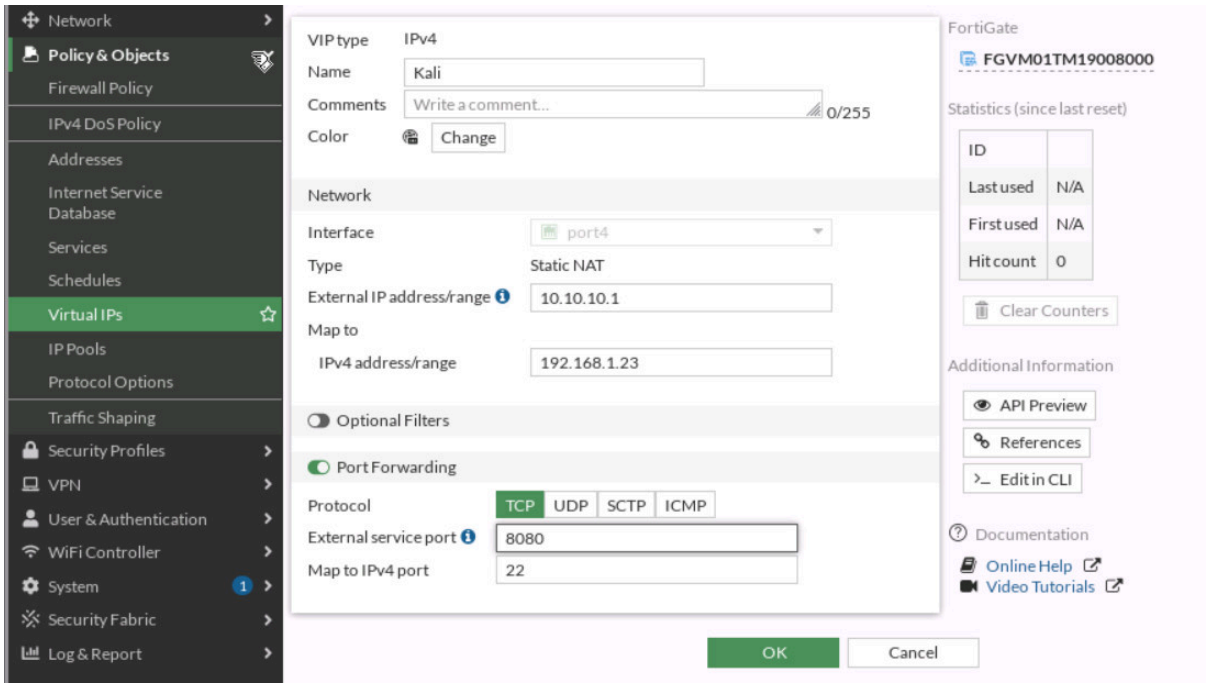


Figure 3.15: Map External port 8080 to local port 22

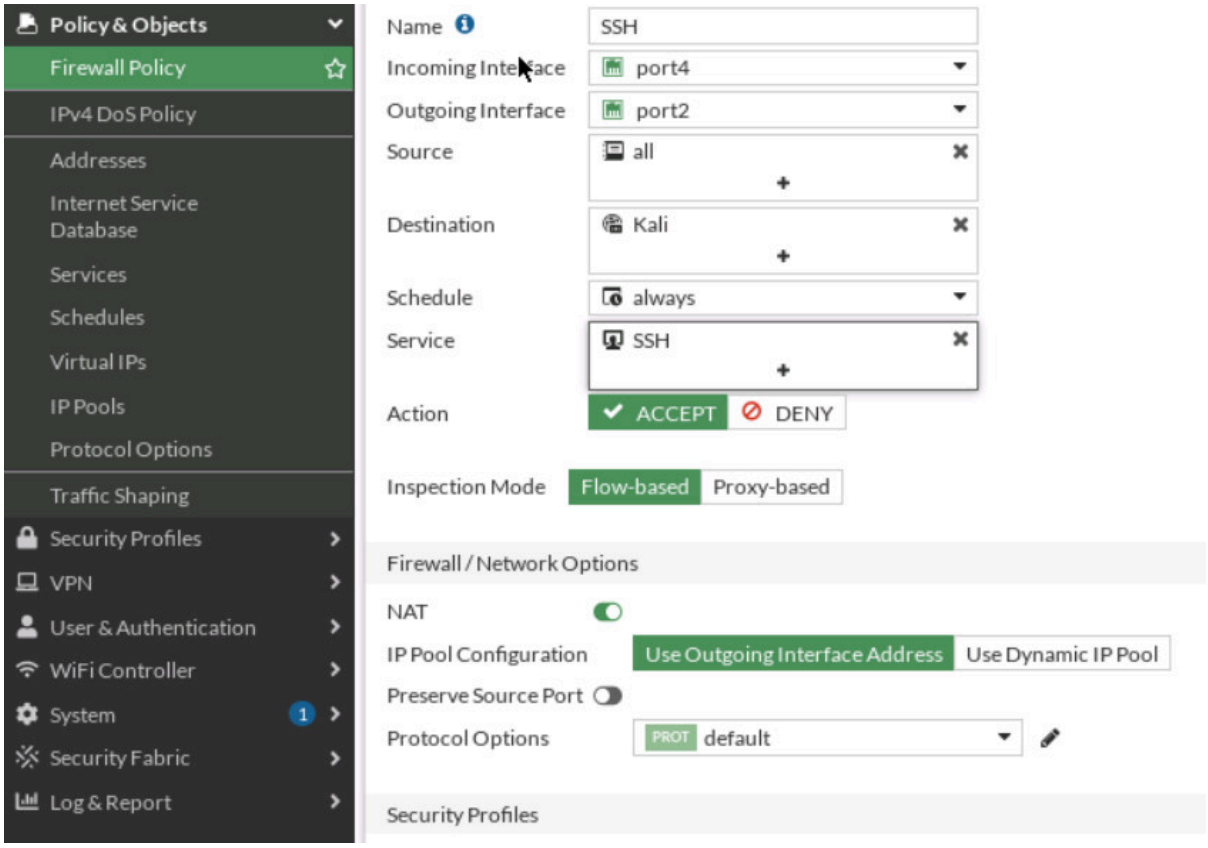


Figure 3.16: Set Firewall Policy

3. Verify your connection from WebTerm (**Hint:** ssh user@10.10.10.1 -p 8080).

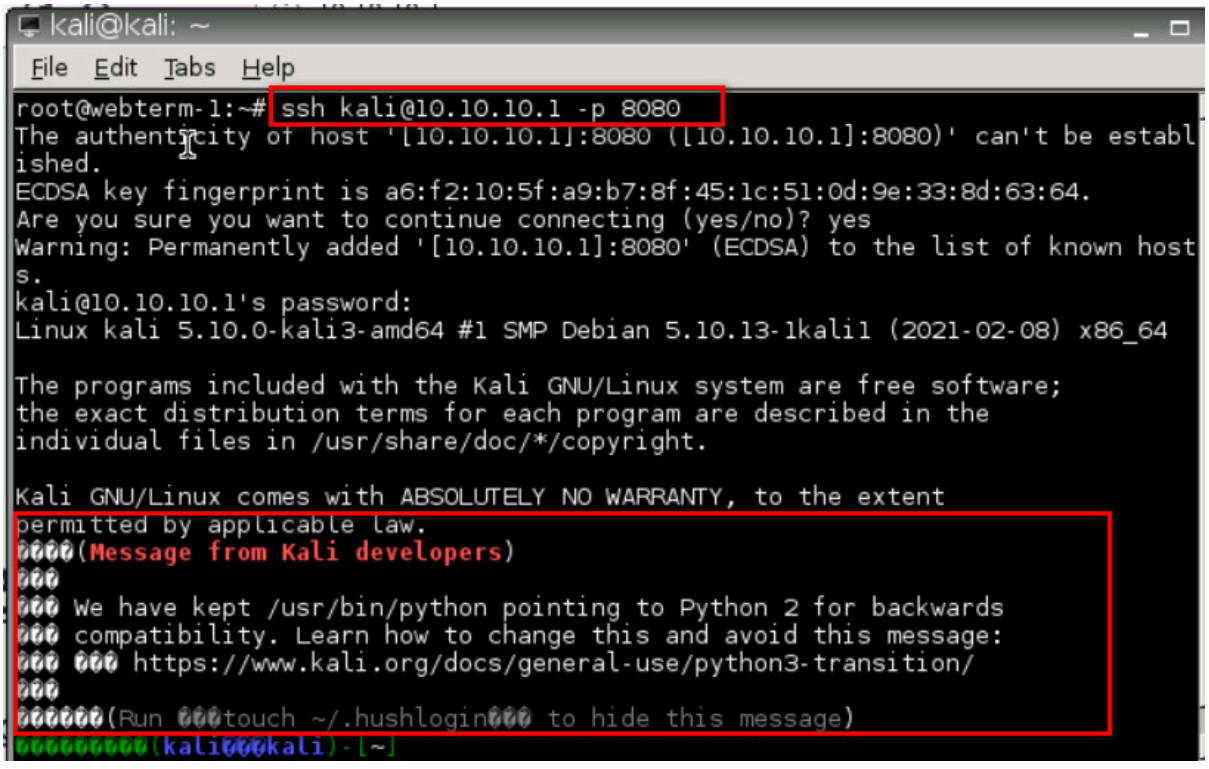


Figure 3.17: Verify SSH connection

Chapter 4. VPN

4.1 IPsec VPN

Learning Objectives

- Configure an IPsec VPN
- Configure a site-to-site VPN

Scenario: We are going to have IPsec VPN from Windows to FortiGate Firewall. First, we are going to install FortiClient on Windows and then we will configure the firewall for FortiClient. The goal of this scenario is to have connectivity from Windows to PC1. You should be able to ping PC1 after you have established your VPN connection.

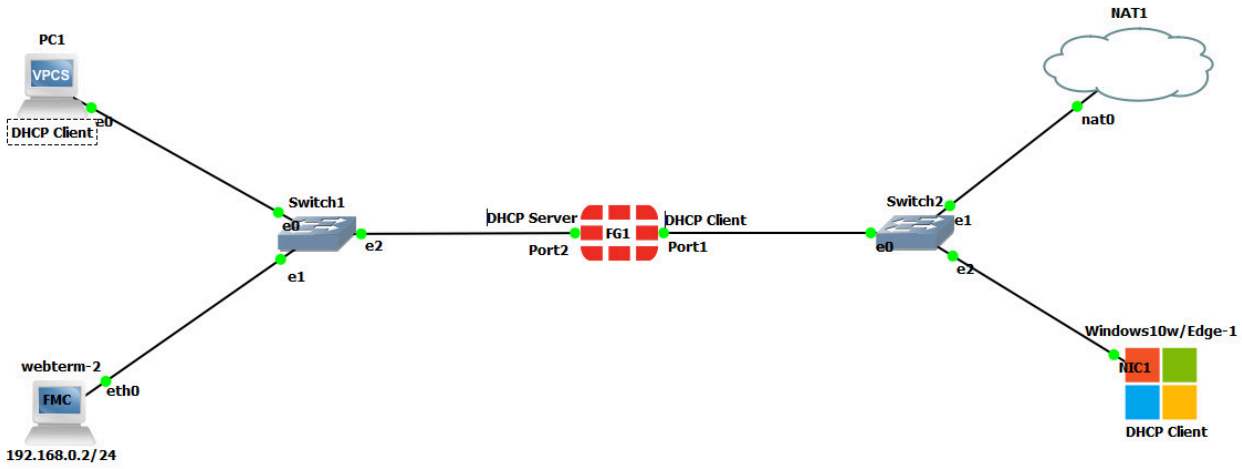


Figure 4.1: Main scenario

Configuration

Table 4.1: Devices configuration

Device	IP address	Access
WebTerm2	192.168.0.2/24	–
VPC	DHCP Client	–
Ethernet Switch1-2	–	–
FortiGate	Port 1: DHCP Client Port 2: 192.168.0.1/24 DHCP Server (192.168.0.10 to 192.168.0.20)	ICMP HTTP HTTPS
Windows	DHCP Client	–

Before you begin the configuration, please remember with VPC's and Web terms this is how we edit their IP settings for static and or DHCP Addressing:

Before dragging in your web terms or other devices remember to always choose GNS3 VM:

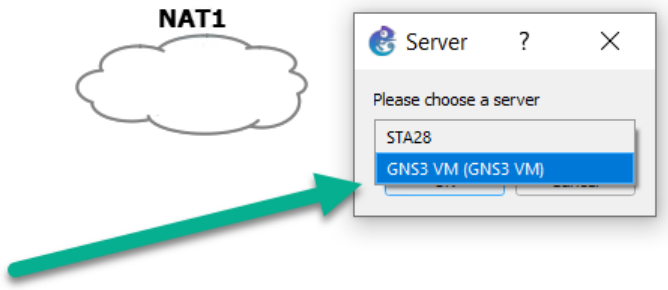


Figure 4.2: Dragging a NAT under GNS3 VM

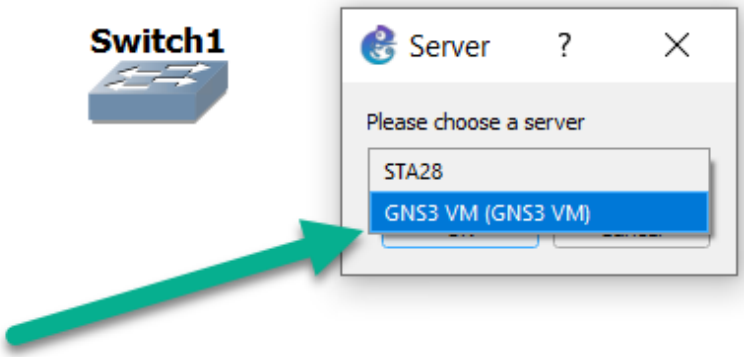


Figure 4.3: Dragging a switch under GNS3 VM

1. Set a DHCP server on interface port2 (Range of IP address should be: 192.168.0.20 to 192.168.0.30, DNS: 4.2.2.4).

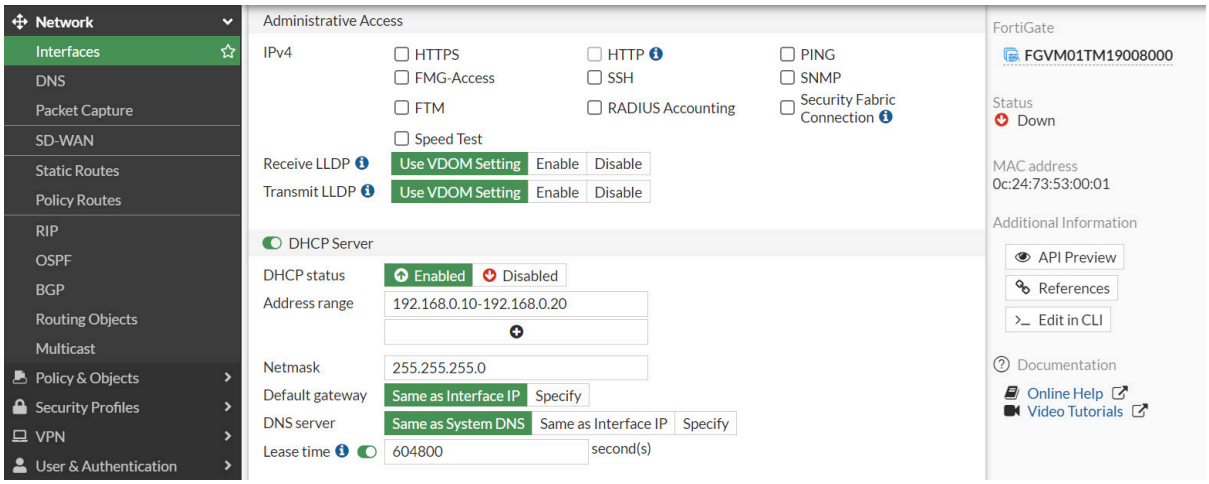


Figure 4.4: Set DHCP IP address

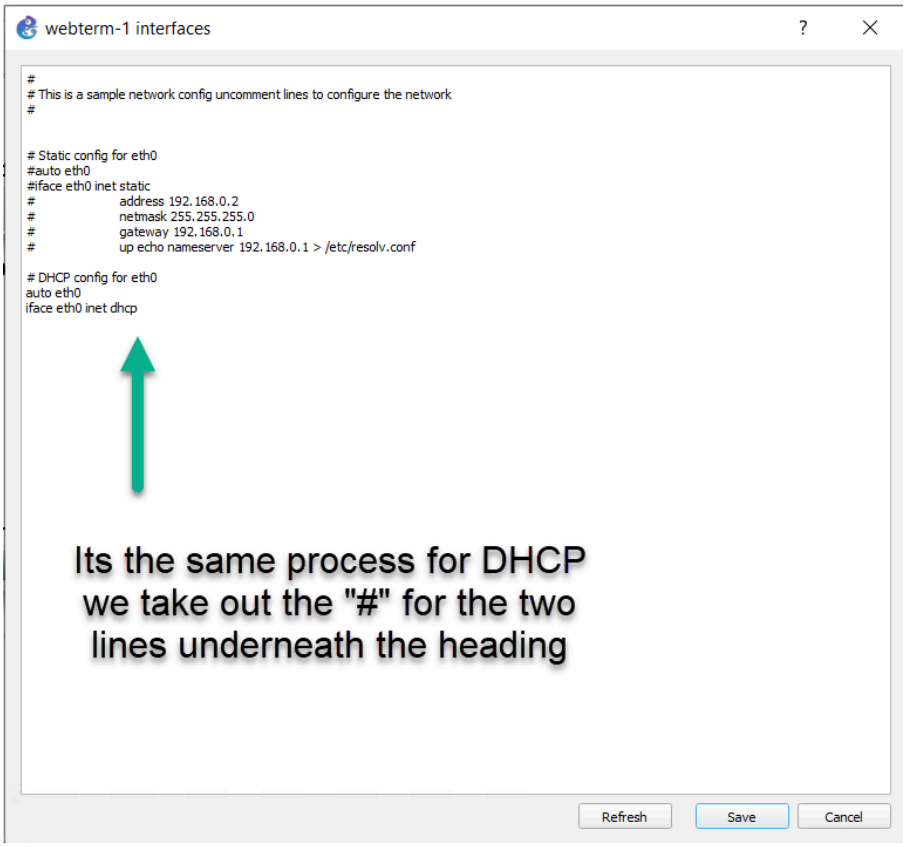


Figure 4.5: Enable DHCP client

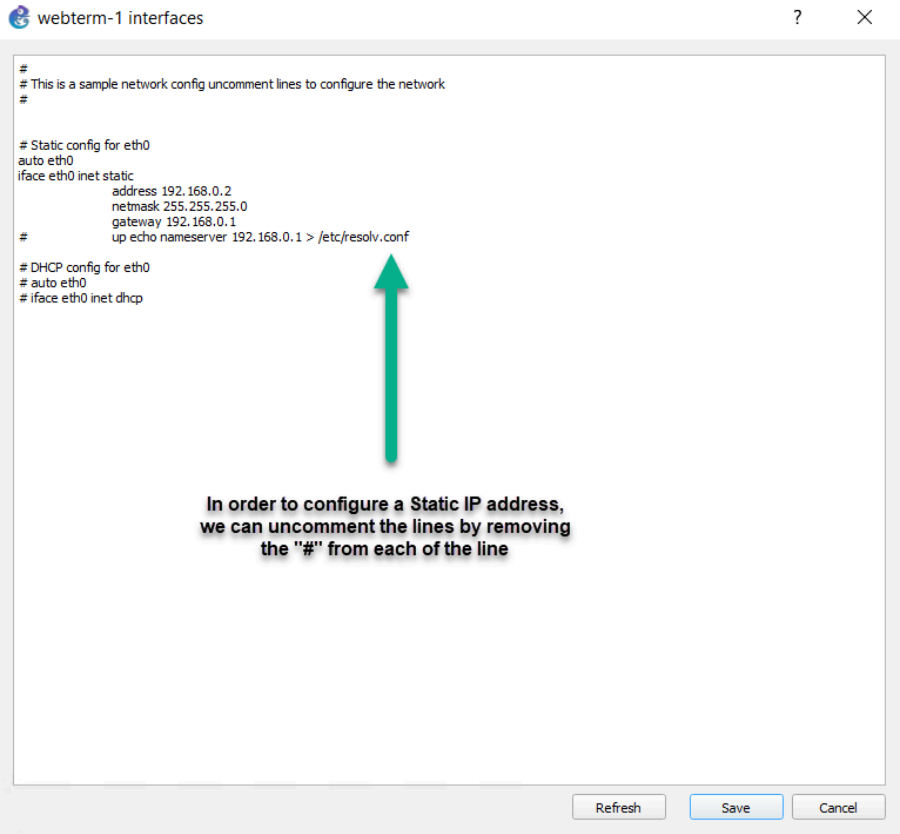


Figure 4.6: Configure a static IP address

2. Go to **User & Authentication** > **User Group** > **Create New**:

    - Name: **VPN_GRP_A0ID**
    - TYPE: **Firewall**

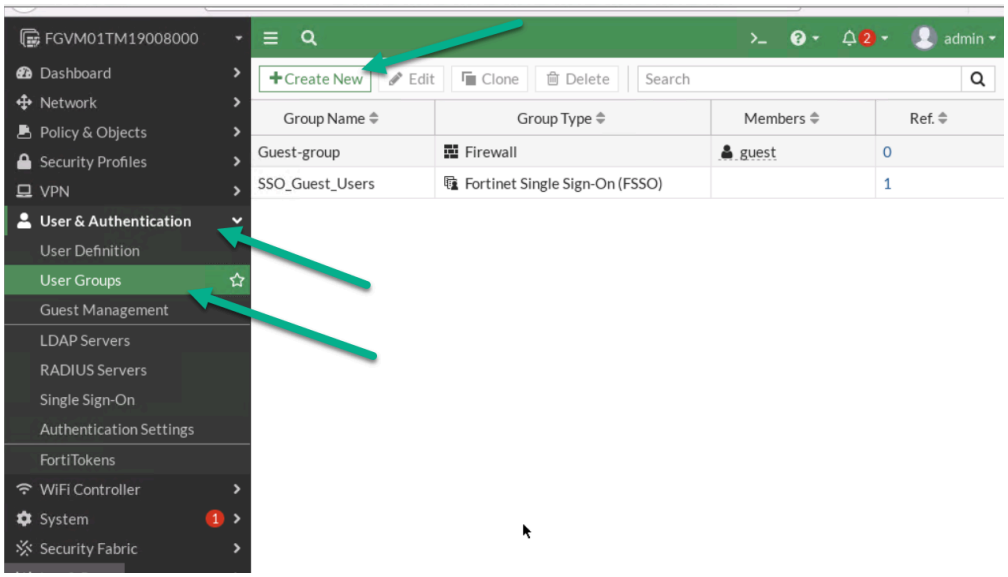


Figure 4.7: Create a user group

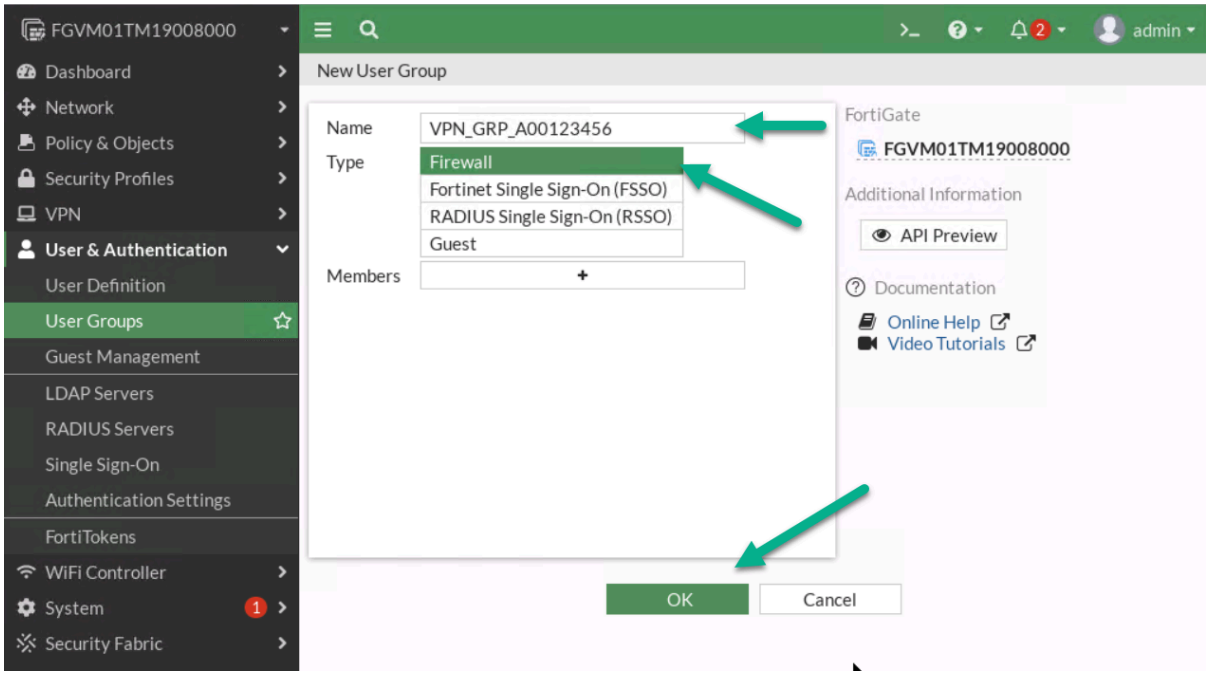


Figure 4.8: Create a group in the firewall

3. Go to **User & Authentication** > **User Definition** > **Create a User**:

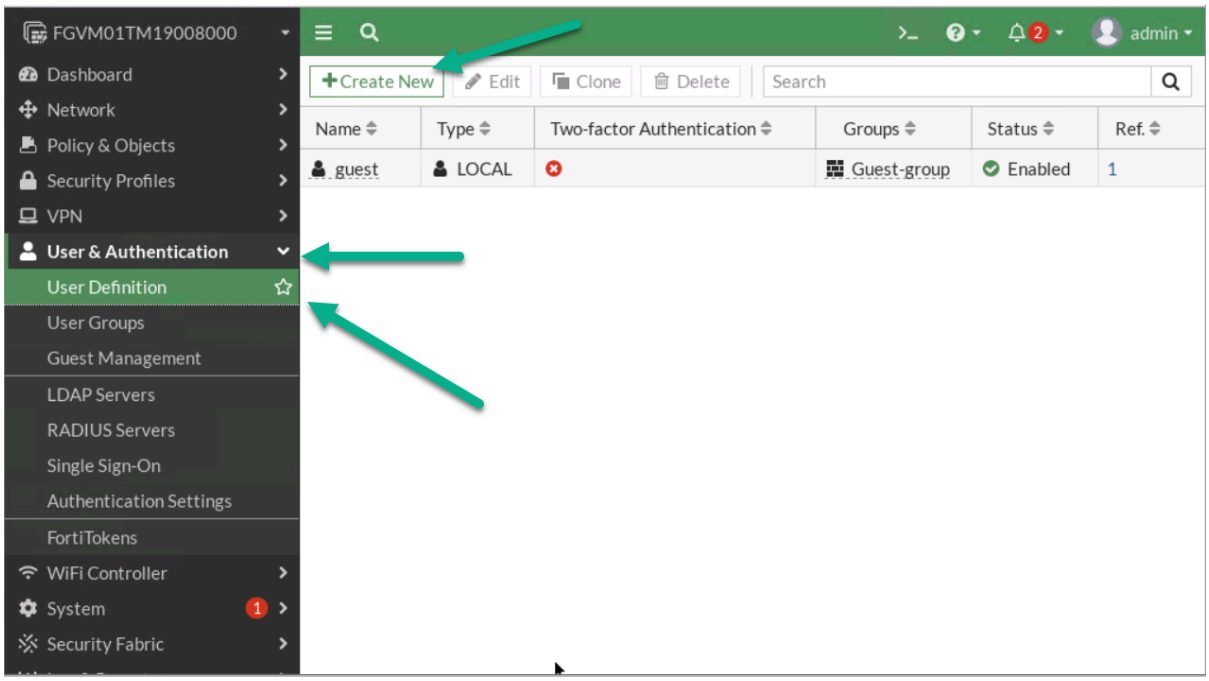


Figure 4.9: Create a new user

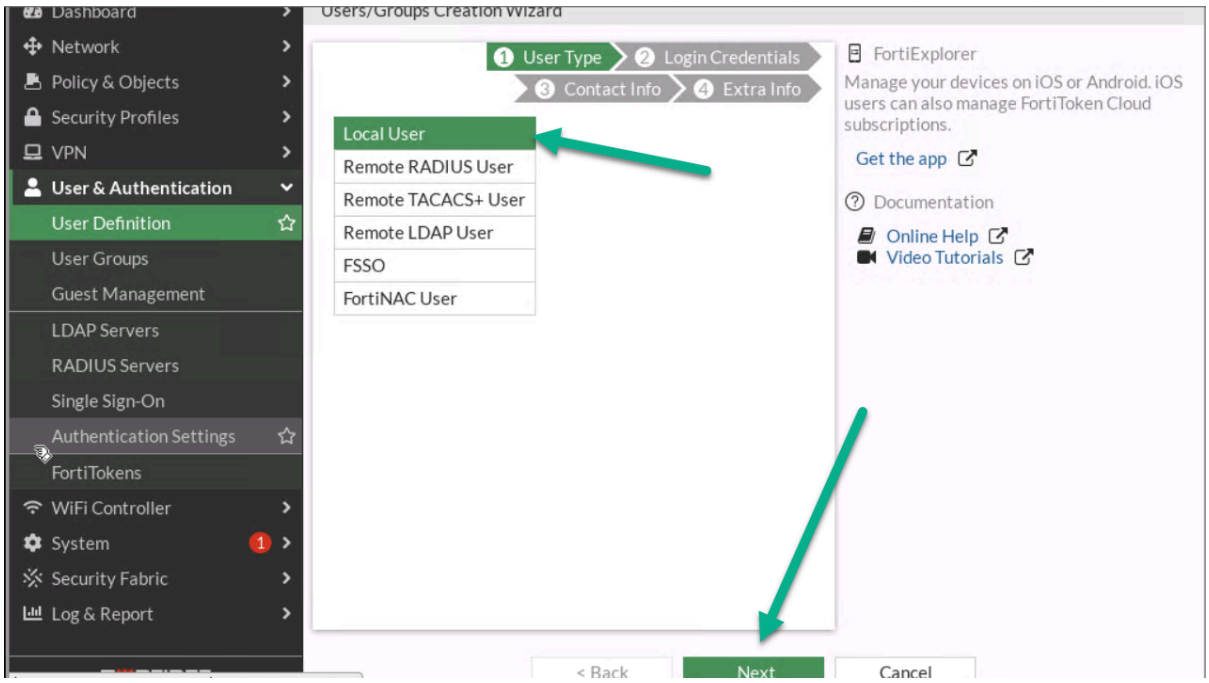


Figure 4.10: Create a local user

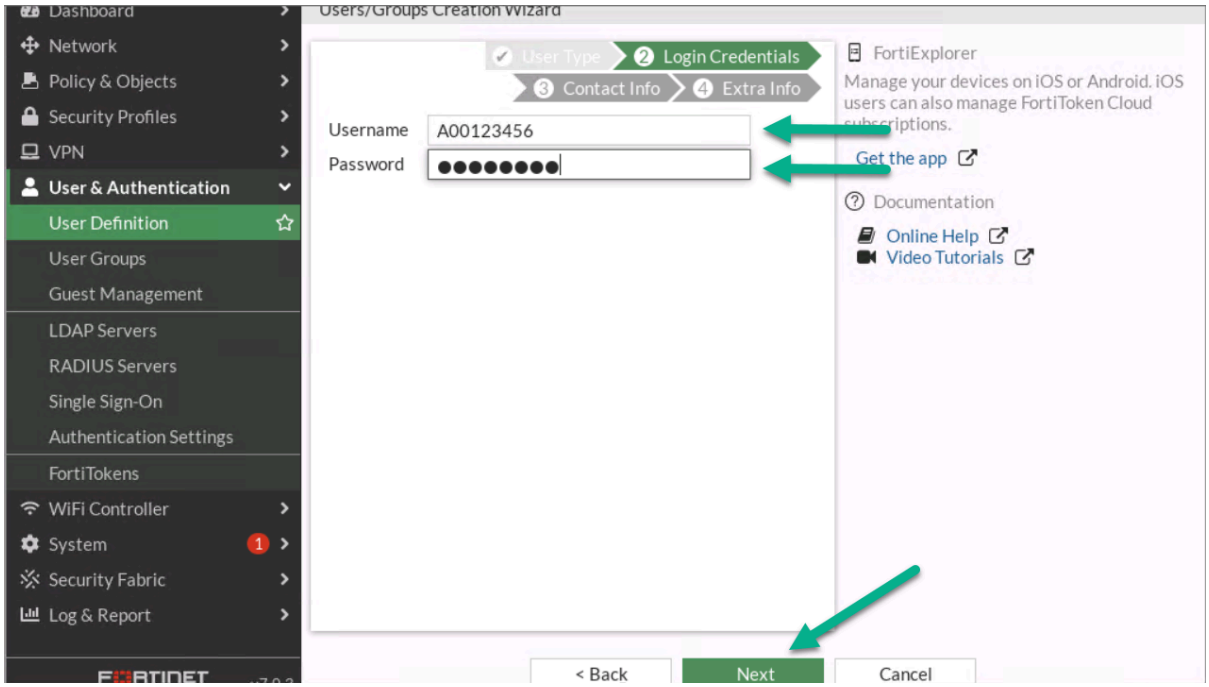


Figure 4.11: Configure login credentials for the user

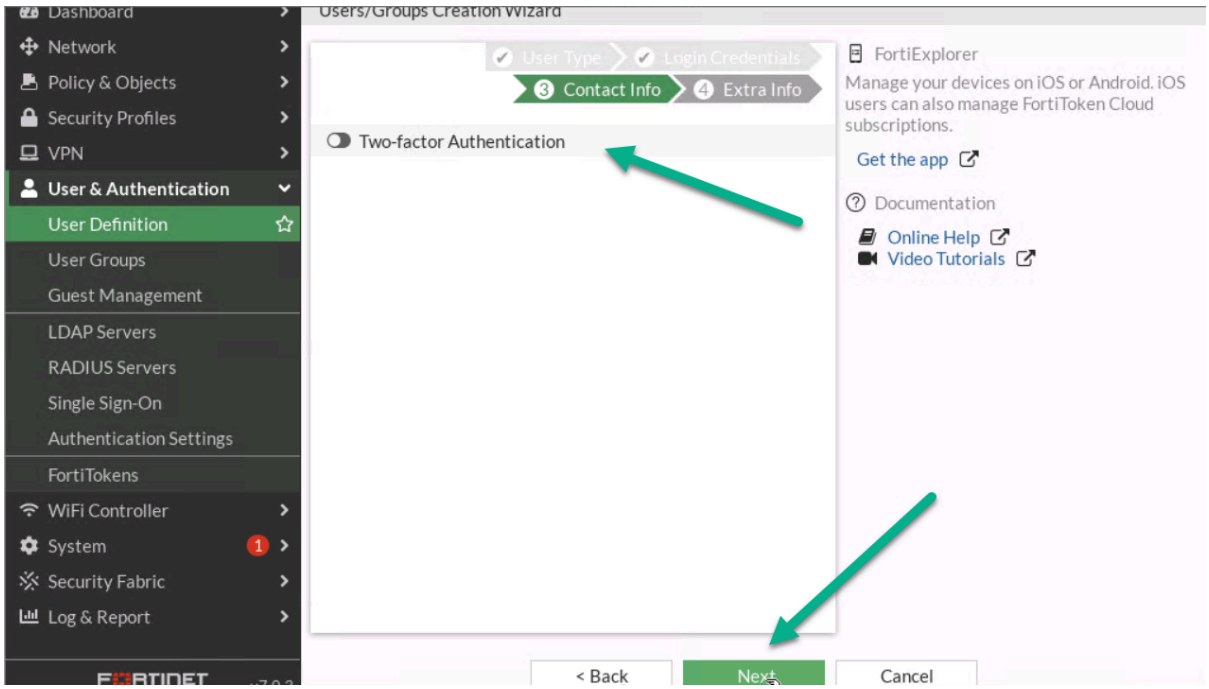


Figure 4.12: Contact info

4. Assign User Group to your profile.

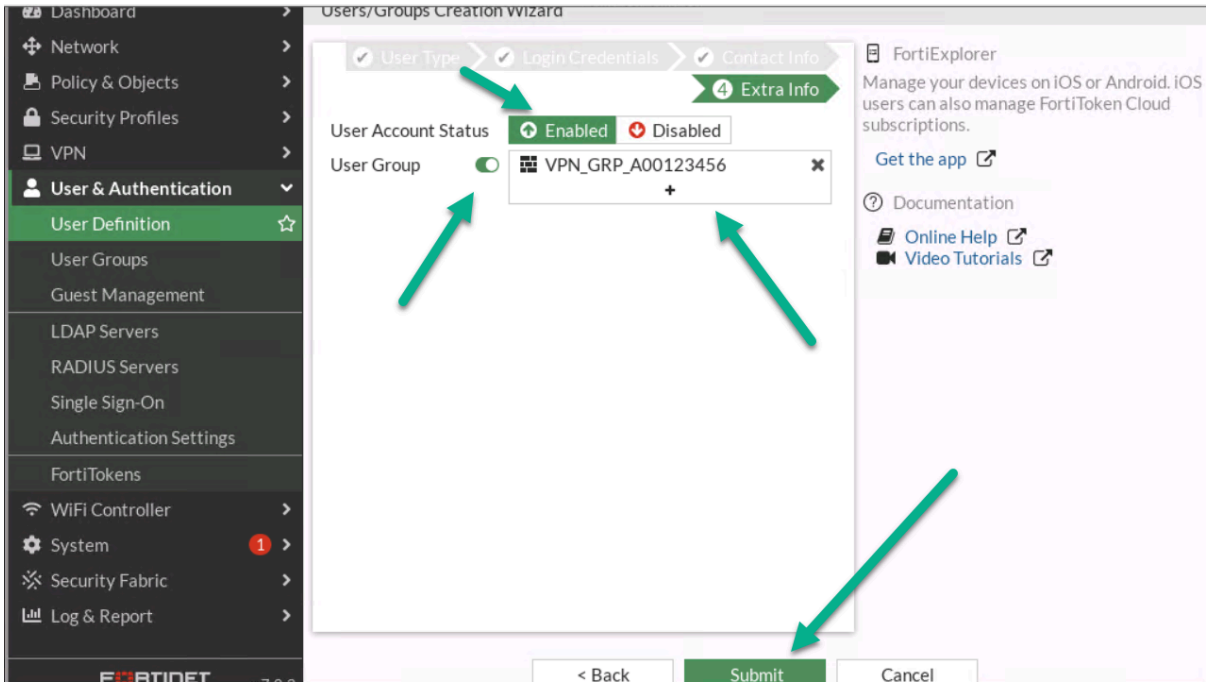


Figure 4.13: Assign a user to the group

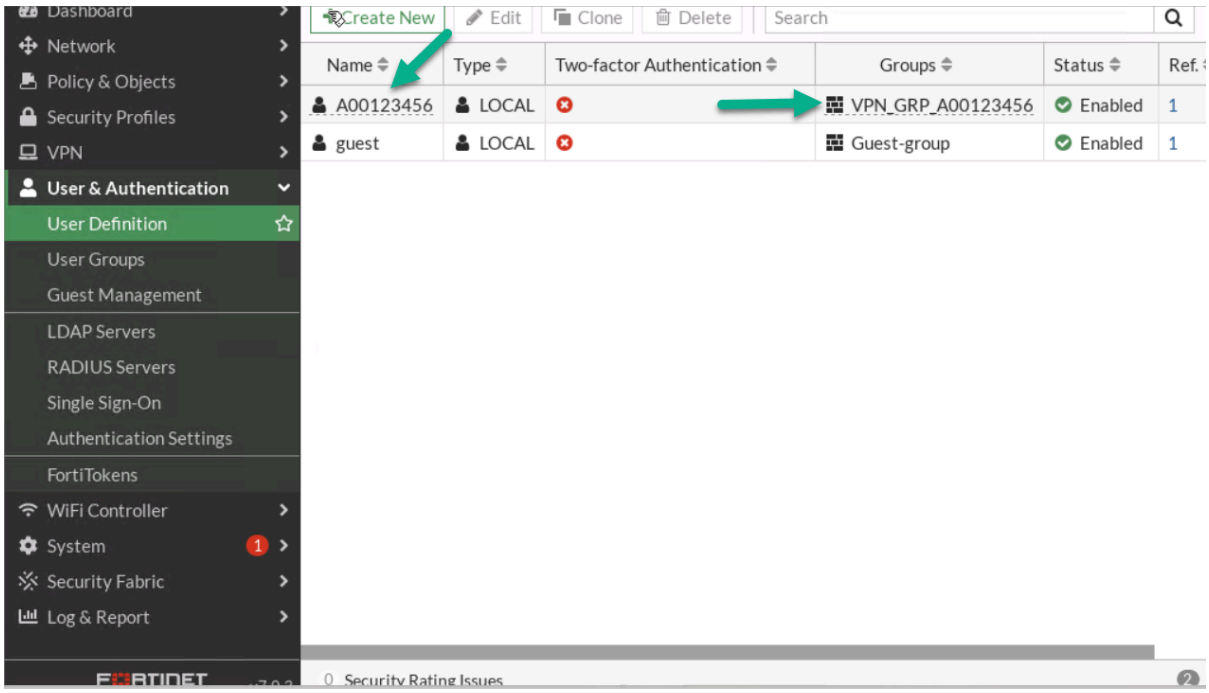


Figure 4.14: Verify configuration

5. Go to **VPN** > **IPsec Wizard**.
    1. First:
        - Select Name: **A0ID- VPN(A0ID is a student ID)**
        - Template Type: **Remote Access**
        - Remote Type Device: **FortiClient**

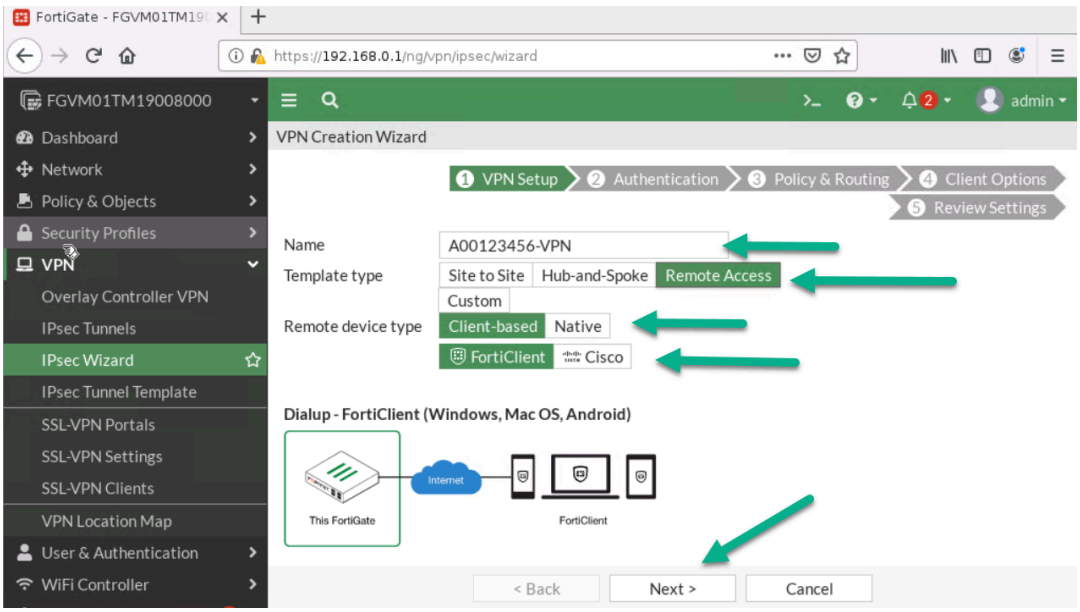


Figure 4.15: Create a VPN connection

    2. Then:

- Incoming Interface: **Port1**
- Pre-shared Key: <Select a key like a password>
- User Group: **VPN_GRP_A0ID**

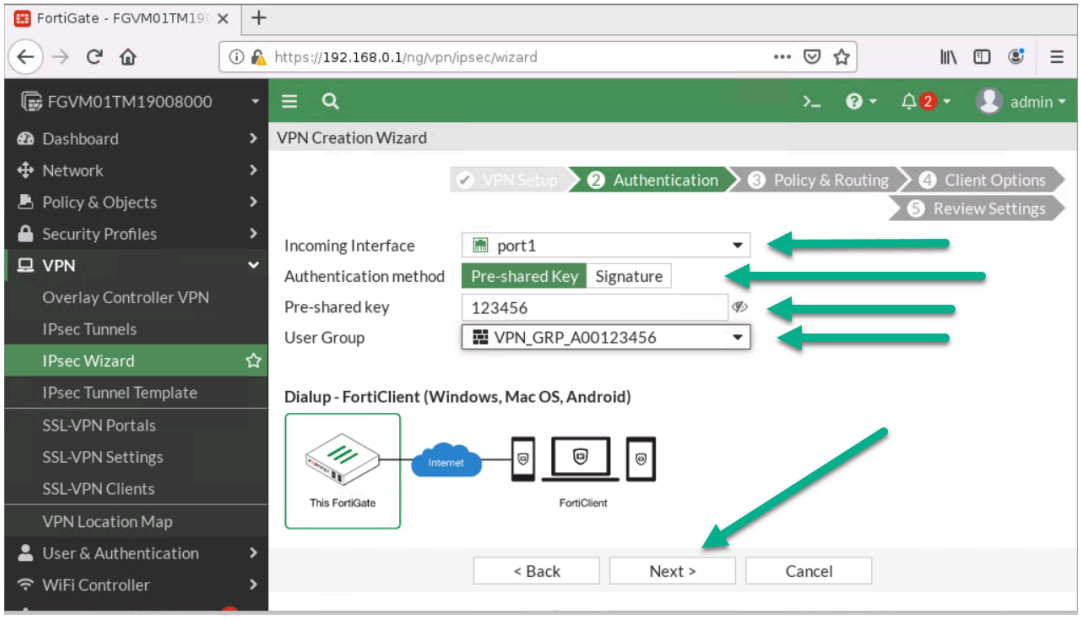


Figure 4.16: Configure authentication

3. Next:

- Local Interface: **Port 2**
- Local Address: Add your local range of IP address (192.168.0.0/24)
- Client Range: **172.16.0.1 to 172.16.0.10**
- Subnet Mask: **255.255.255.0**
- **Disable Split Tunneling**

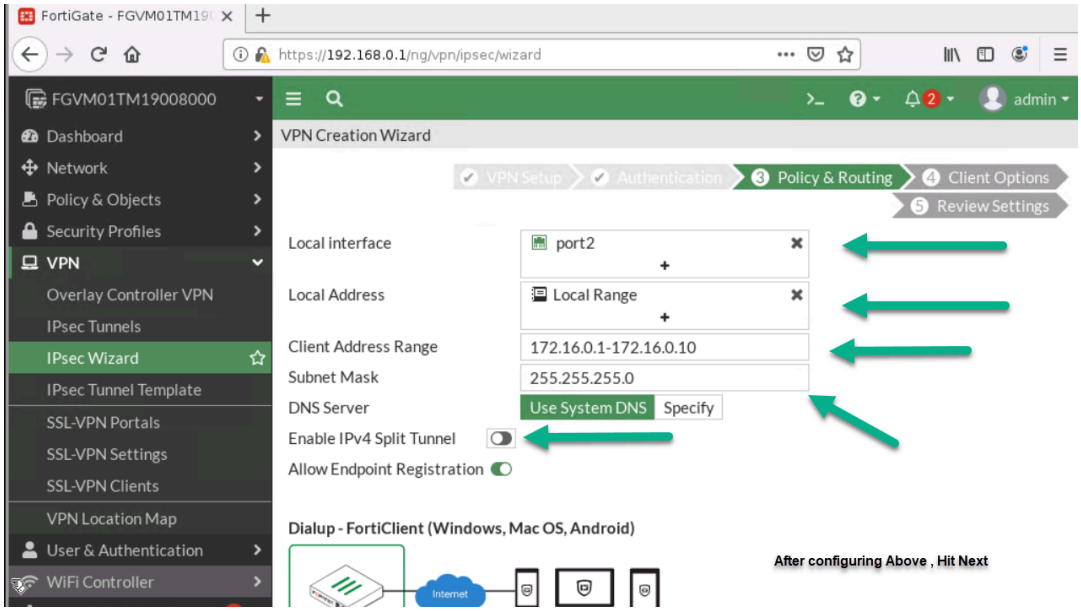


Figure 4.17: Configure Policy & Routing

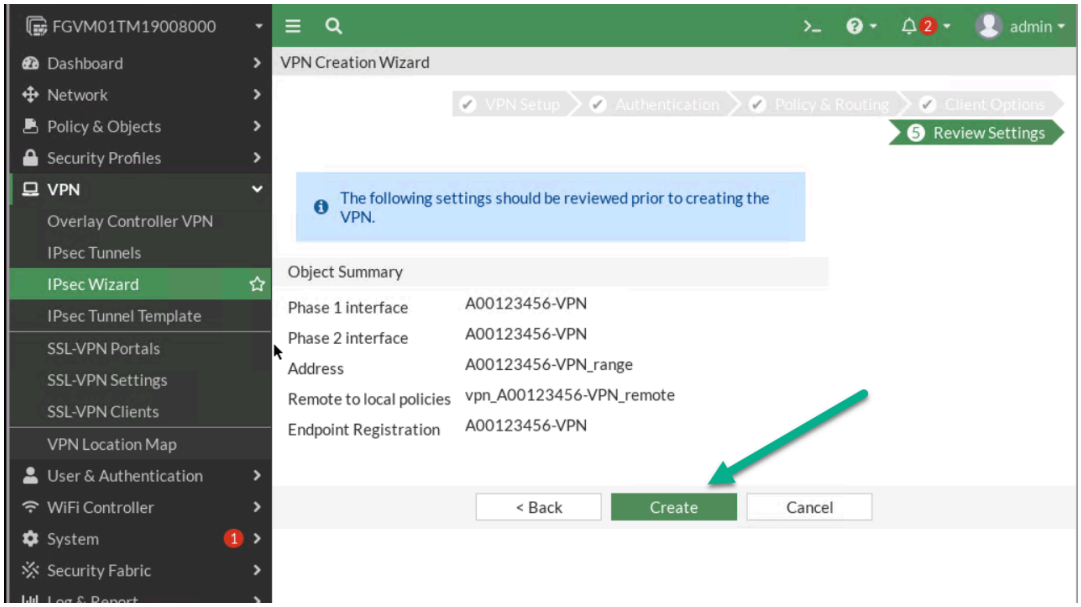


Figure 4.18: Review Settings

6. On Windows machine, download FortiClient from Fortinet (https://www.fortinet.com/products/endpoint-security/forticlient). Install the FortiClient and configure IPsec as set in the previous steps. Your remote Gateway IP should be the Port1 IP address.

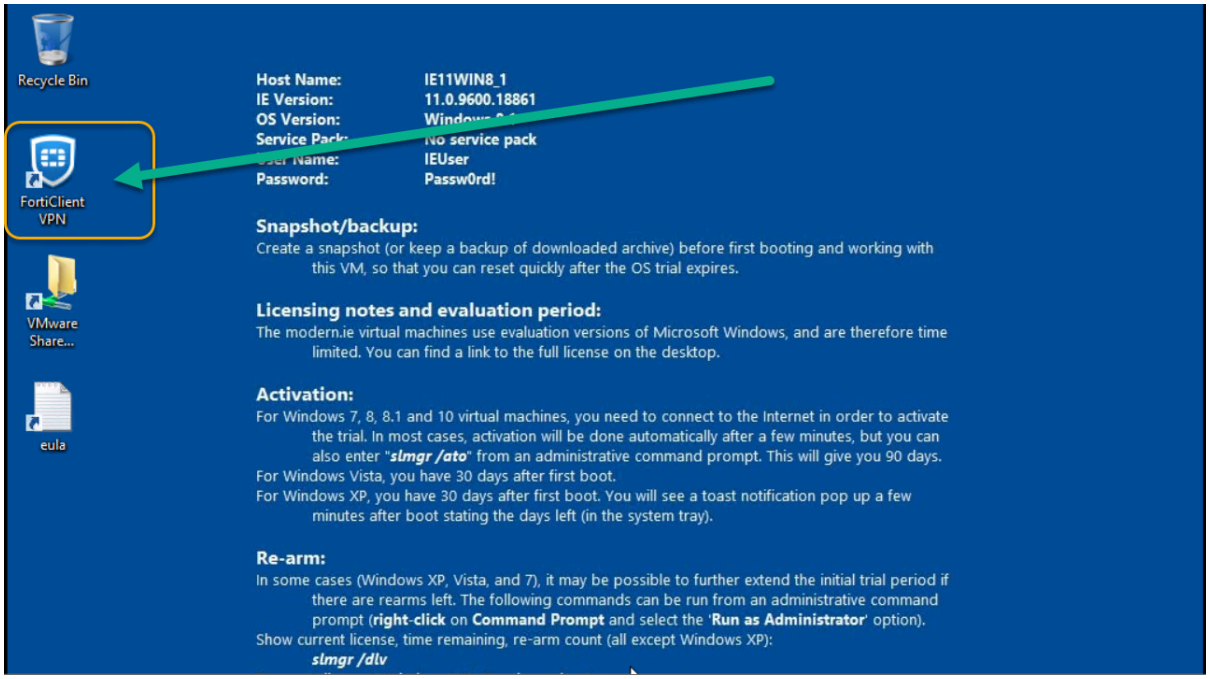


Figure 4.19: Install FortiClient on Windows

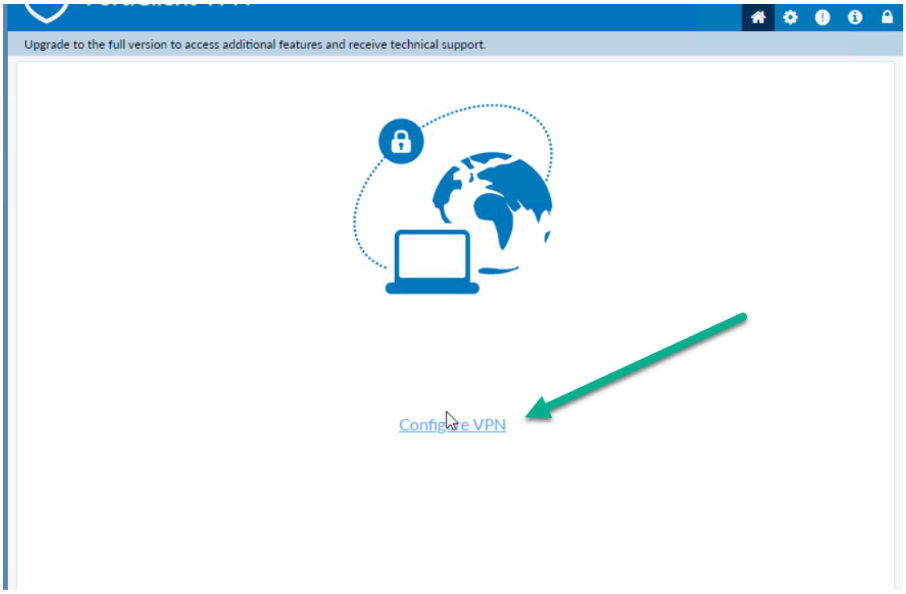
7. 

Figure 4.20: Configure VPN in FortiClient

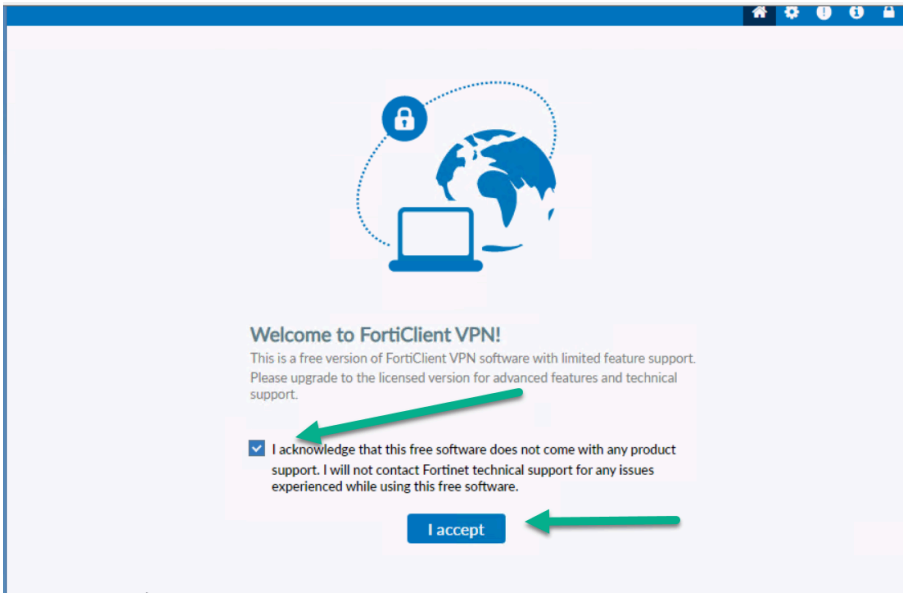
8. 

Figure 4.21: Accept FortiClient Free Licence

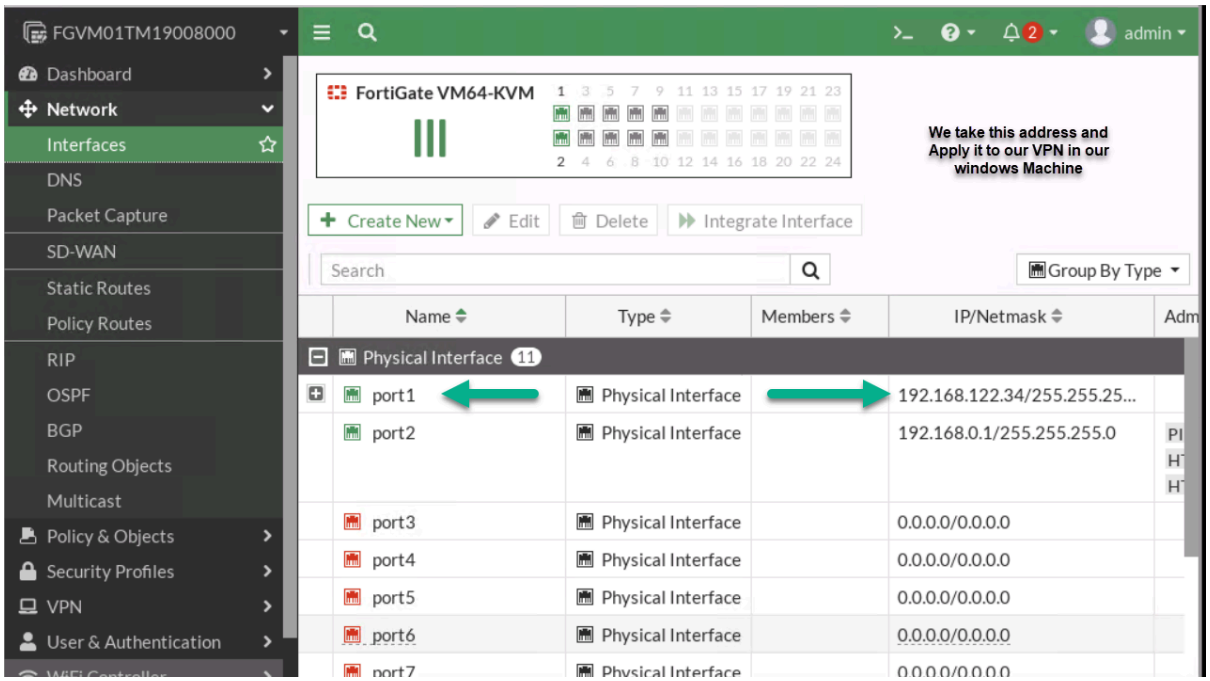
9. 

Figure 4.22: Port1 IP Address

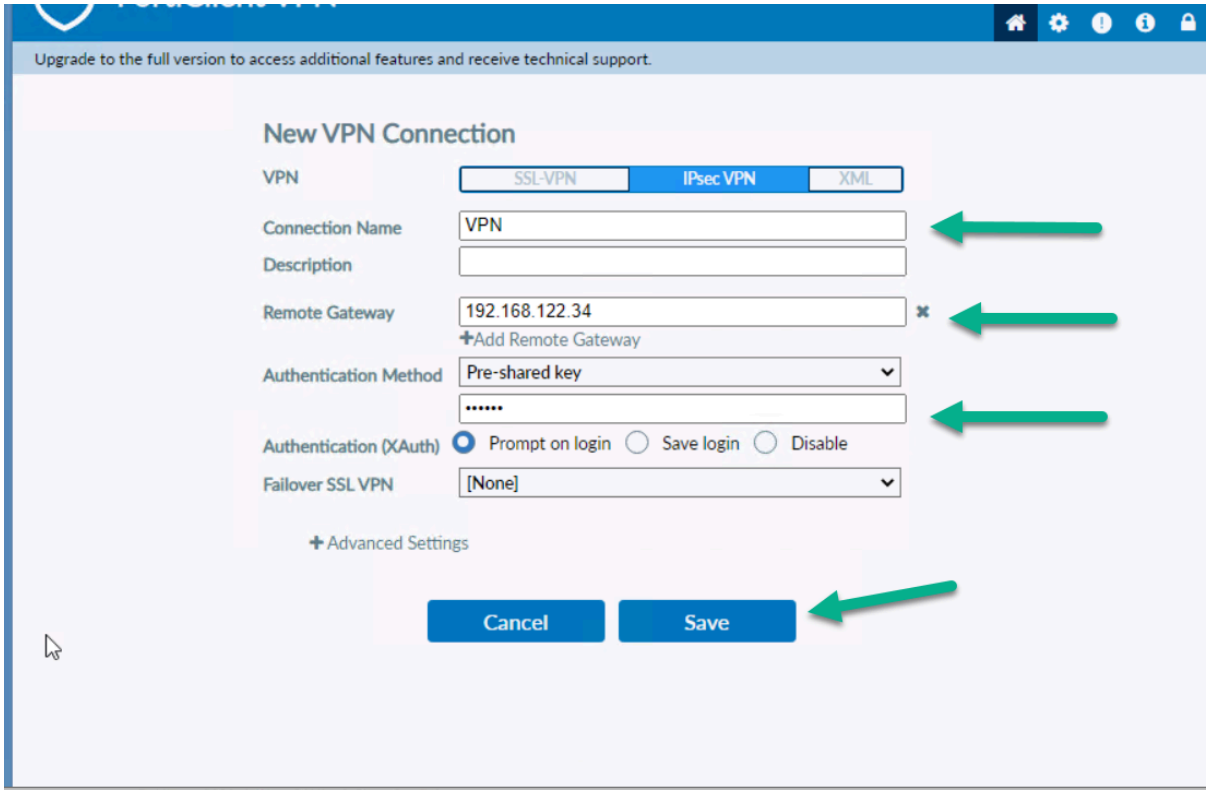
10. 

Figure 4.23: Configure FortiClient Remote Gateway and Pre-shared key

11. You should be able to ping from Windows to VPC.

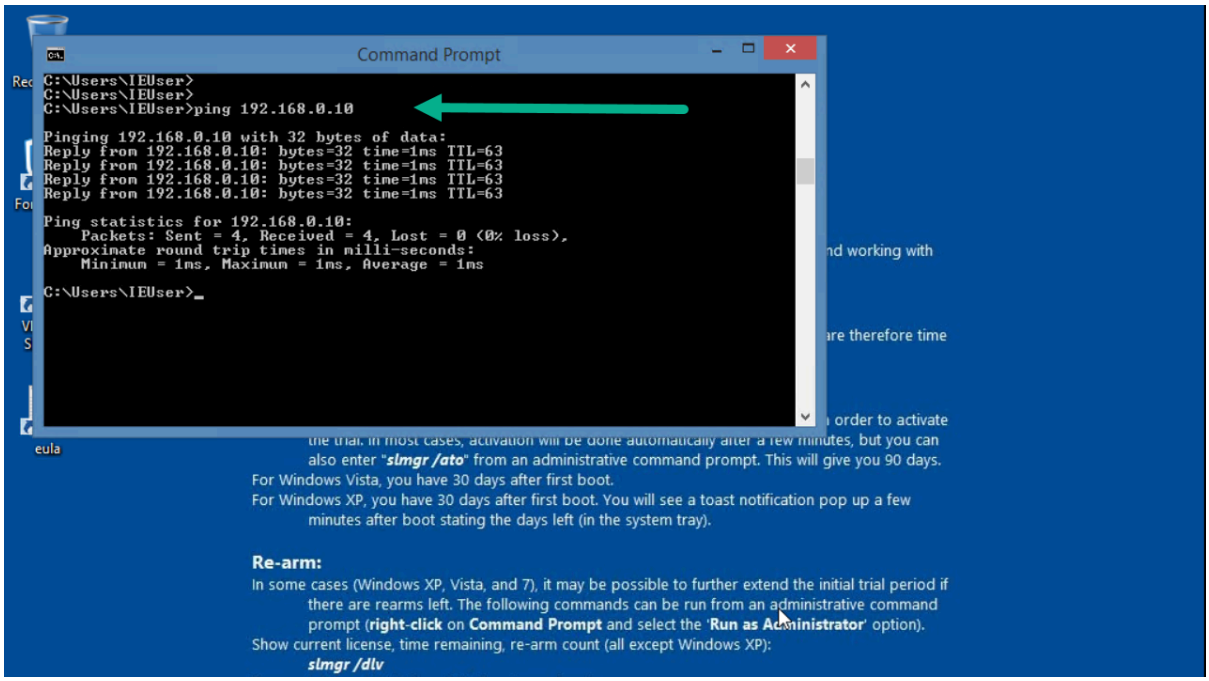


Figure 4.24: Verify configuration

Site-to-Site VPN (IPsec VPN)

Scenario: We are going to have IPsec VPN from WebTerm1 to WebTerm2. First, we are going to configure both firewalls through IPsec VPN Wizards and then we will verify connectivity from WebTerm1 to WebTerm2.

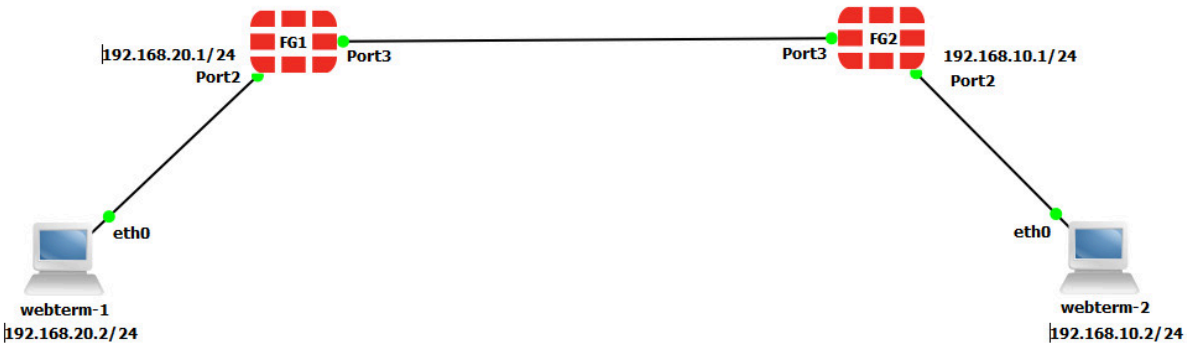


Figure 4.25: Main scenario

To validate Firewalls licences, we are going to connect them to the Internet.

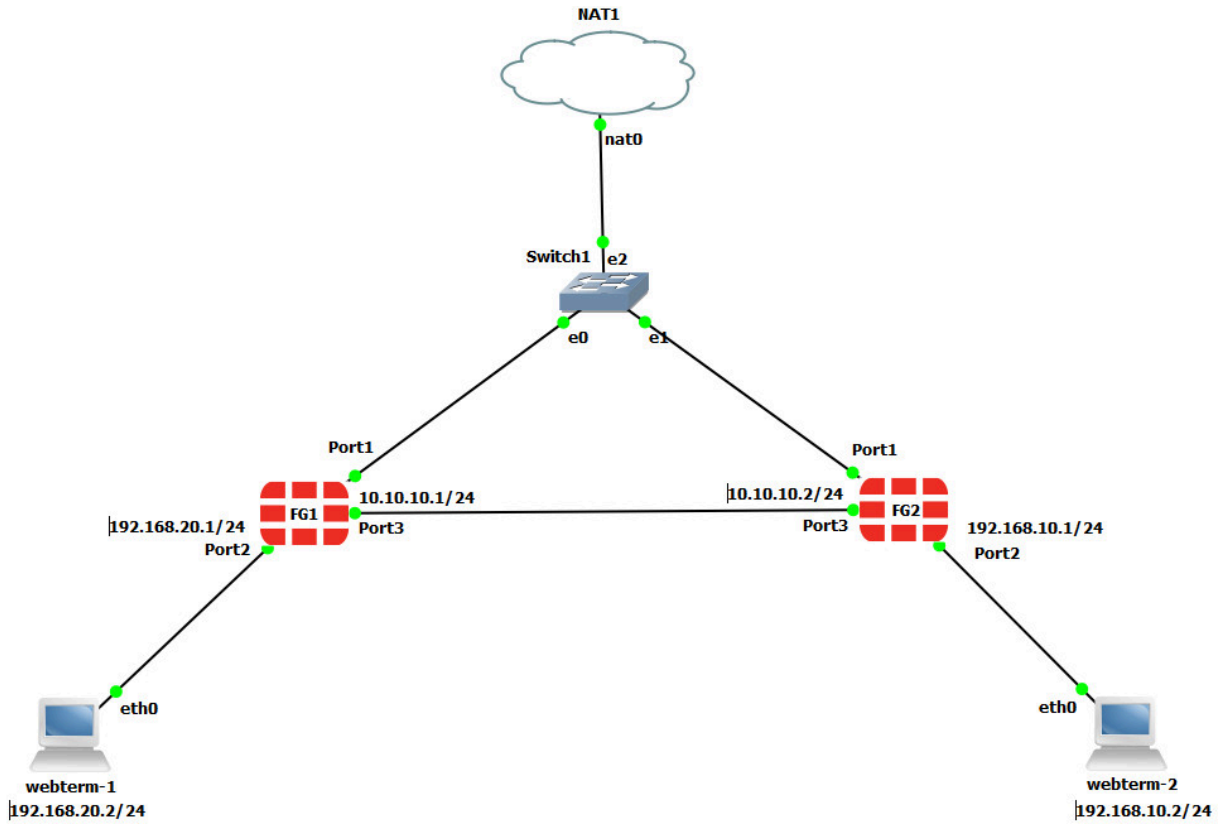


Figure 4.26: Validate firewall licences

Table 4.2: Devices configuration

Device	**IP address**	**Access**
Fortigate1	10.10.10.1/24	ICMP-HTTP-HTTPS
Fortigate2	10.10.10.2/24	ICMP-HTTP-HTTPS
WebTerm1	192.168.20.2/24	–
WebTerm2	192.168.10.2/24	–

1. On the FG1, go to **VPN > IPsec Wizard** and select Site to Site – FortiGate.

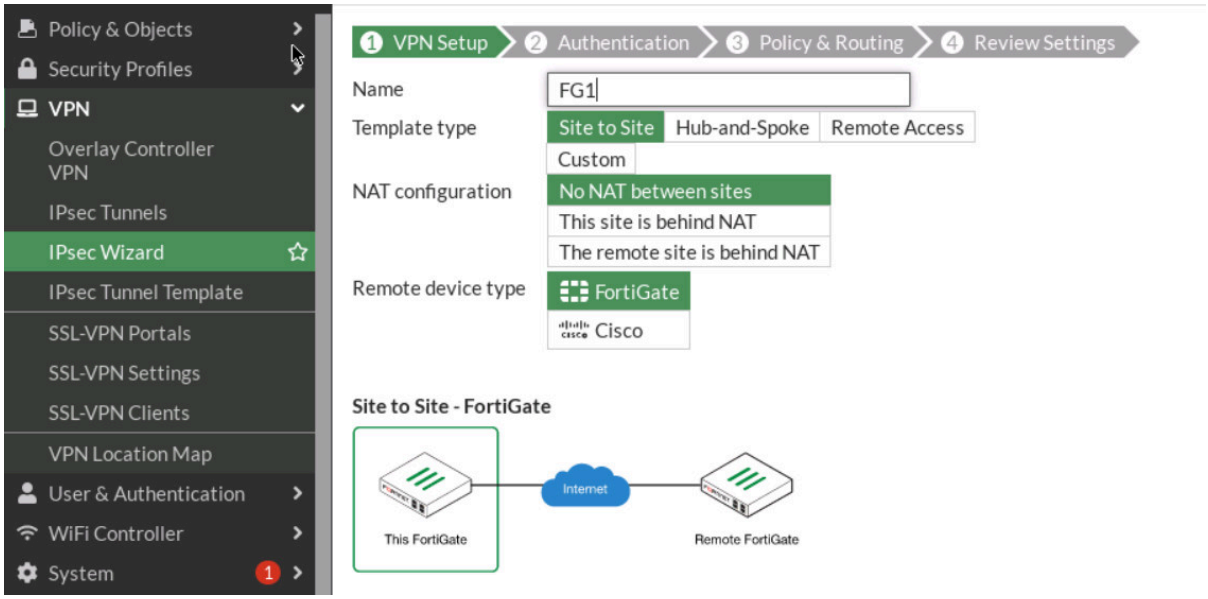


Figure 4.27: VPN Setup

2. Select **Site2Site/ FortiGate /No Nat.** Enter Remote IP: **10.10.10.2/24**, outgoing interface: **port3**.

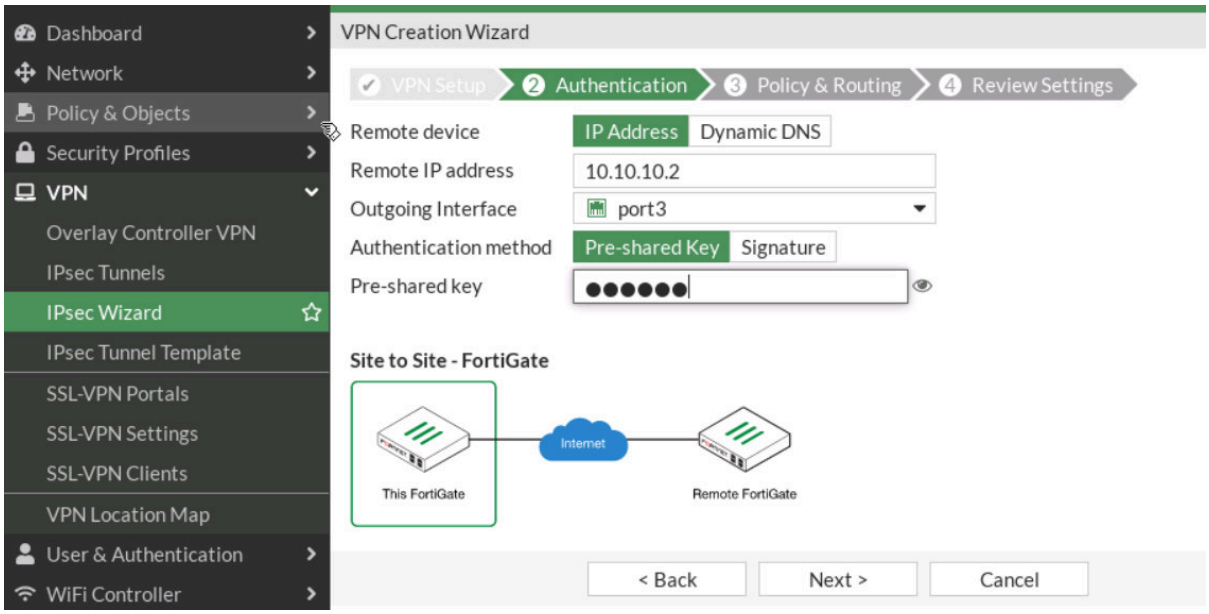


Figure 4.28: Authentication

3. Local Interface: port2, IP: **192.168.20.0/24**, Remote subnet: **192.168.10.0/24**. Through the wizard, FortiGate creates two policies and two static routes in the firewall.

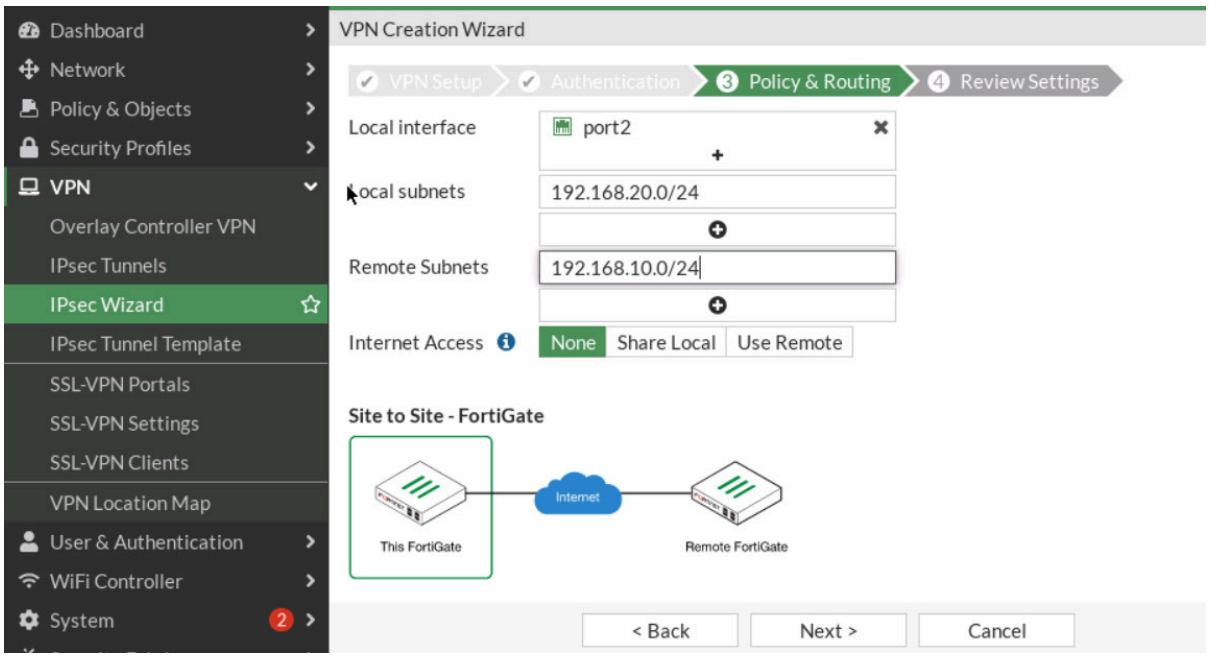


Figure 4.29: Policy & Routing

4. On the FG2, go to **VPN > IPsec Wizard** and select Site-to-Site – FortiGate.

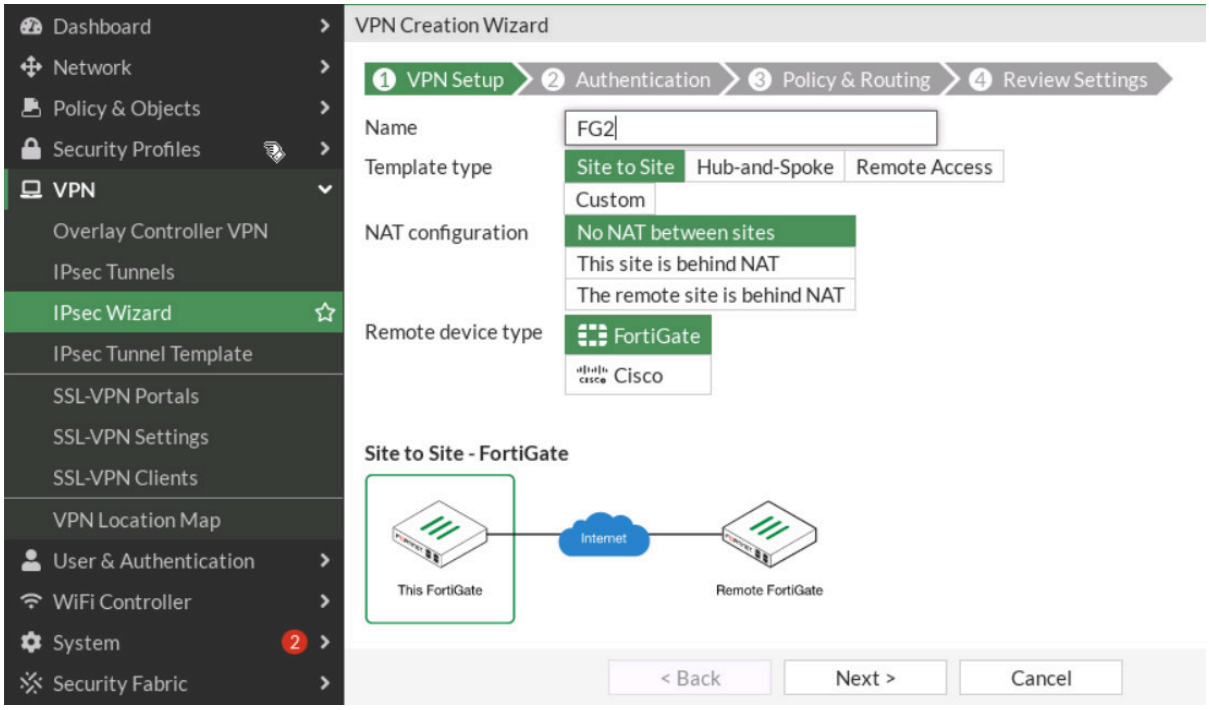


Figure 4.30: Set up FG2

5. Do the same configuration for FG2 (remote IP is 10.10.10.1/24 and local IP is 192.168.10.0/24).

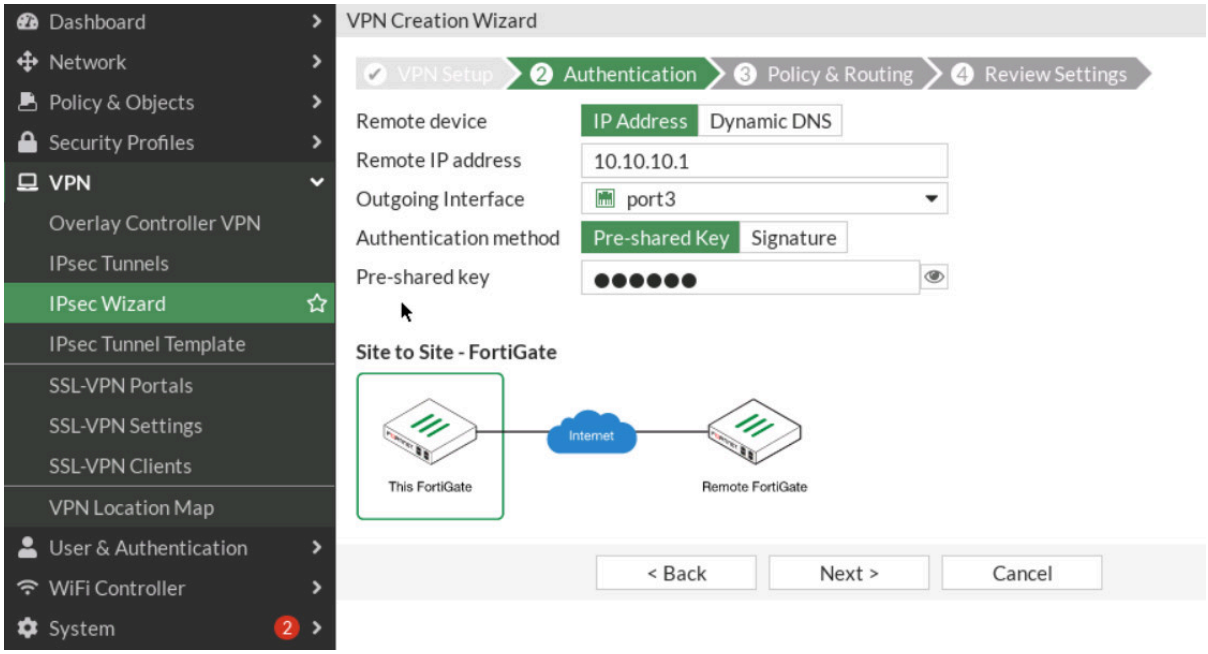


Figure 4.31: Authentication in FG2

6.

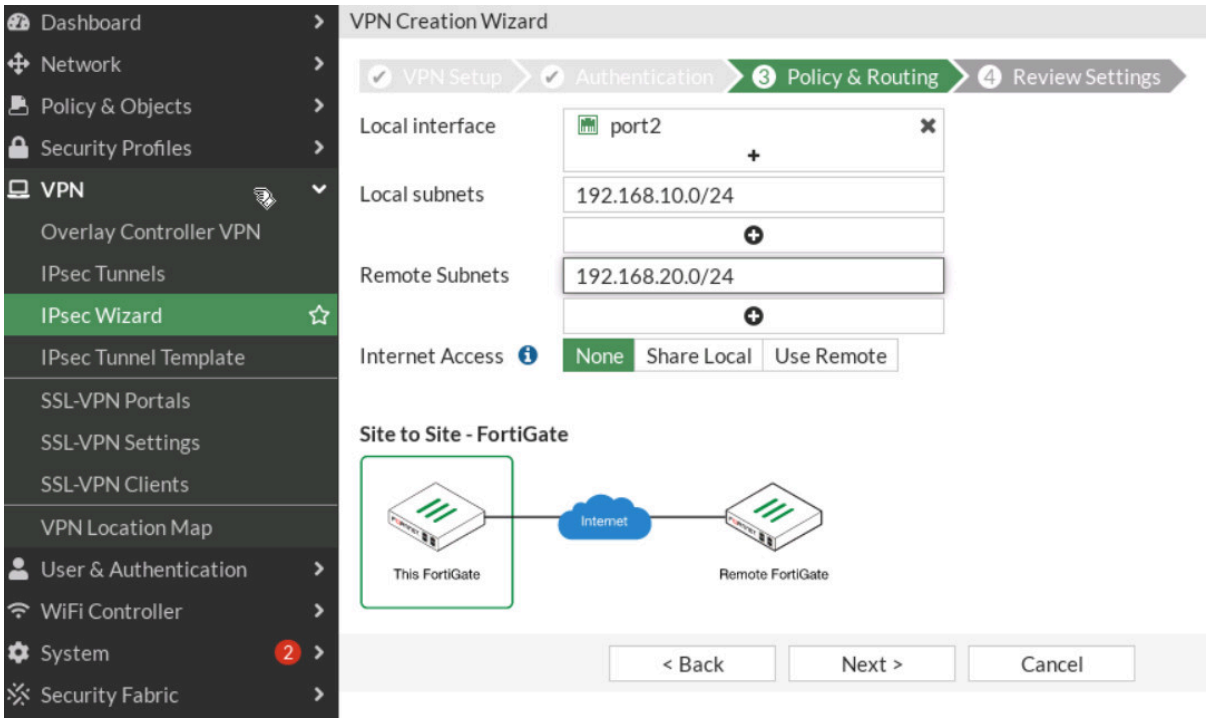


Figure 4.32: Policy & Routing in FG2

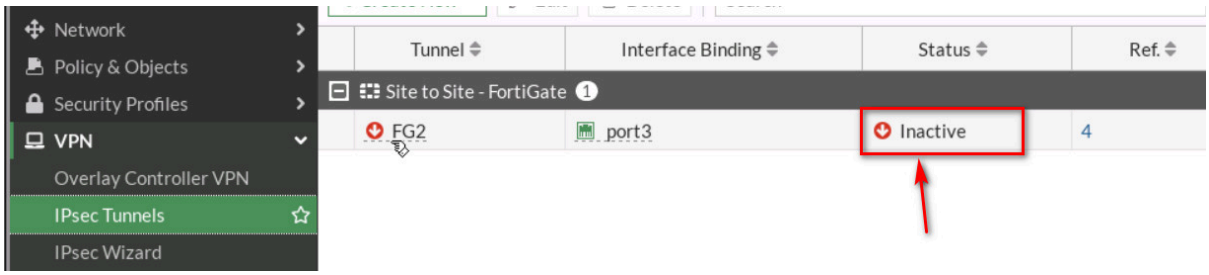
7. 

Figure 4.33: Configure IPsec Tunnels

Then, go to your IPsec Tunnels and double click on Inactive.

On the next windows, right click on the **tunnel** > **Bring UP** > **All Phase 2 selectors**. Then, your tunnel should be up!

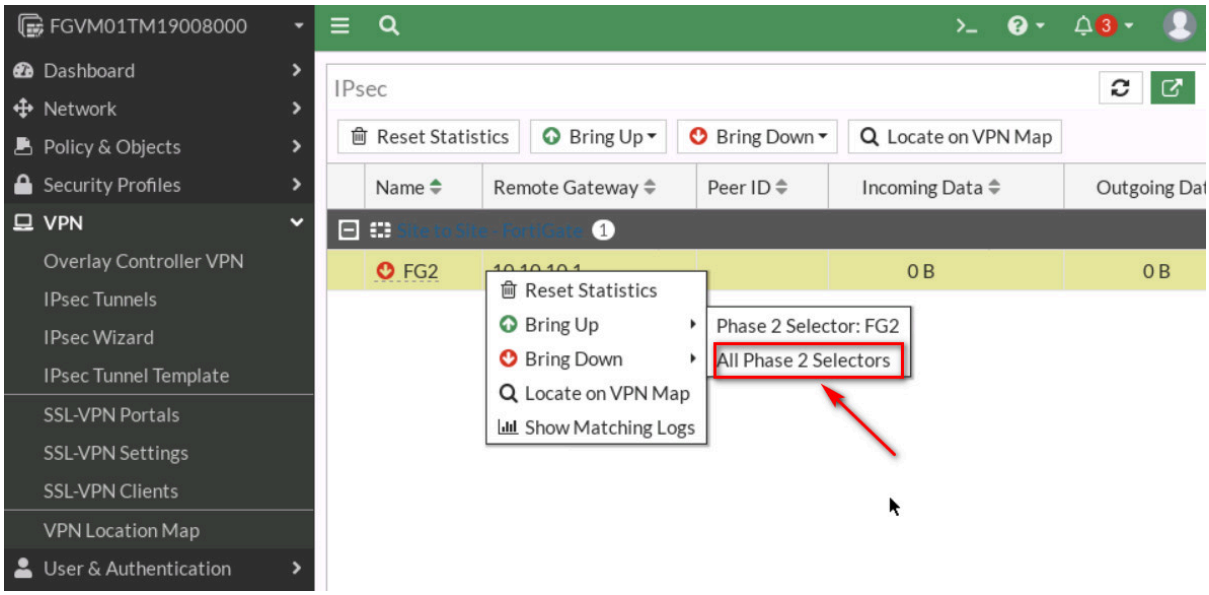


Figure 4.34: Bring up IPsec Tunnel

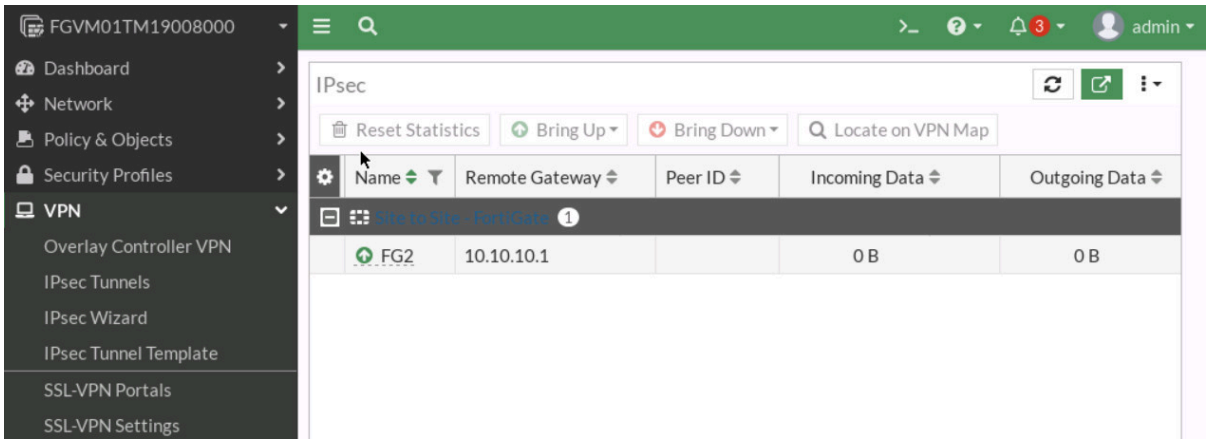


Figure 4.35: Verify the status of the tunnel

8. Go to **Logs & Reports** > **Event** > **VPN Event** and verify your configuration.

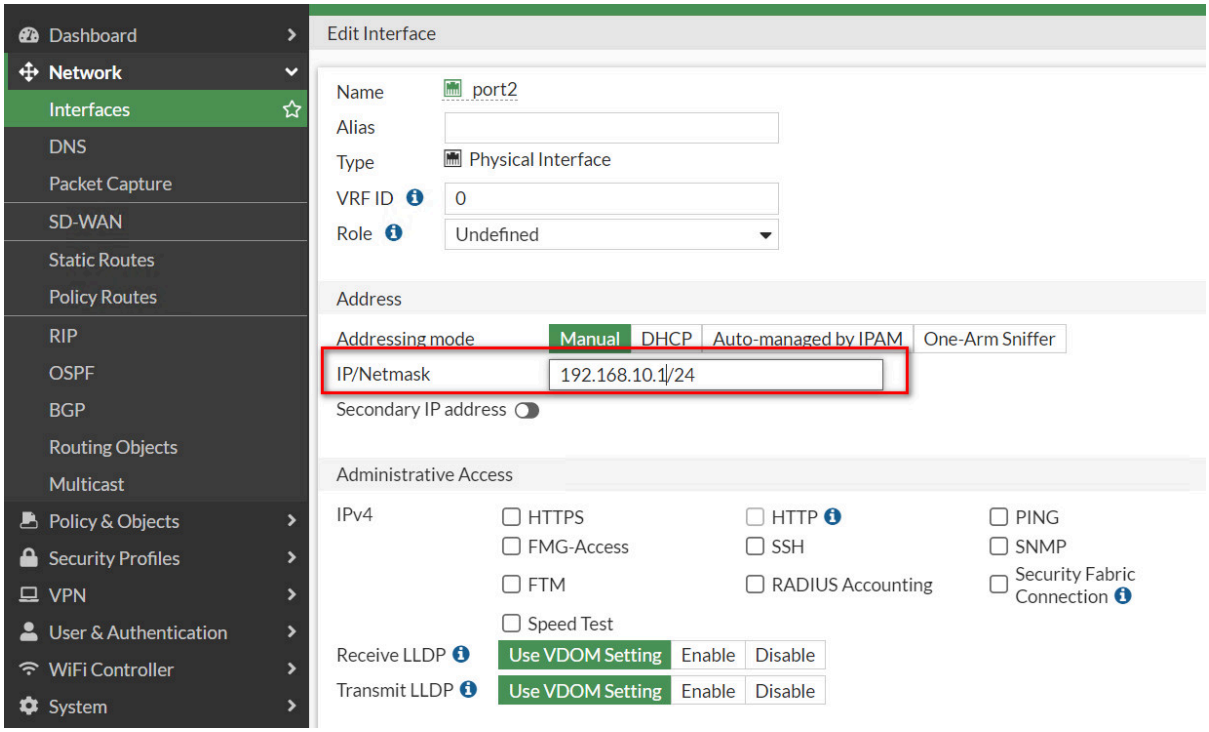


Figure 4.36: Verify configuration

You should be able to ping from WebTerm1 to WebTerm2.

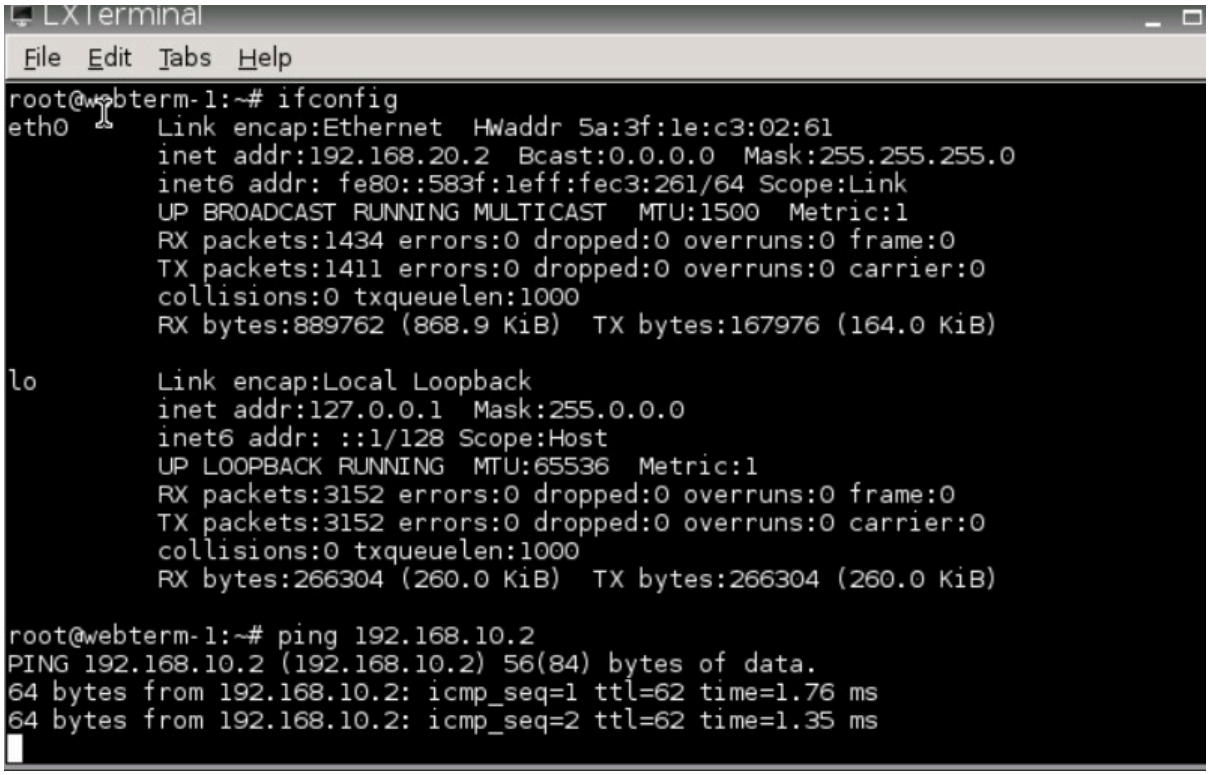


Figure 4.37: Verify configuration

4.2 SSL VPN

Learning Objectives

- Configure a tunnel-based SSL VPN
- Configure a web-based SSL VPN (Web Portal)

Scenario: We are going to have SSL VPN from Windows to FortiGate Firewall. First, we will install FortiClient on Windows and then we will configure the firewall for FortiClient. We have two types of SSL VPN, Web based mode and Tunnel mode. Web based mode doesn't need any agents and you should be able to reach WordPress and SSH Server from Windows. Tunnel mode is through FortiClient. The goal of this scenario is to have connectivity from Windows to WordPress and SSH Server.

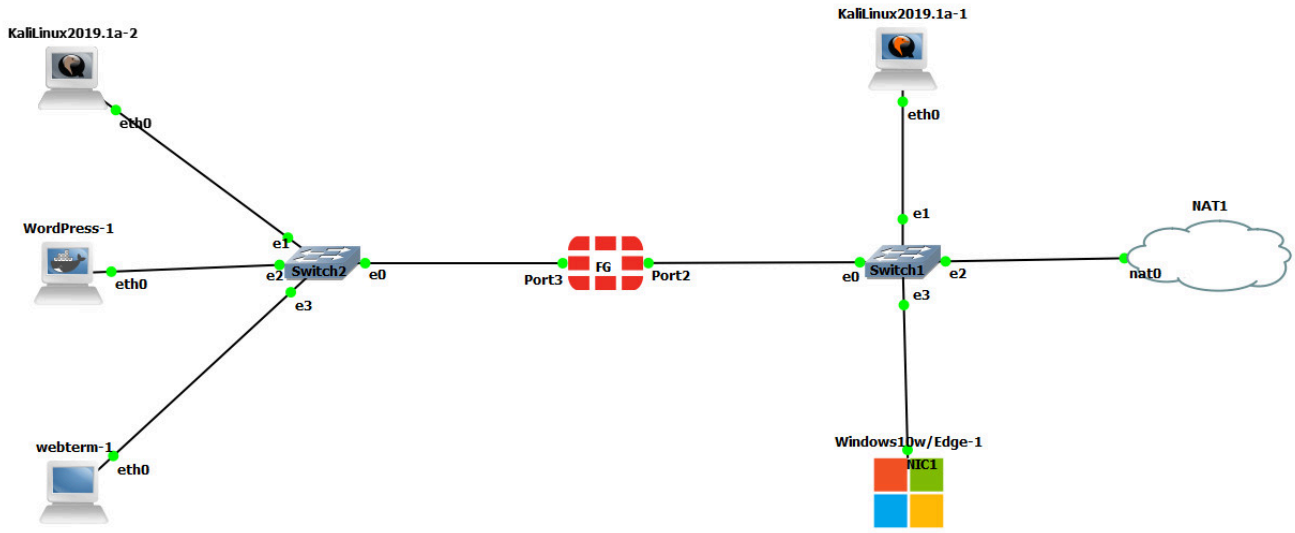


Figure 4.38: Main scenario

Table 4.3: Devices configuration

Device	IP address	Access
FortiGate	Port3: 192.168.1.1/24 – DHCP (192.168.1.20 to 192.168.1.30) Port2: DHCP Client	ICMP-HTTP-HTTPS
WebTerm (FMC)	192.168.1.2/24	–
KALI Linux (SSH Server)	192.168.1.3/24	–
WordPress	192.168.1.4/24	
KALI-outside	DHCP Client	
Windows	DHCP Client	

Configure the interfaces of the firewall. Port2 and Port3 should be configured in the terminal to access the firewall.

1. Port 3 Configuration:

```
FGVM01TM19008000 # config system interface
FGVM01TM19008000 (interface) # edit port3
FGVM01TM19008000 (port3) # set ip 192.168.1.1/24
FGVM01TM19008000 (port3) # set allowaccess http https
FGVM01TM19008000 (port3) # end
FGVM01TM19008000 #
```

Figure 4.39: Port3 settings

2. Port 2 Configuration:

```
FGVM01TM19008000 # config system interface
FGVM01TM19008000 (interface) # edit port2
FGVM01TM19008000 (port2) # set mode dhcp
FGVM01TM19008000 (port2) # end
```

Figure 4.40: Port2 settings

3. Configure DHCP Server on port3.

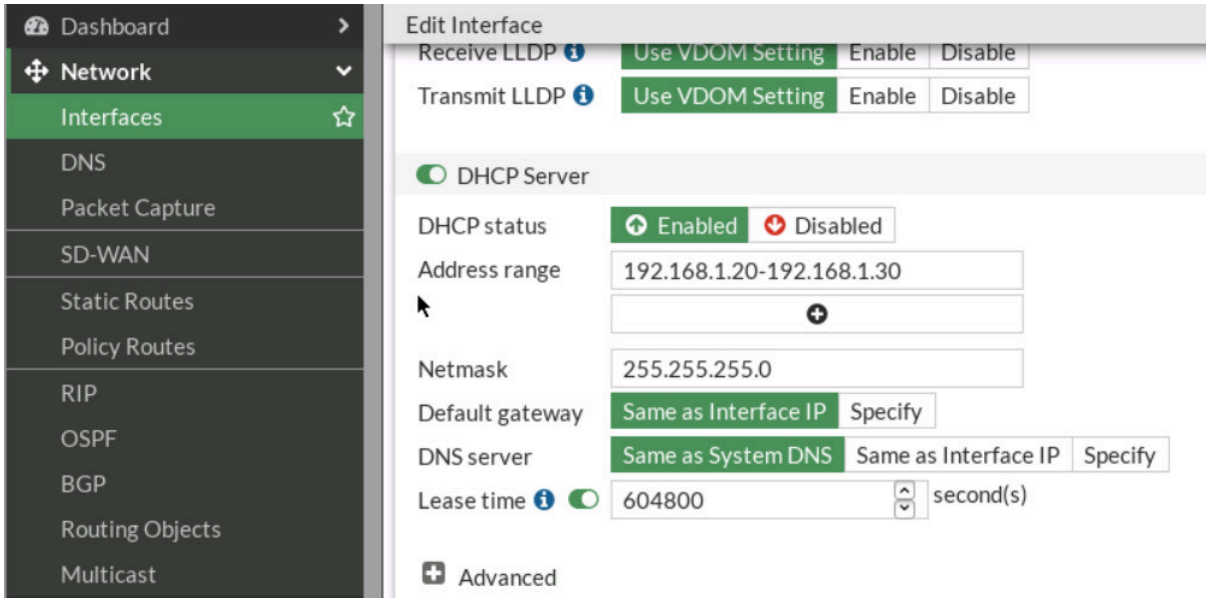


Figure 4.41: Enable DHCP Server on port3

4. Configure user and user group. Go to **User & Authentication** > **User Definition** to create a local user **sslvpnuser1**.

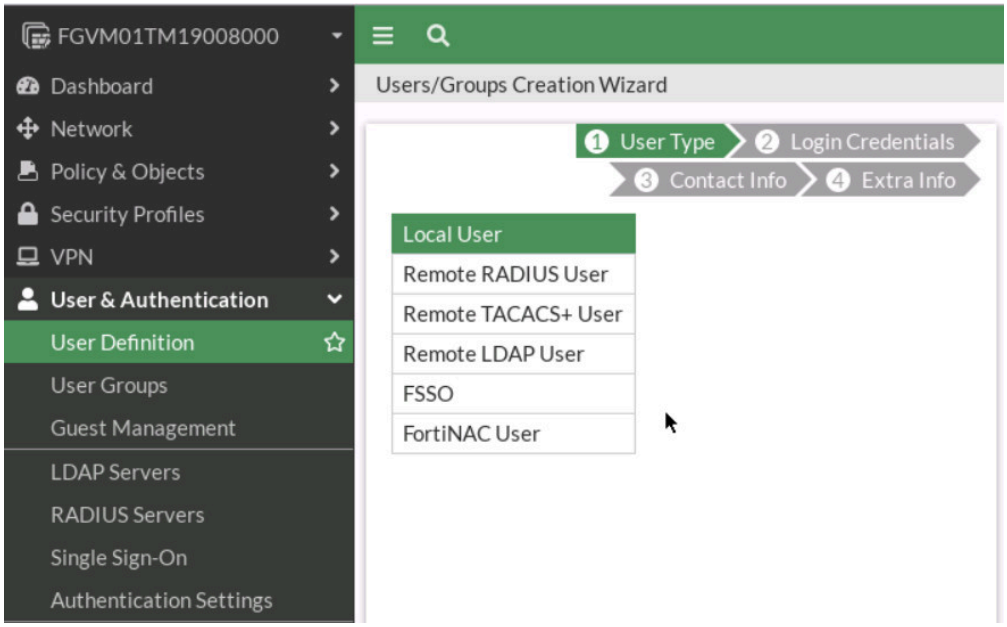


Figure 4.42: Create a local user

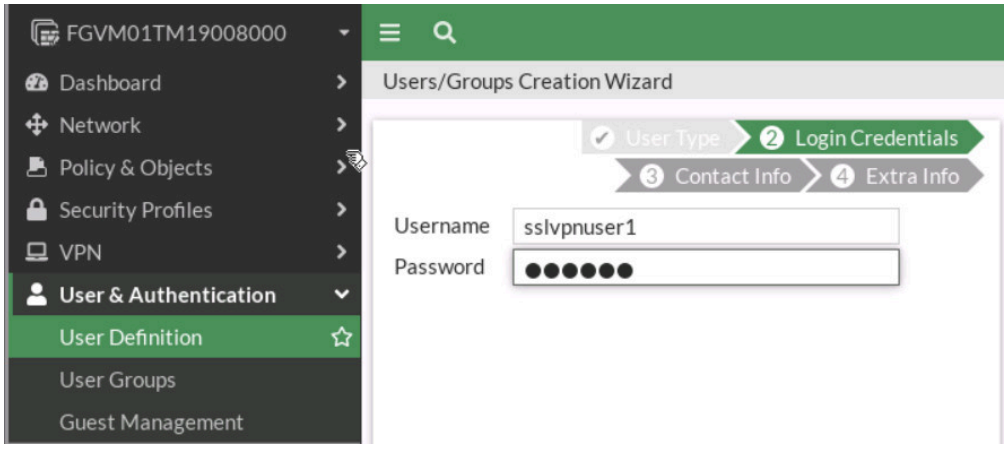


Figure 4.43: Configure login credentials

Go to **User & Authentication** > **User Groups** to create a group **sslvpngroup** with the member **sslvpnuser1**.

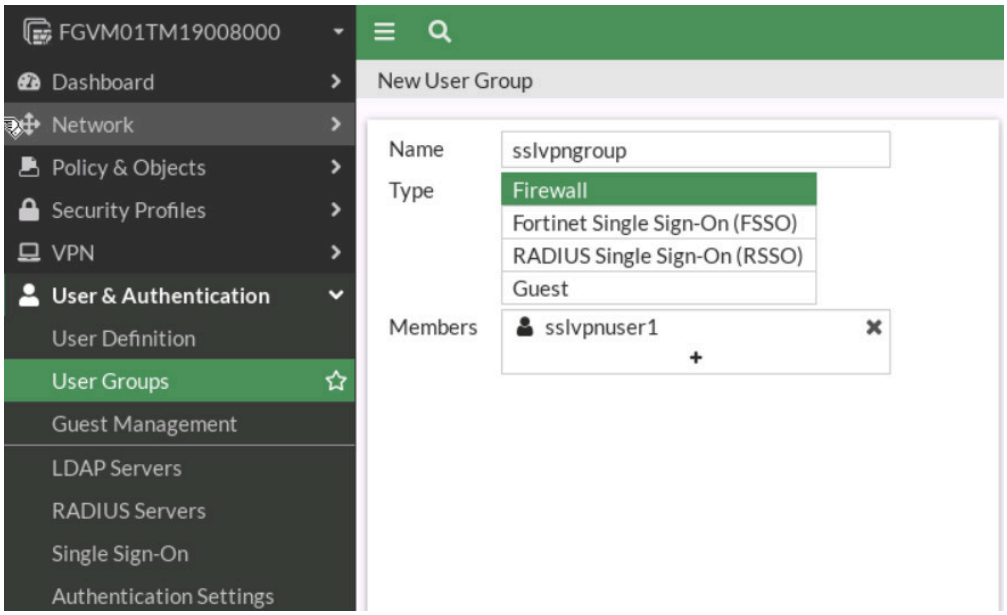


Figure 4.44: Create a group

5. Configure SSL VPN web portal and Tunnel mode. Go to **VPN > SSL-VPN** Portals:
    - **Split-Tunneling:** Disabled
    - **Source IP Pools:** SSLVPN_TUNNEL_ADDR1

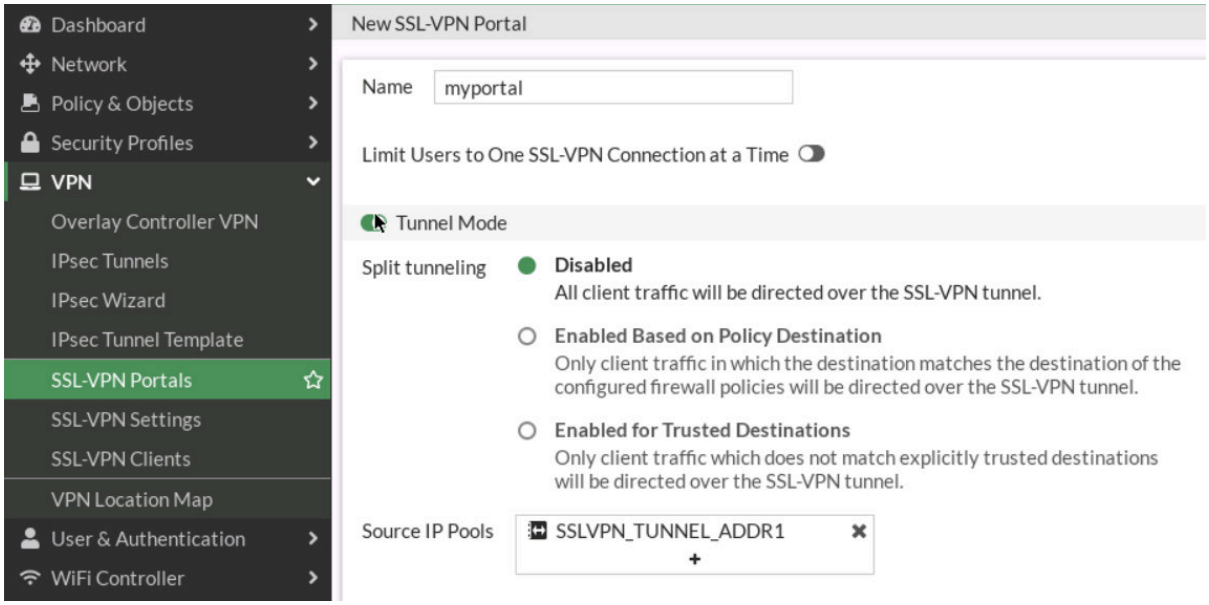


Figure 4.45: SSL-VPN Portal

Go to **VPN** > **SSL-VPN Portals**, add KALI IP address (SSH Server: *IP Address of Kali*) and WordPress (*IP Address of WordPress*) in the bookmark section.

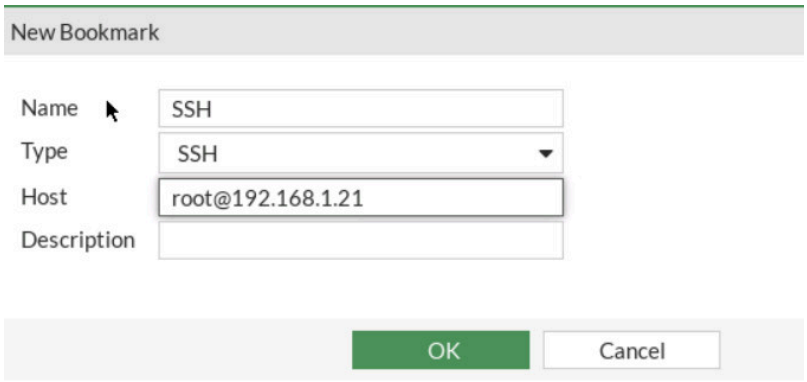


Figure 4.46: Create an SSH bookmark

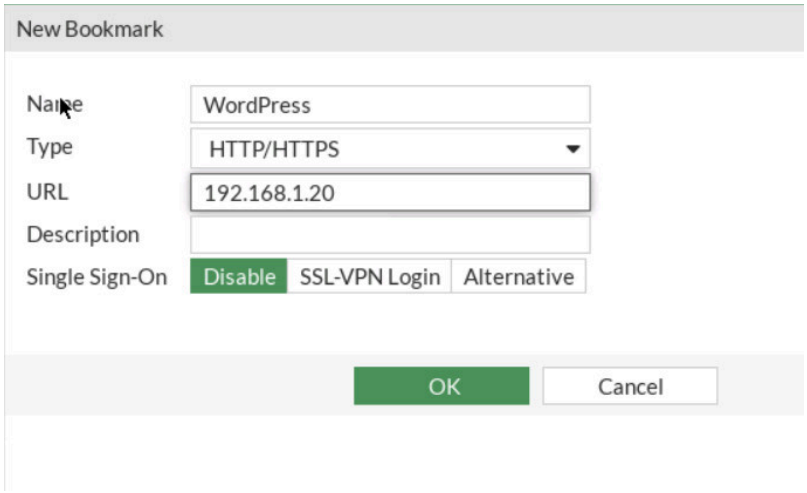


Figure 4.47: Create an HTTP/HTTPS bookmark

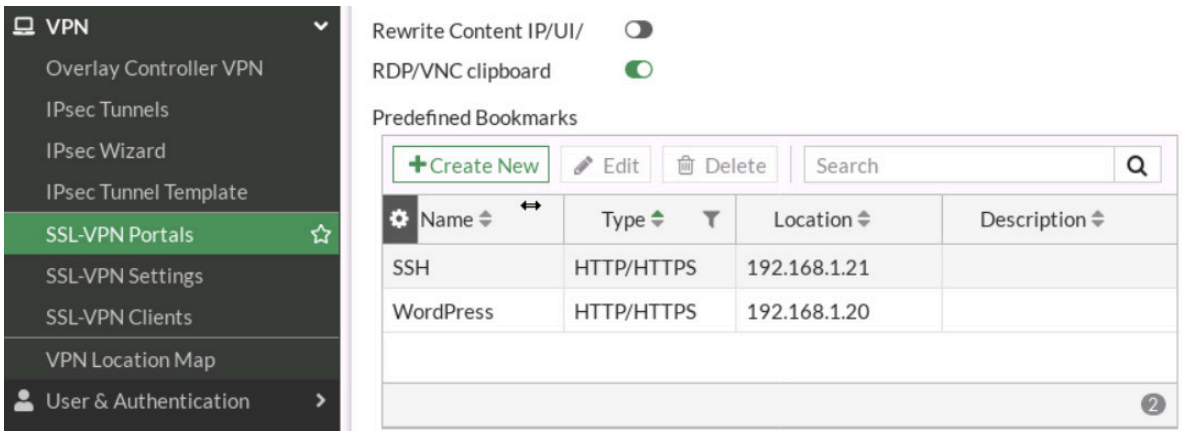


Figure 4.48: Bookmark settings

6. Configure SSL VPN settings. Go to **VPN > SSL-VPN Settings**:

    - For Listen on Interface(s), select Port2.
    - Set Listen on Port to 8080.
    - Server Certificate: Fortinet
    - In restrict Access, select “Allow access from any host”
    - Address range: **Automatically assign address.**
    - In Authentication/Portal Mapping All Other Users/Groups, set the Portal to **MyPortal**
    - Create new Authentication/Portal Mapping for group **sslvpngroup** mapping portal MyPortal.

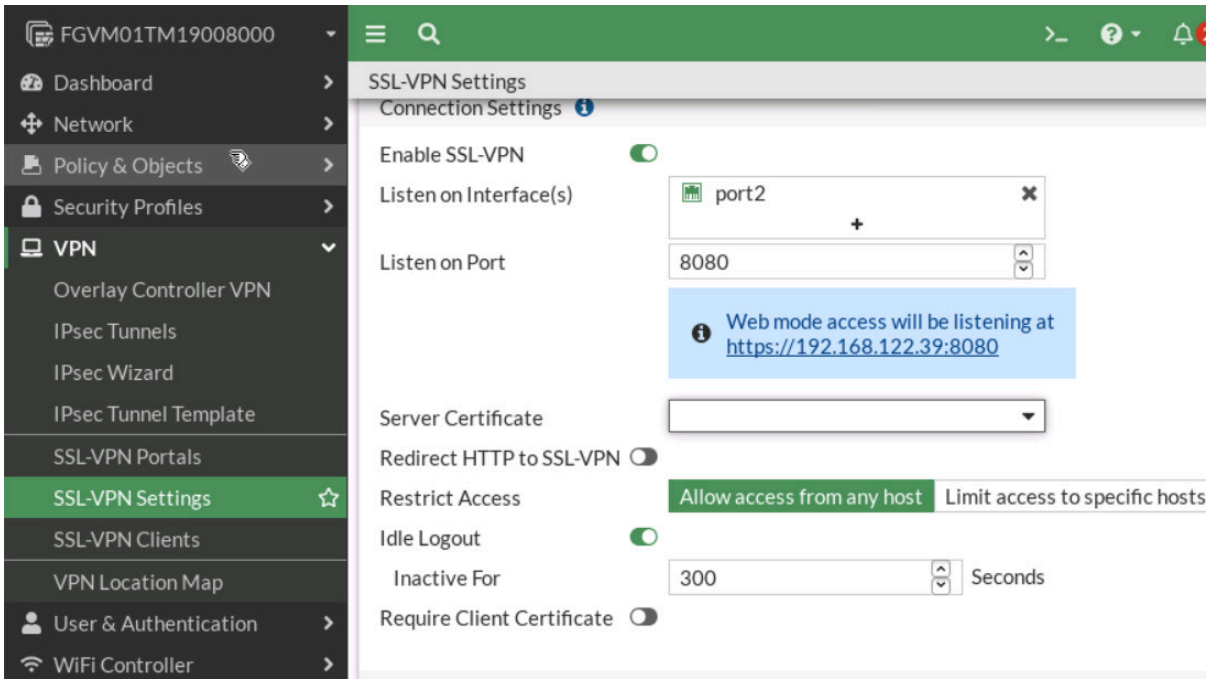


Figure 4.49: Enable SSL-VPN Settings

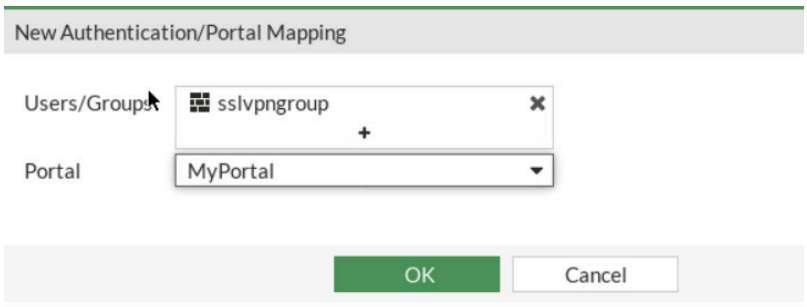


Figure 4.50: Assign sslvpngroup to MyPortal

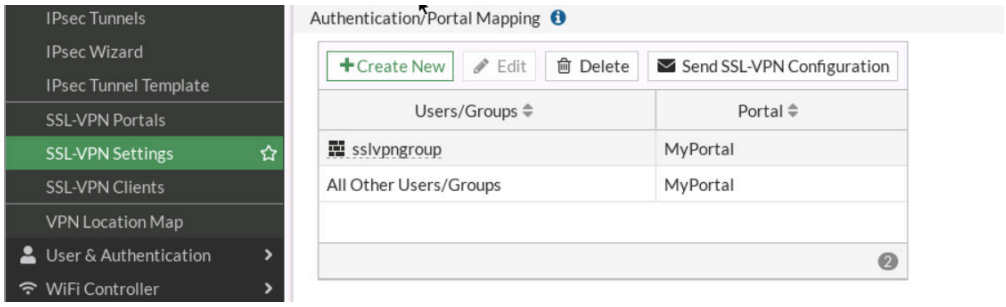


Figure 4.51: Authentication/Portal Mapping

7. Configure SSL VPN firewall policy:
    1. Go to **Policy & Objects > Firewall Policy.**
    2. Fill in the firewall policy name. In this example, **SSLVPN** full tunnel access.
    3. The incoming interface must be SSL-VPN tunnel interface(ssl.root).
    4. Choose an Outgoing Interface. In this example, port3.
    5. Set the Source to all and group to **sslvpngroup**.
    6. Set the Destination to all.
    7. Set Schedule to always, Service to ALL, and Action to Accept.

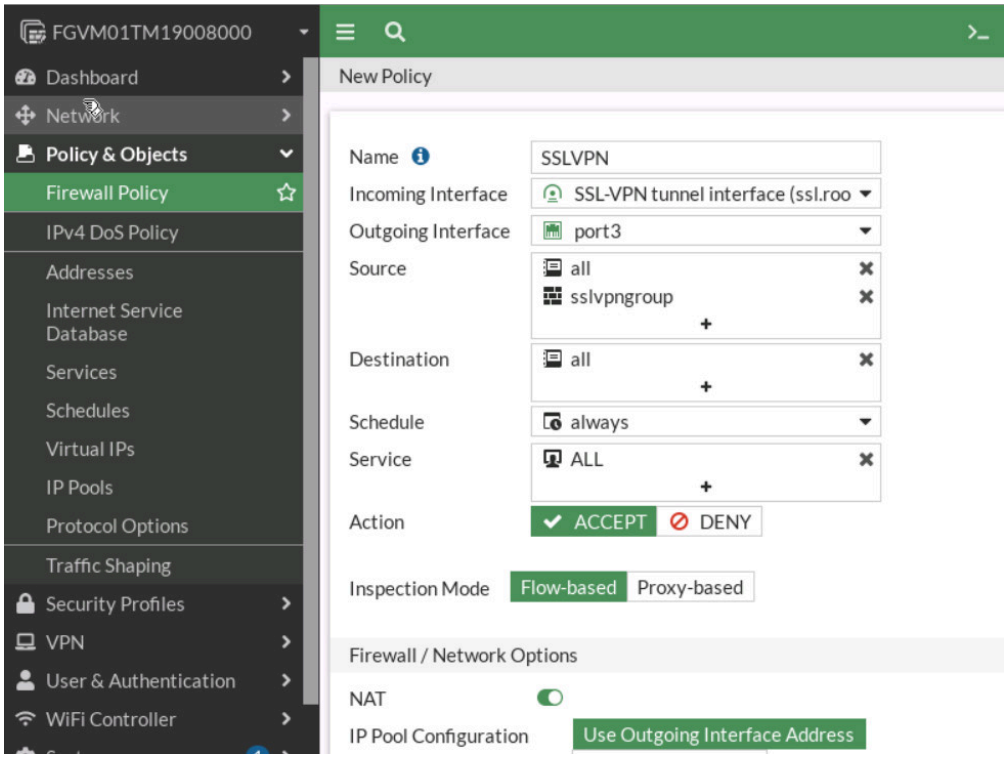


Figure 4.52: Create a Firewall Policy for SSLVPN

8. Now connect to Kali outside and open the browser **https://IP-PORT 2-Firewall:8080** Enter the username and password you created earlier. Then try to connect to the KALI SSH Server and WordPress through the browser.

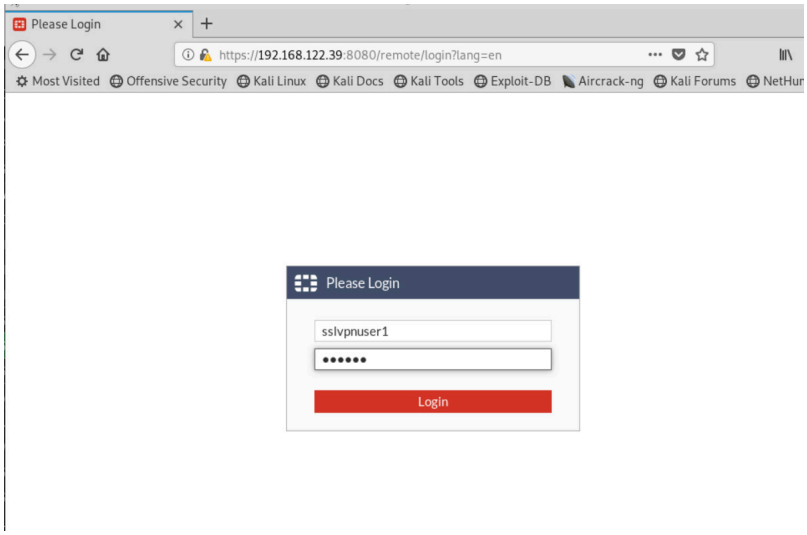


Figure 4.53: SSL-VPN Portal

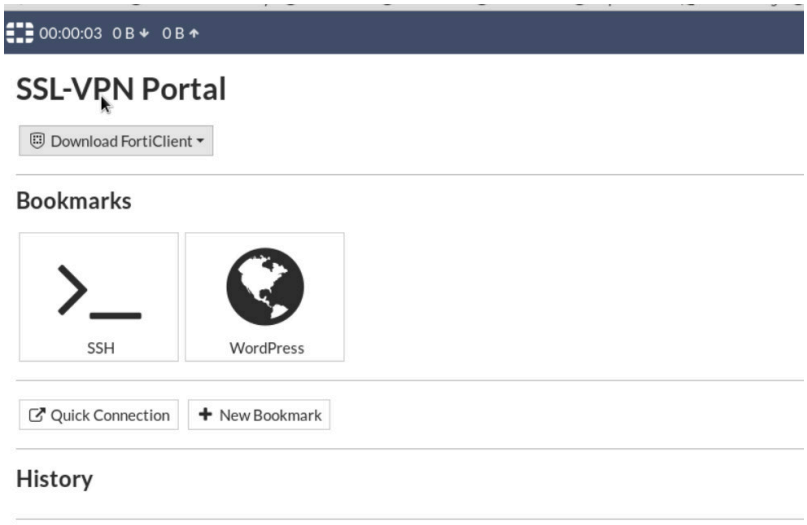


Figure 4.54: SSL-VPN Portal

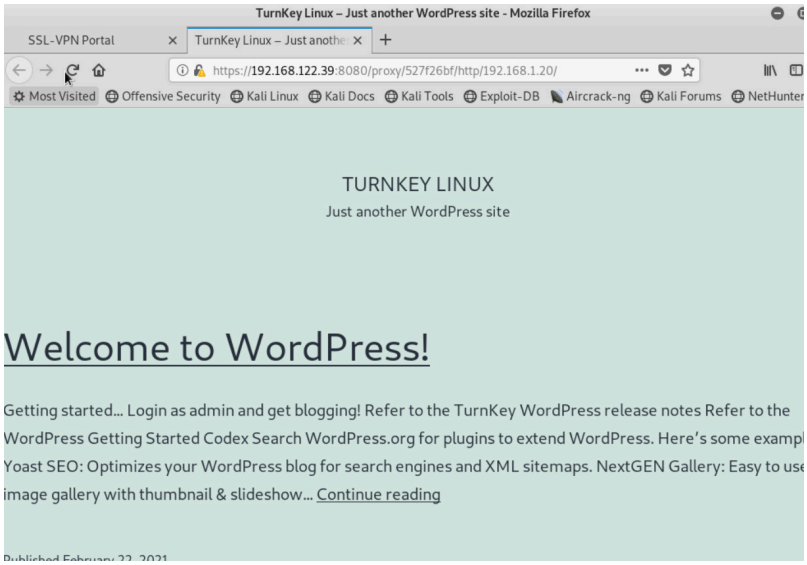


Figure 4.55: Verify WordPress

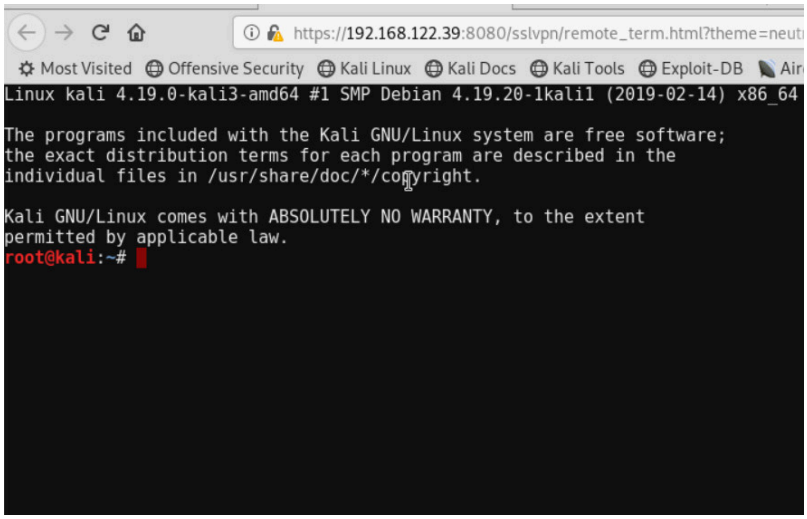


Figure 4.56: Verify SSH

9. Now, go to Windows and install FortiClient on Windows. Try to use FortiClient to connect through SSLVPN.

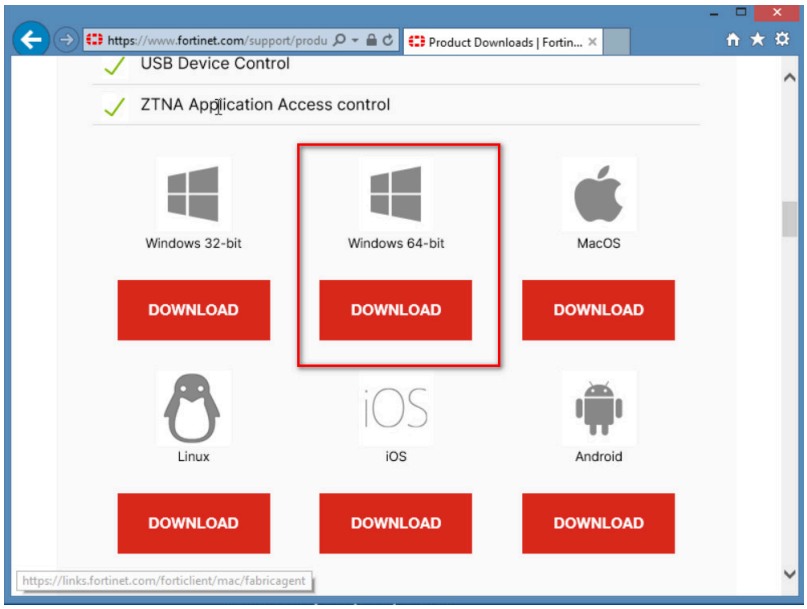


Figure 4.57: Download FortiClient

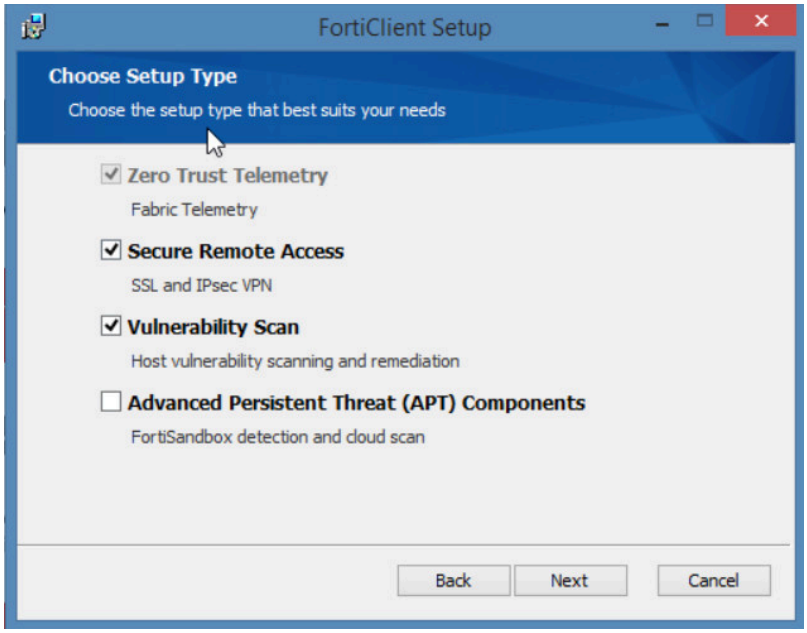


Figure 4.58: FortiClient Installation

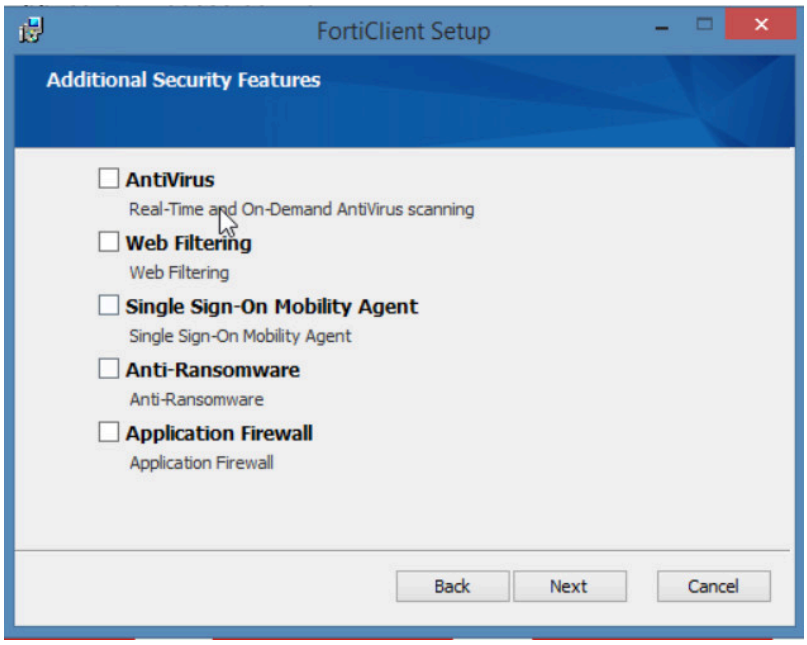


Figure 4.59: FortiClient Installation

10. Configure FortiClient.

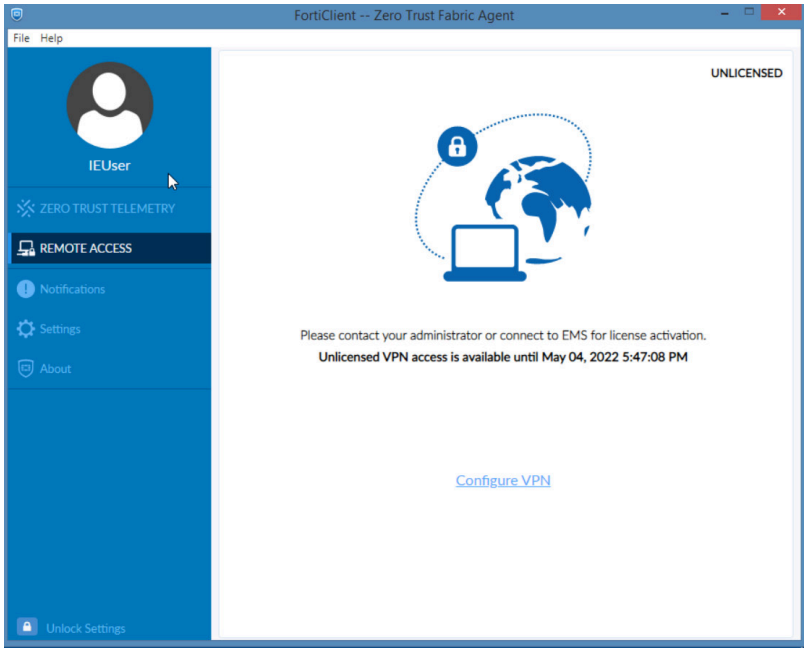


Figure 4.60: Configure FortiClient

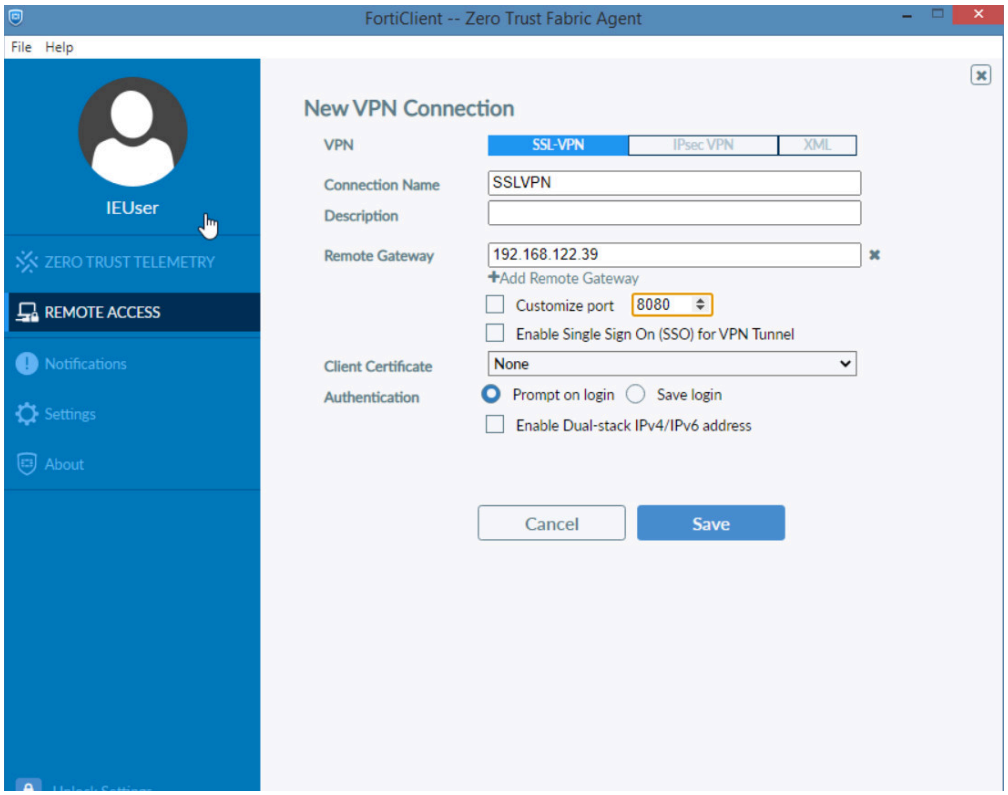


Figure 4.61: Configure SSLVPN

11. Verify configuration. Enter the Username and Password you have set for SSLVPN.

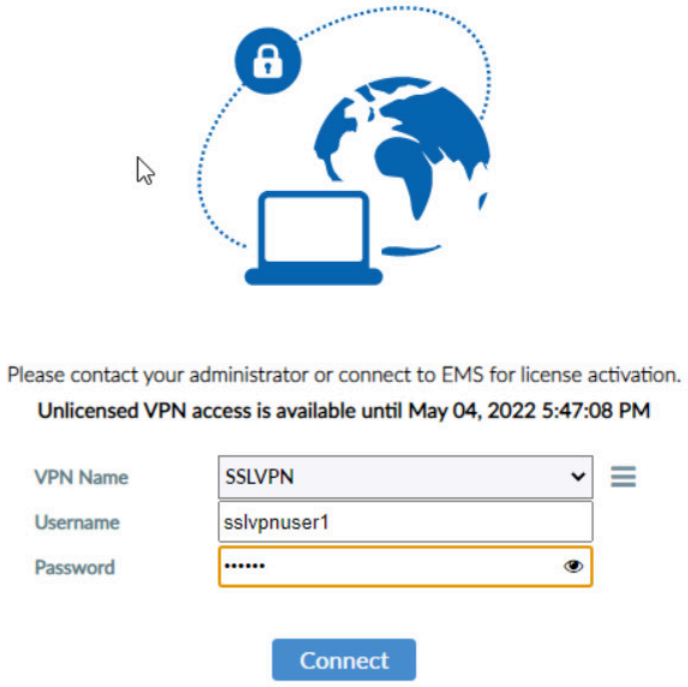


Figure 4.62: SSLVPN Credentials

Accept the Certificate Issuer to have a secure connection.

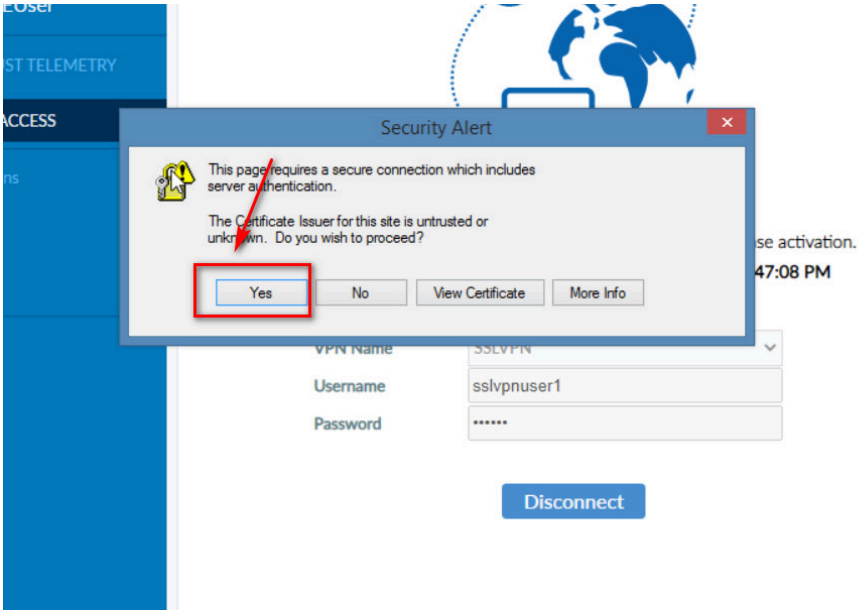


Figure 4.63: Click on Yes in Security Alert

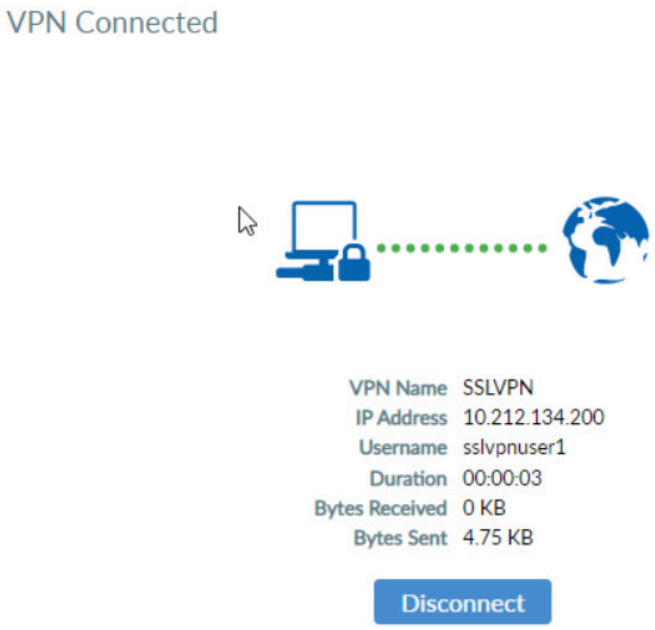


Figure 4.64: Verify SSLVPN Connection

Verify your connectivity by entering the IP address of WordPress.

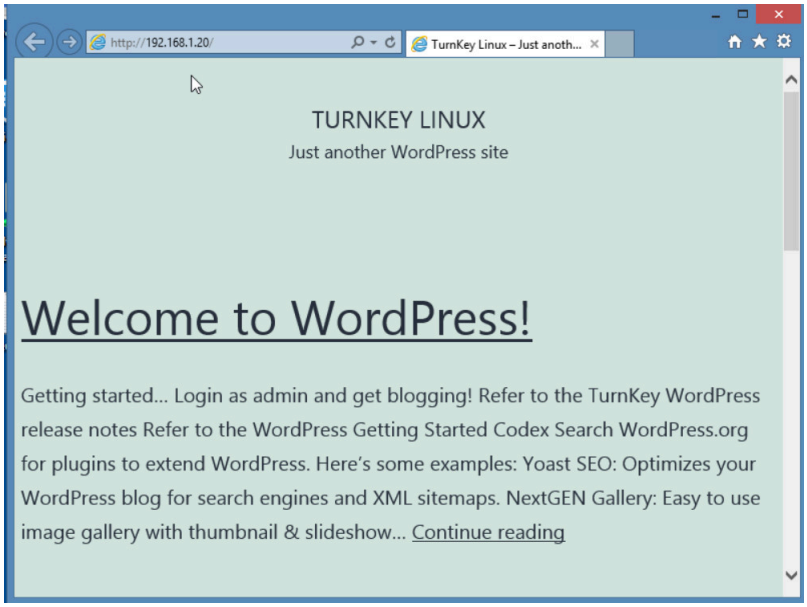


Figure 4.65: Verify WordPress

Verify your connectivity by entering the IP address of SSH Server.

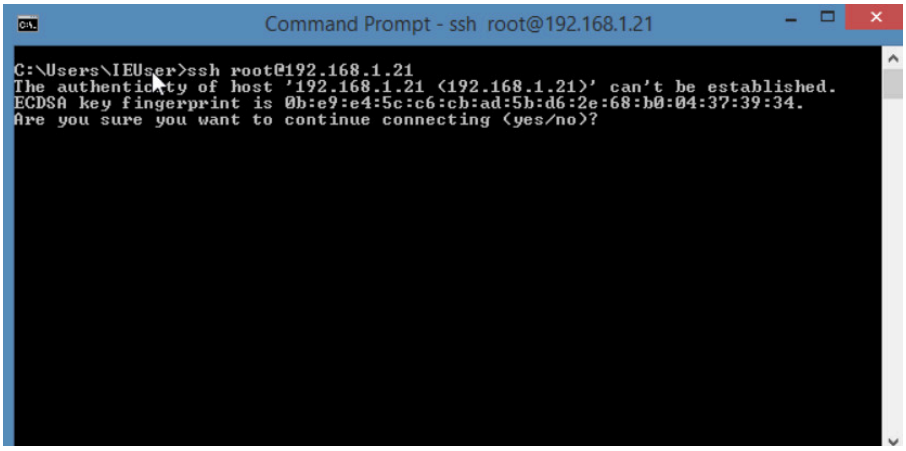


Figure 4.66: Verify SSH

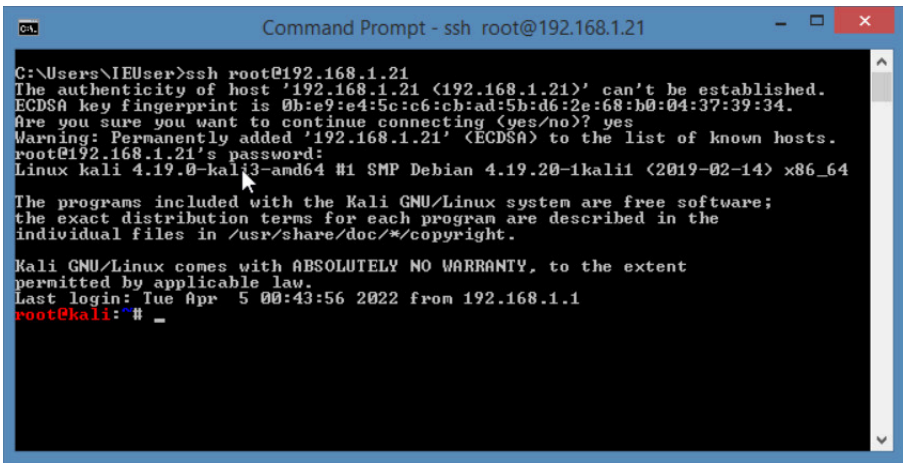


Figure 4.67: Verify SSH connection

Chapter 5. Authentication

5.1 Captive Portal

Learning Objectives

- Configure a Captive Portal

Scenario: We are planning to enable Captive Portal on port2. Then, when users want to connect to the Internet, first they should enter their username and password and after that they are allowed to surf the Internet.

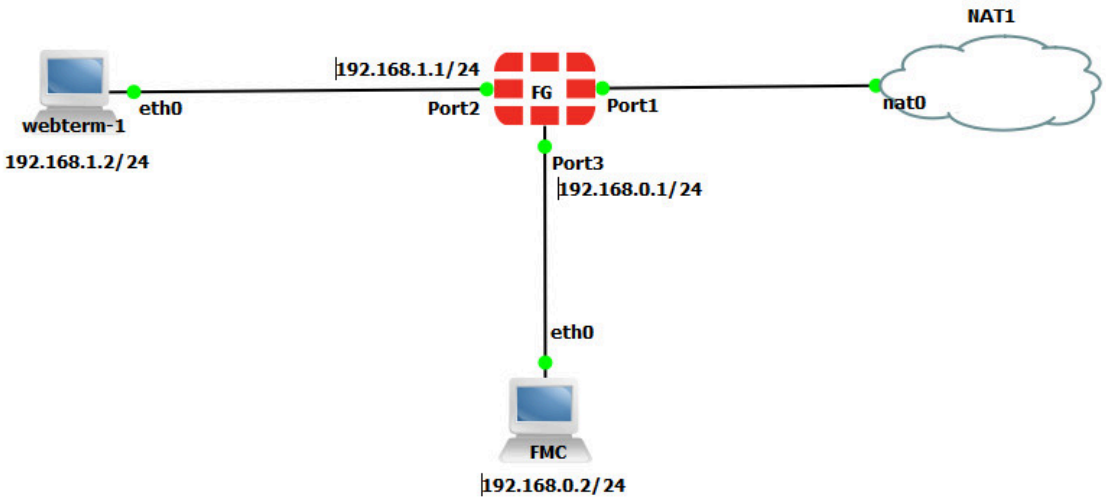


Figure 5.1: Main scenario

Table 5.1: Devices configuration

Device	IP address	Access
WebTerm1	192.168.1.2/24	–
FortiGate	Port 1: DHCP Client Port 2: 192.168.1.1/24 Port 3: 192.168.0.1/24	ICMP HTTP HTTPS
WebTerm (FMC)	192.168.0.2/24	–

1. Prerequisites:
    1. Set the IP addresses in the firewall as above table. The CLI is available as following:

```
FGVM01TM19008000 # config system interface
FGVM01TM19008000 (interface) # edit port1
FGVM01TM19008000 (port1) # set mode dhcp
FGVM01TM19008000 (port1) # end

FGVM01TM19008000 # config system interface
FGVM01TM19008000 (interface) # edit port2
FGVM01TM19008000 (port2) # set ip 192.168.1.1/24
FGVM01TM19008000 (port2) # end

FGVM01TM19008000 # config system interface
FGVM01TM19008000 (interface) # edit port3
FGVM01TM19008000 (port3) # set ip 192.168.0.1/24
FGVM01TM19008000 (port3) # set allowaccess http https
FGVM01TM19008000 (port3) # end
```

    2. Set a static route in the firewall. You should always set the default route in the firewall (0.0.0.0 0.0.0.0 Internet IP).

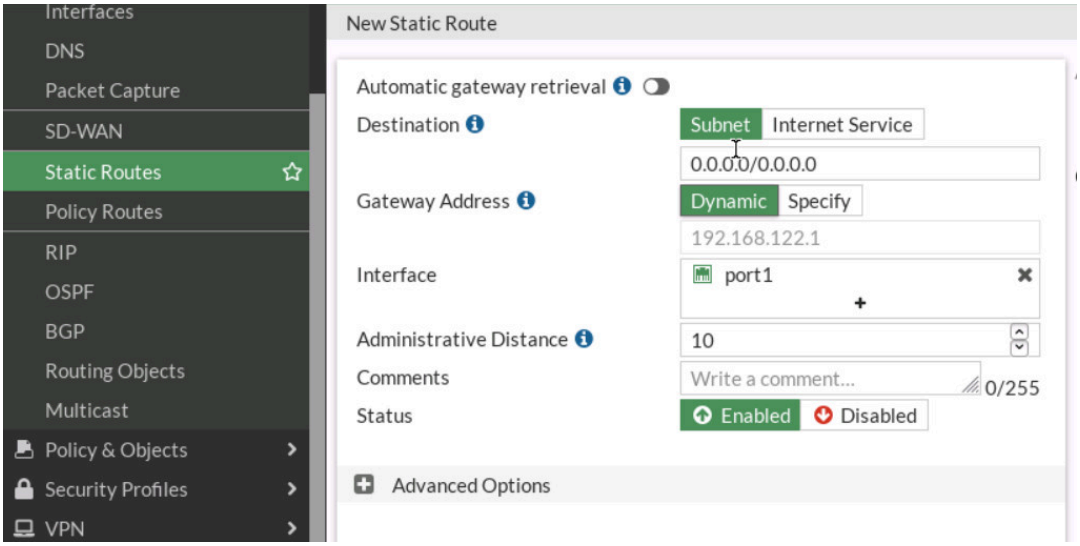


Figure 5.2: Configure a static route

3. Set a Firewall Policy from **port2** to **port1.**

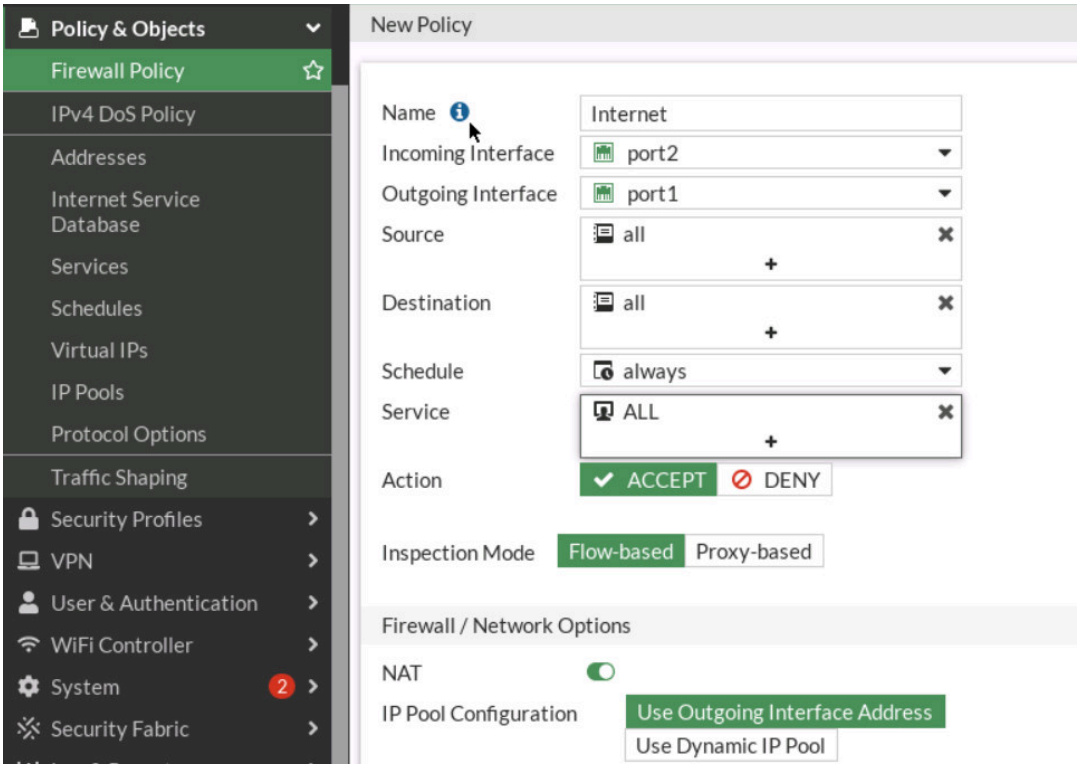


Figure 5.3: Set a Firewall Policy

4. Set the static IP address in WebTerm1 (192.168.1.2/24).

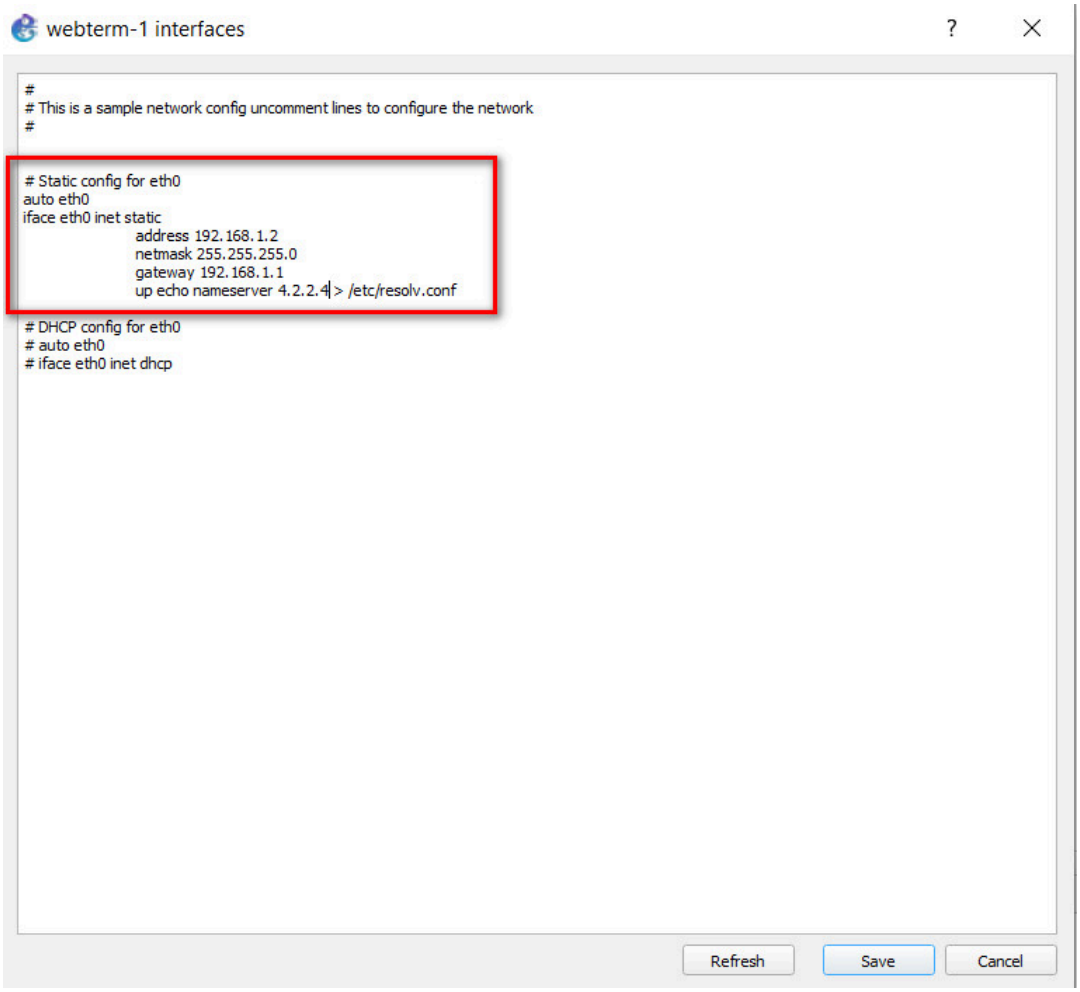


Figure 5.4: Configure a static IP address in WebTerm1

2. Create a user and group. Go to **User & Authentication** > **User Groups**. Create a group name: **CaptivePortal**.

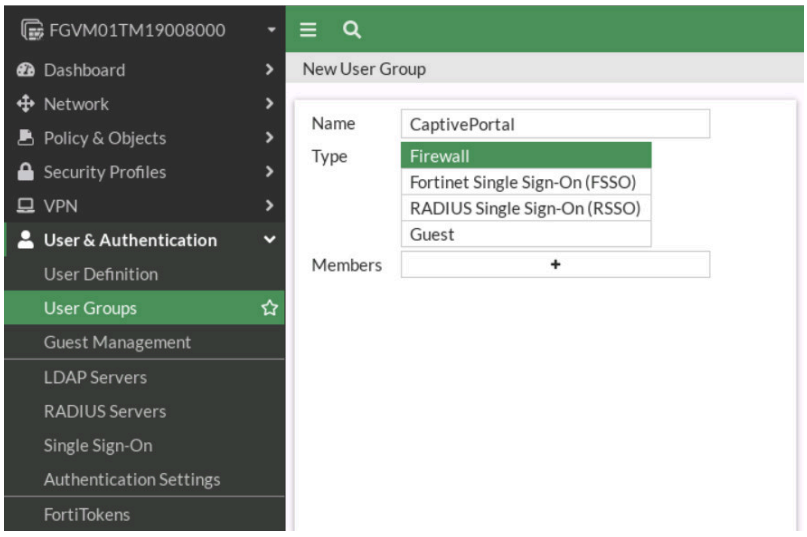


Figure 5.5: Create a group

Go to **User & Authentication** > **User Definition** > **Create a New User** and assign your user in step 4 to A0ID-CaptivePortal Group.

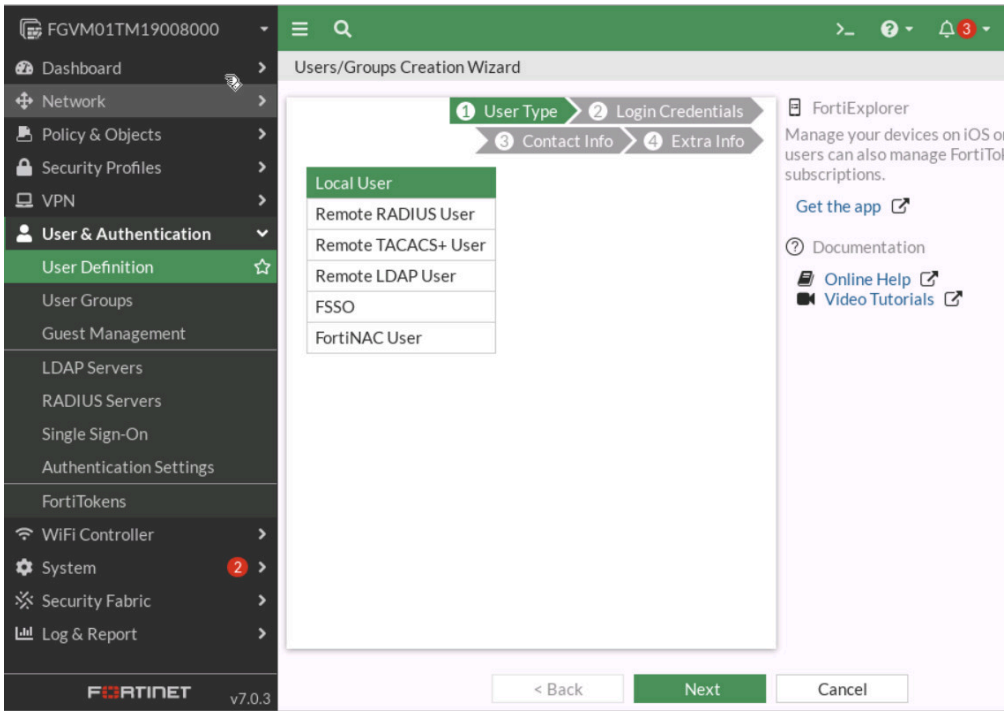


Figure 5.6: Create a user

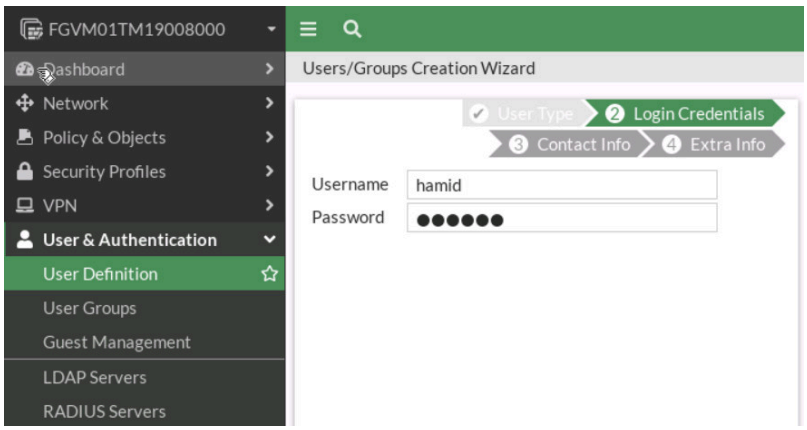


Figure 5.7: Create login credentials

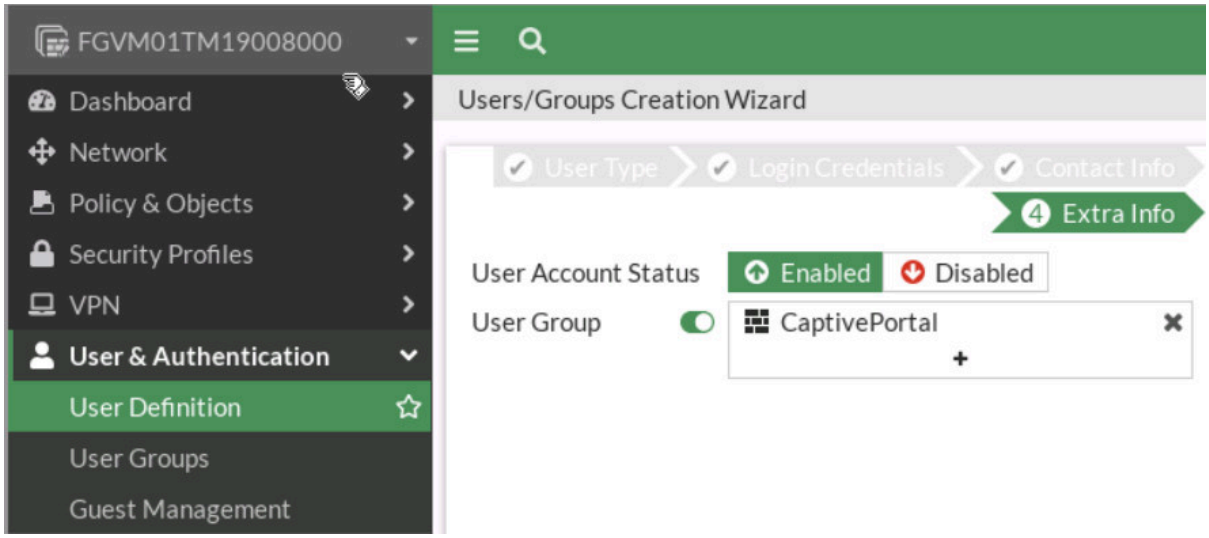


Figure 5.8: Add user to the group

3. Go to **Network** > **Interfaces and edit port 2**. In the Admission Control section, set:

    - **Security mode:** captive portal
    - **Authentication Portal:** Local
    - **User Access:** Restricted to Group and assign the group you have created in the previous step.

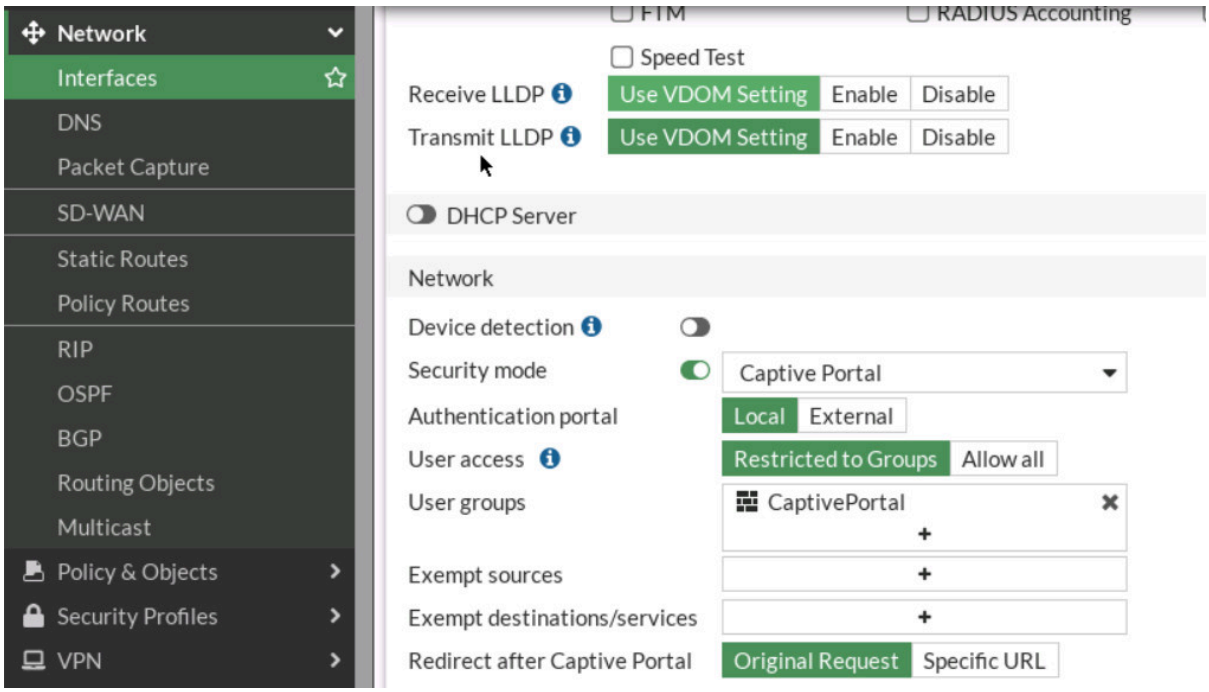


Figure 5.9: Configure Captive Portal on port2

4. Now, open the browser in WebTerm1 and type http://talebi.ca.

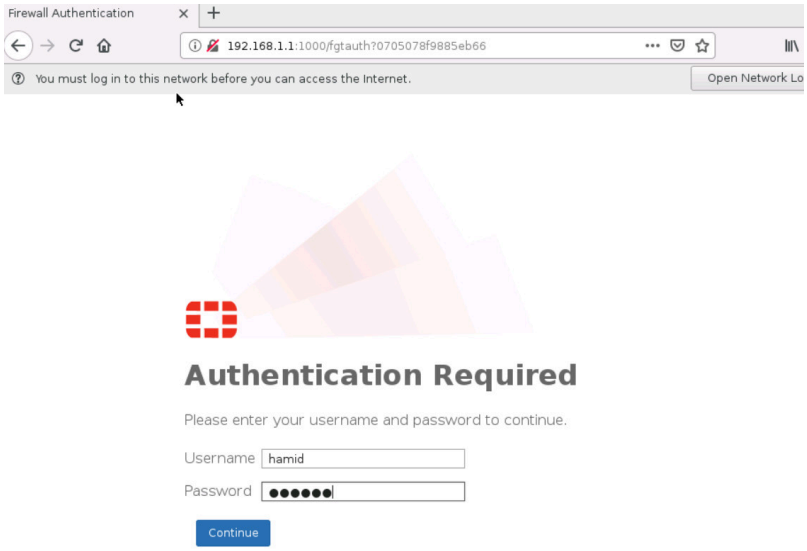


Figure 5.10: Verify Captive Portal

5.2 FSSO

Learning Objectives

- Install FSSO Agent on Windows Server
- Configure a FSSO

Scenario: FSSO stands for Fortinet Single Sign-on and it is used to allow users to login into the network with one single login credential. In this scenario, we are going to focus on agent-based FSSO and we are going to install the agent on Windows Server. Then, anyone logins through Active Directory, we can track them through FortiGate Logs and Events.

1. In this scenario, we are going to join windows 10 to Active Directory that we have set already. The domain controller name is Hamid.local. First, we will join Windows 10 to the domain controller.

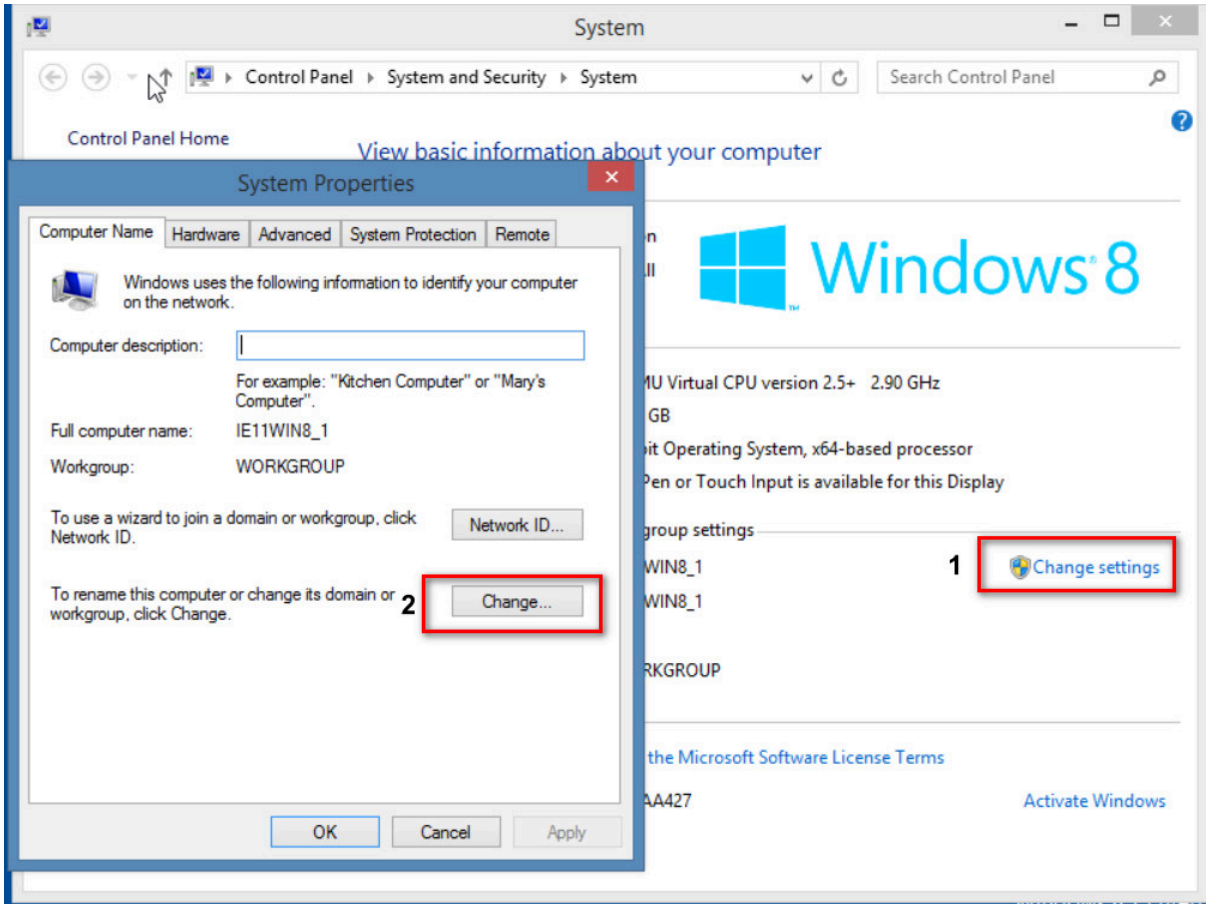


Figure 5.11: Join Windows to the Active Directory

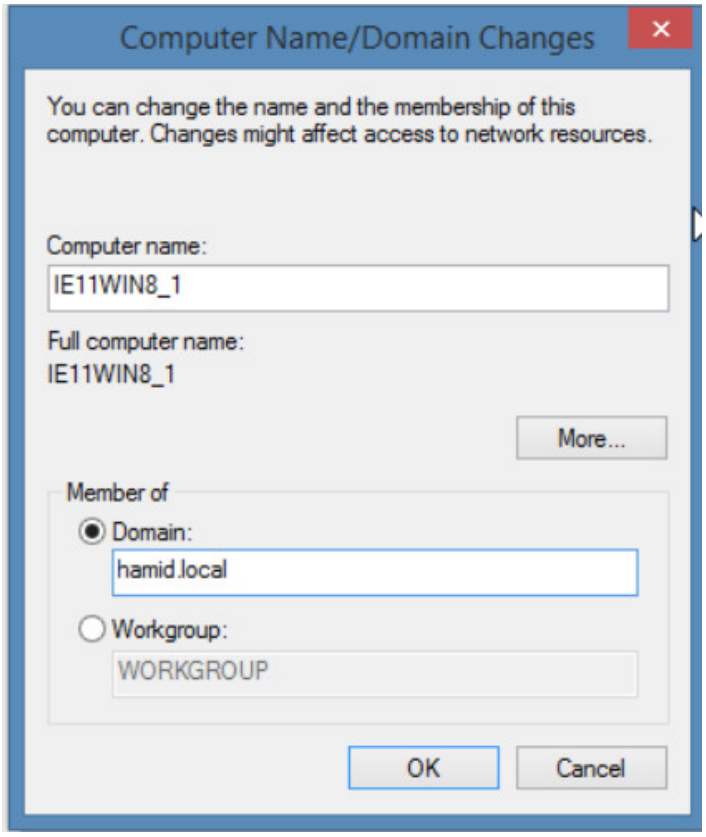


Figure 5.12: Enter Domain name

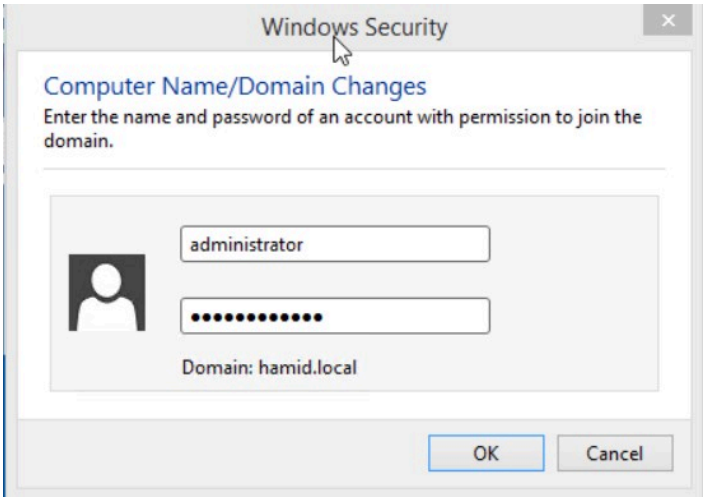


Figure 5.13: Enter username and password of AD administrator

2. Install FSSO Agent on the AD server.

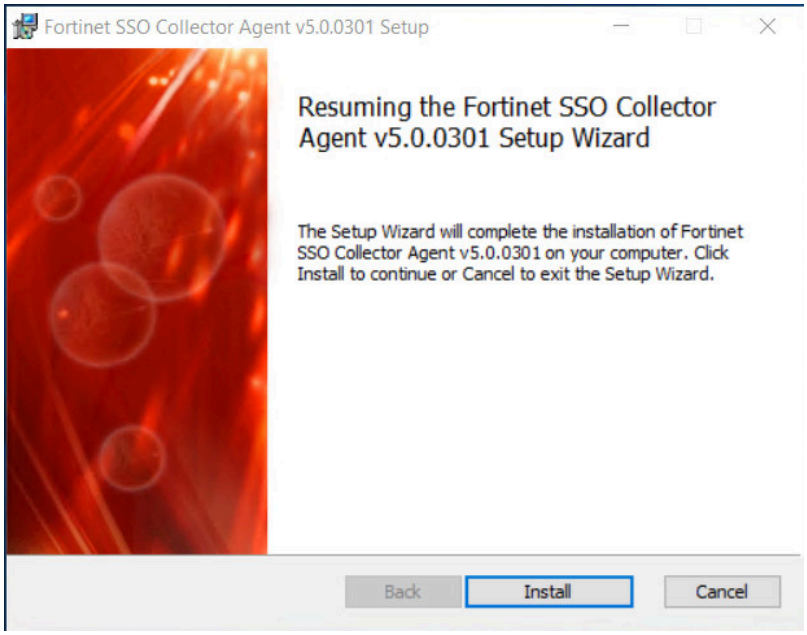


Figure 5.14: Install FSSO Agent

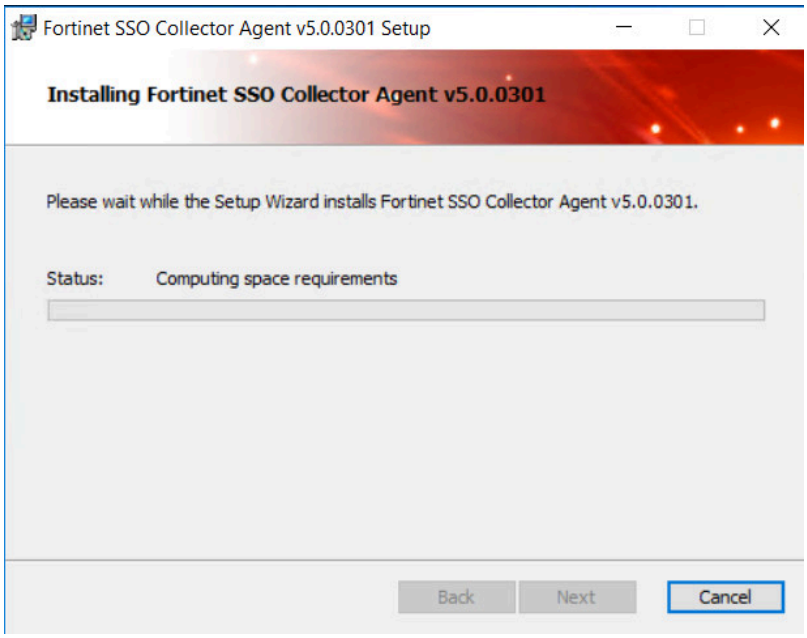


Figure 5.15: Install FSSO Agent

The password you set here for the agent is going to be used in the FortiGate firewall when you want to connect to the FSSO Agent.

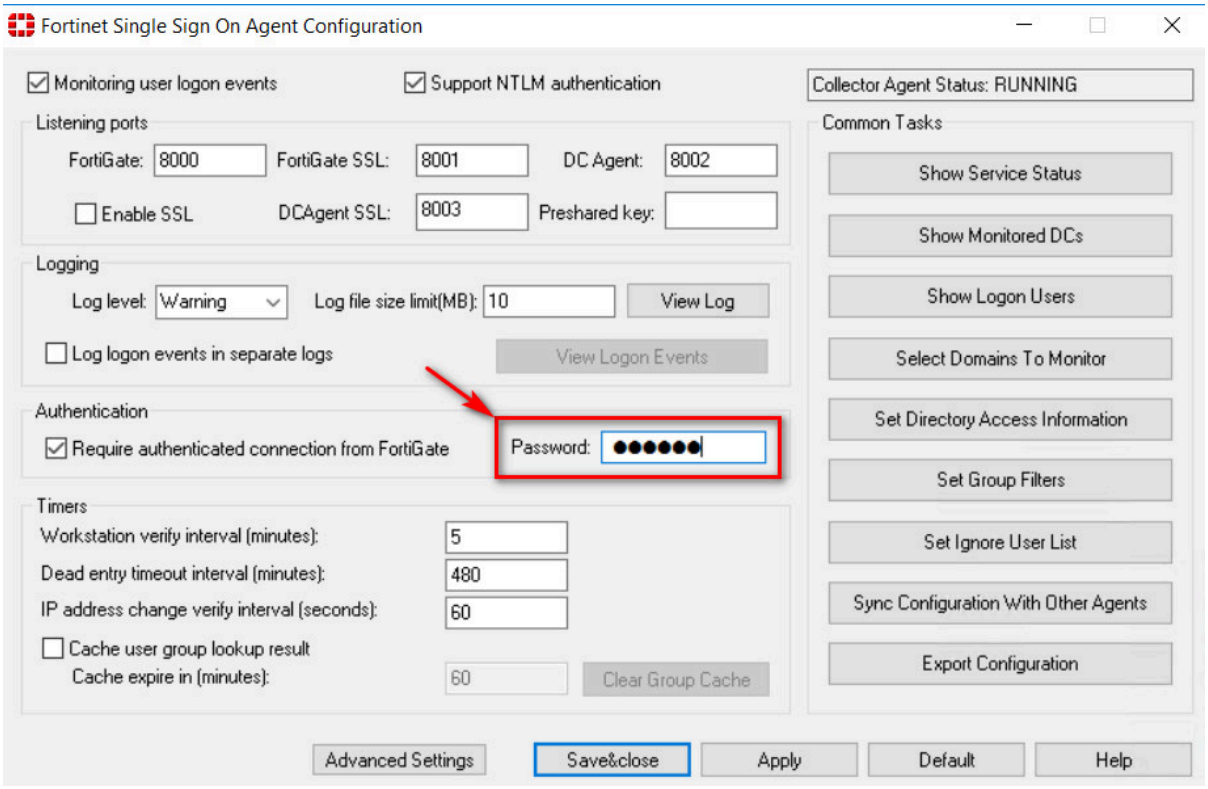


Figure 5.16: Configure FSSO Agent

3. In the FortiGate firewall, go to **Security Fabric** > **External Connectors** > **FSSO Agent on Windows AD**.

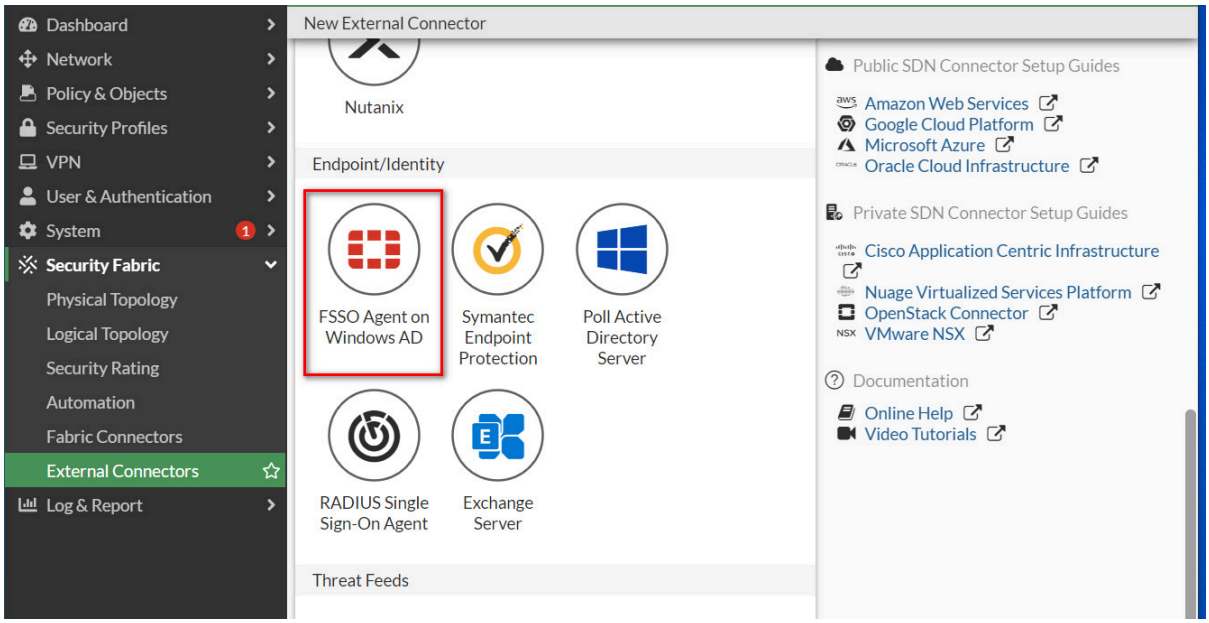


Figure 5.17: Set external connectors

Enter the same password you have set in step 2.

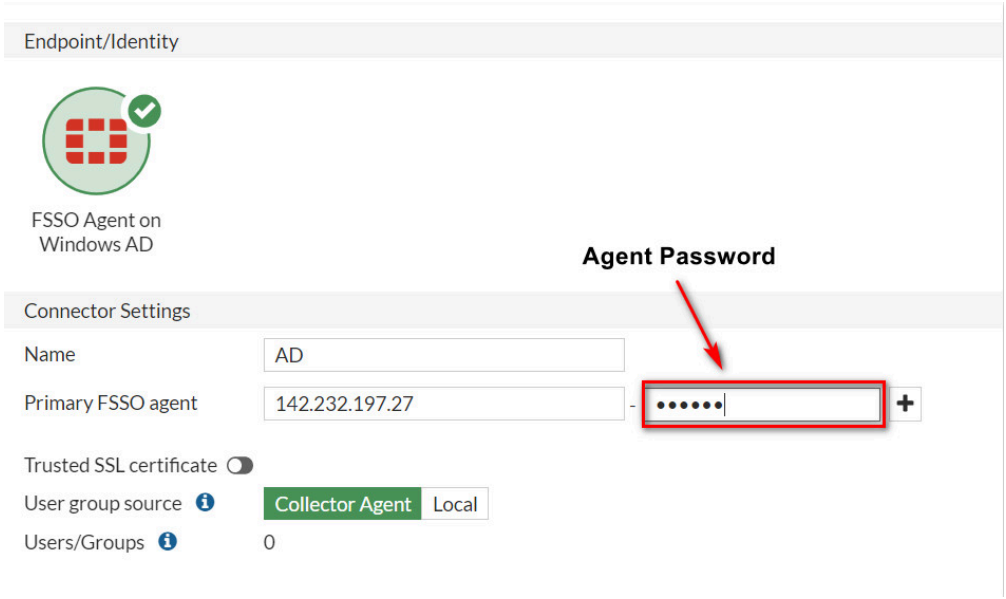


Figure 5.18: Set FSSO Agent settings

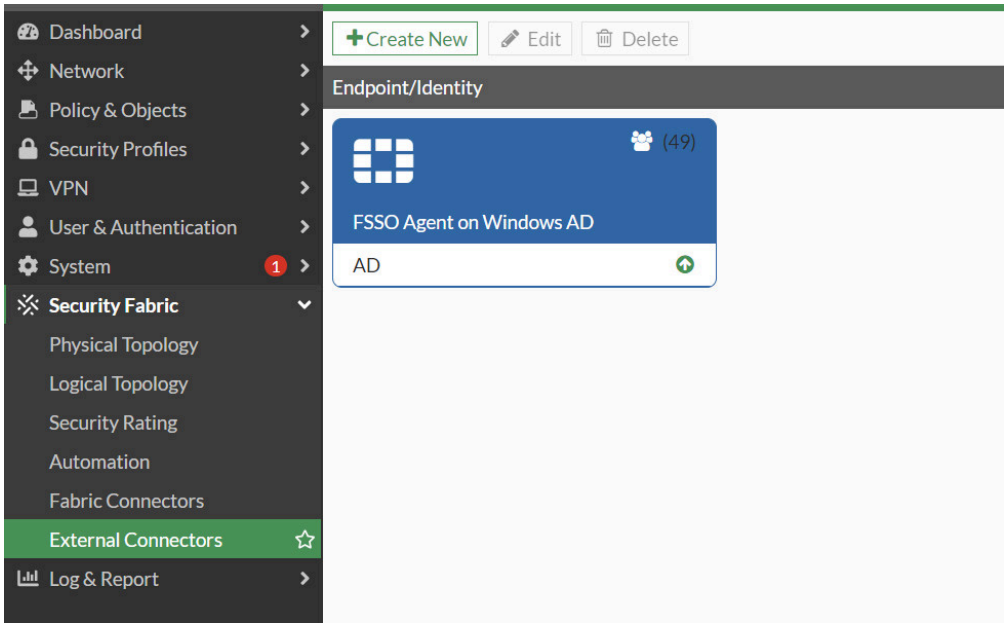


Figure 5.19: FSSO Agent status

4. You should be able to connect to FSSO Agent and you can verify the status of the external connector.
5. Verify your configuration by going to **Log & Report > Events > User Events.**

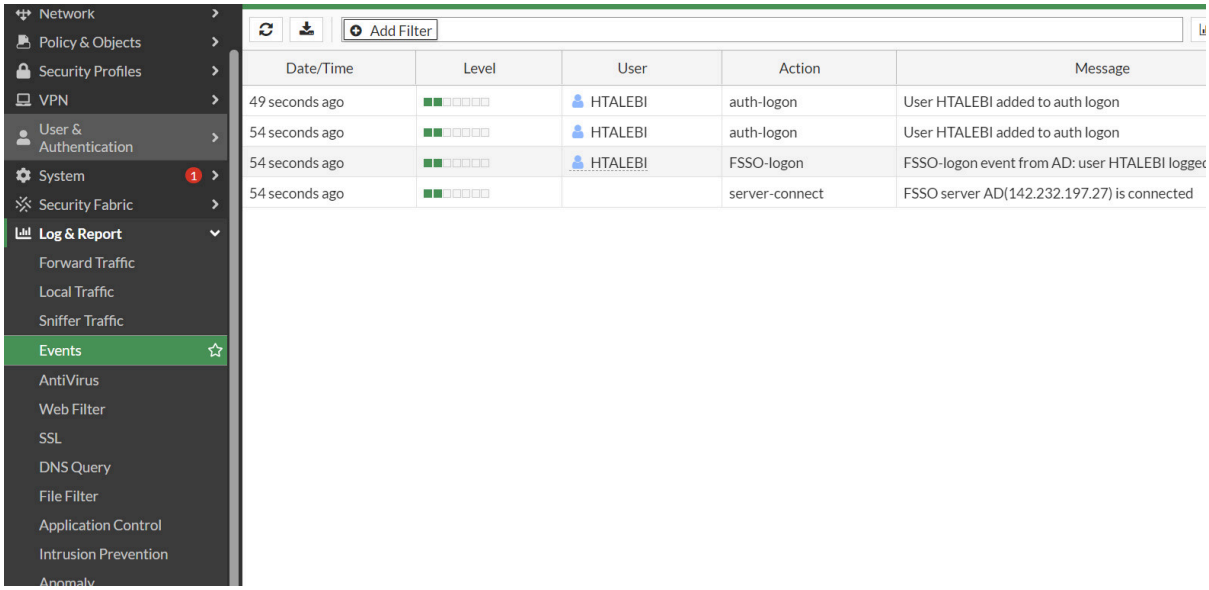


Figure 5.20: FSSO event logs

6. After connecting to the Agent, you should be able to see users and groups in AD when you are creating a new user.

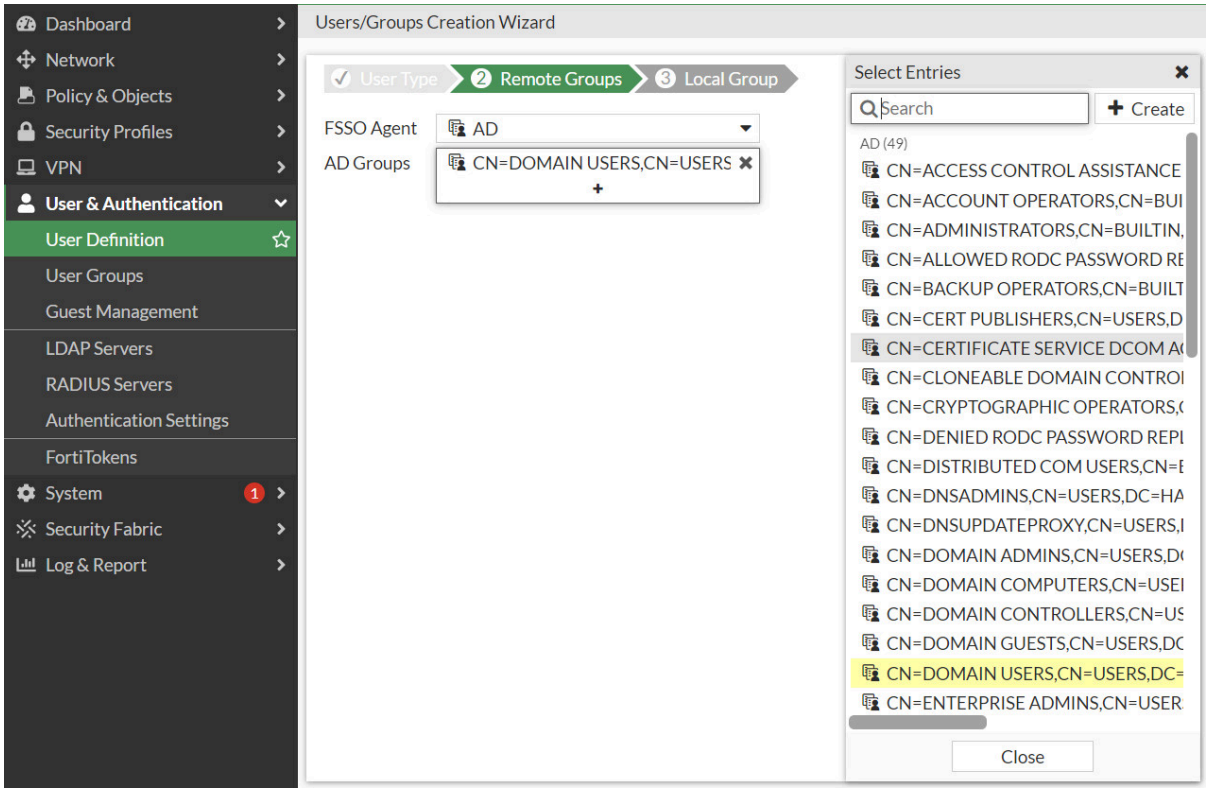


Figure 5.21: Verify configuration

Chapter 6. High Availability

6.1 High Availability

Learning Objectives

- Configure HA (Active-Passive) between two firewalls

Scenario: In this lab, we are going to have two firewalls. One of them is Primary or Active and the other one is Secondary or Passive. We are going to have High Availability between these two firewalls and if we shut down one of them, the other one will be Primary.

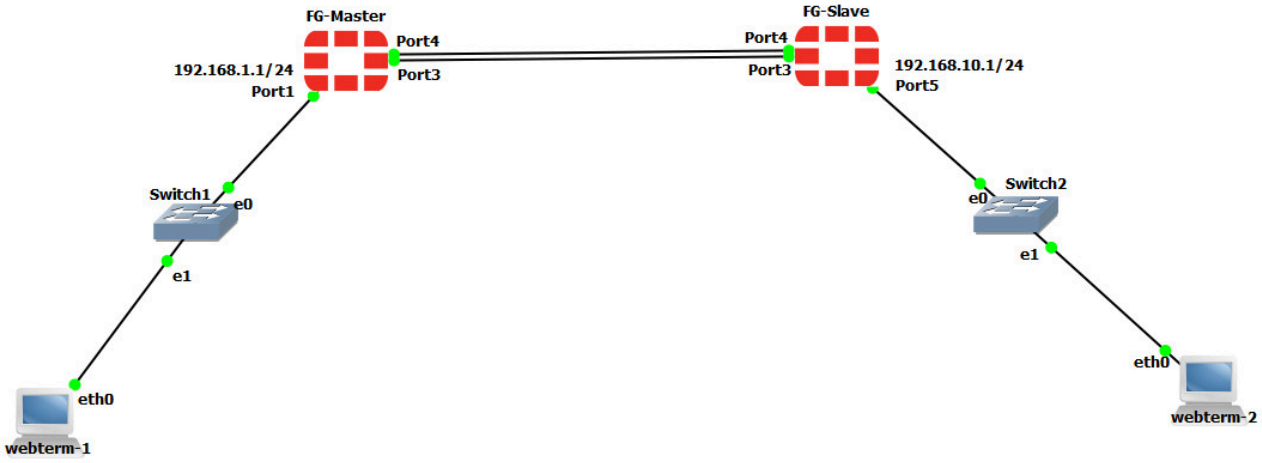


Figure 6.1: Main scenario

Table 6.1: Devices configuration

Device	IP address	Access
WebTerm1	192.168.1.2/24	–
WebTerm2	192.168.10.2/24	–
EthernetSwitch1	–	–
EthernetSwitch2	–	–
FG-Primary	Port 1: 192.168.1.1/24 Port 5: 192.168.10.1/24	ICMP-HTTP-HTTPS
FG-Secondary	Port 1: 192.168.1.1/24 Port 5: 192.168.10.1/24	ICMP-HTTP-HTTPS

1. CLI Configuration for Primary and Secondary:

FG-Primary

FortiGate-VM64-KVM # config system global
FortiGate-VM64-KVM (global) # set hostname FG-Primary
FortiGate-VM64-KVM (global) # end

FG-Primary # config system interface
FG-Primary (interface) # edit port1
FG-Primary (port1) # set mode static
FG-Primary (port1) # set ip 192.168.1.1/24
FG-Primary (port1) # set allowaccess http https ping
FG-Primary (port1) # end
FG-Primary # config system interface
FG-Primary (interface) # edit port5
FG-Primary (port5) # set ip 192.168.10.1/24
FG-Primary (port5) # set allowaccess http https ping
FG-Primary (port5) # end

FG-Secondary

FortiGate-VM64-KVM # config system global
FortiGate-VM64-KVM (global) # set hostname FG-Secondary
FortiGate-VM64-KVM (global) # end

```
FG-Secondary # config system interface
FG-Secondary(interface) # edit port1
FG-Secondary (port1) # set mode static
FG-Secondary (port1) # set ip 192.168.1.1/24
FG-Secondary (port1) # set allowaccess http https ping
FG-Secondary (port1) # end
FG-Secondary # config system interface
FG-Secondary (interface) # edit port5
FG-Secondary (port5) # set ip 192.168.10.1/24
FG-Secondary (port5) # set allowaccess http https ping
FG-Secondary (port5) # end
```

2. Go to **System > HA in the FG-Primary**:
    - Select the Mode: **Active-Passive**
    - Device Priority: **128** (The higher priority is primary)
    - Group Name: **HRT** (The Group name between Primary and Secondary should be the same)
    - Password: **Set a password** (The Password between Primary and Secondary should be the same)
    - Monitor Interface: **Port 3**
    - Heartbeat Interface: **Port 4**

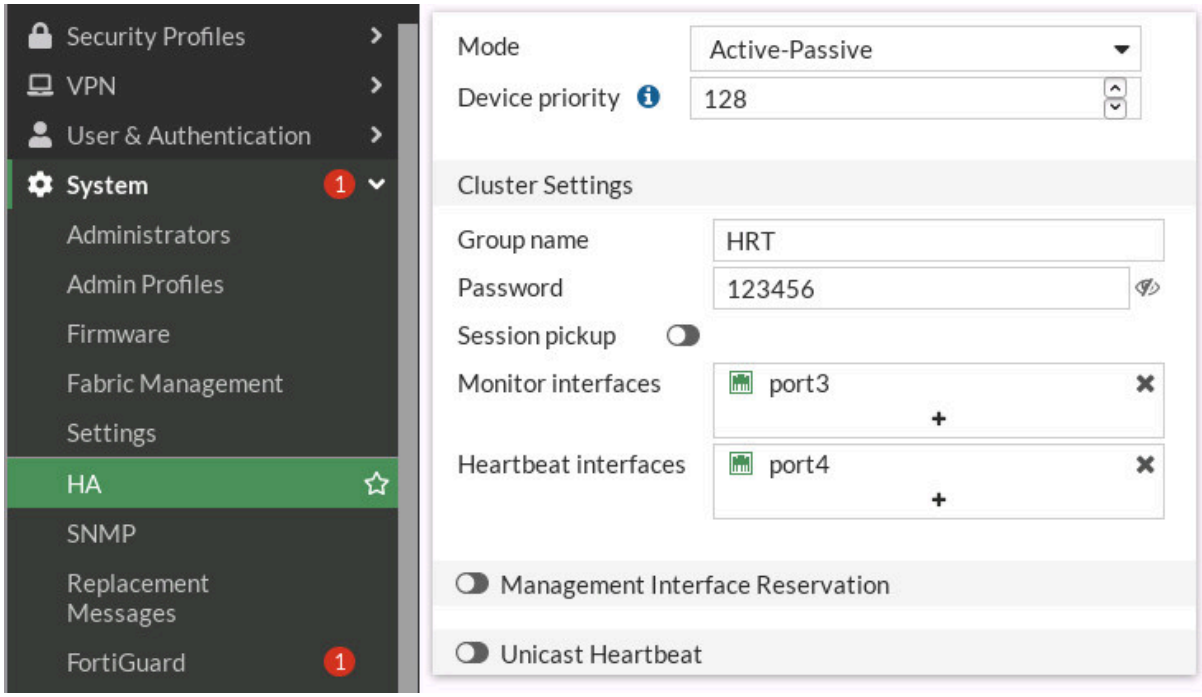


Figure 6.2: HA primary configuration

Do the same configuration in the FG-Secondary but set the Device priority to 50.

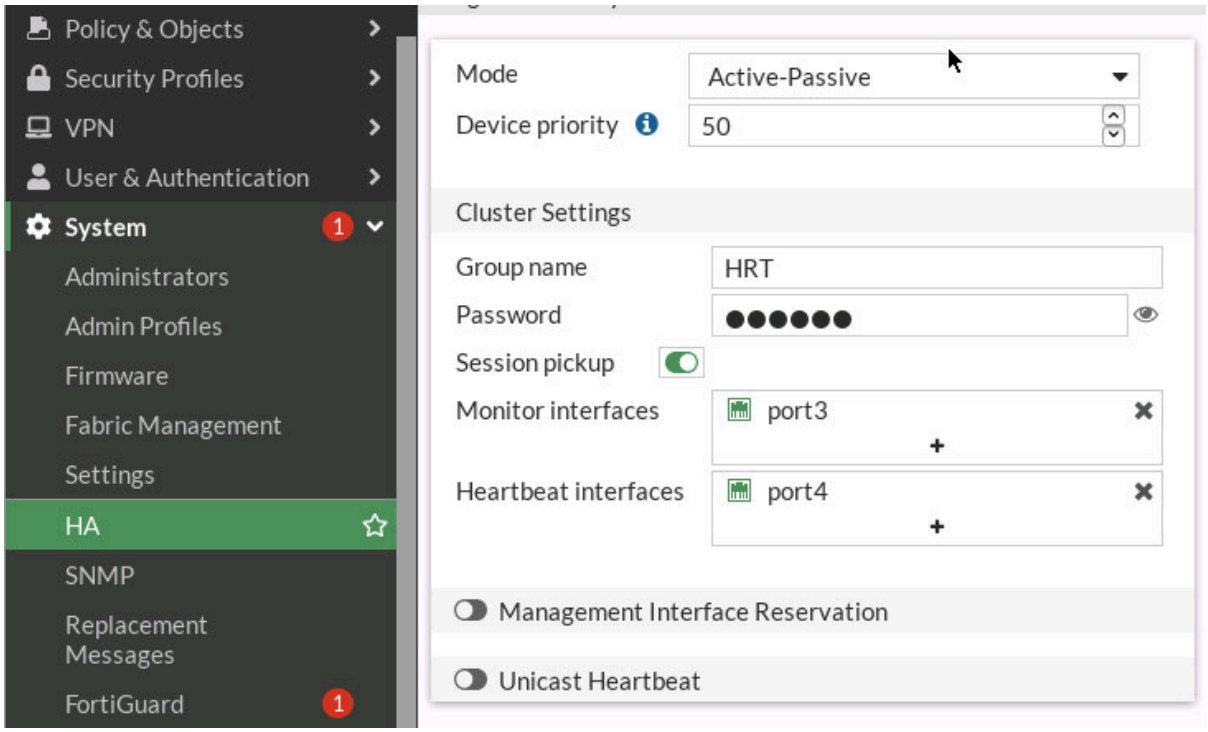


Figure 6.3: HA secondary configuration

3. After setting secondary device, no longer be able to access secondary device. Go to **FG-Primary** > **System** > **HA** and evaluate your result.

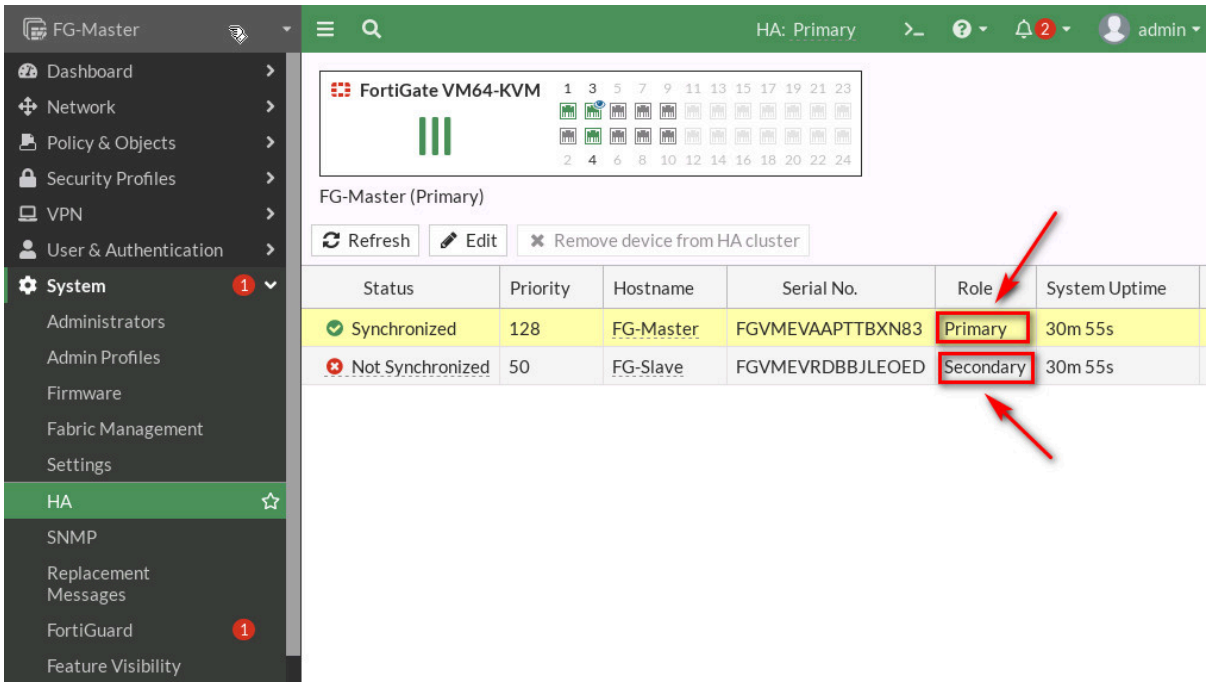


Figure 6.4: HA status

Two devices will be synchronized after a while.

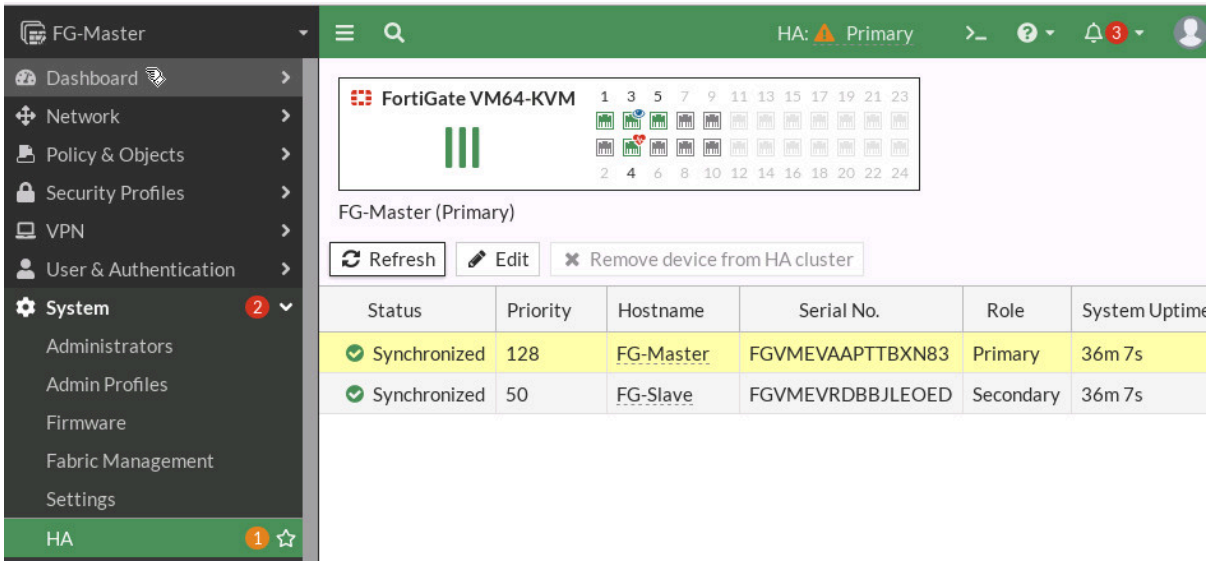


Figure 6.5: HA Synchronized status

4. Now, connect other interfaces like Figure 6.6.

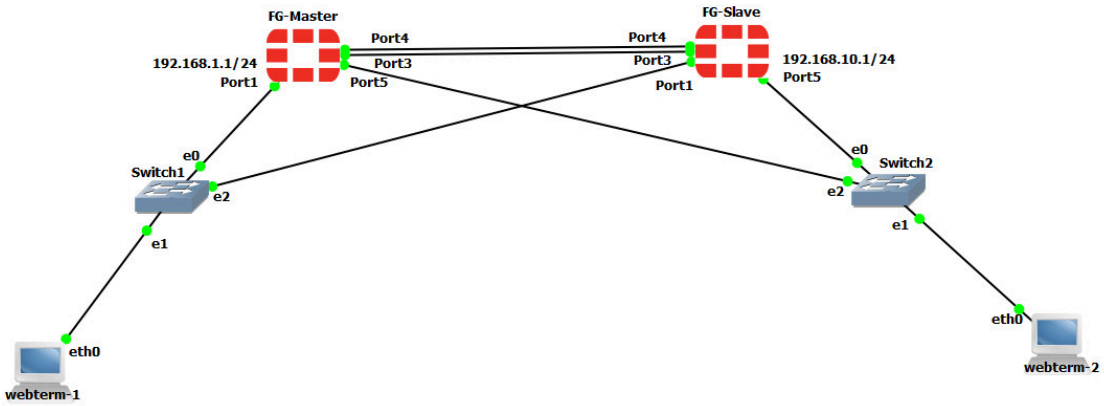


Figure 6.6: Main scenario

Try to Stop FG-Primary and go to WebTerm1. Can you reach the firewall?

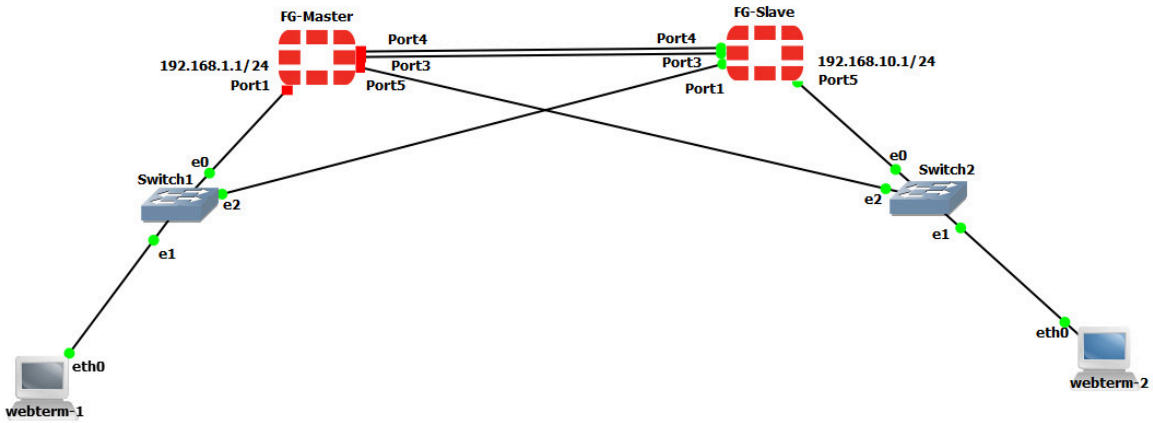


Figure 6.7: Stopping FG-Primary

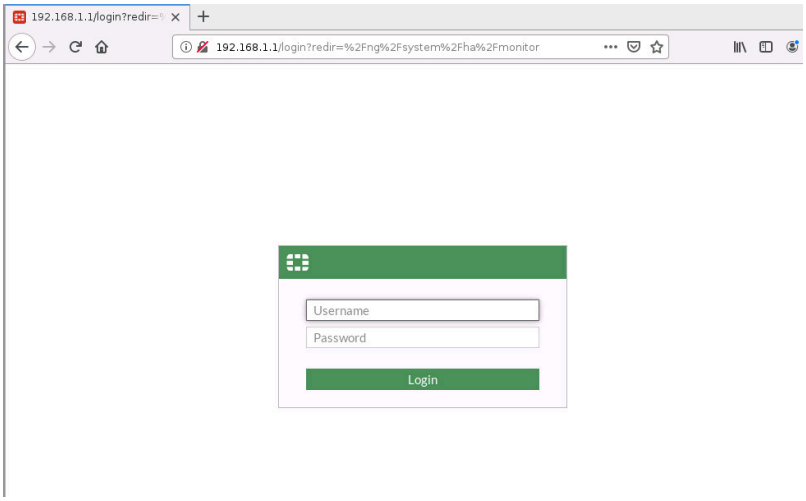


Figure 6.8: Verify connectivity to the firewall

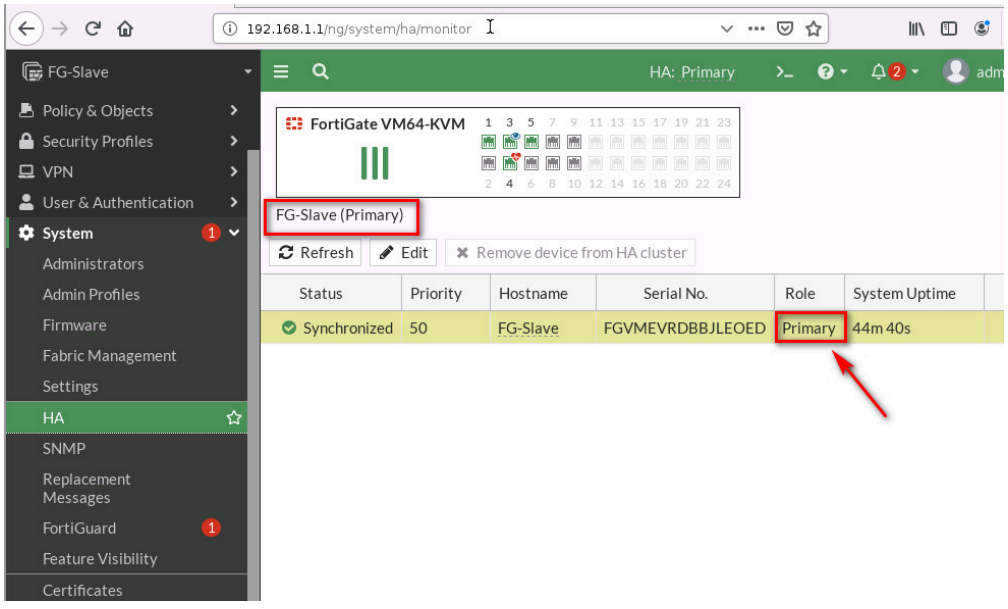


Figure 6.9: Verify firewall role after stopping FG-Primary

5. Go to **Log & Report** > **Events** > **HA Events** and download the log. Verify your result.

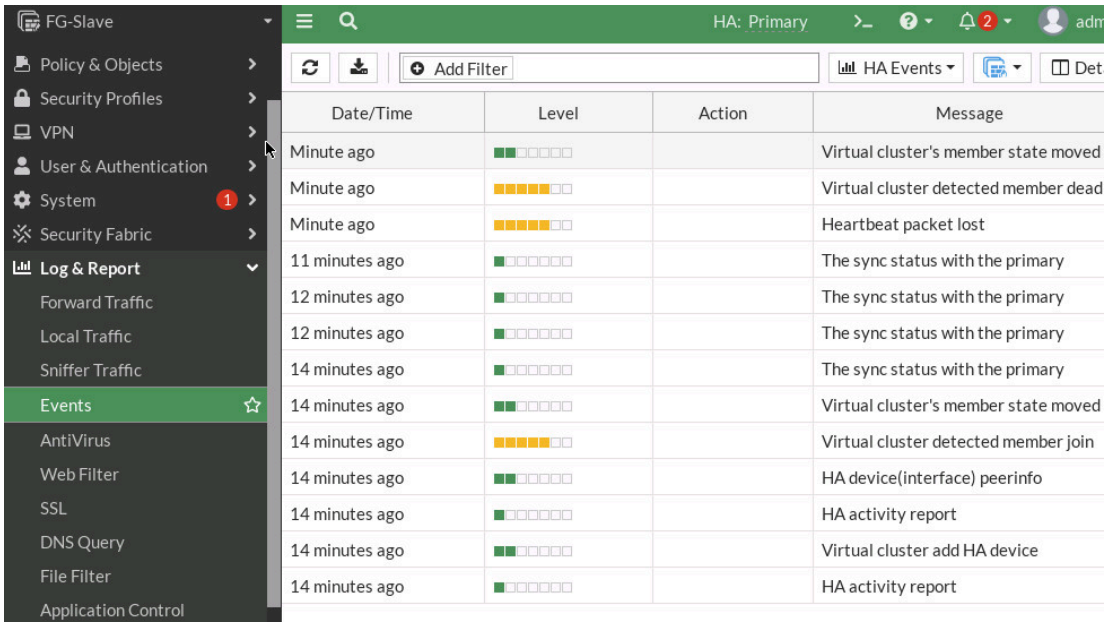


Figure 6.10: HA Events

Chapter 7. Security

7.1 DDoS Prevention

Learning Objectives

- Configure a DDoS prevention profile

Scenario: In this lab, we are going to set a DDoS Prevention on traffic from Port1 to Port2. In Kali, we are going to install a script to do a DOS attack and in the firewall, we will set a DDoS Prevention Policy to block DOS traffic.

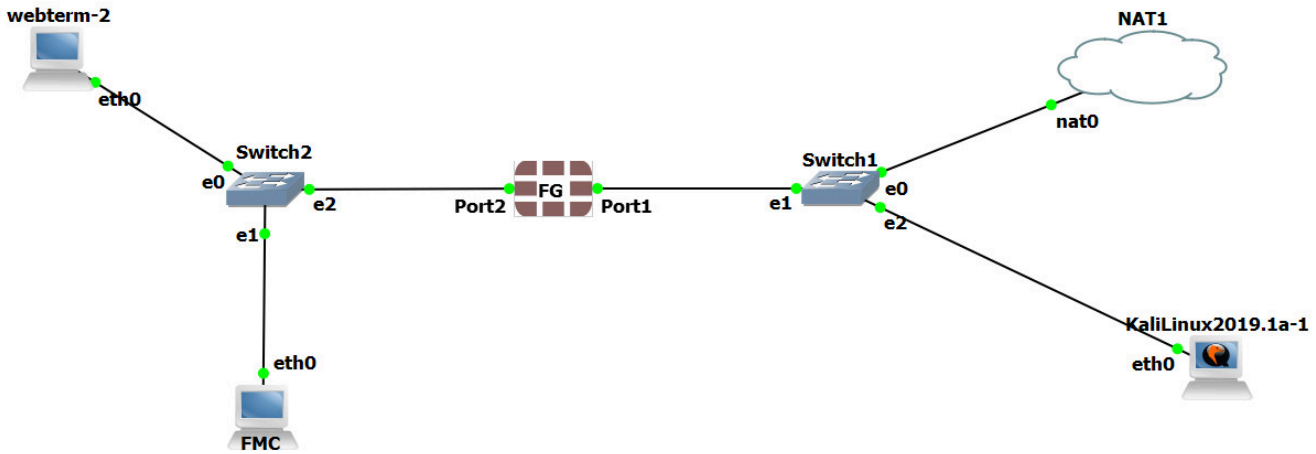


Figure 7.1: Main scenario

Table 7.1: Devices configuration

Device	IP address	Access
Kali1	DHCP Client	–
FortiGate	Port 1: DHCP Client Port 2: 192.168.0.1/24, DHCP Server (192.168.0.10-192.168.0.20)	ICMP-HTTP-HTTPS
WebTerm1 (FMC)	192.168.0.2/24	–
WebTerm2	DHCP Client	–

1. FortiGate CLI Configuration for port2.

```
FGVM01TM19008000 # config system interface
FGVM01TM19008000 (interface) # edit port2
FGVM01TM19008000 (port2) # set ip 192.168.0.1/24
FGVM01TM19008000 (port2) # set allowaccess http https ping
FGVM01TM19008000 (port2) # end
```

2. Go to Kali and Download the pentmenu repository (https://github.com/GinjaChris/pentmenu) and run **DOS** > **UDP FLOOD** > **Enter port1 IP address** > **Port 443**.

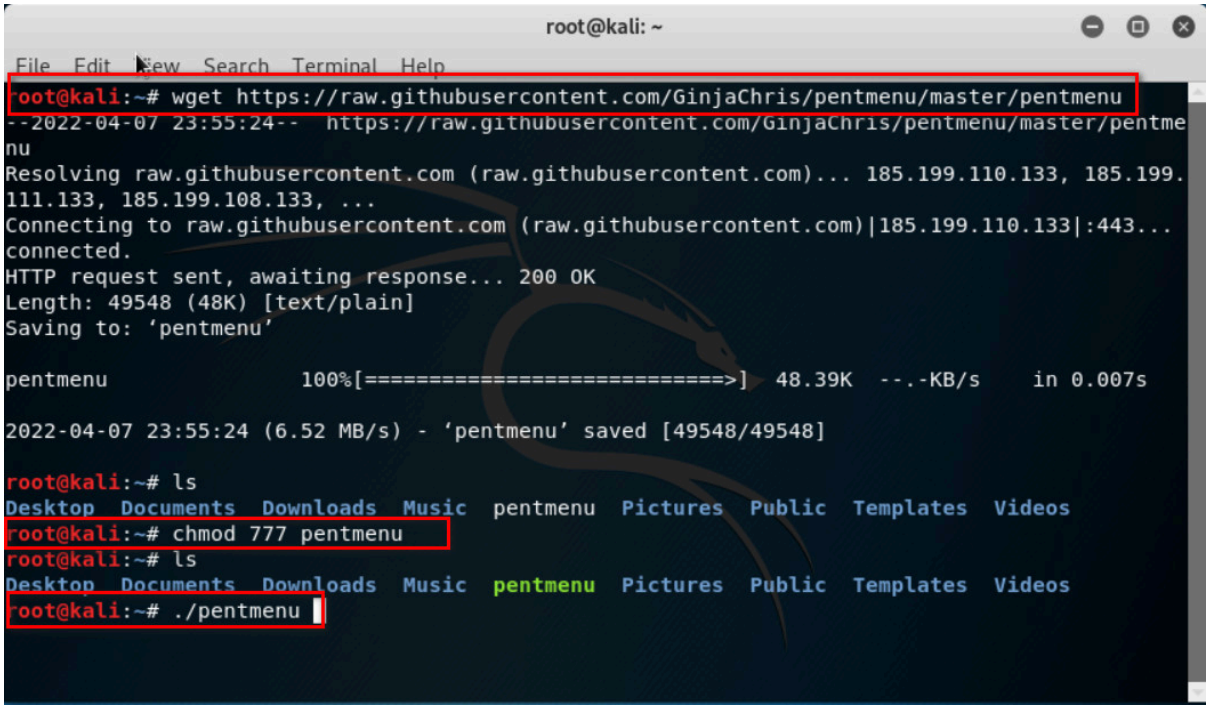


Figure 7.2: Download and execute pentmenu script

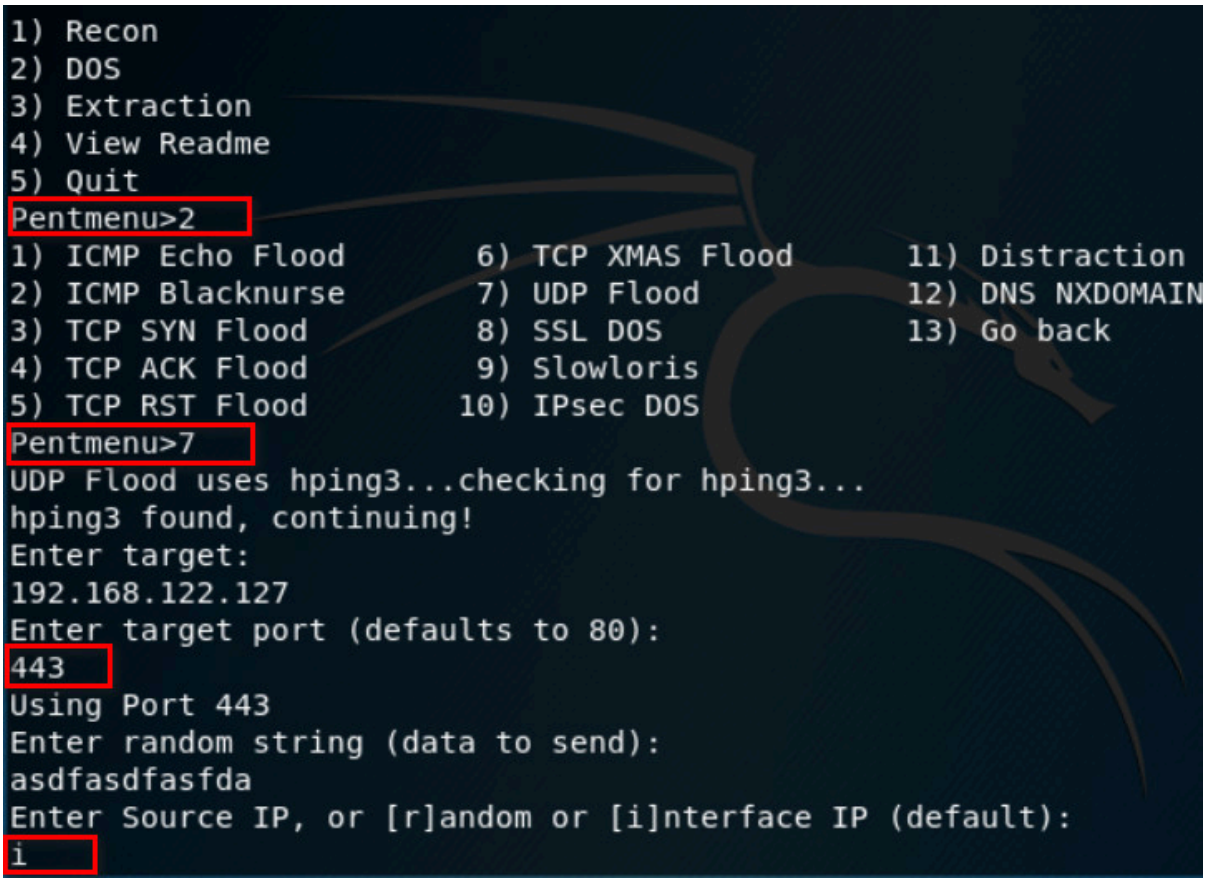


Figure 7.3: Running UDP Flood

3. Go to **Policy & Object** > **IPV4 DOS Policy**:

- Name: **DOS**
- Incoming Interface: **Port1**
- Source, Destination, Service: **all**
- L3 Anomalies: Status and Logging: **Enable, Action Block**
- L4 Anomalies: Status and Logging: **Enable, Action Block**

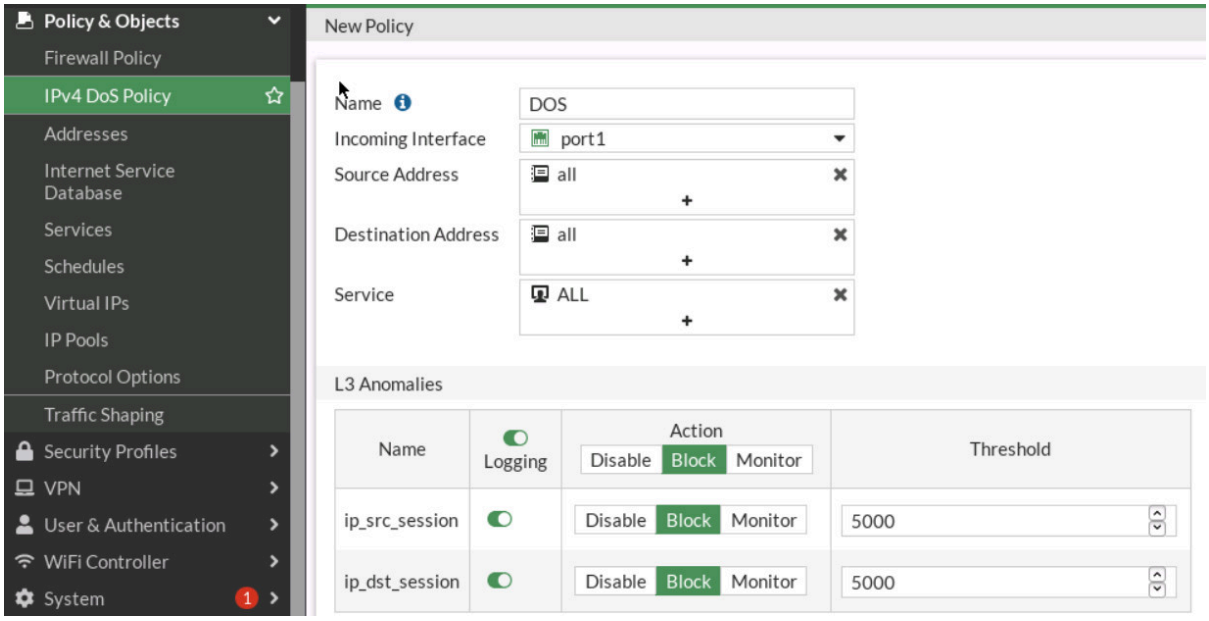


Figure 7.4: IPv4 DoS Policy

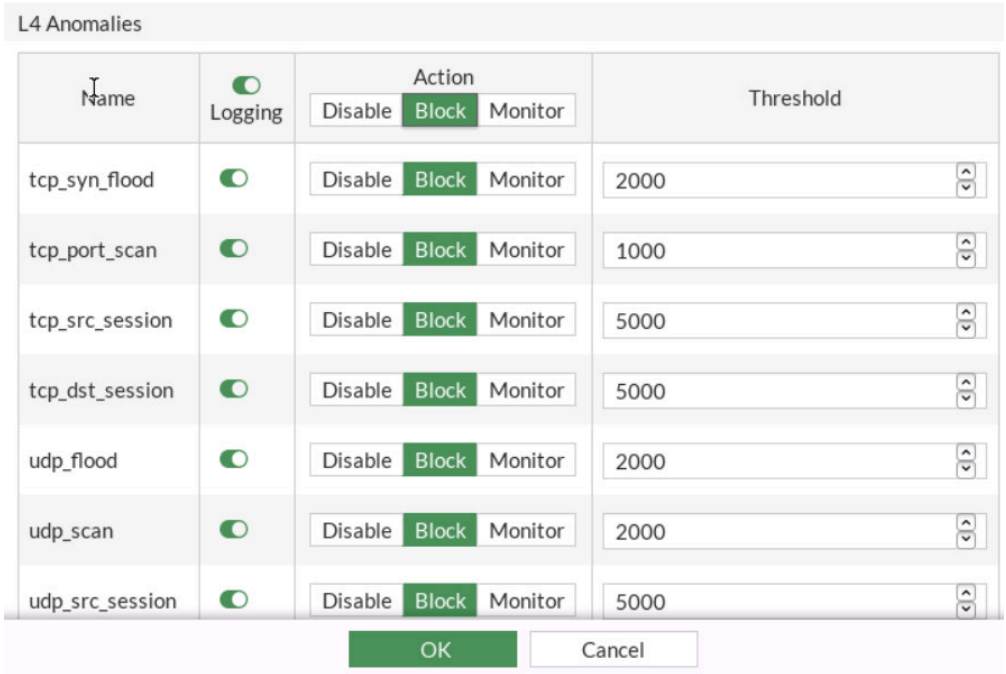


Figure 7.5: IPv4 DOS Policy Settings

4. Now, start the attack again and go to **Log & Report** > **Anomaly**.

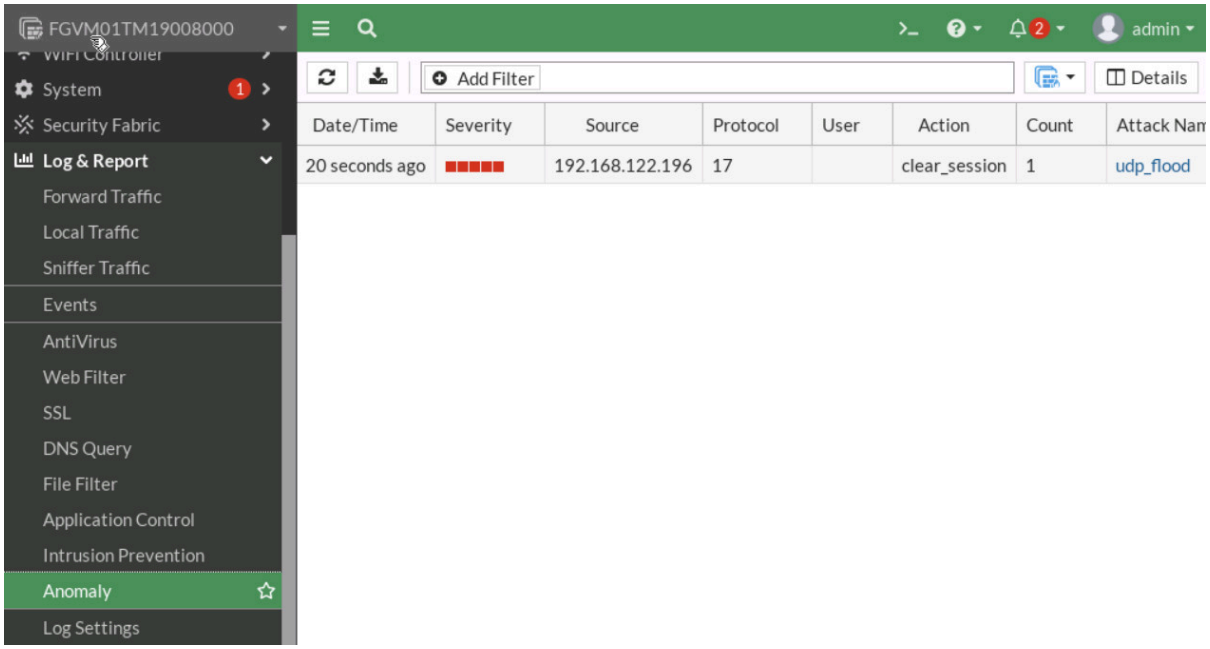


Figure 7.6: View anomaly report

Go to **Dashboard** > **Security** > **Top Threats** and verify your result.

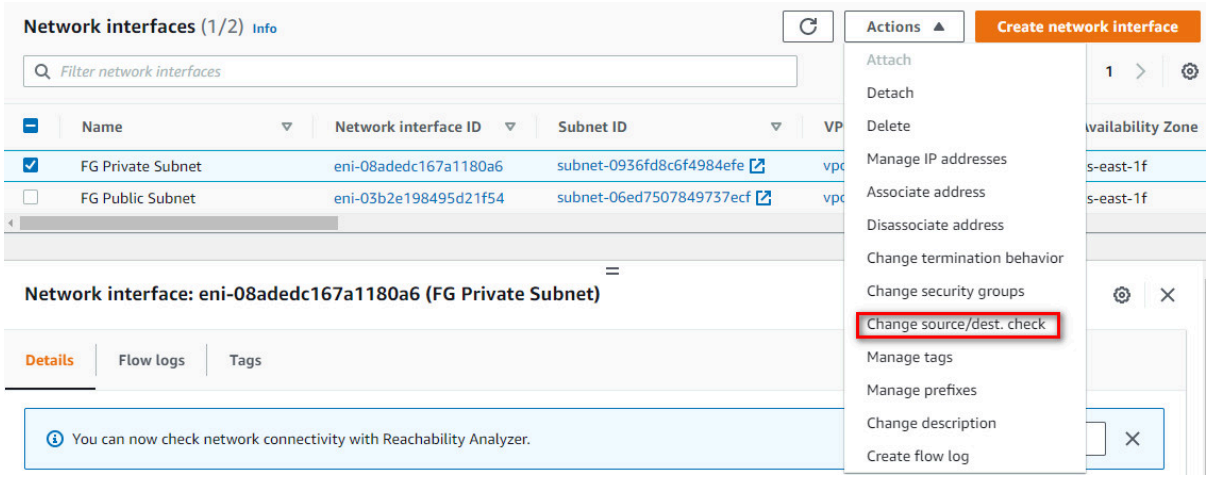


Figure 7.7: Verify result

5. Go to FortiGate CLI and configure DOS Policy for ICMP_flood as follows:

```
FGVM01TM19008000 # config firewall DoS-policy
FGVM01TM19008000 (DoS-policy) # edit 2
FGVM01TM19008000 (2) # set interface “port1”
FGVM01TM19008000 (2) # set srcaddr “all”
FGVM01TM19008000 (2) # set dstaddr “all”
FGVM01TM19008000 (2) # set service “ALL”
```

```
FGVM01TM19008000 (2) # config anomaly
FGVM01TM19008000 (anomaly) # edit “icmp_flood”
FGVM01TM19008000 (icmp_flood) # set status enable
FGVM01TM19008000 (icmp_flood) # set log enable
FGVM01TM19008000 (icmp_flood) # set quarantine attacker
FGVM01TM19008000 (icmp_flood) # set quarantine-expiry 2m
FGVM01TM19008000 (icmp_flood) # set quarantine-log disable
FGVM01TM19008000 (icmp_flood) # set threshold 10
FGVM01TM19008000 (icmp_flood) # next
FGVM01TM19008000 (anomaly) # end
FGVM01TM19008000 (2) # end
```

6. Go to Kali and run this command. First, 10 packets were allowed, and the 11th packet triggered the following block.root@ubuntu:~# ping **-c** 2000 **-i** 0.01 ***Port1-IP-Address***.

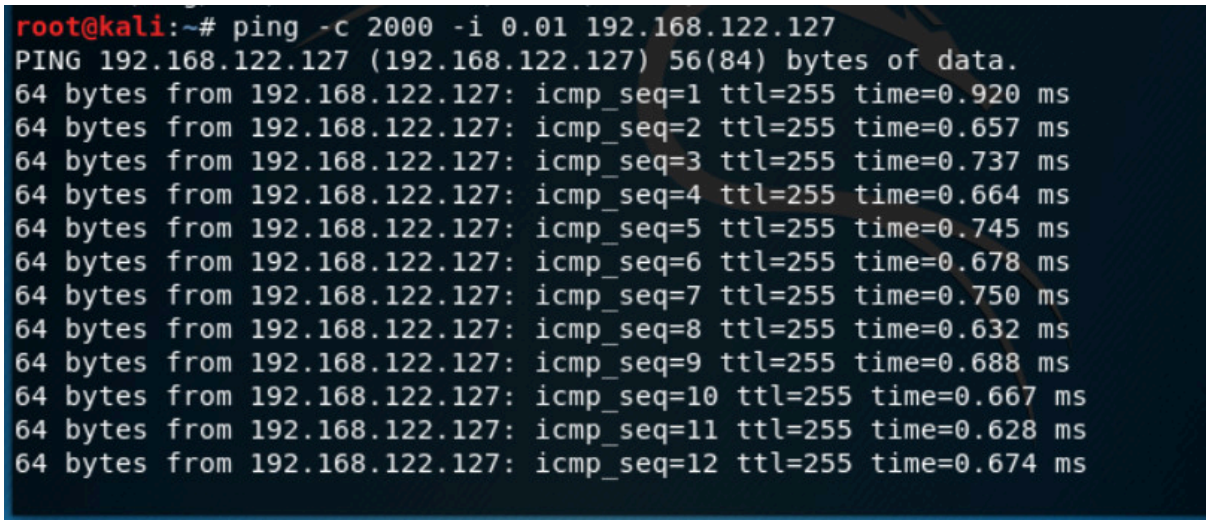


Figure 7.8: Verify DOS prevention

7.2 Security Profile

Learning Objectives

- Configure a Security Profile

Scenario: In this lab, we are going to become familiar with different types of Security Profile such as AntiVirus, File Filter, IPS and DNS Filter. WebTerm2 acts as a local computer and we set a Security Profile on traffic passing from Port2 to Port1.

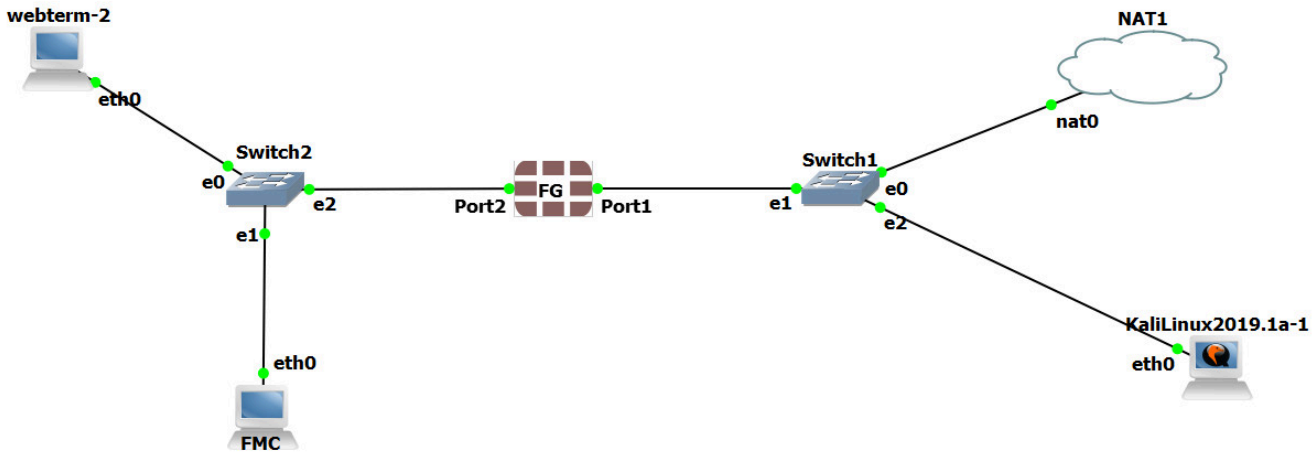


Figure 7.9: Main scenario

1. We will continue the previous scenario and set up a DHCP server on port2.

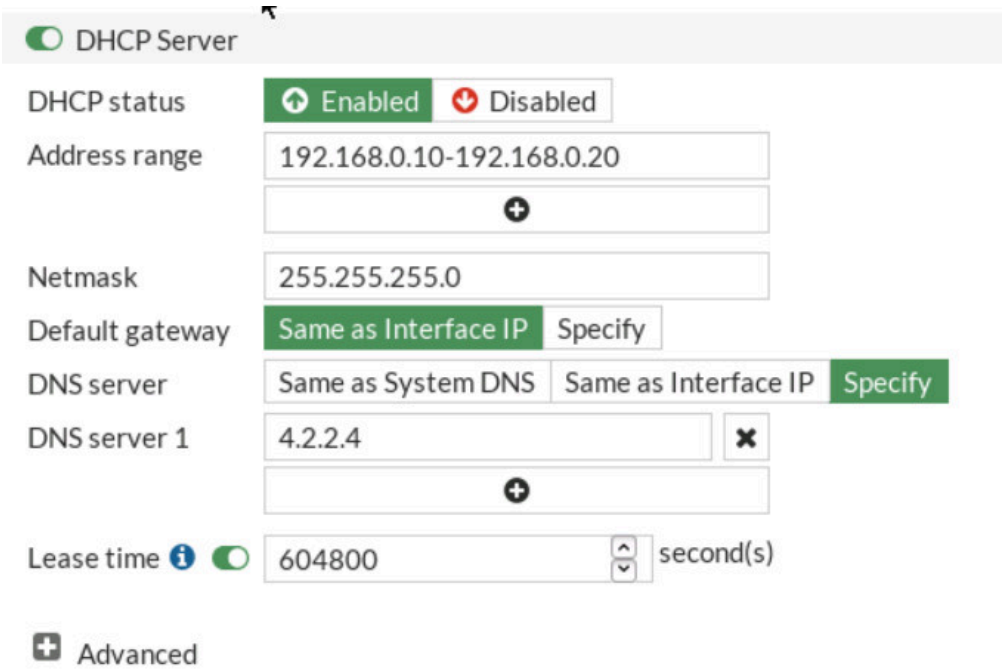


Figure 7.10: Enable DHCP Server on port2

2. Go to **security profile** > **Anti-Virus**, create a new profile:
    - Name: **myantivirus**
    - Scan Mode: **full**
    - Inspection Protocol: **HTTP, SMTP, IMAP, POP3, FTP**

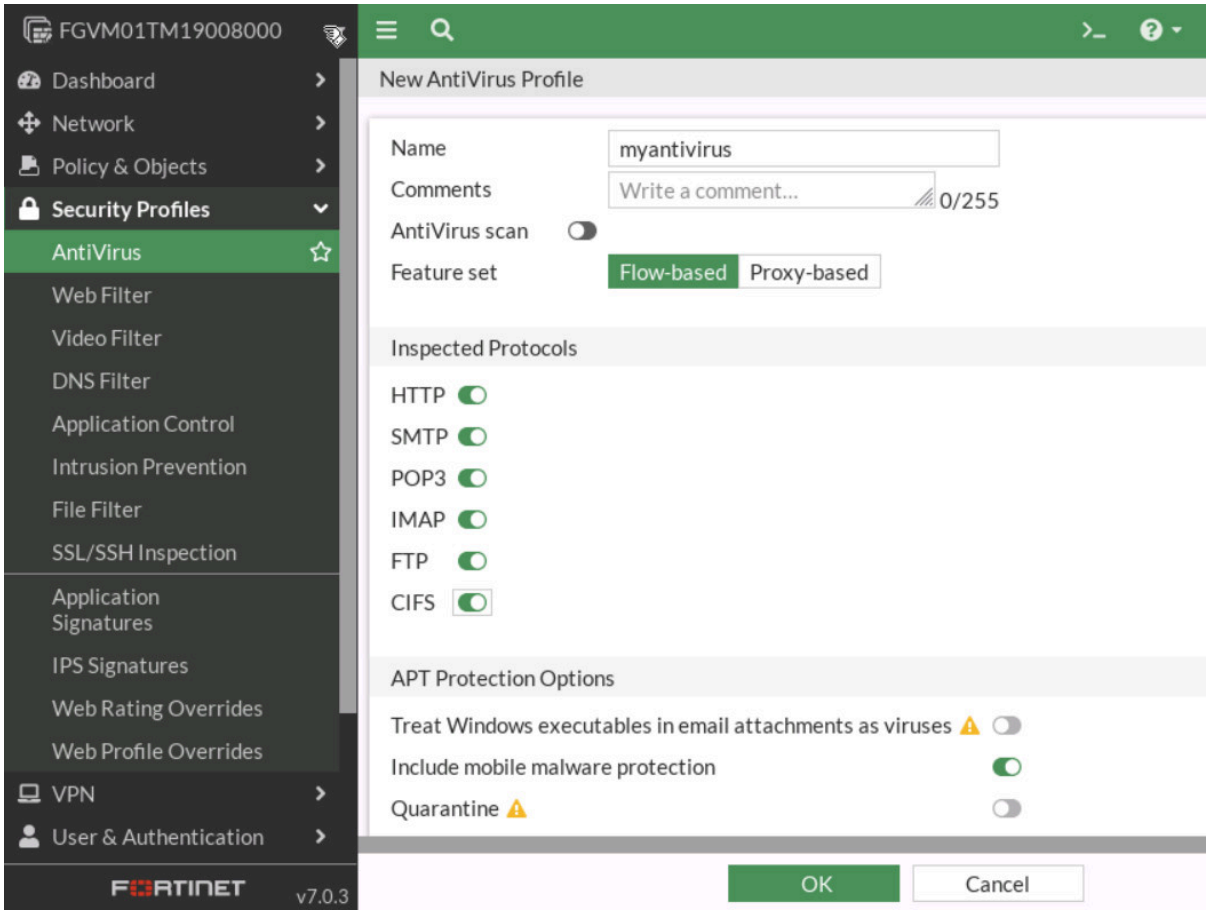


Figure 7.11: AntiVirus Profile

3. Create a Firewall policy:
    - Name: **Port2-to-Port1**
    - Incoming Interface: **Port2**
    - Outgoing interface: **port1**
    - Source, Destination, Service: **all**
    - Security Profile: **myantivirus**

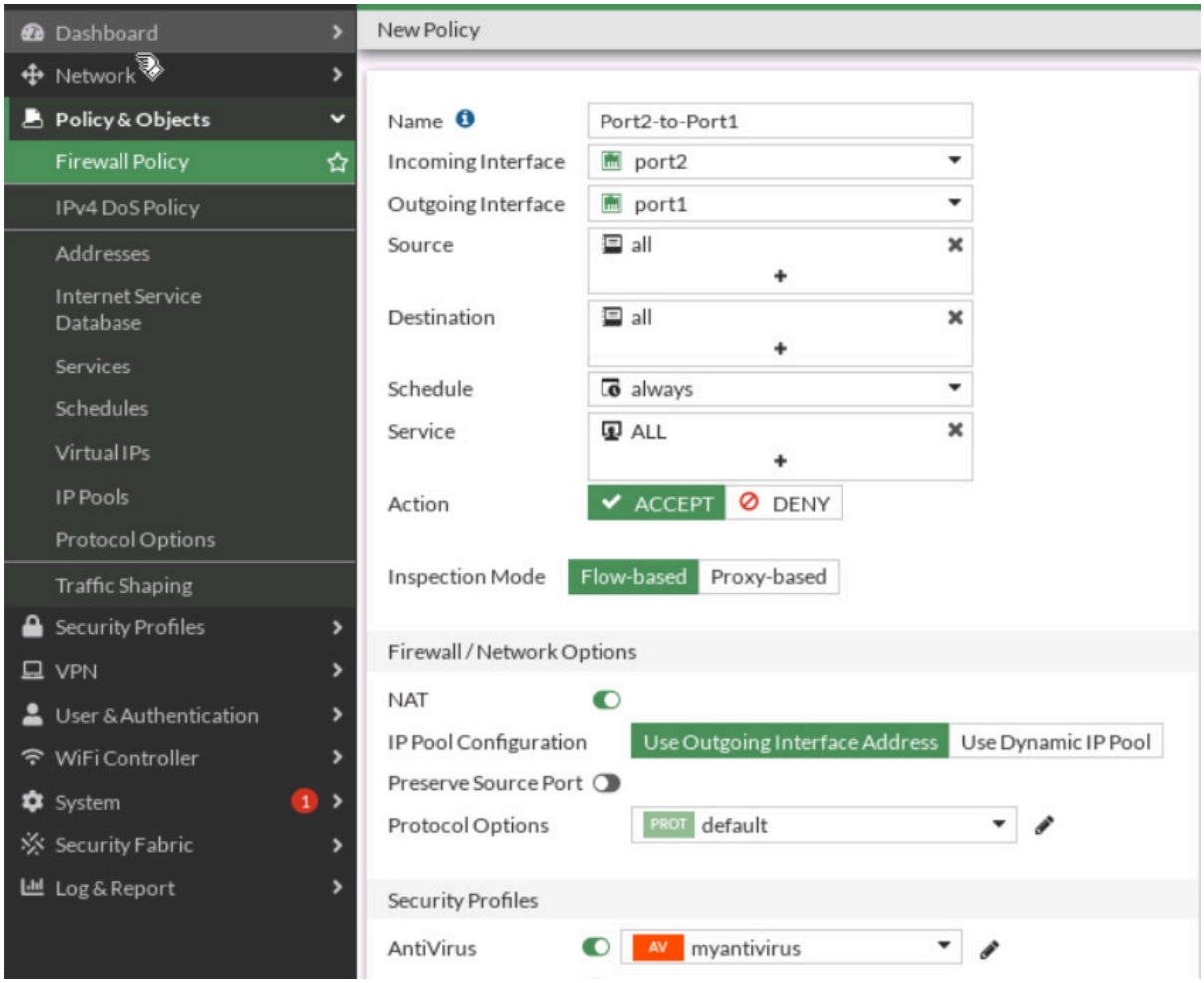


Figure 7.12: Create a Firewall Policy and assign AntiVirus Profile

4. Go to **Security Profile** > **File Filter**, Create a new profile:
    - Name: **MyFileFilter**
    - Create a New Filter rule
        - Name: **Block-PDF-ZIP**
        - Protocols: **HTTP-FTP**
        - File Type: **PDF-ZIP**
        - Action: **Block**
        - Direction: **any**

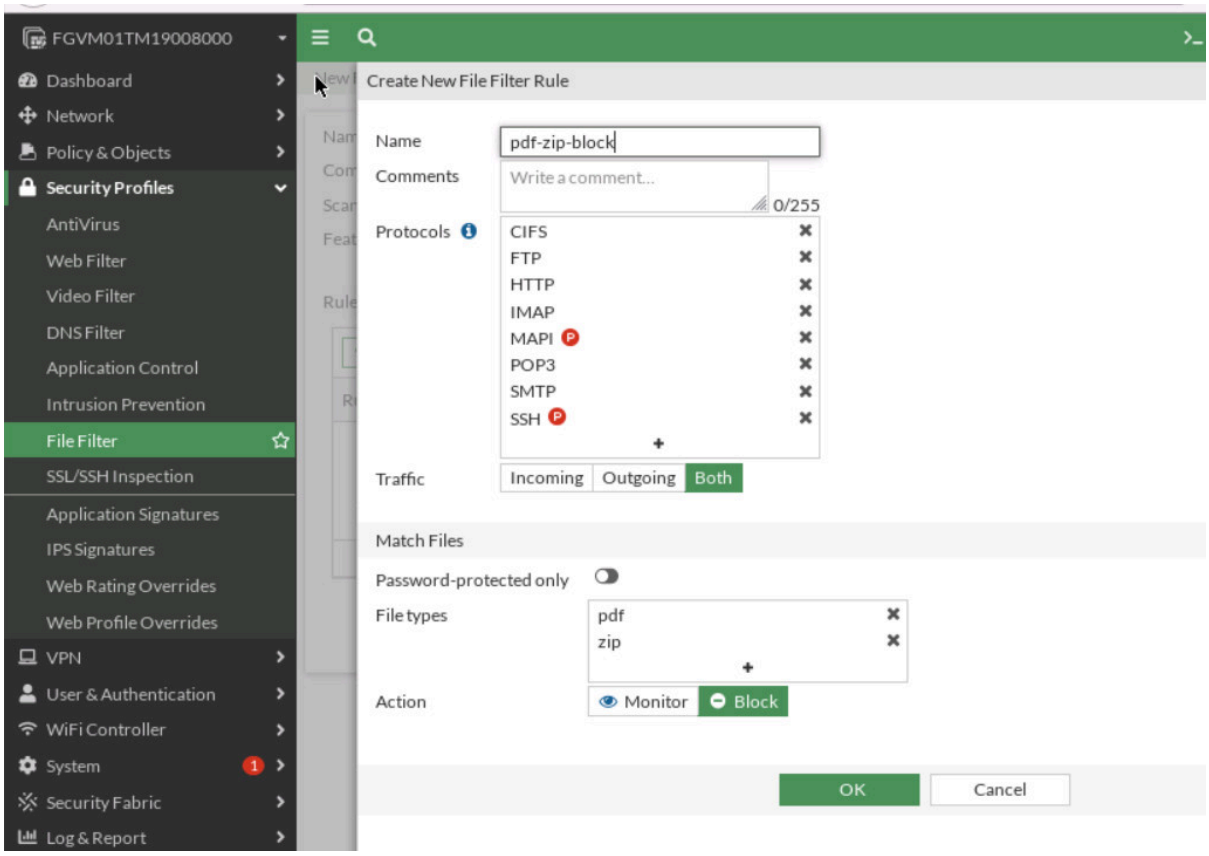


Figure 7.13: File Filter profile

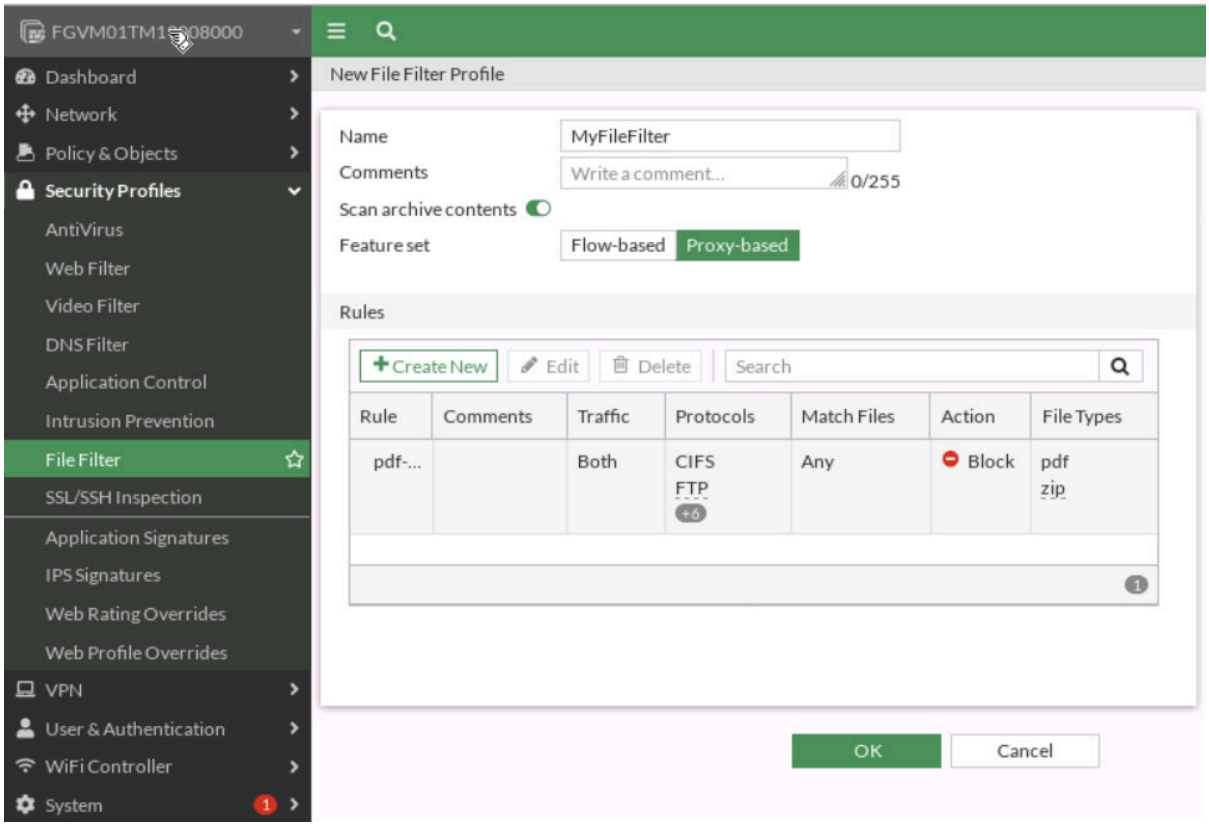


Figure 7.14: Blocking Pdf-Zip

- Set the firewall Policy to **Proxy mode.**
- Go to **Policy & Objects** > **Firewall Policy** and assign MyFileFilter to the "Port2-to-Port1" policy.

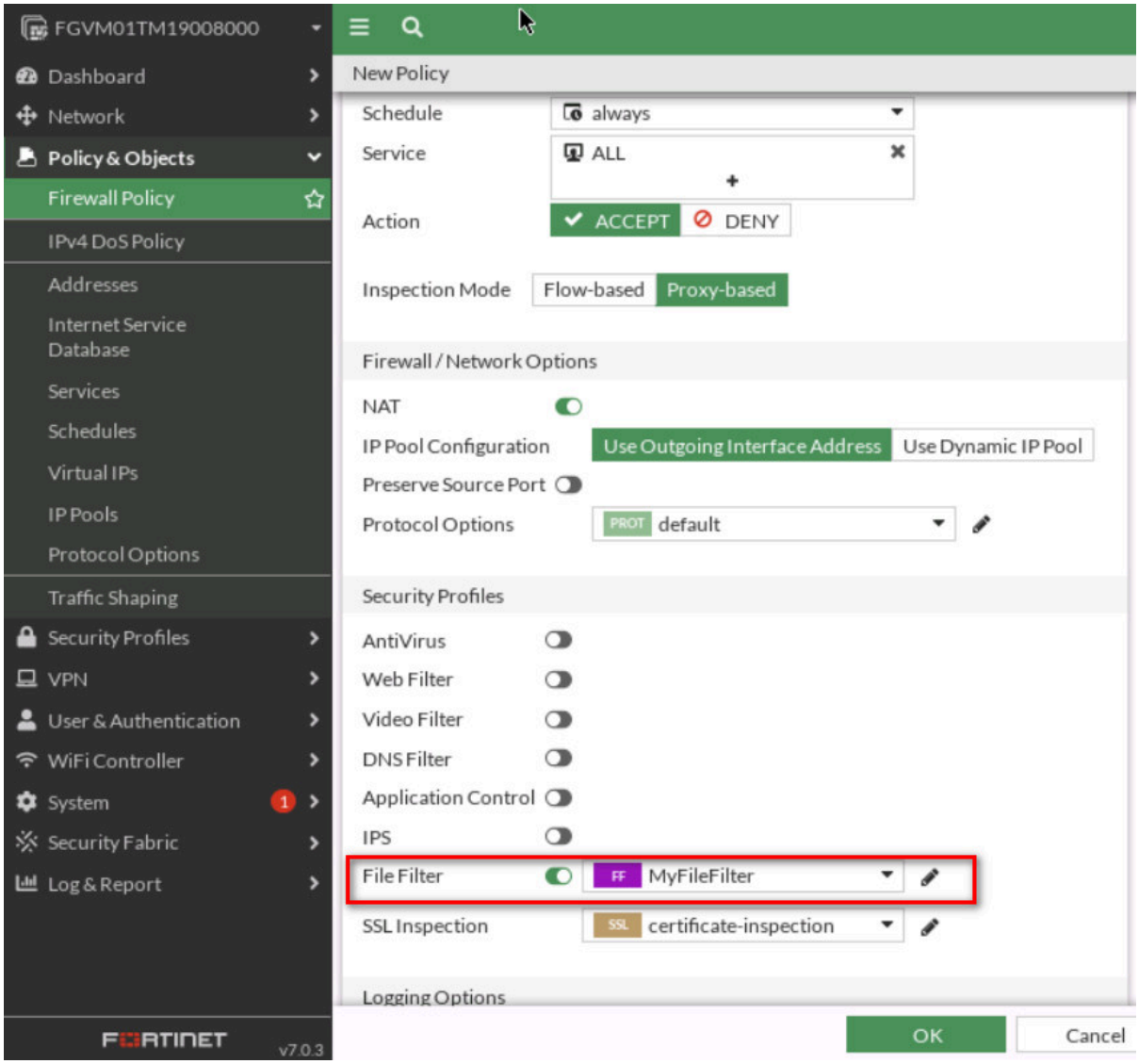


Figure 7.15: Assign File Filter profile to Firewall Policy

5. Go to http://talebi.ca/wp-content/uploads/2021/11/prtgdesktop.pdf and verify your result.

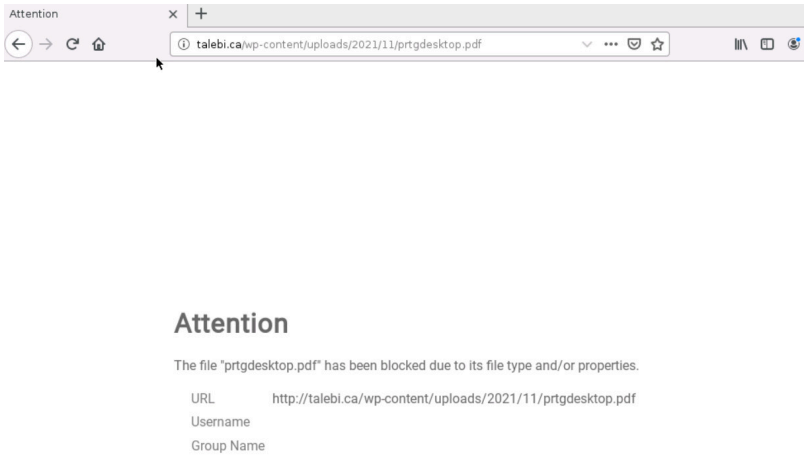


Figure 7.16: Verify configuration

6. Go to **Security Profile** > **Intrusion Prevention**, create a new profile:

    - Name: **MyIPS**
    - Add Signature: **AAEH Botnet, Acuntix Web Vulnerability Scanner, Adobe Flash Player CSRF**

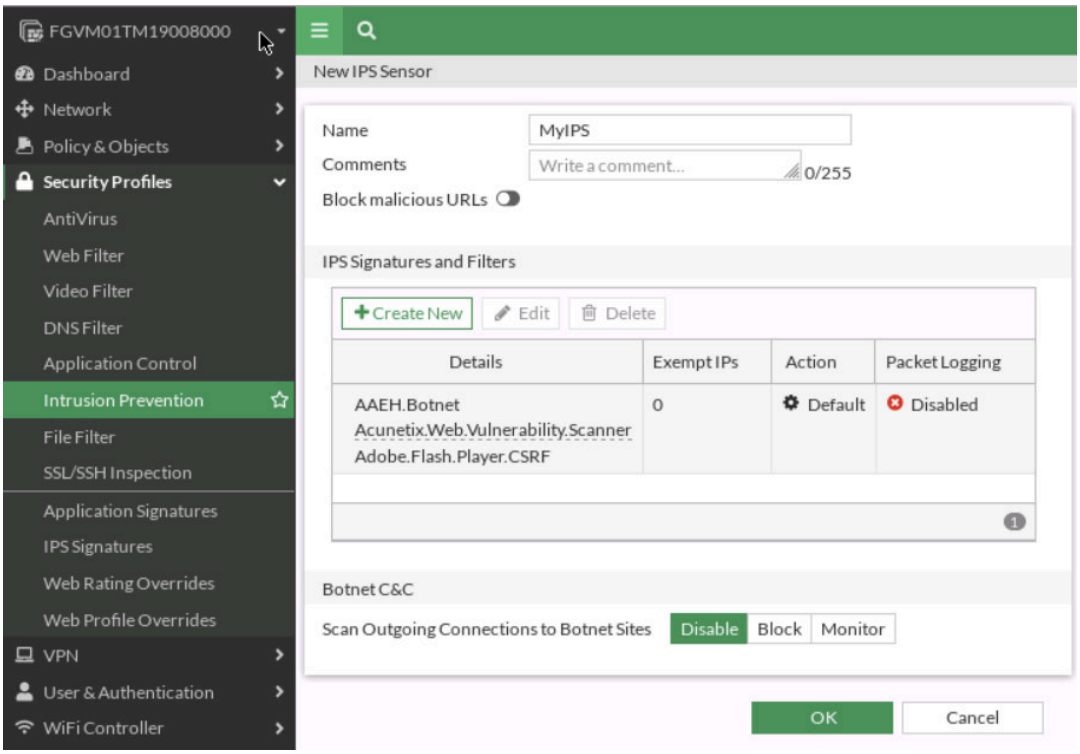


Figure 7.17: Intrusion Prevention Profile

7. Go to **Policy & Objects** > **Firewall Policy** and assign MyIPS to the “Port2-to-Port1” policy.

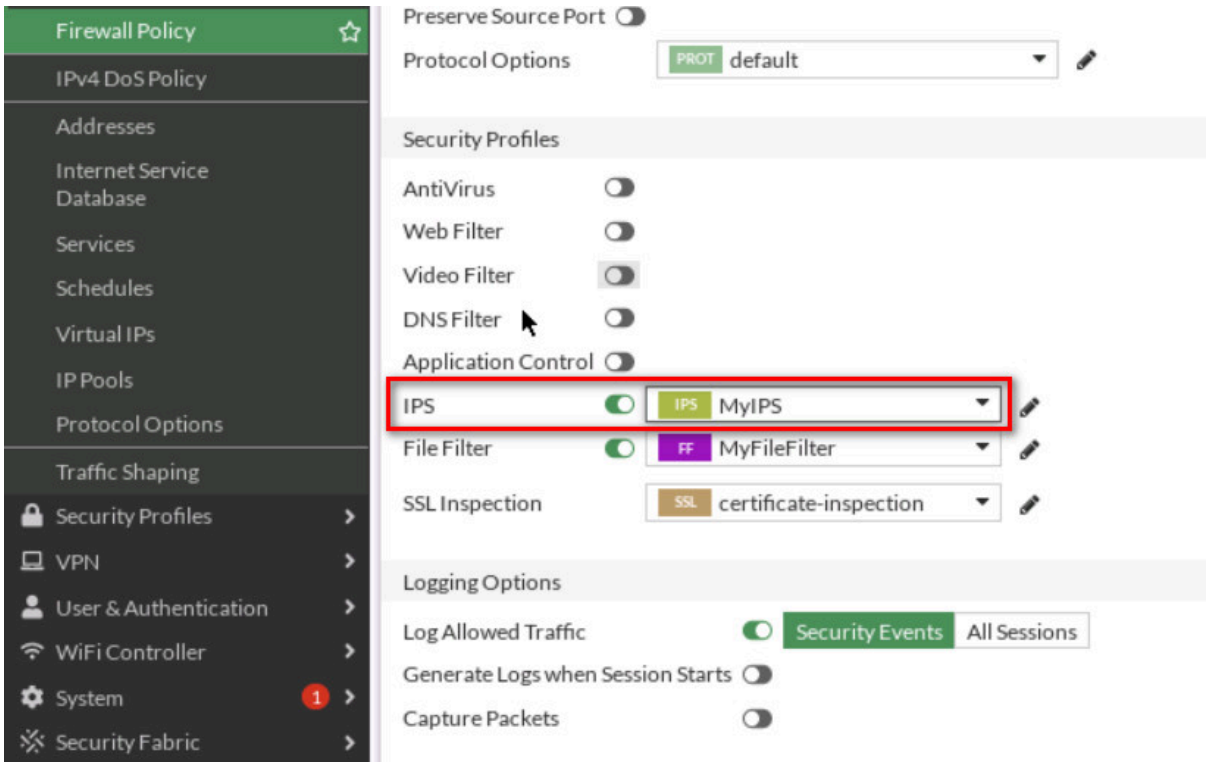


Figure 7.18: Assign IPS profile to Firewall Policy

8. Go to **Security Profile** > **DNS Filter**, create a new profile:
    - Name: **MyDNS**
    - FortiGate Category Based Filter:
        - Bandwidth Consuming: **Peer-to-Peer File Sharing**: Block, **Internet Radio and TV**: Block

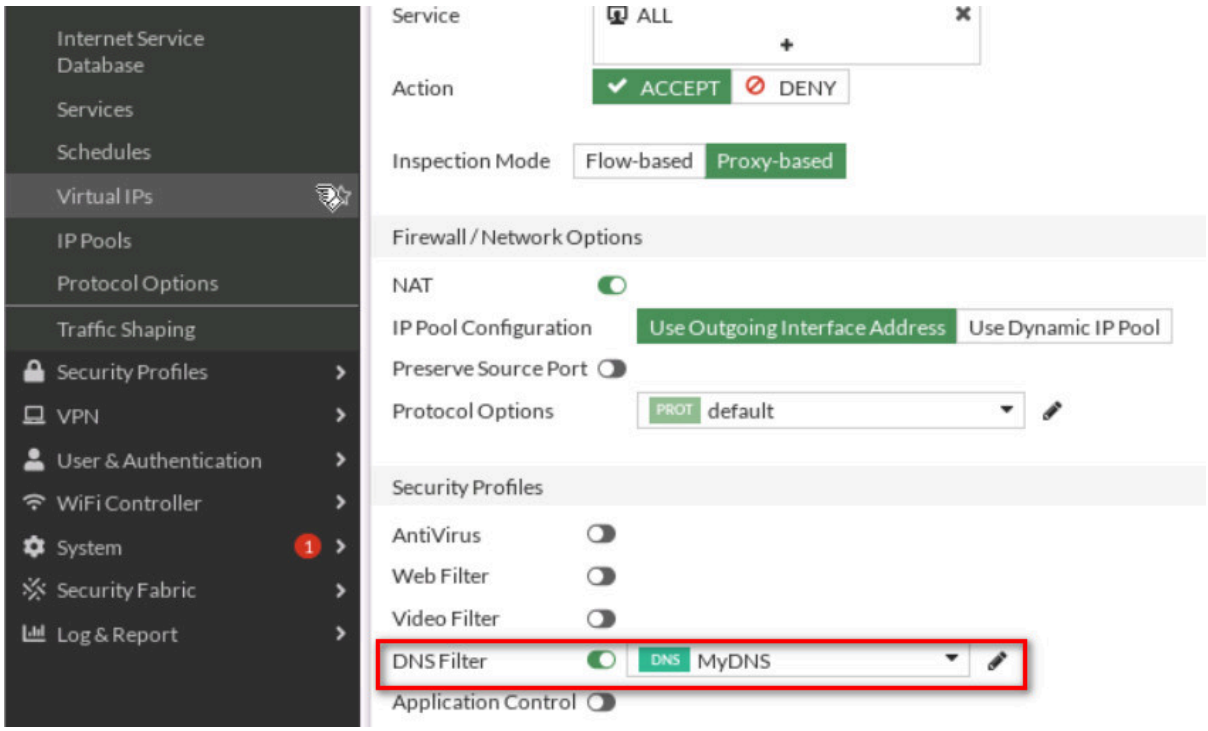


Figure 7.19: Assign DNS Filter Profile to Firewall Policy

You can verify your configuration by visiting **http://talebi.ca**.

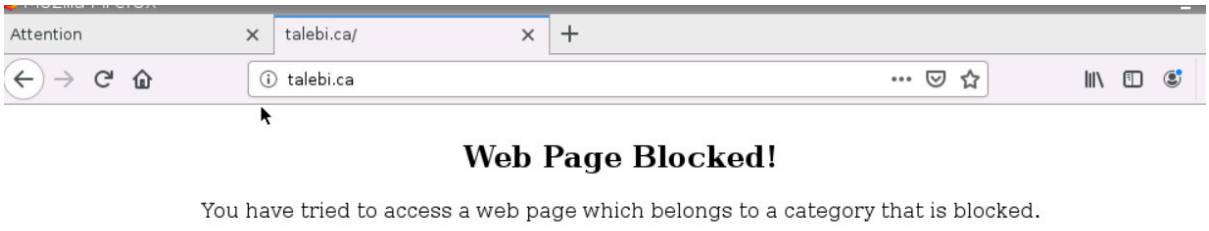


Figure 7.20: Verify configuration

Verify your **Log & Report** > **DNS Query**.

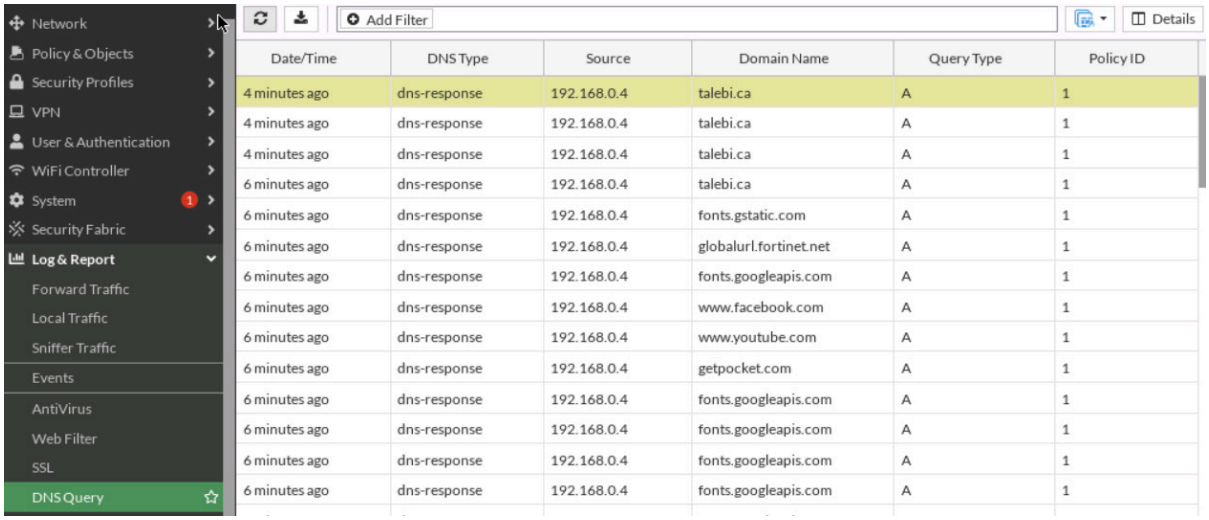


Figure 7.21: Verify

7.3 VLAN and Security Profile

Learning Objectives

- Configure VLANs in FortiGate firewall
- Configure a Security Policy for VLANs

Scenario: In this lab, we are going to learn how to set VLAN on Port2 of the firewall. WebTerm1 is belong to Vlan10 and WebTerm2 is belong to Vlan20. We will set different policies on each VLAN and try to verify configuration.

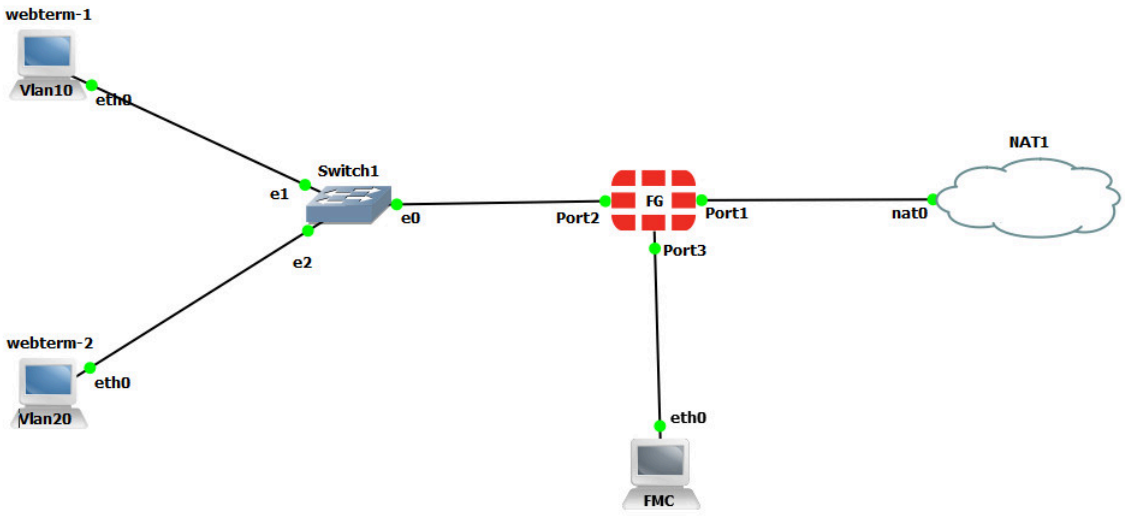


Figure 7.22: Main scenario

Table 7.2: Devices configuration

Device	IP address	Access
FortiGate	Port 1: DHCP Client Port 2: Vlan 10: 192.168.10.1/24 Vlan 20: 192.168.20.1/24	ICMP-HTTP-HTTPS
WebTerm1	DHCP Client	–
WebTerm2	DHCP Client	–

1. Configure switches. Right-click on the **Switch** > **Configure**, configure eth0, eth1, and eth2 as Table 7.3:

Table 7.3: Switch configuration

Port	VLAN	Type
0	1	Dot1q
1	10	Access
2	20	Access

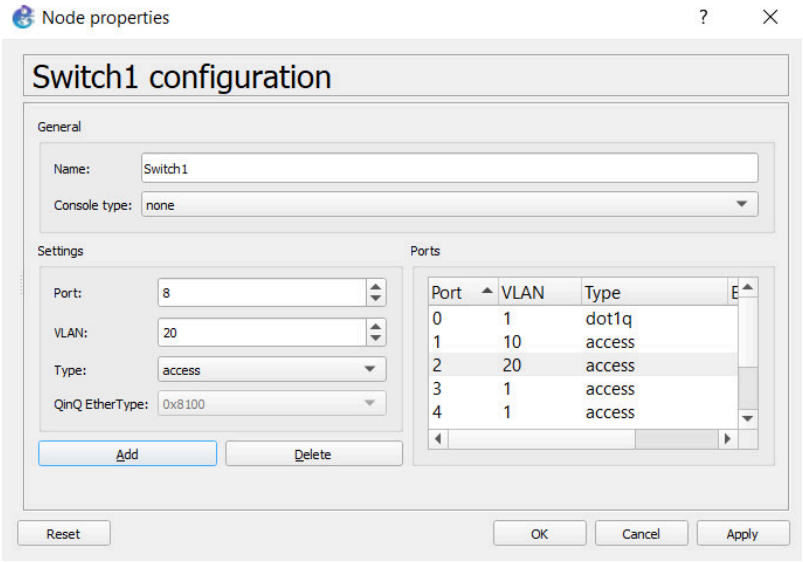


Figure 7.23: Switch configuration

2. You should create two sub-interfaces on port2 of the firewall.

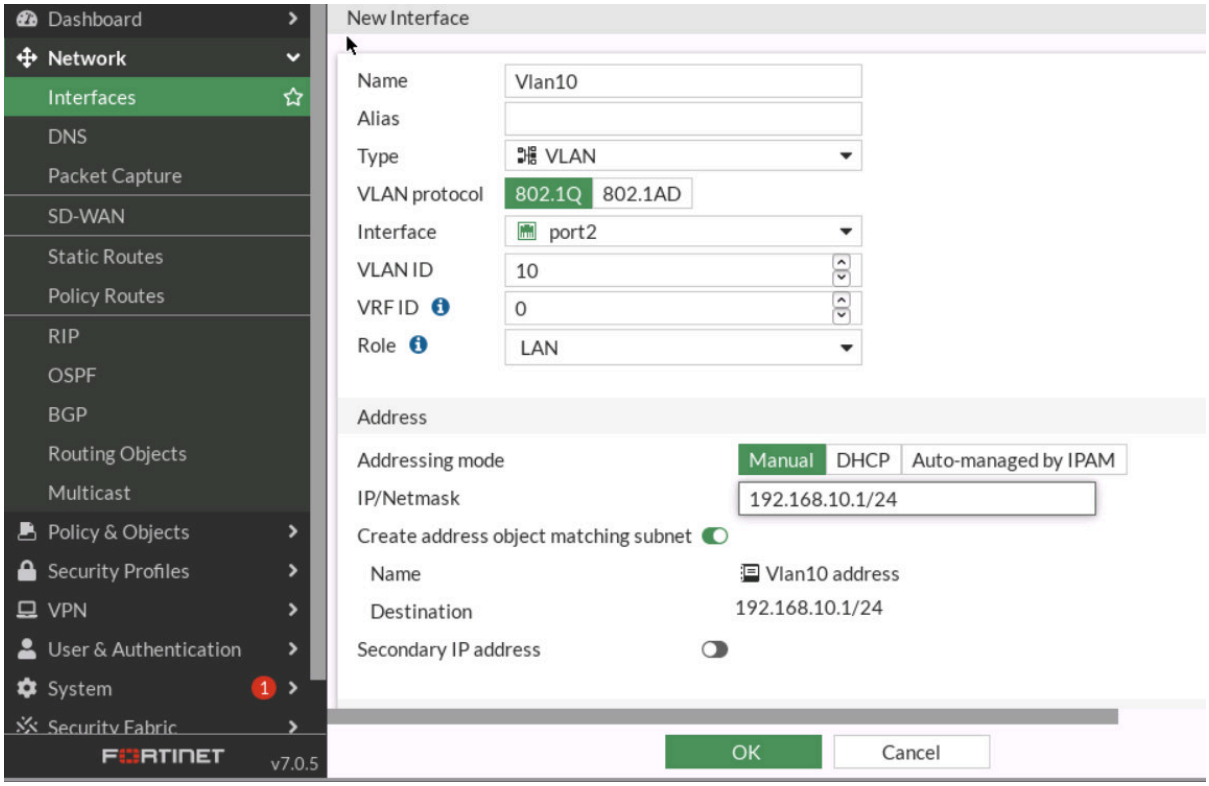


Figure 7.24: Vlan10 Configuration

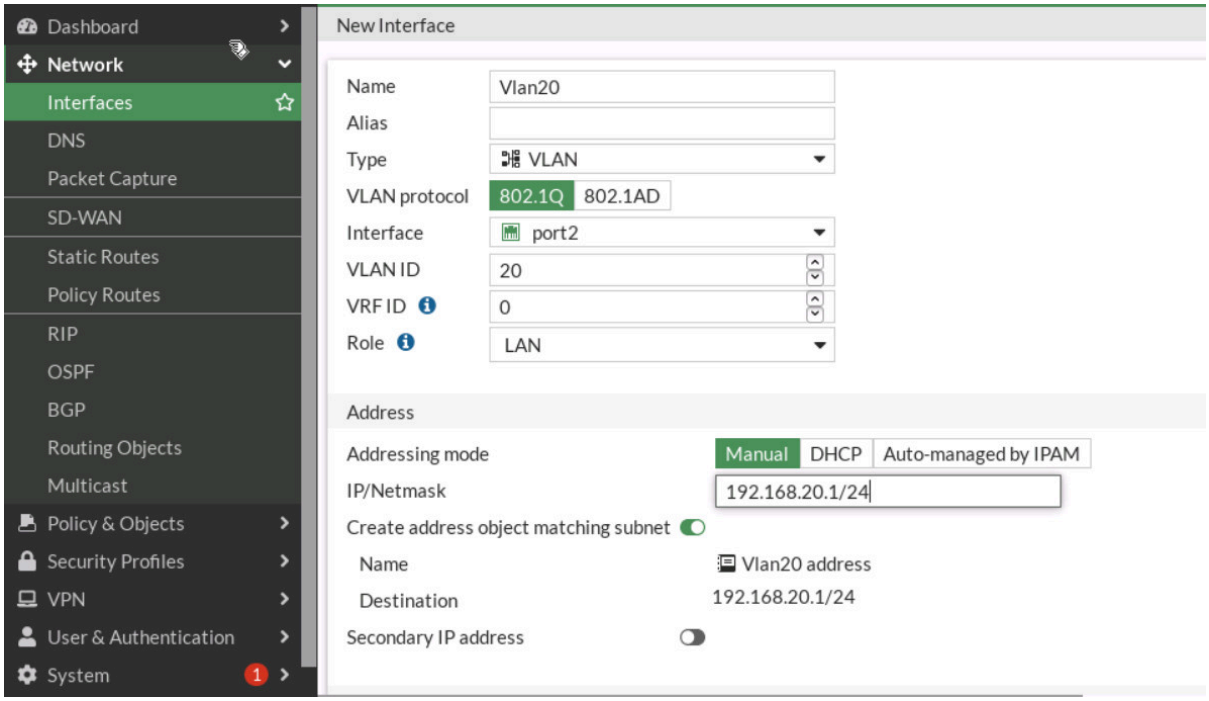


Figure 7.25: Vlan20 Configuration

	port2	Physical Interface		0.0.0.0/0.0.0.0
	vlan10	VLAN		192.168.10.1/255.255.255.0
	vlan20	VLAN		192.168.20.1/255.255.255.0

Figure 7.26: Vlan10 and Vlan20 IP addresses

3. Block YouTube and Social Media on Vlan 20:
    1. Create an application profile as Figure 7.27.

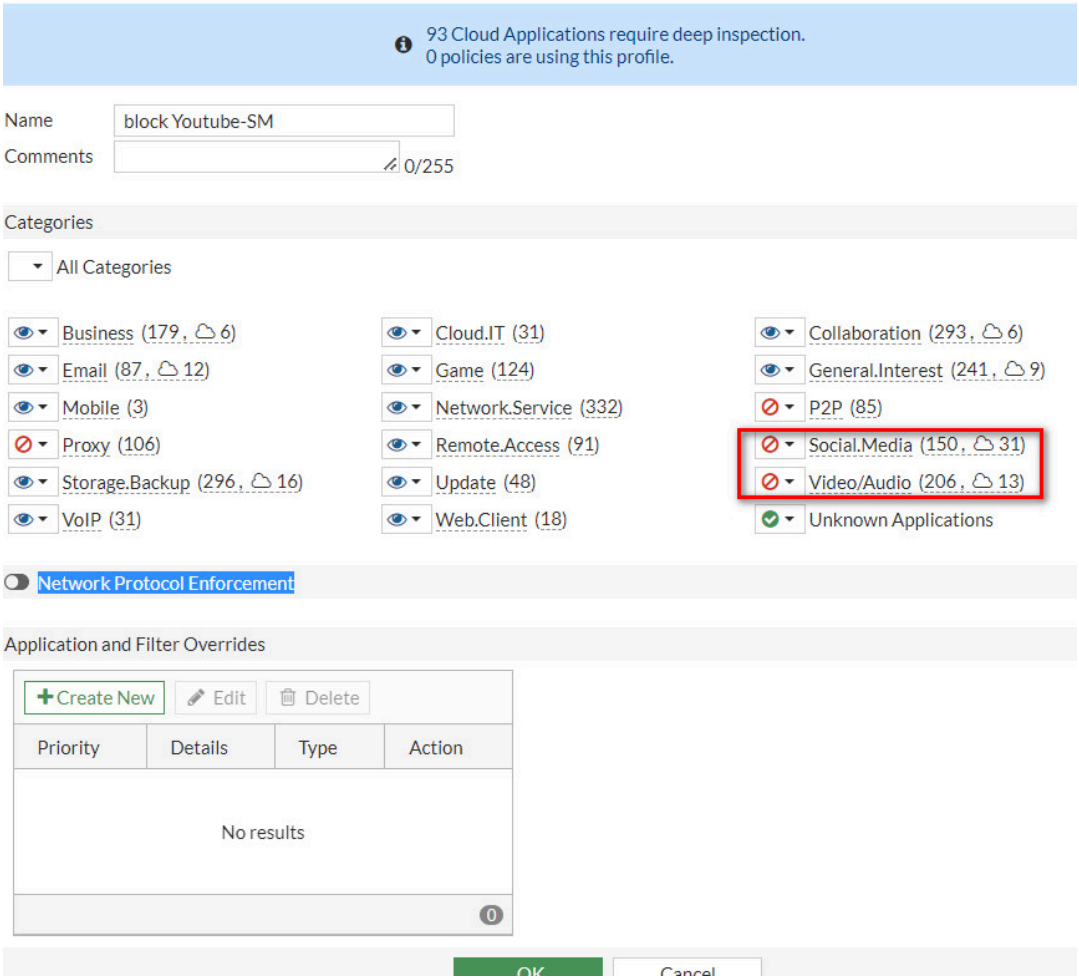


Figure 7.27: Block Social.Media and Video/Audio

    2. Configure Firewall Policy from Vlan 20 to Port1 and assign application control to the Firewall Policy.

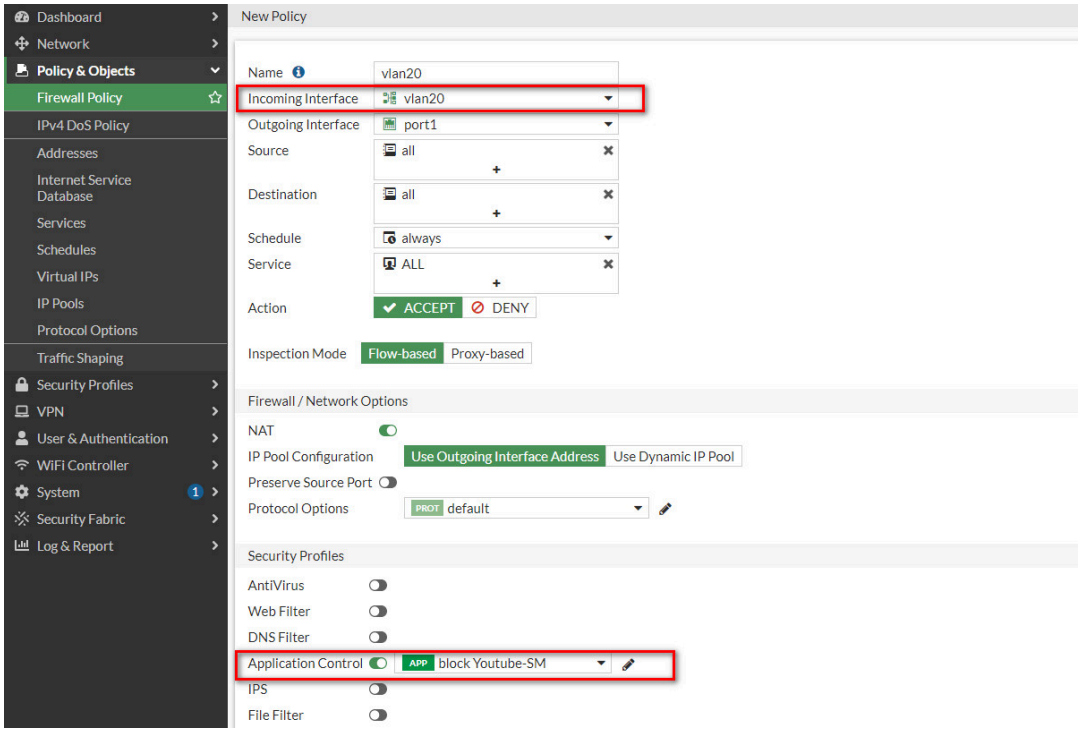


Figure 7.28: Create vlan20 Firewall Policy and assign Application Control Profile

3. Verify your configuration by visiting Twitter.com or YouTube.com.

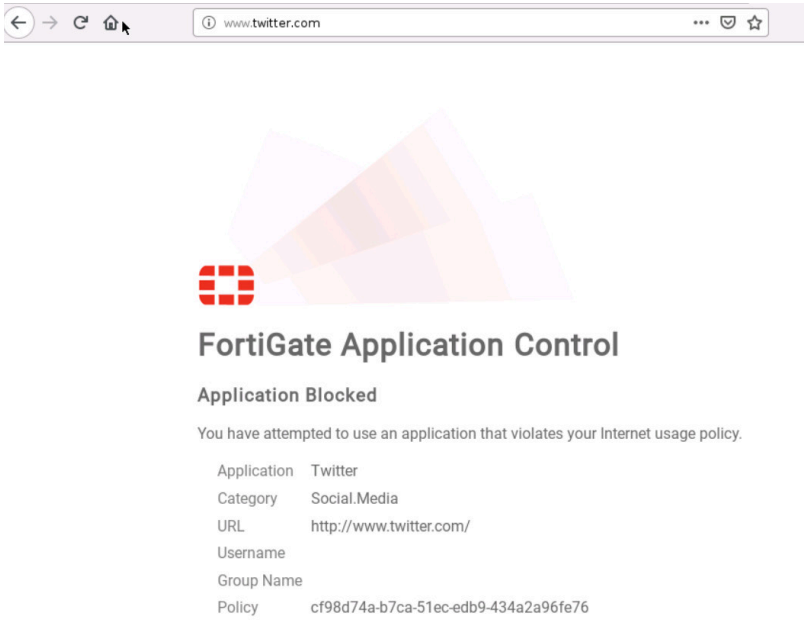


Figure 7.29: Verify configuration

4. Filter .zip, .pdf files on Vlan 10:
    1. Create a File filtezr profile. File filter only works on the unencrypted protocol. Set traffic for both and finally set the action to block.

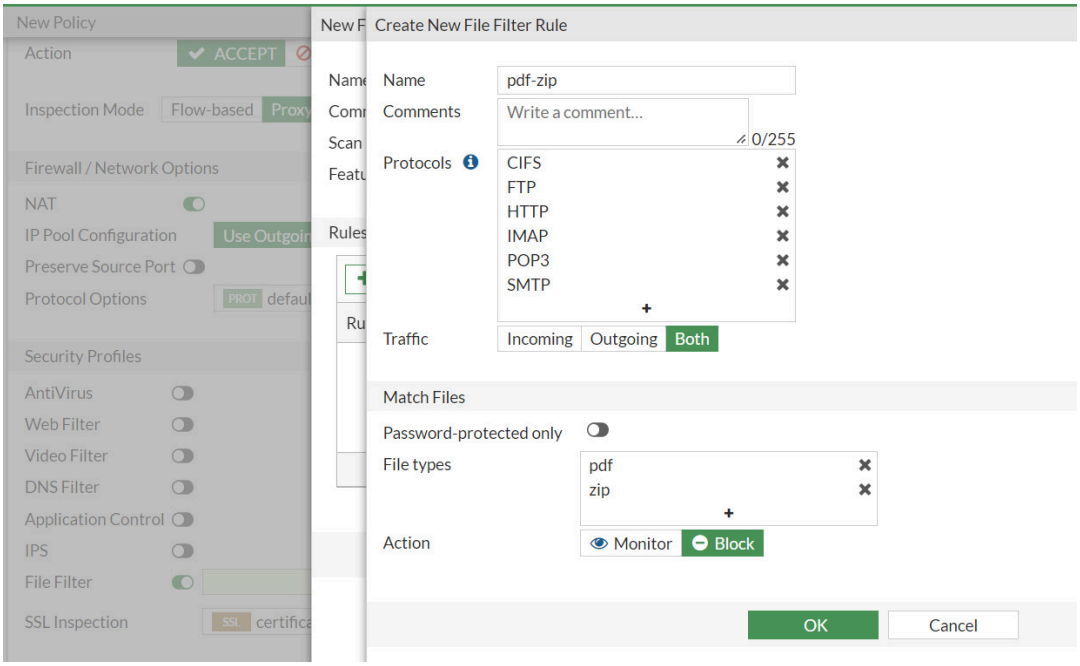


Figure 7.30: Block PDF and ZIP files

2. Make sure to set the feature set as flow-based.

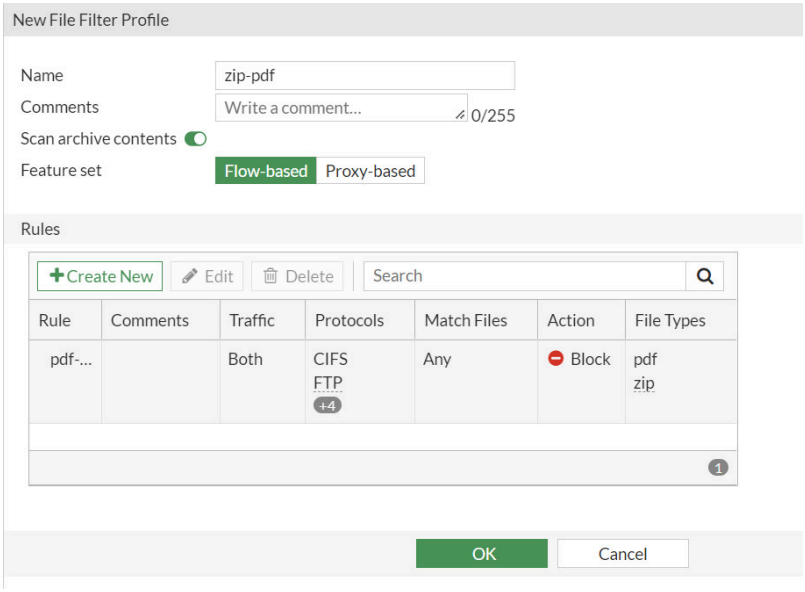


Figure 7.31: Block profile

3. Create a Firewall Policy in the firewall from vlan10 to port1, inspection mode should be Proxy-based, and assign the profile you have created to File Filter.

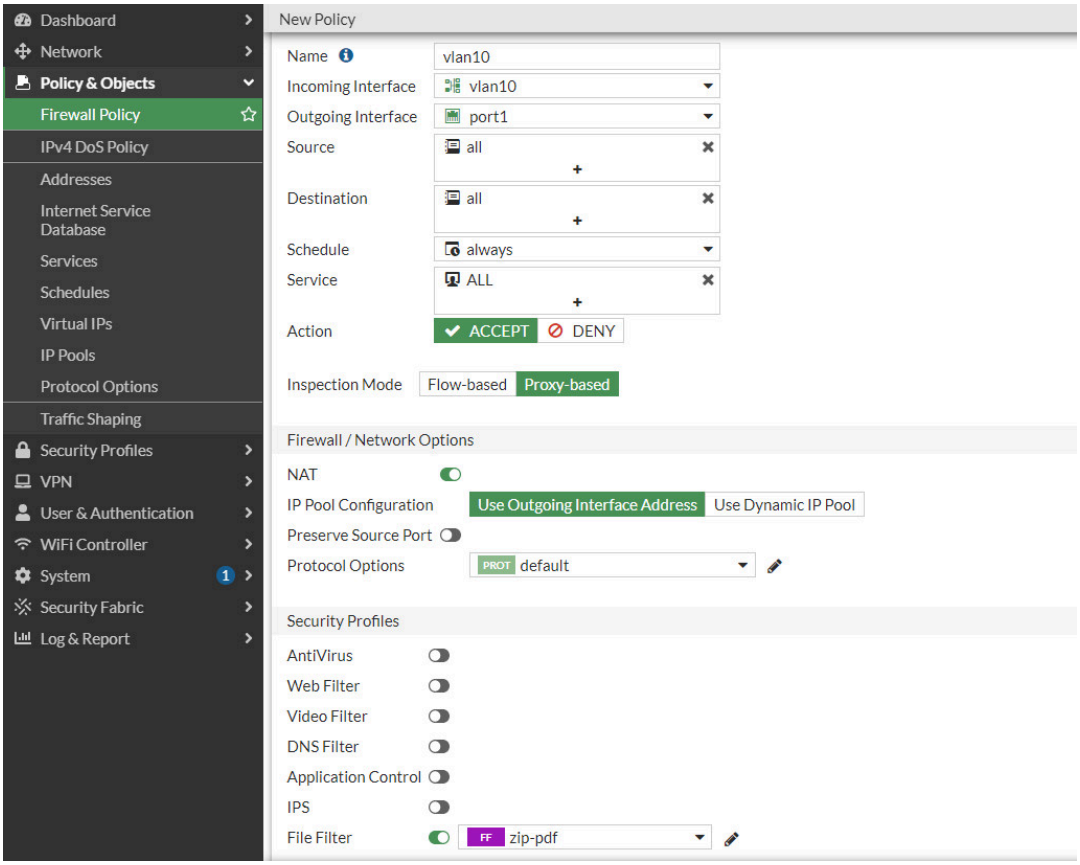


Figure 7.32: Create vlan10 Firewall Policy and assign File Filter Profile

4. Verify your configuration by downloading a zip or pdf file from HTTP websites.

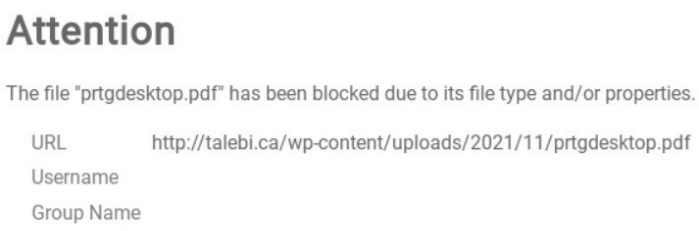


Figure 7.33: Verify configuration

Chapter 8. VDOM

8.1 VDOM

Learning Objectives

- Create a VDOM
- Configure a security policy in VDOMs

Scenario: This example illustrates how to use VDOMs to host two FortiOS instances on a single FortiGate unit.

Virtual Domains (VDOMs) can be used to divide a single FortiGate unit into two or more virtual instances of FortiOS that function as independent FortiGate units. This example simulates an ISP that provides Company A and Company B with distinct internet services. Each company has its own VDOM, IP address, and internal network.

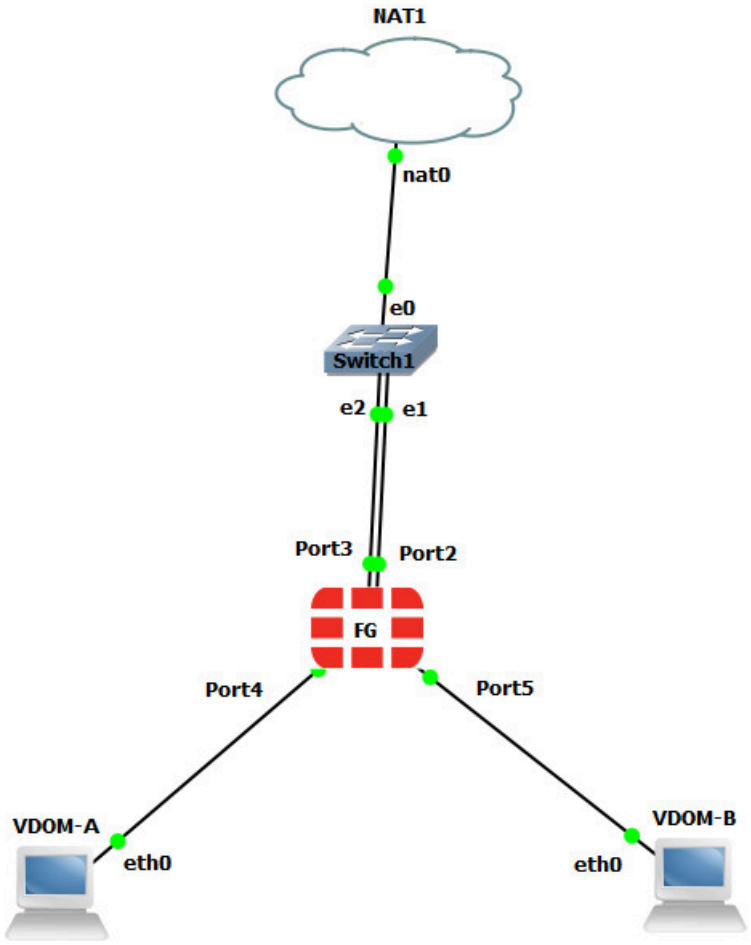


Figure 8.1: Main scenario

Enable VDOMs

Table 8.1: Devices configuration

Device	IP address	Access
WebTerm-VDOMA	DHCP Client	HTTPS
WebTerm-VDOMB	DHCP Client	HTTPS
FortiGate	Port 2: DCHP Client – VDOM B Port 3: DHCP Client – VDOM A Port 4: DHCP SERVER – VDOM A Port 5: DHCP SERVER – VDOM B	Port 2 – Management Access
Ethernet Switch	–	–
NAT	–	–

1. In order to enable Virtual Domains, the following CLI command is required:

```
config system global
set vdom-mode multi-vdom
end
```

2. Log out FortiGate and log in again. You should be able to see the Figure 8.2 result.

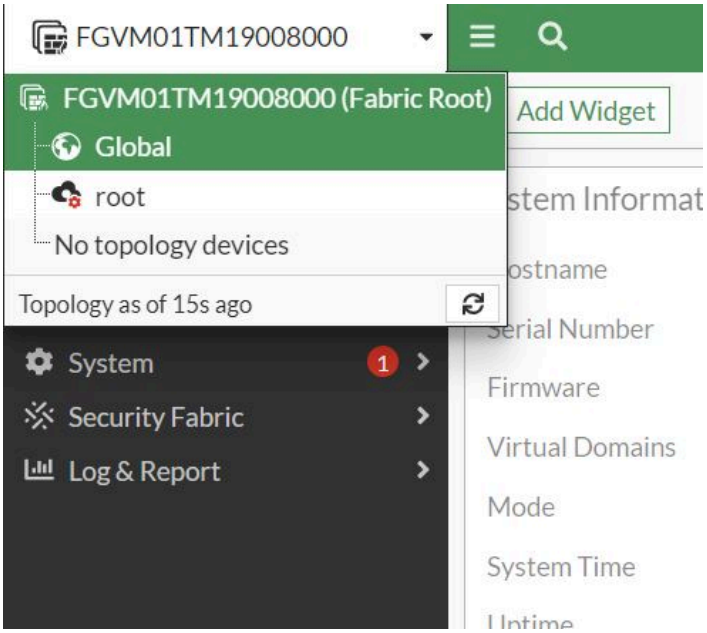


Figure 8.2: Default VDOMs

3. Go to **Global > System > VDOM**. Create two VDOMS, **VDOM-A** and **VDOM-B**. Leave both VDOMs as Enabled, with Operation Mode set to **NAT** and NGFW mode to **profile-based.**

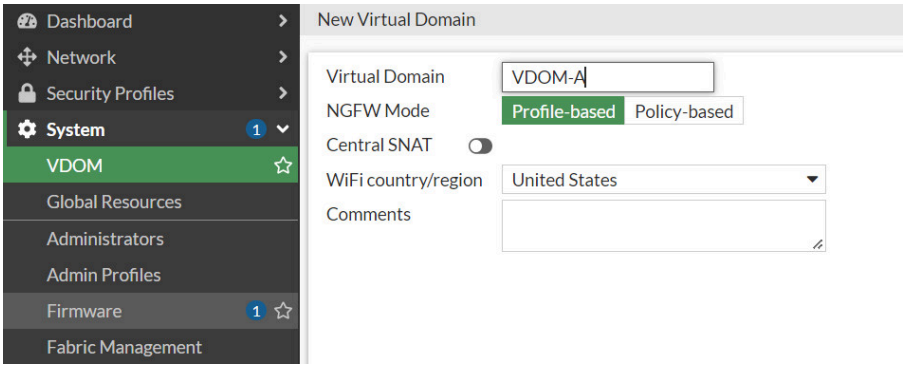


Figure 8.3: VDOM-A configuration

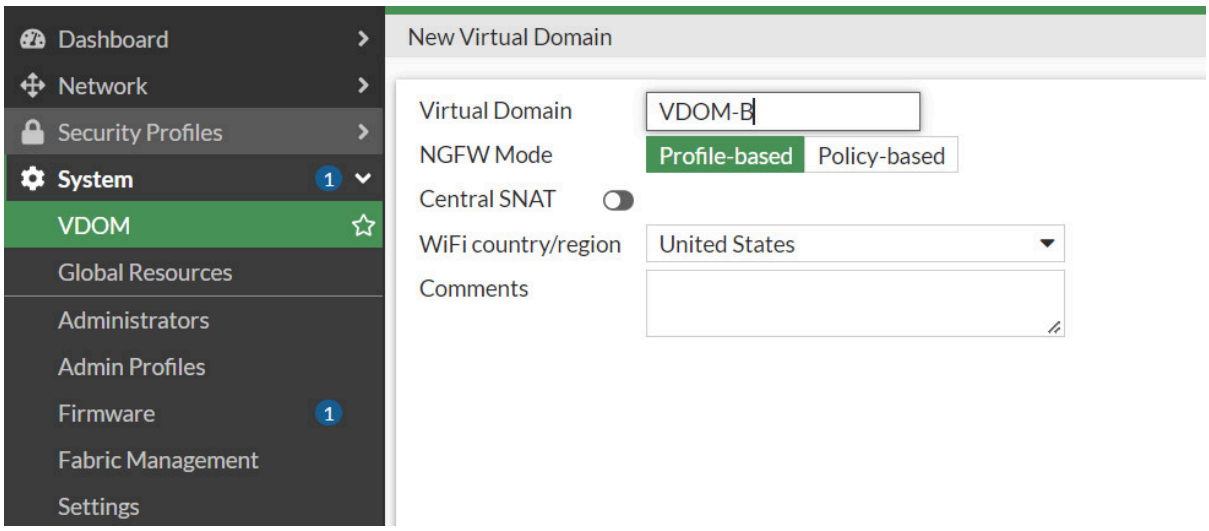


Figure 8.4: VDOM-B configuration

4. Go to **Global** > **Network** > **Interfaces**. Edit Port2 and add it to VDOM-B. Set Addressing Mode to **DHCP**.

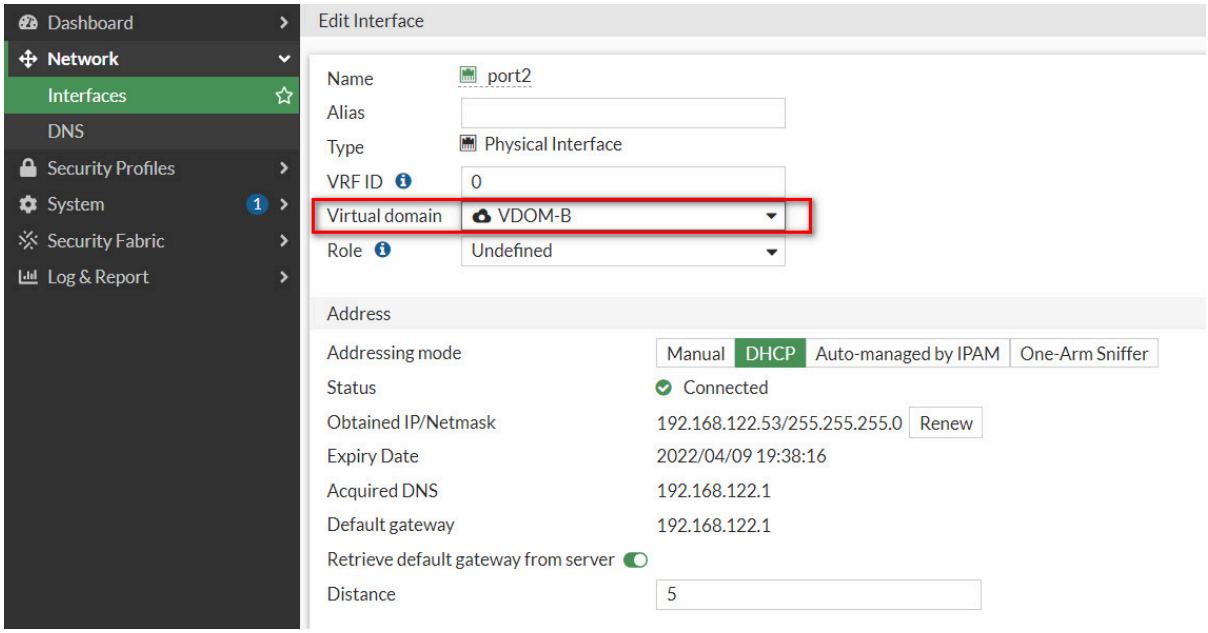


Figure 8.5: Port2 configuration

> If the port is under root and you can't modify it to VDOM-B, you should first delete the references related to the port.

5. Go to **Global** > **Network** > **Interfaces**. Edit Port4 and add it to VDOM-A. Set Addressing Mode to Manual and assign an IP/Network mask to the interface (192.168.91.1/ 255.255.255.0) and finally Enable DHCP Server.

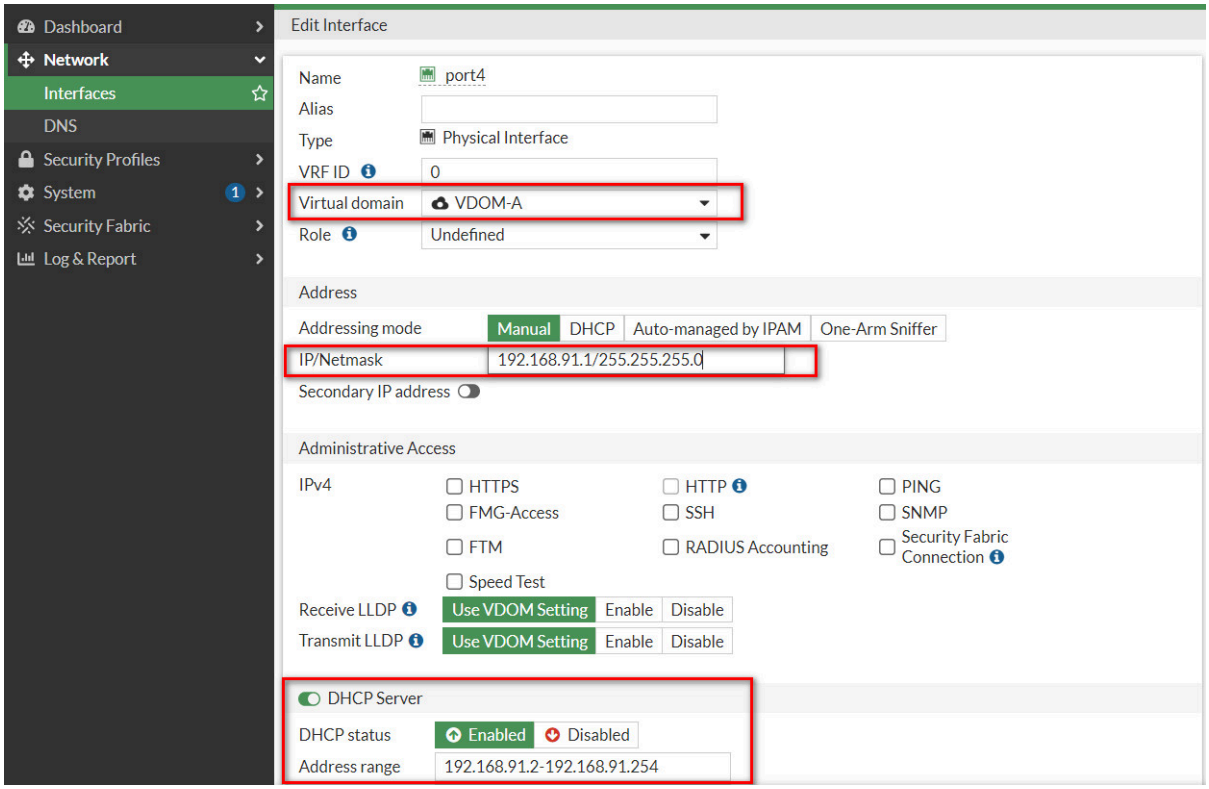


Figure 8.6: Port4 configuration

6. Go to **Global** > **Network** > **Interfaces**. Edit Port3 and add it to VDOM-A and set Addressing Mode to DHCP.

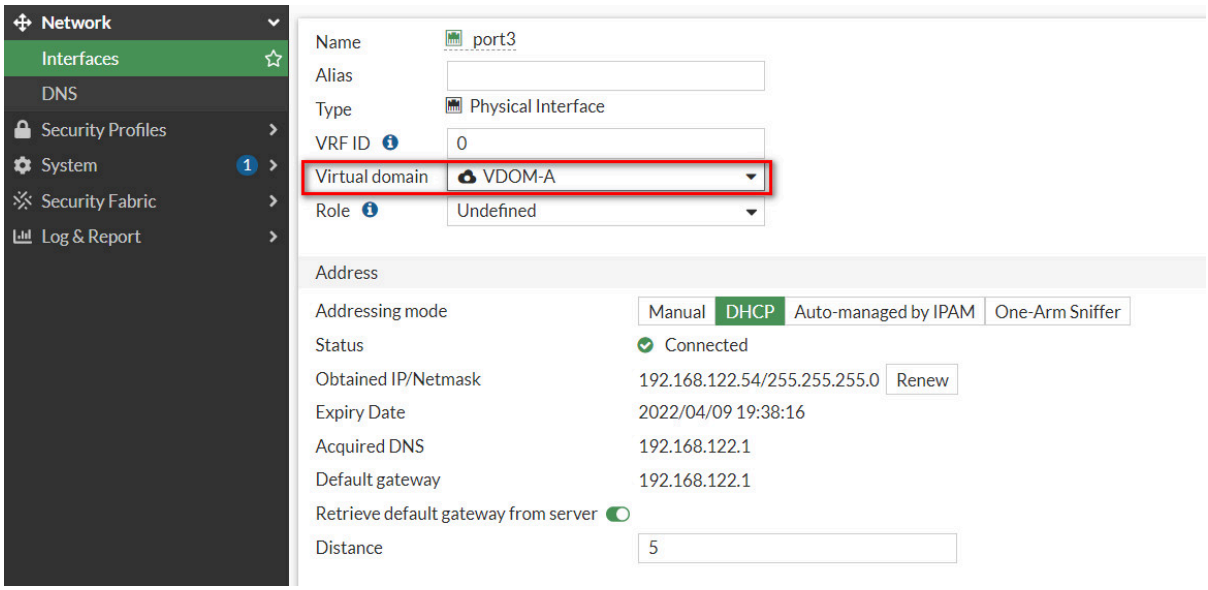


Figure 8.7: Port3 configuration

7. Go to **Global** > **Network** > **Interfaces**. Edit Port5 and add it to VDOM-B. Set Addressing Mode to Manual and assign an IP/Network Mask to the interface (192.168.92.1/ 255.255.255.0) and set Administrative Access to **HTTPS, PING**, and **SSH**. Enable DHCP Server.

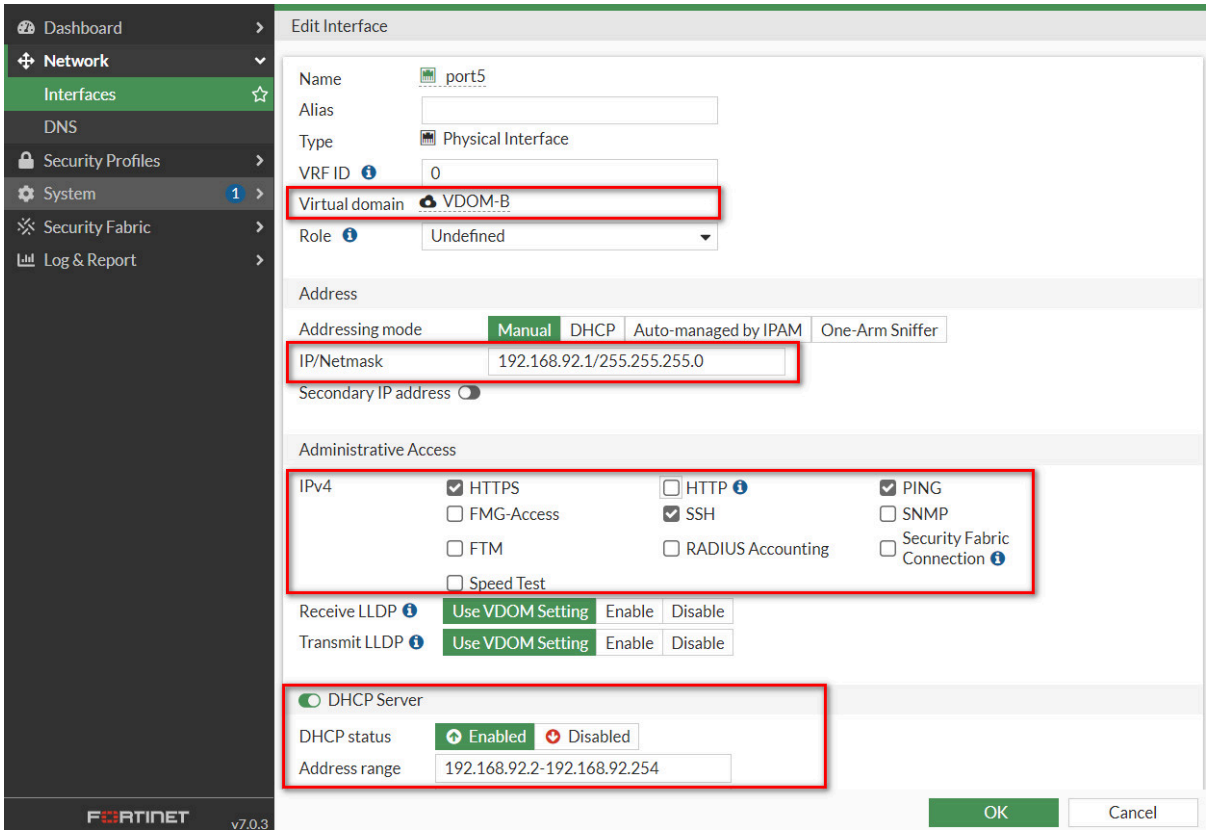


Figure 8.8: Port5 configuration

Creating Administrators for Each VDOM

1. Go to **Global > System > Administrators**. Create an administrator for VDOM-A, called vdom-a. Set Type to **Local User**, enter and confirm a password, set Administrator Profile to **prof_admin**, and set Virtual Domain to **VDOM-A**. Make sure to remove the root VDOM from the Virtual Domain list.

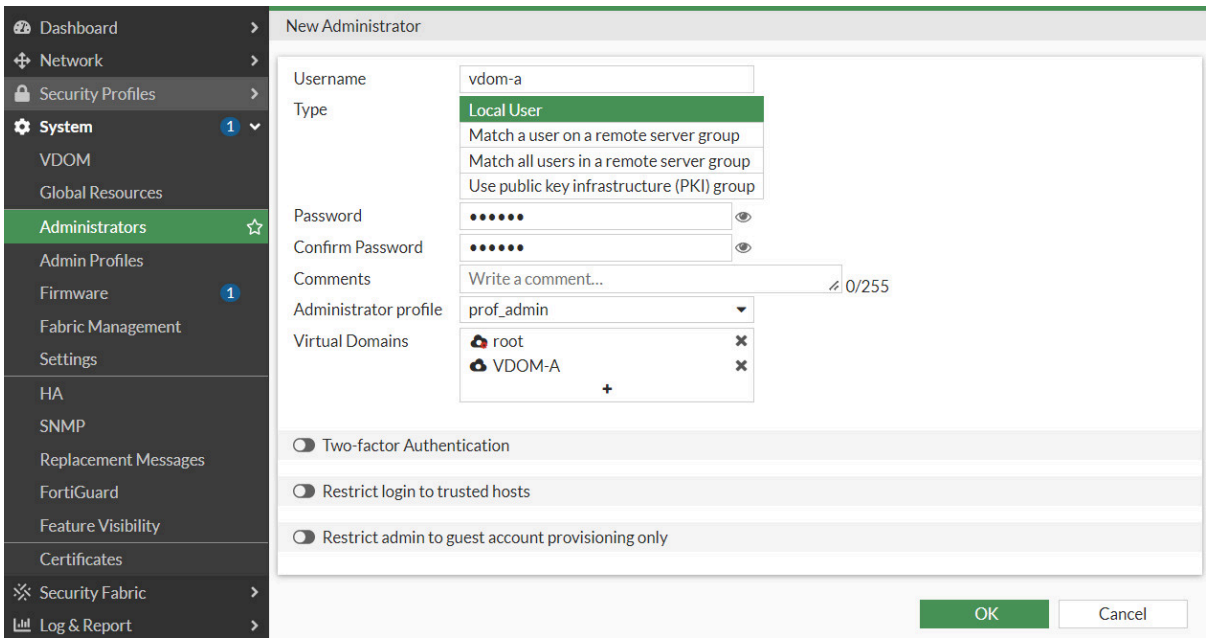


Figure 8.9: Administrators for VDOM-A

2. Go to **Global > System > Administrators**. Create an administrator for **VDOM-B**, called vdom-b. Set Type to **Local User**, enter and confirm a password, set Administrator Profile to **prof_admin**, and set Virtual Domain to **VDOM-B**. Make sure to remove the root VDOM from the Virtual Domain list.

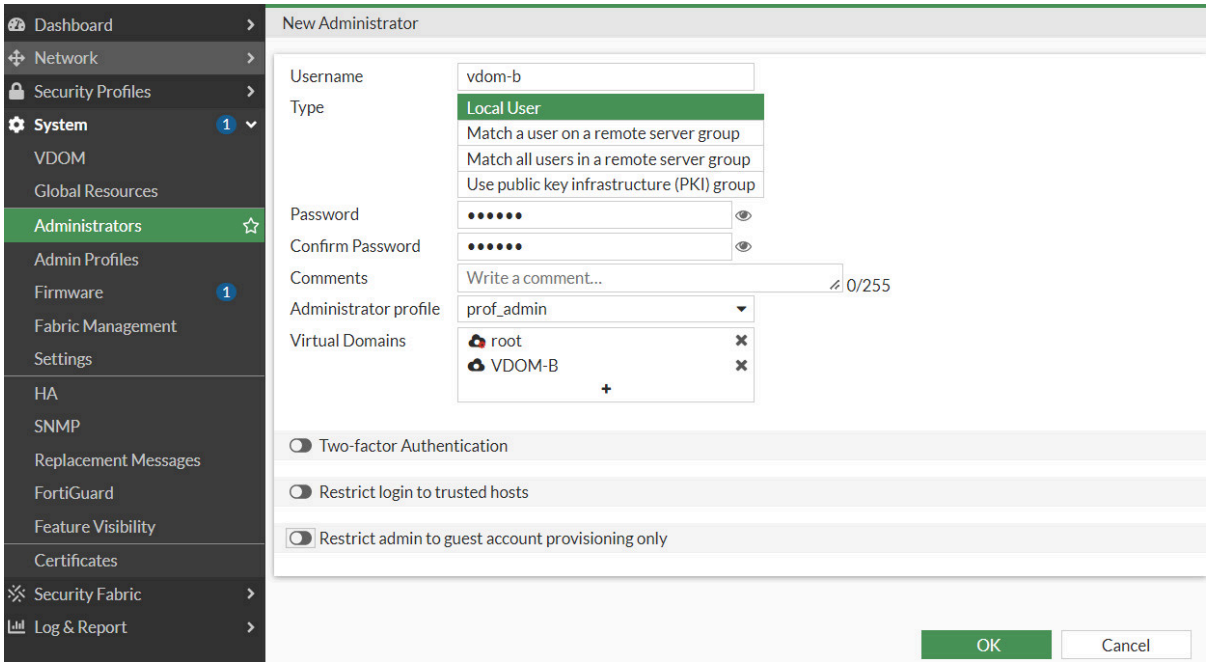


Figure 8.10: Administrators for VDOM-B

Security Policy Setting for VDOM-A

1. **Virtual Domains > VDOM-A > Network > Static Routes**. Click Create New to create a default route for the VDOM. Set Destination IP/Mask to 0.0.0.0/0.0.0.0, set Device to port3,

and set Gateway to the IP of the gateway router.

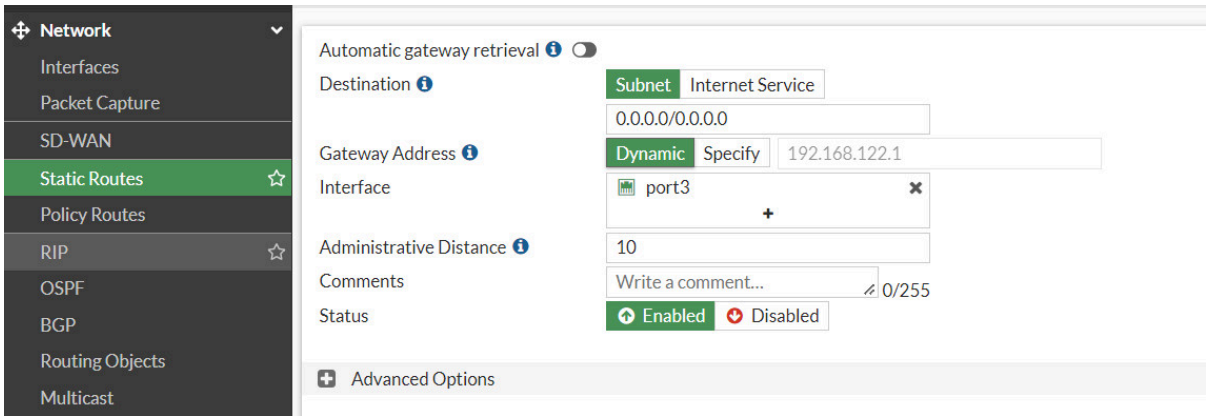


Figure 8.11: Static route in VDOM-A

2. Go to **Policy & Objects > Firewall Policy**. Create a policy to allow internet access. Set Incoming Interface to port4 and Outgoing Interface to port2. Ensure NAT is turned ON. Set Source Address to all, Destination Address to all, and Service to ALL.

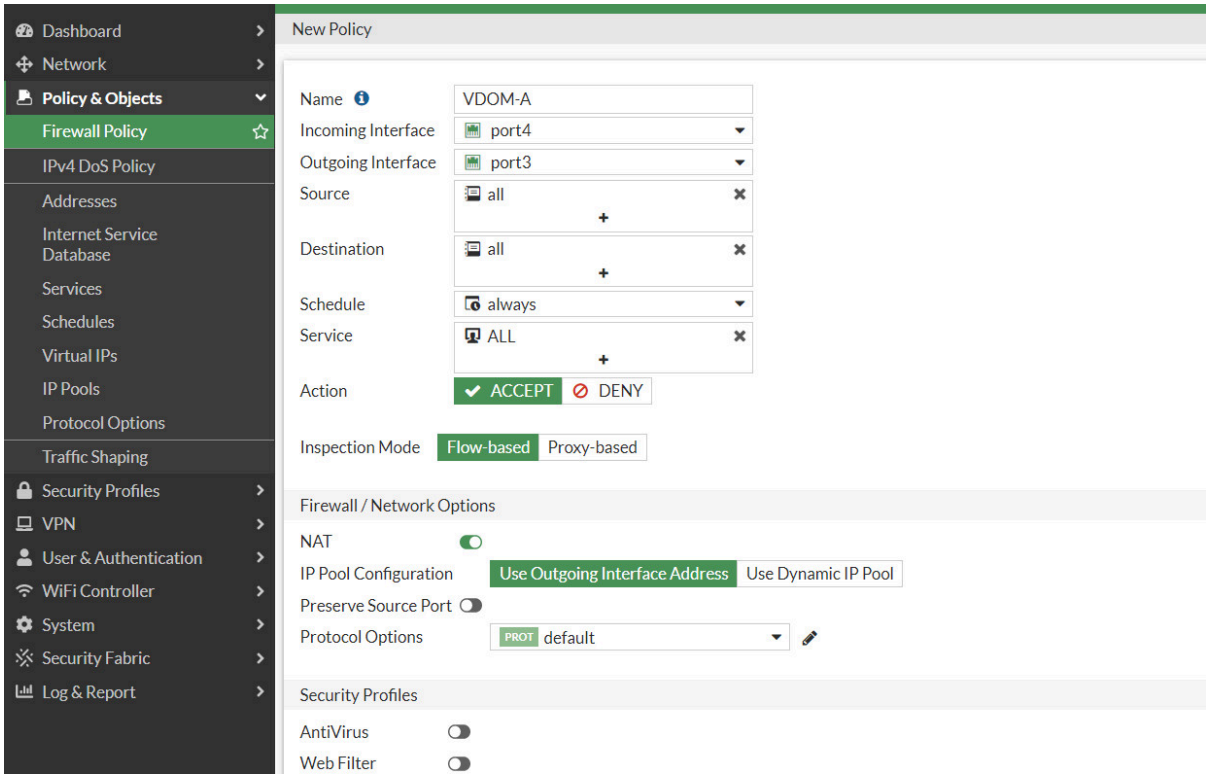


Figure 8.12: Firewall Policy in VDOM-A

3. Now, you should be able to reach the internet from WebTerm VDOM-A.

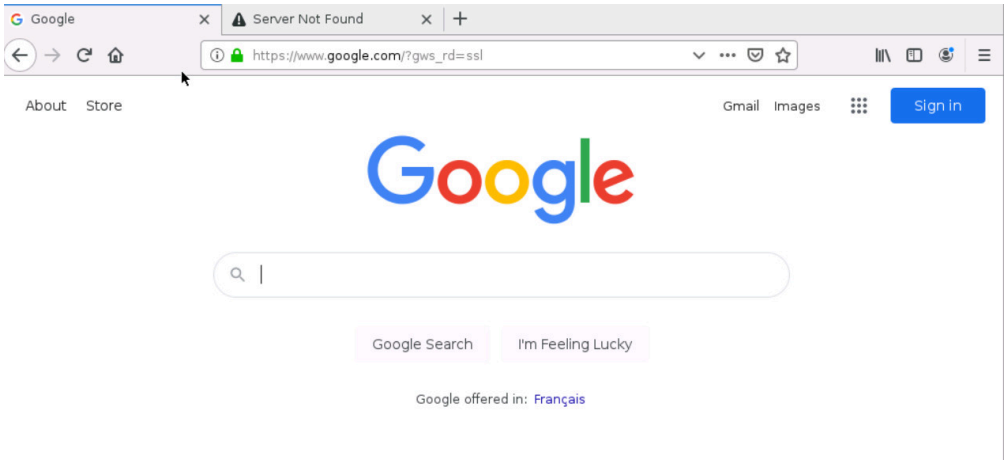


Figure 8.13: Verify configuration in VDOM-A

Security Policy Setting for VDOM-B

1. **Virtual Domains > VDOM-B > Network > Static Routes**. Click Create New to create a default route for the VDOM. Set Destination IP/Mask to 0.0.0.0/0.0.0.0, set Device to port2, and set Gateway to the IP of the gateway router.

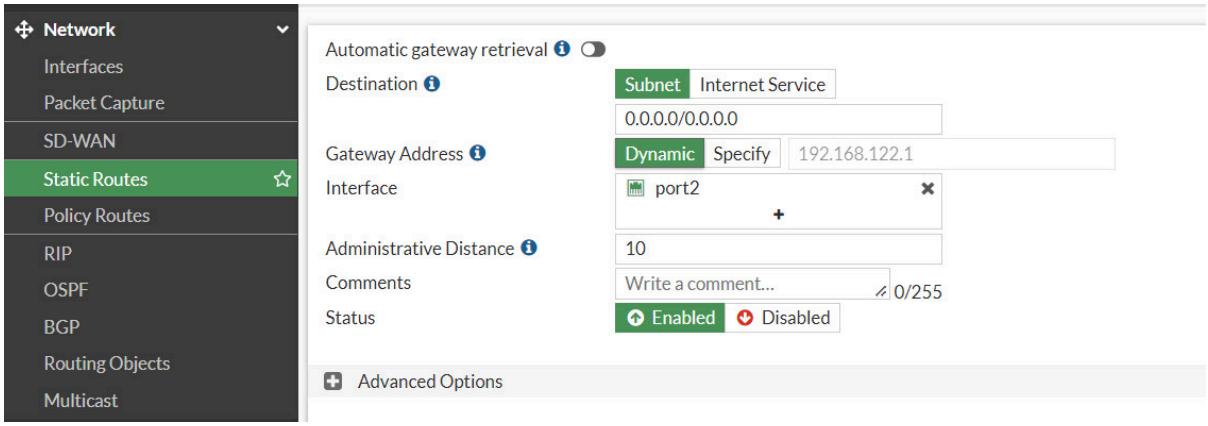


Figure 8.14: Static route in VDOM-B

2. Go to **Policy & Objects > Policy > IPv4**. Create a policy to allow internet access. Set Incoming Interface to port5 and Outgoing Interface to port2. Ensure NAT is turned ON. Set Source Address to all, Destination Address to all, and Service to ALL.

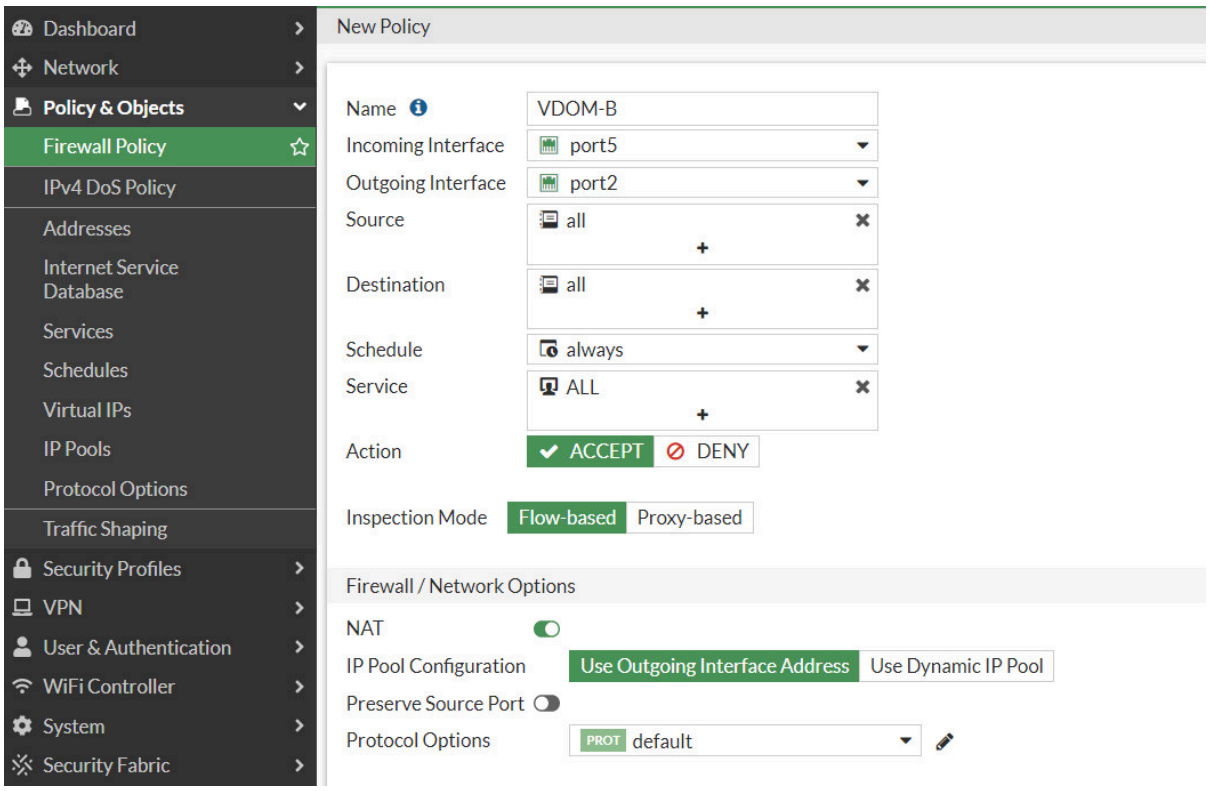


Figure 8.15: Firewall Policy in VDOM-B

3. Create a Traffic shaping under **Policy & Objects** as follows:

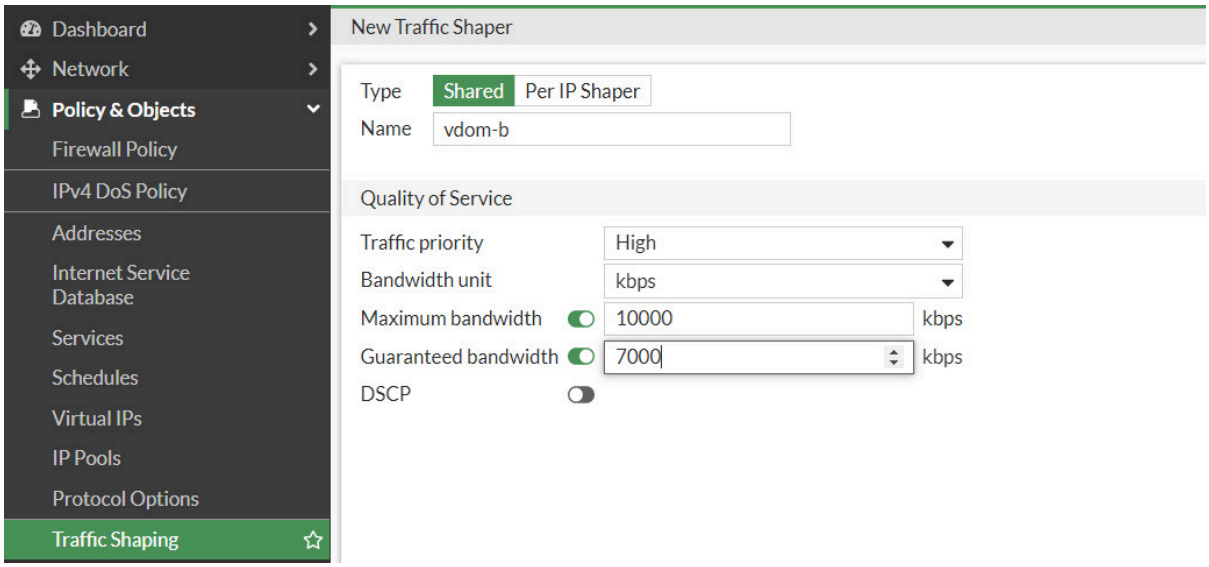


Figure 8.16: Create a traffic shaper in VDOM-B

4. Create a Traffic Shaping Policy with the following configuration:
    - Name: **VDOMB**
    - Source: **All**
    - Destination: **All**
    - Service: **All**

- Outgoing Interface: **Port2**
- Shared Shaper: **VDOMB**
- Reverse Shaper: **VDOMB**

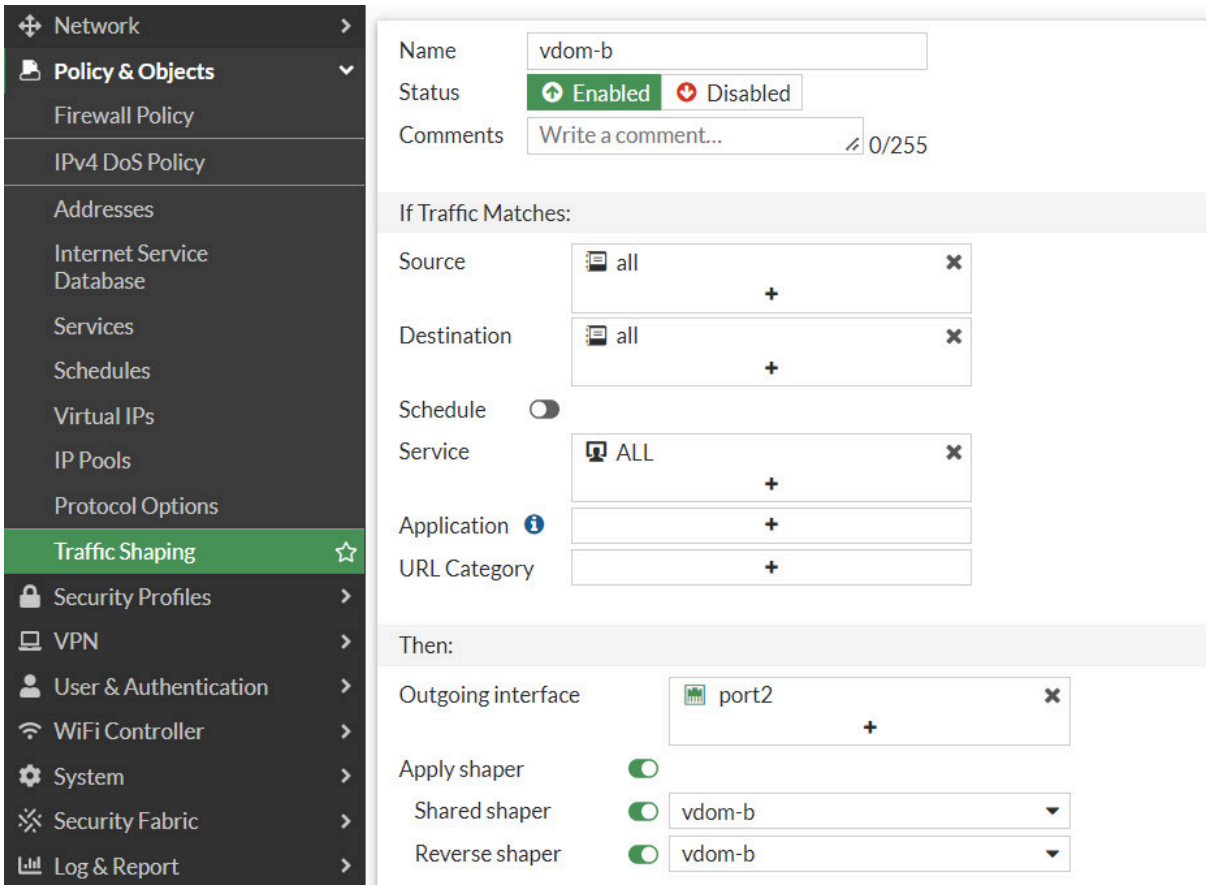


Figure 8.17: Traffic Shaping Policy in VDOM-B

5. Now open the browser in WebTerm VDOM-B and go to Fast.com (https://fast.com) and verify your configuration.

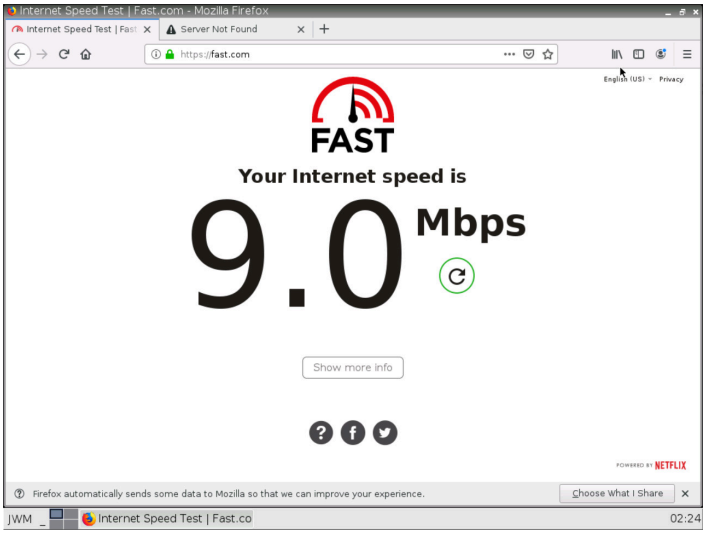


Figure 8.18: Verify configuration in VDOM-B

8.2 Inter-VDOM Routing

Learning Objectives

- Configure a VDOM to pass traffic between VDOMs
- Configure an Inter-VDOM routing

Scenario: Inter-VDOM routing is the communication between VDOMs. VDOM links are virtual interfaces that connect VDOMs. A VDOM link contains a pair of interfaces, each one connected to a VDOM and forming either end of the inter-VDOM connection. We want to create a link between VDOM Sales and Accounting, then the traffic from WebTerm1 should be reached to WebTerm2.

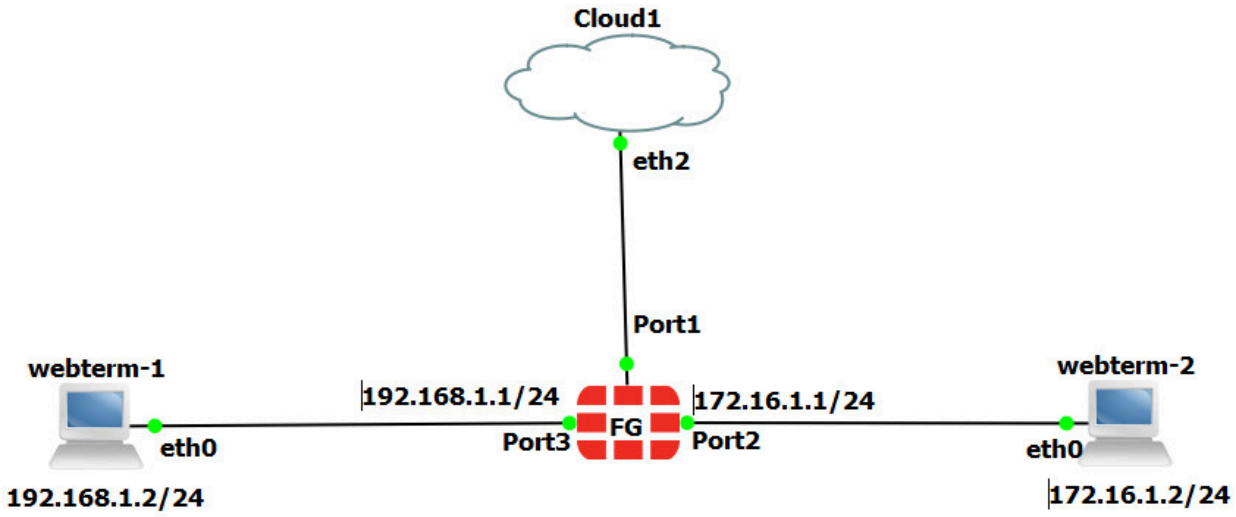


Figure 8.19: Main scenario

Table 8.2: Devices configuration

Device	IP address	Access
WebTerm1	192.168.1.2/24	–
WebTerm2	172.16.1.2/24	–
FortiGate	Port 1: DHCP Client Port 2: 172.16.1.1/24 Port 3: 192.168.1.1/24	Port 1: https, ping
Cloud1		–

1. First, enable VDOMs in the firewall.

```
FGVM01TM19008000 # config system global
FGVM01TM19008000 (global) # set vdom-mode multi-vdom
FGVM01TM19008000 (global) # end
```

2. Create two VDOMs, **Sales** and **Accounting.**

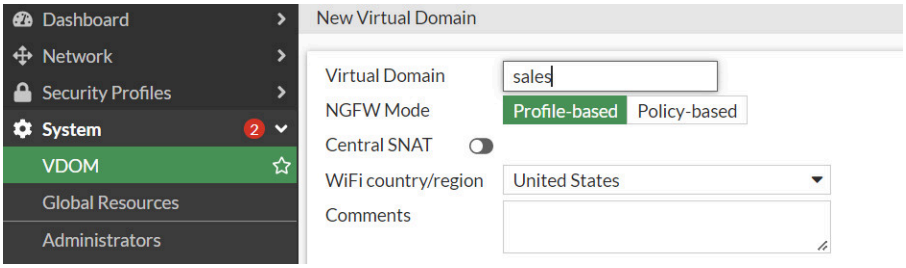


Figure 8.20: Create a VDOM Sales

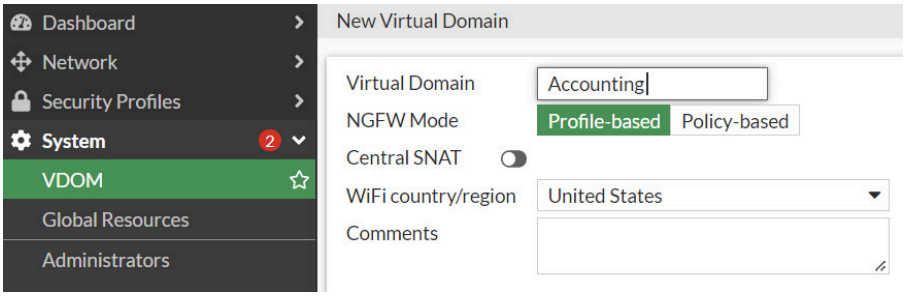


Figure 8.21: Create a VDOM Accounting

3. Configure IP addresses for the Interfaces Port2 and Port3. Assign port3 to Sales Vdom and port2 to Accounting Vdom.

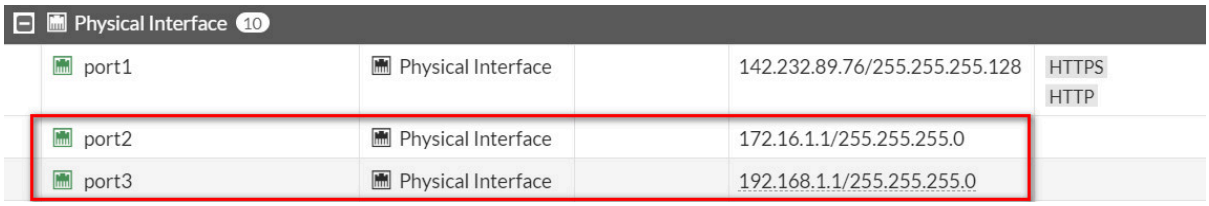


Figure 8.22: Port2 and Port3 IP address configuration

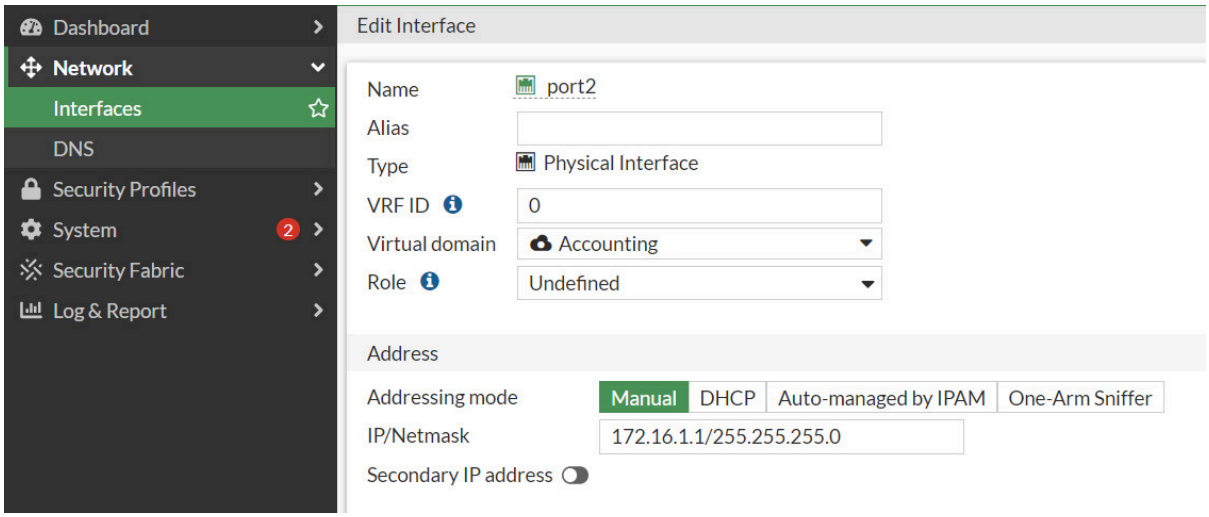


Figure 8.23: Port2 configuration

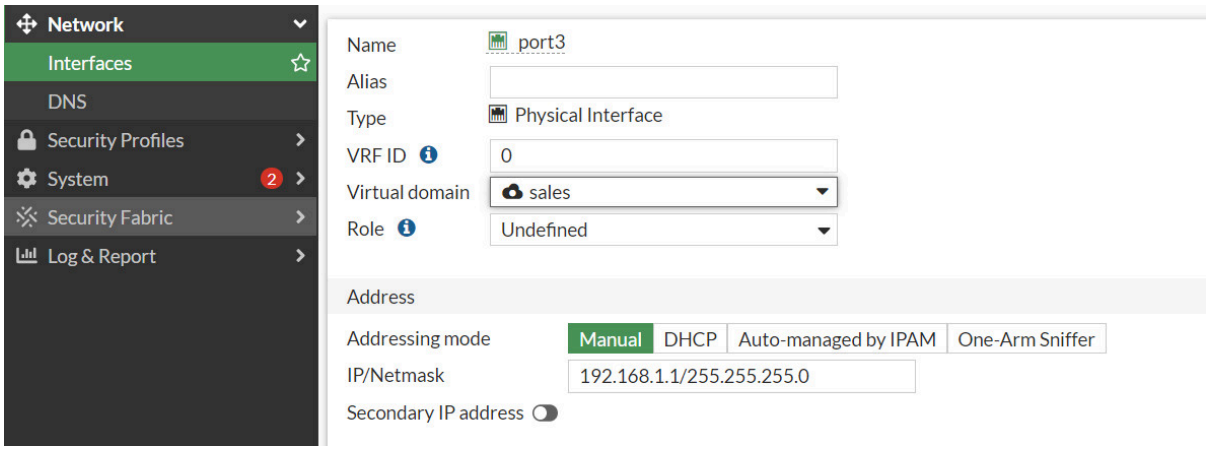


Figure 8.24: Port3 configuration

4. Go to **Global VDOM** > **Network Interfaces** > **Create a new VDOM** Link, and configure it as Figure 8.25:

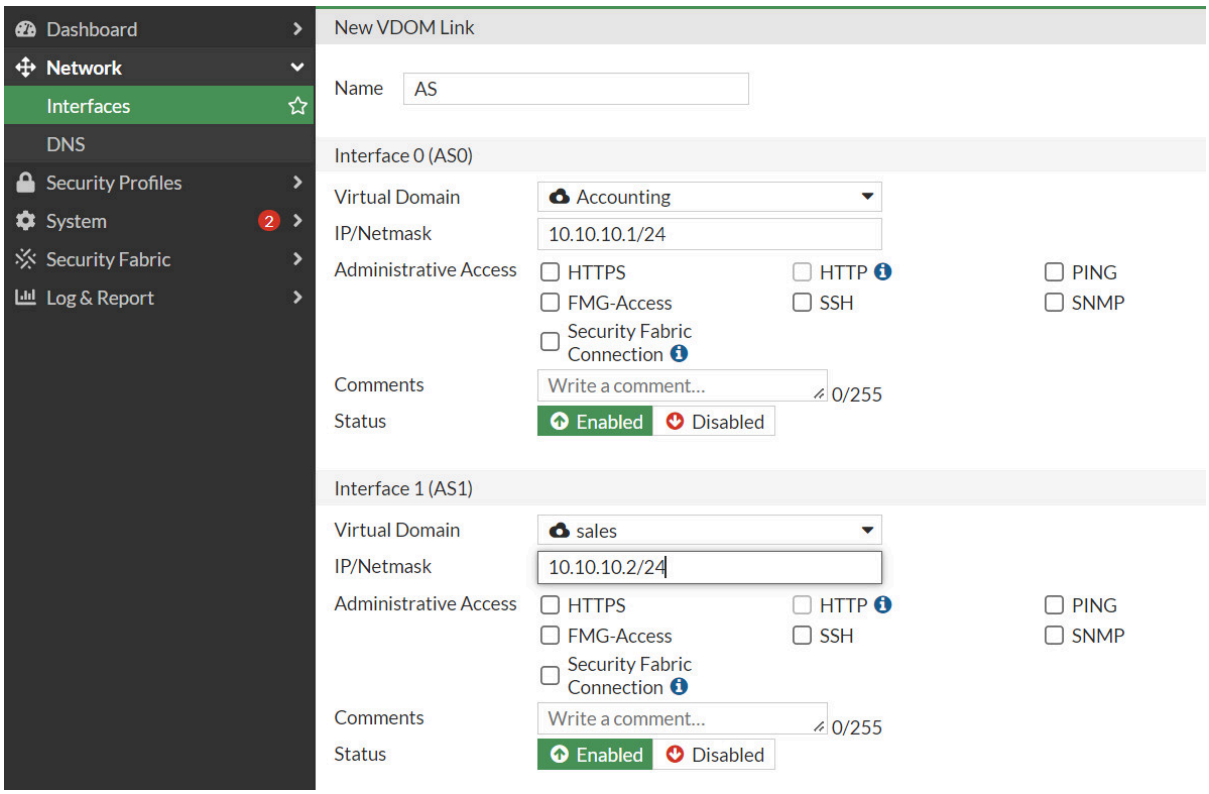


Figure 8.25: Create a VDOM link between Sales and Accounting

5. In Accounting VDOM, Create two static routes:

    - **Destination:** 192.168.1.0/255.255.255.0
    - **Interface:** Accounting-Sales
    - **Gateway:** 10.10.10.2

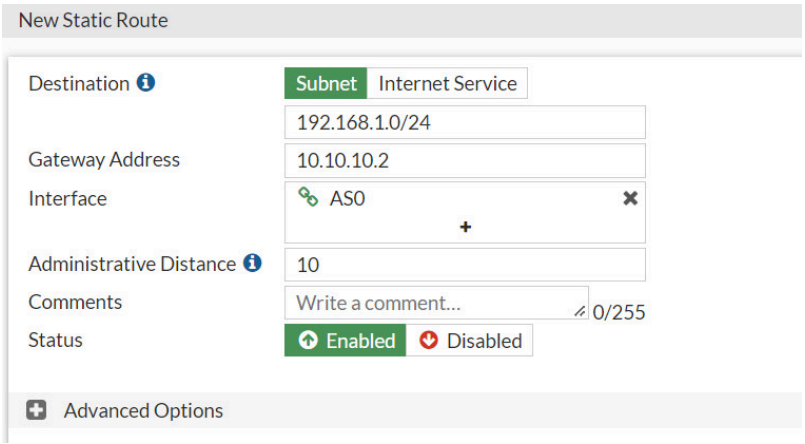


Figure 8.26: Create a static route in Accounting VDOM

    - **Destination:** 172.16.1.0/255.255.255.0
    - **Interface:** Accounting-Sales
    - **Gateway:** 10.10.10.2

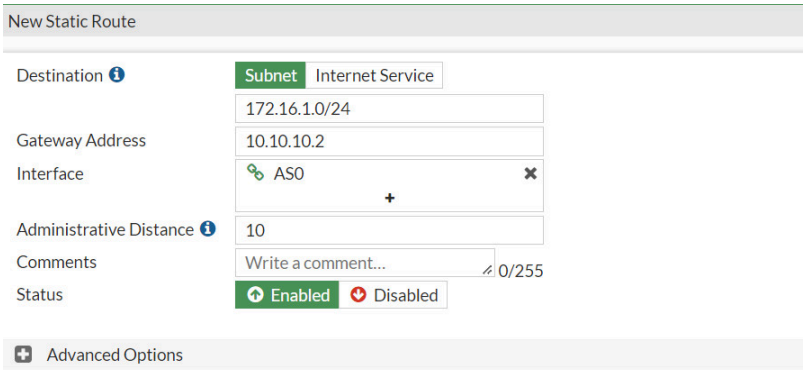


Figure 8.27: Create a static route in Accounting VDOM

6. In Accounting VDOM, Create two Firewall Policies:
    - **Incoming:** Port 2
    - **Outgoing:** AS0
    - NAT Disable

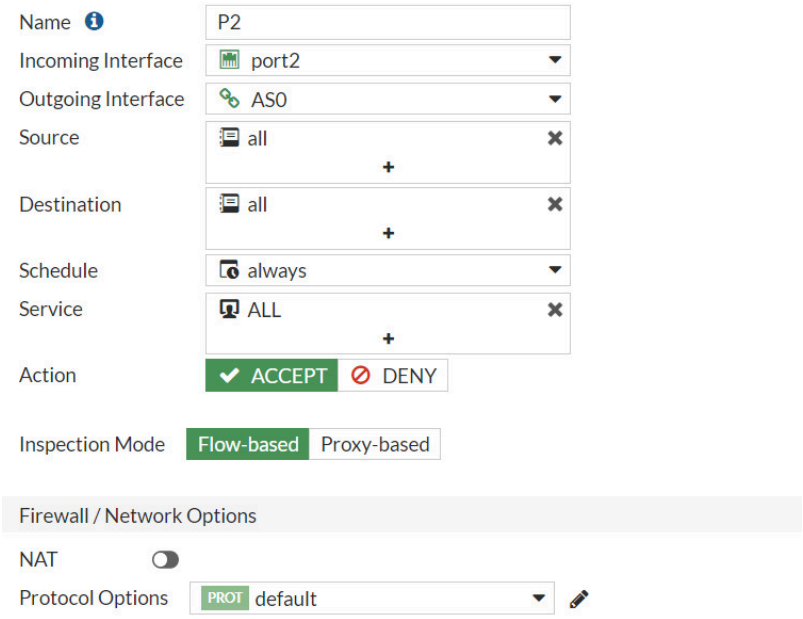


Figure 8.28: Create a Firewall Policy in Accounting VDOM from Port2 to AS0

Incoming:

- **Incoming:** AS0
- **Outgoing**: Port2
- NAT Disable

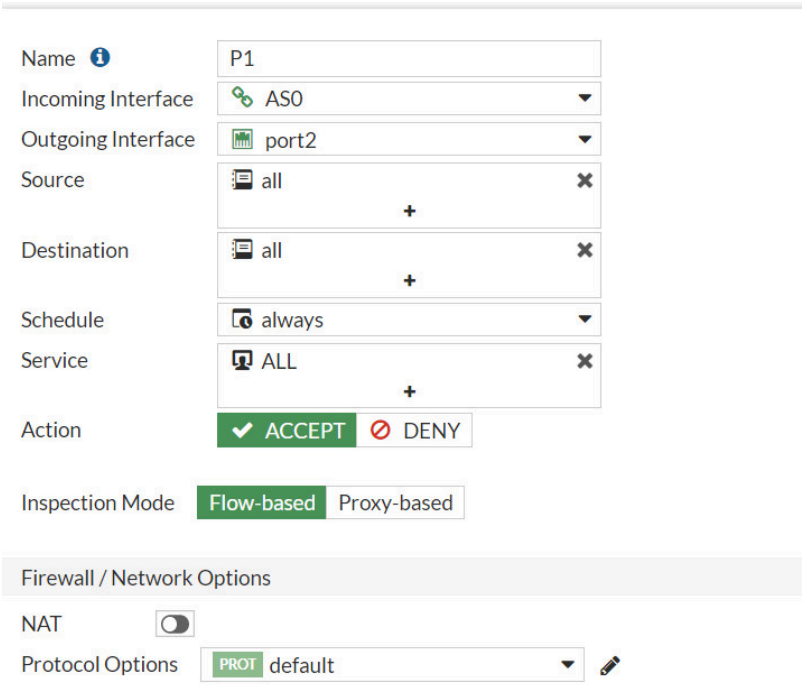


Figure 8.29: Create a Firewall Policy in Accounting VDOM from AS0 to Port2

7. In Sales VDOM, Create two static routes:

    - **Destination:** 192.168.1.0/255.255.255.0
    - **Interface:** AS1
    - **Gateway:** 10.10.10.1

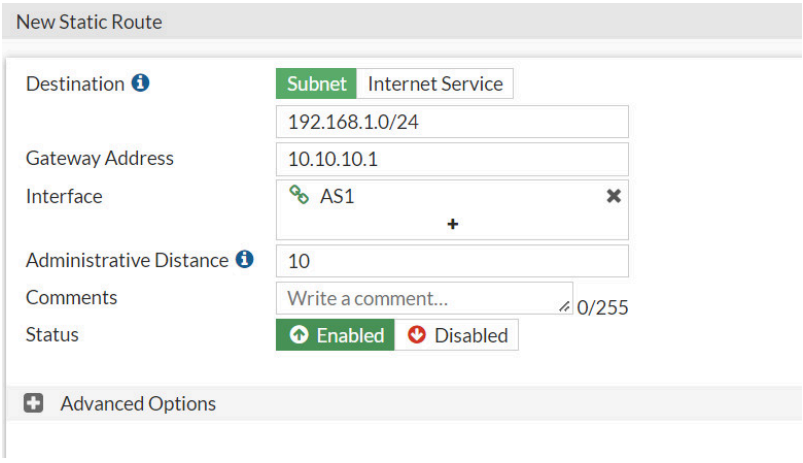


Figure 8.30: Create a static route in Sales VDOM

    - **Destination:** 172.16.1.0/255.255.255.0
    - **Interface:** AS1
    - **Gateway:** 10.10.10.1

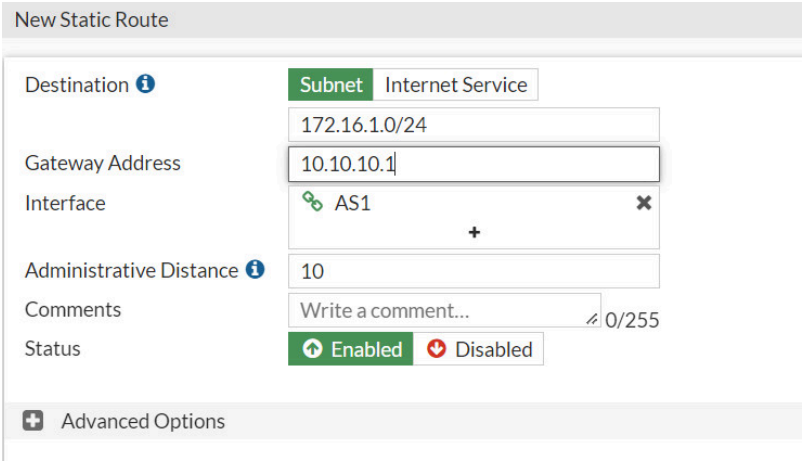


Figure 8.31: Create a static route in Sales VDOM

8. In Sales VDOM, Create two Firewall Policies:

    - **Incoming:** Port3
    - **Outgoing:** AS1
    - **NAT Disable**

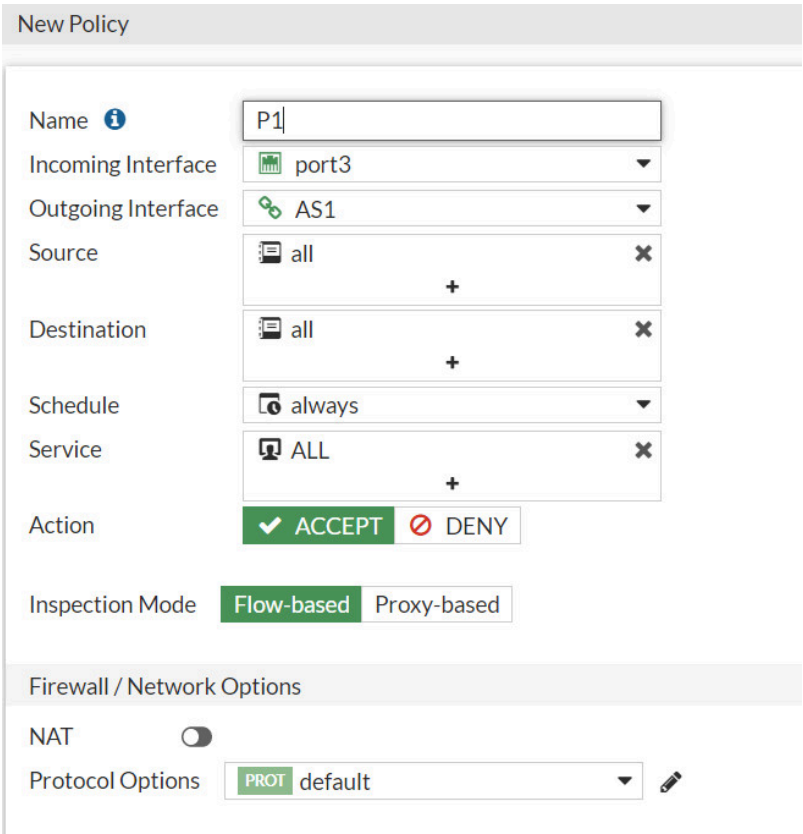


Figure 8.32: Create a Firewall Policy in Sales VDOM from Port3 to AS1

    - **Incoming:** AS1

- **Outgoing:** Port3
- NAT Disable

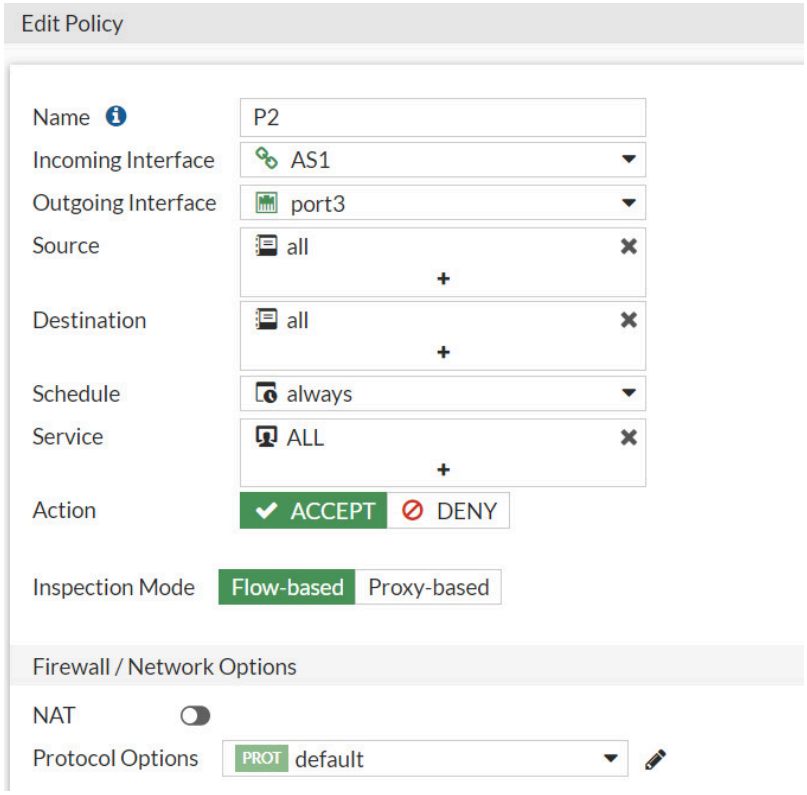


Figure 8.33: Create a Firewall Policy in Sales VDOM from AS1 to Port3

9. Now, you should verify your configuration and should be able to ping from WebTerm1 to WebTerm2.

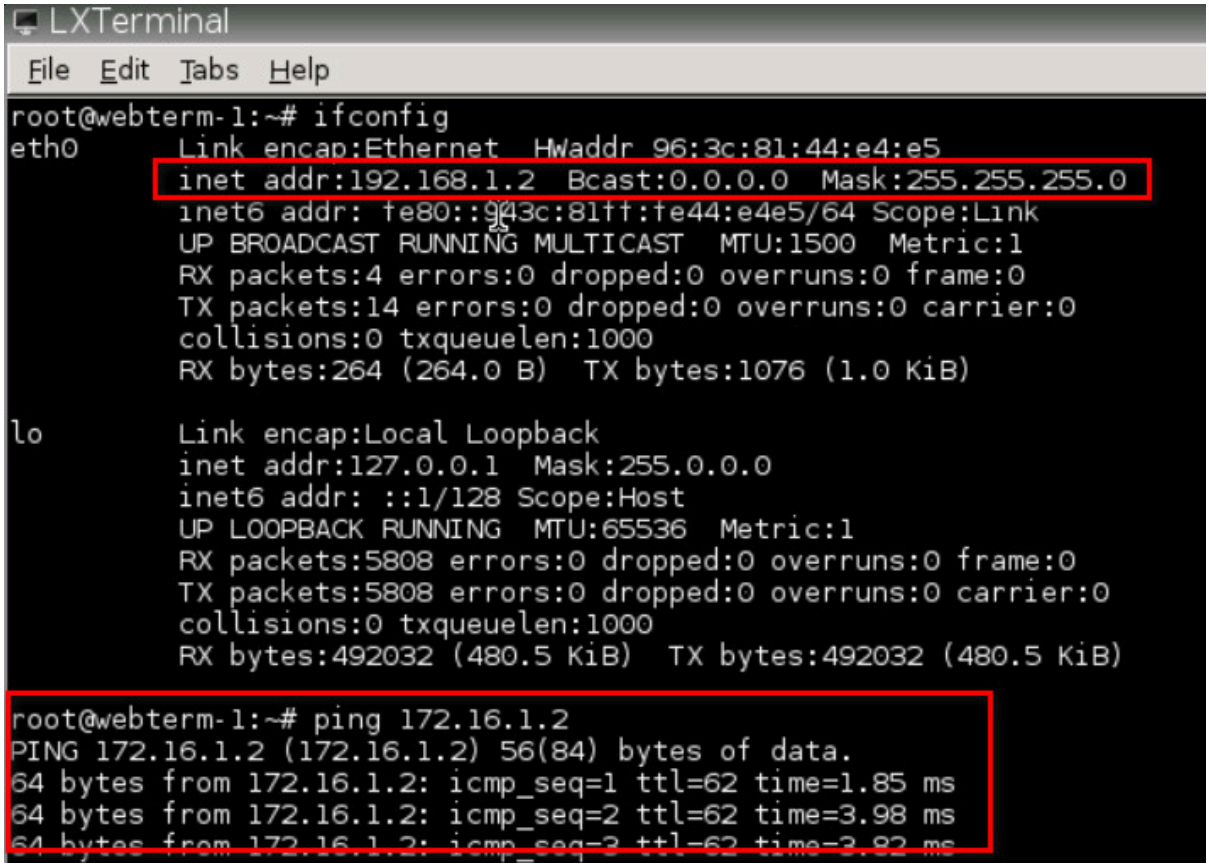


Figure 8.34: Verify configuration

To delete a VDOM link in the CLI:

```
config system vdom-link
delete <VDOM-LINK-Name>
end
```

Chapter 9. SD-WAN

9.1 SD-WAN

Learning Objectives

- Create a Demo of SDWAN
- Configure SDWAN features

Scenario: Software-defined wide-area network (SD-WAN) solutions transform an organization's capabilities by leveraging the corporate wide-area network (WAN) as well as multi-cloud connectivity to deliver high-speed application performance at the WAN edge of branch sites. One of the chief benefits of SD-WAN is that it provides a dynamic path selection among connectivity options—MPLS, 4G/5G, or broadband—ensuring organizations can quickly and easily access business-critical cloud applications.[1] In this scenario, we are simulating SD-WAN by using OpenWrt and this allows you to play with the features of SD-WAN. Port 4 and Port 5 acts like your different connection and you can manage them through SD-WAN.

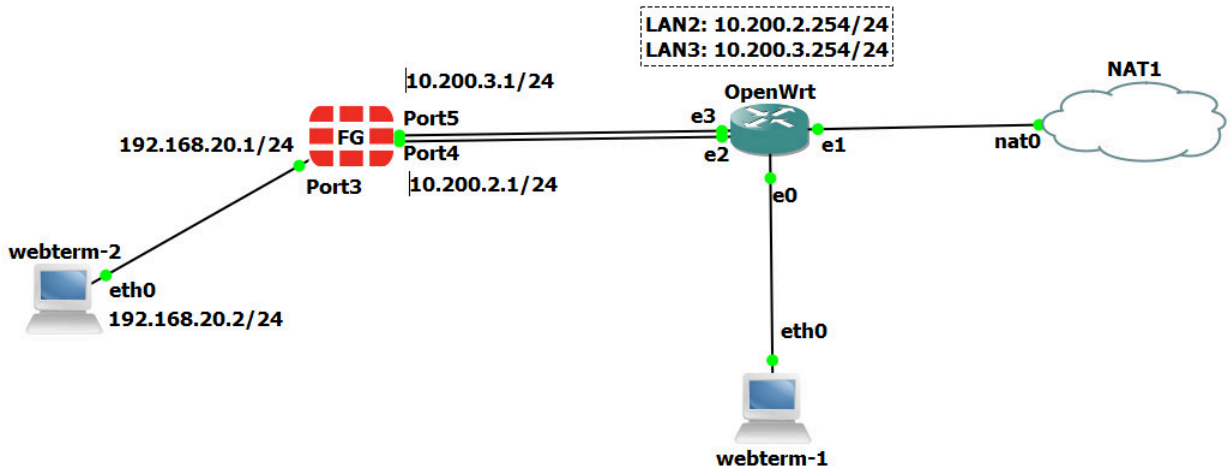


Figure 9.1: Main scenario

1. SD-WAN Document Library (https://docs.fortinet.com/document/fortigate/6.2.10/cookbook/19246/sd-wan)

Table 9.1: Devices configuration

Device	IP address
WebTerm1 (WRT Manager)	192.168.1.2/24
WebTerm2 (Firewall Manager)	192.168.20.2/24, GW: 192.168.20.1, DNS: 4.2.2.4
FortiGate	Port 3: 192.168.20.1/24 Port 4: 10.200.2.1/24 Port 5: 10.200.3.1/24
OpenWrt	Eth0: connected to WRT Manager Eth1: connected to NAT Eth2: 10.200.2.254/24 Eth3: 10.200.3.254/24
NAT	

Configure OpenWrt

To configure OpenWrt, you should connect through port eth0. By default, the IP address of eth0 is 192.168.1.1/24. So, you can set the WRTManager as 192.168.1.2/24 and connect to OpenWrt through the web browser. You can type in the browser: http://192.168.1.1, and click on “Login” without entering any password.

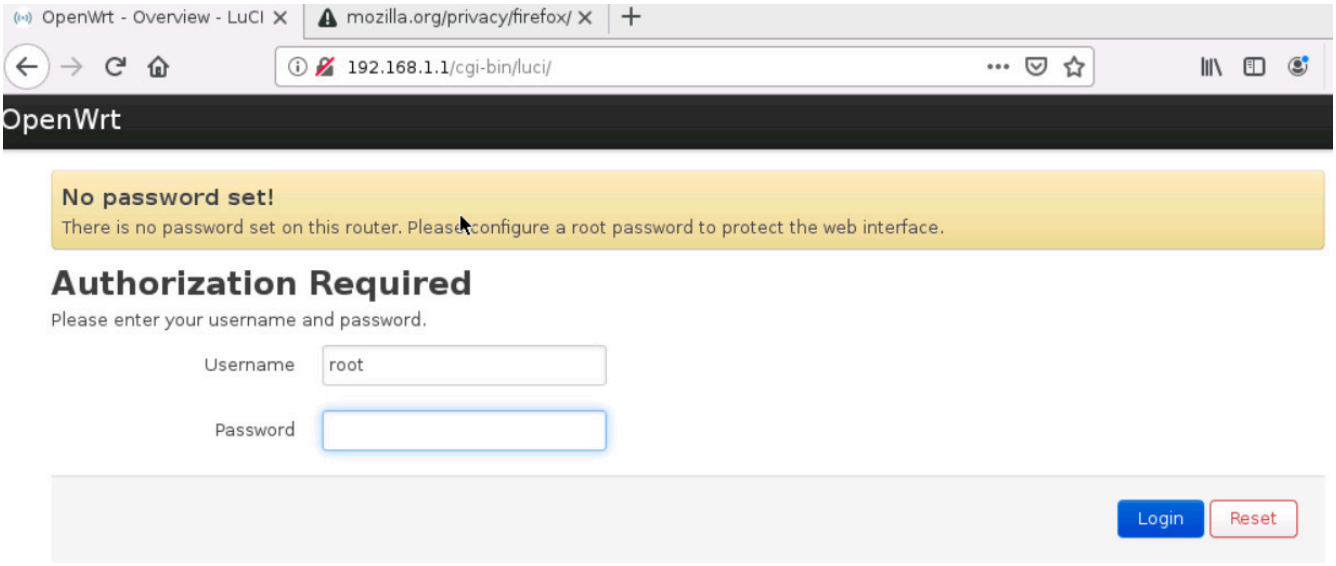


Figure 9.2: OpenWrt

Then, go to **network** > **interfaces** > **Add new interface …**

And Enter the following information:

- Name of Interface: **LAN2**
- Cover the following interface: **eth2**
- Then, submit and add IPV4: **10.200.2.254**, netmask: **255.255.255.0**
- And finally, under Firewall Settings select **firewall-zone** as Lan

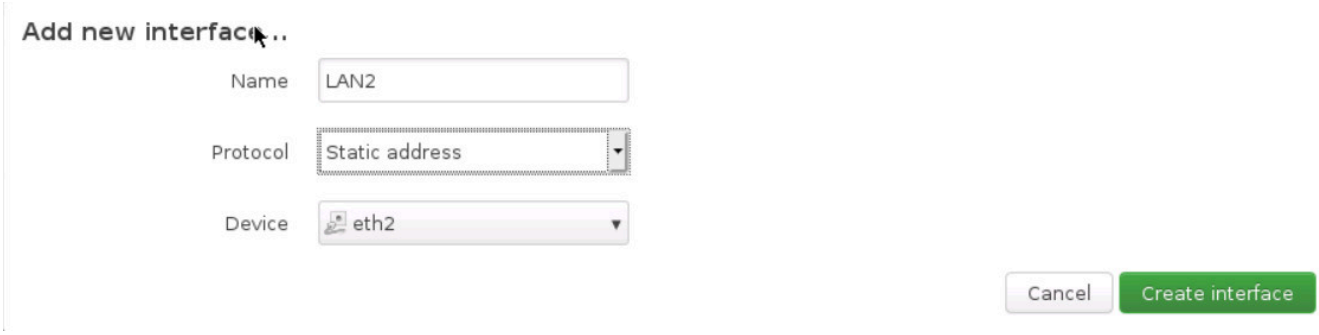


Figure 9.3: Add a new interface

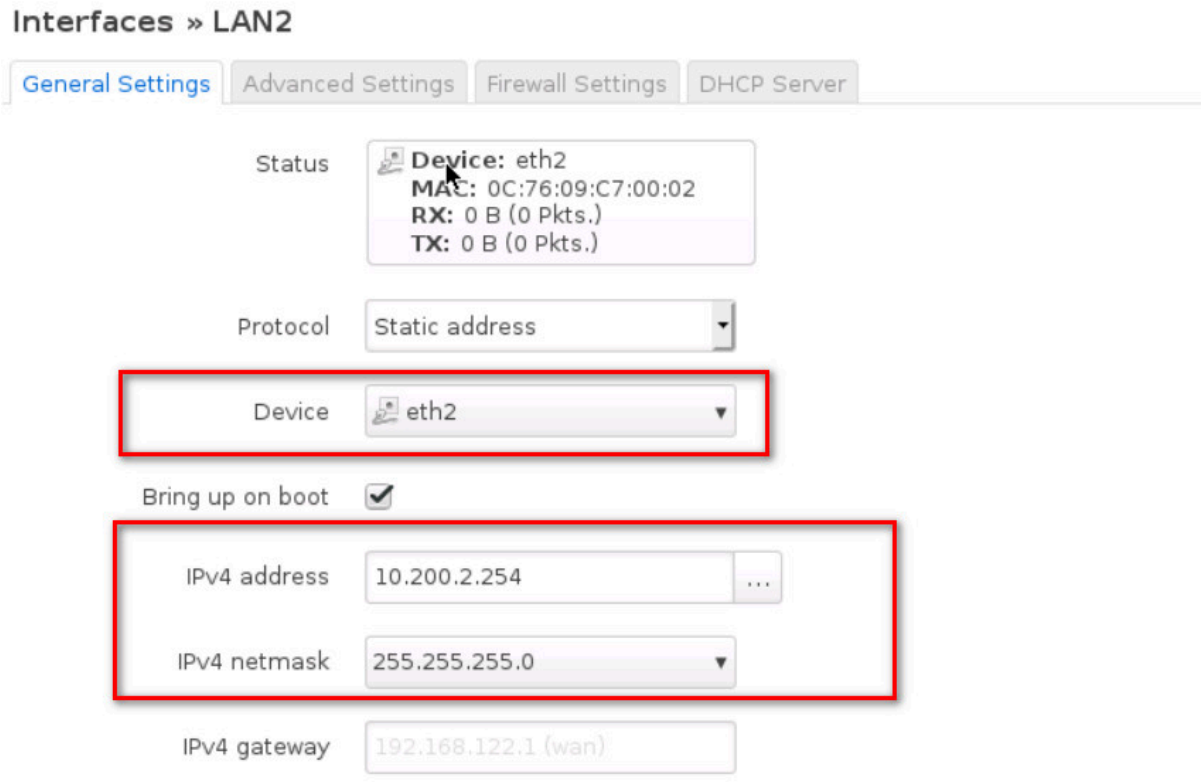


Figure 9.4: LAN2 IPv4 configuration

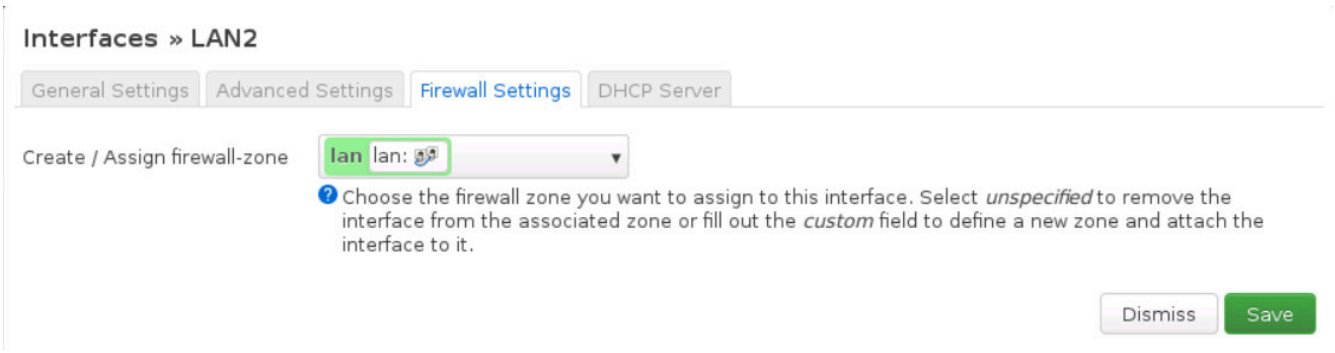


Figure 9.5: Firewall settings for LAN2

- Name of Interface: **LAN3**
- Cover the following interface: **eth3**
- Then, submit and add IPv4: **10.200.3.254** netmask: **255.255.255.0**
- And finally, under Firewall Settings select **firewall-zone** as Lan

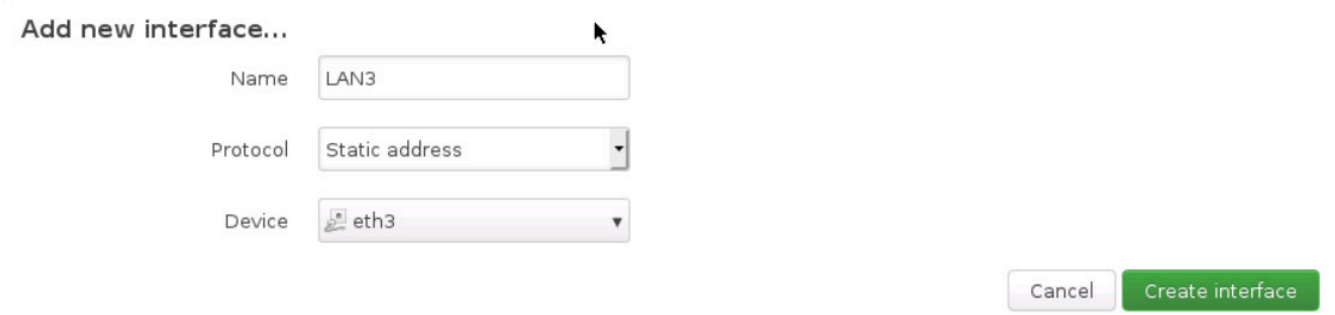


Figure 9.6: Add a new interface (LAN3)

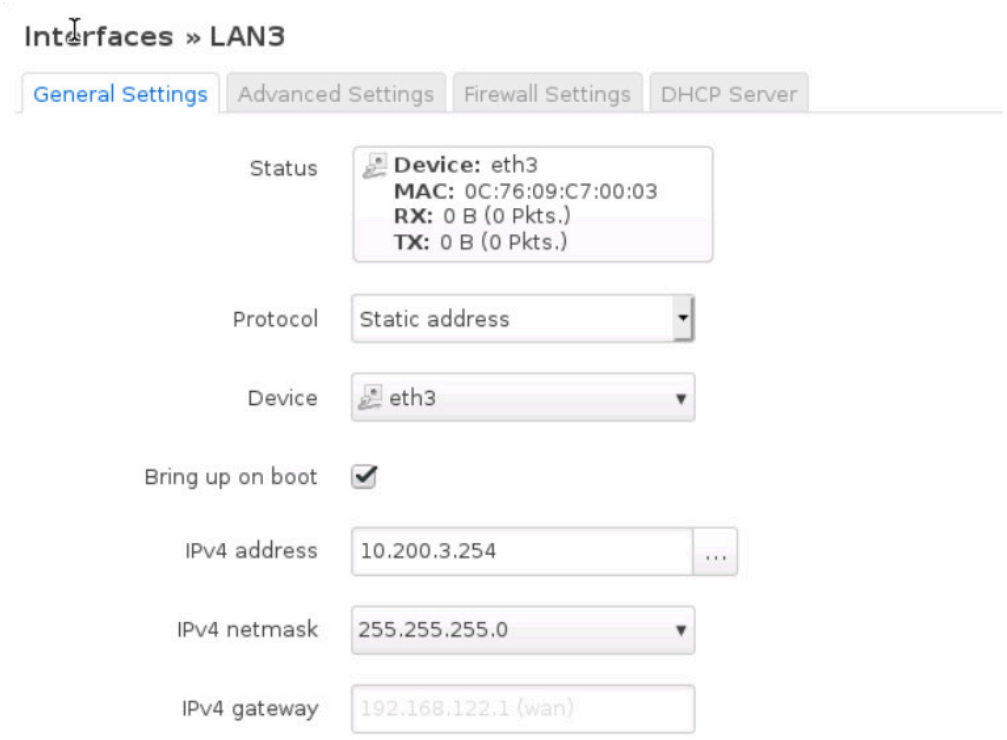


Figure 9.7: IP configuration for LAN3

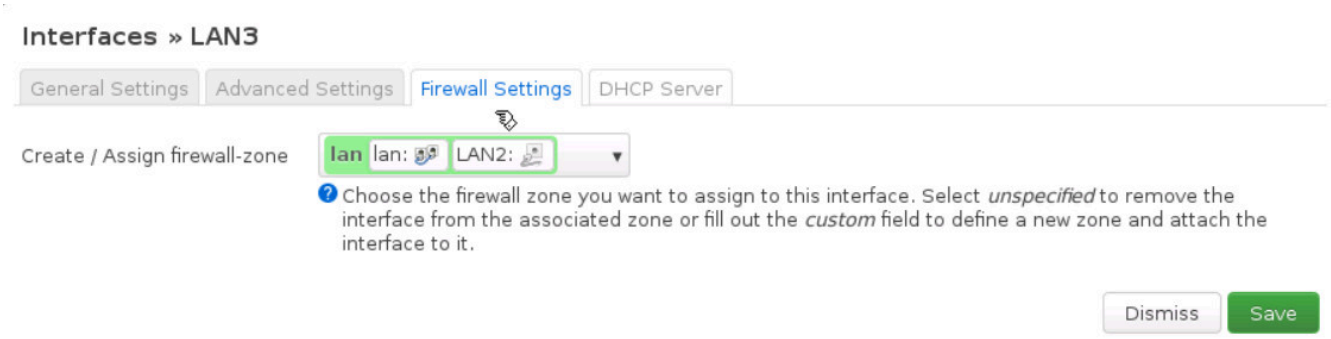


Figure 9.8: Firewall settings for LAN3

Your interfaces in OpenWrt should be like Figure 9.9:

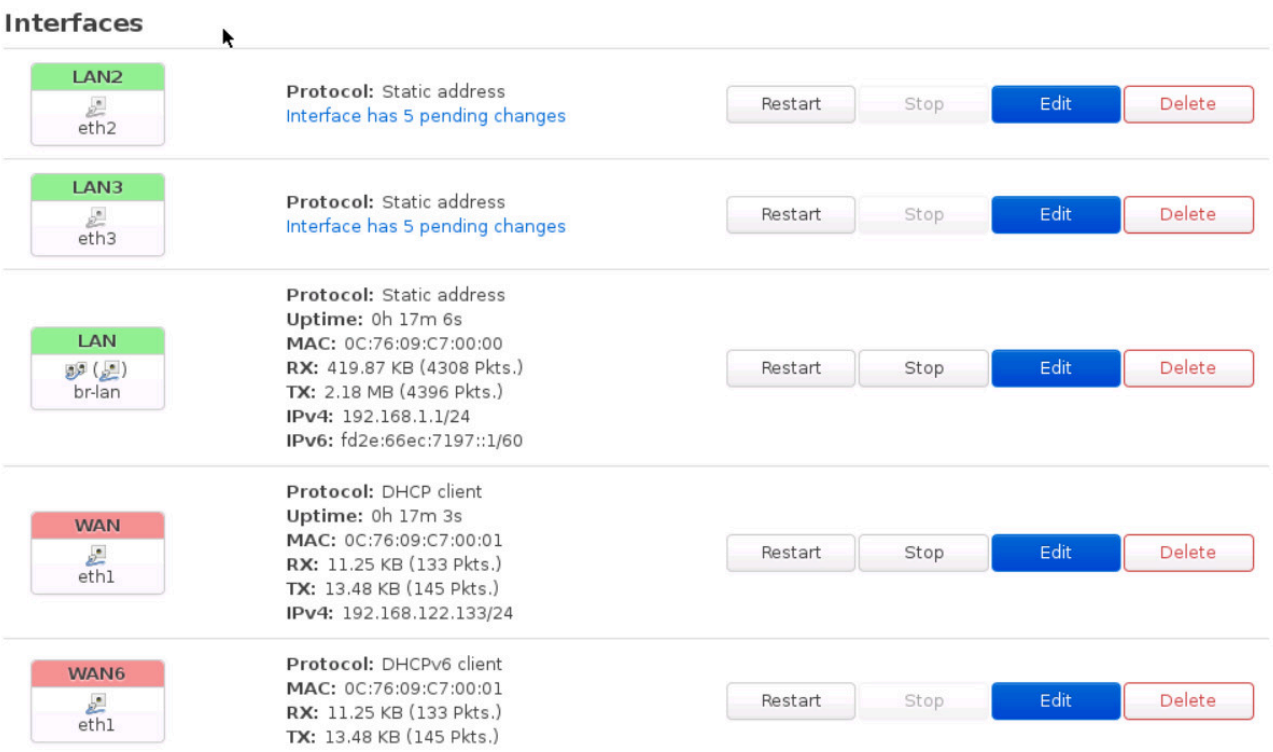


Figure 9.9: OpenWrt Interfaces

Firewall Configuration

1. Set the port3 as a management port and connect it to Firewall Manager (WebTerm2).

```
FGVM01TM19008000 # config system interface
FGVM01TM19008000 (interface) # edit port3
FGVM01TM19008000 (port3) # set ip 192.168.20.1/24
FGVM01TM19008000 (port3) # set allowaccess http https
FGVM01TM19008000 (port3) # end
```

2. Go to **Firewall** > **Network** > **Interfaces** > **port4**. Set Name as **WAN2** and IPv4 as **10.200.2.1/24**.

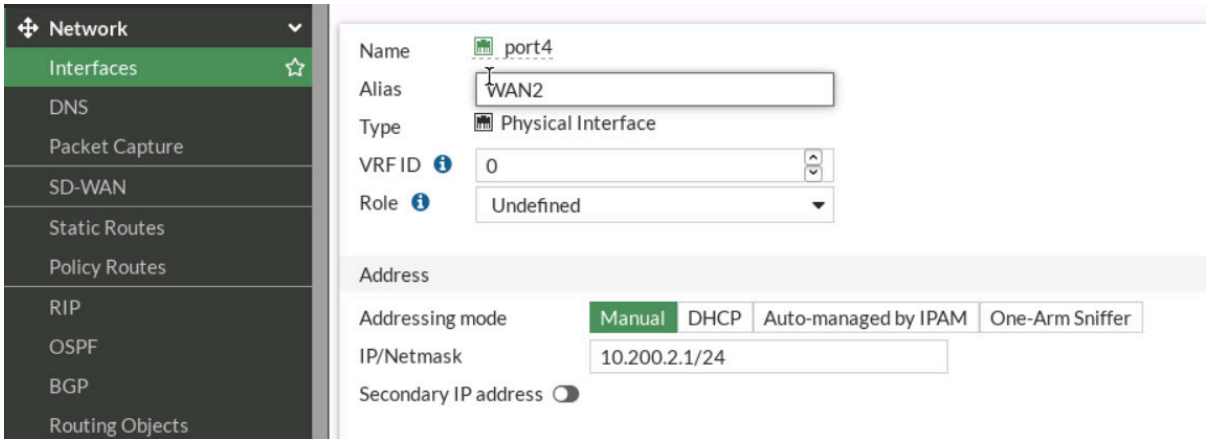


Figure 9.10: Port4 configuration

3. Go to **Firewall** > **Network** > **Interfaces** > **port 5**. Set Name as **WAN3** and IPv4 as **10.200.3.1/24**.

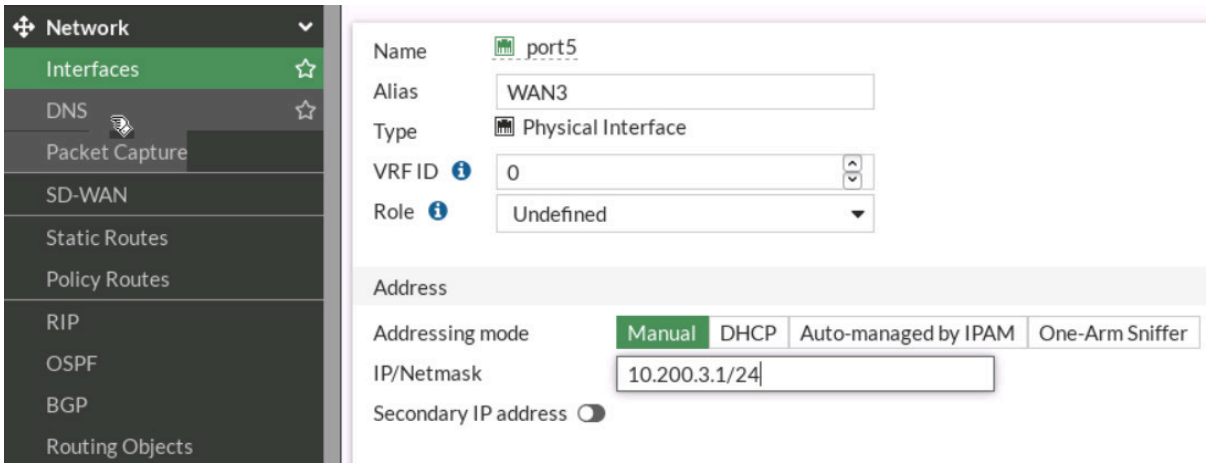


Figure 9.11: Port5 configuration

4. Go to **Network > SD-WAN > Select Interface Port4**. Gateway: **10.200.2.254**.

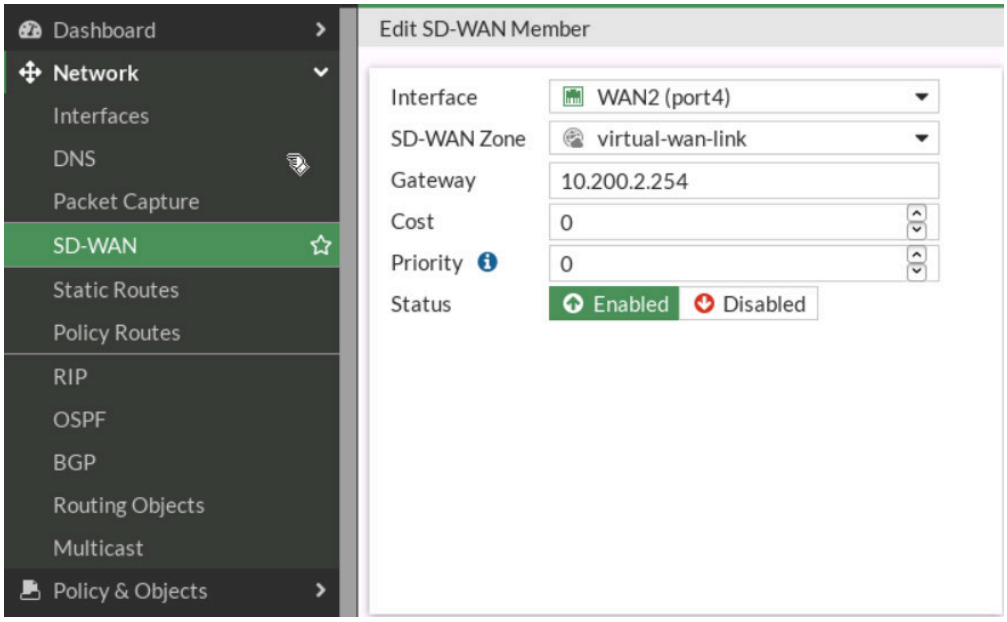


Figure 9.12: Add port4 as SD-WAN members

5. Add **SD-WAN > Select Interface Port5**. Gateway: **10.200.3.254**.

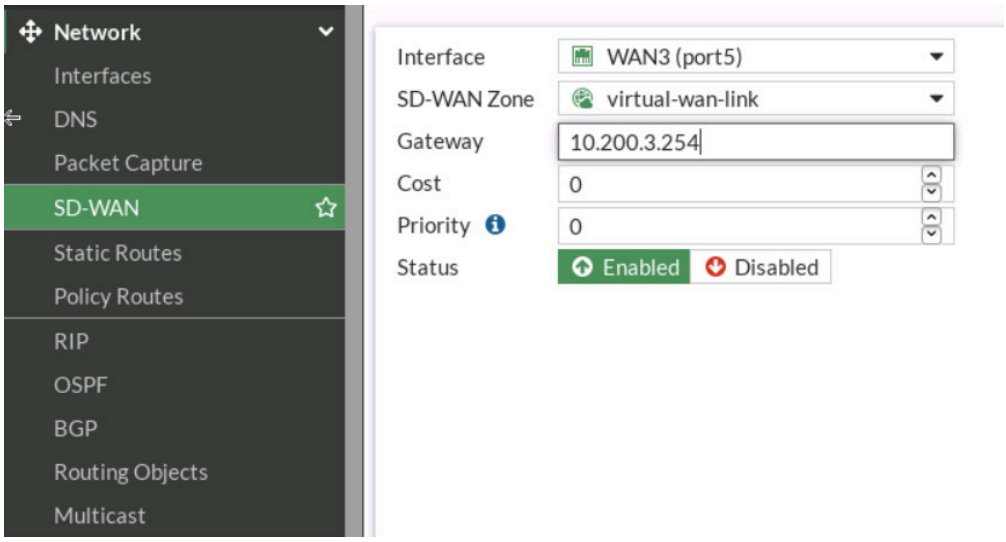


Figure 9.13: Add port5 as SD-WAN members

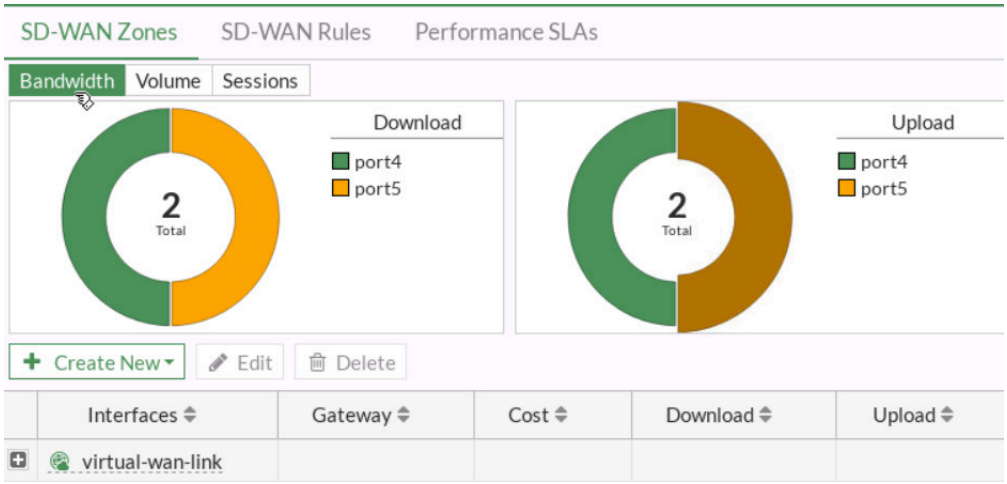


Figure 9.14: SD-WAN Zones

6. Create a static route as Figure 9.15.

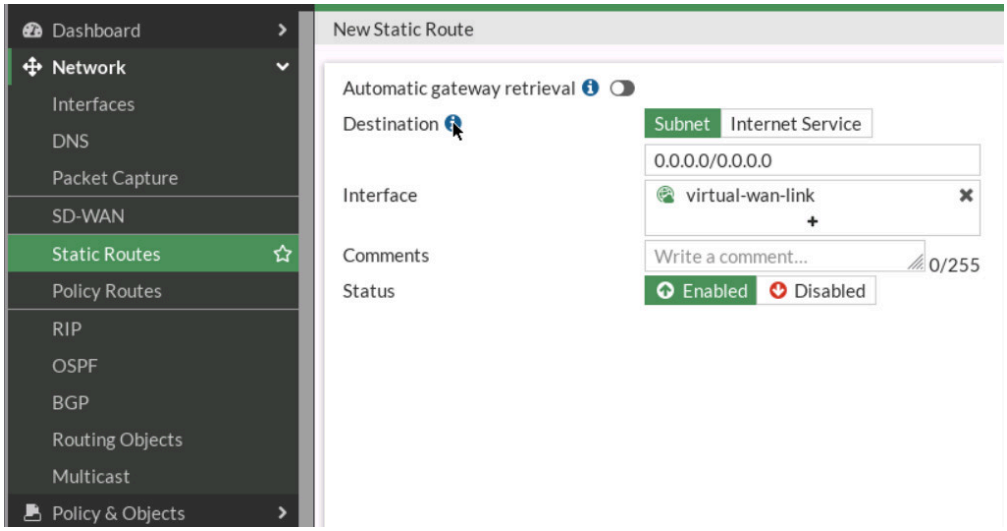


Figure 9.15: Create a static route to SD-WAN

7. Create a firewall policy as following table:

Table 9.2: Firewall Policy configuration

Field	**Value**
Name	SDWAN
Incoming Interface	LAN (PORT3)
Outgoing Interface	SD-WAN
Source	ALL
Destination	ALL
Schedule	Always
Service	ALL

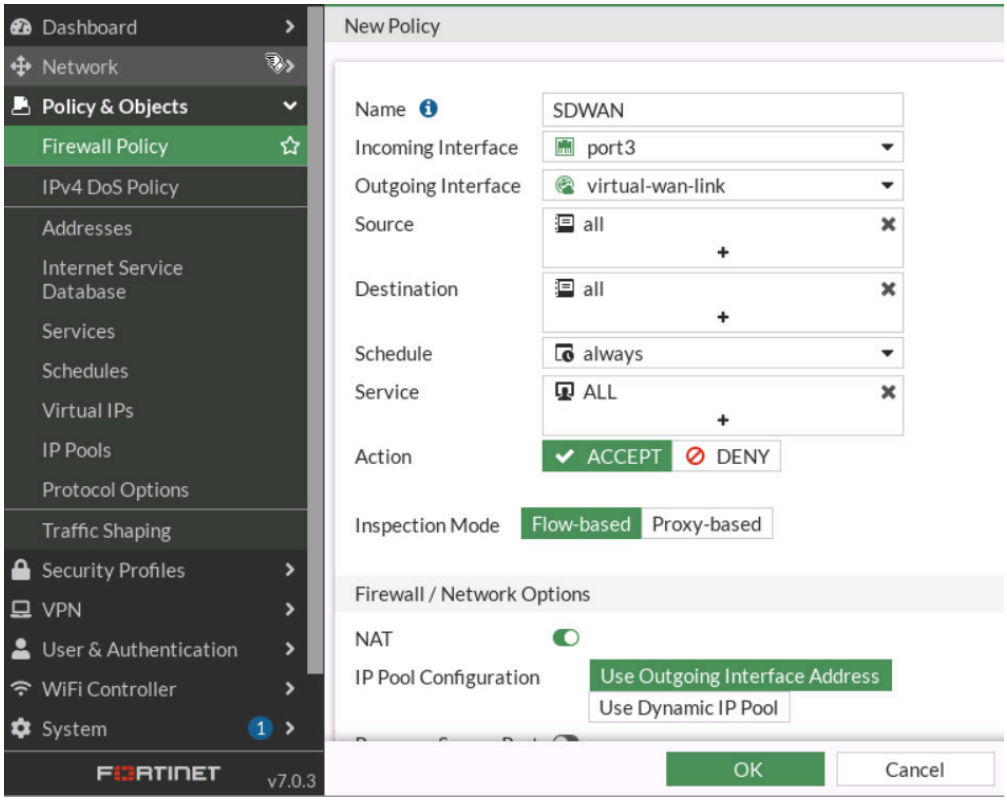


Figure 9.16: Create a Firewall Policy

8. Go to **Network > SD-WAN Rul**e, create a rule as follows:

    - Name: **MyRule**
    - Source Address: **All**
    - Destination Address: **All**
    - Protocol Number: **Any**
    - Strategy: **Best Quality**
    - Interface Preference: **Port 4, Port 5**

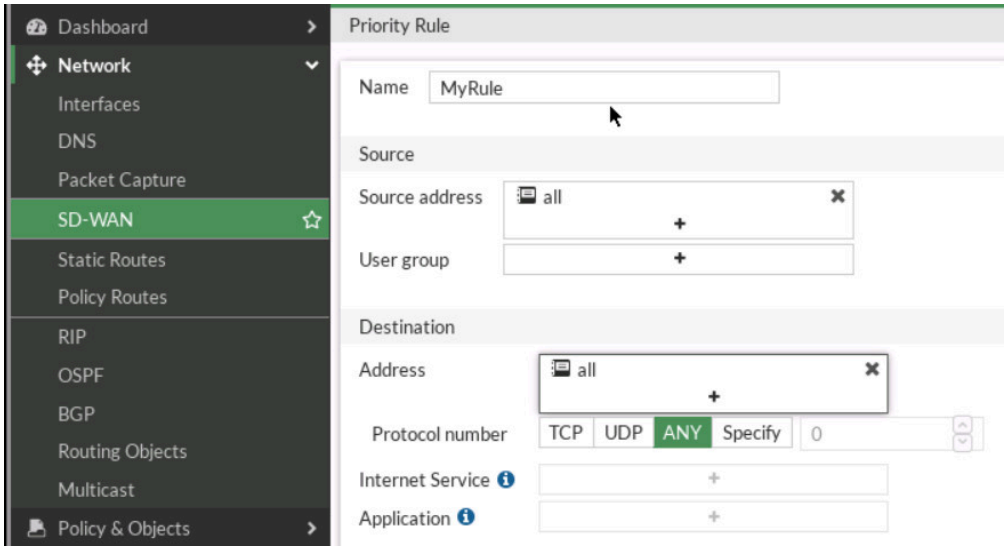


Figure 9.17: Priority Rule

9. Measured SLA. Create a SLA:

    - Name: **MySLA**
    - Protocol: **Ping**
    - Server: **4.2.2.4**
    - Add Target and leave the default parameters

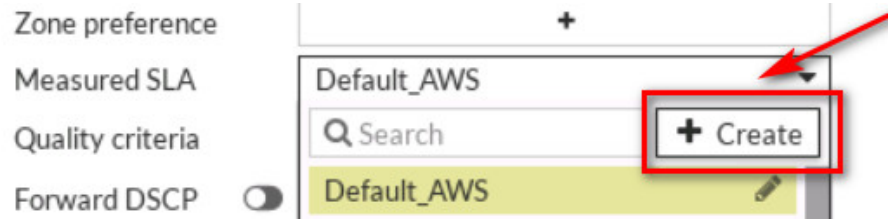


Figure 9.18: Add target

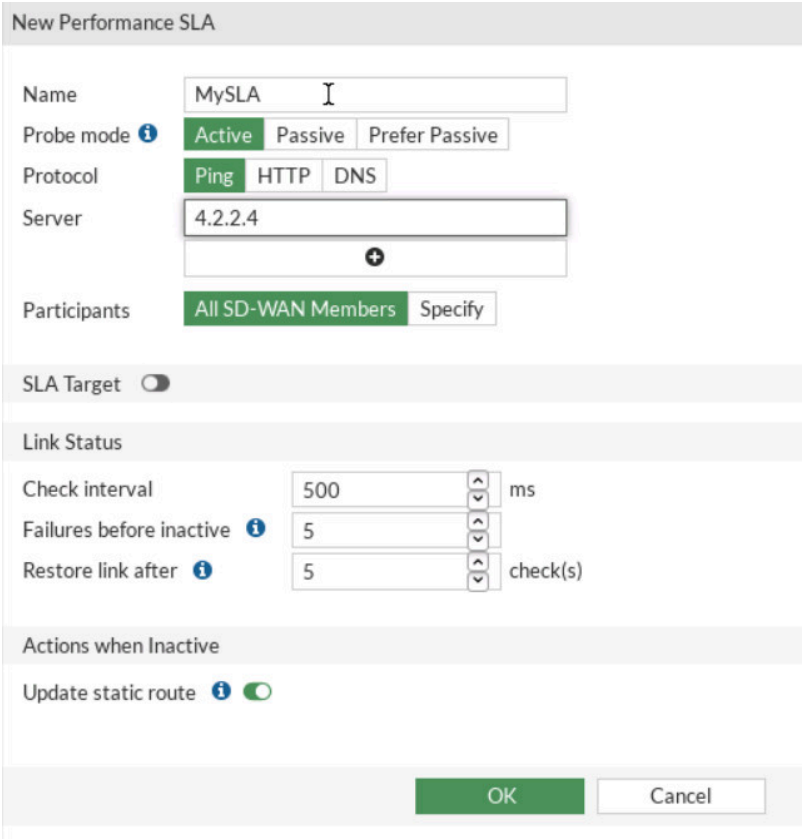


Figure 9.19: Create a SLA

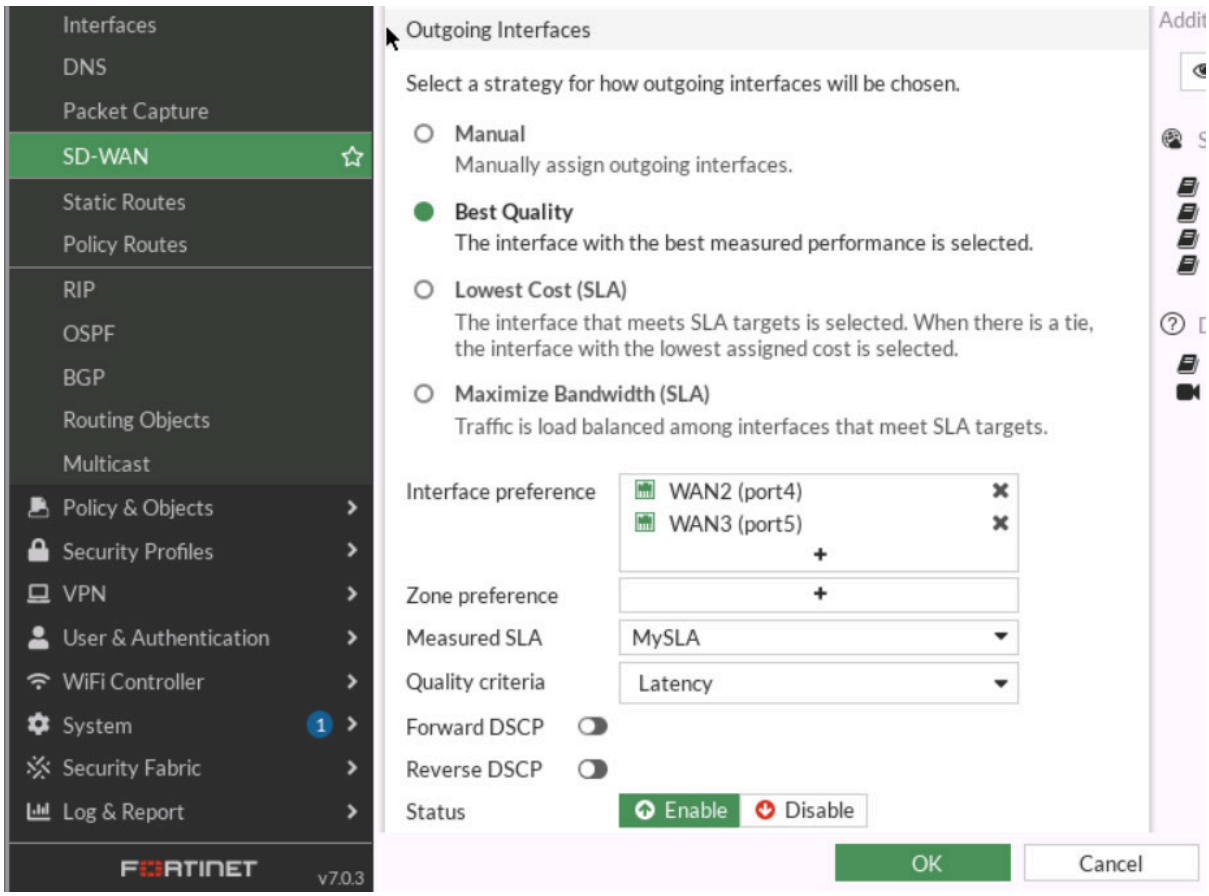


Figure 9.20: SD-WAN Configuration

10. Go to **Network > SD-WAN** and verify your **SD-WAN Usage**.

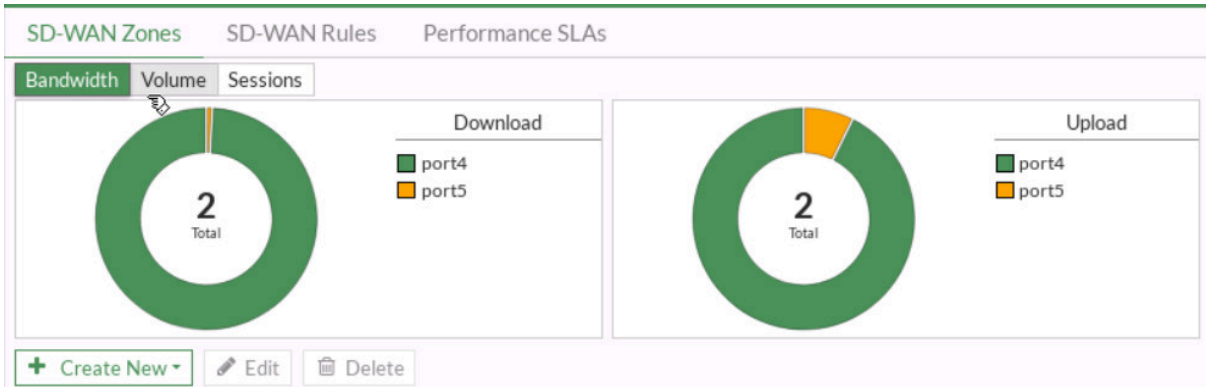


Figure 9.21: SD-WAN usage

11. Now, go to GN3 and disconnect port4. You should be able to reach the Internet from Firewall Manager.

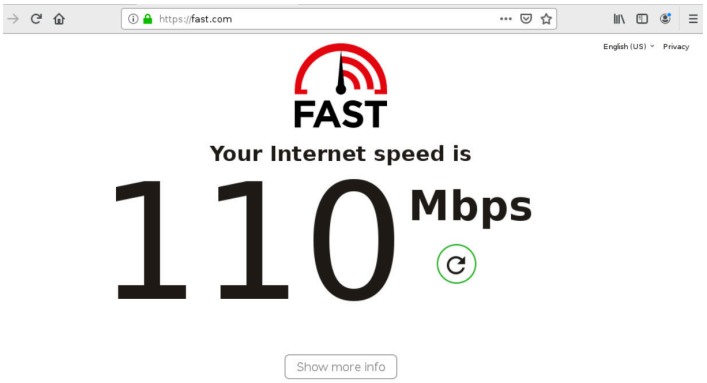


Figure 9.22: Verify configuration

12. Go to **Network > SD-WAN** and verify your **SD-WAN Usage**.

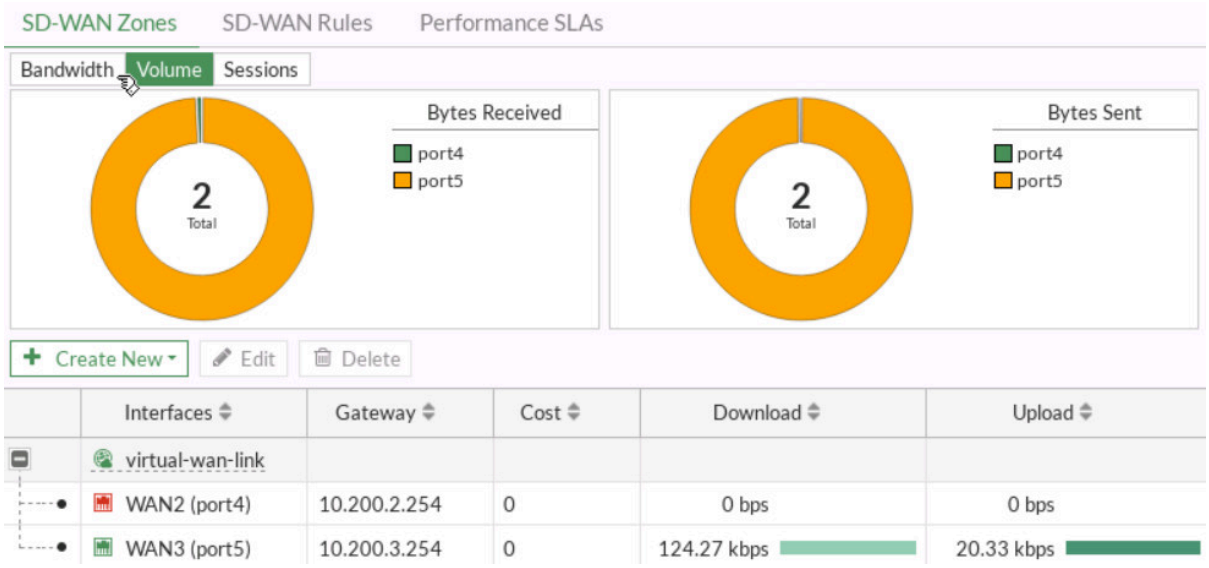


Figure 9.23: Status of interfaces

13. Open the browser in the Firewall Manager and type **msn.com** and then go to the **Dashboard > FortiView Sessions**. Verify your result.

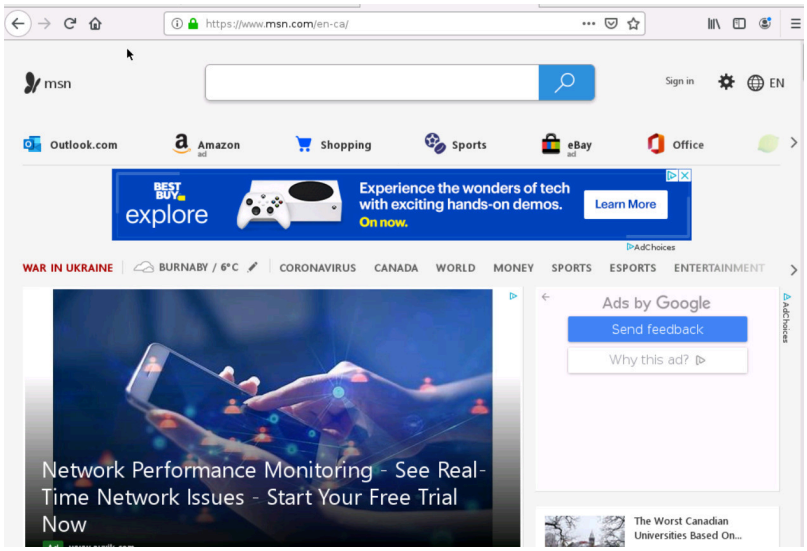


Figure 9.24: Verify configuration

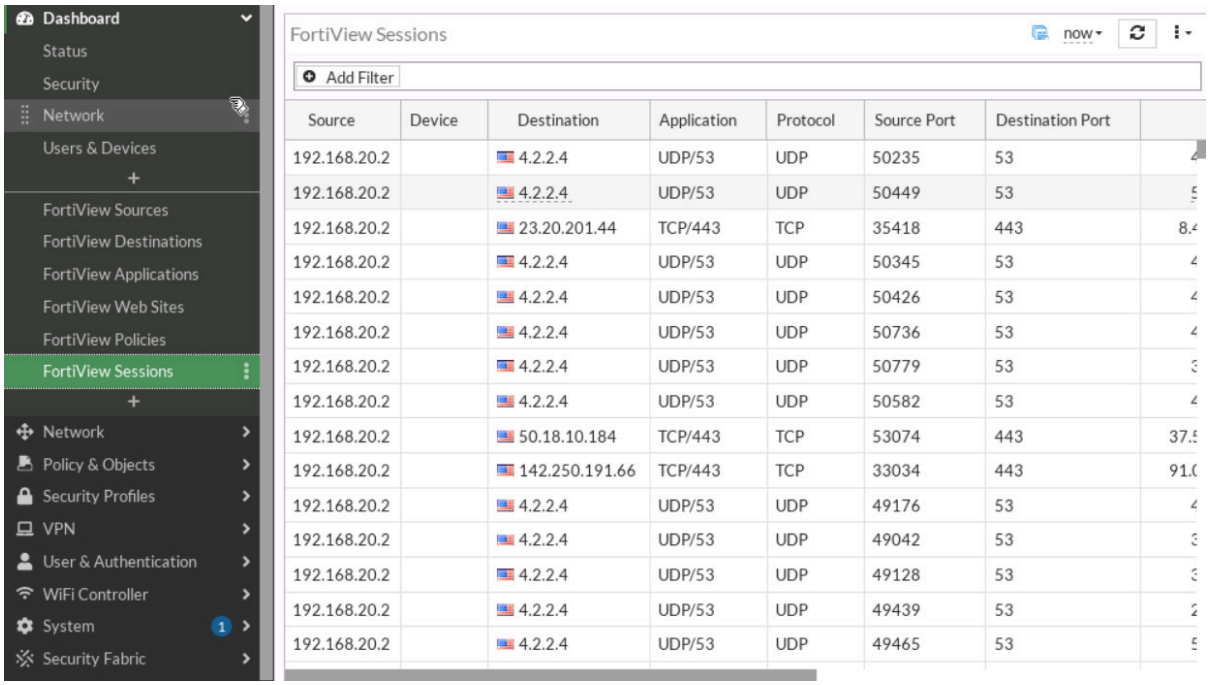


Figure 9.25: FortiView Sessions

14. Go to **Log & Report** > **Event** > **SD-WAN Event**. Verify your result.

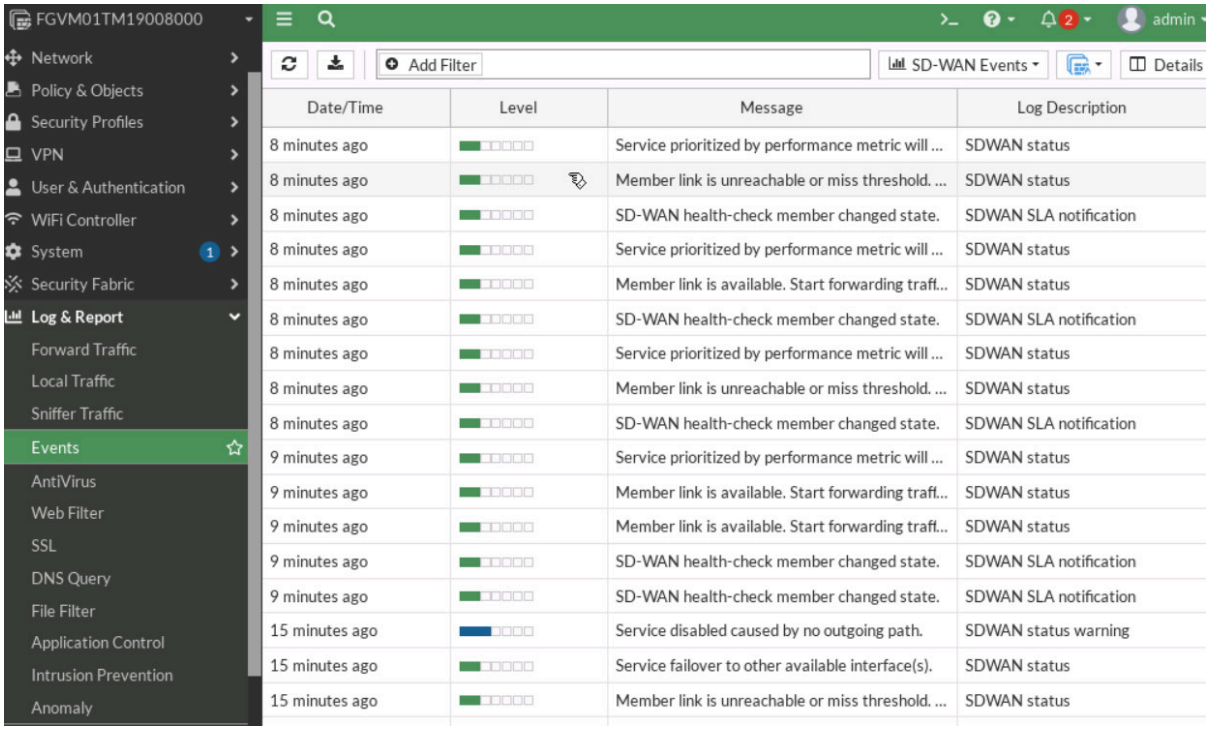


Figure 9.26: SD-WAN Events

Chapter 10. Cloud Technologies

10.1 IPsec VPN from FortiGate (on Premise) to Azure

Learning Objectives

- Configure a Virtual Network Gateway in Azure
- Configure a local network gateway
- Create an IPSEC VPN between Firewall on-Premise and Azure

Scenario: We are going to connect on premise FortiGate to Azure Virtual Gateway. This is going to be IPsec VPN between FortiGate and Azure. First, we will configure Azure and then connect FortiGate through Port1 to Azure Virtual Gateway.

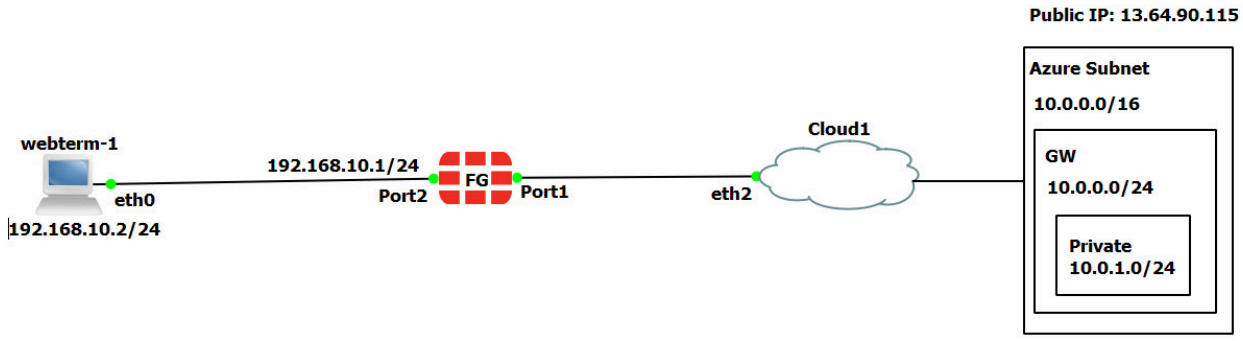


Figure 10.1: Main scenario

Table 10.1: On-premise devices configuration

Device	Configuration	Access
FortiGate	Port 1: DHCP Client Port 2: 192.168.10.1/24	Port1: HTTP, HTTPS, PING
WebTerm1	192.168.10.2/24	–

Azure Configuration

1. Create a resource group in Azure as following:
    - Resource group: **FG**
    - Region: **West US**

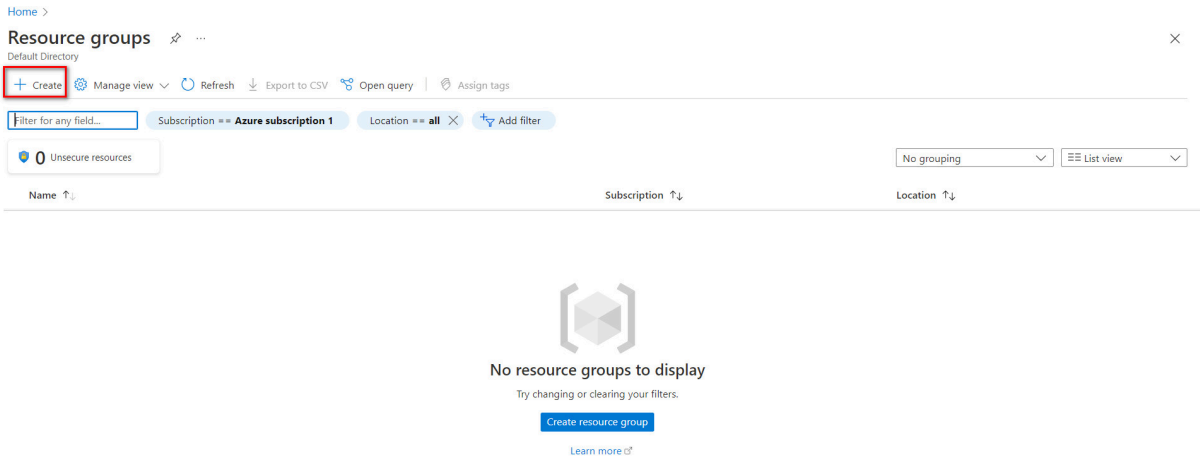


Figure 10.2: Create a resource group

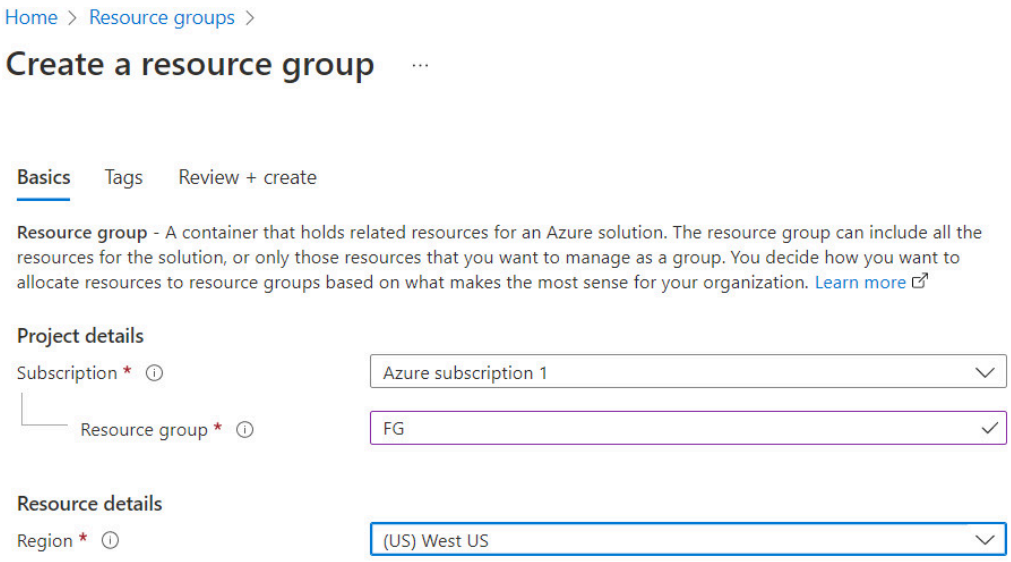


Figure 10.3: Create a resource group

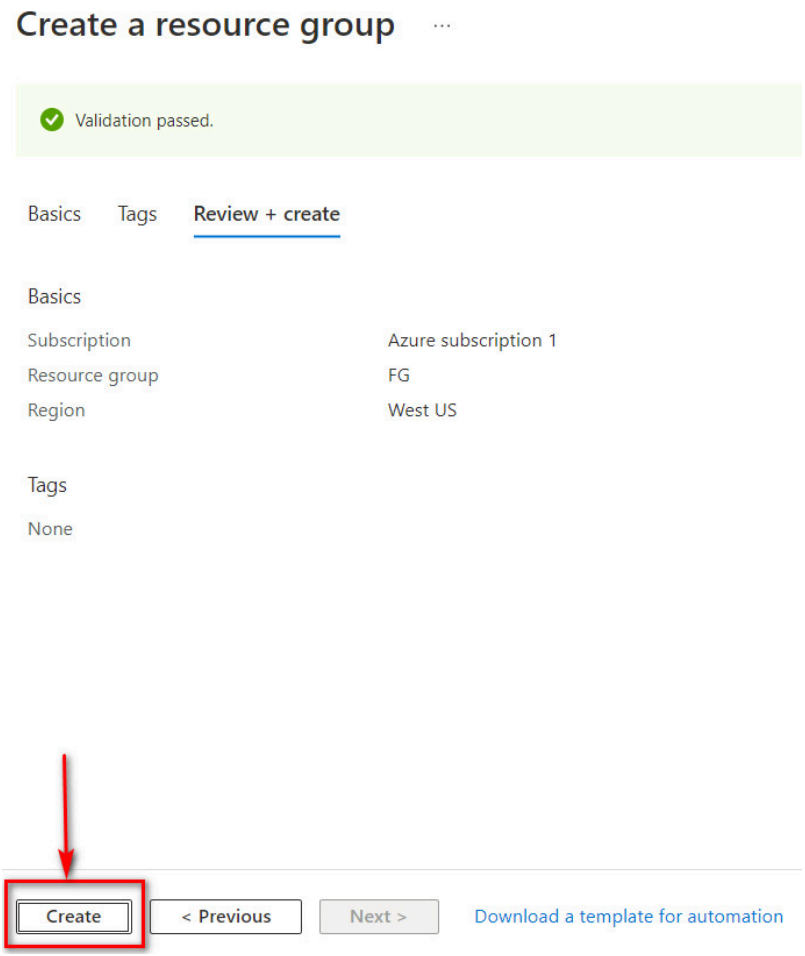


Figure 10.4: Create a resource group

2. Create a virtual network as following:
    - Resource group: **FG**
    - Name: **Azure-FG**
    - Region: **West US**
    - Change the default subnet: **10.0.1.0/24**

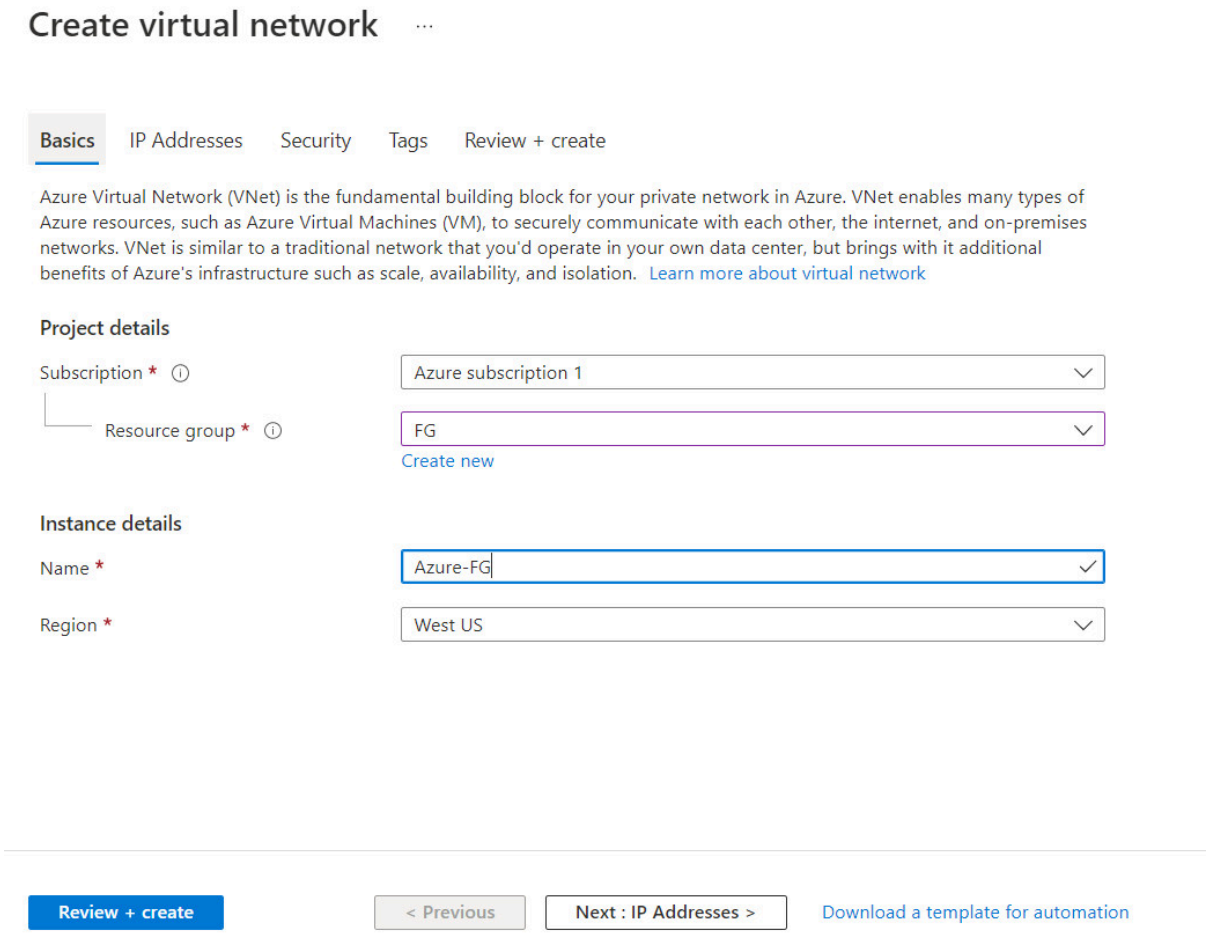


Figure 10.5: Create a virtual network

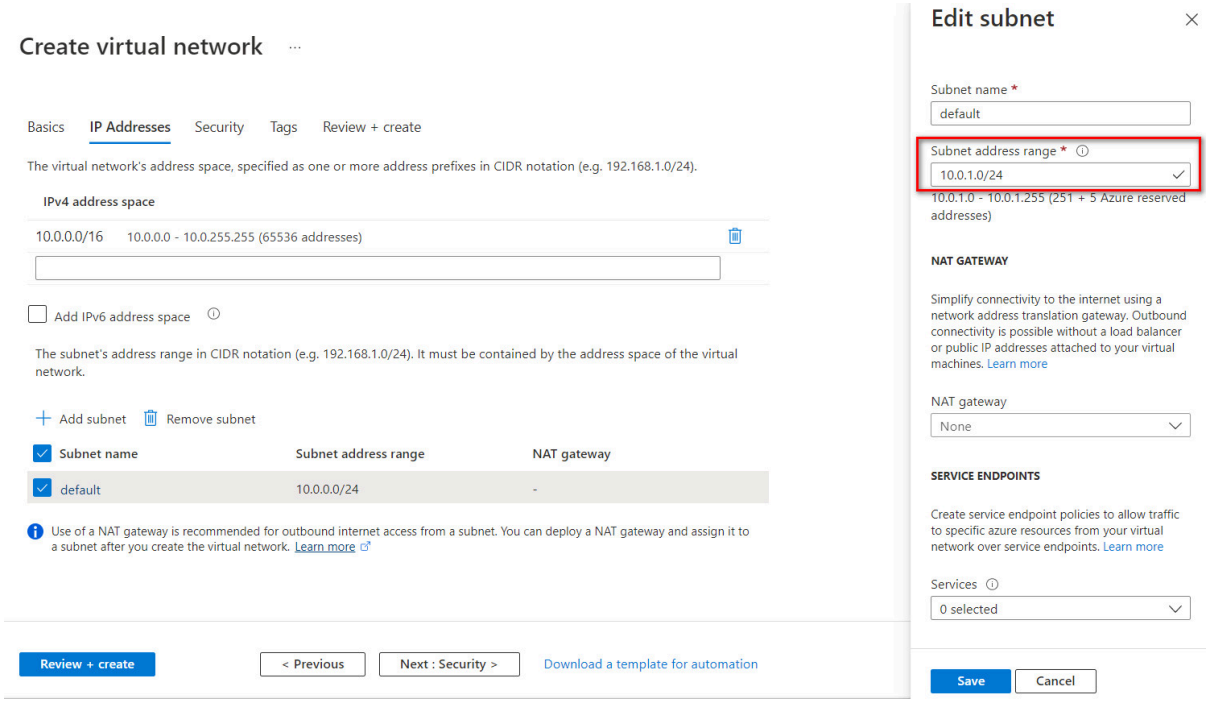


Figure 10.6: Create a virtual network (change default subnet)

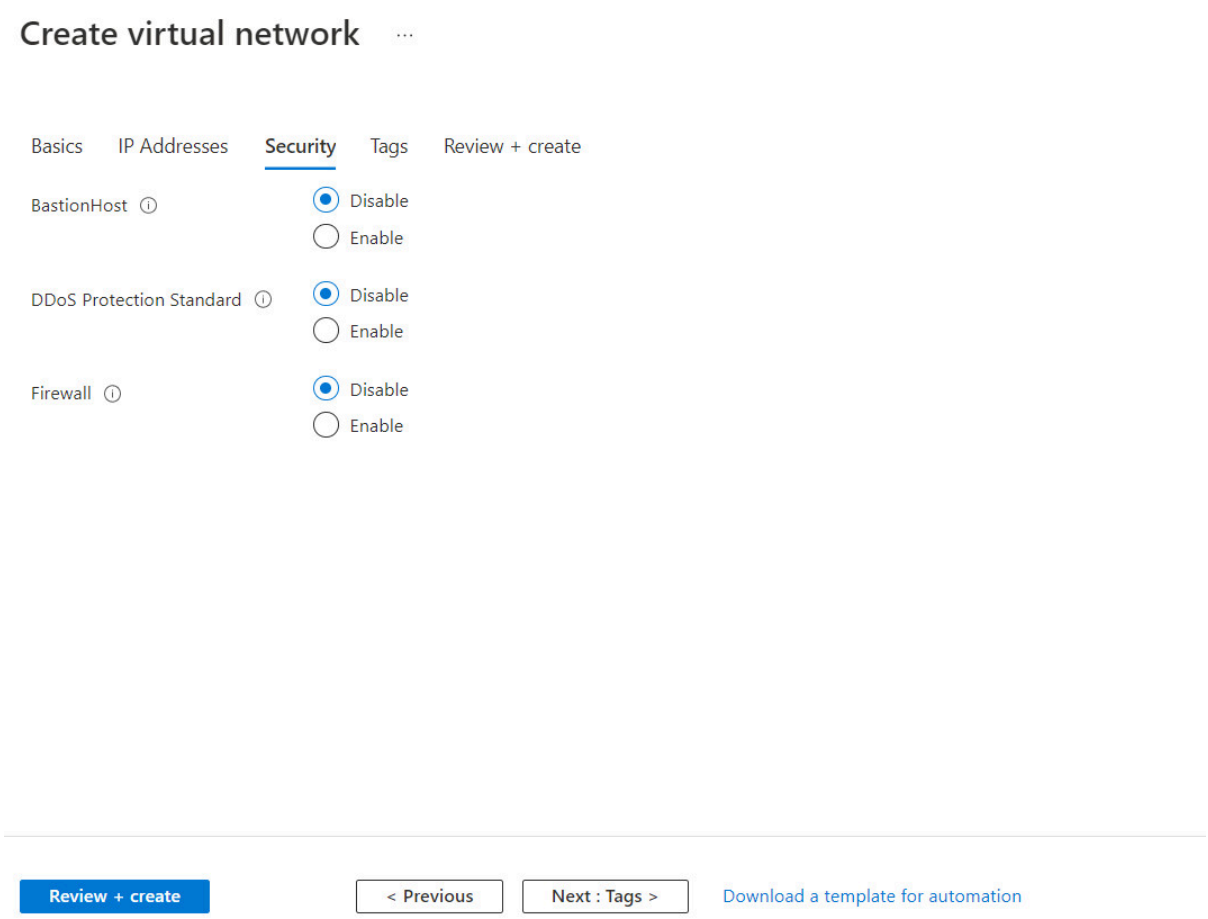


Figure 10.7: Create a virtual network

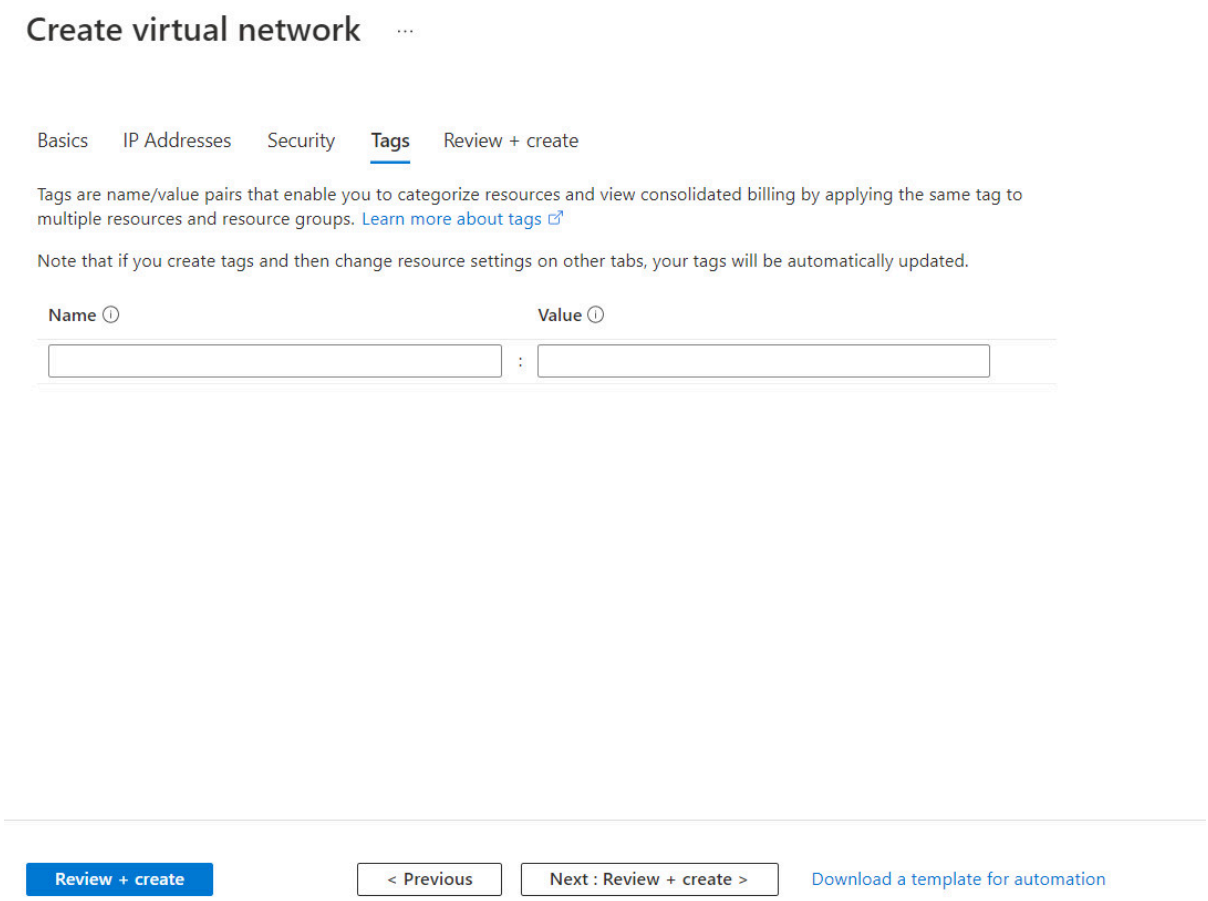


Figure 10.8: Create a virtual network

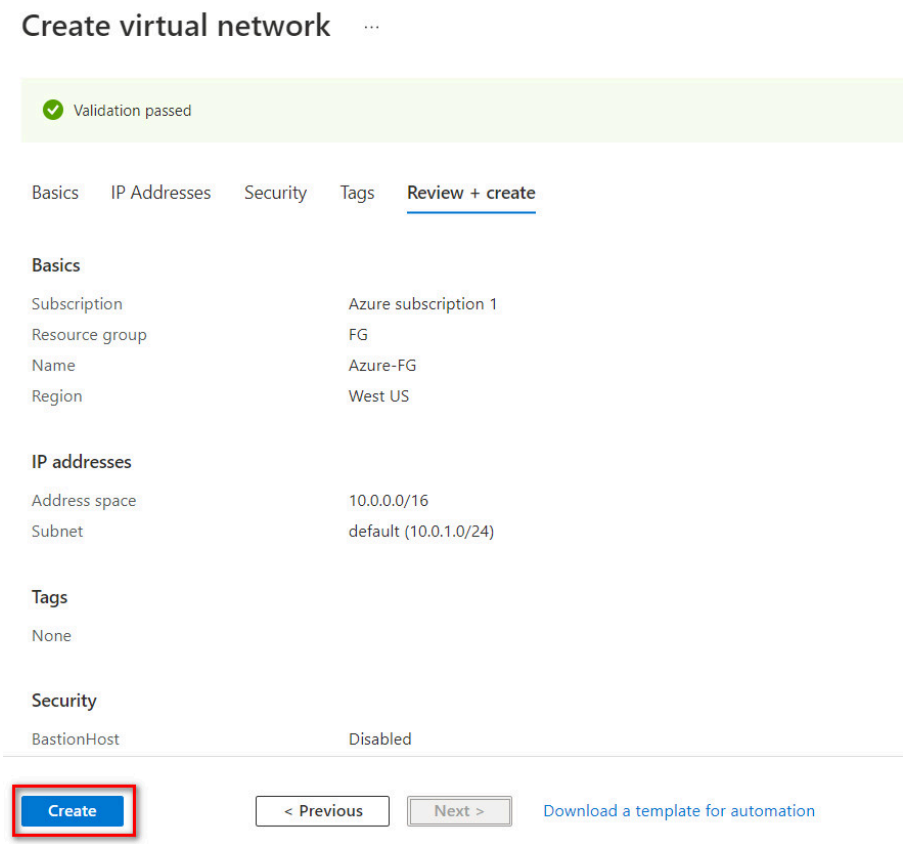


Figure 10.9: Create a virtual network

3. Create a virtual network gateway as following:

    - **Name:** Azure-VPN-FG
    - **Region:** West US
    - **Generation:** Generation1
    - **Gateway subnet address range:** 10.0.0.0/24
    - **Public IP address name:** AzurePublic

    Click on “Create and Review”. It takes around **25** minutes to deploy a virtual network gateway in Azure.

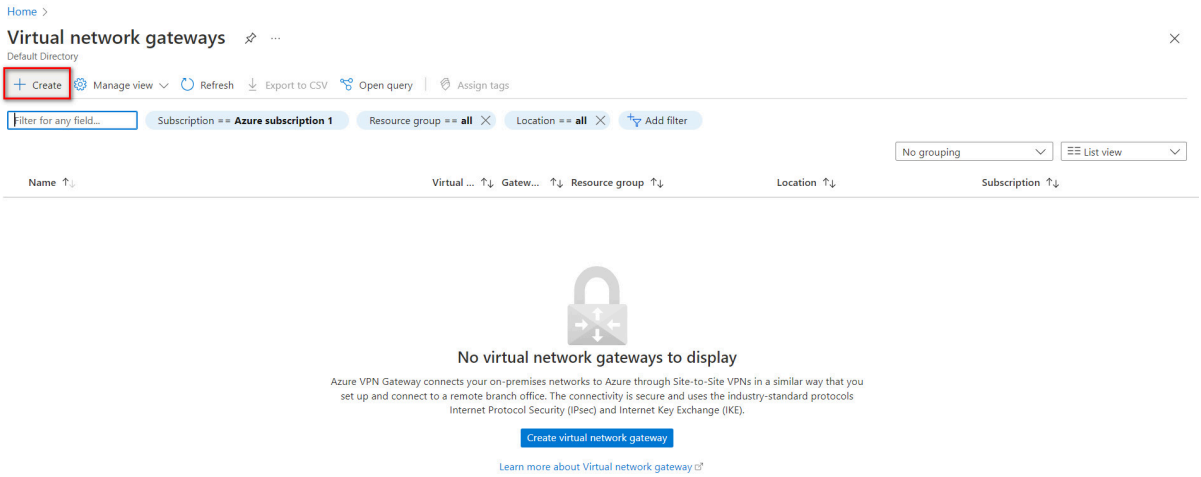


Figure 10.10: Create a virtual network gateway

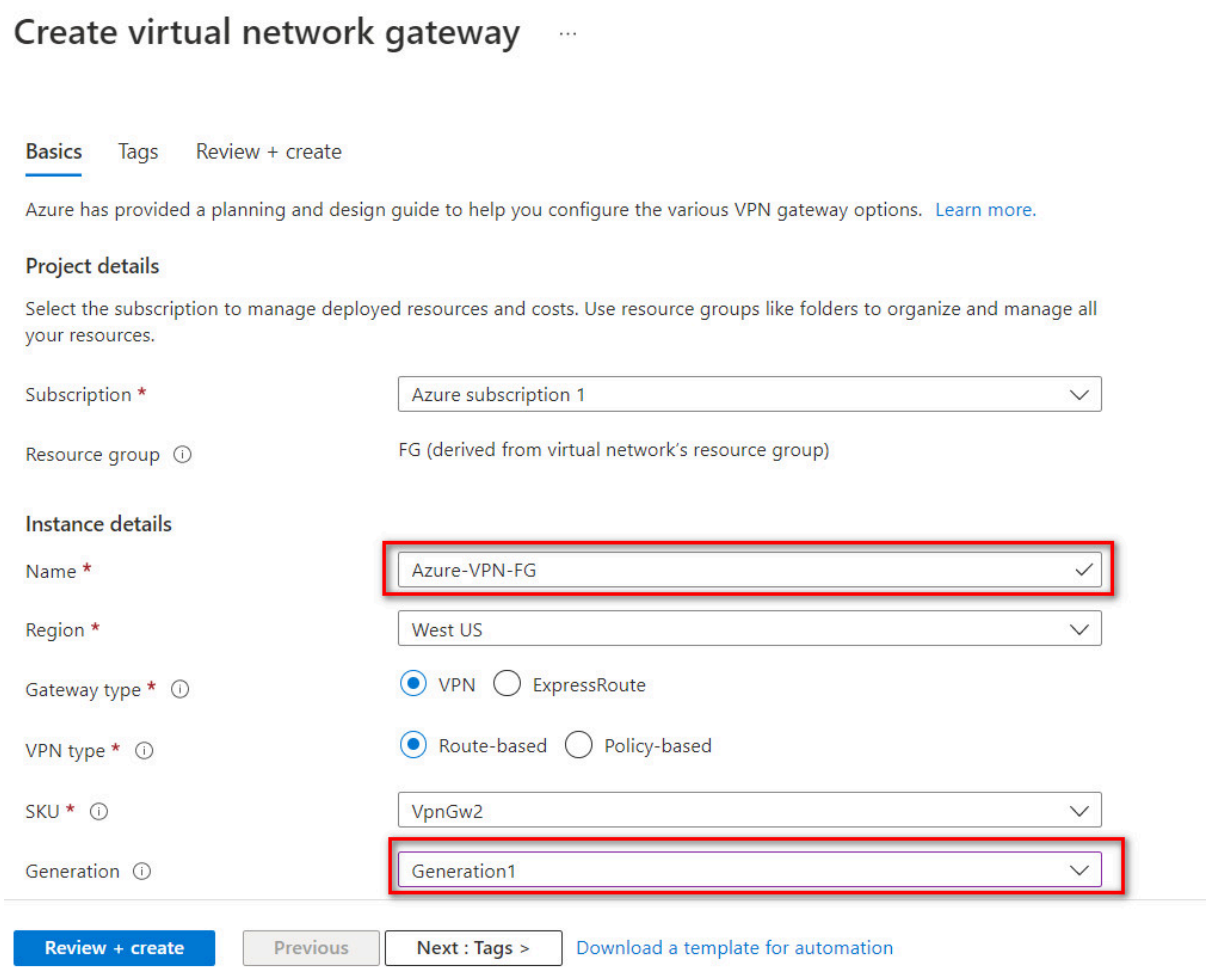


Figure 10.11: Create a virtual network gateway

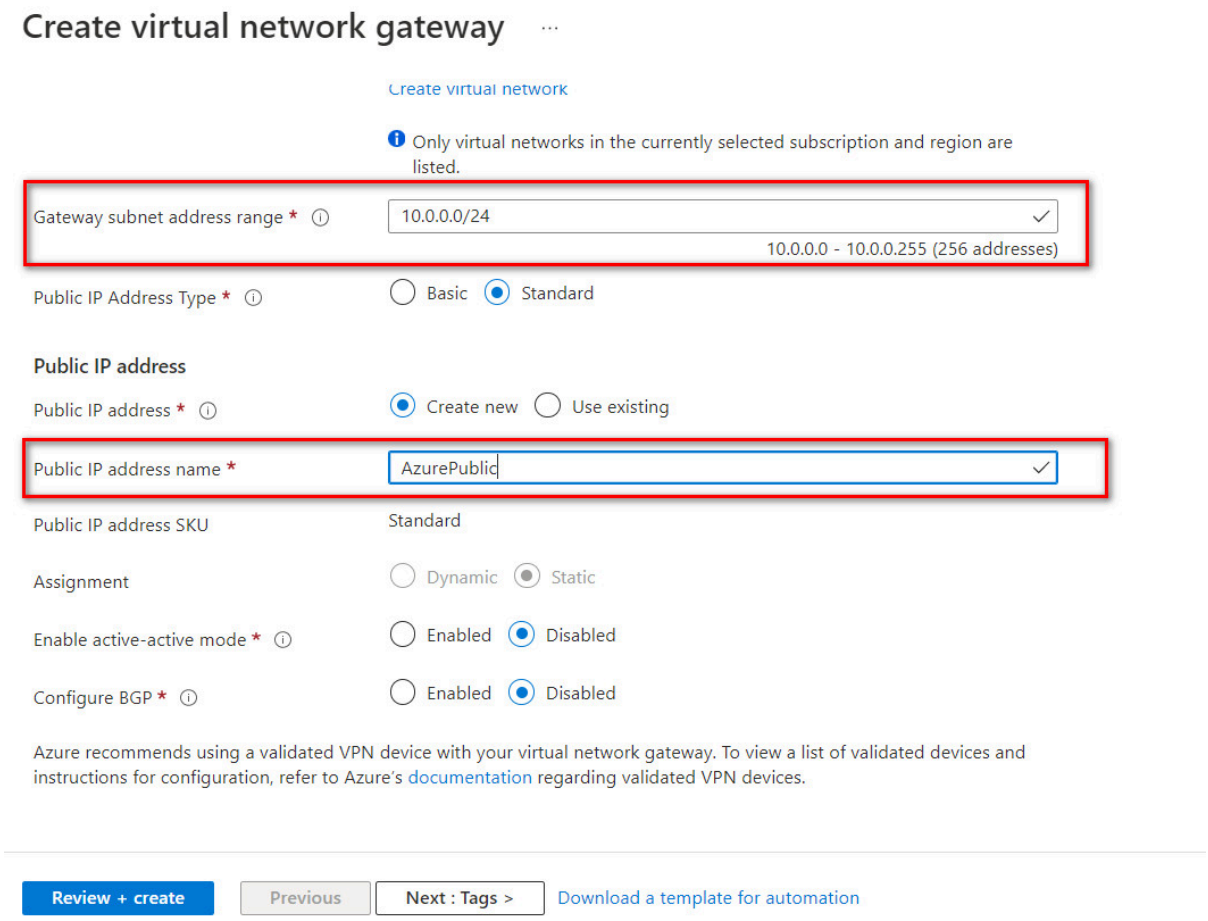


Figure 10.12: Create a virtual network gateway

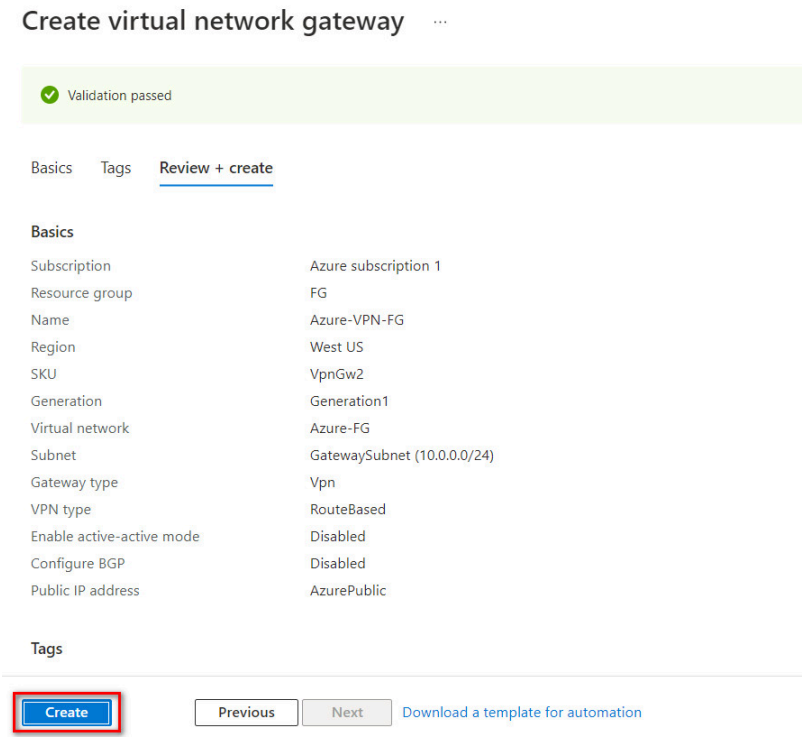


Figure 10.13: Create a virtual network gateway (review + create)

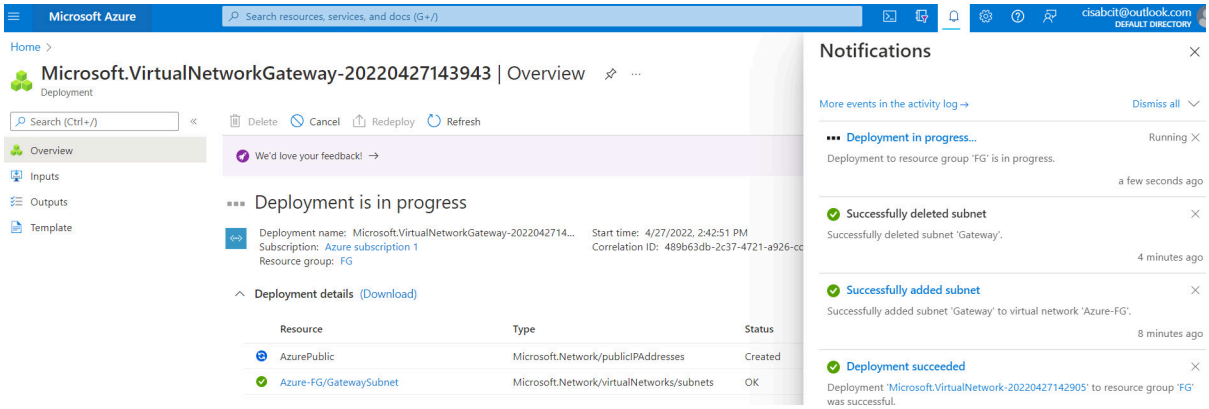


Figure 10.14: Create a virtual network gateway (deployment)

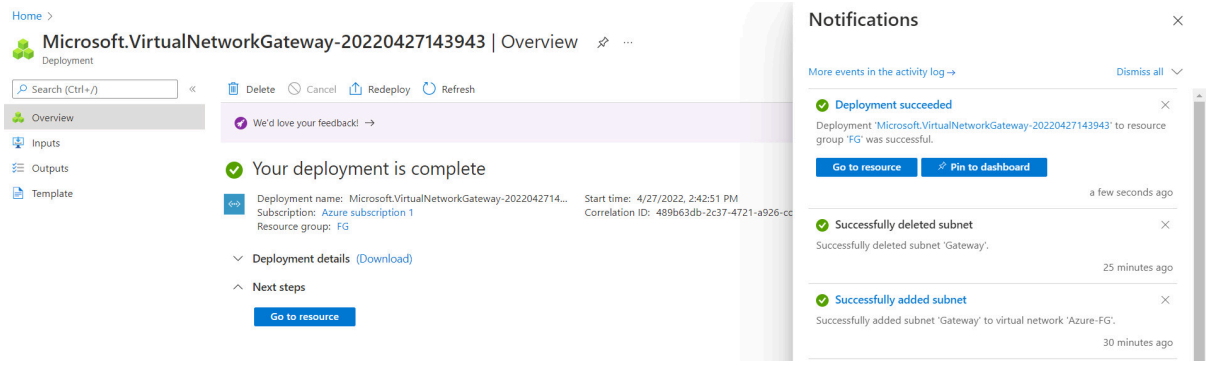


Figure 10.15: Deployment of virtual network gateway

4. Create a local network gateway as following:

- **Resource Group:** FG
- **Region:** West US
- **Name:** FortiGate
- **IP Address:** IP_Address_of_Port1_FortiGate (On premise)
- **Address Space:** IP_Address_LocalNetwork

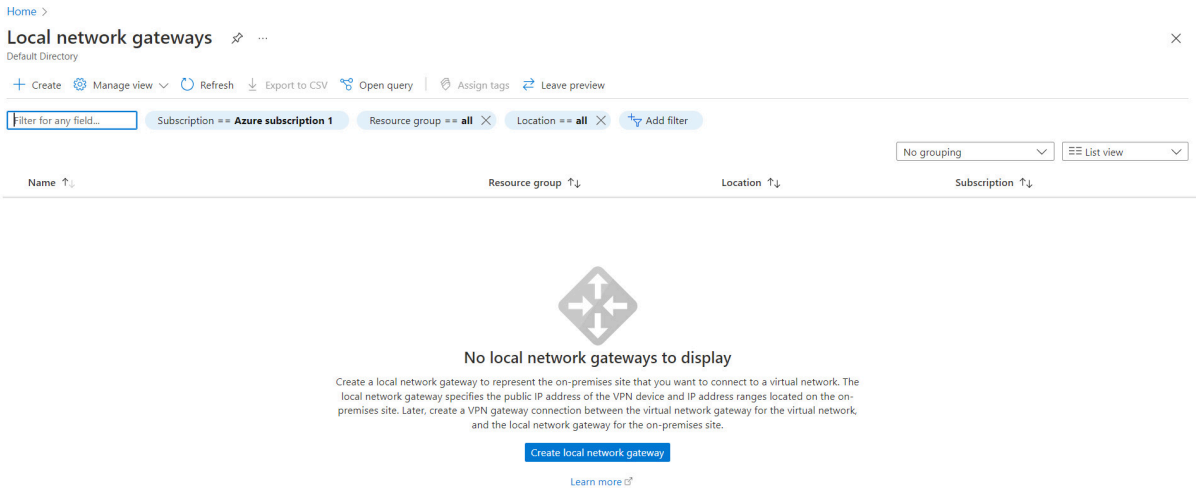


Figure 10.16: Create a local network gateway

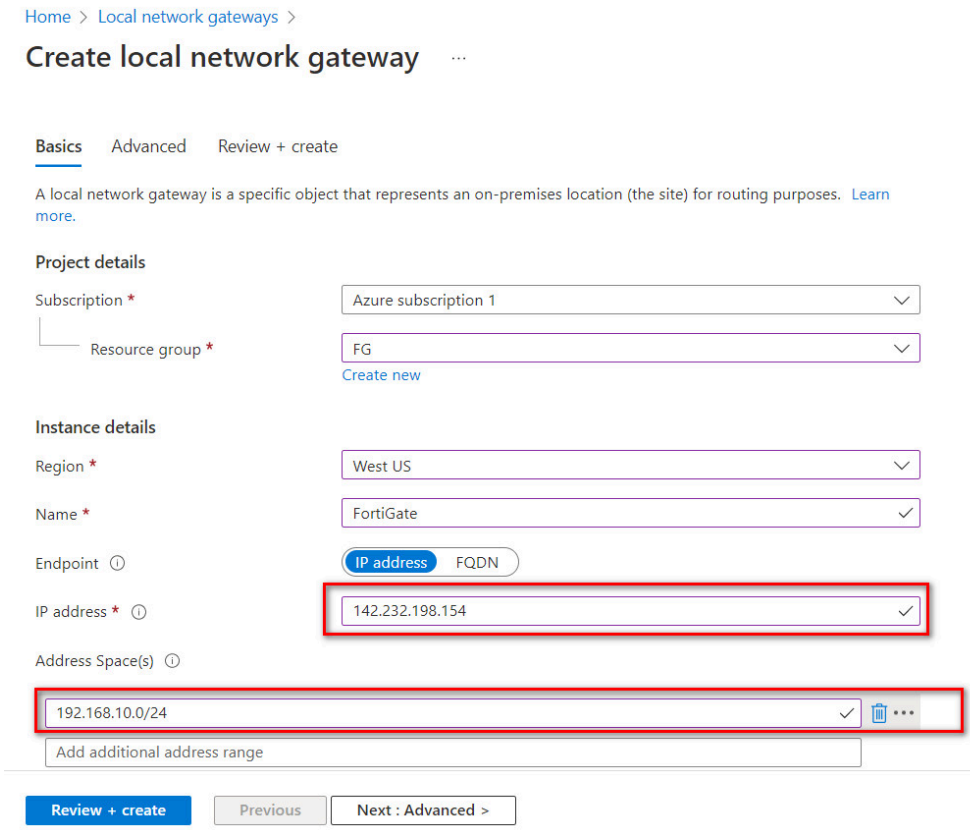


Figure 10.17: Create a local network gateway

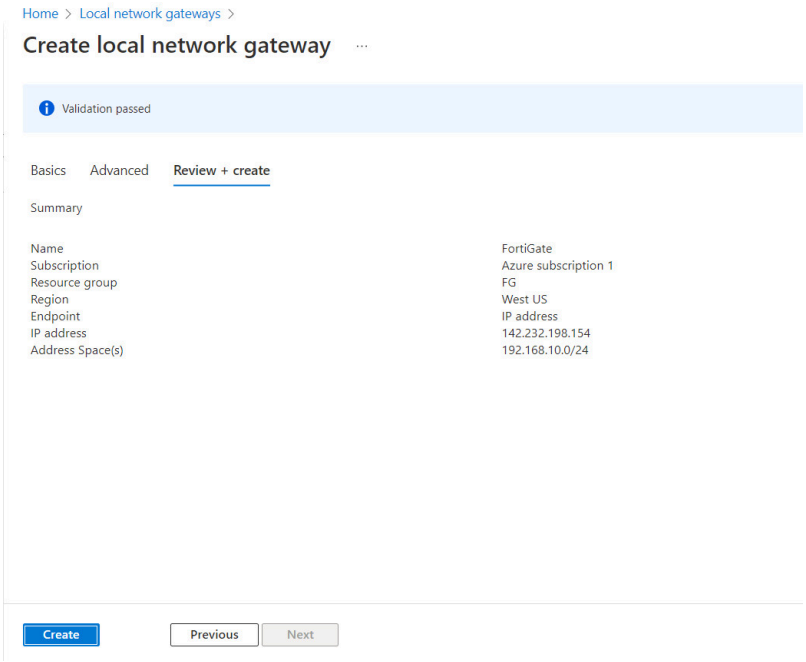


Figure 10.18: Create a local network gateway (review + create)

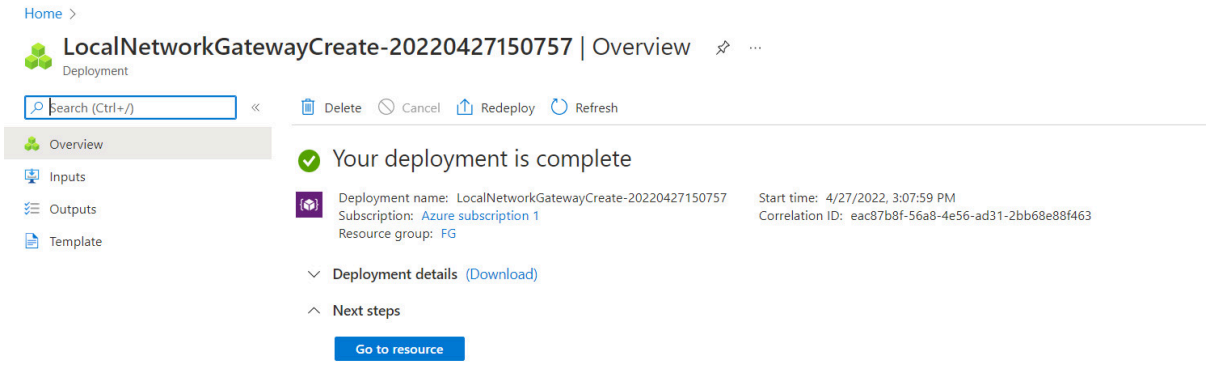


Figure 10.19: Verify local network gateway deployment

5. Go to Virtual network gateway and create a connection in **Virtual network gateways** > **connections** > **Add**:

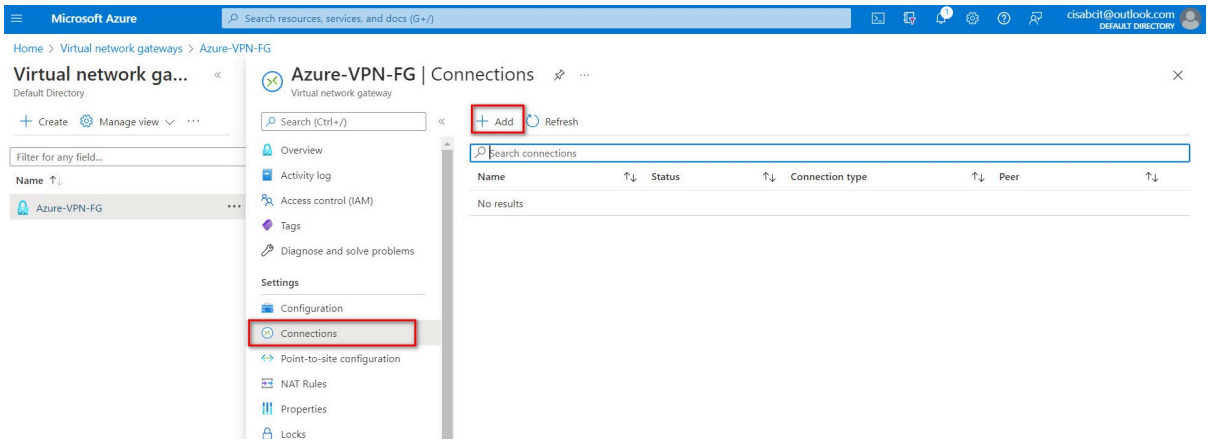


Figure 10.20: Add connections

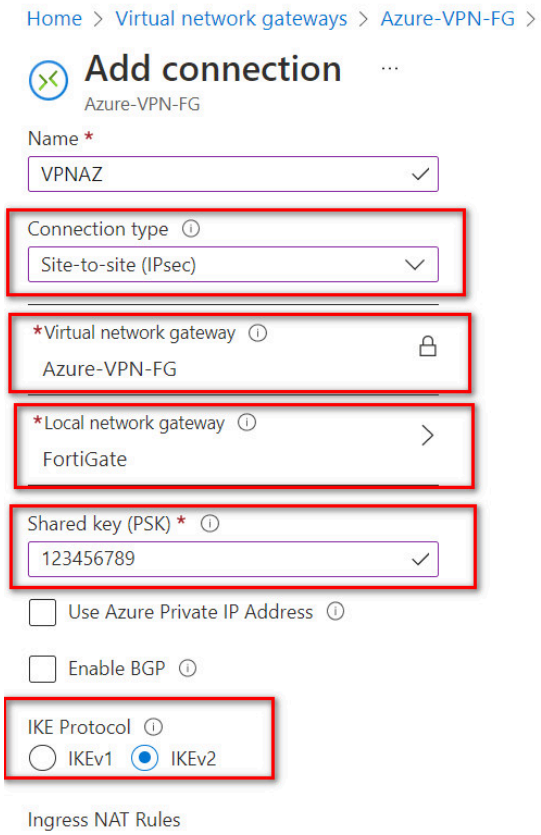


Figure 10.21: Connection configuration

Based on the Microsoft article “About cryptographic requirements and Azure VPN gateways” (https://learn.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-about-compliance-crypto), by default, integrity is SHA384, SHA256, SHA1, MD5 and encryption is AES256, AES192, AES128, DES3, DES. So, we will select SHA1 and AES128 in FortiGate. After doing this step, you should receive a Public IP address in Overview tab.

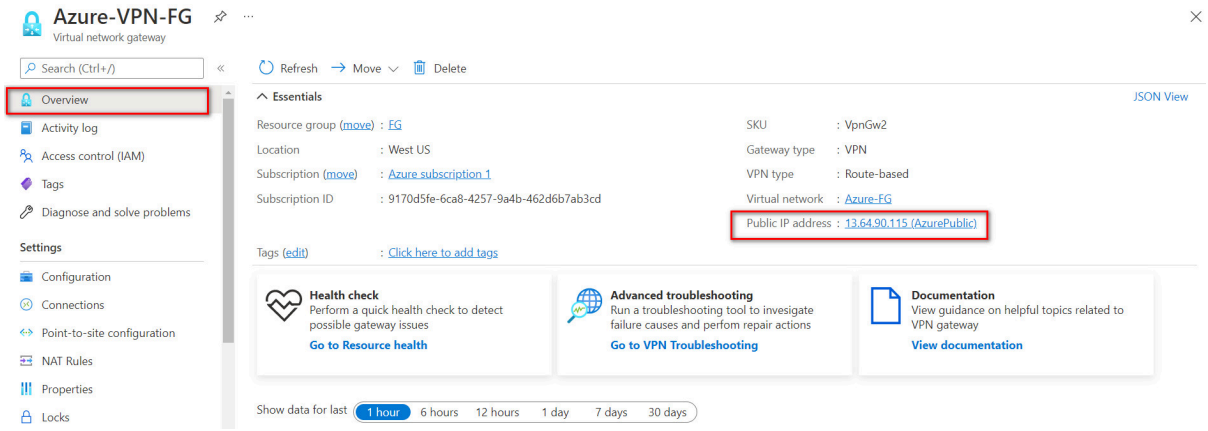


Figure 10.22: Verify public IP address

FortiGate Configuration

1. First, we will configure port 2 IP address.

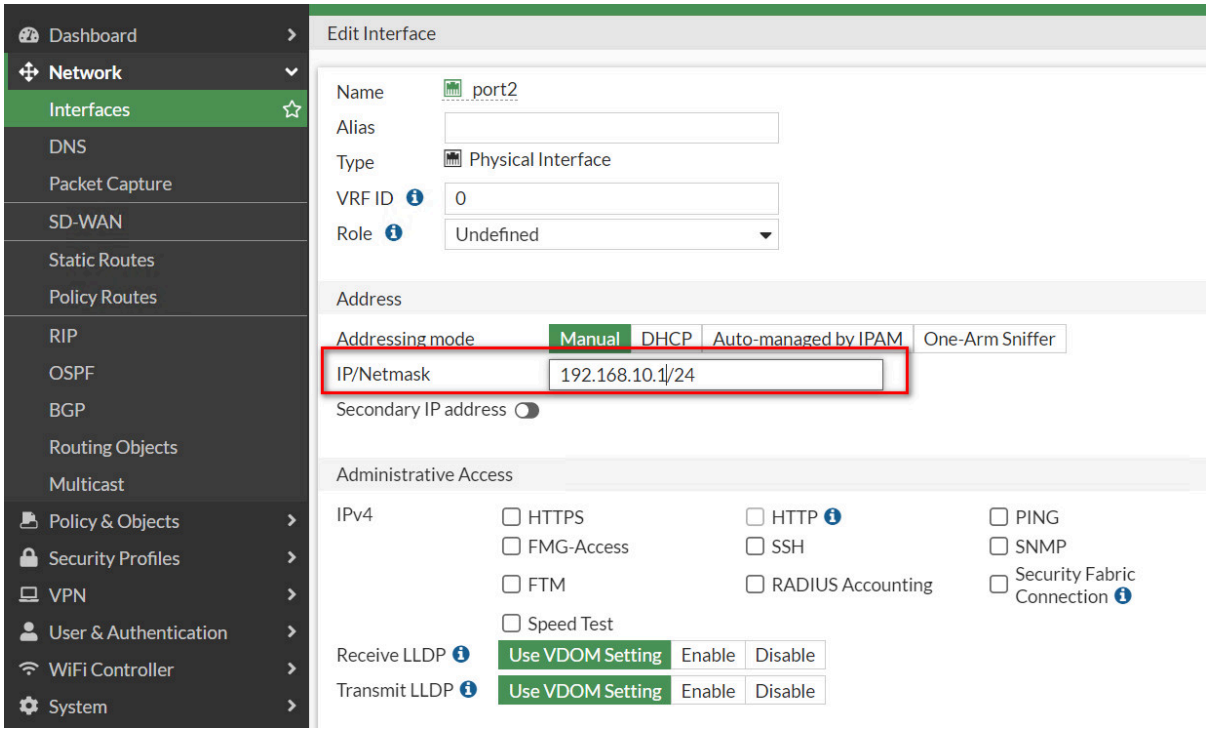


Figure 10.23: Set an IP address for port2

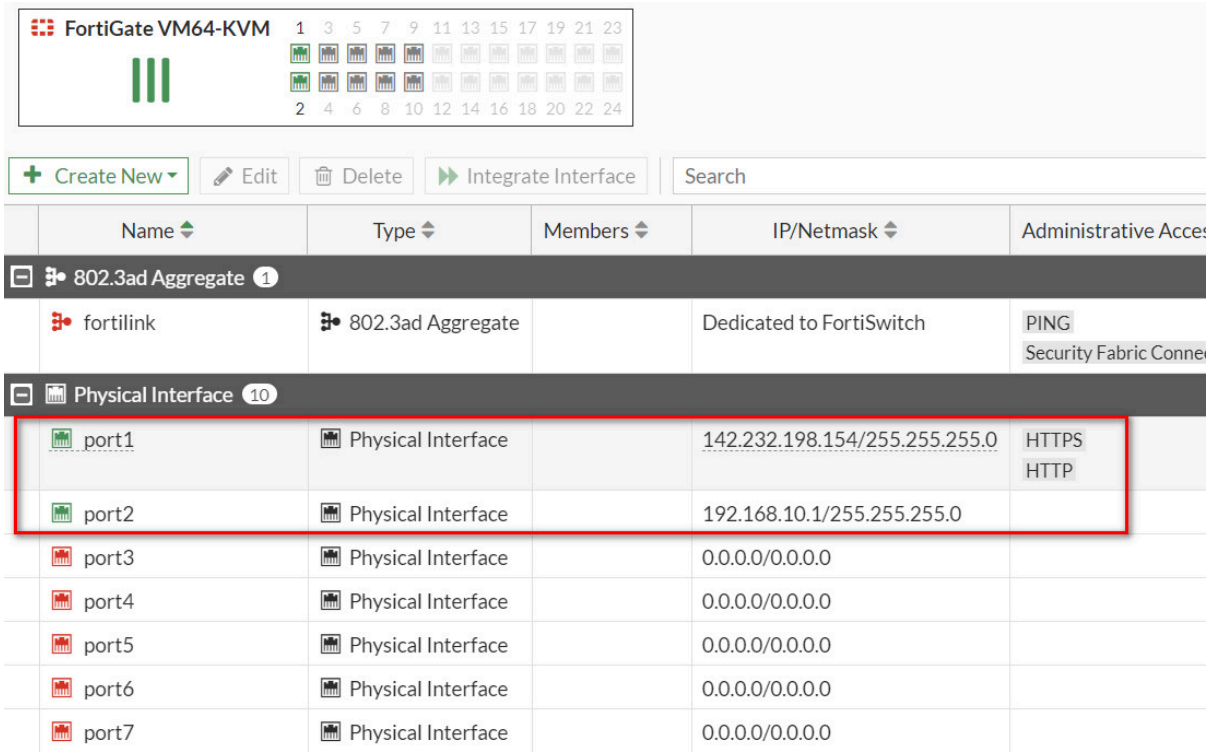


Figure 10.24: Port1 and Port2 IP addresses

2. Create a static route to port1 (WAN Port) as Figure 10.25.

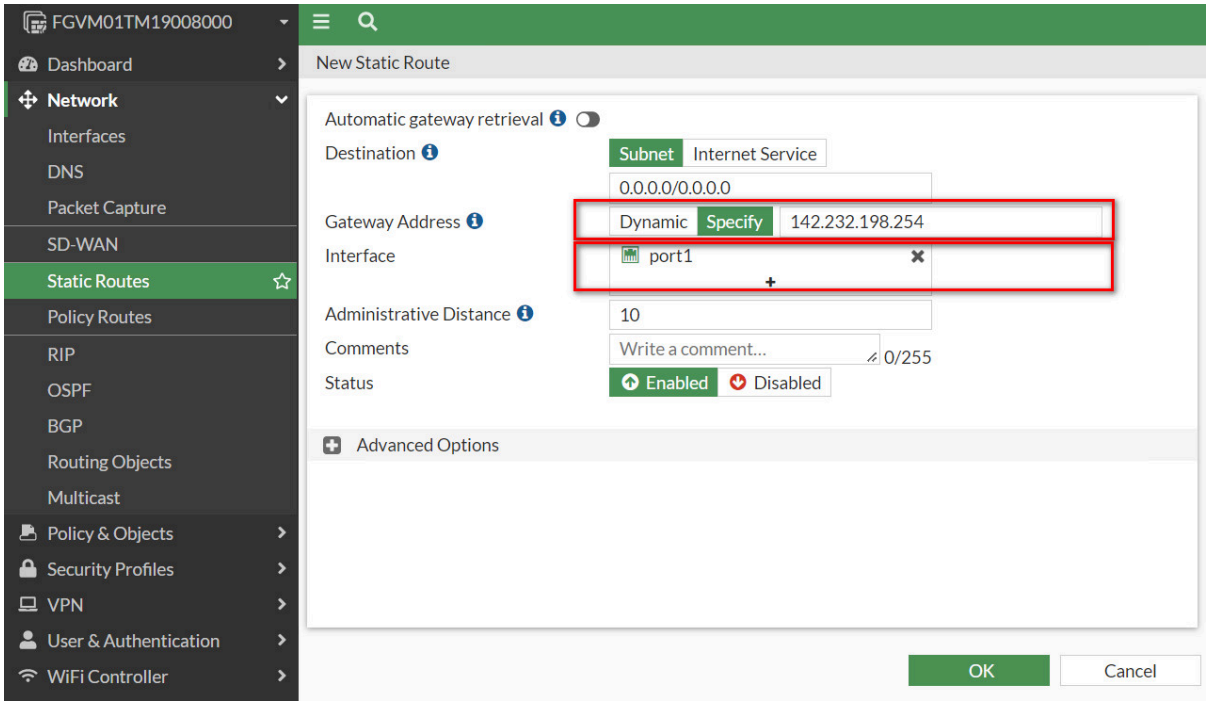


Figure 10.25: Create a static route

3. Create a IPsec Wizard as a custom.

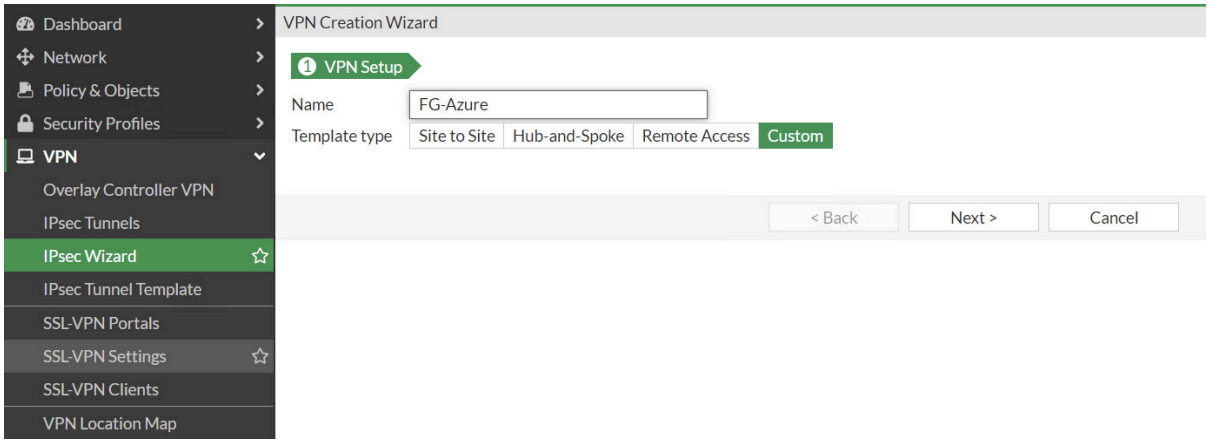


Figure 10.26: Create a custom VPN

- **Remote Gateway IP Address:** *Public_IP_Address_Azure_Virtual_Gateway*
- **Nat Traversal:** Disable
- **Pre-shared Key:** *The same as Azure key (123456789)*
- **Local Address:** 192.168.10.0/24
- **Remote Address:** 10.0.0.0/16
- **Phase 1:** Encryption: AES128, Authentication: SHA-1, DH: 2, lifetime: 28800
- **Phase 2:** Encryption: AES128, Authentication: SHA-1, DH: 2, lifetime: 27000

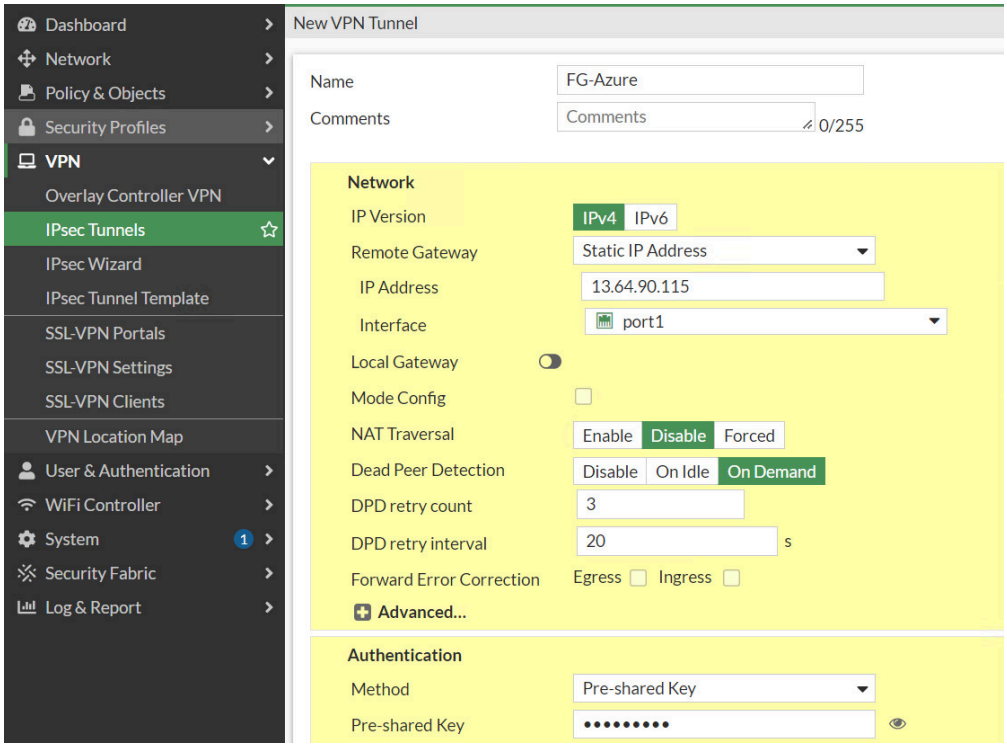


Figure 10.27: Create a custom VPN

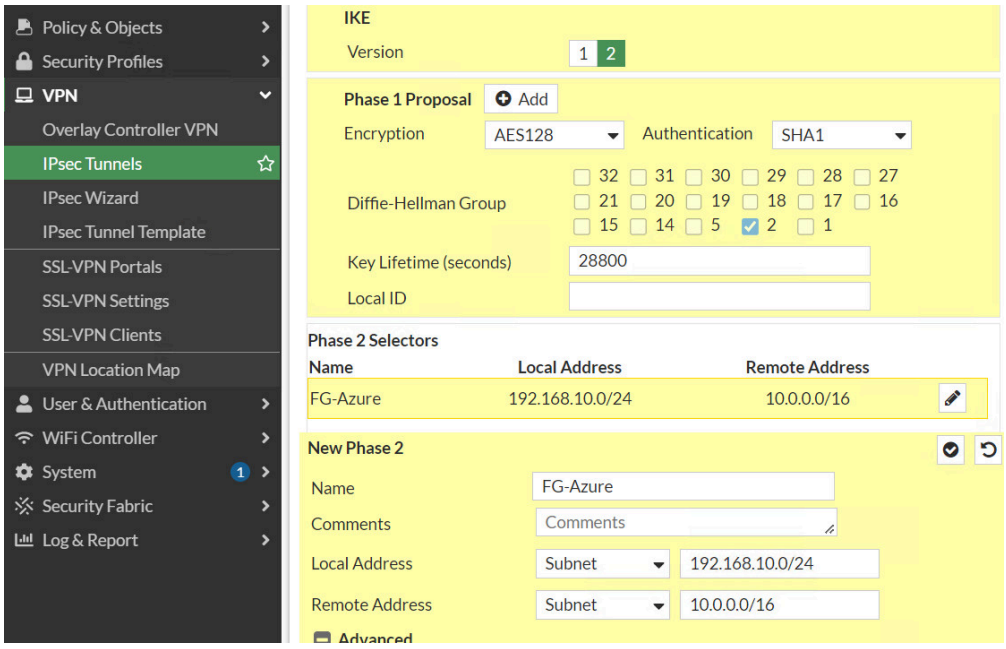


Figure 10.28: Create a custom VPN

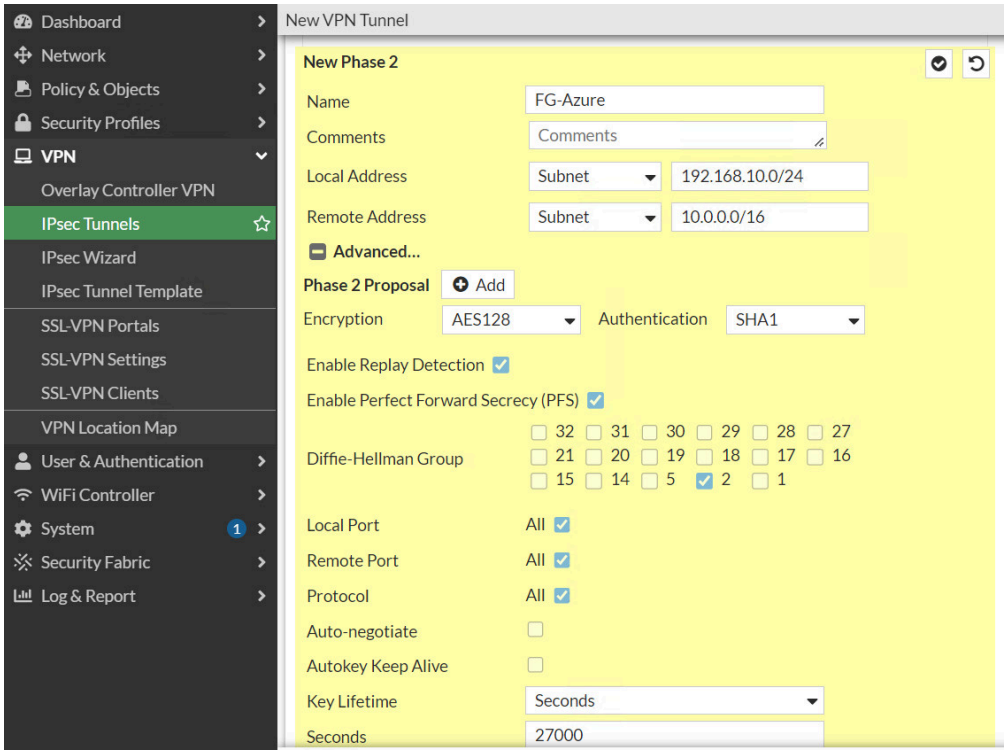


Figure 10.29: Create a custom VPN

4. Create a firewall policy from Port 2 to Tunnel and from Tunnel to Port2. We will create a subnet for LAN on premise and a subnet for Microsoft Azure. Like site-to-site VPN we learned previously, NAT should be disabled here.

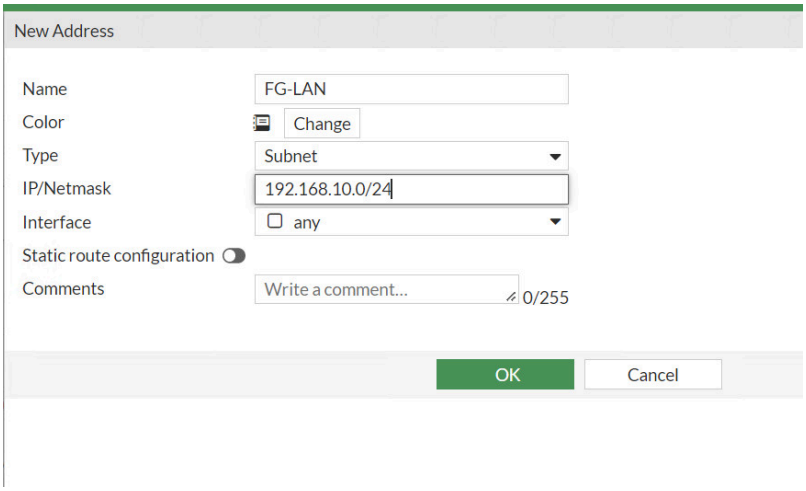


Figure 10.30: Create a subnet for local network

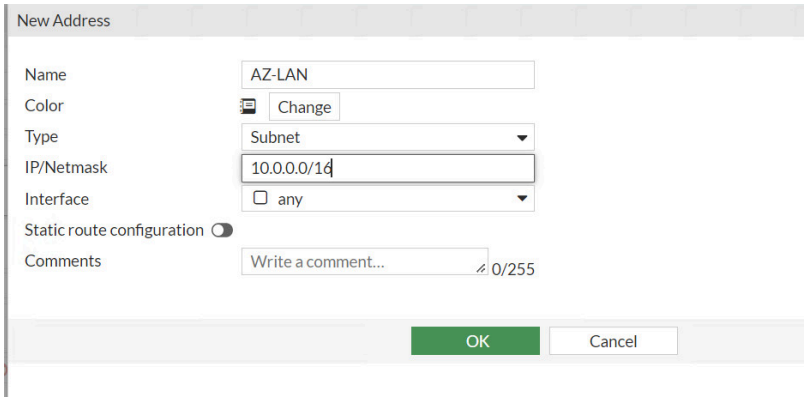


Figure 10.31: Create a subnet for Azure local

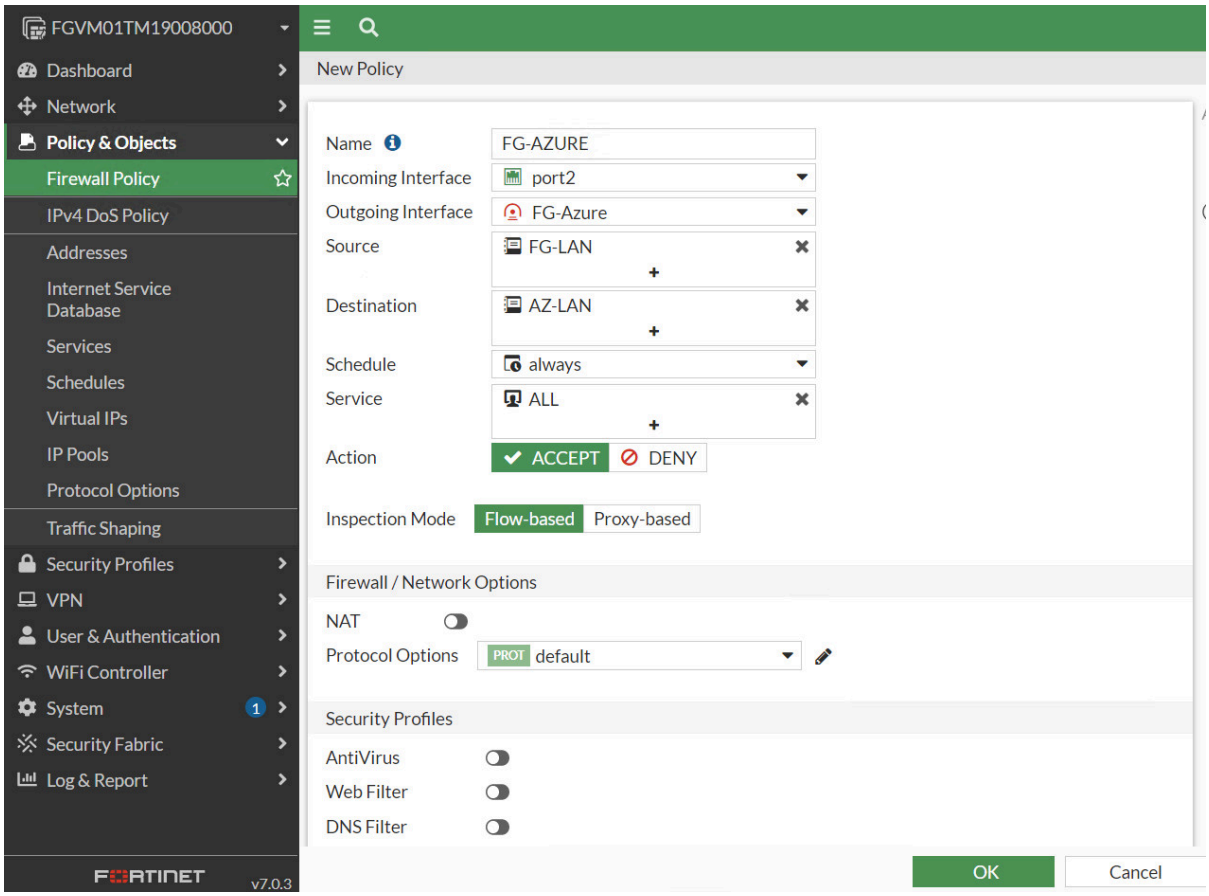


Figure 10.32: Create a policy from port2 to FG-Azure Tunnel

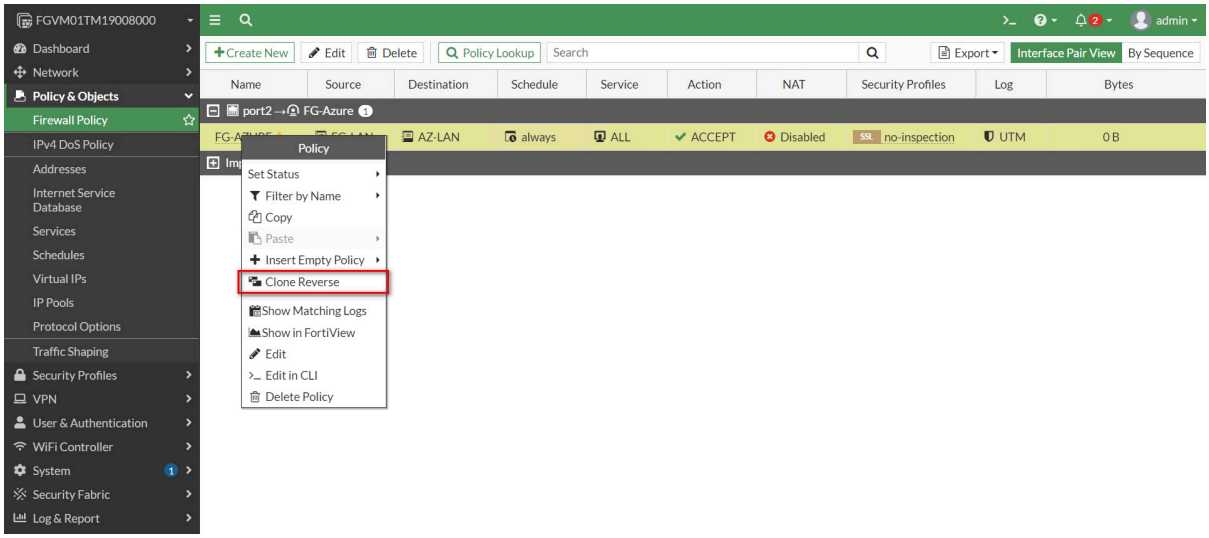


Figure 10.33: Create a policy from FG-Azure Tunnel to port2

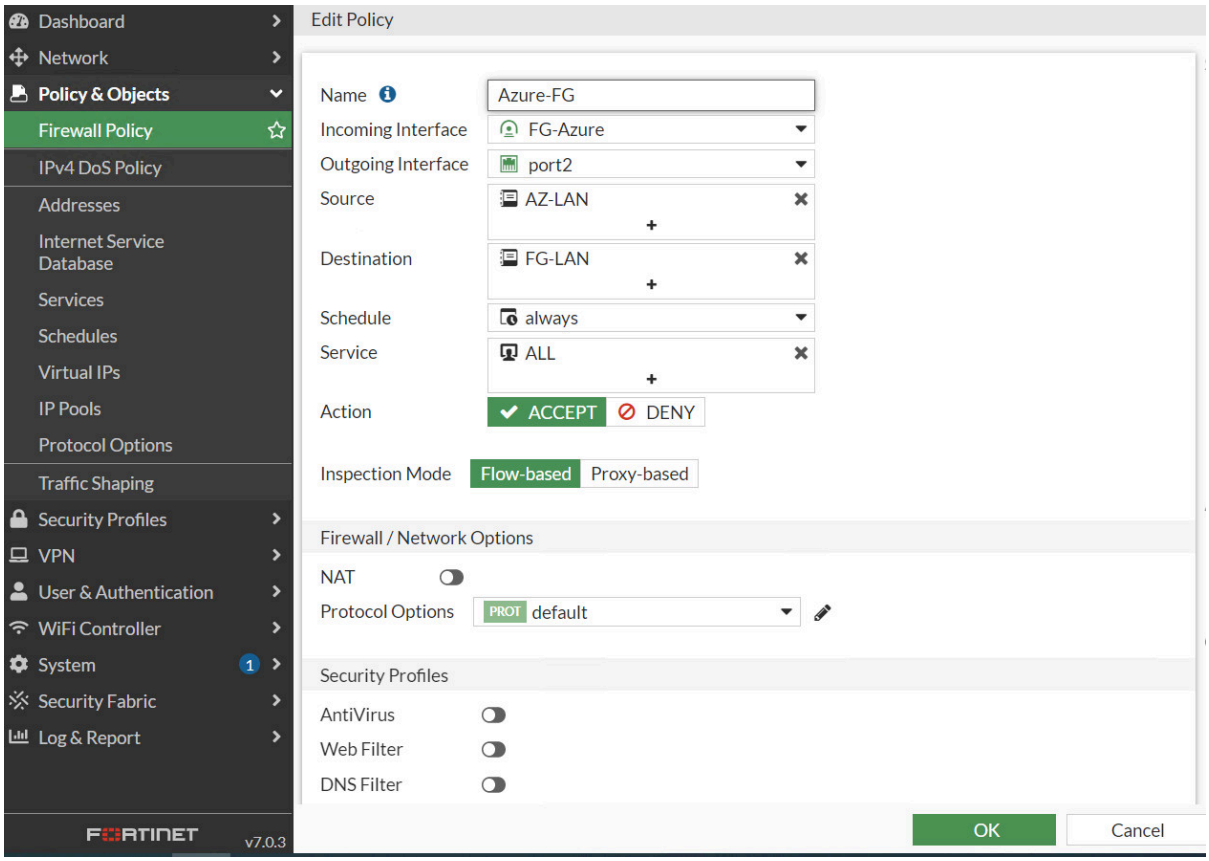


Figure 10.34: Create a policy from FG-Azure Tunnel to port2

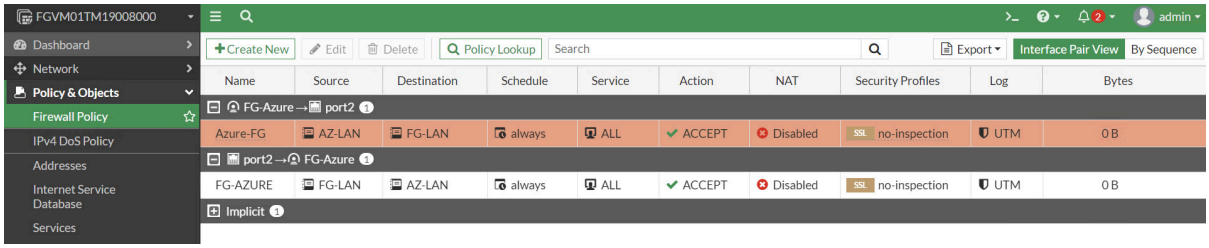


Figure 10.35: Firewall Policies

Verify Connections

If you navigate to IPsec Tunnel, the status should be up.

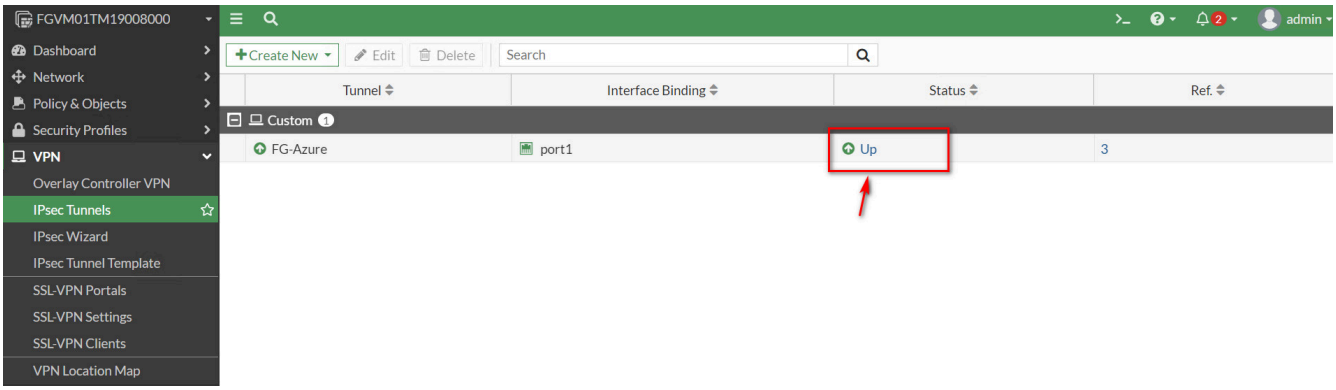


Figure 10.36: Verify status in FortiGate

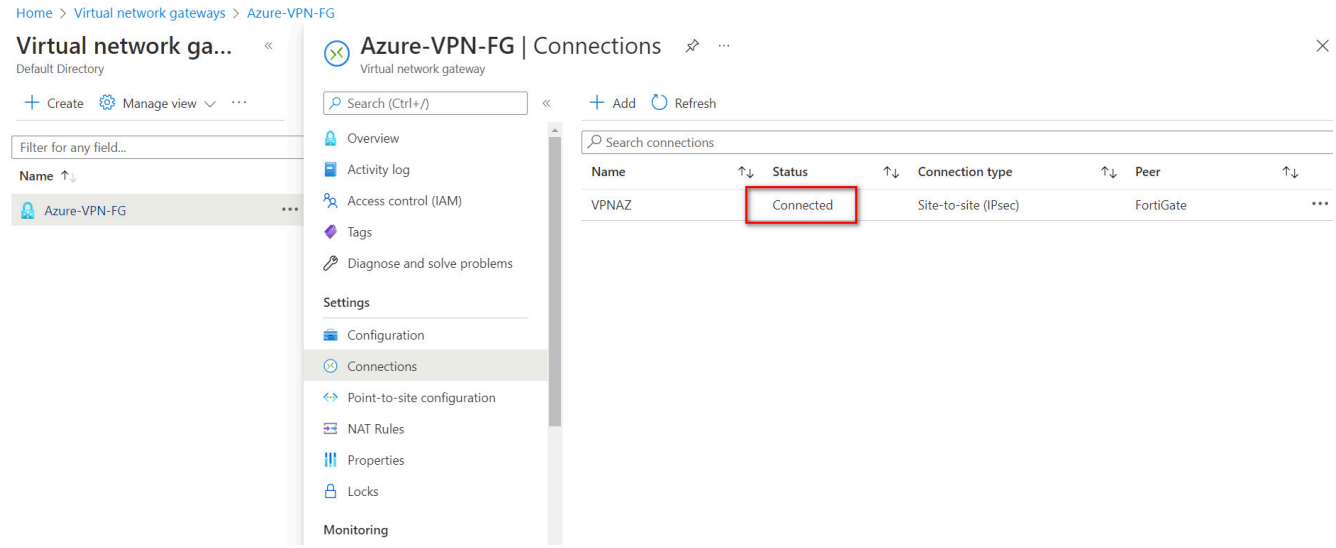


Figure 10.37: Verify status in Azure

10.2 Deploy FortiGate in Azure

Learning Objectives

- Create a FortiGate firewall in Azure through Marketplace
- Identify FortiGate subnets in Azure

Scenario: In this lab, we'll learn how to deploy FortiGate in Azure.

1. Go to Azure Marketplace and search for FortiGate.

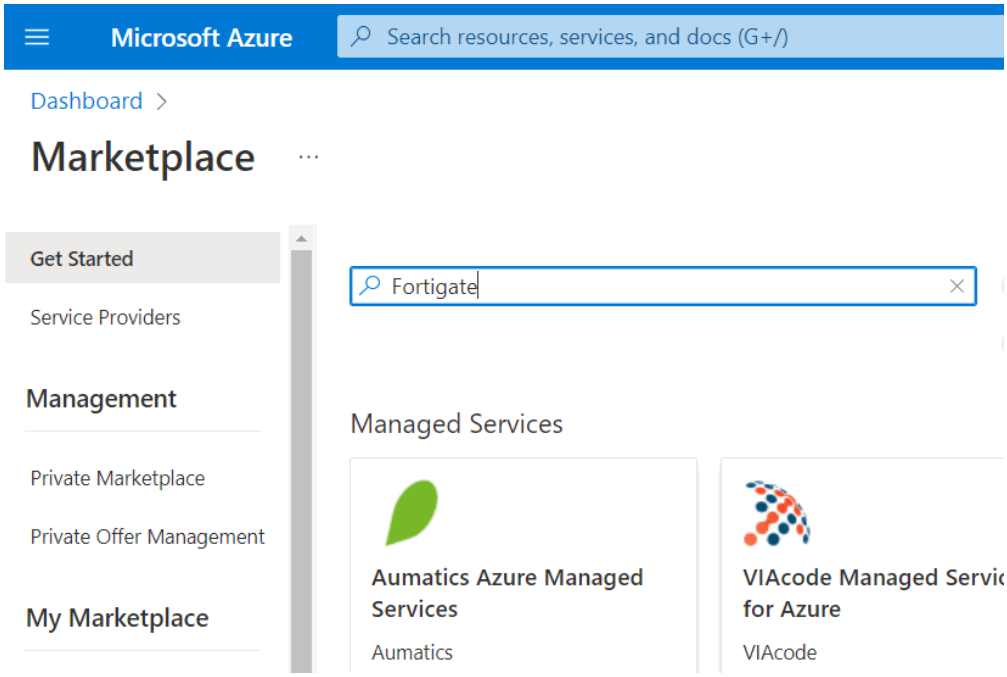


Figure 10.38: Search for FortiGate

2. Select Fortinet FortiGate Next-Generation Firewall.

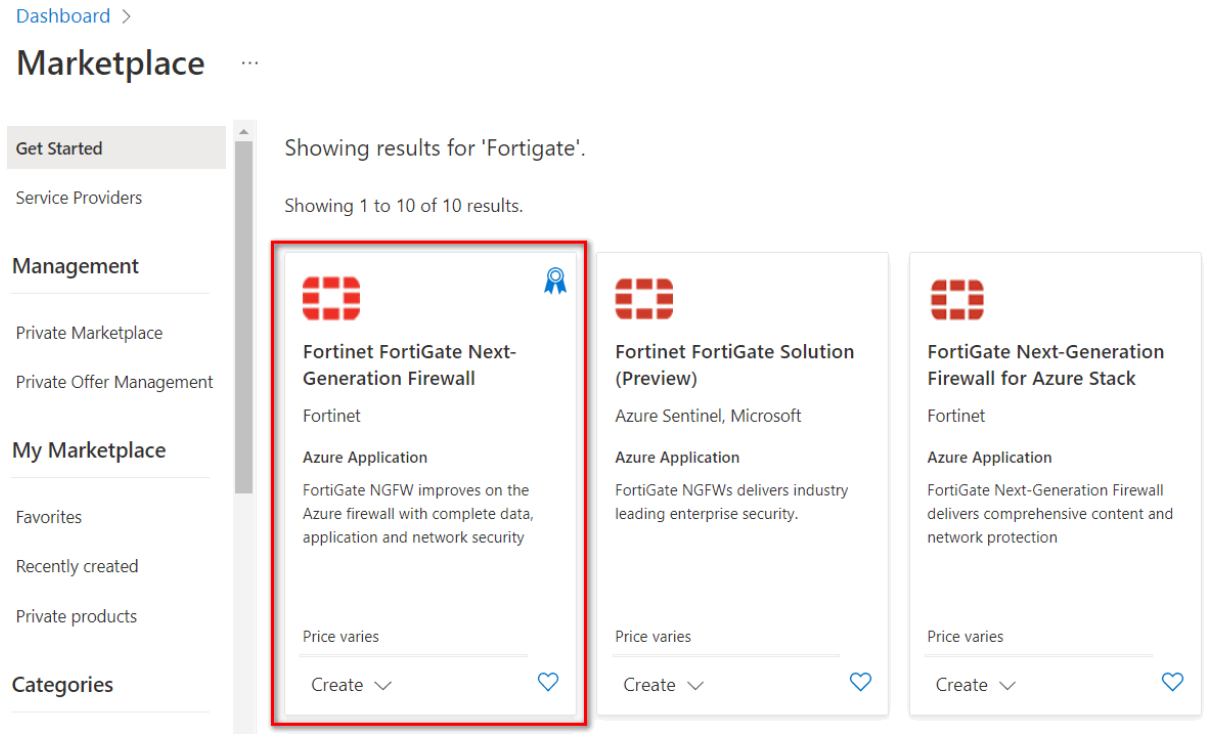


Figure 10.39: Select Fortinet FG Next-Gen

3. Then, Select Single VM from dropdown list.

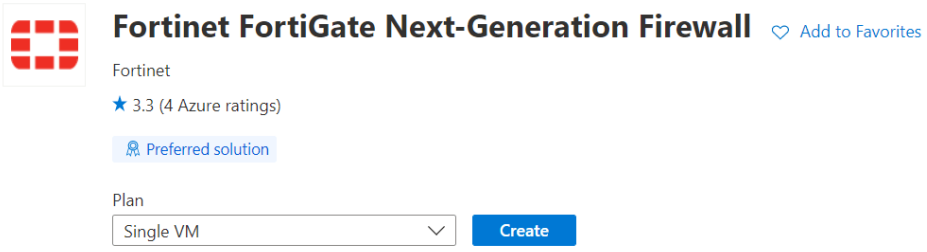


Figure 10.40: Select Single VM

4. Create a firewall information as Figure 10.41.

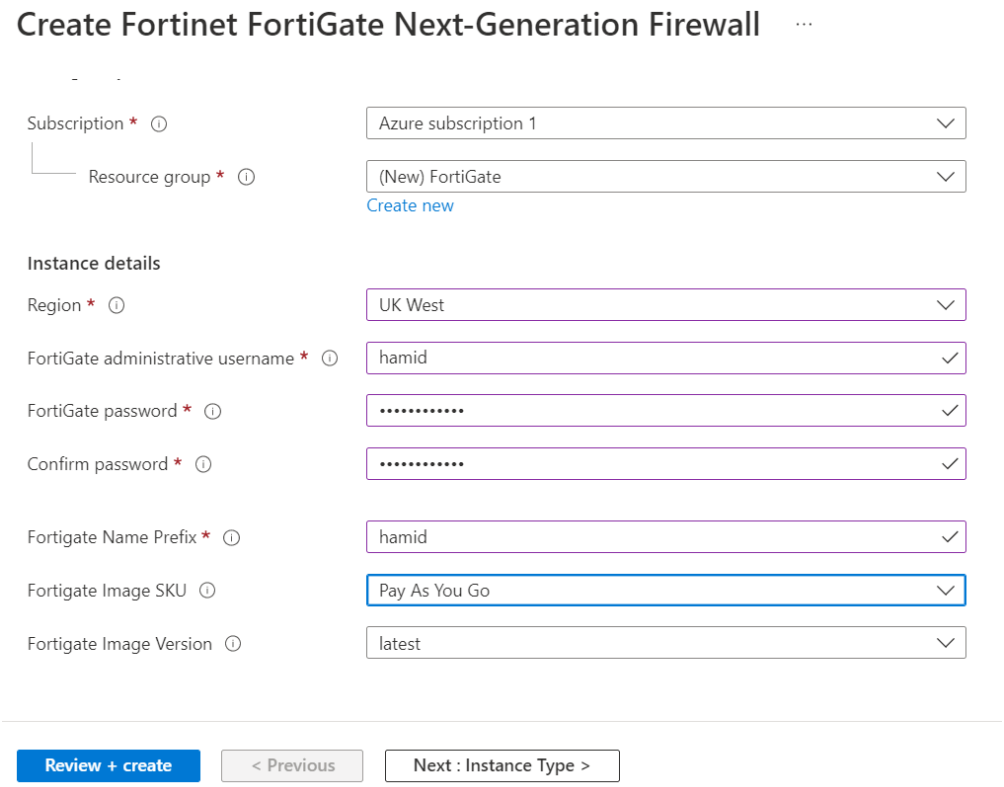


Figure 10.41: Create a Fortinet firewall

5. Leave other tabs as default and press on **"Review+ create"**. It will validate your information and then you can create a FortiGate Firewall.

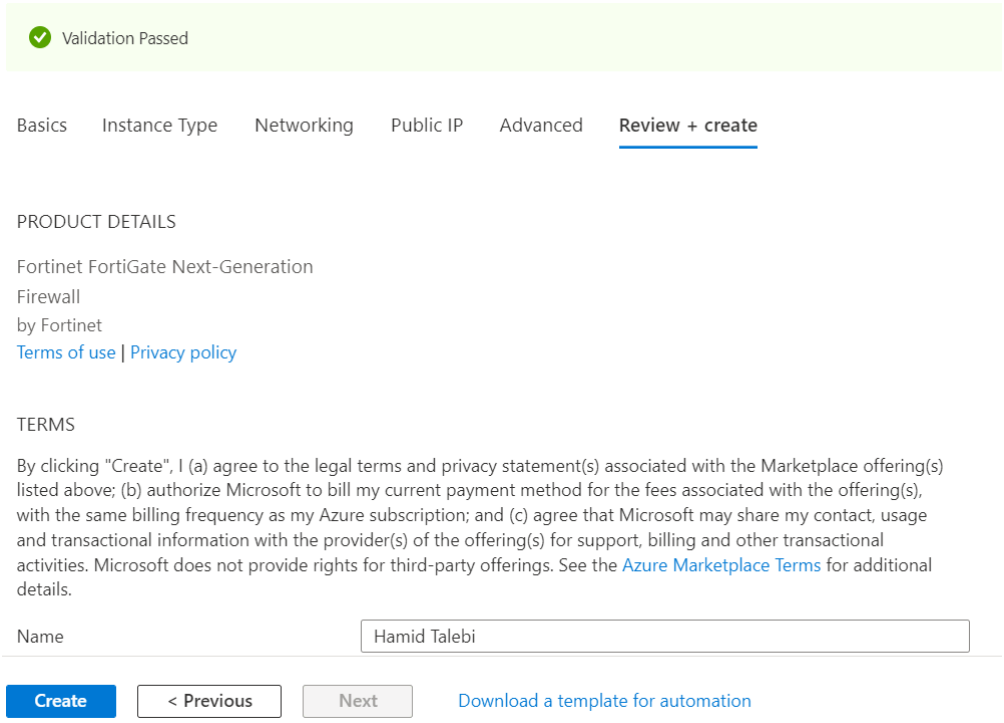


Figure 10.42: Validate configuration

6. Then, it will start deployment of FortiGate. It takes around **5 minutes** to deploy FortiGate.

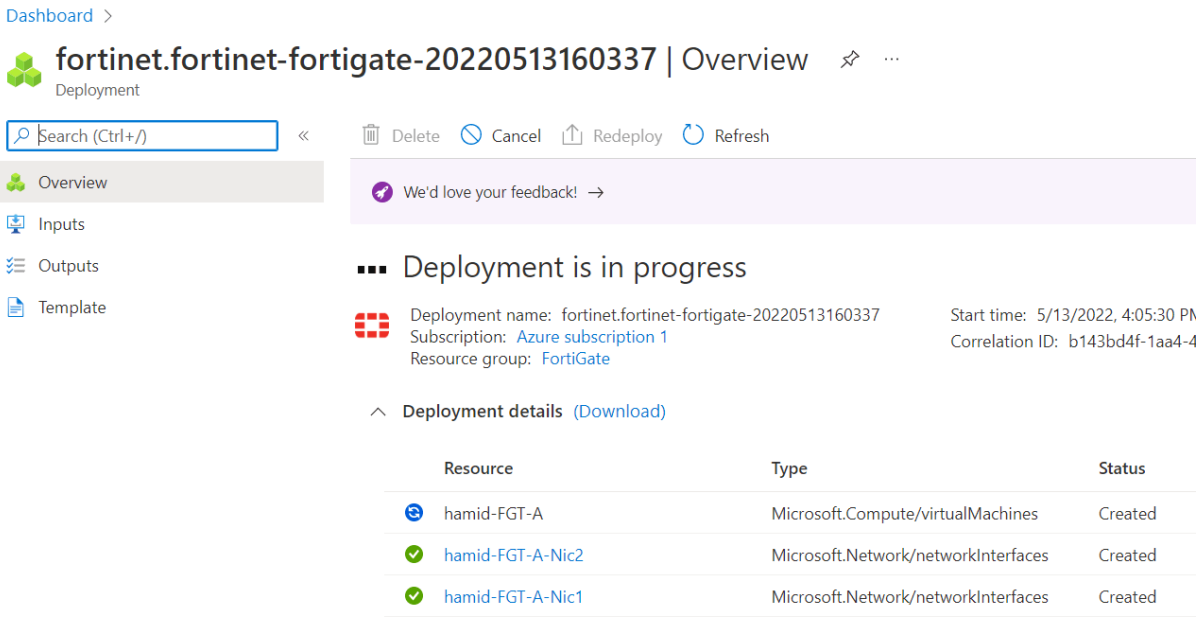


Figure 10.43: Deployment is in progress

Figure 10.44: Deployment is complete

7. After deployment is completed, go to **Resource group** > **FortiGate** > **Overview** and look for FortiGate Public IP address.

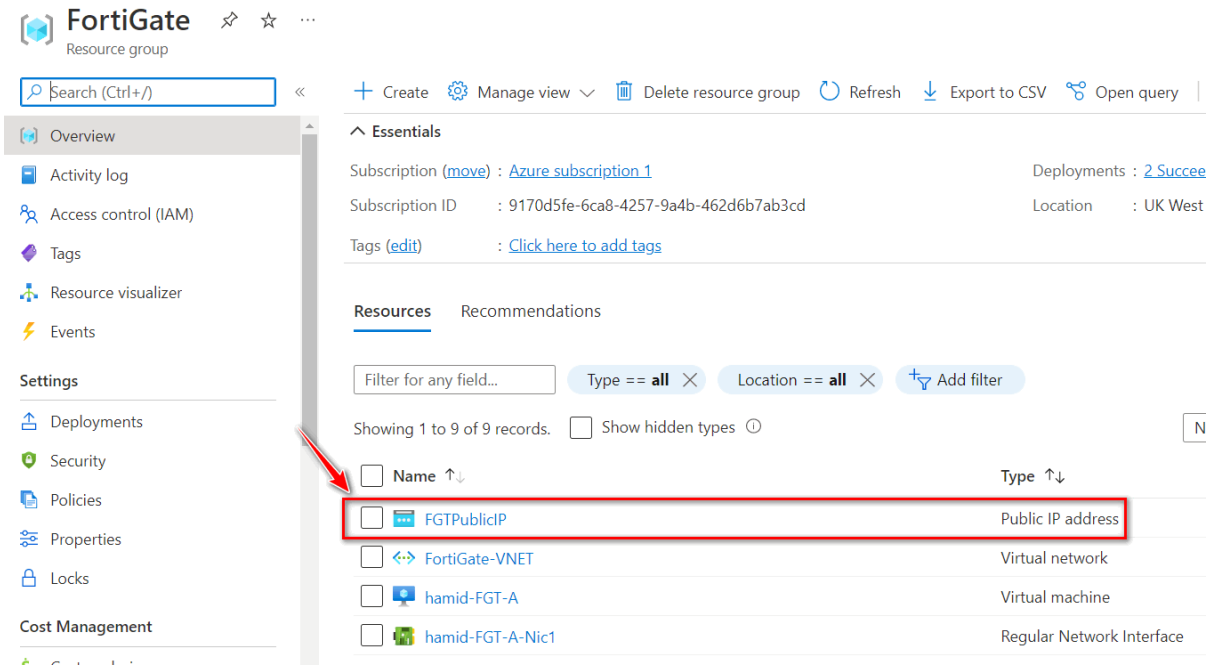


Figure 10.45: FortiGate public IP address

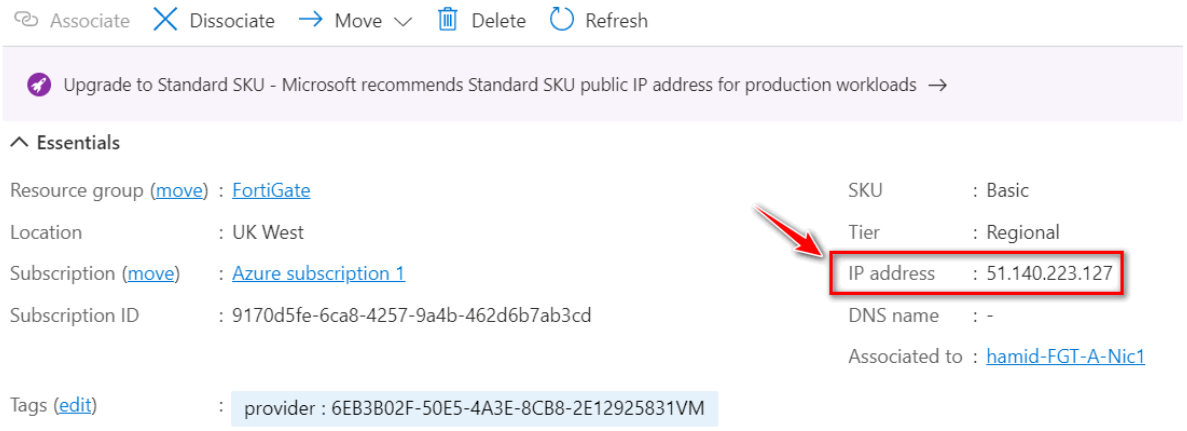


Figure 10.46: FortiGate public IP address

8. Type the IP address in the browser. You should be able to see the FortiGate credentials page. Enter your username and password to login in the firewall.

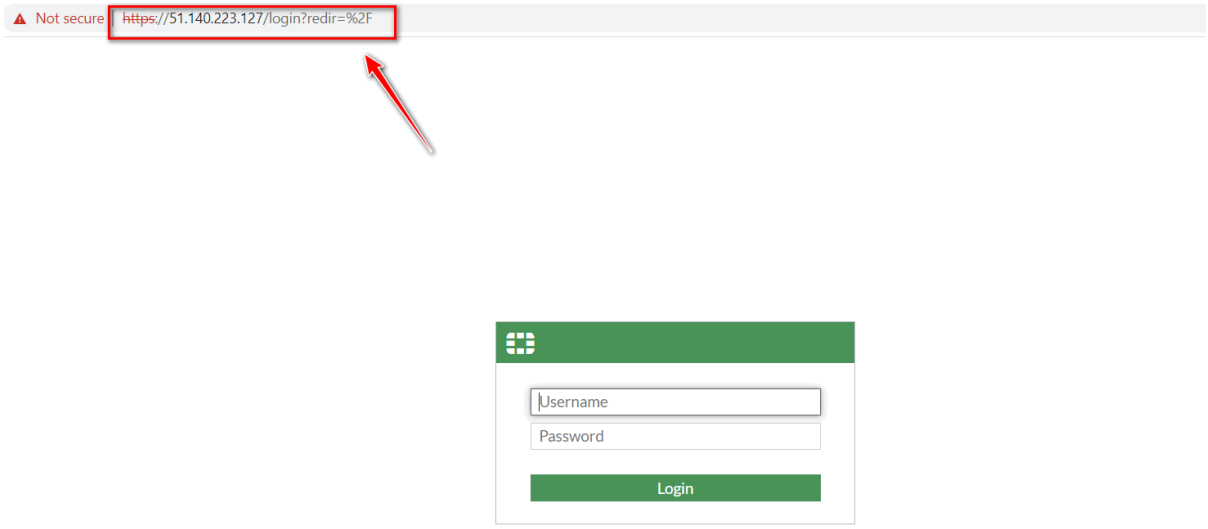


Figure 10.47: FortiGate firewall credential page

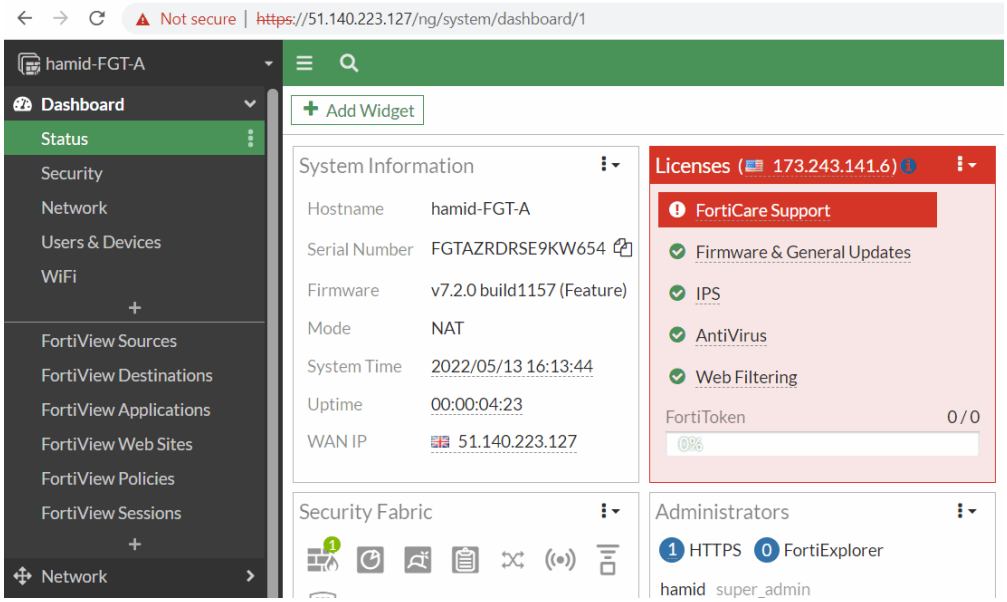


Figure 10.48: FortiGate dashboard

9. Based on Fortinet description, we have three subnets in Azure for FortiGate. **External**, **Internal** and **Protected**. If you are planning to connect a new virtual machine to the firewall internal interface, you should connect it to the Protected subnet.

Table 10.2: FortiGate Subnet description in Azure

Subnet	Description
Subnet1	External subnet used to connect the FortiGate-VM to the Internet.
Subnet2	Internal subnet used as a transit network to one or multiple protected networks containing backend services, such as the web server.
Subnet3	Protected subnet used to deploy services. You can deploy multiples of these subnets. The traffic is sent to the FortiGate for inspection using UDR.

10.3 Site to Site VPN between FortiGate on Premise and FortiGate in the Azure

Learning Objectives

- Configure a VPN Wizard in Azure
- Configure site-to-site VPN between FortiGate on premise and Azure
- Identify FortiGate subnets in Azure

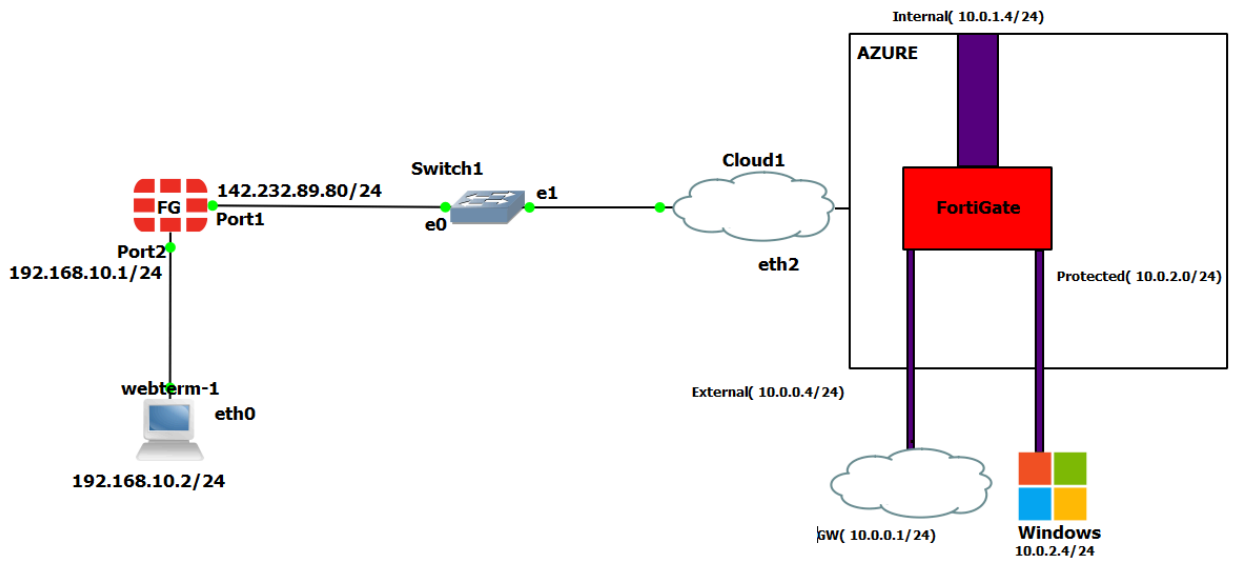


Figure 10.49: Main scenario

Scenario: In this lab, we are going to create a site-to-site VPN from FortiGate on premise to FortiGate in the Azure. Knowing the configuration from section 10.2 is necessary for this lab. Port1 is set as a DHCP, so they will receive an IP address from Cloud.

Table 10.3: Devices configuration

Device	Interface	IP address
FortiGate	Port 1	DHCP Client
	Port 2	192.168.10.1/24
WebTerm	Eth0	192.168.10.2/24

1. On Premise FortiGate Configuration. Follow these steps:
    1. Configure the interfaces of the firewall. Port2 by default is an internal interface and name as a “LAN” and Port1 is an external interface and name as a “WAN”.

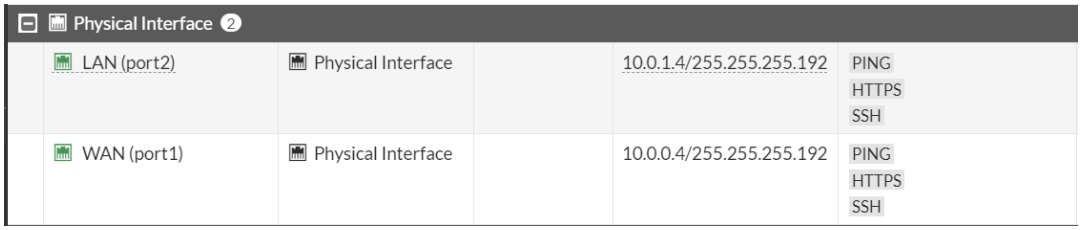


Figure 10.50: Firewall interfaces

    2. Create a site-to-site VPN from IPsec Wizard as Figures 10.51 to 10.53.

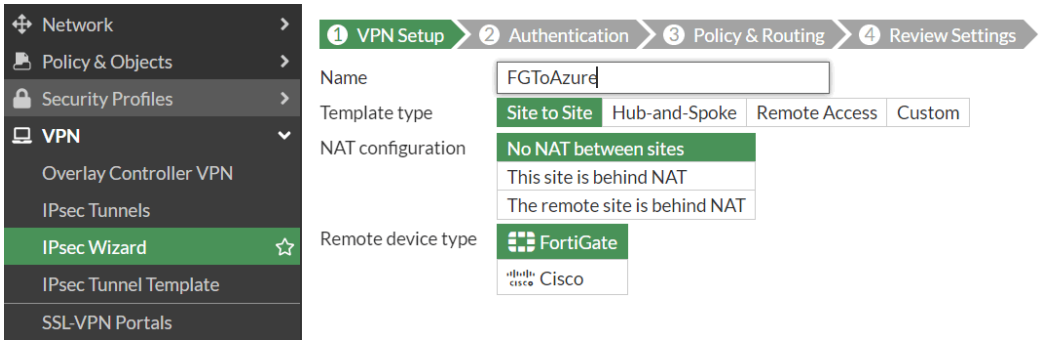


Figure 10.51: Select VPN name

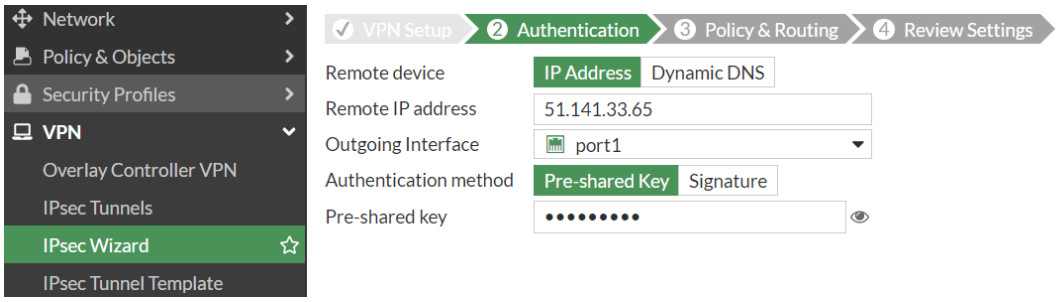


Figure 10.52: Set remote IP address

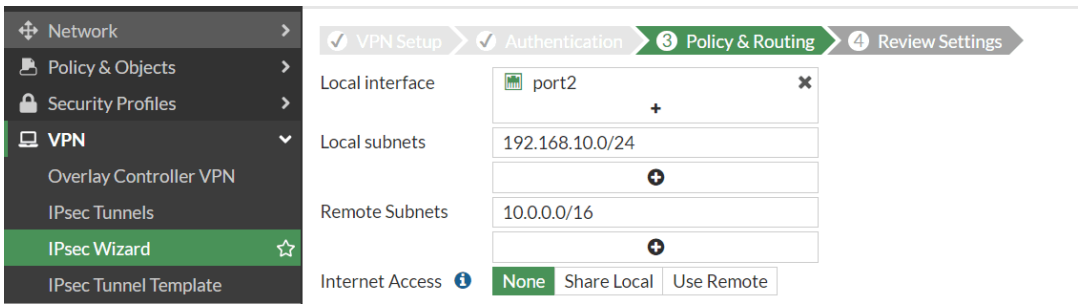


Figure 10.53: Set Policy & Routing

3. Create a static route to the default gateway.

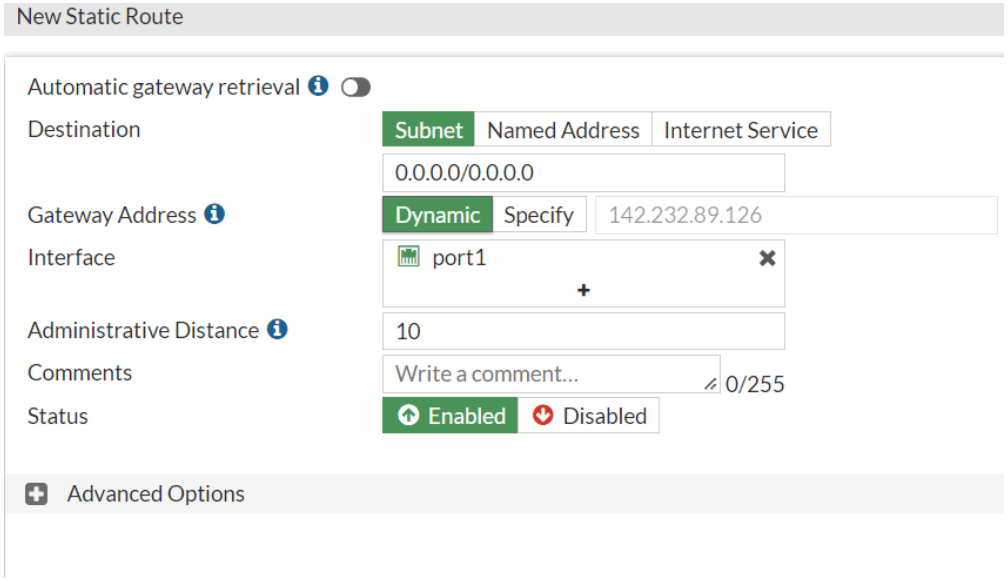


Figure 10.54: Set a default gateway

2. Azure Configuration. Follow these steps:
    1. Create a FortiGate firewall in Azure and configure the interfaces. You need to do all steps found in section 10.1.
    2. Create a VPN from IPsec Wizard as Figures 10.55 to 10.57.

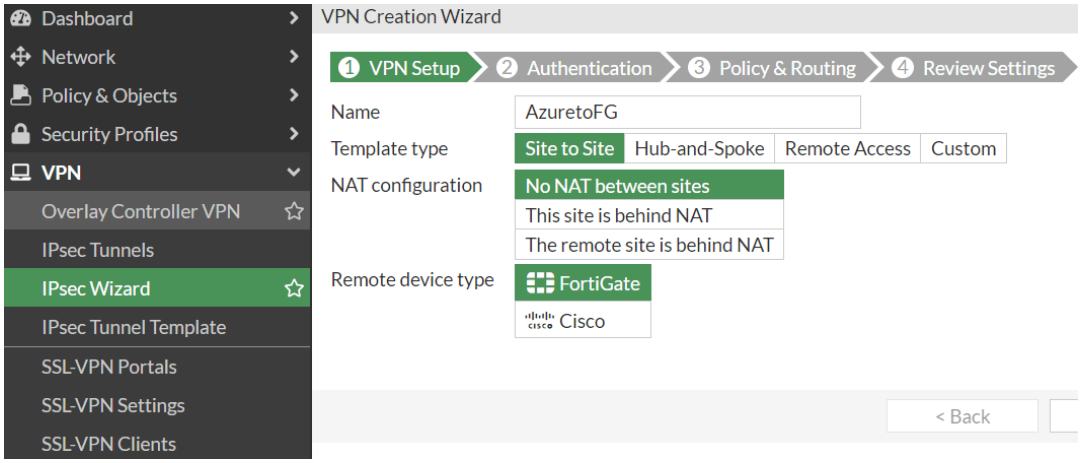


Figure 10.55: Select VPN name

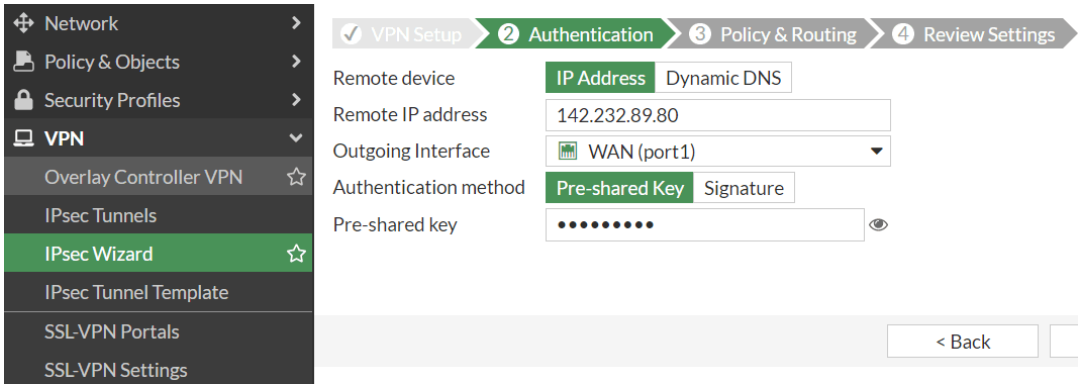


Figure 10.56: Set a remote IP address

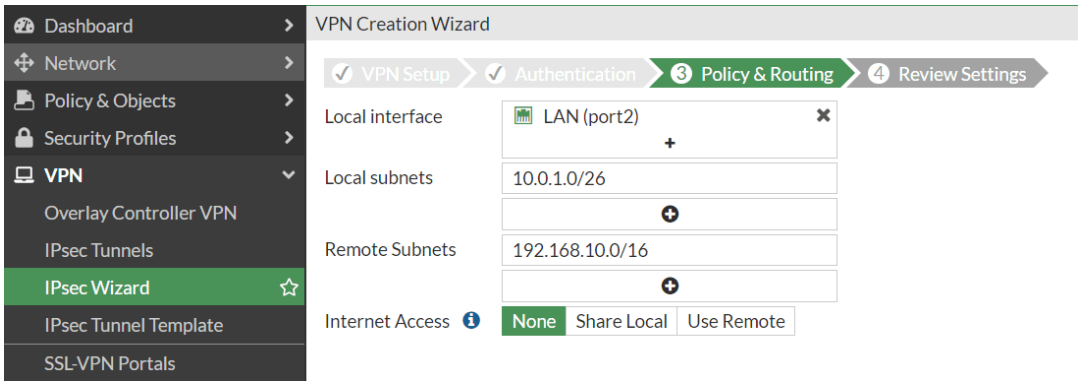


Figure 10.57: Set Policy & Routing

3. Add a Linux or Windows Virtual Machine to **Protected subnet**. You don't need to enable public IP address. Your private IP address should be in the range of 10.0.2.0/24.
4. Go to **VPN** > **IPsec Tunnels** and check status of the tunnel.

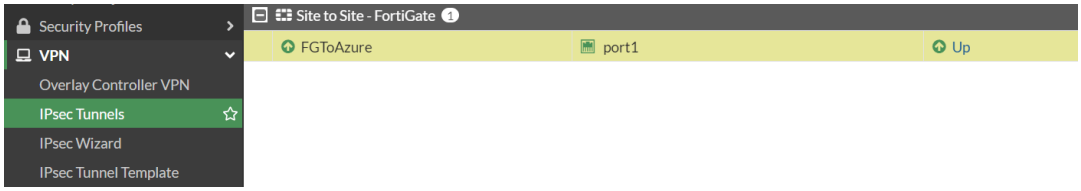


Figure 10.58: Check status of tunnel

5. You should be able to ping from WebTerm to the Virtual Machine.

```
root@webterm-1 ~$ ping 10.0.2.4
PING 10.0.2.4 (10.0.2.4) 56(84) bytes of data.
64 bytes from 10.0.2.4: icmp_seq=1 ttl=64 time=0.033 ms
64 bytes from 10.0.2.4: icmp_seq=2 ttl=64 time=0.060 ms
64 bytes from 10.0.2.4: icmp_seq=3 ttl=64 time=0.046 ms
64 bytes from 10.0.2.4: icmp_seq=4 ttl=64 time=0.044 ms
64 bytes from 10.0.2.4: icmp_seq=5 ttl=64 time=0.047 ms
64 bytes from 10.0.2.4: icmp_seq=6 ttl=64 time=0.048 ms
64 bytes from 10.0.2.4: icmp_seq=7 ttl=64 time=0.048 ms
64 bytes from 10.0.2.4: icmp_seq=8 ttl=64 time=0.052 ms
```

Figure 10.59: Ping from WebTerm to Windows VM

10.4 IPsec VPN from FortiGate (on Premise) to AWS

Learning Objectives

- Configure a Customer Gateway in AWS
- Configure a Virtual Private Gateway
- Create an IPsec VPN between FortiGate on-Premise and AWS

Scenario: We are going to connect on premise FortiGate to AWS Virtual Gateway. This is going to be IPsec VPN between FortiGate and AWS. First, we will configure AWS and then connect FortiGate through Port1 to AWS Virtual Gateway

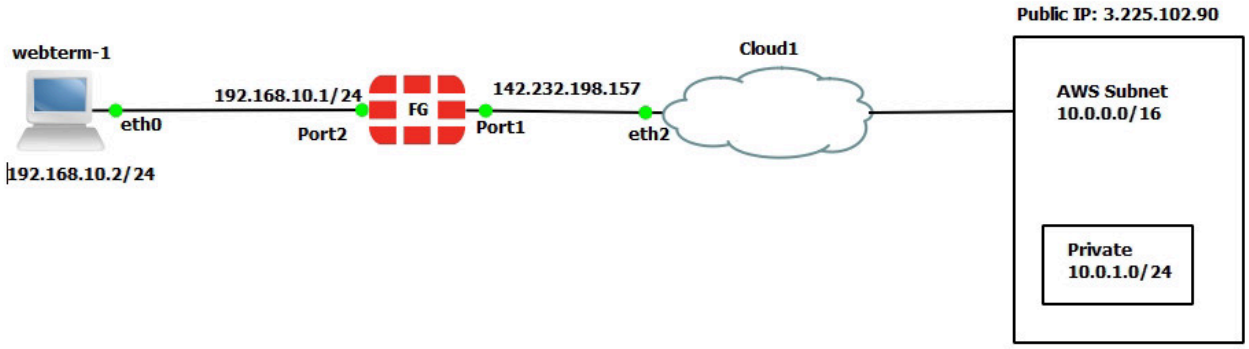


Figure 10.60: Main scenario

Table 10.4: On-premise devices configuration

Device	Configuration	Access
FortiGate	Port 1: DHCP Client Port 2: 192.168.10.1/24	Port1: HTTP, HTTPS, PING
WebTerm1	192.168.10.2/24	–

AWS Configuration

1. Create a VPC for AWS as follows:
    - **Name tag:** AWS Subnet
    - **IPv4 CIDR:** 10.0.0.0/16

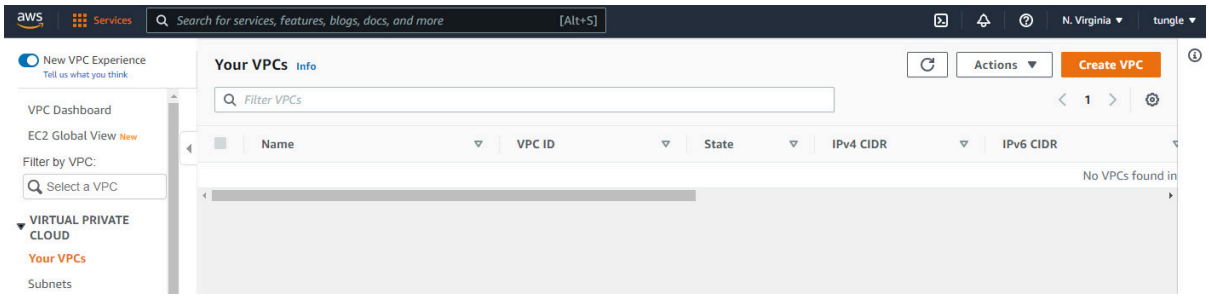


Figure 10.61: Create a VPC

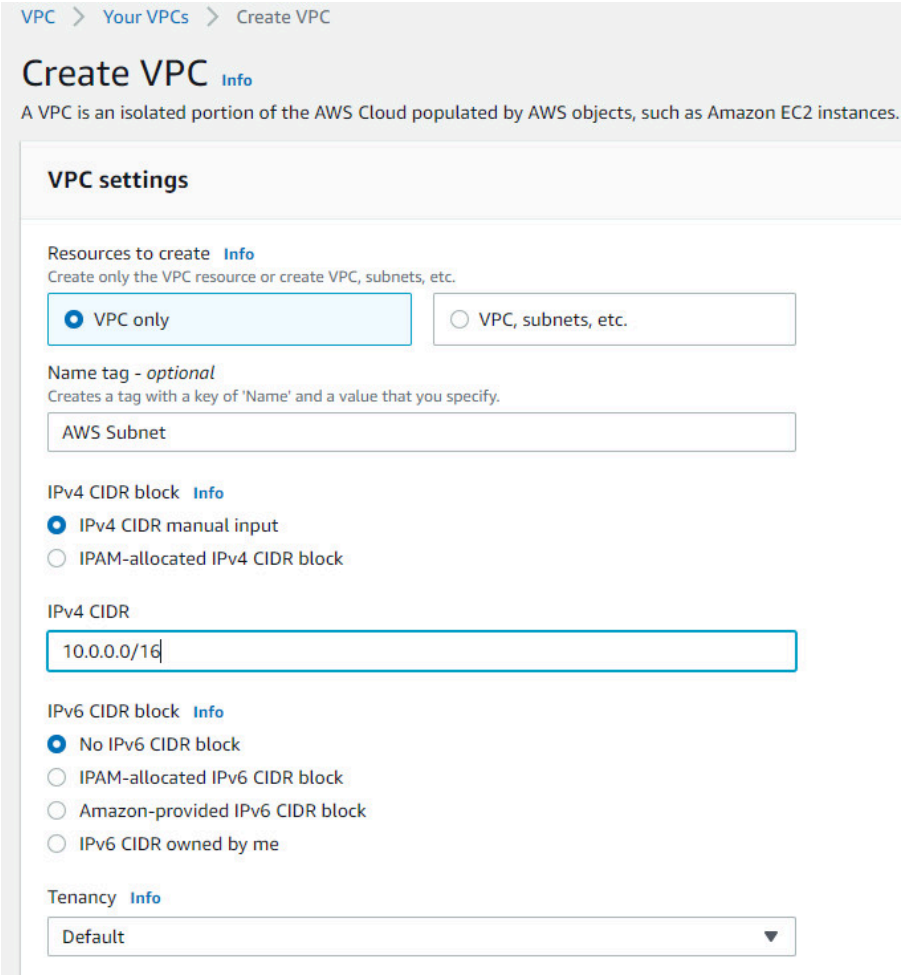


Figure 10.62: Create a VPC named "AWS Subnet"

2. Create a private subnet under AWS VPC as follows:
    - VPC: **AWS Subnet**

- Subnet Name: **Private**
- IPv4 CIDR block**: 10.0.1.0/24**

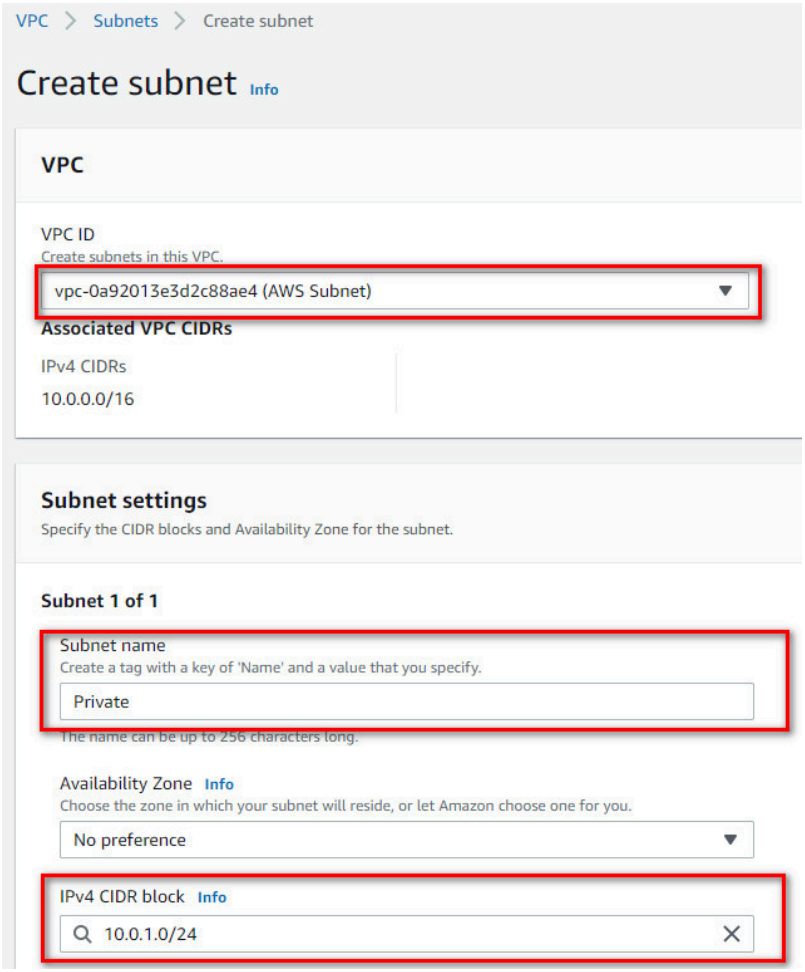


Figure 10.63: Create a subnet under AWS VPC

3. Create an internet gateway as follows:

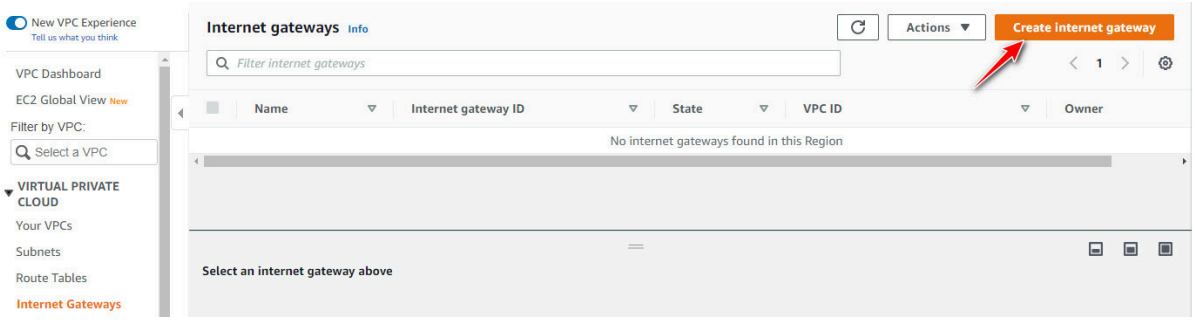


Figure 10.64: Create an internet gateway

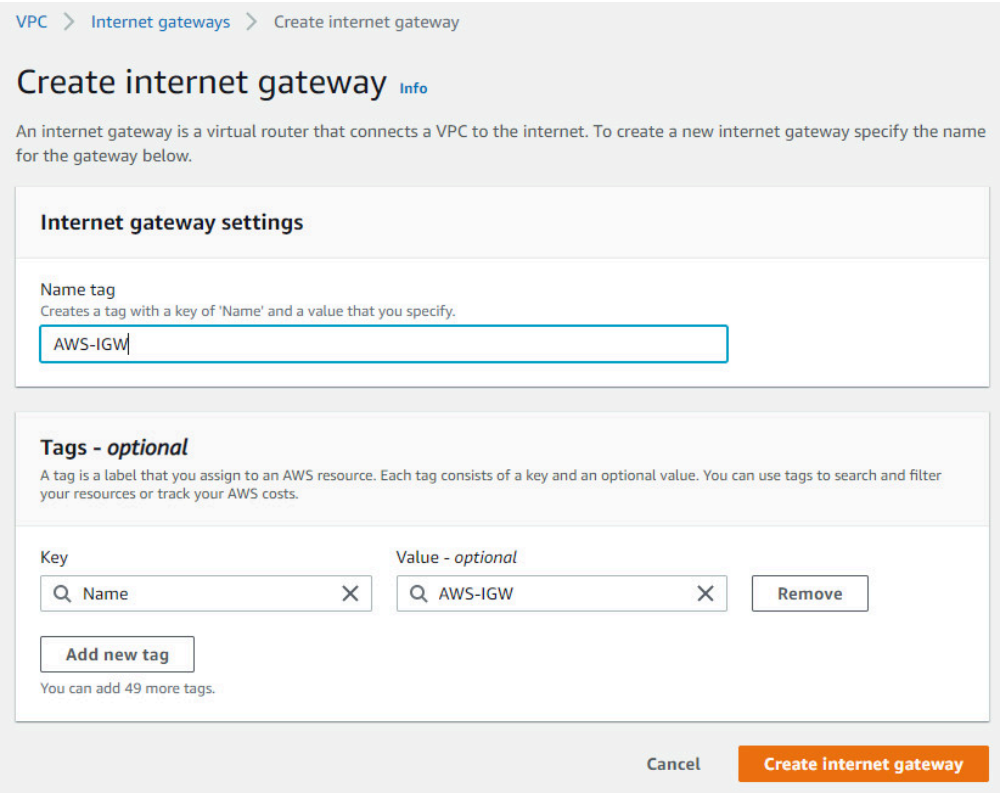


Figure 10.65: Select Name as AWS-IGW

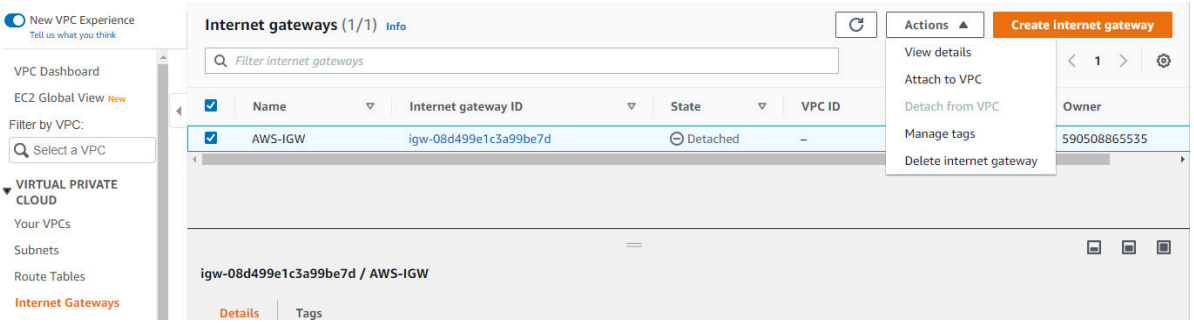


Figure 10.66: Attach the internet gateway to VPC

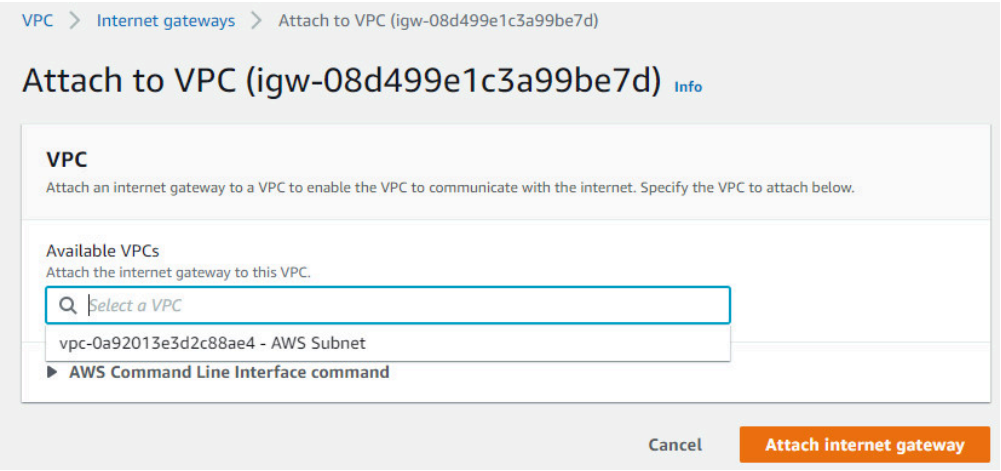


Figure 10.67: Attach the internet gateway to VPC

4. Create a static route to the internet gateway (AWS-IGW). Edit Routes as follows:

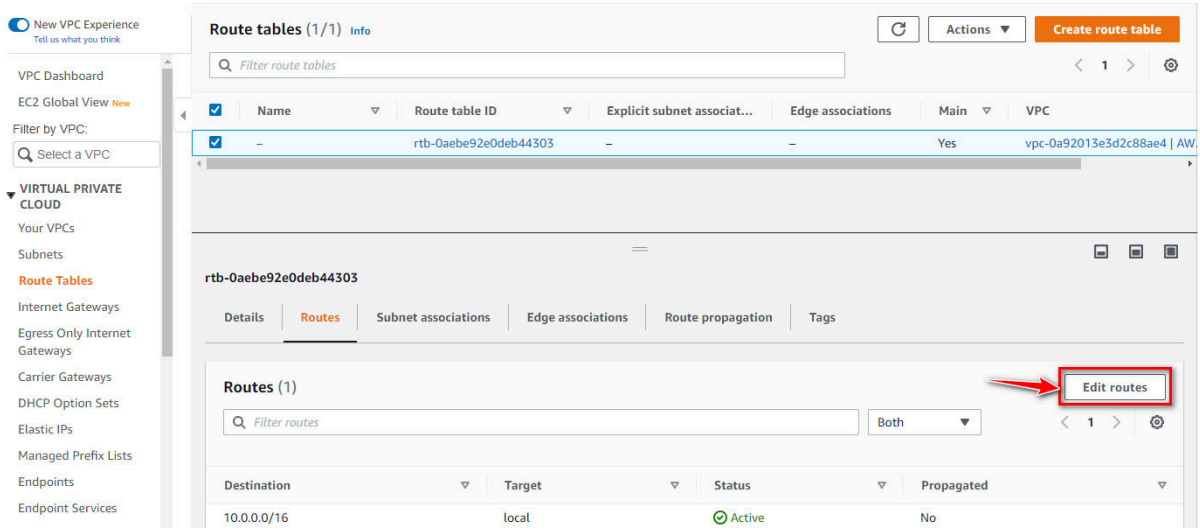


Figure 10.68: Edit routes

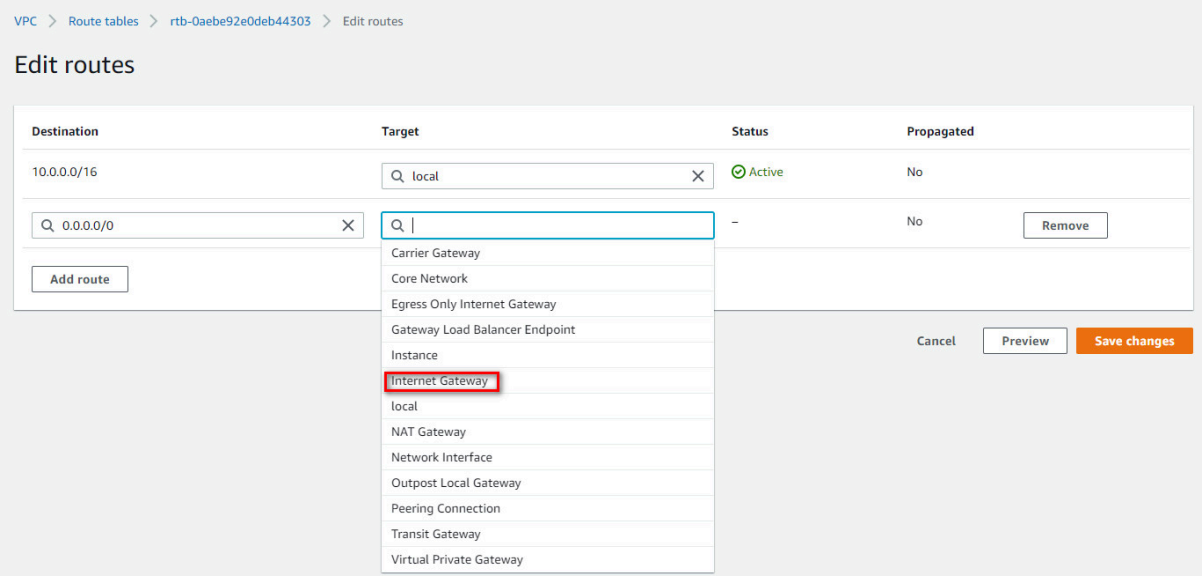


Figure 10.69: Add a new route 0.0.0.0/0 to your internet gateway

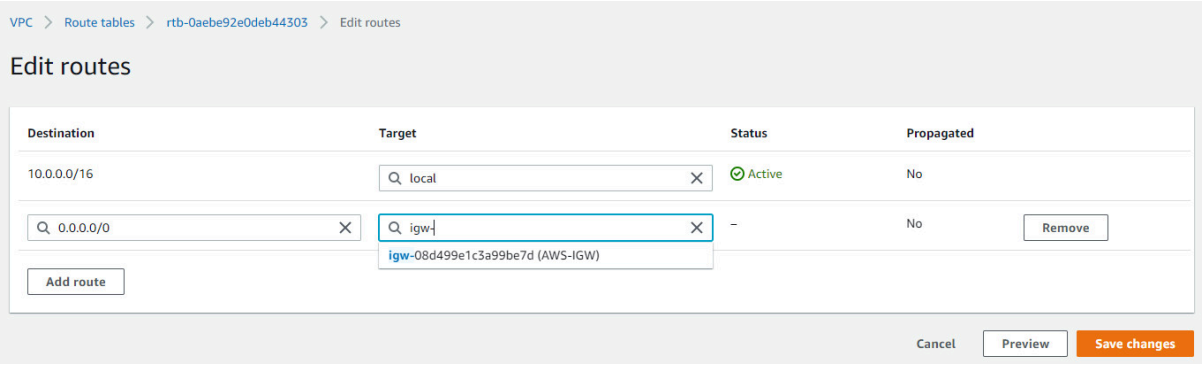


Figure 10.70: Add a new route 0.0.0.0/0 to your internet gateway

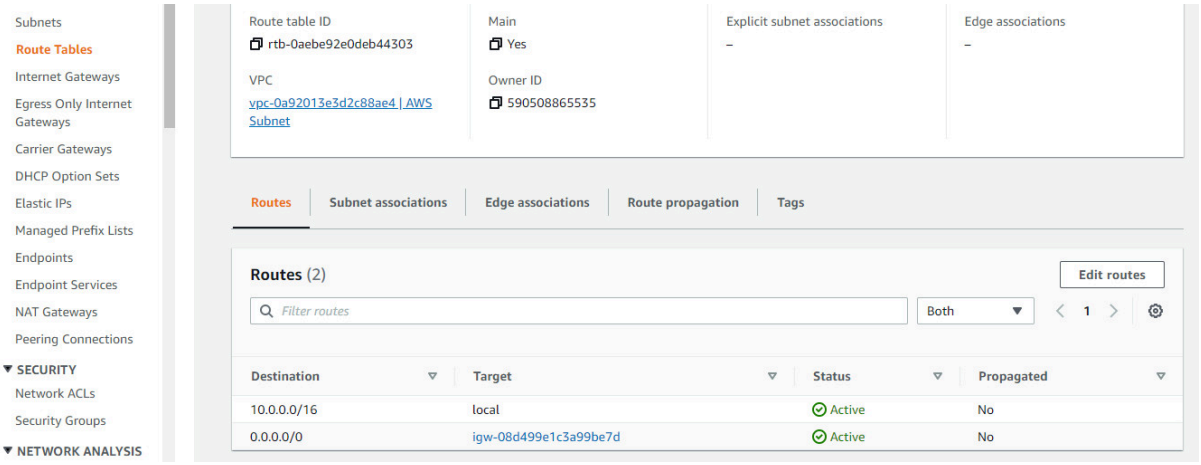


Figure 10.71: Route tables overview

5. Create a customer gateway as follows:

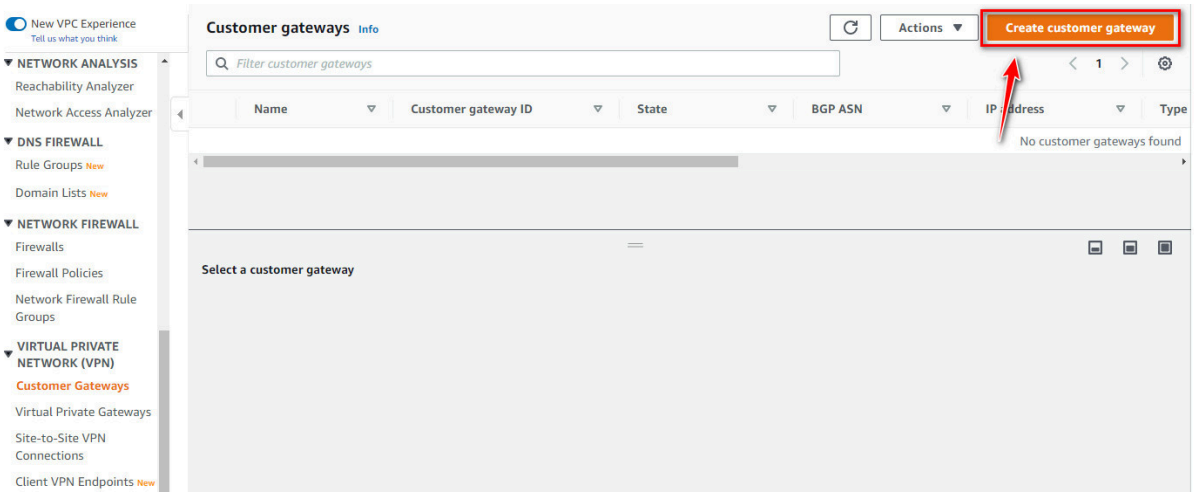


Figure 10.72: Create a customer gateway

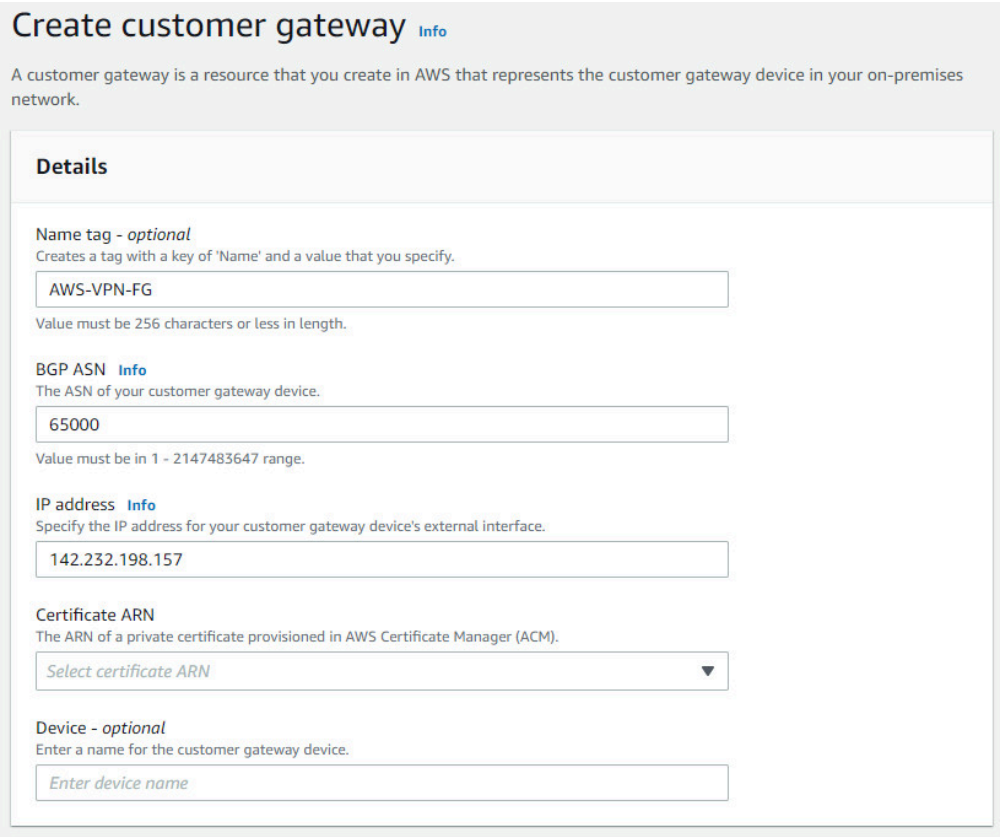


Figure 10.73: Create a customer gateway

6. Create a virtual private gateway as follows:

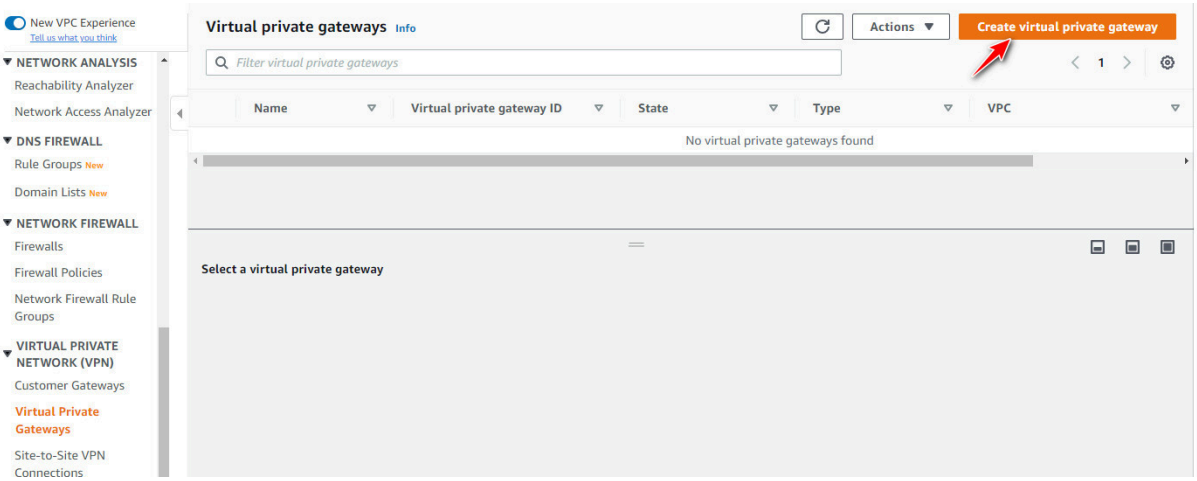


Figure 10.74: Create a virtual private gateway

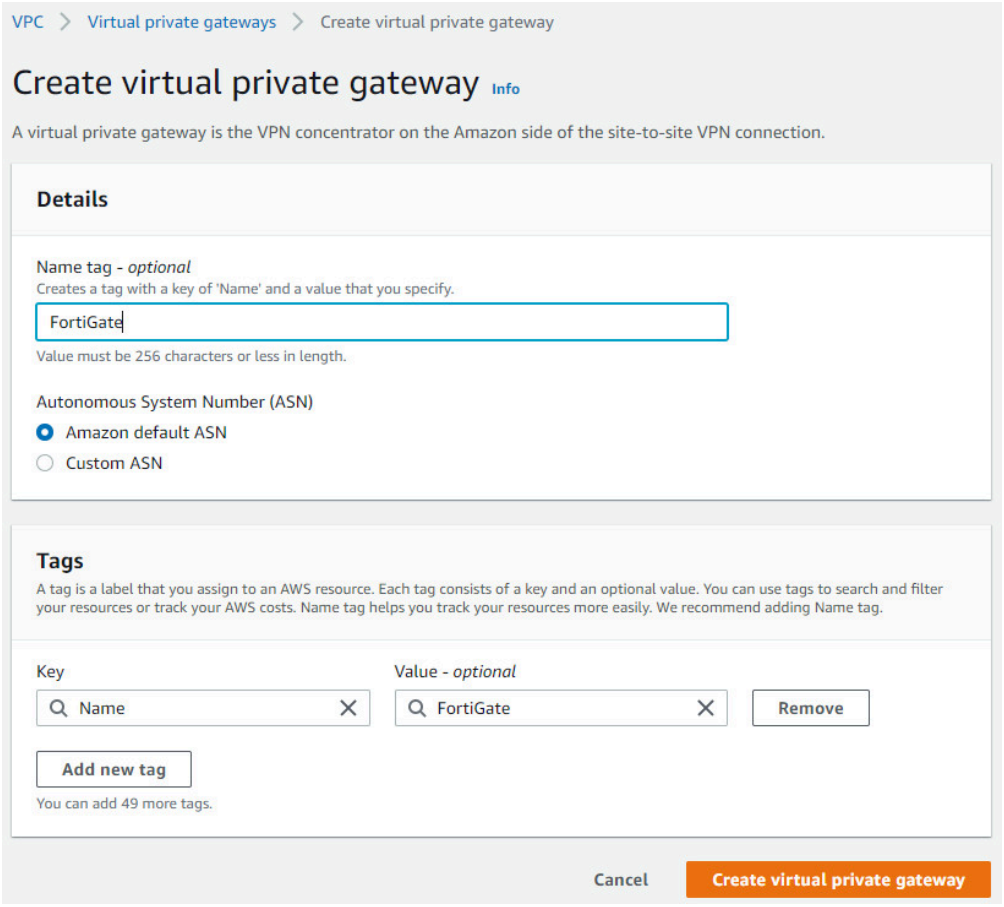


Figure 10.75: Create a virtual private gateway on FortiGate

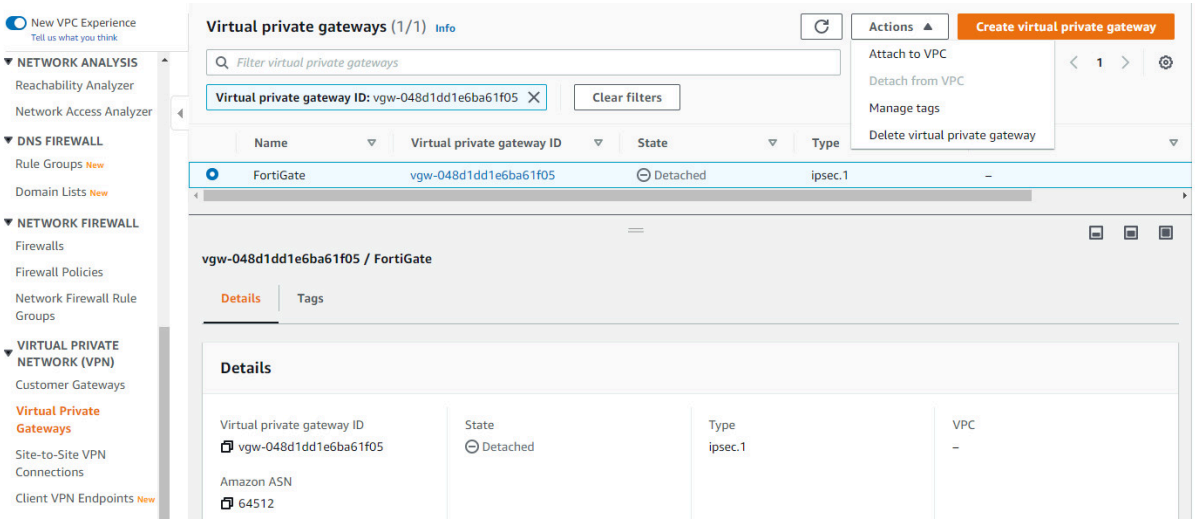


Figure 10.76: Attach virtual private gateway to VPC

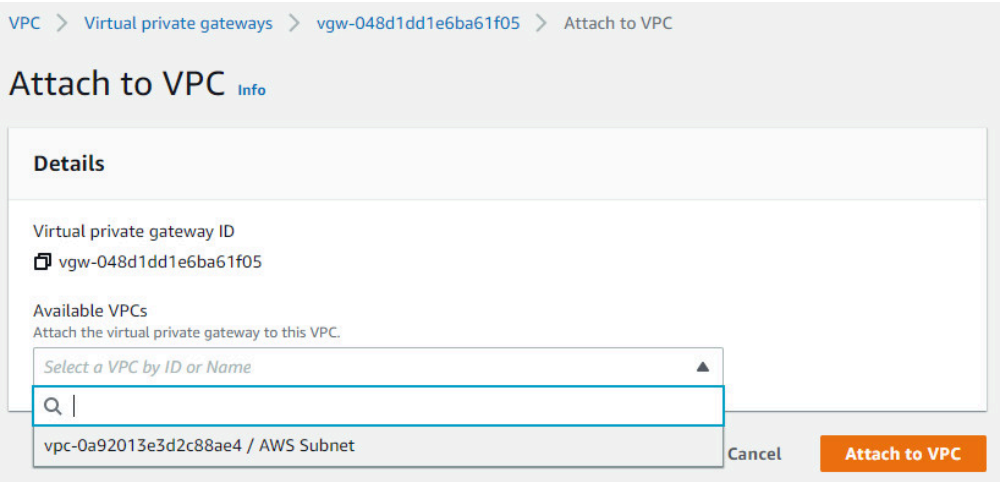


Figure 10.77: Attach virtual private gateway to VPC

7. Create a Site-to-Site VPN connection as follows:

    - **Name Tag:** VPNAWS
    - **Target gateway type:** Virtual private gateway
    - **Virtual Private Gateway:** FortiGate
    - **Customer Gateway ID:** AWS-VPN-FG
    - **Routing options:** Static
    - **Static IP prefixes:** 192.168.10.0/24
    - **Local IPv4 network CIDR:** 192.168.10.0/24
    - **Remote IPV4 network CIDR:** 10.0.1.0/24
    - **Tunnel 1 and Tunnel 2 options:** leave it as default

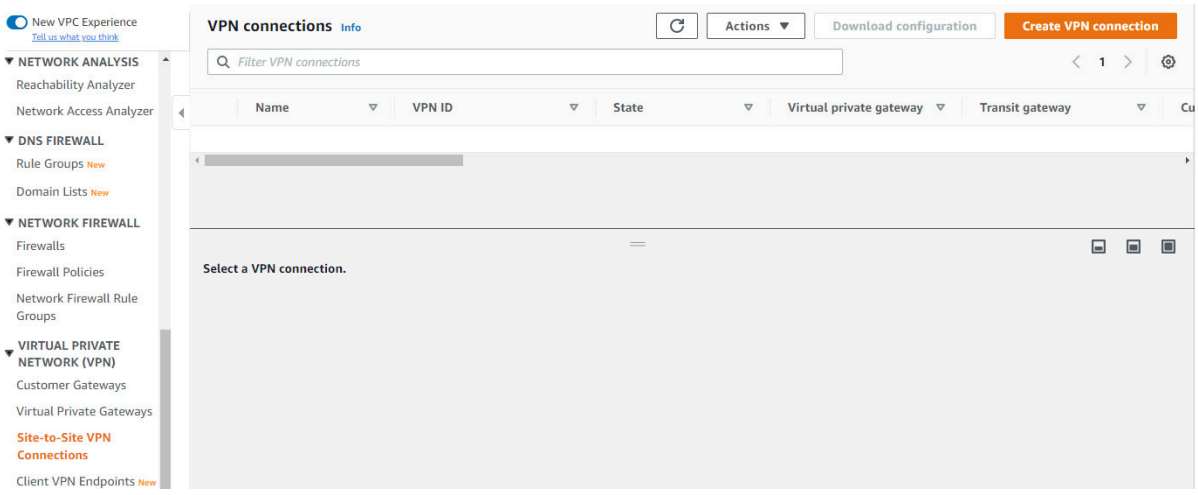


Figure 10.78: Create a site-to-site VPN connection

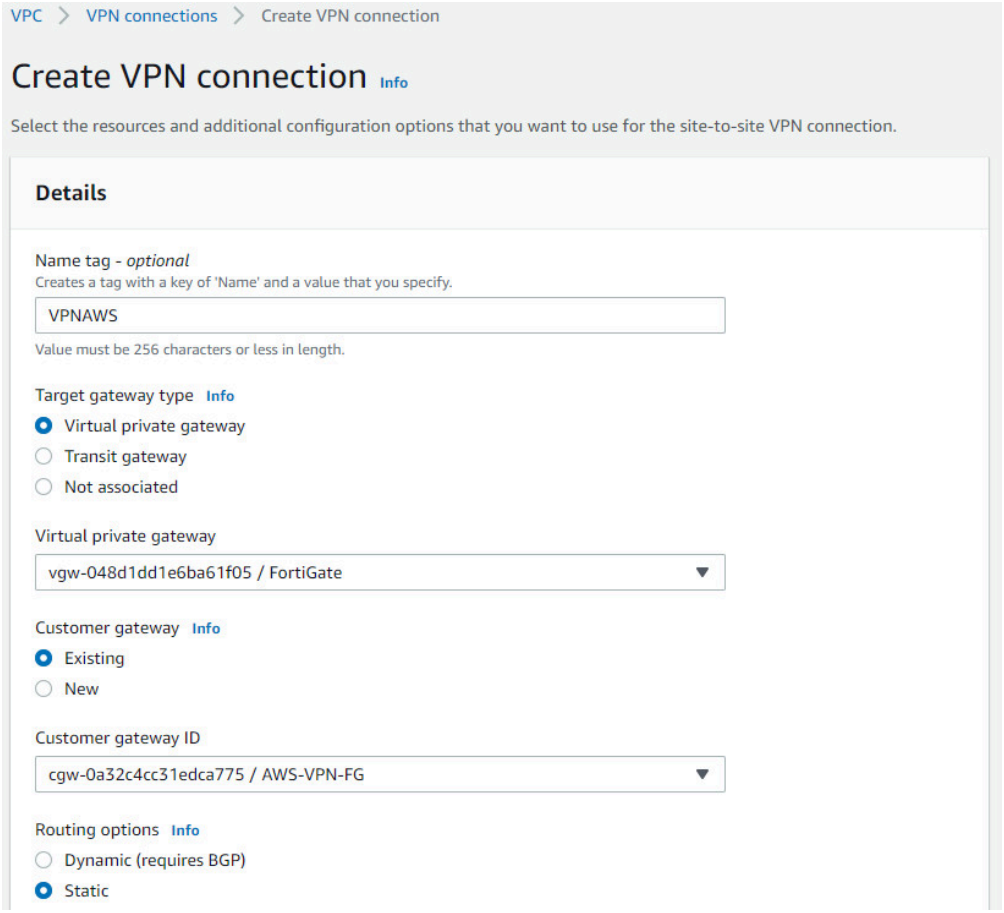


Figure 10.79: Create a site-to-site VPN connection with FortiGate

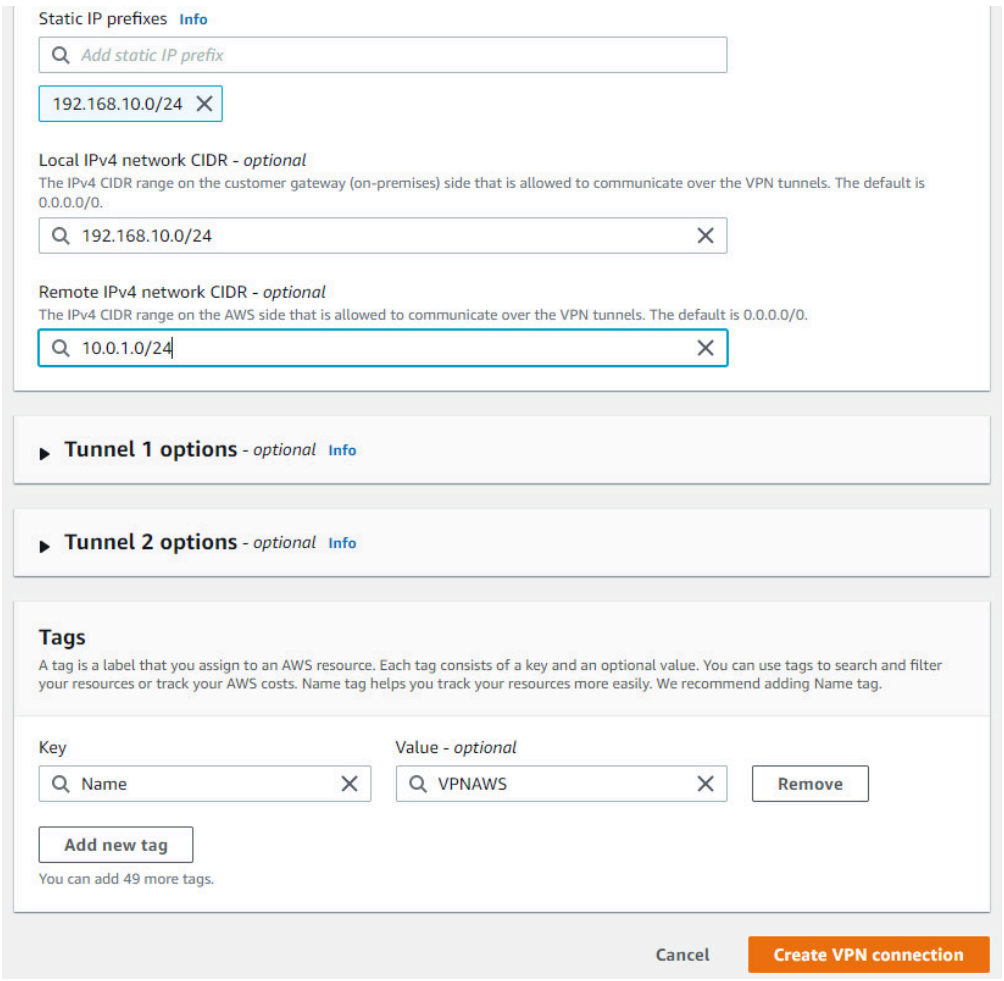


Figure 10.80: Create a site-to-site VPN connection with FortiGate

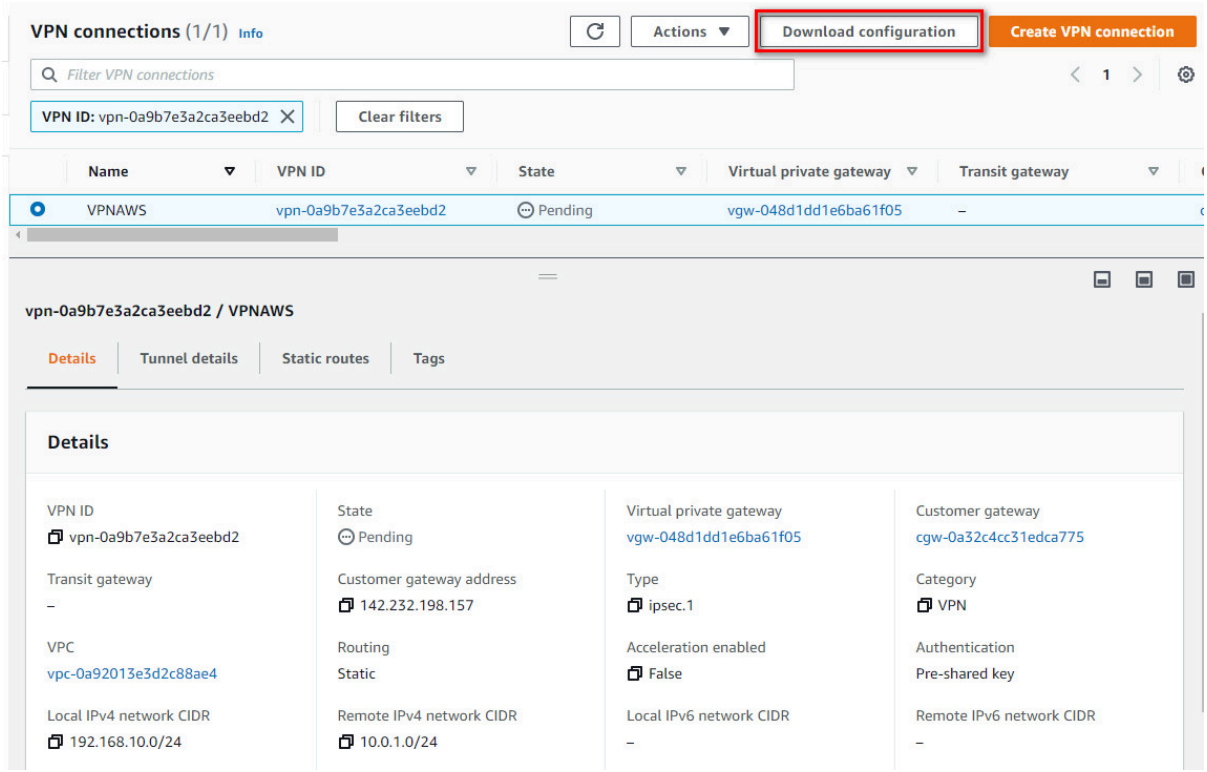


Figure 10.81: Create a site-to-site VPN connection with FortiGate

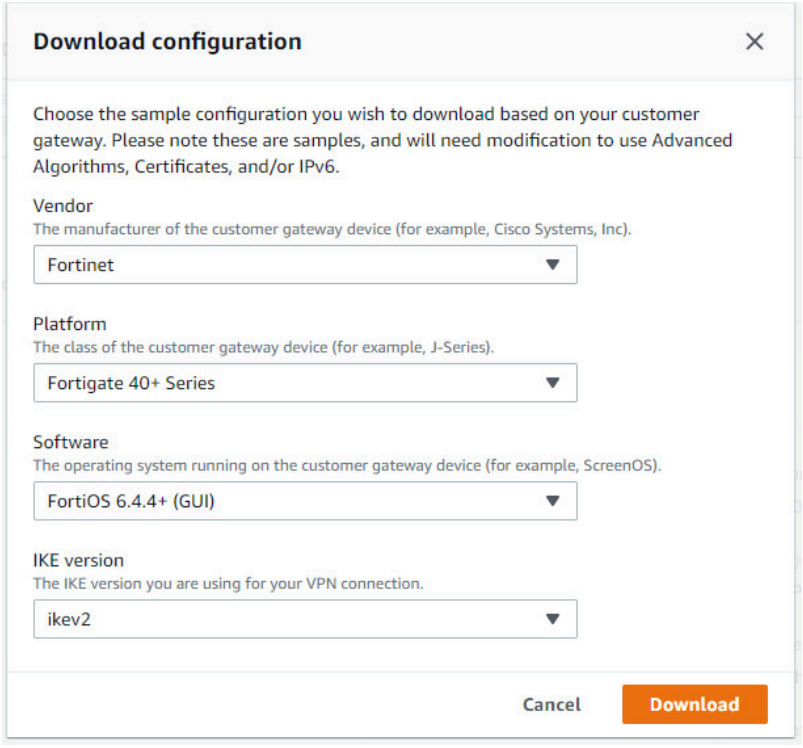


Figure 10.82: Download configuration

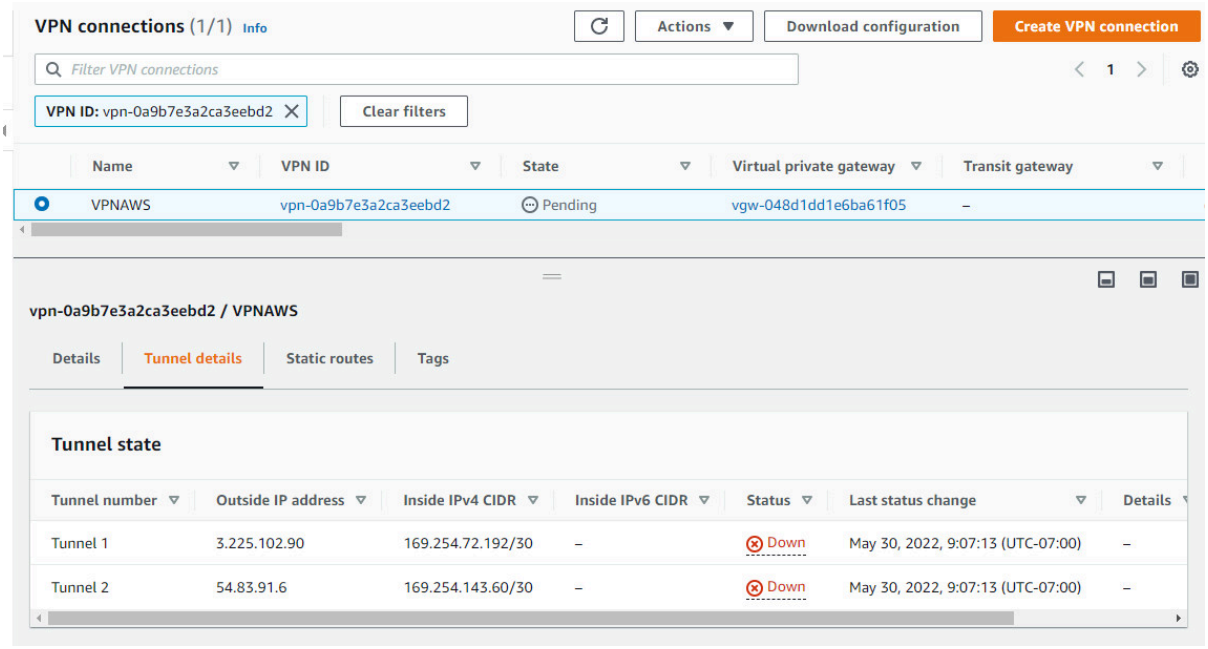


Figure 10.83: Verify public IP address

8. Open the file that you have downloaded on AWS. It will show phase 1 and phase 2 configuration.

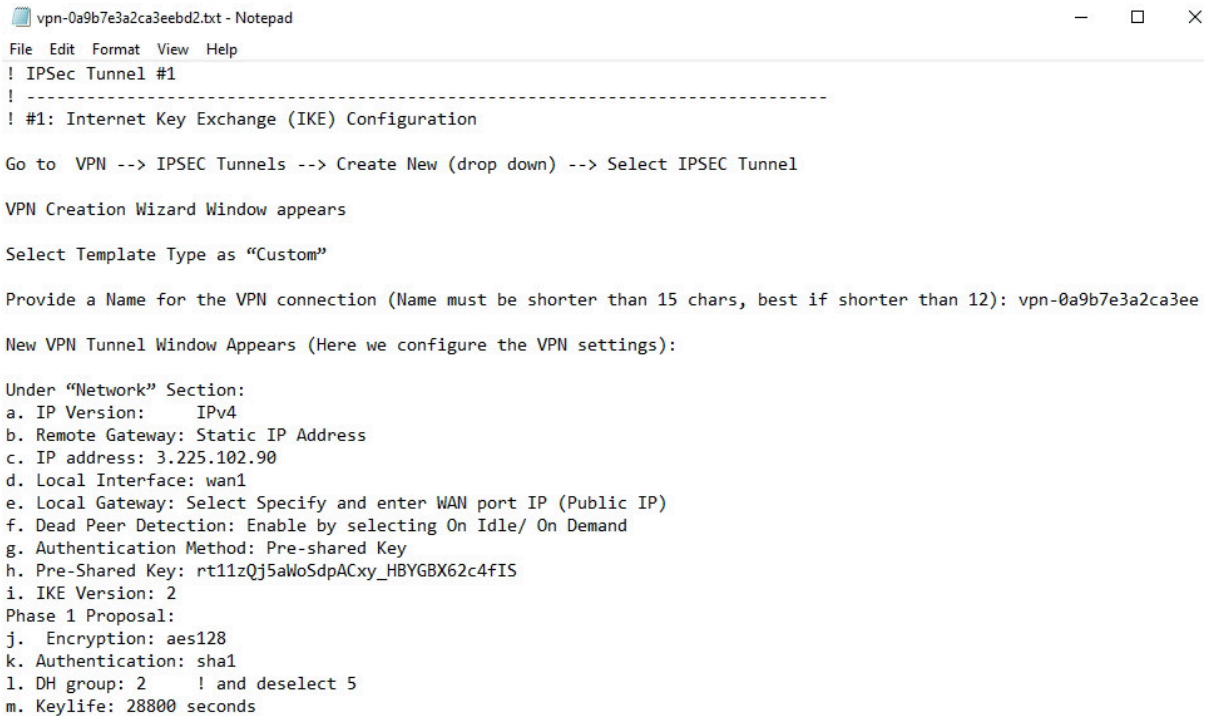


Figure 10.84: IPsec Phase 1

vpn-0a9b7e3a2ca3eebd2.txt - Notepad

File Edit Format View Help

```
! #2: IPSec Configuration

Under Phase 2 Selectors --> New Phase 2
a.      Name:  vpn-0a9b7e3a2ca3eebd2-0
b.      Local Address: LAN subnet behind Fortigate/0.0.0.0/0
c.      Remote Address: AWS Private Subnet/0.0.0.0/0

Under Advanced
d.      Encryption: aes128
e.      Authentication: sha1
f.      Select Enable Replay Detection
g.      Select Perfect Forward Secrecy
h.      DH Group: 2 ! and deselect 5
i.      Keylife: 3600 seconds
j.      Enable Auto-negotiate   ! Autokey Keep Alive is enabled automatically when Auto-negotiate is enabled
k.      Click Ok
```

Figure 10.85: IPsec Phase 2

FortiGate Configuration

1. First, we will configure port1 and port2 IP addresses. port1 should be set as DHCP client and port2 should be set as 192.168.10.1/24.

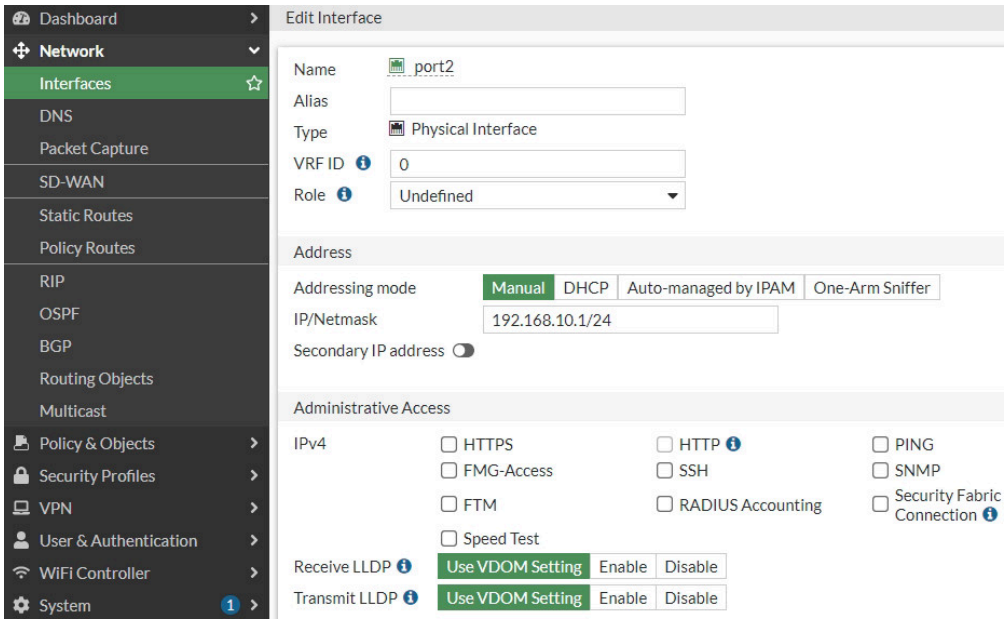


Figure 10.86: Set an IP address for port2

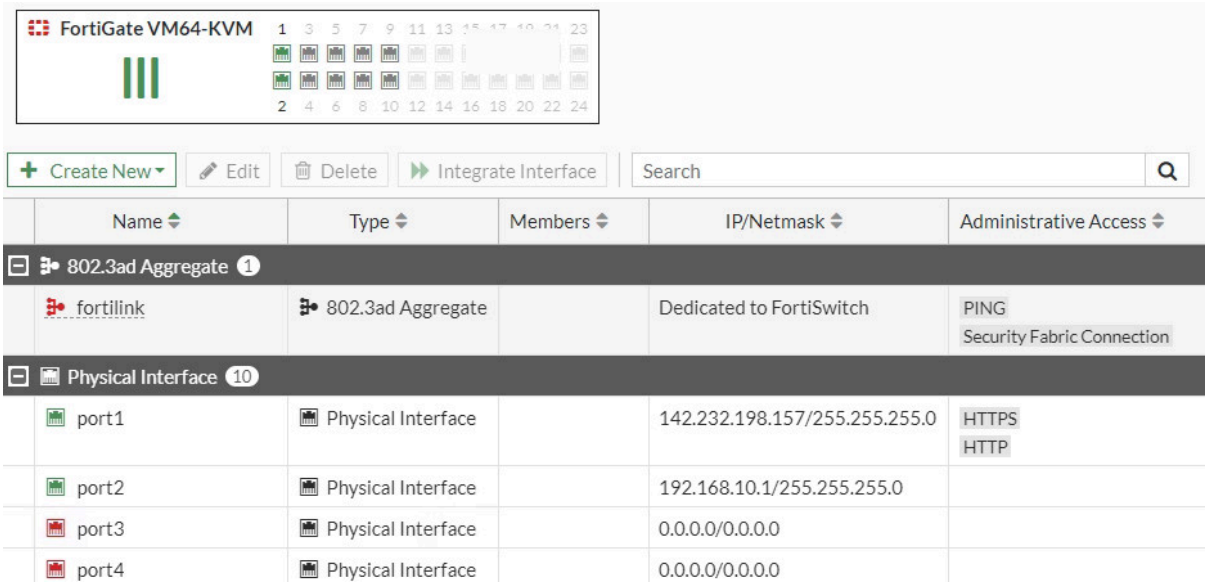


Figure 10.87: Port1 and Port2 IP addresses

2. Create a static route to port1 (WAN Port) as Figure 10.88.

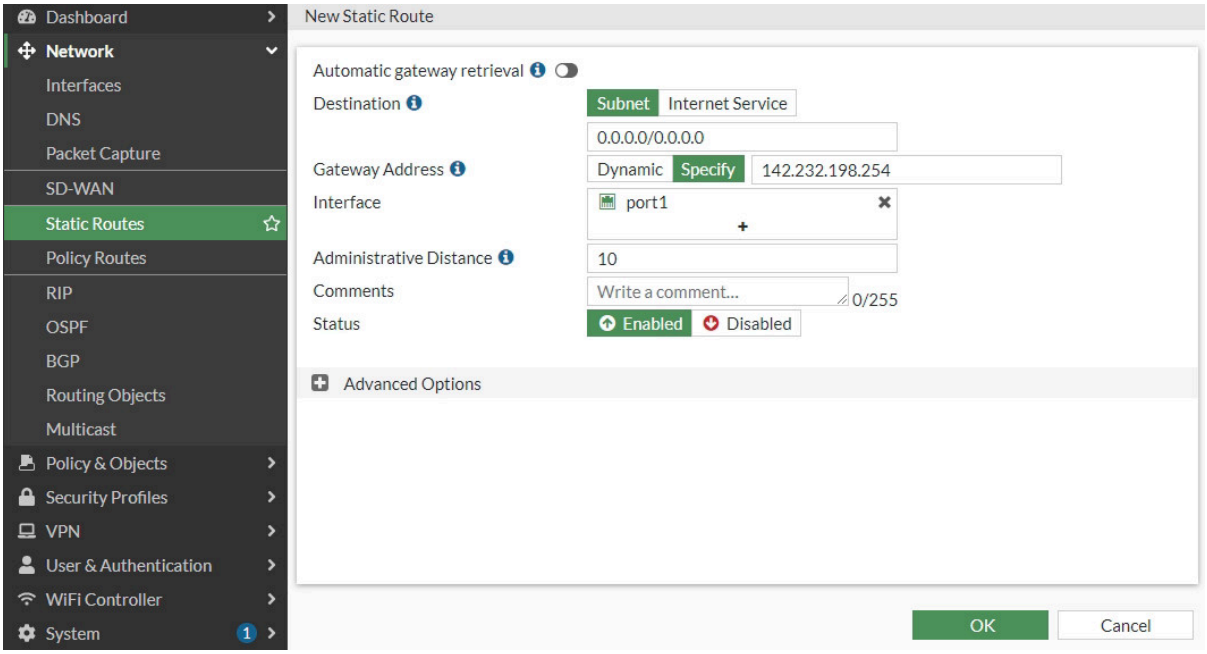


Figure 10.88: Create a static route

3. Create an IPsec Wizard as a custom as follows:

    - **Remote Gateway IP Address:** *Public_IP_Address_AWS_Virtual_Gateway*
    - **Nat Traversal:** Disable
    - **Pre-shared Key:** *The same as AWS key(psWvIznNXaD3e1bWB9mVrODkrYALmrBO)*
    - **Local Address:** 192.168.10.0/24
    - **Remote Address:** 10.0.0.0/16

- **Phase 1:** Encryption: AES128, Authentication: SHA-1, DH: 2, lifetime: 28800
- **Phase 2:** Encryption: AES128, Authentication: SHA-1, DH: 2, lifetime: 3600
- **IKE:** version 2

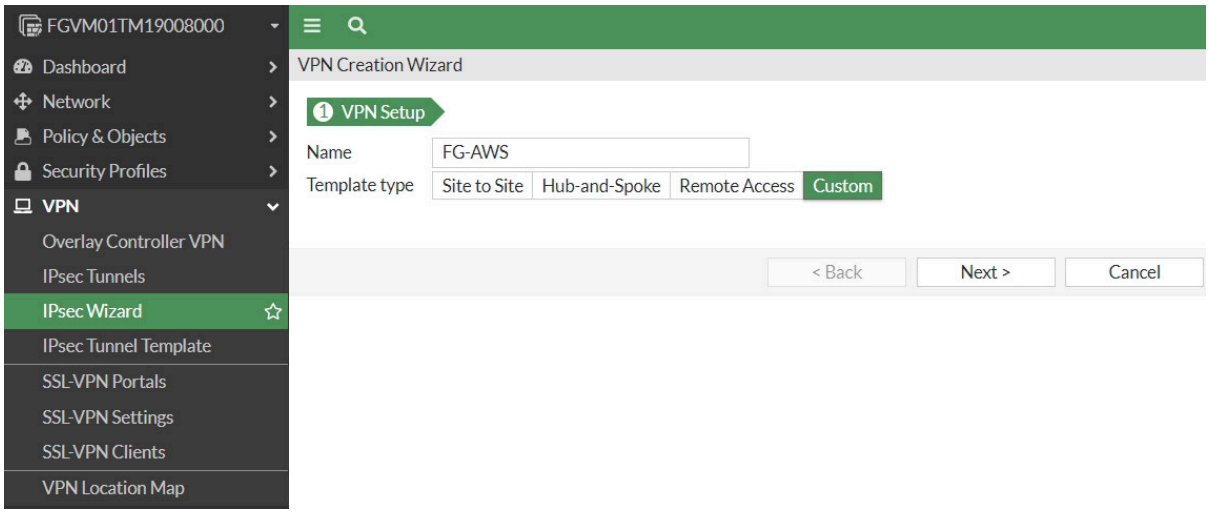


Figure 10.89: Create a custom VPN

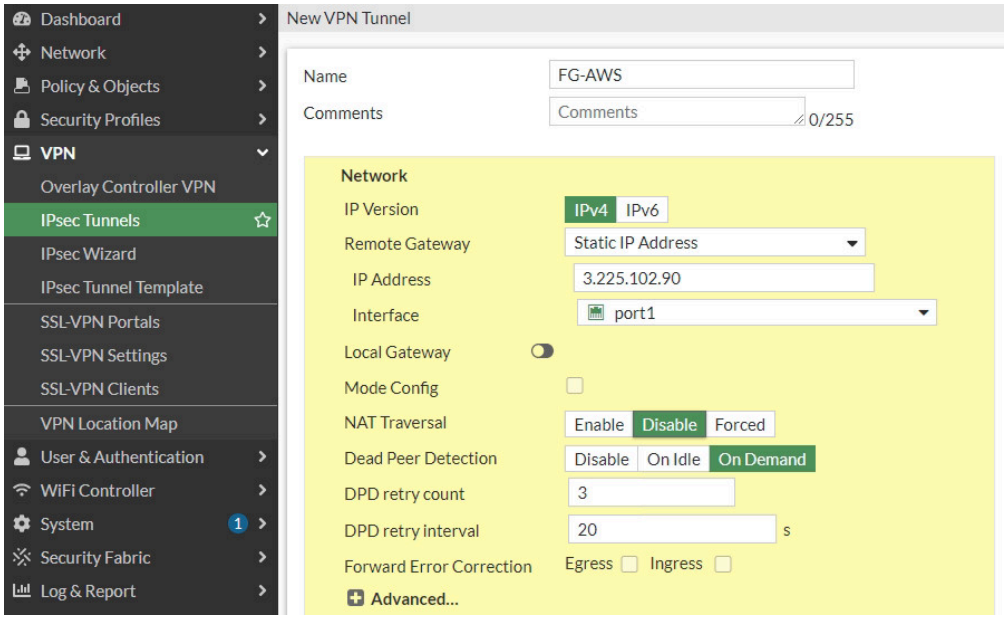


Figure 10.90: Create a custom VPN

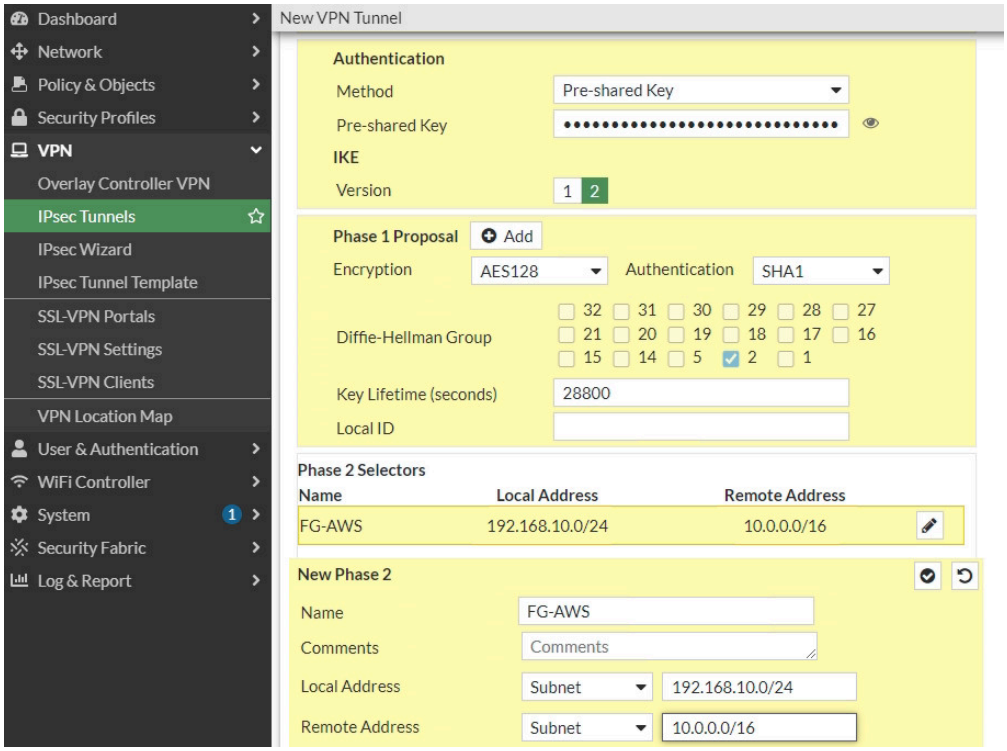


Figure 10.91: Create a custom VPN

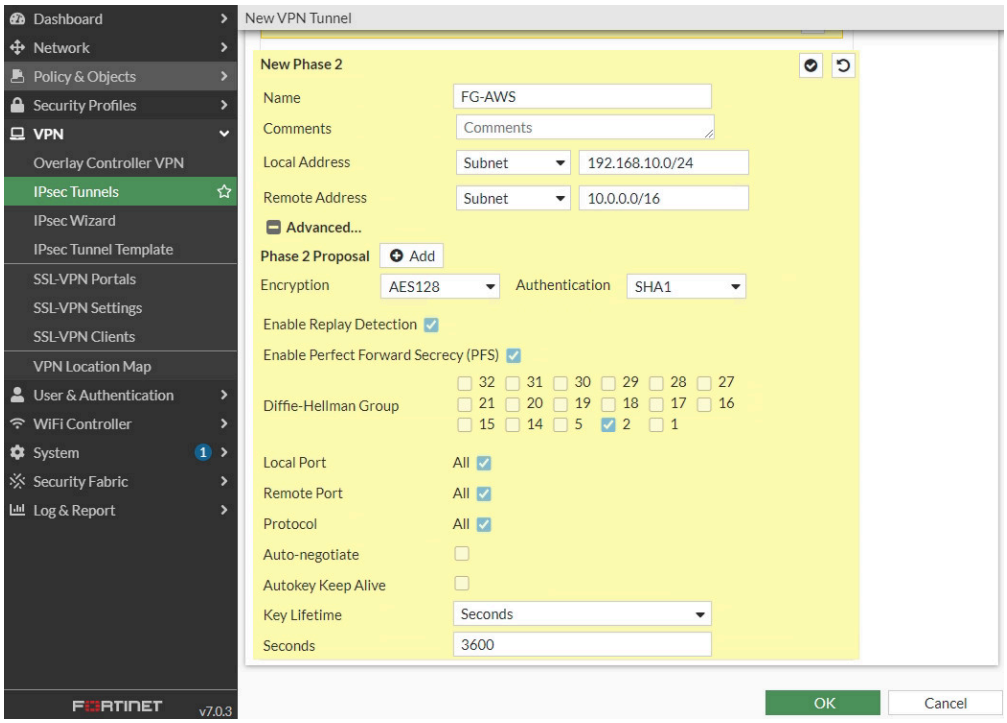


Figure 10.92: Create a custom VPN

4. Set an IP address for FG-AWS tunnel. We will set the IP address based on the configuration file.

vpn-0a9b7e3a2ca3eebd2.txt - Notepad

File Edit Format View Help

```
! #3: Tunnel Interface Configuration

! A tunnel interface is configured to be the logical interface associated
! with the tunnel. All traffic routed to the tunnel interface will be
! encrypted and transmitted to the VPC. Similarly, traffic from the VPC
! will be logically received on this interface.
!
!
! The address of the interface is configured with the setup for your
! Customer Gateway.  If the address changes, the Customer Gateway and VPN
! Connection must be recreated with Amazon VPC.
!
! This is required in order for tunnel failover via gwdetect to function
!
! Perform this from the Global VDOM.

Go to Network Tab --> Interface --> wan1 and edit vpn-0a9b7e3a2ca3eebd2-0

a. IP : 169.254.72.194
b. Remote IP: 169.254.72.193/30
c. Select Ping
d. Administrative Status: Up
e. Select Ok.
```

Figure 10.93: Configuration file for setting an IP address for FG-AWS tunnel

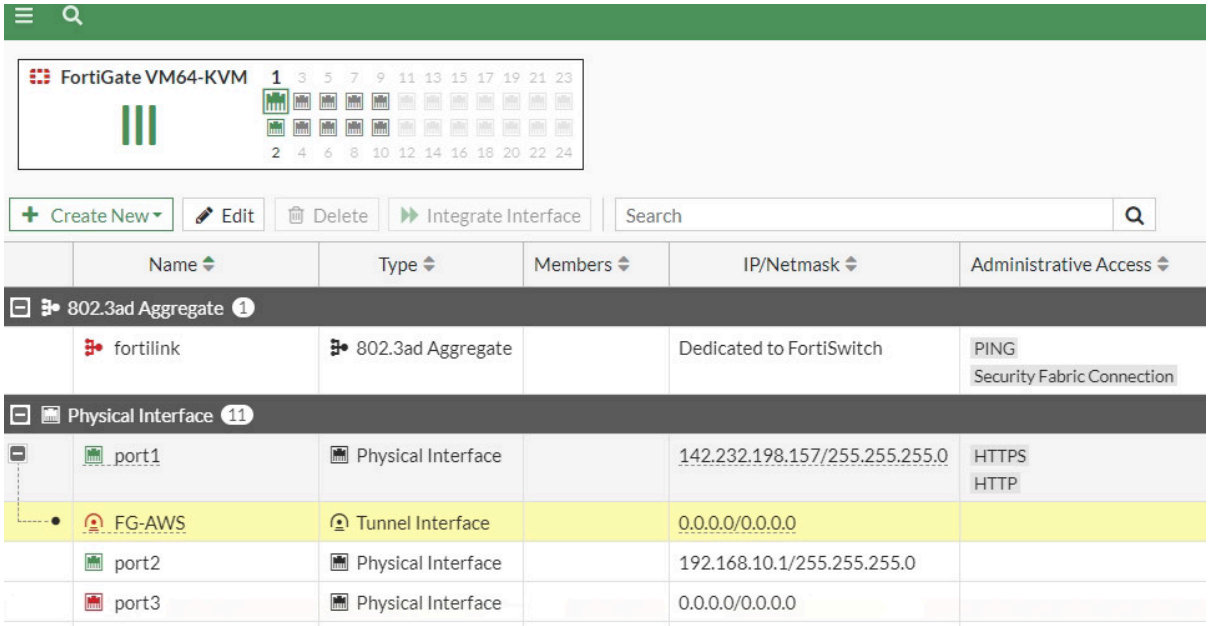


Figure 10.94: Set an IP address for FG-AWS tunnel

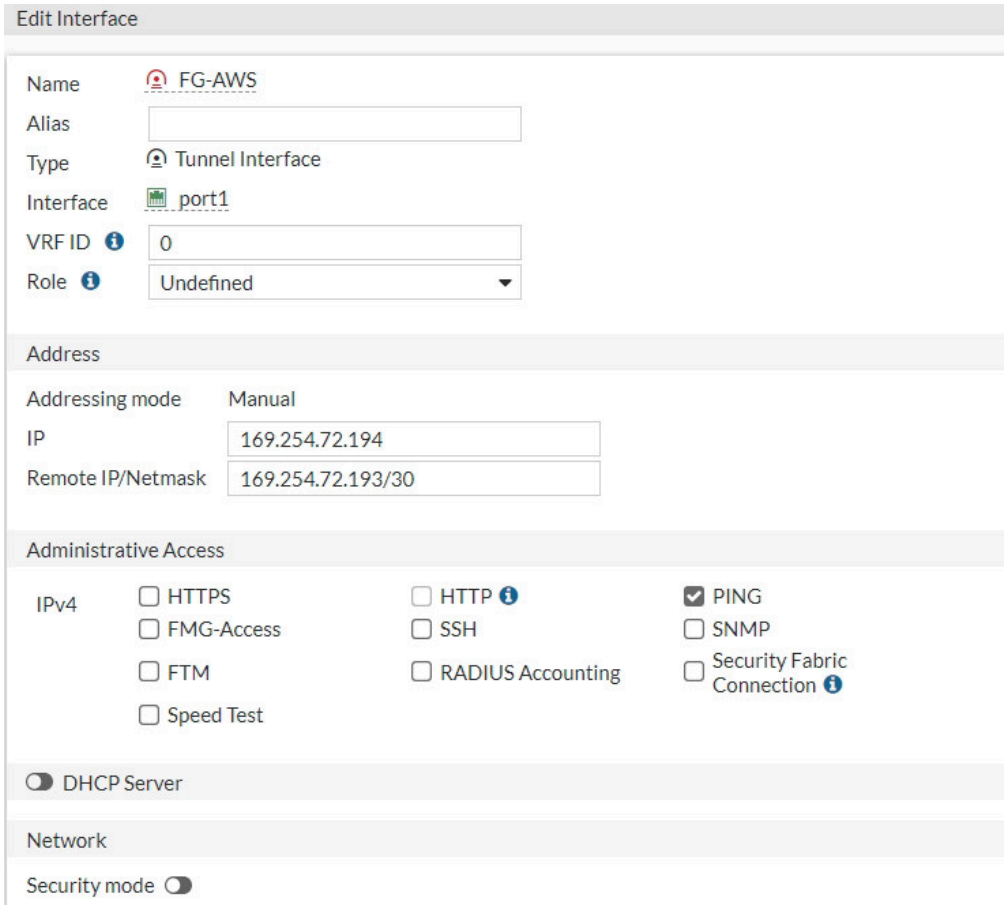


Figure 10.95: Set an IP address for FG-AWS tunnel

5. Create a static route from FG-LAN to AWS-LAN. We will set a static route based on the configuration file.

*vpn-0a9b7e3a2ca3eebd2.txt - Notepad

File Edit Format View Help

```
! #4 Static Route Configuration
Your Customer Gateway needs to set a static route for the prefix corresponding to your
! VPC to send traffic over the tunnel interface.
! An example for a VPC with the prefix 10.0.0.0/16 is provided below:
!
! This is configured from the root VDOM


Go to Network Tab --> Static Routes --> Create New

a. Destination: Subnet (10.0.0.0/16)
b. Interface: vpn-0a9b7e3a2ca3eebd2-0 ! This is the VPN tunnel interface
c. Click Ok
```

Figure 10.96: Configuration file for creating a static route from FG-LAN to AWS-LAN

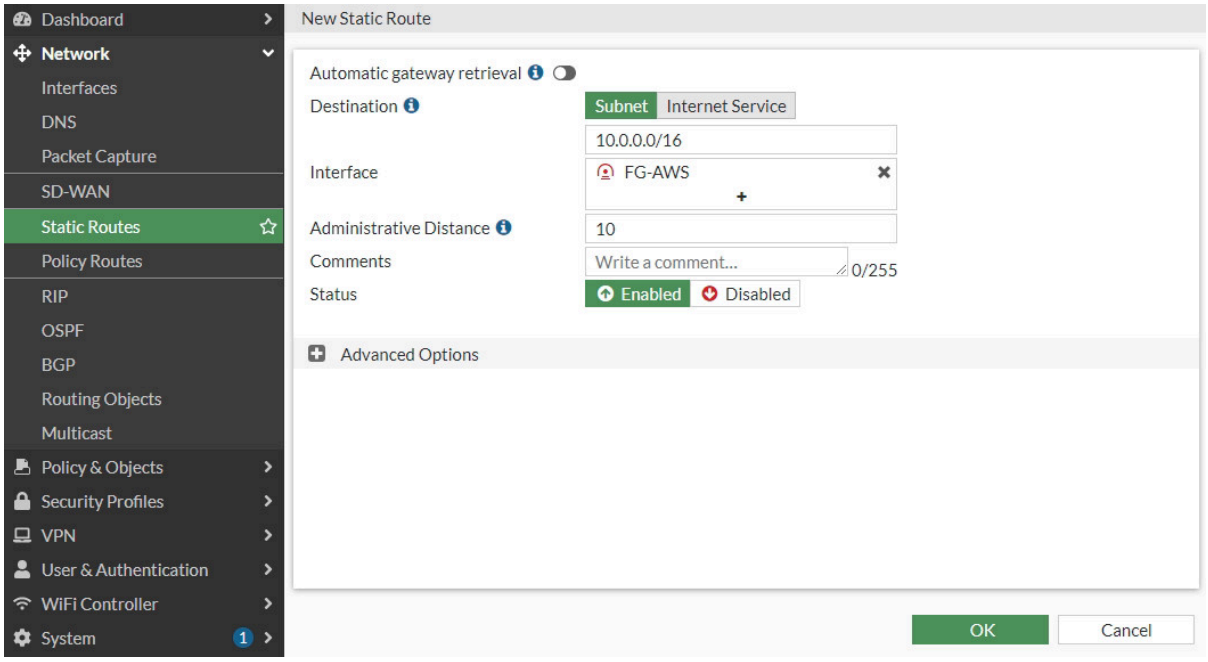


Figure 10.97: Create a static route from FG-LAN to AWS-LAN

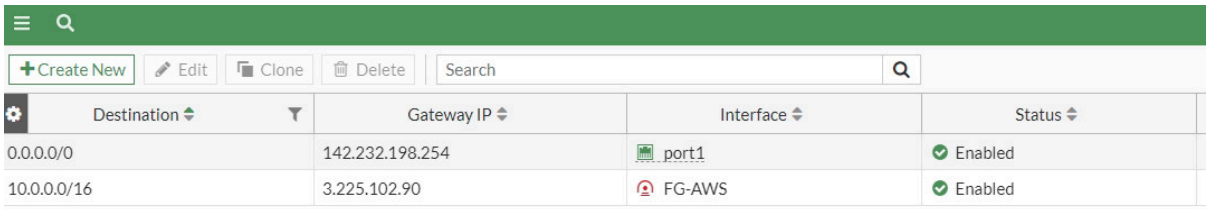


Figure 10.98: Create a static route from FG-LAN to AWS-LAN

6. Create a firewall policy from Port2 to Tunnel and from Tunnel to Port2. We will create a subnet for LAN on premise and a subnet for AWS. Also, in site-to-site VPN, NAT should be disabled here.

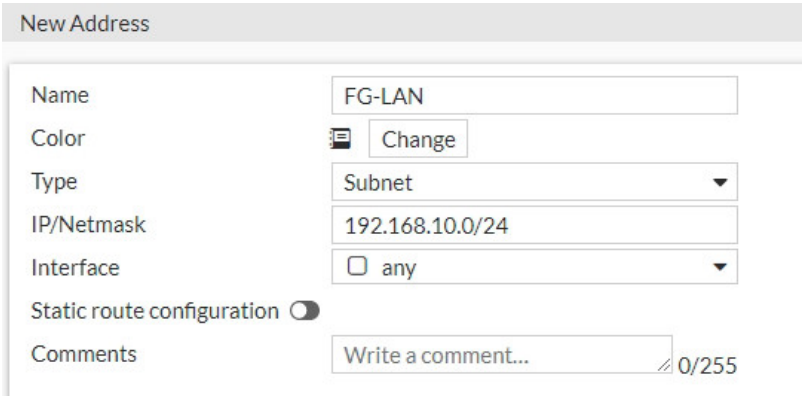


Figure 10.99: Create a subnet for local network

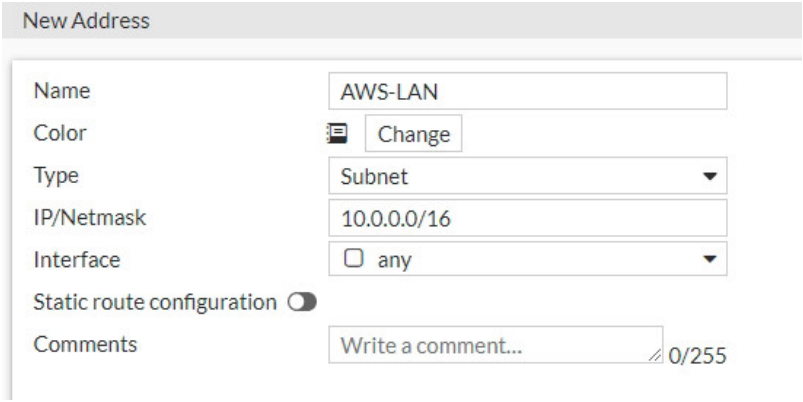


Figure 10.100: Create a subnet for AWS local network

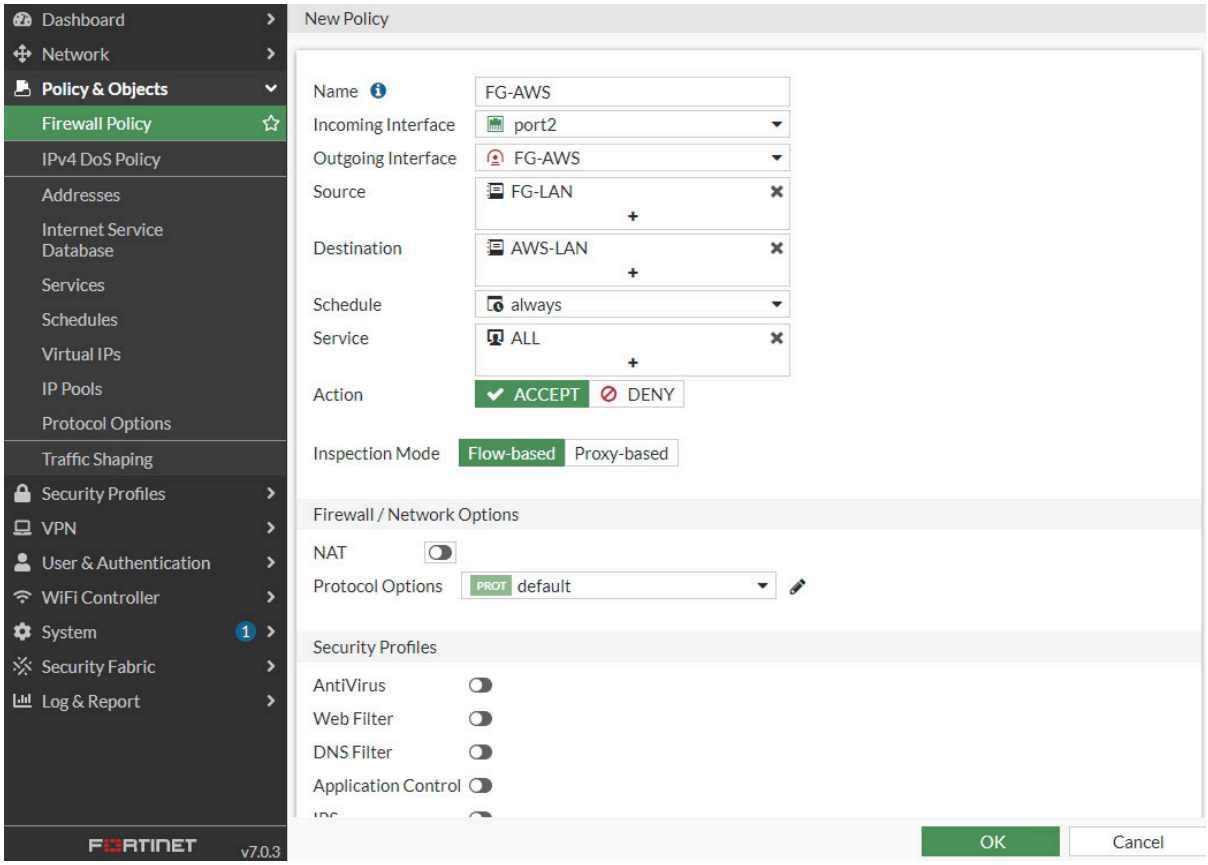


Figure 10.101: Create a policy from port2 to FG-AWS Tunnel

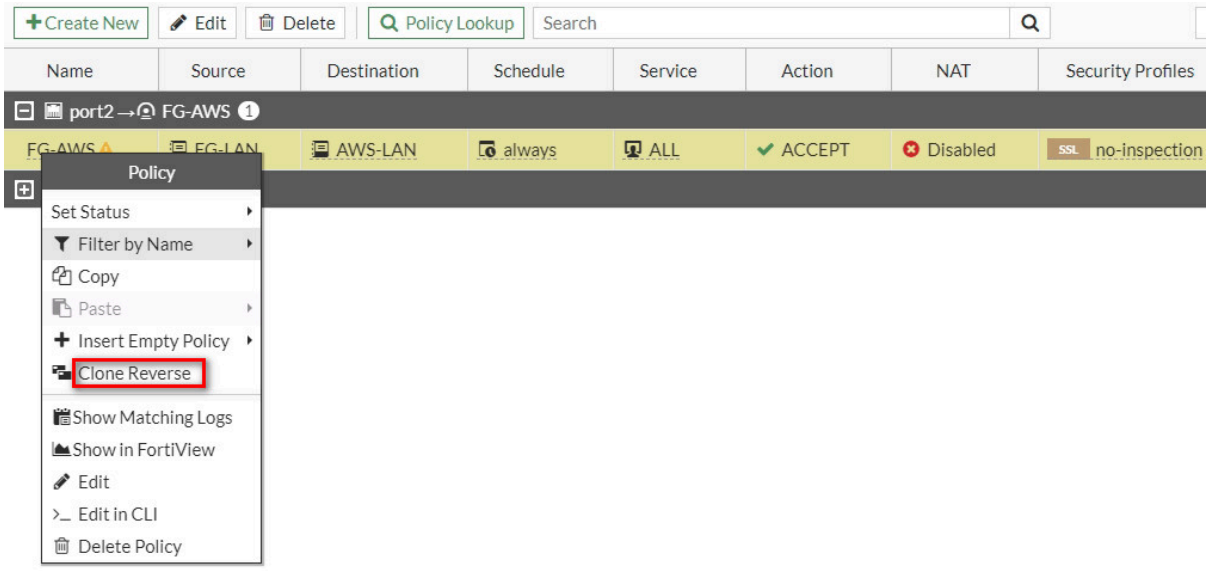


Figure 10.102: Create a policy from FG-AWS Tunnel to port2

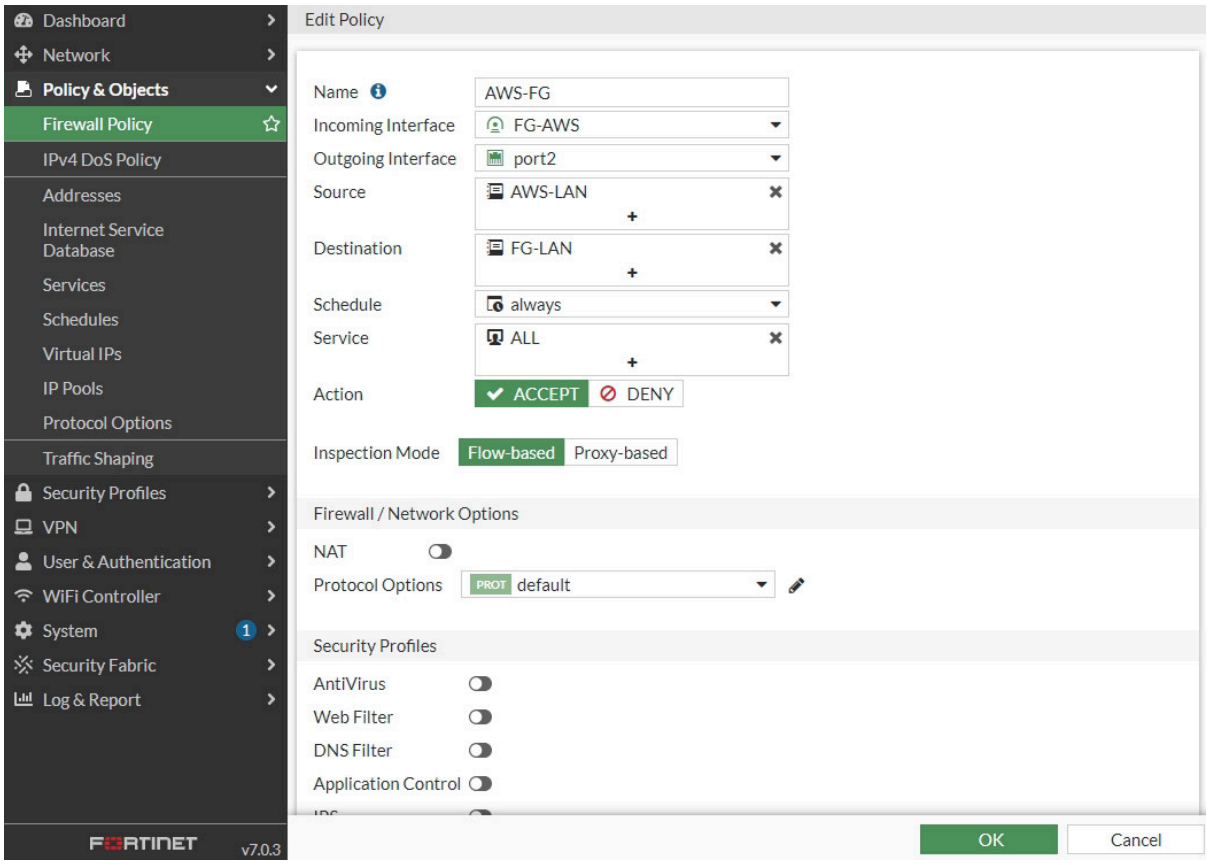


Figure 10.103: Create a policy from AWS-FG Tunnel to port2

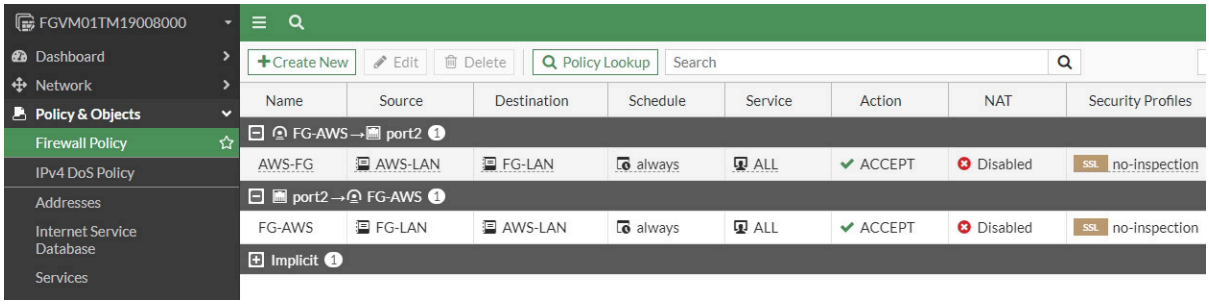


Figure 10.104: Firewall Policies Overview

Verify Connections

If you navigate to IPsec Tunnel, the status should be up.

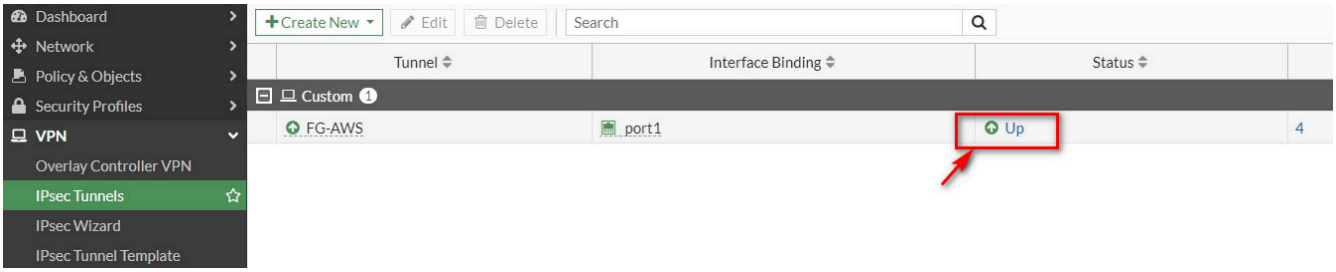


Figure 10.105: Verify tunnel status in FortiGate (on premise)

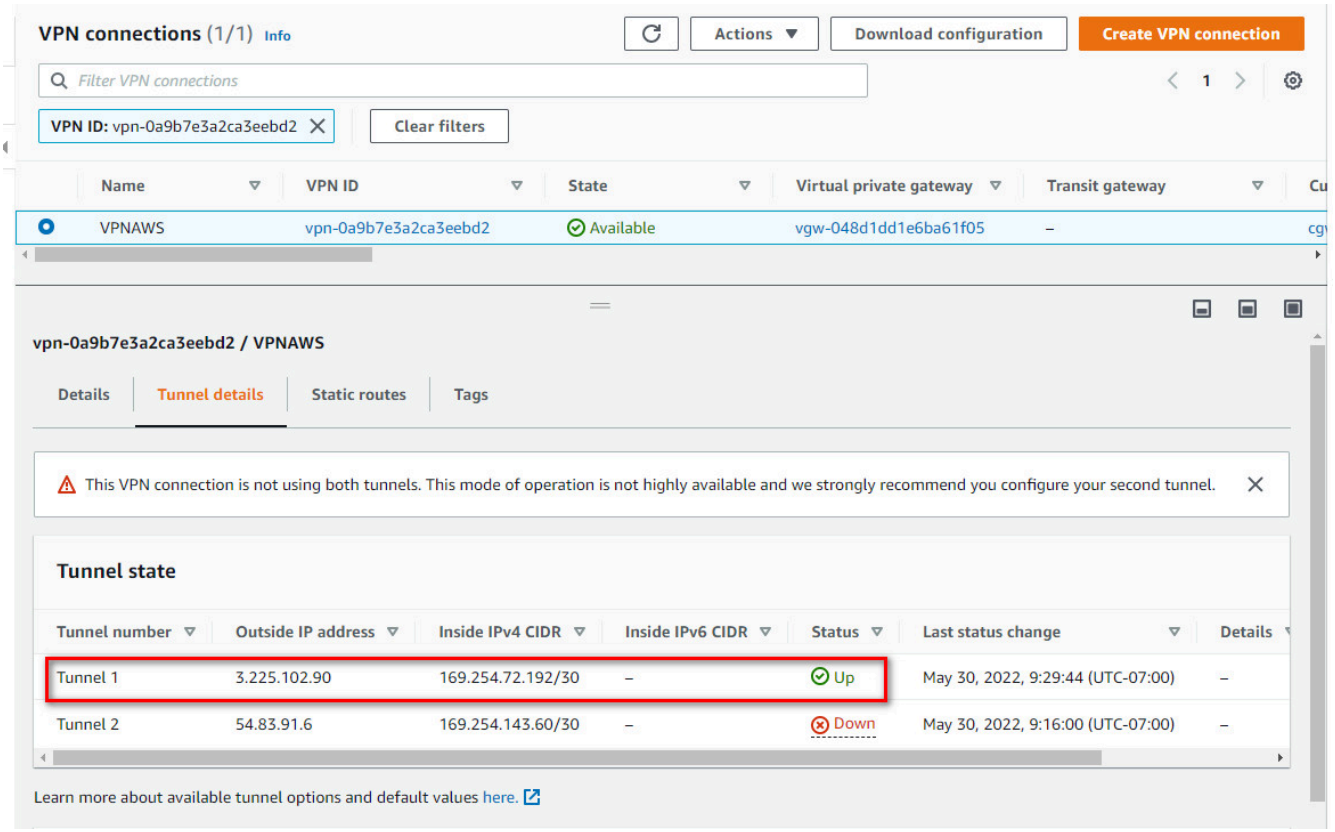


Figure 10.106: Verify tunnel status in AWS

10.5 Deploy FortiGate in AWS

Learning Objectives

- Create a VPC, public and private subnet, internet gateway, route tables
- Create a FortiGate firewall in AWS through Marketplace
- Identify FortiGate subnets in AWS

Scenario: In this lab, we'll learn how to deploy FortiGate in AWS.

AWS Configuration

1. Create a VPC.

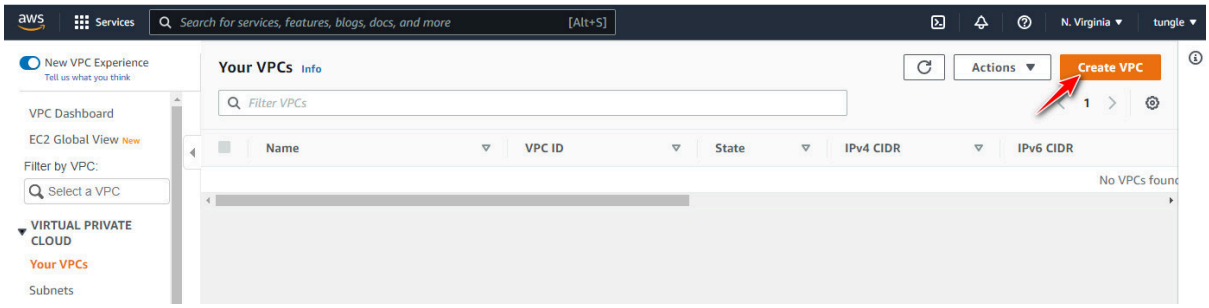


Figure 10.107: Create a VPC

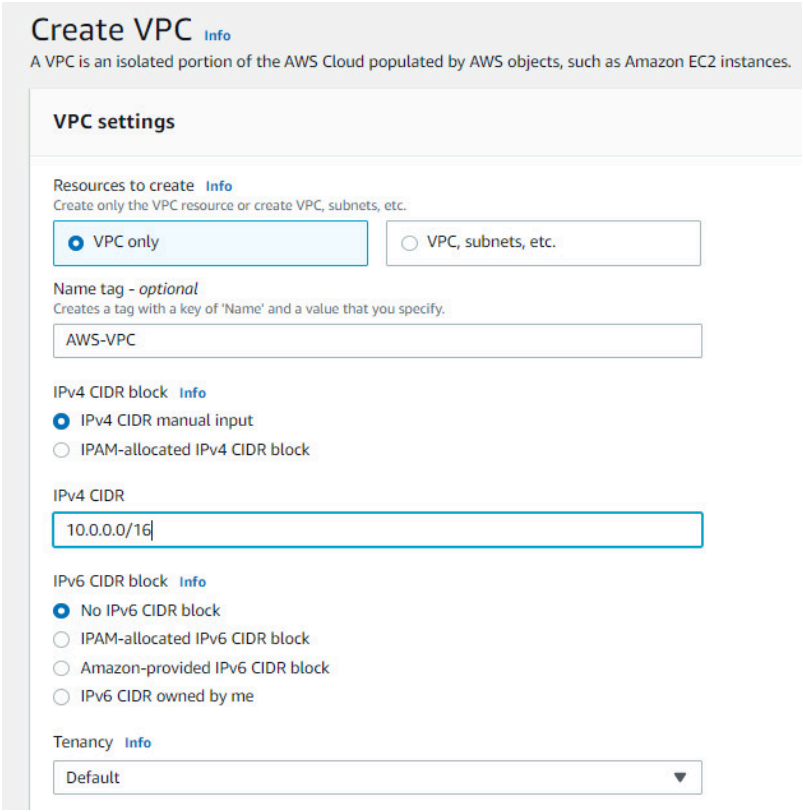


Figure 10.108: Create a VPC named "AWS-VPC"

2. Create a subnet.

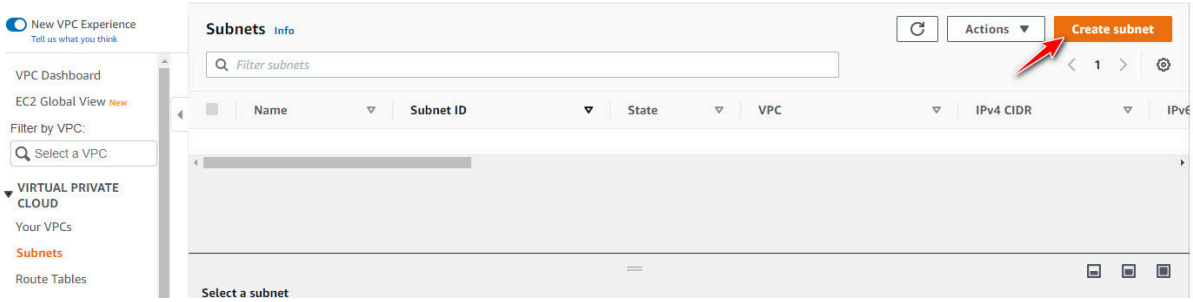


Figure 10.109: Create a subnet

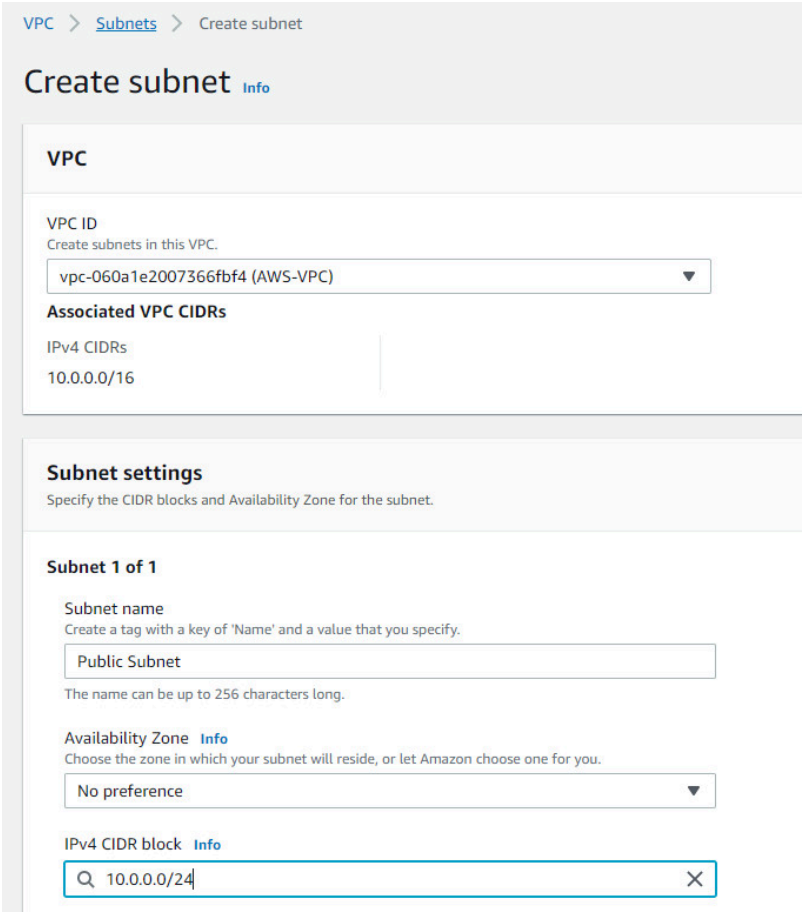


Figure 10.110: Create a public subnet under AWS-VPC

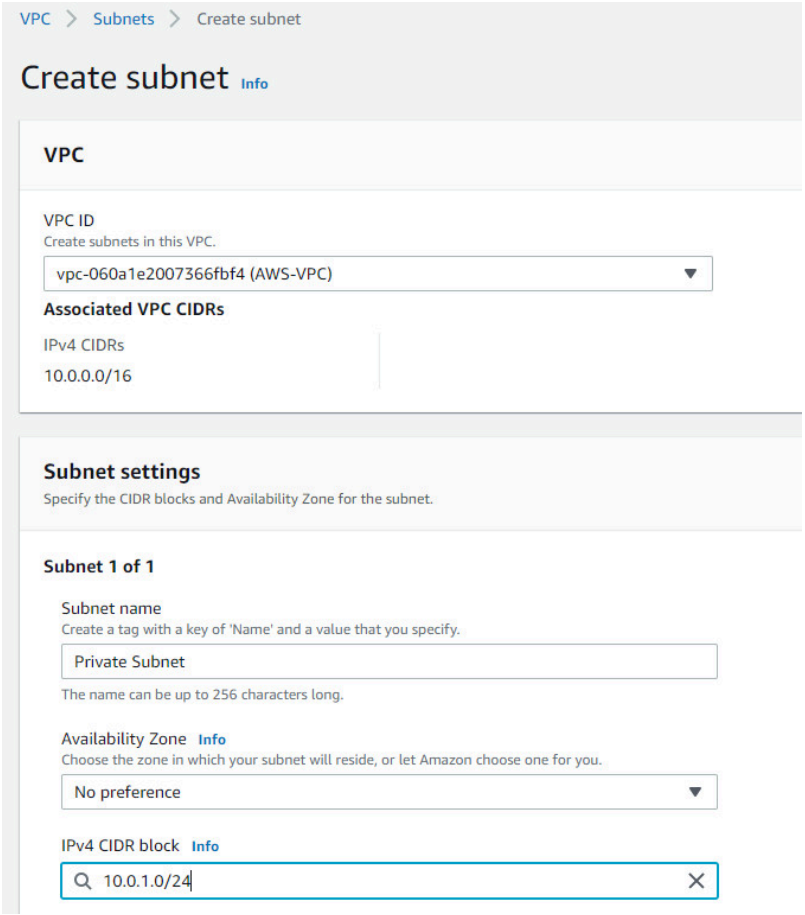


Figure 10.111: Create a private subnet under AWS-VPC

3. Create an internet gateway.

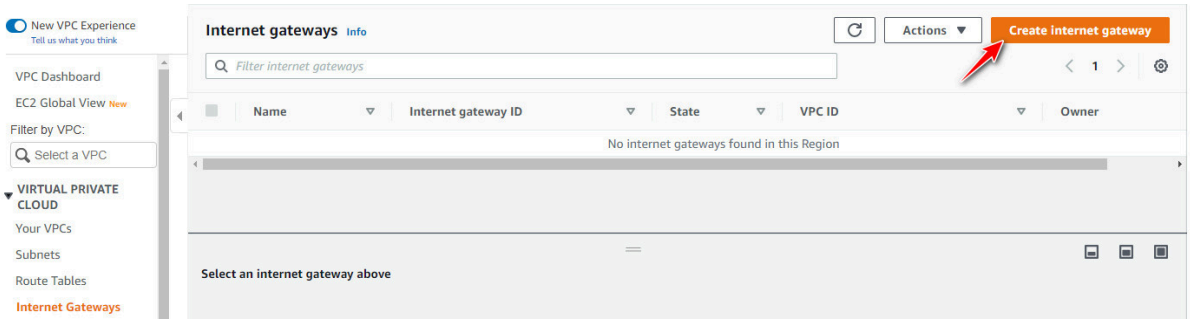


Figure 10.112: Create an internet gateway

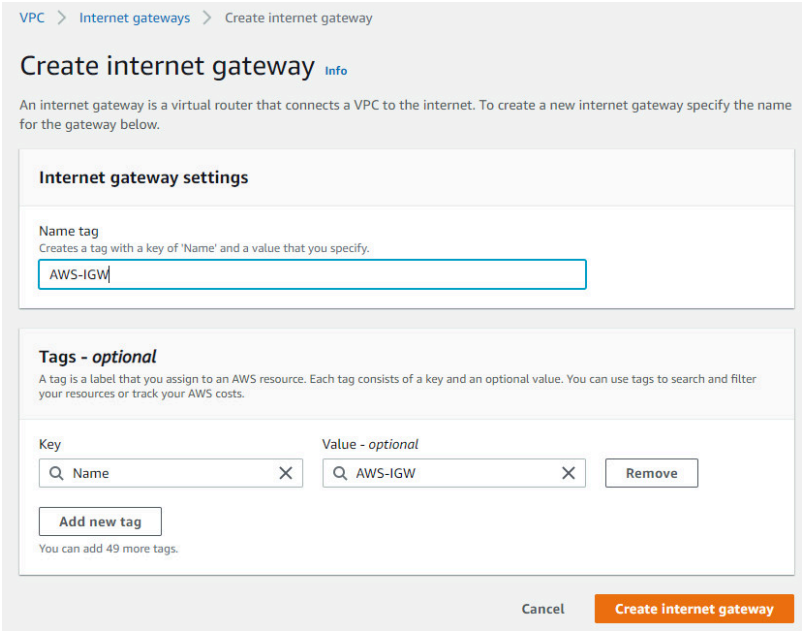


Figure 10.113: Create an internet gateway

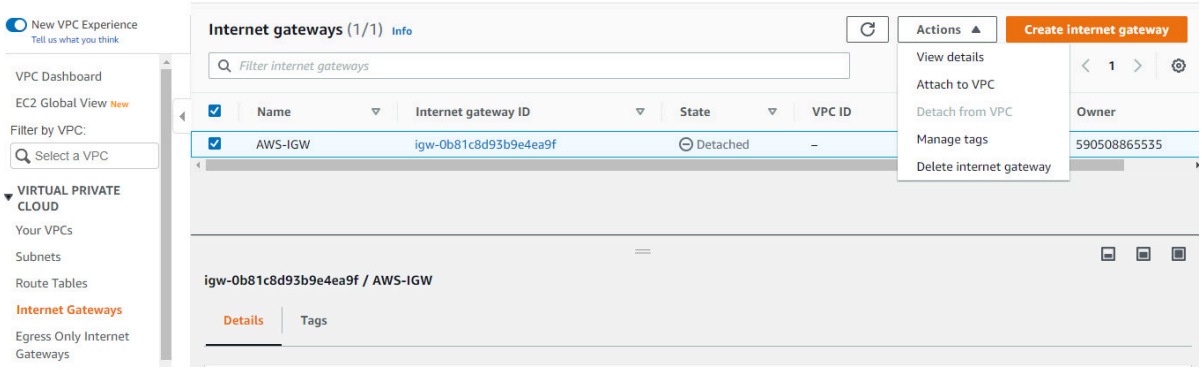


Figure 10.114: Attach an internet gateway to VPC

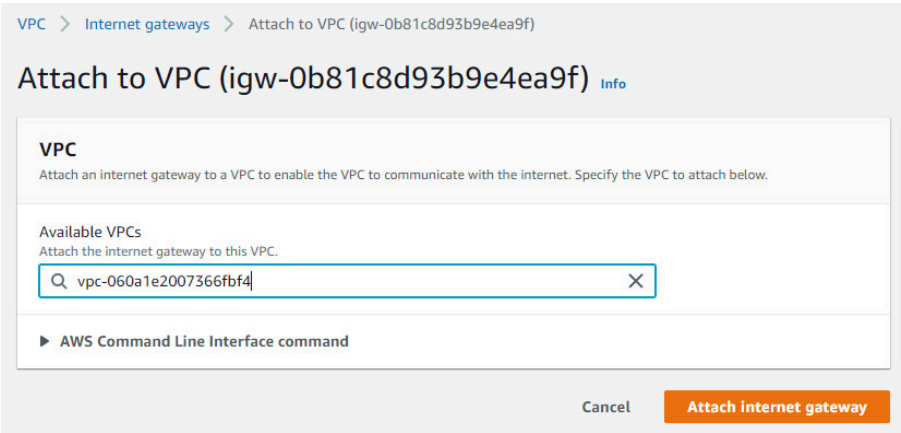


Figure 10.115: Attach an internet gateway to VPC

4. Create a new Public RouteBy default, name of the “built-in route” is “-”. Rename it to Private Route.

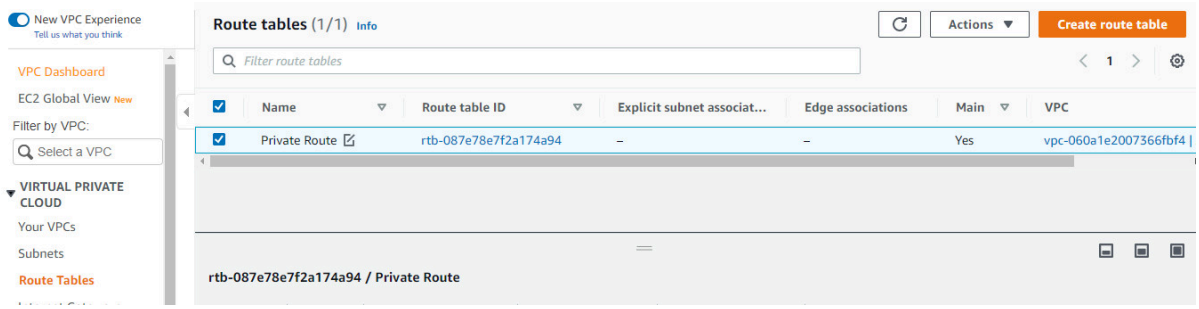


Figure 10.116: Edit private route

Go to **Route tables** > **create route table**.

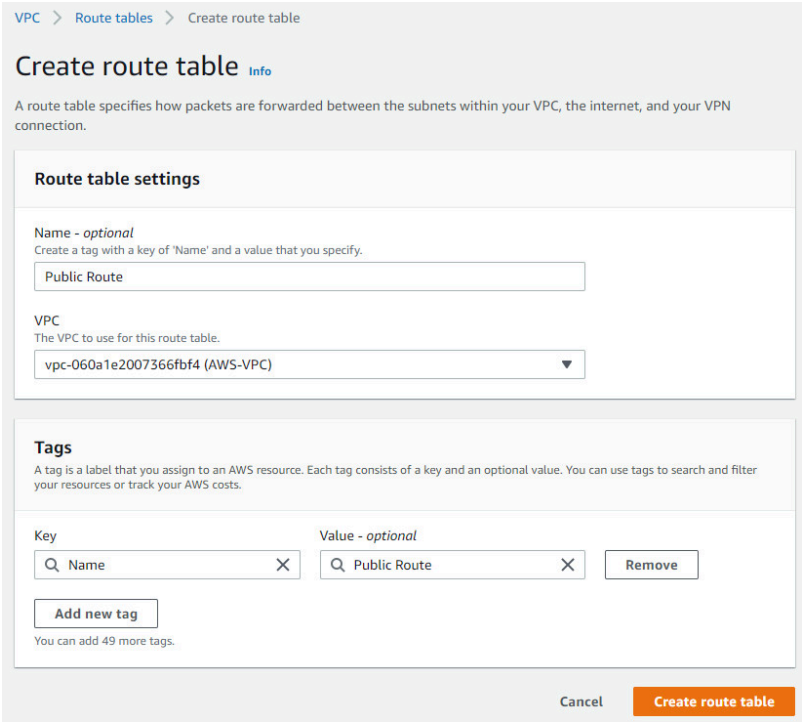


Figure 10.117: Create a public route

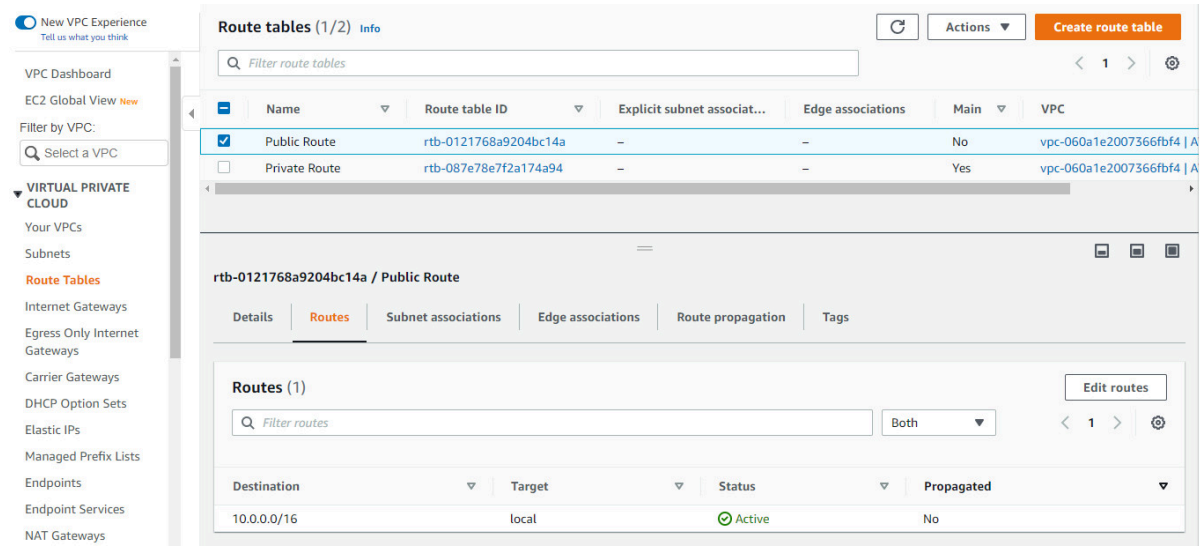


Figure 10.118: Edit routes on Public Route

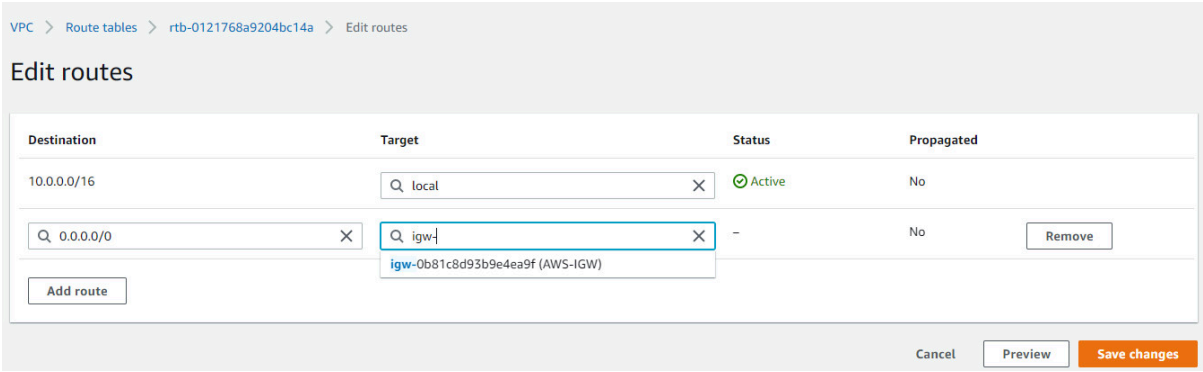


Figure 10.119: Create a new default route to the internet gateway

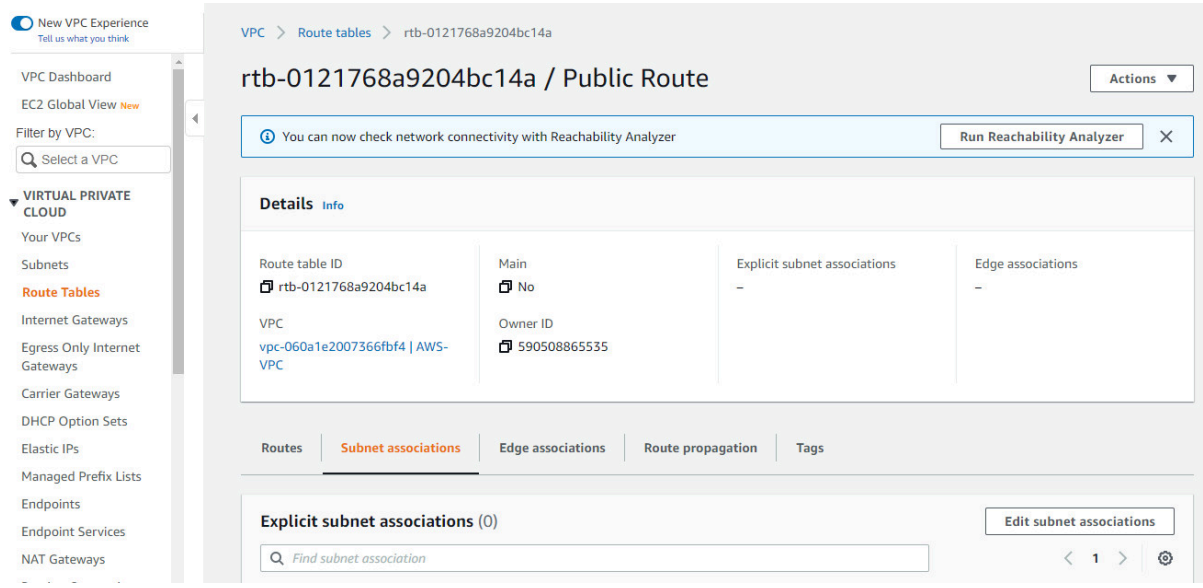


Figure 10.120: Associate Public Subnet to Public Route

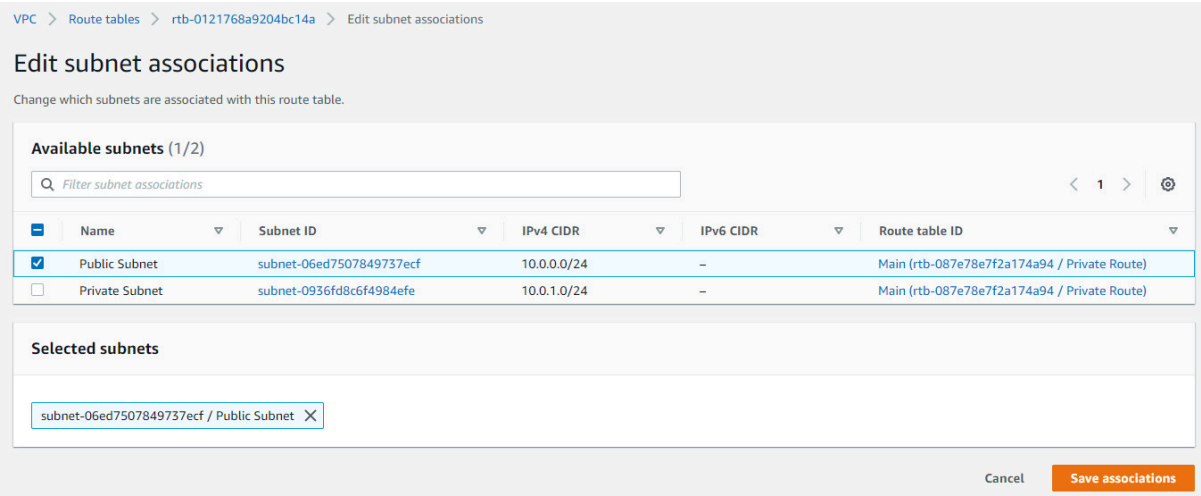


Figure 10.121: Associate Public Subnet to Public Route

5. Create Key Pair. Go to **EC2 – Key Pairs > Create Key Pair**.

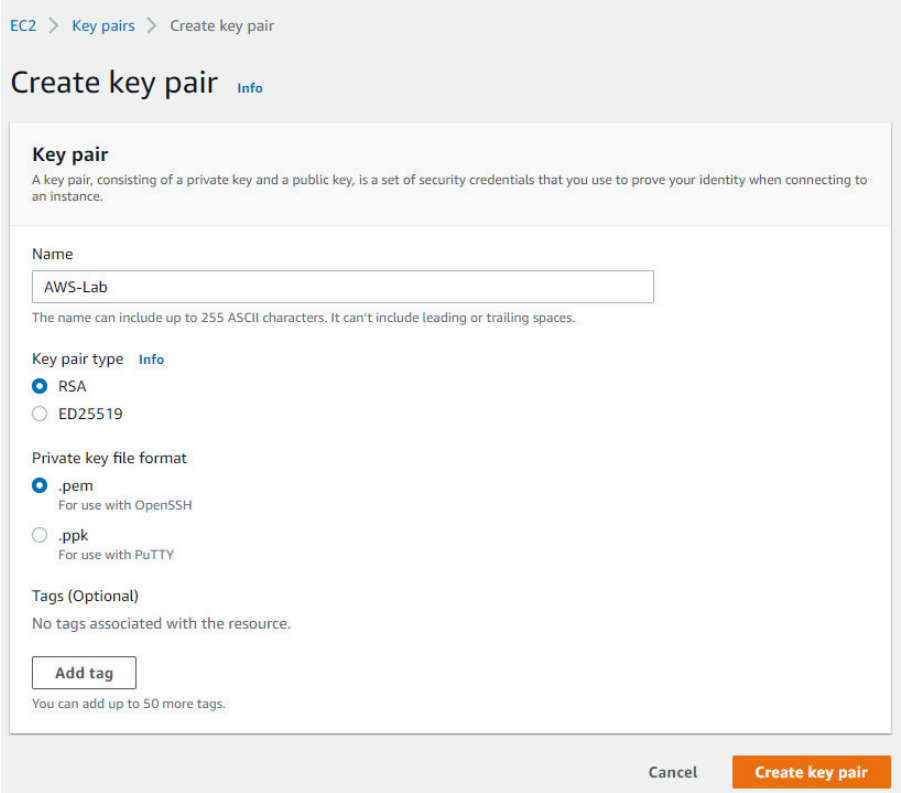


Figure 10.122: Create a key pair

6. Create Instances. Go to **EC2 – Instances** > **Launch instances**.

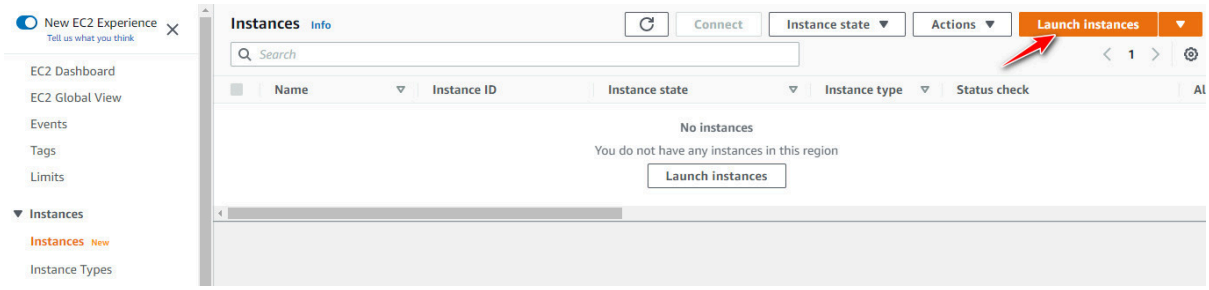


Figure 10.123: Launch a FortiGate instance

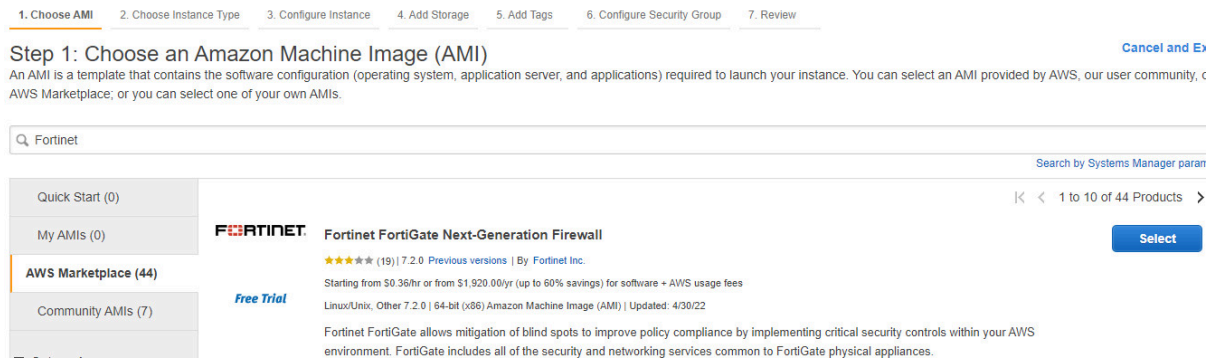


Figure 10.124: Select Fortinet FortiGate Next-Generation Firewall

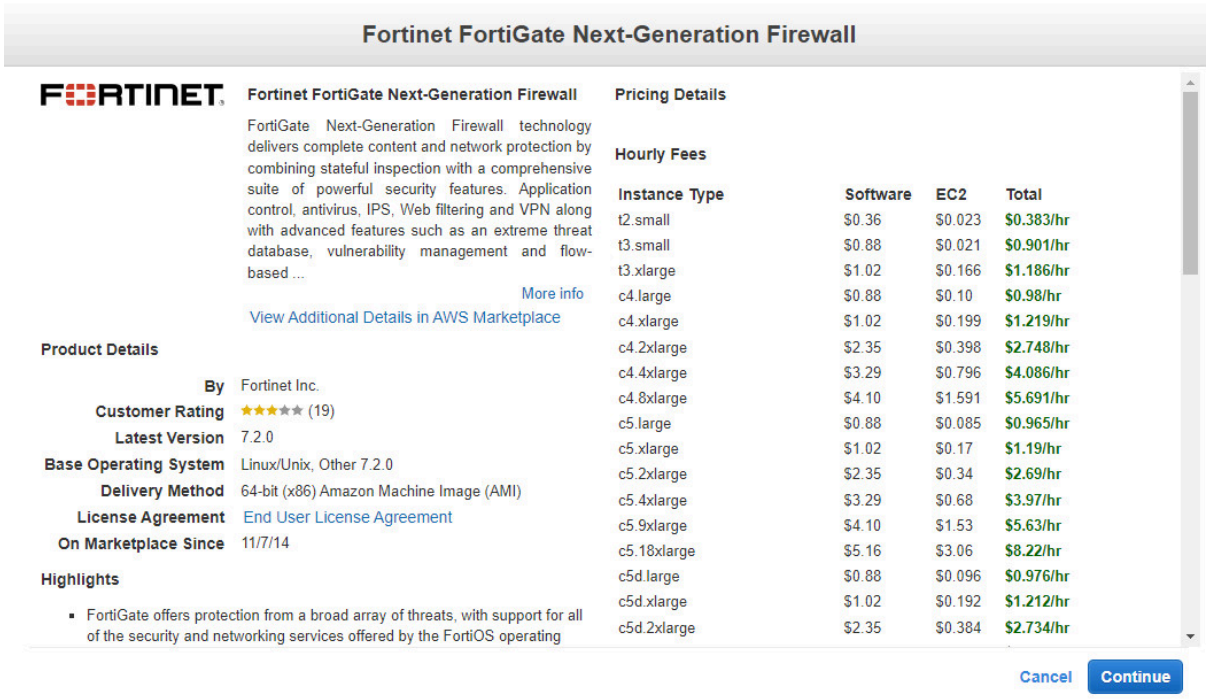


Figure 10.125: Accept FortiGate licence

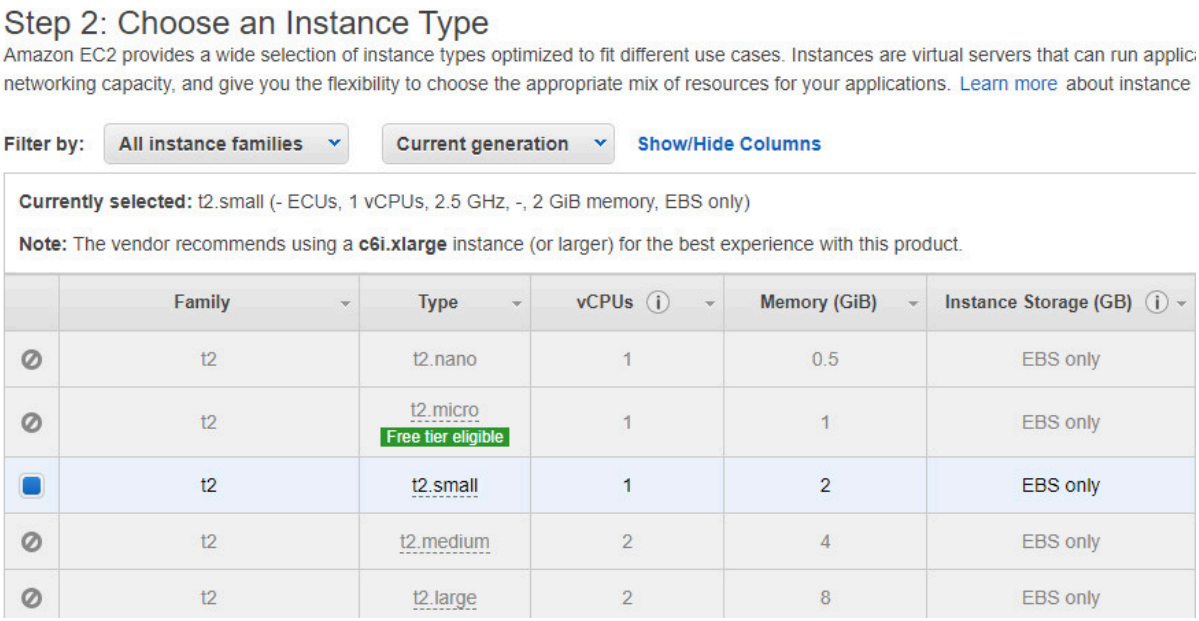


Figure 10.126: Select FortiGate instance type

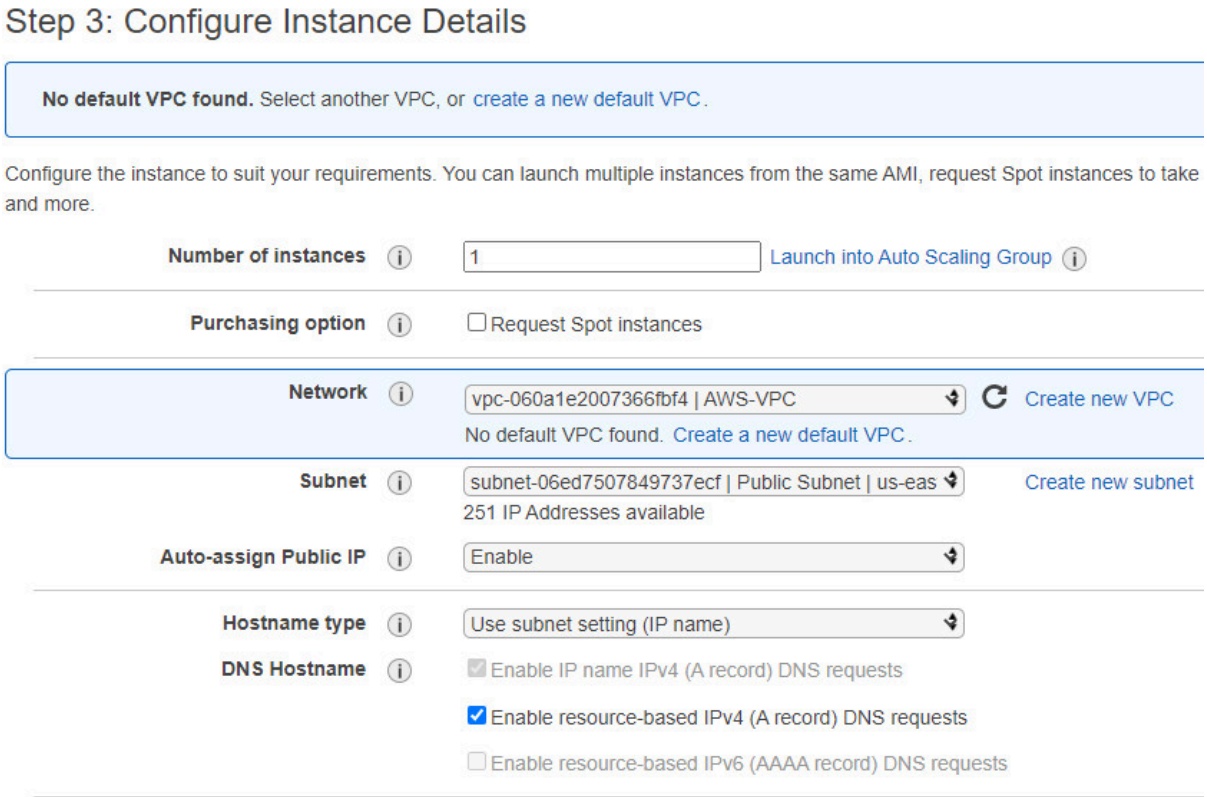


Figure 10.127: Select Network is "AWS-VPC", Subnet is "Public Subnet" and Auto-assign Public IP is "Enable"

Step 4: Add Storage

Your instance will be launched with the following storage device settings. You can attach additional EBS volumes and instance store volumes to your instance, or edit the settings of the root volume. You can also attach additional EBS volumes after launching an instance, but not instance store volumes. Learn more about storage options in Amazon EC2.

Volume Type	Device	Snapshot	Size (GiB)	Volume Type	IOPS	Throughput (MB/s)
Root	/dev/sda1	snap-0ba9f2da5ecf96965	2	General Purpose SSD (gp2)	100 / 3000	N/A
EBS	/dev/sdb	Search (case-insensit	30	General Purpose SSD (gp2)	100 / 3000	N/A

Add New Volume

Figure 10.128: Leave the Add storage as the default

Step 5: Add Tags

A tag consists of a case-sensitive key-value pair. For example, you could define a tag with key = Name and value = Webserver.
A copy of a tag can be applied to volumes, instances or both.
Tags will be applied to all instances and volumes. Learn more about tagging your Amazon EC2 resources.

Key (128 characters maximum)	Value (256 characters maximum)	Instances
Name	FG	☑

Figure 10.129: Assign Tag with Key is Name and Value is FG

Step 6: Configure Security Group

A security group is a set of firewall rules that control the traffic for your instance. On this page, you can add rules to allow specific traffic to reach your instance. For example, i
Internet traffic to reach your instance, add rules that allow unrestricted access to the HTTP and HTTPS ports. You can create a new security group or select from an existing
security groups.

Assign a security group: ◉ Create a **new** security group
○ Select an **existing** security group

Security group name: FortiGate Security Group

Description: FortiGate Security Group

Type	Protocol	Port Range	Source	
SSH	TCP	22	Custom	0.0.0.0/0
HTTP	TCP	80	Custom	0.0.0.0/0
HTTPS	TCP	443	Custom	0.0.0.0/0
Custom TCP F	TCP	541	Custom	0.0.0.0/0
Custom TCP F	TCP	3000	Custom	0.0.0.0/0
Custom TCP F	TCP	8080	Custom	0.0.0.0/0
RDP	TCP	3389	Custom	0.0.0.0/0
All ICMP - IPv	ICMP	0 - 65535	Custom	0.0.0.0/0

Add Rule

Figure 10.130: Change to FortiGate Security Group and add RDP and ICMP to the Security Group

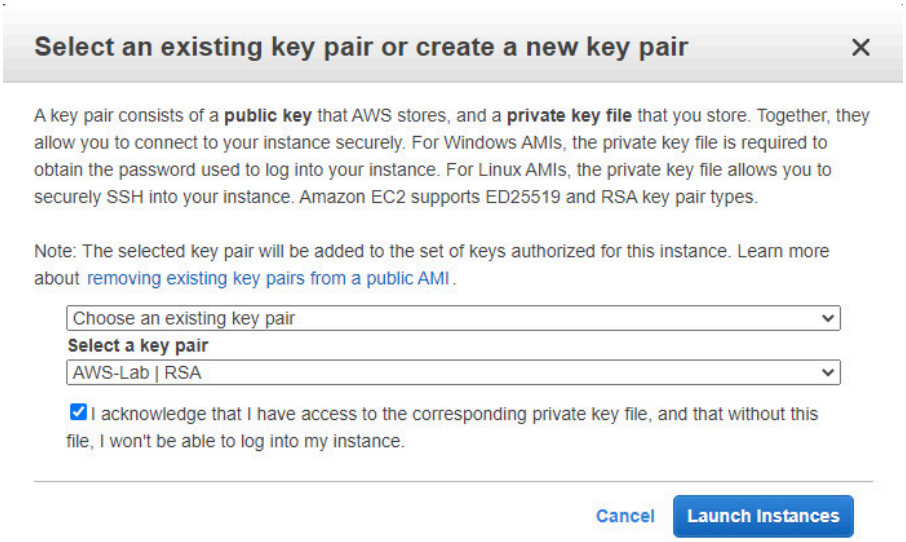


Figure 10.131: Accept key pair and launch instances

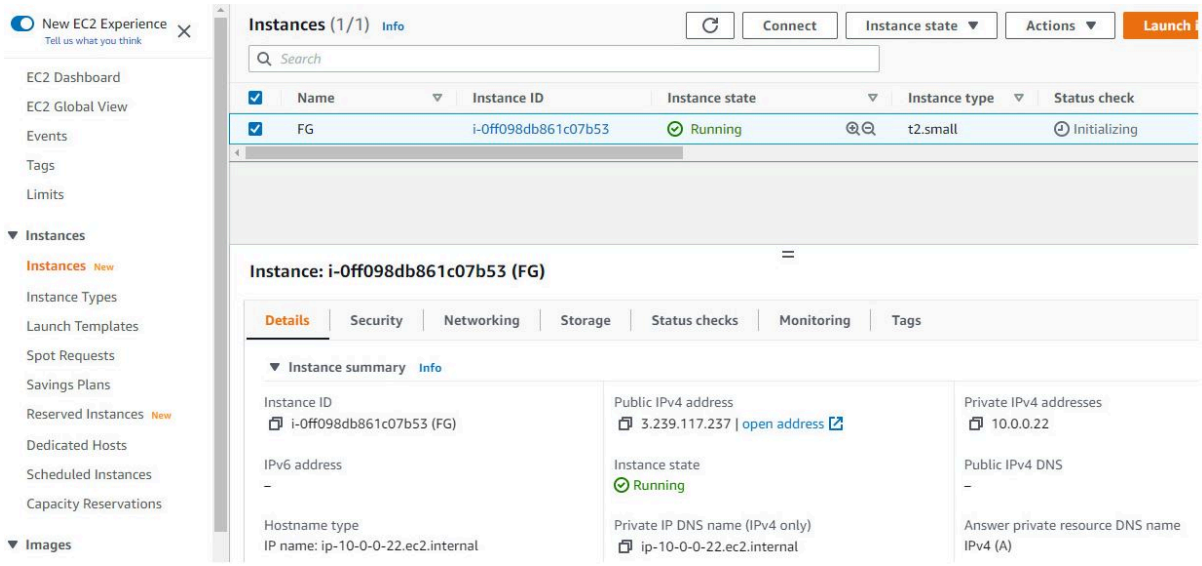


Figure 10.132: FG instance has been launched successfully

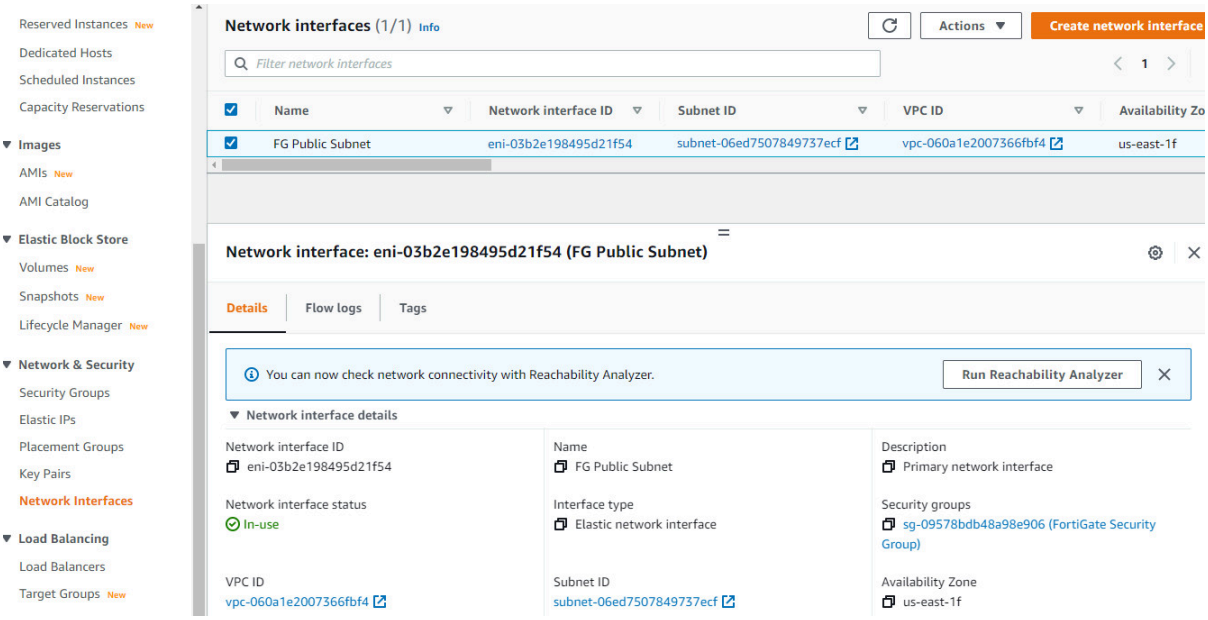


Figure 10.133: Change default interface name to FG Public Subnet

7. Add a new private subnet interface.

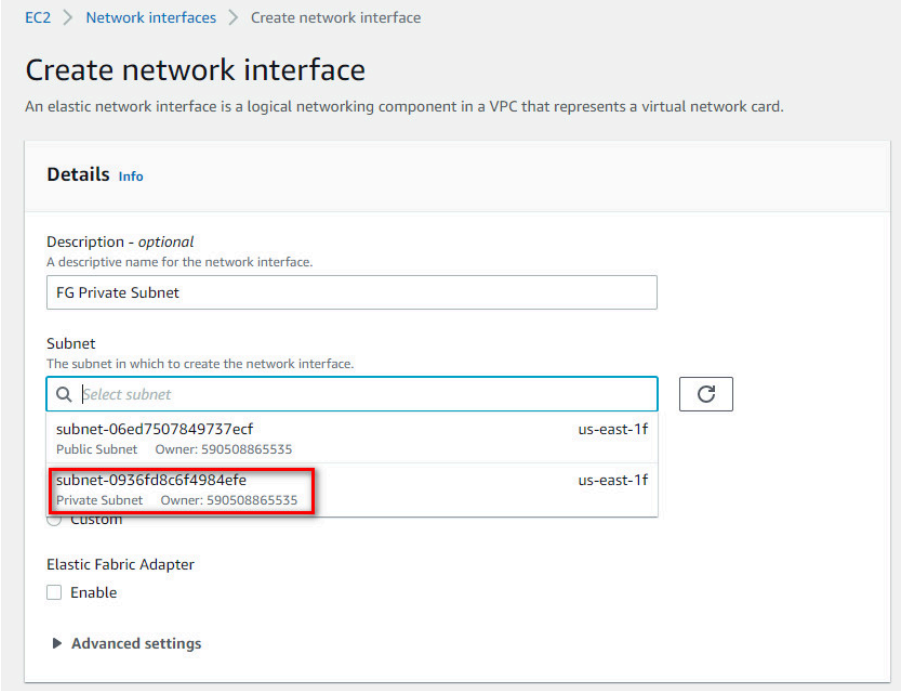


Figure 10.134: Create FG Private Subnet

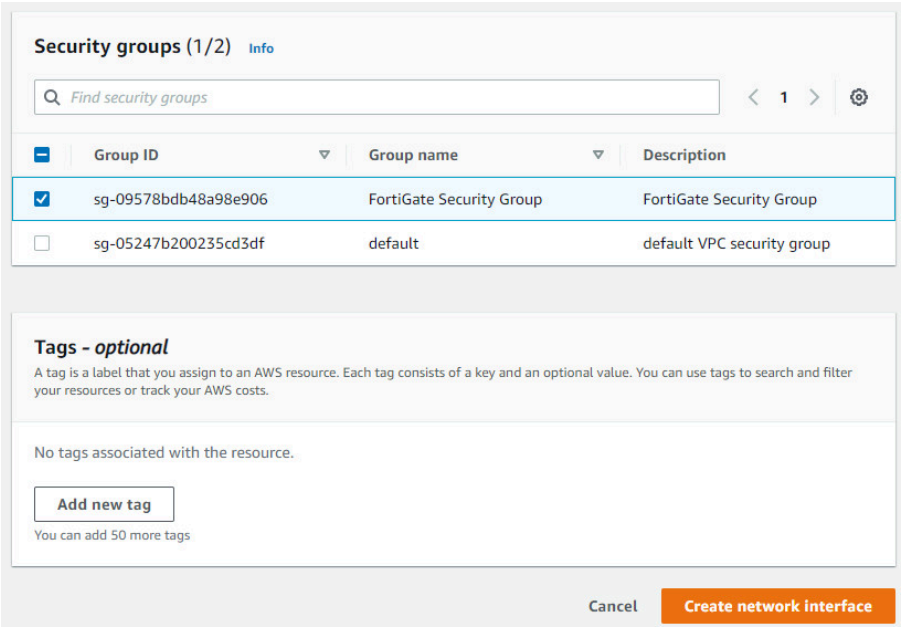


Figure 10.135: Create FG Private Subnet

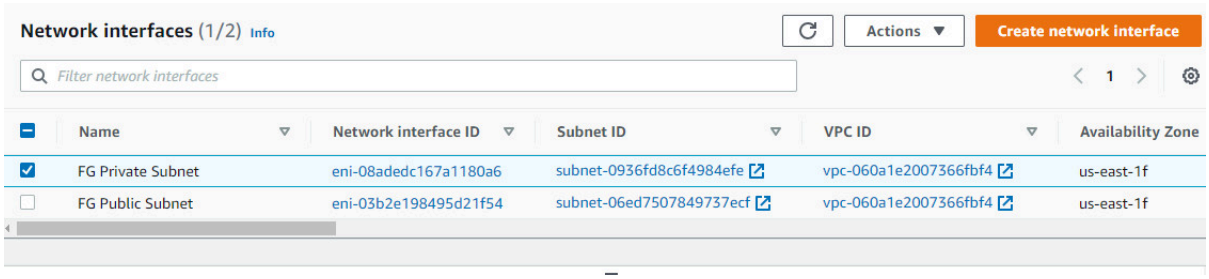


Figure 10.136: Change to FG Private Subnet

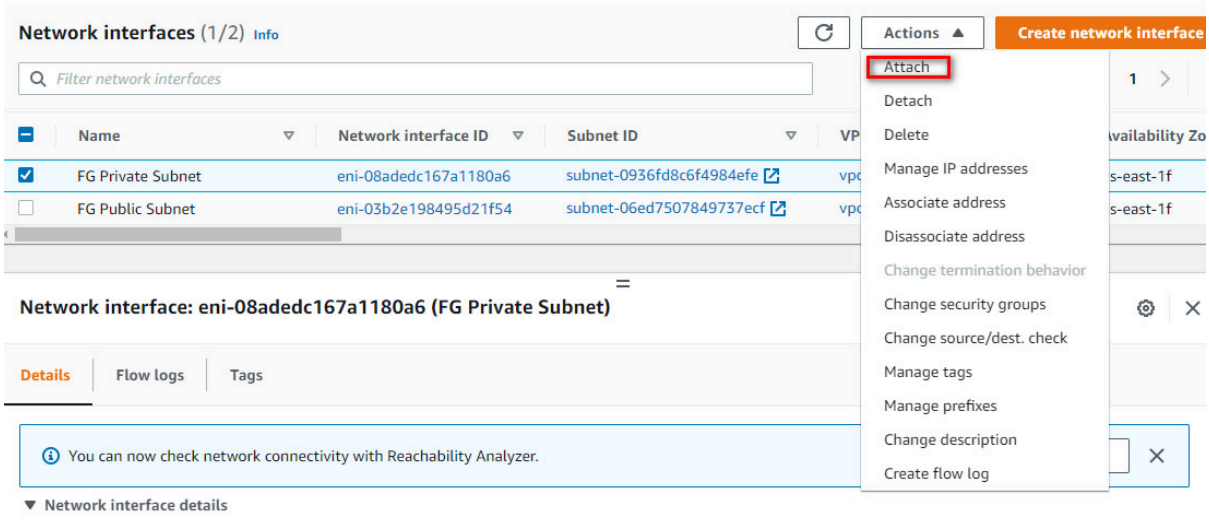


Figure 10.137: Attach the FG Private Subnet to FG

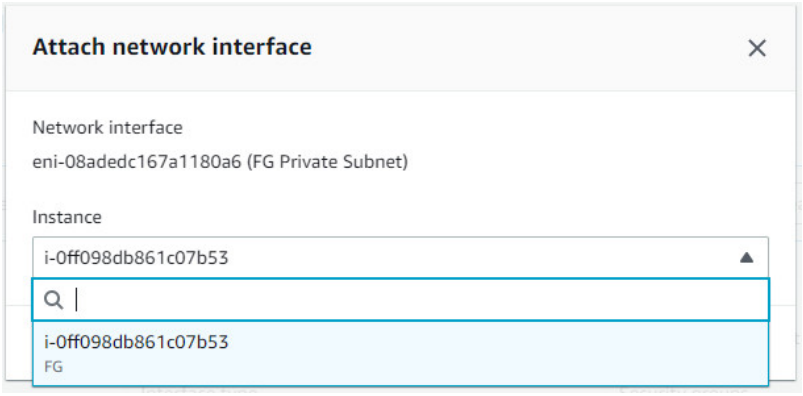


Figure 10.138: Attach the FG Private Subnet to FG

8. Disable Source and Destination check on both FG Private and Public Subnet.

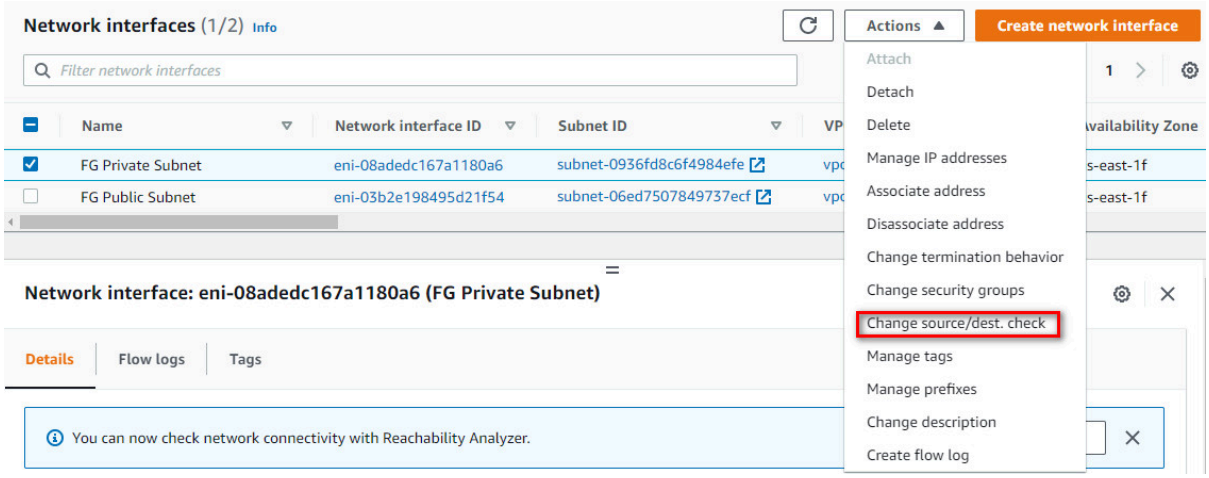


Figure 10.139: Disable source/destination check on FG Private Subnet

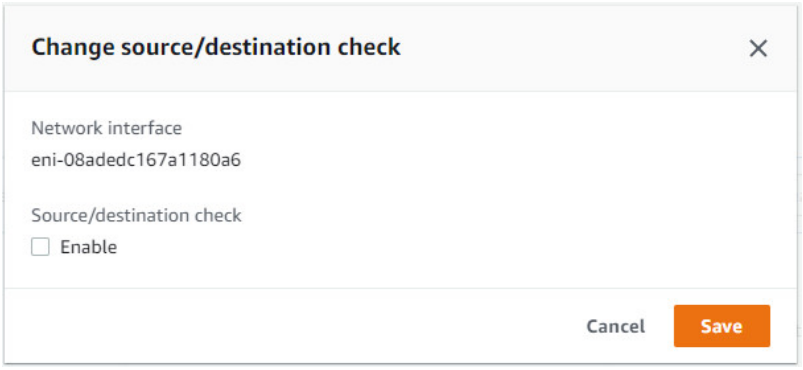


Figure 10.140: Disable source/destination check on FG Private Subnet

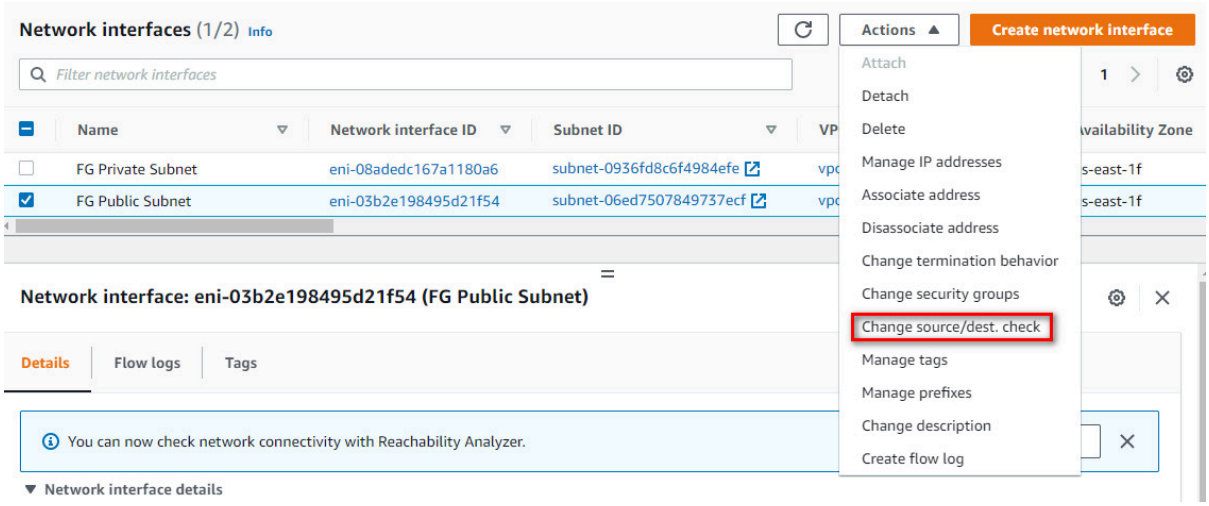


Figure 10.141: Disable source/destination check on FG Public Subnet

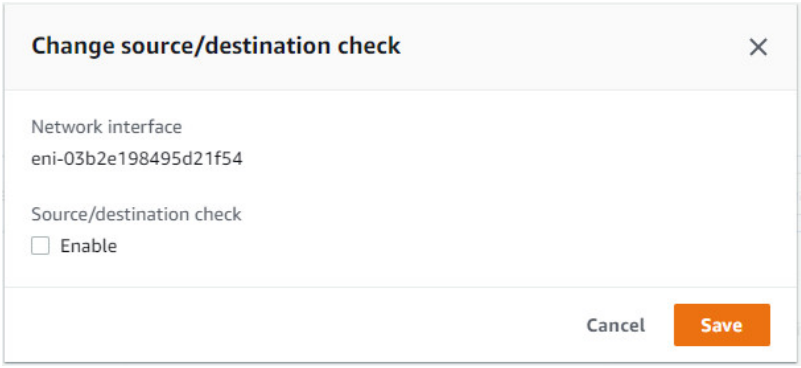


Figure 10.142: Disable source/destination check on FG Public Subnet

9. Edit private route table.

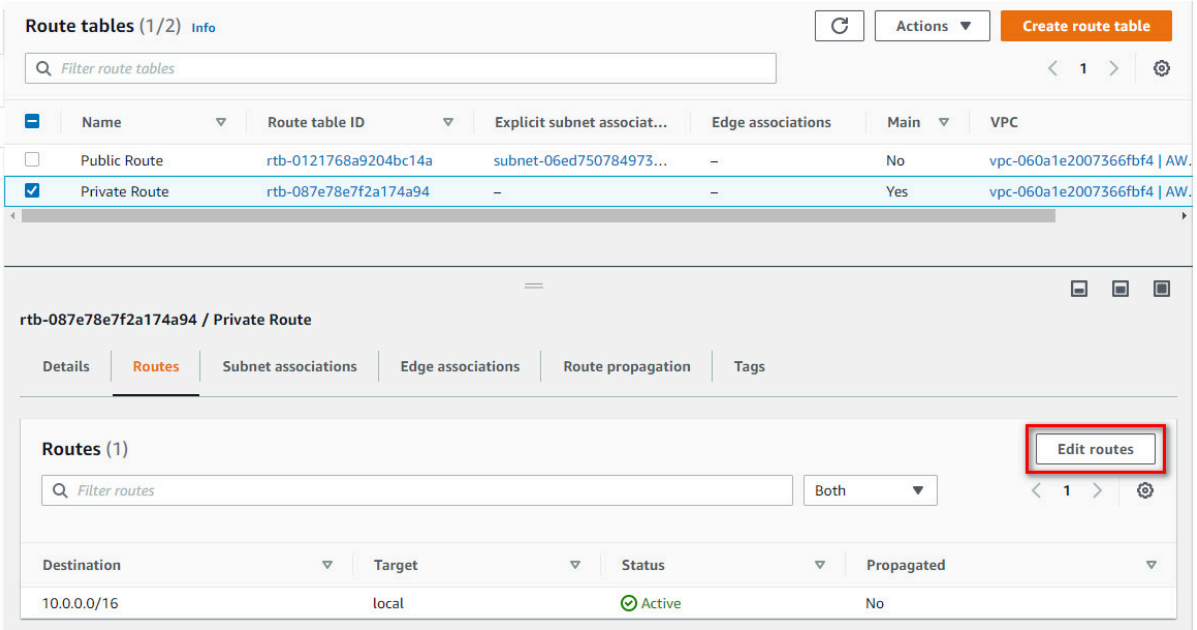


Figure 10.143: Edit Private Route

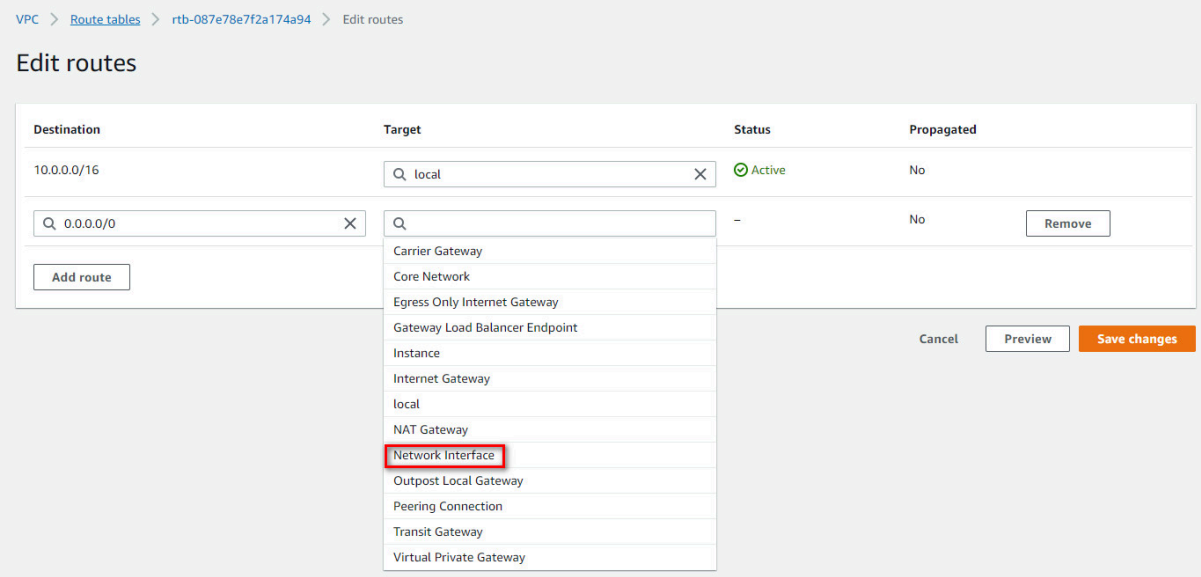


Figure 10.144: Add a default route and select Network Interface

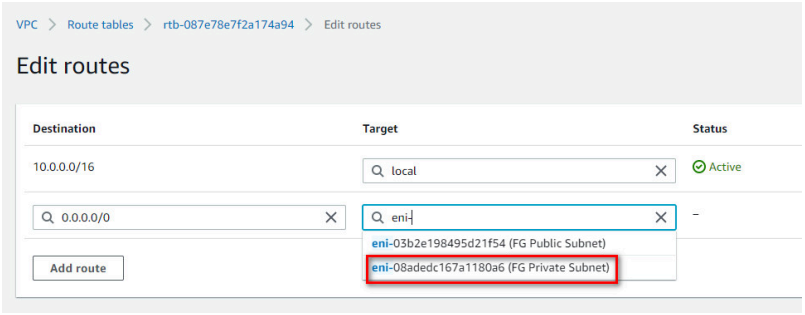


Figure 10.145: Add a default route to target FG Private Subnet

10. Verify Public and Private IP address of FG.

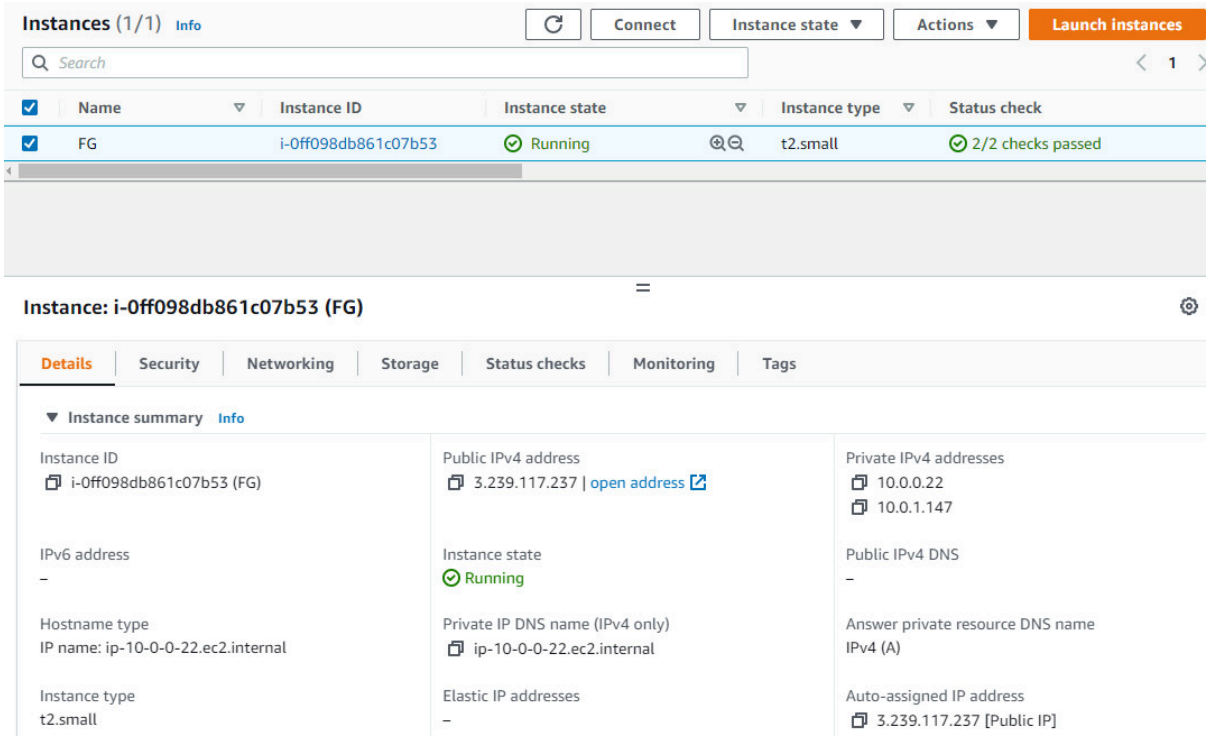


Figure 10.146: Verify public and private IP address of FG

11. Accessing FortiGate on AWS.Type the IP address in the browser. You should be able to see the FortiGate credentials page. Enter your username and password to login to the firewall.

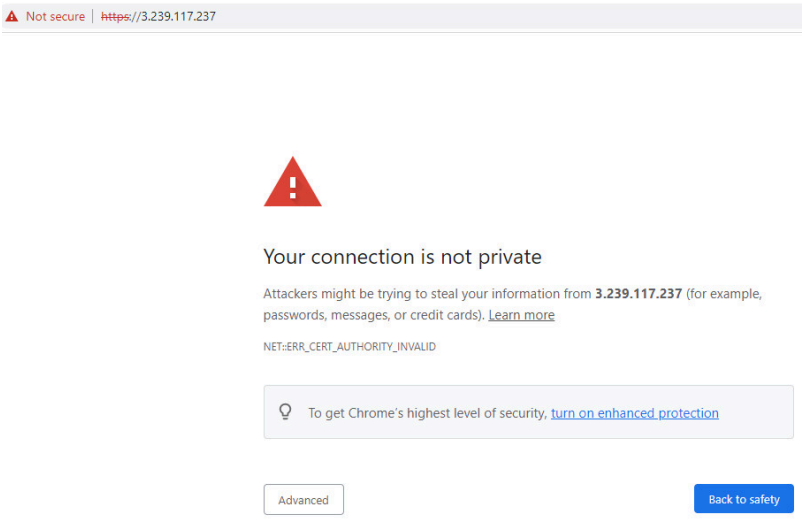


Figure 10.147: Access FortiGate

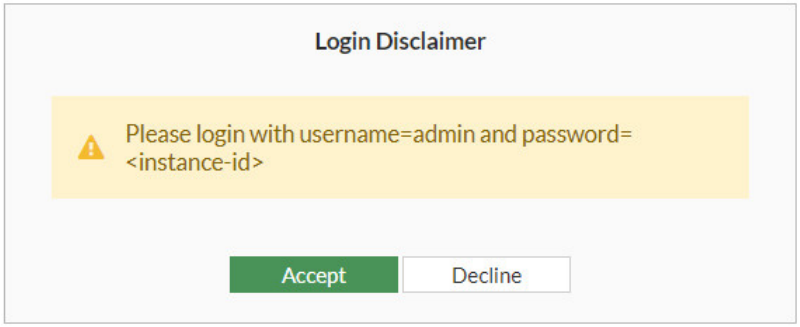


Figure 10.148: Access FortiGate

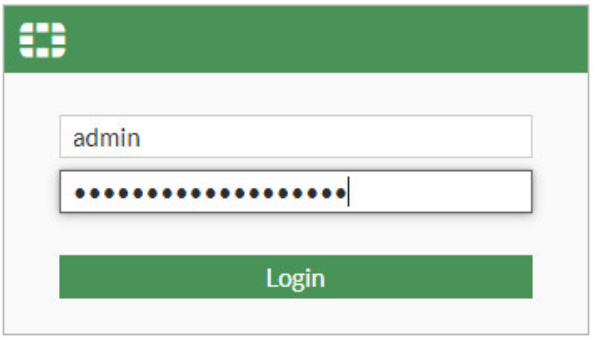


Figure 10.149: Username is admin and password is instance ID of FortiGate

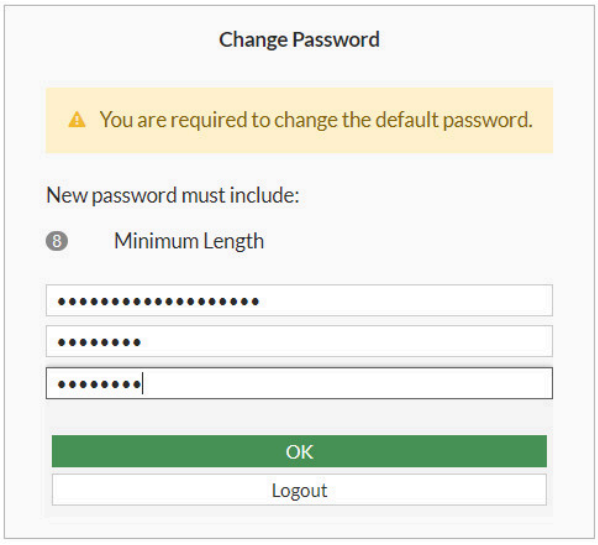


Figure 10.150: Change password

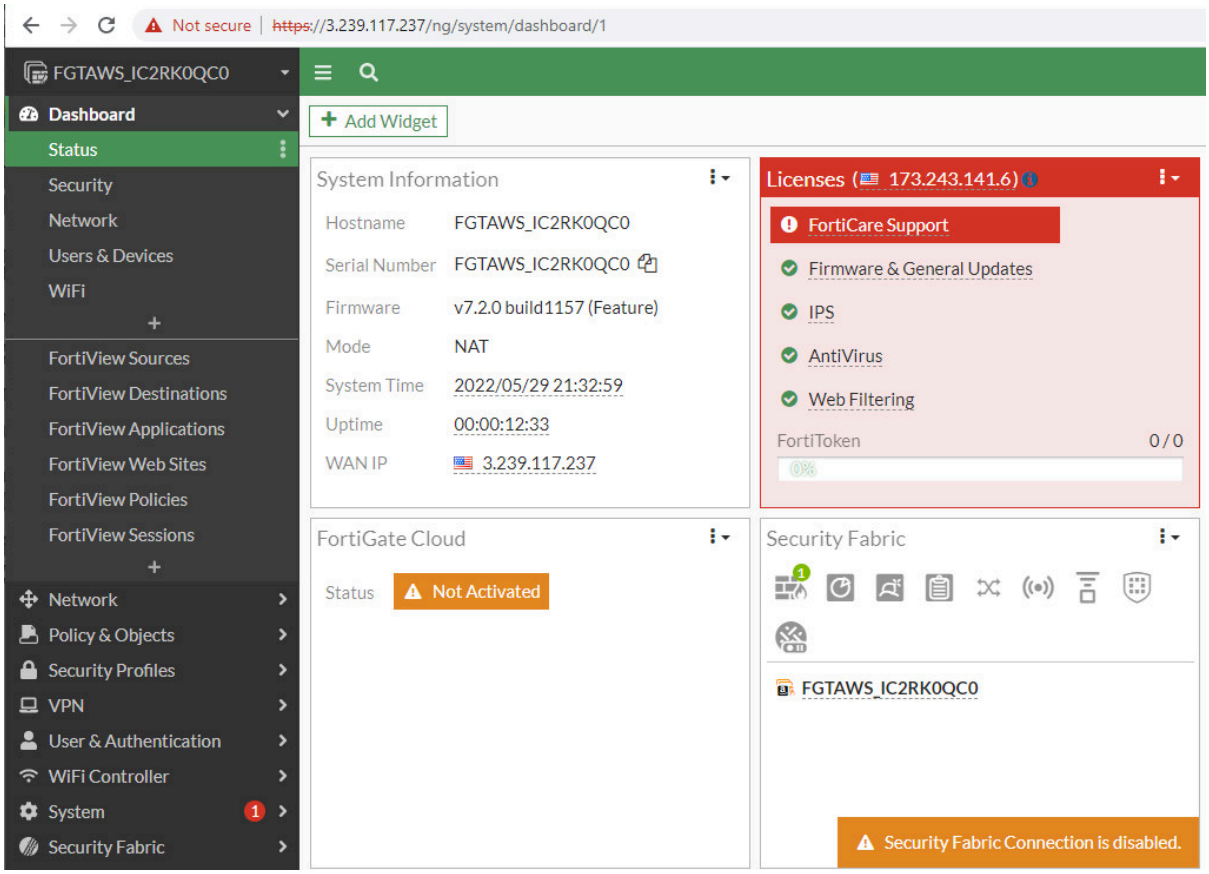


Figure 10.151: FortiGate dashboard

You should set port1 and port2 as DHCP client to receive an IP address from External and LAN subnet. Port1 is belong to External subnet or the internet and port2 is belong to the LAN.

Table 10.5: Port1 and Port2 description

Subnet	Description
Port1	External subnet used to connect the FortiGate-VM to the internet.
Port2	LAN subnet used to deploy services.

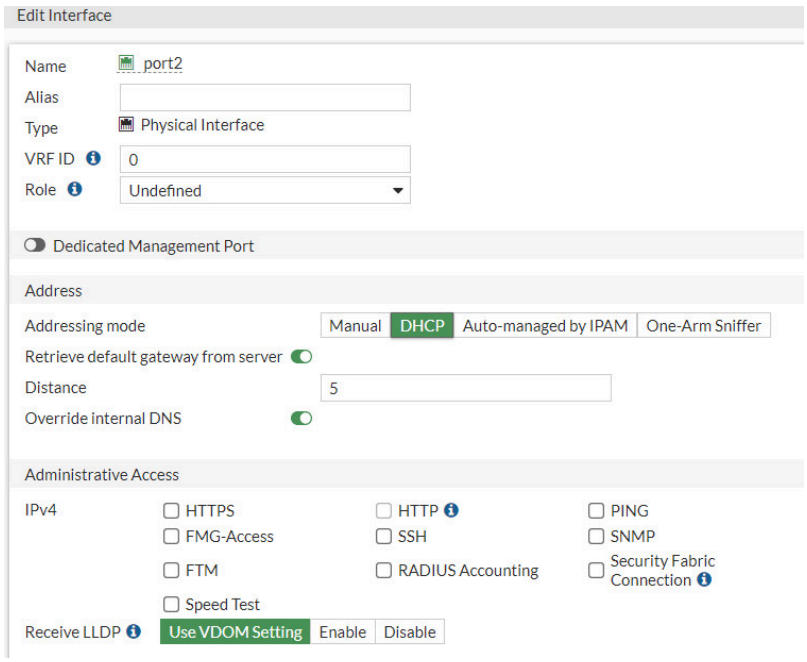


Figure 10.152: Change port2 to DHCP Client

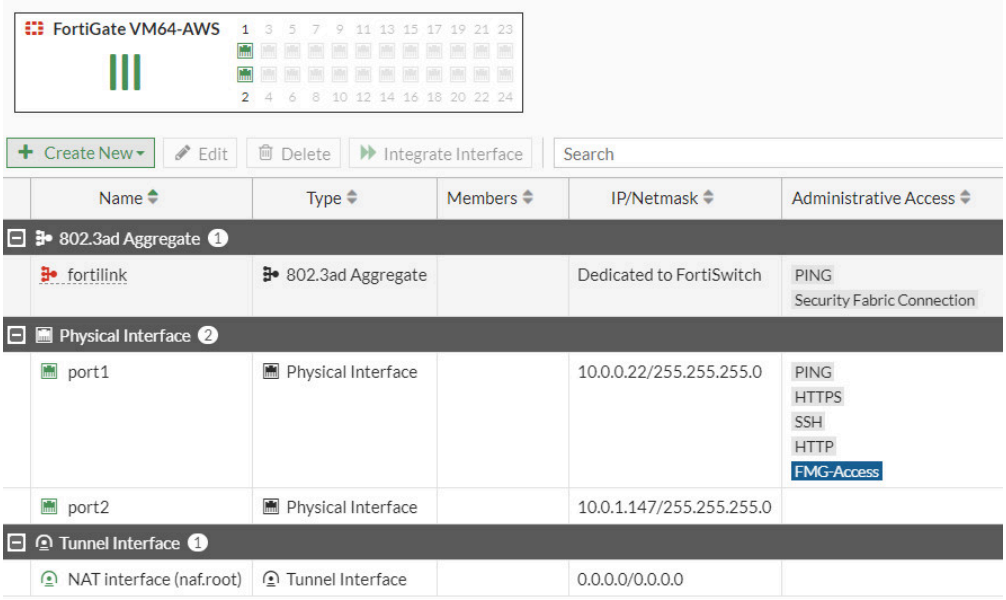


Figure 10.153: FortiGate interfaces

10.6 Site-to-Site VPN between FortiGate on Premise and FortiGate in the AWS

Learning Objectives

- Configure a VPN Wizard in AWS
- Configure site-to-site VPN between FortiGate on premise and AWS
- Identify FortiGate subnets in AWS

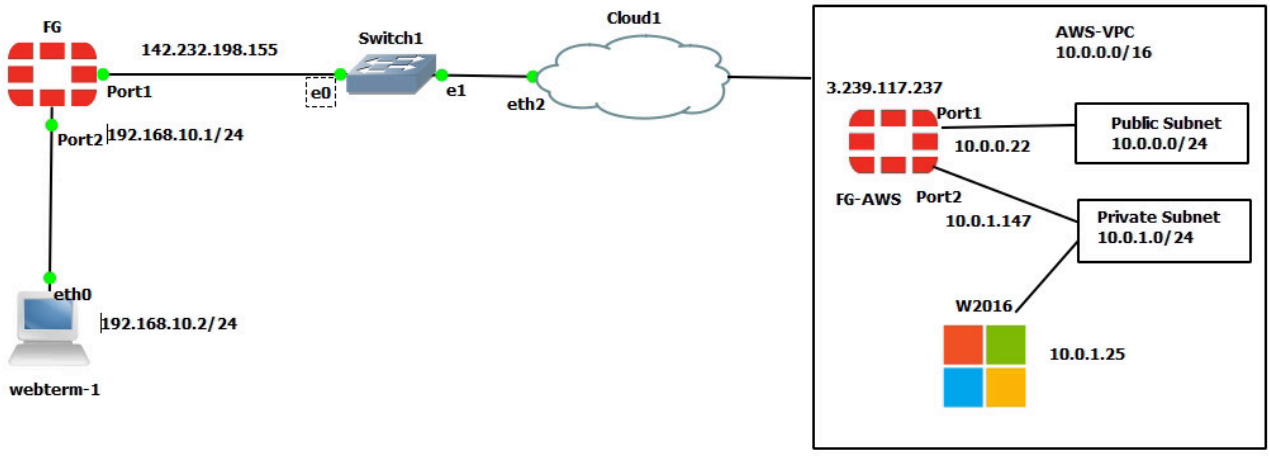


Figure 10.154: Main scenario

Scenario: In this lab, we are going to create a site-to-site VPN from FortiGate on premise to FortiGate in the AWS. Knowing the configuration of section 10.5 is necessary for this lab. Port1 FortiGate on premise is set as a DHCP, so it will receive an IP address from Cloud.

On-Premise FortiGate Configuration

Table 10.6: Devices configuration

Device	Interface	IP address
FortiGate	Port 1	DHCP Client
Port 2	192.168.10.1/24	–
WebTerm	Eth0	192.168.10.2/24

1. Configure the interfaces of the firewall. Port2 by default is an internal interface and named “LAN” and Port1 is an external interface and named “WAN”.

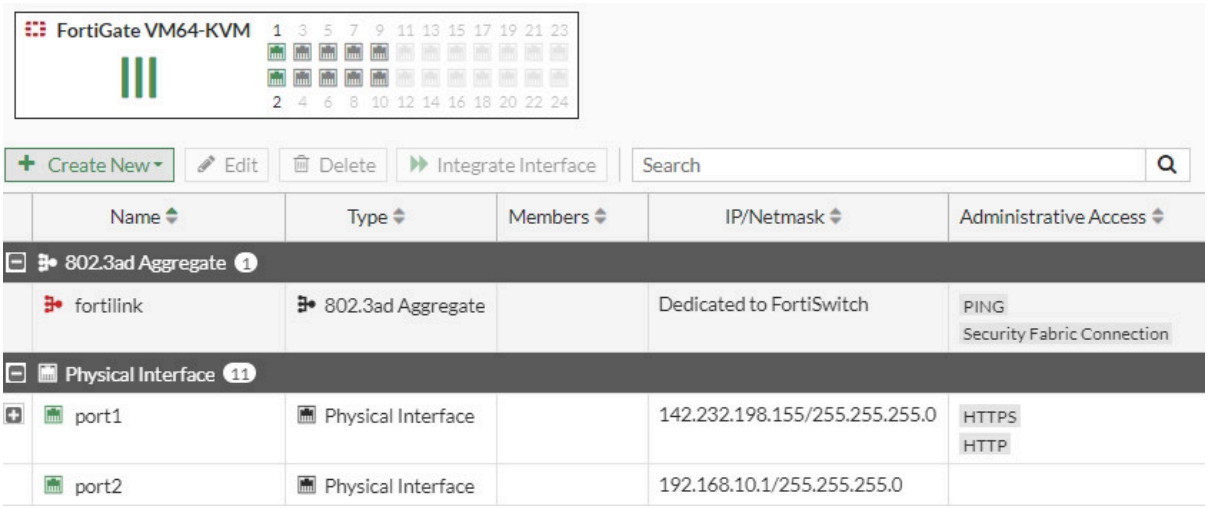


Figure 10.155: Firewall interfaces

2. Create a site-to-site VPN from IPsec Wizard as Figures 10.156 to 10.158.

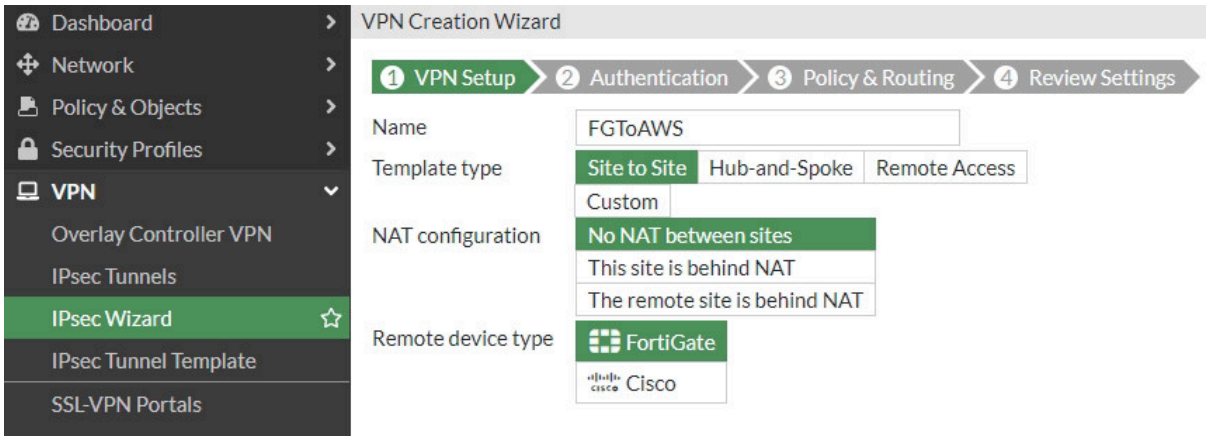


Figure 10.156: Select VPN name

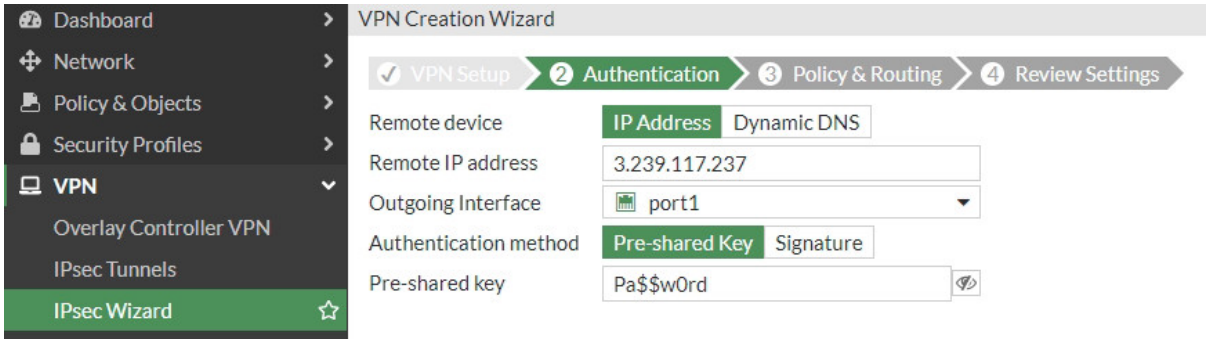


Figure 10.157: Set remote IP address

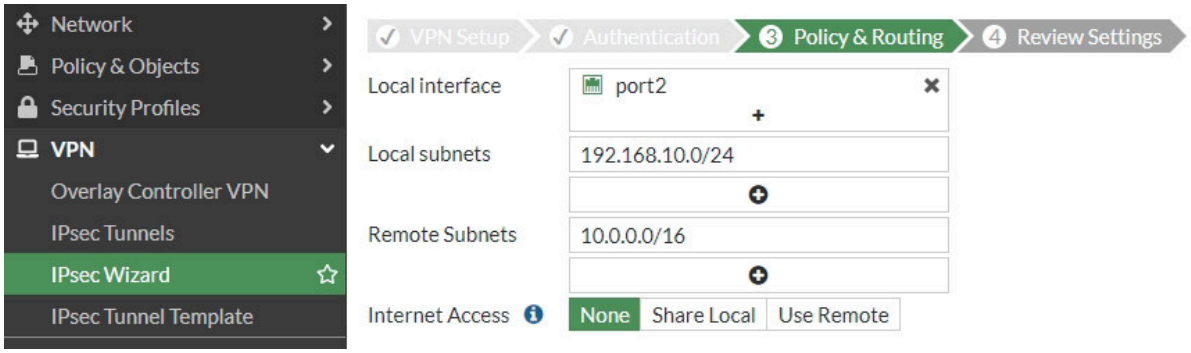


Figure 10.158: Set Policy & Routing

3. Create a static route to the default gateway.

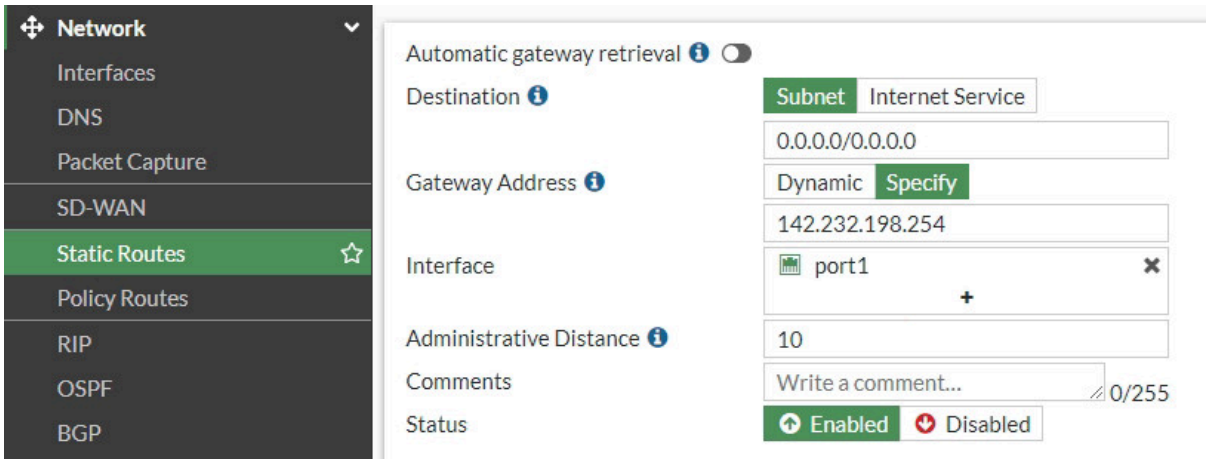


Figure 10.159: Set a default gateway

AWS Configuration

1. Create a FortiGate firewall in AWS and configure the interfaces. You need to do all steps in section 10.5.
2. Create a VPN from IPsec Wizard as Figures 10.160 to 10.162.

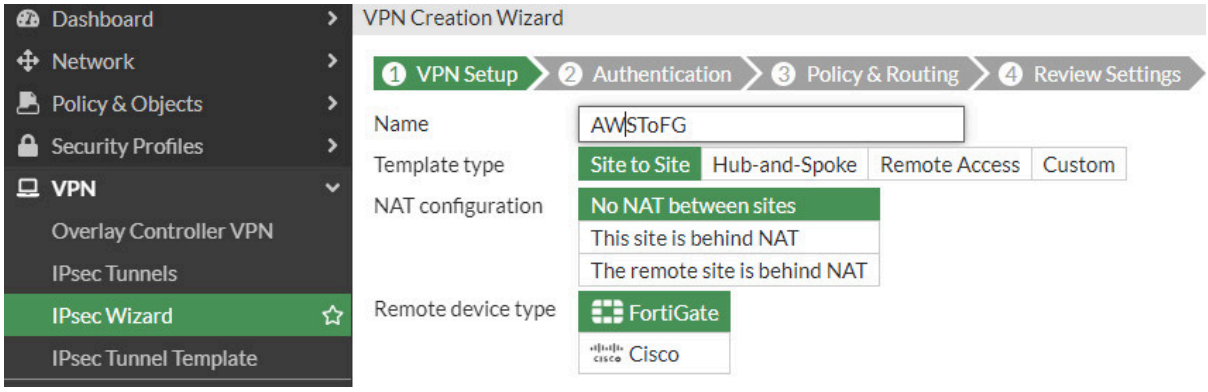


Figure 10.160: Select VPN name

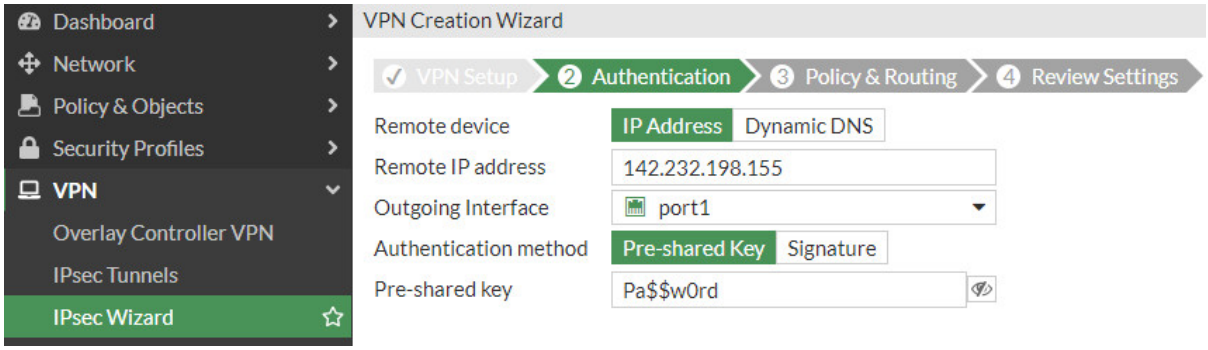


Figure 10.161: Set a remote IP address

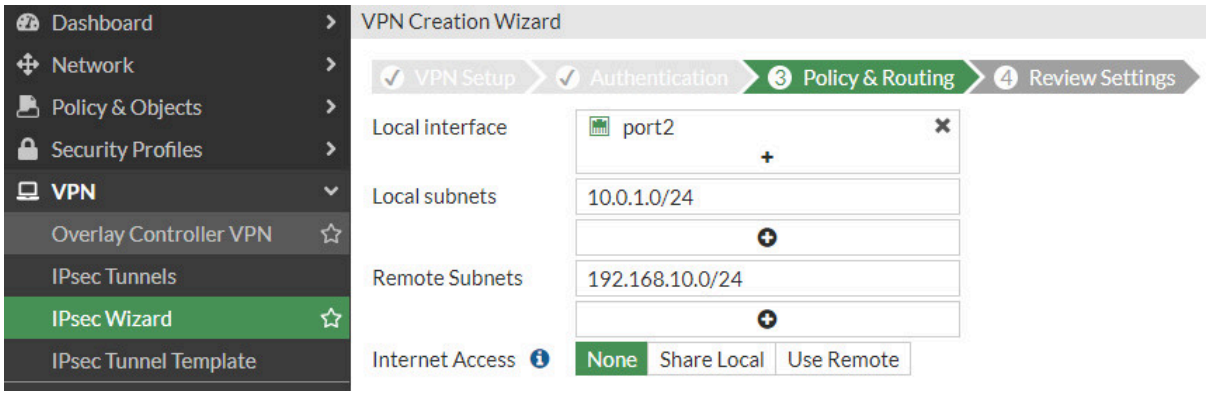


Figure 10.162: Set Policy & Routing

3. Create static routes on FortiGate. We are going to create two static routes as follows:

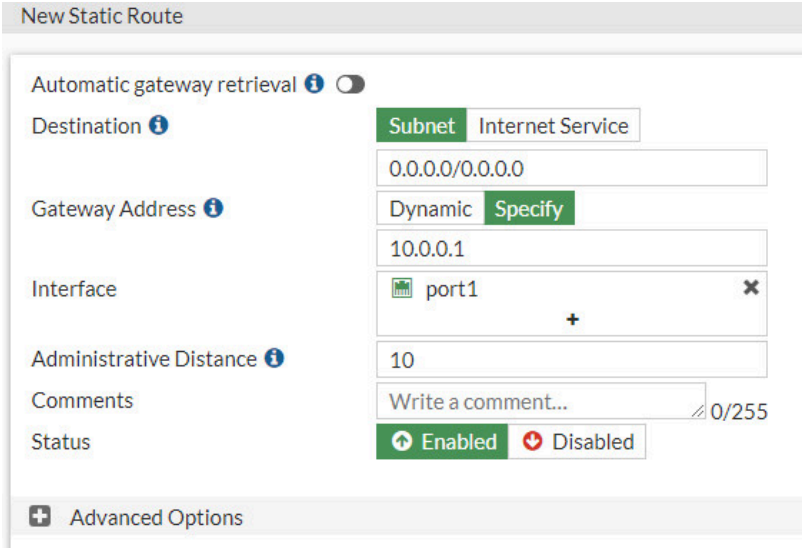


Figure 10.163: Set a default gateway via 10.0.0.1

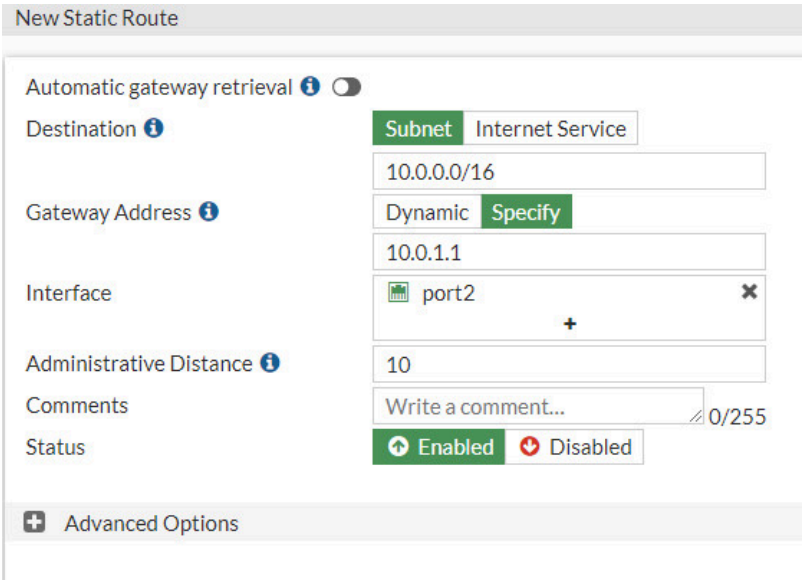


Figure 10.164: Create a static route to 10.0.0.0/16 network via 10.0.1.1

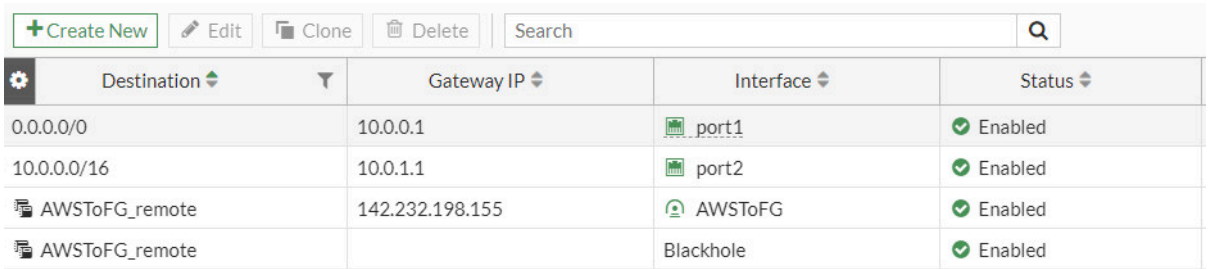


Figure 10.165: Overview of static routes on FortiGate

4. Go to **VPN** > **IPsec Tunnels** and check status of the tunnel.

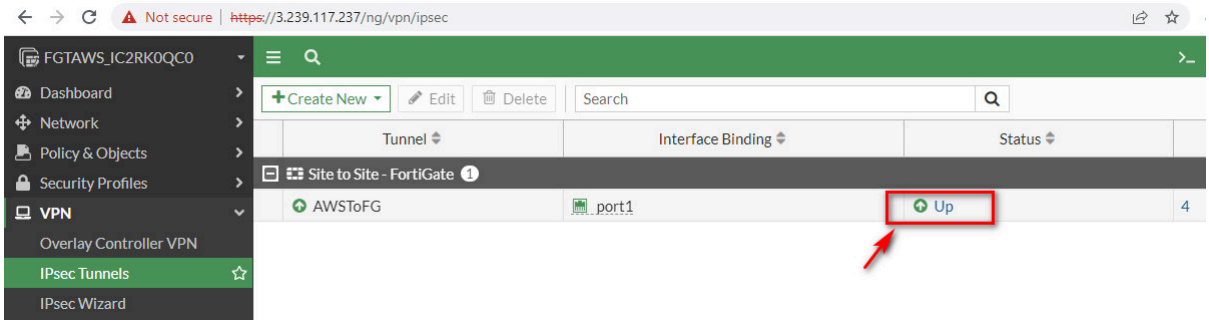


Figure 10.166: Check the status of the tunnel on AWS

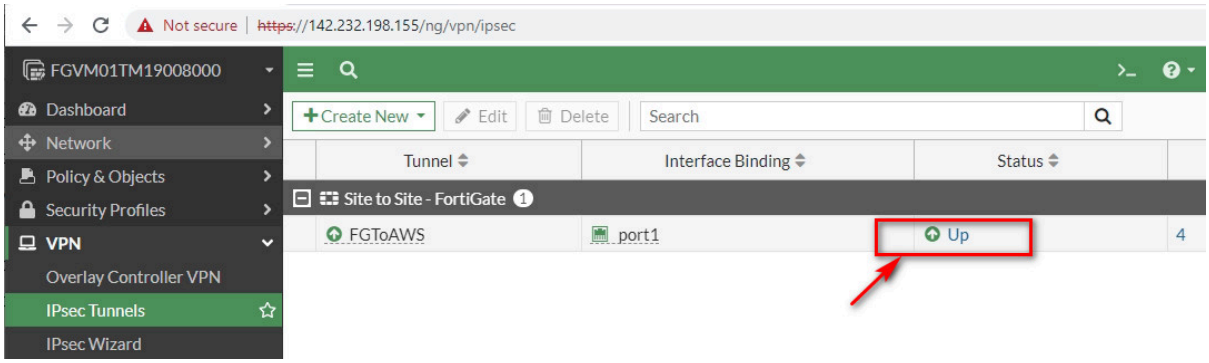


Figure 10.167: Check status of tunnel on FortiGate on premise

5. You should be able to ping from WebTerm to Virtual Machine on AWS and vice versa.

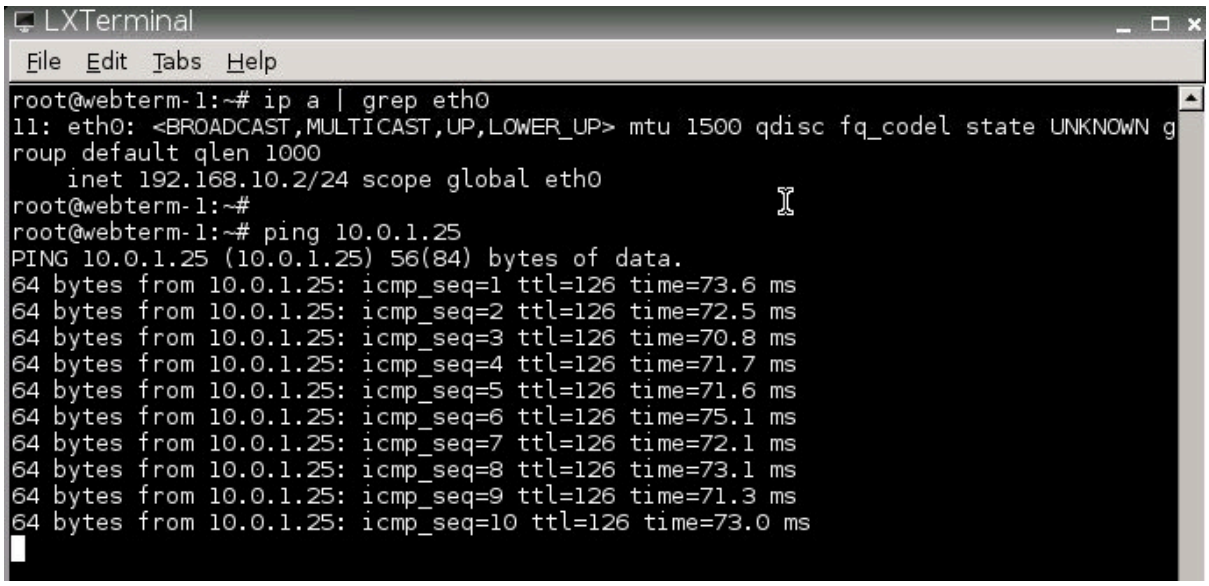


Figure 10.168: Ping from WebTerm to Windows VM

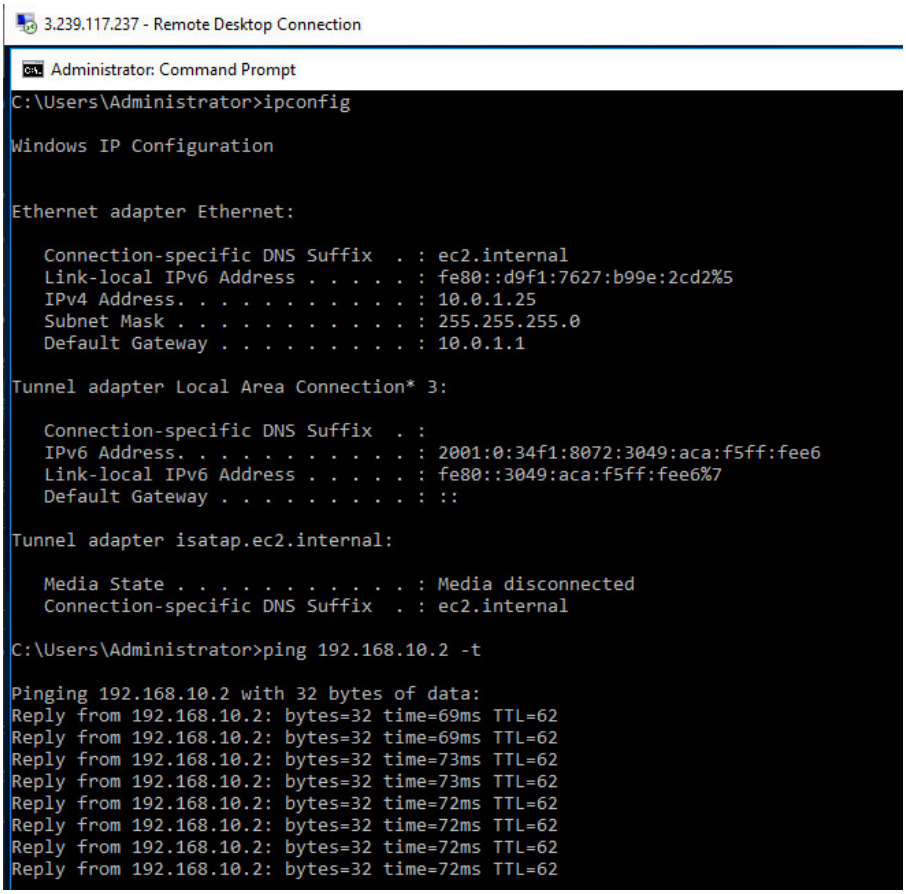


Figure 10.169: Ping from Windows VM to WebTerm

Appendix: GNS3 Basics

In this chapter, we will be going through the basics in GNS3. Try to play with and familiarize yourself with this environment as this is a good tool for network simulations.

Adding a FortiGate Firewall to GNS3

1. Start by adding a new template.

Figure A.1: Create a New template

2. We want to install it from the GNS3 Server, so keep the option default and then press next.

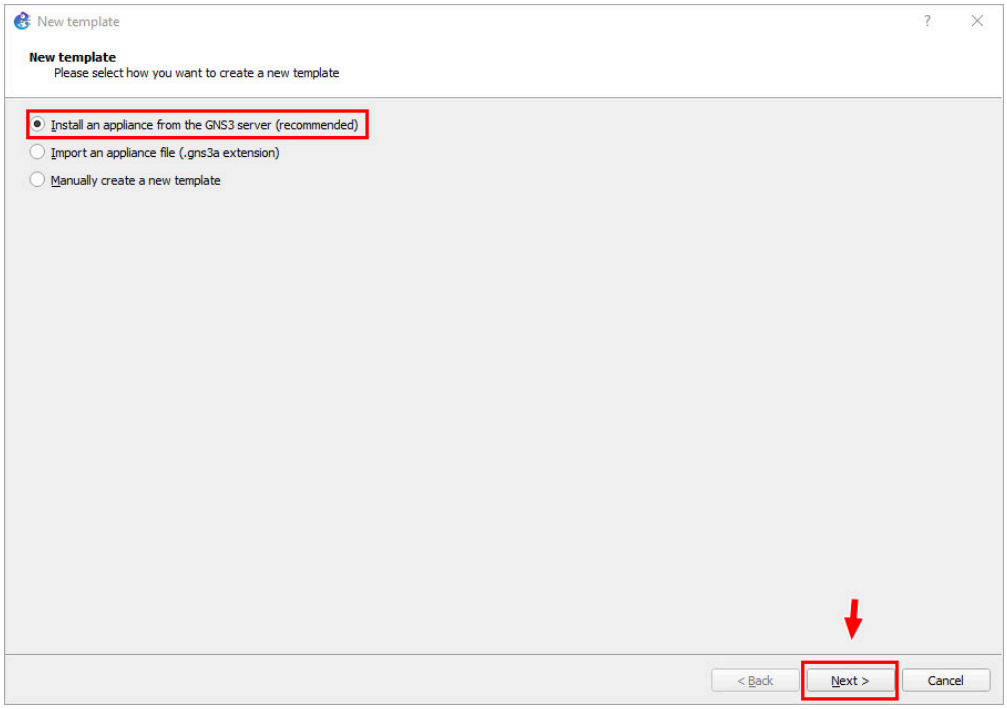


Figure A.2: Select Install an appliance from the GNS3 server

3. On the next window, search for “FortiGate”, and select the option under “Firewalls”, then click “Install.”

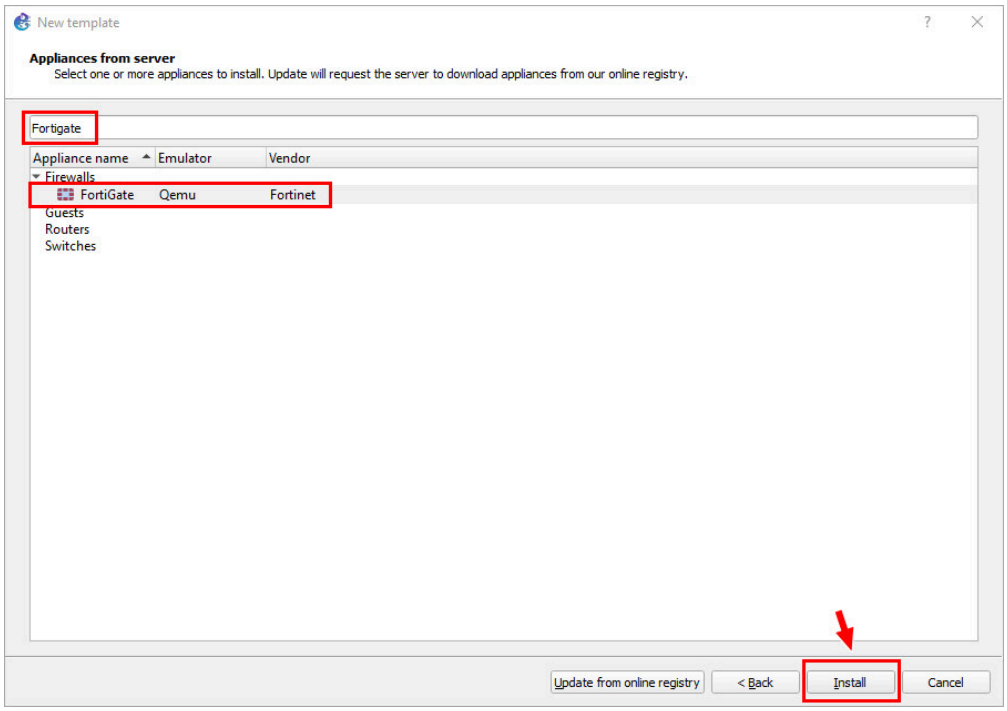


Figure A.3: Search for “FortiGate”

4. Press “Next” on this screen:

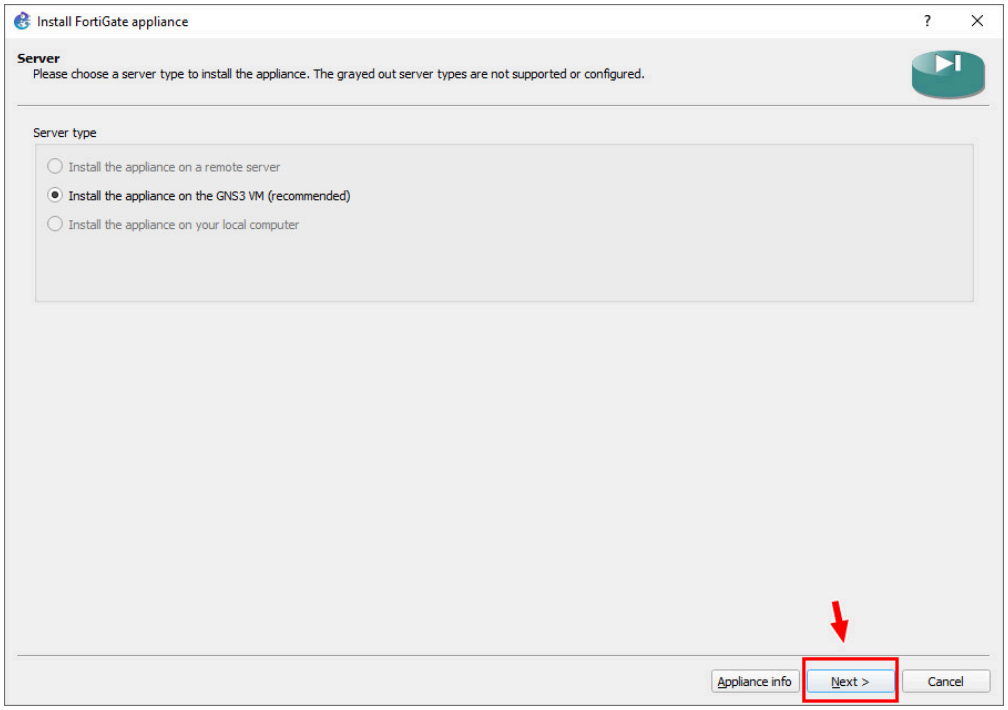


Figure A.4: Install the appliance on the GNS3 VM

5. Press “Next” on this screen:

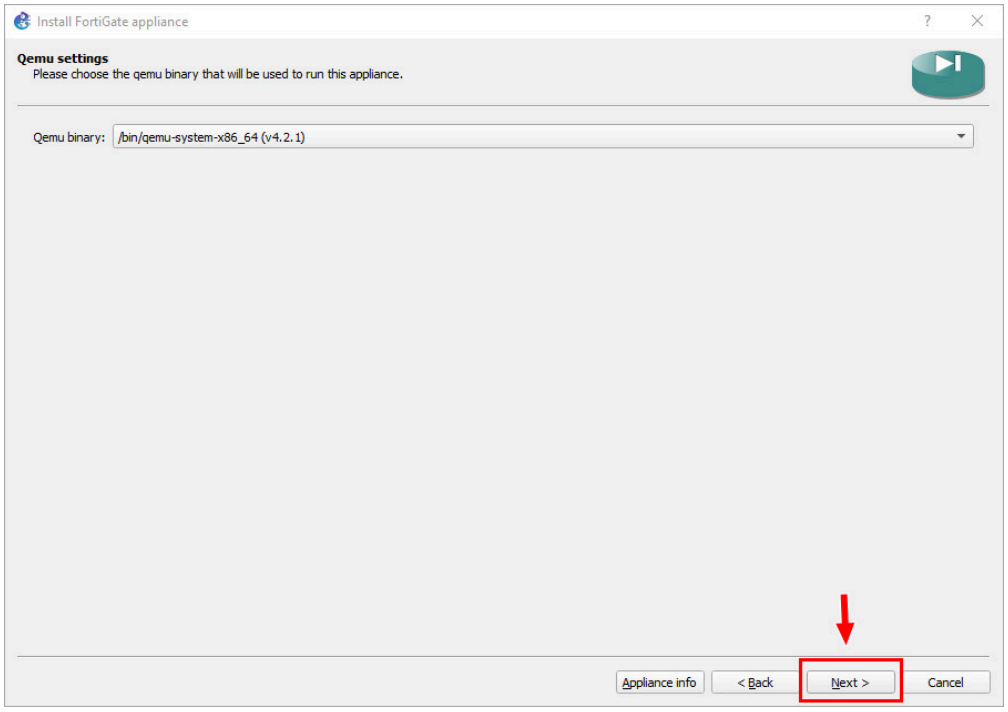


Figure A.5: Qemu settings

6. Tick the “Allow custom files” box.

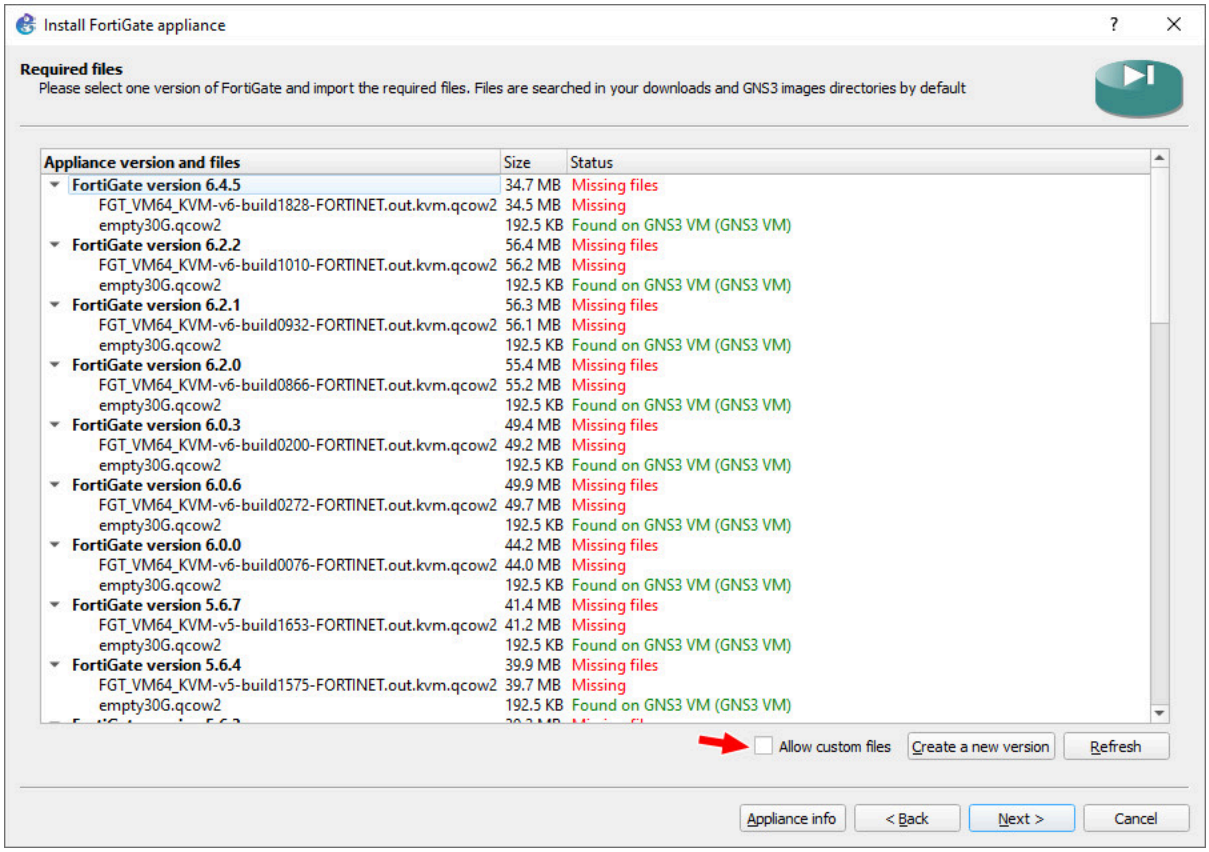


Figure A.6: Tick Allow custom files

7. Click “Yes” on this screen:

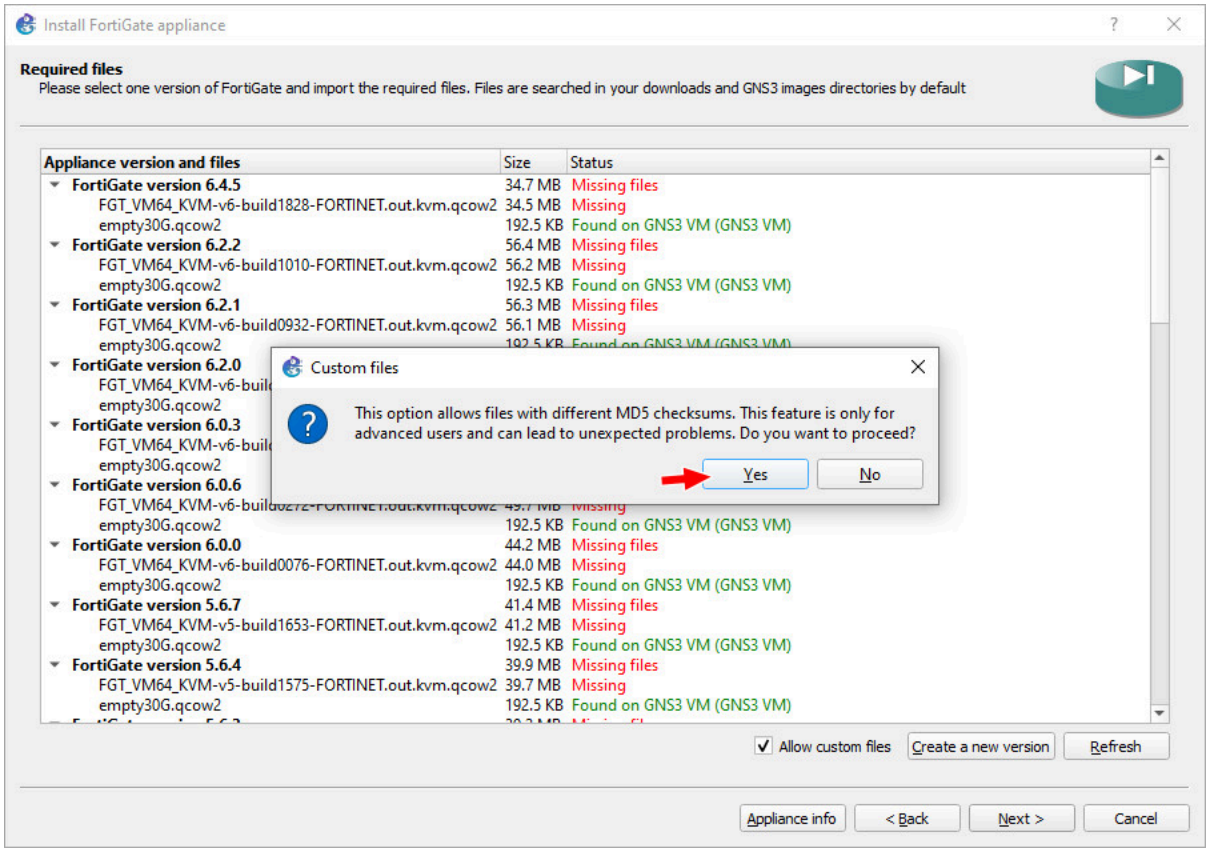


Figure A.7: Click on Yes

8. Highlight a random version.

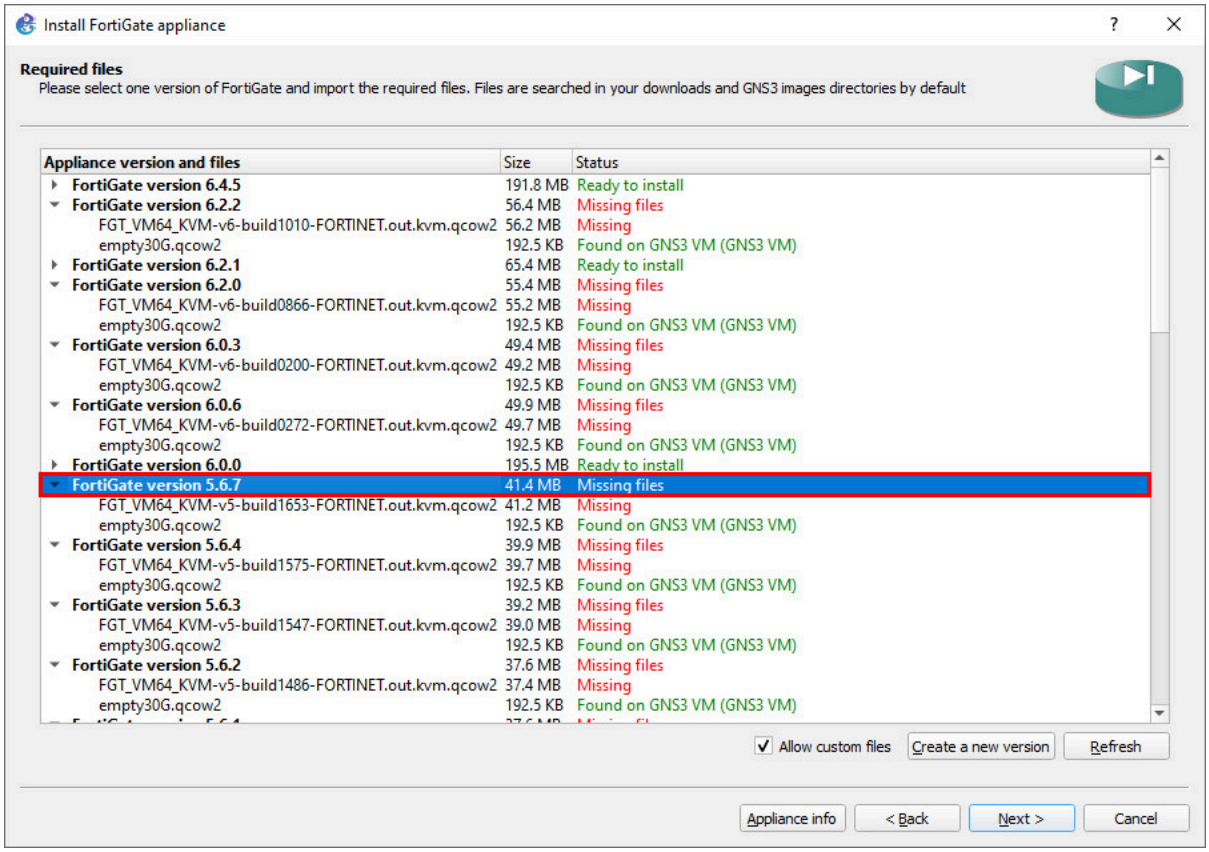


Figure A.8: Highlight a random version

9. Click “Create a new version.”

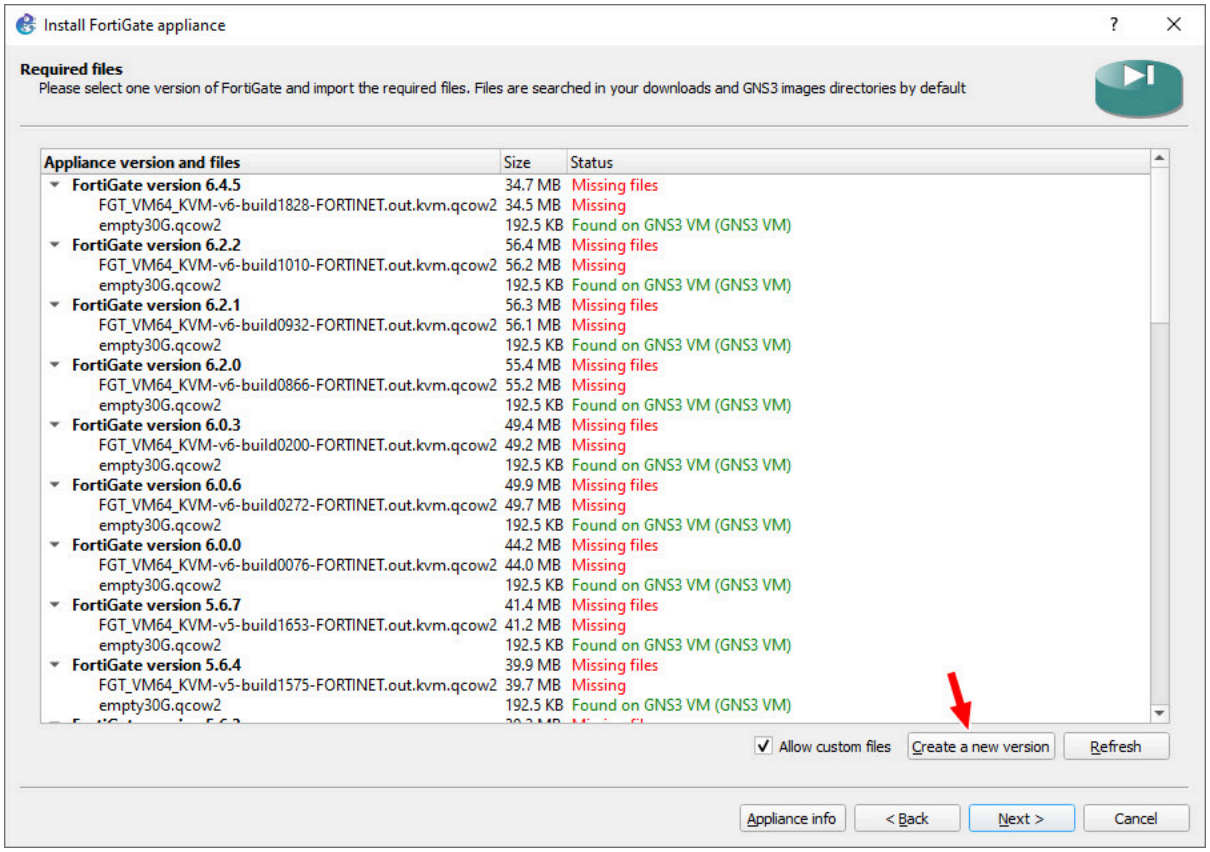


Figure A.9: Create a new version

10. Create a new custom version and select optional name for it.

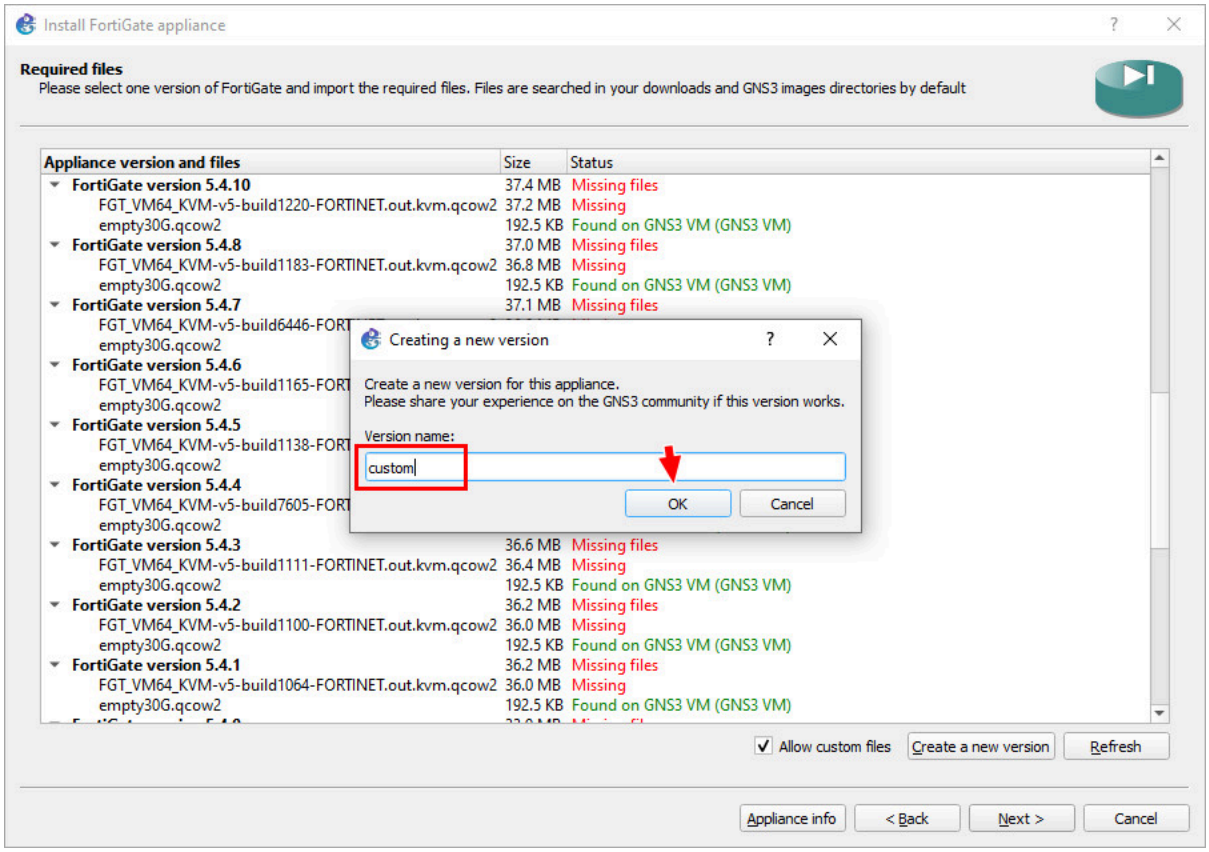


Figure A.10: Create a custom version

11. Press **OK** on this one, too:

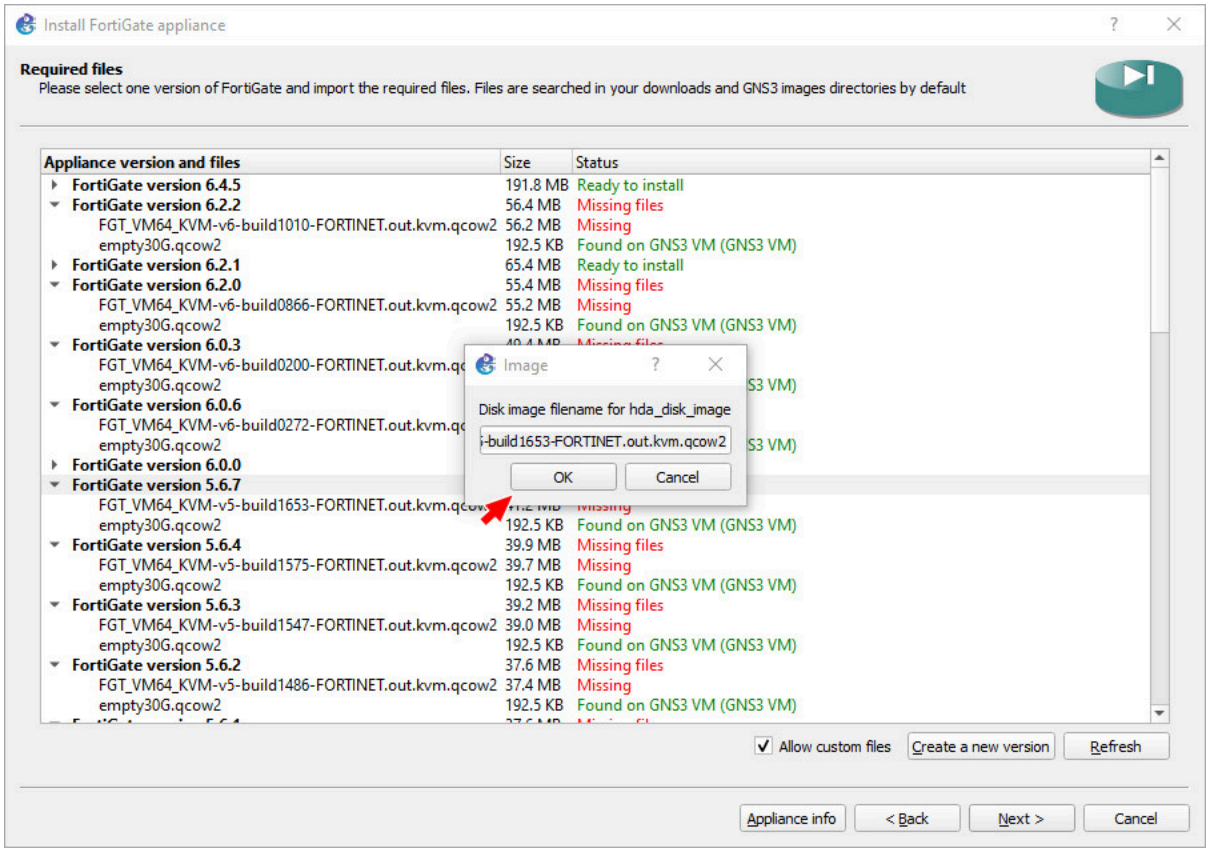


Figure A.11: Click on OK

12. Press **OK** again.

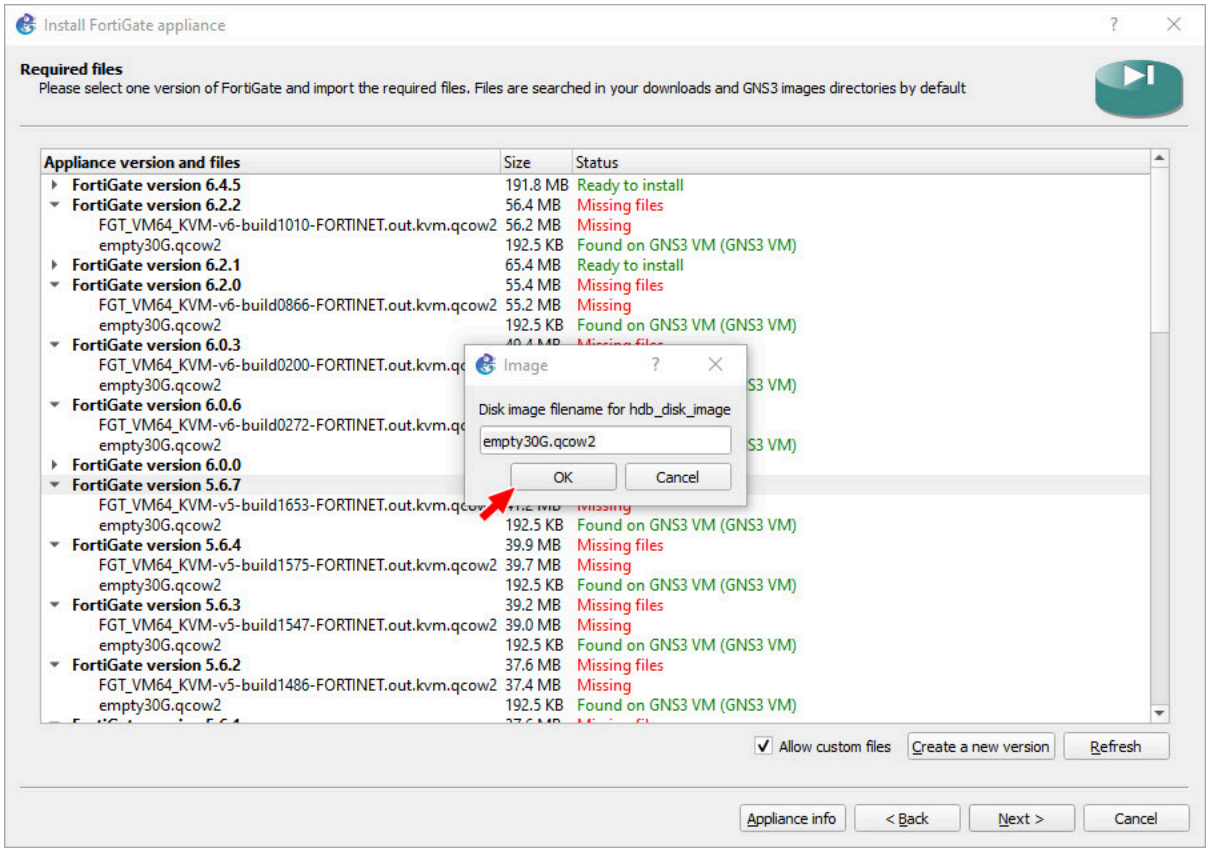


Figure A.12: Click on OK

13. Click on any empty30G file, and click Download. Save that file to your computer.

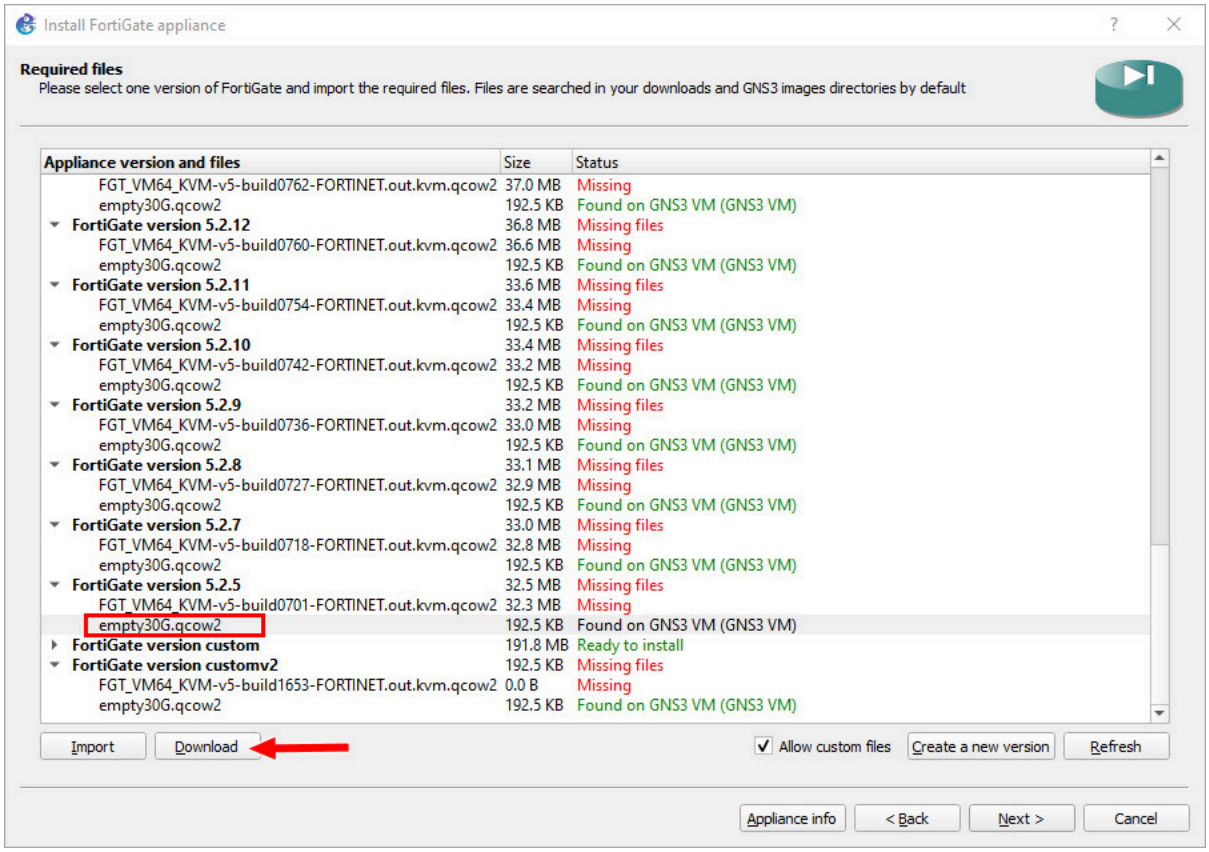


Figure A.13: Download empty30G.qcow2

14. Scroll down to your custom version and click the arrow on the left:

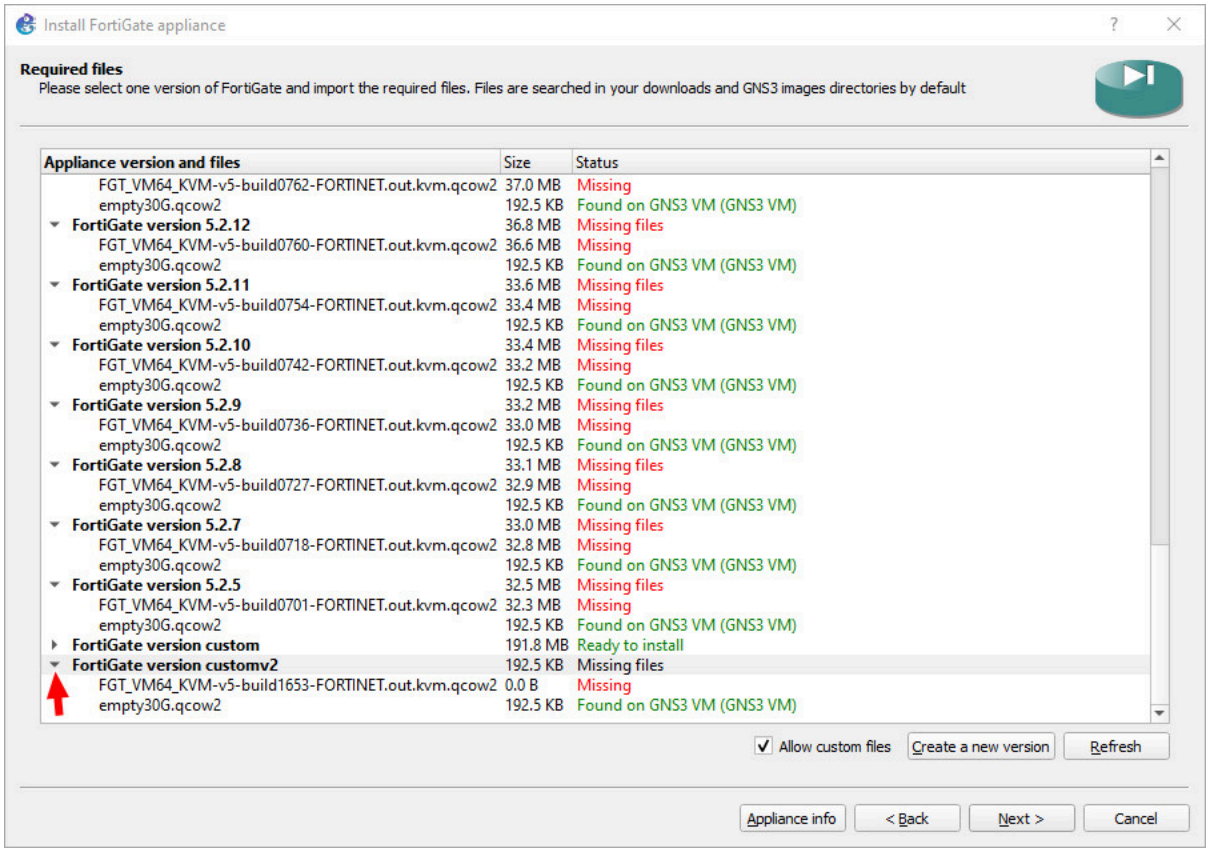


Figure A.14: Select Custom version

15. Click the FGT filename under your custom version and click “Import.”

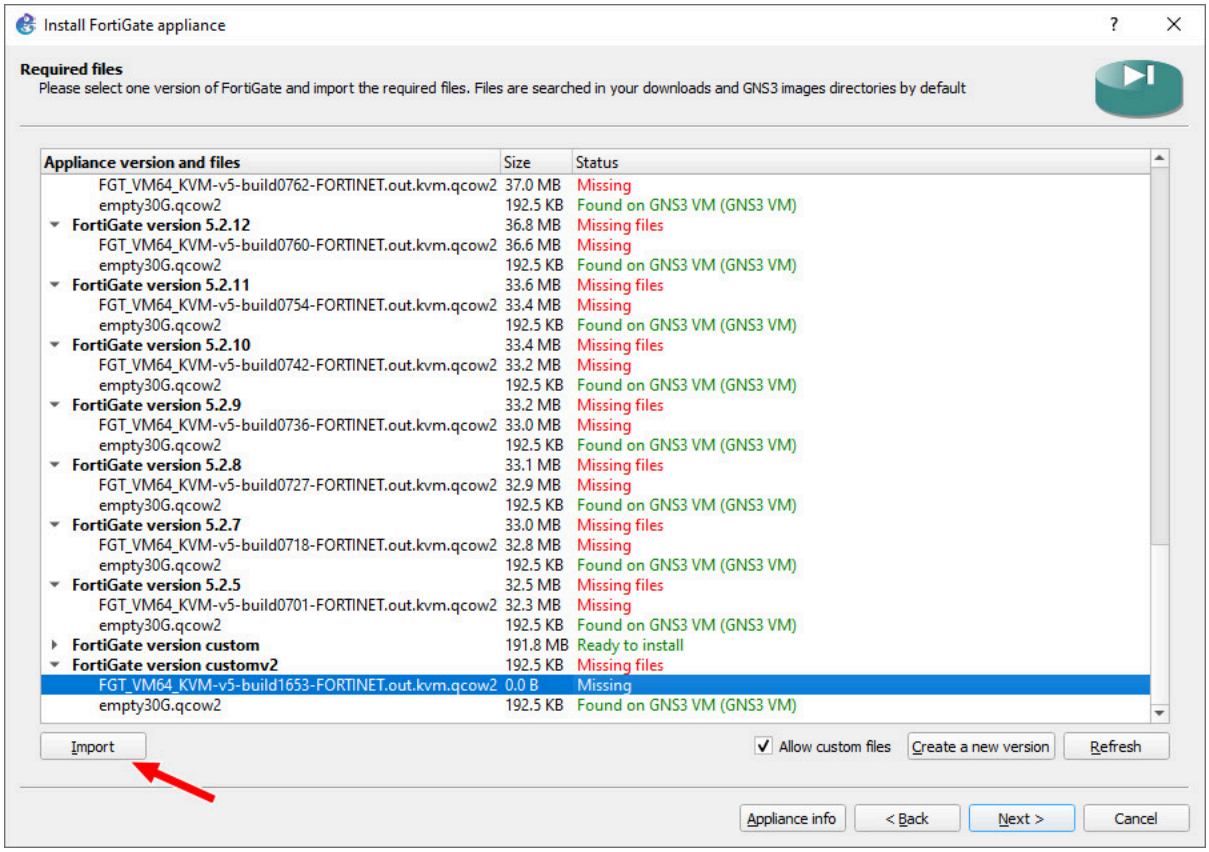


Figure A.15: Import FortiGate Image

16. Navigate to your downloaded FortiGate Firewall image and click “Open.”

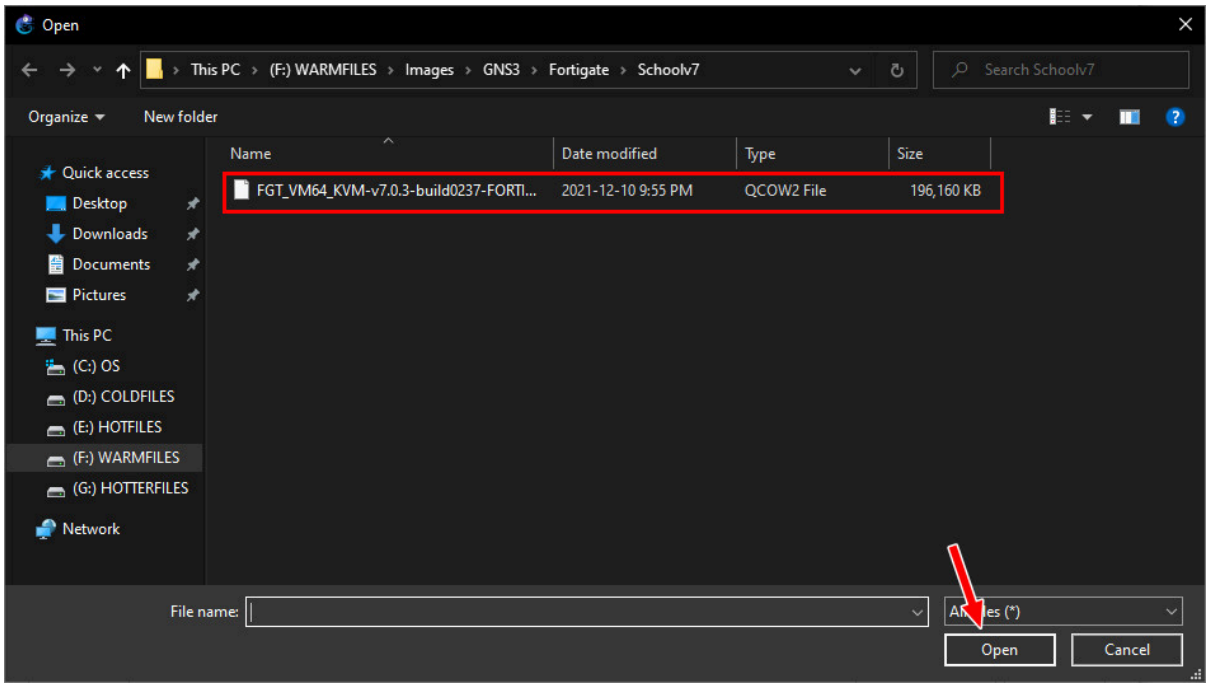


Figure A.16: Select FortiGate Image

17. Still under your custom version, click “Import” on the empty30G file.

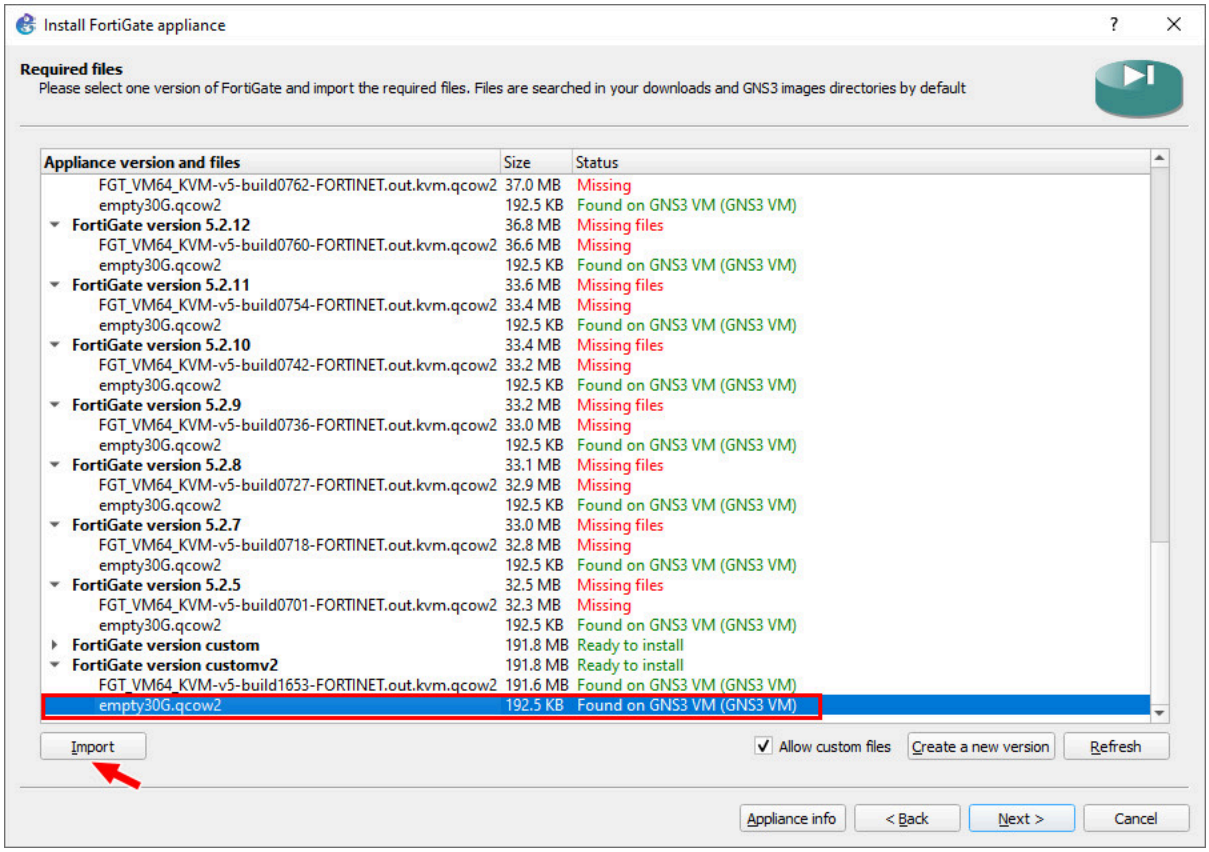


Figure A.17: Select empty30G.qcow2

18. Navigate to your downloaded empty30G file and click “Open.”

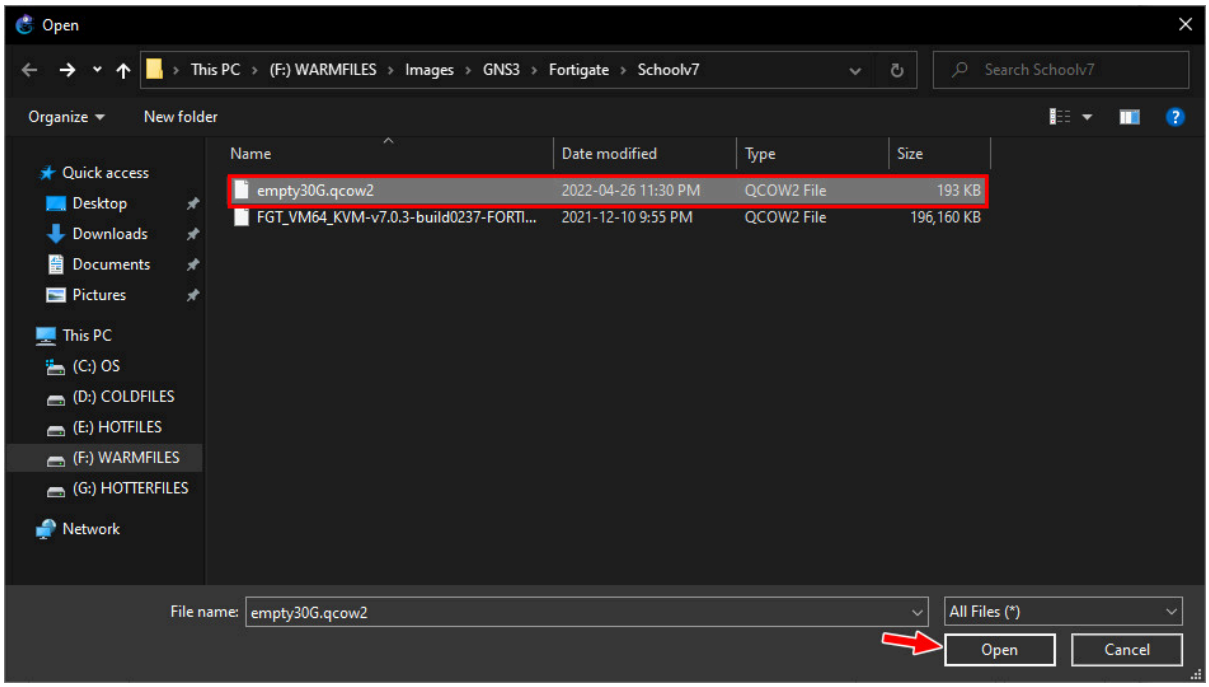


Figure A.18: Import empty30G.qcow2 file

19. After that, highlight the custom version again and click “Next.”

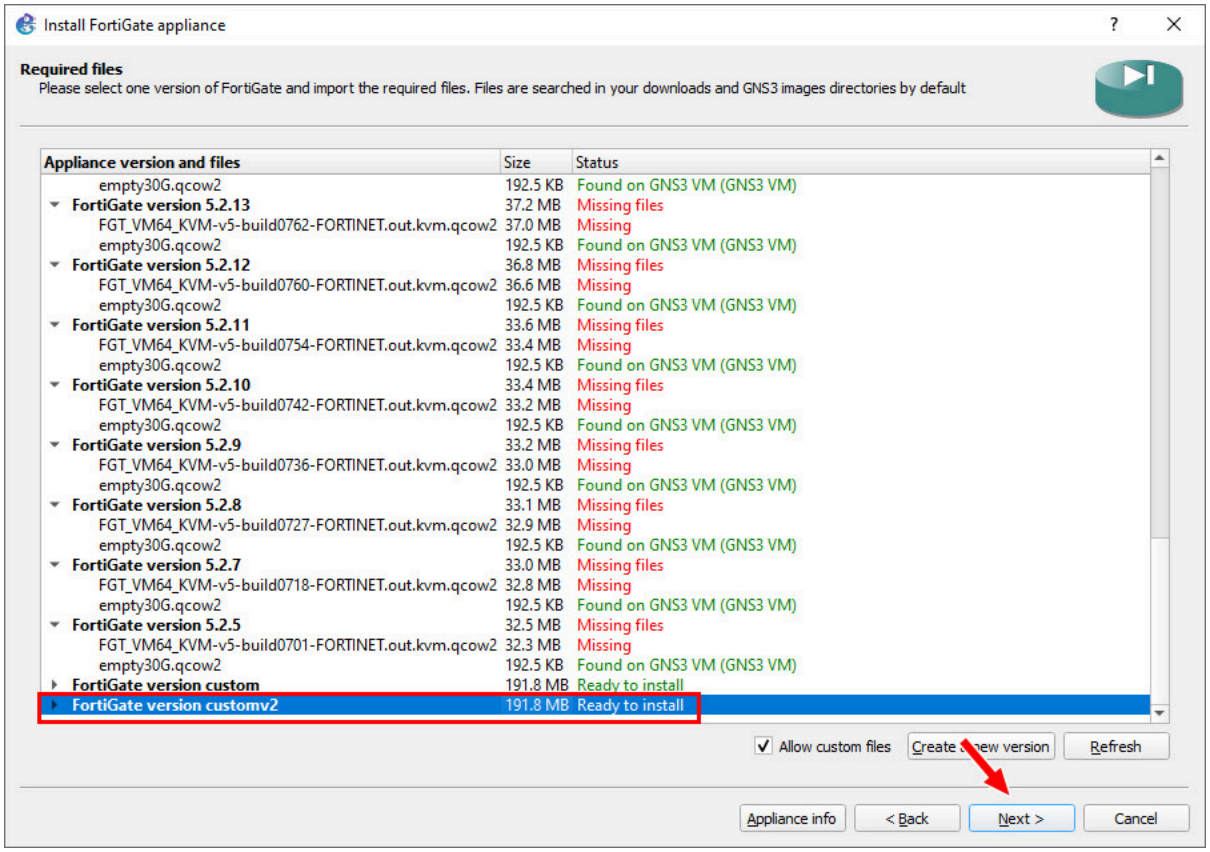


Figure A.19: Select custom version and then click on Next

20. Click “Yes” on this window:

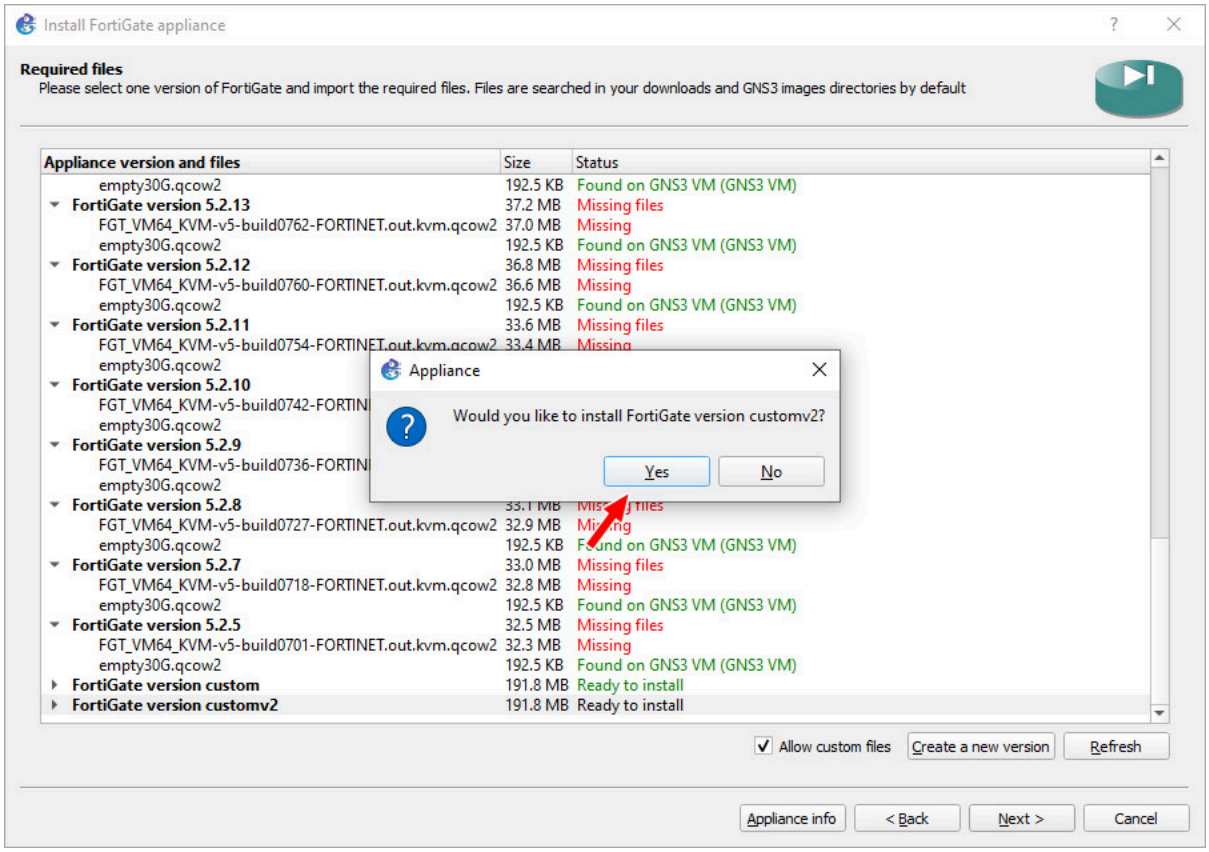


Figure A.20: Click on "Yes"

21. Then click "Finish."

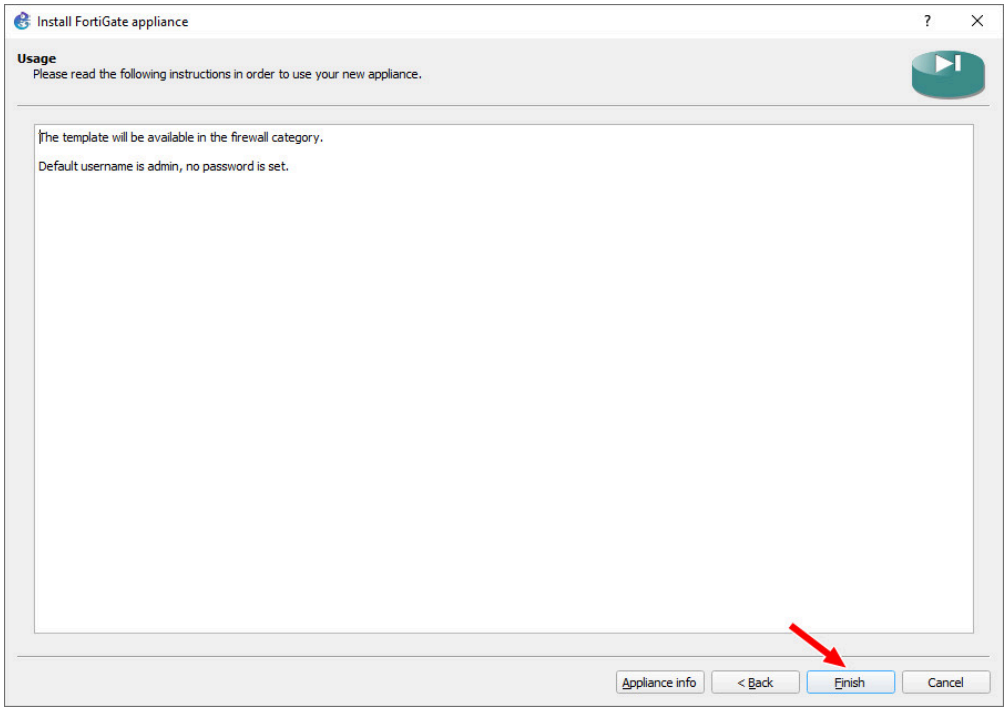


Figure A.21: Click on "Finish"

Configuring Your Palo Alto Firewall Template and Adding the Device

1. Let's start by modifying the GNS3 template of the Palo Alto firewall by right clicking the existing template, and clicking on "Configure template."

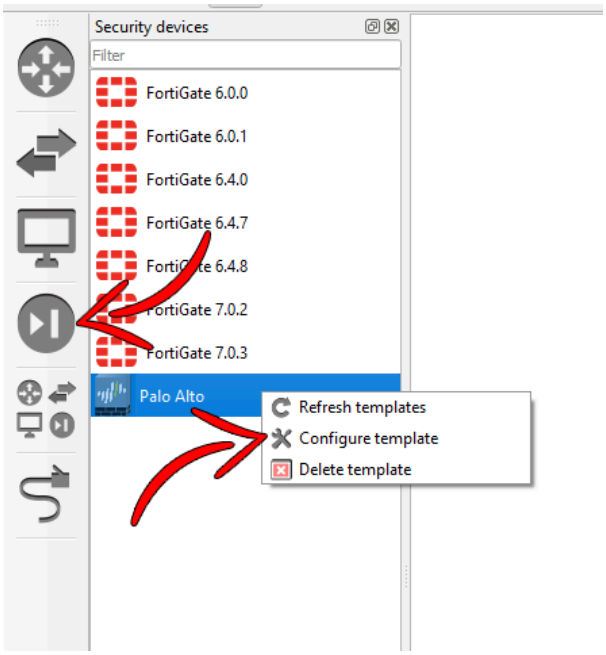


Figure A.22: Configure Palo Alto template

2. Make sure the max amount of RAM is set to at least 4096MB, and the amount of vCPUs are at least 2.

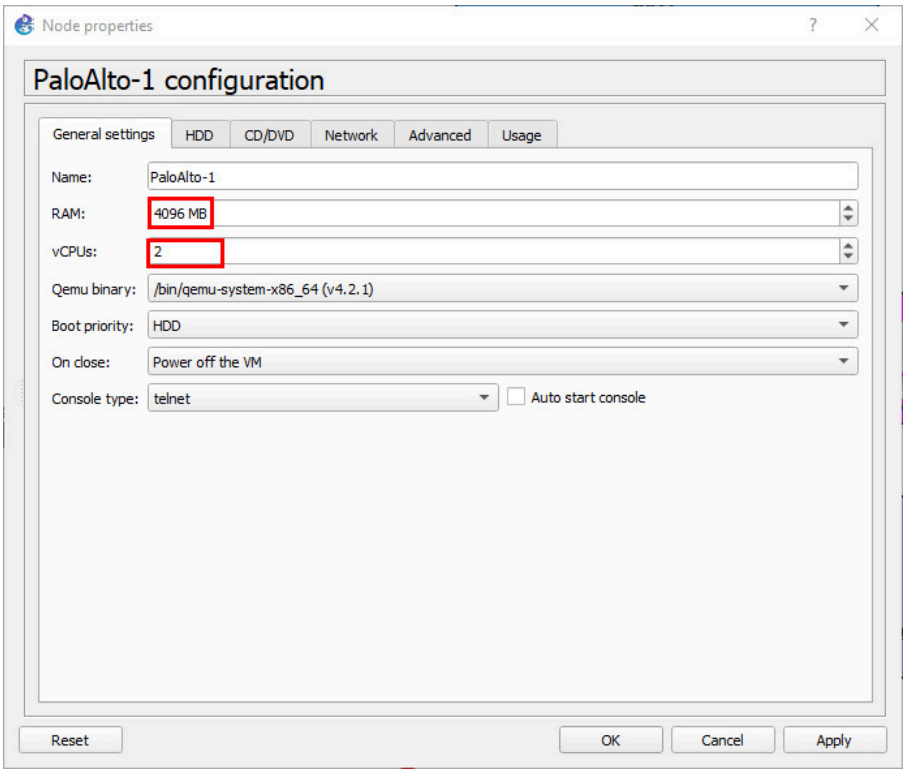


Figure A.23: Configure template

3. Now close the window, and drag in the Palo Alto device from the left hand pane.

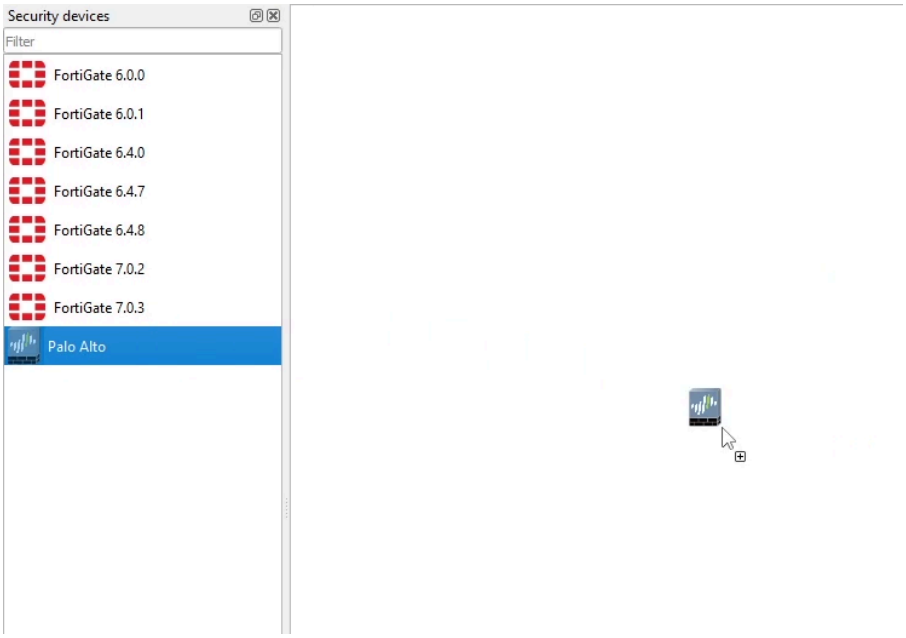


Figure A.24: Drag a Palo Alto in the workspace

4. Once you've dragged in the Palo Alto device, right click it, then click "Start."

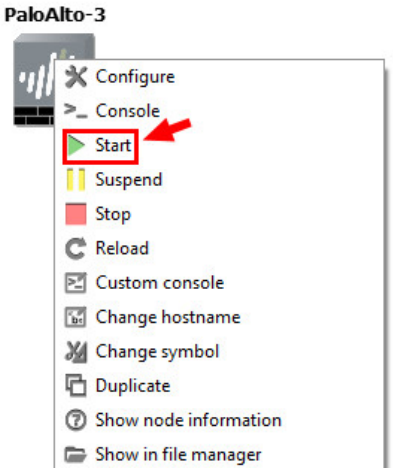


Figure A.25: Start Palo Alto

Keep in mind that this device takes a while to start.

Webterm Installation

1. Let's begin by clicking "New template" on the bottom left hand of GNS3.

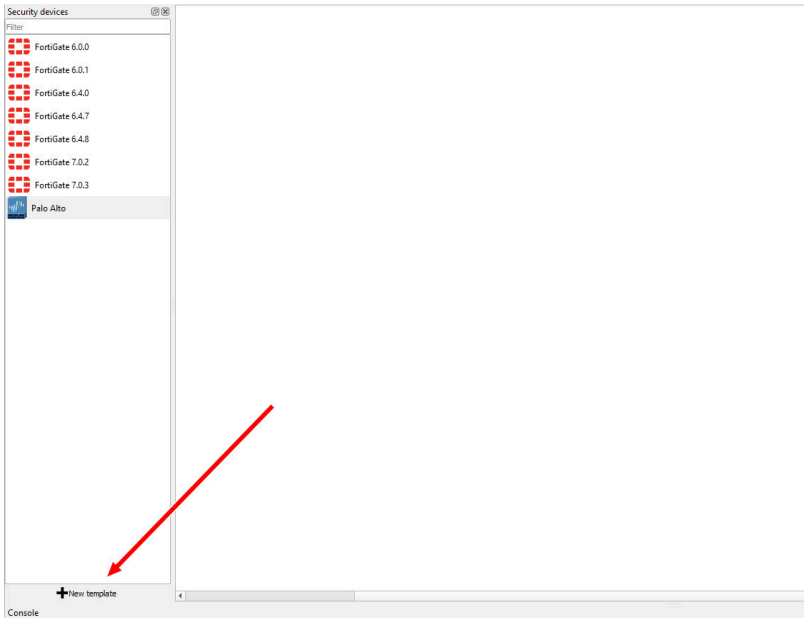


Figure A.26: Create a new template

2. We want to install this into the GNS3 VM. Click on the option to “Install an appliance from the GNS3 Server,” then click next.

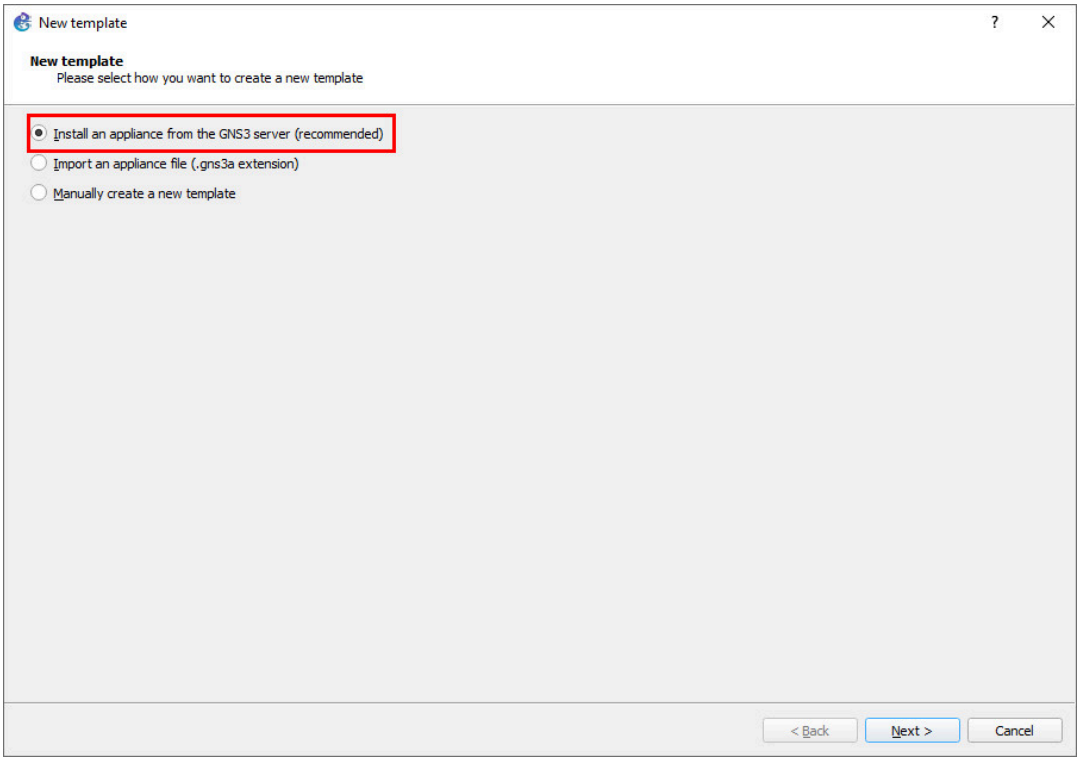


Figure A.27: Install an appliance from the GNS3 server

3. On the next window, search for “webterm,” select the option under “guests,” then click “Install.”

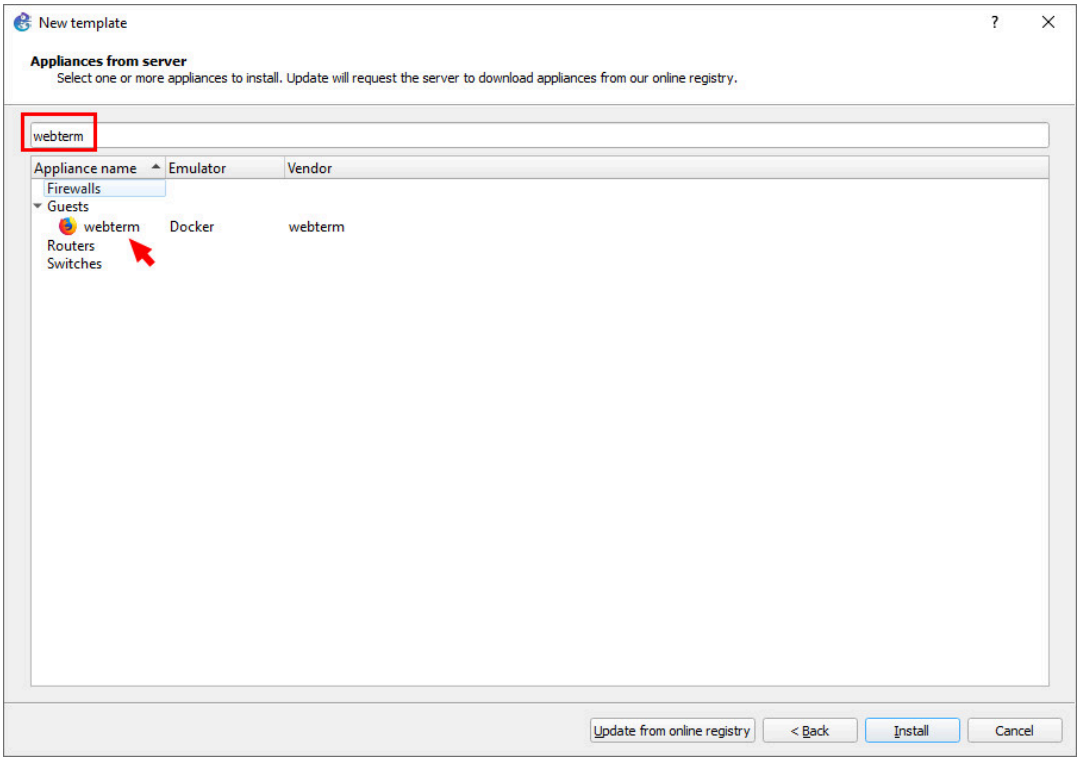


Figure A.28: Search for "webterm"

4. On the next screen, ensure that "Install the appliance on the GNS3 VM" is already selected, then click "Next."

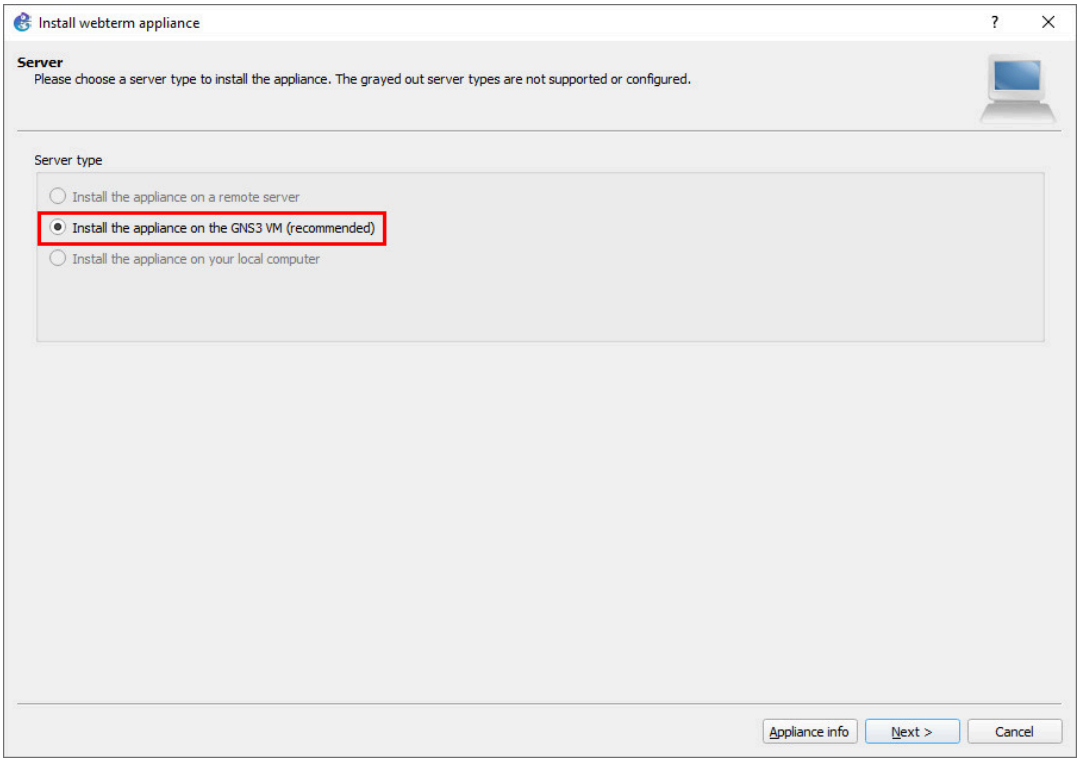


Figure A.29: Select "Install the appliance on the GNS3 VM"

5. On the next screen, click "Finish."

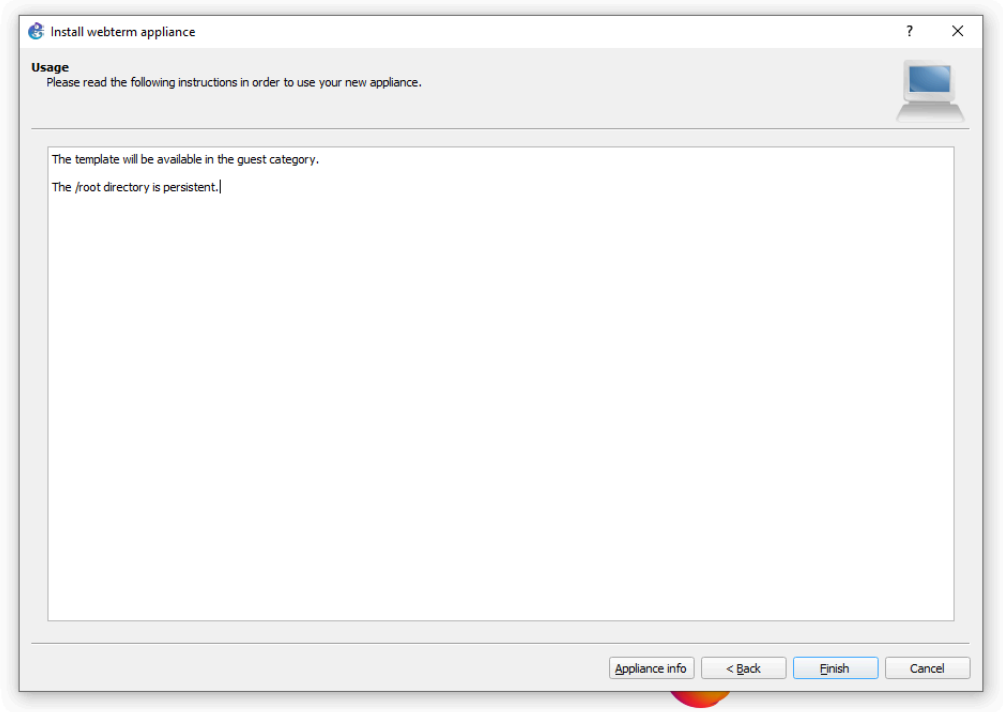


Figure A.30: Click on Finish

After that, it should appear under all devices in GNS3

Configuring Your Webterm Device with a Static IP

1. Drag in the webterm device from the left pane. Then once it finishes downloading the docker file, right click it and select “Edit config.”

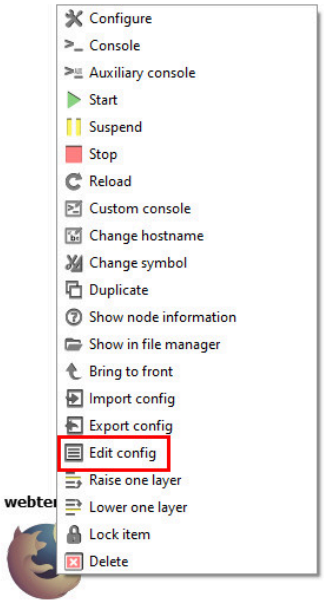


Figure A.31: Edit config

2. A window will pop up containing the device's network configuration. We want to modify this file to match the specified IP address. The final modification should look like a little like this:

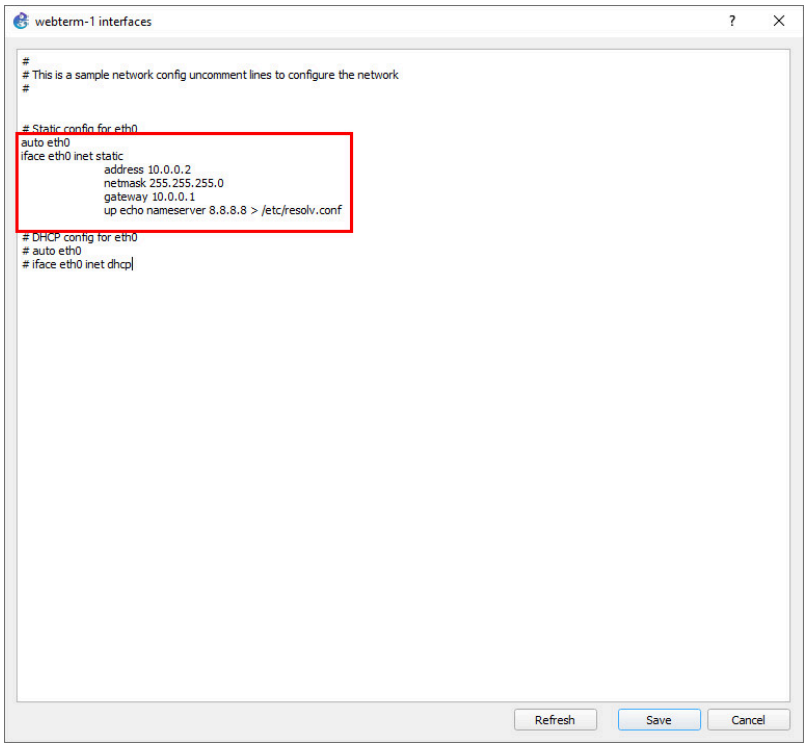


Figure A.32: Static IP address configuration

After these modifications, click on the save button on the bottom right of the window.

Configuring a Webterm DHCP Client

We just need to uncomment these 2 lines to enable DHCP. Click on save and we are done.

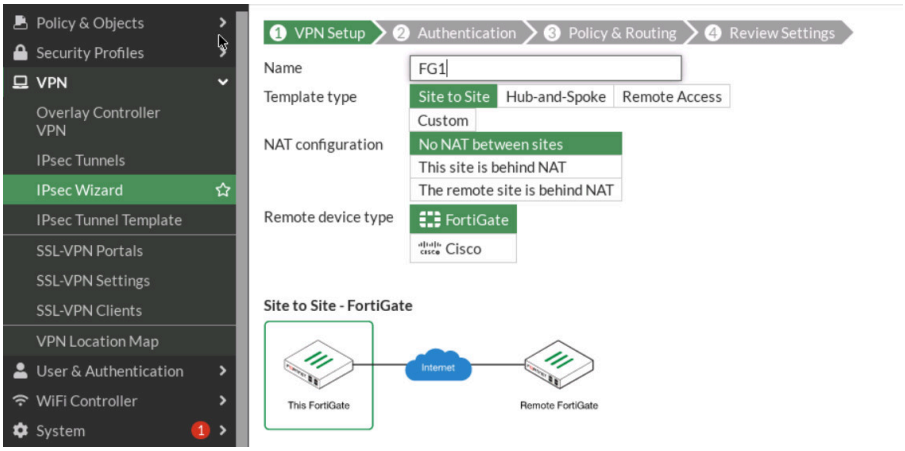


Figure A.33: DHCP IP address configuration

Connecting Devices in GNS3

Please see the example below:[1]

Figure A.34: Connecting devices

Using NAT in GNS3

The NAT device in GNS3 will allow devices in our virtual topology to communicate with the internet. This device is under the all devices section of GNS3.

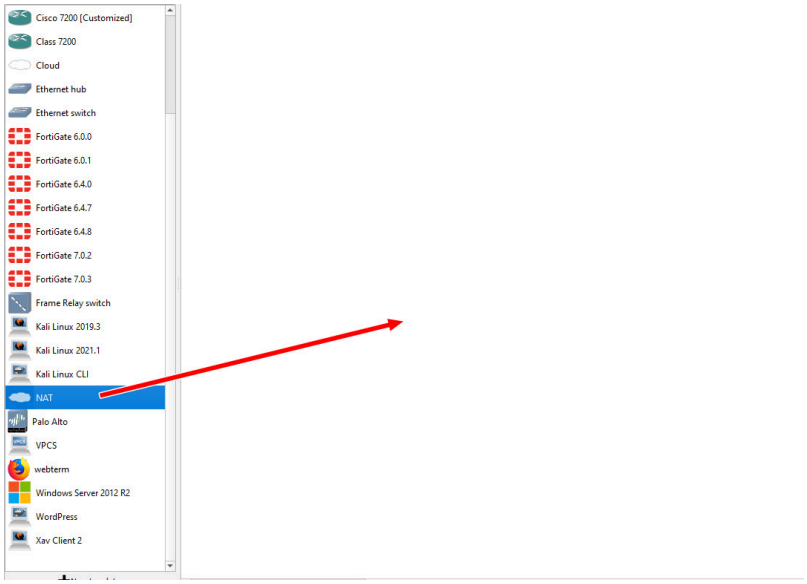


Figure A.35: NAT

1. If using an offline version of the book, navigate to https://opentextbc.ca/fortigatefirewall/back-matter/appendix/ in order to see this animated example.

Make sure you select the GNS3 VM as the option whenever you see this window (applies for all devices)

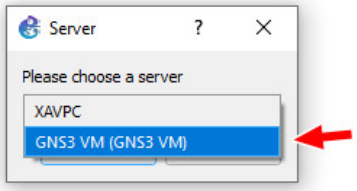


Figure A.36: Choose GNS3 VM

Using Kali in GNS3

Sometimes we need to use Kali to demonstrate an attack. Please keep in mind that Kali is used strictly for testing purposes, and should not be used as a daily driver, to hack your friends, or to pretend to look cool.

1. Let's begin by clicking "New template" on the bottom left hand of GNS3.

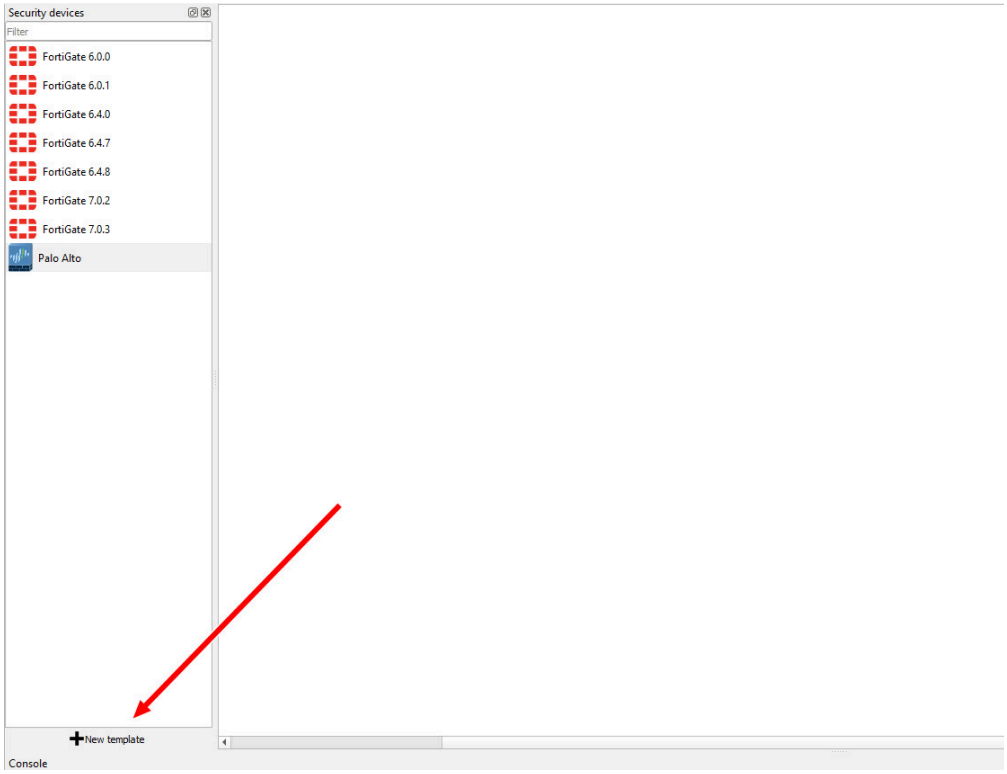


Figure A.37: Create a new template

2. We want to install this into the GNS3 VM. Click on the option to "Install an appliance from the GNS3 Server," then click "Next."

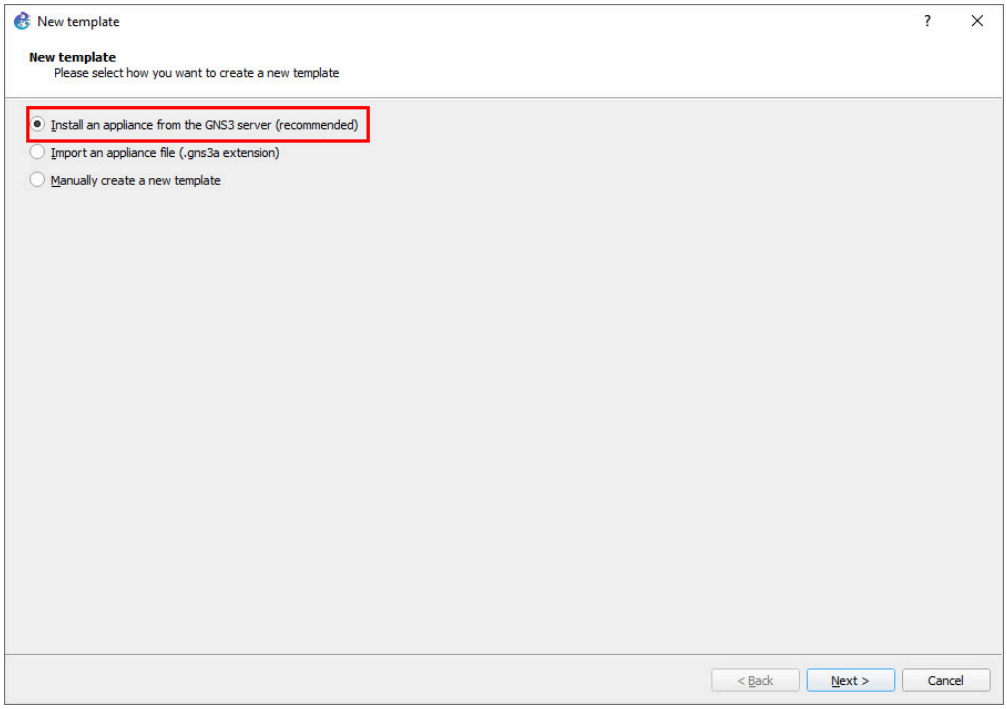


Figure A.38: Select "Install an appliance from the GNS3 Server"

3. On the next window, search for "kali", and select the non "CLI" option.

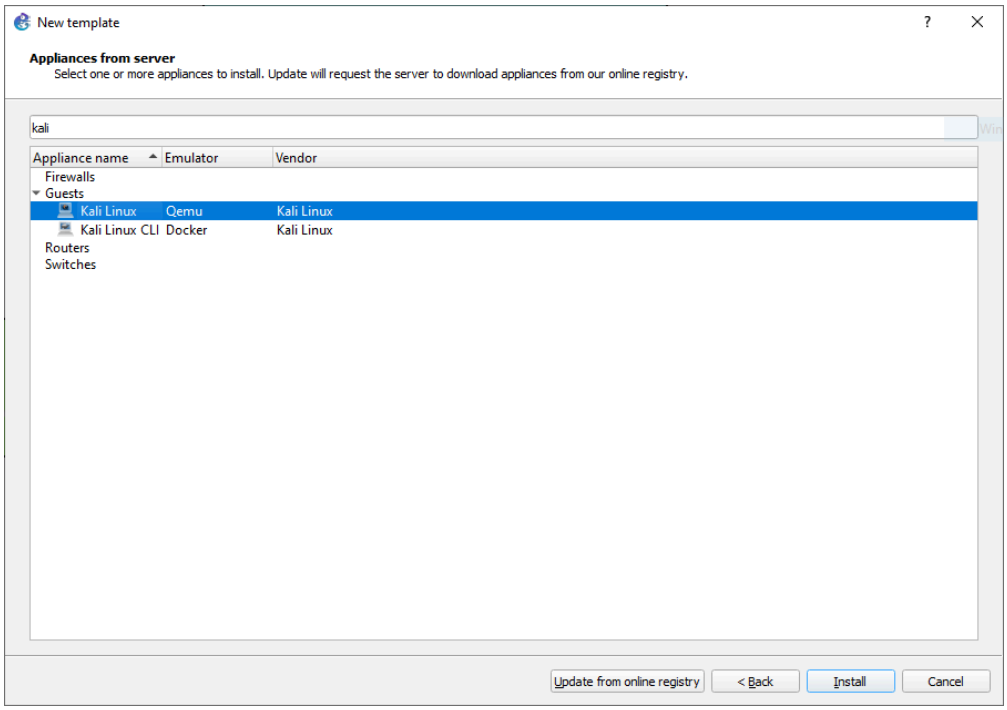


Figure A.39: Select Kali Linux

4. On the next screen, ensure that "Install the appliance on the GNS3 VM" is already selected, then click "Next."

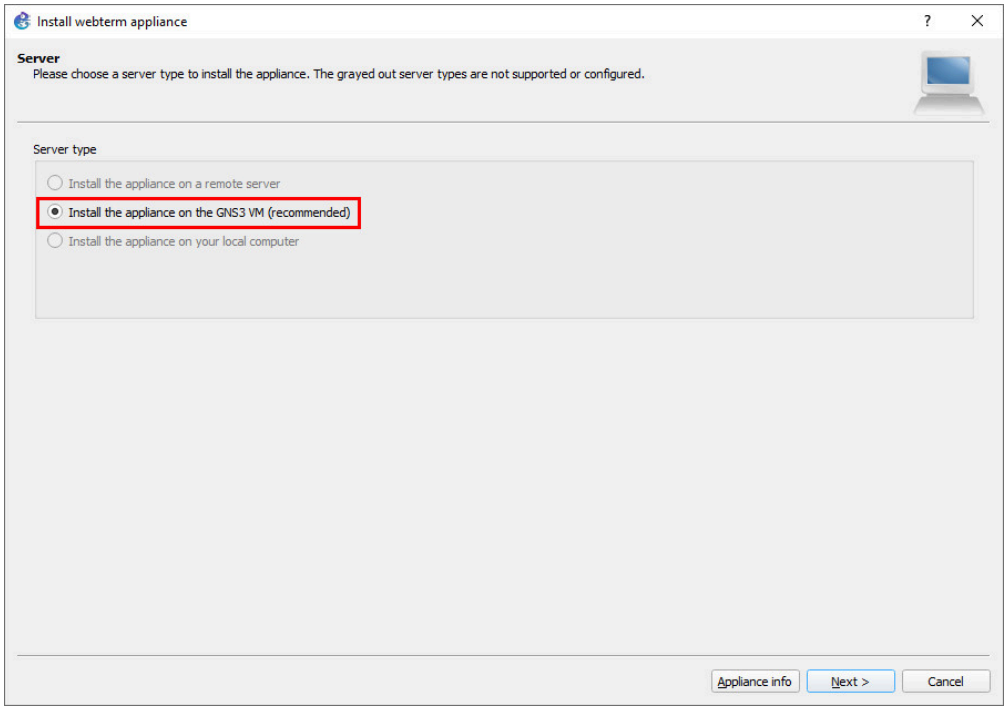


Figure A.40: Install the appliance on the GNS3 VM

5. “Next” again:

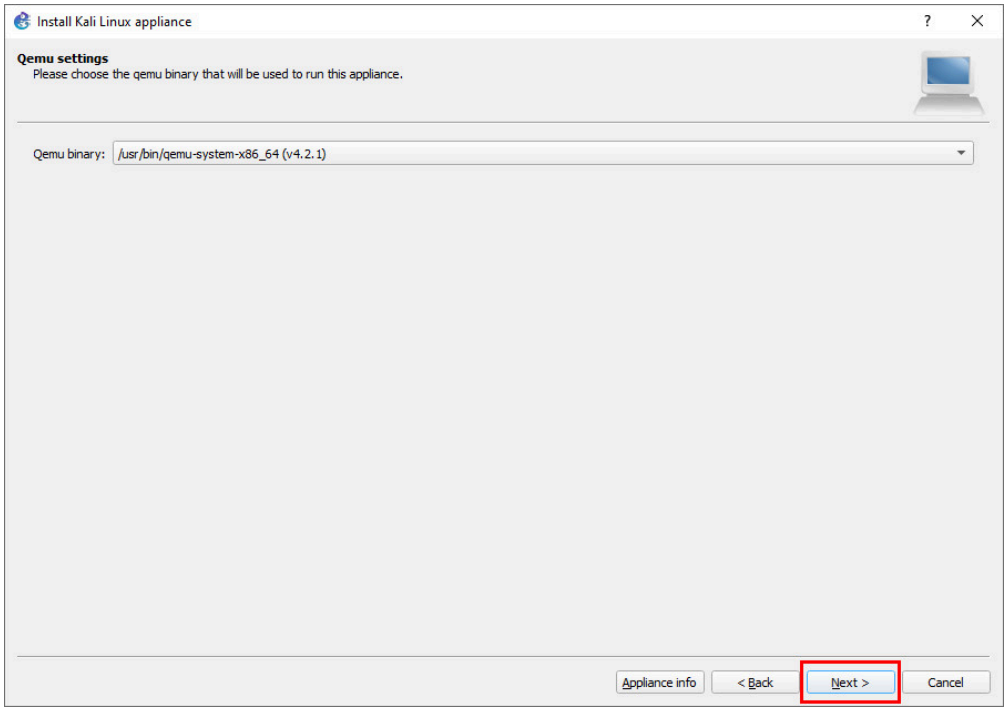


Figure A.41: Qemu binary

6. Expand the “2019” option, and download both missing files.

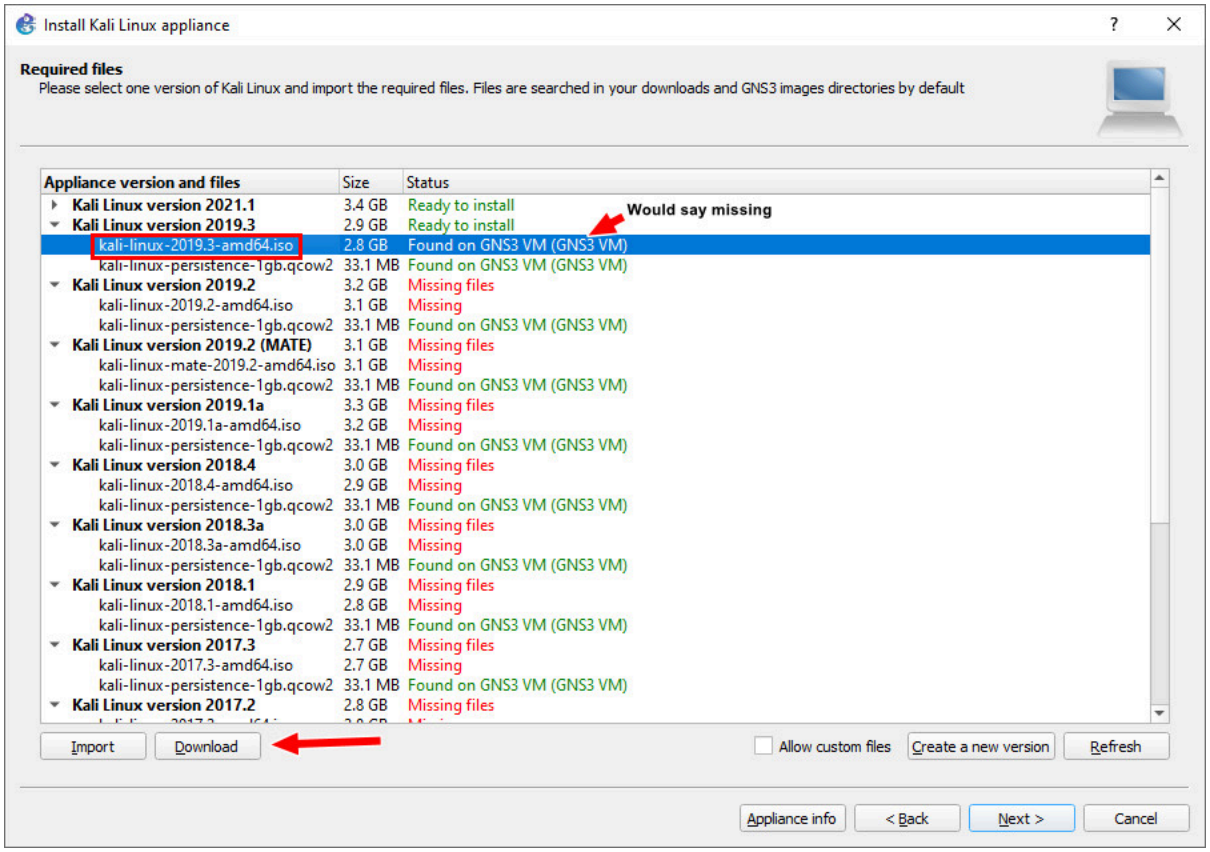


Figure A.42: Select the Kali-Linux version and then Download

7. After that, import the downloaded file to the specified 2019 selection.

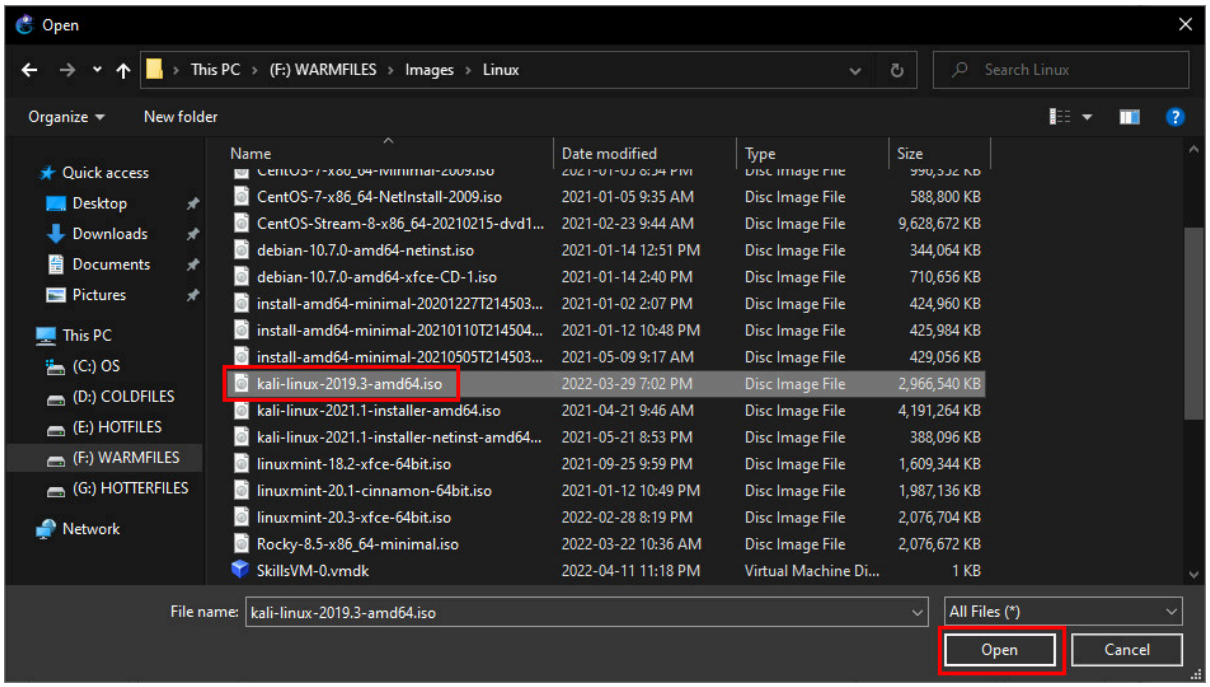


Figure A.43: Select the Kali-Linux downloaded file

8. It should take a second, but GNS3 will start to load up the ISO into the GNS3 VM.

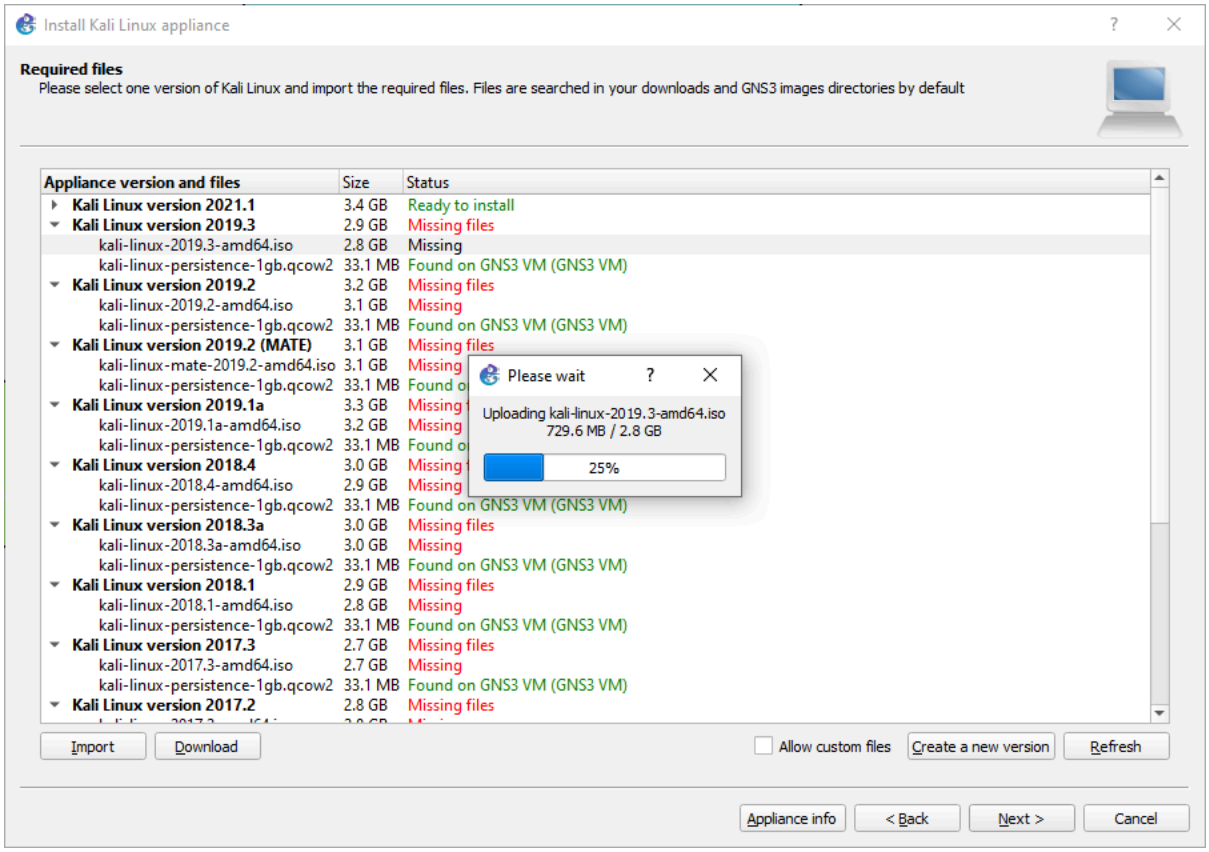


Figure A.44: Load the image

9. After that, click the 2019 version again, then click “Next.”

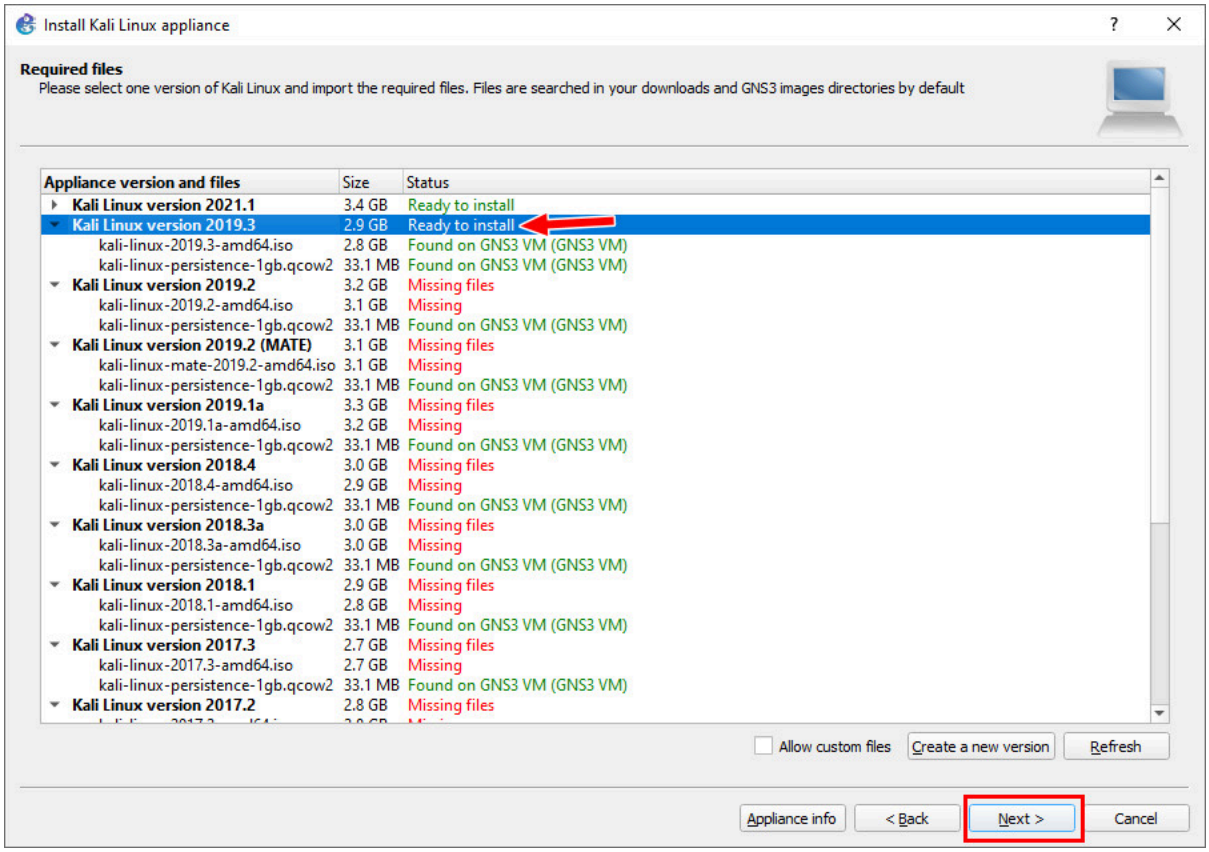


Figure A.45: Ready to install Kali 2019.3

10. Then click “Finish.”

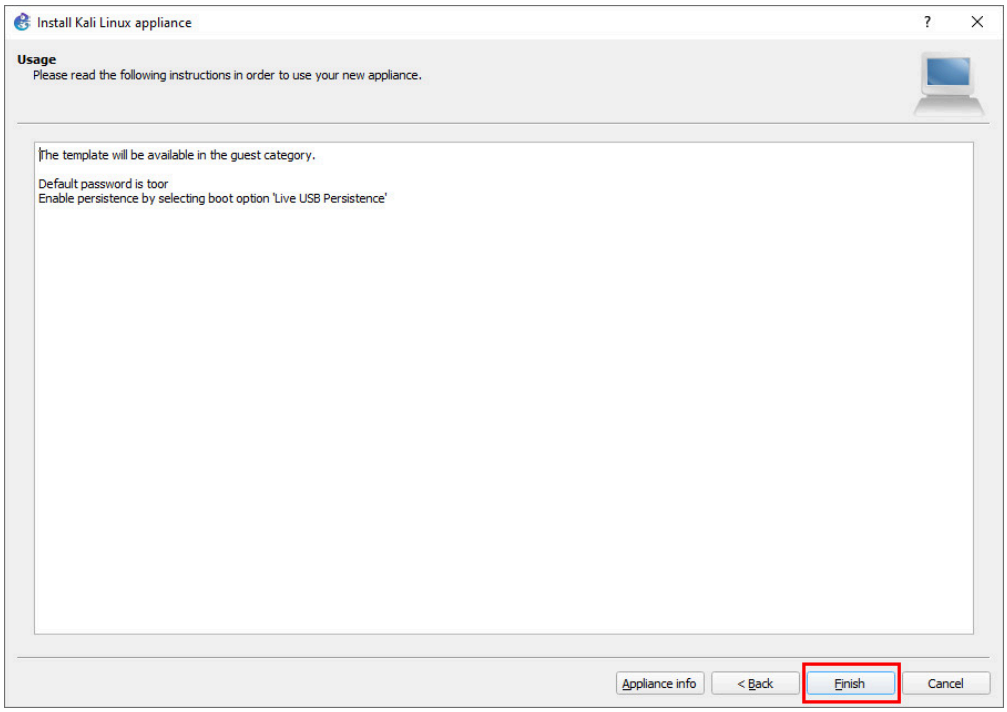


Figure A.46: Click on “Finish”

Using WordPress in GNS3

Sometimes we need a basic webserver to demonstrate website functionality. This can be accomplished using the WordPress appliance in GNS3. Start by clicking the new template button on the bottom of the page.

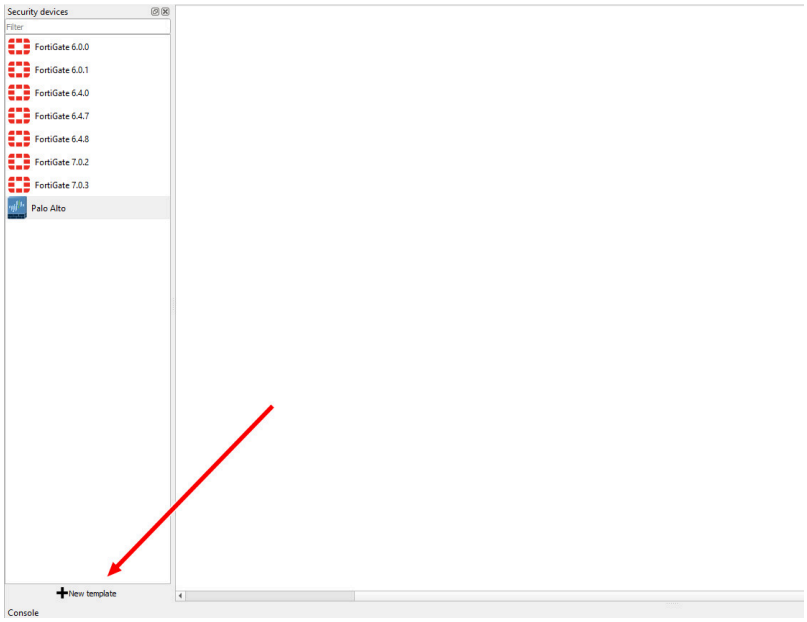


Figure A.47: Create a new template

We want to install an appliance from the GNS3 server.

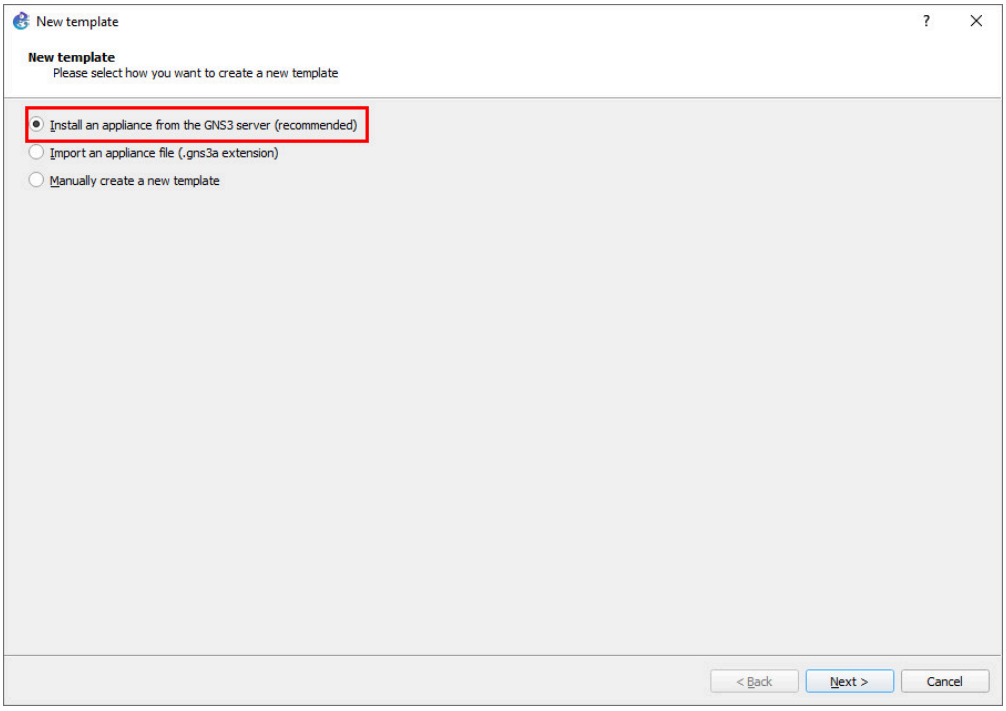


Figure A.48: Install an appliance from the GNS3 server

Look up “WordPress,” then click “Install.”

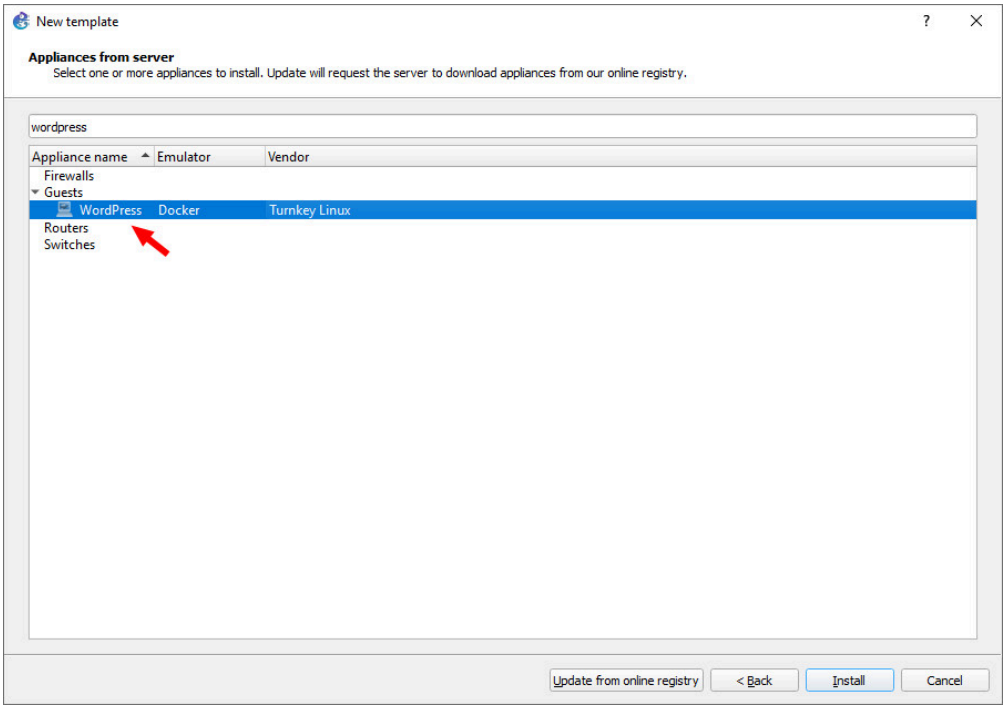


Figure A.49: Search for "WordPress"

Just press next for the following dialogue boxes, and you should now have WordPress!

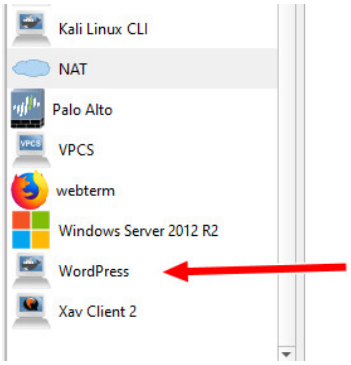


Figure A.50: WordPress installed successfully!

Running WordPress

After changing the interface configuration, start the machine. You will see a dialogue box:

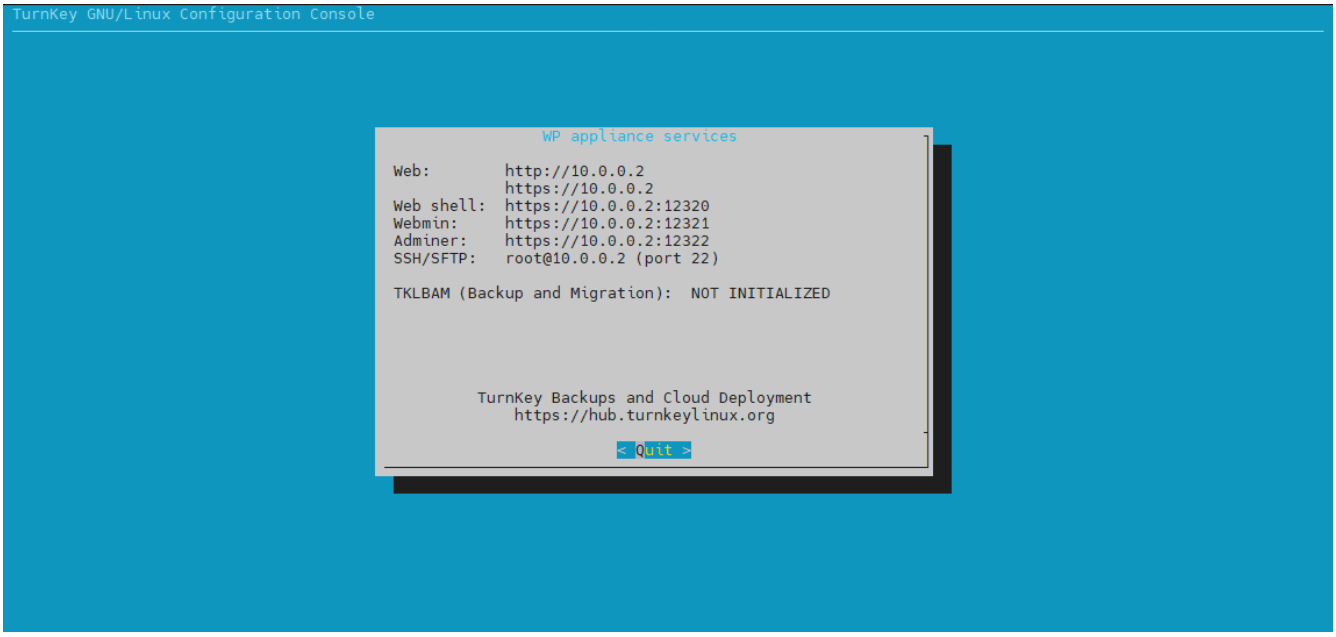


Figure A.51: Running WordPress

Press enter and you'll see the device under some basic configuration. Once you get to the prompt, you can exit that window, and you will have WordPress ready!

```
longer than 15 characters, please use --exec instead of --name.
. ok
[ ok ] Starting LVM2 poll daemon: lvmpolld.
[ ok ] Starting MariaDB database server: mysqld.
[ ok ] Starting Postfix Mail Transport Agent: postfix.
[warn] qemu-ga: transport endpoint not found, not starting ... (warning).
[ ok ] Starting enhanced syslogd: rsyslogd.
[ ok ] Starting OpenBSD Secure Shell server: sshd.
Starting TLS tunnels: /etc/stunnel/shellinabox.conf: started /etc/stunnel/webmin.conf: started
[ ok ] Starting webmindone.
System information for Mon Apr 18 08:22:27 2022 (UTC+0000)

  System load:  1.35               Memory usage:  36.7%
  Processes:    33                 Swap usage:    0.0%
  Usage of /:   12.0% of 479.62GB  IP address for eth0: 10.0.0.2

TKLBAM (Backup and Migration):  NOT INITIALIZED

  To initialize TKLBAM, run the "tklbam-init" command to link this
  system to your TurnKey Hub account. For details see the man page or
  go to:

      https://www.turnkeylinux.org/tklbam


WARNING: The container requires initialization (performed on first login).
This can be performed from the host as follows:

    CID=$(docker ps -l -q)
    CIP=$(docker inspect --format='{{.NetworkSettings.IPAddress}}' $CID)
    docker logs $CID | grep "Random initial root password"
    ssh root@$CIP

WARNING: Exiting this shell will stop the container.
For regular console usage, SSH is recommended.
root@WP /#
```

Figure A.52: WordPress is ready!

Using Switches in GNS3

Usually we just use switches to connect multiple devices together in GNS3. However, it can also be used for VLANs. Start by dragging one in and double clicking it.

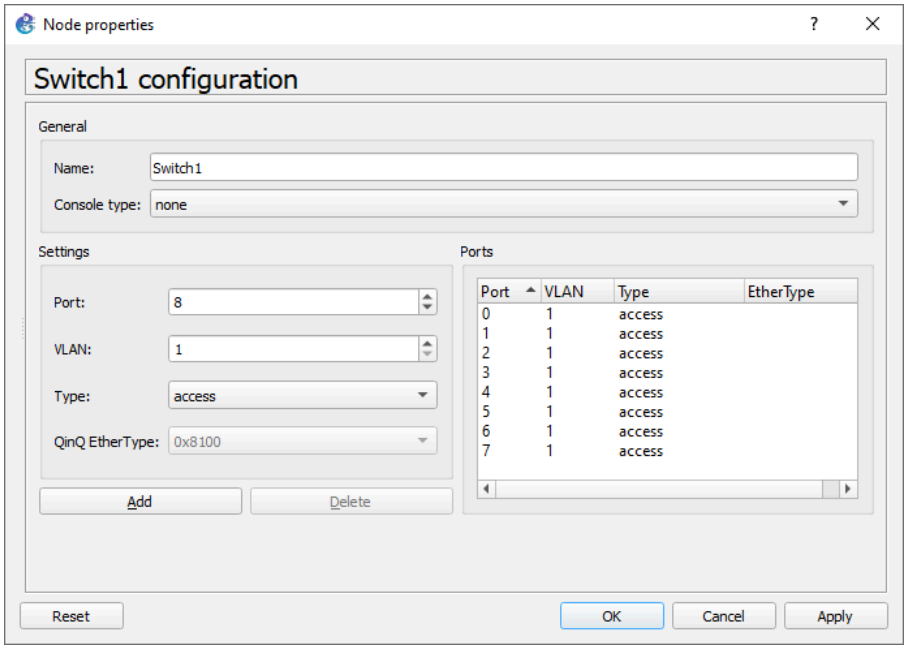


Figure A.53: Switch configuration

Here you can see that they are all basically untagged. To configure a specific port, simply double click your desired port

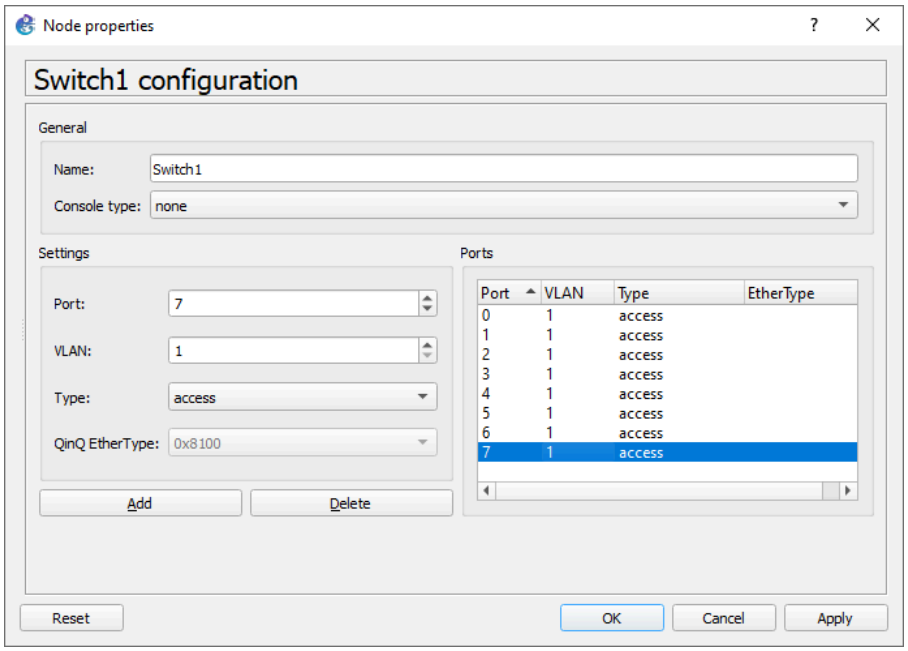


Figure A.54: Switch port configuration

Configure the necessary settings for them (access is for tagging, dot1q is for trunking).

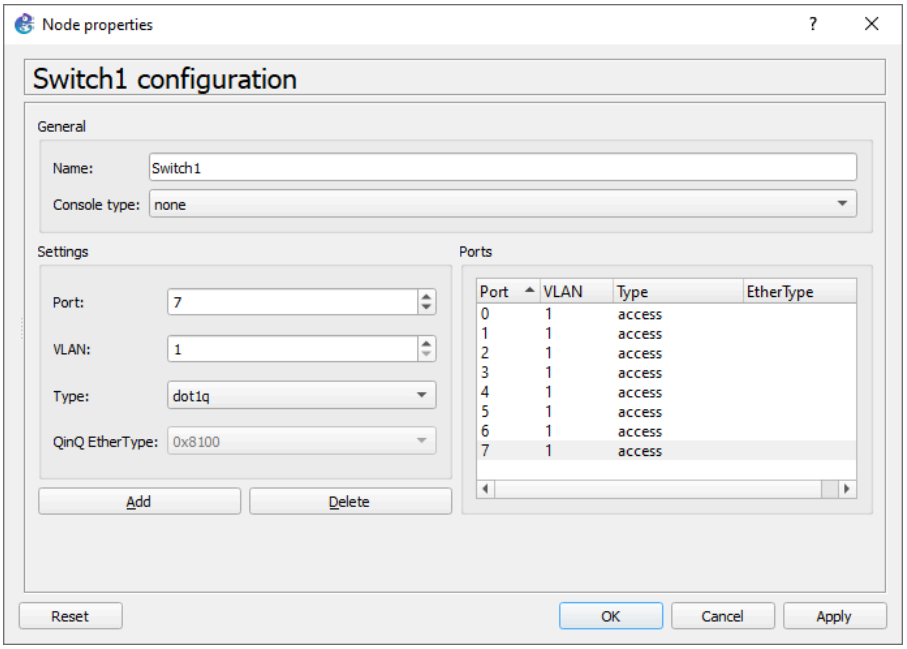


Figure A.55: Switch port configuration

Click on add to **Apply** the changes.

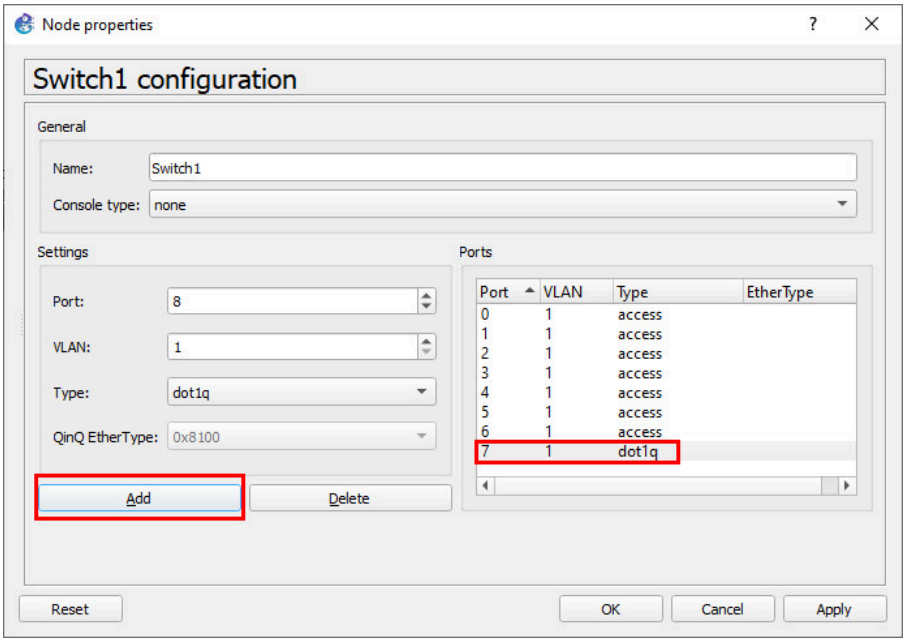


Figure A.56: Switch port configuration

Then click **Apply** and **OK**.

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About the Author

Hamid Talebi (https://talebi.ca/) is an IT engineer with 14 years of experience and is a faculty member at Computer Information System Administration (CISA), School of Energy at BCIT. He has a Master of Science (MS) degree in Network Security. He has expertise and experience working with FortiGate and Palo Alto Firewalls, and SIEM software such as Qradar IBM, FortiSIEM, Splunk, and ArcSight.

Before joining BCIT, Hamid held multiple roles IT security roles with a number of reputable organizations, such as the Canadian Institute for Cybersecurity and Bell. He designed and implemented a honeynet for the CIC and created a large IPS/IDS dataset over AWS for the CSE.

He has been working in developing strong information security architectures with an Agile Project Management delivery methodology and assisting in the development of client IT and security strategies. Hamid has taught Network Security Fundamentals, Enterprise Network Security (FortiGate), Advanced Network Security (Palo Alto – Splunk – FortiSIEM), and Network Programming with Python at BCIT.

Versioning History

This page provides a record of edits and changes made to this book since its initial publication. Whenever edits or updates are made in the text, we provide a record and description of those changes here. If the change is minor, the version number increases by 0.01. If the edits involve substantial updates, the version number increases to the next full number.

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Version	Date	Change	Details
1.00	August 31, 2023	Book published.	