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# FortiGate I

Student Guide  
for FortiGate 5.4.1



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FortiGate I Student Guide

for FortiGate 5.4.1

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## Virtual Lab Basics

In this class, you will use a virtual lab for hands-on exercises. This section explains how to connect to the lab and its virtual machines. It also shows the topology of the virtual machines in the lab.



**Note:** If your trainer asks you to use a different lab, such as devices physically located in your classroom, please ignore this section. This applies only to the virtual lab accessed through the Internet. If you do not know which lab to use, please ask your trainer.

The diagram illustrates a network topology with four hosts and a central cloud. The hosts are arranged in a vertical stack, connected by a central cloud. The connections are as follows:

- LOCAL-WINDOWS** (10.0.1.10) is connected to **LOCAL-FORTIGATE** (10.200.1.1/24) via port1.
- LOCAL-FORTIGATE** (10.200.1.1/24) is connected to **REMOTE-FORTIGATE** (10.200.3.1/24) via eth3.
- REMOTE-FORTIGATE** (10.200.3.1/24) is connected to **REMOTE-WINDOWS** (10.0.2.10) via port6.
- The **cloud** is connected to **LOCAL-FORTIGATE** via eth0.

The hosts are represented by icons: a Windows logo for LOCAL-WINDOWS and REMOTE-WINDOWS, a FortiGate logo for LOCAL-FORTIGATE and REMOTE-FORTIGATE, and a Linux penguin for the central cloud. The cloud is represented by a cloud icon.

It can also diagnose problems with your Java Virtual Machine, firewall, or web proxy.

Use the URL for your location.

North America/South America:

<https://remotelabs.training.fortinet.com/training/syscheck/?location=NAM-West>

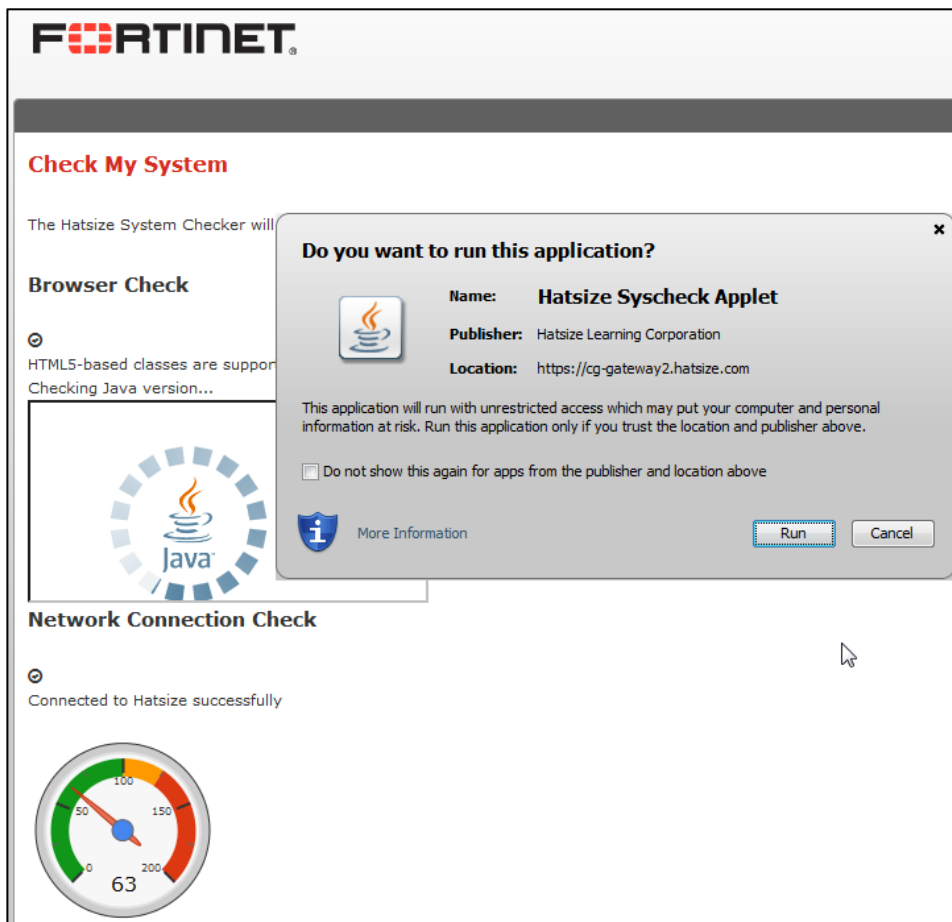
Europe/Middle East/Africa:

<https://remotelabs.training.fortinet.com/training/syscheck/?location=Europe>

Asia/Pacific:

<https://remotelabs.training.fortinet.com/training/syscheck/?location=APAC>

If a security confirmation dialog appears, click **Run**.



If your computer successfully connects to the virtual lab, the result messages for the browser and network checks will each display a check mark icon. Continue to the next step.

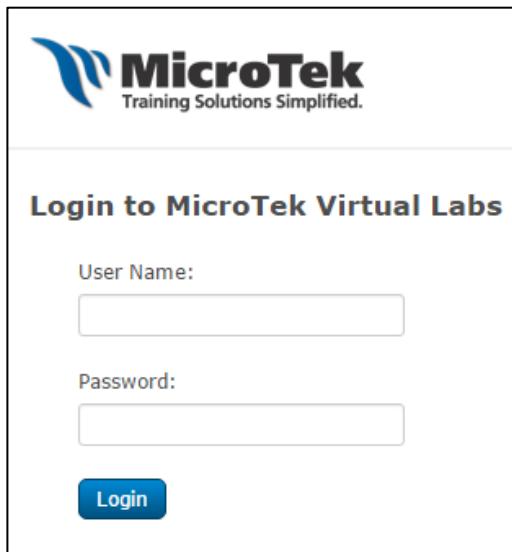
If a browser test fails, this will affect your ability to access the virtual lab environment. If a network test fails, this will affect the usability of the virtual lab environment. For solutions, either click the **Support Knowledge Base** link or ask your trainer.

2. With the user name and password from your trainer, log into the URL for the virtual lab. Either:  
<https://remotelabs.training.fortinet.com/>



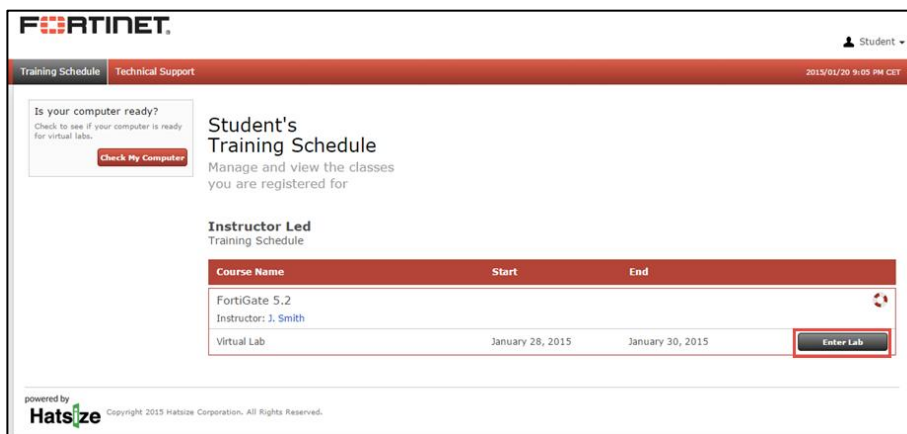
The image shows a Fortinet login interface. At the top is the Fortinet logo. Below it are two input fields: "User Name:" and "Password:". A red "Login" button is positioned below the password field. At the bottom, there are two links: "Forgot your Password?" and "Contact Support".

<https://virtual.mclabs.com/>



The image shows a MicroTek Virtual Labs login interface. At the top is the MicroTek logo with the tagline "Training Solutions Simplified.". Below it is the heading "Login to MicroTek Virtual Labs". There are two input fields: "User Name:" and "Password:". A blue "Login" button is at the bottom.

3. If prompted, select the time zone for your location, then click **Update**.  
This ensures that your class schedule is accurate.
4. Click **Enter Lab**.



The image shows the Fortinet Student's Training Schedule page. The page has a red header with the Fortinet logo and a "Student" dropdown menu. Below the header, there are two tabs: "Training Schedule" and "Technical Support". The "Training Schedule" tab is active. On the left, there is a section titled "Is your computer ready?" with a "Check My Computer" button. The main content area is titled "Student's Training Schedule" and contains the text "Manage and view the classes you are registered for". Below this, there is a section titled "Instructor Led Training Schedule". It contains a table with the following data:

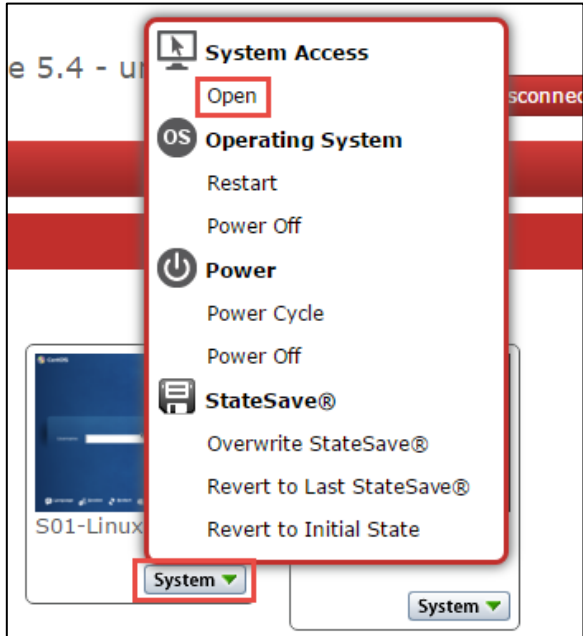
Course Name	Start	End
FortiGate 5.2 Instructor: J. Smith	January 28, 2015	January 30, 2015

At the bottom of the table, there is a red "Enter Lab" button. The page footer includes the text "powered by Hatsize" and "Copyright 2015 Hatsize Corporation. All Rights Reserved."

A list of virtual machines that exist in your virtual lab should appear.

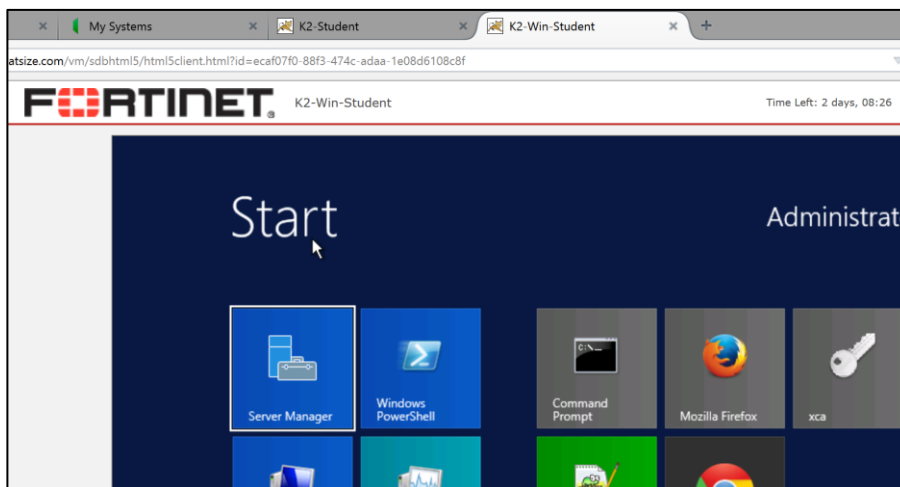
From this page, you can access the console or desktop of any of your virtual devices by either:

- clicking on the device's square, or
- selecting **System** > **Open**.



5. Click **Local-Windows VM** to open a desktop connection to that virtual machine.

A new window should open within a few seconds. (Depending on your account's preferences, the window may be a Java applet. If that is the case, you may need change browser settings to allow Java to run on this web site.)



Connections to Windows and Linux machines will use a remote desktop-like GUI. You should automatically log in. After that, the desktop is displayed.

Connections to Fortinet's VM use the VM console port, which you can use to enter command line interface (CLI) commands.

## Disconnections/Timeouts

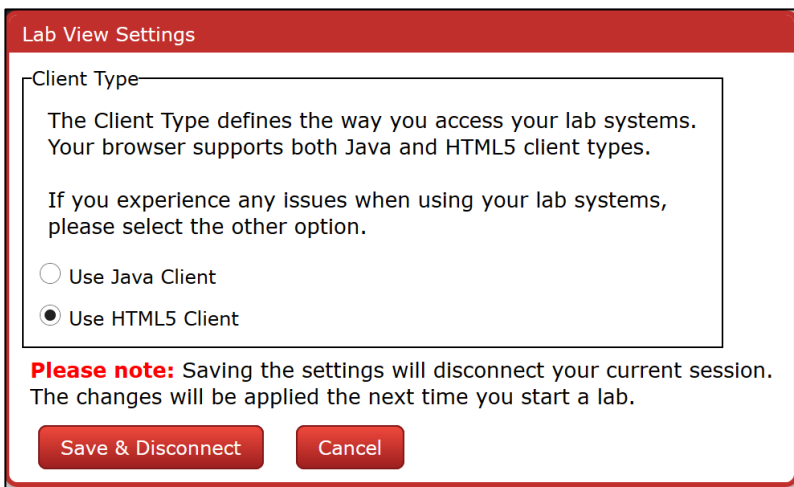
If your computer's connection with the virtual machine times out or if you are accidentally disconnected, to regain access, return to the initial window/tab that contains your session's list of VMs and open the VM again.

If that does not succeed, see Troubleshooting Tips.

## Using Java Instead of HTML5

When you open a VM, by default, your browser will use HTML5 to connect to your lab's VM.

Alternatively, you may be able to use Java instead. Your browser will download and use a Java application to connect to the virtual lab's VM. Not all browsers support the Java plug-in, so if you want to use Java, Mozilla Firefox is recommended. This means that Java must be installed, updated, and enabled in your browser. Once you have done that, in your virtual lab, click the **Settings** button, and then select **Use Java Client**. Click **Save & Disconnect**, then log in again. *(To use this preference, your browser must allow cookies.)*



The image shows a 'Lab View Settings' dialog box with a red header. Inside, there is a section titled 'Client Type' with a description: 'The Client Type defines the way you access your lab systems. Your browser supports both Java and HTML5 client types.' Below this, there is a note: 'If you experience any issues when using your lab systems, please select the other option.' There are two radio buttons: 'Use Java Client' (unselected) and 'Use HTML5 Client' (selected). At the bottom, there is a 'Please note' section stating: 'Saving the settings will disconnect your current session. The changes will be applied the next time you start a lab.' Below the note are two buttons: 'Save & Disconnect' and 'Cancel'.

Lab View Settings

Client Type

The Client Type defines the way you access your lab systems. Your browser supports both Java and HTML5 client types.

If you experience any issues when using your lab systems, please select the other option.

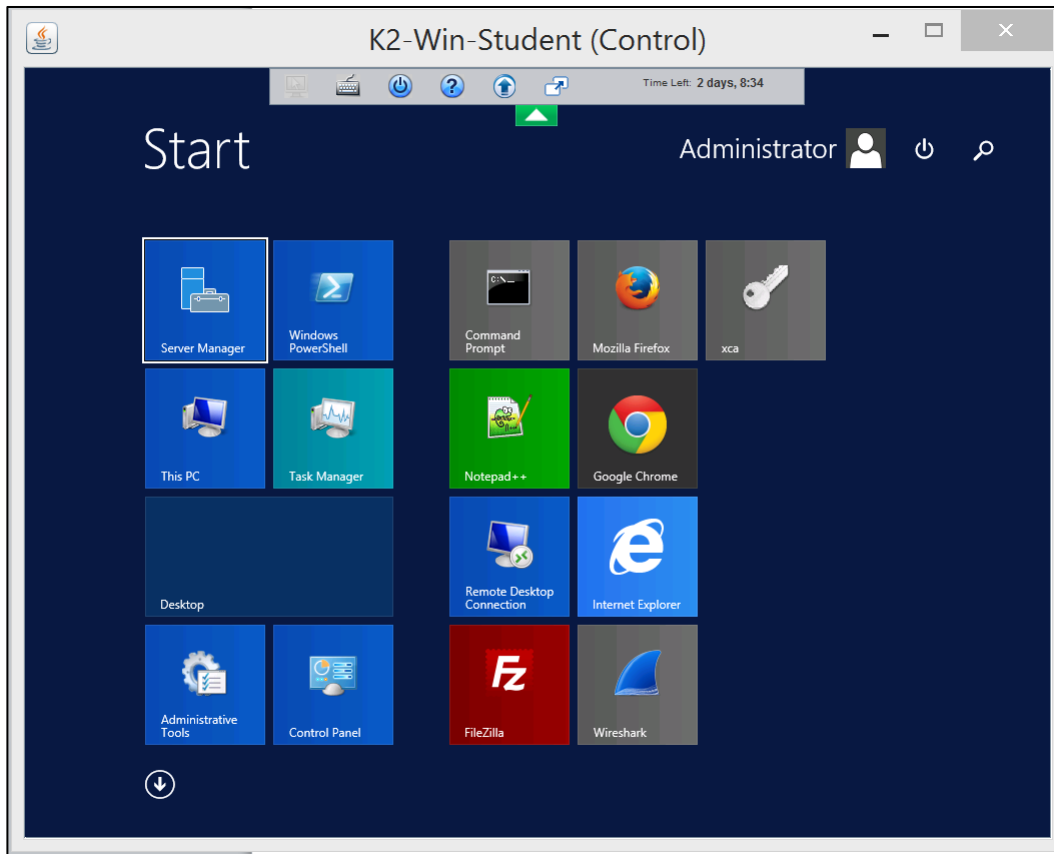
☐ Use Java Client

☒ Use HTML5 Client

**Please note:** Saving the settings will disconnect your current session. The changes will be applied the next time you start a lab.

Save & Disconnect Cancel

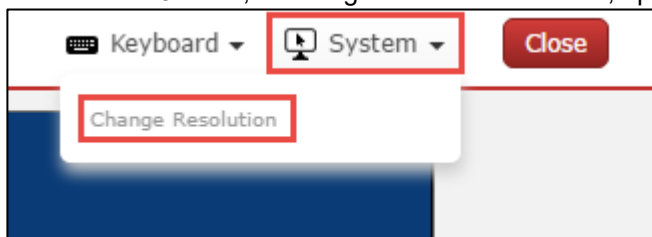
When connecting to a VM, your browser should then open a display in a new applet window.



## Screen Resolution

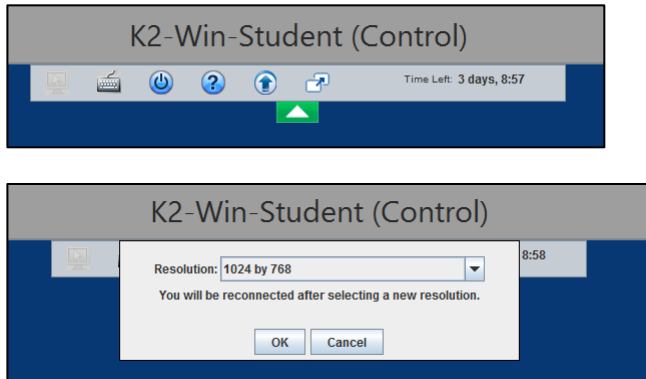
Some Fortinet devices' user interfaces require a minimum screen size.

In the HTML 5 client, to configure screen resolution, open the **System** menu.





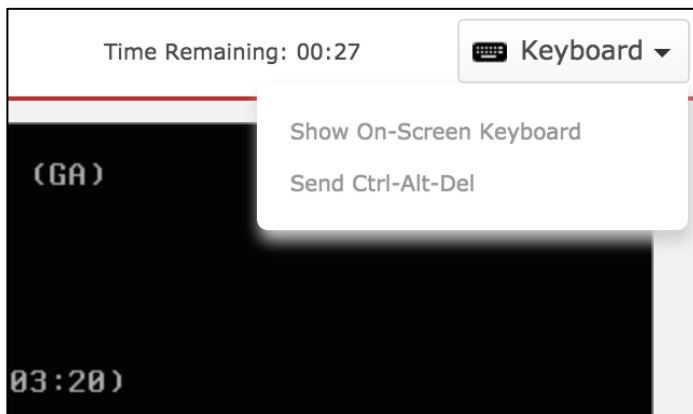
In the Java client, to configure the screen resolution, click the arrow at the top of the window.



## International Keyboards

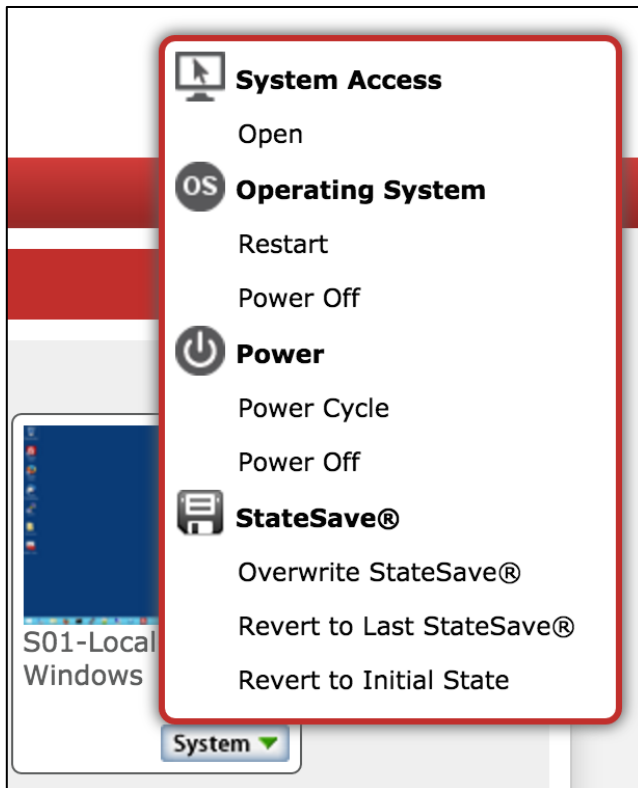
If characters in your language don't display correctly, keyboard mappings may not be correct.

To solve this in the HTML 5 client, open the **Keyboard** menu at the top of the window. Choose to display the on-screen keyboard.

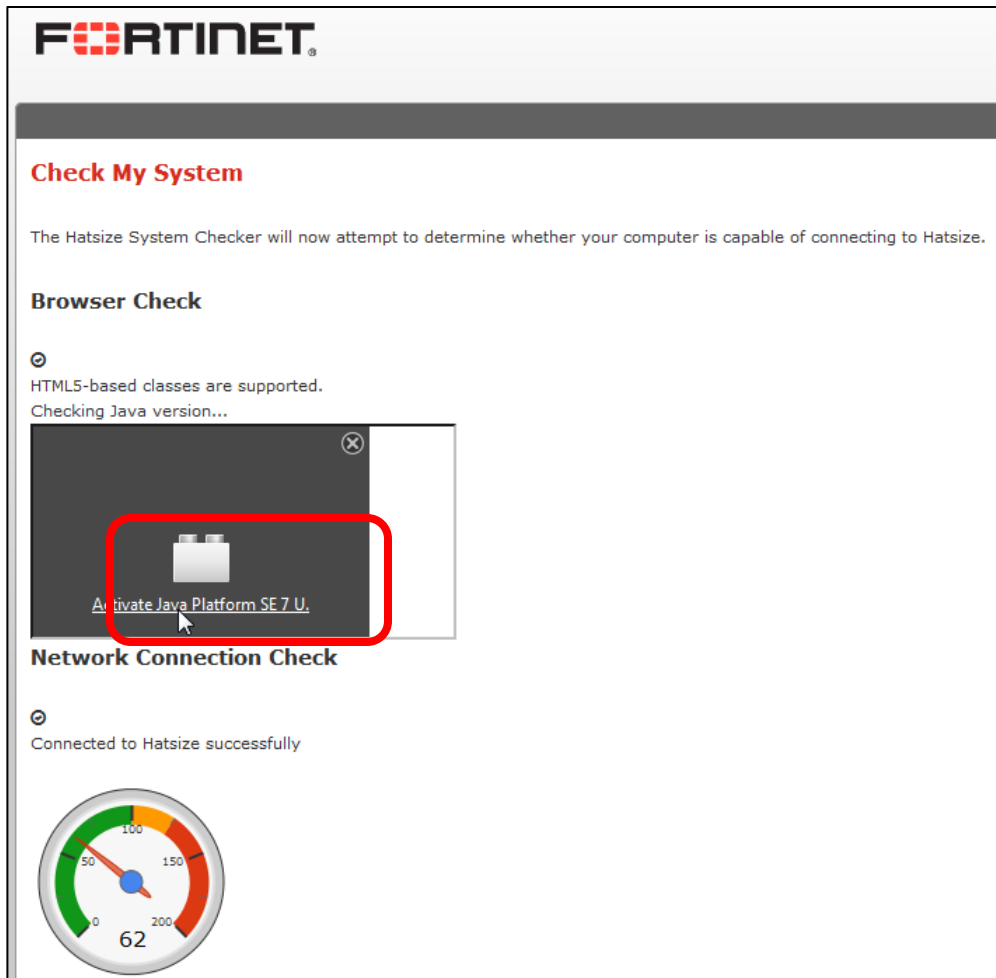


## Troubleshooting Tips

- Do not connect to the virtual lab environment through Wi-Fi, 3G, VPN tunnels or other low-bandwidth or high-latency connections. For best performance, use a stable broadband connection such as a LAN.
- If disconnected unexpectedly from any of the virtual machines (or from the virtual lab portal), please attempt to reconnect. If unable to reconnect, please notify the instructor.
- If you can't connect to a VM, on the VM's icon, click **System > Power Cycle**. This fixes most problems by forcing VM startup and connection initiation. If that does not solve the problem, try **System > Revert to Initial State**.  
**Note:** Reverting to the VM's initial snapshot will undo all of your work. Try other solutions first.



- If the HTML 5 client does not work, try the Java client instead. Remembering this preference requires that your browser allows cookies.
- Do not disable or block Java applets if you want to use the Java client. Network firewalls can block Java executables. Not all browsers/systems allow Java. In late 2015, Google Chrome removed Java compatibility, so it cannot be used with the Java client. On Mac OS X since early 2014, to improve security, Java has been disabled by default. In your browser, you must allow Java for this web site. On Windows, if the Java applet is allowed and successfully downloads, but does not appear to launch, you can open the Java console while troubleshooting. To do this, open the Control Panel, click Java, and change the Java console setting to be **Show console**.  
**Note:** JavaScript is not the same as Java.



- Prepare your computer's settings:
  - Disable screen savers
  - Change the power saving scheme so that your computer is always on, and does not go to sleep or hibernate
- If during the labs, particularly when reloading configuration files, you see a message similar to the one shown below, the VM is waiting for a response from the FortiGuard server.



To retry immediately, go to the console and enter the CLI command:

```
execute update-now
```

# LAB 1–Introduction to FortiGate

This lab provides an introduction to FortiGate's administrative CLI and GUI. Additionally, the lab will guide you through how to properly backup and restore a configuration file as well as create a new administrator account and modify administrative access permissions.

## Objectives

- Access the FortiGate CLI.
- Backup and restore configuration files.
- Find the FortiGate model and FortiOS firmware build information inside a configuration file.
- Create a new administrative user.
- Restrict administrative access.

## Time to Complete

Estimated: 25 minutes

## 1 Working With the Command Line Interface

You will start by accessing a FortiGate device using the command line interface (CLI.)

### Exploring the CLI

The next steps will help you get familiar with the FortiGate CLI.

To explore the CLI

1. In the virtual lab portal, click the **Local-FortiGate** icon to open the FortiGate console. (Alternatively, in the dropdown menu below the icon, click **System > Open**.)



2. At the login prompt, enter the username `admin` (all lower case) and leave the password blank.
3. Enter the following command:

```
get system status
```

This command displays basic status information about the FortiGate. The output includes the FortiGate's serial number, operation mode, and so on. When the `--More--` prompt appears in the CLI, press the spacebar to continue scrolling, press Enter to scroll one line at a time, or press Q to exit.

4. Enter the following command:

```
get ?
```



**Note:** 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.

5. Press the Up Arrow key. This displays the previous `get system status` command. Try some of the other control key sequences that shown here:

Action	Command
Previous command	Up Arrow
Next command	Down Arrow

Beginning of line	CTRL+A
End of line	CTRL+E
Back one word	CTRL+B
Forward one word	CTRL+F
Delete current character	CTRL+D
Clear screen	CTRL+L
Abort command and exit	CTRL+C

6. Enter the command:

```
execute ?
```

This lists all options that the CLI will accept next after the `execute` command.

7. Type `exe` then press the Tab key.

Notice that the CLI completes the current word.

8. Press the spacebar. After that, press the Tab key three times.

Each time that you press the Tab key, the CLI replaces the second word with the next possible option for the `execute` command, in alphabetical order.



**Note:** Almost all commands can be abbreviated. In presentations and labs, many of the commands that you see will be in abbreviated form.

Use this technique to reduce the number of keystrokes that are required to enter a command. In this way, experts can often configure a FortiGate faster through the CLI than the GUI.

If there are other commands that start with the same characters, your abbreviation must be long enough to be specific, so that FortiGate can distinguish them. Otherwise, the CLI will display an error message about ambiguous commands.

9. Enter the following CLI command to check the `port3` interface configuration:

```
show system interface port3
```

10. Enter this command:

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



### Stop and Think

Compare both outputs. How are they different?

The `show full-configuration` displays all the configuration settings for the interface. The `show` command displays only those whose values are different than the default values.

## 2 Configuration Backups

During this lab exercise you will learn how to generate and restore clear-text and encrypted configuration backups.

### Restoring a Configuration From a Backup

In this procedure you will restore a configuration from a backup.

To restore a configuration from a backup

1. In the virtual lab portal, click the **Local-Windows VM** icon to open its VM. (Alternatively, in the dropdown menu below the icon, go to **System > Open.**)



2. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.



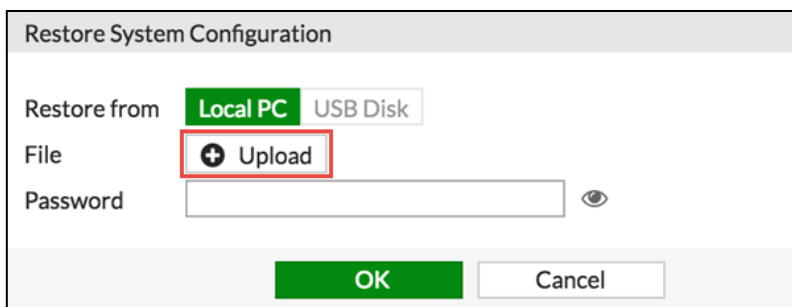
**Note:** All the lab exercises were tested running Mozilla Firefox in Local-Windows VM and Remote-Windows. As a result, to get consistent results, we recommend using Firefox to access both the Internet and the FortiGate GUIs in this virtual environment.

3. Go to the **Dashboard**. (It should be the first screen that appears when you log in.)
4. In the **System Information** widget, click **Restore**.

A dialog should appear where you can select which configuration backup file to restore.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVMEV0000000000
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Mon Jun 13 02:34:33 2016 (FortiGuard)
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /3 in Total <a href="#">[Details]</a>
Uptime:	0 day(s) 0 hour(s) 17 min(s)

5. Click **Upload** to select which backup file to restore.



**Restore System Configuration**

Restore from **Local PC** USB Disk

File **Upload**

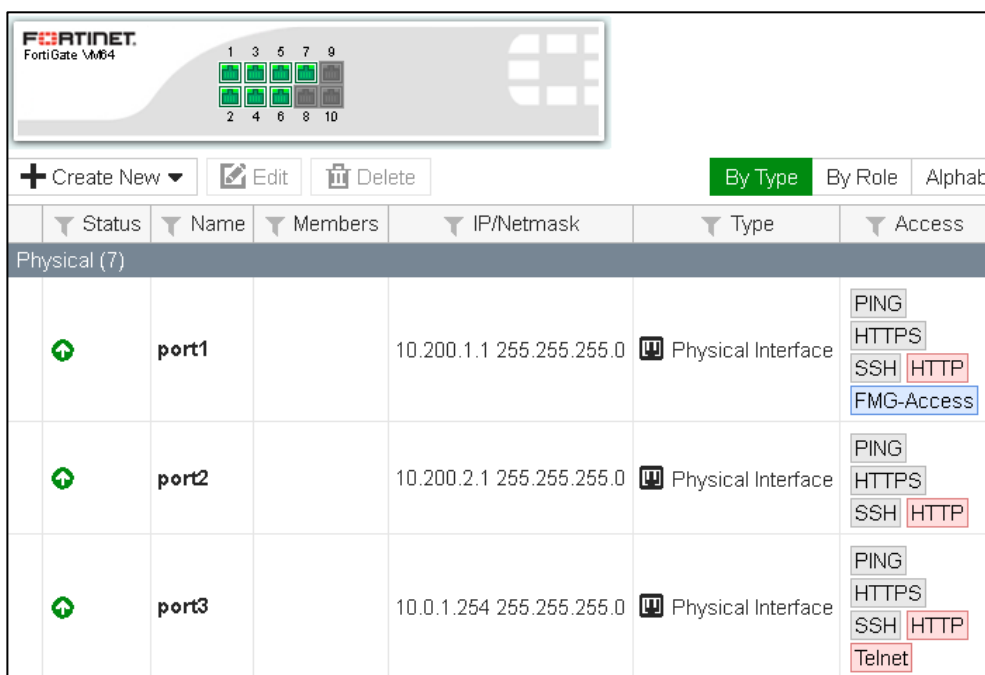
Password

**OK** Cancel

- On your desktop, select the file named **Resources\FortiGate-Introduction\local-initial.conf**, then click **OK**. Click **OK** again to confirm.

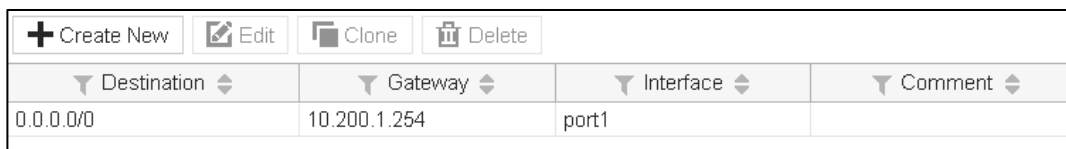
After your browser uploads the configuration, the FortiGate will automatically reboot.

- Refresh the web page and log in again to the Local-FortiGate GUI.
- Go to **Network > Interfaces** and verify that the network interface settings were restored.



Status	Name	Members	IP/Netmask	Type	Access
Physical (7)					
↑	port1		10.200.1.1 255.255.255.0	Physical Interface	PING HTTPS SSH HTTP FMG-Access
↑	port2		10.200.2.1 255.255.255.0	Physical Interface	PING HTTPS SSH HTTP
↑	port3		10.0.1.254 255.255.255.0	Physical Interface	PING HTTPS SSH HTTP Telnet

- Go to **Network > Static Routes**. Verify that the default route was restored.



Destination	Gateway	Interface	Comment
0.0.0.0/0	10.200.1.254	port1	

## Making Configuration Backups

You will create a file with the backup of the FortiGate's current configuration.

To make a configuration backup

- In the Local-FortiGate GUI, go to the **Dashboard**.



2. In the **System Information** widget, click **Backup**.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVMEV0000000000
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Mon Jun 13 02:34:33 2016 (FortiGuard)
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /3 in Total <a href="#">[Details]</a>
Uptime:	0 day(s) 0 hour(s) 17 min(s)

3. Enable **Encryption**.
4. Enter the password `fortinet` twice and click the **OK**.
5. Save the encrypted configuration file to the **Downloads** folder.



**Caution:** Always back up the configuration file before changing your device (even if the change seems minor or unimportant). There is no *undo*. Restoring a backup will allow you to quickly revert changes if you discover problems.

## Restoring an Encrypted Configuration Backup

In this procedure you will restore the configuration backup that you created in the previous procedure.

To restore an encrypted configuration backup

1. In the Local-FortiGate GUI, go to the **Dashboard**.
2. From the **System Information** widget, click **Restore**.
3. Click **Upload** and select the file that you downloaded in the previous procedure.
4. Click **OK**.

Notice that, this time, you must enter the password `fortinet`.

## Comparing Both Configuration Files

You will open both configuration files with Notepad++ and look at the differences.

To compare both configuration files.

1. Start Notepad++ by clicking its icon in the Windows task bar:



2. Open the file with the encrypted configuration backup.
3. Start another instance of Notepad++ and open the initial file you restored:

**Resources\FortiGate-1\Introduction\local-initial.conf**

4. Compare the details in both.



**Note:** In both the clear-text and encrypted configuration files, the top acts as a header, listing the firmware and model information that this configuration belongs to.

## 3 Administrative Accounts

FortiGate offers great flexibility for configuring administrator privileges. You can specify the IP addresses administrators are allowed to connect from. This lab includes some procedures related to working with administrative accounts.

### Creating an Administrator Profile

In this procedure, you will create a new administrator profile with read-only access to most of the configuration settings.

To configure an administrator profile

1. From the Local-FortiGate GUI, go to **System > Admin Profiles**.
2. Click **Create New** and create a new profile called **Security\_Admin\_Profile**.
3. Set **Security Profile Configuration** to **Read-Write**, but set all other permissions to **Read Only**.
4. Click **OK** to save the changes.

### Creating an Administrator Account

In this procedure, you will create a new administrator account. The account will be assigned to the administrator profile created in the previous procedure. This administrator will have only read-only access to most of the configuration settings.

To create an administrator account

1. In the Local-FortiGate GUI, go to **System > Administrators**.
2. Click **Create New** to add a new administrator account. Configure the following settings:

Field	Value
User Name	Security_Admin
Password	fortinet
Confirm Password	fortinet
Type	Local User
Administrator Profile	Security_Admin_Profile



**Note:** Administrator names and passwords are case sensitive. You cannot include characters such as < > ( ) # " in an administrator account name or password. Spaces are allowed, but not as the first or last character.

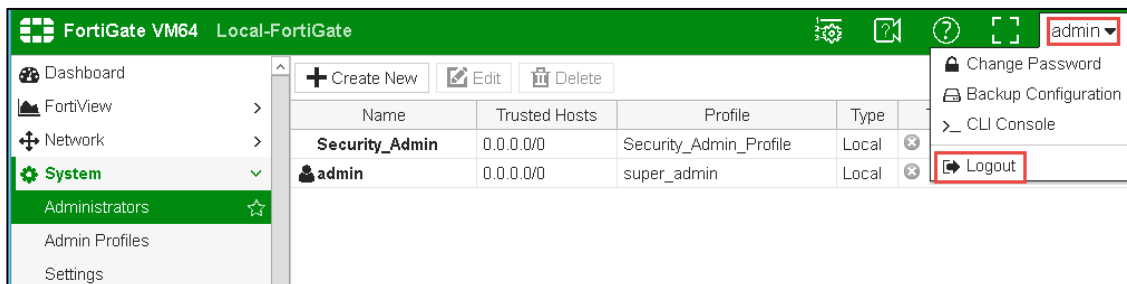
3. Click **OK** to save the changes.

## Testing 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

1. In the Local-FortiGate GUI, log out of the admin account's GUI session.



2. Log in as `Security_Admin` with the password `fortinet`.
3. Test this administrator's access: try to create or modify settings that are not allowed by the account's profile.

You should see that this account can only configure security profiles and monitor FortiGuard quotas (which are related to usage by security profiles).

## Restricting Administrator Access

In this procedure you will restrict access to FortiGate administration. Only administrators connecting from a trusted subnet will be able to access.

To restrict administrator access

1. In the Local-FortiGate GUI, log out of the `Security_Admin` account's GUI session.
2. Log in as `admin`.
3. Go to **System > Administrators**.
4. Edit the `admin` account.
5. Enable **Restrict login to trusted hosts** and set **Trusted Host 1** to the address `10.0.2.0/24`.
6. Click **OK** to save the changes.

## Testing the Restricted Access

In this procedure you will confirm that administrators outside the subnet `10.0.2.0/24` cannot access the FortiGate.

To test the restricted access

1. Log out of the admin account's GUI session.
2. Try to log in back using the `admin` account again. What is the result this time?

Because you are trying to connect from the 10.0.1.10 address, you shouldn't be able to connect. This is because you restricted logins to only the source IP addresses in the list of trusted hosts.

3. In the virtual lab portal, click the **Local-FortiGate** icon. (Alternatively, in the dropdown menu below its icon, go to **System > Open**.)



4. Enter the following CLI commands to add 10.0.1.0/24 as the second trusted IP subnet (**Trusted Host 2**) of the admin account:

```
conf sys admin
edit admin
set trusthost2 10.0.1.0/24
end
```

5. Try to access its GUI again. Access should be restored.

## LAB 2—Logging and Monitoring

In this lab, you will configure logging settings on the Local-FortiGate, configure alert email, and view logs.

### Objectives

- Configure logging on FortiGate so FortiGate understands how to log traffic.
- Configure threat weight.
- Monitor logs through alert emails.
- View logs in the Local-FortiGate GUI.

### Time to Complete

Estimated: 15 minutes

### Prerequisites

Before beginning this lab, you must restore a configuration file to FortiGate.

To restore the FortiGate configuration file

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM010000064692
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Tue Jul 19 05:59:20 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	3 day(s) 21 hour(s) 26 min(s)

3. Select to restore from **Local PC** and click **Upload**.

4. Browse to **Desktop > Resources > FortiGate-I > Logging** and select `local-logging.conf`.
5. Click **OK**.
6. Click **OK** to reboot.

## 1 Configuring Logging on FortiGate

In order to record network activity, you must configure logging on FortiGate. In this exercise, you will configure the logging settings, including threat weight, and then enable logging on a firewall policy.

### Configuring Log Settings

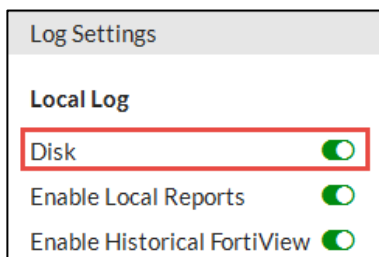
Configuring log settings does not directly generate logs on FortiGate. Rather, log settings define how logs are treated. For example, sending logs in real-time to FortiAnalyzer for storage, enabling local traffic logging, or enabling historical FortiView.

In this exercise, you will enable disk logging so that information can appear in the FortiView dashboards, enable Event logging, and set the GUI to display logs from disk.

#### To configure the log settings

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Log & Report > Log Settings**.
3. Under **Local Log**, ensure **Disk** is enabled.

If disk logging is disabled, only real-time logs will appear in the FortiView dashboards.



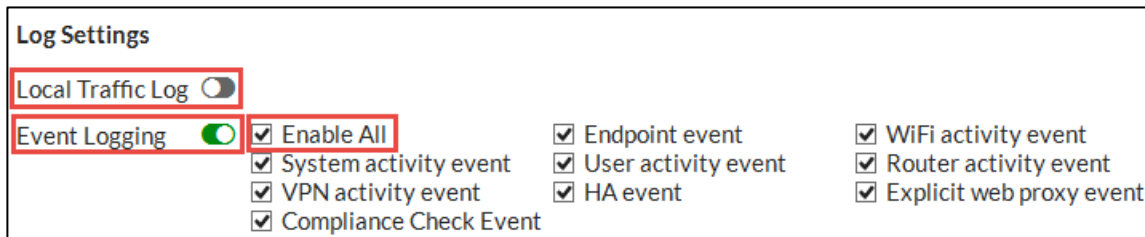
4. Under **Log Settings**, complete the following:

- Ensure **Local Traffic Log** is disabled.

These logs record traffic directly to and from FortiGate and can quickly fill up your disk if not properly managed and monitored. For the purposes of this lab, leave this setting disabled.

- Ensure **Event Logging** is enabled and **Enable All** selected.

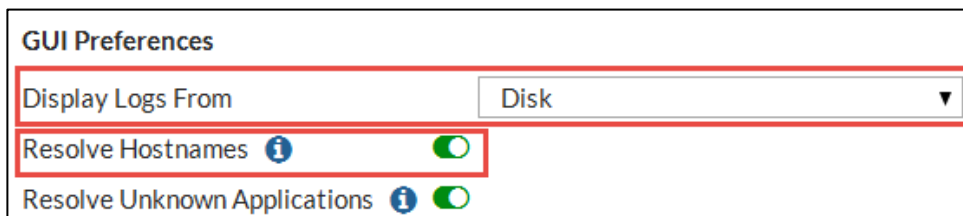
Event logs provide all of the system information generated by the FortiGate device (they are not caused by traffic passing through firewall policies). However, it is good practice to track and monitor events that occur on FortiGate.



5. Under **GUI Preferences**, complete the following:



- Ensure logs are set to display from **Disk**.
- Ensure **Resolve Hostnames** is enabled. This requires FortiGate to perform reverse DNS lookups for all the IPs and makes searching logs easier.



GUI Preferences

Display Logs From Disk

Resolve Hostnames 🔍 🟢

Resolve Unknown Applications 🔍 🟢

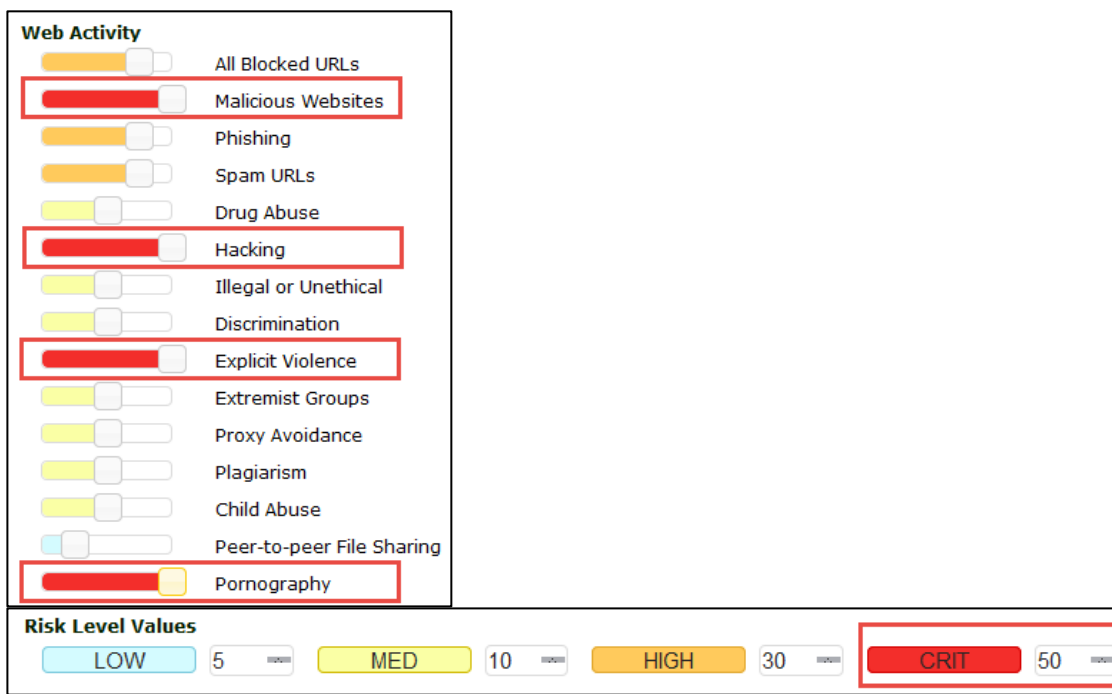
6. Click **Apply**.

## Configuring Threat Weight

Threat weight allows you to set the risk values for low, medium, high, and critical levels and then apply a threat weight to specific categories.

To configure threat weight

1. In the Local-FortiGate GUI, go to **Log & Report > Threat Weight**.
2. Under **Web Activity**, move the slider to the far right to indicate a Critical (50) risk level for the following categories:
  - **Malicious Websites**
  - **Hacking**
  - **Explicit Violence**
  - **Pornography**



Web Activity

All Blocked URLs 🔍 🟡

Malicious Websites 🔍 🔴

Phishing 🔍 🟡

Spam URLs 🔍 🟡

Drug Abuse 🔍 🟡

Hacking 🔍 🔴

Illegal or Unethical 🔍 🟡

Discrimination 🔍 🟡

Explicit Violence 🔍 🔴

Extremist Groups 🔍 🟡

Proxy Avoidance 🔍 🟡

Plagiarism 🔍 🟡

Child Abuse 🔍 🟡

Peer-to-peer File Sharing 🔍 🔵

Pornography 🔍 🔴

Risk Level Values

LOW 5 🟡 MED 10 🟡 HIGH 30 🔴 CRIT 50 🔴

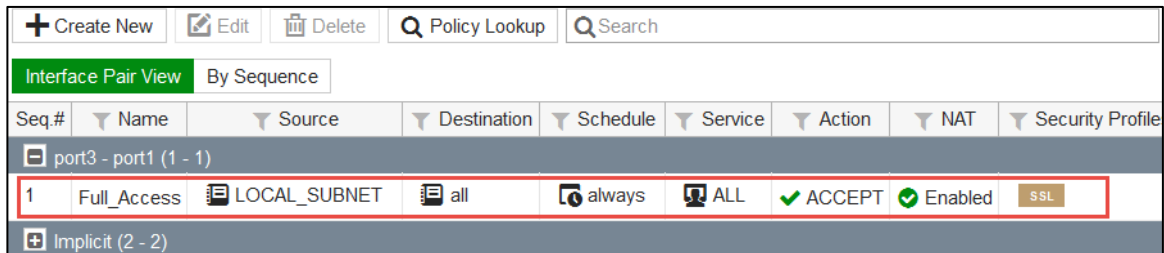
3. Click **Apply**.

## Enabling Logging on a Firewall Policy

Now that your log settings are configured, you must enable logging on your firewall policy. Only when enabled on a firewall policy can a log message generate (based on configured log settings).

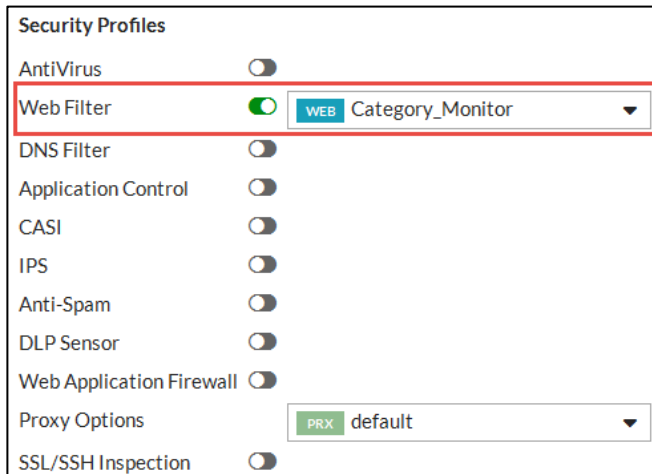
To enable logging on a firewall policy

1. In Local-FortiGate, go to **Policy & Objects > IPv4 Policy** and edit the **Full\_Access** firewall policy.



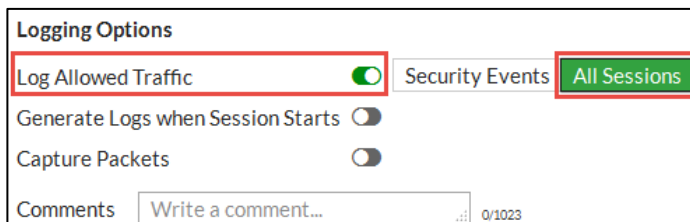
2. Under **Security Profiles**, enable **Web Filter** and select **Category\_Monitor** from the associated drop-down list.

The **Category\_Monitor** web filter was pre-configured for you and is set to block the following categories: Potentially Liable, Adult/Mature Contents, and Security Risk.



3. Under **Logging Options**, enable **Log Allowed Traffic** and select **All Sessions**.

Remember, you will not get logs of any kind if **Log Allowed Traffic** is not enabled.



4. Click **OK**.

You've successfully enabled logging on your firewall policy. Later in this lab, you will test these logging settings.

## 2 Monitoring Logs Through Alert Email

In this exercise, you will configure alert emails, run some traffic through the Local-FortiGate, and view alert emails.

### Configuring Alert Emails

Since you can't always be physically at the FortiGate device, you can monitor events by setting up alert email. Alert emails provide an efficient and direct method of notifying an administrator of events.



**Note:** An SMTP mail server is required for alert email to operate. Since configuring a mail server is out of scope for this lab, it has been pre-configured for you. You can view the email service configuration through the FortiGate GUI under **System > Advanced**.

#### To configure email alerts

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Log & Report > Alert E-mail**.
3. Complete the following:

Field	Value
Email from	FortiGate@training.lab
Email to	admin@training.lab

4. Enable **Send alert email for the following** and complete the following:

- Enter an interval time of 1 minute
- Select **Web access blocked**
- Select **Violation traffic detected**

☒ Send alert email for the following

Interval Time:  (1 - 99999 Min)

☐ Intrusion detected

☐ Virus detected

☒ Web access blocked

☐ HA status changes

☒ Violation traffic detected

☐ Firewall authentication failure

☐ SSL-VPN login failure

☐ Administrator login/logout

☐ IPsec tunnel errors

☐ L2TP/PPTP/PPPoE errors

☐ Configuration changes

☐ FortiGuard license expiry time:  (1 - 100 days)

☐ Disk usage:  (1 - 99)%

☐ Send alert email for logs based on severity

Minimum log level:

5. Click **Apply**.

## Running Traffic Through Local-FortiGate

In order to generate multiple URL requests quickly so FortiGate can generate many different types of logs, you will use the `wget` application to perform a spider crawl. A spider crawl ensures no content is downloaded: only the URL is requested. This is enough to trigger content inspection.



**Note:** `wget` is a free, open source utility for accessing websites. You can use it to quickly test your web filter settings in order to make sure you do not have any block messages with critical websites within your infrastructure.

The pre-configured Web Filter security policy (Category\_Monitor) that you enabled on your firewall policy is set to block many of the URLs you will request. Since you also enabled logging on all sessions in the firewall policy, FortiGate will generate web filter logs.

### To run traffic through Local-FortiGate

1. From the Local-Windows VM desktop, open a Windows command prompt and type the following command:

```
blacklist-urls
```

2. Minimize the command prompt window so the command continues to execute and continue to the next procedure.

## Viewing Alert Emails

Now that traffic is being sent through your FortiGate, you can check the [admin@training.lab](mailto:admin@training.lab) email to see if any alerts have been generated based on that traffic. You configured the alert email to generate an alert every 1 minute any time Web access is blocked and any time a violation in traffic is detected.

The log message that accompanies an alert provides more details about the traffic that caused the alert.

### To view your alert emails

1. From the Local-Windows VM desktop, open Mozilla Thunderbird.



2. Select the inbox of the [admin@training.lab](mailto:admin@training.lab) email account and click **Get Messages**.

You should see a message in the admin inbox with a subject of "Message meets Alert condition". If no email appears in the inbox, wait 30 seconds and click **Get Messages** again.

3. Open the email and review the log message.

As you can see in the example below (you may receive a different log email), the log message header provides the `type` (utm) and `subtype` (webfilter) and the log message body provides information about the Web Filter security profile that was applied to the traffic (Category\_Monitor), the action it took (blocked), and the category description of the traffic (Gambling).

```
Message meets Alert condition
date=2016-06-30 time=08:10:30 devname=Local-FortiGate devid=FGVM010000051131 logid=0316013056 type=utm subtype=webfilter
eventtype=ftgd_blk level=warning vd=root policyid=1 sessionid=439 user="" srcip=10.0.1.10 srcport=57755 srcintf="port3"
dstip=84.20.200.86 dstport=80 dstintf="port1" proto=6 service="HTTP" hostname="bluesq.com" profile="Category_Monitor"
action=blocked reqtype=direct url="/bet" sentbyte=138 rcvbyte=0 direction=outgoing msg="URL belongs to a denied category in
policy" method=domain cat=11 catdesc="Gambling" crscore=30 crlevel=high
```

Search for this information in any of the subsequent logs messages that appear in your inbox so you can better identify and understand your logs.



**Note:** To review more logs, click **Get Messages** in your admin inbox again. You configured your alert email to send messages that meet the alert condition every 1 minute.

4. Close the Thunderbird email client when you are done.



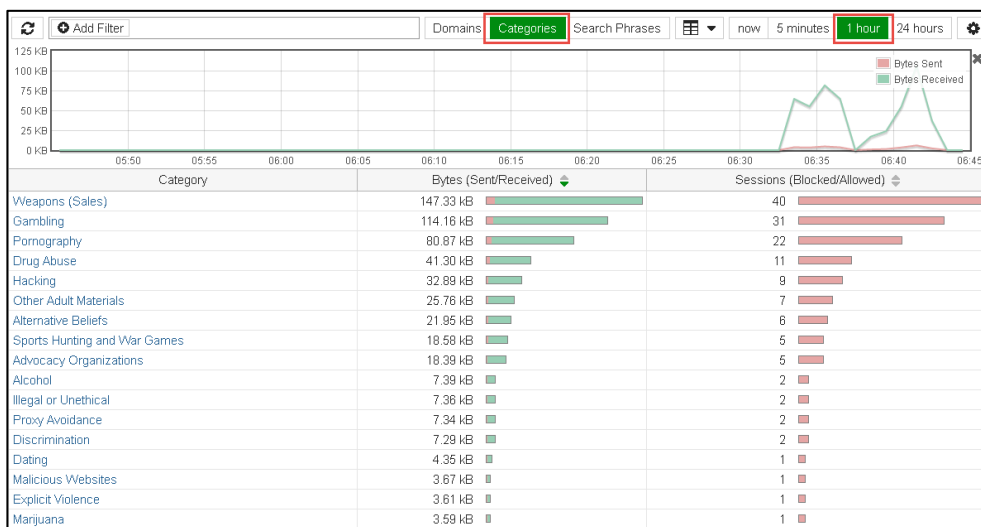
- Select **Action** and **Blocked** to see all blocked traffic.
  - Select **Category Description** and select a category. For example: *Hacking*.
6. Continue to the next procedure.

## To view logs from FortiView

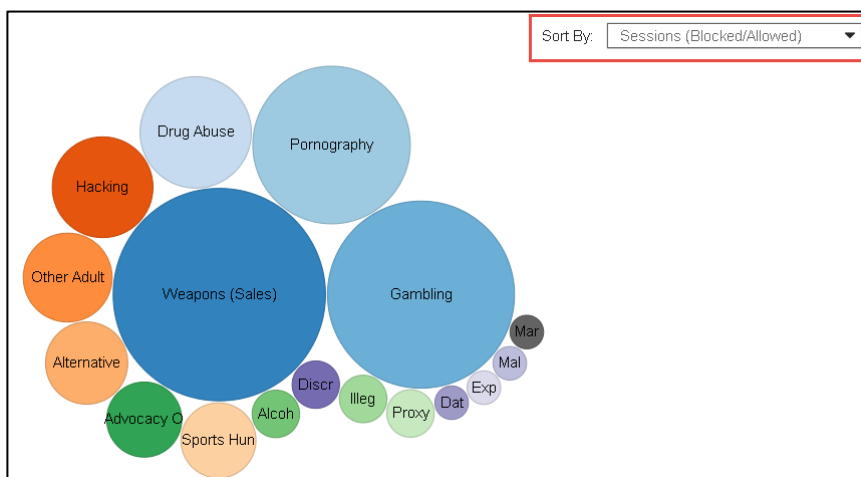
1. In the Local-FortiGate GUI, go to **FortiView > Web Sites**.

By default, the search settings are set to display logs being created **now**. If wget has stopped running and no more logs are being created currently, the page will be blank. This is expected.

2. Use the search settings to display the Web activity in a different way. For example:
  - Select **Categories** and **1 hour** to see the most accessed Web categories in the last hour.



- Click the table icon ( ) and select **Bubble Chart**.
- Use the **Sort By** drop-down list to display the information by **Threat Score**, **Sessions**, or **Bytes**.



3. Close the Windows command prompt to stop running traffic through Local-FortiGate.

## LAB 3–Firewall Policies

### Objectives

- Configure firewall objects and firewall policies.
- Configure source match options available firewall policies.
- Apply firewall service and schedule to firewall policy.
- Configure firewall policy logging options.
- Configure firewall policies based on device types.
- Reorder firewall policies.
- Read and understand logs.
- Use policy lookup to find matching policy.

### Time to Complete

Estimated: 35 minutes

### Prerequisites

Before beginning this lab, you must restore a configuration file to the Local-FortiGate.

To restore the Local-FortiGate configuration file

1. On the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.



System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM010000064692
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Tue Jul 19 05:59:20 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	3 day(s) 21 hour(s) 26 min(s)

3. Select to restore from **Local PC** and click **Upload**.
4. Browse to **Desktop > Resources > FortiGate-I > Firewall-Policies** and select `local-firewall-policy.conf`.
5. Click **OK**.
6. Click **OK** to reboot.

## 1 Creating Firewall Address Objects and Firewall Policies

In this exercise, you will configure firewall address objects. You will also configure IPv4 firewall policy to which you will apply firewall address objects along with schedule, services and log options. Then you will test the firewall policy by passing traffic through it and check the logs for your traffic.

At its core, FortiGate is a firewall, so almost everything that it does to your traffic is linked into your firewall policies.

### Creating Firewall Address Objects

FortiGate has many pre-configured well known address object in factory default configuration. However if they don't meet your organization needs you can configure more.

To create a firewall address object

1. From the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Policy & Objects > Addresses**.
3. Go to **Create New > Address**.
4. Configure the following settings:

Field	Value
Name	LOCAL_SUBNET
Type	IP/Netmask
Subnet / IP Range	10.0.1.0/24
Interface	any

5. Click **OK**.

### Creating a Firewall Policy

First, you will disable the existing firewall policy. Then, you will create more specific firewall policy using the firewall address object that you created in the previous procedure. You will also select specific services and configure log settings.

To disable an existing firewall policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right-click on the **Seq.#** column for **Full\_Access** firewall policy.
3. Select **Status** and click **Disable**.

To create a firewall policy

1. From the **Policy & Objects > IPv4 Policy** section, click **Create New** to add a new firewall policy.

## 2. Configure these settings:

Field	Value
Name	Internet_Access
Incoming Interface	port3
Outgoing Interface	port1
Source	LOCAL_SUBNET
Destination Address	all
Schedule	always
Service	HTTP, HTTPS, DNS, ALL_ICMP, SSH (Tip: Type the name in the search box on right hand side and click on services to add.)
Action	ACCEPT
NAT	Enable
Log Allowed Traffic	Enable and select <b>All Sessions</b>
Generate Logs when Session Starts	Enable
Enable this policy	Enable

## 3. Leave all other settings at their default and click **OK** to save the changes.



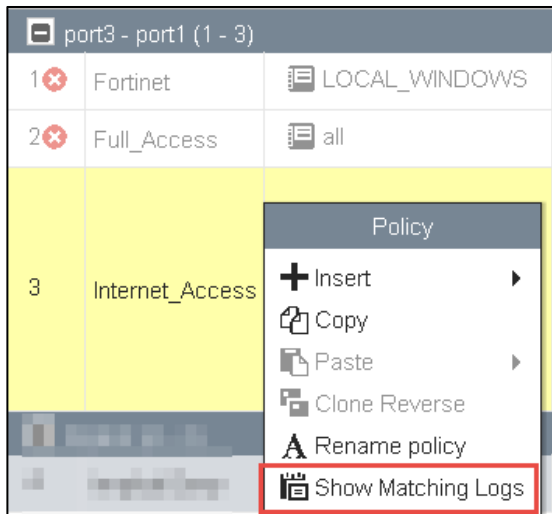
**Note:** When creating firewall policies, remember that FortiGate is a stateful firewall. As a result, you only need to create one firewall policy that matches the direction of the traffic that initiates the session.

## Testing the Firewall Policy and Viewing Generated Logs

Now you have configured the firewall policy, you will test it by passing traffic through it and viewing the generated logs.

### To test and view logs for a firewall policy

1. From the Local-Windows VM, open a web browser and connect to various external web sites such as [www.fortinet.com](http://www.fortinet.com), [www.bbc.com](http://www.bbc.com).
2. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
3. Right-click on the **Seq.#** column of the **Internet\_Access** policy.
4. Click **Show Matching Logs**.



5. Identify the log entries for your Internet browsing traffic.

With the current settings, you should have many log messages with **Accept: session start** in **Result** column. These are the session start logs.

When sessions close, you will have a separate log entry for the amount of data sent and received.

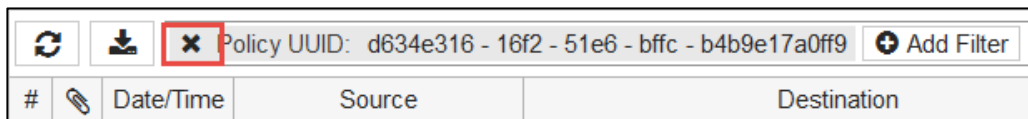


**Note:** Logging session starts will generate twice the amount of log messages. You should use this option only when this level of detail is absolutely necessary.



**Note:** When you click **Show Matching Logs** in the firewall policy, it adds Policy UUID filter in forward traffic logs.

6. In the Forward Traffic logs, click **X** to remove the **Policy UUID** filter.



When you remove the Policy UUID filter, the logs shows unfiltered. We will use the logs in upcoming labs.

7. Close all other browser tabs except Local-FortiGate GUI.

## 2 Reordering Firewall Policies and Firewall Policy Actions

In the applicable interface pair's section, FortiGate will look for a matching policy, beginning at the top. So 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.

In this exercise, 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 behavior of firewall policy reordering.

### Creating a Firewall Policy

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



**Note:** The firewall address LINUX\_ETH1 with IP/Netmask 10.200.1.254/32 is preconfigured for you, and you will be using this address when you create the firewall policy.

#### To create a firewall policy

1. On the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Policy & Objects > IPv4 Policy** and click **Create New**.
3. Configure these settings:

Field	Value
Name	Block_Ping
Incoming Interface	port3
Outgoing Interface	port1
Source	LOCAL_SUBNET
Destination Address	LINUX_ETH1
Schedule	always
Service	PING (Tip: Type the name in the search box on right hand side and click on services to add.)
Action	DENY
Log Violation Traffic	Enable
Enable this policy	Enable

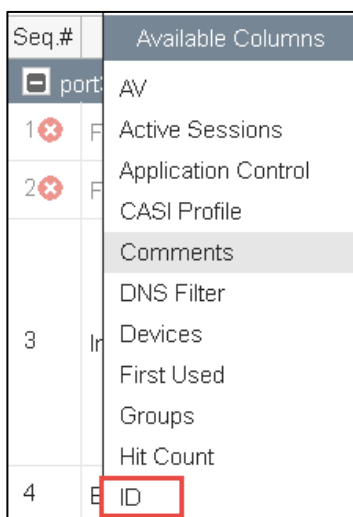
4. Click **OK** to save the changes.

## Adding Policy ID Column

The policy sequence number defines the order in which firewall policies match the traffic from top to bottom. CLI commands use the policy ID instead of the policy sequence number. When policies are moved, the policy sequence number changes accordingly, but the value that sticks with the firewall policy is the policy ID.

To add a policy ID Column

1. In to **Policy & Objects > IPv4 Policy** section, right-click on any of the column headings and select **ID** from **Available Columns**.



2. Scroll to the bottom and click **Apply** to save the changes.
3. You can drag the **ID** column to where you want it positioned in the column list.

## Testing the Reordering of a Firewall Policy

Now that your configuration is ready, you will test by moving the **Block\_Ping** firewall policy above **Internet\_Access** firewall policy. The objective to confirm that after reordering the firewall policy, traffic is matched to a more specific firewall policy, the policy ID remains same, and sequence number changes.

To confirm traffic matches to a more granular firewall policy after reordering the firewall policy

1. From the Local-Windows VM, open a command prompt.
2. Ping the destination address (LINUX\_ETH1) that you configured in the **Block\_Ping** firewall policy.

```
ping -t 10.200.1.254
```

If you have not changed the rule ordering, the ping should still work because it matches the **ACCEPT** policy and not the **DENY** policy that you created. This demonstrates the behavior of policy ordering. The **Block\_Ping** policy was never checked, because the traffic matched the policy at the top (**Internet\_Access**).

3. Leave this window open and perform the next step.

4. In the **Policy & Objects > IPv4 Policy** section, notice the current **Seq.#** number and **ID** (policy ID) for both of these firewall policies.
5. Click the **Seq.#** for the **Block\_Ping** firewall policy.
6. Drag it above the **Internet\_Access** firewall policy.

When you move up the **Block\_Ping** policy, the **Seq.#** number changes, but **ID** (policy ID) remains the same.

7. Return to the Local-Windows VM and look at the command prompt window that is still running the continuous ping.

You should see that the traffic is now blocked and the replies appear as `Request timed out`.

This demonstrates the outcome of the policy reordering. After moving the more granular policy above the general access policy, the traffic is matched to the more granular policy and, based on the action DENY, the traffic stops processing.

8. Close the command prompt window.

## 3 Device Identification

FortiGate can match the traffic by device type by selecting the device in the source field. There are two types of device identification:

- Agentless device identification uses traffic from the device and devices indexed by their MAC address.
- Agent-based device identification uses FortiClient which send its unique FortiClient ID to FortiGate.

In this lab, you will use the agentless device identification technique. You will add the device in the source field to the existing firewall policy and observe the firewall policy source matching behavior.

### Disabling Existing Firewall Policy

First, you will disable the **Block\_Ping** firewall policy and your traffic will match to the **Internet\_Access** firewall policy.

#### To disable existing firewall policy

1. On the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Policy & Objects > IPv4 Policy**.
3. Right-click on the **Seq.#** column for **Block\_Ping** firewall policy.
4. Select **Status** and click on **Disable**.

### Configuring and Testing Device Identification

Now, you will run a continuous ping to an IP address. To test the firewall policy source matching behavior, you will add a non-matching device, such as Linux PC, to the source field.

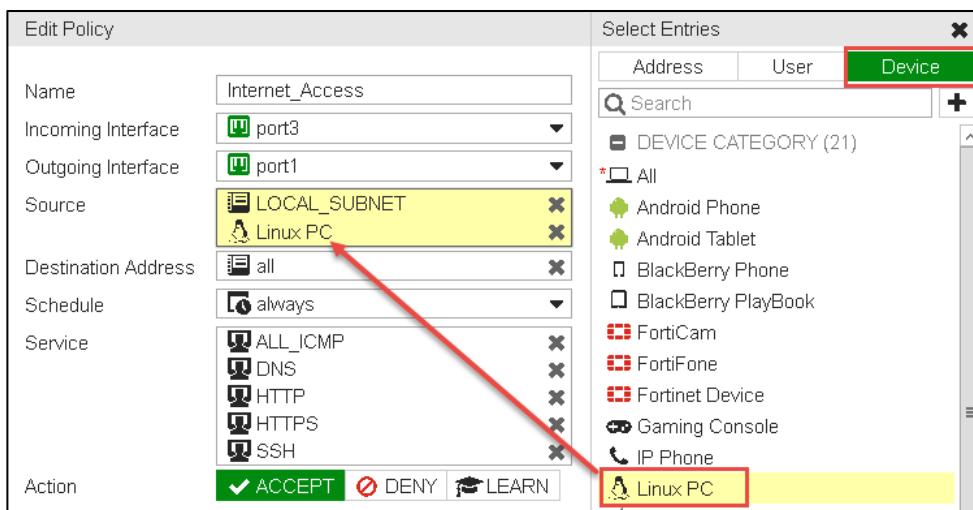
#### To configure and test device identification

1. On the Local-Windows VM, open a command prompt.
2. Run a continuous ping to `10.200.1.254`. Enter:  

```
ping -t 10.200.1.254
```
3. In the **Policy & Objects > IPv4 Policy** on the Local-FortiGate GUI, right click the **Seq.#** column for **Internet\_Access** firewall policy.
4. Click **Edit**.
5. Select **Source**.
6. On the right hand side, select **Device**.
7. Click **Linux PC**.

You are choosing a device type that doesn't match your device (Windows).





8. Click **OK**.

FortiGate will notify you that this action enables device identification on the source interface.

9. Click **OK**.



**Note:** If you enable a source device type in the firewall policy, FortiGate enables device detection on the source interface(s) of the policy,

10. Return to the command prompt on the Local-Windows VM, where you were running continuous ping.

You should see that traffic is blocked.

11. On the Local-Windows VM, try browsing the Internet by opening web browsers and connecting to various external web sites such as [www.fortinet.com](http://www.fortinet.com), [www.bbc.com](http://www.bbc.com).

Confirm the firewall blocks this traffic.

The traffic is blocked because the source device type in the firewall policy is set to Linux-PC, which does not match the Windows device from which the traffic is generated.

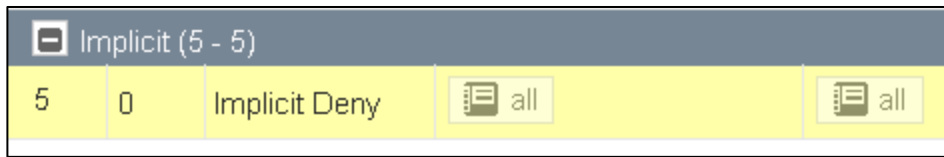
## Modify the Implicit Deny Firewall Policy

FortiGate checks from top to bottom to find a firewall policy that matches the traffic. If none of the firewall policies match the traffic, the default implicit deny firewall policy drops the traffic.

To confirm that the traffic is dropped by the implicit deny policy, you will enable logging on the implicit firewall policy and then check the logs.

### To enable logging on the implicit deny firewall policy

1. In Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right click the **Seq.#** column for the **Implicit Deny** firewall policy.



3. Click **Edit**.
4. Enable **Log Violation Traffic**.
5. Click **OK**.

To confirm traffic is dropped by the implicit deny firewall policy

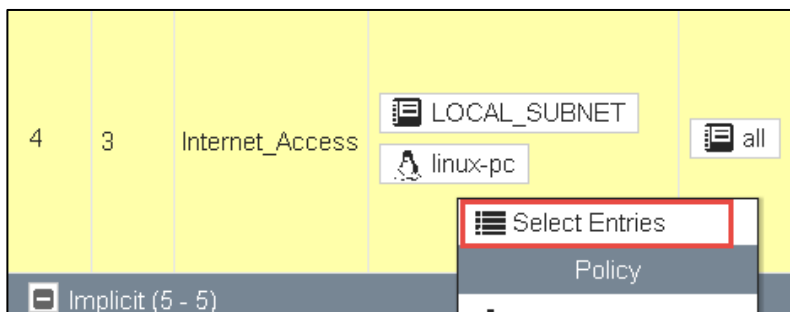
1. In Local-FortiGate GUI, go to **Log & Report > Forward Traffic**.
2. Confirm there are logging entries for the denied ping traffic.

## Reconfiguring Device Identification

Now you will edit the Internet\_Access firewall policy and add a Windows PC to match your Local-Windows VM. You will see that the traffic will be allowed by this policy after you add a matching source device.

To reconfiguring device identification

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right click on the **Source** column for the **Internet\_Access** firewall policy.
3. Click **Select Entries**.



4. Click **Device**.
5. Click **Windows PC** to select it.
6. Click **Linux PC** to unselect it.
7. Click **OK**.

To confirm traffic is allowed by a firewall policy

1. On the Local-Windows VM, return to the continuous ping that you started previously. You should see that traffic is allowed.
2. Close the command prompt window.
3. On the Local-Windows VM, try browsing the Internet by opening web browsers and connecting to various external web sites such as [www.yahoo.com](http://www.yahoo.com), [www.google.com](http://www.google.com).

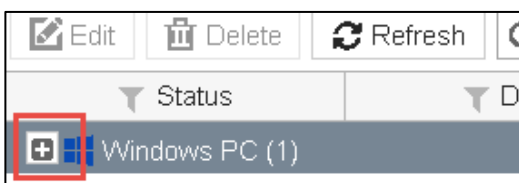
Confirm that the firewall allows this traffic.

## Viewing the Details of an Identified Device

Once a device is identified, FortiGate updates its list of devices and caches the list to the flash disk to speed up detection. You can view the details of an identified device. These details include device type, detection method, and IP address to name a few.

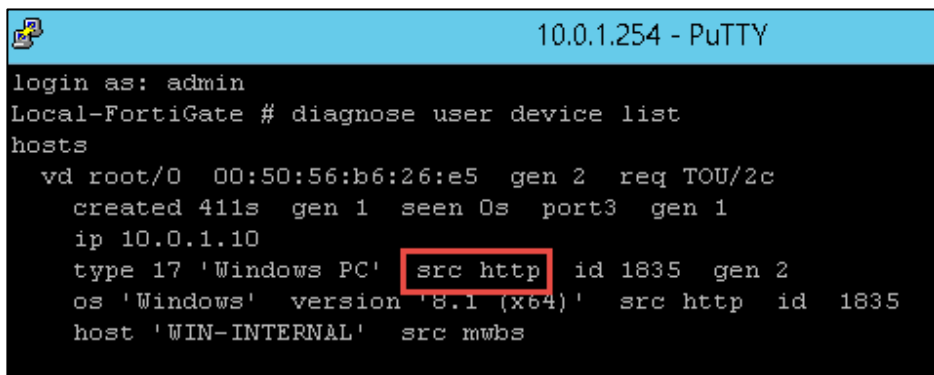
To view the details of identified device

1. In the Local-FortiGate GUI, go to **User & Device > Device Inventory**.
2. Click the **+** sign to expand the list.



3. Review the details of your detected host device.  
You can see device details, such as IP address, interface, status, and more.
4. In the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
5. Log in as `admin` and execute the following command to view detection method and other device details:

```
diagnose user device list
```



## Adding an Identified Device to the Configuration File

The identified device is cached on the FortiGate and is not added to the configuration file. You will be adding the identified device to the configuration file by adding an alias to the device.

To add an identified device to the configuration file

1. In a LOCAL-FORTIGATE PuTTY session, run the following command to confirm that there are no devices in the configuration file:

```
show user device
```

2. In the Local-FortiGate GUI, go to **User & Device > Device Inventory**.
3. Click on your device.
4. Click **Edit**.
5. Configure the following:

Field	Value
Alias	MyDevice

This creates a static device in the configuration file.

6. Click **OK**.
7. In the LOCAL-FORTIGATE PuTTY session, run the following command to confirm that the device now appears in the configuration file as a permanent device:

```
show user device
```

8. In the Local-FortiGate GUI, go to **User & Device > Custom Devices & Groups**.

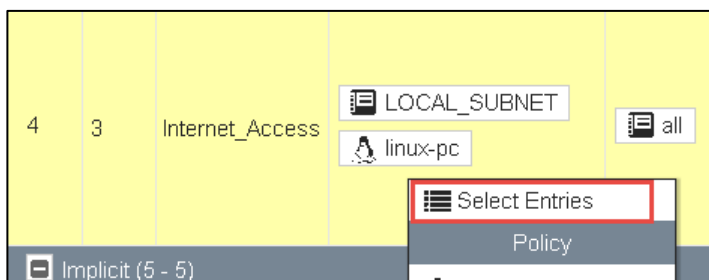
Note that your device is listed under **Custom Devices**.

## Adding a Custom Device to the Firewall Policy

Now that you've added your device as a custom device, you'll add it to the firewall policy.

To add a custom device to the firewall policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right click the **Source** column for **Internet\_Access** firewall policy.
3. Click **Select Entries**.



4. Click **Device** on the right hand side.
5. Click **Windows PC** to unselect it.
6. Under **CUSTOM DEVICE**, click **MyDevice** to select it.
7. Click **OK**.

To confirm traffic is allowed by the firewall policy

1. On the Local-Windows VM, try browsing the Internet by opening web browsers and connecting to various external web sites such as [www.yahoo.com](http://www.yahoo.com), [www.google.com](http://www.google.com).

Confirm that the firewall allows this traffic.

## 4 Policy Lookup

FortiGate can find a matching firewall policy based on the policy lookup input criteria. It is basically creating packet flow over FortiGate without real traffic. From this packet flow, the FortiGate can extract a policy ID and highlight it on the GUI policy configuration page.

In this lab, you will use the policy lookup feature to find matching firewall policy based on input criteria.

### Enabling Existing Firewall Policies

As they were during the configuration and testing the of the firewall policies in the previous labs, most of the configured firewall policies are currently disabled. Now, you will enable the existing firewall policies.

To enable existing firewall policies

1. From the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Policy & Objects > IPv4 Policy**.
3. Right-click on the **Seq.#** column for the **Fortinet** firewall policy.
4. Select **Status** and click **Enable**.
5. Right-click the **Seq.#** column for the **Full\_Access** firewall policy.
6. Select **Status** and click **Enable**.

### Setting Up and Testing Policy Lookup Criteria

Now, you will set up the policy lookup criteria. FortiGate will search and highlight the matching firewall policy based on your input criteria.

To set up and test policy lookup criteria

1. In the **Policy & Objects > IPv4 Policy**, click **Policy Lookup**.
2. Set the following:

Field	Value
Source Interface	port3
Protocol	TCP
Source	10.0.1.100
Source Port	Leave it blank
Destination	fortinet.com
Destination Port	443

3. Click **Search**.

The search will match the **Full\_Access** policy, but not the more specific firewall policy, **Fortinet**.

In the search criteria, the source address is set to 10.0.1.100. This source address is not a part of firewall policy named **Fortinet**; therefore, the search does not match the **Fortinet** firewall policy.



**Note:** When the FortiGate is performing policy lookup, it does a series of checks on ingress, stateful inspection, and egress for the matching firewall policy. It performs the checks from *top to bottom*, before providing results for the matching policy.

4. Click **Policy Lookup** and change the **Source** to 10.0.1.10.

Make sure all the other settings match the settings you used in step 2.

5. Click **Search**.

This time the search matches policy named **Fortinet**, in which destination is set to FQDN.

## Reordering the Firewall Policy

Now you will reorder the firewall policies. You will be moving the **Block\_Ping** firewall policy above the **Full\_Access** policy.

To reorder the firewall policy

1. In **Policy & Objects > IPv4 Policy**, click the **Seq.#** column for the **Block\_Ping** firewall policy.
2. Drag it above the **Full\_Access** firewall policy.
3. The order of your firewall policies should look similar to this:

+ Create New Edit Delete Policy Lookup Search					
Interface Pair View By Sequence					
Seq.#	ID	Name	Source	Destination	Schedule
port3 - port1 (1 - 4)					
1	1	Fortinet	LOCAL_WINDOWS	FORTINET	always
2	4	Block_Ping	LOCAL_SUBNET	LINUX_ETH1	always
3	2	Full_Access	all	all	always
4	3	Internet_Access	LOCAL_SUBNET MyDevice	all	always

## Retesting Policy Lookup After Reordering the Firewall Policies

Now you will test the policy lookup feature after reordering the firewall policies.

To retest policy lookup after reordering firewall policies

1. In **Policy & Objects > IPv4 Policy**, click **Policy Lookup**.
2. Set the following for Policy Lookup:

Field	Value
Source Interface	port3
Protocol	ICMP
ICMP Type	8
ICMP Code	0
Source	10.0.1.100
Destination	10.200.1.254

3. Click **Search**.  
The search will match the **Full\_Access** policy, but not the more specific policy **Block\_Ping**, because it is disabled.
4. Right click the **Seq.#** column of the **Block\_Ping** policy and set the **Status** to **Enable**.
5. Click **Search**.  
This time the search matches more specific and enabled policy, **Block\_Ping**.

# LAB 4–Network Address Translation (NAT)

NAT is used to perform source NAT and destination NAT for the traffic passing through FortiGate. There are two ways to configure source NAT (SNAT) and destination NAT (DNAT).

- firewall policy NAT
- central NAT

In this lab, you will configure and test firewall policy NAT for SNAT using IP pool, and for DNAT using virtual IP (VIP).

You will also enable central NAT. You will configure and test SNAT using central SNAT policy and DNAT using DNAT policy and VIPs.

## Objectives

- Configure destination NAT settings using a VIP.
- Configure the source NAT settings using overload IP pools.
- Enable central NAT.
- Configure a central NAT policy for the source NAT.
- Configure DNAT and VIPs for the destination NAT .

## Time to Complete

Estimated: 50 minutes

## Prerequisites

Before starting the procedures in this lab, you must restore a configuration file to each FortiGate.

**Note:** Make sure to restore the correct configuration in each FortiGate as following the steps below. Failure to restore proper configuration in each FortiGate will prevent you from doing the lab exercise.

### To restore the Remote-FortiGate configuration file

1. On the Local-Windows VM, open a web browser and log in as `admin` to the Remote-FortiGate GUI at `10.200.3.1`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.



System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Remote-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM010000065036
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Tue Jul 19 13:30:44 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	5 day(s) 2 hour(s) 40 min(s)

3. Select to restore from **Local PC** and click **Upload**.
4. Browse to **Desktop > Resources > FortiGate-I > NAT** and select `remote-nat.conf`.
5. Click **OK**.
6. Click **OK** to reboot.

### To restore the Local-FortiGate configuration file

1. On the Local-Windows VM, open a new web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM010000064692
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Tue Jul 19 05:59:20 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	3 day(s) 21 hour(s) 26 min(s)

3. Select to restore from **Local PC** and click **Upload**.
4. Browse to **Desktop > Resources > FortiGate-I > NAT** and select `local-nat.conf`.
5. Click **OK**.
6. Click **OK** to reboot.

## 1 Access Through VIPs

VIP addresses are typically used to NAT external or public IP addresses to internal or private IP addresses.

In this exercise, you will configure a VIP address for the Local-Windows VM. Then you will create an egress-to-ingress firewall policy and apply a VIP address. This will allow Internet connections to the Local-Windows VM. You will also verify the destination NAT and source NAT behavior using CLI commands.

### Creating a VIP

In FortiGate, a VIP is a destination NAT (DNAT) and can only be selected in a firewall policy's destination address field.

In this procedure, you will configure the VIP to map the Local-Windows VM (10.0.1.10) to 10.200.1.200, which is a part of the port1 subnet. You can refer to the diagram for the lab network topology.

#### To create a VIP

1. From the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at 10.0.1.254.
2. Go to **Policy & Objects > Virtual IPs**.
3. Click **Create New** and select **Virtual IP**.
4. Configure the following:

Field	Value
Name	VIP-INTERNAL-HOST
Interface	port1 (port1 is connected to the Internet with IP address 10.200.1.1/24.)
External IP Address/Range	10.200.1.200 - 10.200.1.200 (This is the IP address in the same range as the port1 subnet.)
Mapped IP Address/Range	10.0.1.10

5. Click **OK**.

### Creating a Firewall Policy

You will configure a firewall policy using the VIP that you just created as the destination address.

#### To create a firewall policy

1. In Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Click **Create New**.

### 3. Configure these settings:

Field	Value
Name	Web-Server-Access
Incoming Interface	port1
Outgoing Interface	port3
Source	all
Destination Address	VIP-INTERNAL-HOST <b>Tip:</b> Listed under the Virtual IP section
Schedule	always
Service	HTTP, HTTPS <b>Tip:</b> Use the search field to locate the services.
Action	ACCEPT

4. Under **Firewall/Network Options**, disable **NAT**.
5. Under **Logging Options**, enable **Local Allowed Traffic** and select **All Sessions**.
6. Click **OK**.

## Testing the VIP Firewall Policy

Now that you've configured a firewall policy with the VIP address as the destination, you can test your VIP by accessing it from the Remote-Windows VM, which is behind Remote-FortiGate. Traffic is routed from the Remote-FortiGate to the Local-FortiGate by a Linux machine, which is acting as a router between these two FortiGates. For more information, see the network topology diagram.

You will also test how the source address is NATed by the VIP when traffic is leaving from the Local-Windows VM.

### To test VIPs (DNAT)

1. From the Remote-Windows VM, open a web browser and access the following URL:  
<http://10.200.1.200>  
If the VIP operation is successful, a simple web page appears.
2. Go back to the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
3. Log in as `admin` and execute the following command to check the destination NAT entries in the session table:

```
get system session list
```

Sample output:

```
Local-FortiGate# get system session list
```

```
PROTO  EXPIRE      SOURCE      SOURCE-NAT  DESTINATION  DESTINATION-  
NAT
```

```
tcp    3594    10.200.3.1:49478    -    10.200.1.200:80    10.0.1.10:80
```

You will notice that the destination address 10.200.1.200 is translated to 10.0.1.10, which is the mapping you configured in the VIP.

## Testing Source NAT

As a result of the VIP (which is a static NAT), all NATed outgoing connections from the Local-Windows VM (IP address 10.0.1.10) will use the VIP address to source NAT for the ingress-to-egress firewall policy and *not* the egress interface IP address.

### To test SNAT

1. Return to the PuTTY session the for the Local-FortiGate and execute the following command to clear any existing sessions:

```
diagnose sys session clear
```



**Note:** The firewall is stateful, so any existing sessions will not use this new firewall policy until they time out or are cleared for ingress-to-egress traffic.

This clears the session to the Local-FortiGate from the Local-Windows VM.

2. Close the PuTTY window.
3. In the Local-Windows VM, open a web browser tab and connect to a few websites. For example:
  - [www.fortinet.com](http://www.fortinet.com)
  - [www.yahoo.com](http://www.yahoo.com)
  - [www.bbc.com](http://www.bbc.com)
4. Go back to the Local-Windows VM, open a PuTTY window, and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
5. Log in as `admin` and execute the following command to view the session information:

```
get system session list
```

Sample output:

PROTO	EXPIRE	SOURCE	SOURCE-NAT	DESTINATION	DESTINATION-NAT
T					
udp	113	10.200.1.1:22696	-	121.111.236.179:8888	-
udp	113	10.200.1.1:22696	-	121.111.236.180:8888	-
udp	113	10.200.1.1:22696	-	69.195.205.101:8888	-
udp	113	10.200.1.1:22696	-	69.195.205.102:8888	-
udp	113	10.0.1.254:22696	-	10.0.1.241:8888	-
tcp	3583	10.0.1.10:54240	10.200.1.200:54240	31.13.92.36:443	-
tcp	3575	10.0.1.10:54244	10.200.1.200:54244	31.13.92.14:443	-
tcp	3567	10.0.1.10:54238	10.200.1.200:54238	31.13.76.68:443	-

Note that the outgoing connections from the Local-Windows VM are now being NATed with the VIP address 10.200.1.200, instead of the firewall egress interface IP address (10.200.1.1).

This is a behavior of the SNAT VIP. That is, when you enable SNAT on a policy, a VIP static NAT takes priority over the destination interface IP address.

6. Close PuTTY.
7. Close all browser windows except the Local-FortiGate.

## 2 Dynamic NAT with IP pools

IP pools are used to translate the source address to an address from that pool, rather than the egress interface address.

Currently, the Local-FortiGate translates the source IP address of all traffic generated from the Local-Windows VM to 10.200.1.200 because of the SNAT translation in the VIP.

In this exercise, you will create an IP pool, apply it to ingress-to-egress firewall policy, and verify the SNAT from CLI commands.

### Creating an IP Pool

In this procedure, you will create an IP pool from the range of public IP addresses available on egress port (port1).

#### To create an IP pool

1. From the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at 10.0.1.254.
2. Go to **Policy & Objects > IP Pools**.
3. Click **Create New** and configure the following settings:

Field	Value
Name	INTERNAL-HOST-EXT-IP
Type	Overload
External IP Range/Subnet	10.200.1.100 - 10.200.1.100

4. Click **OK**.

### Editing a Firewall Policy to Use the IP Pool

Now you will apply the IP pool to change the behavior from static NAT to dynamic NAT on ingress-to-egress firewall policy.

#### To edit firewall policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right-click the **Seq.#** column for **Full\_Access** firewall policy.
3. Click **Edit**.
4. Under **Firewall/Network Options**, configure the following settings:

Field	Value
NAT	Enabled
IP Pool Configuration	Use Dynamic IP Pool Click + and select INTERNAL-HOST-EXT-IP

Your configuration will look similar to:

The screenshot shows the configuration for a NAT rule named 'Full\_Access'. The configuration is as follows:

Name	Full_Access
Incoming Interface	port3
Outgoing Interface	port1
Source	all
Destination Address	all
Schedule	always
Service	ALL
Action	<input checked="" type="checkbox"/> ACCEPT <input type="checkbox"/> DENY <input type="checkbox"/> LEARN

**Firewall / Network Options**

NAT	<input checked="" type="checkbox"/>
Fixed Port	<input type="checkbox"/>
IP Pool Configuration	<input type="checkbox"/> Use Outgoing Interface Address <input checked="" type="checkbox"/> Use Dynamic IP Pool
	INTERNAL-HOST-EXT-IP

5. Click **OK**.

## Testing Dynamic NAT with IP Pools

Now that your configuration is ready, you can test dynamic NAT with IP pools by browsing to a few external sites on the Internet. If successful, you will see that the Local-Windows VM IP address (10.0.1.10) is source NATed to the IP pool address of 10.200.1.100.

### To test dynamic NAT with IP pools

1. In the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
2. Log in as `admin` and execute the following command to clear any existing sessions:

```
diagnose sys session clear
```



**Note:** The firewall is stateful, so any existing sessions will not use this updated firewall policy until they time out or are cleared for ingress-to-egress traffic.

3. Close the PuTTY window.
4. In the Local-Windows VM, connect to a few websites. For example:
  - [www.fortinet.com](http://www.fortinet.com)
  - [www.yahoo.com](http://www.yahoo.com)
  - [www.bbc.com](http://www.bbc.com)
5. In the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
6. Log in as `admin` and execute the following command to verify the source NAT IP address that those sessions are using:

```
get system session list
```

Sample output:

PROTO	EXPIRE	SOURCE	SOURCE-NAT	DESTINATION	DESTINATION-NAT
T					
udp	126	10.200.1.1:22696	-	121.111.236.179:8888	-
udp	126	10.200.1.1:22696	-	121.111.236.180:8888	-
udp	126	10.200.1.1:22696	-	69.195.205.101:8888	-
udp	126	10.200.1.1:22696	-	69.195.205.102:8888	-
udp	126	10.0.1.254:22696	-	10.0.1.241:8888	-
tcp	3577	10.0.1.10:56276	10.200.1.100:56276	31.13.92.36:443	-
tcp	3560	10.0.1.10:56290	10.200.1.100:56290	31.13.92.36:443	-
tcp	3552	10.0.1.10:56292	10.200.1.100:56292	31.13.92.14:443	-
tcp	3588	10.0.1.10:56278	10.200.1.100:56278	31.13.74.7:443	-

Notice that the source NAT address is now 10.200.1.100 as configured in the IP pool, and the IP pool has overridden the static NAT VIP.

7. Close PuTTY.
8. Close all browser windows except Local-FortiGate.



## 3 Enabling Central NAT

In central NAT, SNAT and DNAT configurations are per virtual domain (VDOM). The SNAT and DNAT configurations are automatically applied to multiple firewall policies (according to the SNAT and DNAT rules that you specify), as opposed to each firewall policy in the firewall policy NAT.

### Enabling Central NAT

In this procedure, you will enable central NAT. Central NAT can only be enabled and disabled from the CLI.

#### To enable central NAT

1. From the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
2. Log in as `admin` and try to configure the following:

```
config system settings  
  
set central-nat enable  
  
end
```

You will get a message similar to one below:

```
Local-FortiGate (settings) # set central-nat enable  
Cannot enable central-nat with firewall policy using ipool (id=1).  
  
Local-FortiGate (settings) # end
```



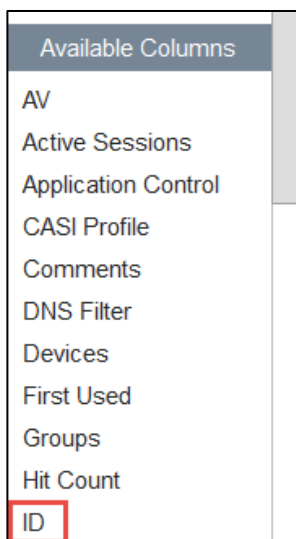
**Note:** When enabling central NAT, you must remove VIP and IP pool references from the existing firewall policies first. The (id=N) is the firewall policy ID reference, not Seq.#, on the GUI.

### Adding a Policy ID Column

In this procedure, you will check that the **ID** column is displayed in the **IPv4 Policy** table, so you can more easily determine which firewall policy is associated with which policy ID. In this instance, you need to determine which policy is id=1, as per the CLI error message above.

#### To add the Policy ID column

1. From the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Policy & Objects > IPv4 Policy**.
3. Check if the ID column is already displayed. If it is not, right-click any of the column headings, select **ID** under **Available Columns** and click **Apply**.



**Tip:** You can drag the **ID** column to where you want it positioned in the column list.

You can now see that the **Full\_Access** firewall policy is policy **ID 1**.

## Modifying the Firewall Policy

In this procedure, you will remove the IP pool from the **Full\_Access** firewall policy (policy **ID 1**), as central NAT can only be enabled if none of the firewall policies have IP pool or VIP addresses associated with them.

### To modify the firewall policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right click **Seq.#** of the **Full\_Access** firewall policy and select **Edit**.
3. Under **Firewall/Network Options**, modify the following settings:

Field	Value
NAT	Enabled
IP Pool Configuration	Use Outgoing Interface Address

4. Click **OK**.

## Enabling Central NAT Again After Removing the IP Pool

Now that you've removed the IP pool from the firewall policy, you can try to enable central NAT again.

### To try to enable central NAT

1. In the Local-Windows VM, go to the **LOCAL-FORTIGATE** PuTTY session you opened earlier.

2. Try to enable central NAT again:

```
config system settings  
  
set central-nat enable  
  
end
```

This time you will get similar message for VIP firewall policy (id=2).

```
Local-FortiGate # config system settings  
  
Local-FortiGate (settings) # set central-nat enable  
Cannot enable central-nat with firewall policy using vip (id=2).  
  
Local-FortiGate (settings) # end
```

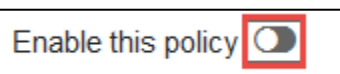
Since you already added the **ID** column to the **IPv4 Policy** page, it shows that policy **ID 2** is the firewall policy labeled **Web-Server-Access**.

## Modifying the Firewall Policy

In this procedure, you will remove the VIP address from the Web-Server-Access firewall policy (policy ID 2), because central NAT can only be enabled if none of the firewall policies have IP pool or VIP addresses associated with them.

### To modify the firewall policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right click on **Seq.#** of the **Web-Server-Access** firewall policy and click **Edit**.
3. Change the **Destination Address** to **all**.
4. Scroll to the bottom of the page and disable the policy.



5. Click **OK**.

## Enabling Central NAT

Now that you have modified the firewall policies to remove the IP pool and VIP addresses, you can finally enable central NAT.

### To enable central NAT after removing IP pool and VIP address from firewall policies

1. In the Local-Windows VM, go to the LOCAL-FORTIGATE PuTTY session you opened earlier.
2. Enable central NAT:

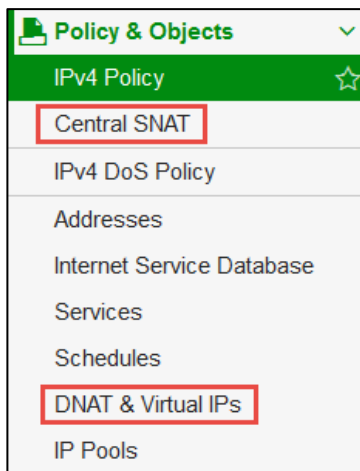
```
config system settings  
  
set central-nat enable
```

end

3. In the Local-FortiGate GUI, refresh your browser for GUI changes to take effect.
4. Go to **Policy & Objects** > **IPv4 Policy**.

You will see two options in the left menu:

- **Central SNAT**
- **DNAT & Virtual IPs**



5. Close the PuTTY window.

## 4 Configuring Central SNAT

A central SNAT policy is applied to multiple firewall policies, based on configured central rule. The NAT on the firewall policy controls whether the central SNAT is used or not.

In this exercise, you will configure a central SNAT policy and test it.

### Deleting DNAT and VIPs

When central NAT is enabled, existing VIPs take precedence over source NAT. As such, you need to delete the VIP object you added in a previous exercise so you can test the source NAT.

To delete DNAT and VIPs

1. From the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Policy & Objects > DNAT & Virtual IPs**.
3. Right click **VIP-INTERNAL-HOST** and click **Delete**.
4. Click **OK**.

### Testing SNAT Without an SNAT Policy

In this procedure, you will test the behavior of FortiGate when an SNAT policy is not configured.

To test SNAT Without an SNAT policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > IP Pools**.
2. Review the settings of **INTERNAL-HOST-EXT-IP**.
3. In the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
4. Log in as `admin` and execute the following command to clear the existing sessions.

```
diagnose sys session clear
```

5. Close the PuTTY window.
6. In the Local-Windows VM, open a web browser and connect to a few websites. For example:
  - [www.fortinet.com](http://www.fortinet.com)
  - [www.yahoo.com](http://www.yahoo.com)
  - [www.bbc.com](http://www.bbc.com)
7. In the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
8. Log in as `admin` and execute the following command to verify the SNAT IP address that those sessions are using:

```
get system session list
```

Sample output:

PROTO	EXPIRE	SOURCE	SOURCE-NAT	DESTINATION	DESTINATION-NAT
tcp	3594	10.0.1.10:61608	10.200.1.1:61608	151.101.48.81:443	-
tcp	3591	10.0.1.10:61678	10.200.1.1:61678	23.73.43.120:443	-
udp	111	10.0.1.10:62292	10.200.1.1:62292	162.159.1.33:53	-
tcp	3595	10.0.1.10:61688	10.200.1.1:61688	172.217.1.198:443	-
tcp	3585	10.0.1.10:61636	10.200.1.1:61636	172.217.1.194:443	-
tcp	3597	10.0.1.10:61646	10.200.1.1:61646	209.121.139.146:80	-
tcp	3591	10.0.1.10:61553	10.200.1.1:61553	23.203.240.233:443	-
tcp	3579	10.0.1.10:61560	10.200.1.1:61560	209.85.232.154:443	-
tcp	3586	10.0.1.10:61658	10.200.1.1:61658	198.41.214.67:443	-
udp	126	10.0.1.10:60934	10.200.1.1:60934	205.251.199.58:53	-
tcp	3593	10.0.1.10:61592	10.200.1.1:61592	151.101.48.81:80	-
tcp	3590	10.0.1.10:61556	10.200.1.1:61556	216.93.180.162:443	-
udp	129	10.0.1.10:62224	10.200.1.1:62224	208.111.184.12:53	-
tcp	3591	10.0.1.10:61563	10.200.1.1:61563	69.59.163.6:443	-
tcp	3580	10.0.1.10:61577	10.200.1.1:61577	199.59.148.84:443	-

Notice that the SNAT address is now 10.200.1.1, which is the egress interface IP (port1).



**Note:** If no central SNAT or matching central SNAT rule exists, FortiGate automatically uses the outgoing interface IP address for the source NAT.

9. Close PuTTY.
10. Close all other browser tabs except the Local-FortiGate GUI.

## Configuring Central SNAT Policy

In this procedure, you will configure a central SNAT policy using the IP pool previously created in the last exercise.

To configure a central NAT policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > Central SNAT**.
2. Click **Create New** and configure the following:

Field	Value
Source Address	all
Destination Address	all
Translated Address	INTERNAL-HOST-EXT-IP
Protocol	ANY

3. Leave all other settings at their defaults and click **OK** to save the changes.

## Verifying that NAT is Enabled on the Firewall Policy

If NAT is enabled on the firewall policy, central SNAT is used. In this procedure, you will verify that NAT is enabled on the firewall policy.

To verify that NAT is enabled on firewall policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Review the **NAT** column of the **Full\_Access** policy to make sure NAT is enabled.



**Note:** There is no option for IP pools. In central SNAT, NAT on the firewall policy controls if the central SNAT is used or not. If NAT is enabled on the firewall policy, central SNAT is used.

## Testing Central SNAT in the Presence of SNAT Policy

Now that your configuration is ready, you can test the behavior of the central SNAT policy.

To test central SNAT in presence of SNAT policy

1. In the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
2. Log in as **admin** and execute the following command to clear the existing sessions:

```
diagnose sys session clear
```

3. Close the PuTTY window.
4. In the Local-Windows VM, connect to a few websites. For example:
  - [www.fortinet.com](http://www.fortinet.com)
  - [www.yahoo.com](http://www.yahoo.com)
  - [www.bbc.com](http://www.bbc.com)
5. In the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
6. Log in as **admin** and execute the following command to verify the source NAT IP address that those sessions are using:

```
get system session list
```

Sample output:

```
Local-FortiGate # get sys session list
```

PROTO	EXPIRE	SOURCE	SOURCE-NAT	DESTINATION	DESTINATION-NAT
tcp	3595	10.0.1.10:61974	10.200.1.100:61974	151.101.48.81:443	-
udp	108	10.0.1.10:60816	10.200.1.100:60816	198.51.45.4:53	-
tcp	3590	10.0.1.10:61956	10.200.1.100:61956	23.73.43.120:443	-
tcp	3588	10.0.1.10:61951	10.200.1.100:61951	208.71.44.31:443	-
udp	113	10.0.1.10:60427	10.200.1.100:60427	192.5.6.30:53	-
tcp	3582	10.0.1.10:61900	10.200.1.100:61900	172.217.1.206:443	-
tcp	3584	10.0.1.10:61958	10.200.1.100:61958	172.217.1.198:443	-
udp	108	10.0.1.10:61613	10.200.1.100:61613	192.5.6.30:53	-
tcp	3598	10.0.1.10:62000	10.200.1.100:62000	209.121.139.147:80	-
tcp	3590	10.0.1.10:62010	10.200.1.100:62010	104.125.241.40:443	-
tcp	3595	10.0.1.10:61913	10.200.1.100:61913	23.203.240.233:443	-
udp	105	10.0.1.10:61639	10.200.1.100:61639	204.13.250.29:53	-
tcp	3594	10.0.1.10:62024	10.200.1.100:62024	52.85.69.19:80	-
udp	113	10.0.1.10:60327	10.200.1.100:60327	96.17.144.47:53	-
udp	113	10.0.1.10:62183	10.200.1.100:62183	84.53.139.194:53	-
udp	108	10.0.1.10:60429	10.200.1.100:60429	96.17.108.36:53	-
tcp	3596	10.0.1.10:61930	10.200.1.100:61930	23.221.116.192:443	-

Notice that the source NAT address is now **10.200.1.100**, which matches the central SNAT policy.

7. Close PuTTY.
8. Close all other browser tabs except Local-FortiGate GUI.

## Creating a Second IP Pool

Now you will create a second IP Pool, which will be used later when creating a second central SNAT policy.

To create a second IP Pool

1. In the Local-FortiGate GUI, go to **Policy & Objects > IP Pools**.
2. Click **Create New** and configure the following:

Field	Value
Name	SNAT-Pool
Type	Overload
External IP Range/Subnet	10.200.1.50 - 10.200.1.50

3. Click **OK**.

## Creating a Second SNAT Policy

Now you will create a more granular SNAT policy by selecting a specific destination address and protocol to match specific traffic.

To create second SNAT policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > Central SNAT**.
2. Click **Create New** and configure the following:

Field	Value
Source Address	all
Destination Address	REMOTE_FORTIGATE
Translated Address	SNAT-Pool
Protocol	TCP

3. Click **OK**.

## Reordering Central SNAT Policies

Now you will reorder the central NAT policies to put the more granular rule on top.

Similar to firewall policies, central SNAT policy is processed from *top to bottom*, and if a match is found, the source address and source port translate based on that central SNAT policy.



## To reorder central SNAT policies

1. In the Local-FortiGate GUI, go to **Policy & Objects > Central SNAT**.
2. Drag the newly created central SNAT policy above the previously created central SNAT policy.

Seq.#	Source Address	Destination	Translated Address
1	all	REMOTE_FORTIGATE	SNAT-Pool
2	all	all	INTERNAL-HOST-EXT-IP

## Testing Central SNAT

Now that your configuration is ready, you can test the central SNAT configuration.

### To test central SNAT

1. In the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
2. Log in as `admin` and execute the following command to clear the existing sessions:

```
diagnose sys session clear
```

3. Again open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
4. Log in as `admin`.
5. From the Local-Windows VM, open a web browser and log in as `admin` to the Remote-FortiGate GUI at 10.200.3.1.
6. In the Local-Windows VM, open a command prompt.
7. Run continuous ping to the Remote-FortiGate IP:

```
ping 10.200.3.1 -t
```

8. In the Local-Windows VM, connect to a few websites. For example:
  - [www.fortinet.com](http://www.fortinet.com)
  - [www.yahoo.com](http://www.yahoo.com)
  - [www.bbc.com](http://www.bbc.com)
9. In the Local-Windows VM, go back to PuTTY session and list the sessions by running following CLI command:

```
get system session list
```

Notice that the TCP sessions to destination 10.200.3.1 are source-NATed 10.200.1.50, as it matches the central SNAT policy.

Sample output:

PROTO	EXPIRE	SOURCE	SOURCE-NAT	DESTINATION	DESTINATION-NAT
udp	165	10.200.1.1:22696	-	121.111.236.179:8888	-
udp	165	10.200.1.1:22696	-	121.111.236.180:8888	-
udp	165	10.200.1.1:22696	-	69.195.205.101:8888	-
udp	165	10.200.1.1:22696	-	69.195.205.102:8888	-
udp	165	10.0.1.254:22696	-	10.0.1.241:8888	-
udp	165	10.200.1.1:22696	-	208.91.112.196:8888	-
udp	165	10.200.1.1:22696	-	208.91.112.198:8888	-
tcp	3598	10.0.1.10:50966	10.200.1.50:50966	10.200.3.1:443	-

ICMP sessions to destination 10.200.3.1 are source-NATed 10.200.1.100, which matches the central SNAT policy at the bottom.

Sample output:

icmp	59	10.0.1.10:1	10.200.1.100:62464	10.200.3.1:8	-
------	----	-------------	--------------------	--------------	---

Also, other TCP sessions to different destinations are translated to 10.200.1.100 based on the matching central SNAT policy at the bottom.



**Note:** A Central SNAT policy is processed from *top to bottom*, similar to firewall policies.

10. Close the command prompt and PuTTY.
11. Close all other browser tabs except the Local-FortiGate GUI.

## 5 DNAT and VIPs

In firewall policy NAT, **Virtual IPs** is selected in the firewall policy as the destination address. In central NAT, as soon as **DNAT & Virtual IPs** is configured, FortiGate automatically creates a rule in the kernel to allow DNAT to occur and no additional configuration is required.

In this exercise, you will configure and test the behavior of central DNAT.

### Creating DNAT and VIPs

In this procedure, you will configure DNAT and VIPs.

#### To create DNAT and VIPs

1. From the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Policy & Objects > DNAT & Virtual IPs**.
3. Click **Create New** and select **DNAT & Virtual IP**.
4. Configure the following settings:

Field	Value
Name	Central-DNAT
Interface	port1
Type	Static NAT (default setting)
External IP Address/Range	10.200.1.150 - 10.200.1.150
Mapped IP Address/Range	10.0.1.10

5. Click **OK**.

### Verifying the Firewall Policy Settings

You will now verify the firewall policy settings for the egress-to-ingress firewall policy.

#### To verify the firewall policy settings

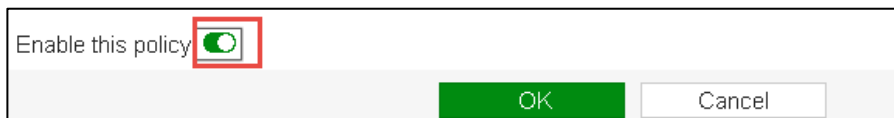
1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right click **Seq.#** of the **Web-Server-Access** firewall policy and click **Edit**.
3. Review the settings of firewall policy.
4. Try to select the **DNAT & Virtual IPs** address in firewall destination address.

You will be not able to do so.



**Note:** VIPs previously created cannot be selected in a firewall policy as a destination address. As soon as a VIP is created, FortiGate automatically creates a rule in the kernel for DNAT to occur.

5. Scroll to the bottom and enable the firewall policy



6. Click **OK**.

## Testing DNAT and VIPs

In this procedure, you will test DNAT and V IPs by accessing the Local-Windows VM.

### To test DNAT and VIPs

1. From the Remote-Windows, open a web browser and access the following URL:

<http://10.200.1.150>

If the VIP operation is successful a simple web page appears.

2. Go back to Local-Windows VM and open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
3. Log in as `admin` and execute the following command to check the destination NAT entries in the session table:

```
get system session list
```

Sample output:

```
Local-FortiGate # get system session list

PROTO EXPIRE      SOURCE      SOURCE-NAT  DESTINATION  DESTINATION-NAT
tcp    3599    10.200.3.1:49183  -           10.200.1.150:80  10.0.1.10:80
```

4. In the Local-Windows VM, open a web browser and try to access few websites. For example:
  - [www.fortinet.com](http://www.fortinet.com)
  - [www.yahoo.com](http://www.yahoo.com)
  - [www.bbc.com](http://www.bbc.com)
5. Go back to PuTTY for LOCAL-FORTIGATE and verify the SNAT IP address those sessions are using:

```
get system session list
```

Sample output:

```
Student # get sys session list
```

PROTO	EXPIRE	SOURCE	SOURCE-NAT	DESTINATION	DESTINATION-NAT
tcp	3596	10.0.1.10:61857	10.200.1.150:61857	216.23.154.74:80	-
tcp	3596	10.0.1.10:61855	10.200.1.150:61855	216.23.154.74:80	-
tcp	3593	10.0.1.10:61853	10.200.1.150:61853	216.23.154.74:80	-
tcp	3595	10.0.1.10:61867	10.200.1.150:61867	216.23.154.74:80	-
tcp	3595	10.0.1.10:61865	10.200.1.150:61865	216.23.154.74:80	-
tcp	3595	10.0.1.10:61869	10.200.1.150:61869	216.23.154.74:80	-
tcp	3598	10.0.1.10:61907	10.200.1.150:61907	216.23.154.88:80	-
tcp	3598	10.0.1.10:61909	10.200.1.150:61909	216.23.154.88:80	-

Notice that the session originating from source IP 10.0.1.10 are source NATed to 10.200.1.150 (VIP) as opposed to the central SNAT policy pool IP of 10.200.1.100. This is expected behavior in central NAT.



**Note:** If both the SNAT and DNAT are defined, the egress traffic will source NAT to the DNAT/VIP address, as opposed to the configured source SNAT policy.

6. Close PuTTY.
7. Close all other browser tabs except Local-FortiGate GUI.

## LAB 5–Firewall Authentication

In this lab, you will configure FortiGate to communicate with a remote LDAP server for server-based password authentication.

You will also configure captive portal, so that any user connecting to the network is prompted for their login credentials (active authentication).

### Objectives

- Configure server-based password authentication with an LDAP server.
- Configure captive portal so users connecting to your network are forced to authenticate.

### Time to Complete

Estimated: 20 minutes

### Prerequisites

Before beginning this lab, you must restore a configuration file to FortiGate.

To restore the FortiGate configuration file

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM010000064692
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Tue Jul 19 05:59:20 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	3 day(s) 21 hour(s) 28 min(s)

3. Select to restore from **Local PC** and click **Upload**.

4. Browse to **Desktop > Resources > FortiGate-I > Firewall-Authentication** and select `local-firewall-authentication.conf`.
5. Click **OK**.
6. Click **OK** to reboot.

## 1 Remote Authentication

In this exercise, you will configure an LDAP server on FortiGate for remote authentication, create a remote authentication group for your remote users, and add that group as a source in a firewall policy.

Finally, you will authenticate over SSL-VPN as one of the remote users, and then monitor the login as the administrator.

### Configuring an LDAP Server on FortiGate

You can configure FortiGate to point to an LDAP server for server-based password authentication using the pre-configured Active Directory service located on the Local-Windows VM. Active Directory already has users available to use in this lab.

#### To configure an LDAP Server on FortiGate

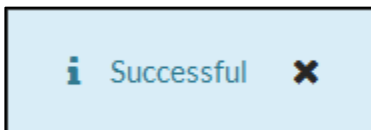
1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **User & Device > LDAP Servers** and click **Create New**.
3. Complete the following:

Field	Value
Name	ADserver
Server IP/Name	10.0.1.10 This is the IP address of the Windows Server, Local-Windows VM. For more information, see Network Topology.
Server Port	389 This is the default port for LDAP.
Common Name Identifier	cn This is the attribute name used to find the user name. Active Directory calls this cn.
Distinguished Name	ou=Training,dc=trainingAD,dc=training,dc=lab This is the domain name for Active Directory on the Windows Server. Active Directory has already been pre-configured, with all users located in the Training organizational unit (ou).
Bind Type	Regular
User DN	cn=ADadmin,cn=users,dc=trainingAD,dc=training,dc=lab We are using the credentials of an Active Directory user called ADadmin to authenticate to Active Directory. ADadmin is located in the Users organizational unit (ou).
Password	Training! This is the password pre-configured for the ADadmin user. You must use it to be able to bind.

4. Click **Test**.



You should receive an indication of a successful connection.



5. Click **OK**.

## Assigning Remote Users to a Firewall Group

In this procedure, you will assign a user located on the LDAP server to a firewall user group called **Remote-users** on FortiGate. This way, you can configure firewall policies to act on the firewall user group.

Generally, groups are used to more effectively manage individuals that have a shared relationship.



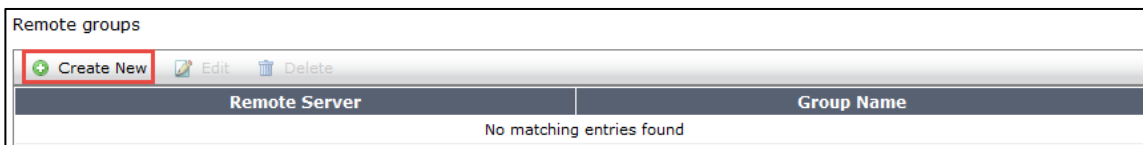
**Note:** The Remote-users group was pre-configured for you. However, it needs to be modified to add the users from the remote LDAP server you just configured in the last procedure.

### To assign a user to a user group

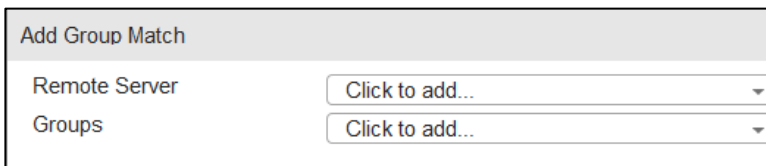
1. In the Local-FortiGate GUI, go to **User & Device > User Groups** and edit the **Remote-users** group.

As you can see, it's currently configured as a firewall group.

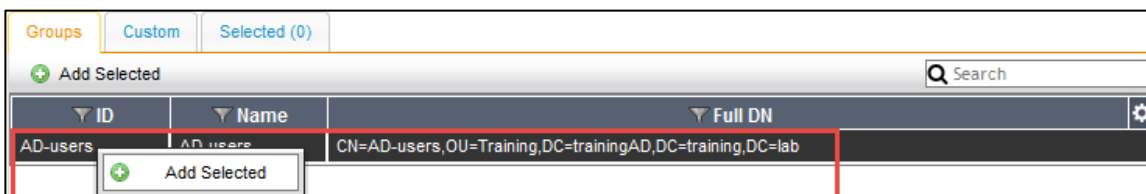
2. To add users from the remote LDAP server, click **Create New** from the **Remote groups** table.



The **Add Group Match** dialog box appears.



3. From the **Remote Server** drop-down list, select **ADserver**.
4. From the **LDAP Groups** table, click **AD-users** under the **Group** tab in the main window and click the **Add Selected** button that appears.



AD-users will appear disabled with a green checkmark, indicating it has been added.

Groups	Custom	Selected (1)
+ Add Selected		
ID	Name	Full DN
✓ AD-users	AD-users	CN=AD-users,OU=Training,DC=trainingAD,DC=training,DC=lab

5. Click **OK**.

The users in this Active Directory group are now included in your FortiGate Remote-users firewall user group. Only users from the remote LDAP server that match this user group entry can authenticate.

New User Group	
Name	Remote-users
Type	<input checked="" type="radio"/> Firewall <input type="radio"/> Fortinet Single Sign-On (FSSO) <input type="radio"/> Guest <input type="radio"/> RADIUS Single Sign-On (RSSO)
Members	Click to add...
Remote groups	
+ Create New Edit Delete	
Remote Server	Group Name
ADserver	CN=AD-users,OU=Training,DC=trainingAD,DC=training,DC=lab

6. Click **OK**.

## Adding the Remote User Group to your Firewall Policy

Now that the LDAP server is added to the Remote-user firewall user group, you can add the group to a firewall policy. This allows you to control access to network resources, as policy decisions are made on the group as a whole.

Since your remote user on your LDAP server will be authenticating over SSL-VPN, you will add the group to an SSL-VPN firewall policy.

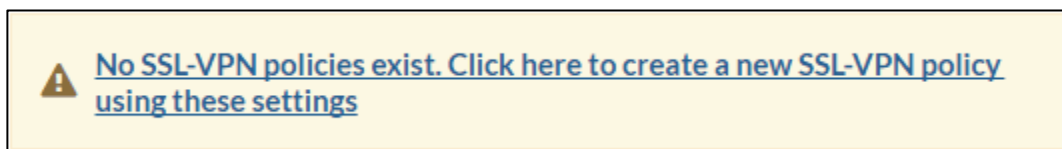


**Note:** Configuring SSL-VPN is out of scope for this lab. As such, the SSL-VPN settings have been pre-configured for you. However, you still need to configure an SSL-VPN firewall policy and add the Remote-user group to it.

### To add the remote user group to your firewall policy

1. In the Local-FortiGate GUI, go to **VPN > SSL-VPN Settings** and click the warning message at the top of the page.

Clicking this warning message will create a new SSL-VPN policy for you using these pre-configured settings.



Complete the following:

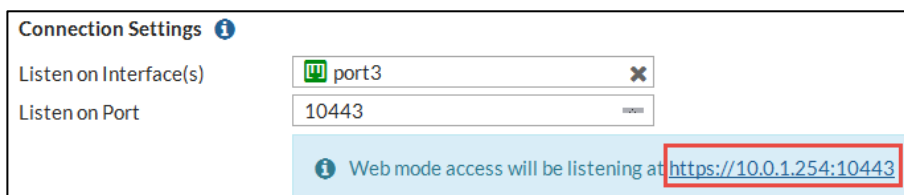
Field	Value
Name	SSL-VPN
Outgoing Interface	port1
Source	LOCAL_SUBNET Remote-users (located under <b>User</b> )
Destination Address	all
Schedule	always
Service	ALL
Action	ACCEPT

- Under **Security Profiles**, enable **Web Filter** and select **Category\_Monitor**.

This Web Filter was pre-configured for you and is set to block the following categories: Potentially Liable, Adult/Mature Contents, and Security Risk.

- Under **Logging Options**, enable **Log Allowed Traffic** and select **All Sessions**.
- Click **OK**.
- Click **OK**.

The **SSL-VPN Settings** page re-appears. Note that web mode access for SSL VPN is listening at <https://10.0.1.254:10443>.



To test whether aduser1 will be able to successfully authenticate

- Test to see whether aduser1 will be able to successfully authenticate:
  - Open PuTTY on Local-Windows VM and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
  - Log in as `admin`.
  - Type the following command:

```
diagnose test authserver ldap <LDAP server name> <LDAP user name>  
<password>
```

Where:

- <LDAP server name> is **ADserver** (case-sensitive)
- <LDAP user name> is **aduser1**
- <password> is **Training!**

You should see something like this for a successful authentication:

```
Local-FortiGate # diagnose test authserver ldap ADserver aduser1 Training!  
authenticate 'aduser1' against 'ADserver' succeeded!  
Group membership(s) - CN=AD-users,OU=Training,DC=trainingAD,DC=training,DC=lab
```

2. Close PuTTY.

## Authenticating and Monitoring

You will authenticate through the pre-configured SSL VPN as aduser1. This user is a member of the Remote\_users group on FortiGate.

You will then monitor the authentication.

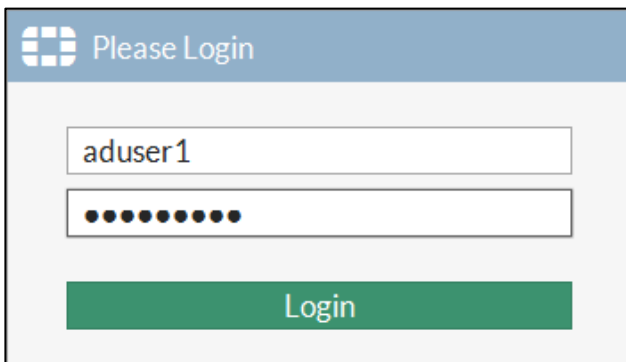
### To authenticate as a remote user

1. In the Local-Windows VM, open a new browser tab and go to <https://10.0.1.254:10443>.

This is the Web mode access for SSL VPN.

If you receive an error that indicates your connection is not secure, click **Advanced** and then select **Add Exception**.

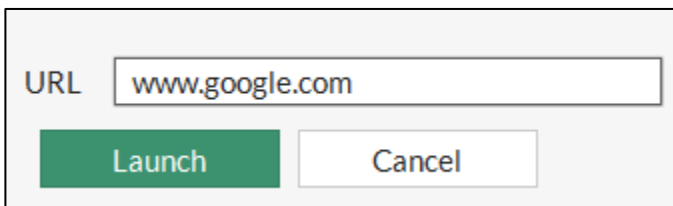
2. Log in as aduser1 with password Training!



The SSL VPN Web portal appears



3. Click **Quick Connection** and in the **URL** field, type [www.google.com](http://www.google.com) and click **Launch**.



The site launches successfully.

4. Return to your browser tab with the SSL-VPN portal and click **Quick Connection** again. This time in the **URL** field type [www.gunsgunsguns.com](http://www.gunsgunsguns.com) and click **Launch**.

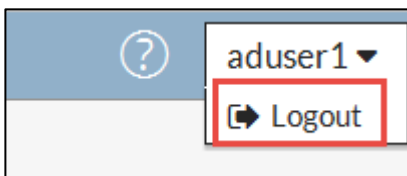
This URL is set to be blocked by the Web Filter security profile you enabled in the SSL VPN firewall policy.



5. Remain logged into the SSL VPN portal and continue to the next procedure.

### To monitor user authentications

1. Return to the browser tab where you are logged into Local-FortiGate as admin.
2. Monitor aduser1. You can view this particular login authentication from the following:
  - **FortiView** > **VPN** (filter on last 5 minutes and double-click the entry to view more details)
  - **Monitor** > **SSL-VPN Monitor**
3. View the activity of aduser1. You can check the following:
  - **FortiView** > **All Sessions**
  - **Log & Report** > **Forward Traffic** (Try filtering by user and any additional filters to get more specific results.)
  - **Log & Report** > **Web Filter** (Try filtering by user and any additional filters to get more specific results.)
4. Return to your browser tab where you are logged into the SSL VPN portal and log out.



You will notice back in the Local-FortiGate GUI (where you are logged in as `admin`) that **Monitor** > **SSL-VPN Monitor** no longer shows the authentication, as the connection is not active. However, **FortiView** > **VPN** retains the login information.

5. Close all your browser tabs except for the tab with the Local-FortiGate GUI.

## 2 Captive Portal

In this exercise, you will configure captive portal and restrict access to a specific user group. Captive portal is a convenient way to authenticate Web users on wired or WiFi networks through an HTML form that requests a user name and password (active authentication).

This exercise involves creating a user group (and adding a user to it); enabling captive portal and restricting access based on that group; and enabling the disclaimer message.

Finally, you will authenticate through captive portal and monitor the authentication.

### Creating a User Group for Captive Portal

Since the goal is to enable captive portal based on a specific group, you must first create a user group and then add a user to the group. For the purposes of this exercise, you will add the user **student** to the group. Student is a local user on FortiGate that was pre-configured for you.

To create a user group for captive portal

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **User & Device > User Groups** and click **Create New**.
3. Complete the following:

Field	Value
Name	CP-group
Type	Firewall
Members	student

4. Click **OK**.

### Enabling Captive Portal

In this procedure, you will enable captive portal on a wired network.

To enable captive portal

1. In the Local-FortiGate GUI, go to **Network > Interfaces** and edit **port3**.  
This port is your incoming traffic. For more information, see the Network Topology.
2. Complete the following under the **Admission Control** section:

Field	Value
Security Mode	Captive Portal
Authentication Portal	Local
User Access	Restricted to Groups
User Groups	CP-group

3. Click **OK**.

## Enabling the Disclaimer Message

In order to provide those logging in through captive portal with a disclaimer message, you must enable disclaimers. Since we are enabling captive portal through a wired interface, disclaimers can only be enabled through the CLI.



**Note:** If captive portal is enabled through WiFi, you can enable disclaimers through the GUI (**WiFi & Switch Controller > SSID**). We are using a wired interface in this lab.

### To enable the disclaimer message

1. Open PuTTY on the Local-Windows VM and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
2. Log in as `admin`.
3. Type the following command:

```
config firewall policy  
  
edit 1  
  
set disclaimer enable  
  
end
```

4. Close PuTTY.

## Authenticating and Monitoring

Now that captive portal is configured and the disclaimer enabled, you can test it by authenticating through captive portal as the **student** user. You will then monitor the authentication as the admin user.

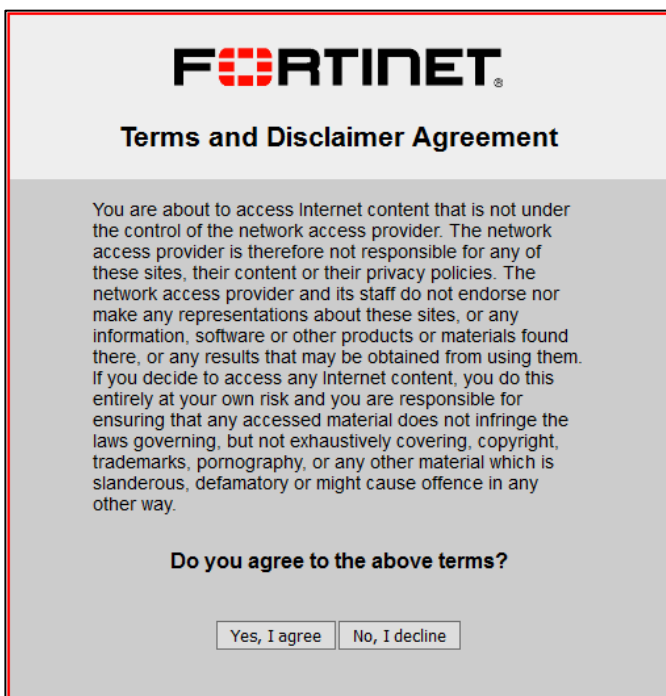
### To authenticate through captive portal

1. In the Local-Windows VM, open a new browser tab and go to any website, such as [www.bbc.com](http://www.bbc.com).
2. When prompted, log in with username `student` and password `fortinet`.



The image shows a Fortinet Authentication Required dialog box. At the top is the Fortinet logo. Below it, the text "Authentication Required" is centered. A message says "Please enter your username and password to continue." There are two input fields: "Username:" with the text "student" and "Password:" with masked characters (dots). A "Continue" button is at the bottom right.

The **Terms and Disclaimer Agreement** dialog appears.



The image shows a Fortinet Terms and Disclaimer Agreement dialog box. At the top is the Fortinet logo. Below it, the text "Terms and Disclaimer Agreement" is centered. A paragraph of text explains that the user is accessing Internet content not under the control of the network access provider and that the provider is not responsible for any of these sites, their content, or their privacy policies. It also states that the network access provider and its staff do not endorse nor make any representations about these sites, or any information, software, or other products or materials found there, or any results that may be obtained from using them. It further states that if the user decides to access any Internet content, they do so entirely at their own risk and are responsible for ensuring that any accessed material does not infringe the laws governing, but not exhaustively covering, copyright, trademarks, pornography, or any other material which is slanderous, defamatory, or might cause offense in any other way. Below the text, it asks "Do you agree to the above terms?" with two buttons: "Yes, I agree" and "No, I decline".

3. Click **Yes, I agree**.



Once you agree to the terms, you are redirected to the website you originally requested.

4. Open additional browser tabs and access a few more websites through captive portal, for example:
  - [www.youtube.com](http://www.youtube.com)
  - [www.cnn.com](http://www.cnn.com)
5. Leave all browser tabs open and continue to the next procedure.



## To monitor active captive portal authentications

1. In the Local-Windows VM, return to the browser tab where you are logged into the Local-FortiGate GUI as `admin`.
2. Monitor the student user. You can view this particular login authentication from **Monitor > Firewall User Monitor**.

 Refresh	De-authenticate	Show all FSSO Logons 			
User Name	User Group	Duration	IP Address	Traffic Volume	Method
student	CP-group	0 day(s) 0 hour(s) 1 minute(s)	10.0.1.10	7.62 MB	 Firewall



**Note:** While the CLI `config user setting` dictates how long a user authenticating through captive portal can remain authenticated, you can choose to manually de-authenticate a captive portal user by selecting the user in the Firewall User Monitor list and clicking **De-authenticate**. Once de-authenticated, the user disappears from the list, as it is reserved for active users only.

3. Select **student** and click **De-authenticate** to manually end the user's session.
4. Click **OK**.
5. Close the browser.

## LAB 6–SSL VPN

In this lab, you will manage user groups and portals for an SSL VPN.

### Objectives

- Configure and connect to an SSL VPN
- Enable authentication security
- Configure a firewall policies for SSL VPN users access to private network resources

### Time to Complete


Estimated: 25 minutes

### Prerequisites

Before beginning this lab, you must restore configuration file to the Local-FortiGate.

To restore the Local-FortiGate configuration file

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM0100 
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Wed Jun 15 11:46:48 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	0 day(s) 0 hour(s) 10 min(s)

3. Click **Upload**, browse to **Desktop > Resources > FortiGate-I > Introduction** and select `local-ssl-vpn.conf`.
4. Click **OK**.
5. Click **OK**.

## 1 Web-Only SSL VPN

FortiGate SSL VPN supports three operation modes: web-only, port forward and tunnel. During this lab exercise you will test the web-only mode. The VPN in this lab will allow VPN users connecting from the Remote-Windows VM to access the local subnet (10.0.1.0/24).

### Configuring the SSL VPN Settings

This procedure configures the SSL VPN settings.

To configure the SSL VPN settings

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **VPN > SSL-VPN Settings**.
3. Under the **Connection Settings**, configure the following values:

Field	Value
Listen on Interface(s)	port1
Listen on Port	10443
Restrict Access	Allow access from any host
Inactive For	3000 seconds
Server Certificate	Fortinet_Factory

4. Under the **Tunnel Mode Client Settings**, select **Automatic assign addresses**.
5. Under the **Authentication/Portal Mapping**, select **All Other Users/Groups** and click **Edit**:

Authentication/Portal Mapping ⓘ

+ Create New ✎ Edit 🗑 Delete

Users/Groups	Portal
All Other Users/Groups	⚠ Not Set

6. Select the portal **web-access** from the drop-down list and click **OK**.
7. Click **Apply** to save all the changes.
8. Click **OK** to confirm the use of the built-in certificate.

### Creating a Firewall Policy for SSL VPN

This procedure will create a firewall policy to allow traffic from SSL VPN users to the local subnet (10.0.1.0/24).

To create a firewall policy for SSL VPN

1. In the Local-FortiGate, go to **Policy & Objects > IPv4 Policy**.
2. Click **Create New** and add the following firewall policy:

Field	Value
Name	SSL VPN Access
Incoming Interface	SSL-VPN tunnel interface
Outgoing Interface	port3
Source	SSLVPN_TUNNEL_ADDR1 SSL_VPN_USERS
Destination Address	LOCAL_SUBNET
Schedule	always
Service	ALL
Action	ACCEPT

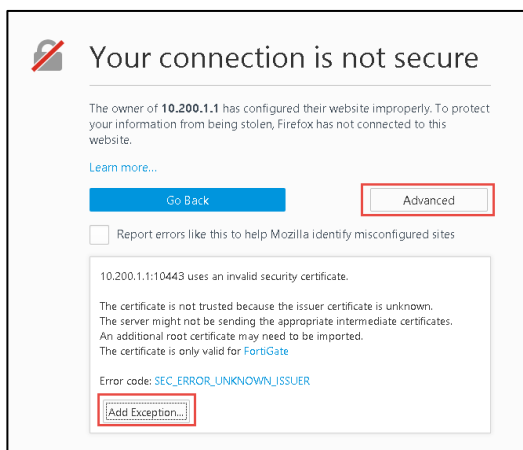
3. Disable **NAT** and click **OK**.
4. Click **OK** to confirm the use of the built-in certificate.

## Testing the SSL VPN

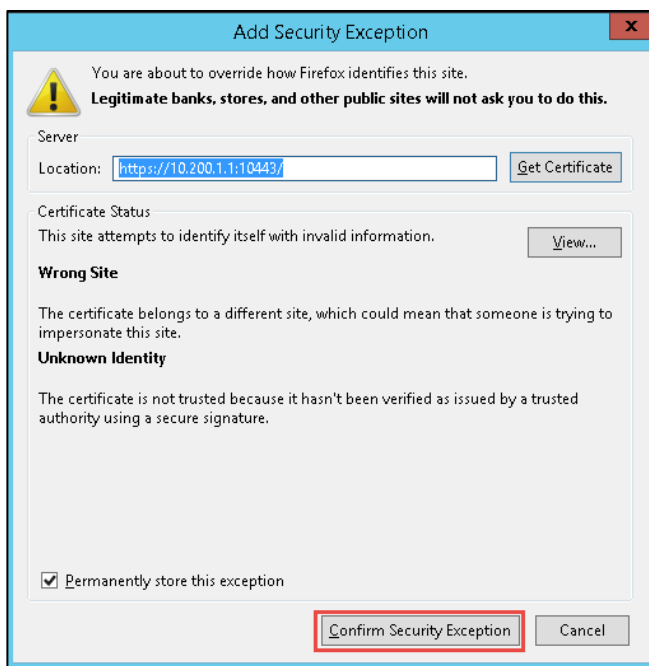
Now you will test the SSL VPN by connecting from the Remote-Windows VM.

To test the SSL VPN

1. Connect to the **Remote-Windows VM**.
2. Open Firefox and connect to:  
<https://10.200.1.1:10443/>
3. To accept the security warning, click **Advanced** and select **Add Exception**.



4. Click **Confirm Security Exception**.

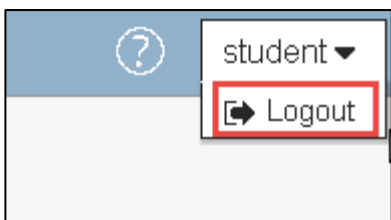


### Stop and Think

Why did you get this security warning?

For SSL connections, the FortiGate is using a built-in certificate, which is signed by a certificate authority that the browser does not trust. In the Certificate Operations lesson of the FortiGate II course, you can learn more about why this happens and how to fix it.

5. Log in as `student` with the password `fortinet`.  
Notice that the web portal is using its default settings.
6. Log out:



## Adding a Bookmark to the Portal

Using this procedure, you will add a bookmark to the portal.

To add a bookmark to the portal

1. Go back to the Local-Windows VM and connect to the Local-FortiGate GUI.
2. Go to **VPN > SSL-VPN Portals**.
3. Click the **web-access** row, and then click **Edit**.

4. In the **Predefined Bookmarks** section, click **Create New**. Configure these settings:

Field	Value
Name	Local-Windows VM
Type	HTTP/HTTPS
URL	<a href="http://10.0.1.10">http://10.0.1.10</a>
Single Sign-On	Disabled

5. Click **OK** to close the bookmark.
6. Click **OK** again to save the portal's settings.

## Testing the Bookmark

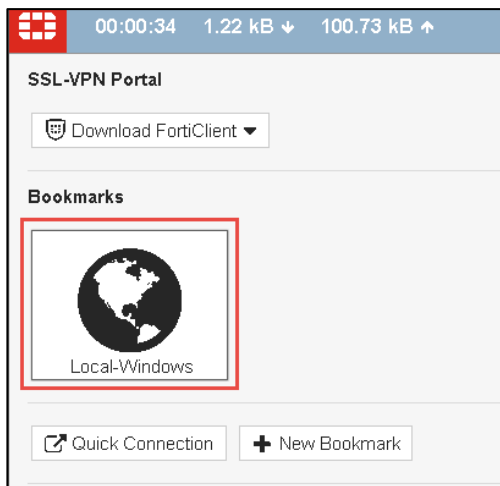
You will connect to the SSL VPN tunnel again from the Remote-Windows VM and confirm that you can access 10.0.1.10 from the bookmark.

To test the bookmark

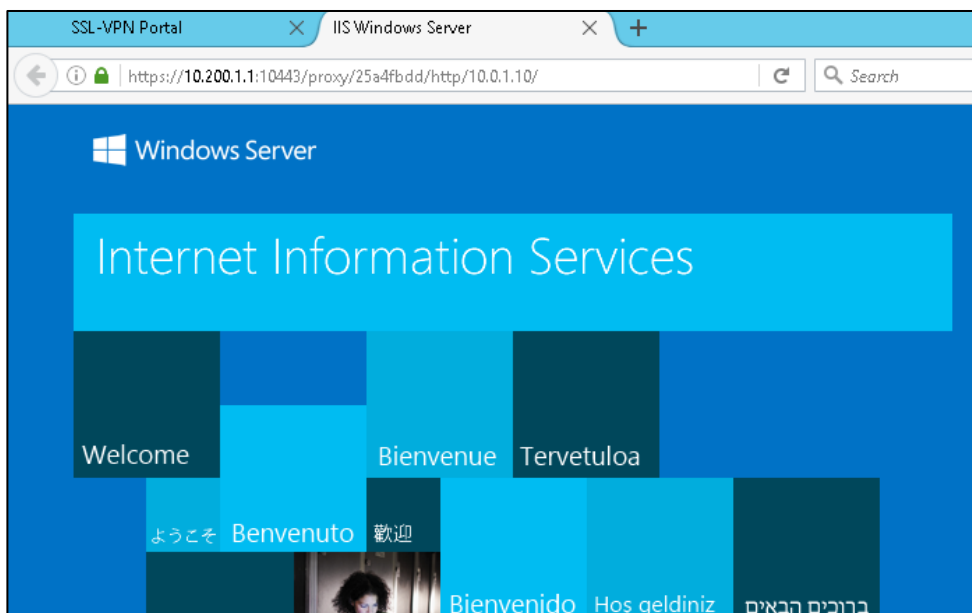
1. From the Remote-Windows VM, open Firefox and connect to the SSL VPN portal again:

<https://10.200.1.1:10443>

2. Log in using the account `student` with the password `fortinet`.
3. Click on the **Local-Windows VM** bookmark.

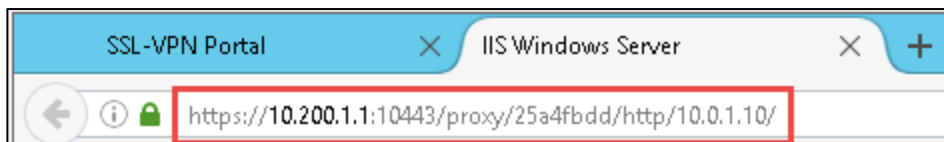


4. You will connect to the web server running in the Local-Windows VM (10.0.1.10).



## Examining the Web-Only (Reverse HTTP Proxy) Mechanism

Observe the URL in the address bar.



What does it mean?

To examine the reverse HTTP proxy mechanism

1. In the browser's address bar, notice the URL.

`https://10.200.1.1:10443/proxy/.../http/10.0.1.10/`

If you were on the local network while accessing the website, the address would be `http://10.0.1.10`. But, since you are accessing it remotely, through FortiGate's HTTP proxy, the URL is different.

Part of the URL	Description
<code>https://10.200.1.1:10443</code>	Indicates that the connection is SSL/TLS-encrypted, and that the portal is on FortiGate's port1 SSL VPN gateway.
<code>/proxy/.../http/</code>	Indicates that the connection is being handled by FortiGate's HTTP reverse proxy.
<code>10.0.1.10/</code>	Indicates the destination IP address of the website inside your private network, which you are accessing through the VPN.



**Note:** The FortiGate encrypts the connection to the browser. But the destination server's IP address in the URL is displayed in clear text, *not* hidden from users. The secondary connection, from FortiGate's HTTP proxy to the bookmarked website, is not encrypted.

## Disconnecting an SSL VPN User

This procedure shows how to disconnect an SSL VPN user from the FortiGate GUI.

### To disconnect an SSL VPN user

1. From the Local-Windows VM, connect back to the Local-FortiGate GUI.
2. Go to **Monitor > SSL-VPN Monitor**.
3. Right click on the user **student** and select **End Session**.

Refresh		
Username	Last Login	Remote Host
student	Wed Jul 20 12:47:20 2016	10.200.3.1
✕ End Session		



## 2 SSL VPN Tunnel Mode

In this exercise, you will change the SSL VPN configuration to support tunnel mode.

### Adding Tunnel Mode

The SSL VPN portal associated with each user group determines who has tunnel mode access. You will change the SSL VPN configuration to use the portal **full-access**, which supports tunnel mode.

To add tunnel mode

1. In the Local-FortiGate GUI, go to **VPN > SSL-VPN Settings**.
2. Under the **Authentication/Portal Mapping**, select **All Other Users/Groups** and click **Edit**:

Authentication/Portal Mapping ⓘ	
+ Create New Edit Delete	
Users/Groups	Portal
All Other Users/Groups	web-access

3. Select **full-access** and click **OK**.
4. Click **Apply**.
5. Click **OK** to confirm the use of the built-in certificate.

### Configuring the Routing for Tunnel Mode

In tunnel mode, the FortiClient installs one or more routes in the SSL VPN client once the tunnel is connected. In this way, traffic destined to the internal subnets is properly routed through the tunnel.

To configure the routing for tunnel mode

1. In the Local-FortiGate GUI, go to **VPN > SSL-VPN Portal**.
2. Select the **full-access** portal and click **Edit**.
3. Set the **Routing Address** to **LOCAL\_SUBNET**:

**Tunnel Mode**

Enable Split Tunneling ⓘ ☒

Routing Address LOCAL\_SUBNET ✕

Source IP Pools SSLVPN\_TUNNEL\_ADDR1 ✕

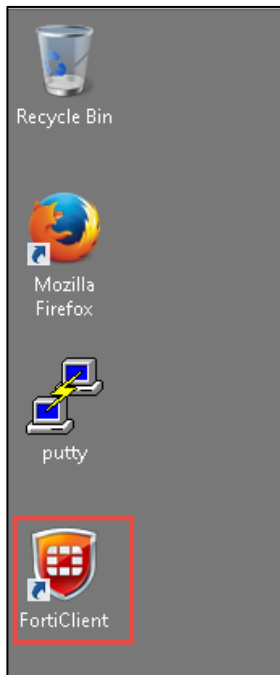
4. Click **OK**.

## Configuring FortiClient for SSL VPN

Connecting SSL VPN tunnel mode requires FortiClient. You will use the FortiClient installed in the Remote-Windows VM to test your configuration.

To configure FortiClient for SSL VPN

1. From the Remote-Windows VM, start **FortiClient**.



2. Click **Configure VPN**.
3. Select the **SSL-VPLN** tab and configure the following settings:

Field	Value
Connection Name	Local-FortiGate
Remote Gateway	10.200.1.1
Customize port	Enabled and 10443

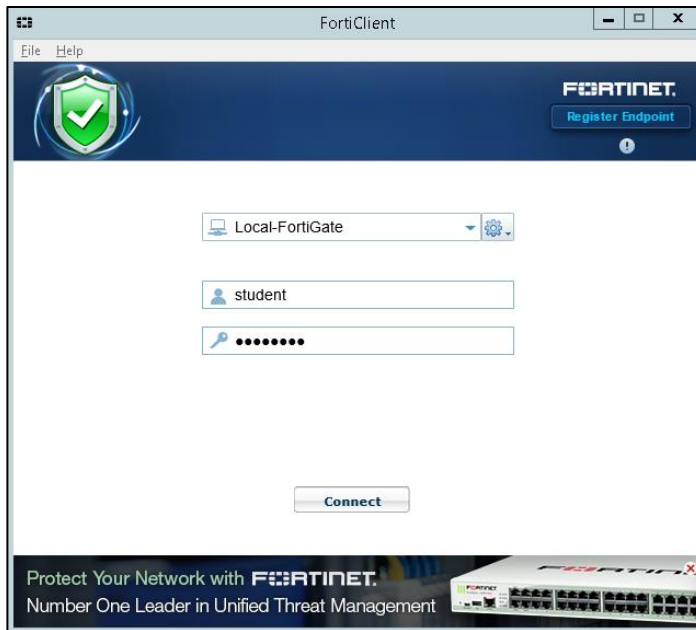
4. Click **Apply**.
5. Click **Close**.

## Testing the Tunnel Mode

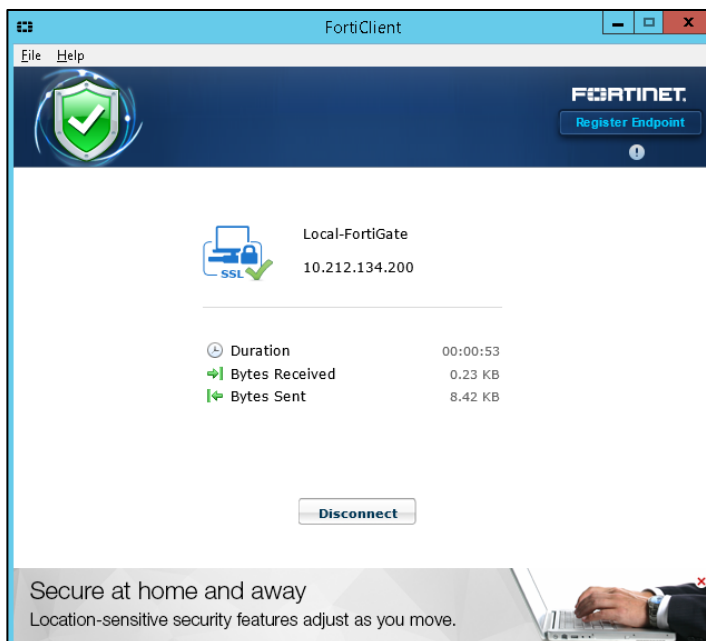
You will connect using the student account to test the tunnel mode.

To test the tunnel mode

1. In the Remote-Windows VM. Open **FortiClient** and enter the username `student` with the password `fortinet`.



2. Click **Connect**.
3. Click **Yes** to accept the certificate.
4. Wait a few seconds and open FortiClient again. You should observe that the tunnel is connected.



5. Open Firefox and access the URL:

<http://10.0.1.10>

Observe that you are now using the web server URL as if you were connected locally. You are not using the reverse HTTP proxy as in the case of web-only mode. Your IP traffic is directly encapsulated over HTTPS and sent through the tunnel.

6. Go back to FortiClient and click **Disconnect**.

## LAB 7–Basic IPsec VPN

In this lab, you will configure a point-to-point IPsec VPN between two FortiGate devices.

### Objectives

- Identify the phases of Internet Key Exchange (IKEv1).
- Compare route-based to policy-based VPNs.
- Deploy a site-to-site VPN between two FortiGates.
- Monitor VPN tunnels.

### Time to Complete

Estimated: 30 minutes

### Prerequisites

Before beginning this lab, you must restore configuration files to the Local-FortiGate and Remote-FortiGate.

To restore the Remote-FortiGate configuration file

1. From the Local-Windows VM, open a browser and log in as `admin` to the Remote-FortiGate GUI at `10.200.3.1`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Remote-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM010000065036
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Tue Jul 19 13:30:44 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	5 day(s) 2 hour(s) 40 min(s)

3. Select to restore from **Local PC** and click **Upload**.

4. Browse to **Desktop > Resources > FortiGate-I > Introduction** and select `remote-initial.conf`.
5. Click **OK**.
6. Click **OK** to reboot.

### To restore the Local-FortiGate configuration file

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM010000064692
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Tue Jul 19 05:59:20 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	3 day(s) 21 hour(s) 26 min(s)

3. Select to restore from **Local PC** and click **Upload**.
4. Browse to **Desktop > Resources > FortiGate-I > Introduction** and select `local-initial.conf`.
5. Click **OK**.
6. Click **OK** to reboot.

## 1 Route-based IPsec VPN

During this lab you will configure an IPsec tunnel between the Local-FortiGate and the Remote-FortiGate for communication between the Local-Windows VM and Remote-Windows.

### Creating a VPN Using the VPN Wizard

You will configure the Local-FortiGate side using the VPN wizard, which creates the IPsec in route-based mode.

To create a VPN using the VPN wizard

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **VPN > IPsec Tunnels**.
3. Click **Create New**.
4. Configure the following settings:

Field	Value
Name	ToRemote
Template Type	Site to Site
Remote Device Type	FortiGate
NAT Configuration	No NAT between sites

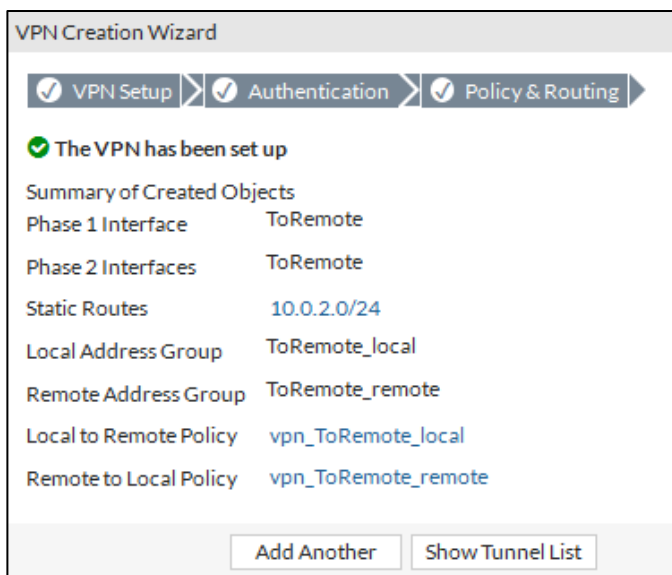
5. Click **Next**.
6. Configure the following settings:

Field	Value
Remote Device	IP Address
IP Address	10.200.3.1
Outgoing interface	port1
Authentication Method	Pre-shared Key
Pre-shared Key	fortinet




7. Click **Next**.
8. Configure the following settings:

Field	Value
Local Interface	port3
Local Subnets	10.0.1.0/24
Remote Subnets	10.0.2.0/24

9. Click **Create**. You should see the following screen:



10. Click **Show Tunnel List**. You will see the VPN you have just created:

<div><div>+ Create New</div><div>Edit</div><div>Delete</div><div>Print Instructions</div></div>				
Tunnel	Interface Binding	Template	Status	Ref.
ToRemote	 port1	 Site to Site - FortiGate	 Inactive	4

## Reviewing the Objects Created By the VPN Wizard

You will review what was created by the VPN wizard.

To review the objects created by the VPN wizard

1. In the Local-FortiGate GUI, go to **VPN > IPsec Tunnels**.
2. Select the VPN and click **Edit**. Observe the quick mode selectors that the wizard configured for you:

Edit VPN Tunnel

Tunnel Template: Site to Site - FortiGate [Convert To Custom Tunnel]

Name: ToRemote

Comments: VPN: ToRemote (Created by VPN wizard) 27/255

Network: Remote Gateway: Static IP Address, Outgoing Interface: port1 [Edit]

Authentication: Authentication Method: Pre-shared Key [Edit]

Phase 2 Selectors

Local Address	Remote Address
10.0.1.0/255.255.255.0	10.0.2.0/255.255.255.0

[OK] [Cancel]

You will need this information to configure the other FortiGate. The quick mode selectors in both sides must mirror each other. In other words, the **Local Address** in one side must match the **Remote Address** in the other side.

- Go to **Network > Interfaces**.
- Click on the plus sign added to **port1**. You will see a new virtual interface named **ToRemote** (matching the phase 1 name).

Status	Name	Members	IP/Netmask	Type	Access
Physical (11)					
	port1		10.200.1.1 255.255.255.0	Physical	PING HTTPS SSH HTTP FMG-Access
	ToRemote		0.0.0.0 0.0.0.0	VPN Tunnel	
	port2		10.200.2.1 255.255.255.0	Physical	PING HTTPS SSH HTTP
	port3		10.0.1.254 255.255.255.0	Physical	PING HTTPS SSH HTTP Telnet



### Stop and Think

What does this virtual interface tell us about the VPN created by the wizard? Is it policy-based or route-based?

### Discussion

The wizard created the VPN using a route-based configuration. The FortiGate automatically adds an IPsec virtual interface for each VPN configured as route-based. This does not happen in a policy-based configuration.

A route-based VPN requires firewall policies and at least one route to the remote network. As you will see, the wizard has created all these additional objects for you.

- Go to **Policy & Objects > Addresses** and observe two new Firewall address objects: **ToRemote\_local\_subnet\_1**, and **ToRemote\_remote\_subnet\_1**.
- Go to **Policy & Objects > IPv4 Policy** and observe the new two firewall policies: one from



**port3** to **ToRemote** and another one from **ToRemote** to **port3**. You will see that the **Action** is both cases is **ACCEPT**.

7. Go to **Network > Static Routes** and look at the static route added by the wizard.

You have completed the VPN configuration on the Local-FortiGate side. In the next exercise you will do the configuration on the Remote-FortiGate side.

## 2 Policy-based IPsec VPN

For learning purposes, you will do the configuration in both FortiGates differently. During this exercise you will create the VPN on the Remote-FortiGate side without using the wizard and using a policy-based configuration.

### Un-hiding the Policy-based VPN Settings

Policy-based configuration is hidden from the GUI by default. You will un-hide it.

#### To un-hide the policy-based VPN settings

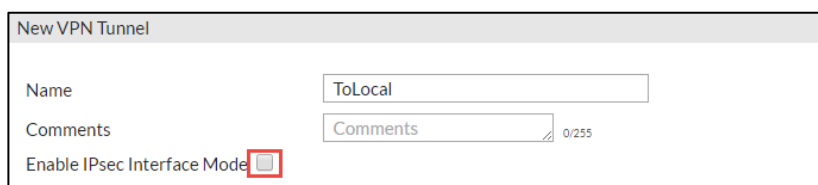
1. From the Local-Windows VM, open a browser and log in as admin to the Remote-FortiGate GUI at 10.200.3.1.
2. Go to **System > Feature Select**.
3. Enable **Policy-based IPsec VPN**.
4. Click **Apply**.

### Creating a Policy-based VPN

You will create the phases 1 and 2.

#### To create a policy-based VPN

1. In the Remote-FortiGate GUI, go to **VPN > IPsec Tunnels**.
2. Click **Create New**.
3. Type the name **ToLocal** and select **Custom** as the template name.
4. Click **Next**.
5. Disable the setting **Enable IPsec Interface Mode**:



New VPN Tunnel

Name: ToLocal

Comments: 0/255

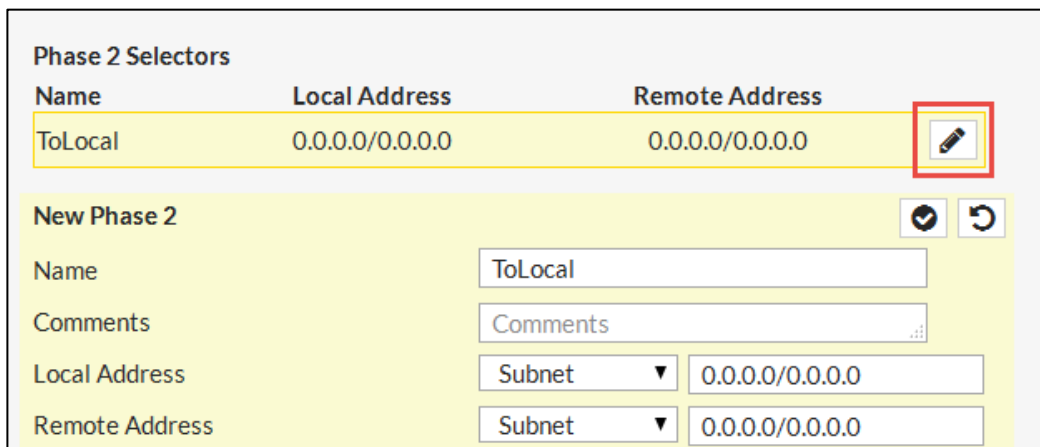
Enable IPsec Interface Mode: ☐

6. Configure the following settings:

Field	Value
Remote Gateway	Static IP Address
IP Address	10.200.1.1
Interface	port4
Mode Config	Disabled
NAT Transversal	Disabled

Dead Peer Detection	On Idle
Method	Pre-shared Key
Pre-shared Key	fortinet

7. Leave the other parameters with its default values and scroll down the windows to display the phase 2 settings. Click the pencil icon to edit the **Phase 2 Selectors**:



**Phase 2 Selectors**

Name	Local Address	Remote Address
ToLocal	0.0.0.0/0.0.0.0	0.0.0.0/0.0.0.0

**New Phase 2**

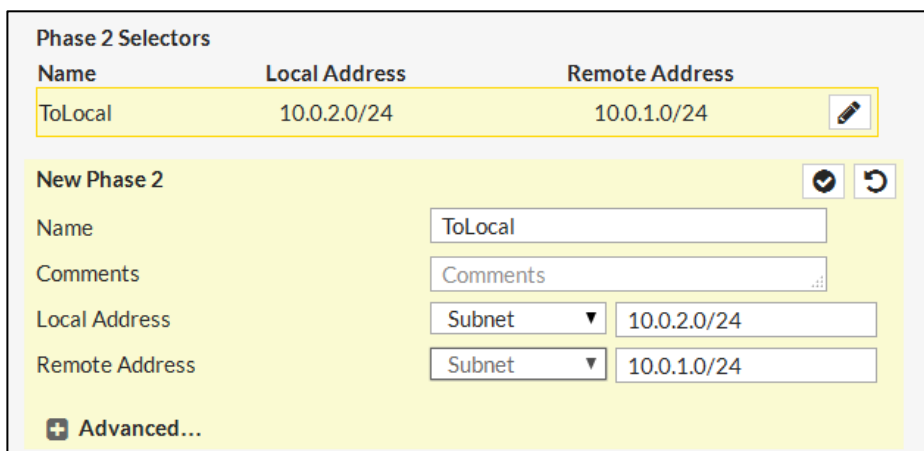
Name: ToLocal

Comments:

Local Address: Subnet 0.0.0.0/0.0.0.0

Remote Address: Subnet 0.0.0.0/0.0.0.0

8. Enter 10.0.2.0/24 as the **Local Address** and 10.0.1.0/24 as the **Remote Address**:



**Phase 2 Selectors**

Name	Local Address	Remote Address
ToLocal	10.0.2.0/24	10.0.1.0/24

**New Phase 2**

Name: ToLocal

Comments:

Local Address: Subnet 10.0.2.0/24

Remote Address: Subnet 10.0.1.0/24

+ Advanced...

9. Click **OK**.



**Note:** Now the quick mode selectors in both sides mirror each other. If that is not the case, the tunnel will not come up.

## Creating a Firewall Policy for Policy-based VPN

The last step is to create a firewall policy to allow traffic. In a policy-based configuration only one policy is required to allow traffic initiated at either side. The policy is applied bi-directionally.

To create a firewall policy for policy-based VPN

1. In the Remote-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.

2. Click **Create New**.
3. Configure the following settings:

Field	Value
Name	VPN traffic to Local
Incoming Interface	port6
Outgoing Interface	port4
Source	REMOTE_SUBNET
Destination Address	LOCAL_SUBNET
Schedule	always
Service	ALL
Action	IPsec
VPN Tunnel	ToLocal
Allow traffic to be initiated from the remote site	Enabled

4. Click **OK**.



**Note:** This is probably the first time you see the action **IPsec** for a firewall policy. In previous exercises the available actions were **Accept** and **Deny** only. The action **IPsec** is displayed in the GUI only when the policy-based VPN settings are not hidden.

## Moving a Firewall Policy

The new policy was created below the firewall policy for Internet traffic. You will need to move it up for the VPN traffic to match it.

### To move a firewall policy

1. In the Remote-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Expand the list of firewall policies from **port6** to **port4**:

Seq.#	Name	Source	Destination	Schedule	Service
port6 - port4 (1 - 2)					
1	Internet	REMOTE_SUBNET	all	always	ALL
2	VPN traffic to Local	REMOTE_SUBNET	LOCAL_SUBNET	always	ALL
Implicit (3 - 3)					

3. Drag and drop the policy for **VPN traffic to Local** to the top:

Seq.#	Name	Source	Destination	Schedule	Service
port6 - port4 (1 - 2)					
1	VPN traffic to Local	REMOTE_SUBNET	LOCAL_SUBNET	always	ALL
2	Internet	REMOTE_SUBNET	all	always	ALL
Implicit (3 - 3)					



### Stop and Think

In the previous exercise, the VPN wizard added a static route for the VPN traffic. Why don't you need to add a static route in this case?

### Discussion

The VPN wizard creates the IPsec using route-based configuration, which always requires additional routes (usually static routes) to route the traffic through the IPsec virtual interface. This is usually not required in policy-based configuration. What policy-based configuration requires is the VPN traffic matching a firewall policy with the action **IPsec**. As traffic from 10.0.2.0/24 to 10.0.1.0/24 matches the existing default route, and so the IPsec firewall policy from **port6** to **port4**, no additional routes are needed.

## 3 Testing and Monitoring the VPN

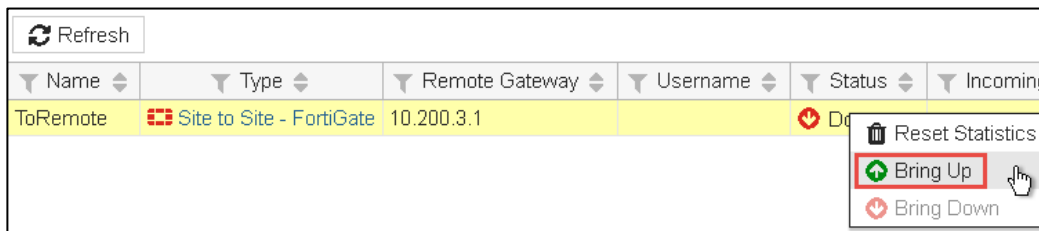
You have finished the configuration in both FortiGates. The next step is to test the VPN.

### Testing the VPN

You will test the VPN.

#### To test the VPN

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Monitor > IPsec Monitor**. Observe that the VPN is currently down.
3. Right click the VPN and select **Bring Up**:



Name	Type	Remote Gateway	Username	Status	Incoming
ToRemote	Site to Site - FortiGate	10.200.3.1		Down	

The **Status** of the VPN will show the green up arrow, indicating that the tunnel is up.



#### Stop and Think

Do I always have to manually bring the tunnel after creating?

#### Discussion

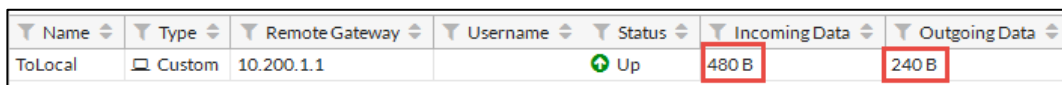
No. With the current configuration, the tunnel will stay down until either you manually bring it up or there is traffic that should be routed through the tunnel. As you are not generating traffic between `10.0.1.0/24` and `10.0.2.0/24` yet, the tunnel was still down. If you had generated the required traffic while the tunnel was down, it would have gone up automatically.

4. Open a command prompt window in the Local-Windows VM and execute the following command to ping Remote-Windows:

```
ping 10.0.2.10
```

The ping should work.

5. Go back to the Local-FortiGate GUI and go to **Monitor > IPsec Monitor**.
6. Click **Refresh** to refresh the screen. You will observe that counters for Incoming Data and Outgoing Data have increased. This indicates that the traffic between `10.0.1.10` and `10.0.2.10` is successfully being encrypted and routed through the tunnel:



Name	Type	Remote Gateway	Username	Status	Incoming Data	Outgoing Data
ToLocal	Custom	10.200.1.1		Up	480 B	240 B

Congratulations. You have successfully configured an IPsec VPN between two FortiGate devices.

## LAB 8—Explicit Web Proxy

In this lab, you will learn how to configure FortiGate to be an explicit web proxy.

### Objectives

- Configure FortiGate to act as an explicit web proxy.
- Use a PAC file to configure explicit proxy settings in web browsers.
- Authenticate and monitor explicit web proxy users.

### Time to Complete

Estimated: 30 minutes

### Prerequisites

Before beginning this lab, you must restore a configuration file to the Local-FortiGate.

To restore the FortiGate configuration file

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM010000064692
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Tue Jul 19 05:59:20 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	3 day(s) 21 hour(s) 26 min(s)

3. Select to restore from **Local PC** and click **Upload**.
4. Browse to **Desktop > Resources > FortiGate-I > Explicit-Proxy** and select `local-explicit-proxy.conf`.
5. Click **OK**.
6. Click **OK** to reboot.

## 1 Configuring the Explicit Web Proxy

During this exercise you will configure the FortiGate to be an explicit web proxy. You will also configure the FortiGate to authenticate explicit web proxy users and allow Internet access to only one user.

After that, you will manually configure Firefox with the proxy IP address and port.

### Un-hiding the Explicit Web Proxy Setting

Explicit web proxy settings are hidden from the GUI by default. You will un-hide them.

To un-hide the explicit web proxy setting

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **System > Feature Select**.
3. Under **Security Features**, enable **Explicit Proxy**.
4. Click **Apply**.

### Enabling Explicit Web Proxy

You will enable explicit web proxy on the network setting.

To enable explicit web proxy

1. In the Local-FortiGate GUI, go to **Network > Explicit Proxy**.
2. Enable **Explicit Web Proxy**.
3. For HTTPS port, select **Use HTTP Port**.
4. Click **Apply**.

### Enabling Explicit Web Proxy on an Interface

You will specify which internal interface the explicit web proxy will listen on.

To enable explicit web proxy on an interface

1. In the Local-FortiGate GUI, go to **Network > Interfaces**
2. Edit the interface **port3**.
3. Enable the option **Enable Explicit Web Proxy**
4. Click **OK**.



## Creating an Explicit Proxy Policy

You will create the policy to allow explicit proxy traffic to the Internet. Only the user **student** will be allowed to browse the Internet through the proxy.

To create an explicit proxy policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > Explicit Proxy Policy**.
2. Click **Create New**.
3. Configure these settings:

Field	Value
Explicit Proxy Type	Web
Enabled On	port3
Outgoing Interface	port1
Source Address	LOCAL_SUBNET
Destination Address	all
Action	AUTHENTICATE

4. Click **Create New** to add an authentication rule:

Explicit Proxy Type: Web FTP

Enabled On: port3

Outgoing Interface: port1

Source Address: STUDENT\_INTERNAL

Destination Address: all

Action: ACCEPT DENY AUTHENTICATE

User Authentication Options

Configure Authentication Rules

+ Create New Edit Delete

Schedule Security Profiles Log Users Groups Display Disclaimer

No matching entries found

5. Configure the following settings:

Field	Value
Users/Groups	student
Schedule	always

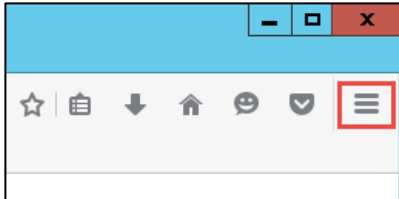
6. Click **OK**.
7. Click **OK**.

## Configuring Firefox for Explicit Web Proxy

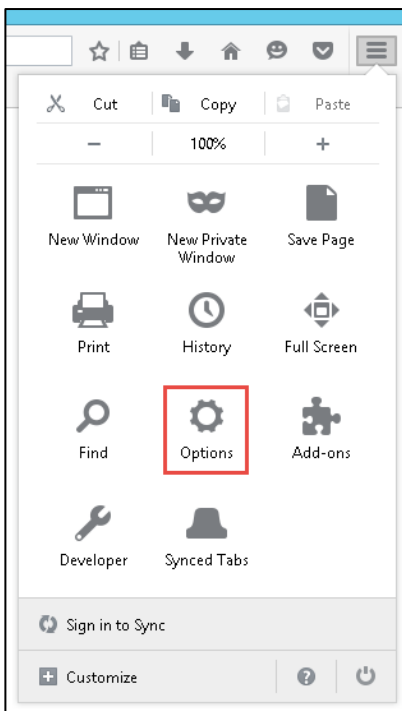
You have configured the Local-FortiGate as an explicit web proxy. Now you will configure Firefox to use it.

To configure Firefox for explicit web proxy

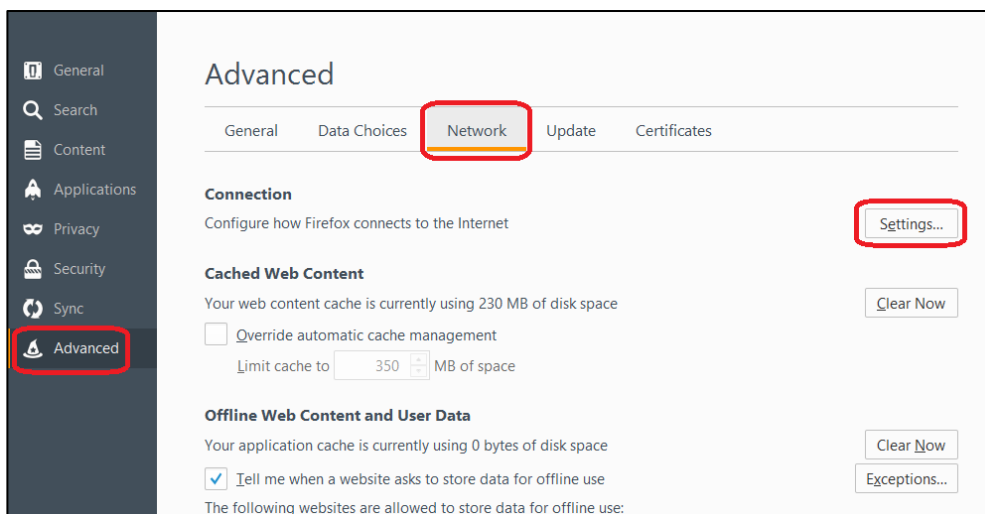
1. On the Local-Windows VM, open Firefox.
2. Click the **Open Menu** icon on the top right corner:



3. Select **Options**:



4. Go to the **Advanced > Network** tab.
5. Click **Settings**:

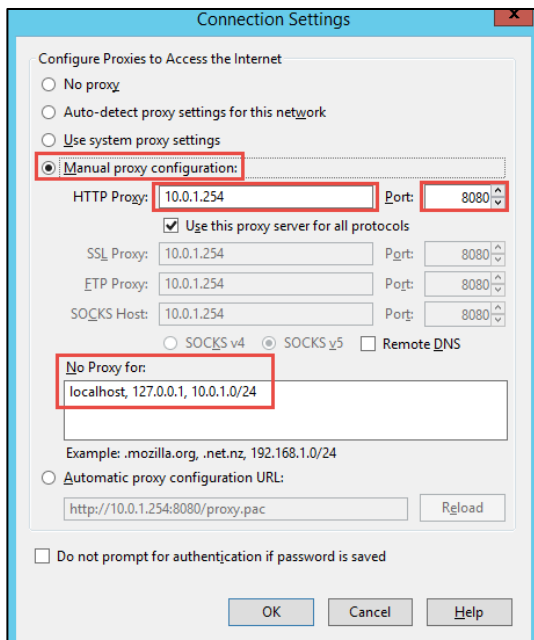


6. Select **Manual proxy configuration** and enter:

Field	Value
HTTP Proxy	10.0.1.254
Port	8080

7. Enable the option **Use this proxy server for all protocols**.

8. Add the subnet 10.0.1.0/24 (separated by a comma) to the **No Proxy for** list. This list contains the names, IP addresses and subnets of web sites that will be exempted from using the proxy:



9. Click **OK**.

10. Close Firefox and open it again.

## Testing the Explicit Web Proxy Configuration

You will test the explicit web proxy configuration.

To test the explicit web proxy configuration

1. From Local-Windows VM, open Firefox and browse to any HTTP web site, such as:

<http://www.pearsonvue.com/fortinet/>

<http://cve.mitre.org>

<http://www.eicar.org>

2. FortiGate will ask for authentication. Use these credentials:

Field	Value
User Name	student
Password	fortinet

After that, you should have Internet access through the explicit web proxy.

## Listing the Active Explicit Web Proxy Users

You will execute a CLI command to display the list of active explicit web proxy users.

To list the active explicit web proxy users

1. In the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
2. Type the following CLI command to check the list of active web proxy users:

```
# diagnose wad user list
```

3. You can also check this list from the GUI, by going to **Monitor > Firewall User Monitor**.

## Listing the Active Explicit Web Proxy Sessions

For each explicit web proxy connection to a web site, two TCP connections are usually created: one from the client to the proxy, and another one from the proxy to the server.

You will run some debug commands to list the sessions established between the client and the proxy; then the sessions established between the proxy and the servers.

To list the active explicit web proxy sessions between the client and the proxy

1. In the Local-Windows VM, open a few tabs in Firefox and generate some HTTP traffic, such as:

<http://www.pearsonvue.com/fortinet/>

<http://cve.mitre.org>

<http://www.eicar.org>

2. From the Local-FortiGate CLI, type these CLI commands while browsing some HTTP sites:

```
diagnose sys session filter clear
```

```
diagnose sys session filter dport 8080
```

```
diagnose sys session list
```

You can also use the grep command to display only the source and destination IP addresses and ports for each session:

```
diagnose sys session list | grep hook=pre
```

Why is the source IP address of all those sessions 10.0.1.10?

Why is the destination IP address of all those sessions 10.0.1.254?

Why don't we see any public IP address listed in those sessions?

**To list the active explicit web proxy sessions between the proxy and the servers**

1. In the Local-Windows VM, open a few tabs in Firefox and generate some HTTP traffic, such as:

<http://www.pearsonvue.com/fortinet/>

<http://cve.mitre.org>

<http://www.eicar.org>

2. From the Local-FortiGate CLI, type these CLI commands while browsing some HTTP sites:

```
diagnose sys session filter clear
```

```
diagnose sys session filter dport 80
```

```
diagnose sys session list | grep hook=out
```

Why is the source IP address of all these sessions 10.200.1.1?

Why don't we see the IP address of Windows server (10.0.1.10)?

## 2 Using a PAC File

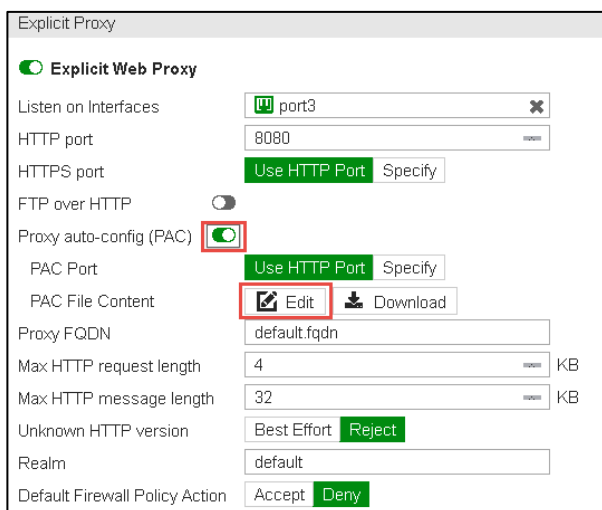
During this exercise, you will configure a proxy auto-config (PAC) file. You will also configure the browser to get the PAC file from the FortiGate and use it.

### Configuring FortiGate to Provide the PAC File

You will configure FortiGate to host a PAC file and make it available for browsers to download it.

To configure FortiGate to provide the PAC file

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Network > Explicit Proxy**.
3. Enable the option **Proxy auto-config (PAC)**.
4. Click the pencil icon to edit the PAC file:



5. Click **Browse**.
6. Select the file **proxy.pac** in the folder **Resources\FortiGate-1\Explicit-Proxy**.
7. Click **Import**.
8. Click **Apply**.
9. Click **Apply**.

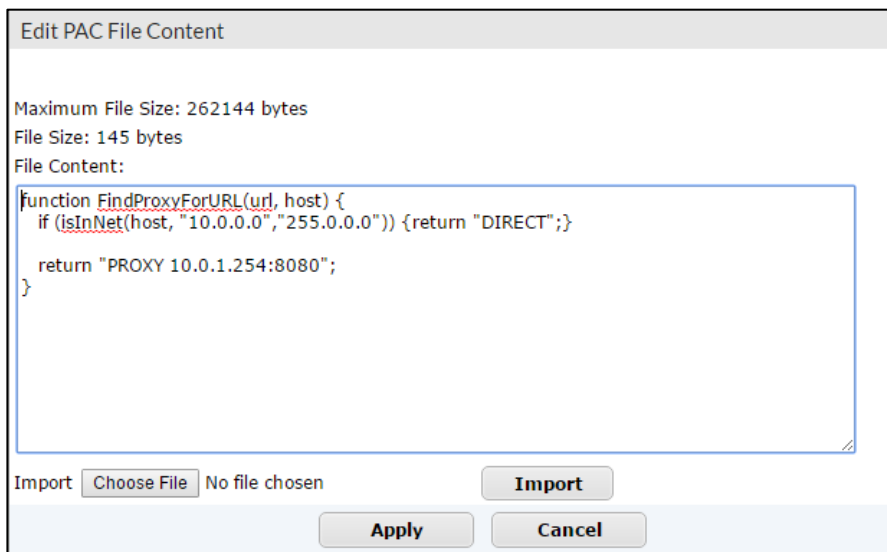
### Checking the PAC File

You will open the PAC file from the Local-FortiGate GUI to review it.

To check the PAC file

1. In the FortiGate GUI, go to **Network > Explicit Proxy**.

2. Click the pencil icon to look at the imported PAC file:



**Note:** The second line in the PAC file specifies that the browser will not use a proxy to reach the servers in the subnet 10.0.0.0/8. The next line configures the browser to use the FortiGate proxy for any other subnet or URL.

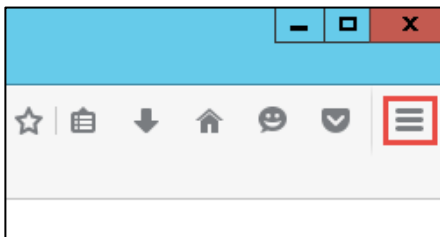
3. Click **Cancel** to close the PAC file.

## Configuring Firefox to Download the PAC File

You will configure Firefox with the URL where the PAC file is hosted. Firefox will connect to the specified URL to download and installed the PAC file.

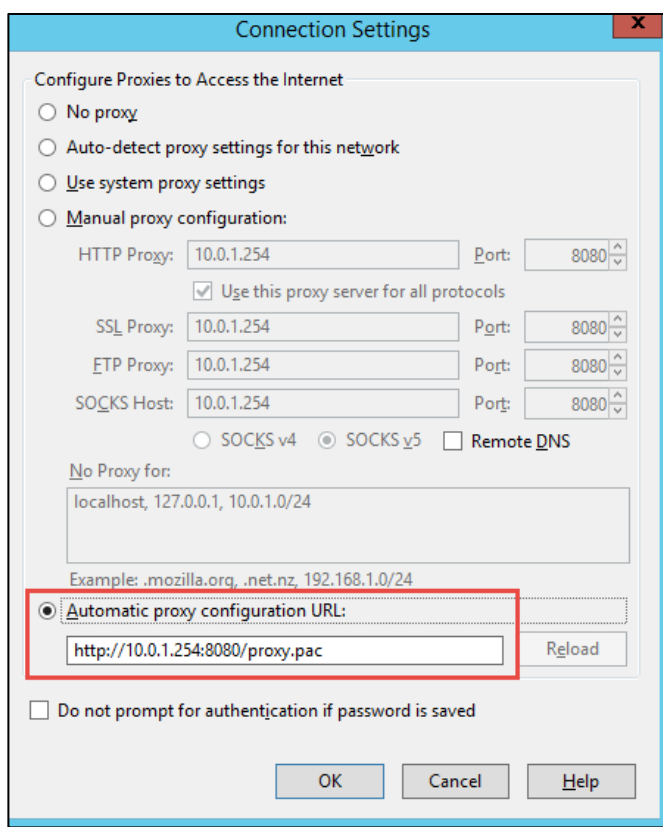
To configure Firefox to download the PAC file

1. From the Local-Windows VM open Firefox.
2. Click the **Open Menu** icon on the top right corner:



3. Select **Options**.
4. Select the **Advanced > Network** tab
5. Click **Settings**.
6. Select the option **Automatic proxy configuration URL** then type:

```
http://10.0.1.254:8080/proxy.pac
```



7. Click **OK**.
8. Close Firefox and open it again.

## Testing the PAC file

You will generate some HTTP traffic from the Local-Windows VM to test the PAC file configuration.

### To test the PAC file

1. In the Local-Windows VM, open a few tabs in Firefox and generate some HTTP traffic, such as:

<http://www.pearsonvue.com/fortinet/>

<http://cve.mitre.org>

<http://www.eicar.org>

If FortiGate asks you to authenticate, use the `student` account used previously (password `fortinet`). The traffic will go through the FortiGate proxy.

2. You will connect to a web site in the subnet 10.0.0.0/8. The browser will not use the proxy and will send the HTTP request directly to the server. Try to connect this server:

<http://10.200.1.254>

It's not working. There's something missing in the FortiGate configuration. Do you know what it is?



## Allowing Traffic that Does Not Require Proxy

The PAC file instructs the browser to not use the proxy for reaching the servers in the subnet 10.0.0.0/8. So, this is traffic that requires a regular firewall policy to be allowed and there is none. You will create the missing firewall policy. Before that, you will create an address object for the subnet 10.0.0.0/8. You will use this object as the destination address for the firewall policy.

To create an address object

1. From the Local-FortiGate GUI, go to **Policy & Objects > Addresses**.
2. Click **Create New** and select **Address**.
3. Configure the following settings:

Field	Value
Category	Address
Name	10_SUBNET
Type	IP/Netmask
Subnet / IP Range	10.0.0.0/8
Interface	any

4. Click **OK**.

To allow traffic that does not require proxy

1. From the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Click **Create New**.
3. Configure the following settings:

Field	Value
Name	10 Subnet
Incoming Interface	port3
Outgoing Interface	port1
Source	LOCAL_SUBNET
Destination Address	10_SUBNET
Schedule	always
Service	ALL
Action	ACCEPT
NAT	Enabled

4. Click **OK**.

## Testing the Traffic that Does not Require Proxy

You will test the firewall policy that allows traffic from Local-Windows VM that does not require proxy.

To test the traffic that does not require proxy

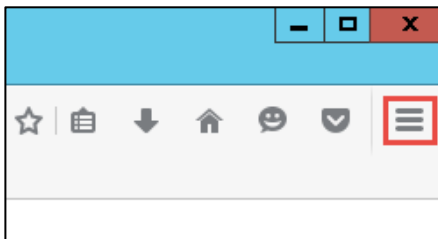
1. From Local-Windows VM, open a Firefox window.
2. Access <http://10.200.1.254> one more time. It will work now.

## Disabling the Explicit Web Proxy in Firefox

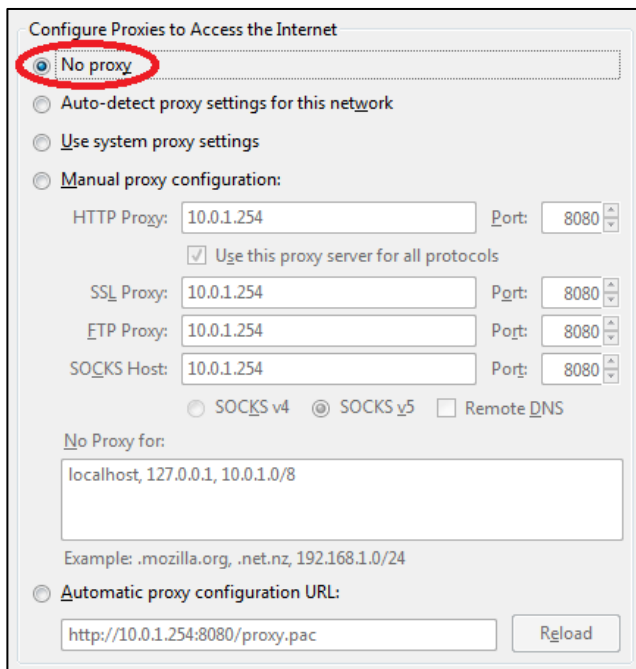
To finish the lab exercise, you will disable the proxy in Firefox.

To disable the explicit web proxy in Firefox

1. From Local-Windows VM, open Firefox.
2. Click the **Open Menu** icon on the top right corner:



3. Click **Options**.
4. Select **Advanced > Network**.
5. Click **Settings**.
6. Select **No proxy**.



7. Click **OK**.
8. Close Firefox and open it again.

## LAB 9–Antivirus

In this lab, you will configure, use, and monitor both proxy-based and flow-based antivirus scanning on Local-FortiGate.

### Objectives

- Configure proxy-based and flow-based antivirus scanning.
- Understand FortiGate antivirus scanning behavior.
- Scan multiple protocols.
- Read and understand antivirus logs.

### Time to Complete

Estimated: 20 minutes

### Prerequisites

Before beginning this lab, you must restore a configuration file to the FortiGate.

To restore the FortiGate configuration file

1. From the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM010000064692
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Tue Jul 19 05:59:20 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	3 day(s) 21 hour(s) 26 min(s)

3. Select to restore from **Local PC** and click **Upload**.

4. Browse to **Desktop > Resources > FortiGate-I > Antivirus** and select `local-antivirus.conf`.
5. Click **OK**.
6. Click **OK** to reboot.

## 1 Proxy-based Antivirus Scanning

In proxy-based scan, each protocol's proxy buffers the entire file (or waits for oversize limit) and scan it. The client must wait for the scan to finish.

In this exercise, you will configure proxy-based antivirus scanning, including associated security features (such as proxy options and deep-inspection) and apply it to the firewall policy. You will observe the behavior antivirus scanning when deep-inspection is disabled or enabled. Finally, you will view the logs and summary information for the antivirus activity.

### Configuring Proxy-based Antivirus settings

The configuration file you uploaded at the beginning of this lab already has proxy-based antivirus settings pre-configured for you. In this procedure, you will verify the settings, and enable the proxy-based antivirus profile on your firewall policy.

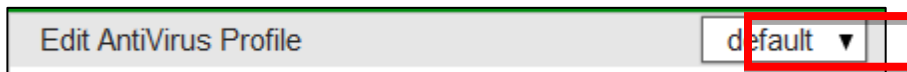
#### To review Proxy-based Antivirus Profile

1. From the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.

2. Go to **Dashboard > System Information** widget.

You will notice that **Inspection Mode** is set to **Proxy-based**.

3. Go to **Security Profiles > AntiVirus** and select the **default** antivirus profile.



4. Verify that the **Detect Viruses** is set to **Block** and **HTTP** scanning is enabled under **Inspected Protocols**.

This profile defines the behavior for virus scanning on the traffic that matches policies using that profile.

### Enabling the Antivirus Profile on a Firewall Policy

Now that your antivirus profile is configured, you must enable antivirus profile on your firewall policy. When antivirus profile is enabled on a firewall policy, it can scan for viruses and can generate logs (based on configured log settings).

#### To enable Antivirus Profile on a Firewall Policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right-click on the **Seq.#** column for **AV\_Scan** firewall policy.
3. Click **Edit**.
4. Under **Security Profiles**, enable **AntiVirus** and select **default** from the associated drop-down list.



**Note:** When selecting an antivirus profile, **Proxy Options** is automatically enabled. You cannot disable **Proxy Options**, but can select any pre-configured proxy options profile from the associated drop-down list.

5. Leave all other settings at their defaults and click **OK** to save the changes.
6. Optionally, if you would like to see the **default** proxy options profile selected in the firewall policy, go to **Security Profiles > Proxy Options**.

This profile determines how FortiGate's proxies pick up protocols. For example, The HTTP listening port is set to port 80.

## Testing the Antivirus Configuration

In this procedure, you will download the EICAR file to your Local-Windows VM. The EICAR test file is an industry-standard virus used to test antivirus detection with an undamaging test file. The file contains the following characters:

```
X5O!P%@AP[4\PZX54(P^)7CC)7}$EICAR-STANDARD-ANTIVIRUS-TEST-FILE!$H+H*
```

### To test the antivirus configuration

1. In the Local-Windows VM, launch a web browser and access the following web site:  
<http://eicar.org>
2. On the EICAR web page, click **DOWNLOAD ANTI MALWARE TESTFILE** (located in the top right-hand corner of the page) and then click the **Download** link that appears on the left.
3. Download the any of the EICAR sample files from the section **Download area using the standard protocol http**.

FortiGate should block the download attempt, and insert a replacement message similar to the following:



FortiGate shows the HTTP virus message when it blocks or quarantines infected files.

4. In the message that is displayed, click the link to view information about the detected virus on the Fortinet Virus Encyclopedia.

## Viewing the Antivirus Logs

The purpose of logs is to help you monitor your network traffic, locate problems, establish

baselines, and make adjustments to network security, if necessary.

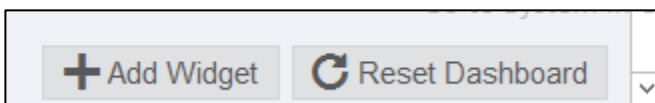
### To view the antivirus logs

1. In the Local-FortiGate GUI, go to **Log & Report > Forward Traffic**.
2. Locate the antivirus log message and double click on it.  
The **Details** tab shows forward traffic log information along with the action taken.
3. Click **Security** tab to view security log information which provides information more specific to security event such as file name, Virus/Botnet and reference to name a few.
4. You can also view antivirus security logs under **Log & Report > AntiVirus**.



**Note:** The **AntiVirus** logs section will not display if there are no AV logs. FortiGate will show it after creating logs. If this menu item does not display, log out from the FortiGate GUI and log in again to refresh it.

5. Go to the **Dashboard**.
6. Add the **Advanced Threat Protection Statistics** widget to view the summary statistics of the antivirus activity.



The **Advanced Threat Protection Statistics** widget provides statistics about the number of files submitted and the results of those scans.

## Enabling SSL Inspection on a Firewall Policy

So far you have tested the un-encrypted traffic for antivirus scanning. In order for the FortiGate to inspect the encrypted traffic, deep inspection must be enabled on the firewall policy. By enabling this feature, FortiGate will filter on traffic that is using the SSL encrypted protocol and is very similar to man-in-the-middle (MITM) attack.

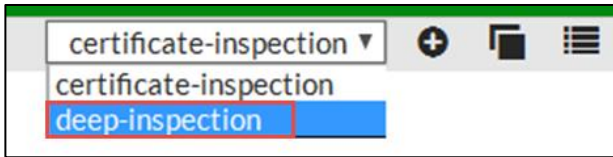
### To test antivirus scanning without SSL Inspection enabled on firewall policy

1. In the Local-Windows VM, launch a web browser and access the following web site:  
<http://eicar.org>
2. On the EICAR web page, click **DOWNLOAD ANTI MALWARE TESTFILE** and then click the **Download** link that appears on the left.
3. This time, download the EICAR sample file from the **Download area using the secure, SSL enabled protocol https** section.

Your download should succeed. FortiGate should not block the file, because we have not enabled full SSL inspection.

### To review SSL inspection profile

1. In the Local-FortiGate GUI, go to **Security Profiles > SSL/SSH Inspection**.
2. Select the **deep-inspection** profile from the dropdown on the right-hand side.



3. Review and verify the following:
  - **Inspection Method** is set to **Full SSL Inspection**.
  - **Protocol Port Mappings** have **HTTPS** enabled and set to port **443**.

To enable SSL inspection profile on a firewall policy and test it

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right-click on **Seq.#** column for **AV\_Scan** firewall policy.
3. Click **Edit**.
4. Under **Security Profiles**, enable **SSL/SSH Inspection** and select **deep-inspection** from the associated drop-down list.
5. Leave all other settings at their defaults and click **OK** to save the changes.
6. Return to the EICAR web page and attempt to download the eicar.com file from the **Download area using the secure, SSL enabled protocol https** section.



**Note:** If the FortiGate self-signed full inspection certificate is not installed on the browser, end users will see a certificate warning. In this environment, FortiGate self-signed SSL inspection certificate is installed on the browser.

7. This FortiGate should block the download and replace it with a message. If it doesn't, you may need to clear your cache. In Firefox, go to **History > Clear Recent History > Everything**.



## 2 Flow-based Antivirus Scanning

Flow-based scanning has two modes:

- Quick scan uses a compact antivirus database and performs faster scanning because it doesn't cache the file in memory.
- Full scan uses the full antivirus database. It caches the file locally, but transmits it simultaneously to end client. Everything is transmitted, except last packet. The last packet is delayed and whole file is sent to AV engine for scanning.

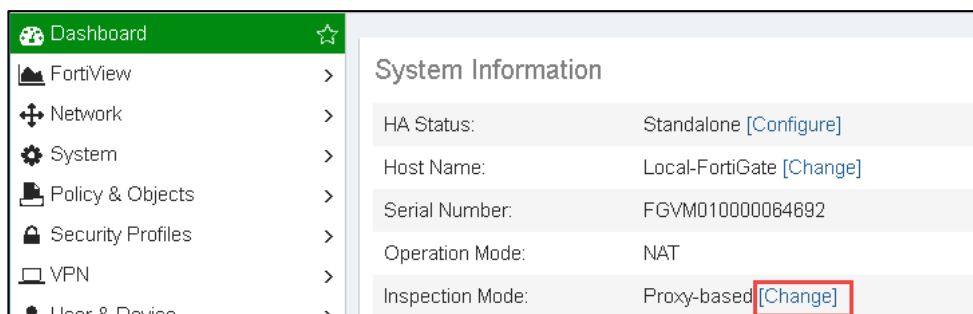
In this exercise, you will change the FortiGate inspection mode to flow-based, which will convert supported proxy-based profiles to flow-based and will remove any proxy-specific settings. You will test the flow-based scanning using FTP protocol.

### Switching FortiGate Inspection Mode

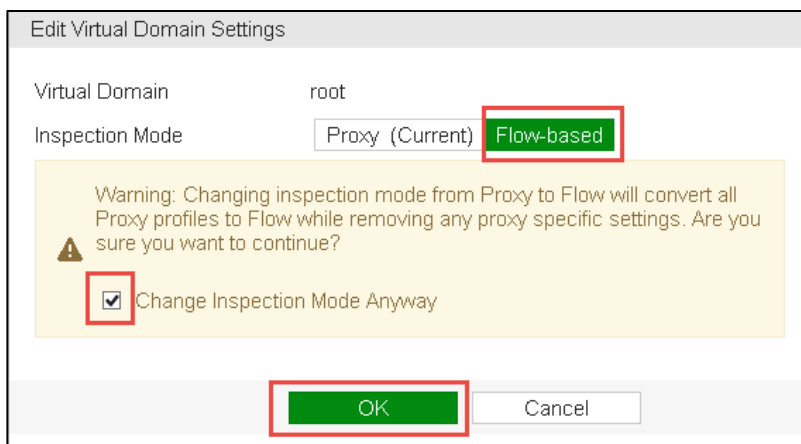
On the FortiGate, proxy-based inspection mode is enabled by default. You will be switching the inspection mode from proxy-based to flow-based.

To switch FortiGate Inspection Mode

1. From the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard > System Information** widget.
3. Click **[Change]** in the **Inspection Mode** column to change from **Proxy-based** to **Flow-based**.



4. Select **Flow-based**, accept the warning message, and click **OK** to save the changes.



**Note:** Switching from one inspection mode to another will result in the conversion of profiles and removal or addition of security features, based on the selected mode.

## Reviewing the Flow-based Antivirus Profile

Now you've changed the inspection mode to flow-based, you will view the antivirus profile to see the changes.

To review flow-based antivirus profile

1. In the Local-FortiGate GUI, go to **Security Profiles > AntiVirus**.
2. Review the **default** antivirus profile.

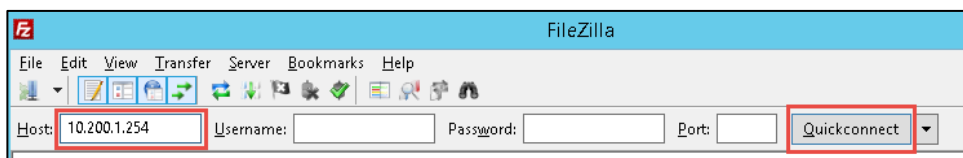
You will notice the default antivirus profile has switched from proxy-based profile to a full flow-based profile. You will also see that **Proxy Options** have been removed from under **Security Profiles**.

## Testing the Flow-based Antivirus Profile

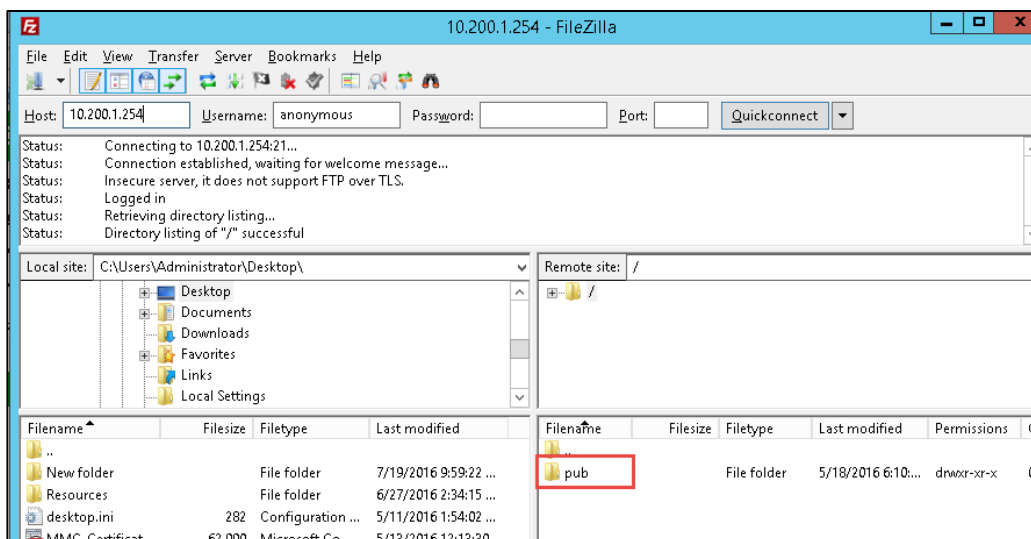
You will be now test the flow-based antivirus profile.

To test the antivirus configuration

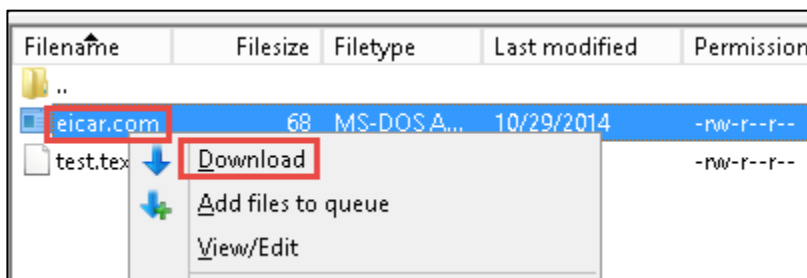
1. From the Local-Windows VM, locate and open the FileZilla FTP client software.
2. Connect to 10.200.1.254. Leave the username and password blank to use anonymous FTP.



3. On the **Remote** side, click the **pub** folder.



4. Right-click the **ecicar.com** file and select **Download**.



The client should display an error message that the server aborted the connection.



**Note:** With flow-based virus scanning, data from the file has already been sent to the client, so no immediate block message/page may appear.

## Viewing the Antivirus Logs

Now you will check and confirm the logs for the testing you just performed.

To view the antivirus logs

1. In the Local-FortiGate GUI, go to **Log & Report > Forward Traffic**.
2. Locate the antivirus logs message. Double click the log entry to select it.

The **Details** tab shows forward traffic log information along with the action taken.

3. Click the **Security** tab to view security log information. This includes information more specific to the security event such as file name, Virus/Botnet, and reference, to name a few.
4. You can also view antivirus security logs under **Log & Report > AntiVirus**.

## LAB 10–Web Filtering

In this lab, you will configure one of the most used security profiles on FortiGate: web filter. This includes configuring a FortiGuard category-based filter, applying the web filter profile on a firewall policy, testing your configuration, and basic troubleshooting.

You will also apply overrides to FortiGuard website categories and perform overrides to the web filtering profile. The web filtering overrides allow you to execute different actions, rather than the configured actions on the web filter security profile.

### Objectives

- Configure web filtering on a FortiGate device.
- Apply the FortiGuard category-based option for web filtering.
- Troubleshoot the web filter.
- Read and interpret web filter log entries.
- Configure web rating overrides.
- Configure web profile overrides.

### Time to Complete

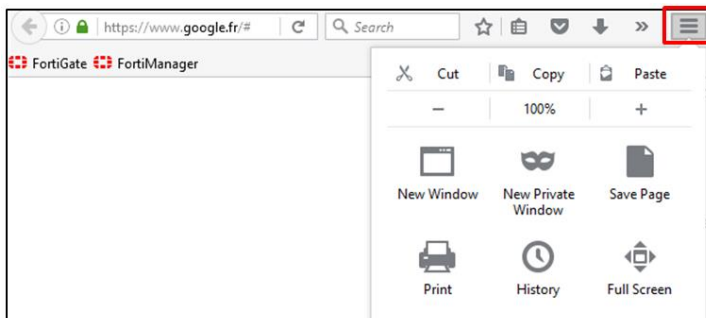
Estimated: 25 minutes

### Prerequisites

Before beginning this lab, you must clear your web browser history/cache and restore a configuration file to the Local-FortiGate.

#### To clear the web browser history

1. From the Local-Windows VM, open the browser and click the menu icon in the upper-right corner.



2. Go to **History > Clear Recent History** and select **Everything** as the time range to clear.
3. Click **Clear Now**.

To restore the FortiGate configuration file

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM010000064692
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Tue Jul 19 05:59:20 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	3 day(s) 21 hour(s) 26 min(s)

3. Select to restore from **Local PC** and click **Upload**.
4. Browse to **Desktop > Resources > FortiGate-I > Web-Filtering** and select `local-web-filtering.conf`.
5. Click **OK**.
6. Click **OK** to reboot.

## 1 FortiGuard Web Filtering

In order to configure FortiGate for web filtering based on FortiGuard categories, you must ensure FortiGate has a valid FortiGuard security subscription license. The license provides the web filtering capabilities necessary to protect against inappropriate websites.

You must then configure a category-based web filter security profile on FortiGate and apply the security profile on a firewall policy to inspect the HTTP traffic.

Finally you can test different actions taken by the FortiGate according to the website rating.

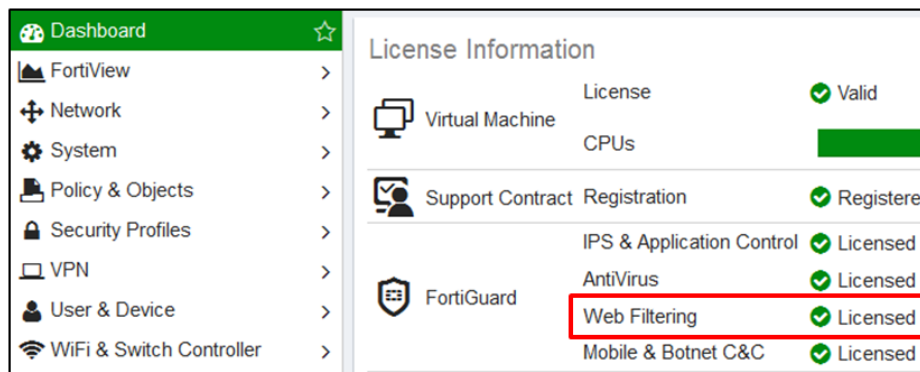
### Reviewing the FortiGate settings

You will review the inspection mode and the license status according to the uploaded settings. You will also list the FortiGuard distribution servers (FDS) that your FortiGate will use to send the web filtering requests.

To review the restored settings on FortiGate

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard**, and from the **License Information** widget, confirm that the **FortiGuard Web Filtering** service is licensed and active.

A green check mark should be displayed.



3. Open PuTTY from the Local-Windows VM, and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
4. Log in as `admin` and type the following command to check the status of the web filtering service:

```
get webfilter status
```

The `get webfilter status` and `diagnose debug rating` commands show the list of FortiGuard FDS that your FortiGate uses to send web filtering requests. In normal operations, FortiGate only sends the rating requests to the server on the top of the list. Each server is probed for round trip time (RTT) every two minutes.



## Stop and Think

Why does only one IP address appear from my network in the server list?

## Discussion

Your lab environment uses a FortiManager at 10.0.1.241, which has been configured as a local FDS server. It contains a local copy of the FDS web rating database.

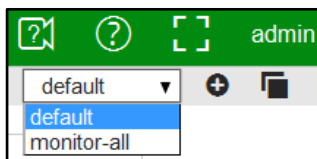
FortiGate sends the rating requests to FortiManager instead of the public FDS servers. For this reason, the output of the above command lists only the FortiManager IP address.

## Configuring a FortiGuard Category-based Web Filter

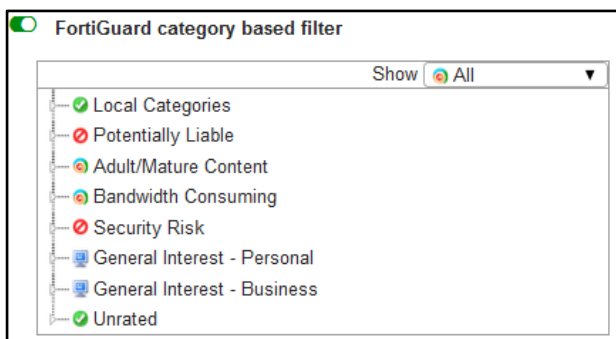
You will observe the web filtering profile by default and configure the FortiGuard category-based filter.

To configure the web-filter security profile

1. In the Local-FortiGate GUI, go to **Security Profiles > Web Filter**.
2. From the upper-right drop-down list, ensure **default** is selected as your web filter profile:



3. Enable **FortiGuard category based filter**:



4. Review the preassigned actions for each category.

Category	Action
Local Categories	Allow
Potentially Liable	Block
Adult/Mature Content	Block: <b>Other Adult Material</b> and <b>Pornography</b> Monitor : All other sub-categories
Bandwidth Consuming	Block: <b>Streaming Media and Download</b> Warning: All other sub-categories

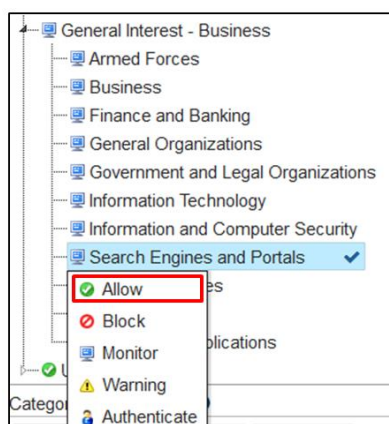


Security Risk	Block
General Interest - Personal	Monitor
General Interest - Business	Monitor
Unrated	Allow

Expand **General Interest - Business** to view the sub-categories:



5. Right-click **Search Engines and Portals** and select **Allow**:



6. Click **Apply**.

## Applying the Web Filter Profile on a Firewall Policy

Now that you have configured the web filter profile, you must enable this security profile on a firewall policy in order to start inspecting web traffic.

You will also enable the logs to store and analyze the security events generated by the web traffic.

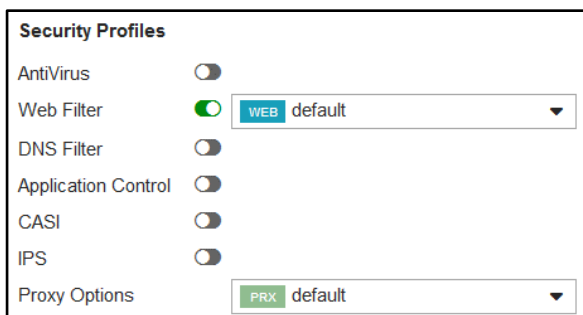
To apply a security profile on a firewall policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy** and edit policy named **Internet\_Access**.

Seq.#	Name	Source	Destination	Schedule	Service	Action	NAT	Security Profiles	Log
port3 - port1 (1 - 1)									
1	Internet_Access	all	all	always	ALL	✓ ACCEPT	✓ Enabled		✗ Disabled

2. Under the **Security Profiles** section, enable **Web Filter** and select **default**.

Note that this action enables the **Proxy Options** profile.



3. Under **Logging Options**, enable **Log Allowed Traffic** and select **Security Events** to enable the UTM log:



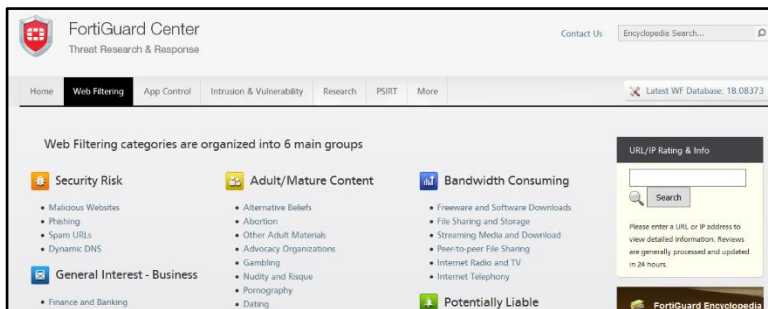
4. Keep all other default settings and click **OK**.

## Testing the Web Filter

For the purposes of this lab, you will review the website ratings and test the web filter security profile you configured for each category.

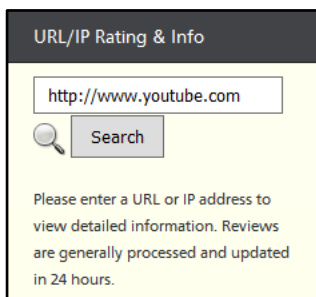
To review the FortiGuard web filtering categories

1. In the Local-Windows VM, open a browser and go to <http://www.fortiguard.com/webfilter>.



2. Use the **URL/IP Rating & Info** tool and search for the following URL:

<http://www.youtube.com>



This is one of the websites you will use later to test your web filter.

As you can see, YouTube is listed in the **Steaming Media and Download** category.

- Use the **URL/IP Rating & Info** tool again to find the rated category for the following websites:

<http://www.skype.com/>

<http://www.ask.com/>

<http://www.bing.com/>

URL/IP Rating & Info

Please enter a URL or IP address to view detailed information. Reviews are generally processed and updated in 24 hours.

URL/IP Rating & Info

Please enter a URL or IP address to view detailed information. Reviews are generally processed and updated in 24 hours.

URL/IP Rating & Info

Please enter a URL or IP address to view detailed information. Reviews are generally processed and updated in 24 hours.

You will test your web filter using these websites as well.

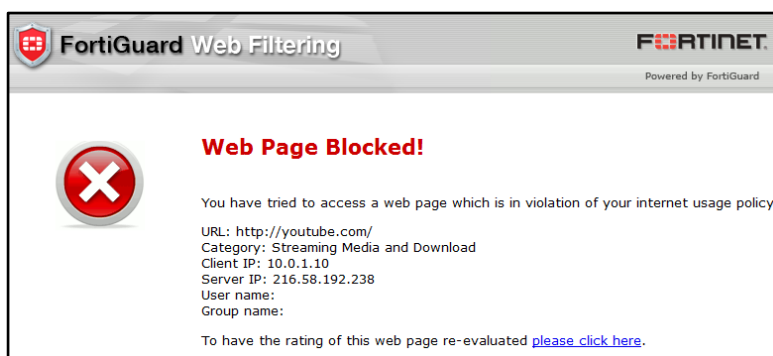
This table shows the category assigned to each URL as well as the action FortiGate will take based on your web filter security profile:

Website	Category	Action
<a href="http://www.youtube.com/">http://www.youtube.com/</a>	Streaming Media category	Block
<a href="http://www.skype.com/">http://www.skype.com/</a>	Internet Telephony	Warning
<a href="http://www.bing.com/">http://www.bing.com/</a>	Search Engines and Portals	Allow

## To test the web filter

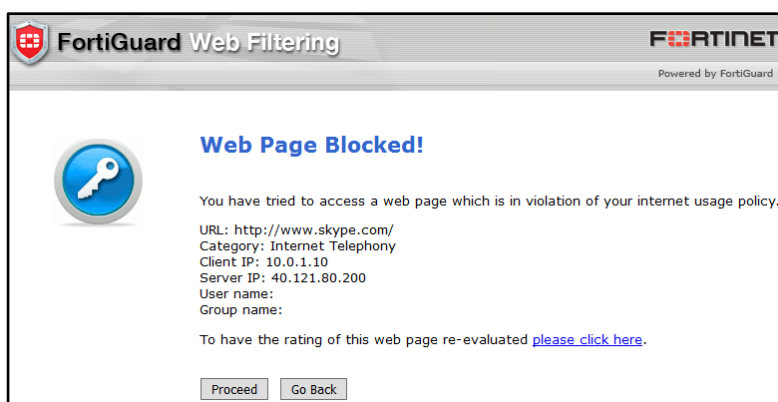
- In the Local-Windows VM, open a new browser tab and go to <http://www.youtube.com>.

A block page displays according to the predefined action for this website category.



- Open a new browser tab and go to <http://www.skype.com/>.

A warning page displays according to the predefined action for this website category.



3. Click **Proceed** to accept the warning and access the website.
4. Open a new browser tab and go to `http://www.bing.com/`.  
This website appears, as it belongs to the **Search Engines and Portals** category which is set to **Allow**.

## Creating a Web Rating Override

In the procedure you will override the category for [www.bing.com](http://www.bing.com).

To create a web rating override

1. In the Local-FortiGate GUI, go to **Security Profiles > Web Rating Overrides**.
2. Click **Create New** and configure the following settings:

Field	Value
URL	<a href="http://www.bing.com">www.bing.com</a>
Category	Security Risk
Sub-Category	Malicious Websites

3. Click **OK**.

## Testing the Web Rating Override

You will test the web rating override you created in the previous procedure. To confirm that the FortiGate is taking the local override, you will enable the real time debug for the web filtering process.

Real time debugs show what a process is doing in real time.

To troubleshoot the web filter

1. In the Local-Windows VM, open PuTTY and connect to the **LOCAL-FORTIGATE** saved session (connect over SSH).
2. Log in as `admin` and type the following commands to enable the web filtering real time debug:

```
diagnose debug application urlfilter -1
```

```
diagnose debug enable
```

3. Open a new browser tab, and try again to access the website [www.bing.com](http://www.bing.com).
4. Go back to your PuTTY CLI session and observe the output. It should be similar to the one below:

```
msg="received a request /tmp/.wad_202_0_0.url.socket, addr_len=31:  
d=www.bing.com:80, id=183, vfname='root', vfid=0, profile='default',  
type=0, client=10.0.1.10, url_source=1, url="/"
```

**Url matches local rating**

```
action=10(ftgd-block) wf-act=3(BLOCK) user="N/A" src=10.0.1.10  
sport=53863 dst=204.79.197.200 dport=80 service="http" cat=26  
cat_desc="Malicious Websites" hostname="www.bing.com" url="/"
```

The diagnostic output indicates the URL matches a local rating instead of a FortiGuard rating.

So, [http://www.bing.com/](http://www.bing.com) is blocked, because you have overridden its category rating!

5. Type the following commands to stop the real time debug:

```
diagnose debug application urlfilter 0
```

```
diagnose debug disable
```

## 2 Web Filtering Authentication

In this exercise, you will configure and test the authenticate action for web filtering categories.

### Setting Up the Authenticate Action

You will first override the category for [www.bing.com](http://www.bing.com) to **Proxy Avoidance**. After that, you will set the action for this FortiGuard category to **Authenticate**.

To override the category

1. From the Local-Windows VM, open a browser and log in as admin to the Local-FortiGate GUI at 10.0.1.254.
2. Go to **Security Profiles > Web Rating Overrides**.

There is an entry for [www.bing.com](http://www.bing.com). The override category is set to **Malicious Websites**, which is a **Security Risk** subcategory. **Security Risk** is set to **Block** by default.

URL	Override Category	Original Category	Status
www.bing.com	Malicious Websites	Search Engines and Portals	Enabled

3. Edit the rating override for [www.bing.com](http://www.bing.com) and change the category and sub-category:

Field	Value
Category	Potentially Liable
Sub-Category	Proxy Avoidance

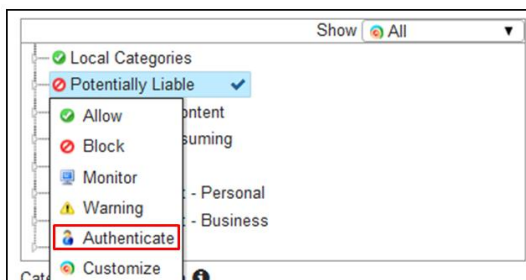


**Note:** The **Potentially Liable** category is set to **Block**, by default in your FortiGate.

4. Click **OK**.

To set up the authenticate action

1. In the Local-FortiGate GUI, go to **Security Profiles > Web Filter**.
2. Under FortiGuard categories, right-click **Potentially Liable** and select **Authenticate**.



3. The **Edit Filter** widget will appear. Use the following settings:

Field	Value
Warning Interval	5 minutes

Selected User Groups	Override_Permissions
----------------------	----------------------

- Click **OK**.
- Click **Apply**.



**Note:** For the purpose of this lab, the **Override\_Permissions** is a predefined user group. To review the user groups, go to **User & Devices > User Groups**.

## Defining Users and Groups

You will define a user in order to test the authenticate action.

To create an user

- Go to **User & Devices > User Definition**.
- Click **Create New**.
- Select **Local User** as the **User Type**.
- Click **Next** and configure the following settings:

Field	Value
User Name	student
Password	fortinet

- Click **Next**.
- Click **Next**.
- Enable **User Group** and select **Override\_Permissions** from the drop-down list.
- Click **Create**.

The **student** user is created.

User Name	Type	Two-factor Authentication	Ref.
guest	LOCAL	✖	1
student	LOCAL	✖	1

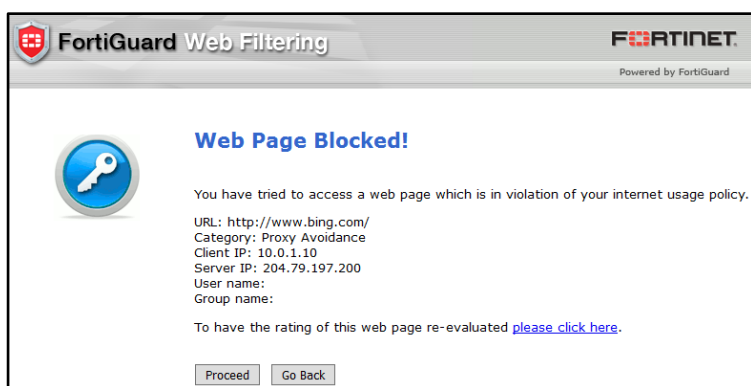
## Testing the Authenticate Action

In section, you will test access to a website with the authenticate action and then analyze the logs made by the security events.

To test the web rating override

- Open a new browser tab, and try to access <http://www.bing.com>.

A web page blocked message appears. Note that it is a different message from the one that appeared before:



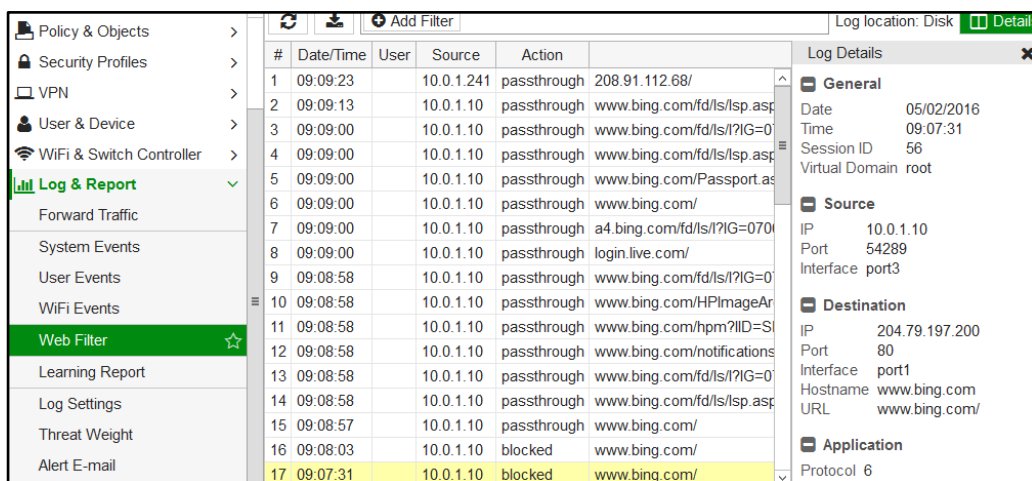
2. Click **Proceed**.
3. Enter the following credentials:

Field	Value
Username	student
Password	fortinet

This website now displays correctly.

To review the web filter logs for web rating overrides

1. Return to the Local-FortiGate GUI and go to **Log & Report > Web Filter**.



**Note:** The **Web Filter** logs section will not display if there are no web filtering logs. FortiGate will show it after creating logs. If this menu item does not display, log out from the FortiGate GUI and log in again to refresh it.

According to the logs, <http://www.bing.com> was initially blocked, but after clicking **Proceed** and authenticating, the logs show a different action: **passthrough**.

Remember, <http://www.bing.com> is rated by FortiGuard as belonging to the **Search Engines and Portals** category, where the action, by default, is set to **Allow**.

But for this website, you changed the category to **Potentially Liable**.



## 3 Web Profile Overrides

After you have tested the web rating overrides, you will test web profile overrides.

The web profile overrides feature changes the rules applied to inspected traffic. It authorizes some users, user groups, or predefined source IPs, to use a different web filter profile.

### Configure Web Profile Overrides

In this procedure, you will allow users to override blocked categories. Those users must authenticate in order to apply a different web filter profile.

To configure a Web Profile Override

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Security Profiles > Web Filter**.
3. Enable **Allow users to override blocked categories** and enter the following options:

Field	Value
Group that can override	Override Permissions
Profile can switch to	monitor-all
Switch applies to	IP
Switch duration	Predefined 0 Day(s)   0 Hour(s)   15 Minute(s)

4. Click **Apply** to save the changes.

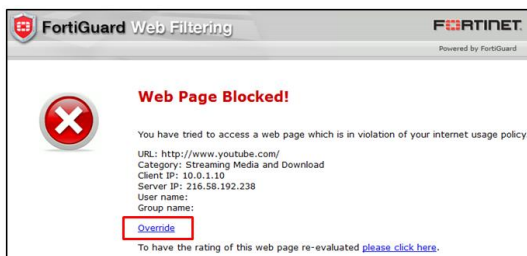
### Testing the Web Profile Override

Finally, you will test the global access for a blocked category and authenticate to apply a new web filter profile. You will also review the web filter logs to verify how actions change once the new web profile is applied.

To test the web profile override

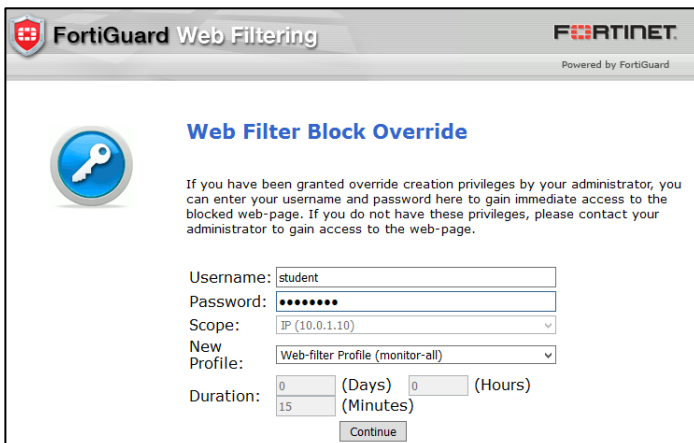
1. Open a new browser tab, and try to access `www.youtube.com`.

A block page appears according to the action for this website category. However, this block message is different from the one that appeared in exercise 1. It includes an override link at the bottom:



2. Click **Override**.

A block override message appears:



The screenshot shows the 'Web Filter Block Override' form in the FortiGuard Web Filtering interface. It includes fields for Username (student), Password (masked), Scope (IP (10.0.1.10)), New Profile (Web-filter Profile (monitor-all)), and Duration (0 Days, 0 Hours, 15 Minutes). A 'Continue' button is at the bottom.

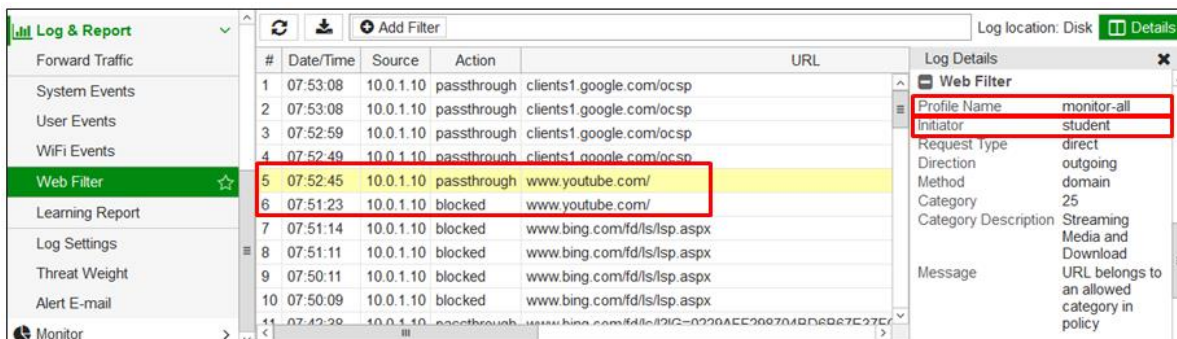
3. Enter the following credentials and click **Continue**:

Field	Value
Username	student
Password	fortinet

FortiGate overrides the default profile and allows you to access the website.

To review the web filter logs for web profile overrides

1. From the Local-FortiGate GUI, go to **Log & Report > Web Filter**.
2. Compare the current **passthrough** entries with the older **block** logs.



The screenshot shows the 'Log & Report' interface with the 'Web Filter' log selected. The log table has columns: #, Date/Time, Source, Action, and URL. The log details pane on the right shows the 'Web Filter' details for the selected entry, including Profile Name (monitor-all), Initiator (student), Request Type (direct), Direction (outgoing), Method (domain), Category (25), and Category Description (Streaming Media and Download). The message states: 'URL belongs to an allowed category in policy'.

#	Date/Time	Source	Action	URL
1	07:53:08	10.0.1.10	passthrough	clients1.google.com/ocsp
2	07:53:08	10.0.1.10	passthrough	clients1.google.com/ocsp
3	07:52:59	10.0.1.10	passthrough	clients1.google.com/ocsp
4	07:52:49	10.0.1.10	passthrough	clients1.google.com/ocsp
5	07:52:45	10.0.1.10	passthrough	www.youtube.com/
6	07:51:23	10.0.1.10	blocked	www.youtube.com/
7	07:51:14	10.0.1.10	blocked	www.bing.com/fd/ls/lsp.aspx
8	07:51:11	10.0.1.10	blocked	www.bing.com/fd/ls/lsp.aspx
9	07:50:11	10.0.1.10	blocked	www.bing.com/fd/ls/lsp.aspx
10	07:50:09	10.0.1.10	blocked	www.bing.com/fd/ls/lsp.aspx
11	07:42:28	10.0.1.10	passthrough	www.bing.com/fd/ls/lsp.aspx

3. Click **Details** at the upper-right corner. Notice the web profile used is different.

## LAB 11–Application Control

In this lab, you will configure and use the application control and cloud access security inspection (CASI) to take appropriate action on an application. You will view logs and monitor from FortiView. You will also use application control feature along with traffic shaping to limit the bandwidth of an application.

### Objectives

- Configure application control.
- Read and understand application control logs and applications from FortiView.
- Configure and monitor traffic shaping for application control.
- Configure CASI for granular control of applications.

### Time to Complete

Estimated: 25 minutes

### Prerequisites

Before beginning this lab, you must restore a configuration file to FortiGate.

To restore the FortiGate configuration file

1. From the Local-Windows VM, open a web browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Dashboard**, and from the **System Information** widget click **Restore**.

System Information	
HA Status:	Standalone <a href="#">[Configure]</a>
Host Name:	Local-FortiGate <a href="#">[Change]</a>
Serial Number:	FGVM010000064692
Operation Mode:	NAT
Inspection Mode:	Proxy-based <a href="#">[Change]</a>
System Time:	Tue Jul 19 05:59:20 2016 (FortiGuard) <a href="#">[Change]</a>
Firmware Version:	v5.4.1,build1064 (GA) <a href="#">[Update]</a>
System Configuration:	<a href="#">[Backup]</a> <a href="#">[Restore]</a> <a href="#">[Revisions]</a>
Current Administrator:	admin <a href="#">[Change Password]</a> /1 in Total <a href="#">[Details]</a>
Uptime:	3 day(s) 21 hour(s) 26 min(s)

3. From your local PC (Local-Windows VM), click **Upload** and go to **Desktop > Resources >**

**FortiGate-I > Application-Control** and select `local-application-control.conf`.

4. Click **OK**.
5. Click **OK**.

## 1 Creating an Application Control Profile

In this exercise, you will create an application control profile. The FortiGate matches the traffic in this order:

1. application overrides
2. filter overrides
3. categories

You will also view the application control logs and applications from FortiView to confirm the applications are logged correctly.

### Configuring Application Overrides

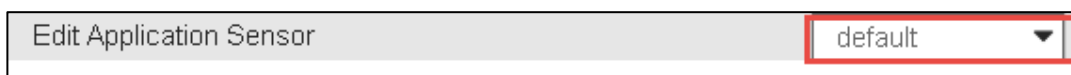
The configuration file for this exercise already has the application control categories set to monitor (except *Unknown Applications*). This allows the applications to pass, but also records a log message.

In this exercise, you will configure application overrides. The application overrides will take precedence over application categories.

To configure application overrides

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Security Profiles > Application Control**.
3. Review the **default** application control sensor.

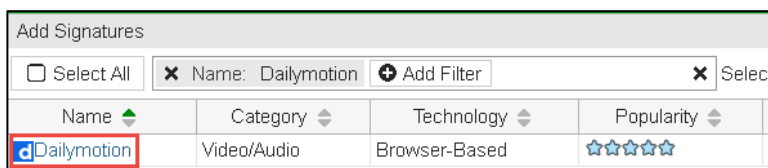
Verify that you are selecting the application sensor named **default**.



Edit Application Sensor


default

4. On the **Edit Application Sensor** page, click **Add Signatures** under **Application Overrides** to add an application signature.
5. In the **Add Signature** page, click **Add Filter**.
6. Click **Name** and type **dailymotion** in the search field.
7. From populated list, click the **Dailymotion** application to select it.
8. Click **Dailymotion**:



Add Signatures

☐ Select All    ☒ Name: Dailymotion        ☒ Select

Name	Category	Technology	Popularity
 Dailymotion	Video/Audio	Browser-Based	☆☆☆☆☆

9. Click **Use Selected Signature** at the bottom.

Your configuration should look like the following:

Application Overrides		
<div><span>+ Add Signatures</span> <span>Edit Parameters</span> <span>Delete</span></div>		
Application Signature	Category	Action
Dailymotion	Video/Audio	Block

The action for this should show as **Block**.

10. Click **Apply** at the bottom of the **Edit Application Sensor** page.

## Verifying that an Application Control Profile is Applied

The configuration file for this exercise already has the **default** application control profile added to firewall policy and you will be verifying that.

To verify that an application control profile is applied to a firewall policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right click the **Seq.#** column of the **App\_control** firewall policy.
3. Click **Edit**.
4. Under the **Security Profiles** section, verify **Application Control** is turned on and the **default** application control sensor is selected.

Security Profiles	
AntiVirus	<input type="checkbox"/>
Web Filter	<input type="checkbox"/>
DNS Filter	<input type="checkbox"/>
Application Control	<input checked="" type="checkbox"/> <span>APP default</span>

5. Click **Cancel**.

## Testing the Application Control Profile

Now your configuration is complete. You will test the application control profile by going to the application that you blocked in the application overrides configuration.

To test application control profile

1. In the Local-Windows VM, open a new web browser window and go to the following URL:  
<http://dailymotion.com>.  
You should observe that you cannot connect to this site. It times out.
2. In the Local-FortiGate GUI, go to the **Security Profiles > Application Control**.
3. Edit the **default** application sensor again.
4. Enable **Replacement Messages for HTTP-based Applications** at the bottom of the profile.

5. Click **Apply**.
6. Go to the <http://dailymotion.com> website again.  
Now FortiGate should display a block message.

## Viewing Logs

Now you will view the logs for the test you just performed.

### To view logs

1. In the Local-FortiGate GUI, go to **Log & Report > Application Control**.



**Note:** The **Application Control** logs section will not display if there are no application control logs. FortiGate will show it after creating logs. If this menu item does not display, log out from the FortiGate GUI and log in again to refresh it.

2. Search and view the log information for **Dailymotion** to confirm that this action was correctly logged.
3. Double click on the log to view more details.  
It will show you application sensor name, name, category, and the action taken by FortiGate.
4. Go to **Log & Report > Forward Traffic** and search and view the log information for **Dailymotion**.  
You can see more details about this log such as NATed IP, Bytes sent/received, action, and application.

## 2 Limiting Traffic Using Traffic Shapers

You can limit the bandwidth consumption of an application category or specific application by configuring a traffic shaping policy. You must ensure that the matching criteria aligns with the firewall policy or policies to which you want to apply shaping.

In this exercise, you will configure and apply traffic shaping to an application to limit its bandwidth consumption.

### Modifying Application Overrides Action

You will be modifying the application override for **Dailymotion** application to change the action from **Block** to **Monitor**. Then you will apply traffic shaping in the next procedure.

#### To modify Application Overrides action

1. From the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Security Profiles > Application Control**.
3. Verify that you are selecting the application sensor named **default**.
4. Under **Application Overrides**, right-click **Dailymotion** and click **Monitor**.  
This will change the action for **Dailymotion** from **Block** to **Monitor**.
5. Click **Apply**.



**Note:** In order for the traffic shaping, the signature must be allowed in application control profile.

### Configuring Traffic Shaper Policy

The traffic shaper is preconfigured for you. You will be configuring a traffic shaper policy using the pre-configured traffic shaper to limit the bandwidth use for Dailymotion.

#### To configure Traffic Shaper Policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > Traffic Shapers**.
2. For the **DAILYMOTION\_SHAPER** traffic shaper look closely at the **Max Bandwidth** column.  
You will notice that maximum amount of allowed bandwidth is very low.
3. Go to **Policy & Objects > Traffic Shaping Policy** and click **Create New**.
4. Configure the following.

Field	Value
Source	all
Destination	all



Service	ALL
Application	Dailymotion (Tip: Type the name in the search box on right hand side and click on Dailymotion to add.)
Outgoing Interface	port1 (Tip: Remember this is FortiGate egress interface.)
Reverse Shaper	Enable and apply DAILYMOTION_SHAPER
Enable this policy:	Enable

Your configuration should look like this:

New Shaping Policy

Matching Criteria

Source

all

×

Destination

all

×

Service

ALL

×

Application Category

+

Application

Dailymotion

×

URL Category

+

Apply shaper

Outgoing Interface

port1

×

Shared Shaper

▼

Reverse Shaper

DAILYMOTION\_SHAPER

▼

Per-IP Shaper

▼

Enable this policy

5. Click **OK**.



**Note:** The **Shared Shaper** option is to limit the bandwidth from ingress-to-egress, useful for limiting uploading bandwidth. **Reverse Shaper** is to limit bandwidth from egress-to-ingress, useful for limiting downloading/streaming bandwidth.



**Note:** You must ensure that the matching criteria align with the firewall policy or policies to which you want to apply shaping.

## Testing Traffic Shaping

Now that your configuration is complete, you test traffic shaping by playing a video on Dailymotion.

## To test traffic shaping

1. In the Local-Windows VM, open a web browser and go to the following URL:

<http://dailymotion.com>

2. Try to play any video.

You will notice access to this site is slow and video is taking long time to buffer and play.



**Note:** If your classroom is using a virtual lab, the underlying hardware is shared, and so the amount of available bandwidth for Internet access varies by usage by other simultaneous use. The traffic shaper is set to a very low value in order to make sure that the difference in behavior is easily noticeable. In real networks, this setting would be greater.

3. In the Local-FortiGate GUI, go to **Policy & Objects > Traffic Shapers**.
4. Review the **DAILYMOTION\_SHAPER** for **Bandwidth Utilization** and **Dropped Bytes** columns.

You might need to refresh the FortiGate GUI to view the statistics on **Traffic Shapers**.

You will notice the bandwidth utilization by the Dailymotion application and FortiGate is dropping the packets which are in excess from the configured bandwidth in the traffic shaper.



**Note:** Monitor statistics are current as of the time that you requested the GUI page, so make sure to view them while a video is downloading. Also refresh the page few times to get the results.

## 3 Configuring CASI

The CASI profile allows fine-grained control over cloud applications such as YouTube, Dropbox, and Netflix to name a few. As most of the cloud based applications uses SSL encryption, you must enable deep inspection in the firewall policy.

In this exercise, you will allow granular control over cloud based applications.

### Configuring a CASI Profile

You will be configuring a CASI profile.

To configure a CASI profile

1. On the Local-Windows VM, open a browser and log in as `admin` to the Local-FortiGate GUI at `10.0.1.254`.
2. Go to **Security Profiles > Cloud Access Security Inspection**.
3. Review the **default** CASI profile on which all the applications action is set to monitor.
4. Under **General.Interest**, change the action to **Block** for **Bing Search**.
5. Click **Apply** at the bottom.

**Optional configuration:** If you have account on [www.facebook.com](http://www.facebook.com) or [www.linkedin.com](http://www.linkedin.com), follow the steps below:

- Under **Social.Media** click on + sign besides **Facebook** and change the action to **Block** for **Login**.
- Under **Social.Media** click on + sign besides **LinkedIn** and change the action to **Block** for **Login**.
- Click **Apply** at the bottom.

### Enabling CASI and Verifying Deep Inspection is Enabled on the Firewall Policy

As most of the cloud applications are HTTPS, so remember that for those, you will also need an SSL/SSH inspection profile in the firewall policy.

**Note:** For CASI to work at all, man in the middle (MITM) must be correctly set up, without certificate warnings. Firefox uses its own certificate store, whereas Chrome and IE use Microsoft's.

In this environment, the FortiGate CA certificate for SSL inspection is preloaded into the Firefox browser.

To enable CASI and verify deep inspection is enabled on firewall policy

1. In the Local-FortiGate GUI, go to **Policy & Objects > IPv4 Policy**.
2. Right click the **Seq.#** column of the **App\_control** firewall policy and click **Edit**.
3. Under **Security Profiles**, enable **CASI** and select **default** from the associated drop-down list.
4. In the **Security Profiles**, verify that **SSL/SSH Inspection** is **enabled** and **deep-inspection** is selected.

5. Click **OK**.

## Testing CASI

Now that your configuration is complete, you test CASI by going to the application that you configured.

### To test CASI

1. In the Local-Windows VM, open a new web browser window and go to the following URL:  
<http://www.bing.com>.

2. Try to search anything such as Fortinet, Youtube, or Facebook.

The page will be blocked.

**Optional testing:** If you have account on [www.facebook.com](http://www.facebook.com) or [www.linkedin.com](http://www.linkedin.com), you can open a new web browser window and go to <https://www.facebook.com> or <https://www.linkedin.com>.

Try logging into your account. You will notice you are not able to login.

3. In the Local-FortiGate GUI, go to **Log & Reports > Application Control**.



**Note:** The **Application Control** logs section will not display if there are no application control logs. FortiGate will show it after creating logs. If this menu item does not display, log out from the FortiGate GUI and log in again to refresh it.

4. Search the logs for Bing, Facebook, or LinkedIn.

You will see similar logs as one below.

Date/Time	Source	Destination	Application Name	Action	Application User	Application Details
13:29:34	10.0.1.10	[redacted] [icon]	LinkedIn_Login	block	s.sai [redacted]	Login
13:29:21	10.0.1.10	[redacted] 6	LinkedIn	pass		
13:57:54	10.0.1.10	[redacted] [icon]	Bing_Search_Search.Phrase	block	10.0.1.10	Search Phrase: test

In this example, look at the **Application User** and **Application Details** columns.

For LinkedIn, login to LinkedIn is blocked, but access to the website is allowed in the log below.

For Bing search, it shows the search phrase.

## Appendix A: Additional Resources

Training Services	<a href="http://www.fortinet.com/training">http://www.fortinet.com/training</a>
Technical Documentation	<a href="http://docs.fortinet.com">http://docs.fortinet.com</a>
Knowledge Base	<a href="http://kb.fortinet.com">http://kb.fortinet.com</a>
Forums	<a href="https://forum.fortinet.com/">https://forum.fortinet.com/</a>
Customer Service & Support	<a href="https://support.fortinet.com">https://support.fortinet.com</a>
FortiGuard Threat Research & Response	<a href="http://www.fortiguard.com">http://www.fortiguard.com</a>

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Appendix B: Presentation Slides

## **Appendix B: Presentation Slides**





In this lesson, you will learn about FortiGate administration basics. This includes how – and where – FortiGate fits into your existing network architecture.

## Objectives

- Identify major features of FortiGate
- Differentiate between FortiGuard queries and packages
- Choose an operation mode
- Restrict administration to access via management networks
- Create administrator accounts with specific permissions
- Reset a lost admin password
- Run the built-in DNS server on an interface
- Run the built-in DHCP server on an interface
- Back up and restore configuration files
- Install new FortiGate firmware



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After completing this lesson, you should have the practical skills and knowledge of FortiGate administration fundamentals required to do the following:

- log in to your FortiGate
- create administrator accounts
- configure basic network settings, and
- use your FortiGate's GUI or CLI.

You'll also be able to set up FortiGate to act as your local network's DNS or DHCP server.

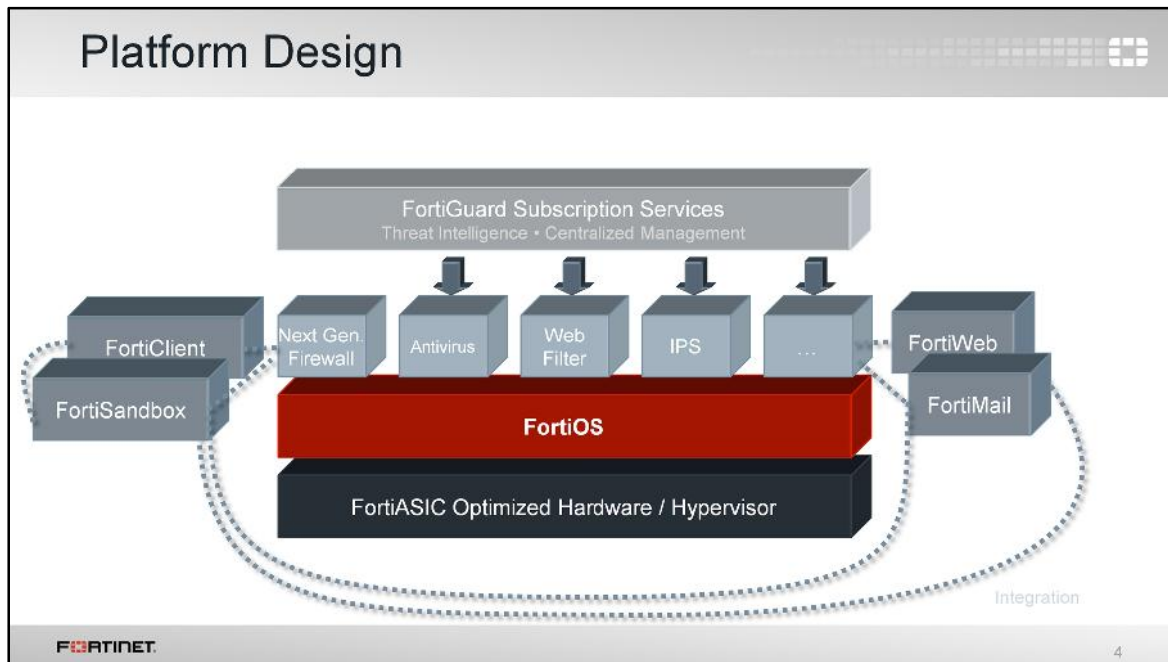
Lab exercises can help you to test and reinforce your skills.





To start, let's talk about how FortiGate is different from traditional firewalls or other vendors that you may have worked with.

From the beginning, FortiGate has been synonymous with unified threat management (UTM): a traditional firewall with specialized security devices, such as VPN gateways and IPS sensors bundled into one device. FortiGate UTM proved popular with small-to-medium businesses (SMB) and enterprises or campuses that have many branch offices. However, for managed security service providers (MSSPs) and data centers looking for the best performance, Fortinet's FortiASIC chips and next-generation firewall features have been popular instead. How can FortiGate serve all of these types of networks?

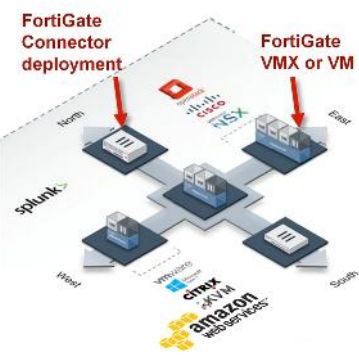


In this architecture diagram, you can see how FortiGate platforms add strength, without compromising flexibility. Like separate, dedicated security devices, FortiGates are still *internally* modular. Plus:

- **Devices add duplication.** Sometimes, dedication *doesn't* mean efficiency. If it's overloaded, can one device borrow free RAM from nine others? Do you want to configure policies, logging, and routing on 10 separate devices? Does 10 times the duplication bring you 10 times the benefit, or is it a hassle? For smaller to midsize businesses or enterprise branch offices, UTM is often a superior solution compared to separate dedicated appliances.
- **FortiGate hardware isn't just off-the-shelf.** It's carrier-grade. Underneath, most FortiGate models have one or more specialized circuits called ASICs that are engineered by Fortinet. For example, a CP or NP chip handles cryptography and packet forwarding more efficiently. Compared to a single-purpose device with only a CPU, FortiGate can have dramatically better performance. This is especially critical for data centers and carriers where throughput is business critical. (The exception? Virtualization platforms – VMware, Citrix Xen, Microsoft, or Oracle Virtual Box – have general-purpose vCPUs. But, virtualization might be worthwhile due to other benefits, such as distributed computing and cloud-based security.)
- **FortiGate is flexible.** If all you need is fast firewalling and antivirus, FortiGate won't require you to waste CPU, RAM, and electricity on other features. In each firewall policy, UTM and next-generation firewall modules can be enabled or disabled. Also, you won't pay more to add VPN seat licenses later. What requires a subscription? Only ongoing FortiGuard subscription services.
- **FortiGate cooperates.** A preference for open standards instead of proprietary protocols means less vendor lock-in and more choice for system integrators. And, as your network grows, FortiGate can leverage other Fortinet products such as FortiSandbox and FortiWeb to distribute processing for deeper security and optimal performance – a total security fabric approach.

## Topology in the Cloud

- **Deploy FortiGate in virtualized networks**
  - **FortiGate VM** – Same features as physical appliance *except* FortiASIC
  - **FortiGate VMX** – Subset of features for VMware NSX (East-West) data flows
  - **FortiGate Connector for Cisco ACI** – Subset for Cisco ACI (North-South) data flows... Integrates physical or virtual appliance
- **Faster setup & teardown: SDN + VMs**



Licenses	Max. 1 / 2 / 4 / 8 vCPU
Hypervisor	VMware, Hyper-V, KVM, Citrix Xen Server, Open Source Xen, Azure, Amazon AWS BYOL & on-demand
Memory	Max. 1/4/8/12 GB
10/100/1000 Interfaces	2-4 virtual NICs
Storage Capacity	40+ GB

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If you deploy FortiGates as *virtualized* appliances – not physical – that platform still will be familiar.

FortiGate virtual machines (VMs) have the same features as a physical FortiGate, *except* for hardware acceleration. Why? First, hypervisors' hardware abstraction layer software is made by VMware, Xen, and other hypervisor manufacturers, *not* by Fortinet. Those other manufacturers don't make Fortinet's proprietary FortiASIC chips. But there is another reason, too. The purpose of hypervisors' generic virtual CPUs and other virtual chips is to abstract the hardware details. That way, all VM guest OSs can run on a common platform, no matter the different hardware where the hypervisors are installed. Unlike vCPUs or vGPUs that use generic, *non-optimal* RAM and vCPUs for abstraction, FortiASIC chips are (by definition) specialized *optimized* circuits. Therefore, a virtualized ASIC chip would not have the same performance benefits as a physical ASIC chip.


If performance on equivalent hardware is less, you may wonder, why would anyone use a FortiGate VM? In large scale networks that change rapidly and may have many tenants, equivalent processing power and distribution may be achievable by using larger amounts of cheaper, general purpose hardware. Also, trading some performance for other benefits may be worth it. The owner can benefit strongly from faster network and appliance deployment and teardown.


FortiGate VMX and the FortiGate Connector for Cisco ACI extend this vision. They are a specialized version of FortiOS and an API that allow you to orchestrate rapid network changes through standards, such as OpenStack for software-defined networking (SDN). So:

- FortiGate VM is deployed as a guest VM on the hypervisor.
- FortiGate VMX is deployed inside a hypervisor's vNetworks, *between* guest VMs.
- FortiGate Connector for Cisco ACI allows ACI to deploy physical *or* virtual FortiGate VMs for North/South traffic.

## FortiGuard Subscription Services

- Internet connection and contract required
- Provided by FortiGuard Distribution Network (FDN)
  - Major data centers in North America, Asia, and Europe
    - Or, from FDN through your FortiManager
  - FortiGate prefers data center in nearest time zone, but will adjust by server load
- Package updates: FortiGuard Antivirus and IPS
  - [update.fortiguards.net](http://update.fortiguards.net)
  - TCP port 443 (SSL)
- Live queries: FortiGuard Web Filtering and Antispam
  - [service.fortiguards.net](http://service.fortiguards.net)
  - Proprietary protocol on UDP port 53 or 8888



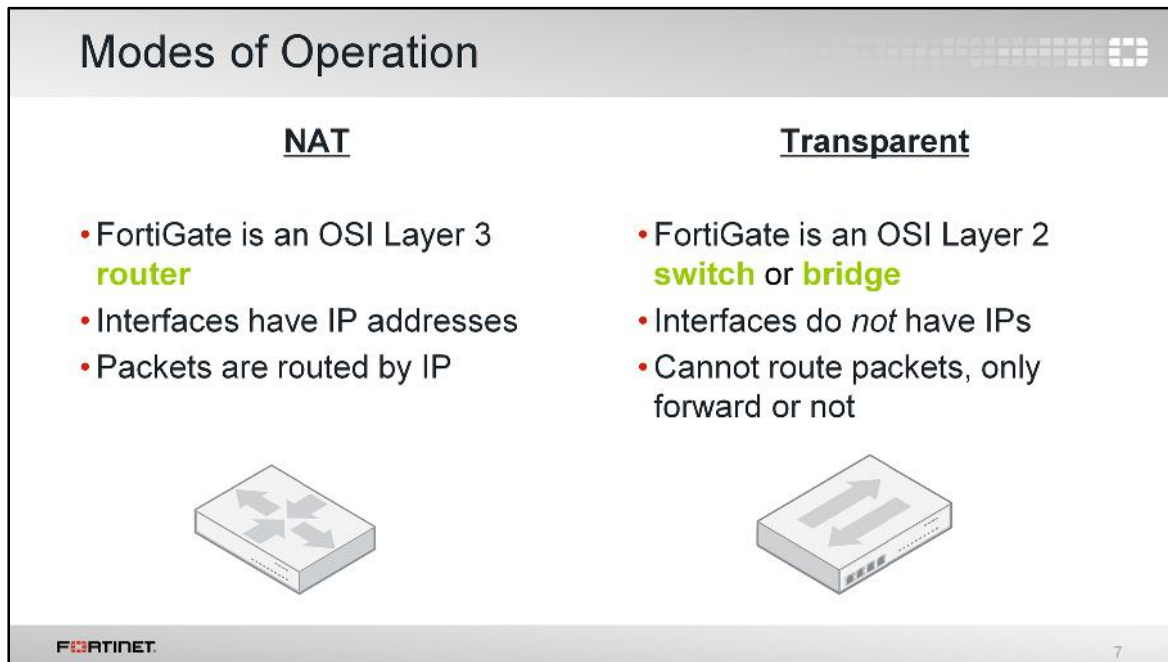
6

FortiGuard subscription services give your FortiGate access to 24 x 7 security updates powered by Fortinet's researchers. Your FortiGate uses FortiGuard in two ways:

- by periodically requesting packages that contain a new engine and many signatures, and
- by querying the FDN on an individual URL or host name.

Queries are real-time – that is, FortiGate asks the FDN every time it scans for spam or filtered websites. Also, queries use UDP for transport – they are connectionless and the protocol is not designed for fault tolerance, but for speed. So, they require that your FortiGate have a reliable Internet connection.

Downloaded packages like antivirus and IPS, however, aren't that frequent. They use TCP for reliable transport. Their associated FortiGate features continue to function even if FortiGate does not have reliable Internet connectivity. Keep in mind, though, that you should still avoid interruptions. If your FortiGate must try repeatedly to download updates, it can't detect new threats during that time.

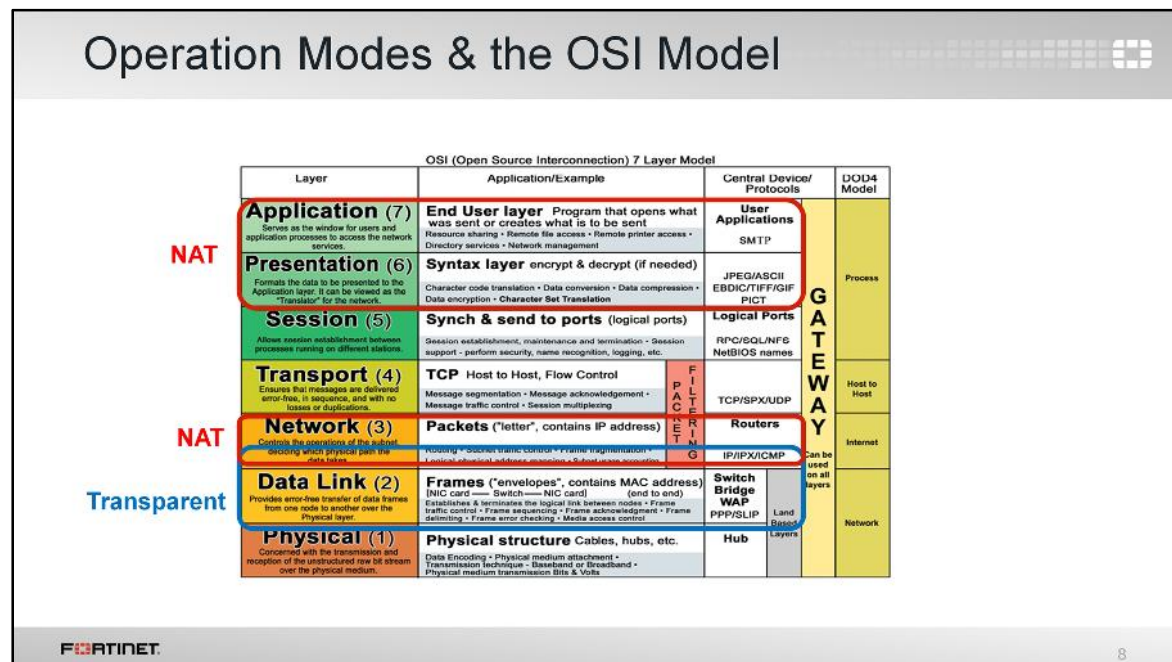


So now you've seen a simplified overview of the software architecture. What about the network architecture? Where does FortiGate fit in?

When you deploy a FortiGate, you can choose on the dashboard between two modes: NAT or transparent.

- In NAT mode, FortiGate forwards packets based on Layer 3, like a router. Each of its logical network interfaces have an IP address.
- In transparent mode, FortiGate forwards packets at Layer 2, like a switch. So, except for the management interface, its interfaces have no IP address.

Interfaces *can* be exceptions to the router vs. switch operation mode on an individual basis, however. We'll show these later.



What does that mean for your traffic, in terms of the 7-layer OSI model? Which operation mode should you choose?

NAT mode is the most common choice. In NAT mode, the destination address is the FortiGate's address. Typically, FortiGate will rewrite the destination address, and/or port number and source address in the IP network layer, into the server's private network address before forwarding the packet – in other words, it will apply NAT and port forwarding. Depending on your presentation and application layer protocols, it might also:

- Terminate SSL or TLS sessions so back-end servers don't need to decrypt
- Modify the addresses in the application layer headers, such as the Host and X-Forwarded-For addresses in the HTTP header

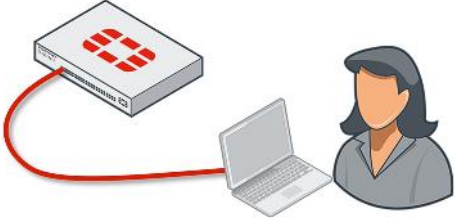
So, NAT mode works well for edge or gateway security, where you divide your private IPv4 network from an external network such as guest Wi-Fi or the Internet.


In transparent mode, the destination address is the server's address – *not* a FortiGate's interface. As a result, it usually *doesn't* need to rewrite encapsulated layers – with the exception of TCP SYN-related analysis. Only the MAC address in the frame is rewritten. So, in complex IP environments such as MSSP or mobile phone carriers, this simplifies deployment. Only the management interface needs an IP address. But because network-facing interfaces don't have an IP address, you must verify that your topology doesn't have any loops at Layer 2 – Ethernet.



## Factory Default Settings

- port1 / internal interface IP: 192.168.1.99/24
- PING, HTTP, HTTPS, and SSH protocol management enabled
- Built-in DHCP server is enabled on port1 / internal interface
  - Only on low-end models that support DHCP server
- Default login:
  - User: **admin**
  - Password: (blank)
    - Both are case sensitive
    - Modify the default (blank) root password!





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NAT mode is the default operation mode. What are the other default settings? Once you've removed your FortiGate from its box, what do you do next?

Let's take a look at how you set up a FortiGate.

Attach your computer's network cable to port1 or the internal switch ports (depending on your model) to begin setup. In most of the low-end models, there is a DHCP server on that interface, so, if your computer's network settings have DHCP enabled, your computer should automatically get an IP, and you can begin setup quickly.

To access the GUI on FortiGate or FortiWifi, open a web browser and go to `http://192.168.1.99`.


Remember: the default login is publicly available knowledge. Never leave the default password blank! Your network is only as secure as your FortiGate's `admin` account. Before you connect your FortiGate to your overall network, you should set a complex password. You should also restrict it so that FortiGate allows administrative connections only from your local console or management subnet.

## Resetting a Lost admin Password

User: maintainer  
Password: bcpb<serial-number>  
All letters in <serial-number> *must* be upper case: "FGT60..." etc.

- All FortiGate models and some other Fortinet device types
- Only after hard power cycle
  - Soft cycle (reboot) does not work for security reasons
- Only during first 30 seconds *after* boot (varies by model)
  - Tip: Copy serial number into terminal buffer, then paste
- Only through hardware console port
  - Requires physical access for security reasons
  - If compliance/risk of physical access requires, maintainer can be disabled

```
config sys global
set admin-maintainer disable
end
```



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What happens if you forget the password for your `admin` account, or a hostile employee changes it?

This recovery method is available on all FortiGate devices and even some non-FortiGate devices like FortiMail. It's a *temporary* account, only available through the local console port, and only after a hard reboot – disrupting power by unplugging or switching off the power, then restoring it. FortiGate must be physically shut off, then turned back on – not simply rebooted through the CLI. That's the difference between a hard boot and a soft boot.


Even then, the `maintainer` login will only be available for login for about 30 seconds after boot completes.


If you can't ensure physical security, or have compliance requirements, you can disable the `maintainer` account. Use caution: if you disable `maintainer` and then lose your `admin` password, you cannot recover access to your FortiGate.



## Console Port

- Each FortiGate ships with a console cable
- Console connection requires a terminal emulator
  - PuTTY
  - Tera Term
- Type varies by model
  - Older models: serial port with null model cable
  - Newer models
    - RJ-45 port with RJ-45-to-serial cable, or
    - USB 2 port to FortiExplorer





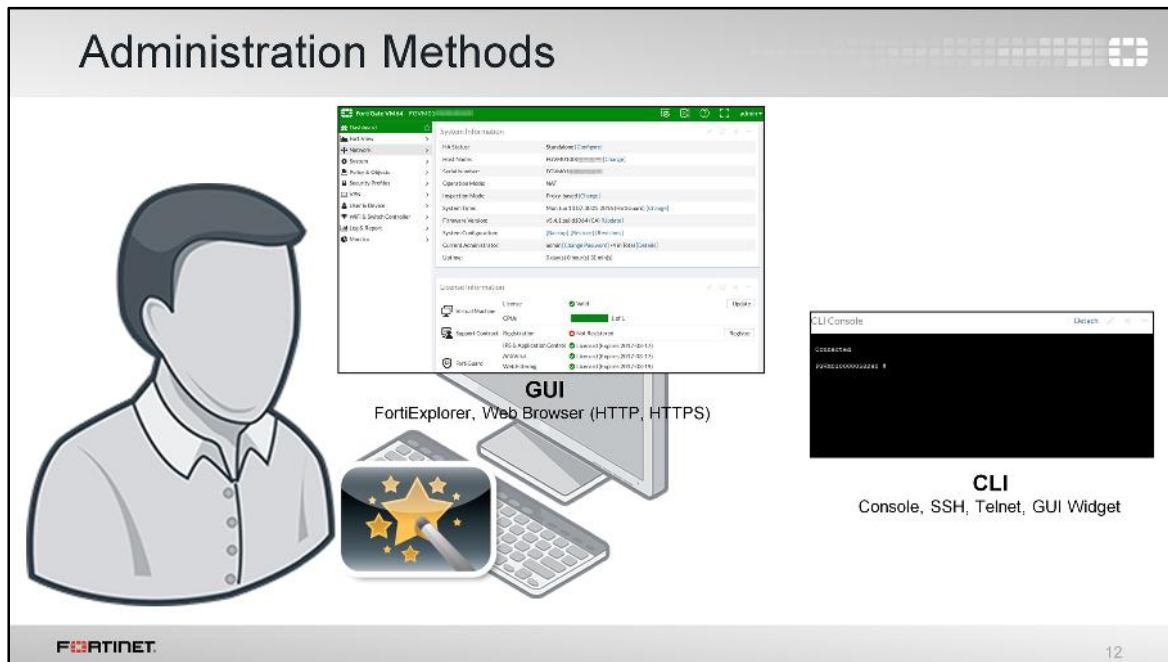
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All FortiGate models have a console port. This provides CLI access without a network.

- On older models, it's a serial port. A standard null modem cable can be used to connect the serial port to your computer's serial port.
- On newer models, it's an RJ-45 port. Access by connecting an RJ-45-to-serial cable from your computer's serial port to the RJ-45 port on the FortiGate.
- In some newer models, the console port is a USB2 port. In that case, you'll plug in the USB cable, then open FortiExplorer.

Each device ships with its appropriate cable.

Serial ports on computers are becoming less common. If your computer has one, you can purchase a USB-to-serial adapter.



Most features are available in both the GUI and CLI, but there are a few exceptions. For example, reports can't be viewed in the CLI. Also, the rarely used advanced settings and diagnostic commands for power users are usually not available in the GUI.

What if you don't want to use the GUI?

There is also a CLI. As you become more familiar with FortiGate, and especially if you want to script its configuration, you may want to use the CLI in addition to the GUI. You can access the CLI through either the JavaScript widget in the GUI named *CLI Console*, or through a terminal emulator such as Tera Term (<http://tssh2.sourceforge.jp/index.html.en>) or PuTTY (<http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html>). Your terminal emulator can connect through the network – SSH or telnet – or the local console port.

SNMP and some other administrative protocols are also supported, but they are read-only. They can't be used for basic setup. Let's focus on setup now.

Administrator Profiles

- **System > Administrator**

New Administrator

User Name: admin1

Password: [masked]

Confirm Password: [masked]

Comments: Write a comment... 0/255

Type: Local User

Match a user on a remote server group

Match all users in a remote server

Administrator Profile: super\_admin

Security

Two-factor Authentication: [checked]

FortiToken: FTKMOB63BC206AD2

Activation Email address: [checkbox]

Activation SMS number: [checkbox]

Restrict login to trusted hosts: [checked]


Whichever method you use, start by logging in as admin. Begin by creating accounts for other administrators.

It's not shown here, but instead of creating accounts on FortiGate itself, you could configure FortiGate to query a remote authentication server. You could also require personal certificates authenticated through your PKI certificate authority, instead of passwords.

Choose strong, complex passwords. For example, you could use multiple interleaved words with varying capitalization, and randomly insert numbers and punctuation. Do not use short passwords, or passwords that contain names, dates, or words that exist in any dictionary. These will be very weak against brute force attacks. To audit the strength of your passwords, use tools such as L0phtcrack (<http://www.l0phtcrack.com/>) or John the Ripper (<http://www.openwall.com/john/>). Risk of attackers brute forcing your firewall is especially high if you connect the management port to the Internet.

In order to restrict access to specific features, you can assign permissions.

Administrator Profiles: Permissions			
	None	Read	Read-Write
System Configuration	✗	✗	✓
Network Configuration	✗	✗	✓
Firewall Configuration	✗	✓	✗
VPN Configuration	✓	✗	✗
WiFi Controller	✓	✗	✗
Log & Report	✗	✓	✗

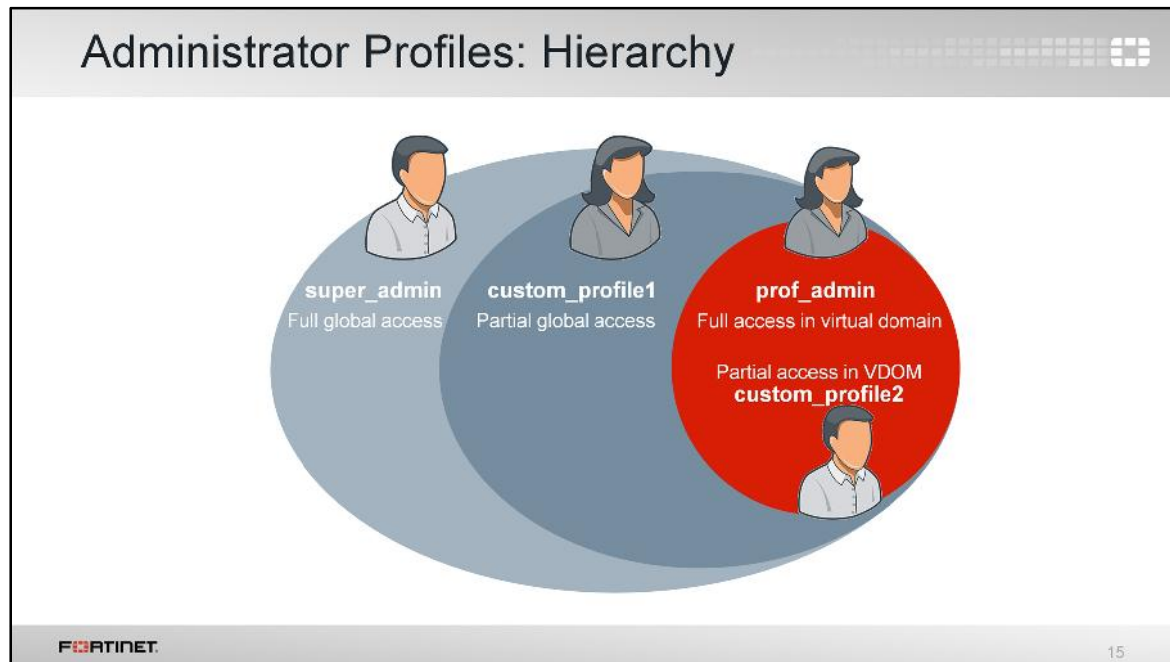


When assigning permissions in an admin profile, you can specify read-and-write, read-only, or no access to each area.

By default, there is a special profile named *super\_admin*, which is used by the account named *admin*. It cannot be changed. It provides full access to everything, making the *admin* account similar to a root superuser account.

The *prof\_admin* is another default profile. It also provides full access, but unlike *super\_admin*, it only applies to its virtual domain – not the global settings of the FortiGate. Also, its permissions can be changed.

You aren't required to use a default profile. You could, for example, create a profile named *auditor\_access* with read-only permissions. Restricting a person's permissions to those necessary for his or her job is a good best practice, because even if that account is compromised, the compromise is not complete. To do this, create administrative admin profiles, then select the appropriate profile when configuring an account.

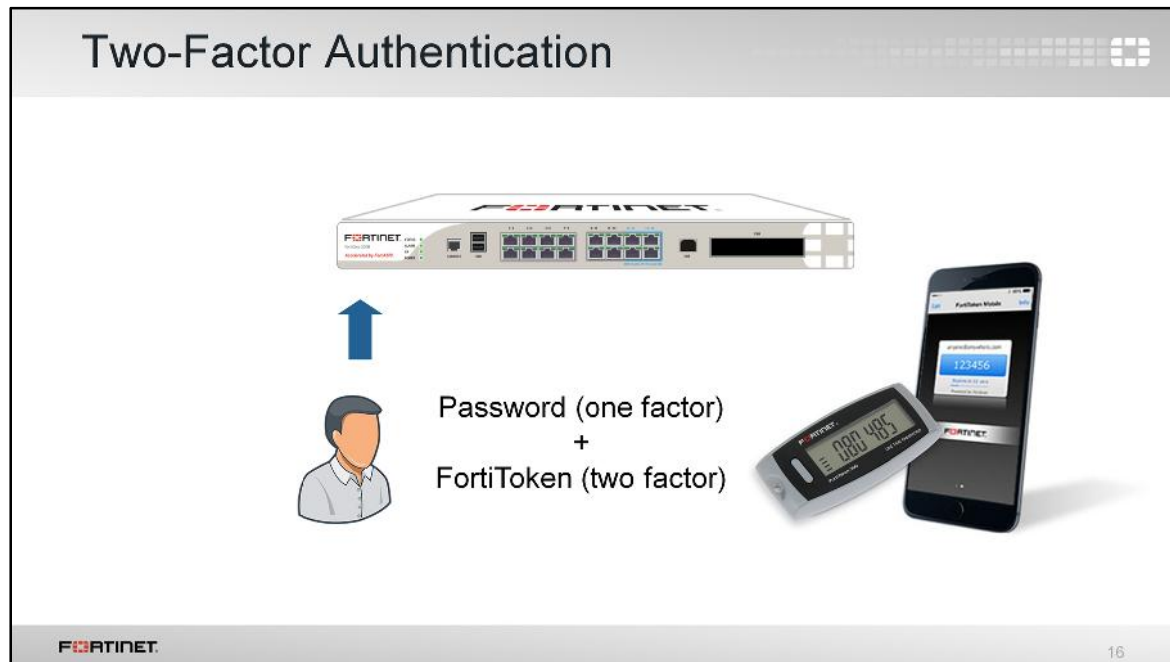


What are the effects of admin profiles?

It's actually more than just read or write access.

Depending on the type of admin profile that you assign, each administrator may not be able to access the entire FortiGate. For example, you could configure an account that can only view log messages. Administrators may not be able to access global settings outside their assigned virtual domain either. Virtual domains (VDOMs) are a way of subdividing the resources and configurations on a single FortiGate. VDOMs are explained in more detail in the *FortiGate II: Virtual Domains* lesson.

Administrators with a smaller scope of permissions cannot create, or even view, accounts with more permissions. So, for example, an administrator using the *prof\_admin* or a custom profile cannot see – or reset the password of – accounts that use the *super\_admin* profile.



To further secure access to your network security, use two-factor authentication.

Two-factor authentication just means that instead of only using one method to verify your identity – typically a password or personal certificate – you verify identity in two ways. In the example shown here, two-factor authentication would mean a password plus an RSA randomly generated number from a FortiToken that is synchronized with FortiGate.

## Other Two-Factor Authentication

**New Administrator**

User Name:

Password:

Confirm Password:

Comments:  0/255

Type:

- Local User**
- Match a user on a remote server group
- Match all users in a remote server group

Administrator Profile:

Security:

- ☒ Two-factor Authentication
- FortiToken:
- Activation Email address ☐
- Activation SMS number ☐
- ☒ Restrict login to trusted hosts

Trusted Hosts:

FortiToken is not the only option if you want to use two-factor authentication. Remember, two-factor only means that you use two methods to verify a person's identity.

Alternatively, instead of using FortiToken, FortiGate can send an email to the administrator's address, or send a text message as a form of authentication.

To be able to do this, you must first configure FortiGate with the settings of a mail server (so that it can use it to send email), or an SMS server. The mail server can be configured under the **Advanced** page in the GUI, or in the CLI. SMS settings, however, are CLI only.

## Administrative Access: Trusted Sources

- FortiGate will not respond to administrative protocols or login attempts *except* from these IPs or subnets

Type

Local User

Match a user on a remote server group

Match all users in a remote server group

Administrator Profile: super\_admin

Security

Two-factor Authentication

FortiToken: FTKMOB49AF7C8B6D

Activation Email address

Activation SMS number

Restrict login to trusted hosts

Trusted Host 1: 172.16.1.0/24

Trusted Host 2: 172.16.5.0/24

Trusted Host 3: 172.16.8.0/24

Restrict admin to guest account provisioning only

OK Cancel

Another way to secure your FortiGate is to define which hosts or subnets are trusted sources of login attempts.

Define all three, for all accounts. (If you leave any IPv4 address as 0.0.0.0/0, it means that connections from any source IP will be allowed – obviously not what you want.) Notice that each account can define its management host or subnet differently. This is especially useful if you will be setting up VDOMs on your FortiGate, where the VDOM's administrators may not even belong to the same organization.

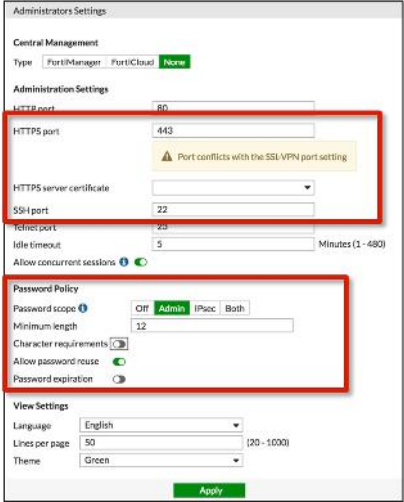
Now try to access FortiGate's GUI or CLI from an external IP. Does it work? No. Your web browser or terminal emulator won't receive a response. Not even to a ping.

Unless you connect from the network administrators' subnet, FortiGate won't allow you to even *try* to log in. So external brute force is impossible. So is discovery by ICMP.



## Administrative Access: Ports and Password

- Port numbers are customizable
- Only using secure access (SSH, HTTPS) is recommended



Administrators Settings

Central Management

Type: ☐ FortiManager ☐ FortiCloud ☒ None

Administration Settings

HTTP port: 80

HTTPS port: 443

HTTPS server certificate:

SSH port: 22

Web port: 80

Idle timeout: 5 Minutes (1 - 480)

Allow concurrent sessions: ☒

Password Policy

Password scope: ☐ Off ☒ Admin ☐ IPsec ☐ Both

Minimum length: 12

Character requirements: ☒

Allow password reuse: ☒

Password expiration: ☒

View Settings

Language: English

Lines per page: 50 (20 - 1000)

Theme: Green

Apply

You may also want to customize the administrative protocols' port numbers.

You can also choose whether to allow concurrent sessions. This can be used to prevent accidentally overwriting settings, if you usually keep multiple browser tabs open, or accidentally leave a CLI session open without saving the settings, then begin a GUI session and accidentally edit the same settings differently.

For better security, use only secure protocols, and enforce password complexity and changes.

## Administrative Access: Protocols

- Enable acceptable management protocols on each interface independently
  - Separate IPv4 and IPv6
  - IPv6 options hidden by default
- Also protocols where FortiGate is the destination IP
  - FortiTelemetry
  - CAPWAP
  - FortiManager

The screenshot shows the 'Edit Interface' configuration page for 'port1 (00:0C:29:61:9E:27)'. The 'Restrict Access' section is highlighted with a red box. It contains the following options:

- Administrative Access: ☐ HTTPS, ☒ PING, ☐ FMG-Access, ☐ CAPWAP
- ☐ SSH, ☐ SNMP, ☐ RADIUS Accounting, ☐ FortiTelemetry

The 'Status' section at the bottom shows the interface is 'Enabled'.

We've defined the management subnet – that is, the trusted hosts – for each administrator account. How do you enable or disable management protocols?

This is specific to each interface. For example, if your administrators connect to FortiGate only from port1, you should disable all administrative access on all other ports. This prevents brute force attempts and also insecure access.

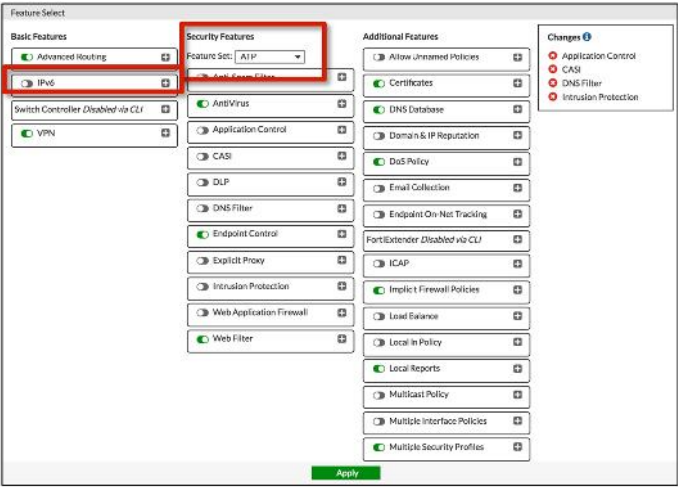
Notice that some protocols like FortiTelemetry are *not* actually for administrative access, but, like GUI and CLI access, they are protocols where the packets will have FortiGate as a destination IP – not only use FortiGate as the next hop or bridge.

For better security, it's always best to only use secure, encrypted methods of access. Some protocols – such as telnet, ICMP, HTTP, and SNMP version 1 – don't have encryption or even authentication. So they should never be enabled on public, untrusted networks.

IPv4 and IPv6 protocols are separate. It's possible, for example, to have both IPv4 and IPv6 addresses on an interface, but only respond to pings on IPv6. However, IPv6 is hidden in the GUI by default. How do you show IPv6 settings?

## Features Hidden by Default

- By default, some features like IPv6 are hidden in GUI
  - Hidden features are *not* disabled
- Hide/show via **System > Feature Select**
  - In *Feature Select*, select to hide/show groups of features commonly used together



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FortiGate has hundreds of features. If you don't use all of them, hiding features that you don't use makes it easier to focus on your work.

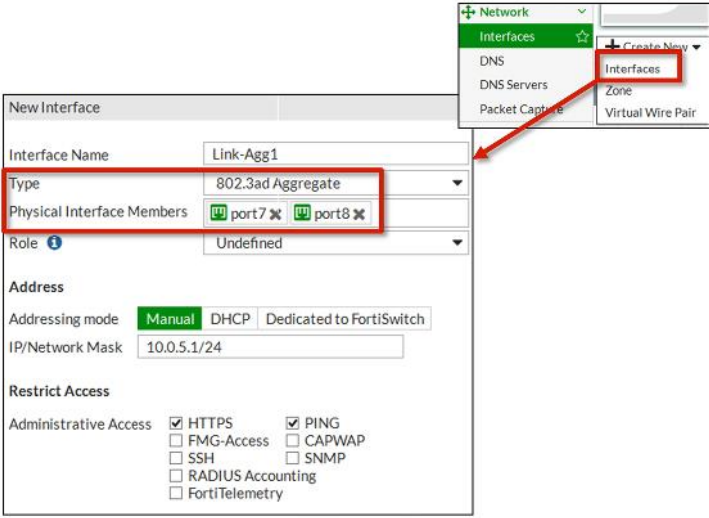
Hiding a feature in the GUI does not disable it. It is still functional, and still can be configured through the CLI.

Some advanced or less commonly used features, such as IPv6, are hidden by default.

To show hidden features, go to the **Feature Select** page.

## Link Aggregation

- Bundles several physical ports to form a single point-to-point logical channel with greater bandwidth
  - Increases redundancy for higher availability



The screenshot shows the FortiGate GUI for creating a new interface. The 'New Interface' form is open, and the 'Type' is set to '802.3ad Aggregate'. The 'Physical Interface Members' are listed as 'port7' and 'port8'. The 'Address' section shows 'Addressing mode' set to 'Manual' and 'IP/Network Mask' set to '10.0.5.1/24'. The 'Restrict Access' section shows 'Administrative Access' with checkboxes for 'HTTPS', 'SSH', 'RADIUS Accounting', 'FortiTelemetry', 'PING', 'CAPWAP', and 'SNMP'. A red box highlights the 'Type' and 'Physical Interface Members' fields. A red arrow points from the 'Interfaces' menu item in the top right to the 'New Interface' form.

Link aggregation is when multiple physical interfaces are logically bound into a single channel. Link aggregation increases bandwidth and provides redundancy between two network devices.

## Interface IPs

- In NAT mode, interfaces can't be used until they have an IP address
  - Manually assigned
  - Automatic
    - DHCP
    - PPPoE (configured through CLI)
- Exceptions: One-Arm Sniffer or FortiSwitch

Interface Name

port5 (00:0C:29:29:38:02)

Alias

Link Status

Up

Type

Physical Interface

Role

Undefined

Address

Addressing mode

Manual

DHCP

One-Arm Sniffer

Dedicated to FortiSwitch

IP/Network Mask

10.0.2.254/24

Address

Addressing mode

Status

Obtained IP/Netmask

Expiry Date

Acquired DNS

Default Gateway

Retrieve default gateway from server

Distance

Override internal DNS

Manual

DHCP

connected

10.0.0.48 255.255.255.0

June 10, 2016 12:23 AM

10.0.0.1

10.0.0.1

☒

5

☒

Renew

Once you have administrator accounts, they can configure the network interfaces.

Remember, when the FortiGate device is in NAT mode, every interface that handles traffic must have an IP address. There are two exceptions to this rule, which we will cover next. When in NAT mode, the IP address allows packets with this interface to have a source and destination at the IP layer. There are multiple ways to get an IP address:

- Manual
- Automatic, using either DHCP or PPPoE (PPPoE is configured through the CLI)

As we mentioned earlier, there are two exceptions to the IP address requirement: **One-Arm Sniffer** and **Dedicate to FortiSwitch** interfaces. These interfaces *aren't* assigned an address.

- When **One-Arm Sniffer** is selected as the addressing mode, it operates in promiscuous mode. As a result, regardless of each packet's destination address, FortiGate can inspect all traffic that arrives. So, although the *overall* FortiGate is in NAT mode, acting as a router, the One-Arm Sniffer interface does not act as a router. It receives traffic, but cannot send. There are more considerations, which are in the *FortiGate II Intrusion Prevention System* lesson.
- When **Dedicated to FortiSwitch** is selected as the addressing mode, FortiGate automatically assigns an IP address to this interface. The **Dedicated to FortiSwitch** is an interface setting that is used to manage FortiSwitch from the FortiGate.

## Interface Role Compared to Alias

- Role defines groups of interface settings typically together
  - Avoids accidental misconfiguration
  - Four types:
    - WAN
    - LAN
    - DMZ
    - Undefined (show all settings)
  - Not in list of policies
- Alias is nickname for interface
  - Used in list of policies to label interfaces by purpose

The screenshot shows two configuration windows. The top window, 'Edit Interface', is for 'port3 (00:0C:29:29:38:EE)'. It has an 'Alias' field set to 'Internal\_network' and a 'Role' dropdown menu set to 'Undefined'. The dropdown menu also shows options for 'LAN', 'WAN', and 'DMZ'. The bottom window, 'Policy & Objects > IPv4 Policy', shows a table of policies. The first policy, 'Test1', has a source of 'Internal\_network' and a destination of '10-0-1-subnet'.

Seq.#	Name	Source
1	Test1	Internal_network (port3) - port1 (1-3)
2	Test2	10-0-1-subnet

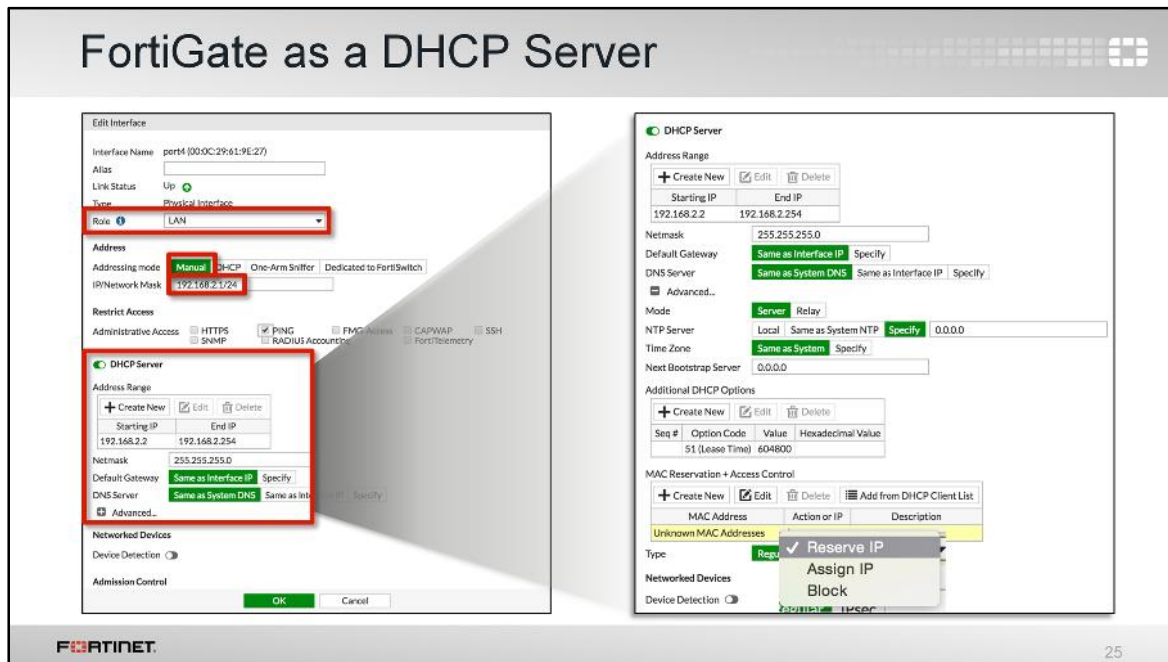
How many times you have seen network issues caused by a DHCP server – not client – enabled on the WAN interface?

Beginning in FortiOS 5.4.0, you can configure the interface's role. Roles show only normal interface settings for that part of a topology. Settings that do not apply to the current role are hidden. This prevents accidental misconfiguration.

For example, when the role is configured as **WAN**, there is no DHCP server, device detection, and secondary IP address configuration available. Device detection is usually used to detect devices internally on your LAN; that is, you won't offer IP addresses to all hosts on the Internet, and so on.

If there is an unusual case, and you need to use an option that's hidden by the current role, you can always switch the role to **Undefined**. This displays all options.

To help you remember the use of each interface, you can give them aliases. For example, you could call port3 *lab\_network*. This can help to make your list of policies easier to comprehend.

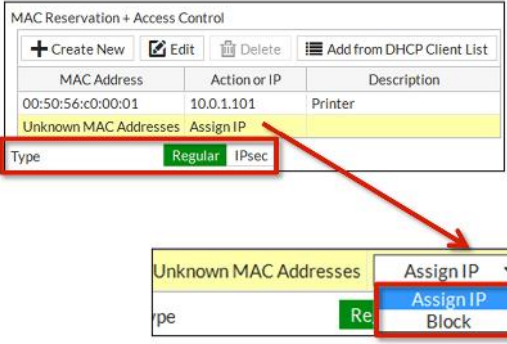


Wireless clients aren't the only ones that can use FortiGate as their DHCP server.

For an interface (such as port3), select the **Manual** option, enter a static IP, and then enable the **DHCP Server** option. Options for the built-in DHCP server will appear, including provisioning features, such as DHCP options and MAC reservation. You can also block specific MAC addresses, as if there were a Layer 2 firewall policy.

## DHCP Server: IP Reservation

- Reservations re-assign IP address to the same host
  - To reserve, select IP address or choose existing DHCP lease
  - Identify reservation as either:
    - Regular (over Ethernet)
    - Over IPsec
- FortiGate uses host's MAC address to look up its IP address in reservation table
- Actions if MAC is unknown



MAC Reservation + Access Control

MAC Address	Action or IP	Description
00:50:56:c0:00:01	10.0.1.101	Printer

Unknown MAC Addresses Assign IP

Type Regular IPsec

Unknown MAC Addresses Assign IP


Type Re Assign IP Block

For the built-in DHCP server, you can reserve specific IP addresses for devices with specific MAC addresses. Those devices will always receive the same lease, *unless* the number of devices exceeds the size of the IP pool.



## FortiGate as a DNS Server

- Resolves DNS lookups from internal network
  - Enabled per interface
  - Not appropriate for Internet service due to load
- One DNS database can be shared by all FortiGate interfaces
  - Can be separate per VDOM
- Resolution methods:
  - Forward — Relay requests to the next server (in DNS settings)
  - Non-recursive — Use FortiGate DNS database only; drop unresolvable queries
  - Recursive — Use FortiGate DNS database first; relay unresolvable queries to next server (in DNS settings)

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Like with DHCP, you can also configure FortiGate to act as your local DNS server. You can enable and configure DNS separately, on each interface.

A local DNS server can improve performance for your FortiMail or other devices that use DNS queries frequently. If your FortiGate offers DHCP to your local network, DHCP can be used to configure those hosts to use FortiGate as both the gateway and DNS server.


FortiGate can answer DNS queries in one of three ways:

- by relaying all queries – that is, acting as a DNS relay instead of a DNS server,
- by relaying only the queries it can't resolve to your ISP's DNS server, or
- by returning a null response if it can't resolve queries itself.

Beginning with FortiOS 5.4, you can configure all modes in the GUI, without using the CLI.

## DNS Forwarding

- Forwarding allows DNS control without local FQDN database
- Sends query to external DNS server



**DNS Service on Interface**

Create New Edit Delete

	Interface	Mode
<input type="checkbox"/>	port3	Forward to System DNS

**DNS Database**

Create New Edit Delete


	DNS Zone	Domain Name	Type	View	TTL	# of Entries
--	----------	-------------	------	------	-----	--------------

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If you choose the DNS forwarding option, you can control DNS queries within your own network, without having to enter any DNS names in FortiGate's DNS server.

## DNS Database: Configuration

- Add DNS zones
  - Each zone has its own domain name
  - RFC 1034 and 1035
- Add DNS entries to each zone
  - Host name
  - IP address it resolves to
  - Types supported:
    - IPv4 address (A) or IPv6 address (AAAA)
    - Name server (NS)
    - Canonical name (CNAME)
    - Mail exchange (MX) server
    - IPv4 (PTR) or IPv6 (PTR)

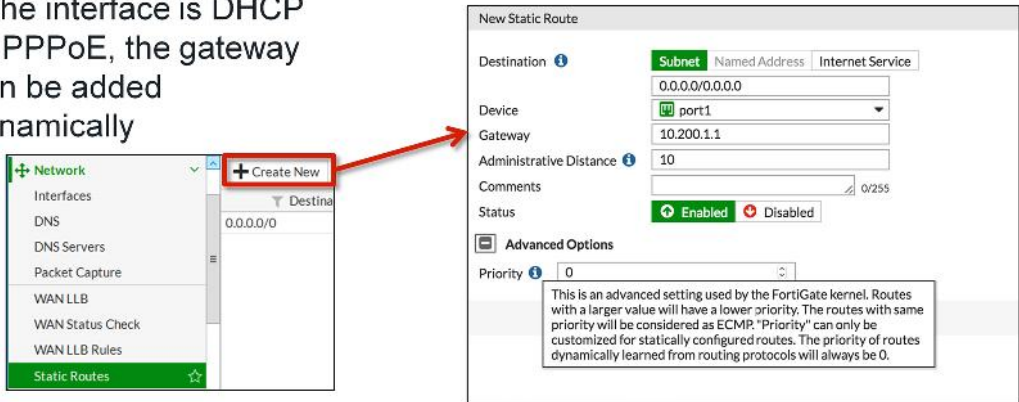
29

If you choose to have your DNS server resolve queries, or you choose a split DNS, you must set up a DNS database on your FortiGate.

This defines the host names that FortiGate will resolve queries for. Use the zone file syntax outlined by RFCs 1034 and 1035.

## Static Gateway

- Must be at least one default gateway
- If the interface is DHCP or PPPoE, the gateway can be added dynamically



The screenshot displays the FortiGate configuration interface. On the left, the 'Static Routes' menu item is highlighted. A red box encloses the '+ Create New' button, with a red arrow pointing to the 'New Static Route' configuration window. This window contains the following fields: 'Destination' (0.0.0.0/0.0.0.0), 'Device' (port1), 'Gateway' (10.200.1.1), 'Administrative Distance' (10), 'Comments' (empty), 'Status' (Enabled), and 'Advanced Options' (Priority: 0). A tooltip for the Priority field states: 'This is an advanced setting used by the FortiGate kernel. Routes with a larger value will have a lower priority. The routes with same priority will be considered as ECMP. "Priority" can only be customized for statically configured routes. The priority of routes dynamically learned from routing protocols will always be 0.'

Lastly, before you can integrate FortiGate into your network, FortiGate must have a default gateway.


If FortiGate gets its IP address through a dynamic method such as DHCP or PPPoE, then it will also retrieve the default gateway.

Otherwise, you must configure a static route. Without this, FortiGate will not be able to respond to packets outside the subnets directly attached to its own interfaces. It probably also won't be able to connect to FortiGuard for updates, and may not properly route traffic.

Routing details are covered in another lesson. For now, you should usually make sure that FortiGate has a route that matches all packets (destination is 0.0.0.0/0), and forwards them through the network interface that is connected to the Internet, to the IP address of the next router.

Routing completes the basic network settings that are required before you can configure firewall policies.

## Configuration Files



- Configuration can be saved to an external device
  - Optional encryption
  - Can back up automatically
    - Upon logout
    - Not available on all models
- To restore a previous configuration, upload file
  - Reboots FortiGate

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Now that FortiGate has basic network settings and administrative accounts, let's look at how to back up the configuration.

You can encrypt configuration files with a password, if necessary. Besides securing the privacy of your configuration, it also has some effects you may not expect. Once encrypted, the configuration file cannot be decrypted without the password and a FortiGate of the same model and firmware. This means that if you send an encrypted configuration file to Fortinet Technical Support, even if you give them the password, they still cannot load your configuration until they get access to the same model of FortiGate. This can cause unnecessary delays when resolving your ticket.

Even if the configuration is not encrypted as a *whole*, each password is encrypted individually. So in many cases, encrypting the entire configuration file may not be necessary.

If you enable virtual domains, subdividing the resources and configuration of your FortiGate, each VDOM administrator can back up and restore their own configurations. You don't have to back up the entire FortiGate configuration.

## Configuration File Format

**Plain Text**

```
#config-version FW60D5.04 FW-build 1064  
131031:opmode=0:username=admin:conf_file_ver=10488  
925954160275734#buildno=1064#global_vdom=1
```

**Encrypted**

```
#FGBK[0]FW60D5[04]1064
```

- Only non-default and important settings (smaller file size)
- Header shows device model and firmware
  - After the header, the encrypted file is not readable
- Restoring configuration
  - Encrypted? Same device/model + build + password required
  - Unencrypted? Same model required
    - Different build OK if upgrade path is supported

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If you open the configuration file in a text editor, you'll see that both encrypted and unencrypted configuration files contain a clear text header that contains some basic information about the device. The diagram shown here shows what information is included.

To restore an encrypted configuration, you must upload it to the same model of FortiGate, with the same firmware version, then provide the password.

To restore an unencrypted configuration file, you are only required to match the FortiGate model. If the firmware is different, FortiGate will attempt to upgrade the configuration, similar to how it uses upgrade scripts on the existing configuration when upgrading firmware.


Usually, the configuration file only contains non-default settings, plus a few default, yet crucial, settings. This minimizes the size of the backup, which could otherwise be several MB in size.

## Upgrade

System Information

HA Status:	Standalone [Configure]
Host Name:	Local-FortiGate [Change]
Serial Number:	FGVMEV0000000000
Operation Mode:	NAT
Inspection Mode:	Proxy-based [Change]
System Time:	Thu Jun 9 17:06:19 2016 (FortiGuard)
Firmware Version:	v5.4.1.build1064 (GA) <b>[Update]</b>
System Configuration:	[Backup] [Restore] [Revisions]
Current Administrator:	admin [Change Password] / 2 in Total [Details]
Uptime:	0 day(s) 10 hour(s) 32 min(s)

1. Back up configuration (full config backup from CLI).
2. Download copy of current firmware in case reversion is needed.
3. Have physical access, or terminal server connected to local console, in case reversion is needed.
4. **READ RELEASE NOTES** (upgrade path, other useful information).
5. Upgrade.

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Upgrading the firmware on a FortiGate is simple. The easiest method is to click the **Update** link on the **System Information** widget on the dashboard, then choose a firmware file that you have downloaded from `support.fortinet.com`.


If you want to make a clean install by overwriting both the existing firmware and its current configuration, you can do this using the local console CLI, within the boot loader menu, while FortiGate is rebooting. However, this is not the usual method.

## Downgrade

System Information

HA Status:	Standalone [Configure]
Host Name:	Local-FortiGate [Change]
Serial Number:	FGVMEV000000000
Operation Mode:	NAT
Inspection Mode:	Proxy-based [Change]
System Time:	Thu Jun 9 17:06:19 2016 (FortiGuard)
Firmware Version:	v5.4.1.build1064 (Go [Update])
System Configuration:	[Backup] [Restore] [Revisions]
Current Administrator:	admin (Change Password) / 2 In Total [Details]
Uptime:	0 day(s) 10 hour(s) 32 min(s)

1. Get the pre-upgrade configuration file.
2. Download a copy of current firmware in case reversion is needed.
3. Have physical access, or terminal server connected to local console, in case reversion is needed.
4. READ RELEASE NOTES (Does downgrade preserve config?).
5. Downgrade.
6. If required, upload configuration that matches firmware version.

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You can also downgrade the firmware. Since settings change in each firmware version, you should have a configuration file in the syntax that is compatible with the firmware.

Remember to read the release notes. Sometimes a downgrade between firmware versions that preserves the configuration is not possible, such as when the OS changed from 32-bit to 64-bit. In that situation, the only way to downgrade is to format the disk, then reinstall.

Once you've determined the downgrade is possible, verify everything again, then start the downgrade. After the downgrade completes, restore a configuration backup that is compatible with that version.


Why should you keep emergency firmware and physical access?

Old firmware versions don't know how to convert future configurations. Also, when upgrading through a path that is not supported by the configuration translation scripts, you *might* lose all settings except basic access settings, such as administrator accounts and network interface IP addresses. Another rare, but possible, scenario is that the firmware could be corrupted when you are uploading it. For all of those reasons, you should always have local console access during an upgrade, in case of emergency. However, in practice, if you read the release notes and have a reliable connection to the GUI or CLI, it should not usually be necessary.



## Review

- ✓ Key FortiGate features
- ✓ FortiGuard services
- ✓ Administrators and permissions
- ✓ Operating mode differences
- ✓ Basic network settings
- ✓ Console ports
- ✓ How to show and hide features in the GUI
- ✓ Built-in DHCP and DNS servers
- ✓ Configuration backup and restoration
- ✓ Upgrade and downgrade



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To review, these are the topics that we just talked about.


We looked at how FortiGate can replace multiple single-purpose devices, yet increase power efficiency and throughput. We explained the differences between FortiGuard services, and how those are part of the UTM architecture. We showed how to configure administrator accounts, permissions, and how to harden administrative access. We also explained how to choose the operation mode based upon the behavior you need for each network interface, how to configure the network settings, and finally how to back up the configuration and install firmware.




In this lesson, we'll examine logging and monitoring on the FortiGate.

## Objectives

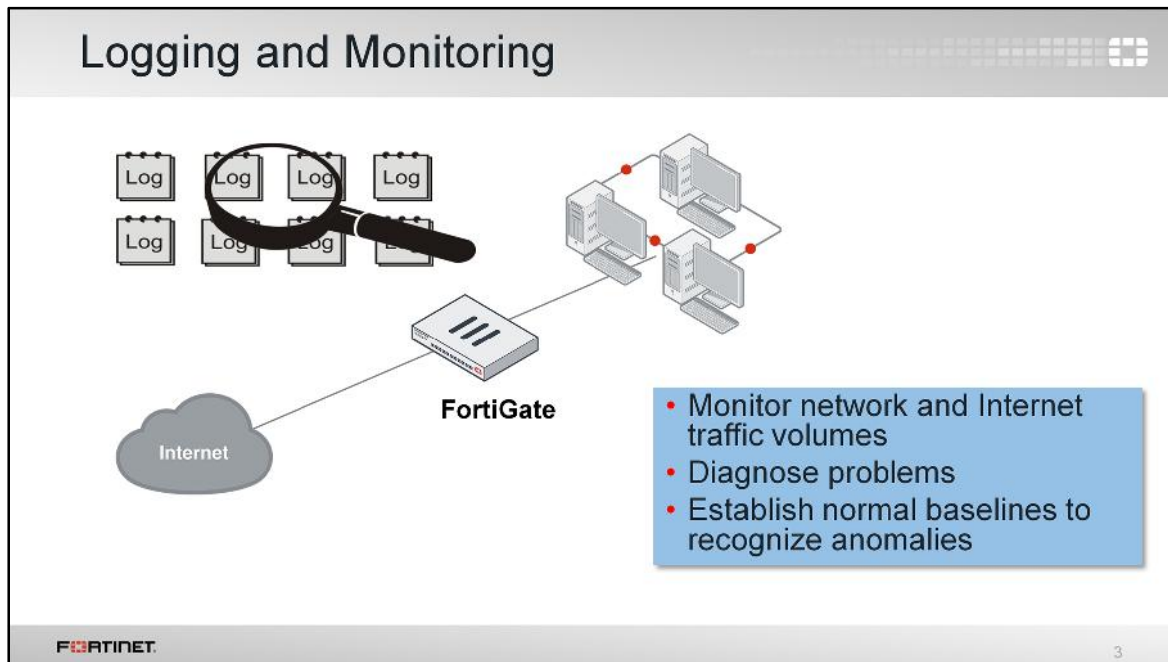
- Describe log types and subtypes
- Describe log severity levels
- Describe log format (header and body)
- Identify log storage locations
- Configure log settings
- Configure remote logging
- Enable logging on firewall policies
- View, filter, download, and export logs
- Monitor your network
- Configure alert email
- Configure, run, and view reports



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After completing this lesson, you should have these practical skills that you can use to better secure your network through logging and monitoring. This includes:

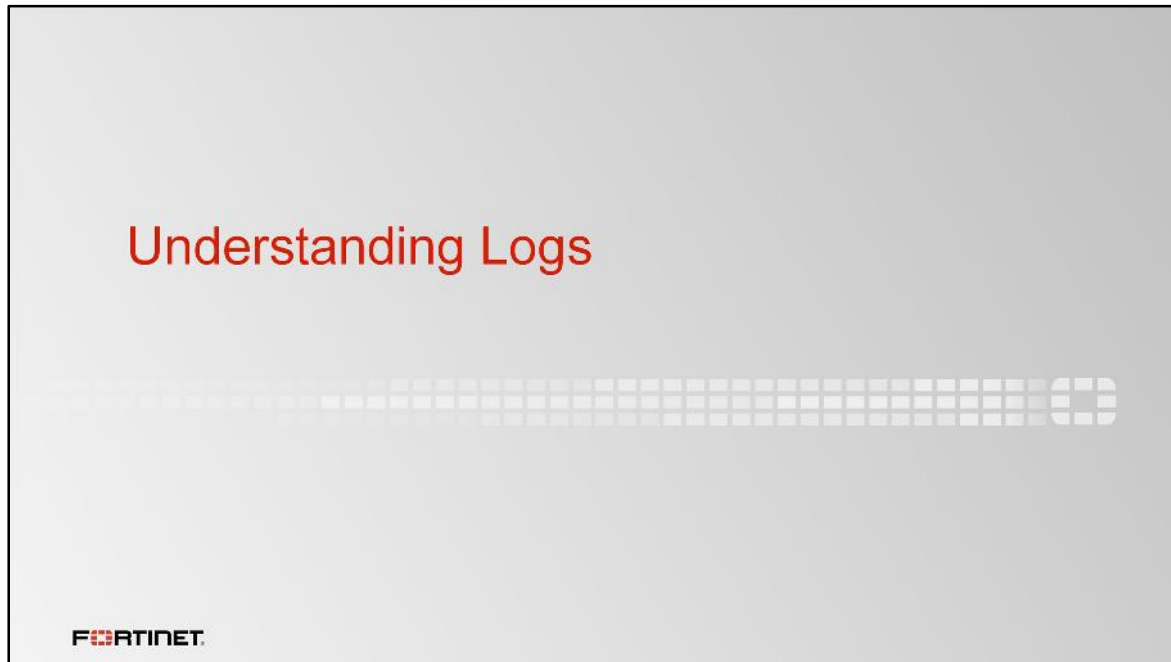
- Describing log types and subtypes
- Describing log severity levels
- Describing log format (header and body)
- Identifying log storage locations
- Configuring log settings
- Configuring remote logging
- Enabling logging on firewall policies
- Viewing, filtering, downloading, and exporting logs
- Monitoring your network
- Configuring alert email
- Configuring, running, and viewing reports



When traffic passes through FortiGate to your network, FortiGate scans the traffic and then takes action based on the firewall policies in place. This activity is recorded and the information is contained in a log message. The log message is stored in a log file that is then stored on a device capable of storing logs, such as FortiGate or an external storage device.

The purpose of logs is to help you monitor your network traffic, locate problems, establish baselines, and more. Logs provide you with a greater perspective of your network, allowing you to make adjustments to your network security, if necessary.

Some organizations have legal requirements when it comes to logging, so it is important to be aware of your organization's policies during configuration.




In this section, we will briefly examine logs, including log types and subtypes, log severity levels, and log message layout.

Log Types and Subtypes		
Traffic	Event	Security
Forward	Endpoint Control	Application Control
Local	High Availability	Antivirus
Sniffer	System	Data Leak Prevention (DLP)
	User	Anti-Spam
	Router	Web Filter
	VPN	Intrusion Prevention System (IPS)
	WAD	Anomaly (DoS-policy)
	Wireless	WAF

WAN optimization logs are found within traffic logs.

GPRS Tunneling Protocol (GTP) logs are now handled separately from default event logs.

If no security logs exist, the log menu item does not appear under the **Log & Report** menu.

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On FortiGate, there are three different types of logs: traffic logs, event logs, and security logs. Each type is further divided into sub-types.

Traffic logs record traffic flow information, such as an HTTP/HTTPS request and its response, if any. It contains subtypes named forward, local, and sniffer.

- Forward traffic logs contain information about traffic that FortiGate either accepted or rejected according to a firewall policy.
- Local traffic logs contain information about traffic directly to and from the FortiGate's management IP addresses. They also include connections to the GUI and FortiGuard queries.
- Sniffer logs contain information related to packet capture.

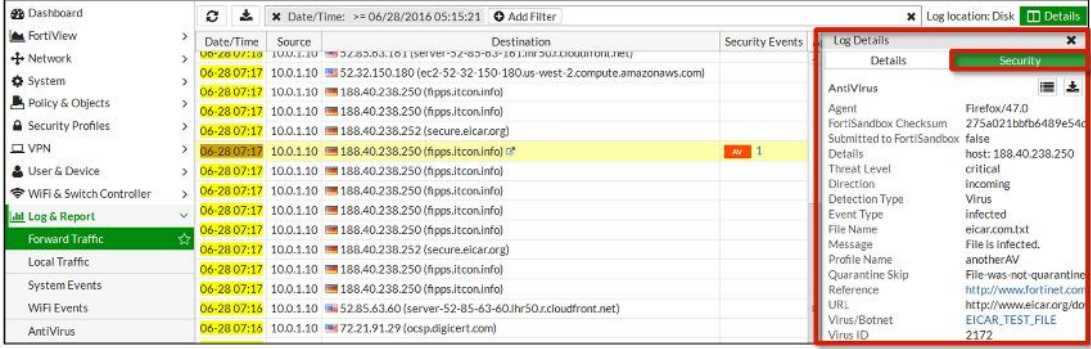
Event logs record system and administrative events, such as adding or modifying configuration, or daemon activities. It contains subtypes named endpoint control, high availability, system, user, router, VPN, WAD, and wireless.

- System event logs contain information related to operations, such as automatic FortiGuard updates and GUI logins.
- User logs contain logon and logoff events for firewall policies with user authentication.
- Router, VPN, WAD, and wireless subtypes include logs for those features. For example, VPN contains IPsec and SSL VPN log entries.

Finally, security logs record logs for the security events such as virus attacks and intrusion attempts. They contain log entries based on the security profile type (log type = utm), including Application Control, Antivirus, DLP, Anti-Spam (Email Filter), Web Filter, Intrusion Protection, Anomaly (DoS-policy), and WAF. Security logs and subtypes are only visible in the GUI menu if logs are created within it—if no security logs exist, the log menu item does not appear.

## Security Events

- View security events in the **Forward Traffic** log under the **Log Details** pane
  - Less CPU intensive with fewer open files



Date/Time	Source	Destination	Security Events
06-28-07:17	10.0.1.10	52.32.150.180 (ec2-52-32-150-180.us-west-2.compute.amazonaws.com)	
06-28-07:17	10.0.1.10	188.40.238.250 (https.itcon.info)	
06-28-07:17	10.0.1.10	188.40.238.250 (https.itcon.info)	
06-28-07:17	10.0.1.10	188.40.238.252 (secure.eicar.org)	
06-28-07:17	10.0.1.10	188.40.238.250 (https.itcon.info)	av 1
06-28-07:17	10.0.1.10	188.40.238.250 (https.itcon.info)	
06-28-07:17	10.0.1.10	188.40.238.250 (https.itcon.info)	
06-28-07:17	10.0.1.10	188.40.238.250 (https.itcon.info)	
06-28-07:17	10.0.1.10	188.40.238.252 (secure.eicar.org)	
06-28-07:17	10.0.1.10	188.40.238.250 (https.itcon.info)	
06-28-07:17	10.0.1.10	188.40.238.250 (https.itcon.info)	
06-28-07:16	10.0.1.10	52.85.63.60 (server-52-85-63-60.lhr50.r.cloudfront.net)	
06-28-07:16	10.0.1.10	72.21.91.29 (ocsp.digicert.com)	

**Log Details**

Details

Security

AntiVirus

Agent: Firefox/47.0

FortiSandbox Checksum: 275a021b0b6489e54c

Submitted to FortiSandbox: false

Details: host: 188.40.238.250

Threat Level: critical

Direction: incoming

Detection Type: Virus

Event Type: infected

File Name: eicar.com.txt

Message: File is infected.

Profile Name: anotherAV

Quarantine Skip: File was not quarantined

Reference: http://www.fortinet.com

URL: http://www.eicar.org/ido

Virus/Botnet: EICAR\_TEST\_FILE

Virus ID: 2172

It should be noted that, by default, events related to security appear in the **Forward Traffic** log in the **Log Details** pane under the **Security** tab. This is for performance: fewer open file handles is less CPU intensive for the operating system.

Log Severity Levels	
Levels	Description
0 – Emergency	System unstable
1 – Alert	Immediate action required
2 – Critical	Functionality affected
3 – Error	Error exists that can affect functionality
4 – Warning	Functionality could be affected
5 – Notification	Information about normal events
6 – Information	General system information

Each log entry includes a log level (or priority level) that ranges in order of importance from emergency to information.

There is also a debug level, the lowest level. It puts diagnostic information into the event log. The debug level is rarely used, unless you are actively investigating an issue with Fortinet Technical Support. Generally, the lowest level you want to use is information, but even this level generates many logs and could cause premature hard disk failure. Depending on the type of log and the needs of your organization, you may want to log only notification levels or higher.

You and your organization's policies dictate what must be logged.



## Log Message Layout

- Log header (similar in all logs)
  - Type and subtype = name of log file
  - Level = severity level

```
date=2016-06-14 time=12:05:28 logid=0316013056 type=utm subtype=webfilter  
eventtype=ftgd_blk level=warning vd=root
```
- Log body (varies by log type)
  - policyid = Firewall policy applied to session
  - srcip and dstip = Source and destination IP
  - action = Action by FortiGate
  - hostname = URL or IP of host
  - msg = Reason for the action

```
policyid=1 sessionid=10879 user="" srcip=10.0.1.10 srcport=60952  
srcintf="port3" dstip=52.84.14.233 dstport=80 dstintf="port1" proto=6  
service="HTTP" hostname="miniclip.com" profile="default" action=blocked  
reqtype=direct url="/favicon.ico" sentbyte=297 rcvbyte=0 direction=outgoing  
msg="URL belongs to a denied category in policy" method=domain cat=20  
catdesc="Games" crscore=30 crlevel=high
```

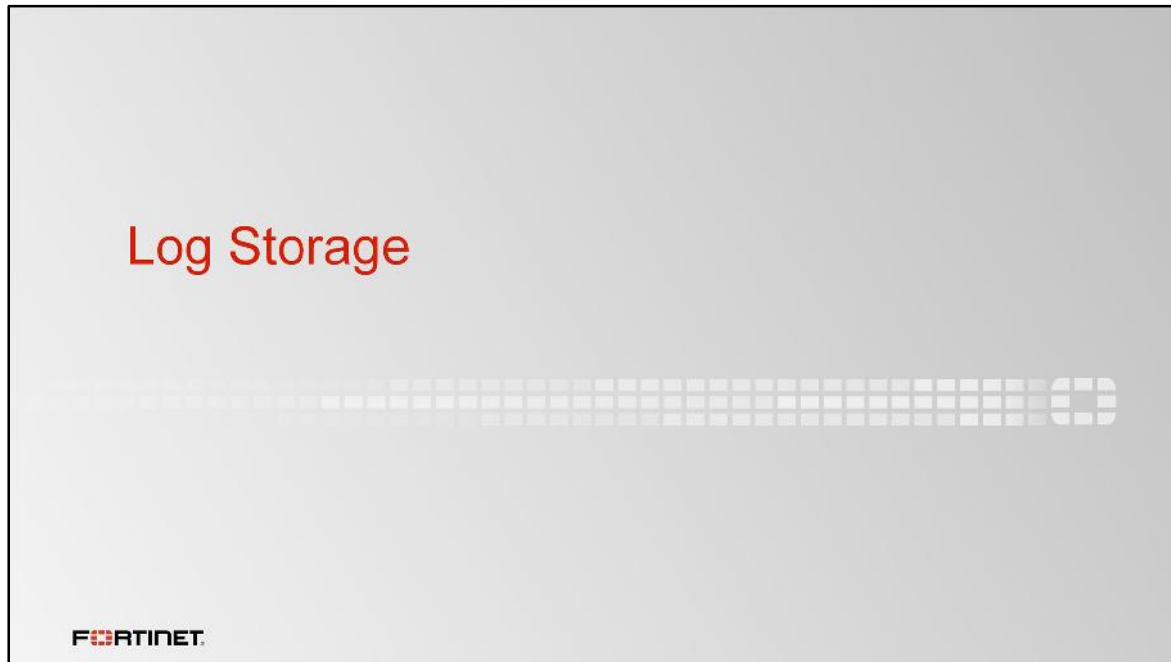
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Every log message has a standard layout comprised of two sections: a header and a body.

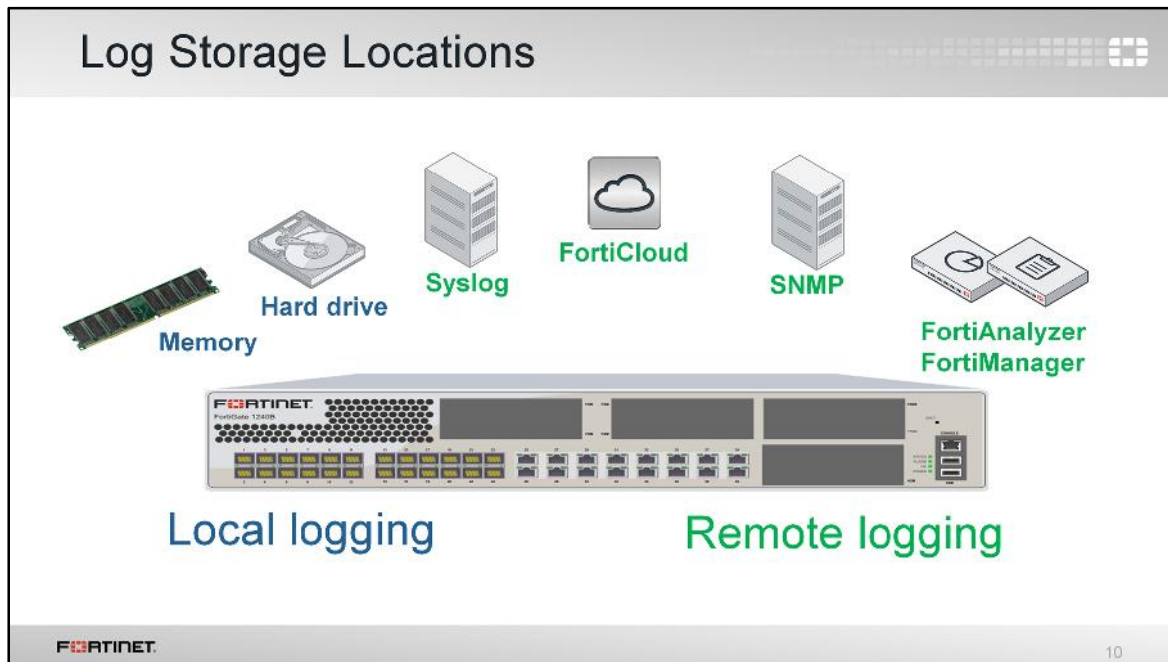
The header contains fields that are common to all log types, such as originating date and time, log identifier, log category, severity level, and virtual domain (VDOM). The value of each field, however, is specific to the log message. As you can see in the raw log entry example, the log type is UTM, the subtype is webfilter, and the level is warning. The type and subtype of logs determine what fields appear in the log body.

The body, therefore, describes the reason why the log was created and actions taken by FortiGate. These fields vary by log type. In the above example, the `policyid` field indicates which firewall rule matched the traffic, the `srcip` field indicates the source IP address, the `dstip` field indicates the destination IP address, the `hostname` indicates the URL or IP of the host, the `action` field indicates what FortiGate did when it found a policy that matched the traffic, and the `msg` fields indicates the reason for the action taken. In this example, the action is `blocked`, which means that FortiGate prevented this IP packet from passing, and the reason is because it belonged to a denied category in the firewall policy.

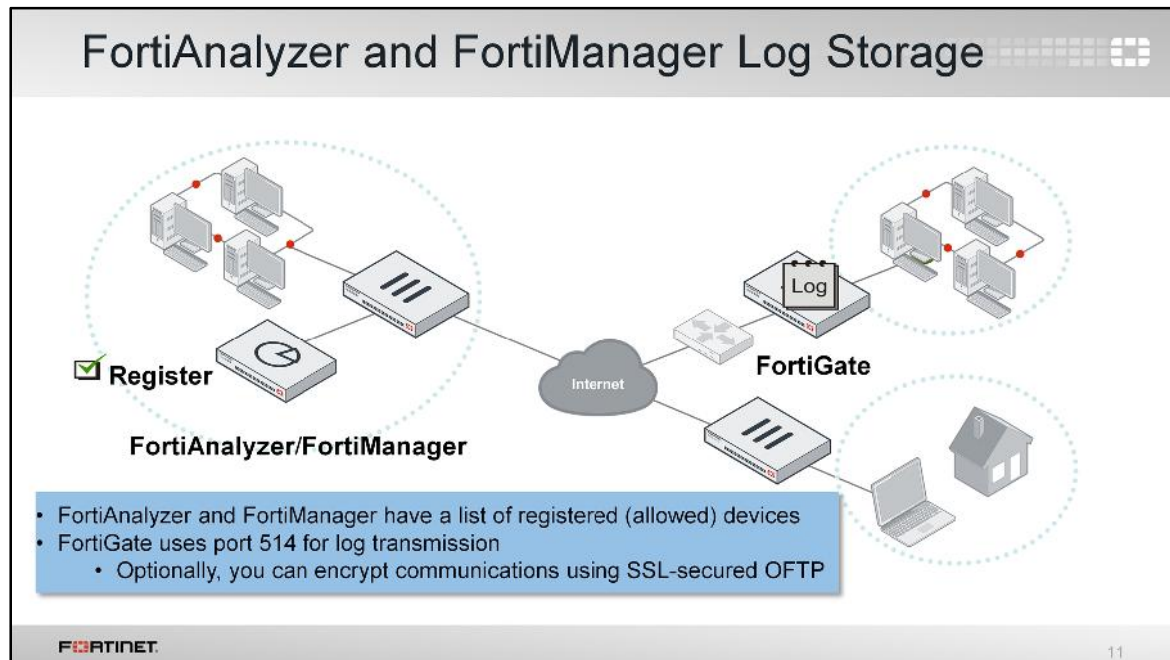
If you log to a third-party device, such as a syslog server, knowing the log structure is crucial to integration. For information on log structures and associated meanings, visit <http://docs.fortinet.com>.



This section explains log storage options on FortiGate.



You can choose to store logs in a variety of places, both on and off the FortiGate device. Locally, FortiGate has its own memory and many devices have a built-in hard drive. Externally, you can store logs on Syslog servers, FortiCloud, SNMP, or a FortiAnalyzer or FortiManager device.



FortiAnalyzer and FortiManager are external logging devices with which FortiGate can communicate. You can place FortiAnalyzer or FortiManager in the same network as FortiGate, or outside of it.

In order for FortiGate to send logs to FortiAnalyzer or FortiManager, you must register FortiGate with FortiAnalyzer or FortiManager. Once registered, the FortiAnalyzer or FortiManager can begin to accept incoming logs from FortiGate.

FortiGate uses port 514 for log transmission. Optionally, you can encrypt communications using SSL encrypted OFTP traffic, so when a log message is generated, it is safely transmitted across an unsecure network.

Log messages are stored on disk and transmitted to FortiAnalyzer as plain text in LZ4 compressed format. This reduces disk log size and reduces log transmission time and bandwidth usage.

## Comparing FortiAnalyzer and FortiManager

- FortiAnalyzer – Long term, dedicated storage of log data
  - Log limit dependent on model
- FortiManager – Central management of multiple FortiGate devices
  - Can also store logs and generate reports, but has fixed amount per day that is less than FortiAnalyzer
- FortiGate can store and upload log events or upload in real time
  - Store and upload only available to FortiGates with internal hard drive

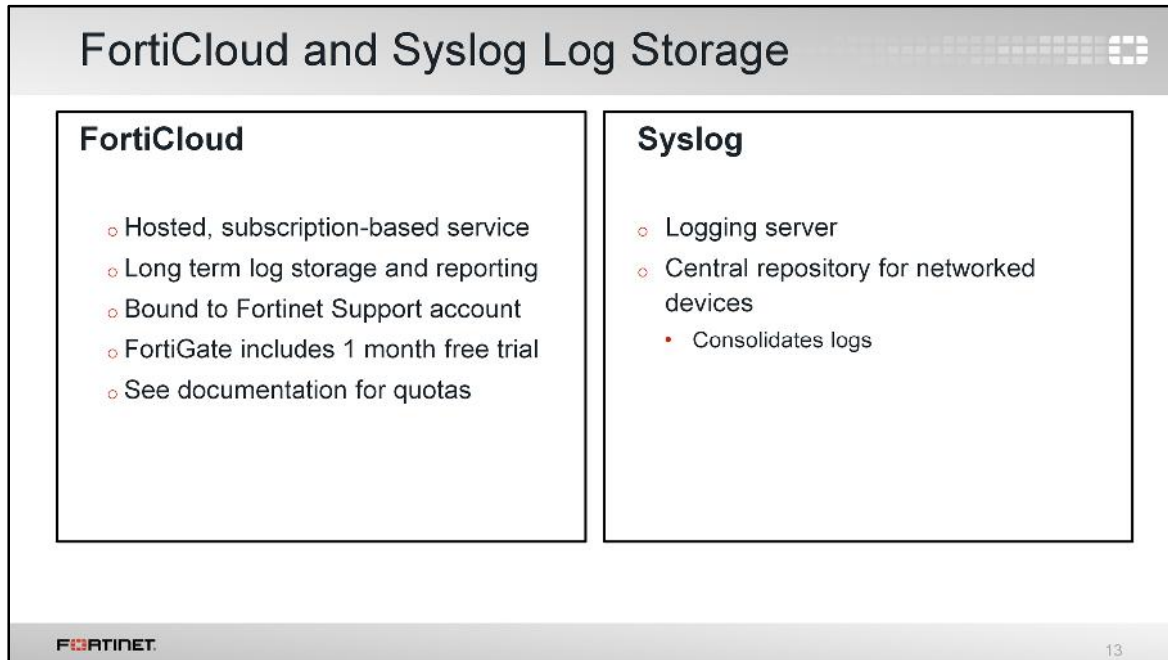
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So far, we've discussed FortiAnalyzer and FortiManager as interchangeable external logging devices for FortiGate. While configuring FortiGate to send logs to FortiAnalyzer or FortiManager is identical — they share a common hardware and software platform — FortiAnalyzer and FortiManager actually have different capabilities that are worth noting. Both take log entries, but the primary purpose of FortiManager is to centrally manage multiple FortiGate devices. As such, log volumes are limited to a fixed amount per-day, which are less than FortiAnalyzer. On the other hand, the primary purpose of FortiAnalyzer is to store and analyze logs, so the log limit is much higher (though the limit is model-dependent).

At the most basic level, what you can do with the logs received on FortiManager is no different than what you can do with logs received on FortiAnalyzer.

FortiGate has two methods for transmitting the log events: store and upload and real-time. The store and upload option is only available to FortiGates with internal hard drives.

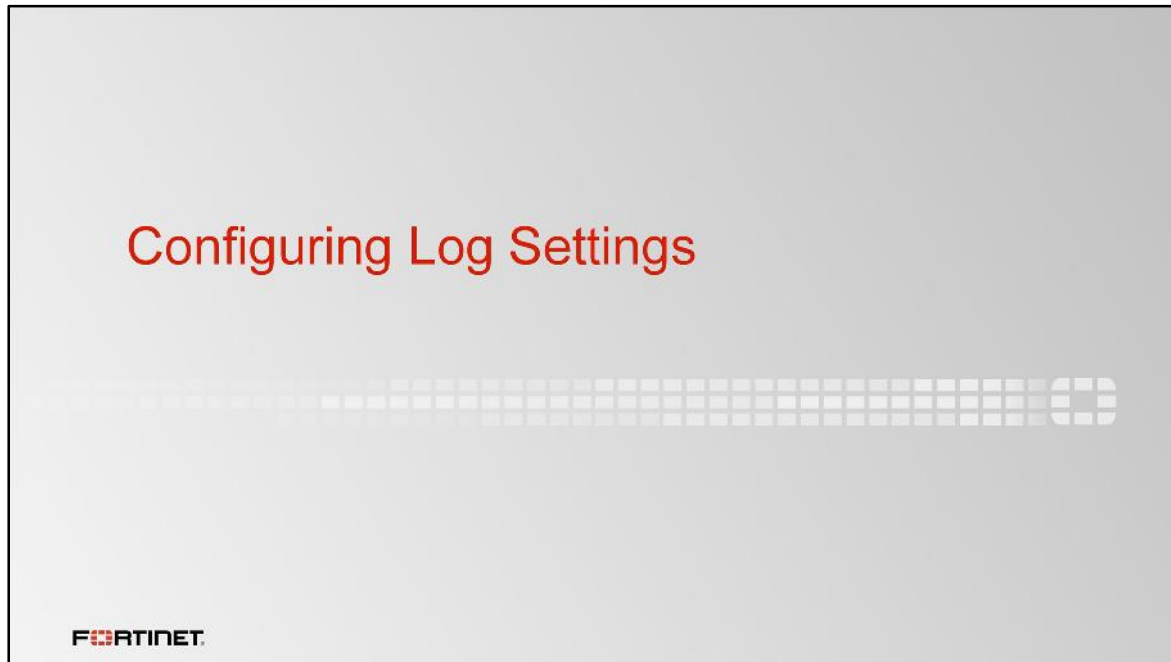


FortiCloud and Syslog are other external logging options you can use to store FortiGate logs.

FortiCloud is a Fortinet subscription-based, hosted security management and log retention service that offers long-term storage of logs with reporting. If you have a smaller network, FortiCloud is usually more feasible than buying a dedicated logging appliance.

Every FortiGate comes with a free one month trial of FortiCloud. Through the FortiGate GUI, you can bind FortiCloud to your Fortinet Technical Support & Customer Service account, activate the trial, and start sending logs. When disk usage is set to WAN optimization (`wanopt`), the store and upload option for logging to FortiCloud is also removed.

Syslog is a logging server that is used as a central repository for networked devices. FortiGate can send logs to a Syslog server.



Logging FortiGate activity requires certain configuration settings so that FortiGate can record the activity. These settings are referred to as log settings. While you can configure logs through the CLI using the `config log` command, this section focuses mainly on the GUI.

For effective logging, your FortiGate system date and time should be accurate. You can either manually set the system date and time, or configure FortiGate to automatically keep its time correct by synchronizing with a Network Time Protocol (NTP) server.

## Which Settings Generate Logs

Policy Log Setting	Security Profiles	Behavior
Log Allowed Traffic = disabled	Disabled	No Forward Traffic or Security Logs
Log Allowed Traffic = disabled	Enabled	No Forward Traffic or Security Logs
Security Events = enabled	Disabled	No Forward Traffic or Security Logs
Security Events = enabled	Enabled	Security log events appear in Forward Traffic log and Security log. A Forward Traffic log generates for packets causing a security event.
All Sessions = enabled	Disabled	A Forward Traffic log generates for every single session.
All Sessions = disabled	Enabled	Security log events appear in Forward Traffic log and Security log. A Forward Traffic log generates for every single session

- **Hardware acceleration affects logging**
  - Traffic offloaded to NP processors is not logged
    - Can disable hardware acceleration
    - Can enable NP packet logging (degrades NP performance)

This chart illustrates the expected behavior when you enable different logging options.

The first column, Policy Log Setting, shows the log setting on the firewall policy: **Log Allowed Traffic** (enable or disable), **Security Events** (enable or disable), or **All Sessions** (enable or disable). In the associated example screenshot, **Log Allowed Traffic** is enabled and **All Sessions** is enabled.

The second column shows whether a security profile is enabled or disabled on the firewall policy. In the associated example screenshot, an Antivirus security profile is enabled.

The last column shows the behavior. If you enable any profiles on your policy and logging is not enabled, you will not get logs of any kind—even if the profile is configured to block the traffic. So, if you apply a security profile, it's important to consider the logging setting.



## Local Log Settings

- **Log & Report > Log Settings**
  - Disk logging
    - If disabled, FortiView logs are only available in real-time
  - Local reports
  - Historical FortiView
    - Requires disk logging
- Back up and restore local disk logs from the CLI


```
# execute log backup <filename>
```

**Local Log**

- Disk ☒
- Enable Local Reports ☒
- Enable Historical FortiView ☒

**Disk Usage**

Free Space 22.97 GB (100%)Used Space 0 B (0%)



Logs older than 7 days (default) are deleted from disk

From the **Log Settings** page, you can enable local logging to disk, as well as enable local reports and historical FortiView. A pie chart illustrates disk usage, informing you how much used space and free space is available on your local disk. A historical disk usage chart is also available.

Disk logging must be enabled in order for information to appear in the FortiView dashboards (if disabled, logs display in real-time only). You can also enable this setting through the CLI `config log disk setting` command. Only certain FortiGate models support disk logging.

Note that logs older than seven (7) days, by default, are deleted from disk (log age is configurable). If your log disk becomes full, event logs are deleted last.

You can back up local disk logs using the `execute log backup` CLI command.

## Remote Logging Settings: FortiAnalyzer/FortiManager

- Can configure up to three separate FortiAnalyzer and FortiManager devices through the CLI
  - Multiple devices may be needed for redundancy
  - Generating and sending logs requires resources – be aware!

### • Log & Report > Log Settings

#### Remote Logging and Archiving

Send Logs to FortiAnalyzer/FortiManager ☒

IP Address

Upload Option 

Store & Upload Logs Realtime

Store & Upload Logs 

Daily

Time

Encrypt Log Transmission ☒

```
# config log [fortianalyzer|fortianalyzer2|fortianalyzer3] setting
set status enable
set server x.x.x.x
end
```

Commands *not* cumulative

You can configure remote logging to FortiAnalyzer or FortiManager through both the GUI and the CLI.

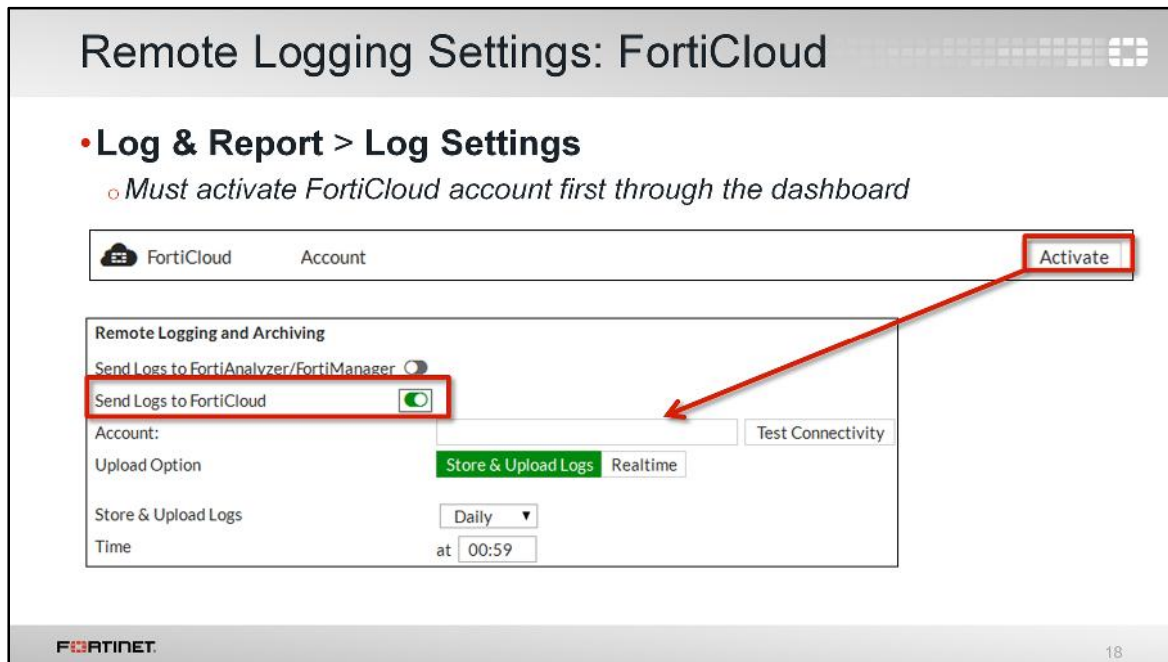
- GUI: From the **Log Settings** page, enable logging to FortiAnalyzer/FortiManager and enter the IP address of the remote logging device.
- CLI: For both FortiAnalyzer and FortiManager, use the `config log fortianalyzer setting` command. Even though FortiManager isn't explicitly mentioned in the command, it is used for FortiManager as well. Through the CLI, up to three separate devices for maximum failover protection of log data can be added. The command for the three devices are not cumulative.

You must also specify how you want to upload your logs. You can choose to store logs to disk and then upload to FortiAnalyzer or FortiManager later—in which case you need to specify a schedule (for example, daily at 00:59)—or you can upload logs in real-time. Generating logs uses system resources, so if FortiGate frequently creates and sends logs to multiple places, CPU and RAM usage will increase.

You can encrypt communications using SSL-secured OFTP by enabling **Encrypt Log Transmission**.

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You can configure remote logging to FortiCloud through the **Log Settings** page as well. But before you can enable logging to FortiCloud, you must first activate your FortiCloud account. Once activated, you can enable FortiCloud logging. You must add your FortiCloud account so FortiGate can communicate with your FortiCloud account and set the upload option. If you want to store your logs to disk first and then upload to FortiCloud, you must specify a schedule.

## Remote Logging Settings: Syslog

- **Log & Report > Log Settings**
  - Enable and add IP/FQDN of Syslog
- Ensure Syslog is configured for logging
- Can configure up to four remote Syslog servers from the CLI

Remote Logging and Archiving

Send Logs to FortiAnalyzer/FortiManager ☐

Send Logs to FortiCloud ☐

Send Logs to Syslog ☒

IP Address/FQDN:

```
# config log <syslogd | syslogd2 | syslogd3 | syslogd4>
```

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You can also configure remote logging to Syslog through the **Log Settings** page. You must add the Syslog IP address or FQDN so FortiGate and Syslog can communicate.

From the CLI, you can configure up to four remote Syslog servers with the `config log syslogd` command.

## Local Traffic and Event Logging Settings

- **Log & Report > Log Settings**
- Local traffic logs = traffic directly to and from FortiGate
  - Disabled by default
- Event logs = system information generated by the FortiGate device

**Log Settings**

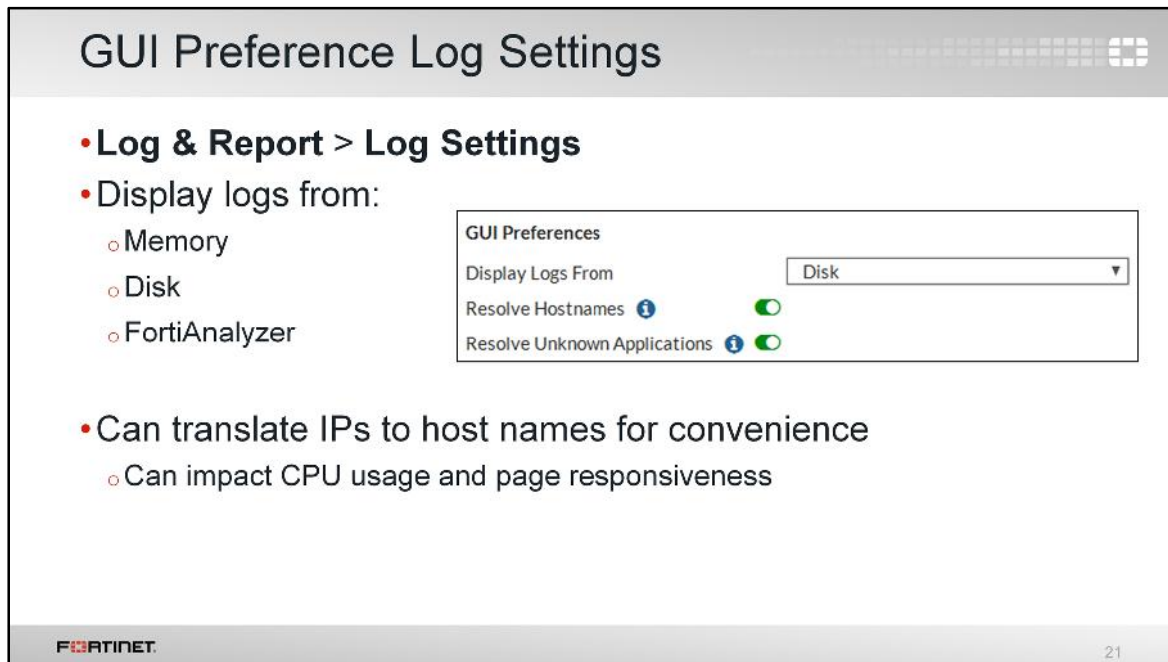
Local Traffic Log	<input checked="" type="checkbox"/> Enable All	<input type="checkbox"/> Log Denied Unicast Traffic	<input type="checkbox"/> Log Allowed Traffic
	<input type="checkbox"/> Log Local Out Traffic	<input type="checkbox"/> Log Denied Broadcast Traffic	
Event Logging	<input checked="" type="checkbox"/> Enable All	<input checked="" type="checkbox"/> Endpoint event	<input checked="" type="checkbox"/> WiFi activity event
	<input checked="" type="checkbox"/> System activity event	<input checked="" type="checkbox"/> User activity event	<input checked="" type="checkbox"/> Router activity event
	<input checked="" type="checkbox"/> VPN activity event	<input checked="" type="checkbox"/> HA event	<input checked="" type="checkbox"/> Explicit web proxy event
	<input checked="" type="checkbox"/> Compliance Check Event		

You can also choose which events you want to appear in the local traffic log and the event log.

Local traffic logs provide information about traffic directly to and from FortiGate. This option is disabled by default due to the large number of logs they can generate.

Event logs provide all of the system information generated by the FortiGate device, such as administrator logins, configuration changes made by administrators, user activity, and daily operations of the device—they are not caused by traffic passing through firewall policies. For example, route-based VPNs going up and down or routing protocol activity are not caused by traffic passing through a firewall policy. One exception might be the user log, as it does record user logon/logoff events on traffic that passes through policies.

The event logs you choose to enable depends on what features you are implementing and what information you need to get out of the logs.



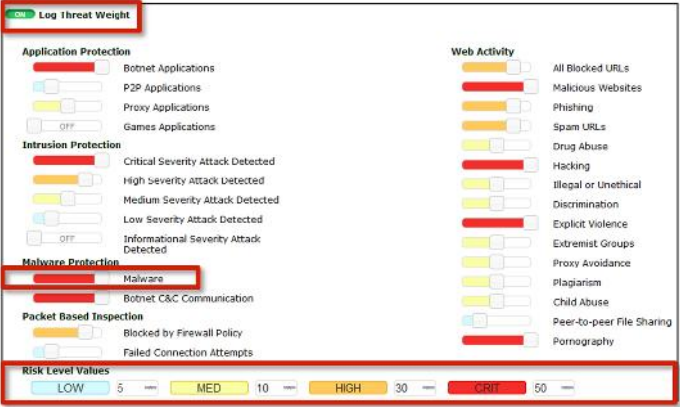
Additionally, you can configure how logs are displayed in the GUI.

For example, you can specify whether the GUI:

- displays logs from memory, disk, or FortiAnalyzer
- resolves IPs to host names. This requires FortiGate to perform reverse DNS lookups for all the IPs. If your DNS server is not available or is slow to reply, this can impact your ability to look through the logs as the requests will time out.

## Configuring Threat Weight

- **Log & Report > Threat Weight**
- Set risk level values for low, medium, high, and critical
- Associate a threat weight
- View detected threats from **FortiView > Threats**



The screenshot displays the 'Log Threat Weight' configuration page. It features several sections with sliders for assigning risk levels (LOW, MED, HIGH, CRIT) to different threat categories. The 'Malware Protection' section is highlighted, showing 'Malware' set to 'CRIT'. The 'Risk Level Values' section at the bottom shows a scale from LOW (5) to MED (10) to HIGH (30) to CRIT (50).

**Application Protection**

- Botnet Applications
- P2P Applications
- Proxy Applications
- Games Applications

**Intrusion Protection**

- Critical Severity Attack Detected
- High Severity Attack Detected
- Medium Severity Attack Detected
- Low Severity Attack Detected
- Informational Severity Attack Detected

**Malware Protection**

- Malware
- Botnet C&C Communication

**Packet Based Inspection**

- Blocked by Firewall Policy
- Failed Connection Attempts

**Web Activity**

- All Blocked URLs
- Malicious Websites
- Phishing
- Spam URLs
- Drug Abuse
- Hacking
- Illegal or Unethical
- Discrimination
- Explicit Violence
- Extremist Groups
- Proxy Avoidance
- Plagiarism
- Child Abuse
- Peer-to-peer File Sharing
- Pornography

**Risk Level Values**

LOW 5 MED 10 HIGH 30 CRIT 50

You can configure the threat weight definition through the **Threat Weight** page. This allows you to set the risk values for low, medium, high, and critical levels, and then apply a threat weight to each category-based item.

In the above example, malware has a threat weight of critical. You can adjust this threat weight based on your organizational requirements. Once threat weight is configured, you can view all detected threats from the **Threats** page.

## Enabling Logging on Firewall Policies

- Firewall policy setting decides if a log message is generated or not
  - **Log Settings** only decides if and where log is stored

Must enable logging on the firewall policy!

**Logging Options**  
☒ Log Allowed Traffic ☒ Security Events ☒ All Sessions  
☐ Generate Logs when Session Starts  
☐ Capture Packets  
Comments  0/1023

**Security Profiles**  
AntiVirus ☐  
**Web Filter** ☒ WEB Category\_Monitor  
DNS Filter ☐  
Application Control ☐  
CASI ☐  
IPS ☐  
Anti-Spam ☐  
**DLP Sensor** ☒ DLP Archive\_Sites  
Web Application Firewall ☐  
**Proxy Options** ☒ PREX Inspection\_Settings  
SSL/SSH Inspection ☐

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Once all your logging settings are configured, you can enable logging on your firewall policies. Only when enabled on a firewall policy can a log message generate (based on configured log settings).

Generally, if you configure your FortiGate to inspect traffic, you should also enable logging for that security feature to help you track and debug your traffic flow. Except for violations that you consider to be low in severity – web filtering, for example – you’ll want to know if your FortiGate is blocking attacks. Most attacks don’t succeed in a security breach on the first try. A proactive approach, when you notice a persistent attacker whose methods seem to be evolving, can avoid a security breach. To get early warnings like this, enable logging for your security profiles.

To enable logging on security profiles, edit your firewall policy, enable the security profile, and select your configured security profile from the associated drop-down list. Remember that you will not get logs of any kind if **Log Allowed Traffic** isn’t enabled in the **Logging Options** section.



## Affect of Logging on Performance

- More Logs = More CPU + More Disk Space
- Security profiles log when matching criteria is met
- Traffic logs record every session
  - Extra information for troubleshooting
  - Some UTM events too
  - More system intensive

```
# config system global
set sys-perf-log-interval <number from 0-15>
end
```

Enable performance statistic logging for remote logging devices on FortiGate

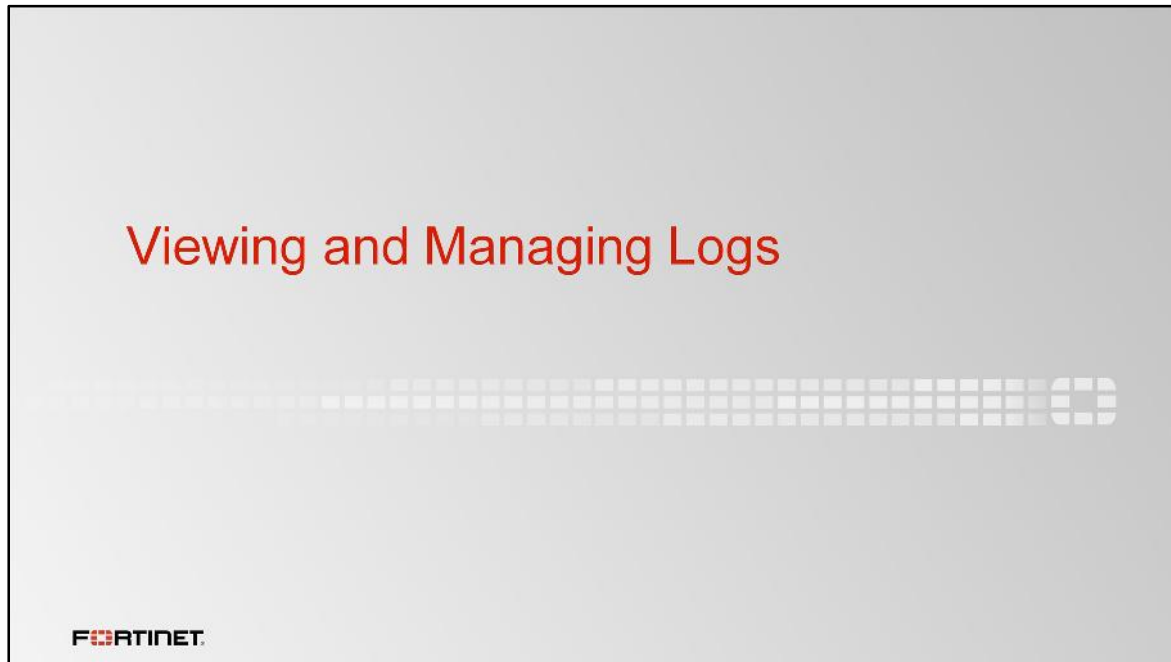
**FORTINET**

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It's important to remember that the more logs that get generated, the heavier the toll on your CPU and memory resources. Storing logs for a period of time also requires disk space, as does accessing them. So, before configuring logging, make sure it is worth the extra resources and that your system can handle the influx.

Also important to note is logging behavior with security profiles. Security profiles create log events when traffic is detected. Depending on the amount of traffic you have and logging settings that are enabled, your traffic logs can swell and, ultimately, impact the performance of your firewall.

On remote logging devices, such as FortiAnalyzer and Syslog, you can enable performance statistic logging on FortiGate from the CLI to occur every 1-15 minutes. This is not available for local disk logging or FortiCloud.



In this section, we will examine how to view, filter, download, and export logs. While you can view and manage logs through the CLI using the `execute log filter` and `execute log display` commands, this section focuses on the GUI.

### Viewing Log Messages (GUI)

The screenshot displays the FortiGate GUI's 'Log & Report' section. On the left, a sidebar lists various log categories: Forward Traffic, Local Traffic, System Events, VPN Events, User Events, WiFi Events, Web Filter, Data Leak Prevention, Log Settings, and Threat Weight. The main area shows a table of log messages with columns for #, Date/Time, Source, Destination, and Application. A red box highlights the 'Log location: Disk' and 'Details' buttons in the top right. A blue arrow points from the 'Log Settings' menu item to a text box stating 'Items in Log & Report menu depend on configuration as well as incoming logs'. Another blue arrow points from the 'Log Settings' menu item to a text box stating 'Changed from Log Settings page'.

#	Date/Time	Source	Destination	Application
1	07:55:24	10.0.1.10	75.98.166.66 (serendipity.li)	HTTP
2	07:55:23	10.0.1.10	75.98.166.66 (serendipity.li)	HTTP
3	07:55:23	10.0.1.10	75.98.166.66 (serendipity.li)	HTTP
4	07:55:18	10.0.1.10	66.39.28.123 (sepulchritude.com)	HTTP
5	07:55:13	10.0.1.10	64.70.19.34 (rhodium.ws)	HTTP
6	07:55:07	10.0.1.10	72.3.233.244 (searchaclu.org)	HTTP
7	07:54:55	10.0.1.10	69.163.200.170 (resort.com)	HTTP
8	07:54:53	10.0.1.10	216.92.24.11 (psymon.com)	HTTP
9	07:54:52	10.0.1.10	84.205.160.20 (osi.bmj.net.pl)	HTTP

Log location: Disk Details

Log Details

General

Date 03/28/2016  
Time 07:55:24  
Duration 6s  
Session ID 193  
Virtual Domain root  
NAT Translation Source

Source

IP 10.0.1.10  
NAT IP 10.200.1.1  
Port 55768  
Country Reserved  
Interface port3

Destination

IP 75.98.166.66  
Host Name serendipity.li  
Port 80  
Country United States  
Interface port1

Application

You can view your logs in the GUI under the **Log & Report** menu. The options that appear in this menu depend on your configuration. Security logs appear only if security events exist.

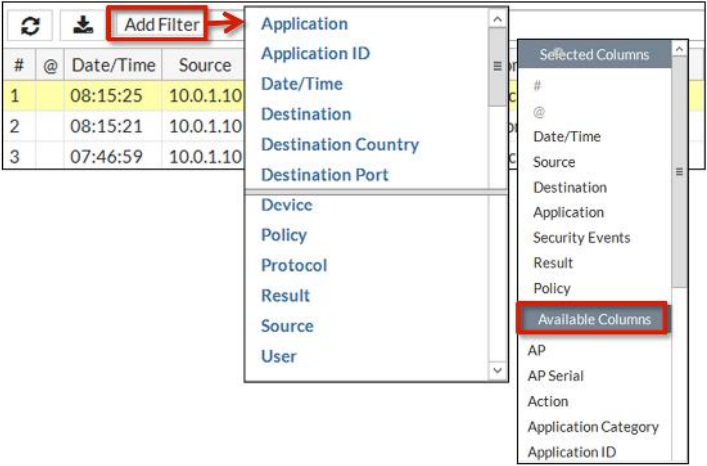
Select the type of log you want to view, such as **Forward Traffic**. Logs then appear in a formatted table view. To view the log details, select the log from the table. The log details then appear in the **Log Details** pane to the right.

If archiving is enabled on security profiles that support it (such as DLP), archiving information appears within the **Log Details** pane under the **Archived Data** section. Archived logs are also recorded when using FortiAnalyzer or FortiCloud.

If you configured FortiGate to log to multiple locations and want to view logs from those locations, you must specify the location from the **Log Settings** page. In this screenshot, the log location is set to **Disk**, as that is the configured setting on the **Log Settings** page. If logging to a remote location, such as Syslog, you must view logs through that device instead.

## Filter Settings

- Reduces the number of log entries displayed
- Filters are per column; more can be added
- Right-click the column of a specific log for quick filter options
  - Filter options based on log type and column



#	@	Date/Time	Source
1		08:15:25	10.0.1.10
2		08:15:21	10.0.1.10
3		07:46:59	10.0.1.10

Available Columns:

- Application
- Application ID
- Date/Time
- Destination
- Destination Country
- Destination Port
- Device
- Policy
- Protocol
- Result
- Source
- User

Depending on your configuration, your FortiGate might record a high volume of logs. This can make it more difficult to locate a specific log or log type, especially during an investigation.

To navigate the logs more efficiently, you can set up log filters. The more information you specify in the filter, the easier it is to find the precise log entry. Filters are configurable for each column of log data in the display.

By default, the most common columns are shown and less common columns are hidden. Accordingly, if filtering data based on a column that is hidden, be sure to add the column as a selected column. To add columns, right-click any column field and from the pop-up menu that appears, select the column from the **Available Columns** section.

## Quick Filters and Log Viewer Quarantine

- Right-click log to apply quick filters
- Option to quarantine
  - Simplifies administration
- Quarantine Source
  - Block traffic from user (Source IP) permanently or for a period of time
- Quarantine FortiClient
  - Activates host quarantine
- Release user from **Monitor > User Quarantine**

Policy:

- ☒ Edit Matching Policy (Guest)
- ☐ Show Policy in Policy List

Quarantine:

- ☒ Quarantine Source Address (10.0.1.10)

Filter by Destination:

- 96.45.33.104
- ! 96.45.33.104

Quarantine Duration

A User Quarantine ban will be created. It can be removed in Monitor » User Quarantine

Quarantine Type **Temporary** Permanent

Duration 30 min Minutes ▾

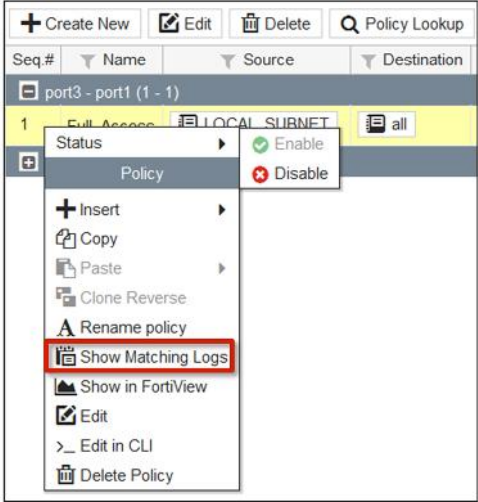
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There is also an option to apply a quick filter to logs. Right-click the column of a specific log message and select one of the filter options that appear (options differ based on log type and column).

FortiGate also allows you to quickly quarantine the source address through the log viewer. Right-click the log and select **Quarantine Source Address** from the dialog box that appears. You can set the quarantine to **Temporary** or **Permanent** and subsequently manage the quarantine from the **User Quarantine** page.

## Viewing Logs Associated with a Firewall Policy

- **Policy & Objects > IPv4 Policy**
- Access log messages generated by individual policies



The screenshot displays the FortiGate web interface. On the left, the navigation pane shows 'Policy & Objects > IPv4 Policy'. The main area shows a table of firewall policies. The first policy, 'port3 - port1 (1 - 1)', is selected. A right-click context menu is open over this policy. The menu includes options like 'Status', 'Policy', 'Insert', 'Copy', 'Paste', 'Clone Reverse', 'Rename policy', 'Show Matching Logs' (highlighted with a red box), 'Show in FortiView', 'Edit', 'Edit in CLI', and 'Delete Policy'. The 'Show Matching Logs' option is the one to be selected to view logs for this specific policy.

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You can also access log messages generated by individual policies. Right-click the policy for which you want to view all associated logs, and from the pop-up menu, select **Show Matching Logs**.


## Downloading Logs

- **Log & Report**

#	Date/Time	Level	User	Action
1	02-20 10:41	INFO	aduser1	authentication
2	02-19 13:35	INFO	aduser1	authentication
3	02-19 13:35	INFO	aduser1	authentication

- **Download debug logs**
  - **System > Advanced**

- **Download Debug Logs**



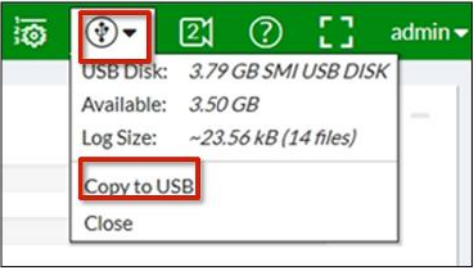
The screenshot shows a web interface for downloading logs. A table lists three log entries. A red box highlights a download icon in the top left of the table. A red arrow points from this icon to a Firefox dialog box. The dialog box is titled 'Opening UserEventLog-disk-2016-02-25T13\_00\_05.169203...' and contains the text 'You have chosen to open: UserEventLog-disk-2016-02-25T13\_00\_05.169203.log which is: Text Document from: https://10.0.1.254'. It offers three options: 'Open with Notepad (default)', 'Save File' (selected), and 'Do this automatically for files like this from now on.'.

You can download raw (unformatted) logs by clicking the download icon on the associated log type page (for example, System Event logs). You can filter the logs first if you want to download only a subset of logs.

You can also download debug logs from the **Advanced** page. Debug log messages are only generated if the log severity level is set to Debug. Customer Support may request debug logs to assist with troubleshooting.

## Backing Up Logs

- Three methods for backing up logs (copying log files from database to specified location):
  - FTP
  - TFTP
  - USB



```
# execute backup disk alllogs usb
# execute backup disk log usb <log_type>
```

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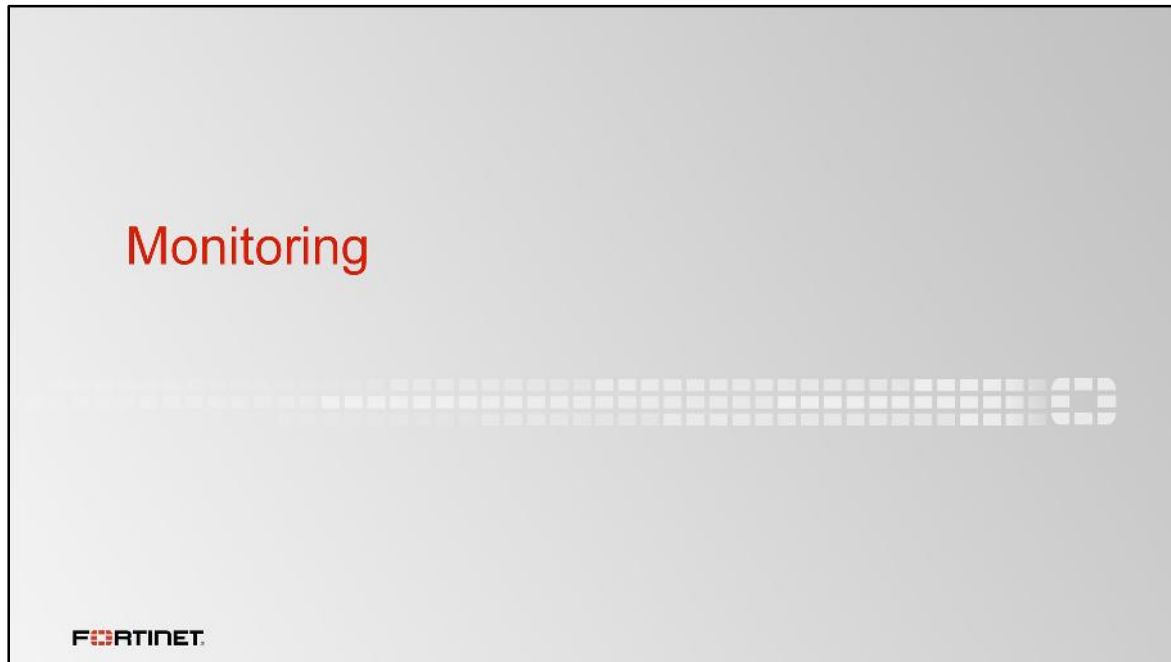
There are three methods for exporting logs: FTP, TFTP, and USB.

For USB, logs are exported as LZ4 compressed files. You can export to USB from both the CLI and GUI.

When you insert a USB drive into the USB port of your FortiGate, the USB menu appears in the GUI. The menu displays the amount of storage available on the USB disk as well as the log file size. Click **Copy to USB** to copy the log file to the USB drive.

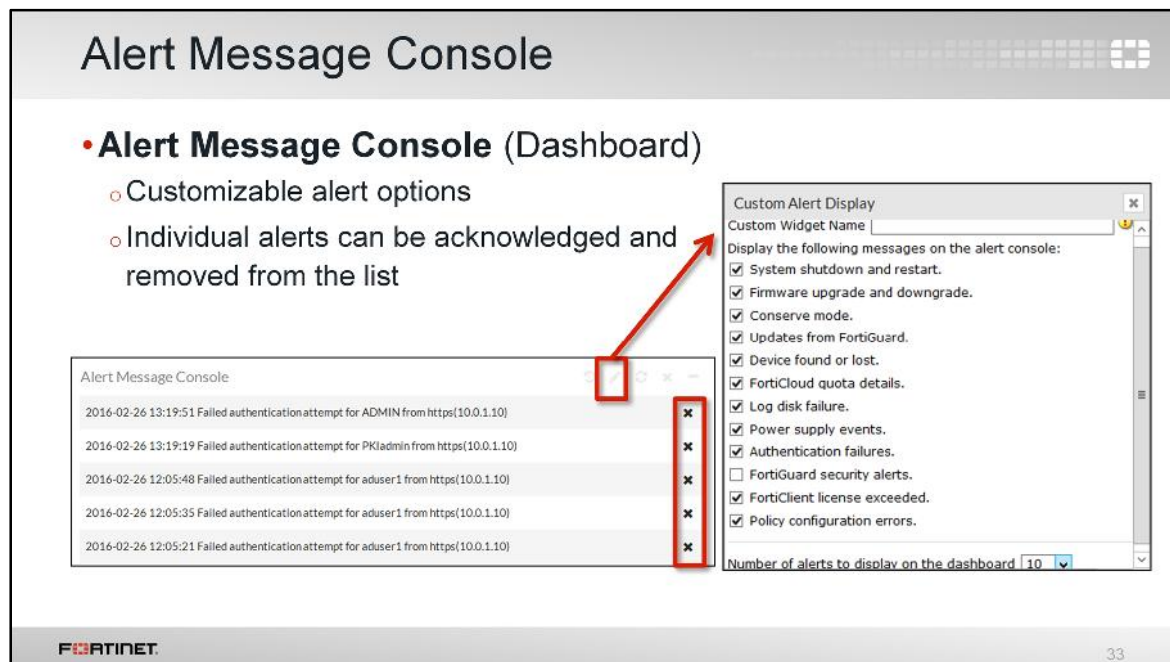
From the CLI, use the `execute backup disk alllogs usb` command to back up all logs to USB. Or to back up just the traffic logs to USB, use the `execute backup disk log usb <log_type>` command (where `<log_type>` is traffic, event, virus, webfilter, and so on).





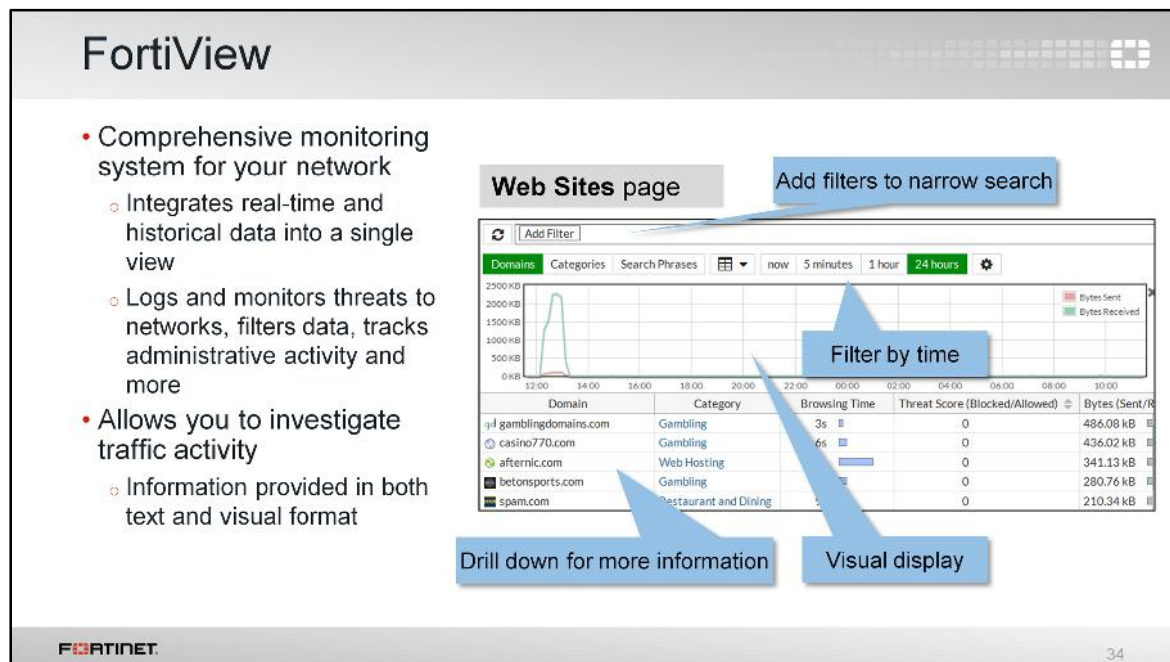
Monitoring your FortiGate is critical for incident response. If you are monitoring your network continuously, you may be able to stop an attack in progress, or, if a breach is successful, know where reinforcement is needed. How the attack occurs may reveal weaknesses in your configuration or give important clues about the attacker's identity.

There are many ways you can monitor your network. You can monitor through the **Alert Message Console**, the **FortiView** menu, the **Monitor** menu, alert email, and SNMP.



The **Alert Message Console** is a widget located on the dashboard of the GUI. You can configure the widget to display alerts according to your preferences by clicking the pencil icon. For example, you can configure which events you want to appear as alerts and the number of alerts displayed. These alerts are not logging related alerts, but system related alerts.

When an alert appears in the **Alert Message Console**, it remains there until acknowledged. Once you investigate the issue (and make adjustments if necessary), you can remove it from the list.




FortiView is a comprehensive monitoring system for your network that integrates real-time and historical data into a single view on your FortiGate. It can log and monitor threats to networks, filter data on multiple levels, keep track of administrative activity, and more.

Through the various pages under the FortiView menu, you can investigate traffic activity and employ multiple filters to narrow your view over a specific timeframe (local storage is required to view logs 24 hours in the past). Note that some FortiGate models support a 7-day time display. This can only be enabled through the CLI using the `config log setting` command.

## FortiView monitoring options

- **Sources and Destinations:** Traffic sources and destinations
- **Interfaces:** Current and historical data per interface (includes bandwidth)
- **Countries:** Source and destination countries (includes country map visualization)
- **Traffic Shaping:** Existing traffic shapers information (sessions, bandwidth, dropped bytes, and more)
- **All Sessions:** All FortiGate traffic
- **Applications and Cloud Applications:** Applications and cloud applications being used on your network
- **Web Sites:** Top allowed and blocked websites
- **Threats:** Top users involved in incidences and top threats to network
- **Threat Map:** Risks from international locations arriving at your location
- **System Events:** Security events detected by FortiGate



FortiView

Physical Topology

Logical Topology

Sources

Destinations

Interfaces

Policies

Countries

WiFi Clients

Traffic Shaping

All Sessions

Applications

Cloud Applications

Web Sites

Threats

Threat Map

Failed Authentication

System Events

Admin Logins

VPN

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Some of the areas you can monitor under the **FortiView** menu include:

- **Sources:** Allows you to view information about the sources of traffic on your FortiGate. You can use this to investigate a spike in traffic, for example.
- **Interfaces:** Allows you to perform current and historical monitoring by interface, with the ability to monitor bandwidth, in particular. You can use this to investigate traffic spikes associated with an IP address, for example.
- **Countries:** Allows you to filter traffic according to source and destination countries. This includes the option to view the country map visualization. You can use this to investigate international source bandwidth usage for specific sources, for example.
- **All Sessions:** Allows you to view information about all FortiGate traffic. This console has the greatest number of column filter options. You can use this to filter sessions by port number and application type, for example.
- **Applications:** Allows you to view information about the applications being used on your network.
- **Cloud Applications:** Allows you to view information about the cloud-based applications being used on your network.
- **Web Sites:** Allows you to view information about the top allowed and top blocked websites by domain or FortiGuard categories. You can use this to investigate an instance of proxy avoidance, for example.
- **Threats:** Allows you to view information about the top users involved in incidences as well as the top threats in your network.
- **Threat Map:** Allows you to view risks coming from various international locations arriving at your location, displayed through a map. You can use this to investigate various international threats.

## Monitoring

• **Monitor** → Collects monitoring functions

Refresh

Route Lookup

Type	Subtype	Network	Gateway	Interface	Up Time
Static		0.0.0.0/0	10.200.1.254	port1	
Connected		10.0.1.0/24	0.0.0.0	port3	
Connected		10.200.1.0/24	0.0.0.0	port1	
Connected		10.200.2.0/24	0.0.0.0	port2	

Monitor

Routing Monitor

DHCP Monitor

WAN Link Monitor

FortiGuard Quota

IPsec Monitor

SSL-VPN Monitor

Firewall User Monitor

User Quarantine Monitor

FortiClient Monitor

WiFi Client Monitor

Rogue AP Monitor

WiFi Health Monitor

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You can also monitor various monitoring functions from the **Monitor** menu, such as routing, DHCP, WAN link, FortiGuard quota, IPsec, SSL VPN, firewall users, user quarantine, FortiClient, WiFi, and rogue AP.

For example, the **Routing Monitor** displays routing information that includes type, subtype, network, gateway, interface, and up time.

## Alert Email

- Send notification to email upon detection of event
- Must configure SMTP server first!

System > Advanced

Email Service

Use Custom Email Server ☒

SMTP Server: 10.200.1.254

Port: 25

Default Reply To: admin@training.lab

Authentication: ☐

Security Mode: **None** SMTPS STARTTLS

Once SMTP server configured, **Alert E-Mail** menu item appears

Email from: Student\_FortiGate@training.lab

Email to: admin@training.lab  
admin2@training.lab

Send alert email for the following

Interval Time: 5 (1 - 9999 Min)

☒ Intrusion detected

☒ Virus detected

☐ Web access blocked

☐ HA status changes

☒ Violation traffic detected

☒ Firewall authentication failure

☐ SSL-VPN login failure

☐ Administrator login/logout

☐ IPsec tunnel errors

☐ L2TP/PPTP/PPPoE errors

☐ Configuration changes

☐ FortiGuard license expiry time: 15 (1 - 100 days)

☒ Disk usage: 75 (1 - 99)%

☐ Send alert email for logs based on severity

Minimum log level: Alert

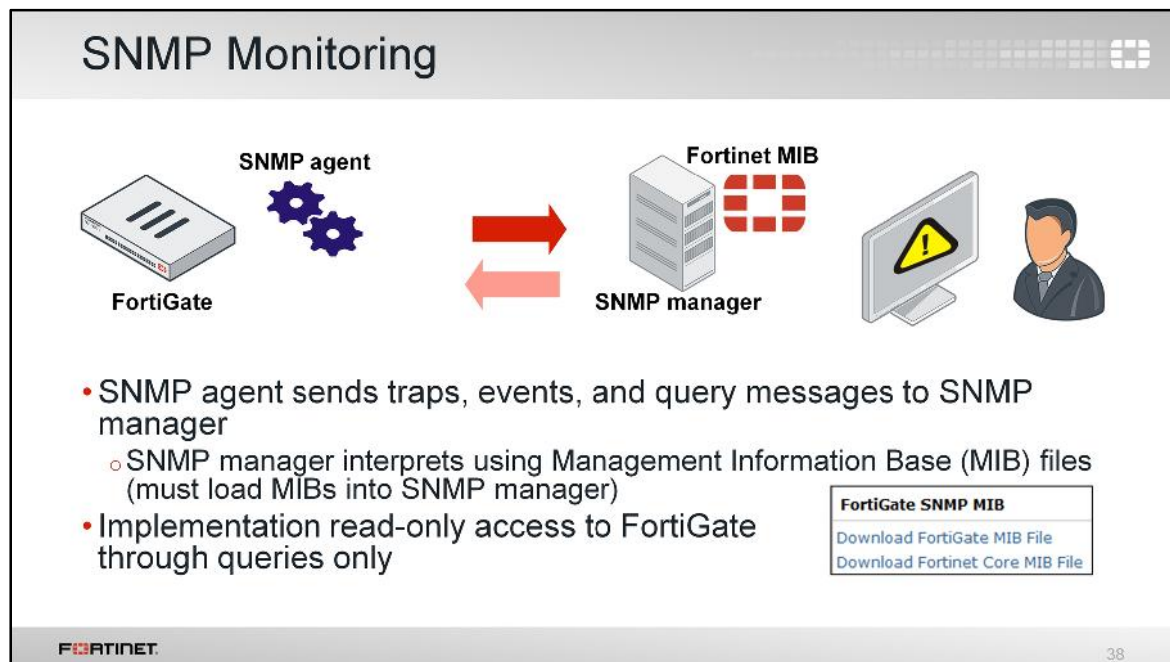
Configure up to three recipients

Send alert by type OR by severity level

Since you can't always be physically at the device, you can monitor events by setting up alert email. Alert emails provide an efficient and direct method of notifying an administrator of events.

Before you can configure alert email, you must have a SMTP server set up on FortiGate. Once configured, the **Alert E-Mail** menu item appears.

You can configure alert emails from the **Alert E-Mail** page. You can trigger alert emails based on type (such as any time an intrusion is detected or there is a firewall authentication failure) or on minimum log severity level (such as all logs at the Alert level or above). You can configure up to three recipients.

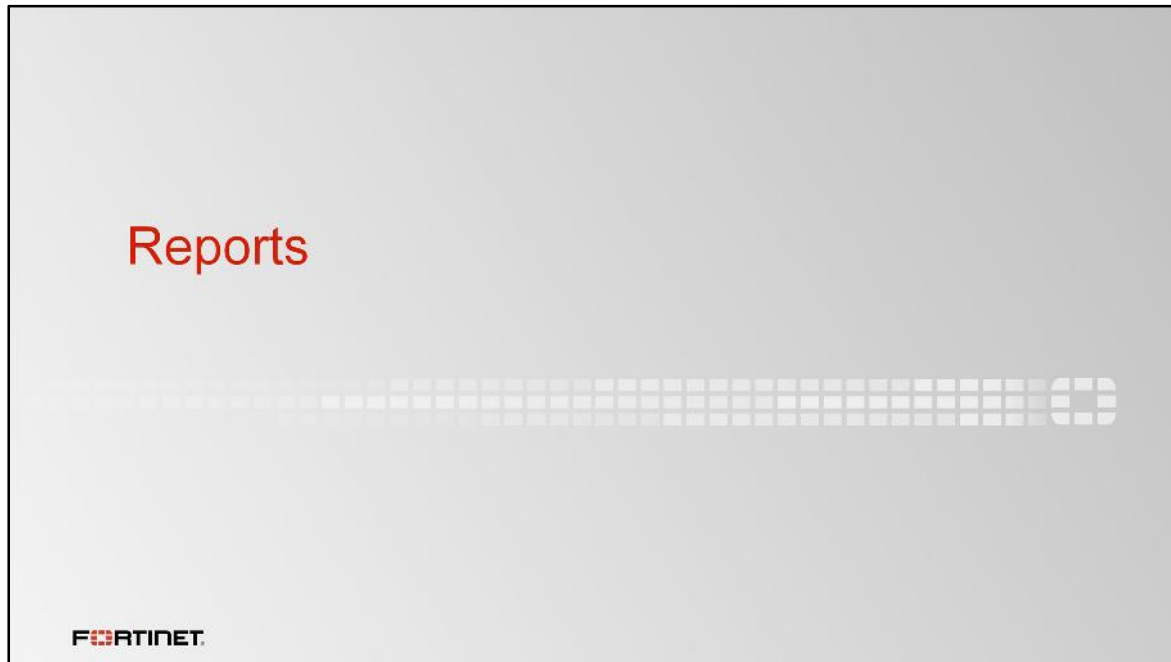


Simple Network Management Protocol (SNMP) enables you to monitor hardware on your network. You can configure the hardware, such as the FortiGate SNMP agent, to report system information and send traps (alarms or event messages) to SNMP managers. An SNMP manager, or host, is typically a computer running an application that can read the incoming trap and event messages from the agent and send out SNMP queries to the SNMP agents.

In order to configure FortiGate for SNMP monitoring, your SNMP manager needs the Management Information Base (MIB) file. A MIB is a text file that describes a list of SNMP data objects and provides information the SNMP manager needs to interpret the SNMP traps and events sent by the FortiGate device SNMP agent.

The FortiGate SNMP implementation is read-only. SNMP v1, v2c, and v3-compliant SNMP managers have read-only access to FortiGate system information through queries and can receive trap messages from FortiGate.

You can download the MIB files from the **System >SNMP** page or from the Fortinet Technical Support Web site ([support.fortinet.com](http://support.fortinet.com)).




Reports provide a clear, concise overview of what is happening on your network based on log data, without manually going through large amounts of logs. This section provides a brief overview of FortiGate reports.



## Report Overview

- Reports extract information from the database
- Log database uses Structured Query Language (SQL)
- Reports are built from datasets (SQL statements)
- Two default reports:
  - **Learning Report**
  - **Local Report**

 **Log & Report** ✓

Forward Traffic

Local Traffic

System Events

WiFi Events

AntiVirus


**Learning Report**

Local Reports

Log Settings

Threat Weight

Alert E-mail

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The FortiGate database that is used to store logs is also used to extract information for reports. The log database uses Structured Query Language (SQL).

Reports are built from datasets, which are SQL statements that tell FortiGate what information to extract from the database.

FortiGate also includes two default reports: Learning report and Local report.

## Cyber Threat Assessment Learning Report

- Learning report: **Cyber Threat Assessment Learning Report**
- Action = **LEARN** on firewall policy
- Captures data across all traffic and security vectors
- Collects and logs meaningful data for recommendation purposes, including:
  - Deployment Methodology
  - Executive Summary
  - Security and Threat Prevention
    - High Risk Applications; Application Vulnerability Exploits; Malware, Botnets, and Spyware/Adware; At-Risk Devices and Hosts
  - User Productivity
    - Application Usage, Web Usage



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When learning mode is enabled on a firewall policy, data across all traffic and security vectors is captured and generated in the **Cyber Threat Assessment Learning Report**. The purpose of this report is to allow users to easily implement a *monitor then enforce* process.

Data includes:

- Deployment methodology
- Executive summary
- Security and threat prevention, which includes high risk applications; application vulnerability exploits; malware, botnets, and spyware/adware; and at-risk devices and hosts
- User productivity, which includes application usage and web usage

## Enabling Learning Reports

- Requirements:
  - Enable disk logging
  - Ensure **Policy Learning** is enabled on **System > Feature Select**, so **Learning Report** menu visible
  - Enable **LEARN** mode on a firewall policy
- Per-VDOM

The screenshot shows the FortiGate configuration interface. At the top, the title 'Enabling Learning Reports' is displayed. Below it, a list of requirements is provided. A red arrow points from the text 'Ensure Policy Learning is enabled on System > Feature Select' to a toggle switch labeled 'Policy Learning' which is currently turned on. Another red arrow points from the text 'Enable LEARN mode on a firewall policy' to the 'LEARN' button in the 'Action' field of a firewall policy configuration table. The table has the following fields: Name (Full\_Access), Incoming Interface (port3), Outgoing Interface (port1), Source (LOCAL\_SUBNET), Destination Address (all), Schedule (always), Service (ALL), and Action (ACCEPT, DENY, LEARN). The 'LEARN' button is highlighted with a red box. To the right of the table, a 'Log & Report' menu is visible, showing options like Forward Traffic, Local Traffic, System Events, WiFi Events, AntiVirus, Learning Report, Local Reports, Log Settings, Threat Weight, and Alert E-mail. The 'Learning Report' option is highlighted with a green checkmark.

Name	Full_Access
Incoming Interface	port3
Outgoing Interface	port1
Source	LOCAL_SUBNET
Destination Address	all
Schedule	always
Service	ALL
Action	ACCEPT DENY <b>LEARN</b>

To enable learning reports, you must enable disk logging and ensure **Policy Learning** is enabled on the **Feature Select** page.

You must also set **Action** to **LEARN** in the firewall policy. Once enabled, the policy automatically applies default static profiles and passes traffic to security profiles for monitoring. It also enables logging with full capabilities, which are tagged as *Learning* in the logs.

Learning reports are enabled per-VDOM.

## Viewing Learning Reports

- View full report or report summary
- Specify time period
  - 5 minutes
  - 1 hour
  - 24 hours

Table of Contents ▾ Full Report Report Summary 5 minutes 1 hour 24 hours

Full report provides category explanations

### Top Web Applications

In today's network environments, many applications leverage HTTP for communications – even some you wouldn't normally expect. The primary benefit of HTTP is that communication is ubiquitous, universally accepted and (generally) open on most firewalls. For most business-related and whitelisted applications this typically augments communication, but some non-business applications also use HTTP in either unproductive or potentially nefarious ways.

Application	Sessions	Bytes (Sent/Received)
<input type="checkbox"/> OCSP	3	2.53 kB
<input checked="" type="checkbox"/> HTTPBROWSER_Firefox	2	516 B

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You can select to view either the full report or report summary. They both provide the same data, but the full report provides supplementary text-based explanations of the various report categories.

You can also specify the time period of the report. The report can provide data for the last 5 minutes, 1 hour, or 24 hours.

## FortiGate Security Report

- Local Report: **FortiGate Security Report**
  - Can run the report on demand, daily, or weekly
  - Can email report
- Compiles security feature activity from various security-related logs

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The **FortiGate Security Report** compiles security feature activity from various security-related logs, such as virus and attack logs. You can run the report on demand, or on a daily or weekly basis as well as choose to email the generated report.

## Enabling Local Reports

- Requirements:
  - Enable disk logging
  - Enable local reports

Local Log

Disk ☒

Enable Local Reports ☒

Enable Historical FortiView ☒

Local Reports ☒

Log & Report

Forward Traffic

Local Traffic

System Events

WiFi Events

AntiVirus

Learning Report

Local Reports

Log Settings

Threat Weight

Alert E-mail

- Ensure **Local Reports** is enabled on **System > Feature Select**, so **Local Report** menu visible

- Per-VDOM

FortiOS reports are configured from logs stored on the FortiGate hard drive. As such, you must enable disk logging on the **Log Settings** page. You must also enable local reports in order to view and edit reports.

If you do not see **Local Reports** in the GUI menu, go to the **Feature Select** page and enable **Local Reports**.

Local reports are enabled per-VDOM.

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## Configuring, Running, and Viewing Reports

- **Log & Report > Local Reports**

**Report Options**

Generate Report: Daily

Time: 00:00

☐ Email Generated Reports

**Historical Reports**

Report Name	Data Range	Size
On-Demand-default-2016-03-03-071150	Mar 02, 07:00 AM - Mar 03, 06:59 AM	120.29 kB
Schedule-default-2016-02-26-000100	Feb 25, 12:00 AM - Feb 25, 11:59 PM	110.56 kB
Schedule-default-2016-02-25-000100	Feb 24, 12:00 AM - Feb 24, 11:59 PM	109.14 kB
Schedule-default-2016-02-22-000100	Feb 21, 12:00 AM - Feb 21, 11:59 PM	107.37 kB
Schedule-default-2016-02-04-000100	Feb 03, 12:00 AM - Feb 03, 11:59 PM	92.16 kB
Schedule-default-2016-01-25-000100	Jan 24, 12:00 AM - Jan 24, 11:59 PM	92.46 kB
Schedule-default-2016-01-24-000100	Jan 23, 12:00 AM - Jan 23, 11:59 PM	92.45 kB
Schedule-default-2016-01-23-000100	Jan 22, 12:00 AM - Jan 22, 11:59 PM	93.37 kB

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You can configure report options, run reports on demand, and view reports from the **Local Reports** page.

Report options include specifying a schedule to run a report (for example, daily or weekly at a specific time of day), and specifying whether to email the generated reports. If you do not want to schedule reports, you can choose to generate on demand instead. You can run on demand reports even if scheduling is enabled by clicking **Run Now**.

You can view all generated reports from the **Historical Reports** table.

## Review

- ✓ Describe log types and subtypes
- ✓ Describe log severity levels
- ✓ Describe log format (header and body)
- ✓ Identify log storage locations
- ✓ Configure log settings
- ✓ Configure remote logging
- ✓ Enable logging on firewall policies
- ✓ View, filter, download, and export logs
- ✓ Monitor your network
- ✓ Configure alert email
- ✓ Configure, run, and view reports

**FORTINET**

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After this lesson, you should have the knowledge and skills required to:

- Describe log types and subtypes
- Describe log severity levels
- Describe log format (header and body)
- Identify log storage locations
- Configure log settings
- Configure remote logging
- Enable logging on firewall policies
- View, filter, download, and export logs
- Monitor your network
- Configure alert email
- Configure, run, and view reports







In this lesson, you will learn how to understand and apply the firewall policies to allow and deny traffic passing through FortiGate. At its core, FortiGate is a firewall, so almost everything that it does to your traffic is linked into your firewall policies.

## Objectives

- Identify components of firewall policies
- Match traffic to firewall policies by:
  - Source IP address, device ID/type, or user
  - Interface or zone
- Configure firewall policies
  - Configure log blocked traffic
- Identify policy list views
- Understand use of policy ID and sequence number
  - Reorder firewall policies for correct matching
- Demonstrate how to find matching policies for traffic type from the FortiGate GUI






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After this lesson, you should be able to properly identify the different components used in a firewall policy. You'll be able to configure and test your firewall policies, arrange them to correctly match traffic, and monitor traffic passing through them.

## What Are Firewall Policies?

- Policies define:
  - Which traffic matches them
  - How to process traffic that matches
- When a new IP session packet arrives, FortiGate:
  - Starts at the top of the list to look for a policy match
  - Applies the first matching policy
- **Implicit deny**
  - No matching policy?  
FortiGate drops packet



Seq #	Name	Source	Destination	Schedule	Service	Action	NAT
1	text	REMOTE_INTERNAL	all	always	ALL	Accept	Enabled
2	text2	all	all	always	ALL	Accept	Enabled
3	Remote	STUDENT	REMOTE_L1H1	always	ALL	Accept	Enabled
4	Web_Access	all	all	always	Web Access	Accept	Enabled
5	Full_Access	all	all	always	ALL	Accept	Enabled
6	FTP_Deny	all	all	always	FTP	Deny	Disabled
7	Implicit Deny	all	all	always	ALL	Deny	Enabled

To begin, let's talk about what firewall policies are.

Firewall policies define which traffic matches, and what FortiGate will do if it does.

Should the traffic be allowed? This is decided first based on simple criteria such as the source. Then, if the policy itself does not block the traffic, FortiGate begins more computationally expensive security profile inspection (often known as Unified Threat Management (UTM)), such as antivirus, application control, and web-filtering, if you've chosen it in the policy. Those scans could block the traffic if, for example, it contains a virus. Otherwise, the traffic is allowed.

Will NAT be applied? Authentication required? Firewall policies also determine that. Once processing is finished, FortiGate forwards the packet towards its destination.

FortiGate looks for the matching firewall policy from 'top to bottom' and, if a match is found, the traffic is processed based on that firewall policy. If no match is found, it is finally dropped by the default Implicit Deny policy.

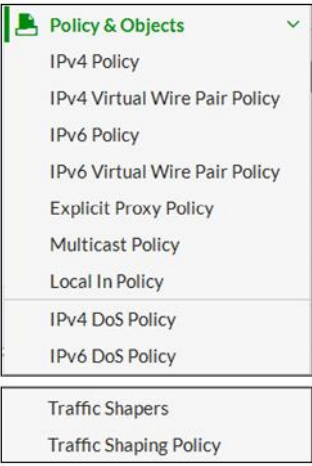
## Components and Policy Types

**Objects Policies Use**

- Interface/interface groups
- Address/user/device definitions
- Service definitions
- Schedules
- NAT rules
- Security profiles

**Policy Types**

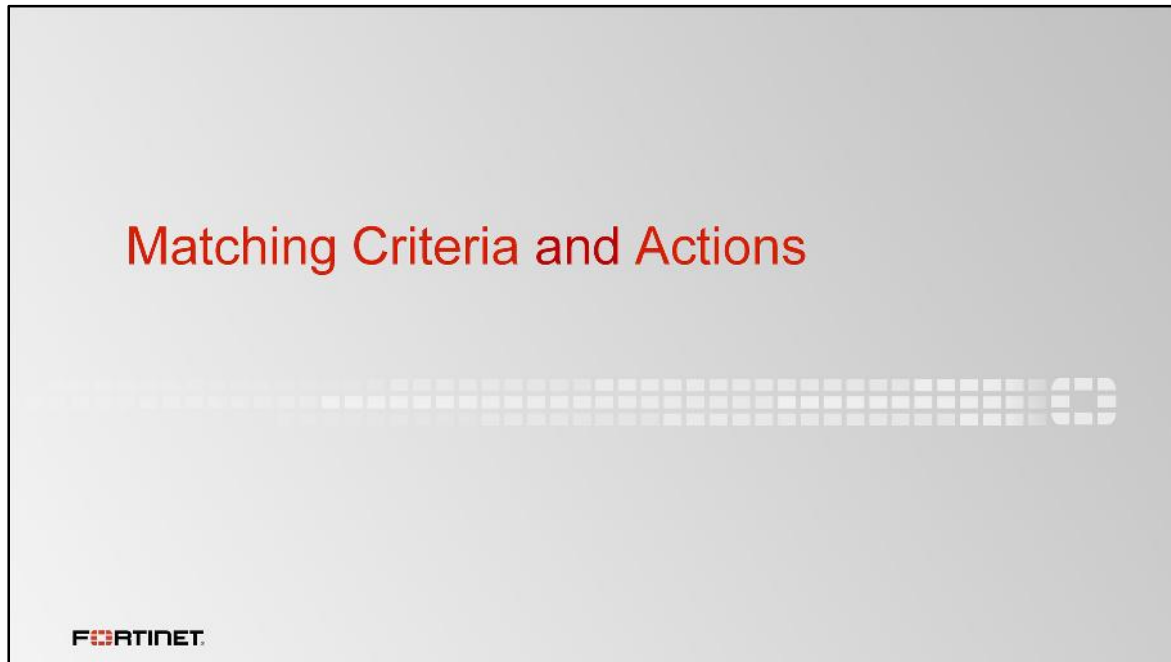
- IPv4, IPv6
- Virtual wire pair (IPv4, IPv6)
- Explicit proxy
- Multicast
- Origin/destination is FortiGate itself (Local traffic)
- DoS (IPv4, IPv6)
- Traffic shaping



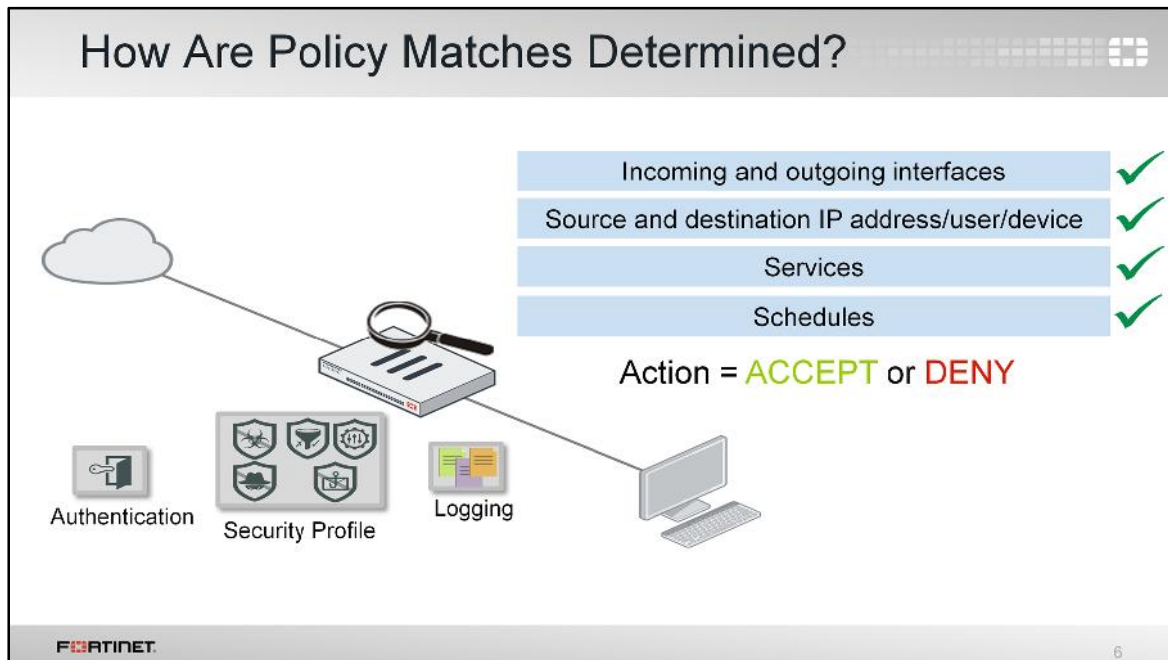
The screenshot shows the 'Policy & Objects' menu in the FortiGate web interface. The menu is titled 'Policy & Objects' with a green checkmark. It contains a list of policy types: IPv4 Policy, IPv4 Virtual Wire Pair Policy, IPv6 Policy, IPv6 Virtual Wire Pair Policy, Explicit Proxy Policy, Multicast Policy, Local In Policy, IPv4 DoS Policy, and IPv6 DoS Policy. Below this list, there is a section for 'Traffic Shapers' containing 'Traffic Shaping Policy'.

Each policy matches traffic and applies security by referring to objects that you've defined, such as addresses and profiles.

What about other firewall policy types? Do IPv6 or virtual wire policies exist? Yes. And they use slightly different objects that are relevant to their type. In this lesson, we are discussing IPv4 firewall policies as they are the most common use case.



Now we know what a firewall policy is. In this section, you will learn how FortiGate matches traffic with the firewall policies and takes appropriate action based on the matching policy.



When a packet arrives, how does FortiGate find a matching policy? Each policy has match criteria, which you can define using [the following](#) objects:

- Ingress and egress
- Source and destination: IP address, device ID, or user
- Network service(s): IP protocol and port number
- Schedule: applies during configured times
- Action : accept or deny

Once FortiGate finds a matching policy, it applies the configured settings for packet processing. Is antivirus scanning or web filtering applied? Will source NAT be applied?

For example, if you want to block incoming FTP to all but a few FTP servers, you would define the addresses of your FTP servers, select those as the destination, and select FTP as the service. You probably *wouldn't* specify a source (often any location on the Internet is allowed) or schedule (usually FTP servers are always available, day or night). Finally, you would set the **Action** setting to **Accept**.

This *might* be enough, but often you'll want more thorough security. Here, the policy also authenticates the user, scans for viruses, and logs blocked connection attempts.

## Simplify: Interfaces and Zones

The screenshot shows the FortiGate web interface for 'Network > Interfaces'. A table lists various interfaces, including physical ports and a DMZ zone. A red box highlights the 'Zone (5)' section, which includes DMZ, port4, port5, port6, and port7. To the right, a diagram of a FortiGate router shows two ports with arrows indicating 'Incoming' and 'Outgoing' traffic. A red box on the router's ports is labeled 'Zone'.

Interface	Name	IP/Netmask	Type
Virtual Wire Pair	port1	10.200.1.1 255.255.255.0	Physical
	port2	10.200.2.1 255.255.255.0	Physical
	port3	10.0.1.254 255.255.255.0	Physical
	port8	0.0.0.0 0.0.0.0	Physical
	port9	0.0.0.0 0.0.0.0	Physical
	port10	0.0.0.0 0.0.0.0	Physical
Zone (5)	DMZ		Zone
	port4	192.168.1.1 255.255.255.0	Physical
	port5	192.168.10.1 255.255.255.0	Physical
	port6	0.0.0.0 0.0.0.0	Physical
	port7	0.0.0.0 0.0.0.0	Physical

- **Incoming Interface:** Interface / zone *receiving* packets
- **Outgoing Interface:** Interface / zone *forwarding* packets

Zone: Logical group of interfaces  
To match policies with traffic, select one (or more) interfaces or **ANY**

To begin describing how FortiGate finds a policy for each packet, let's start with the interface(s).

Packets arrive on an incoming, or ingress, interface. Routing determines the outgoing, or egress, interface. In each policy, you *must* set a source and destination interface; even if one or both are set to **any**. Both interfaces must match the policy's interface criteria in order to be a successful match.

For example, if you configure policies between port3 (LAN) ingress and port1 (WAN) egress and a packet arrives on port2, the packet would *not* match your policies and therefore be dropped due to the implicit deny policy at the end of the list. Even if the policy is from port3 (LAN) ingress to **any** egress, the packet would still be dropped because it did not match the incoming interface.

To simplify policy configuration, you can group interfaces into logical zones. For example, you could group port4 to port7 as a DMZ zone. Zones can be created from the **Interfaces** page. However, you should note that an interface in a zone cannot be referenced individually, and if you need to remove the interface from the zone, you must remove all references to that interface (for example, firewall policies, firewall addresses, and so on). If you think that you might need to reference interfaces individually, you should set multiple source and destination interfaces in the firewall policy, instead of using zones.

## Selecting Multiple Interfaces or any Interface

- Disabled by default
  - Cannot select multiple interfaces or any interface in firewall policy from GUI
- Can be enabled from **System > Feature Select**

**Multiple interface policies disabled**

**Multiple interface policies enabled**

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By default, you can only select a single interface as the incoming interface and a single interface as the outgoing interface. This is because the option to select multiple interfaces, or **any** interface in a firewall policy, is disabled from the GUI. However, you can enable the **Multiple Interface Policies** under the **Feature Select** page to disable the single interface restriction.

You can also select multiple interfaces, or **any** interface, if you configure a firewall policy from the CLI, regardless of the default GUI setting.

It is also worth mentioning that when **any** interface is chosen, you cannot select multiple interfaces for that interface. In this example, because **any** is selected as the outgoing interface, you cannot add any additional interfaces.



## Matching by Source

- **Must** specify at least one source (address)
- **May** specify either, neither, or both:
  - Source User
  - Source Device
- **Source Address**
  - IP address
  - Subnet (IP/Netmask)
  - FQDN
  - Wildcard FQDN
  - Geography
- **Source User** – Individual user or user group. This may refer to:
  - Local firewall accounts
  - Accounts on a remote server (e.g. Active Directory, LDAP, RADIUS)
  - FSSO
  - Personal certificate (PKI-authenticated) users
- **Source Device** – Identified or manually defined client device
  - Enables device identification on the source interface

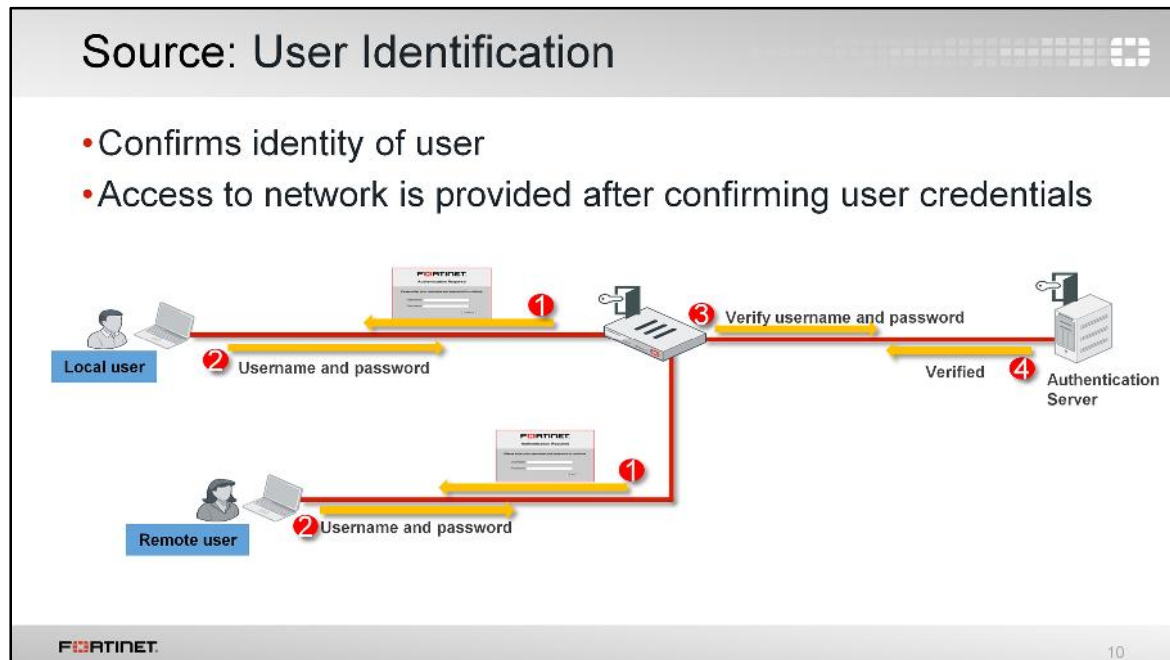
The screenshot shows the 'Edit Policy' window in the FortiGate GUI. The 'Name' field is set to 'Training'. The 'Incoming Interface' is 'port3' and the 'Outgoing Interface' is 'port1'. The 'Source' field is highlighted with a red box and labeled 'Mandatory source address field'. The 'User' and 'Device' fields are also highlighted with red boxes and labeled 'Optional'. Below the 'Edit Policy' window, the 'Addresses' table is shown with a row for 'Test' with FQDN 'test1.com' and IP '0.0.0.0/0'. A red box highlights the 'Unresolved FQDN: test1.com' warning message.

The next match criteria that FortiGate considers is the packet's source.

In each firewall policy, you *must* select a source address object. Optionally, you can refine your definition of the source address by *also* selecting a user, a group, or a specific device. If your organization allows BYOD (Bring Your Own Device), then a combination of all three provides a much more granular match, for increased security.

**Note:** In FortiOS 5.4, you can allow the subnet (IP/Netmask) to be visible in a static route configuration, which can be used when configuring a static route.

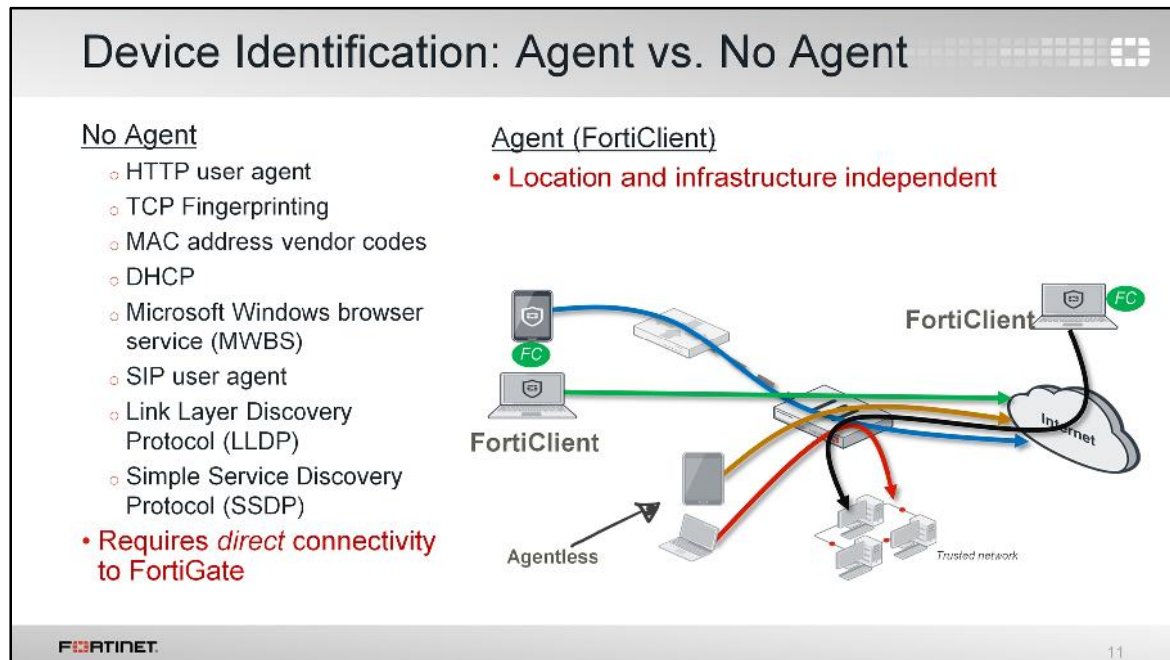
When selecting a fully qualified domain name (FQDN) as the source address, it must be resolved by DNS and cached in FortiGate. Make sure FortiGate is configured properly for DNS settings. If FortiGate is not able to resolve a FQDN address, it will present with a warning message and a firewall policy containing a FQDN may not function properly.



If a user is added as part of the source, it must be verified before allowing or denying access based on the firewall policy. There are different ways a user can be authenticated. For a local user, the username and password is configured locally on FortiGate. When a local user authenticates, it must match the username and password configured on the FortiGate locally.

If it is a remote user (for example, LDAP or RADIUS), FortiGate receives the username and password from the remote user and passes this information to the authentication server. The authentication server verifies the user login credentials and updates FortiGate. Once FortiGate receives that information, access to the network is granted based on the firewall policy.

A Fortinet Single Sign-On (FSSO) user authenticates by logging in with their username and password that is configured on the domain controller and access is granted based on the group information on FortiGate.



There are two device identification techniques: with an agent, and without.

Agentless uses traffic from the device. Devices are indexed by their MAC address and there are various ways to identify devices:

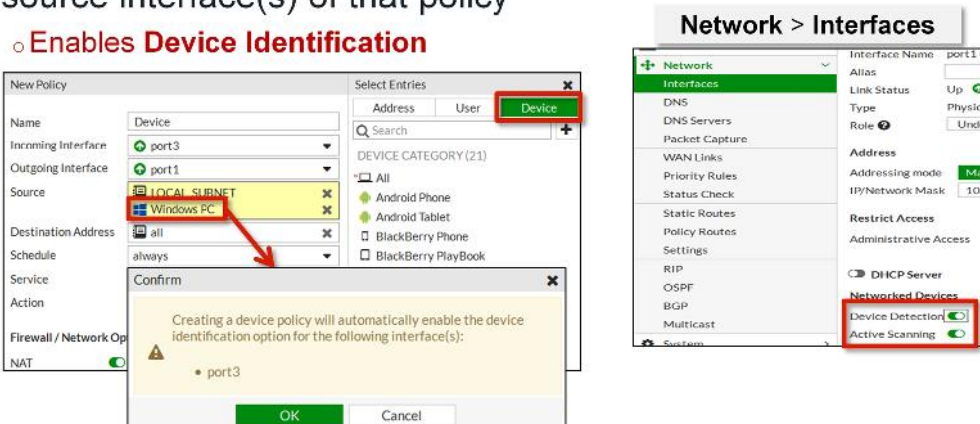
- HTTP "User-Agent:" header
- TCP fingerprint
- MAC address OUI
- DHCP (option 60 class identifier, option 12 host\_name)
- Microsoft Windows browser service (MWBS)
- SIP user agent
- Link Layer Discovery Protocol (LLDP)
- Simple Service Discovery Protocol (SSDP)

**Note:** FortiGate uses "first come, first served" to determine the device identity. For example, if a device is detected by the HTTP user agent, FortiGate updates its device table with the detected MAC address and scanning stops as soon as the type has been determined for that MAC address.

Agent-based uses FortiClient. FortiClient sends information to FortiGate, and the device is tracked by its unique FortiClient UID.

## Device Identification

- **Source Device Type** – Device identification enabled on the source interface(s) of that policy
  - **Enables Device Identification**



The screenshot illustrates the configuration of Device Identification on a FortiGate. On the left, the 'New Policy' window is shown with the 'Device' entry selected in the 'Select Entries' tab. The 'Source' field is set to 'LOCAL SUBNET' and 'Windows PC'. A confirmation dialog indicates that creating a device policy will enable device identification for 'port3'. On the right, the 'Network > Interfaces' window shows 'port1' with 'Device Detection' and 'Active Scanning' enabled.

If you enable **Source Device Type** in the firewall policy, FortiGate enables **Device Detection** and **Active Scanning** on the source interface(s) of the policy. By default, FortiGate uses **Device Detection** (passive scanning) which runs the scans based on the arrival of traffic.

What is active scanning?

If passive detection fails to detect the device type for over five minutes, active scanning is triggered and scans every three minutes. If active scanning fails to detect the device type, the next scan occurs 10 minutes later. If that scan fails, the next occurs 15 minutes later. FortiGate uses an  $(N+1)*5$  minutes algorithm for scanning, where  $N$  is the number of scans that have been done. Active scanning scans for device type, OS, and OS version.

## Device Identification: Device List (GUI and CLI)

• **User & Device > Device Inventory**

**User & Device > Custom Devices & Groups**

Status	Device	OS	User	IP Address	Interface
Online	00:0c:29:0b:db:a9	Linux / CentOS 5 (x64)		10.200.2.254	port2
Online	00:0c:29:0b:db:a9	WIN-OS/IMMO6QN6G	Saurabh	10.0.1.10	port3
Online	00:0c:29:0b:db:a9	WIN-OS/IMMO6QN6G		10.200.3.1	port1
Online	00:0c:29:0b:db:a9	WIN-OS/IMMO6QN6G		10.200.2.22	port2

```
Student # diag user device list
Hosts
vd root/0 00:0c:29:0b:db:a9 gen 195/34/140 req 3c redir 0
created 1524s seen 1s port1
ip 10.200.3.1
type 8 'Windows PC'
src tcp
vd root/0 00:0c:29:0b:db:a9 gen 189/39/108 req 0
created 1118s seen 200s port2
ip 10.200.2.254
type 6 'Linux PC'
src http
os 'Linux' version '2.6.18-128.el5xen'
vd root/0 00:0c:29:0b:db:a9 gen 194/38/139 req 0
created 1509s seen 3s port3
ip 10.0.1.10(b) ip6 fe80::dc52:a641:a012:3014
type 8 'Windows PC'
src forticlient
os 'Windows' version 'server' src forticlient id 0 c 1
host 'WIN-OS/IMMO6QN6G' src forticlient
```

The **Device List** shows the list of detected devices. It also shows the total number of devices detected. You can right-click on any detected device to edit, delete, or view details in FortiView. The details include session, destination, policies, and more.

You can also define static entries for device and/or device groups. By default, devices are grouped into **Custom Device Groups**; however, if a predefined device group doesn't match your organizational needs, you can create a custom group.

Devices are indexed by MAC and identified from multiple sources. The CLI command `diagnose user device list` shows a more detailed listing than the **Device Inventory** page, including the detection method. In this worked example, devices are detected by source as TCP fingerprinting, HTTP user agent, and FortiClient.

Detected devices are saved to FortiGate's flash drive. Therefore, on restart, FortiGate knows that devices have already been identified, and does not have to re-categorize each device.

The user displayed in the device information is just a tag; it cannot be used as a means of identification for an authentication policy.

## Endpoint Control

- FortiGate can control FortiClient settings via FortiClient profiles and registration
- Enable **FortiTelemetry** on FortiGate interface(s) for registration

**Network > Interfaces**

**Restrict Access**

Administrative Access: ☒ HTTPS ☒ PING ☒ HTTP ☐ FMG-Access  
☒ FortiTelemetry ☒ SNMP ☒ TELNET ☐ RADIUS Accou

**Enforce FortiTelemetry for all FortiClients** ☒ **Optional settings**

**Mandatory to allow FortiClient for registration**

**FortiClient Console**

**Compliance** ☒ This computer is in compliance with Local-FortiGate (10.0.1254) [Click to Disconnect](#)

**AntiVirus** Realtime Protection Disabled

**Web Filter** Web Filter Enabled

**Registered FortiClient**

**FortiClient UID**

```
Student # diagnose endpoint registration list
FortiClient # 10.0.1.10
UID = 4E2602B29AEF47B7876E5600668CF839
status = registered
source IP = 10.0.1.10
source MAC = 00:0c:29:65:6d:99
```

FortiGate can control FortiClient settings through the FortiClient profile and registration. In order for FortiClient to register with FortiGate, **FortiTelemetry** must be enabled on the applicable interface. There are other configuration settings worth mentioning, such as **Enforce FortiTelemetry for all FortiClients**. If enabled, non-complaint devices are blocked and redirected to a web portal that explains the non-compliance and provides a link to download FortiClient. You can exempt devices from FortiClient enforcement using source and/or destination or services.

Once FortiClient is registered, it is added into the device list. FortiGate also pushes the FortiClient profile to the registered FortiClient(s). You may configure the default FortiClient profile or add additional profiles.

You can also view the FortiClient endpoint information from the **FortiClient Monitor** page.

You can run `diagnose user device list` or `diagnose endpoint registration list` to view the FortiClient unique UID.

FortiClient devices have a unique id which can be used as an index for the device. The unique id is used *instead of* the MAC address, because using MAC addresses can be problematic when a device has multiple MAC addresses (such as servers or virtual machines), or when there is no Layer 2 visibility of the device.

The **License Information** widget on the FortiGate GUI dashboard shows the total number of registered devices and the total number of devices available for registration. Windows and Mac OS X FortiClient installers are also available from this dashboard widget.



## Endpoint Control

- Firewall policies with **Source Device Type** restrict access to specific devices



The screenshot displays the FortiGate web interface for editing a firewall policy. On the left, the 'Policy & Objects' menu is expanded, showing 'IPv4 Policy' selected. The main area is titled 'Edit Policy' and contains the following configuration:

Field	Value
Name	FortiClient
Incoming Interface	port3
Outgoing Interface	port1
Source	LOCAL_SUBNET, Windows PC
Destination Address	all
Schedule	always
Service	ALL
Action	ACCEPT

FortiClient is the agent-based approach for source device type.

As shown in the previous slide, FortiClient enforcement is enabled on the interface(s). Firewall policies with this source interface will force the user to download or register FortiClient with FortiGate. In FortiOS 5.2, FortiClient enforcement was enabled on a policy-by-policy basis.

### Example: Matching Policy by Source

- Matches by source address, user, and device type

The screenshot shows the FortiGate Firewall Policy configuration interface. The 'Source' field is highlighted with a red box and contains 'LOCAL\_SUBNET', 'Marketing', 'Mac', 'Windows PC', and 'iPad'. The 'Address' field is highlighted with a red box and contains 'IP Phone', 'Linux PC', 'Mac', 'Media Streaming', 'Other Network Device', 'Printer', 'iPad', 'iPhone', 'Router/NAT Device', 'Windows PC', 'Windows Phone', and 'Windows Tablet'. The 'User' field is highlighted with a red box and contains 'Marketing', 'Mac', 'Windows PC', and 'iPad'. The 'Device' field is highlighted with a red box and contains 'Mac', 'Media Streaming', 'Other Network Device', 'Printer', 'iPad', 'iPhone', 'Router/NAT Device', 'Windows PC', 'Windows Phone', and 'Windows Tablet'. Red arrows point from the 'Address', 'User', and 'Device' labels to their respective fields.


Here, all three source selectors identify the user group, device type, and specific subnet.

Remember, user and device are optional objects. They are used here to make the policy more specific. If you wanted the policy to match more traffic, you would leave the **user** and **device** objects undefined.



## Matching by Destination

- Like source, address objects can use:
  - Subnet (IP/Netmask)
  - IP Range
  - FQDN
    - Wildcard FQDN
  - Geography
- DNS query used to resolve FQDN
- Country defines addresses by ISP's geographical location
  - Database updated periodically with FortiGuard



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Like the packet's source, FortiGate also checks the destination address for a match.

Address objects may be a host name, IP subnet, or range. If you enter a FQDN as the address object, make sure that you've configured your FortiGate with DNS settings. FortiGate uses DNS to resolve those FQDN host names to IP addresses, which are what actually appear in the IP header.

Geographic addresses, which are groups or ranges of addresses allocated to a country, can be selected instead. These objects are updated via FortiGuard.

Why is there is no option to select user or devices? The user identification or device identification is determined at the ingress interface, and packets are forwarded only to the egress interface once user or device authentication is successful.

## Scheduling

- **Objects > Schedules**
- Policies apply only during specific times and days
  - Example: A less restrictive 'lunch time' policy
  - Default schedule applies all the time
  - Recurring
    - Happens every time during specified day(s) of the week
  - One-time
    - Happens only once

### Recurring Schedule

New Schedule

Type: **Recurring** One-time

Name:

Days: ☐ Sunday ☒ Monday ☒ Tuesday ☒ Wednesday ☒ Thursday ☒ Friday ☐ Saturday

All Day: ☐

Start Time: Hour 9 Minute 0

Stop Time: Hour 5 Minute 59

OK Cancel

### One-time Schedule

New Schedule

Type: Recurring **One-time**

Name: Maintenance window

Start Date: 2016/01/01


End Date: 2016/01/03


Start Time: Hour 2 Minute 30

Stop Time: Hour 3 Minute 0

Pre-expiration event log: ☒ Number of days before: 1

OK Cancel





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Schedules add a time element to the policy. For example, a policy allowing backup software may activate at night, or a remote address may be allowed for testing purposes, and a schedule provides a test window.


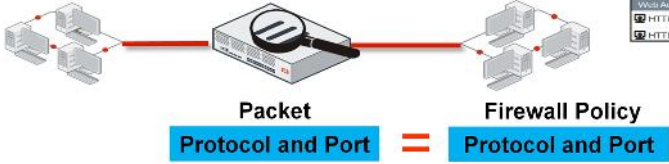
Schedules can be configured from the **Schedules** page and use a 24-hour time clock. There are a few configuration settings worth mentioning:

**Recurring:** When configuring recurring schedules, if the stop time is set earlier than the start time, the stop time will occur the next day. For example, if you select Sunday as the day, 10:00 as the start time, and 09:00 as the stop time, the schedule will stop on Monday at 09:00. If the start and stop time are identical, the schedule will run for 24 hours.

**One-time:** The start date and time must be earlier than stop date and time. You can also enable **Pre-expiration event log**, which will generate an event log N number of days before the schedule expires, where N can be from 1 to 100 days.

## Matching by Service

- **Service** determines matching transmission protocol (UDP, TCP, and so on) and port number
  - Or higher layer, such as application protocols (HTTP, HTTPS, DNS...)
- Can be predefined or custom
- **ALL** matches all ports and protocols



Service Name	Category	Protocol	Port
ALL	General	ANY	IP
ALL/ICMP	General	ICMP/ANY	ICMP
ALL/TCP	General	TCP/1-65535	TCP/UDP/SCTP
ALL/UDP	General	UDP/1-65535	TCP/UDP/SCTP
Web Access (2)	Web Access	TCP/80	TCP/UDP/SCTP
HTTP	Web Access	TCP/80	TCP/UDP/SCTP
HTTPS	Web Access	TCP/443	TCP/UDP/SCTP

**Packet Protocol and Port = Firewall Policy Protocol and Port**

Another criterion that FortiGate uses to match policies is the packet's service.

At the IP layer, protocol numbers (for example, TCP, UDP, SCTP, and so on) together with source and destination ports, define each network service. Generally, only a destination port (that is, the server's listening port) is defined. Some legacy applications may use a specific source port, but in most modern applications, the source port is randomly determined at transmission time, and therefore is not a reliable way to define the service.

For example, the predefined service object named HTTP is TCP destination port 80 and the predefined service object named HTTPS is TCP destination port 443. However, the source ports are ephemeral and, therefore, not defined.

By default, services are grouped together to simplify administration, so you can view the services **By Category** or **Alphabetically**. If the predefined services doesn't meet your organizational needs, you can create one or more new services, service groups, and categories.



So far we have learned about firewall policies matching criteria and the action that FortiGate can take. In this section, you will learn how to configure firewall policies.

## Configuring Firewall Policies

- **Policy & Objects > IPv4 Policy**
  - Mandatory policy name (configurable from **System > Feature Select**)
  - Flat GUI view allows:
    - Select by clicking
    - Drag and drop

```
config firewall policy
edit 1
set name "Unrestricted"
set uuid 2204966e-47f7-51..
```

Universally Unique Identified (UUID)

Enabled by default  
*MUST* specify unique name

Highlights selected entry

When you configure a new firewall policy from the GUI, you *must* specify a unique name for the firewall policy because it is enabled by default (but optional in the CLI). This helps the administrator to quickly identify the policy that they are looking for. However, you can make this feature optional in GUI from the **Feature Select** page by enabling **Allow Unnamed Policies** under **Additional Features**.

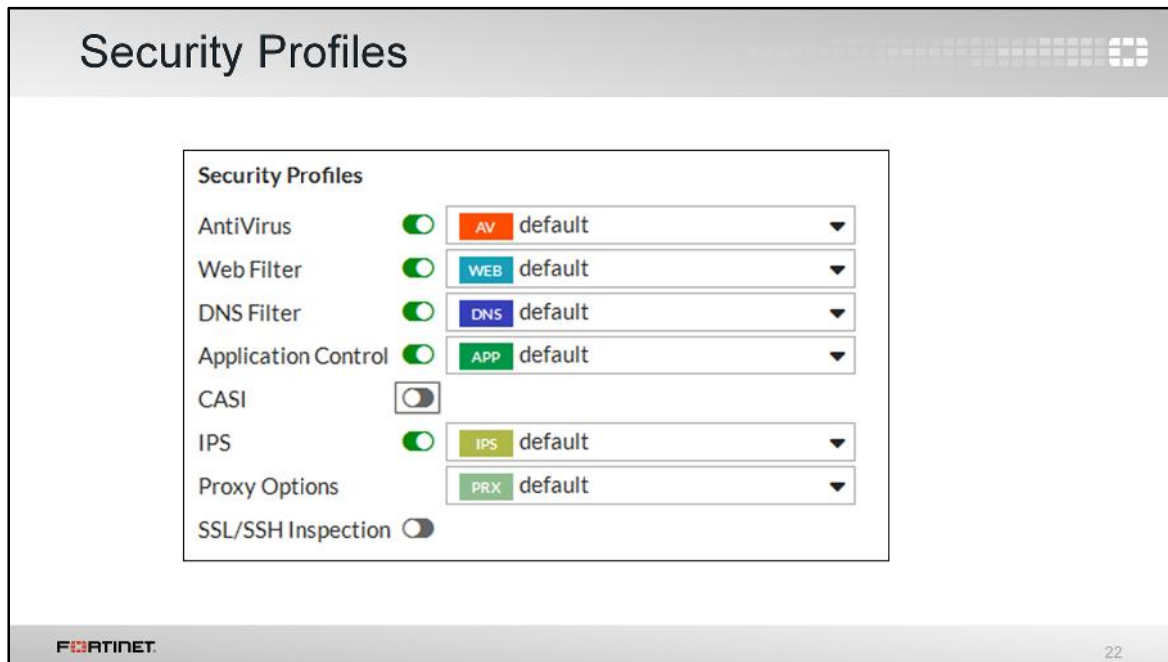
**Note:** When upgrading from a previous FortiGate firmware version (for example, 5.2) or a policy configured from the CLI, no policy names are assigned. However, if you modify an existing policy from the GUI, you *must* specify a unique name.

The FortiGate flat GUI view allows you to select interfaces and other objects by clicking or dragging and dropping on the list populated on the right-hand side.

There are many other options that you can configure from the firewall policy, such as firewall and network options, security profiles, logging options, and enabling or disabling a policy.

When creating firewall objects or policies, a Universally Unique Identified (UUID) attribute is added so that logs can record these UUID and improve functionality when integrating with FortiManager or FortiAnalyzer.

When creating firewall policies, remember that FortiGate is a stateful firewall. As a result, you only need to create one firewall policy that matches the direction of the traffic that initiates the session. FortiGate will automatically remember the source-destination pair and allow replies.

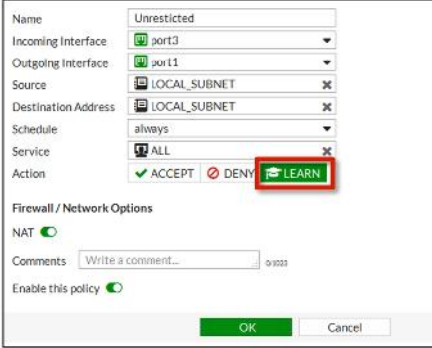


One of the most important features that a firewall policy can apply is security profiles, such as IPS and antivirus. A security profile inspects each packet in the traffic flow, where the session has already been conditionally accepted by the firewall policy.

When inspecting traffic, FortiGate can use one of two methods: flow-based or proxy-based. Different security features are supported by each type.

## Learning Mode

- Allows everything through firewall policy but with fully enabled logging capabilities
  - Enables hidden security profiles
    - Action set to monitor
    - User unable to view or edit them
- All logs generated from these policies will be tagged as *Learning*.
- Provides cyber threat assessment report
  - **Log & Reports > Learning Reports**
  - Uses all learning logs and security vectors

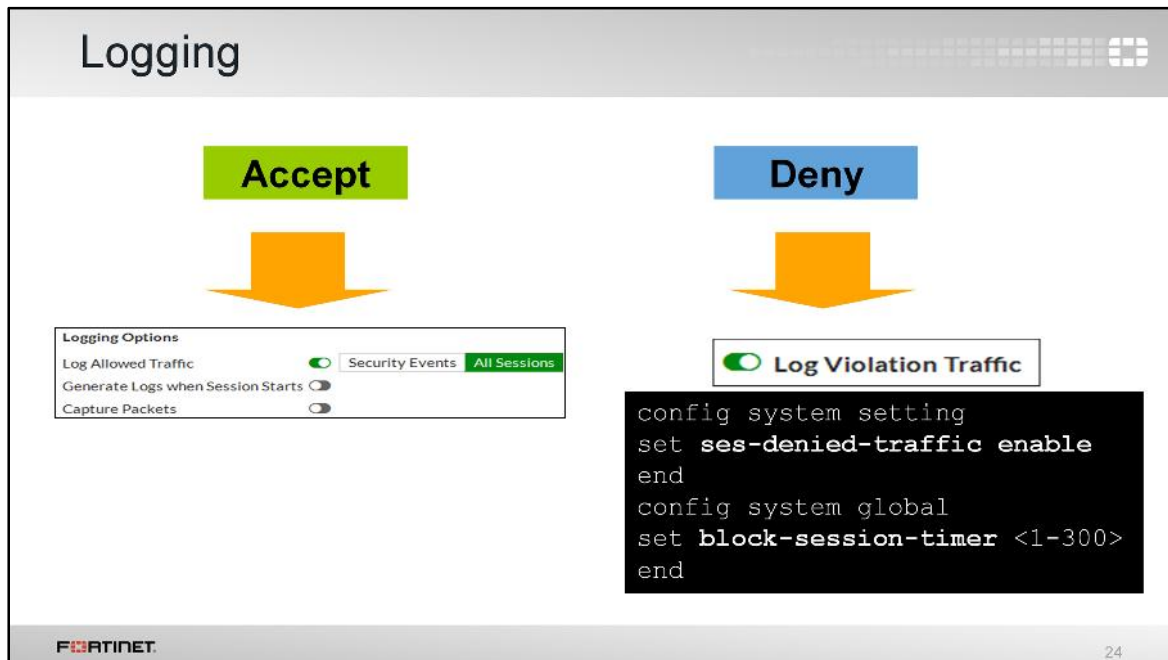


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You can also enable learning mode on a firewall policy. When you set **Action** to **LEARN**, the firewall policy automatically applies default static profiles and passes traffic to security profiles for monitoring. It also enables logging with full capabilities, which are tagged as *Learning* in the logs.

You can view the comprehensive report that results from learning mode under the **Learning Reports** page. This report uses all of the learning logs, across all traffic and security vectors, to generate a complete summary report. This enables users to easily implement a *monitor then enforce* process.



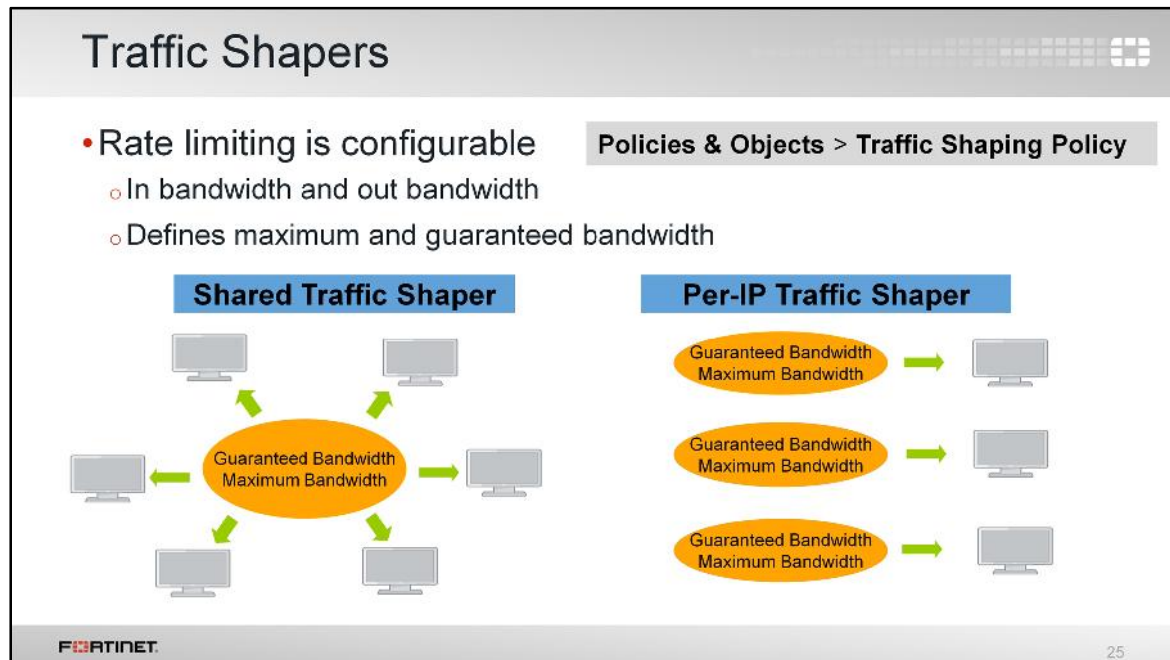
If you enable **Generate Logs when Session Starts**, FortiGate will create a traffic log when the session begins. But remember that increasing logging decreases performance, so use it only where necessary.

If you have enabled logging in the policy, FortiGate will generate traffic logs once a firewall policy closes an IP session.

During the session, if a security profile detects a violation, FortiGate will record the attack log immediately. To reduce the amount of log messages generated and improve performance, you can enable a session table entry of dropped traffic. This creates the denied session in the session table and, if the session is denied, all packets of that session are also denied. This option is in the CLI, and is called `ses-denied-traffic`. You can also set the duration for block sessions. This determines how long a session will be kept in the session table by setting `block-session-timer` in the CLI. By default, it is set to 30 seconds.

If the GUI option **Generate Logs when Session Starts** is not displayed, this means that your FortiGate device does not have internal storage. This option is in the CLI, regardless of internal storage, and is called `set logtraffic-start enable`.





Two types of traffic shapers can be configured: shared and per-IP.

A shared shaper applies a total bandwidth to all traffic using that shaper. The scope can be per-policy or for all policies referencing that shaper. FortiGate can count the packet rates of ingress and egress to police traffic.

In FortiOS 5.4, traffic shaping policies are created separately on the **Traffic Shaping Policy** page. FortiGate allows you to create three types of traffic shaping policies:

- Shared policy shaping: Bandwidth management of security policies
- Per-IP shaping: Bandwidth management of user IP addresses
- Application control shaping: Bandwidth management by application

When creating traffic shaping policies, you must ensure that the *Matching Criteria* is the same as the firewall policies you want to apply shaping to. Note that these apply equally to TCP and UDP, and UDP protocols may not recover as gracefully from packet loss.



So far you have learned how to configure firewall policies. In this section, you will learn how to manage and fine-tune settings for firewall policies.

## Policy List: Interface Pair View and By Sequence

- **Policy & Objects > IPv4 Policy**
- **Interface Pair View**
  - Lists policies by ingress/egress interfaces
- **By Sequence (only)**
  - If multiple source/destination interfaces or matches **any** interface

Can view By Sequence also

Interface Policy pairs

Multiple interface

any interface

Interface pair view is currently disabled because:

- One or more policies are using the 'any' interface.
- One or more policies are configured with multiple source or destination interfaces.

Firewall policies appear in an organized list. It's either organized in **Interface Pair View**, or **By Sequence**.

Usually, it will appear in **Interface Pair View**. Each section contains policies for that ingress-egress pair. Alternatively, you can view your policies as a single, comprehensive list by selecting **By Sequence** at the top of the page.

In some cases, you won't have a choice of which view is used.

If you use multiple source and destination interfaces or the **any** interface in a firewall policy, policies cannot be separated into sections by interface pairs – some would be triplets or more. So instead, policies are then always displayed in a single list (**By Sequence**).

To help you remember the use of each interface, you can give them aliases. For example, you could call port3 *Internal\_network*. This can help to make your list of policies easier to comprehend.

## Policy ID and Adjusting Policy Order

- Policy IDs are identifiers
  - CLI commands use policy ID instead of sequence number
- In GUI, drag-and-drop **Seq. #**

**Before policy move**

Seq.#	ID	Name	Source	Destination	Schedule	Service	Action
1	5	Test2	all	all	always	ALL	Accept
2	7	Full_Access	all	all	always	ALL	Accept
3	8	Block_Syslog	all	all	always	SYSLOG	Deny

**After policy move**

Seq.#	ID	Name	Source	Destination	Schedule	Service	Action
1	5	Test2	all	all	always	ALL	Accept
2	8	Block_Syslog	all	all	always	SYSLOG	Deny
3	7	Full_Access	all	all	always	ALL	Accept

**CLI Snippets:**

**Before policy move:**

```
config firewall policy
edit <policy_id>
end
```

**After policy move:**

```
config firewall policy
edit 7
set name "Full_Access"
set uuid 2c487b8c-8e59-5f
set srcintf "port3"

edit 8
set name "Block_Syslog"
set uuid bf431ed4-8ecb-5f
set srcintf "port3"
```

Firewall policies in the GUI are ordered primarily by the policy sequence number. Policy sequence numbers define the order in which rules are processed. Policy IDs are identifiers. By default, sequence numbers are displayed on the GUI. CLI commands, however, use policy ID.

Be careful not to accidentally modify the wrong policy. To avoid such errors, you can add the policy ID to the GUI using the column settings.

Remember that we mentioned that only the first matching policy applies? Moving your policies into the *correct position* is important. It affects which traffic is blocked or allowed. In the applicable interface pair's section, FortiGate will look for a matching policy, beginning at the top. So 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.

Here, we're moving a policy (sequence number 3, ID 8) that only matches syslog traffic above a more general **Full\_Access** (accept everything from everywhere) policy. Otherwise, FortiGate would always apply the first matching policy – **Full\_Access** – and never reach the **Block\_Syslog** policy.

Notice that after moving this policy up, the sequence number changed from 3 to 2, but the policy ID 8 remained the same in the GUI. As the CLI only uses policy ID, before moving, policy ID 7 was on top, and after the move, policy ID 8 is on the top.

As a best practice, always add the policy ID column in the GUI. While sequence number changes when a policy is moved, the value that remains with a policy is the policy ID.

## Simplify: Groups of Sources/Services

- Each address and service object referenced individually, or...
- Using groups, rewrite to simplify policies

The screenshot displays the Fortinet Firewall Policy configuration interface. It shows two policy tables and two configuration windows. The top table, 'port3: port1 (1-4)', lists two policies: Policy 1 (ID 5, Name 'Email') and Policy 2 (ID 4, Name 'Web-FTP'). Policy 1 has source objects 'LAN\_1' and 'LAN\_2', destination 'all', schedule 'always', and service 'Email Access'. Policy 2 has source objects 'LAN\_1' and 'LAN\_2', destination 'all', schedule 'always', and services 'HTTP', 'HTTPS', 'DNS', and 'FTP'. The bottom table, 'port2: port1 (1-4)', shows the simplified version: Policy 1 (ID 5, Name 'Email') with source 'LAN' and service 'Email Access'; Policy 2 (ID 4, Name 'Web-FTP') with source 'LAN' and service 'Web-FTP'. The 'Edit Address Group' window shows a group named 'LAN' with members 'LAN\_1' and 'LAN\_2'. The 'New Service Group' window shows a group named 'Web-FTP' with members 'HTTP', 'HTTPS', 'DNS', and 'FTP'. Red boxes and arrows highlight the mapping from the original policy objects to the simplified group objects.

Seq.#	ID	Name	Source	Destination	Schedule	Service	Action	NAT
port3: port1 (1-4)								
1	5	Email	LAN_1 LAN_2	all	always	Email Access	Accept	Enabled
2	4	Web-FTP	LAN_1 LAN_2	all	always	HTTP HTTPS DNS FTP	Accept	Enabled

Seq.#	ID	Name	Source	Destination	Schedule	Service	Action	NAT
port2: port1 (1-4)								
1	5	Email	LAN	all	always	Email Access	Accept	Enabled
2	4	Web-FTP	LAN	all	always	Web-FTP	Accept	Enabled

To reduce the total number of firewall policies in RAM and to simplify administration, you can group service and address objects. Then you can reference that group in the firewall policy, instead of selecting multiple objects each time or making multiple policies.

Here, we see four services that match the policy: HTTP, HTTPS, FTP, and DNS. DNS is usually used by HTTP, as people remember domain names for web sites instead of their IP addresses. If you need to make many policies for web and FTP traffic, then it makes sense to create a service object named **Web-FTP**. That way, you don't have to manually select all four services each time you make a policy. Policies can reference the **Web-FTP** service group instead.

Also, if you notice, you can consolidate these two firewall policies, as they have the same source and destination, except the services are different. You can consolidate source address as source group and create a service group containing all the services for web, FTP, and email access.

When consolidating two firewall policies, the other settings in the firewall policy, such as logging and security profiles, should match.

## Object Usage

- Allows for faster changes to settings
- Reference column shows if the object is being used
  - Links directly to the referencing object

Name	Type	Details	Ref.	Interface	Visibility
all	Subnet	0.0.0.0/0	5	Any	✓
android	Wildcard FQDN	*.android.com	1	Any	✓

Usage of Address: all

Object Name	Number of times object used	Referenced by policy ID
Marketing	3	2 References
Policy (2)	4	2 References

We've just shown several component objects that can be re-used as you make policies. What if you want to delete an object?

If it's being used, you can't. First, you must reconfigure the objects that are currently using it. The GUI provides a simple way to find out where in the FortiGate's configuration an object is being referenced. See the numbers in the **Ref.** column? They are the number of places where that object is being used. The number is actually a link, so if you click it, you can see which objects use it.

In this example, address **all** is being used by an address group and two firewall policies. If you select a firewall policy, you can use the **Edit**, **View List**, and **View Properties** tabs.

- **Edit**: It allows you to edit the selected object. In this example, it shows the edit page for the firewall policy ID 3.
- **View List**: It allows you to view selected objects in its category. In this example, it will show you the list of all the firewall policies.
- **View Properties**: It shows where the object is used in that configuration. In this example, address object **all** is being used in the destination address and source address of that firewall policy.



## Firewall Policy: Fine Tuning

- Right-click menu contains various options to add/modify policies

The screenshot displays the FortiGate Firewall Policy configuration page. A table lists three policies. The first policy, 'STUDENT', is selected. A right-click context menu is open over the first policy, showing options like 'Status', 'Policy', 'Insert', 'Copy', 'Paste', 'Clone Reverse', 'Rename policy', 'Insert Section Label', 'Show Matching Logs', 'Show In FortiView', 'Edit', 'Edit in CLI', and 'Delete Policy'. The 'Edit in CLI' option is highlighted. Another right-click menu is open over the 'Service' column of the first policy, showing options like 'Select Entries', 'Service', 'Edit', and 'Show References'. The 'Select Entries' option is highlighted. A third window, 'Select Entries', is open, showing a list of services (AFS3, AH, ALL, ALL\_ICMP, ALL\_ICMP6, ALL\_TCP, ALL\_UDP, BGP, DCE-RPC, etc.) with 'ALL\_ICMP' selected. A CLI console window is also open, showing the command 'config firewall policy' and 'edit "2"', with the output 'Student (policy) # edit "2"' and 'Student (2) # |'.

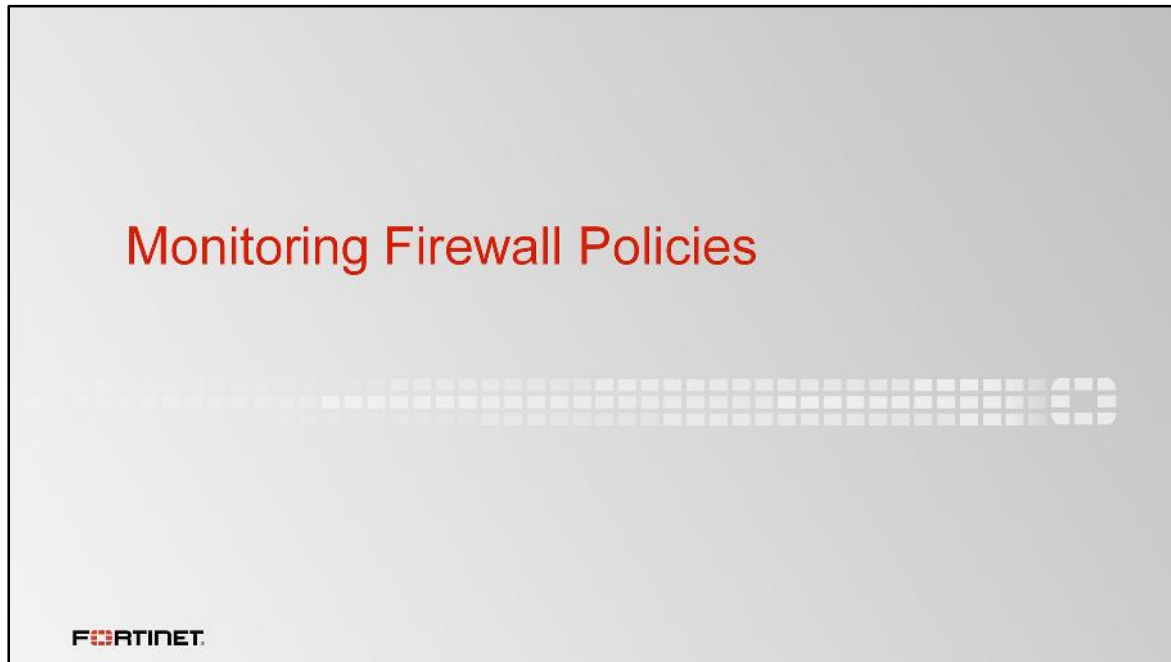
Seq.#	Name	Source	Destination	Schedule	Service	Action	NAT
1	Fortinet	STUDENT	REMOTE_INTERNAL	always	Service	Enabled	Enabled
2	Policy	all	all	always	Service	Enabled	Enabled
3	+	REMOTE_ETH1	REMOTE_ETH1	always	Service	Enabled	Enabled

```
CLI Console (connected)
10.0.1.234:system(config)#show-18sample-18moder
Connected
config firewall policy
edit "2"
Student # config firewall policy
Student (policy) # edit "2"
Student (2) # |
```

You can right-click any firewall policy sequence to see different menu options to edit or modify the policy. The options include enabling or disabling a firewall policy, inserting firewall policies (above or below), copying and pasting policies, and cloning reverse (only if NAT is disabled on that policy).

Clicking **Edit in CLI** opens the CLI console for the firewall policy or object selected.

Right-clicking the objects provides you with options to add or remove an object of the same type, modify an object, and show a reference for that object.




So far, we have learned about managing firewall policies. In this section, you will learn how to monitor and find matching firewall policies using the policy lookup feature.



## Policy Lookup (GUI)

- Packet flow without real traffic required to trace matching policy
- Searches matching policy based on input criteria
  - Source Interface
  - Protocol
    - Requires more granular input criteria
  - Source IP address
  - Destination IP/FQDN
- Policy lookup checks
  - Reverse path forward (RPF)
  - Destination NAT, if matching Virtual IP
  - Route lookup, to resolve destination interface
  - Iprope list lookup



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In FortiOS 5.4, you can find a matching firewall policy based on the policy lookup input criteria. It is basically creating packet flow over FortiGate without real traffic, from which it can extract a policy ID from flow trace and highlight it on the GUI policy configuration page.

Depending upon the protocol you select (for example, TCP, UDP, IP, ICMP, and so on), you need to define other input criteria. For example, when you select TCP as the protocol, you need to define the source address, source port (optional), destination port, and destination address. When you select ICMP as the protocol, you need to define the ICMP type/code, source address, and destination address.

When FortiGate is performing policy lookup, it performs a series of checks on ingress, stateful inspection, and egress, for the matching firewall policy from top to bottom before providing results for the matching policy.

**Note:** If the firewall policy status is set to disable, the policy lookup skips the disabled policy and checks for the next matching policy in the list.

## Policy Lookup Example (GUI)

- Highlights matching policy after search

The screenshot shows the FortiGate GUI with a Policy Lookup search. The search criteria are: Source Interface: port3, Protocol: TCP, Source: 10.0.1.100, Source Port: Optional (1-65535), Destination: 4.2.2.2, Destination Port: 21. The search results show three policies, with the first policy (Test1) highlighted as the matching policy.

Seq.#	Name	Source	Destination	Schedule	Service	Action	NAT
1	Test1	10-0-1-subnet	all	always	FTP	Accept	Enabled
2	Test2	10-0-1-10	Fortinet_FQDN	always	ALL	Accept	Enabled
3	Full_Access	all	all	always	ALL	Accept	Enabled

Based on the input criteria, after clicking **Search**, the trace result will be selected, and highlighted, on the **IPv4 Policy** page.

## Review

- ✓ How packets match a firewall policy
- ✓ How FortiGate defines matching traffic
  - ✓ Interfaces vs. zones
  - ✓ Domain name / IP address objects
  - ✓ Device list and endpoint control
  - ✓ Network services
- ✓ Configuring firewall policies
- ✓ Reordering policies to match more granular policies first
- ✓ Using policy lookup to find matching policies

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To review, here's all the topics we covered in this lesson:


- How packets match a firewall policy
- How FortiGate defines matching traffic
- Configuring firewall policies
- Reordering policies to match more granular policies first
- Using policy lookup to find matching policies




In this lesson, you will learn how Network Address Translation (NAT) is configured and used to do source NAT and destination NAT for the traffic passing through FortiGate.

## Objectives

- Choose between firewall policy NAT vs. central NAT
- Configure firewall policy source NAT and destination NAT (Virtual IP)
  - Apply source NAT with IP pool (overload vs. one-to-one, fixed port range and port block allocation)
  - Configure destination NAT with virtual IPs or a virtual server
- Configure central NAT
  - Configure source NAT with central SNAT policy
  - Configure destination NAT with DNAT & Virtual IPs
- Use a SIP session helper for VoIP
- Understand the session table





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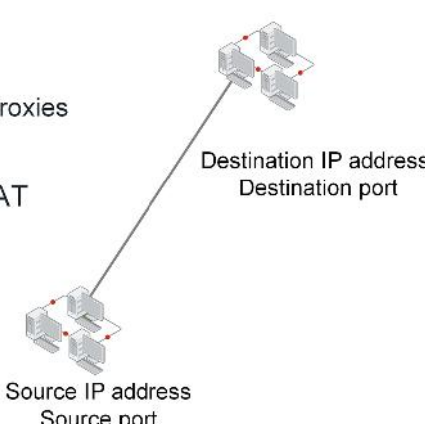
After completing this lesson, you should have these practical skills that you can use to configure and implement source NAT and destination NAT for traffic passing through the FortiGate.

This includes:

- Choosing between firewall policy NAT and central NAT
- Configuring firewall policy source NAT and destination NAT (Virtual IP)
- Configuring central NAT
- Using a SIP session helper for VoIP
- Understanding the session table on FortiGate

## NAT and PAT

- Network Address Translation – NAT
  - Change an IP layer address of a packet
    - Some protocols like SIP also have addresses at the application layer, requiring session helpers/proxies
  - Source Network Address Translation – SNAT
  - Destination Network Address Translation – DNAT
- Port Address Translation – PAT
  - Change the IP layer port number of a packet



Source IP address  
Source port

Destination IP address  
Destination port

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In addition to security scans, firewall policies also determine what network address translation (NAT) or port address translation (PAT) to apply to each packet.


NAT and PAT, also known as NAPT, translate internal, typically private, IP addresses to external, typically public or Internet, IP addresses.

In FortiOS, NAT and traffic forwarding applies to the same firewall policy. However, diagnostics clearly show NAT and forwarding as separate actions.

- The NAT option in a firewall policy, and IP pools, are *source NAT*.
- Virtual IPs are *destination NAT*.

## Firewall Policy NAT vs. Central NAT

- Two ways to configure source / destination NAT
- Firewall policy NAT
  - Source NAT and destination NAT must be configured for each firewall policy
    - Source NAT uses outgoing interface address or configured IP pool
    - Destination NAT uses configured Virtual IP as destination address
- Central NAT
  - Source NAT and destination NAT configurations are per virtual domain – applies to multiple firewall policies based on SNAT and DNAT rules
    - Source NAT rule is configured from central SNAT policy
    - Destination NAT is configured from DNAT & Virtual IPs

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When you use firewall policy NAT mode, you must configure SNAT and DNAT for each firewall policy.

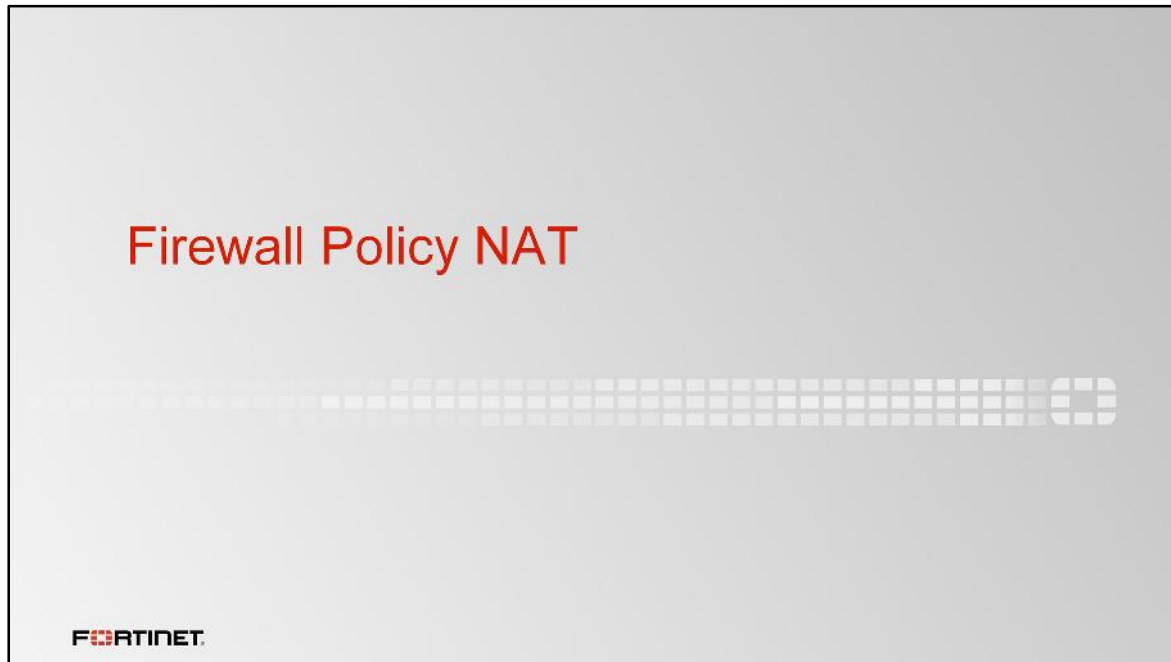
Central NAT configurations are per virtual domain (discussed later in the training), which means SNAT and DNAT configurations automatically applies to multiple firewall policies, according to the SNAT and DNAT rules that you specify, as opposed to each firewall policy in firewall policy NAT.

As a best practice, when you use central NAT, you should make sure to configure specific SNAT and DNAT rules so that it will match only desired firewall policies in your configuration.

Both firewall policy NAT and central NAT produce the same results.

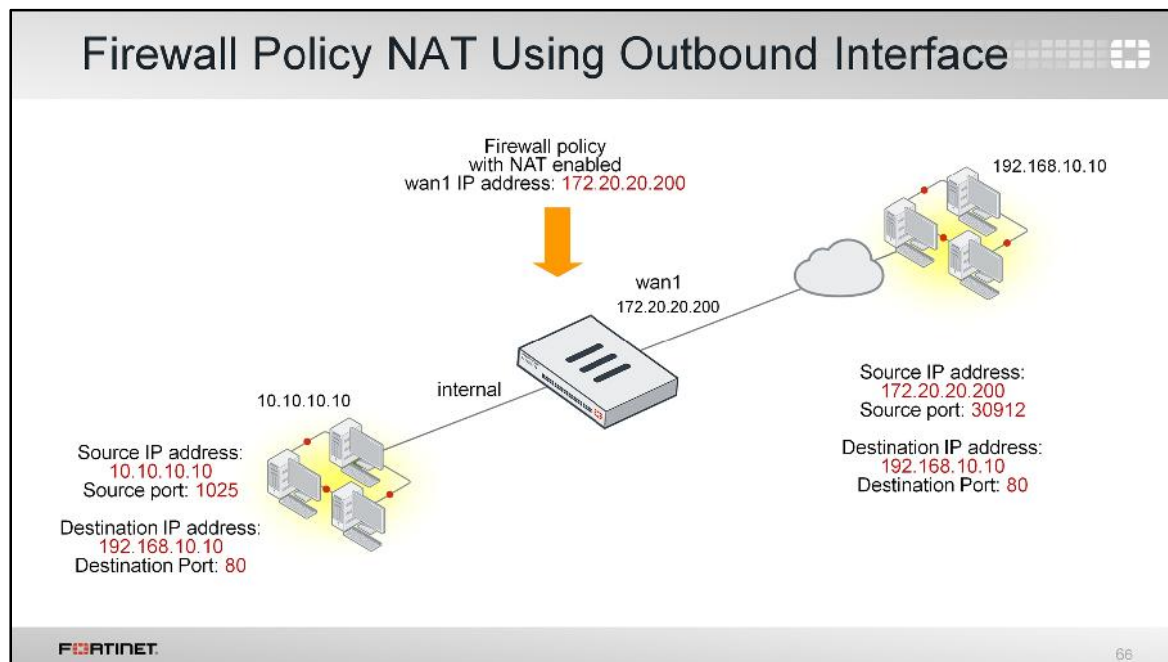
An example would be a small branch office, where you have fewer firewall policies. In this case, you can use firewall policy NAT.

In the case of a managed service provider, central NAT can be used to do SNAT and DNAT for a virtual domain containing a large number of firewall policies. You only have to configure central SNAT and DNAT rules once, and they can be applied to multiple firewall policies.



In this section, you will learn how to configure firewall policy NAT to perform source NAT and destination NAT, and how it is applied to the traffic traversing through FortiGate.

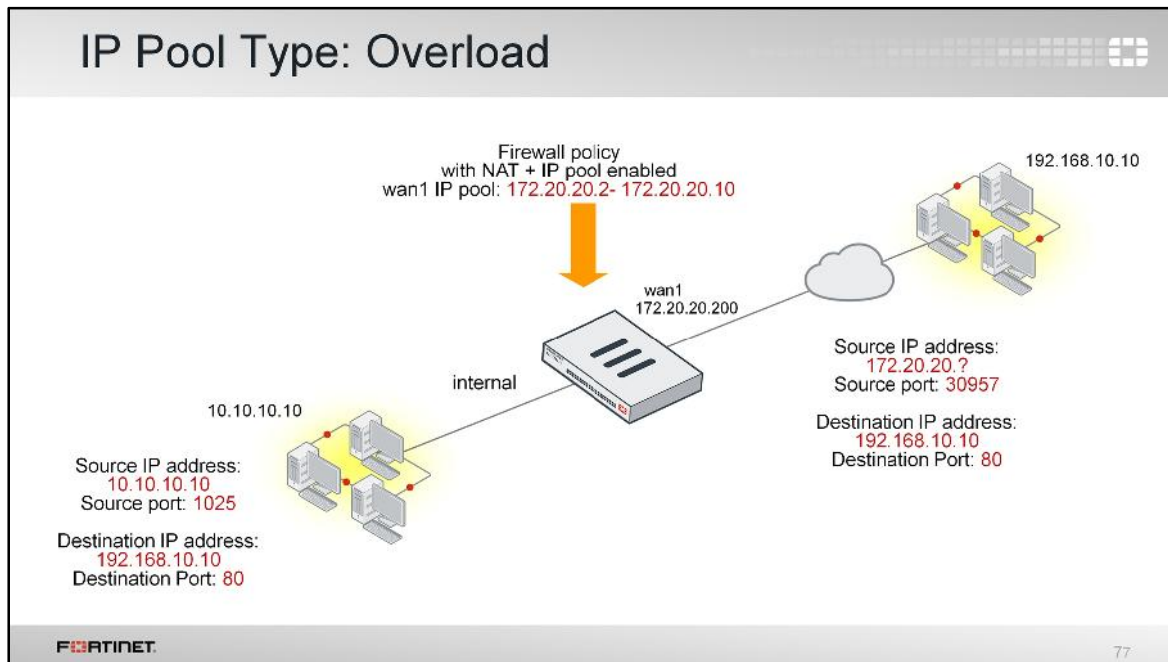




The source NAT option uses the egress interface address when NAT is enabled on the firewall policy. This is a many-to-one NAT. In other words, port address translation (PAT) is used and connections are tracked using the original source address and source port combinations as well as the allocated source port. This is the same behavior as the overload IP pool type, discussed later.

Optionally, you may select a fixed port, in which case the source port translation is disabled. With fixed port, if two or more connections require the same source port for a single IP address, only one connection can establish.

In this example, a firewall policy from internal to wan1 (IP address 172.20.20.200) is created, and the user initiates traffic from source 10.10.10.10:1025 destined for 192.168.10.10:80. As NAT is enabled on the firewall policy, the source IP address is translated to egress interface IP with port translation.



If you use an IP pool, the source address is translated to an address from that pool, rather than the egress interface address. The larger the number of addresses in the pool, the greater the number of connections that can be supported.

The default IP pool type is overload. In IP pool type overload, a many-to-one or few relationship and port translation is used.

In this example, source IP 10.10.10.10 will be translated to an IP address from the IP pool (172.20.20.2 – 172.20.20.10).

## IP Pool Type: One-to-One

- Default type is **Overload**
- Type **One-to-one** associates an internal IP with a pool IP on a first-come, first-served basis
  - Port address translation is disabled

STUDENT	#	get	system	session	list		
PROTO	EXPIRE	SOURCE	SOURCE-NAT	DESTINATION	DESTINATION-NAT		
tcp	9	10.0.1.10:2706	10.200.1.6:2706	10.200.1.254:80	-		
tcp	7	10.0.1.10:2701	10.200.1.6:2701	10.200.1.254:80	-		
tcp	5	10.0.1.10:2702	10.200.1.6:2702	10.200.1.254:80	-		
tcp	3	10.0.1.10:2700	10.200.1.6:2700	10.200.1.254:80	-		
tcp	1	10.0.1.10:2698	10.200.1.6:2698	10.200.1.254:80	-		
tcp	0	10.0.1.10:2696	10.200.1.6:2696	10.200.1.254:80	-		
tcp	5	10.200.1.1:1220	-	10.200.1.241:541	-		
udp	127	10.0.1.10:49585	-	10.0.1.254:53	-		
udp	126	10.0.1.10:50599	-	10.0.1.254:53	-		
udp	128	10.0.1.10:53043	-	10.0.1.254:53	-		

- Refuses connection if no unallocated address

In the one-to-one pool type, an internal IP address is mapped with an external address on a first-come, first-served basis.

There is a single mapping of an internal address to an external address. Mappings are not fixed and if there are no more addresses available, a connection will be refused.

Also, in one-to-one, port address translation is not required. In the example, you can see the same source port is shown for both the ingress and egress address.

## IP Pool Type: Fixed Port Range

- Type **Fixed Port Range** associates an internal IP range with an external IP range
  - Port address translation is disabled

STUDENT	#	get system session list				
PROTO	EXPIRE	SOURCE	SOURCE-NAT	DESTINATION	DEST	
tcp	3574	10.0.1.11:60843	10.200.1.8:60843	216.23.154.83:80	-	-
tcp	3562	10.0.1.11:60809	10.200.1.8:60809	216.23.154.81:80	-	-
tcp	3563	10.0.1.11:60819	10.200.1.8:60819	216.23.154.74:80	-	-
tcp	3564	10.0.1.11:60817	10.200.1.8:60817	216.23.154.74:80	-	-
tcp	3564	10.0.1.11:60815	10.200.1.8:60815	216.23.154.74:80	-	-
tcp	3567	10.0.1.11:60807	10.200.1.8:60807	216.23.154.81:80	-	-
tcp	3563	10.0.1.11:60813	10.200.1.8:60813	216.23.154.74:80	-	-
tcp	3566	10.0.1.11:60805	10.200.1.8:60805	216.23.154.81:80	-	-
tcp	3600	10.200.1.254:33521	-	10.200.1.1:22	-	-
tcp	3591	10.0.1.11:60867	10.200.1.8:60867	23.21.70.11:80	-	-
tcp	9	10.0.1.10:7112	10.200.1.7:7112	10.200.1.254:80	-	-
tcp	7	10.0.1.10:7110	10.200.1.7:7110	10.200.1.254:80	-	-
tcp	5	10.0.1.10:7108	10.200.1.7:7108	10.200.1.254:80	-	-
tcp	3	10.0.1.10:7106	10.200.1.7:7106	10.200.1.254:80	-	-
tcp	1	10.0.1.10:7104	10.200.1.7:7104	10.200.1.254:80	-	-

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In the fixed port range pool type, it provides an explicit relationship between internal IP address ranges and external IP address ranges, and disables port address translation. It allows fixed mapping of internal start IP / internal end IP range to external start IP / external end IP range.

This example uses a fixed port range IP pool.

The internal address range 10.0.1.10-10.0.1.11 maps to the external address range 10.200.1.7-10.200.1.8.

## IP Pool Type: Port Block Allocation

- Type **Port Block Allocation** assigns a block size and number per host for a range of external IP addresses
  - Using a small 64-block size and 1 block

```
hping --faster -p 80 -S 10.200.1.254
```

```
STUDENT # diagnose sys session stat
misc info: session count=79 setup_rate=0 exp_count=0 clash=0
memory_tension_drop=0 ephemeral=0/65536 removeable=0
delete=0, flush=0, dev_down=0/0
TCP sessions:
  1 in ESTABLISHED state
  74 in SYN_SENT state
  1 in CLOSE_WAIT state
```
  - Using an overload type

```
hping --faster -p 80 -S 10.200.1.254
```

```
STUDENT # diagnose sys session stat
misc info: session count=10227 setup_rate=982 exp_count=0 clash=0
memory_tension_drop=0 ephemeral=0/65536 removeable=0
delete=0, flush=0, dev_down=0/0
TCP sessions:
  34 in ESTABLISHED state
  10117 in SYN_SENT state
  1 in SYN_RECV state
```


These two CLI outputs illustrate the behavior difference between the port block allocation type and the default overload type.

Using `hping`, a rogue client generates many SYN packets per second. In the first example, the port block allocation type limits the client to 64 connections for that IP pool. Other users will not be impacted by the rogue client.

In the second example, the overload type imposes no limits, and the rogue client uses many more connections in the session table. Other users will now be impacted.

## Virtual IPs (VIPs)

- Destination NAT objects
- Default type is static NAT
  - Can be restricted to forward only certain ports
- From the CLI, you can select either `load-balance` or `server-load-balance`
- VIPs should be routable to the external facing (ingress) interface for return traffic

1111

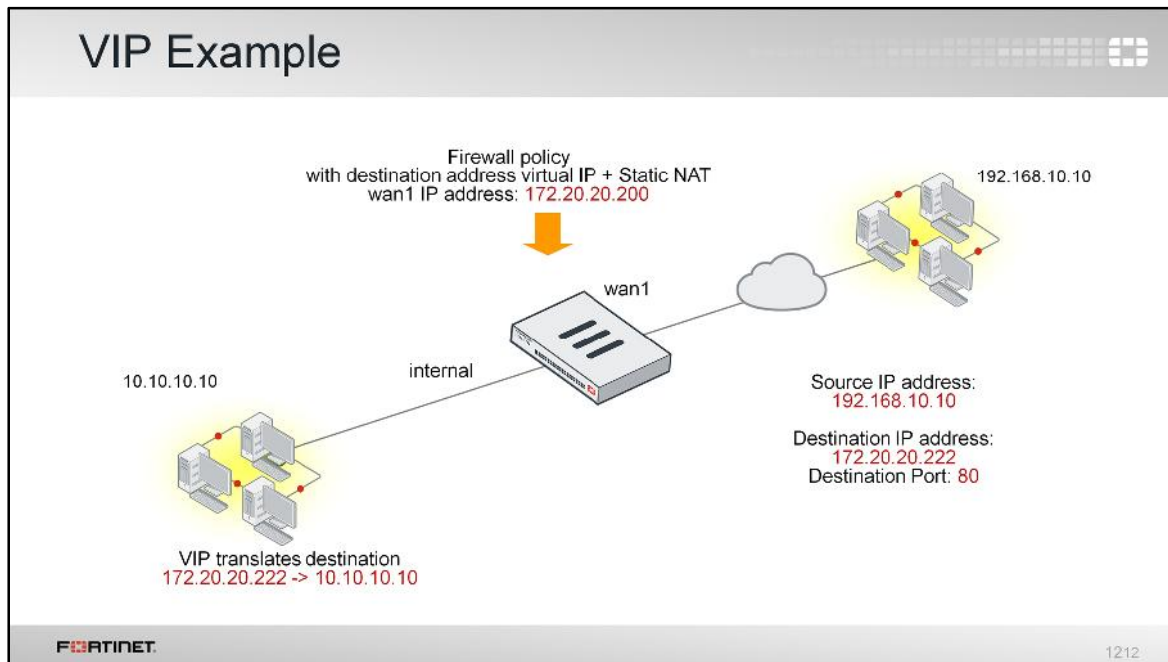
Virtual IPs (VIPs) are destination NAT objects. For sessions matching a VIP, the destination address is translated: usually a public Internet address is translated to a server's private network address. VIPs are selected in the firewall policy's **Destination Address** field.

The default VIP type is static NAT. This is a one-to-one mapping, which applies for incoming and outgoing connections. That is, an outgoing policy with NAT enabled would use the VIP address instead of the egress interface address. This behavior, however, can be overridden by use of an IP pool.

The static NAT VIP can be restricted to forward only certain ports. For example, connections to the external IP on port 8080 map to the internal IP on port 80.

From the CLI, you can select as the NAT type `load-balance` and `server-load-balance`. Plain load balancing distributes connections from an external IP address to multiple internal addresses. The later builds on that mechanism, using a virtual server and real servers, and provides session persistence and server availability check mechanisms.

VIPs should be routable to the external facing (ingress) interface. FortiOS responds to ARP requests for VIP and IP pool objects. ARP responses are configurable.



(slide contains animation)

In this example, source IP address 192.168.10.10 is trying to access destination IP address 172.20.20.222 over port TCP 80.

(click)

Connections to the VIP 172.20.20.222 are NATed to the internal host 10.10.10.10.

Because this is static NAT, all NATed outgoing connections from 10.10.10.10 will use the VIP address in the packet's destination field, not the egress interface's address.



## Policy Fall Through Exceptions – VIP

- Default behavior “If this policy does not match, try the next”
  - Doesn't block egress-to-ingress connection even deny policy is top of list
- Virtual IP policy (WAN to LAN)

Seq.#	Name	Source	Destination	Schedule	Service	Action
4	Deny	Deny_IP	all	always	ALL	Deny
5	Allow_access	all	Web_server	always	ALL	Accept

Still can access VIP from below policy, even deny policy is on top of the list

VIP

Action = Deny

```
config firewall policy
edit <policy ID for deny>
set match-vip enable
end
```

OR

```
config firewall policy
edit <policy ID for deny>
set dstaddr "Virtual IP object"
end
```

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In FortiOS 5.2 and 5.4, traffic is permitted to fall through to the next policy; however, when you use VIP firewall policies, there can be some exceptions.

When VIP(s) are configured, for incoming (WAN to LAN) connections, it will be first matched against the VIP table.

In this worked example, a firewall policy from WAN to LAN is configured with a specific source and the action is deny. There is second firewall policy that is allowing access to VIP (the destination address). Even though the deny firewall policy is at the top of the list, the denied source is still allowed by the second firewall policy to access VIP.

In order to block traffic from the denied source, you must enable set match-vip enable in the deny firewall policy, which skips the VIP id checking. Alternatively, you can configure the destination address as the virtual IP in the deny policy instead of all.





In this section, you will learn how to configure central NAT to perform source NAT and destination NAT.

Central SNAT and DNAT (VIP) is another method of defining source and destination NAT. This allows network address translation with more granularity in terms of controlling IP address, protocol, and port translation.

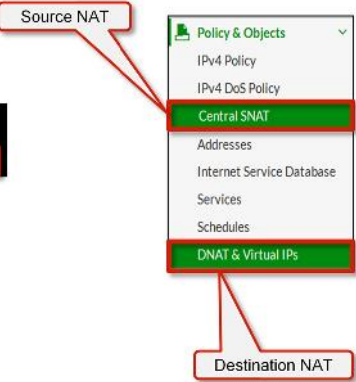
## Central NAT

- Enabled or disabled from the *CLI (only)*

```
config system settings
set central-nat {enable|disable}
end
```

  - Must remove VIP and IP pool references from existing policies

```
config system settings
set central-nat enable
Cannot enable central-nat with firewall policy using vip (id=2).
```
- Once enabled, can configure from GUI
  - Central SNAT: Source network address translation
  - DNAT & Virtual IPs: Destination network address translation
- If upgrading FortiGate firmware from 5.2 to 5.4
  - Must reconfigure central SNAT policy



Prior to FortiGate firmware version 5.4, central NAT could only be configured for source NAT. In FortiGate firmware version 5.4, it allows you to configure both – central SNAT and DNAT (VIP).

By default, central NAT is disabled and can only be enabled from the CLI. Once central NAT is enabled, you can configure these two options from the GUI:

Central SNAT: Source network address translation

DNAT & Virtual IPs: Destination network address translation

What happens if you try to enable central NAT, but there are still IP pool or VIPs configured in firewall policies?

The CLI will not allow this and will present with a message referencing firewall policy ID with Virtual IP or IP pool. You must remove Virtual IP or IP pool references from existing firewall policies in order to enable central NAT.

Also, it's worth mentioning that if central NAT is enabled in FortiGate firmware 5.2, the central-nat table under system settings does not convert if you try to upgrade to FortiGate firmware 5.4. This causes firewall policies with central NAT to use the outgoing interface IP address. You must reconfigure the central SNAT policy after upgrading the FortiGate firmware to 5.4.

## Central SNAT


- SNAT configuration changes when central NAT is enabled
  - Per Virtual Domain based

Central NAT	Enabled	Steps to Configure
Source NAT		1. Define IP pool 2. Configure central SNAT policy 3. Enable NAT on firewall policy

- If *no matching* central SNAT rule exists, FortiGate uses default destination interface address
  - Processed from *top to bottom*
- Matching criteria based on
  - Source address
  - Destination address
  - Protocol
  - Source port
    - Most protocols don't need this

### Policy & Objects > Central SNAT

Seq.#	Source Address	Destination	Translated Address	Protocol Number
1	STUDENT_INTERNAL	LINUX_ETH1	SNAT_pool_2	132
2	all	REMOTE_ETH1	SNAT_pool_1	6
3	all	all	SNAT_pool_1	0



1616

Starting in FortiGate 5.4, a central SNAT policy is applied to a virtual domain (VDOM), and not to a specific firewall policy. The NAT on the firewall policy controls whether the central SNAT is used or not. If NAT is enabled on a firewall policy, central SNAT is used. (VDM be discussed later in the training.)

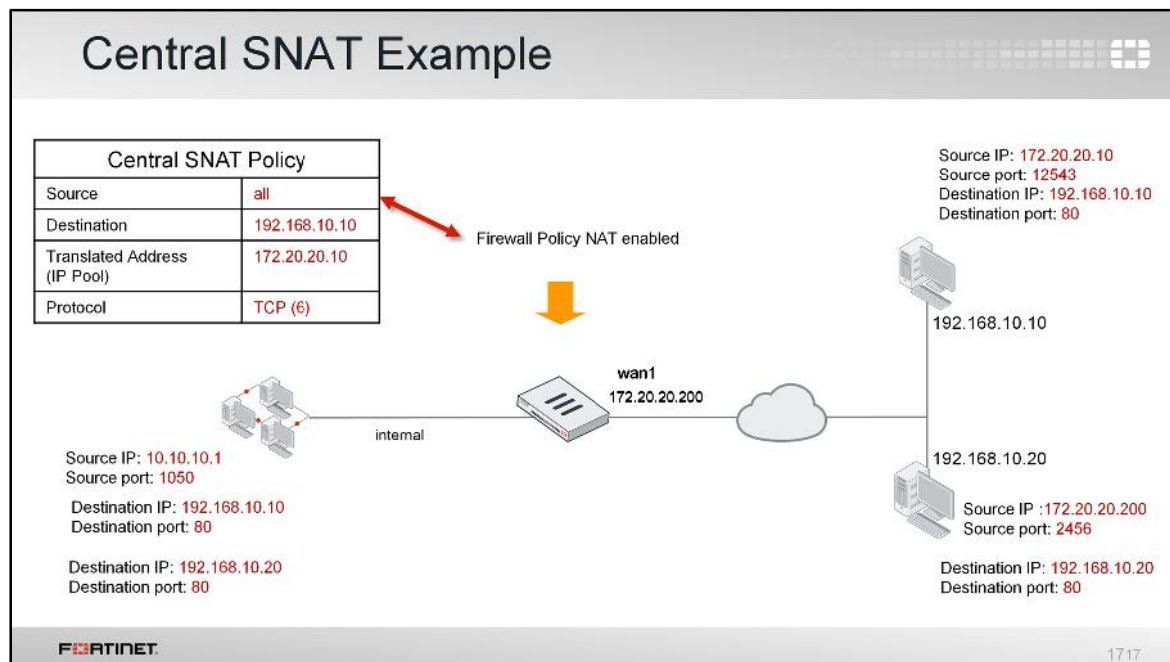
If the central SNAT policy criteria matches with the traffic based on multiple firewall policies, the central SNAT policy will be applied to those firewall policies as long as NAT is enabled on those firewall policies.

What happens if NAT is enabled on a firewall policy when there is no matching central SNAT policy or no central SNAT policy configured? In this case, if no matching central SNAT rule exists, then FortiGate will automatically use the *outgoing interface IP address for the source NAT*.

Similar to firewall policies, a central SNAT policy is processed from *top to bottom* and if a match is found, source address and source port are translated based on that central SNAT policy.

You can have more granular control over traffic passing through firewall policies by defining matching criteria in the central SNAT policy, based on:

- Source address
- Destination address
- Protocol
- Source port



(slide contains animation)

In this example, the central SNAT policy translates the source IP address to the defined IP pool address (172.20.20.10). However, the translation takes place only if the traffic matches all the variables defined in the central SNAT policy, that is, traffic from the source IP address must be destined for destination IP address (192.168.10.10) and TCP protocol. For illustration purposes, only a single IP address is used for the destination, and the IP pool type is set to overload with a single IP address.

(click)

The firewall policy is created from internal to wan1 with NAT enabled. Remember that the NAT option on the firewall policy controls whether or not a central SNAT policy is used.

(click)

If the user tries any TCP-based sessions (for example http, https) to destination IP address 192.168.10.10, the source IP address will be translated to an IP pool address(s) defined in the central NAT policy.

What if the user tries to send any ICMP or UDP-based traffic to 192.168.10.10? Will the source address be translated to the IP pool defined in the central NAT policy?

(click)

As the central SNAT policy does not match, FortiGate will automatically use the outgoing interface IP address (wan1) for the source NAT. What if the user tries TCP-based traffic to another destination IP address, 192.168.10.20? Will the source address be translated to the IP pool defined in the central NAT policy?

(click)


Again, the destination IP address of 192.168.10.20 does not match with the central NAT policy, so FortiGate will use the outgoing interface IP address (wan1) for the source NAT.

## Central DNAT & Virtual IPs

- Enabling central NAT changes Destination NAT configuration
  - Per Virtual Domain based

Central NAT Enabled	Steps to Configure
Destination NAT (VIP)	1. Define DNAT & Virtual IPs (No additional configurations required)

- As soon as Virtual IP is created, a rule is created in kernel to allow DNAT to occur
  - Firewall policy destination address – all or mapped IP of VIP
    - VIP cannot be selected in firewall policy as destination address

1818

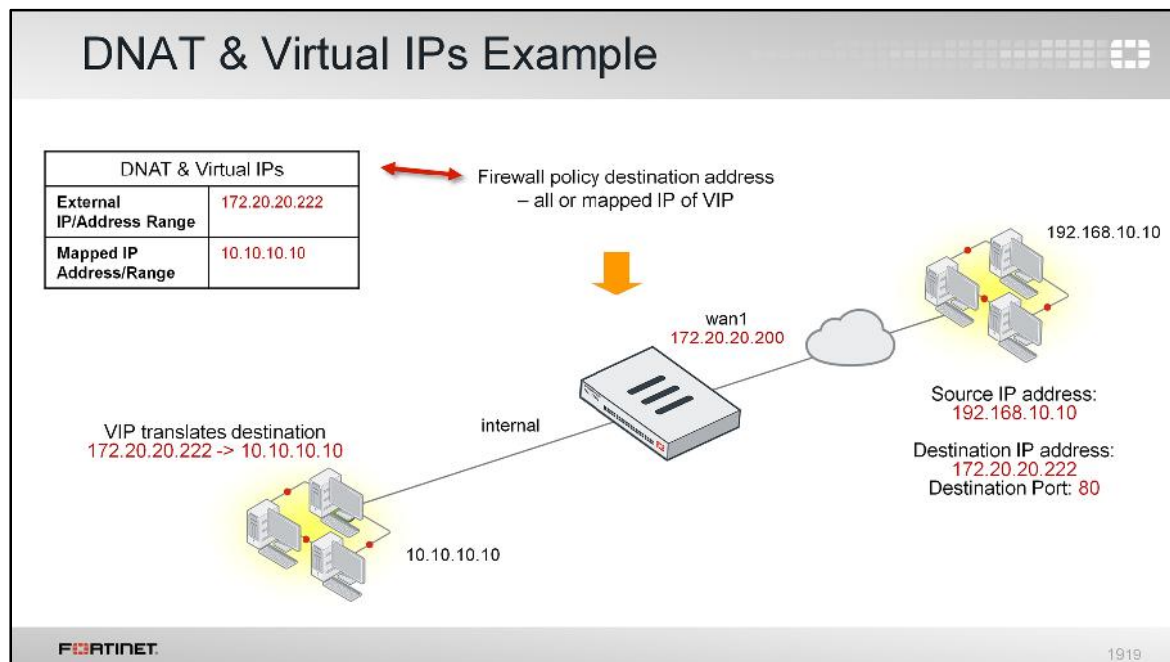
Traditionally in FortiGate, Virtual IPs are selected in the firewall policy as destination address.

Starting in FortiGate 5.4 firmware, you can configure DNAT & Virtual IPs for destination NAT, which is also per VDOM. As soon as VIP is configured, FortiGate automatically creates a rule in the kernel to allow destination NAT to occur and no additional configuration is required.

Do you lose the granularity of being able to define a firewall policy for a specific VIP and services?

No, you don't, assuming you have several wan to internal policies, and multiple VIPs, and you want to allow services for some VIPs and other services for other VIPs. You can define each firewall policy with the destination address of the mapped IP of the VIP, and select the appropriate services to allow or deny.

Note that if both central SNAT and central DNAT (VIP) are configured, the outgoing (internal to wan) traffic will source NAT to the DNAT/VIP address, based on the central SNAT and DNAT (VIP) configurations.



(slide contains animation)

In this example, a DNAT & Virtual IPs rule is created to map external IP address 172.20.20.222 to internal IP address 10.10.10.10. Remember, as soon as a Virtual IP is created, a rule is created in the kernel to allow DNAT to occur.

(click)

Firewall policy from wan1 to internal is created with the destination address **all** or **Mapped IP Address/Range** (10.10.10.10) of the VIP.

(click)

Source IP address 192.168.10.10 is trying to access destination IP address 172.20.20.222 over port TCP 80. Connections to the VIP 172.20.20.222 are NATed to the internal host 10.10.10.10, without any additional configuration.

## Disabling Central NAT

- If central NAT is enabled and configured for SNAT and DNAT, and then disabled:
  - Outgoing traffic may *SNAT to egress interface IP address*
  - Incoming traffic previously configured with DNAT & Virtual IPs will *stop working*

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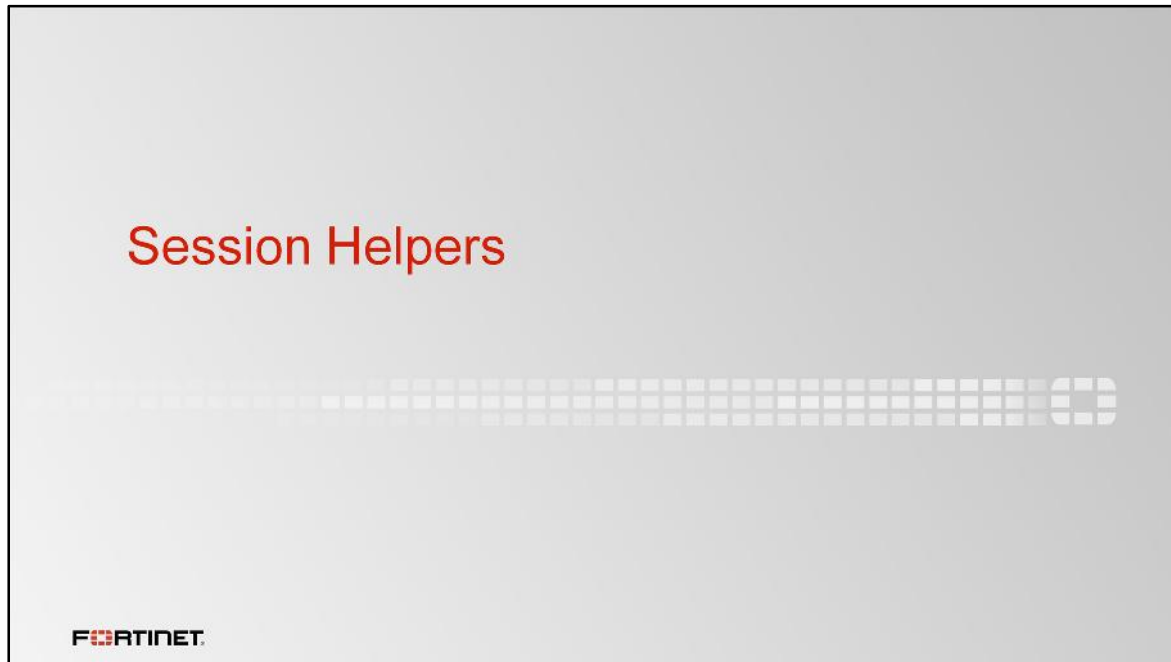
2020

Central NAT can be disabled from the CLI by running `set central-nat disable` under the `config system setting`. What happens to firewall policies that are using central SNAT and DNAT rules, if central NAT is disabled?

The incoming to outgoing firewall policies may still work using the egress interface IP address. However, the incoming to outgoing firewall policies will not use the IP pool addresses, which were previously tied to the central SNAT policy. If you need to use the IP pool, you need to edit the firewall policy to use IP pool.

Egress-to-ingress firewall policies that use DNAT & Virtual IP, will stop working because, in central NAT, the destination address in the firewall policy is simply an address object, not an actual VIP. Without the central-nat hook into the DNAT table, the address object will cause a forward policy check failure – the traffic will be denied by policy ID 0.

You need to edit the egress-to-ingress firewall policies and select VIP as the destination address.




In this section, you will learn how session helpers are used to analyse data in the packets of some protocols and how to allow those protocols to pass traffic through FortiGate.



## Session Helpers

- Some traffic types require more packet modification for the application to work
  - Configurable via CLI
- For example:
  - Handling of FTP passive mode connections: control connection is separate from data connection
  - Header rewrites in SIP SDP payloads required because of NAT actions
- To show configured session helpers:

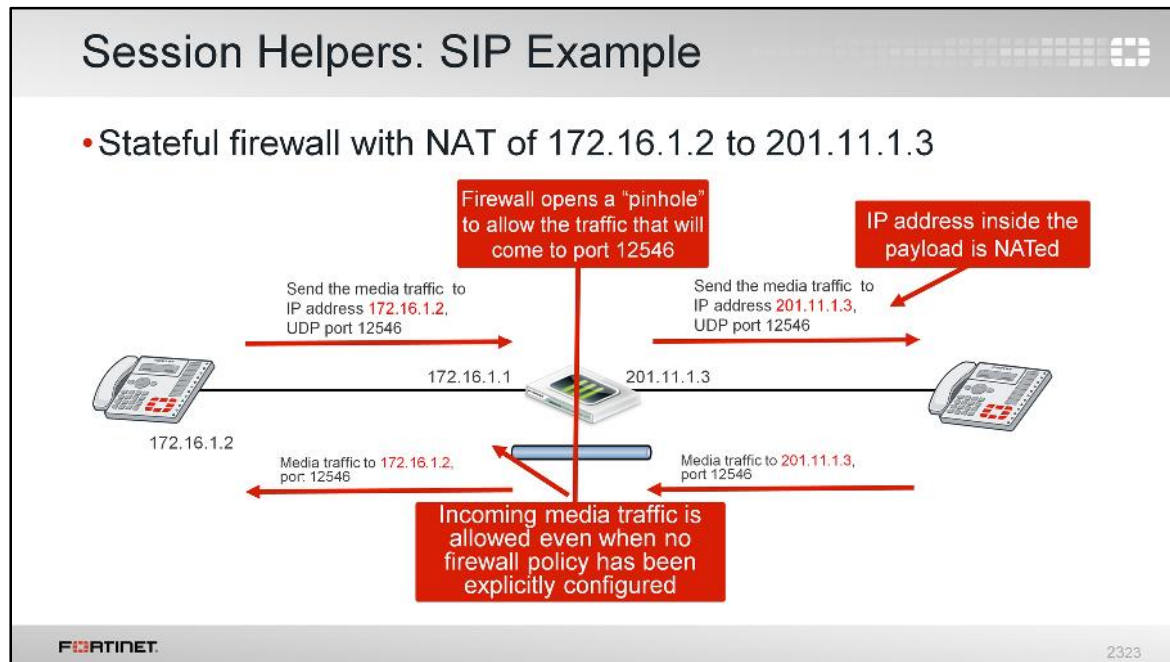
```
show system session-helper
```

2222

Some application layer protocols are not fully independent of the lower layers, such as the network or transport layer. The addresses may be repeated in the application layer, for example. If the session helper detects such a pattern, it may change the application headers or create required secondary connections.

A good example is where an application has both a control and a data or media channel, such as with FTP. Firewalls will typically allow the control channel and rely on the session helpers to handle the dynamic data or media transmission connections.

When more advanced application tracking and control is required, an Application Layer Gateway (ALG) can be used. The VoIP profile is an example of an ALG.



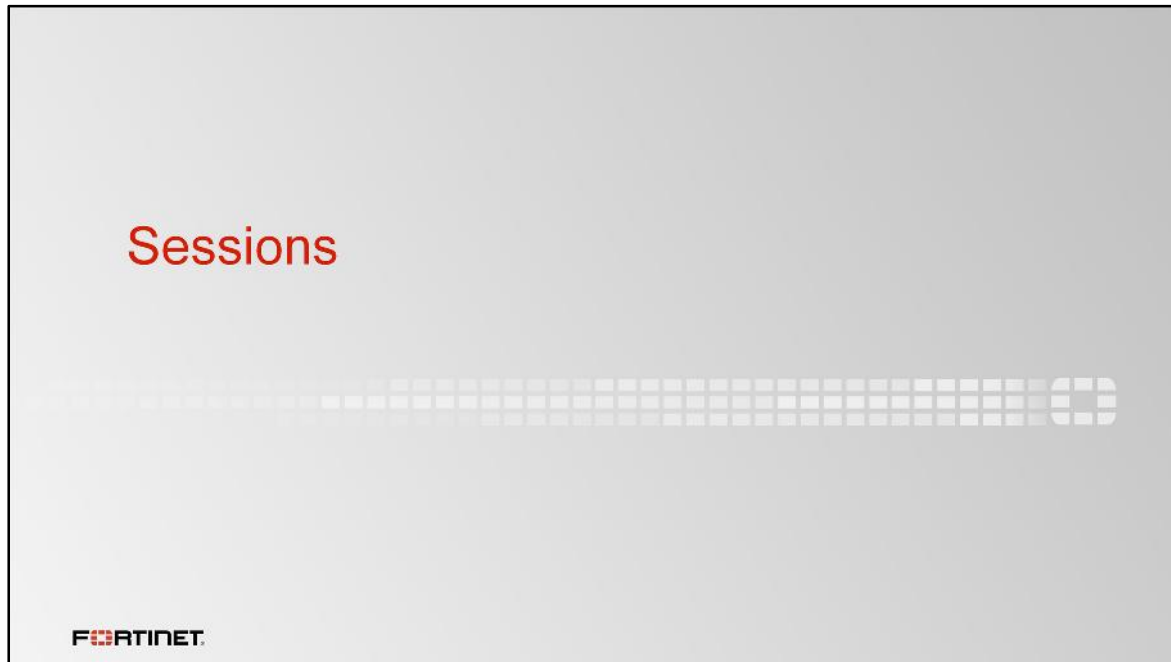
In this example, the media recipient address in the SIP SDP payload is modified to reflect the NATed IP address.

(click)

Notice how, because firewall policies are stateful, a pinhole is opened to allow reply traffic,

(click)

even though you have not explicitly created a firewall policy to allow incoming traffic. This concept is used with some other protocols too, such as NAT-T for IPsec.



In this section, you will learn how a session table keeps track of the session information, which can be helpful to understand the actions applied to the traffic, such as source NAT, destination NAT, and routing, for example.

## Session Table

- Accepted IP sessions tracked in kernel's session table
  - Hardware acceleration affects this
- Stores information about the session
  - Source and destination addresses, port number pairs, state, timeout
  - Source and destination interfaces
  - Source and destination NAT actions
- Performance metrics
  - Max. concurrent sessions
  - New sessions per second

FortiView > All Sessions

Source	Source Interface	NAT Source	NAT Source Port	Destination	Destination Interface
10.0.1.10	port3	10.200.1.200	57394	199.83.44.59	port1
10.0.1.10	port3	10.200.1.200	59259	68.67.129.151	port1
10.0.1.10	port3	10.200.1.200	59265	68.67.129.151	port1

2525

You can view the **All Sessions** page from the GUI, but the CLI provides more information regarding sessions in the session table.

Firewall performance of connections per session and maximum number of connections are indicated by the session table. But keep in mind that if your FortiGate contains FortiASIC NP chips designed to accelerate processing without loading the CPU, this may not be completely accurate. The session table reflects what is known to, and processed by, the CPU.

## Session TTL (time to live)

- Reducing timers may improve performance when session table is full by closing sessions earlier
  - Don't close *too* soon, though... Can cause connection errors

TCP default TTL

```
config system session-ttl
set default 3600
end
```

Specific state timers

```
config system global
set tcp-halfclose-timer 120
set tcp-halfopen-timer 10
set tcp-timewait-timer 1
set udp-idle-timer 60
end
```

- Timers can be applied in policies and objects, and have precedence:
  - Firewall Services > Firewall Policies > Global Sessions

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Each session on the FortiGate can idle for a finite time, which is defined by time to live (TTL). Once the FortiGate detects the session is idle after some time of inactivity and TTL is reached, the session is deleted from the session table.

Since the session table has a finite amount of RAM that it can use on your FortiGate, adjusting the session TTL can improve performance. There are global default timers, session state timers, and timers configurable in firewall objects.

## diagnose sys session

- The session table also indicates policy actions
  - Clear any previous filter


```
diagnose sys session filter clear
```
  - Set the filter

```
diagnose sys session filter ?
```

dport	destination port
dst	destination IP address
policy	policy id
sport	source port
src	source ip address
  - List all entries matching the configured filter

```
diagnose sys session list
```
  - Purge all entries matching the configured filter

```
diagnose sys session clear
```

2727

The `diagnose sys session` command tree provides many options to filter, clear, or show the list of sessions. You can also list brief information about sessions by running the `get system session list` CLI command.

Before looking at the session table, first build a filter. To look at our test connection, you can filter on `dst 10.200.1.254` and `dport 80`.

### Session Table: TCP Example

```
# diagnose sys session filter dst 10.200.1.254
# diag sys session filter dport 80
# diag sys session list
session info: proto=6 proto_state=05 duration=2 expire=78 timeout=3600 flags=00000000
sockflag=00000000 sockport=0 av_idx=0 use=3
origin-shaper=
reply-shaper=
per ip shaper=
ha id=0 policy dir=0 tunnel=/ vlan_cos=0/255
state=may_dirty
statistic(bytes/packets/allow_err): org=538/6/1 reply=5407/6/0 tuples=2 speed(Bps/kbps):2596/20
origin->sink: org pre->post, reply pre->post dev 5->3/3->3 gwy 10.200.1.254/10.0.1.10
hook=pre dir=org act=snat 10.0.1.10:64624->10.200.1.254:80(10.200.1.1:64624)
hook=pre dir=reply act=dnat 10.200.1.254:80->10.200.1.1:64624(10.0.1.10:64624)
pos/(before,after) 0/(0,0), 0/(0,0)
misc=0 policy_id=1 auth_info=0 chk_client_info=0 vd=0
serial=00023a22 tos=ff/ff ips_view=0 app_list=0 app=0 url_cat=0
dd_type=0 dd_mode=0
```

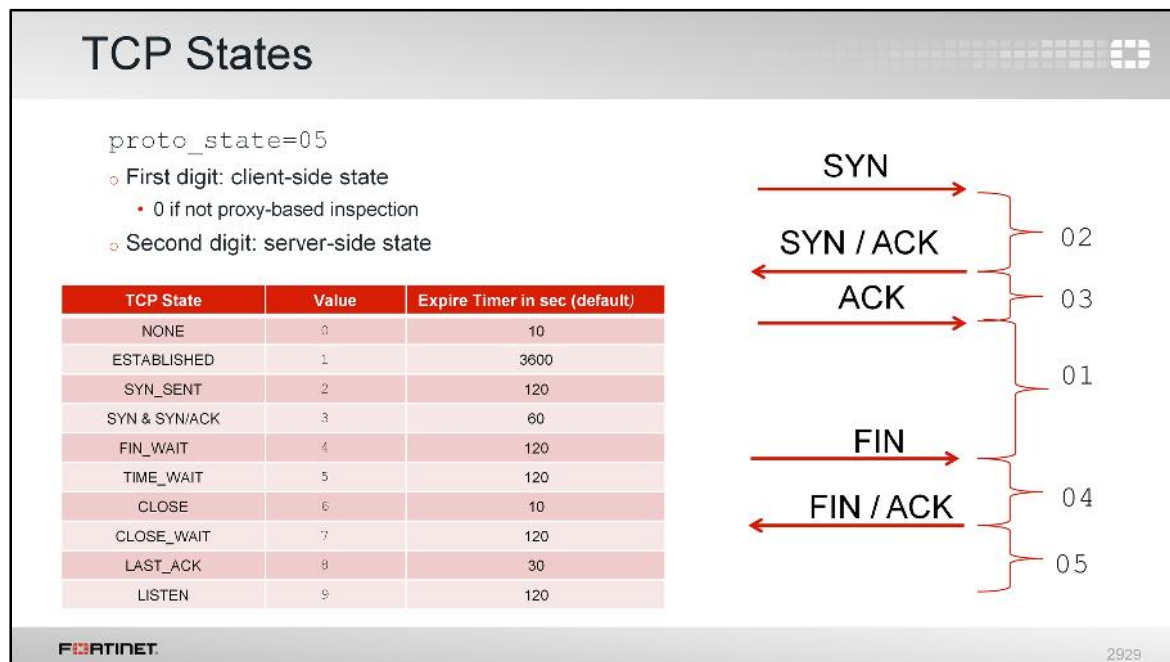
Diagram illustrating the Session Table: TCP Example output, with annotations highlighting key fields:

- TCP state**: proto\_state=05
- Session TTL**: timeout=3600
- Routing operation**: org pre->post, reply pre->post dev 5->3/3->3 gwy 10.200.1.254/10.0.1.10
- NAT operation**: hook=pre dir=org act=snat 10.0.1.10:64624->10.200.1.254:80(10.200.1.1:64624) and hook=pre dir=reply act=dnat 10.200.1.254:80->10.200.1.1:64624(10.0.1.10:64624)
- Policy ID**: policy\_id=1

In this example, you can see the session TTL, which reflects how long FortiGate can receive no packets until it will remove the session from its table.

Here you can see the routing and NAT actions that apply to the traffic. The firewall policy ID is also tracked.

The `proto_state` for TCP is taken from its state machine, which we'll talk about next.



In the previous slide, remember that the session table contained a number that indicated the connection's current TCP state. These are the states of the TCP state machine. They are single digit values, but `proto_state` is always shown as two digits. This is because FortiGate is a stateful firewall and keeps track of the original direction (client-side state) and the reply direction (server-side state). If there are too many connections in the SYN state for long periods of time, this indicates a SYN flood, which you can mitigate with DoS policies.

This table and flow graph correlate the second digit value with the different TCP session states. For example, when the FortiGate receives the SYN packet, the second digit is 2. It goes to 3 once the SYN/ACK is received. After the three-way handshake, the state value changes to 1.

When a session is closed by both sides, FortiGate keeps it in the session table for a few seconds more, to allow any out-of-order packets that could arrive after the FIN/ACK packet. This is the state value 5.



### ICMP and UDP Protocol States

- Even though UDP is stateless, FortiGate still uses two session state values:

UDP State	Value
UDP traffic one way only	0
UDP traffic both ways	1

- ICMP has no state
  - `proto_state` is always 00

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Although UDP is a message-oriented, stateless protocol – it doesn't inherently require confirmed bi-directional connections like TCP, so there is no connection state. However, FortiGate's session table does use the `proto_state=` field to track unidirectional UDP as state 0, and bidirectional UDP as state 1.

When FortiGate receives the first packet, it creates the entry and sets the state to 0. If the destination replies, FortiGate updates the state flag to 1 for the remainder of the conversation.

Notably, ICMP, such as ping and traceroute, have no protocol state and it will always show `proto_state=00`.

## Review

- ✓ Choose between firewall policy NAT and central NAT
- ✓ Different types of IP pools configuration for source NAT
- ✓ Virtual IPs configuration for destination NAT
- ✓ Central SNAT policy configuration for source NAT
- ✓ DNAT & Virtual IPs
- ✓ Use a SIP session helper for VoIP
- ✓ How to interpret the session table

3131

To review, we discussed:

- Choosing between firewall policy NAT and central NAT
- Different types of IP pools configuration for source NAT
- Virtual IPs configuration for destination NAT
- Central SNAT policy configuration for source NAT
- DNAT & Virtual IPs
- Using a SIP session helper for VoIP
- How to interpret the session table



In this lesson, we will show you how to use authentication on the firewall policies of a FortiGate.

## Objectives

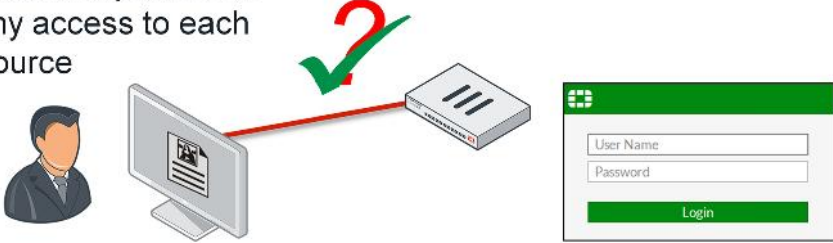
- Describe firewall authentication
- Identify the different methods of firewall authentication available on FortiGate devices
- Identify supported remote authentication servers
- Configure users for local password authentication, server-based password authentication, and two-factor authentication
- Describe active and passive authentication and order of operations
- Configure remote authentication servers
- Configure user authentication
- Configure Captive Portal and disclaimers
- Monitor firewall users



After completing this lesson, you should understand the mechanics of firewall authentication on FortiGate and have the practical skills required to configure firewall authentication.

## Firewall authentication

- Includes authentication of users and user groups
  - More reliable than just IP address and device type
  - Users must authenticate by entering valid credentials
- Once FortiGate identifies the user or device, FortiGate applies firewall policies and profiles to allow or deny access to each network resource



The diagram illustrates the authentication process. On the left, a user icon is connected to a computer monitor icon. A red line with a green checkmark and a red question mark points from the computer to a FortiGate firewall device (routers icon). To the right of the firewall is a login form with fields for 'User Name' and 'Password', and a 'Login' button.

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3

Traditional firewalling grants network access by authenticating the source IP address and device. This is inadequate and can pose a security risk, as the firewall cannot determine who is using the device to which it is granting access.

FortiGate includes authentication of users and user groups. As a result, you can follow individuals across multiple devices.


Where access is controlled by user or user group, users must authenticate by entering valid credentials (such as user name and password). Once FortiGate validates the user, FortiGate applies firewall policies and profiles to allow or deny access to specific network resources.



In this section, we will examine the methods of firewall authentication available on FortiGate.

## FortiGate Methods of Firewall Authentication

- Local password authentication
  - User name and password stored on FortiGate
- Server-based password authentication (also called remote password authentication)
  - Password stored on a POP3, RADIUS, LDAP, and TACACS+ server
- Two-factor authentication
  - Enabled on top of an existing method
  - Requires something you know *and* something you have (token or certificate)

5

FortiGate includes three types of firewall authentication:

- Local password authentication
- Server-based password authentication (also called remote password authentication)
- Two-factor authentication. This is a method of authentication that is enabled on top of an existing method — it cannot be enabled without first configuring one of the other methods. It requires something you know, such as a password, and something you have, such as a token or certificate.

Over the next few slides, we will cover each method of firewall authentication in more detail.

## Local Password Authentication

- User accounts stored locally on FortiGate
  - Works well for single-FortiGate installations
- User accounts created through **User & Device > User Definition**

The diagram illustrates the local password authentication process. It shows a user logging in (1) and a user name/password being sent to the FortiGate (2). The screenshots show the 'Local User' configuration wizard steps: User Type, Login Credentials, Contact Info, and Extra Info.

**Local User Configuration Wizard Steps:**

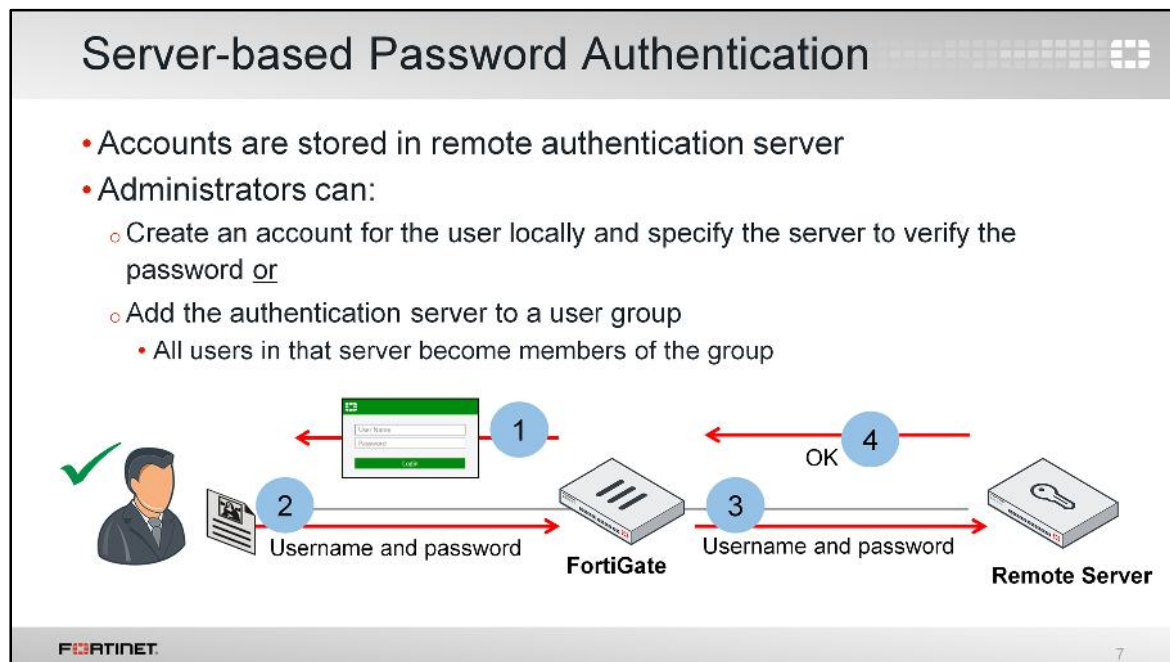
- User Type:** Local User
- Login Credentials:** User Name: student, Password: [masked]
- Contact Info:** Email Address: student@fortinet.lab, SMS: [disabled]
- Extra Info:** Enable User Account: [checked], Two-factor Authentication: [disabled], User Group: [selected]

The first and simplest method of authentication is local password authentication. User account information (user name and password) is stored locally on the FortiGate device. This method works well for a single-FortiGate installation.

Local accounts are created through the **User Definition** page where a wizard takes you through the process. For local password authentication, select **Local User** as the user type and create a user name and password. If desired, you can also add email and SMS information to the account, enable two-factor authentication, and add the user to a pre-configured user group.

Once you create the user, you can add the user—or any pre-configured user group in which the user is a member—to a firewall policy in order to authenticate. We will discuss user groups and firewall policies later in this lesson.

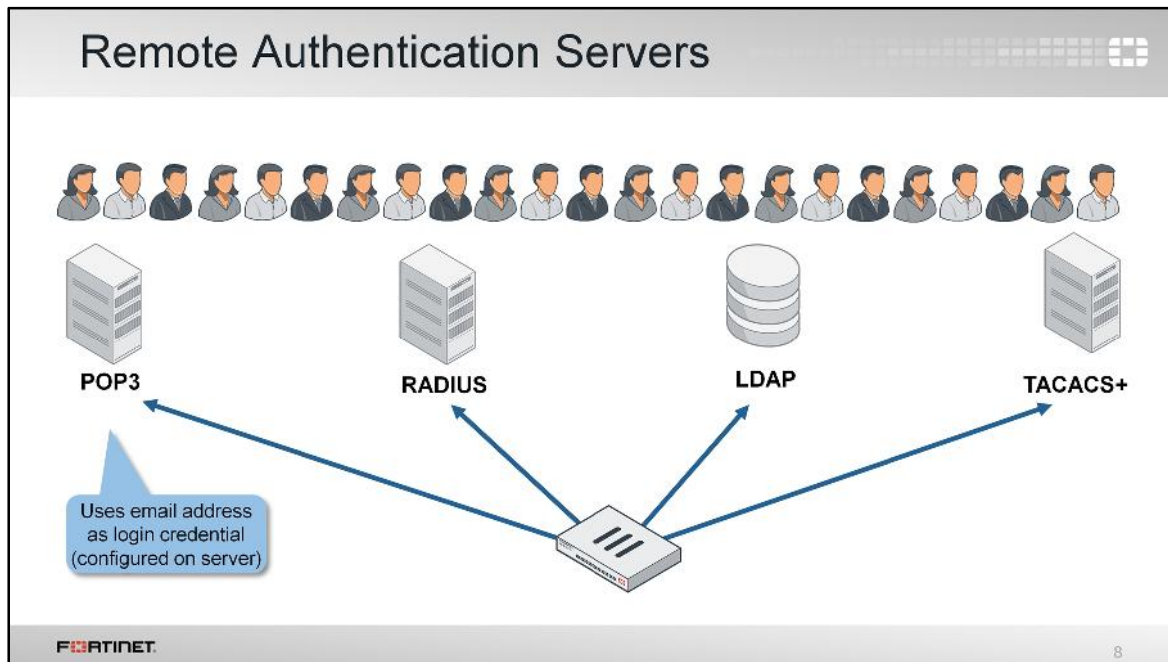




With server-based password authentication, a remote authentication server is used to authenticate users. This method is desirable when multiple FortiGate devices need to authenticate the same users or user groups, or when adding a FortiGate to a network that already contains an authentication server.

When you use a remote authentication server to authenticate users, FortiGate sends the user's entered credentials to the remote authentication server. The remote authentication server responds by indicating whether the credentials are valid or not. If valid, FortiGate consults its configuration to deal with the traffic. Note that it is the remote authentication server — not FortiGate — that evaluates the user credentials.

With this authentication method, FortiGate does not store all (or, in the case of some configurations, any) of the user information locally.

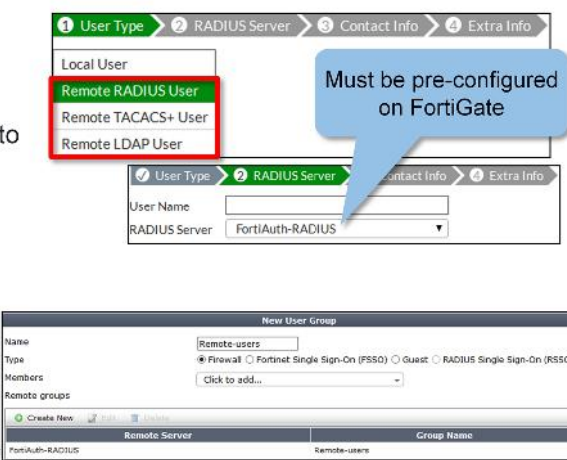


FortiGate provides support for many remote authentication servers, including POP3, RADIUS, LDAP, and TACACS+.

POP3 is the only server that requires the email address as the login credential. All other remote authentication servers use the user name. Some POP3 servers require the full email with domain (user@example.com), others require the suffix only, while still others accept both formats. This is determined by the configuration of the server itself and is not a setting on FortiGate. You can only configure POP3 authentication through the CLI. Note that LDAP can be configured to validate with email rather than the user name.

## Server-based Password Authentication: Users

- Create user accounts on FortiGate
  - **User & Device > User Definition**
    - Select remote server type and point to pre-configured remote server
    - Add user to a group
- Add the remote authentication server to user groups
  - **User & Device > User Definition**



The image shows two screenshots from the FortiGate web interface. The top screenshot is the 'User Definition' wizard, step 2 'RADIUS Server'. It shows options for 'Local User', 'Remote RADIUS User' (highlighted with a red box), 'Remote TACACS+ User', and 'Remote LDAP User'. A blue callout bubble points to the 'Remote RADIUS User' option with the text 'Must be pre-configured on FortiGate'. Below this, the 'RADIUS Server' dropdown is set to 'FortiAuth-RADIUS'. The bottom screenshot is the 'New User Group' configuration page. It shows 'Name' as 'Remote-users', 'Type' as 'Firewall' (selected), and 'Members' as 'Click to add...'. A table at the bottom lists 'Remote Server' as 'FortiAuth-RADIUS' and 'Group Name' as 'Remote-users'. A blue callout bubble points to the 'Remote-users' group name with the text 'Must be pre-configured on FortiGate'.

Must be pre-configured on FortiGate

Must be pre-configured on FortiGate

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You can configure FortiGate to use external authentication servers in two ways:

- Create user accounts on FortiGate. With this method, you must select the remote authentication server type (RADIUS, TACACS+, LDAP), point FortiGate to your pre-configured remote authentication server, and add the user to an appropriate group. Remember, POP3 is only configurable through the CLI.
- Add the remote authentication server to user groups. With this method, you must create a user group and add the pre-configured remote server to the group. Accordingly, any user who has an account on the remote authentication server can authenticate. If you are using an LDAP server as the remote authentication server, you can control access to specific LDAP groups as defined on the LDAP server.

Similar to local password authentication, you must then add the pre-configured user group (in which the user is a member) to a firewall policy in order to authenticate. We will discuss user groups and firewall policies later in this lesson.

## Two-Factor Authentication

- Strong authentication that improves security by preventing attacks associated with the use of static passwords alone
- Requires two independent ways of identifying a user:
  - Something you know, such as password or PIN
  - Something you have, such as a token or certificate
- Available on both user and administrator accounts
  - User / user group is added to a firewall policy in order to authenticate
- Two-factor authentication does not work with explicit proxies



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The final firewall authentication method you can use is two-factor authentication.

Traditional user authentication requires your user name plus something you know, such as a password. The weakness with this traditional method of authentication is that if someone obtains your user name, they only need your password to compromise your account. Furthermore, since people tend to use the same password across multiple accounts (some sites with more security vulnerabilities than others), accounts are vulnerable to attack, regardless of password strength.


Two-factor authentication, on the other hand, requires something you know, such as a password, and something you have, such as a token or certificate. This increases the complexity for an attacker to compromise an account, as it puts less importance on often vulnerable passwords.

You can use two-factor authentication on FortiGate with both user and administrator accounts. Again, the user (or user group to which the user belongs) is added to a firewall policy in order to authenticate.

Note that you cannot use two-factor authentication with explicit proxies.

## Two-Factor Authentication and One-Time Passwords

- OTPs one-time use only
  - More secure than static passwords
- OTPs can be time-based or event-based
  - FortiTokens and Email / SMS OTPs are time-based
- Methods of OTP delivery:
  - FortiToken 200 / FortiToken Mobile
    - Generates a 6-digit code every 60 seconds based on a unique seed and GMT time.
  - Email / SMS: One-time password (OTP) sent to user's email or SMS respectively
    - Email / SMS must be configured in user's account.
- NTP server recommended!

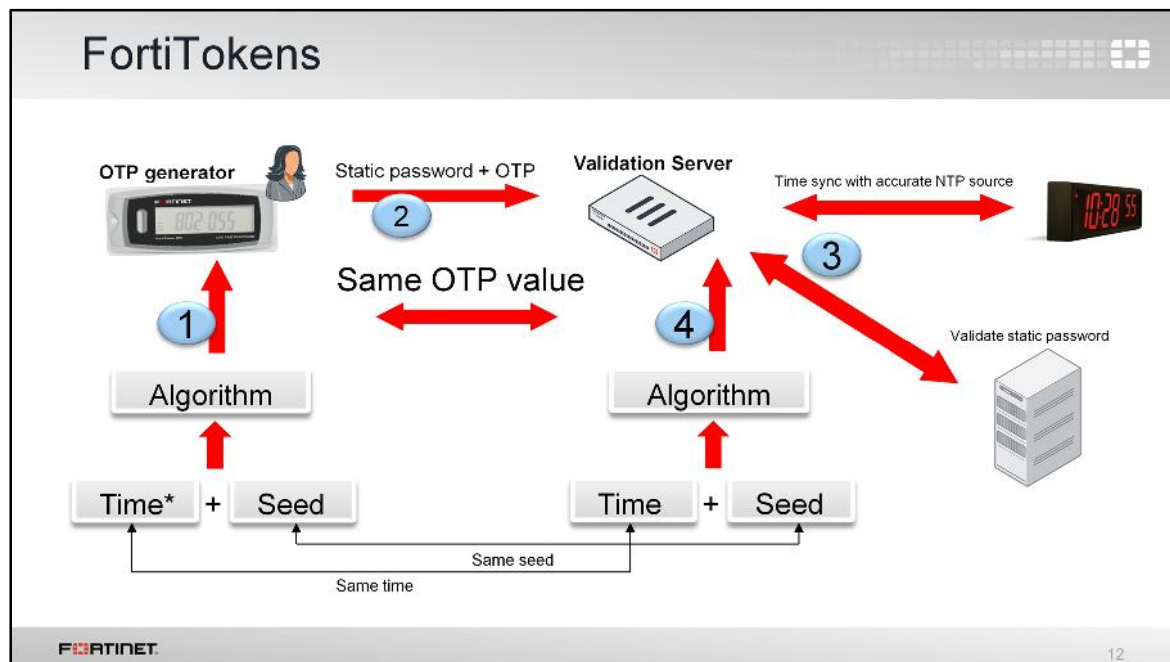


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You can use one-time passwords (OTPs) as your second factor. OTPs are more secure than static passwords because the passcode keeps changing at regular intervals and is only valid for a short amount of time. Once you use the OTP it cannot be used again, so even if it is intercepted, it is useless.

FortiGate can deliver OTPs through tokens, such as FortiToken 200 (hardware token) and FortiToken Mobile (software token), as well as through email or SMS. If delivering over email or SMS, the user account must contain that user contact information.

FortiTokens and OTPs through email and SMS are time-based. The FortiTokens, for example, generate a new 6-digit password every 60 seconds (by default). An NTP server is highly recommended to ensure the OTPs remain in sync.



Tokens use a specific algorithm to generate a one-time password. The algorithm consists of:

- a seed, which is a unique, randomly-generated number that does not change in time, and
- the time, which is obtained from an internal, accurate, clock.

Both seed and time go through an algorithm that generates a one-time password (or passcode) on the token. The passcode has a short life span, usually measured in seconds (60 seconds for a FortiToken 200, possibly more or less for other RSA key generators). Once the life span ends, a new passcode generates.

With two-factor authentication using a token, the user must first log in with a static password followed by the passcode generated by the token. A validation server (FortiGate) receives the user's credentials and validates the static password first. The validation server then proceeds to validate the passcode. It does so by re-generating the same passcode using the seed and system time (which is synchronized with the one on the token) and comparing it with the one received from the user. If the static password is valid, and the one-time password matches, the user is successfully authenticated. Again, both the token and the validation server must use the same seed and have synchronized system clocks. As such, it is crucial that you configure the date and time properly on your FortiGate or link it to an NTP server (recommended).



## Assigning a FortiToken to a User – Step 1

• **User & Device > FortiTokens**

**+ Create New** Edit Delete Activate Provision Refresh Search

Type	Serial Number	Status	User	Drift
<input type="checkbox"/> Mobile Token	FTKMOB49AF7C8B6D	Available		0
<input type="checkbox"/> Mobile Token	FTKMOB4975658F0A	Available		0

Type: Hard Token Mobile Token

Comments:

Serial Number:

Type: Hard Token Mobile Token

Activation Code:

Two free FortiToken Mobile activations

Cannot register FortiTokens on more than one FortiGate.

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You can add a FortiToken 200 or FortiToken Mobile to FortiGate through the **FortiTokens** page.

For the hard token, a serial number is used to provide FortiGate with details on the initial seed value. If you have several hard tokens to add, you can import a text file, where one serial number is listed per line.

For the soft token, an activation code is required. Note that each FortiGate (and FortiGate VM) provides two free FortiToken Mobile activations. Any additional tokens must be purchased from Fortinet.

You cannot register FortiTokens on more than one FortiGate. If you want to use the same FortiToken for authentication on multiple FortiGate devices, you must use a central validation server, such as FortiAuthenticator. In that case, FortiTokens are registered on FortiAuthenticator and FortiGate uses FortiAuthenticator as its validation server.

## Assigning a FortiToken to a User – Step 2

- **User & Device**
- **Enable Two-factor Authentication** and select registered FortiToken

Can add user to a group and create a firewall policy based on the user group.

User Name	student
User Account Status	<input checked="" type="checkbox"/> Enabled <input type="checkbox"/> Disabled
User Type	Local User
Password	••••••••
Email Address	
SMS	<input type="checkbox"/>
Two-factor Authentication	<input checked="" type="checkbox"/>
Token	FTKMOB4975658F0A
User Group	<input type="checkbox"/>

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Once you have registered the FortiTokens with FortiGate, you can assign them to users to use as their second factor authentication method. To assign a token, edit (or create) the user account and select **Enable Two-factor Authentication**. From the drop-down list, select the registered token you want to assign.



## Two-Factor Authentication and Certificates

- Can add a PKI user account on FortiGate
  - Must add first user through CLI
  - Subsequent users through GUI: **User & Device > PKI**

Must import the CA certificate that issued the user certificate and select it here

```
# config user peer
edit <username>
  set cn <cn of user cert>
  set ca <CA that issued user cert>
  set two-factor enable
  set passwd <password>
end
```

Name:

Subject:

CA:

☒ Two-factor authentication

Password:

Confirm password:

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You can also use X.509 digital certificates as your second factor, though FortiGate also accepts certificates as a standalone authentication method. Users that authenticate with digital certificates are known as PKI (Public Key Infrastructure) users.


To use certificates, you must first import the Certificate Authority (CA) certificate that is issuing your user certificates into FortiGate. The user must also install their personal certificate in the personal certificate store on their computer (if using the Firefox browser, users must install their user certificate in the Firefox certificate repository). Then you can add the PKI user accounts to FortiGate.

You must add your first PKI user through the CLI using the `config user peer` command (subsequent users can be added through the **PKI** page in the GUI). You can then include PKI users in firewall user groups and add the group as a source in a firewall policy.

Certificate-based authentication is covered in more detail in the *FortiGate II: Certificate Operations* lesson.

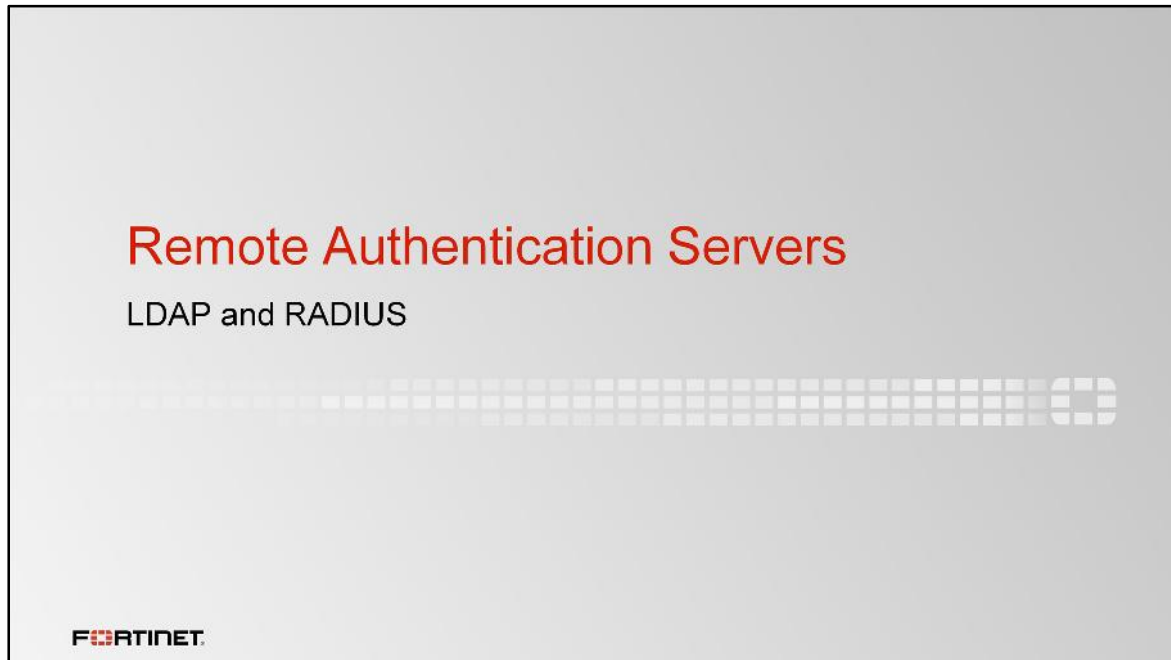
## Authentication Methods and Active Authentication

- Active
  - User receives a login prompt
  - Must manually enter credentials to authenticate
  - LDAP, RADIUS, Local, and TACACS+
- Passive
  - User does not receive a login prompt
  - Credentials are determined automatically**
    - Method varies depending on type of authentication used
  - FSSO, RSSO, and NTLM

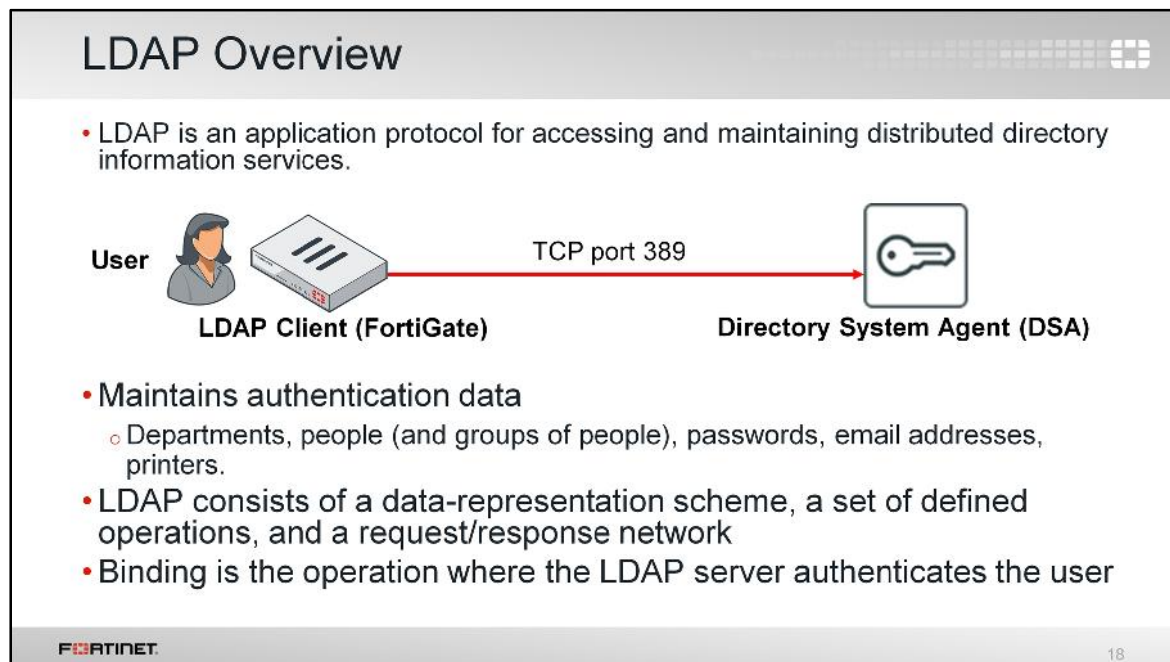
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All the authentication methods we've discussed—local password authentication, server-based authentication, and two-factor authentication—use active authentication. Active authentication means that users are prompted to manually enter their login credentials before being granted access.

But not all users authenticate the same way. Some users can be granted access transparently, as user information is determined without ever asking the user to enter their login credentials. This is known as passive authentication. Passive authentication occurs with the Single Sign-on method for server-based password authentication: FSSO, RSSO, and NTLM. This is discussed in the *FortiGate II: FSSO* lesson.



This section discusses how you can configure FortiGate to point to an existing LDAP or RADIUS server to use for server-based password authentication.




Lightweight Directory Access Protocol (LDAP) is an application protocol for accessing and maintaining distributed directory information services.

The LDAP protocol is used to maintain authentication data that may include departments, people, groups of people, passwords, email addresses, and printers. LDAP consists of a data-representation scheme, a set of defined operations, and a request and response network.

In the LDAP protocol, there are a number of operations a client can request, such as search, compare, and add/delete an entry. Binding is the operation where the LDAP server authenticates the user. If the user is successfully authenticated, binding allows the user access to the LDAP server based on that user's permissions.

## LDAP Directory Tree

- LDAP structure is similar to a tree that contains entries (objects) in each branch
- Each entry as a unique ID, the Distinguished Name (DN)
- Each DN also has attributes
- Each attribute has a name and one or more values
- The attributes are defined in the directory schema



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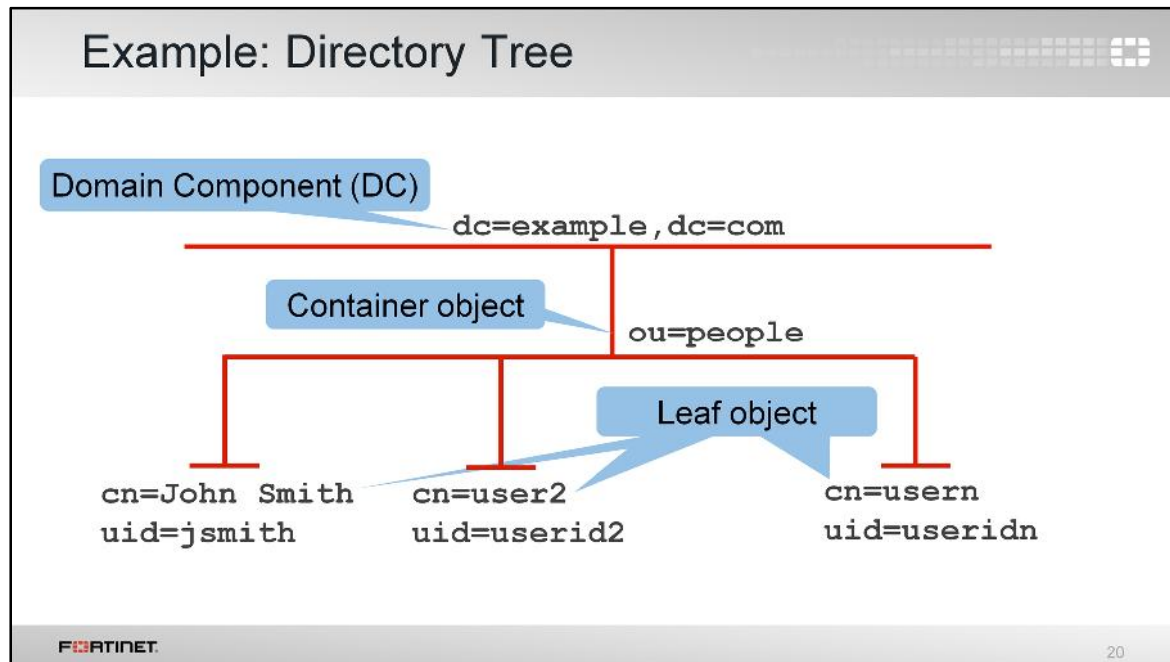
The root of the LDAP directory tree represents the organization itself, and is defined as a Domain Component (DC). The DC is usually a DNS domain such as `example.com` (as the name contains a dot, it is written as two parts separated by a comma: `dc=example,dc=com`). Additional entries, known as objects, can be added to the hierarchy as needed. Objects are generally of two types: containers and leafs.

Containers are objects that can include other objects, similar to a folder in a file system. Example containers include:

- Country (represented as `c`)
- Organizational Unit (represented as `ou`)
- Organization (represented as `o`)

Leafs are objects at the end of a branch and have no subordinate objects. Example leafs include:

- user ID (represented as `uid`)
- common name (represented as `cn`)



This is an example of a simple LDAP hierarchy.

The FortiGate device (acting as an LDAP client) requesting authentication must be configured to address its request to the right part of the hierarchy where user records exist. This is called the Distinguished Name (dn). In this example, the dn is `ou=people, dc=example, dc=com`.

The authentication request must also specify the particular user account entry. This can be either the Common Name (cn) or, on a computer network, the user ID (uid), as that is the information users use to log in. Note that if the object name includes a space, such as John Smith, you must enclose the text with double-quotes. For example: `cn="John Smith"`.

## Configuring an LDAP server on FortiGate

• User & Device > LDAP Servers

Directory tree attribute that identifies users

Part of the hierarchy where user records exist

Credentials for an LDAP administrator

Name	ADserver
Server IP/Name	10.0.1.10
Server Port	636
Common Name Identifier	cn
Distinguished Name	ningAD,dc=training,dc=lab <input type="button" value="Fetch DN"/>
Bind Type	Simple Anonymous <b>Regular</b>
User DN	cn=ADadmin,cn=users,dc=
Password	*****
Secure Connection	<input checked="" type="checkbox"/>
Protocol	<b>LDAPS</b> STARTTLS
Certificate	No Certificate ▼
<input type="button" value="Test"/>	

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You can configure FortiGate to point to an LDAP server for server-based password authentication through the **LDAP Servers** page. The configuration depends heavily on the server's schema and security settings. Windows Active Directory is very common.

**Common Name Identifier** is the attribute name used to find the user name. Some schemas will call this `uid`. Active Directory calls it `sAMAccountName` or sometimes `cn`.

**Distinguished Name** identifies the top of the tree to look in, which is generally the `dc` value. You must use the correct X.500 or LDAP format.

**Bind Type** depends on the security settings of the LDAP server. Regular bind is required if searching across multiple domains and requires the credentials of a user that is authorized perform LDAP queries (for example, an LDAP administrator).


If you want to have a secure connection between FortiGate and the remote LDAP server, enable **Secure Connection** and include the LDAP server protocol (LDAPS or STARTTLS) as well as the CA certificate that verifies the server certificate.

Note that the **Test** button only tests whether the connection to the LDAP server is successful or not. To test whether a user's credentials can successfully authenticate, you must use the CLI.

## Testing the LDAP Query

- `diagnose test authserver <server_name> <username> <password>`
- Example:

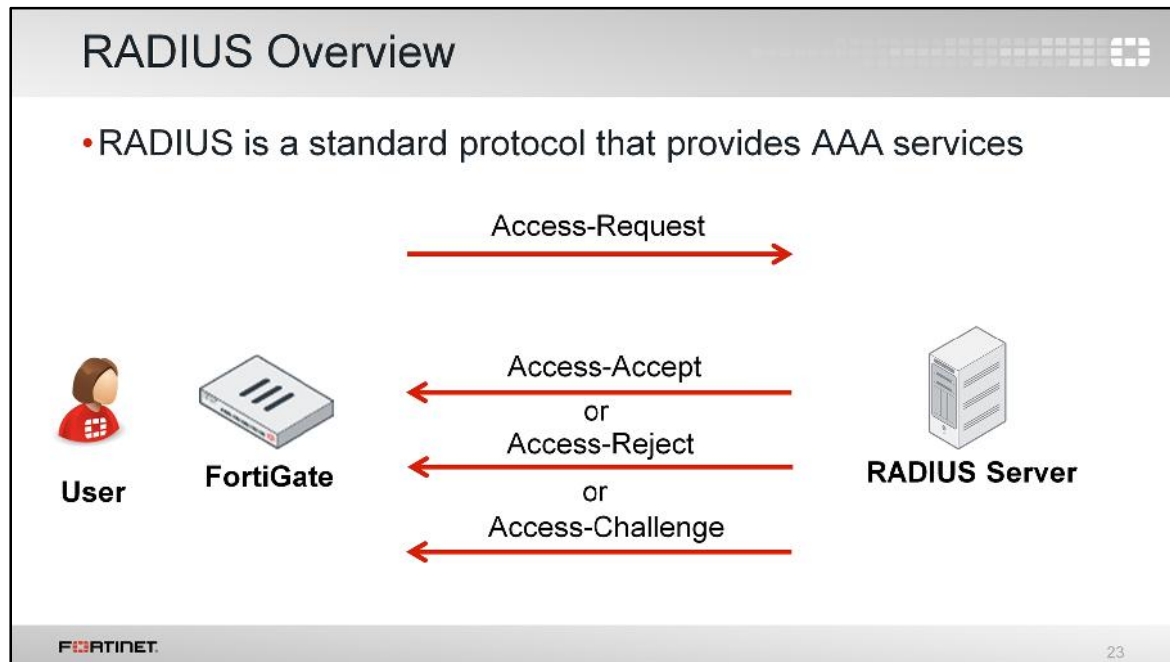
```
# diagnose test authserver ldap ADserver aduser1 Training!  
  
authenticate 'aduser1' against 'ADserver' succeeded!  
Group membership(s) - CN=AD-  
users,OU=Training,DC=trainingAD,DC=training,DC=lab
```

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Use the `diagnose test authserver` command in the CLI to test whether a user's credentials can successfully authenticate. You want to ensure that authentication is successful prior to implementing it on any of your firewall policies.

The response from the server reports success, failure, and group membership details.





RADIUS is much different than LDAP, as there is no directory tree structure to consider. RADIUS is a standard protocol that provides authentication, authorization, and accounting (AAA) services.

When a user is authenticating, the client (FortiGate) sends an Access-Request packet to the RADIUS server. The reply from the server will be one of the following:

- Access-Accept, which means that the user credentials are OK
- Access-Reject, which means that the credentials are wrong, or
- Access-Challenge, which means that the server is requesting a secondary password ID, token, or certificate. This is typically the reply from the server when using two-factor authentication.

Not all RADIUS clients support the RADIUS challenge method.

Configuring a RADIUS Server on FortiGate

User & Device > RADIUS Servers

IP address or FQDN of the RADIUS server

The RADIUS server's secret (must match)

Name	FortiAuth-RADIUS
Primary Server IP/Name	10.0.1.150
Primary Server Secret	•••••••• Test Connectivity
Secondary Server IP/Name	
Secondary Server Secret	Test Connectivity
Authentication Method	Default Specify
NAS IP / Called Station ID	
Include in every User Group	<input type="checkbox"/>

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You can configure FortiGate to point to a RADIUS server for server-based password authentication through the **RADIUS Servers** page.

The **Primary Server IP/Name** is the IP address or FQDN of the RADIUS server.

The **Primary Server Secret** is the secret that was set up on the RADIUS server in order to allow remote queries. Backup servers (with separate secrets) can be defined in case the primary server fails.

**Authentication Method** refers to the authentication protocol that the RADIUS server supports. Options include chap, pap (default), mschap, and mschap2.

Similar to LDAP configuration, the **Test Connectivity** button only tests whether the connection to the RADIUS server is successful or not. To test whether a user's credentials can successfully authenticate, you must use the CLI.

Note that Fortinet has a Vendor-Specific Attributes (VSA) dictionary to identify the Fortinet-proprietary RADIUS attributes. This will allow you to extend the basic functionality of RADIUS. You can obtain the Fortinet VSA dictionary from the Fortinet Knowledge Base ([kb.fortinet.com](http://kb.fortinet.com)).

## Testing RADIUS Queries

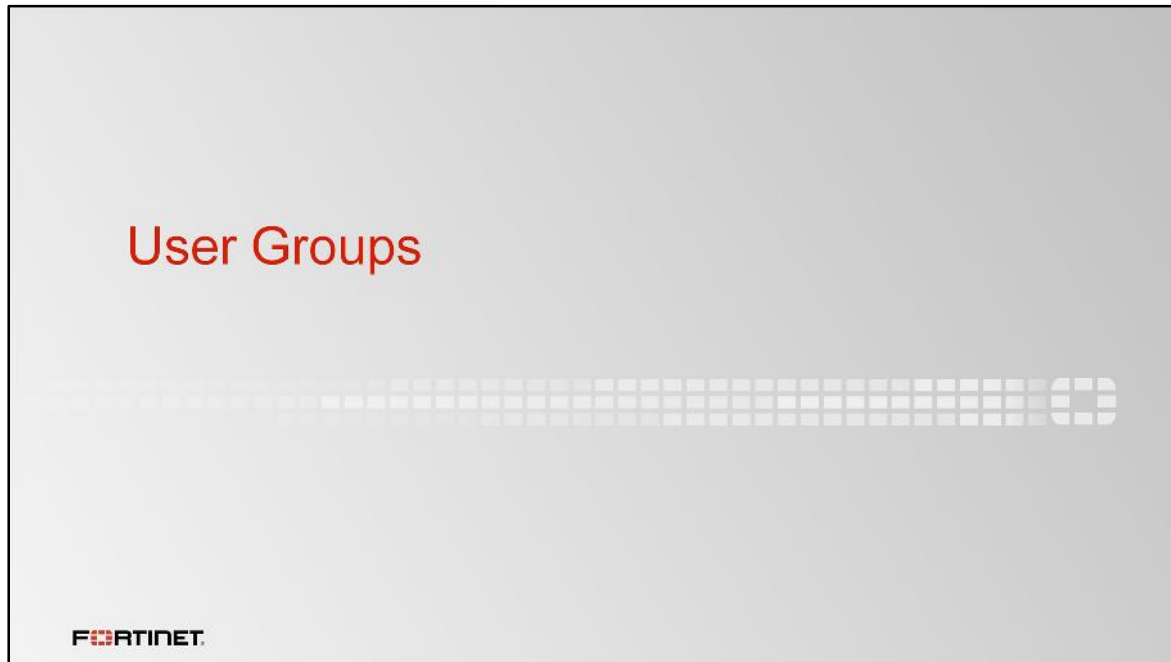
- `diagnose test authserver radius <server_name> <scheme> <user> <password>`
- Example:

```
# diagnose test authserver radius FortiAuth-RADIUS pap  
student fortinet  
  
authenticate 'aduser1' against 'pap' succeeded,  
server=primary assigned_rad_session_id=810153440  
session_timeout=0 secs!  
Group membership(s) - remote-AD-admins
```

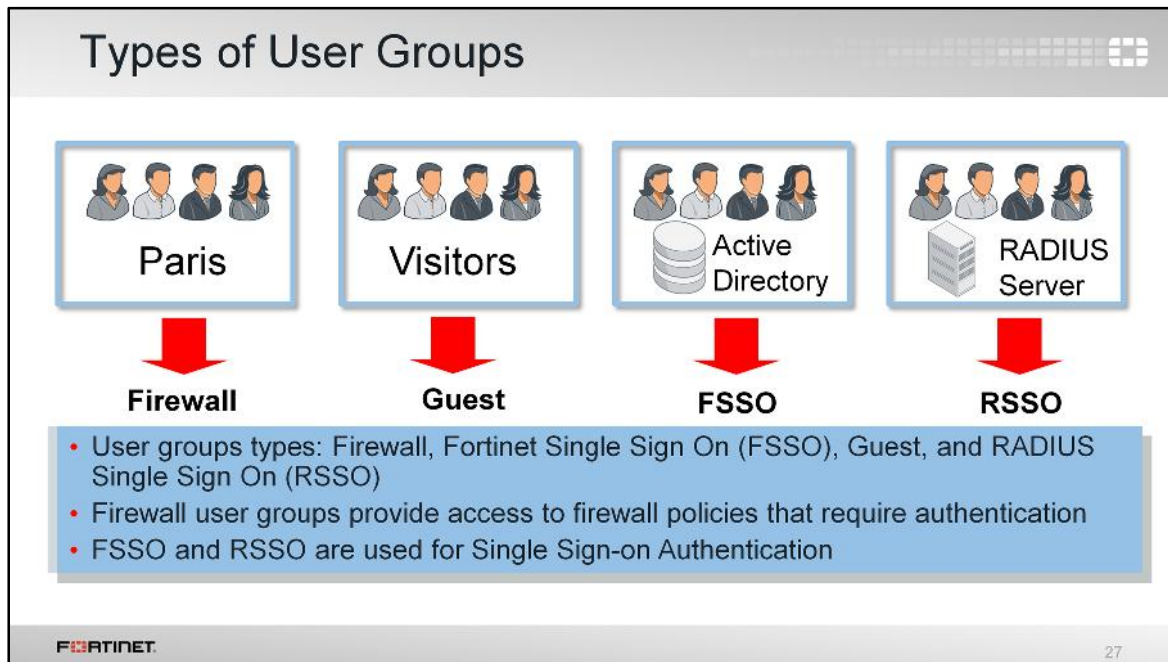
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Testing RADIUS is much the same as LDAP. Use the `diagnose test authserver` command in the CLI to test whether a user's credentials can successfully authenticate. Again, you should do this to ensure authentication is successful prior to implementing it on any of your firewall policies.

Like LDAP, it reports success, failure, and group membership details depending on the server's response. Deeper troubleshooting requires server access.



This section examines how to assign users to user groups, so you can configure firewall policies to act on the user group.



FortiGate allows administrators to assign users to groups. Generally, groups are used to more effectively manage individuals that have some kind of shared relationship. You might want to group employees by business area, such as Finance or HR, or by employee type, such as contractors or guests.

Once you create user groups, you can add them to firewall policies. This allows you to control access to network resources, as policy decisions are made on the group as a whole. You can define both local and remote user groups on a FortiGate device. There are four user group types:

- Firewall
- Guest
- Fortinet Single Sign-On (FSSO)
- RADIUS Single Sign-On (RSSO)

The firewall user groups do not need to match any sort of group that may already exist on a server. The firewall user groups exist solely to make configuration of firewall policies easier.

Most authentication types have the option to make decisions based on the individual user, rather than just user groups.

## Guest User Groups

- Most commonly used for guest access in wireless networks
- Guest groups contain temporary accounts

Name: Guests

Type: ☐ Firewall ☐ Fortinet Single Sign-On (FSSO) ☒ Guest ☐ RADIUS Single Sign-On (RSSO)

☐ Enable Batch Guest Account Creation

User ID: Auto-Generate

Password: Auto-Generate

Expire Type: Immediately

Default Expire Time: 4 Hours

Maximum Accounts: ☐

☐ Enable Name

☒ Enable Sponsor

☒ Enable Company

☒ Enable Email

☐ Enable SMS

☐ Required

☐ Required

Account expiry

Guest user groups are different from firewall user groups in that they exclusively contain temporary guest user accounts (the whole account, not just the password), and are most commonly used in wireless networks. Guest accounts expire after a predetermined amount of time.

Administrators can manually create guest accounts or create many guest accounts at once using randomly-generated user IDs and passwords. This reduces administrator workload for large events. Once created, you can add accounts to the guest user group and associate the group to a firewall policy.

You can create guest management administrators that only have access to create and manage guest user accounts.

## Configuring User Groups

### • User & Device > User Groups

Name

Type

Members

Remote groups

Training-users

☒ Firewall ☐ Fortinet Single Sign-On (FSSO) ☐ Guest ☐ RADIUS Single Sign-On (RSSO)

Please Select

LOCAL  
guest  
student  
PEER  
aduser1  
aduser2

Create New Edit Delete

Remote Server	Group Name
ADserver	CN=AD-users,OU=Training,DC=trainingAD,DC=training,DC=lab
FortiAuth-RADIUS	Any

Can add pre-configured remote servers to the group

Add members to group (local or PKI peer)

Can select specific LDAP groups as defined on the LDAP server

You can configure user groups through the **User Group** page. You must specify the user group type and add users to the group. Depending on the group you create, different configurations are required. For the firewall user group, for example, members can consist of local users, PKI peer users, and users from one or more remote authentication servers. If your remote authentication server is an LDAP server, you can select specific LDAP groups to add to your user group as defined on the LDAP server. Note that you can also select RADIUS groups, but this requires additional configuration on your RADIUS server and FortiGate (see knowledge base article FD36464).

User groups simplify your configuration if you want to treat specific users in the same way. For example, if you want to provide the entire Training department with access to the same network resources. If you want to treat all users differently, you would need to add all users to firewall policies separately.

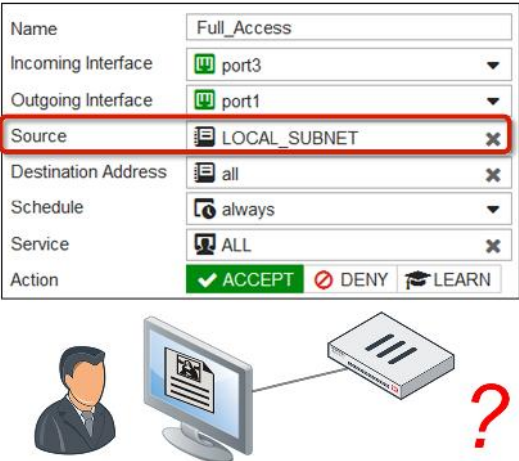


This section examines how you can use firewall policies for authentication.



## Firewall Policy: Source

- Firewall policies can use user and user group objects to define the source. Includes:
  - Local firewall accounts
  - External (remote) server accounts
  - PKI (certificate) users
  - FSSO users
- Successful authentication = anyone that belongs to the group



Name	Full_Access
Incoming Interface	port3
Outgoing Interface	port1
Source	LOCAL_SUBNET
Destination Address	all
Schedule	always
Service	ALL
Action	<input checked="" type="checkbox"/> ACCEPT <input type="checkbox"/> DENY <input type="checkbox"/> LEARN

A firewall policy consists of access and inspection rules (compartmentalized sets of instructions) that tell FortiGate how to handle traffic on the interface whose traffic they filter. After the user makes an initial connection attempt, FortiGate checks the firewall policies to determine whether to accept or deny the communication session. However, a firewall policy also includes a number of other instructions, such as those dealing with authentication. You can use the source of a firewall policy for this purpose. The source of a firewall policy must include the source address (IP address), but you can also include the user, user group, and device type as well. In this way, any user, user group, or device that is included in the source definition for the firewall policy can successfully authenticate.

User and user groups can consist of local firewall accounts, external server accounts, PKI users, and FSSO users.

## Firewall Policy: Service

- DNS traffic can be allowed if user has not authenticated yet
  - Hostname resolution is often required by application layer protocol (HTTP/HTTPS/FTP/Telnet) that is used to authenticate
  - DNS service must be explicitly listed as a service in the policy

Seq.#	Name	Source	Destination	Schedule	Service	Action	NAT
port3 - port1 (1 - 1)							
1	Full_Access	LOCAL_SUBNET	all	always	DNS HTTP	ACCEPT	Enabled

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A firewall policy also checks the service in order to transport the named protocols or group of protocols. No service (with the exception of DNS) is allowed through the firewall policy prior to successful user authentication. DNS is usually used by HTTP so that people can use domain names for websites instead of their IP address. DNS is allowed because it is a base protocol and will most likely be required to initially see proper authentication protocol traffic. Hostname resolution is almost always a requirement for any protocol. However, the DNS service must still be defined as allowed within the policy in order for it to pass.

In the following example, policy sequence 1 (Full\_Access) allows users to use external DNS servers in order to resolve host names, prior to successful authentication. DNS is also allowed if authentication is unsuccessful, because users need to be able to try to authenticate again. Any service that includes DNS would function the same way, like the default ALL service.

HTTP service is TCP port 80 and does not include DNS (UDP port 53).

## Protocols

- Firewall policy must allow a protocol in order to show authentication dialog used in active authentication
  - HTTP
  - HTTPS
  - FTP
  - Telnet
- All other services are not allowed until the user has first authenticated successfully through one of the protocols above



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Aside from the DNS server, the firewall policy must specify the protocols allowed, such as HTTP, HTTPS, FTP, and Telnet. If the firewall policy that has authentication enabled does not allow at least one of the supported protocols for obtaining user credentials, the user will not be able to authenticate.

Protocols are required for all authentication methods that use active authentication (local password authentication, server-based password authentication, and two-factor authentication). Active authentication prompts the user for user credentials based on:

- the protocol of the traffic, and
- the firewall policy.

Passive authentication, on the other hand, determines the user identity behind the scenes and does not require any specific services to be allowed within the policy.

## Mixing Policies

- Enabling authentication on a policy does not always force an active authentication prompt

Seq.#	Name	Source	Destination	Schedule	Service	Action	NAT
port3 - port1 (1 - 2)							
1	Full_Access	LOCAL_SUBNET HR-group	all	always	ALL	✓ ACCEPT	✓ Enabled
2		LOCAL_SUBNET	all	always	ALL	✓ ACCEPT	✓ Enabled

- Two options:
  - Enable authentication on every policy that could match the traffic
  - Enable a captive portal on the ingress interface for the traffic

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In this example, assuming active authentication is used, any initial traffic from LOCAL\_SUBNET will not match policy sequence 1 (Full\_Access). Policy sequence 1 looks for both IP and user and user group information (LOCAL\_SUBNET and HR-group respectively), and since the user has not yet authenticated, the user group aspect of the traffic does not match. Since the policy match is not complete, FortiGate does not apply that firewall policy.


Next, FortiGate evaluates policy sequence 2 to see if the traffic matches. It matches all criteria, so traffic is allowed with no need to authenticate.

When only active authentication is used, if all possible policies that could match the source IP have authentication enabled, then the user will receive a login prompt (assuming they use an acceptable login protocol). In other words, if policy sequence 2 also had authentication enabled, the users would receive login prompts.

If passive authentication is used and it can successfully obtain user details, then traffic from LOCAL\_SUBNET with users that belong to HR-group will apply to policy sequence 1, even though policy sequence 2 does not have authentication enabled.

## Order of Operations

- If login cannot first be determined passively, then FortiGate uses active authentication
  - FortiGate will not prompt the user for login credentials when the user can be determined passively
  - Active authentication is intended to be used as a backup when passive authentication fails



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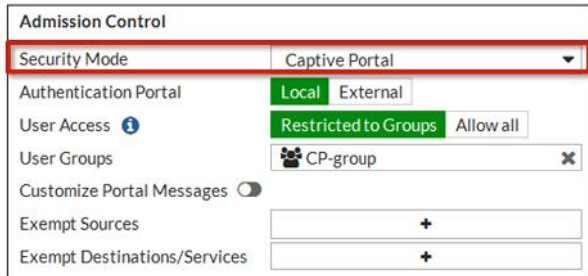
If you are using both active and passive authentication, and a user's credentials can be determined through passive means, the user will never receive a login prompt, regardless of the order of any firewall policies. This is because there is no need for FortiGate to prompt the user for login credentials when it can determine who the user is passively. When active and passive authentication methods are combined, active authentication is intended to be used as a backup only when passive authentication fails.



In this section, we will examine authenticating through a captive portal.

## Captive Portal

- Authenticates users on a Web page that requests a user name and password
  - Enabled at interface level (**Network > Interfaces**)
- Only active authentication methods can use captive portal
- Can host captive portal on a FortiGate or an external authentication server



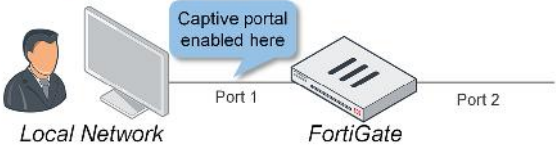
The screenshot shows the 'Admission Control' configuration page in the FortiGate web interface. The 'Security Mode' dropdown menu is highlighted with a red rectangle and is set to 'Captive Portal'. Below it, the 'Authentication Portal' is set to 'Local' (with 'External' as an alternative). The 'User Access' is set to 'Restricted to Groups' (with 'Allow all' as an alternative). The 'User Groups' field is set to 'CP-group'. There are also sections for 'Customize Portal Messages' (with a toggle switch), 'Exempt Sources', and 'Exempt Destinations/Services', each with a '+' button to add entries.

If you want all users connecting to the network to be prompted for their login credentials (active authentication), you can enable captive portal. Captive portal is a convenient way to authenticate Web users on wired or WiFi networks through an HTML form that requests a user name and password.

You can host a captive portal on a FortiGate device or an external authentication server.

## Configuring Captive Portal

- Configured on network interfaces
  - Network > Interfaces**
- For WiFi, WiFi SSID must first exist
  - WiFi & Switch Controller > SSID**



**Admission Control**

Security Mode	Captive Portal
Authentication Portal	Local External
User Access	Restricted to Groups Allow all
User Groups	CP-group
Customize Portal Messages	<input type="checkbox"/>
Exempt Sources	+
Exempt Destinations/Services	+

**WiFi Settings**

Interface Name	SSID	Traffic Mode	Security Mode
WiFi	fortinet	Tunnel	WPA2 Personal

**WiFi Settings**

SSID	fortinet
Security Mode	Captive Portal
Portal Type	Authentication Disclaimer + Authentication Disclaimer Only

Captive portal, for both wired and WiFi networks, is enabled at the interface level — regardless of the firewall policy that allows it or the port that it ultimately leaves by (authentication being enabled or disabled on the policy is not a factor). This is true for any network interface, including WiFi and VLAN interfaces. On the local network, the captive portal setting must be enabled on the incoming port.

You can configure captive portal from the **Interfaces** page. Select the required interface and under **Admission Control**, select **Captive Portal** as the security mode. Note that if configuring captive portal for a WiFi network, the WiFi SSID must first exist.

Captive portals are not compatible with interfaces in DHCP mode.



## User access: Restricted to Groups and Allow All

- **Restrict to Groups**
  - Groups in the *captive portal* configuration are allowed
- **Allow all:**
  - Groups in the *firewall policies* configuration are allowed

The top screenshot shows the 'Admission Control' configuration page. Under 'User Access', 'Restricted to Groups' is selected. The 'User Groups' list includes 'CP-group' and 'CP-group2'.

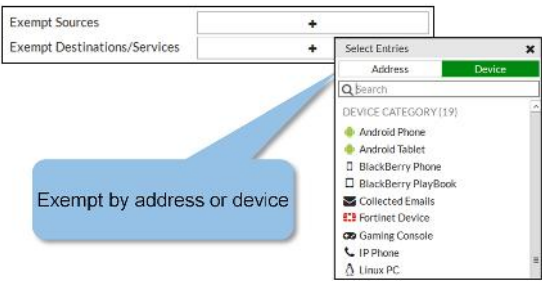
The bottom screenshot shows the 'Admission Control' configuration page with 'Allow all' selected under 'User Access'. Below this, a table of firewall policies is visible. A red arrow points to the 'Auth' row in the table.

Seq #	Name	Source	Destination	Schedule	Service	Action	NAT
1	Auth	CP-group CP-group2	all	always	ALL	ACCEPT	Enabled

Under **Admission Control**, you also have the option to restrict captive portal user access. Select **Restrict to Groups** to control the access from the captive portal configuration. Select **Allow all** to control the access in the firewall policy configuration.

## Captive Portal Exceptions

- Can suppress captive portal for specific devices
  - Printers, fax machines, and so on.



```
#config user security-exempt-list
edit <list_name>
config rule
edit <name>
set srcaddr | devices |
dstaddr | service
next
end
```

```
#config firewall policy
edit <policy_id>
set captive-portal-exempt enable
end
```

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You can also configure a firewall policy to suppress captive portal for specific devices. This is useful for devices that are unable to actively authenticate, such as printers and fax machines, but still need to be allowed by the firewall policy. When suppressed, traffic that matches the source and destination are not presented with the captive portal login page.

There are two ways you can bypass captive portal:

- through the GUI. You can enable captive portal exemptions through the GUI in the same place you enabled captive portal (**Network > Interfaces**).
- through the CLI. You can enable captive portal exemptions through the `security-exempt-list` setting. The `captive-portal-exempt` setting must also be enabled for each firewall policy and only applies to traffic that matches that policy.

## Terms of Service Disclaimer

- Displays the Terms and Disclaimer Agreement page before the user authenticates
  - User must accept disclaimer to proceed
  - Once accepted, user is directed to the original destination

```
#config firewall policy
edit <policy_id>
set disclaimer enable
end
```

The diagram illustrates the process of displaying a Terms and Disclaimer Agreement. A user is shown at a computer, connected to a FortiGate firewall. The firewall is connected to a captive portal that displays the agreement. The agreement text is as follows:

**FORTINET**  
Terms and Disclaimer Agreement

You are about to access Internet content that is not under the control of the network access provider. The network access provider is not responsible for any of these sites, their content or their privacy policies. The network access provider and its staff do not endorse nor make any representations about these sites, or any information, software or other products or materials found there, or any results that may be obtained from using them. If you decide to access any Internet content, you do this entirely at your own risk and you are responsible for ensuring that any accessed material does not infringe the laws governing, and not the responsibility of, copyright, trademarks, pornography, or any other material which is unlawful, defamatory or might cause offence in any other way.

Do you agree to the above terms?

Through the CLI command `config firewall policy`, you can enable a terms of service disclaimer to be used in combination with captive portal authentication, if desired. A disclaimer is a statement of the legal responsibilities of the user and the host organization that the user must agree to before proceeding. With this configuration (disclaimer + authentication), the portal presents the disclaimer page immediately after successful authentication. The user must accept the terms outlined in the disclaimer in order to proceed to the URL requested.

Neither a security exemption list or a captive portal exemption on a firewall can bypass a disclaimer.

## Customizing Portal Messages

- **System > Replacement Messages**
  - Select **Extended View**
- Not all disclaimers are/need to be the same
  - Text can be altered
  - Images can be added (to HTML messages)

Page	Replacement HTML
Authentication Success Page	Replacement HTML for authentication success page
Block Notification Page	Replacement HTML for block notification page
Certificate Password Page	Replacement HTML for certificate password page
Declined Disclaimer Page	Replacement HTML for user declined disclaimer page
Disclaimer Page	Replacement HTML for authentication disclaimer page

```
<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01//EN">
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=
<style type="text/css">
html,body{
height:100%;
padding:0;
margin:0;
}.oc{
display:table;
width:100%;
height:100%;
}.ic{
display:table-cell;
vertical-align:middle;
height:100%;
}form{
display:block;
background:#ccc;
border:2px solid red;
padding:0 0 20px 0;
width:500px;
font-family:helvetica,sans-serif;
font-size:12px;
}
```

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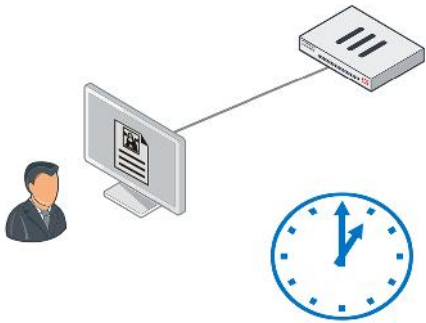
FortiGate allows you to customize portal messages, which includes the login page and disclaimer page. You can customize the messages from the **Replacement Messages** page.

The disclaimer page is in HTML, so you must have knowledge of HTML in order to customize the message. The default layout is the **Simple View**, which hides most of the replacement messages. Use **Extended View** to show all editable replacement messages.

## Authentication Timeout

```
#config user setting
set auth-timeout-type [idle-timeout|hard-timeout|new-session]
end
```

- Timeout specifies how long a user can remain idle before the user must authenticate again
  - Default is 5 minutes
- Three options for behavior:
  - Idle (default) – No traffic for that amount of time
  - Hard – Authentication expires after that amount of time, regardless of activity
  - New session – Authentication expires if no new session is created



The diagram illustrates a user at a computer connected to a FortiGate firewall. A clock icon is shown next to the connection, representing the authentication timeout period.

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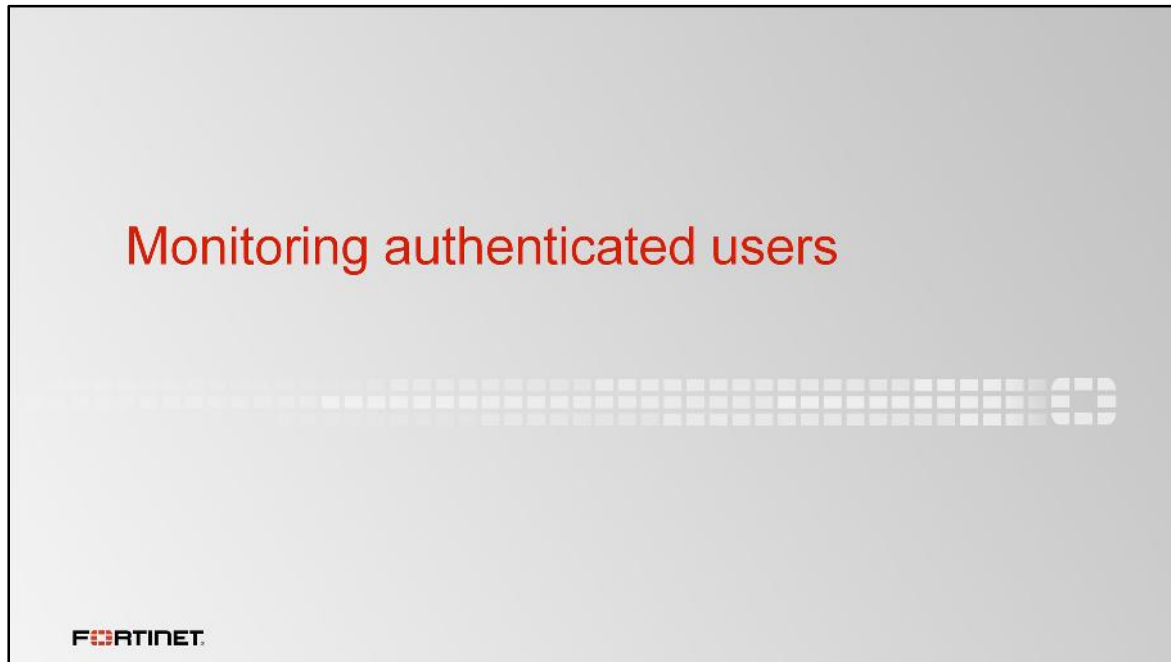
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An authentication timeout is useful for security reasons, as it minimizes the risk of someone using the IP of the legitimate authenticated user. It also ensures users do not authenticate and then stay in memory indefinitely. If users stay in memory forever, it would eventually lead to memory exhaustion.

There are three options for timeout behavior:

- **Idle** – Looks at the packets from the host's IP. If there are no packets generated by the host device in the configured timeframe then the user is logged out.
- **Hard** – Time is an absolute value. Regardless of the user's behavior, the timer starts as soon as the user authenticates and expires after the configured value.
- **New session** – Even if traffic is being generated on existing communications channels, the authentication expires if no new sessions are created through the firewall from the host device, within the configured timeout value.

Choose the type of timeout that best suits the needs of authentication in your environment.



In this last section, we will examine how to monitor authenticated users.

**Monitoring Users**

• **Monitor > Firewall User Monitor**

Refresh De-authenticate Show all FSSO Logons

User Name	User Group	Duration	IP Address	Traffic Volume	Method
aduser1	LDAP-users	0 day(s) 0 hour(s) 1 minute(s)	10.0.1.10	5.22 MB	Firewall

• Also used to terminate authenticated sessions

Refresh De-authenticate

Confirm

Are you sure you want to de-authenticate the selected user(s)?

OK Cancel

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You can monitor users who authenticate through your firewall policies through the **Firewall User Monitor** page. It displays the user, user group, duration, IP address, traffic volume, and authentication method.

It does not include administrators, as they are not authenticating through firewall policies that allow traffic — they are logging directly into the FortiGate.

This page also allows you to de-authenticate a user, or multiple users, simultaneously.

## Monitoring Failed Authentication

• **FortiView > Failed Authentication**

User	Source	Login Type	Destination	Failed Attempts
aduser1	10.0.1.10	Firewall	10.0.1.254 - port3 (Policy: 0)	1

#	1	Action	authentication
Authentication Protocol	HTTP(10.0.1.10)	Date/Time	13:35:20
Destination	10.0.1.254	Group	N/A
Interface	port3	Level	
Log Description	Authentication failed	Log ID	43009
Message	User aduser1 failed in authentication	Policy	0
Reason	N/A	Source	aduser1 (10.0.1.10)
Status	failure	Sub Type	user
Timestamp	2/19/2016, 1:35:20 PM	User	aduser1
Virtual Domain	root		

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You can monitor failed firewall authentications from the **Failed Authentication** page. By double-clicking any of the entries, a drill-down view appears. This displays more detailed information on that user's authentication attempts, including the date and time of each login attempt, a message explaining the reason each authentication failed (for example, a mismatched password), and the source IP address.

This page is useful in determining whether or not your FortiGate is under a brute force attack. If you see multiple failed login attempts from the same IP, you can (for example) add a local-in policy to block that IP.



## Review

- ✓ Firewall authentication
- ✓ Firewall authentication methods
- ✓ Remote authentication servers
- ✓ User configuration for local password authentication, server-based password authentication, and two-factor authentication (tokens, certificates)
- ✓ Active and passive authentication
- ✓ Remote authentication server configuration (LDAP and RADIUS)
- ✓ User authentication
- ✓ Captive Portal and disclaimers configuration
- ✓ Firewall user monitoring

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In this lesson, we discussed:


- Firewall authentication
- Firewall authentication methods
- Remote authentication servers
- User configuration for local password authentication, server-based password authentication, and two-factor authentication (tokens, certificates)
- Active and passive authentication
- Remote authentication server configuration (LDAP and RADIUS)
- User authentication
- Captive Portal and disclaimers configuration
- Firewall user monitoring




In this lesson, you will learn how to use and configure SSL VPNs. SSL VPNs are an easy way of providing access to your private network for remote users.

## Objectives

- Describe the differences between SSL VPN and IPsec VPN
- Describe the differences between SSL VPN modes
- Configure SSL VPN options such as bookmarks and realms
- Configure firewall policies and authentication for SSL VPN
- Strengthen security for SSL VPN access
  - Two-factor authentication
  - Client enforcement
- Monitor SSL VPN connected users



2

After completing this lesson, you should have these practical skills required to configure an SSL VPN for your organization. You should be able to:

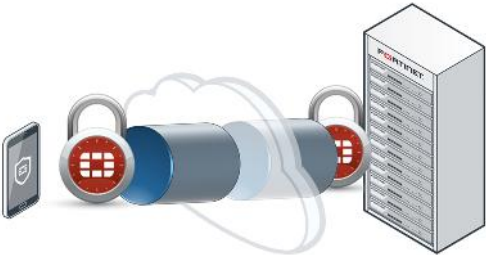
- Describe the differences between SSL VPN and IPsec VPN
- Describe the differences between SSL VPN modes
- Configure SSL VPN options
- Configure firewall policies and authentication for SSL VPN
- Strengthen security for SSL VPN access
- Monitor SSL VPN connected users



Before we show how to configure SSL VPN, let's examine how the technology works. What is SSL VPN? How is it different from other types of VPNs?

## What are Virtual Private Networks?

- *Securely* connect remote LANs/devices
  - Employees that travel
  - Branch offices to servers at central office
- *Safely* transmit private data across the Internet
  - Tamper-proof
    - Attackers can't change message/file
  - Encrypt
    - Unauthorized users can't eavesdrop
  - Authenticate
    - Only known users can access the private network



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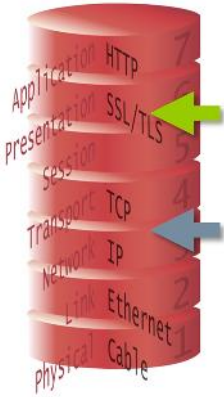
A virtual private network (VPN) creates a tunnel that gives users or remote LANs secure access to your private network, as if they were connected on your local LAN.

A VPN is *often* used when LANs are separated by an untrusted public network, such as the Internet. As well as providing users with secure access to private networks while they are traveling, a VPN can also interconnect branch office networks located across the Internet, and maybe even on the other side of the world.

User data inside a VPN tunnel is encrypted for privacy. It cannot be read, even if it is intercepted by unauthorized users. VPNs also use security methods to ensure that only authorized users can establish a VPN and access the private network's resources. They typically also provide tamper proofing.

### Comparison Between SSL VPN and IPsec VPN

IPsec VPN	SSL VPN
<ul style="list-style-type: none"><li>• IPsec tunnel (ESP layer)</li></ul>	<ul style="list-style-type: none"><li>• HTTPS tunnel (SSL/TLS layer)</li></ul>
<ul style="list-style-type: none"><li>• Can be between:<ul style="list-style-type: none"><li>• FortiClient + FortiGate</li><li>• FortiGate + FortiGate</li><li>• FortiGate + compatible third-party IPsec VPN gateway</li><li>• FortiGate + compatible third-party IPsec VPN clients</li></ul></li></ul>	<ul style="list-style-type: none"><li>• Can be between:<ul style="list-style-type: none"><li>• Browser/FortiClient + FortiGate</li></ul></li></ul>
<ul style="list-style-type: none"><li>• Log in through IPsec client<ul style="list-style-type: none"><li>• Site-to-site doesn't require IPsec client</li></ul></li></ul>	<ul style="list-style-type: none"><li>• Log in through:<ul style="list-style-type: none"><li>• HTTPS web page on FortiGate, or</li><li>• Use <code>fortissl</code> virtual adapter (FortiClient)</li></ul></li></ul>



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(slide contains animations)

Most VPNs are SSL or IPsec VPNs. FortiOS supports both, as well as less common, weaker VPNs such as PPTP. In this lesson, we will focus on SSL VPNs.

So how are SSL VPNs different from IPsec VPNs?

First, the protocols are different. SSL and TLS are commonly used to encapsulate and secure ecommerce and online banking on the web (HTTP). SSL VPNs use a similar technique, but often with non-HTTP protocols encapsulated. SSL is higher up on the network stack than IP, and, therefore, usually require more bits – more bandwidth – for SSL VPN headers. In comparison, IPsec uses some special protocols. The primary one is ESP, which encapsulates and encrypts UDP, RDP, HTTP, or other protocols that are inside in the IPsec tunnel.

What else is different?

(click)



IPsec VPN is a standard. It can interoperate with multiple vendors, and supports peers that are devices and gateways – not just user clients with FortiGate only, like SSL VPN does.


(click)

The client software is also different.

### Comparison Between SSL VPN and IPsec VPN (cont.)

IPsec VPN	SSL VPN
<ul style="list-style-type: none"><li>• Industry standard</li><li>• Flexible<ul style="list-style-type: none"><li>• Mesh and star topologies</li><li>• For clients or peer gateways</li><li>• Extensible cryptography</li></ul></li><li>• Installation required</li><li>• Better for:<ul style="list-style-type: none"><li>• Office-to-office traffic</li><li>• Data centers</li></ul></li></ul>	<ul style="list-style-type: none"><li>• Vendor-specific</li><li>• Simpler setup<ul style="list-style-type: none"><li>• Only client to FortiGate</li><li>• No user-configured settings</li><li>• Technical support less requested</li></ul></li><li>• Can be zero-install<ul style="list-style-type: none"><li>• OK for Internet cafés, libraries</li></ul></li><li>• Better for users</li></ul>



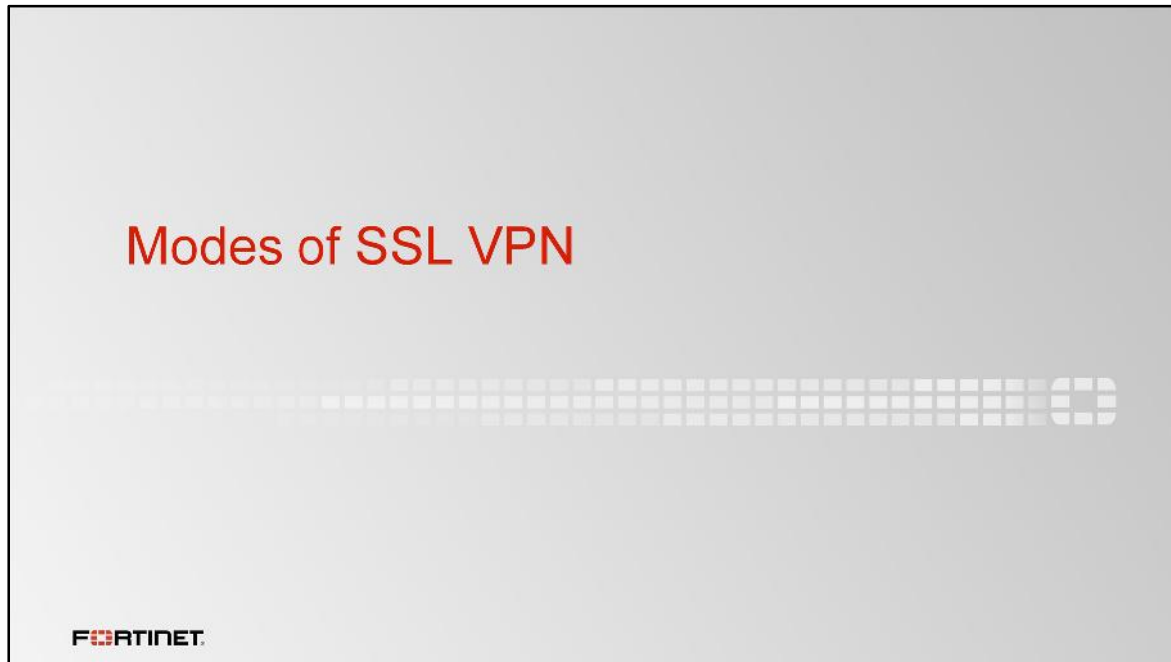
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In an SSL VPN, your web browser might be the *only* client software you need. Go to FortiGate's SSL VPN portal (an HTTPS web page), and then log in. Alternatively, you can install a plugin or FortiClient. This increases the number of protocols that can be sent through the VPN tunnel.

Once you've logged in, the SSL VPN connects your computer to your private network. No user-configured settings are required, and firewalls are typically configured to allow outgoing HTTP, so technical support calls are less likely. Simplicity makes SSL VPN ideal for non-technical users, or users who connect from public computers, such as those found in public libraries and Internet cafés.

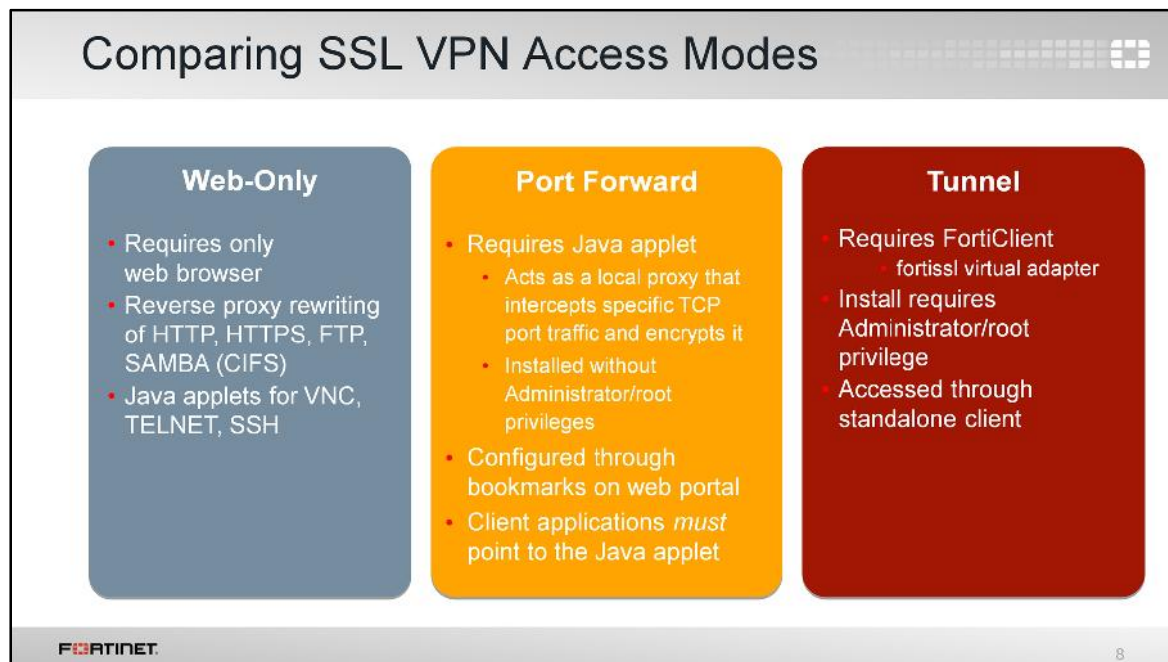
In comparison, to use IPsec VPN, you're usually required to install special client software, or have a local gateway, such as a desktop model FortiGate, in order to connect to the remote gateway. You might also need to configure firewalls between VPN peers to allow IPsec protocols. But, IPsec is a standard protocol supported by most vendors, so a VPN session can be established not only between two FortiGate devices, but also between different vendors' devices, and between a gateway and clients. It's highly extensible and configurable. By comparison, SSL VPN can only be established between a computer and a vendor-specific gateway, such as FortiGate.

In general, IPsec VPN is preferred when tunnels must be up continuously and interoperate with many types of devices, while SSL VPN is preferred when people travel and need to connect to the office.



There are three modes you can use to access an SSL VPN. Let's examine them.





Here are the three modes you can use to access SSL VPN. All of them can build an SSL VPN connection, but they don't all support the same features.

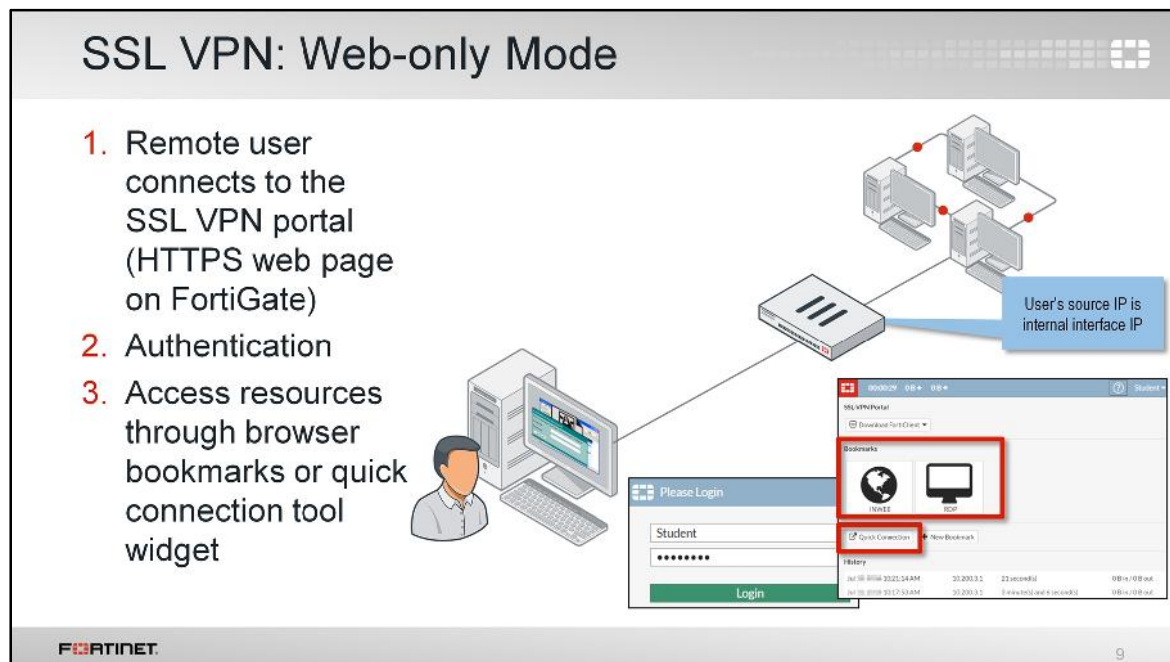
What are the differences?

Web-only access is the simplest access mode. Like you would with any other HTTPS website, you simply log in to the SSL VPN portal web page on FortiGate. It acts like a server-side reverse proxy that connects you with the applications on the private network. But this mechanism doesn't work for everything – just a few popular protocols, such as HTTP, FTP, and Windows shares.

Port forward access expands on the capabilities offered by web-only access. Instead of using *only* the browser and FortiGate's HTTP proxy, a Java applet is installed on the client's computer that acts as a local proxy. You or your users must configure the applications to send IP traffic to the local proxy applet. Then, the applet can redirect the packets to the FortiGate's SSL VPN gateway. You must also configure bookmarks in the SSL VPN portal.

Tunnel mode supports the most protocols. However, it requires administrator/root privileges because you need to install a VPN client, or, more specifically, a virtual network adapter. To begin tunneling traffic using this virtual adapter, you must use FortiClient or its standalone fortissl VPN client component.

Which should you choose? It depends on which applications you need to send through the VPN, the technical knowledge of your users, and whether or not you have administrative permissions on their computers.

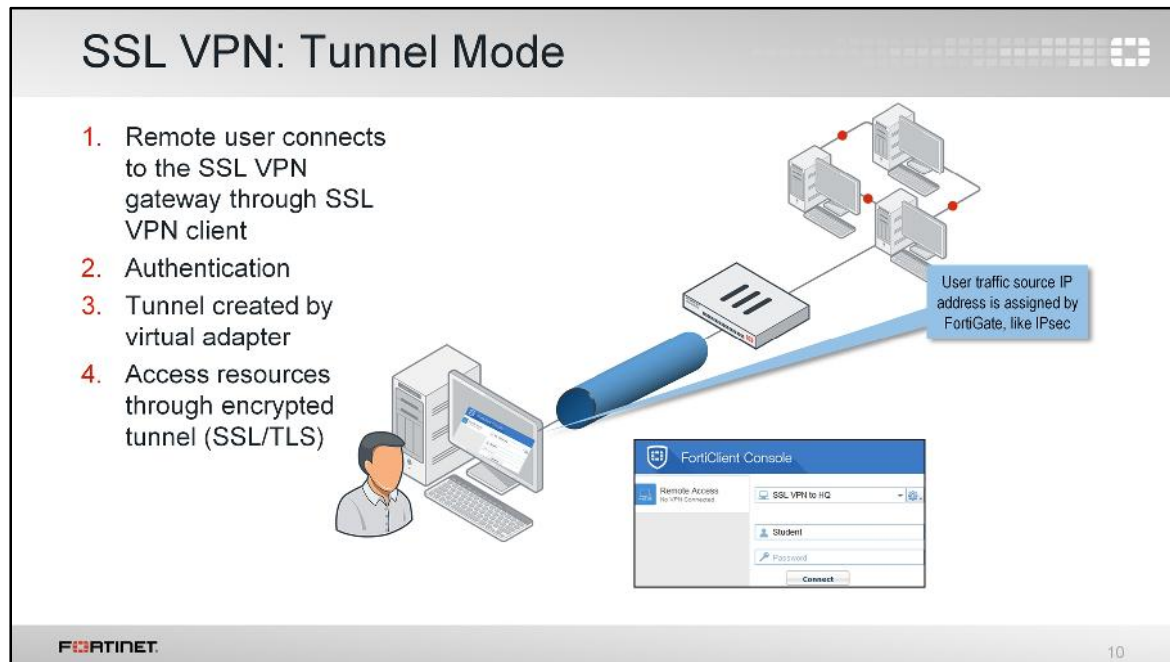


Web-only mode is used to connect to the FortiGate device from any browser, using HTTPS. Once connected, users need credentials in order to pass an authentication check. Once authenticated, users are presented with a portal that contains resources for them to access. Different users can have different portals with different resources and access permissions.

The **Bookmarks** section contains links to all or some of the resources available for the user to access. The **Quick Connection** widget allows users to type the URL or IP address of the server they want to reach. A web-only SSL VPN user makes use of these two widgets to access the internal network. The main advantage of web-only mode is that it does not usually require you to install extra software.

Web-only mode has two main disadvantages:

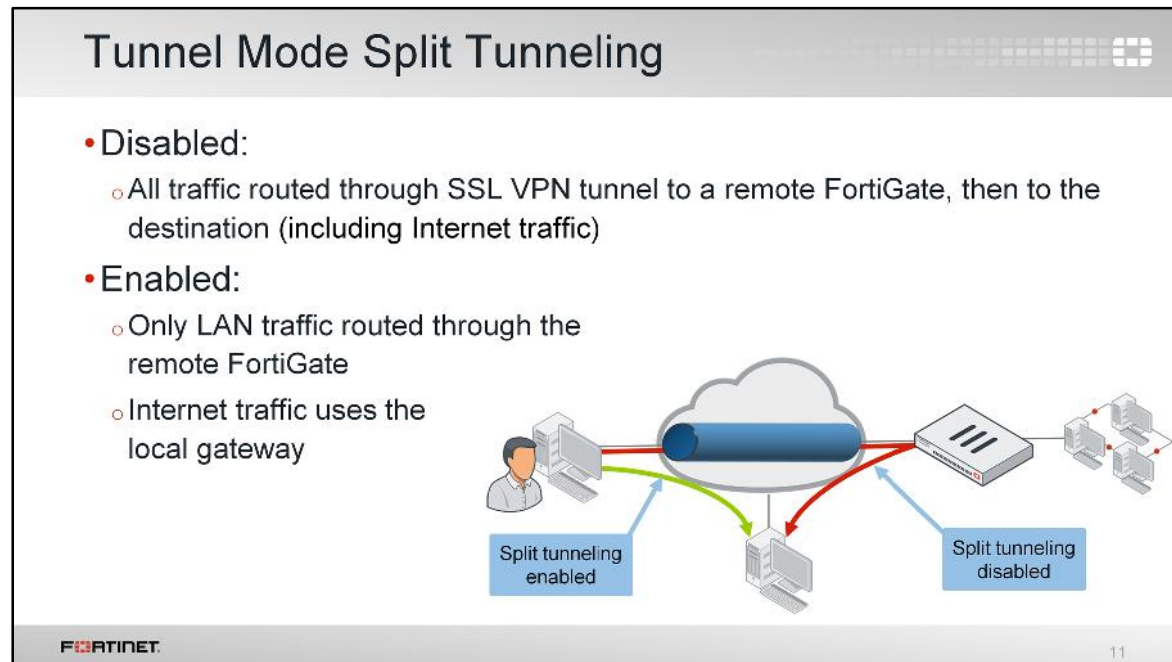
- First, all interaction with the internal network must be done from the browser exclusively (through the Web portal). External network applications running on the user's PC cannot send data across the VPN.
- Second, a limited number of protocols are supported, such as HTTP/HTTPS, FTP, RDP, SMB/CIFS, SSH, Telnet, VNC, and Ping.



Tunnel mode SSL VPN requires the SSL VPN client (FortiClient) to connect to FortiGate. Users must connect to FortiGate through FortiClient and successfully authenticate. When the user initiates a VPN connection with FortiGate through the SSL VPN client, FortiGate establishes a tunnel with the client and assigns the client a virtual IP address from a range of reserved addresses. The client uses the assigned IP address as its source address for the duration of the connection. Inside the tunnel, traffic is encapsulated with SSL/ TLS and sent to the other side. FortiGate receives the traffic and de-encapsulates the IP packets, forwarding them to the private network as if they originated from inside the network.

The main advantage of tunnel mode over web-only mode is that, once the VPN is established, any IP network application running on the client can send traffic through the tunnel.

The main disadvantage is that tunnel mode requires the installation of a VPN software client, which requires administrative privileges.




Tunnel mode can operate in two different ways: with and without split tunneling enabled.

When split tunneling is disabled, all IP traffic generated by the client's computer – including Internet traffic – is routed across the SSL tunnel to FortiGate. This sets up FortiGate as the default gateway for the host. You can use this method in order to apply UTM features to the traffic on those SSL VPN clients, or to monitor or restrict Internet access. This adds more latency and increases bandwidth usage.

When split tunneling is enabled, only traffic that is destined for the private network *behind* the remote FortiGate is routed through the tunnel.

## Ways of Connecting to SSL VPN

- Web-only mode through browser
  - Web portal displays status of SSL VPN
  - SSL VPN stays up only while SSL VPN portal page is open
- Tunnel mode through FortiClient
  - Tunnel is up only while SSL VPN client is connected
  - Adds virtual network adapter called *fortissl*
    - FortiGate assigns a virtual IP address to the client from a pool of reserved addresses



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There are two methods you can use to connect to an SSL VPN.

The first method is through a browser. The limitation is that the browser window or tab with the SSL VPN portal must remain open in order to keep the SSL VPN up.

The second method is through a standalone SSL VPN client, which requires you to install an SSL VPN client on the user's PC. When the SSL VPN client is installed, a virtual network adapter called *fortissl* is added to the user's PC. This virtual adapter dynamically receives an IP address from FortiGate each time a new VPN is established. All packets sent by the client use this virtual IP address as the source address.

## SSL VPN: Port Forward

- Extension of web-only mode that simulates tunnel mode
  - If no administrative access to install the virtual tunnel adapter
- Port forward uses a Java applet to extend the amount of applications supported by web-only mode
  - Applet listens to local ports on the user's computer
  - Encrypts and forwards all traffic to FortiGate (similar to tunnel mode)
  - Specific bookmarks for the user are created that act as tunnels
- User must configure their applications to point to local proxy

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Tunnel mode requires the installation of a virtual network adapter, which requires administrative level access to accomplish. Because of this access requirement, tunnel mode is not always a feasible option. For those situations where tunnel mode isn't practical and web-only mode isn't flexible enough, there is a web-only extension called port forward mode.

Rather than use a virtual adapter to create a tunnel with an IP that is separate from the local IP, port forward uses a Java applet to set up a local proxy that is accessed by connecting to the loopback address.



In this section, you will learn how to configure SSL VPN on a FortiGate and related components.



## How to Configure SSL VPN

1. Set up user accounts and groups
2. Configure portal
3. Configure SSL VPN settings
4. Create a firewall policy to accept and decrypt packets
  - Generally used to allow access to internal network
5. (Optional) Create a firewall policy to route traffic to the Internet
  - Useful when split tunneling is disabled to route all the client's traffic through FortiGate to Internet – FortiGate can be used to apply security profiles

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To configure SSL VPN, you must take these steps:

1. Configure user accounts and groups.
2. Configure the portal.
3. Configure SSL VPN settings.
4. Create a firewall policy to accept and decrypt packets. This policy is also used to provide access to internal networks.
5. Optionally, you can configure a firewall policy to route SSL VPN user traffic to the Internet and apply security profiles. User traffic will go to the Internet through FortiGate where you can monitor or restrict client access to the Internet.

Some steps can be configured in different order, but not always.




## Step 1: Configure User Accounts and Groups


Many SSL VPN authentication methods:

- Local Password Authentication
- Remote Password Authentication (or server-based authentication):
  - LDAP
  - RADIUS
  - TACACS+
- Two-factor authentication
  - Better security than just passwords

Two-factor

User name with password (one factor) 

+

Token code (two factor) 

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The first step is to create the accounts and user groups for the SSL VPN clients.

All the FortiGate authentication methods, with the exception of remote password authentication using the Fortinet Single Sign-On (FSSO) protocol, can be used for SSL VPN authentication. This includes local password authentication and remote password authentication (using the LDAP, RADIUS, and TACACS+ protocols).

You can also configure two-factor authentication with FortiToken for better security.

## Step 2: Configure the Portal(s)

- Define user access to:
  - Tunnel
  - Web portal
  - Bookmarks
  - Concurrent SSL VPN connections

**Tunnel mode**

**Web mode**

**Bookmarks**

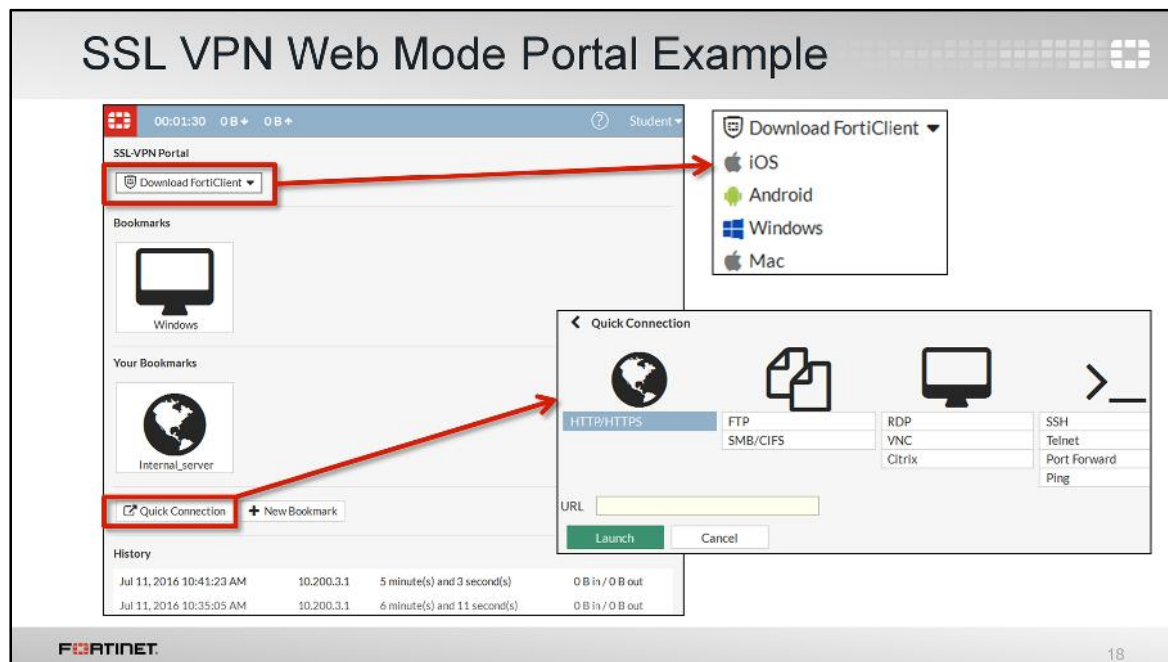
Name	Type	Location	Description
No matching entries found			

The second step is to configure the portal. A portal is simply a web page that contains tools and resource links for the users to access.

Options on the portal can be enabled or disabled to allow or deny access. You can configure options such as tunnel mode, show login history, predefined bookmarks, and more. You can individually configure and link each portal to a specific user or user group so they only have access to required resources.

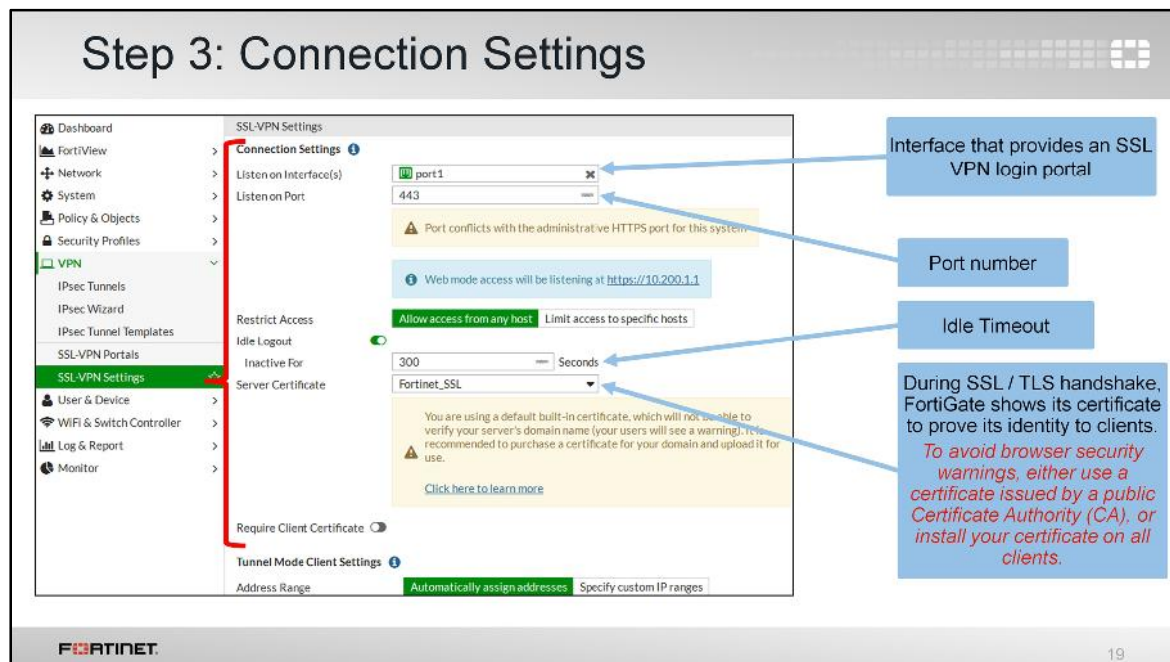
In tunnel mode, when you enable split tunneling you are required to select a **Routing Address** setting, which usually specifies networks behind the FortiGate for the SSL-VPN users to access.

There are several different theme options that provide different color coding to the portals as well.



This is a sample of an SSL VPN web-mode portal page after the user logs in.

It contains various widgets, based on the configuration of the portal. The **Bookmarks**, **Your Bookmarks**, and **Quick Connection** widgets are for web-only mode. You can download a standalone client from the **Download FortiClient** drop-down menu. This standalone client is used to connect to SSL VPN in tunnel mode.



The third step is to configure the general settings. First, we'll talk about the connection settings, then the tunnel mode client settings, and, finally, the authentication portal mapping settings.

Like other HTTPS websites, the SSL VPN portal presents a digital certificate when users are connecting. By default, the presented certificate is self-signed, which triggers the browser to show a certificate warning. To avoid the warning, you should use a digital certificate signed by a Certificate Authority (CA) that is known to the browser. Alternatively, you can load the digital certificate into the browser as a trusted authority.

By default, an inactive SSL VPN is disconnected after 300 seconds (5 minutes) of inactivity. You can change this timeout through the **Idle Logout** setting in the GUI. Note that the idle logout is separate from the authentication idle timeout that is discussed in the *FortiGate I Firewall Authentication* lesson.

Also by default, the port for the SSL VPN portal is 443. This means users need to connect to the IP address of FortiGate and to port 443 (which is also the standard port for the administration HTTPS protocol) using HTTPS. In the CLI, you can also enable `https-redirect` under `config vpn ssl` settings, in which users that connect using HTTP (TCP port 80) will automatically get redirected to HTTPS.

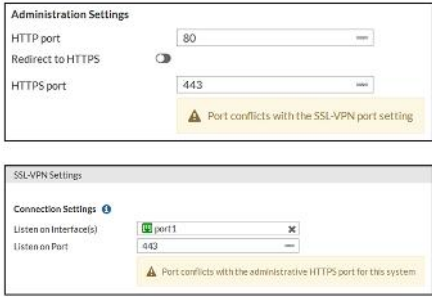
## SSL VPN login and Administrator login

- By default, the administrator GUI and SSL VPN portal both use the same HTTPS port
- OK if services are enabled on different NICs

Example:

- Administrator access through HTTPS port 443 on management LAN (port4)
- SSL VPN access through HTTPS port 443 on port1

- If both features use the same port and are enabled on same interface, only the SSL VPN portal appears



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In a default configuration, the SSL VPN login portal and the administrator login for HTTPS both use port 443.

This is convenient because users do not need to specify the port in their browser. For example, `https://www.example.com/` automatically uses port 443 in any browser. This is considered a valid setup on FortiGate because you generally don't access the SSL VPN login through every interface. Likewise you generally don't enable administrative access on every interface of your FortiGate. So even though the ports may overlap, the interfaces that each one uses to access may not.

If the SSL VPN login portal and HTTPS admin access both use the same port, and are both enabled on the same interface, only the SSL VPN login portal will appear. In order to have access to both on the same interface, you need to change the port number for one of the services. This will affect the port number for that service on all interfaces.

## Step 3: Tunnel Mode Client Settings

The screenshot displays the FortiGate web interface for configuring SSL-VPN settings. The left sidebar shows the navigation menu with 'VPN' expanded and 'SSL-VPN Settings' selected. The main content area is titled 'SSL-VPN Settings' and includes a warning about the default certificate. The 'Tunnel Mode Client Settings' section is highlighted, showing the 'Address Range' configuration. Two callout boxes provide additional context: one points to the 'Automatically assign addresses' button, stating 'IPs assigned to clients' virtual adapters while joined to VPN', and another points to the 'Same as client system DNS' button, stating 'If internal domain names must be resolved by internal DNS'.

**Annotations:**

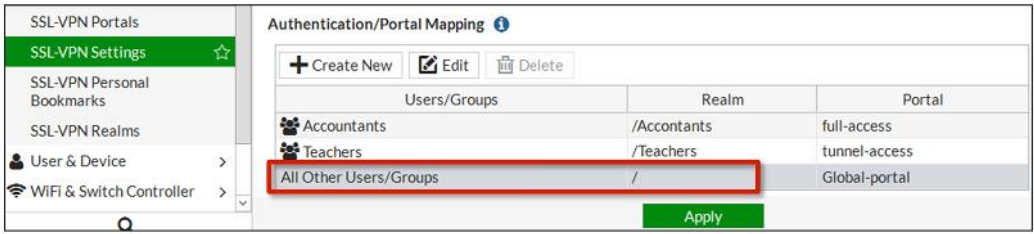
- IPs assigned to clients' virtual adapters while joined to VPN
- If internal domain names must be resolved by internal DNS

Once you set up your SSL VPN connection settings, you can define your **Tunnel Mode Client Settings**. When users connect, the tunnel is assigned an IP address. You can choose to use the default range or create your own range. The IP range determines how many users can connect concurrently.

DNS servers will only be effective if DNS traffic is sent over the VPN tunnel. Generally, this will only be the case when split tunnel mode is disabled and all traffic is being sent from the client PC across the tunnel.

## Step 3: Authentication Portal Mapping

- Can specify different portals for each user/group
- Predefined **All Other Users/Groups** cannot be deleted
  - Can change its portal



Users/Groups	Realm	Portal
Accountants	/Accountants	full-access
Teachers	/Teachers	tunnel-access
All Other Users/Groups	/	Global-portal

Apply

The last part of step three is to set up the authentication rules that map users to the appropriate portal and realm. These settings allow different groups of users to access different portals and/or realms.

The default rule applies to the root realm and must be present, otherwise an error message appears that prevents any setting changes from being saved.

In the above example, accountants and teachers have access only to their own realms. If they need access to the root realm to see the global portal, you would need to add an additional authentication rule.



### Step 4: Firewall Policies to/from SSL VPN interface

- Listens for connections to SSL VPN portal
- ssl.root policy enables portal with user authentication
- Incoming Interface is the SSL VPN's virtual interface
  - Example: **ssl.root** for **root** VDOM
- Passes decrypted traffic to Outgoing Interface

#### Edit Policy

Name	SSLVPN	
Incoming Interface	SSL-VPN tunnel interface (ssl.root)	
Outgoing Interface	Internal	
Source	all	X
	Training_One	X
	Training_Two	X
Destination Address	all	
Schedule	always	
Service	ALL	
Action	ACCEPT DENY LEARN	

The fourth, and last mandatory step, involves creating firewall policies for login.

SSL VPN traffic on FortiGate uses a virtual interface called `ssl.<vdom_name>`. Each virtual domain (VDOM) contains a different virtual interface based on its name. By default, if VDOMs are not enabled, then the device operates with a single VDOM called `root`.

In order to activate and successfully log in to the SSL VPN, there must be a firewall policy from the SSL VPN interface to the interface to which you want to allow access for the SSL VPN users, including all of the users/groups that can log in as the source. Without a policy like this, no login portal is presented to users.

If there are resources behind other interfaces that users need access to, then you need to create additional policies that allow traffic from **ssl.root** to exit those interfaces.



## Example: Access to other Internal Resources

- All traffic generated by user exits through `ssl.<vdom_name>` interface
- Both web and tunnel mode

```
edit 11
  set srcintf "ssl.root"
  set dstintf "dmz"
  set srcaddr "all"
  set dstaddr "Mail_Server"
  set action accept
  set schedule "always"
  set service "ALL"
  set groups "Accountants"
  set nat enable
next
```

```
edit 12
  set srcintf "ssl.root"
  set dstintf "internal"
  set srcaddr "all"
  set dstaddr "Database"
  set action accept
  set schedule "always"
  set service "ALL"
  set groups "Teachers"
  set nat enable
next
```

The diagram illustrates a network setup where a user connects to a FortiGate router via the WAN interface. The router has a DMZ interface connected to an email server and an internal interface connected to a MySQL database. The user is shown accessing the router via WAN.

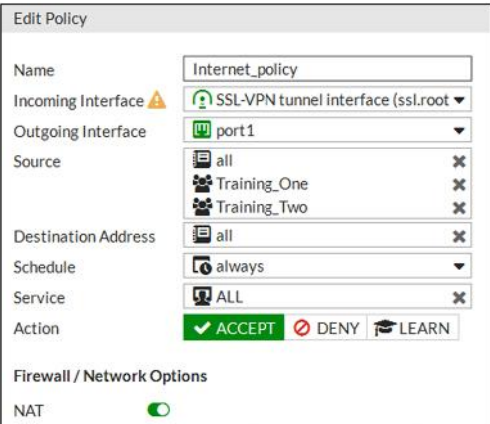
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Any traffic from SSL VPN users – whether in web portal or tunnel mode – exits from the `ssl.<vdom_name>` interface. Here is an example of firewall policies that are configured to allow access to resources behind other interfaces that users need access to when connected through SSL VPN.

## Step 5: Firewall Policy to Access Internet

- **ssl.root to egress interface firewall policy allows access to the Internet**
  - Required when split tunneling is disabled

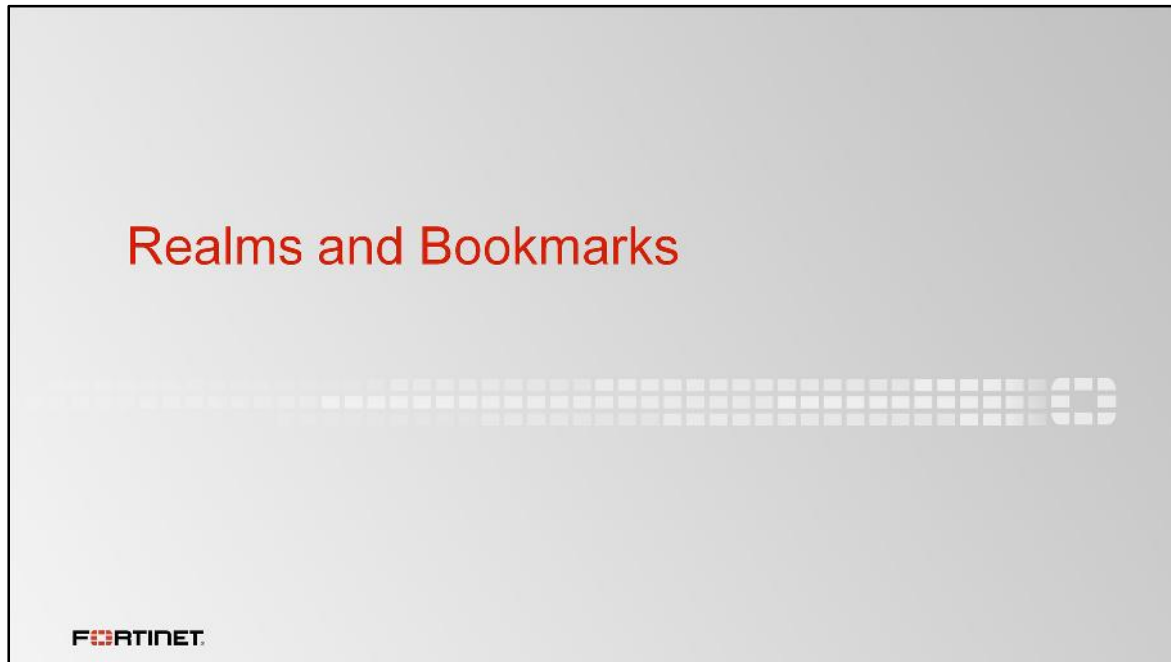


The screenshot shows the 'Edit Policy' configuration window for a firewall policy named 'Internet\_policy'. The configuration is as follows:

Field	Value
Name	Internet_policy
Incoming Interface	SSL-VPN tunnel interface (ssl.root)
Outgoing Interface	port1
Source	all, Training_One, Training_Two
Destination Address	all
Schedule	always
Service	ALL
Action	ACCEPT, DENY, LEARN
Firewall / Network Options	NAT (enabled)

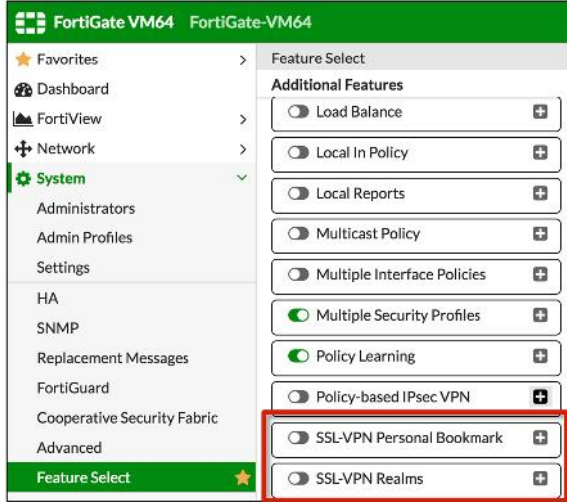
Fortinet logo is visible in the bottom left corner of the slide.

If split tunneling is disabled, you need to create an additional firewall policy from **ssl.root** to the egress interface to allow clients to provide access to the Internet. On this firewall policy, you can also apply security profiles to restrict user access to the Internet.



In this section, you'll learn how to configure realms and bookmarks.

## How to Show Realms / Personal Bookmarks



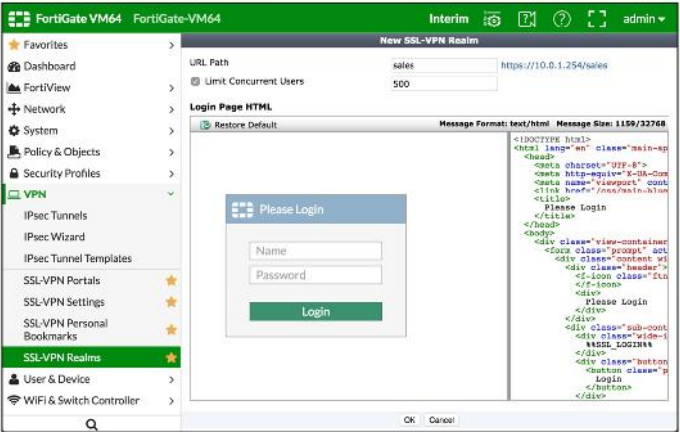
- Hidden by default
- To show, go to **System > Feature Select**

The screenshot shows the FortiGate VM64 web interface. The left sidebar contains the navigation menu with 'System' highlighted. The main content area shows the 'Feature Select' page under 'System'. The 'Additional Features' section lists various features with toggle switches. The 'SSL-VPN Personal Bookmark' and 'SSL-VPN Realms' features are highlighted with a red box, indicating they are hidden by default and can be enabled.

By default, all SSL VPN users will see the same bookmarks, configured by an administrator, and the same theme.

## Realms

- By default, same portal for all users  
`https://10.0.1.254/`
- Can make URLs for specialized portals (realms)  
`https://10.0.1.254/sales`  
`https://10.0.1.254/hr`



The screenshot displays the FortiGate VM64 web interface. The left sidebar contains a navigation menu with options like Favorites, Dashboard, FortiView, Network, System, Policy & Objects, Security Profiles, VPN, IPsec Tunnels, IPsec Wizard, IPsec Tunnel Templates, SSL-VPN Portals, SSL-VPN Settings, SSL-VPN Personal Bookmarks, SSL-VPN Realms, User & Device, and WiFi & Switch Controller. The 'SSL-VPN Realms' option is selected. The main panel shows the 'New SSL-VPN Realm' configuration page. It includes fields for 'URL Path' (set to 'sales') and 'Limit Concurrent Users' (set to 500). Below these is the 'Login Page HTML' section, which has a 'Restore Default' button and a preview of the login page. The preview shows a 'Please Login' form with 'Name' and 'Password' input fields and a 'Login' button. The HTML code for the login page is also displayed on the right side of the preview.


To add flexibility to your SSL VPN deployment, you may consider configuring SSL-VPN realms. The realms are custom login pages, usually for user groups, such as your accounting team and your sales team, but can be for individual users as well. With realms, users and user groups can access different portals based on the URL they enter. This is unlike a default deployment, where SSL VPN login is handled by going directly to the FortiGate's IP address. With different portals, you can customize each login page separately, as well as limit concurrent user logins separately.

Example of realms on a FortiGate:

```
https://192.168.1.1
https://192.168.1.1/Accounting
https://192.168.1.1/TechnicalSupport
https://192.168.1.1/Sales
```

## What is an SSL VPN Bookmark?

- Not the same as your browser's bookmarks
- Inside SSL VPN web portal
- Settings for applications that are passing through the VPN tunnel

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The SSL VPN bookmarks provides links to network resources. You can use the administrator-defined bookmarks and you can also add your own personal bookmarks.

## How to Configure User Bookmarks

- Also configure settings required by `apptype`
  - Example: `web` requires that you configure `url`, `ftp` requires `folder...`
- Only two types use port forwarding bookmarks:
  - `citrix`
  - `portforward`

```
config vpn ssl web user-bookmark
  edit <user_name>
    config bookmarks
      edit <bookmark_name>
        set apptype {citrix | ftp | portforward | rdp | smb | ssh | telnet | vnc | web}
        set description <text_string>
        set sso {auto|disable}
      next
    next
  end
```

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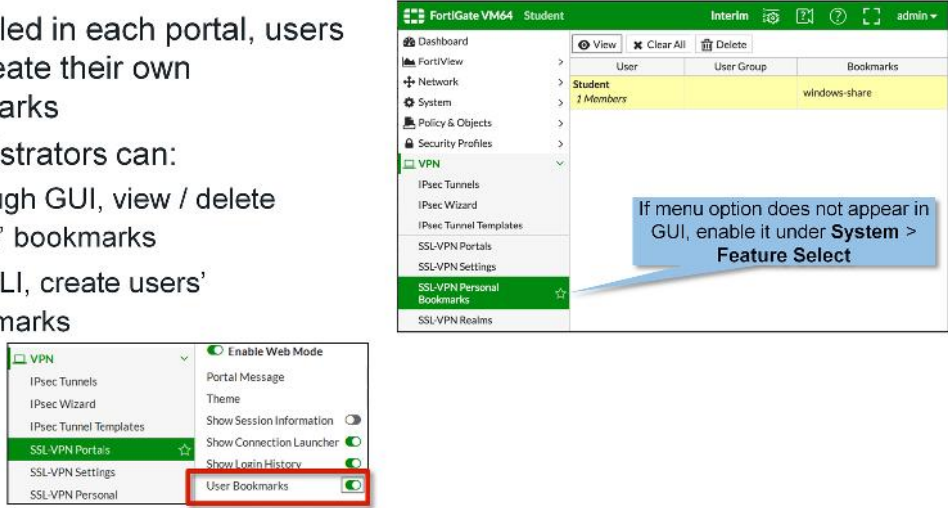
From the CLI of FortiGate, you can create bookmarks for each user. These bookmarks will appear even if the user bookmark option is disabled in the portal, because that option only effects the users' ability to create and modify their *own* bookmarks – not administrator-defined ones.

Depending on the type of bookmark you want to create, you may need to configure additional information that the application requires, such as URLs for websites and folders for FTP sites.

Only two types of bookmarks can be used with the port forwarding method (an extension of web-only mode): `citrix` and `portforward`. `Citrix` is specific for connecting the client to the citrix server. `Portforward` is a generic type of bookmark that you can customize to the traffic.

## Personal Bookmarks

- If enabled in each portal, users can create their own bookmarks
- Administrators can:
  - Through GUI, view / delete users' bookmarks
  - Via CLI, create users' bookmarks



The screenshot displays the FortiGate VM64 GUI. On the left, the 'VPN' menu is expanded, showing 'SSL-VPN Personal Bookmarks' with a star icon. A red box highlights the 'User Bookmarks' toggle switch, which is currently turned on. On the right, the 'SSL-VPN Personal Bookmarks' page is shown, displaying a table with columns for 'User', 'User Group', and 'Bookmarks'. A blue callout box points to the 'System > Feature Select' menu option, stating: 'If menu option does not appear in GUI, enable it under System > Feature Select'.

FortiGate VM64 Student Interim admin

VPN

- IPsec Tunnels
- IPsec Wizard
- IPsec Tunnel Templates
- SSL-VPN Portals
- SSL-VPN Settings
- SSL-VPN Personal

Enable Web Mode

- Portal Message
- Theme
- Show Session Information
- Show Connection Launcher
- Show Login History
- User Bookmarks

SSL-VPN Personal Bookmarks

User	User Group	Bookmarks
Student	1 Members	windows-share

If menu option does not appear in GUI, enable it under System > Feature Select

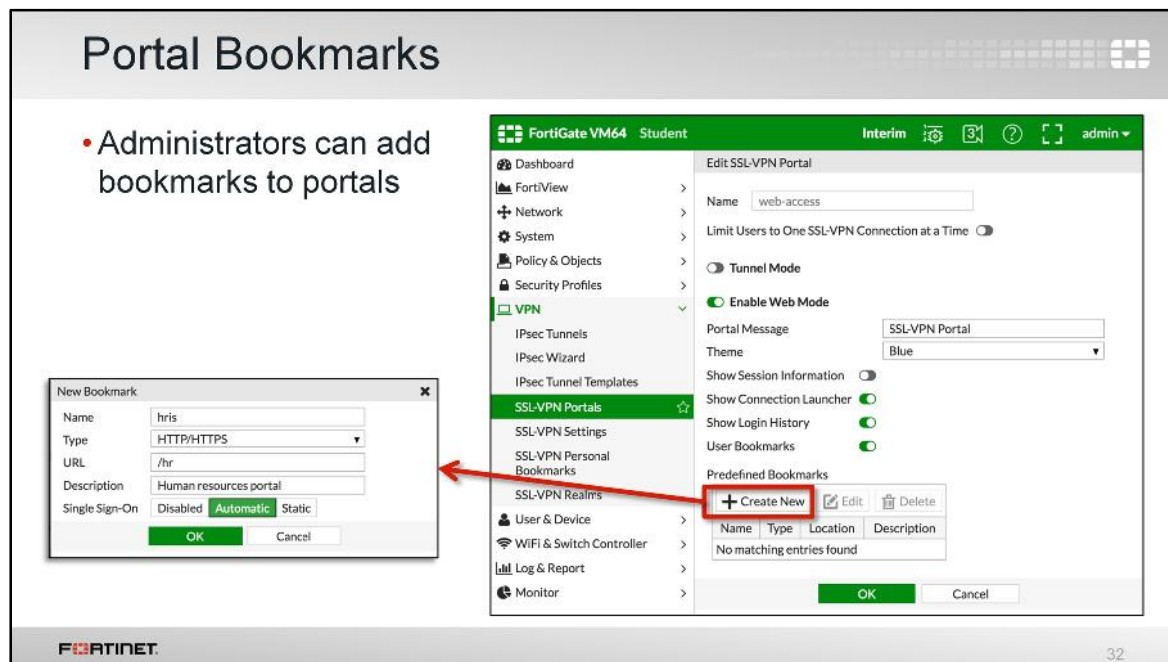
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When users log into their individual portal, there is an option that allows them to create their own bookmarks. An administrator must enable the **User Bookmarks** option on the **SSL-VPN Portal** page to allow this.

Administrators can view and delete user-added bookmarks through the **SSL-VPN Personal Bookmarks** page. This allows administrators to monitor and remove any unwanted bookmarks that do not meet with corporate policy.

**Note:** If **SSL-VPN Personal Bookmarks** does not appear as a menu option, you can enable it on the **Feature Select** page.






Instead of just adding bookmarks for individual users, administrators can also add bookmarks for everyone that uses each portal. This allows bookmarks to appear for all users who log in to that particular portal. These bookmarks use the exact same configuration options that personal bookmarks do, but can be configured from the GUI, rather than the CLI. Users cannot modify administrator-added bookmarks, whether you have created them on a per-user or per-portal basis.




In this section, you will learn how you can use additional options to restrict users connecting to SSL VPN, which helps to ensure your internal network is secure and can limit the possibility of attacks and viruses entering the network from an outside source.

## Better SSL VPN Security

- Client integrity check
- Restrict addresses where clients can connect from
- Require client certificates
- Two-factor authentication
- FortiClient





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Since SSL VPNs are methods for people outside your network to connect to resources inside your network, you must take appropriate measures to ensure the safety and security of the information in your network. There are multiple options and settings available to help secure SSL VPN access.

In the following slides, we'll cover client integrity checking and restricting host connection addresses.

## Securing Access: Client Integrity Checking

- SSL VPN gateway checks client
  - Requires Microsoft Windows
- Detects client security applications recognized by the Windows Security Center (antivirus and firewall)
- Checks status of applications through Globally Unique Identifiers (GUID) (Custom Host Checks)
- Determines the state of the applications (active/inactive, current version number, and signature updates)

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When a user connects to your network through SSL VPN, a portal is established between your network and the user PC. The VPN session is secured natively in two ways: the connection is encrypted and the user must log in with their credentials, such as a user name and password. However, you can configure additional security checks to increase the security of the connection.

One method of increasing your security is through client integrity checking. Client integrity ensures that the connecting computer is secure by checking whether specific security software, such as antivirus or firewall software, is installed and running. This feature only supports Microsoft Windows clients, as it accesses the Windows Security Center to perform its checks. Alternatively, you can customize this feature to check the status of other applications by using their Globally Unique Identifier (GUID). The GUID is a unique ID in the Windows Configuration Registry that identifies each Windows application. Client integrity can also check the current software and signature versions for the antivirus and firewall applications.

## Client Integrity Check: Configuration

- External vendor software ensures client integrity
- Checks if required software is installed on client
  - If not, FortiGate rejects SSL VPN connection attempt
- CLI-only configuration:

```
config vpn ssl web portal
    edit <portal_name>
        set host-check {none|av|fw|av-fw|custom}
        set host-check-interval <seconds>
    end
config vpn ssl web host-check-software
    show
```

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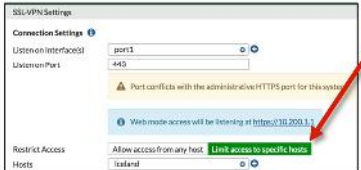
The client integrity check is performed while the VPN is still establishing, just after user authentication has finished. If the required software is not running on the client's PC, the VPN connection attempt is rejected, even with valid user credentials. Client integrity is enabled per web portal and only by using CLI commands.

The list of recognized software, along with the associated registry key value is available through the CLI. Software is split into three categories: antivirus (av), firewall (fw), and custom. Custom is used for customized or proprietary software that an organization may require. Administrators can only configure these settings through the CLI.

The disadvantage of enabling client integrity checking is that it can result in a lot of administrative overhead. First, all users must have their security software updated in order to successfully establish a connection. Second, software updates can result in a change to the registry key values, which can also prevent a user from successfully connecting. As such, administrators must have in-depth knowledge of the Windows operating system and subsequent registry behavior in order to properly make extended use of, as well as maintain, this feature.

## Securing Access: Restricting Host IPs

- Default set to specific hosts but empty
- To *allow* only specific hosts, specify IPs
- To *exclude* specific hosts, inverse the IP list through the CLI

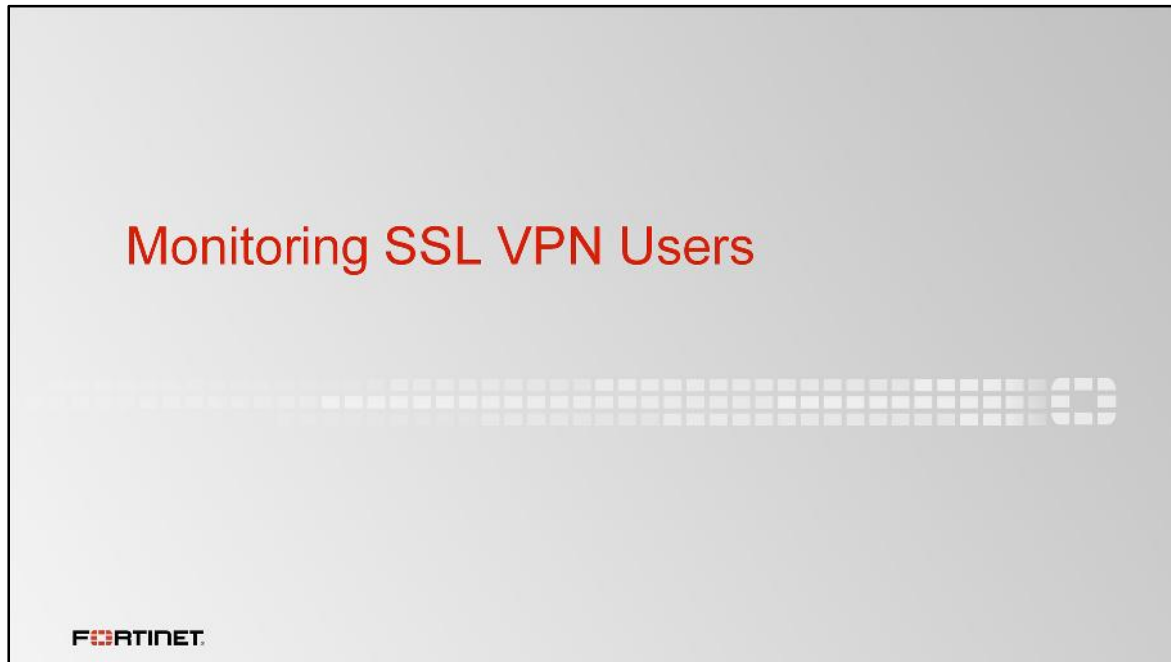


```
config vpn ssl setting
    set source-address-negate
    [enable|disable]
    set source-address6-
    negate [enable|disable]
end
```

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The second method you can use to help secure SSL VPN access is restricting host connection addresses. Setting up IP restriction rules can be very useful when considering proper security configuration. Not all IPs need, or should be allowed, access to the login page. This method allows you to set up rules to restrict access from specific IPs. One simple rule is to allow or disallow traffic based on geographic IP addresses. From the CLI, you can configure the VPN SSL setting to disallow specific IPs.

The default configuration is set to **Limit access to specific hosts** but the **Hosts** field is empty. You must specify the IP address or network in the **Hosts** field. This will allow only those users to access the login page. The **Allow access from any host** setting allows all IPs to connect.



In this section, we'll examine how to monitor SSL VPN users.

## Monitoring SSL VPN Sessions

• **Monitor > SSL-VPN Monitor**

Right click to terminate active SSL VPN session

Username	Last Login	Remote Host	Active Connections
Student2	Jul 12 11:31:29 2016	10.200.3.1	Tunnel: 10.212.134.200
Student	Tue Jul 12 11:31:55 2016	10.150.150.1	

Web-only user

Tunnel mode shows SSL VPN IP address assigned during the session

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You can monitor which SSL VPN users are connected from the **SSL-VPN Monitor** page. This shows the names of all SSL VPN users that are currently connected to the FortiGate, their IP addresses (both inside the tunnel and outside), and connection times.

When a user connects using tunnel model, the **Active Connections** column shows the IP address assigned by FortiGate to the fortissl virtual adapter on the client's computer. Otherwise, the user is connected only to the web portal page.



## SSL VPN Authentication Session vs. Idle Timeout

- Firewall policy authentication session is associated with SSL VPN tunnel session
- Forces expiration of firewall policy authentication session when associated SSL VPN tunnel session has ended
  - Prevents reuse of authenticated SSL VPN firewall policies (not yet expired) by a different user after the initial user terminates the SSL VPN tunnel session
- SSL VPN authentication is not subject to the firewall authentication timeout setting
  - Separate idle setting for SSL VPN

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When an SSL VPN is disconnected, either by the user or through the SSL VPN idle setting, all associated sessions in the FortiGate session table are deleted. This prevents reuse of authenticated SSL VPN sessions (not yet expired) after the initial user terminates the tunnel.

The SSL VPN user idle setting is not associated with the firewall authentication timeout setting. It is a separate idle option specifically for SSL VPN users. A remote user is considered idle when FortiGate does not see any packets or activity from the user within the configured timeout period.

## Review

- ✓ The differences between SSL VPN and IPsec VPN
- ✓ Methods of connecting to SSL VPN tunnels
  - ✓ Web-only mode vs. tunnel mode (including split-tunneling) vs. port forwarding
- ✓ Configuring SSL VPN
  - ✓ Portals, bookmarks, and realms
- ✓ Securing SSL VPN clients
  - ✓ Two-factor authentication
  - ✓ Restricting host connection access
  - ✓ Client integrity checks
- ✓ Monitoring SSL VPN users

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In this lesson, we discussed:

- What SSL VPN is and how it operates
- Differences between SSL VPN and IPsec VPN
- Web-only mode, tunnel mode (including split tunneling), and port forwarding
- Methods of connecting to SSL VPN tunnels
- Configuring SSL VPN, including portals, bookmarks, and realms
- Securing SSL VPN access through client integrity checking and restricting host connection access
- Monitoring SSL VPN users



In this lesson, we will show you how to set up a site-to-site IPsec VPN.

VPNs are heavily used in today's IT infrastructure to join private corporate networks across the Internet. IPsec is an RFC standard. So, whether you have FortiGate devices only or mix in another vendor's devices, the principles are essentially the same.

## Objectives

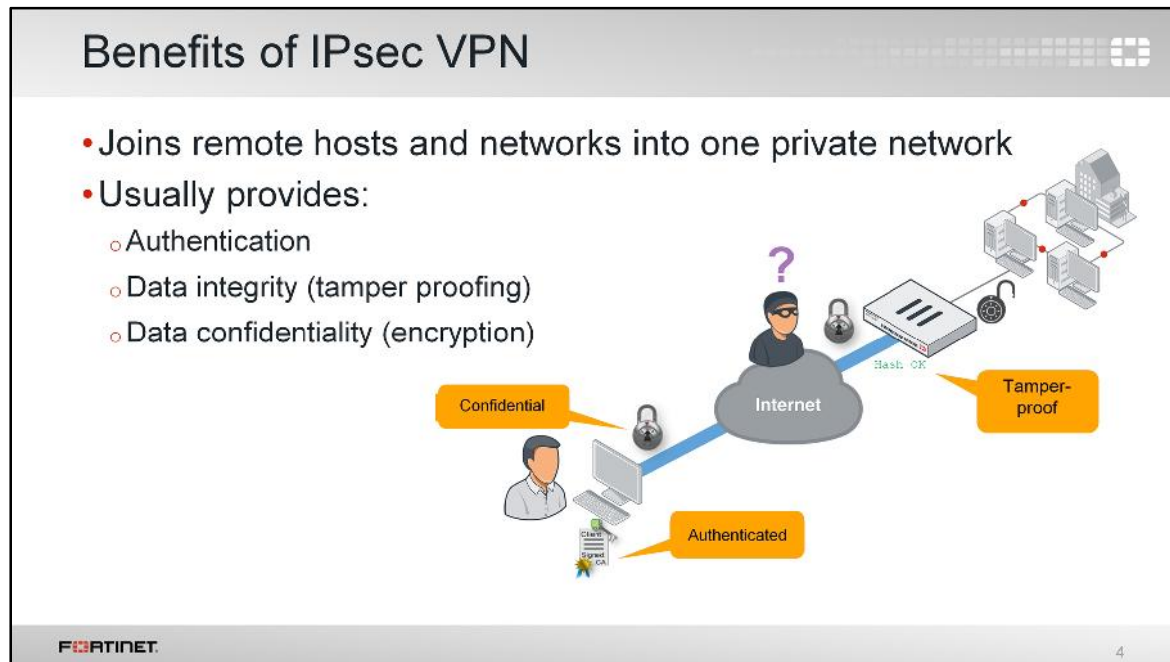
- Define the architectural components of IPsec VPN
- Identify the phases of Internet Key Exchange (IKEv1)
- Compare route-based vs. policy-based configuration modes
- Deploy a site-to-site VPN between two FortiGates
- Monitor VPN tunnels



After completing this lesson, you should have the practical skills that you need to set up a simple IPsec tunnel between two locations. You will learn how to choose between configuring a policy-based or route-based VPN as well as how to verify the status of each tunnel.



First, let's take a look at some basic IPsec concepts.



What is IPsec? When should you use it?

IPsec is a vendor-neutral standard set of protocols used to join two physically distinct LANs. The LANs are joined as if they were a single logical network, despite being separated by the Internet.

In theory, IPsec *does* support null encryption – that is, you can make VPNs that don't encrypt traffic. IPsec also supports null data integrity. But does that provide any advantages over plain traffic? No. No one can trust traffic that may have had an attack injected by an attacker. Rarely do people want data sent by an unknown person. Most people also want private network data, such as credit card transactions and medical records, to remain private.

So, in reality, regardless of vendor, IPsec VPNs almost always have settings for three important benefits:

- Authentication, to verify the identity of both ends,
- Data integrity, or HMAC, to prove that encapsulated data has not been tampered with as it traverses a potentially hostile network, and
- Confidentiality, or encryption, to ensure that only the intended recipient can read the message.

## What is the IPsec Protocol?

- Actually multiple protocols that work together
  - AH provides integrity but not encryption. So although it's defined in RFC, it is *not* used by FortiGate
- Port numbers/encapsulation varies by NAT

Protocol	NAT	No NAT
IKE RFC 2409 (IKEv1) RFC 4306 (IKEv2)	IP protocol 17: UDP port 500 (UDP 4500 for rekey, quick mode, mode-cfg)	IP protocol 17: UDP port 500
ESP RFC 4303	IP protocol 17: UDP port 4500	IP protocol 50

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If you're passing your VPN through firewalls, it helps to know which protocols to allow.

Really, IPsec is a suite of separate protocols. It includes:

- Internet Key Exchange (IKE): IKE is used to authenticate peers, exchange keys, and negotiate the encryption and checksums that will be used; essentially, it is the *control channel*
- Authentication Header (AH): AH contains the authentication header – the checksums that verify the integrity of the data
- Encapsulation Security Payload (ESP): ESP is the encapsulated security payload – the encrypted payload, essentially, the *data channel*


So, if you need to pass IPsec traffic through a firewall, remember: allowing just one protocol or port number is usually not enough.

Note that the IPsec RFC mentions AH. However, AH does not offer encryption, an important benefit. So it is not used by FortiGate. As a result, you don't need to allow IP protocol 51.

To make a VPN, you must configure matching settings on both ends – whether the VPN is between two FortiGates, a FortiGate and FortiClient, or a third-party device and a FortiGate. If the settings don't match, tunnel setup will fail.

## How Does IPsec Work?

- **Encapsulation**
  - Other protocols wrapped inside IPsec
  - What's inside? Varies by mode
    - Transport mode – TCP/UDP
    - Tunnel mode – Additional IP layer, *then* TCP/UDP
- **Negotiation** like SSL/TLS
  - Authentication
  - Handshake to exchange keys, settings



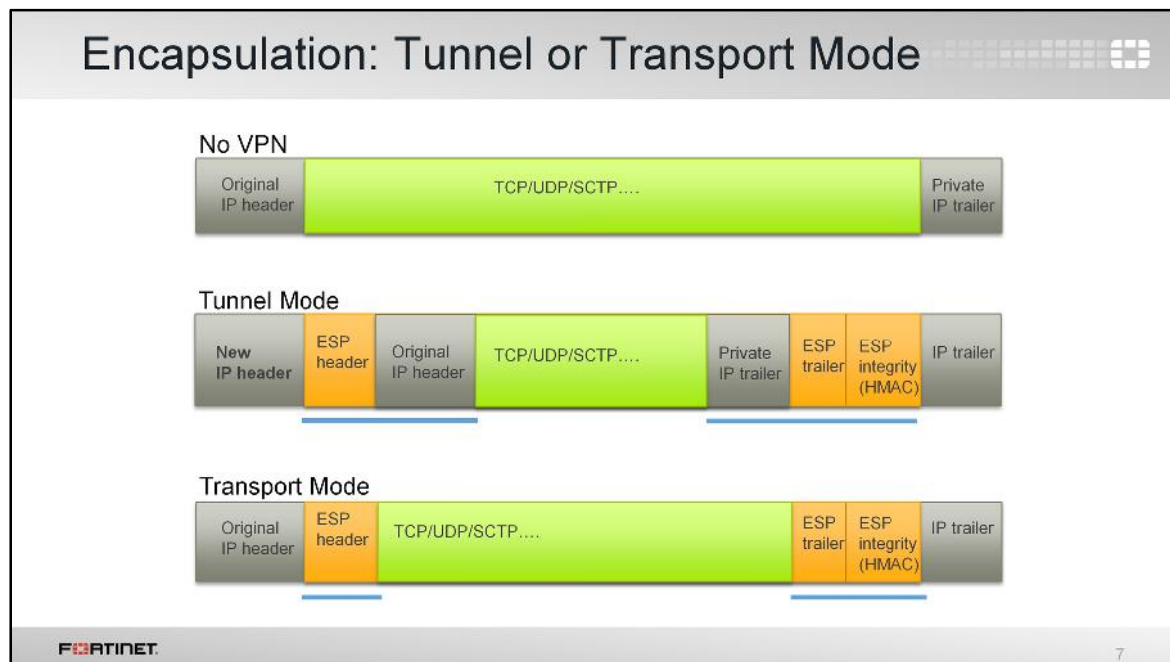
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IPsec provides services at the IP (network) layer. During the tunnel establishment, both ends negotiate the encryption and authentication algorithms to use.

After the tunnel has been negotiated and is up, data is encrypted and encapsulated into ESP packets.





What's encapsulated? It depends on the mode. IPsec can operate in two modes: transport mode, or tunnel mode.

- Transport mode directly encapsulates and protects the fourth layer (transport) and above. The original IP header is not protected and no additional IP header is added.
- Tunnel mode is a true tunnel. The whole IP packet is encapsulated and a new IP header is added at the beginning. Once the IPsec packet reaches the remote LAN, and is unwrapped, the original packet can continue on its journey.

Notice that after you remove the VPN-related headers, a transport mode packet can't be transmitted any further; it has no second IP header inside, so it's not routable. For that reason, this mode is usually used only for end-to-end (or client-to-client) VPNs.

## Negotiation: Security Association (SA)

- IKE allows the parties involved in a transaction to set up their security associations (SAs)
  - SAs are the basis for building security functions into IPsec
  - In normal two-way traffic the exchange is secured by a pair of SAs
  - IPsec administrators decide the encryption and authentication algorithms that can be used in the exchange
- IKE uses two distinct phases:
  - Phase 1
  - Phase 2

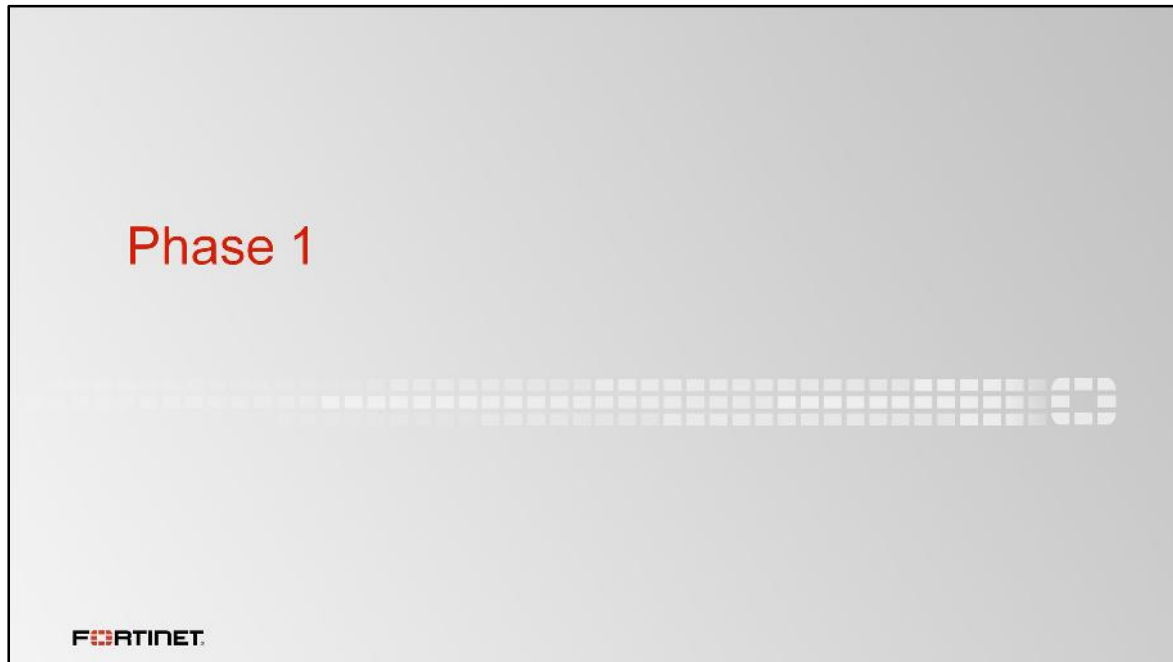
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In order to create an IPsec tunnel, both devices must establish their security associations (SAs) and secret keys, which are facilitated by the IKE protocol.

The IPsec architecture uses SAs as the basis for building security functions into IPsec. A SA is simply the bundle of algorithms and parameters being used to encrypt and authenticate data travelling through the tunnel. In normal two-way traffic, this exchange is secured by a pair of SAs, one for each traffic direction. Essentially, both sides of the tunnel must agree on the security rules. If both sides cannot agree on the rules for sending data and verifying each other's identity, then the tunnel will not be established.


IKE uses two distinct phases: phase 1 and phase 2.



How does FortiGate bring up a VPN? Let's begin by talking about IKE phase 1.

## Phase 1 Overview

- Each endpoint of the tunnel – the initiator and the responder – connects and begins to set up the VPN
- On first connection, channel is not secure
  - Unencrypted keys can be intercepted
- To exchange sensitive private keys, both ends have to create a temporary secure channel
  - Will negotiate for real keys in the tunnel later




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Phase 1 is when each endpoint of the tunnel – the initiator and the responder – connects and begins to set up the VPN.


When they first connect, the channel is not secure yet. An attacker in the middle could intercept unencrypted keys. Neither end has a strong guarantee of the other's identity, so how can they exchange sensitive private keys?

They can't. First, both ends have to create a temporary secure channel. They'll use this to protect strong authentication and negotiate the real keys for the tunnel later.

## Phase 1—How it Works



1. **Authenticate peers**
  - Pre-shared key or digital signature
  - Extended authentication (XAuth)
2. **Negotiate one bidirectional SA (called IKE SA)**
  - In IKE v1, two possible ways:
    - Main mode: six packets exchanged
    - Aggressive mode: three packets exchanged
  - Not the same as final SAs later
  - **Temporary encrypted tunnel for DH**
3. **Diffie-Hellman exchange for secret keys**

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Let's look at how this works.


This is phase 1, where peers say hello and create an SA that defines a temporary secure channel. The SA is called the IKE SA and is bidirectional.

Settings must agree. Otherwise the phase 1 will fail. (Each side wouldn't be able to decrypt or authenticate traffic from the other.)

At the end of phase 1, the negotiated IKE SA is used to negotiate the Diffie-Hellman keys that will be used in phase 2.

## Diffie-Hellman

- Key agreement method
  - Peers communicate over an unsecure channel
  - Independently calculate a private key using only public keys
- Each FortiGate uses shared secret key + nonce to calculate keys for:
  - Symmetric encryption algorithms (such as 3DES, AES)
  - Symmetric authentication (HMACs)



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Diffie-Hellman uses the public key (that both ends know) plus a mathematical factor called a nonce in order to generate a common private key.

This is crucial. With Diffie-Hellman, even if an attacker can listen in to the messages containing the public keys, they cannot determine the secret key.

The new private key is used to calculate additional keys for symmetric encryption and authentication.

## NAT Traversal (NAT-T)

- ESP can't support NAT as it has no port numbers
- If NAT-T is set to **Enable**, it detects if NAT devices exist on the path
  - If yes, ESP is encapsulated over **UDP 4500**
  - Recommended if initiator / responder is behind NAT
- If NAT-T is set to **Forced**:
  - ESP is always encapsulated over UDP, even when there are no NAT devices on the path



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The ESP protocol usually has problems crossing devices doing NAT. One of the reasons is that ESP does not have port numbers, like TCP and UDP do, to differentiate traffic from one tunnel to another.

To solve this, NAT transversal (NAT-T) was added to the IPsec specifications. When NAT-T is enabled on both ends, peers can detect any NAT device along the path. If NAT is found, then:

- Both phase 2 and remaining phase 1 packets change to UDP port 4500
- Both ends encapsulate ESP within UDP port 4500

So, if you have two FortiGates that are behind, for example, an ISP modem that has NAT, you will probably need to enable this setting.

When NAT-T is set to **Forced**, UDP port 4500 is always used, even when there is no NAT device along the path.




Once details such as NAT-T and symmetric keys have been determined, your FortiGate is ready to establish the final SAs that define the ESP channel.

It does this through IKE phase 2.




## Phase 2—How it Works



1. Negotiates two unidirectional SAs for ESP (called IPsec SAs)
  - Protected by phase IKE SA
2. When SAs are about to expire, renegotiates
  - Optionally **Perfect Forward Secrecy (PFS)** forces the use of Diffie-Hellman to generate new keys each time the phase 2 expires

- Each phase 1 can have multiple phase 2s
  - High security subnets can have stronger ESP

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Once phase 1 has established a somewhat secure channel and private keys, phase 2 begins.

Phase 2 negotiates security parameters for two IPsec SAs – not to be confused with the IKE SA. They are the phase 2 SAs – not the phase 1 SA – that ESP uses to transmit data between LANs.


IKE phase 2 does not end once ESP begins. Phase 2 periodically renegotiates cryptography. This maintains security. Also, if you enable perfect forward secrecy, each time phase 2 expires, FortiGate will use Diffie-Hellman to recalculate new secret keys. In this way, new keys are not derived from older keys, making it much harder for an attacker to crack the tunnel.

Each phase 1 can have multiple phase 2s. When would this happen?

For example, you may want to use different encryption keys for each subnet whose traffic is crossing the tunnel. How does FortiGate select which phase 2 to use? By checking which quick mode selector the traffic matches.

## Quick Mode Selectors

- If multiple phase 2s exist, directs traffic to the right phase 2
  - Allow granular security settings for each LAN
  - If traffic does not match an IPsec SA selector, it is dropped
  - In point-to-point VPNs, selectors must match
    - Source on one FortiGate is the destination setting on the other
- Select which SA to apply by:
  - Destination and source IP subnet(s)
  - Protocol number
  - Source port and destination port



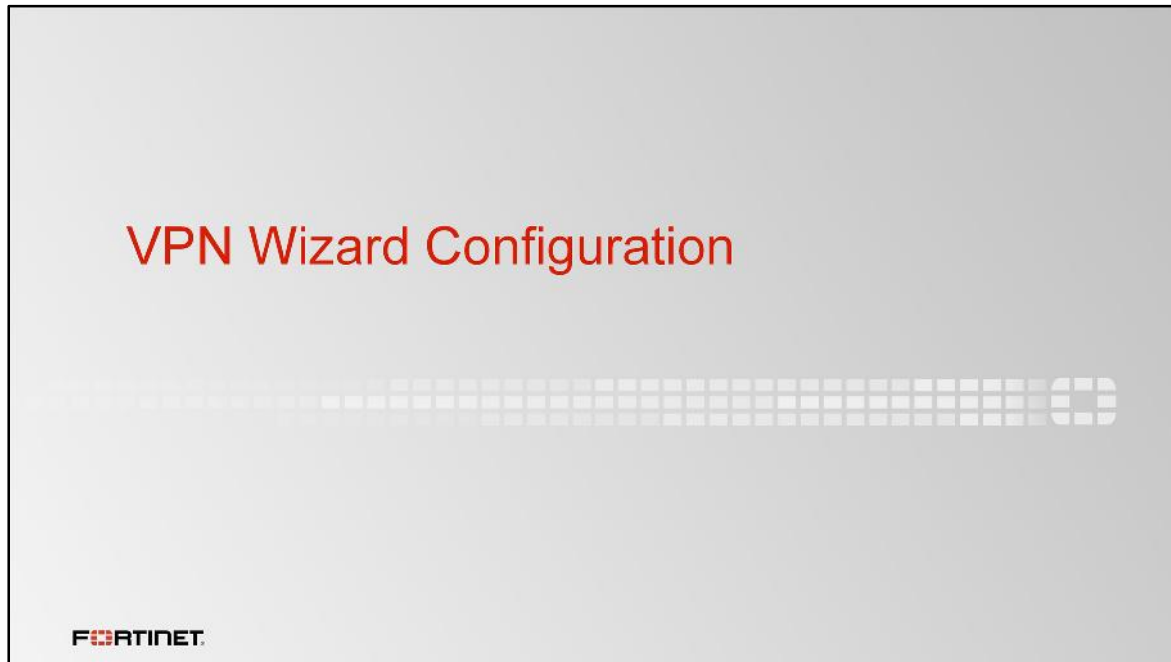
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During phase 2, we must configure a pair of settings called *quick mode selectors*. They identify and direct traffic to the appropriate phase 2. In other words, it allows granular SAs.

Selectors behave similarly to a firewall policy. VPN traffic must match selectors in one of the phase 2 SAs. If it does not, the traffic is dropped.

When configuring selectors, specify the source and destination IP subnet that will match each phase 2. You can also specify the protocol number and source and destination ports for the allowed traffic. In point-to-point VPNs, such as connecting a branch office FortiGate to a headquarter FortiGate, both sides' configuration must mirror each other.

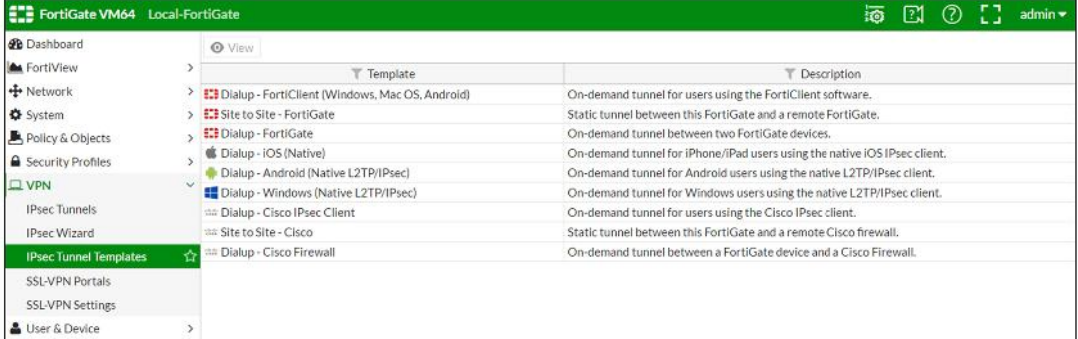
Quick mode selector configuration for dial-up VPNs is different, and details are covered in the *Advanced IPsec* lesson.



Let's talk about how to configure IPsec tunnels using the VPN wizard.

## IPsec VPN Templates

- Defaults for VPN:



Template	Description
Dialup - FortiClient (Windows, Mac OS, Android)	On-demand tunnel for users using the FortiClient software.
Site to Site - FortiGate	Static tunnel between this FortiGate and a remote FortiGate.
Dialup - FortiGate	On-demand tunnel between two FortiGate devices.
Dialup - iOS (Native)	On-demand tunnel for iPhone/iPad users using the native iOS IPsec client.
Dialup - Android (Native L2TP/IPsec)	On-demand tunnel for Android users using the native L2TP/IPsec client.
Dialup - Windows (Native L2TP/IPsec)	On-demand tunnel for Windows users using the native L2TP/IPsec client.
Dialup - Cisco IPsec Client	On-demand tunnel for users using the Cisco IPsec client.
Site to Site - Cisco	Static tunnel between this FortiGate and a remote Cisco firewall.
Dialup - Cisco Firewall	On-demand tunnel between a FortiGate device and a Cisco Firewall.

Because encapsulation styles and other settings vary, and any mismatches cause VPNs to fail, starting with FortiOS 5.2, there are VPN templates.

You can use these templates to simplify VPN setup – reducing the guesswork about what settings are compatible between devices.

The VPN wizard uses these templates to make IPsec VPN creation easier for administrators.

## VPN Configuration Wizard

1. Choose template.
2. Define pre-shared key, gateway interface, and peer IP.
3. Define local and remote LANs.

The image shows three sequential screenshots of the Fortinet VPN Configuration Wizard, connected by red arrows indicating the flow of the process.

- Screenshot 1 (VPN Setup):** Shows the 'Name' field set to 'ToRemote', 'Template Type' set to 'Site to Site', 'Remote Device Type' set to 'FortiGate', and 'NAT Configuration' set to 'No NAT between sites'.
- Screenshot 2 (Authentication):** Shows the 'Remote Device' set to 'IP Address', 'IP Address' set to '10.200.3.1', 'Outgoing Interface' set to 'port1', 'Authentication Method' set to 'Pre-shared Key', and 'Pre-shared Key' set to '\*\*\*\*\*'.
- Screenshot 3 (Policy & Routing):** Shows the 'Local Interface' set to 'port3', 'Local Subnets' set to '10.0.10/24', and 'Remote Subnets' set to '10.0.20/24'.

Wizard adds the firewall policies and routes

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The VPN wizard is comprised of a three-step process. Administrators provide the VPN name, remote IP, authentication method, interfaces, and subnets.

When the VPN wizard is completed, it automatically creates many of the required objects:

- Addresses and address groups
- Static routes
- Policies
- Phase 1 and phase 2 settings



If you need detailed control of your VPN, such as for IKE version 2, you can still configure it manually.

Policy-based Compared to Route-based		
<ul style="list-style-type: none"><li>• Generally, route-based VPNs offer more:<ul style="list-style-type: none"><li>◦ Control</li><li>◦ Flexibility</li></ul></li></ul>		
Feature	Policy-based	Route-based
FortiGate operation mode	NAT and transparent	Only NAT
L2TP-over-IPsec	Yes	Yes
GRE-over-IPsec	No	Yes
Routing Protocols	No	Yes
Number of policies per VPN	One policy controls both traffic directions	2 policies usually – one for each direction

On FortiGate, there are two ways to manually configure an IPsec VPN. They define how to create the firewall policies for VPN traffic: route-based configuration and policy-based configuration. (In our old documentation, “route-based” used to be called “interface-based”.)


How do you know when to use policy-based or route-based?

Generally, try to use route-based. It offers more flexibility and control.

In comparison, transparent mode supports only policy-based VPNs.

## Policy-based Compared to Route-based

- **Route-based (interface-based)**
  - Traffic must be routed to IPsec virtual network interface
  - Usually two firewall policies with action **ACCEPT** required (one per direction)
- **Policy-based**
  - One firewall policy with action **IPSEC** required
  - Hidden in the GUI by default. To show:



The screenshot shows the FortiGate GUI's 'Feature Select' tab. On the left, a sidebar lists 'Cooperative Security Fabric', 'Advanced', 'Feature Select' (highlighted with a green bar and a star icon), and 'Certificates'. On the right, a list of features is shown with toggle switches and plus icons: 'Policy Learning' (checked), 'Policy-based IPsec VPN' (checked and highlighted with a red rectangle), 'SSL-VPN Personal Bookmark' (unchecked), and 'SSL-VPN Realms' (unchecked).

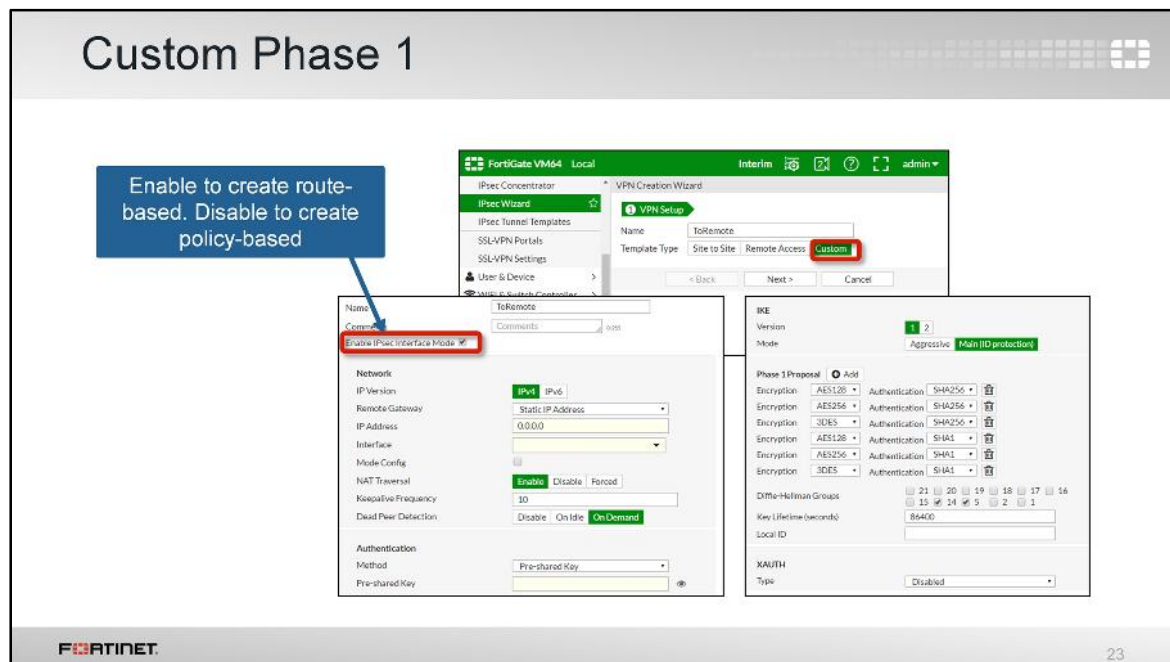
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How are the two configuration modes different?

- In a route-based configuration, FortiGate automatically adds a virtual interface with the VPN name. Two firewall policies with the action **ACCEPT** are usually required: one for sessions originating on the local network, and another for sessions from the remote network. You also need to route the VPN traffic to the virtual network interface. (Usually, you'll use static routes.) This is the type of VPN configuration created by the VPN wizard.
- In a policy-based configuration, only one firewall policy with the action **IPSEC** is usually required. The policy is bidirectional. By default, the GUI hides the policy-based configuration settings.

Both sides of your VPN don't need to be configured using the same mode. You can configure one peer as route-based and the other as policy-based. But the phase 1 and phase 2 settings must match.





If you are configuring a custom VPN, you can start from the wizard. Click **Custom** (no template).

Configure the remote FortiGate's WAN IP address, and indicate which network interface on this local FortiGate is the gateway that leads to it. FortiGate will use this to connect to the other end.

If your peers use pre-shared keys for the initial (IKE) authentication, both peers must be configured with the same pre-shared key. For phase 1, choose which encryption and authentication to propose, and so on. They must match, too. If peers can't agree on IKE security, even phase 1 won't be established.

## Custom Phase 2

Phase 2 Selectors	Local Address	Remote Address
Name		
ToRemote	0.0.0.0/0.0.0.0	0.0.0.0/0.0.0.0

New Phase 2

Name: ToRemote

Comments: Comments

Local Address: Subnet 0.0.0.0/0.0.0.0

Remote Address: Subnet 0.0.0.0/0.0.0.0

Advanced...

Phase 2 Proposal

Encryption	Authentication
AES128	SHA1
AES256	SHA1
3DES	SHA1
AES128	SHA256
AES256	SHA256
3DES	SHA256

Enable Replay Detection ☒

Enable Perfect Forward Secrecy (PFS) ☒

Diffie-Hellman Group

Local Port: All ☒

Remote Port: All ☒

Protocol: All ☒

Auto-negotiate ☐

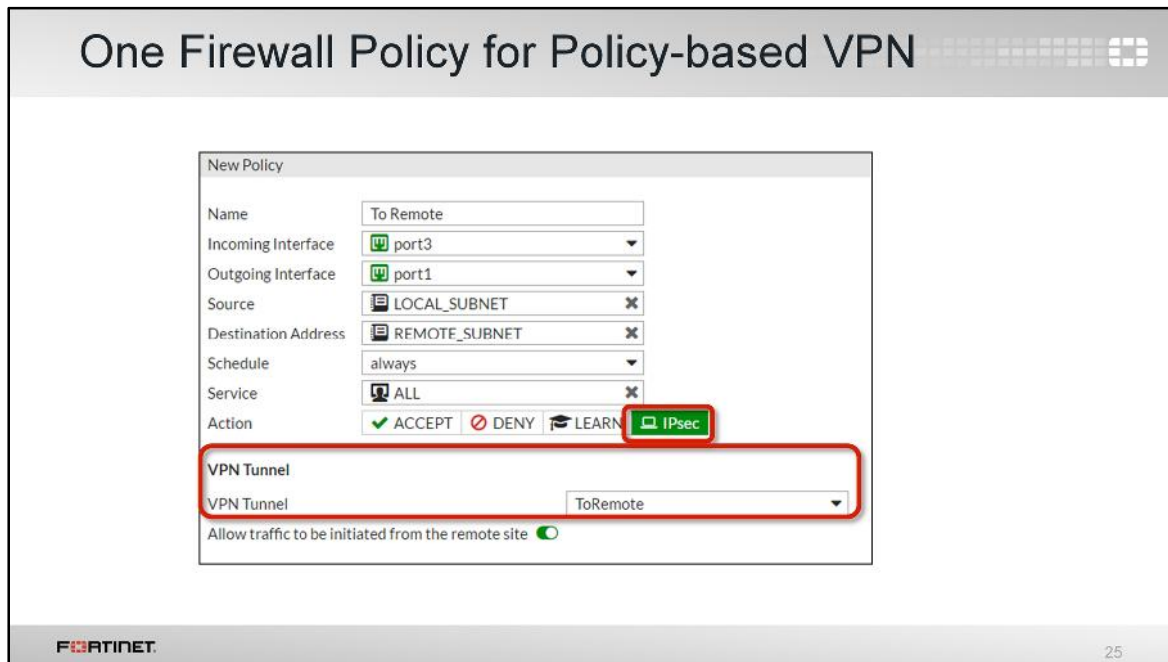
Autokey Keep Alive ☐

Key Lifetime: Seconds

Seconds: 43200

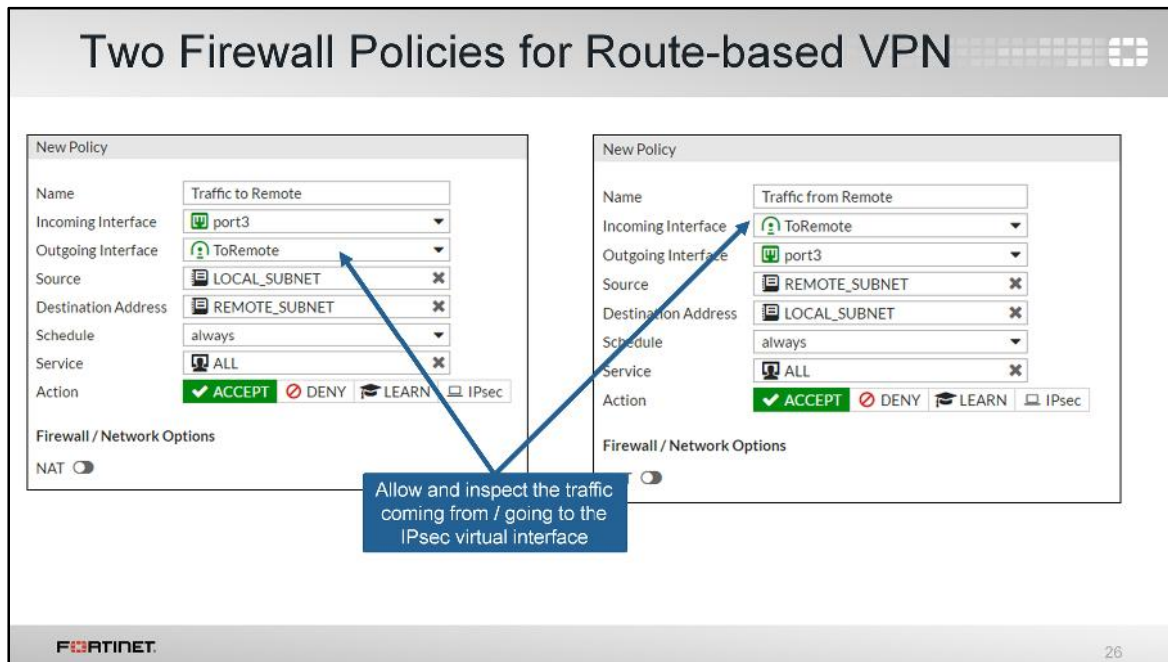
Once phase 1 completes, phase 2 begins. This sets up the ESP tunnels that will be used for actual data transfer. For each subnet on each end of the VPN, you can specify different levels of ESP security. For example, connections to the Finance LAN might need larger key sizes and stronger authentication. To do this, configure multiple phase 2 entries. For simplicity, here, we show only one phase 2: the **Local Address** is our LAN, and the **Remote Address** is the remote LAN.

Remember that if traffic doesn't match the quick mode selectors of any phase 2 SA, the IPsec engine will drop the packet. Usually, it's more intuitive to filter traffic with firewall policies. So if you don't want to use quick mode selector filtering, you can just create one phase 2 with the quick mode selectors set to 0.0.0.0/0.



If you used the wizard, it would have created routes and policies suitable for a route-based VPN. What if you, for example, have a FortiGate in transparent mode? Transparent mode only supports policy-based VPNs, which cannot be created with the wizard (the wizard only creates route-based VPNs.)

Remember, first, you must enable the GUI to show policy-based IPsec options. Configure your phases as before, then create a policy. When policy-based VPN settings are visible, an additional firewall policy **Action** setting is available. Choose **IPsec**. Then choose the policy-based VPN to use.



With a route-based VPN, firewall policies are different.

- There are two policies usually, not one.
- The interface doesn't match a WAN interface; it matches the virtual interface, which, in this example, is named **HQ-to-Branch**.

The VPN wizard is the easiest way to make these. If you did that, you can skip this step.

But if you want to manually set up a VPN, use these as examples.

### Custom: Routing Traffic (Route-based Only)

New Static Route

Destination ⓘ

Subnet Named Address Internet Service

10.0.2.0/24

Device

ToRemote

Administrative Distance ⓘ

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Comments

0/255

Status

Enabled Disabled

Advanced Options

Remote LAN subnet

IPsec virtual interface

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In route-based VPN, you also need to route VPN traffic destined for the remote LAN to the IPsec interface. If you used the wizard, this was created for you automatically.

To do this manually, usually you'll add a static route.

You usually do not need this step when configuring a policy-based VPN, as traffic that does not belong to any internal subnet is routed through the default gateway, which uses the WAN interface.

## IPsec VPN Monitor

- Monitor IPsec VPN tunnels
  - Stop and start tunnels
  - Display address, proxy IDs, timeout information

Name	Type	Remote Category	Username	Timeout	Incoming Data	Outgoing Data	Phase 2 Selectors	Proxy ID Destination	Proxy ID Source	Status
VPN To Remote 2	Site to Site - FortiGate	10.200.4.1		0			VPN To Remote 2	0:10.0.2.0/255.255.255.0	0:10.0.1.0/255.255.255.0	Down
VPN To Remote 1	Site to Site - FortiGate	10.200.3.1		43875	360 B	180 B	VPN To Remote 1	0:10.0.2.0/255.255.255.0	0:10.0.1.0/255.255.255.0	Up

Annotations:

- Phase 1 name (points to VPN To Remote 1)
- Key life remaining time (points to 43875)
- Local Quick Mode Selector (points to VPN To Remote 1)
- Remote Quick Mode Selector (points to 0:10.0.2.0/255.255.255.0)
- Status (points to Up/Down status)
- Start / stop the tunnel (points to Up/Down status)


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In the GUI, there is a tool to monitor the status of your IPsec VPNs. Through this tool, you can see how much traffic has passed through each tunnel. You can also start and stop individual tunnels, and get additional details.

If the tunnel is up, there will be a green arrow appearing next to its name. If it is down or not in use, then a red arrow is displayed.

## Review

- ✓ Benefits of VPN
- ✓ How IPsec VPN works
- ✓ IKE phase 1 and phase 2
- ✓ Policy-based and route-based configuration modes
- ✓ VPN configuration wizard
- ✓ Static point-to-point IPsec configuration
- ✓ Monitoring VPN tunnels

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To review, these are the topics we've talked about. We presented an overview of the IPsec technology, which includes phase 1, phase 2, Diffie-Hellman, and quick mode selectors. We also showed the difference between policy-based and route-based configuration modes, how to configure a point-to-point VPN, and how use the VPN monitor.



In this lesson, you will learn how to configure FortiGate to act as an explicit web proxy.

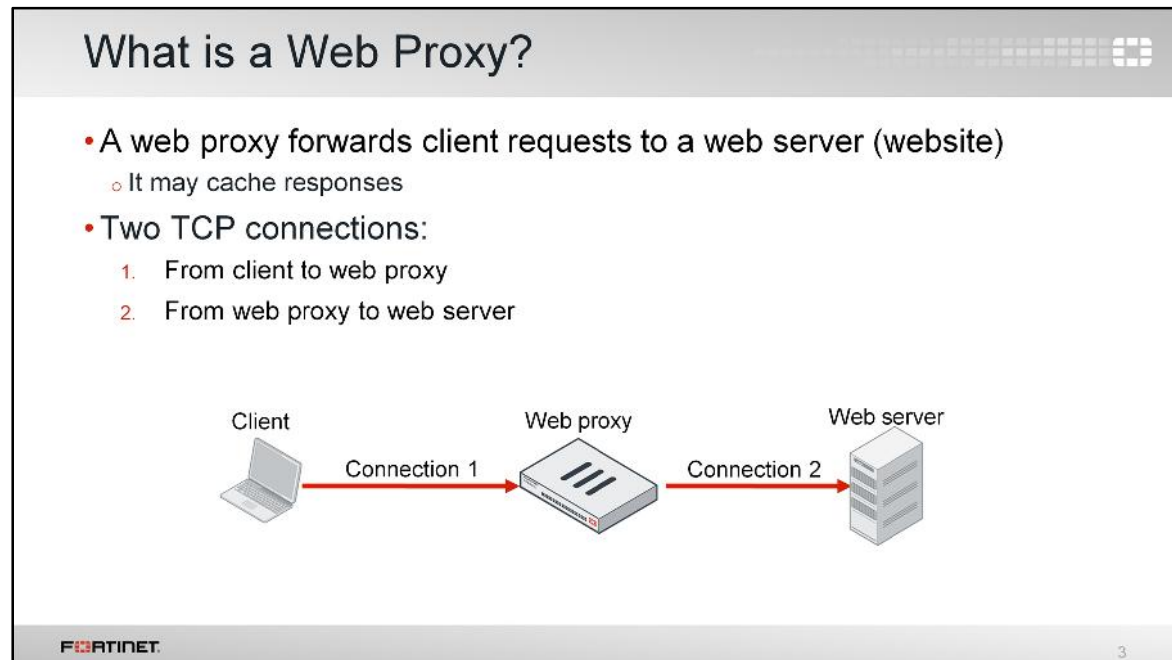


## Objectives

- Configure FortiGate to act as an explicit web proxy
- Use a PAC file and WPAD to configure explicit proxy settings in web browsers
- Reduce WAN bandwidth usage and improve responsiveness using web cache
- Apply security policies to web proxy traffic based on HTTP headers
- Authenticate and monitor explicit web proxy users

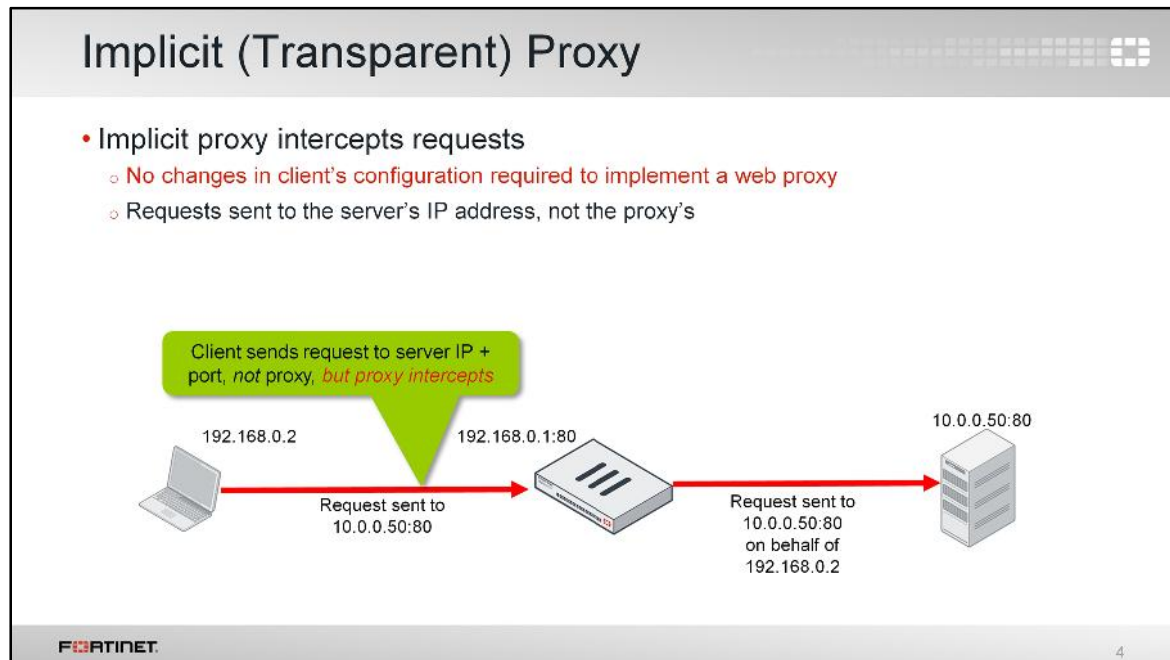


After completing this lesson, you will have the practical skills required to configure FortiGate to act as an explicit web proxy. This covers how to use a PAC file and WPAD to configure explicit proxy settings in web browsers, reduce WAN bandwidth using web cache, apply security policies to web proxy traffic based on the HTTP headers, and authenticate and monitor explicit web proxy users.



A web proxy receives or intercepts requests from a client to a server. If allowed, and if no cache is available, the web proxy forwards the client's request to the web server.

Two TCP connections are created: one from the client to the web proxy, and one from the web proxy to the server.

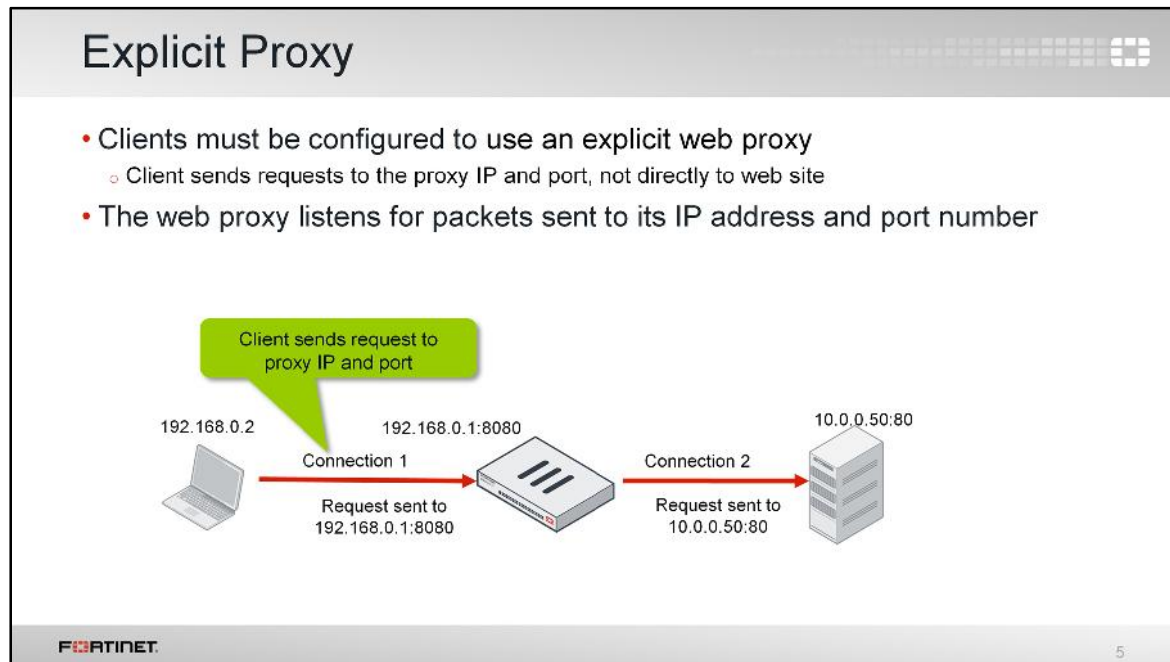


An implicit web proxy does not require any configuration changes to the client's configuration. Clients continue to use the web, just like they would without a web proxy.

Clients send requests to the web server's IP address and port number. The web proxy intercepts the client's requests transparently; that is, at the IP layer. The destination address doesn't change.

Does this mean that no configuration changes are required to use an implicit web proxy? Not necessarily.


In most network configurations, both incoming and outgoing traffic is routed through FortiGate. As a result, all web browsing traffic will be intercepted by the implicit web proxy. However, if a clients' traffic isn't configured to be routed through FortiGate, you must reconfigure routing so that the packets will be routed through FortiGate, where the implicit web proxy can intercept it.



How is an explicit web proxy different from an implicit web proxy? When you use explicit web proxy, you must configure clients to send the requests to the web proxy IP address and port number, not the website's servers.

## How to Configure Web Browsers for Explicit Proxy

- There are three methods for configuration:
  - Browser settings
  - Proxy automatic configuration (PAC) file
  - Web proxy auto-discovery protocol (WPAD)

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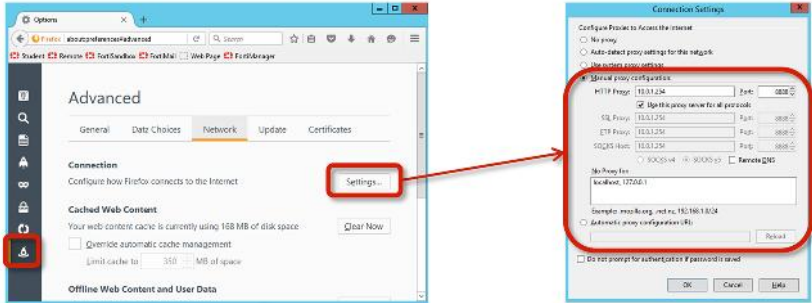
How do you configure users' web browsers to use an explicit web proxy?

One way is to set up the proxy IP address and port manually (browser settings). In large networks you can use an Active Directory login script or roaming profile, rather than configure each computer individually.

Alternatively, you can configure browsers to use explicit proxies by installing a PAC file, or using the web proxy auto-discovery protocol (WPAD).

## Browser Settings

- Configure web browsers settings with the proxy server IP address (or FQDN) and port number
- You can configure destinations to be exceptions from the web proxy
  - For these destinations, the browser does not send requests to the web proxy




The image shows two screenshots from a Firefox browser. The left screenshot shows the 'Advanced' settings tab with the 'Network' sub-tab selected. A red box highlights the 'Settings...' button in the 'Connection' section. The right screenshot shows the 'Connection Settings' dialog box. A red box highlights the 'Manual proxy configuration' section, which includes fields for 'HTTP Proxy', 'SOCKS Host', and 'SOCKS Port'. The 'HTTP Proxy' field is set to '10.1.1.254' and the 'SOCKS Port' field is set to '8080'. The 'SOCKS Host' field is set to '10.1.1.254' and the 'SOCKS Port' field is set to '8080'. The 'SOCKS Host' field is also set to '10.1.1.254' and the 'SOCKS Port' field is set to '8080'. The 'SOCKS Host' field is also set to '10.1.1.254' and the 'SOCKS Port' field is set to '8080'.

When you set up an explicit web proxy by configuring the web browser settings, you must provide the proxy's FQDN or IP address and TCP port number. You can specify *only* one proxy address at a time.

If you want to exempt specific destination IP addresses, subnets, and FQDNs from using the proxy, you can add them to a list. For those destinations, the browser will send the requests directly to the web servers.

## Proxy Automatic Configuration (PAC)

- Usually stored on the web proxy
- Defines how browsers choose a proxy
  - Supports for more than one proxy
  - Specifies which traffic will be sent to which proxy
- Configure each browser with the PAC file's URL
- By default, FortiGate can host the PAC file at:  
`http://<FortiGate_IP>:<Port>/proxy.pac`

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Another configuration method uses a standard explicit auto-configuration file, called a PAC file. A PAC file contains instructions that tell the browser when to use a proxy and which proxy to use, depending on the destination.

This configuration method supports the use of multiple web proxy servers.

To deploy the PAC file, first you must install it on an HTTP server that the clients can reach. (Your FortiGate can act as the HTTP server for the PAC file.) Then, you must configure all browsers with the PAC file's URL. In larger networks, you usually won't do this individually; instead, you will use your domain to define the PAC file's URL.

## PAC File Example

```
function FindProxyForURL(url, host) {  
    if (shExpMatch(url, "*.example.com/*")) {  
        return "DIRECT";  
    }  
    if (shExpMatch(url, "*.example.com:*/*")) {  
        return "DIRECT";  
    }  
    if (isInNet(host, "10.0.0.0", "255.255.255.0")) {  
        return "PROXY fastproxy.example.com:8080";  
    }  
    return "PROXY proxy.example.com:8080";  
}
```

Connections to any example.com subdomain don't use any proxy

Otherwise, all other traffic uses proxy.example.com:8080

Connections to 10.0.0.0/24 use fastproxy.example.com:8080

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What does a PAC file contain?

A PAC file is a JavaScript. It determines whether the request will be proxied, and what the addresses for the proxies are.


In this example:

- The PAC file allows any connection to `example.com` to bypass the proxies.
- Connections to servers in the `10.0.0.0/24` subnet use the proxy named `fastproxy.example.com`.
- All other requests are made through the proxy named `proxy.example.com`.



## Web Proxy Auto-discovery Protocol (WPAD)

- Browsers can use WPAD to locate the PAC file
- WPAD can use two discovery methods:
  - Dynamic host configuration protocol (DHCP) query
  - Domain name system (DNS) query
- Usually, browsers try DHCP method first
  - If DHCP method fails, browsers try DNS method
  - Some browsers only support DNS method

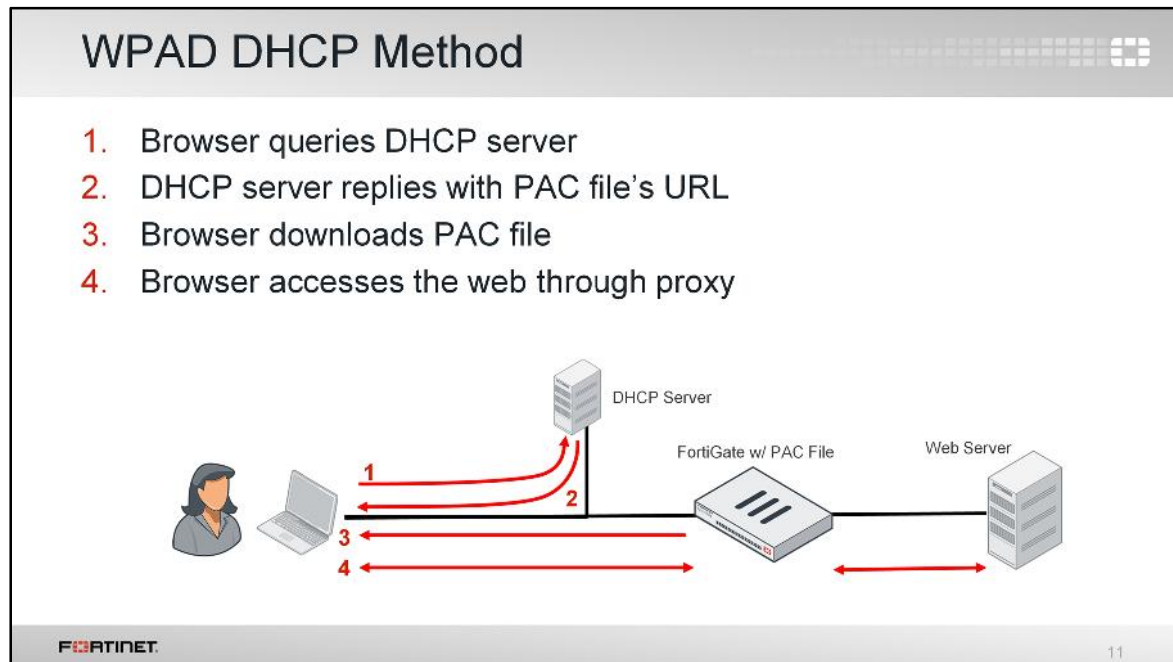


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Browsers use the web proxy auto-discovery protocol (WPAD) to determine the URL where the PAC file is located.

WPAD can use two discovery methods: DNS-based and DHCP-based.

Most browsers try the DHCP server method first. If it fails, they try the DNS server method.



(slide contains animation)

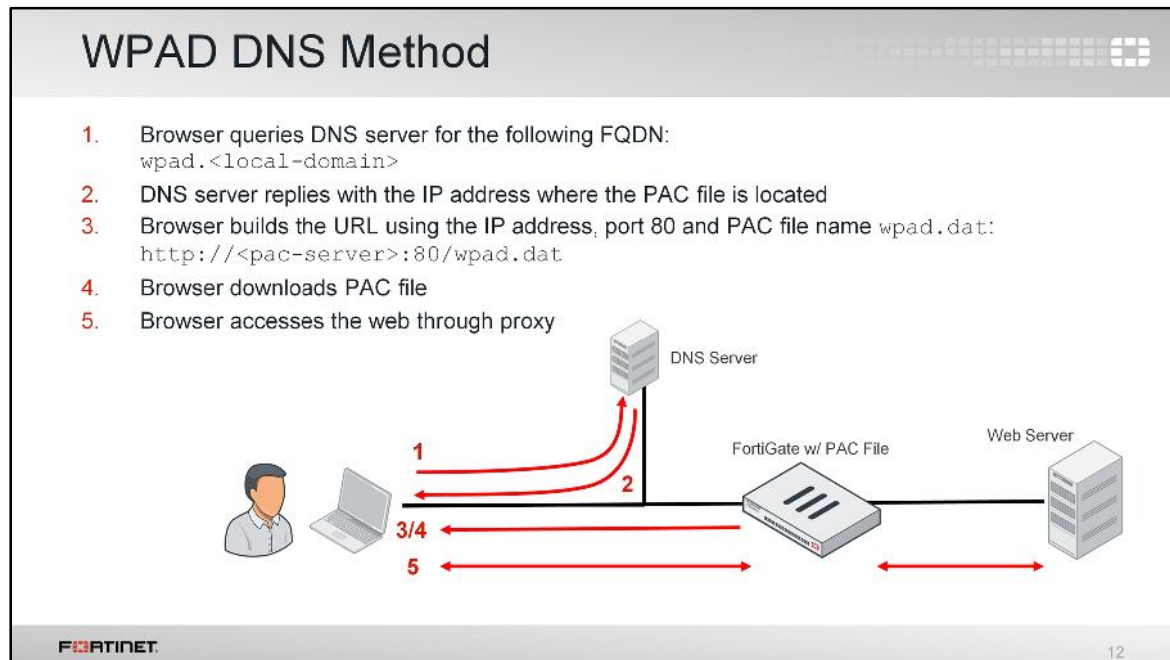
With the DHCP method, the browser sends a DHCPINFORM request to the DHCP server.

(click)

The DHCP server replies with the PAC file's URL.

(click)

The browser downloads the PAC file, and accesses the Internet through the proxy.



(slide contains animation)

The DNS method is very similar to the DHCP method. The differences are in the required PAC URL.

First, the browser queries the DNS server to resolve the FQDN `wpad.<local-domain>`.

(click)


The DNS server replies with the IP address of the web server where the PAC file is located. *This method always uses TCP port 80 and the PAC file name `wpad.dat`.*

(click)

The browser downloads the PAC file, then accesses the web through the proxies indicated in the PAC file.

## Proxy with Web Cache

- Proxy can provide caching
  - Support varies by model
- Upon first request, cache keeps a temporary copy of static web content
- Next requests for unchanged content receives cached copy
- Improves:
  - WAN bandwidth usage
  - Server load
  - Perceived responsiveness

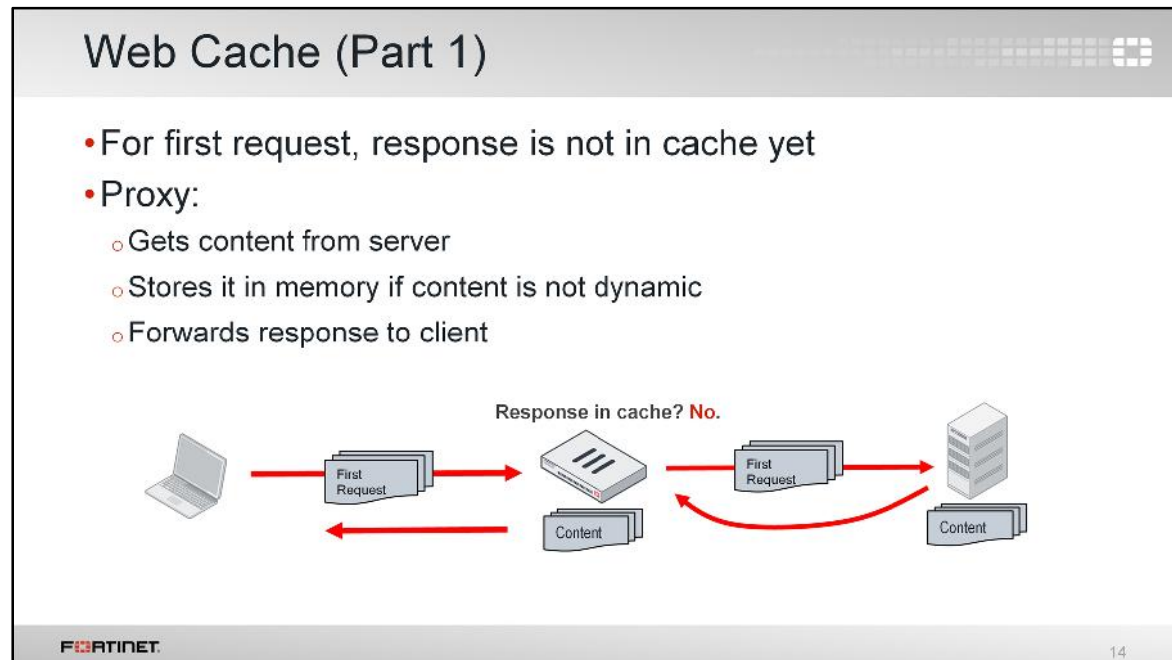


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Usually, you will enable the proxy to cache responses from web servers.

A web cache stores responses from web servers. So, when a client repeats a request, FortiGate can quickly send the cached content (response), instead of forwarding the request and waiting for the response. This reduces WAN bandwidth usage, server load, and delay.

Web cache is supported in both implicit and explicit web proxy modes.

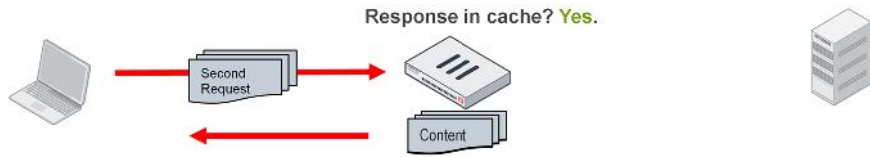


If you've enabled caching, when the client makes a request, the proxy checks first if the requested URL is already in memory.

If it is not, the proxy forwards the request to the server. When it responds, FortiGate stores the response in memory – that is, it adds content to its cache. Additionally, the proxy forwards a copy of the content to the client.

## Web Cache (Part 2)

- For later requests, response is usually already in cache
  - Proxy forwards a copy from cache to client
  - Does *not* download content from server again
  - Dynamic content is one exception, so proxy treats it like first request every time



Response in cache? **Yes.**

Second Request

Content

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What happens when a client repeats a request for a URL?

FortiGate will recognize that the URL has been requested before and forwards a copy of the content from the cache to the client. Unless the content on the server has changed, the proxy does not need to request it from the server again. From the client's perspective, each response after the initial request is faster.

Because dynamic URLs are not exactly the same, and their content may be personalized for each client, they are usually not cached.

## Explicit Web Proxy Authentication

- IP-based
  - **IP sessions** from same **source IP address** are treated as a single user
  - Not recommended if multiple users are behind source NAT
    - Internet access sharing, Citrix, terminal servers, and so on
- Session-based
  - **HTTP sessions** are treated as a single user
  - Can differentiate multiple clients behind the same source IP address
  - After authentication, browser stores user information in a **session cookie**
  - Each subsequent request contains the session cookie
  - Requires more resources



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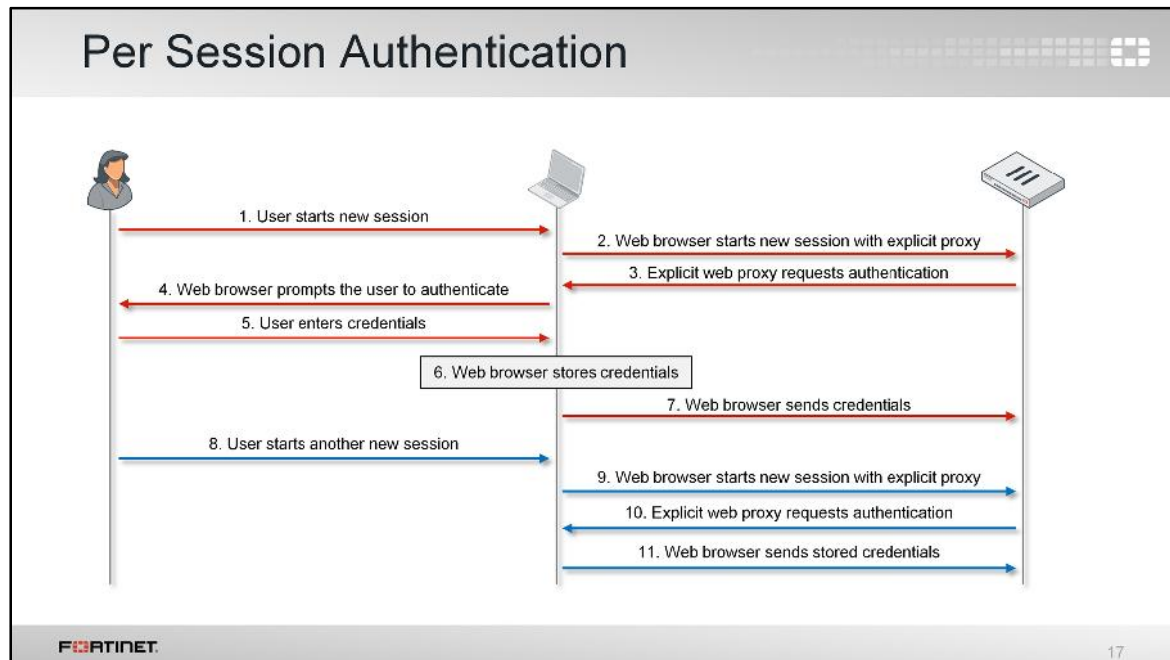
Given that caching consumes system resources, do you want all users to be able to use the cache?

You can configure FortiGate's HTTP proxy to allow access only to authenticated users that belong to specific user groups. Authentication can be based on either source IP address or HTTP session.

How should you decide which to use?

IP-based authentication requires less RAM to remember the authenticated sessions. However, it should only be used when each user has a different IP address (and there is no NAT device between them and the FortiGate).

If you have multiple users sharing the same IP address, such as in the case of users behind NAT, use HTTP session-based authentication instead. In this mode, each browser inserts an HTTP cookie in its requests. The cookie identifies the user. This method requires slightly more RAM because FortiGate must remember all session cookies.




What does the traffic flow look like when a user authenticates with the explicit proxy, using HTTP session-based authentication?

If a user connects and the request doesn't have any associated authentication session, FortiGate replies to the browser, requesting login credentials. The browser prompts the user to authenticate, and remembers the authenticated state by storing a cookie.


If the same user makes more requests later, the browser automatically sends the same cookie again. FortiGate identifies the user by this session cookie. The user does not need to authenticate for every request, only the first time.



## How to Configure Explicit Web Proxy



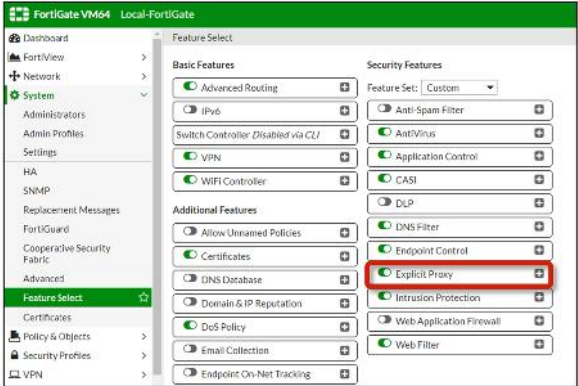
1. Enable explicit web proxy
2. Indicate which internal interfaces the explicit web proxy will listen on
3. Create explicit proxy policies to allow and inspect traffic
4. Configure each client's browsers to connect through the proxy

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These are the steps for configuring a FortiGate as an explicit web proxy. We will show the details of each step next.

## Showing Explicit Proxy Settings

- Explicit web proxy settings are hidden in GUI by default
  - **System > Feature Select**
  - Enable **Explicit Proxy**



The screenshot shows the FortiGate VM64 Local-FortiGate GUI. On the left is a navigation menu with 'System' expanded and 'Feature Select' selected. The main area is titled 'Feature Select' and contains two columns of features. Under 'Basic Features', 'Explicit Proxy' is listed and highlighted with a red box. Other features include Advanced Routing, IPv6, Switch Controller, VPN, and WFI Controller. Under 'Additional Features', there are options like Allow Unnamed Policies, Certificates, DNS Database, Domain & IP Reputation, DoS Policy, Email Collection, and Endpoint On-Net Tracking. On the right, 'Security Features' are listed, including Anti-Spam Filter, AntiVirus, Application Control, CASI, DLP, DNS Filter, Endpoint Control, Intrusion Protection, Web Application Firewall, and Web Filter. A 'Feature Set' dropdown is set to 'Custom'.

By default, the explicit web proxy settings are hidden in the GUI. To show them, enable **Explicit Proxy** on the **Feature Select** page.

## Enabling Web Proxy

Proxy listening TCP port

Enable for FortiGate to provide the PAC file

Edit the PAC file

Default action for proxy traffic that does not match any explicit proxy policy

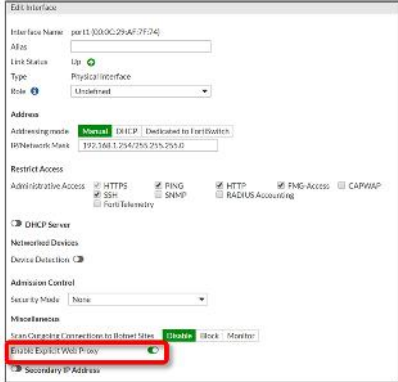
Once explicit proxy settings are visible in the GUI, you can enable and configure them.

You can configure the TCP port where the proxy is listening, edit and upload the PAC file, and choose the default action that FortiGate takes for traffic that doesn't match any explicit proxy policy.

We will talk about the explicit proxy policies later.

## Enabling Web Proxy in the Interfaces

- Specify which interfaces listen for connections to proxy

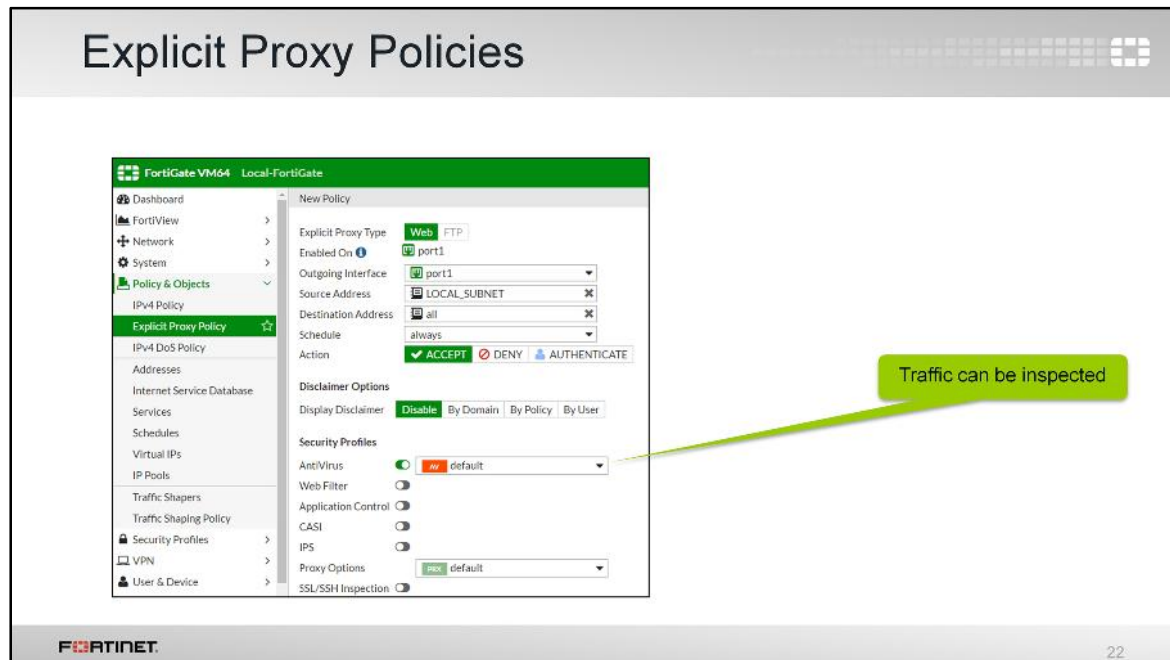


The screenshot shows the 'Edit Interface' configuration window for 'port1 (300C:29AF:7F74)'. The 'Address' section shows 'Virtual DHCP' and 'Destination to FortiGate'. The 'Restrict Access' section has checkboxes for 'HTTPS', 'SSH', 'PING', 'HTTP', 'PING-Access', and 'CAPWAP'. The 'Miscellaneous' section at the bottom has a checkbox for 'Explicit Web Proxy' which is checked and highlighted with a red box. Other options like 'DHCP Server', 'Networked Devices', 'Device Detection', 'Admission Control', and 'Security Mode' are also visible.

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After enabling the explicit web proxy globally, you must specify on which interfaces the proxy will listen for connections.



The next step is to create explicit proxy policies to specify which traffic and users are allowed to use the proxy. Policies for explicit proxy are configured in a different configuration section than the regular firewall policies.

Proxy traffic can be inspected: antivirus, web filtering, application control, IPS, DLP, and CASI inspections are available.

When the proxy traffic matches an explicit proxy policy, FortiGate takes one of three possible actions: accept the traffic, deny it, or request authentication before accepting it.

## Explicit Proxy Policies with Authentication

Explicit Proxy Type: Web, FTP

Enabled On: port1

Outgoing Interface: port1

Source Address: LOCAL\_SUBNET

Destination Address: all

Action: ☒ ACCEPT ☐ DENY ☒ AUTHENTICATE

User Authentication Options

Configure Authentication Rules

Schedule	Security Profiles	Log	Users	Groups	Display Disclaimer
always	UTM	<input checked="" type="checkbox"/>	UTM	training	Disable
always	UTM	<input checked="" type="checkbox"/>	UTM	Guest-group	Disable

IP Based Authentication: ☐

Default Authentication Method: Basic

Web Proxy Forwarding Server: ☐

Action is **Authenticate**

Create authentication rules


Guest-group supported

Select IP or session-based authentication

If you select **Authenticate** as the action, you will be presented with the option to add authentication rules. These rules specify which users and user groups are allowed, and what kind of inspection is applied to each of them.

## Explicit Proxy Policies with Authentication

- No fall-through, unlike the regular firewall policies
- Regardless of user authentication status, FortiGate uses the first policy that matches
- Doesn't evaluate other rules after first match

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Authentication for the explicit proxy behaves differently than it does for firewall policies.

With the explicit proxy, FortiGate will not *fall through* to try the next authentication rule. FortiGate always applies the first policy that matches all criteria. It doesn't evaluate any policy after the first match, even for users that have not authenticated yet.

### Example: Explicit Proxy Authentication

Seq.#	Source	Destination	Schedule	Action	Security Profiles	Log	Bytes
web proxy - port1 (1 - 2)							
1	10.0.1.0/24	all		✓ Authenticate			0 B
1.1	Students		always			UTM	
2	10.0.0.0/8	all	always	✓ Accept		UTM	0 B

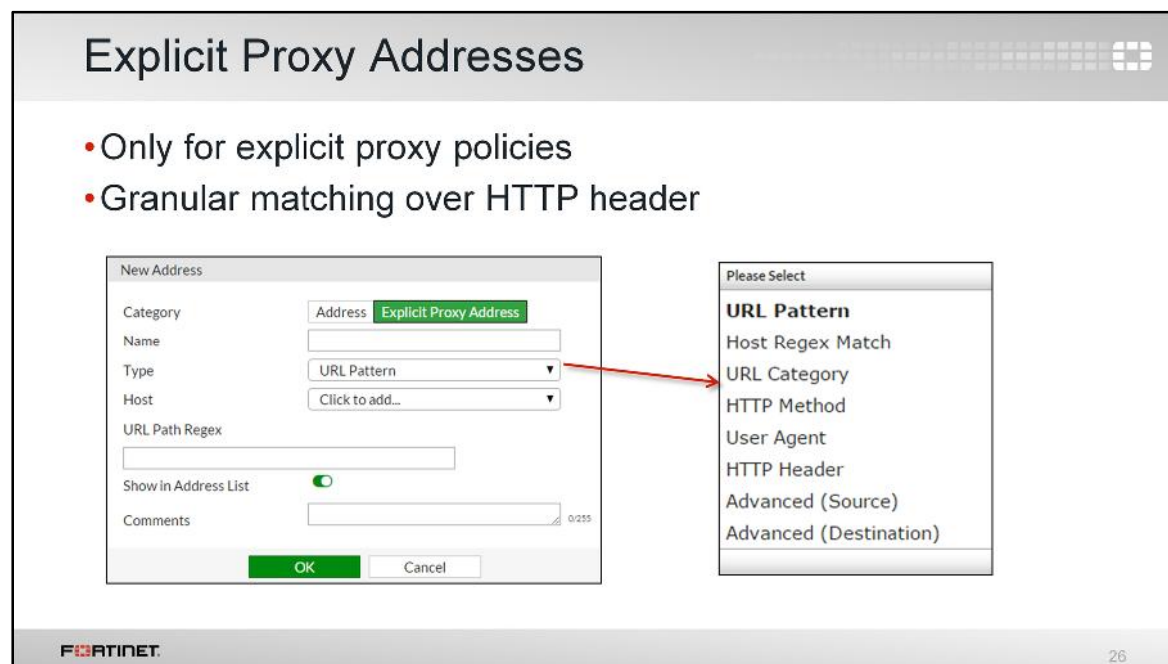
- Policy 2 allows unrestricted access from 10.0.0.0/24
- But users in 10.0.1.0/24 must *always* authenticate
  - Their traffic matches policy 1 first

In this example, the first proxy policy matches traffic from 10.0.1.0/24. It only allows users that belong to the user group **Students**.

The second policy allows traffic – without authentication – only if the source address matches 10.0.0.0/8.

With this configuration, if traffic arrives from the 10.0.1.0/24 subnet, and that user has not authenticated yet, then FortiGate prompts the user to authenticate. Traffic from that source IP address always matches the first policy, and FortiGate does not continue to evaluate other policies in the list after it finds a match. So, FortiGate never applies the second policy for that subnet – only for the rest of 10.0.0.0/8.





Like with firewall policies, when creating explicit proxy policies, you use firewall address objects to specify the source and destination. There is one category of address objects that are used only for explicit proxy: explicit proxy addresses.


Explicit proxy addresses offer more granularity when matching HTTP traffic. They can match HTTP traffic based on the content of any HTTP field.

For example, the HTTP headers include a field named Host, which usually contains the FQDN of the web server. With explicit proxy addresses, you can create policies that match the traffic based on this destination FQDN, regardless of the destination IP address.

Another example is matching by URL pattern. Explicit proxy addresses can match traffic to URLs that match a regex expression, regardless of the destination IP address.

## Explicit Proxy Address Types

- Destination address:
  - URL pattern
  - Host regex
  - URL category - URL filtering
  - Advanced (destination) - combines URL pattern and URL category
- Source address:
  - HTTP method
  - User agent
  - HTTP header field - specify the header name and matching value
  - Advanced (source) - combines the three above



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There are two groups of explicit proxy address types:

One group is for address types that are used as destination in explicit proxy policies. They can match URL patterns, URL categories, and HTTP host names.

The other group is for address types that are used as a source in explicit proxy policies. They can match HTTP methods, user agents, and other HTTP headers fields.

### Example: Explicit Proxy Address

- Deny HTTP file uploads to Fortinet web site:

web proxy - port1 (1 - 2)							
1	POST_From_Students	Fortinet	always	Deny	All	0 B	
2	all	all	always	Accept	UTM	0 B	

Category: Explicit Proxy Address

Name: POST\_From\_Students

Type: HTTP Method

Host: student\_internal

Request Method: POST

Show in Address List: ☒

Comments: 0/255

Category: Explicit Proxy Address

Name: Fortinet

Type: Host Regex Match

Host Regex Pattern: \*fortinet.com

Show in Address List: ☒

Comments: 0/255

OK Cancel

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In this example, the administrator created an explicit proxy policy to block any attempt from the **student\_internal** subnet to upload files to the Fortinet website. The administrator created two explicit proxy addresses for this purpose:

- The **POST\_From\_Students** address matches any HTTP POST request coming from the **student\_internal** subnet.
- The **Fortinet** address matches any web connection to a host name that contains the text string `fortinet.com`.

## WPAD DNS Method Configuration

- DNS method requires:
  - PAC file name `wpad.dat`
  - Download the PAC files using port 80
- So, change FortiGate default configuration, to comply with these requirements:

```
config web-proxy explicit
  set pac-file-server-status enable
  set pac-file-server-port 80
  set pac-file-name wpad.dat
end
```

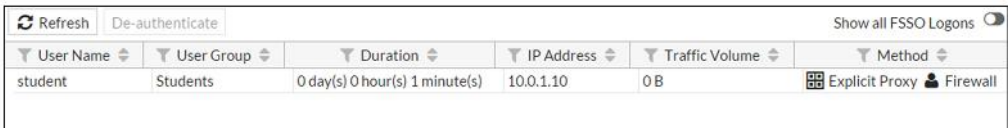
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If you are using the WPAD DNS method to configure the browser, you may need to edit the FortiGate configuration to change the default file name and listening port number.

As we explained before, the DNS method always assumes that the PAC file is located at `http://<FortiGate_IP_Address>:80/wpad.dat`.

So, if your clients use the DNS method, you must configure FortiGate to offer the PAC file named `wpad.dat`, and to listen for requests for it on port 80.

## Monitoring the Proxy Users

- From the GUI:  


User Name	User Group	Duration	IP Address	Traffic Volume	Method
student	Students	0 day(s) 0 hour(s) 1 minute(s)	10.0.1.10	0 B	Explicit Proxy Firewall
- From the CLI:

```
# diagnose wad user list
student 10.0.1.10 id:40 VD: root, duration: 18
```
- To remove all current proxy authentication sessions:


```
# diagnose wad user clear
```

Once the web proxy is working, you can monitor which users are connected to it – that is, the proxy's session table. You can do this from the GUI, or from the CLI by using the command:

```
diagnose wad user list
```

## Review

- ✓ What is an explicit web proxy?
- ✓ PAC file vs. web proxy auto-discovery protocol (WPAD)
- ✓ Web cache
- ✓ IP-based vs. session-based authentication
- ✓ Explicit web proxy configuration
- ✓ Explicit proxy addresses
- ✓ Monitoring explicit proxy users



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To review, these are the topics that we just talked about.

We discussed explicit web proxy concepts. We also showed how to configure and monitor a FortiGate that is acting as an explicit web proxy, and how to configure web browsers to use the proxy. Depending on your situation, we explained that some configuration choices require more RAM, or specific port numbers.



In this lesson, we will show you how to configure, use, and monitor antivirus scanning on a FortiGate.

Since antivirus scanning is one of the features that, depending on your configuration and chosen signature database, can use significant RAM, we will also show you how to resolve conserve mode.

## Objectives

- Categorize malware types and evasion techniques
- Detect and block malwares
  - Identify order of scan
- Update antivirus database through FortiGuard services
- Differences between FortiGate inspection modes
- Choose between proxy-based and flow-based antivirus scans
- Configure antivirus profile
- Search logs for antivirus events
- Check if FortiGate is in memory conserve mode





After completing this lesson, you should have these practical skills that you can use to configure antivirus and optimize memory usage on your FortiGate.



## What is Malware?

- A category of software that has a detrimental effect, such as gaining access to system, gathering sensitive information, corrupting the system or destroying data
- Viruses
  - Self-replicating code that installs copies of themselves into other programs
    - Often attached to an executable file
    - Does not require user consent, or tricks user into giving permission
    - Infects and spreads on its own
  - Small in size
- Grayware
  - Unwanted applications that are not classified as virus but can be annoying and may cause security risks
    - Spyware, Adware often bundled with shareware / free software
  - Size varies




3

Malicious software has evolved into many types. Although we often refer to all types of malicious software as *viruses*, not every piece of unwanted software behaves like a virus. Malware is not always self-replicating, and sometimes users willingly install it. To refer inclusively to viruses, worms, Trojans, spyware, and all others, we now use the term *malware*.

Malware can be divided into two major types:

- Viruses: Usually installed without user's consent and spread on their own from one computer to another, generally through an exploit without the user's knowledge.
- Grayware: May require some kind of user interaction. It convinces users that the benefit of installing it outweighs the cost, such as browser toolbars that also track the user's activity and insert ads into web pages.

Malware Types and Behavior	
Malware Types	Behaviour
<b>Trojans</b>	<ul style="list-style-type: none"><li>Malicious program used to hack user computer to spy on user activities to steal sensitive data, corrupt, and/or block access to data</li><li>Can set up backdoor control mechanism</li></ul>
<b>Worms</b>	<ul style="list-style-type: none"><li>Spread to other hosts through network without user interactions</li><li>Consumes resources (bandwidth, storage) using vulnerabilities on the target computer</li></ul>
<b>Spyware</b>	<ul style="list-style-type: none"><li>Tracks browsing history and web site passwords without user knowledge</li></ul>
<b>Ransomware</b>	<ul style="list-style-type: none"><li>Encrypts files and demands payment to unlock</li></ul>
<b>Rootkit</b>	<ul style="list-style-type: none"><li>Gets "root" or "Administrator" account access</li><li>Has maximum permissions, so normal users may not be able to detect it</li></ul>
<b>Keylogger</b>	<ul style="list-style-type: none"><li>Records passwords, bank accounts</li></ul>
<b>Botnets</b>	<ul style="list-style-type: none"><li>Compromises computer which acts as zombie for-hire botnet</li><li>Target host can be used to send spam or Distributed DoS attacks</li></ul>



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Regardless of how the virus spreads, once installed, a virus is somehow malicious. Some common malware threats are:

- Trojans, such as Zeus, trick users into letting down their defenses and installing them. Once installed, they can spy on user activities to steal sensitive data, such as bank account numbers and passwords. Trojans can also set up a backdoor control on the target host providing access to malicious users.
- Worms, such as Conficker and Code Red, spread by connecting to open ports on the network and exploiting misconfigurations or other vulnerabilities.
- Spyware, such as Zango, collects information about the user's computer without the user's knowledge.
- Ransomware, such as the CryptoLocker, holds the computer hostage, often encrypting critical user data with a password or secret key, until payment of some kind is made.
- Rootkit enables administrative level access to the target computer without user knowledge or consent.
- Key loggers record keystrokes and return them to a remote location – including sending administrator logins and personal email addresses.
- Mass mailers transform computers into open relay mail servers for the botnet, often managed through a remote command and control.

Are all viruses malicious? By definition, yes. But some academics have written beneficial worm-like software. It spreads through the same exploits, but then cleans infections and/or patches the host. For example, Creeper was followed by Reaper, which removed Creeper from infected systems.

## Evasion Techniques

- Encryption
  - Payload is encrypted and a decryption function that is included in the code is used before executing
- Polymorphism
  - Uses encryption keys or can changes the code when executing, but the function (definition) of the code does not change
  - Requires polymorphic engine in payload
- Metamorphism
  - Rewrites its own code which looks totally different with each infection
    - Used to avoid pattern-recognition
  - Requires metamorphic engine in payload



One species of ant, many shapes.  
Source: <http://en.wikipedia.org/wiki/Ant>

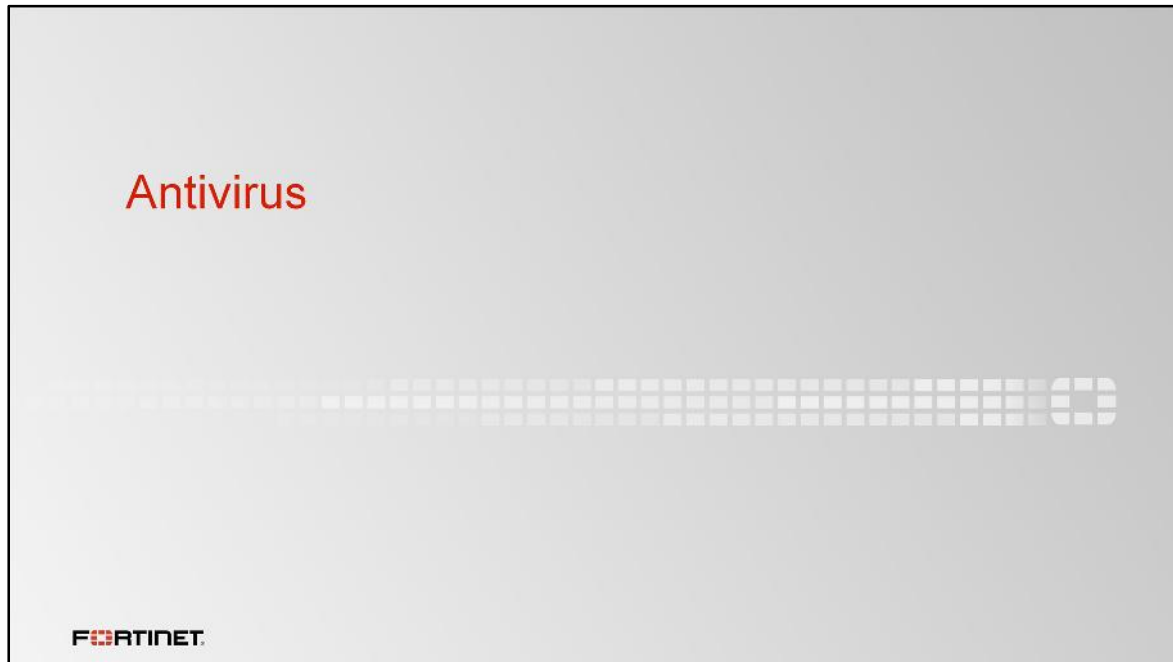
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Just as viruses have evolved many vectors for spreading, they also have evolved many techniques for evading antivirus engines and manual analysis.

Viruses can encrypt their payloads, or change the code. As a result, when comparing a signature to the binary sample, the two won't be an exact, bit-by-bit match. So in order to detect the virus, the engine must be able to either:

- match flexibly, or
- ignore the changeable parts of the code, and match only based on the polymorphic or metamorphic engine.




Now you know some different ways that viruses spread and evade detection. In this section, you will learn some of the methods that FortiGate uses to detect and block them.

## What is Antivirus and How Does It Work?

### Database of virus signatures to identify infections

- Virus names: <vector>/<pattern>
  - Example: W32/Kryptik.EMT!tr
    - <vector> for a virus will always be the same, but vendors assign different IDs for <pattern>
- To detect a virus, the antivirus engine must match file with pattern (<signature>)
- Each vendor uses different detection engines & signatures
  - MD5
  - CRC
  - Combinations of file attributes
  - Binary values in some areas
  - Encryption keys
  - Parts of code

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An antivirus is a database of virus signatures to identify infections. During an antivirus scan, in order to be detected as a virus, the virus must match a defined pattern called a signature.

Different vendors have different names for the same virus. Some vendors use patterns that detect one virus for each pattern, while others use patterns that are more flexible and can catch multiple viruses with a single pattern. The pattern that is used depends on the vendor's engine.

What is standard is the attack vector designation. It's at the beginning of the name. For example, if the vector is W32, it represents 32-bit Windows. W64 represents 64-bit Windows and JS represents JavaScript (which is cross-platform).

At the host level, a host-based antivirus software such as FortiClient helps. But host-based antivirus cannot be installed on routers. Guest Wi-Fi networks and ISP customers also might not have antivirus software installed.

So how can you protect them and your own network from these malware threats?

## Antivirus Scanning Techniques

- Antivirus Scan
  - Detect and eliminate malware in real-time
    - Stop threats from spreading
  - Preserve your public IP's client reputation
- Grayware Scan
  - Antivirus actions apply
- Heuristics Scan
  - Looks for virus-like code
    - (Example: Modifies registry to restart itself after reboot)
  - Counts virus-like attributes
  - If greater than a threshold, file is suspicious
  - **False positive possible**

### Order of Scan

- 1 Antivirus Scan
- 2 Grayware Scan
- 3 Heuristics Scan

Optional (must be enabled in CLI)

Just like viruses, which have many ways to avoid detection, FortiGate has many techniques that it can use to detect them. They include:

- Antivirus Scan: The first, fastest, simplest way to detect malware is if it is an exact match for a signature in the antivirus database.
- Grayware: It is not technically a virus. Remember, it is often bundled with innocuous software, but it does have unwanted side effects, so it is categorized as malware. Often, grayware can be detected this way, with a simple FortiGuard Grayware signature.
- Heuristics: They are based on probability, so they increase the possibility of false positives, but they also can detect zero-day viruses – viruses that are new and unknown, and therefore no signature exists yet. If your network is a frequent target, enabling heuristics may be worth the performance cost because it can help you to detect a virus before the outbreak begins. By default, when the antivirus scan's heuristic engine detects a virus-like characteristic, it will log the file as *Suspicious* – but will not block it. You can choose whether to block or allow suspicious files.

The grayware and heuristics are optional functions which must be enabled in the CLI.

- You can enable and disable grayware under the CLI command `config antivirus setting`.
- You can configure the action for the heuristic scan to pass/block/disable under the CLI command `config antivirus heuristic`.

As these are done as separate steps, antivirus scanning must be enabled as well. If grayware and heuristic are enabled, FortiGate applies the scan in the following order: Antivirus Scan > Grayware Scan > Heuristics Scan.

## Sandboxing

- **Can detect zero-day attacks with high certainty**
  - FortiGate uploads files to FortiCloud Sandbox / FortiSandbox appliance
    - Must activate a FortiCloud account to use to use FortiCloud Sandbox
  - File executed in an isolated environment ("sandbox")
  - Examines effects to detect new malware
  - Can configure to receive new signature from FortiCloud Sandbox / FortiSandbox appliance

Uploading files and receiving new signatures is per antivirus profile

Send Files to FortiSandbox Appliance for Inspection ☐ None ☒ All Supported Files

Do not submit files matching types

Do not submit files matching file name patterns

Use FortiSandbox Database ☒

### System > Cooperative Security Fabric

☒ Sandbox inspection

FortiSandbox type ☒ FortiSandbox Appliance ☐ FortiSandbox Cloud

Server

Notifier Email

Applied Threat Intelligence

Dynamic Malware Detection version	2.16434 (signatures: 39)
URL Threat Detection version	2.6322 (entries: 1000)

What if heuristics is too uncertain? What if you need a more sophisticated, more certain way to detect malware, and to find zero-day viruses?

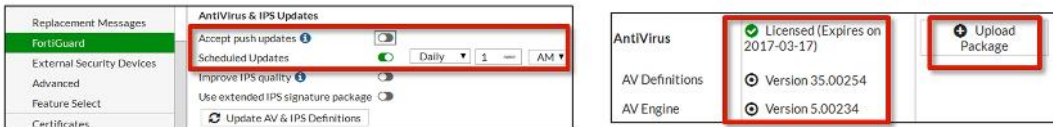
You can integrate your antivirus scans with FortiSandbox. For environments that require more certainty, FortiSandbox executes the file within a protected environment, then examines the effects of the software to see if it is dangerous.

For example, let's say you have two files. Both alter the system registry and are therefore suspicious. One is a driver installation – its behavior is normal – but the second file installs a virus that connects to a botnet command and control server. Sandboxing would reveal the difference, and can be configured to receive supplementary signature database from Sandbox.

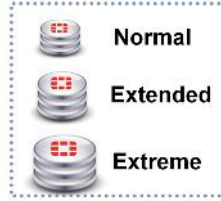


## Antivirus Signature Database

- **System > FortiGuard**
  - Requires subscription to FortiGuard Antivirus



- Antivirus scanning engine relies on the antivirus signature database
- Choosing antivirus signature database (CLI only)
  - Normal – Includes common recent attacks and is available on all models
  - Extended – Includes normal plus additional recent non-active viruses
  - Extreme – Includes extended plus additional old dormant viruses



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You can update your FortiGate's antivirus database using push, schedule, or both methods. The scheduled updates allow you to configure scheduled updates at regular intervals, such as hourly, daily, or weekly. You can also enable **Accept push updates**, which allows you to add new definitions as soon as released by FortiGuard. This is useful for high-security environments, as FortiGate will receive urgent security updates as soon as they are released.

Regardless of which method you select, virus scanning *must* be enabled in at least one firewall policy. Otherwise, FortiGate will not download any updates. Alternatively, you can download packages from the Fortinet customer service and support website (requires subscription), and then manually upload them to your FortiGate. You can verify the update status and signature versions from the **FortiGuard** page on the GUI or you can run `diagnose autoupdate status` and `diagnose autoupdate versions` from the CLI.

Multiple FortiGuard antivirus databases exist and can be configured under the CLI command `config antivirus setting`. Support varies by FortiGate model.

- All FortiGate devices have the **normal** database, which only contains signatures for viruses detected in recent months determined by the FortiGuard Global Security Research Team. It is the smallest database, and, therefore, results in the fastest scans, but does not detect all known viruses.
- Some models support the **extended** database, which detects viruses that are no longer active. Vulnerable platforms are still common, and/or these viruses could be an issue later.
- The **extreme** database is intended for high-security environments and detects all known viruses, including for legacy operating systems no longer widely used.



## Mobile Malware Database

- Requires separate subscription
- Ensures protection against latest threats targeting mobile platforms
  - Apple IOS
  - Android
  - Windows mobile devices
- Proactive threat intelligence library offers complete protection against mobile threats

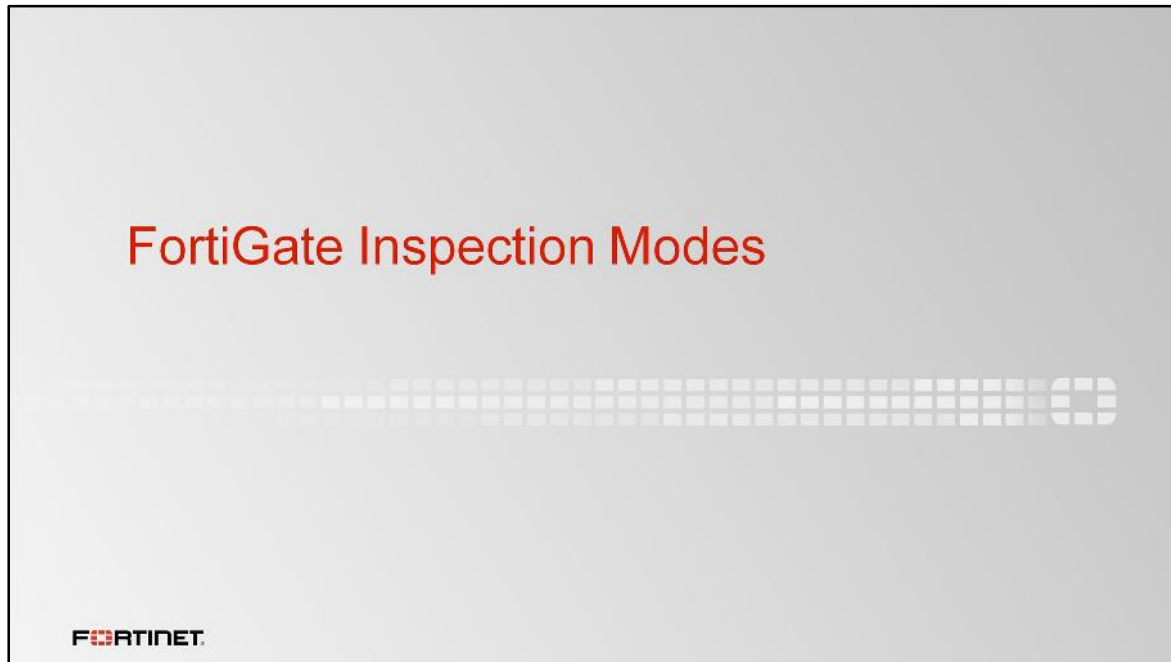
<https://fortiguard.com/avmobilethreats>

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Web Filtering	✔ Licensed (Expires 2017-03-19)
Mobile & Botnet C&C	✘ Not Registered

How to Subscribe

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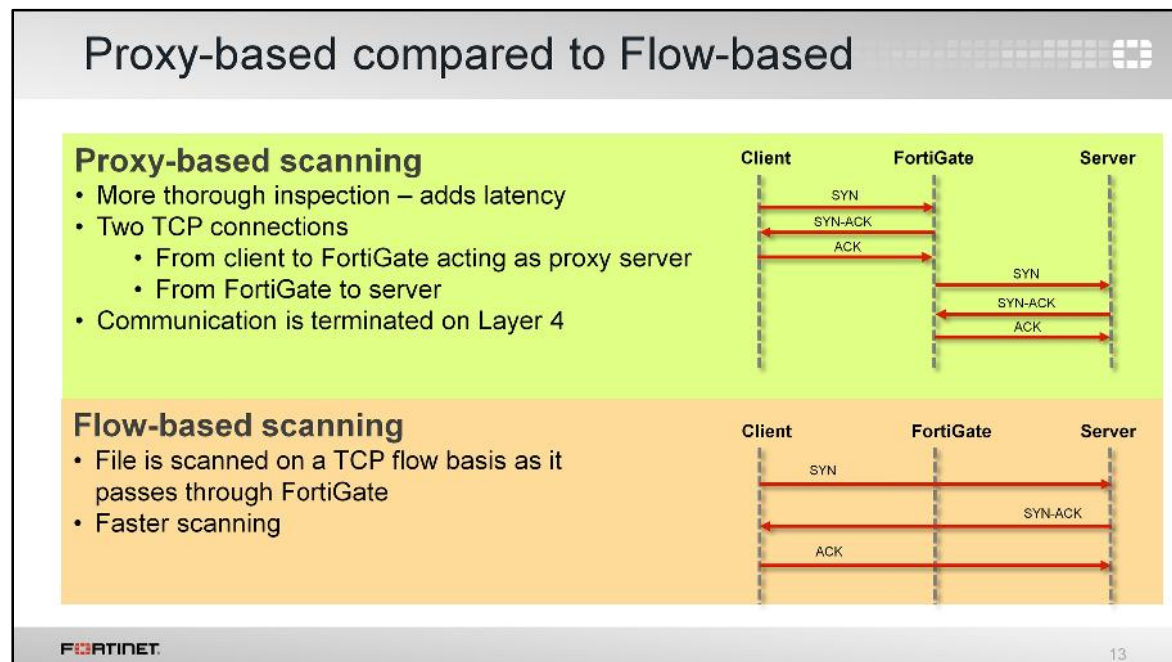
FortiGuard mobile security subscription is a separate subscription from antivirus subscription. You can also click How to Subscribe to get the detailed instructions about the subscription. As more and more organizations are allowing bring your own device (BYOD), mobile security subscription can ensure up-to-date protection against the latest threats targeting mobile platforms. You can also view the list of mobile threats covered by FortiGuard from <https://fortiguard.com/avmobilethreats>.



In this section, we will examine the FortiGate inspection modes, which includes:

- Flow-based
- Proxy-based

The inspection mode determines how FortiGate will scan the traffic for different security profile features.



Let's talk about proxy-based scanning first.

Proxy-based scanning typically refers to transparent proxy. It's called transparent because at the IP layer, FortiGate is not the destination address, yet FortiGate intercepts the traffic anyway.

In TCP connections, FortiGate's proxy generates the SYN-ACK to the client and completes the three-way handshake with the client before creating a second, new connection to the server. If the payload is less than the oversize limit, the proxy buffers transmitted files or emails for inspection before continuing transmission. The proxy analyzes and may change headers such as HTTP Host and URL for web filtering. If a security profile decides to block the connection, the proxy can send a replacement message to the client.

This adds latency to the overall transmission speed.

How are flow-based scans different?

There is no proxy. If you are familiar with the TCP flow analysis of Wireshark, then that is essentially what the flow engine sees. Packets are analyzed and forwarded as they are received. Original traffic is not altered. Therefore, advanced features that modify content, such as safe search enforcement, are not supported.

## FortiGate Inspection Modes

- Two types of scanning mode
  - Flow-based
    - Only supports flow-based profiles
  - Proxy-based
    - Supports proxy-based profiles
    - Also supports flow-based profiles from CLI
    - Supports more features – DNS Filter, Explicit Proxy, WAF....
- Per virtual domain (VDOM) setting
  - Default mode is proxy
  - Can toggle the mode from CLI or GUI
    - **Global > System > VDOM**

Edit Virtual Domain Settings

Virtual Domain	root
Inspection Mode	<b>Proxy (Current)</b> Flow-based

OK Cancel

```
config system settings
set inspection-mode {proxy | flow}
end
```

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FortiGate supports two types of scanning modes:

- Flow-based is optimized for performance and supports fewer security features.
- Proxy-based is optimized for user friendliness and supports more security profile features and more configuration options for those individual features. For example, web profile overrides for web filtering is only supported in proxy mode.

The default inspection mode is **Proxy** and can be toggled from the **System Information** widget on the dashboard of the FortiGate GUI. If the virtual domain is enabled on FortiGate, you can toggle between flow- and proxy-based inspection mode from **Global > System > VDOM** for each VDOM.

## Switching between Inspection modes

- Switching from Proxy to Flow
  - Converts all proxy-based profiles to flow-based profiles
  - Proxy specific settings are removed *with warning*
- Switching from Flow to Proxy
  - Converts all flow-based profiles to proxy-based profiles with default settings
  - *No warning message*
- Switching from proxy to flow back to proxy
  - Will not produce original configuration
  - Will use supported default configurations



**Proxy to Flow**

Warning: Changing inspection mode from Proxy to Flow will convert all Proxy profiles to Flow while removing any proxy specific settings. Are you sure you want to continue?

☐ Change Inspection Mode Anyway

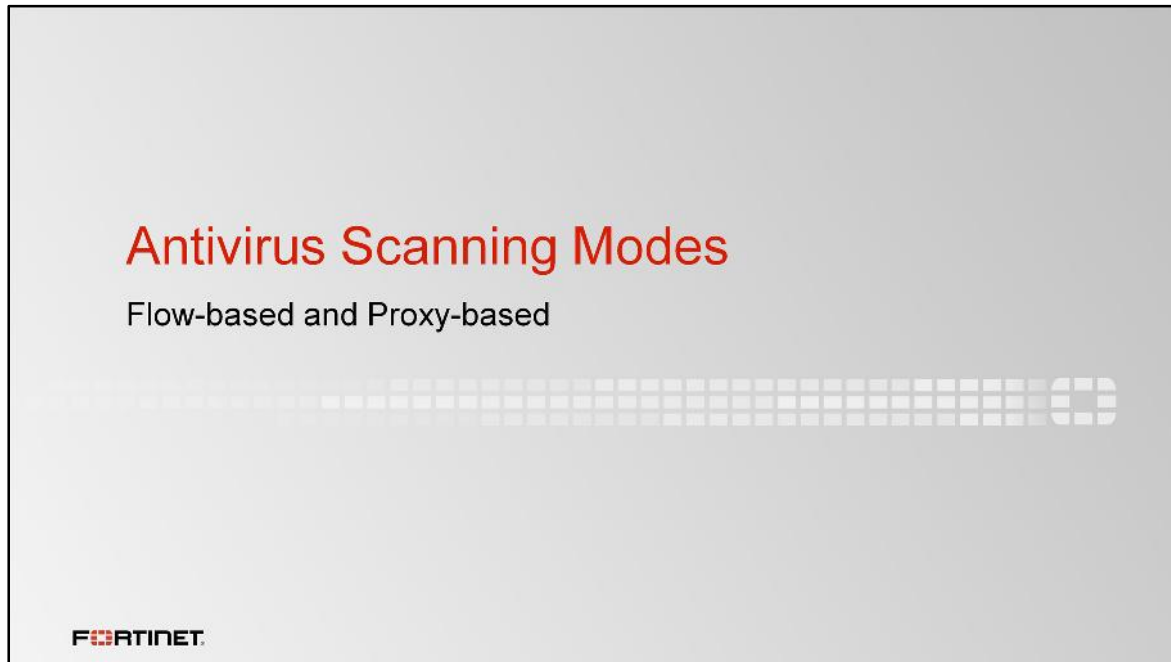
**Flow to Proxy**

OK Cancel

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You can toggle between proxy-based and flow-based inspection, which will result in supported security profiles and related configurations being converted to flow-based or proxy-based. Firewall policies will display security profile and related settings based on the inspection mode selected. Changing from proxy to flow back to proxy will not result in the original configurations and some of the configuration elements will use default configuration settings.



In this section, you will learn how antivirus uses the inspection modes to scan and detect malware.

## Proxy-based Scan

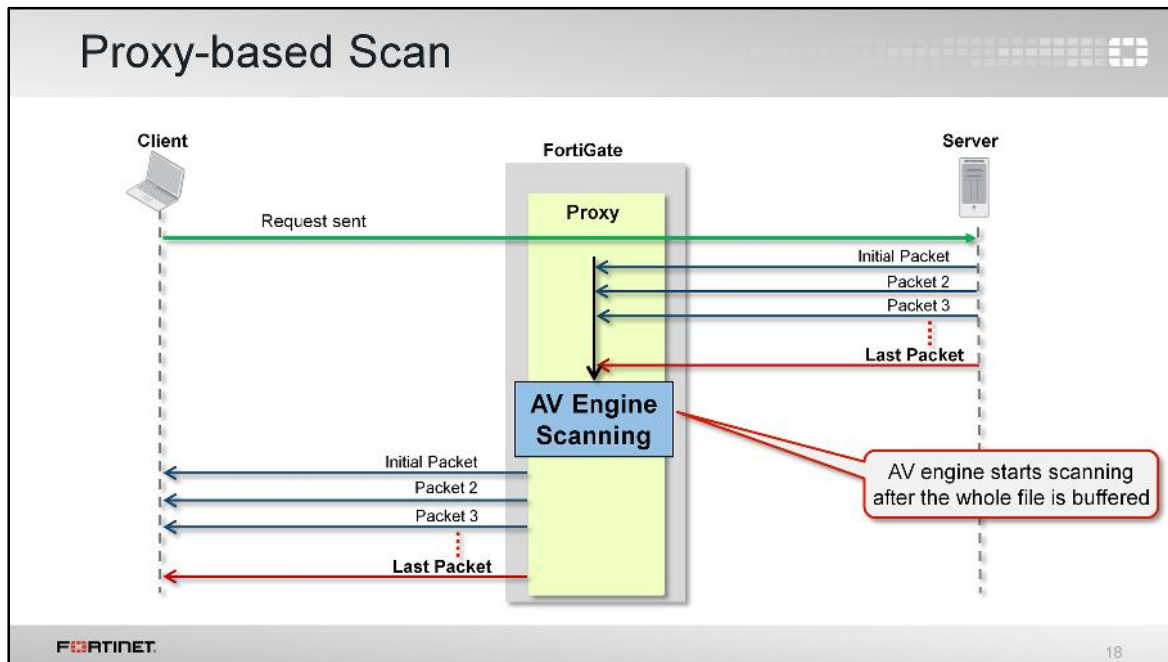
- Uses full antivirus database
- FortiGate buffers the whole file
  - AV engine starts scanning once end of file is detected
    - Files bigger than buffer size are not scanned – can configure to pass or block
  - Packets are sent to the client after scan finishes– *client must wait*
  - **Highest perceived latency**
- Displays block replacement immediately if virus is detected

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Each protocol's proxy picks up a connection and buffers the entire file first (or waits until the oversize limit is reached) before scanning. The client must wait for the scanning to finish. If the virus is detected, the block replacement page is displayed immediately. As FortiGate has to buffer the whole file and then do the scanning, it takes a long time to scan. Also from the client point of view, it has to wait for the scanning to finish and might terminate the connection due to lack of data.

You can configure client comforting for HTTP and FTP from the `config firewall profile-protocol-options` command tree. This allows the proxy to slowly transmit some data until it can complete the buffer and finish the scan. This prevents a connection or session timeout. No block replacement message appears in the first attempt, as FortiGate is transmitting the packets to the end client.



With a proxy-based scan, the client sends a request and FortiGate starts buffering the whole file, then sends it to the AV engine for scanning. If the file is clean (without any viruses), FortiGate starts transmitting the file to the end client. If a virus is found, no packets are delivered to the end client and the proxy sends the replacement block message to the end client.



## Flow-based: Full Scan

- Uses full antivirus database
- FortiGate buffers the whole file, but transmits to client simultaneously
  - IPS checks for the rule match
  - When the *last packet* arrives, the AV engine starts the scanning
    - Files bigger than buffer size are not scanned – can configure to pass or block
    - Packets are not delayed by scan – *except last packet*
  - Lower perceived latency
- If a virus is detected, last packet is dropped and the connection is reset
  - If identical request is made, block replacement page is inserted immediately

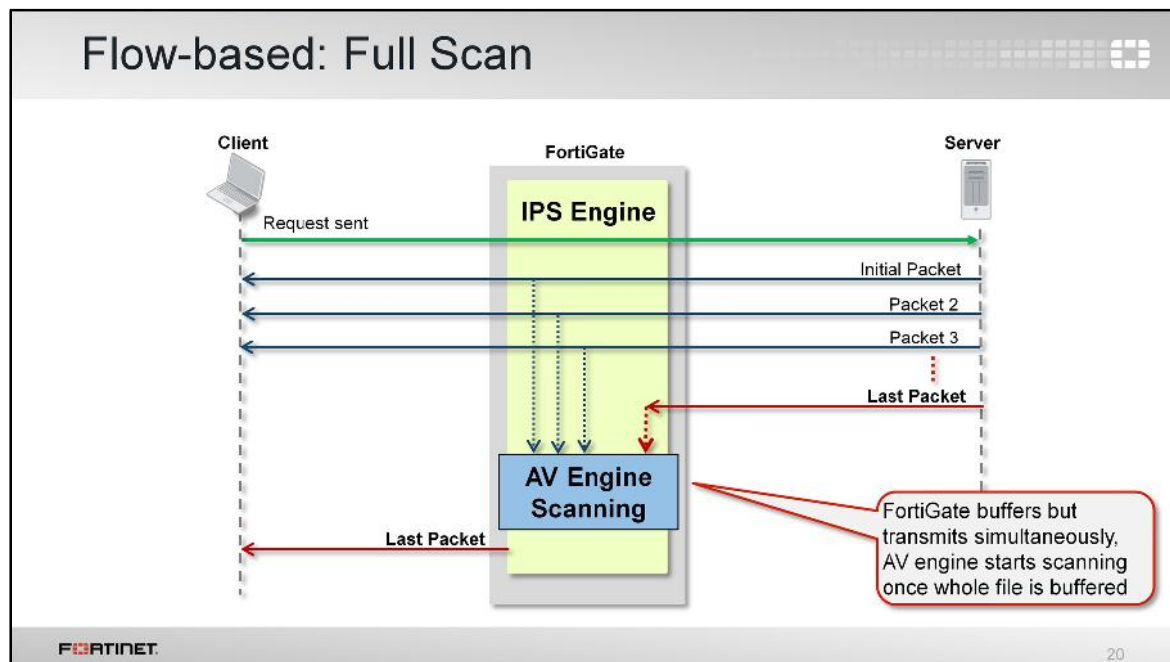
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The flow-based full antivirus scan mode uses the full antivirus database (the compact AVDB is a subset of the full antivirus database) and the IPS engine to examine the network traffic. It doesn't analyze sessions in discrete protocol stages. The flow-based engine starts scanning with a raw IP+TCP packet, not necessarily in order, and has to extract the payload to discover the viral payloads regardless of surrounding protocol details. As the file is transmitted simultaneously, flow-based scanning consumes more CPU cycles, but, depending on your model, some flow-based operations may be performed by a specialized FortiASIC chip, further improving performance. The flow-based scanning caches the copy of the packet locally on the FortiGate and also forwards the packet to the end client at the same time. Once the last packet is received, FortiGate also caches that, but puts the last packet on hold and has the whole file for scanning. The IPS engine checks for the rule match and then sends to the AV engine for scanning.

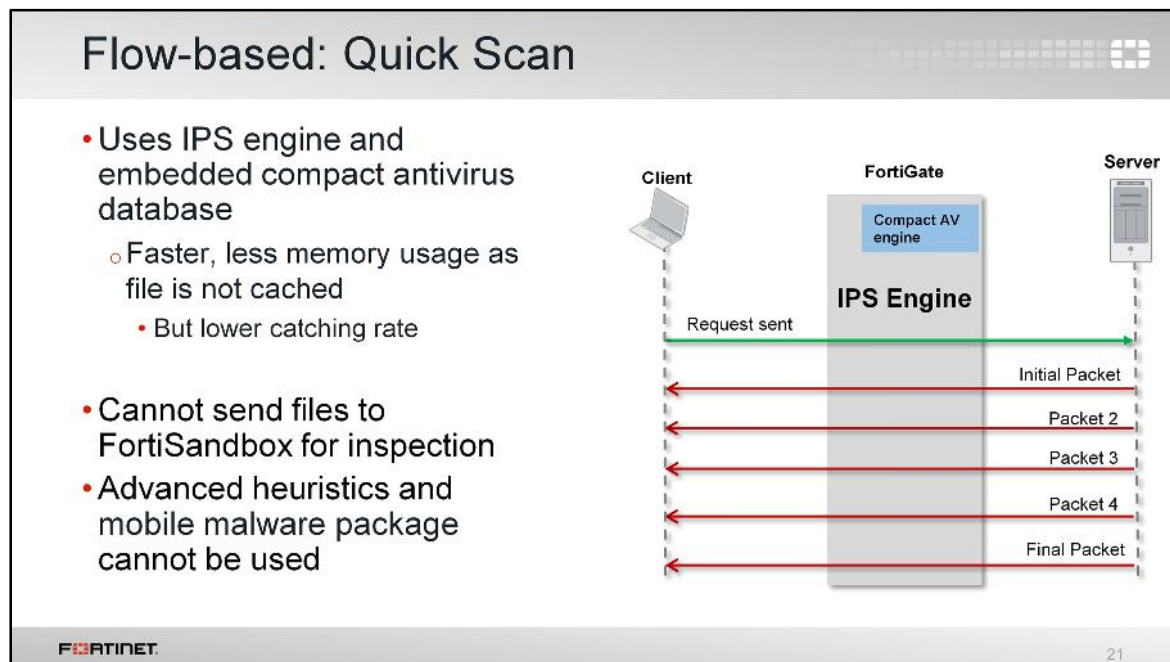
There can be two scenarios if a virus is detected:

- If the scan detects a virus in the TCP session when it may have already forwarded packets to the client, it resets the connection, but doesn't insert the block replacement page. So the client may think it is a network error and try again. The FortiGate IPS engine caches the URL and, during the second attempt to download the same file, the block replacement page displays immediately without engaging the antivirus engine. Even if the client has received most of the file in the first attempt, the file will be truncated and the client will not be able to open a truncated file.
- If the virus is detected at the start of the stream, flow-based scanning can insert the block replacement page at the first attempt.



As you can see, the client sends a request and starts receiving the packets immediately, but FortiGate is also caching those packets simultaneously. When the last packet arrives, FortiGate caches it and puts it on hold. Then it sends the whole cached file to the IPS engine where rule match is checked and passed to the AV engine for scanning after that. If the AV scan does not detect any viruses and the result comes back clean, the last cached packet is regenerated and delivered to the client. However, if a virus is found, the last packet is dropped. Even if the client has received most of the file, the file will be truncated and the client will be not able to open a truncated file.

Regardless of which mode you use, the scan techniques will give similar detection rates. How can you choose between the scan engines? If performance is your top priority, then flow-based is more appropriate. If security is your priority, proxy-based – with client comforting disabled – is more appropriate.



The flow-based quick scan uses an IPS engine along with an embedded compact antivirus database containing less signatures. The IPS engine examines the network traffic for viruses, worms, Trojans, and malware, without the need to buffer the file being checked. It provides better performance, but detection rate is lower.


The quick scan does have some limitations compared to full flow-based scan and proxy-based scan. Quick scan cannot send files to FortiSandbox for inspection, cannot use advanced heuristics, and cannot use mobile malware packages. Low-end FortiGate models don't support flow-based quick scan.

Antivirus Scanning Modes Comparison			
	Proxy	Full Flow	Quick Flow
Catching Rate	Highest	Highest	High
Sandbox Support	Yes	Yes	No
Advanced Heuristic	Yes	Yes	No
Mobile malware package	Yes	Yes	No
Memory usage	High	High	Low
Perceived Latency	Highest	High	Low
MAPI, NNTP Scanning	Yes	No	No
SMB Scanning	No	Yes	Yes
HTTP, FTP, IMAP, POP3, SMTP Scanning	Yes	Yes	Yes

This table shows the comparison between all three antivirus scanning modes.

## Protocol Options – Large Files

- Large Files: Block or Not?
  - Bigger than buffer cannot be scanned for viruses
  - Log if file is too large? (Default: No)
  - **Block if file is too large? (Default: No)**



00001010111010  
Buffer in RAM  
11011101011110 Over

```
config firewall profile-protocol-options
edit <profile_name>
set oversize-log {enable|disable}
config <protocol_name>
set oversize-limit [1-<model_limit>]
set options oversize
end
end
```

Applies to all protocols

Per protocol setting

Setting 'options' to 'oversize' blocks large files bigger than buffer

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So what is the recommended buffer limit? It varies by model and configuration. You can adjust `oversize-limit` for your unique network for optimal performance. A smaller buffer minimizes proxy latency and (for both scanning modes) RAM usage, but that may allow viruses to pass through undetected. With a buffer that's too large, clients may notice transmission timeouts. You need to balance the two.

If you aren't sure how large of a buffer you need, you can temporarily enable `oversize-log` to see if the large files come frequently and are important to allow.

Files that are too large for the maximum buffer size cannot be scanned. The default is to allow files to pass. This is because large files are often harmless, and many networks have antivirus software installed on endpoints, which minimizes unnecessary help desk calls. But, if you require a very secure environment, or if your endpoints have no antivirus software, you can change this setting – on a per-protocol basis from the CLI – so that FortiGate blocks oversized files.

If oversized files are blocked, then your endpoints are safe. You won't need logs about oversize files for forensics, so you may be able to improve performance slightly by disabling `oversize-log`.

## Protocol Options – Compressed Files

- Often, compression algorithms can be identified using header only
- Archives are unpacked and files/archives within are scanned separately
  - Nested archives are supported (default is 12 layers)
  - Decompressed files have a separate oversize limit
- Password-protected archives cannot be decompressed

```
config firewall profile-protocol-options
edit <profile_name>
config <protocol_name>
set uncompressed-oversize-limit [1-<model_limit>]
set uncompressed-nest-limit [1-200]
end
end
```

Per protocol setting

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Large files are often compressed. When compressed files go through scanning, the compression acts like encryption: the signatures won't match. So, FortiGate must decompress the file in order to scan it.

Before decompressing a file, FortiGate must first identify the compression algorithm. Some archive types can be correctly identified using only the header. Also, FortiGate must check whether the file is password-protected. If the archive is protected with a password, FortiGate can't decompress it, and, therefore, can't scan it.

FortiGate then decompresses files into RAM. Just like other large files, the RAM buffer has a maximum size configured in `uncompress-oversize-limit`. Increasing this limit may decrease performance, but it allows you to scan larger compressed files.

If an archive is nested – for example, if an attacker is trying to circumvent your scans by putting a ZIP file inside the ZIP file – FortiGate will try to undo all layers of compression. By default, FortiGate will attempt to decompress and scan up to 12 layers deep, but you can configure it to scan up to 200 layers deep. Often, you shouldn't increase this setting as it increases RAM usage.



## Detection Rate and File Size Limit – Relationship

- Most malware is small
- Very large files require more RAM to scan completely
- Often, scanning only small files is an acceptable risk
  - Default: 10 MB threshold for `oversize`
  - Maximum size varies by model

	1MB	2MB	3MB	4MB	5MB	6MB	7MB	8MB	9MB	10MB	∞
exploit	99.83%	99.95%	99.97%	99.97%	99.98%	99.98%	99.99%	100%	100%	100%	100%
mass-mailer	99.62%	99.87%	100%	100%	100%	100%	100%	100%	100%	100%	100%
phish	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
spyware	95.08%	97.97%	98.88%	99.47%	99.76%	99.83%	99.89%	99.91%	99.94%	99.95%	100%
trojan	97.52%	99.24%	99.62%	99.80%	99.88%	99.93%	99.95%	99.97%	99.98%	99.98%	100%
virus	98.27%	99.37%	99.63%	99.80%	99.88%	99.93%	99.95%	99.97%	99.98%	99.99%	100%
worm	99.02%	99.65%	99.74%	99.86%	99.89%	99.92%	99.94%	99.94%	99.95%	99.96%	100%

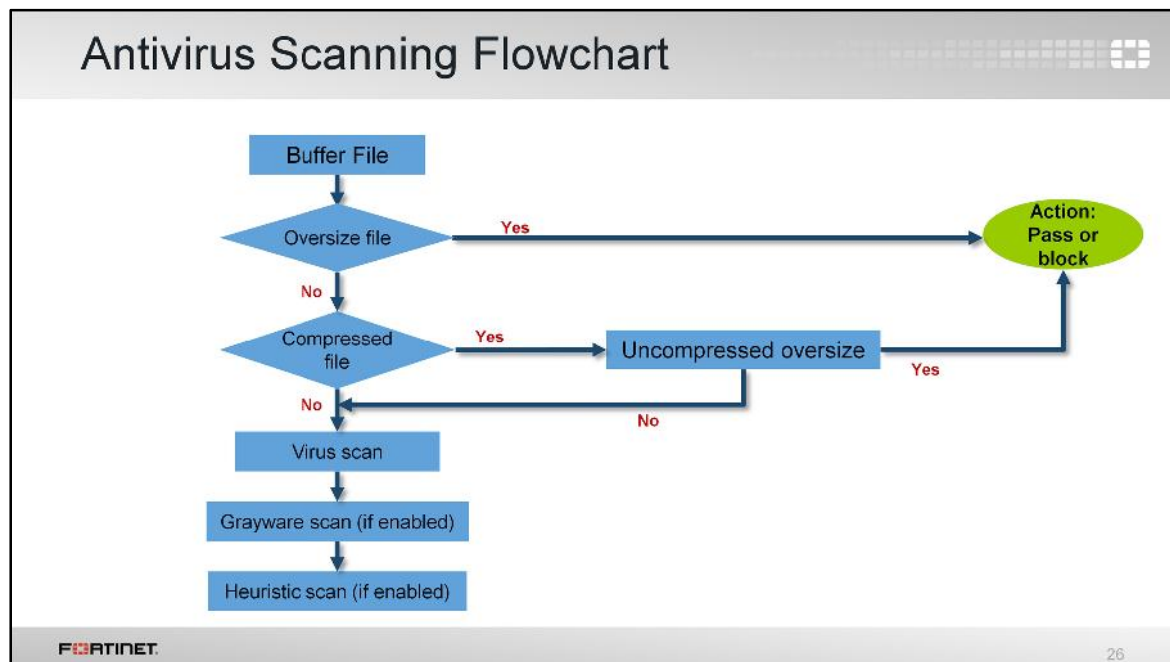
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Full flow-based and proxy-based scanning buffers up to your specified file size limit. The default is 10 MB. It's large enough for most files, except movies. If your FortiGate model has more RAM, you may be able to increase this threshold.

Without a limit, very large files could exhaust the scan memory. So this threshold balances risk vs. performance. Is this tradeoff unique to FortiGate, or to a specific model? No. Regardless of vendor or model, you must make a choice. This is due to the difference between scans in theory, that have no limits, and scans on real-world devices that have finite RAM. In order to detect 100% of malware regardless of file size, a firewall would need infinitely large RAM – something that no device has in the real world.

Most viruses are very small. This table shows a typical tradeoff. You can see that with the default 10 MB threshold, only 0.01% of viruses pass through.



The antivirus starts buffering the file and checks for the oversize and uncompressed oversize file limits. If the buffer is full, the antivirus scan has a simple behavior: FortiGate will, depending on your setting, either block or pass the file. The default action is to pass the large files bigger than buffer. This is because FortiGate does not have the entire file and it would be impossible to determine whether or not the file contains a virus.

If the file has been completely transmitted – that is, FortiGate reaches the byte that marks the end of the file (EoF) – then FortiGate uses these scans in this order.

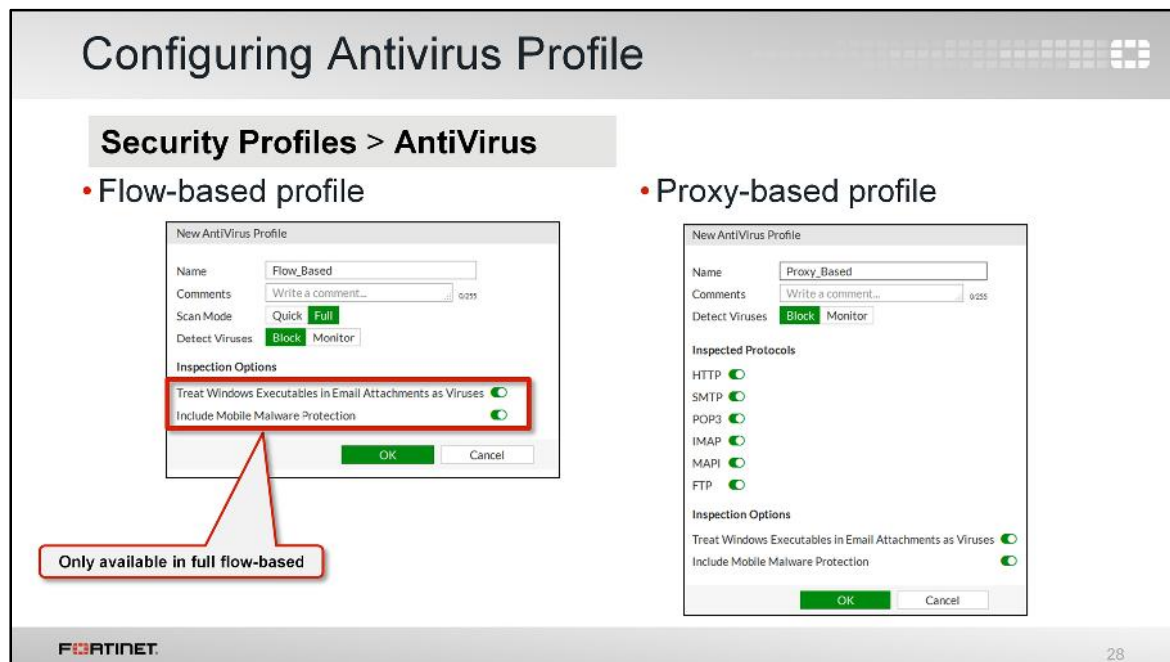
The virus scan is first, because the results have high certainty and the computations are fast. Heuristics, which are less certain, are applied last.

If you consider all of these settings together, this is the complete decision tree that FortiGate uses for antivirus scans.





In this section, you will learn how to configure an antivirus profile on FortiGate and related components.



The antivirus profile can be configured from the **AntiVirus** page. The full flow-based and proxy-based antivirus profiles provide the same inspection options, which include:

- **Include Mobile Malware Protection:** The mobile malware protection contains signatures for mobile malware such as android devices. It is also worth mentioning that mobile malware protection requires a separate license.
- **Treat Windows Executables in Email Attachment as Viruses:** By default, this option is enabled and files (including compressed files) identified as Windows executables can be treated as viruses.

From the antivirus profile, you can define what FortiGate should do if it detects an infected file.

Once an antivirus profile is configured it is applied in the firewall policy.

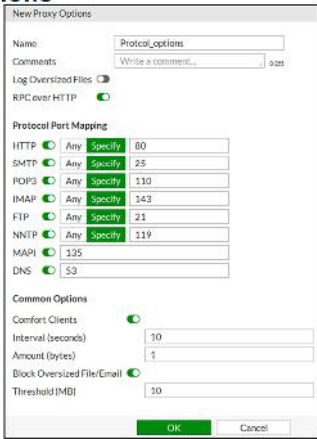
But what about encrypted protocols? Encryption is a popular method for attackers to circumvent security. As you would expect, FortiGate can scan encrypted protocols, which we will examine shortly.

## Configuring Protocol Options

- Allow you to configure protocol options
  - For proxy-based VDOM can be configured from GUI and CLI
  - For flow-based VDOM it can be configured from *CLI only*

```
config firewall profile-protocol-options
edit <profile_name>
config <protocol_name>
```

- Can configure:
  - Protocol port mappings
  - Common options
  - Web and email options

**Security Profiles > Proxy Options**  


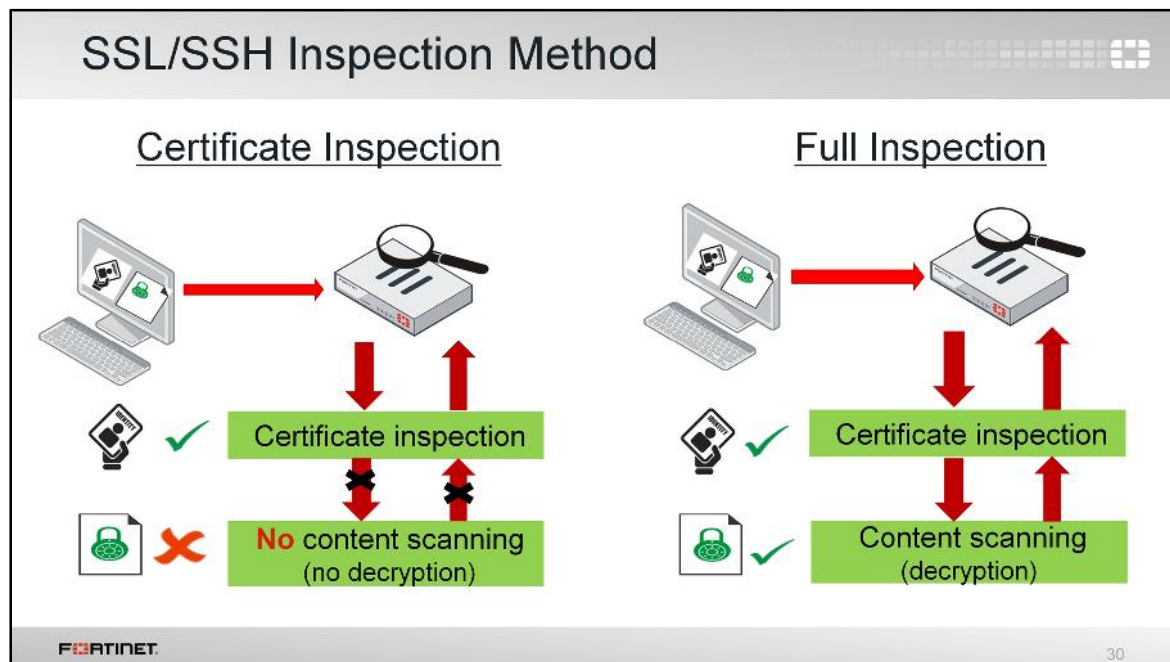
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Protocol options provides more granular control, allowing you to configure protocol port mappings, common options, web, and email options to name a few.

It is also worth mentioning that in proxy-based VDOM, these settings can be configured from the **Proxy Options** page in the GUI. The **Proxy Options** settings are not only applicable to proxy-based VDOMs, but also to flow-based VDOMs and can be configured under `config firewall profile-protocol-options` in the CLI.

Protocol options are used by antivirus and other security profiles, such as web filtering, DNS filtering, and DLP sensor to name a few.

Once protocol options are configured, it is applied in the firewall policy.



To scan secure protocols, select an SSL/SSH inspection profile in the traffic's matching firewall policy. There are two levels of inspection:

- Certificate-only
- Full content inspection

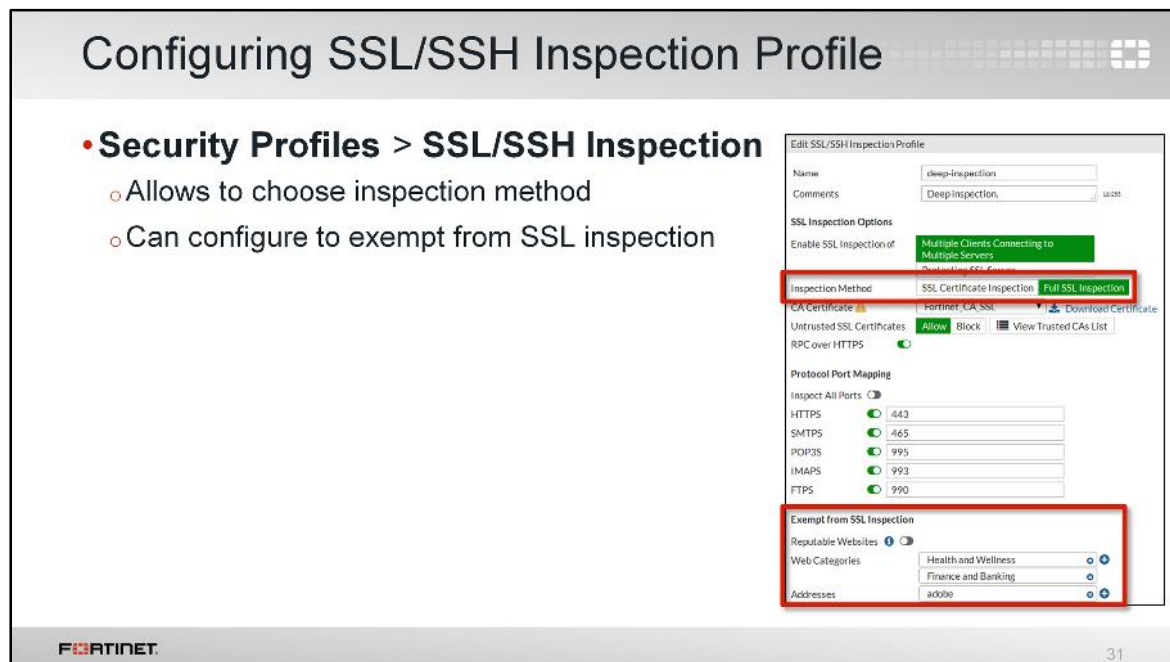
Certificate-only inspection verifies the certificate and any unencrypted headers that are sent before encryption begins. FortiGate doesn't interrupt the handshake. So, when the certificate-only inspection is applied, antivirus can't scan contents and is effectively bypassed. When is certificate-only mode effective? Only if you need to act on the certificate or URL of a website. In this case, the client sends unencrypted headers before the encryption handshake occurs.

What if you want to scan the content inside the payload of the packet?

In full inspection level, FortiGate terminates the SSL/TLS handshake at its own interface, before it reaches the server. When certificates and private keys are exchanged, it is with FortiGate and not the server. Next, FortiGate starts a second connection with the server.

Because traffic is unencrypted while passing between its interfaces, FortiGate can inspect the contents and look for matches with the antivirus signature database, before it re-encrypts the packet and forwards it.

For these reasons, full inspection level is the best choice for making the antivirus scan effective.



The SSL/SSH profile allows you to configure the inspection method, protocol port mapping, and exemption from SSL/SSH inspection.

If you set the inspection method to **Full SSL Inspection**, FortiGate validates the certificate, but also decrypts the payloads for antivirus scanning. As this method uses an authorized man-in-the-middle (MITM) attack, clients will detect the inspection. Users may need to either override the SSL validation failure or install your certificate authority (CA) certificate.

Once the SSL/SSH profile is configured it is applied in the firewall policy.

## Antivirus Block Page

- Like web filtering block page
  - File name
  - Virus name
  - Web site host & URL
  - Source & Destination IP
  - Use name & group (if authentication is enabled)
  - Link to FortiGuard Encyclopedia

### High Security Alert!!

You are not permitted to download the file "eicar.com" because it is infected with the virus "EICAR\_TEST\_FILE".

URL: <http://www.eicar.org/download/eicar.com>

File quarantined as: [disabled]

[http://www.fortinet.com/ve?vn=EICAR\\_TEST\\_FILE](http://www.fortinet.com/ve?vn=EICAR_TEST_FILE)

Client IP: 10.0.1.10  
Server IP: 188.40.238.250  
User name:  
Group name:

#### Info

Released: Oct 14, 1996  
Description Updated: Jan 05, 2015

#### Detection Availability

	Active DB	Extended DB	Mobile
FortiGate	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> High <input checked="" type="checkbox"/> Low	<input type="checkbox"/>
FortiClient	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FortiMail	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

#### Virus: EICAR\_TEST\_FILE

#### Analysis

This detection is for a non-malicious test file that was developed by the European Institute for Computer Antivirus Research (EICAR) and Computer Antivirus Research Organization (CARO) in order to check if the installed antivirus software is working properly. When detected, the antivirus software should be able to treat it the same way as it would with a real malware file.

#### Recommended Action

For proxy-based scanning (with client comforting disabled), a block replacement page is immediately displayed if a virus is detected. For flow-based scanning, if a virus is detected at the start of the stream, the block replacement page is inserted at the first attempt. However, if the virus is detected after transmitting a few packets, the block replacement page is not inserted. However, FortiGate caches the URL and can insert the replacement page immediately on the second attempt.

Note that if deep inspection is enabled, all HTTPS-based applications will also provide this replacement message.

The block page includes information about the:

- File name
- Virus name
- Web site host & URL
- Source & Destination IP
- User name and group (if authentication is enabled)
- Link to FortiGuard Encyclopedia – which provides analysis, recommended actions (if any), and detection availability

You can go directly to the FortiGuard Encyclopedia website (<http://fortiguard.com/encyclopedia>) to view information about other malware. You can also scan and/or submit a sample of a suspected malware at <http://submission.fortinet.com>.

## Virus Statistics

- **Dashboard > Advanced Threat Protection Statistics** widget
- Shows statistics for
  - Virus scan
  - Sandbox

Advanced Threat Protection Statistics	
<b>FortiGate Statistics</b>	
Number of Files Scanned	23
Malicious	2
Detected Zero-Day Malware Variants	0
Suspicious Files	0
Clean	21
<b>FortiSandbox Cloud Statistics (Last 7 Days)</b>	
# of Files Submitted to FortiGuard Sandbox	3
Malicious	0
Suspicious (high risk)	0
Suspicious (medium risk)	0
Suspicious (low risk)	0
Clean	3

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You can find virus scanning statistics through the **Advanced Threat Protection Statistics** widget on the dashboard.

If your FortiGate is submitting files for sandboxing, it keeps statistics about the number of files submitted and the results of those scans. These statistics are separate from files that are scanned locally on FortiGate.

## Logging and Monitoring

- Log & Report > AntiVirus

#	Date/Time	Services	Source	File Name	Virus Scan	User	Details	Action
1	07.07.01	HTTP	10.0.1.10	eicar.com	EICAR_TEST_FILE	host	168.40.238.250	blocked

### Log Details

- General**
- Source**
- Destination**
- Application**
  - Protocol: 8
  - Service: HTTP
- Data**
  - File Name: eicar.com
- Action**
  - Action: blocked
  - Policy: 1
- Security**
- AntiVirus**
  - Profile Name: AV-test
  - Virus Board: EICAR\_TEST\_FILE
  - Virus ID: 2172
  - Reference: [http://www.fortinet.com/ve?vn=EICAR\\_TEST\\_FILE](http://www.fortinet.com/ve?vn=EICAR_TEST_FILE)
  - Detection Type: Virus
  - Direction: incoming
  - Quarantine Skip: File was not quarantined.
  - FortiSandbox Checksum: 275a021bbfb6489e54a471899f7d
  - Submitted to FortiSandbox: false
  - Message: File is infected.

Link to FortiGuard encyclopedia

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If you have logging enabled, you can find details about them under the **AntiVirus** log page.

When the antivirus scan detects a virus, by default it creates a log about what virus was detected, as well as the action, policy ID, antivirus profile name, and detection type. It also provides a link for more information on the FortiGuard website.

You can also view log details under the **Forward Traffic** log page, where firewall policies record activity. You'll also find a summary of traffic where FortiGate applied an antivirus action. Again, this is because antivirus is applied on a firewall policy.

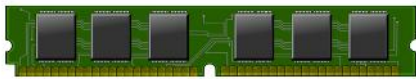




In this section, you will learn about memory conserve mode.

## Memory Conserve Mode

- **FortiOS protects itself when memory usage is high**
  - Prevents using so much memory that the FortiGate becomes unresponsive
  - Once usage is lower, FortiGate leaves conserve mode
- **Two types:**
  - Kernel
  - System



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If your FortiGate memory usage is high, you should examine the event log. Look for messages related to conserve mode. Memory conserve mode occurs when FortiGate does not have enough RAM available to handle traffic.

UTM inspection (especially proxy-based) increases memory usage beyond simple firewall policies. In other words, when antivirus is enabled, FortiGate is more likely to use more memory, which can cause FortiGate to go in to conserve mode. You can determine whether antivirus or any other process is using too much memory by running the CLI command `diagnose sys top`.

There are two types of memory conserve mode: kernel and system.

Kernel Conserve Mode Thresholds		
Total memory	Enter margin	Exit margin
< 1 GB	Free < 20%	Free > 30%
>= 1 GB	Free <= 200 MB	Free > 300 MB

- Actions:
  - Proxies are bypassed
  - FortiGate configuration cannot be changed

Two margins or thresholds determine when FortiGate enters and exits the kernel conserve mode. For all the latest FortiGate models (which have 64-bit CPUs) the margins for kernel conserve mode depend on the total overall memory.

When a FortiGate is in kernel conserve mode, any proxy inspection is bypassed, and administrators cannot perform configuration changes.

System Conserve Mode Thresholds		
Total memory	Enter margin	Exit margin
<= 128 MB	Free <= 5 MB	Free > 10 MB
<= 256 MB	Free <= 10 MB	Free > 20 MB
< 512 MB	Free <= 40 MB	Free > 60 MB
<= 1 GB	Free < 20%	Free > 30%
> 1 GB	Free < 12%	Free > 18%

• Actions:

- Depends on the `fail-open` setting

Like kernel conserve mode, two different thresholds determine when FortiGate enters and exits the system conserve mode. The margins also depend on the total amount of overall memory.

## Proxy Fail-Open Setting

- **av-failopen** governs FortiGate behavior for UTM-inspected traffic while in system conserve mode

```
config system global
    set av-failopen {idledrop | off | one-shot | pass}
end
```

- **idledrop** – Drops all idle proxy sessions
- **off** – All new sessions with UTM scanning enabled are not passed
- **one-shot** – Attempt UTM scanning on all new sessions
- **pass (default)** – All new sessions pass without inspection

The **av-failopen** is the CLI (only) setting that controls FortiGate's behavior while it is in system conserve mode.

### System Memory Conserve Mode Diagnostics

```
# diagnose hardware sysinfo shm

SHM counter:          10316
SHM allocated: 617643792
SHM total: 1572380672
conserve mode: on - mem
system last entered:  Fri Jun  3 10:16:39 2016
sys fd last entered:  n/a
SHM FS total: 1607806976
SHM FS free:  990134272
SHM FS avail: 990134272
SHM FS alloc: 617672704
```

Off = No system  
conserve mode  
on - mem = system  
conserve mode


**FORTINET**

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This command is used to determine if a FortiGate device is currently in system conserve mode.

## Memory Conserve Mode Event Logs

- **System conserve mode:**  
`type=event subtype=system level=critical devid=FGTxxxxxxx  
vd=root msg="The system has entered system conserve mode"  
logdesc="System entering conserve mode" free=242 sysconserve=on  
total=2024 entermargin=242 exitmargin=364 service=worker`
- **Kernel conserve mode:**  
`type=event subtype=system level=critical devid=FGTxxxxxxx  
vd=root msg="Kernel enters conserve mode" logdesc="Kernel  
enters conserve mode" conserve=on free="51131 pages" red="51200  
pages" service=kernel`

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These are the entries generated in the event logs when a FortiGate enters kernel and system conserve mode.

## Fail-Open Session Setting

- Specifies the action if a proxy runs out of connections

```
config system global
    set av-failopen-session {enable | disable}
```

- enable – Use behavior from av-failopen setting
- disable (default) – Block all new sessions



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An option related to fail-open sessions is `av-failopen-session`. This setting kicks in not during a high memory situation, but when a proxy on the FortiGate runs out of available sessions to process the traffic.

If `av-failopen-session` is enabled, then FortiGate will act according to the `av-failopen` setting. Otherwise, by default, it will block new sessions until proxy connections become available.



## Review

- ✓ Types of malware
- ✓ Heuristic, grayware and antivirus scans
- ✓ Types of antivirus databases
- ✓ Sandboxing
- ✓ Proxy-based vs. flow-based scans
  - ✓ Scanning large / compressed files
  - ✓ Order of scans
- ✓ How to scan encrypted traffic
- ✓ Searching logs for antivirus events
- ✓ Memory conserve mode

**FORTINET**

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To review, here are the topics we covered in this lesson. We discussed:


- Malware terminology
- The different types of scanning that can be enabled on FortiGate
- Three types of antivirus database
- Sandboxing and how it can be used
- Blocking botnet connections
- The difference between proxy-based and flow-based virus scanning
- The different antivirus databases
- The behavior of oversized files
- The order of operations within the virus scanning engine
- How to handle an undetected piece of malware
- Virus scanning encrypted traffic
- How to read virus detection logs
- What memory conserve mode is




In this lesson, we will show you how to set up filters to control website access. This feature is commonly used by network administrators.

## Objectives

- Identify FortiGate web filtering mechanisms
- Choose an appropriate web filtering mode
- Apply web or DNS filter profiles
- Create static URL or domain filters
- Override FortiGuard web filtering
- Apply filter exemptions and rating overrides
- Monitor logs for web filtering events





2

After completing this lesson, you should have these practical skills:

- Identify FortiGate web filtering mechanisms
- Choose an appropriate web filtering mode to manage and track web content
- Apply web or DNS filter profiles
- Create static URL or domain filters
- Override FortiGuard web filtering
- Apply filter exemptions and rating overrides
- Monitor logs for web filtering events

Accordingly, you will know how to select the appropriate URL filter method for blocking, monitoring, exempting, or allowing websites.


Familiarity with website design and behavior, as well as the HTTP protocol, are useful to understanding this lesson.


Lab exercises can help you to test and reinforce your skills.

## Why apply web filtering?

Mitigate the negative affects of inappropriate web content

- Preserve employee productivity
- Prevent network congestion
- Prevent data loss and exposure of confidential information
- Decrease exposure to Web-based vulnerabilities
- Prevent copyright infringement
- Prevent viewing of inappropriate or offensive material



3

Web filtering helps to control, or track, the websites that people visit.

There are many reasons why network administrators apply web filtering, such as to:

- preserve employee productivity,
- prevent network congestion, where valuable bandwidth is used for non-business purposes,
- prevent loss or exposure of confidential information,
- decrease exposure to web-based threats,
- limit legal liability when employees access or download inappropriate or offensive material,
- prevent copyright infringement caused by employees downloading or distributing copyrighted materials, and
- prevent children from viewing inappropriate material.



There are two ways you can apply filtering to websites: web filtering and DNS filtering.

Let's start by defining how FortiGate handles the URL filtering process.

## Configuring Inspection Mode

- Select inspection mode
  - Customizable at VDOM level

```
config system settings
  set inspection-mode flow|proxy
end
```

Protocol ports can be customized

The screenshot displays the FortiGate configuration interface. The 'System Information' tab is active, showing various system details. The 'Inspection Mode' is set to 'Proxy-based [Change]', which is highlighted with a red box. A red arrow points from the 'Customizable at VDOM level' text to this box. Below, the 'Security Profiles' section is expanded, showing a list of protocols and their corresponding port mappings. The 'Protocol Port Mapping' table is also highlighted with a red box.

Protocol	Any	Specify	Port
HTTP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	80
SMTP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	25
POP3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	110
IMAP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	143
FTP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	21
NNTP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	119
MAPI	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	135
DNS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	53

FortiGate website filters are also security profiles, which are customizable according to the selected inspection mode. So, the first step before setting up any web filter is to configure the inspection mode. Inspection mode is a *system* setting, customizable at the VDOM level.


When your FortiGate is set up to proxy inspection mode, a proxy options profile must also be defined. This profile determines the protocols that your security profiles will use, for example, to inspect web or DNS traffic.


Note that HTTPS inspection port numbers, and other settings related to the handling of SSL, are defined separately in the SSL/SSH inspection profile.

## Web Filtering Modes

Flow-based	Proxy-based
<ul style="list-style-type: none"><li>• Analyze TCP flow between client and server<ul style="list-style-type: none"><li>◦ Use <i>IPS engine</i> for inspection</li></ul></li><li>• Less latency than proxy-based</li><li>• Not as flexible as proxy-based<ul style="list-style-type: none"><li>◦ Intercepts at Layer 3</li><li>◦ Limited URL Actions</li><li>◦ Not all web filtering features are available</li></ul></li></ul>	<ul style="list-style-type: none"><li>• Intercept traffic between client and server<ul style="list-style-type: none"><li>◦ Use a transparent proxy</li></ul></li><li>• More latency and resource intensive</li><li>• Most inspection options available<ul style="list-style-type: none"><li>◦ Intercepts at Level 7</li></ul></li></ul>

Both inspect full URL and offer customizable block pages






FortiGate's inspection modes have different considerations to filter websites:

- Flow-based web filtering is achieved by analyzing the TCP flow of the traffic between the client and the server. It provides less flexibility, and has less configuration options to inspect web traffic. It intercepts at Layer 3 and works with the Layer 4 data.
- Proxy-based web filtering is achieved using a transparent proxy that intercepts traffic between the client and the server. Proxy-based provides more flexibility to inspect web traffic because it intercepts at Layer 7. It also has more configuration options. However, note that this option uses more CPU resources.

## DNS-Based Web Filtering

- Use DNS queries to decide access
- FortiGate must use FortiGuard DNS service for DNS lookups
  - DNS queries redirected to FortiGuard SDNS server
- Lightweight
  - Lacks the precision of HTTP filtering
- SSL inspection never required
  - DNS is plaintext
- Cannot inspect URL, only host name
  - DNS resolves host name
- Supports URL filtering and FortiGuard category only

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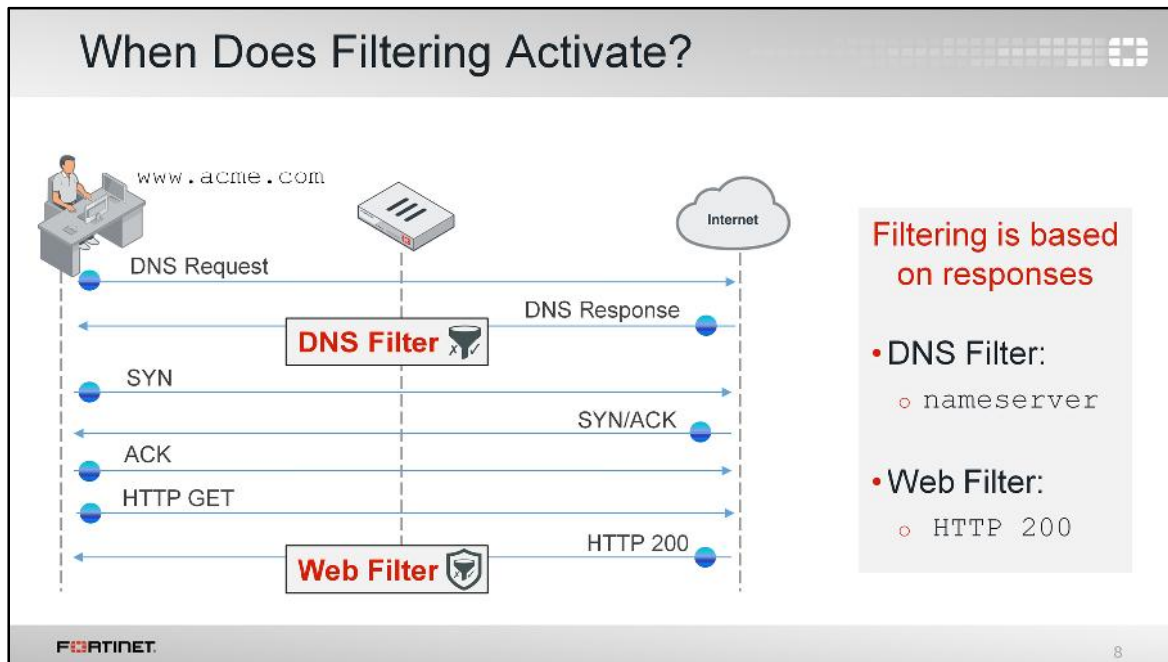
As mentioned, you can also inspect DNS traffic, but this option is limited only to proxy-based mode, and is presented as a new security profile feature.

How does it work?

Rather than looking at the HTTP protocol, this option filters the DNS request that occurs prior to an HTTP GET request. This has the advantage of being very lightweight, but at a cost, because it lacks the precision of HTTP filtering.

Every protocol will generate DNS requests in order to resolve a host name, therefore this kind of filtering will impact all of the higher level protocols that depend on DNS, not just web traffic. For example, it could apply FortiGuard categories to DNS requests for FTP servers. Very few web filtering features are possible beyond host name filtering, due to the amount of data available at the point of inspection.





(slide contains animation)

This example illustrates the difference between the traditional HTTP filter and filtering at the DNS lookup process.

(click)

DNS filtering looks at the `nameserver` response, which typically occurs when you connect to a website.

(click)

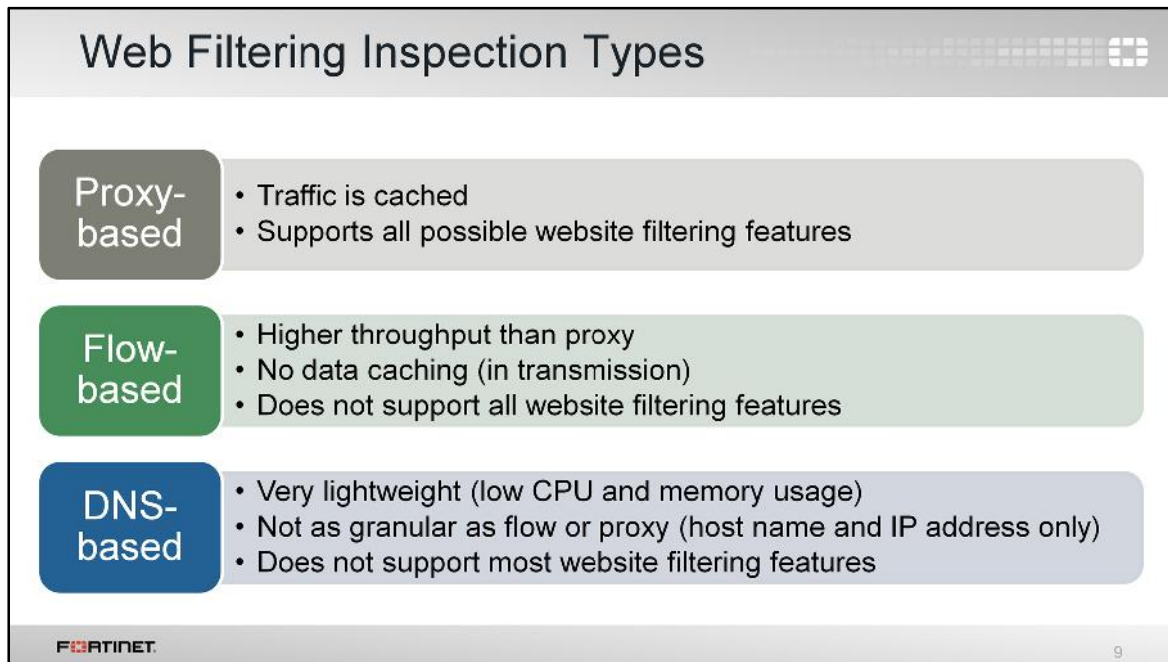
Web filtering looks for the `HTTP 200` response, returned when you successfully access the website.

So, as shown, in HTTP the domain name and URL are separate pieces. The domain name might look like this in the header: `Host: www.acme.com`, and the URL might look like this in the header: `/index.php?login=true`.

If we filter by domain, sometimes it blocks too much. For example, the blogs on `tumblr.com` are considered different content, because of all the different authors. In that case, you can be more specific, and block by the URL part, `tumblr.com/hacking`, for example.

Remember the `Host:` header? That is what gets the DNS lookup before the HTTP request.

Obviously the URL is not in a DNS request.

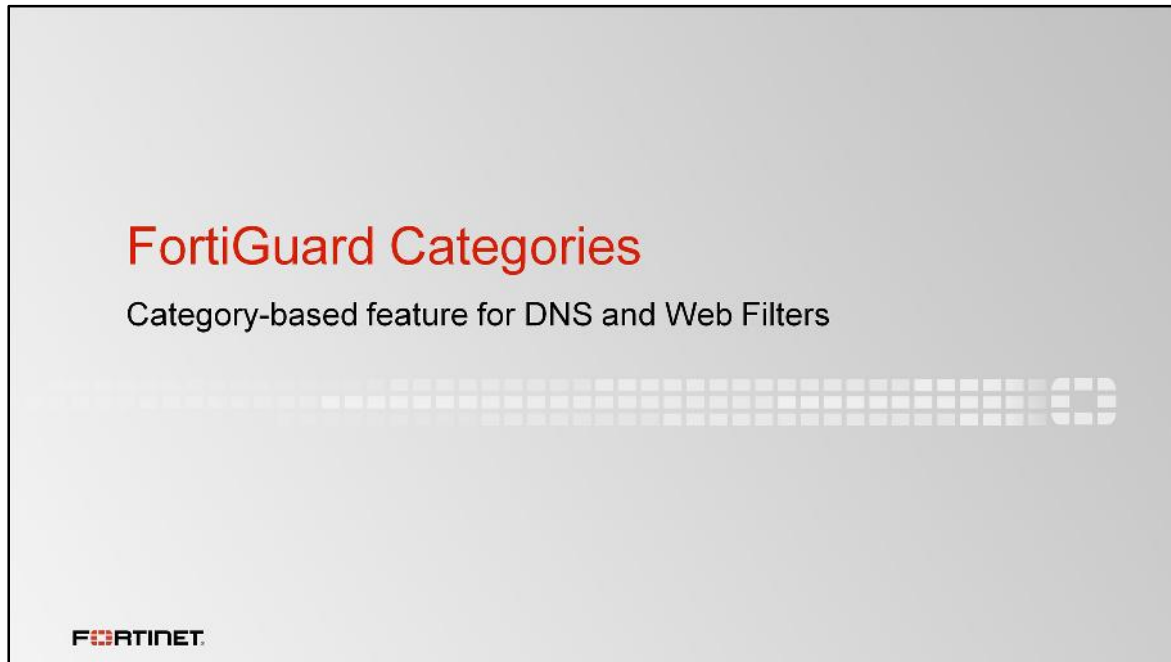


Let's summarize the web inspection modes.

Proxy-based caches traffic, so it can cause a noticeable delay depending on the file size, oversize limit, and connection speed. It does, however, support a greater number of web filtering features.

Flow-based has a higher throughput rate, compared to proxy-based, because it does not cache data so there is no transmission delay.


DNS-based is very lightweight because it handles only the `nameserver` lookup, but suffers from accuracy issues because it does not see the full URL.




Now, let's see how FortiGate applies DNS and web filtering by querying the FortiGuard categories.

## FortiGuard Category Filter

- Split into multiple categories and sub-categories
  - Release new categories and sub-categories compatible with updated firmware
  - Older firmware has new values mapped to existing categories
- Live connection to FortiGuard
  - Active contract required
  - 7-day grace period on expiry
- FortiManager can be used instead of FortiGuard





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Rather than block or allow websites individually, FortiGuard category filtering looks at the category that a website has been rated with. The action is taken based on that category, and not based on the URL itself.

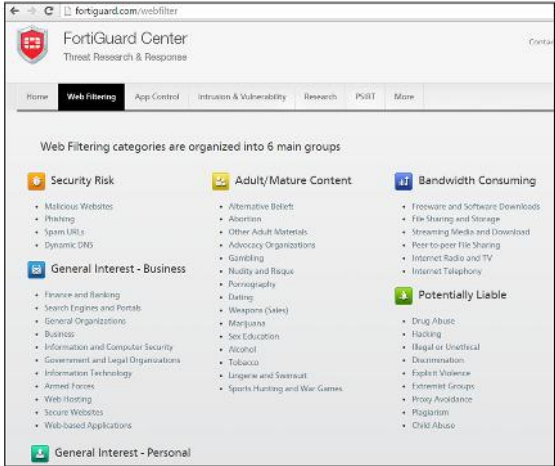
FortiGuard category filtering is a live service that requires an active contract, which validates connections to the FortiGuard network. If the contract expires, there is a 7-day grace period to renew it before the service cuts off. So, after the 7-day grace period, FortiGate will not be able to rate websites and every visit will be treated as a rating error.

Also, FortiManager can be configured to act as a local FortiGuard server instead. For this it is necessary to download the databases into FortiManager and configure your FortiGate to validate the categories against FortiManager instead of FortiGuard.

## How Categories are Decided?

FortiGate queries the FDN to determine a website category

- Web filter rating determined by:
  - Human rater
  - Text analysis
  - Exploitation of web structure
- Description of categories:
  - [www.fortiguards.com/webfilter](http://www.fortiguards.com/webfilter)



The screenshot shows the FortiGuard Center website with the 'Web Filtering' tab selected. It displays a list of web filtering categories organized into six main groups: Security Risk, Adult/Mature Content, Bandwidth Consuming, General Interest - Business, General Interest - Personal, and Potentially Liable. Each group contains a list of specific categories and subcategories.

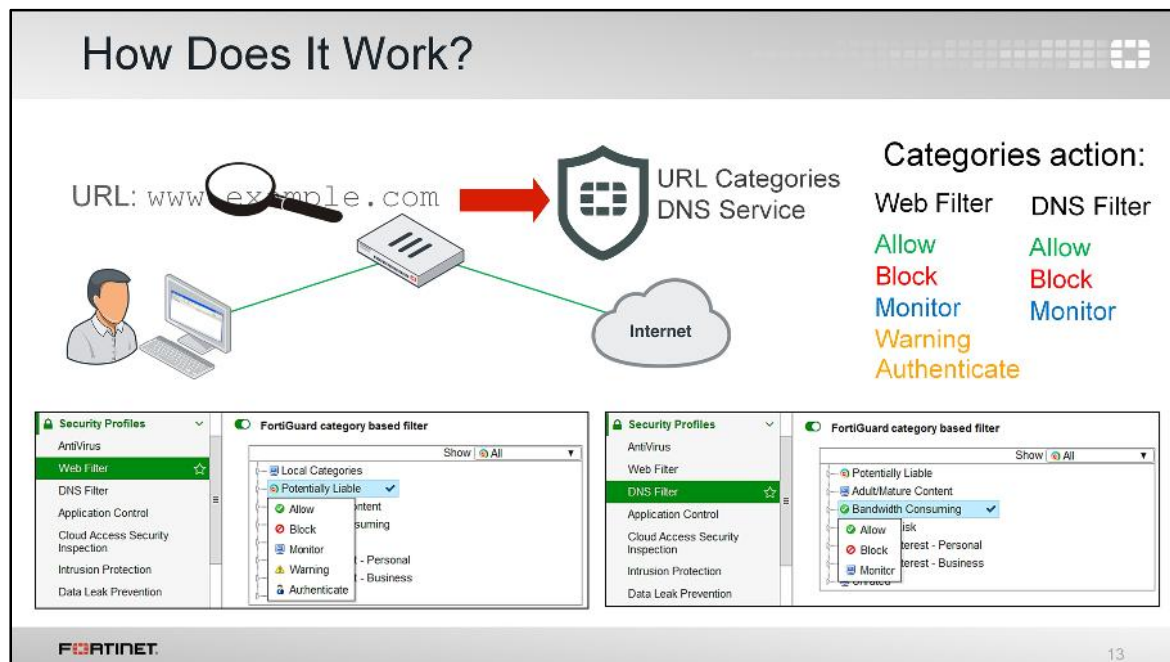
Fortinet

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How does FortiGuard decide the categories?

Website categories are determined by both automatic and human methods. The FortiGuard team has automatic web crawlers that look at various aspects of the website in order to come up with a rating. There are also people who examine websites and look into rating requests to determine categories.

To review the complete list of categories and subcategories, go to [www.fortiguards.com/webfilter](http://www.fortiguards.com/webfilter).



So, how does it work?

FortiGate queries the FortiGuard Distribution Network (FDN)—or the FortiManager if it has been configured to act as a local FortiGuard server—to determine the category of a requested webpage.

Hence, when users visit websites, FortiGate uses the FortiGuard live service to find out the category for the URL and take a configured action for that category, such as allow or block access. With this feature, you can perform bulk URL filtering without needing to individually define each website.


Also, to use the FortiGate's DNS filter, you must use the FortiGuard DNS service for DNS lookups. DNS lookup requests sent to the FortiGuard DNS service return with an IP address and a domain rating that includes the FortiGuard category of the webpage.

You can enable the FortiGuard category filtering on the web filter or DNS filter profiles. Categories and sub-categories are listed, and the action to perform can be individually customized.

The available actions are: allow, block, monitor, warning, and authenticate. Warning and authenticate are exclusively category-based actions. Let's see how they work.

## Web Filter FortiGuard Category Action: Warning

- Category Action =
  - ✓ Allow
  - ✗ Block
  - 📺 Monitor
  - ⚠ Warning
  - 🔑 Authenticate
- Exclusive for Web filtering
  - Proxy-mode only
  - Not available at:
    - Static URL filtering feature
    - DNS filter profile
- FortiGuard Warning Page
  - Customizable warning interval



FortiGate - FGVM100...

FortiGuard Web Filtering

Powered by FortiGuard

**Web Page Blocked!**

You have tried to access a web page which is in violation of your internet usage policy.

URL: http://youtube.com/  
Category: Streaming Media and Download  
Client IP: 10.0.1.10  
Server IP: 216.58.192.238  
User name:  
Group name:

To have the rating of this web page re-evaluated [please click here.](#)

The warning action is only available for proxy-based inspection. This action informs users that the requested website is not allowed by the internet policies. However, it gives the choice to go to the website or go back to the previous website.

The warning interval can be customized, so you can present this warning page at a specific time during your configured period.



The authenticate action is also a FortiGuard category-based action for proxy-based inspection. This action blocks the requested websites, unless the user enters a successful passcode.

The interval of time to allow access with this category is customizable. So users are not prompted to authenticate again if they access other websites in the same category, until the timer expires.


You can apply this action to define individual users that belong to any authentication group.



## FortiGuard Quotas


- Only for Web Filter
  - With proxy-mode inspection
- Can only apply to the actions:
  - **Monitor, Warning, or Authenticate**
- Assign quota for each source IP
  - Or for each user if authentication is enabled
- Dedicated monitor feature

### Configuration:



Category	Quota
Games	15 min

### Monitor:



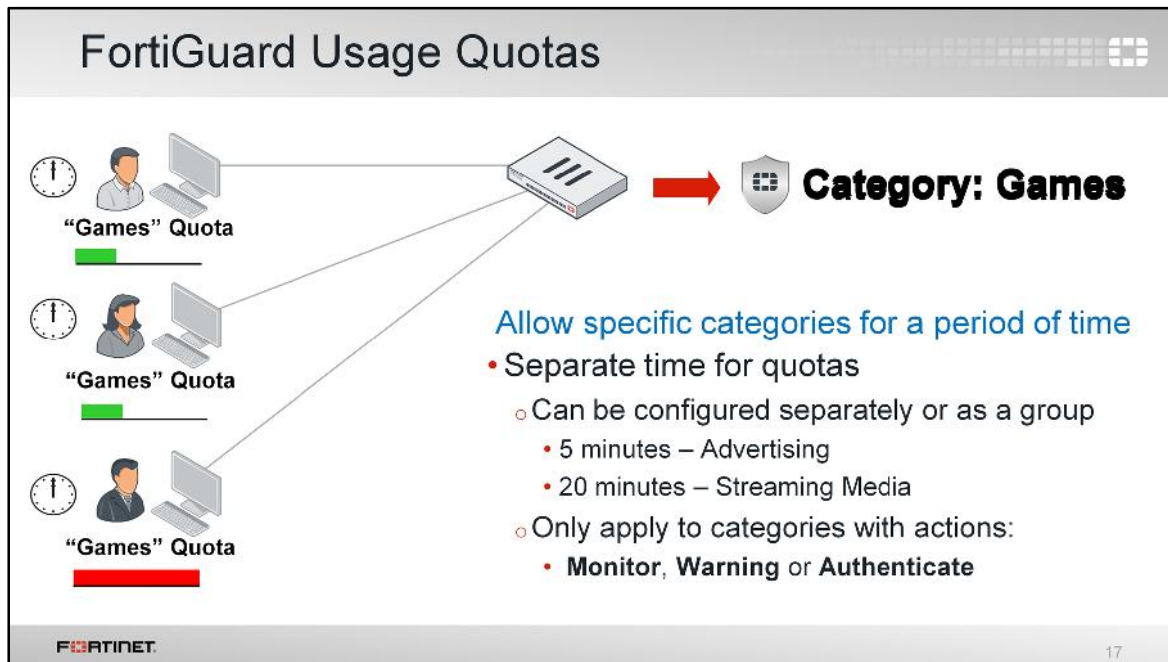
User	Web Filter Profile	Used Quota
10.0.1.10	default	5 Minutes 34 Seconds

There's also another feature to customize quotas of time to access the categories set up to monitor, warning, or authenticate in the web filter profile.

You can customize multiple quotas (timers). Each one can either be linked to a single category or multiple categories. If the quota applies to multiple categories, the timer is shared among all the categories instead of having a single timer for each individual category.

If the authentication action is not enabled, FortiGate automatically assigns the quotas for each source IP as the monitor feature shows.

Let's see how quotas work.



As illustrated, the FortiGuard quota limits the time users spend on websites, based on category.

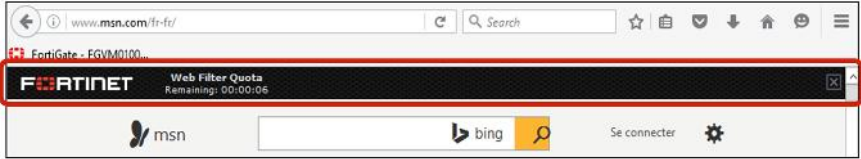

A quota cannot redirect you once the website is loaded in the browser. For example, if you have 45 seconds left on your quota, and you access a website from this category, it will likely finish loading before the remaining 45 seconds. Then you can stay in that site, and it won't be blocked until the browser is refreshed.

The reason for this is that the connection to the website is not generally a live stream. Once you receive the information, the connection is closed.

## Fortinet Bar

Provide direct feedback to users

- Related to security profiles
  - FortiGuard Quota, application control, etc.
- Is a proxy option
  - Communication port by default: 8011



FORTINET

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Some FortiGate features can't provide direct feedback to users. For example, FortiGuard quota doesn't provide any feedback until users exceed the quota and refresh the browser, unless the Fortinet bar is enabled.


The Fortinet bar injects a Java applet that communicates to FortiGate and gets additional information from features that would otherwise provide no direct feedback.

The Fortinet bar provides a countdown for FortiGuard quotas. Other features that can't block pages (for example, application control) will show block events in the top bar.

## Web Filter Cache

Improves performance by reducing requests to FortiGuard

- Cache is checked before sending request to FortiGuard server
  - FortiGate remembers response of visited websites
  - TTL settings control the number of seconds query results are cached
  - Request is considered a rating error after timeout (15 seconds as default)
- UDP ports 53 or 8888 for FortiGuard or FortiManager communications



```
config system fortiguard
set webfilter-cache enable|disable
set webfilter-cache-ttl 300-86400
set webfilter-timeout 1-30
end
```

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FortiGate can maintain a list of recent website's rating responses in memory, so if the URL is already known, FortiGate doesn't send back a rating request.

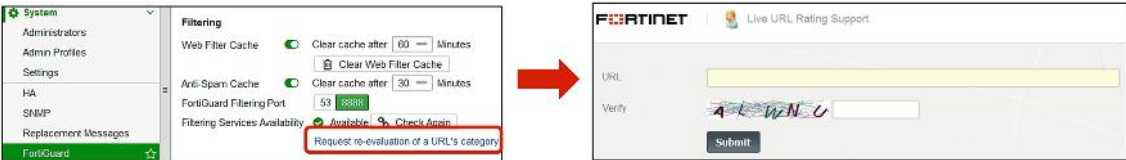
Two ports are available to query the servers (FortiGuard or FortiManager): port 53 and port 8888. Port 53 is the default, since it is also the port used for DNS and almost guaranteed to be open. However, any kind of inspection will reveal that this traffic is not DNS and prevent the service from working. In this case, you can switch to the alternate port 8888, but this port is not guaranteed to be open in all networks, so you will need to check beforehand.

Caching responses reduces the amount of time it takes to establish a rating for a website. Also, memory lookup is much quicker than packets travelling on the Internet.

The timeout defaults to 15 seconds, but can be adjusted as high as 30 seconds if necessary.


## FortiGuard Rating Submissions

- Request to re-evaluate a website's rating:



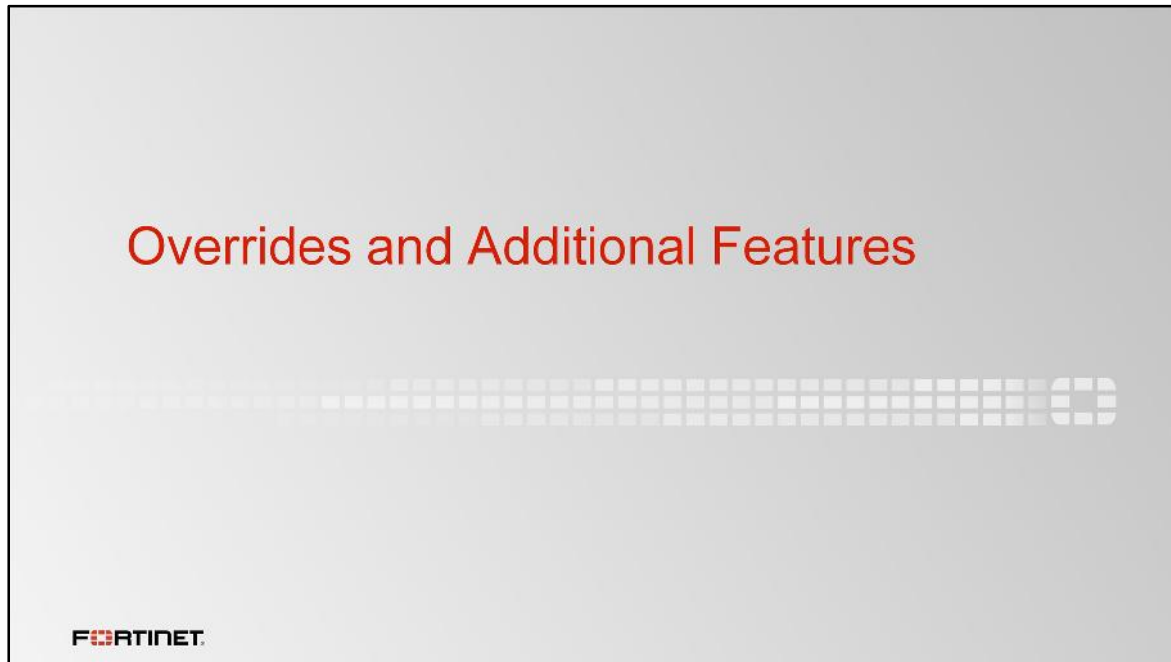
The screenshot shows the FortiGuard Rating Submissions interface. On the left, there is a sidebar with a 'System' menu. The main content area is titled 'Filtering' and contains several settings: 'Web Filter Cache' (checked), 'Clear cache after' (60 Minutes), 'Clear Web Filter Cache' (button), 'Anti-Spam Cache' (checked), 'Clear cache after' (30 Minutes), 'FortiGuard Filtering Port' (53), and 'Filtering Services Availability' (Available). A red box highlights the 'Check Again' button next to 'Filtering Services Availability'. A red arrow points from this button to the 'Live URL Rating Support' form on the right. The form has a 'URL' field, a 'Verify' field, and a 'Submit' button.

- Request for a website rating: [www.fortiguards.com/webfilter](http://www.fortiguards.com/webfilter)



The screenshot shows the FortiGuard Rating Submissions interface. On the left, there is a sidebar with a 'System' menu. The main content area is titled 'URL/IP Rating & Info' and contains a search bar and a 'Search' button. A red arrow points from the search bar to the 'Classification/Rating Request' form on the right. The form has fields for 'Name\*', 'Company\*', 'Email\*', and a 'Comment' text area.


There is always the possibility for errors in ratings, or a scenario where you simply do not agree with the rating given. So, you can use the web portal to contact the FortiGuard team to submit a website for a new rating, or get it rated if it is not already in the database.



Category filtering is not granular like static URL filtering. If you want to change any default FortiGuard categories, FortiGate provides an override option.

## Web Rating Override

- Override the rating applied to a host name by FortiGuard Service
  - Host name reassigned to a completely different category and uses that action
  - Rating overrides are checked prior to contacting FortiGuard for a rating
- Override applies to FortiGate device only
  - Changes are not submitted to FortiGuard Subscription Services
- Host names only
  - google.com ✓
  - www.google.com ✓
  - www.google.com/index.html ✗
  - google.\* ✗

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When using FortiGuard category filtering to allow or block access to a website, one option is to make a web rating override and define the website into a different category. Web ratings are only for host names—no URLs or wildcard characters are allowed.

If the contract expires, and the 7-day grace period passes, web rating overrides will be not be effective. All website categories will still be considered rating errors.

## Web Rating Override: Configuration

- Change a website category, not the category action
  - Make an exception

FortiGate VM64 FGVM010000051907 Interim admin

Security Profiles

- AntiVirus
- Web Filter
- DNS Filter
- Application Control
- Cloud Access Security Inspection
- Intrusion Protection
- Data Leak Prevention
- FortiClient Profiles
- Proxy Options
- SSL/SSH Inspection
- Web Rating Overrides**
- Web Profile Overrides

+ Create New Edit Delete Custom Categories Search

URL	Override Category	Original Category	Status
Business			
fortinet.com	Business	undefined	Enabled
Phishing			
somewebste.org	Phishing	undefined	Enabled

Edit Web Rating Overrides

URL:  Lookup Rating

Override to

Category:

Sub-Category:

OK Cancel

If you want to make an exception, for example, rather than unblock access to a potentially unwanted category, just change the website to an allowed category. The reverse can also be performed, you can block a website that belongs to an allowed category.

Remember that changing categories does not automatically result in a different action for the website. This will depend on the settings within the web filter profile.



## Custom Categories

Additional customized categories can be added

- Categories *in use* cannot be deleted

Name	Number of Override URLs	Number of Web Filter Profile References
custom1	0	1
custom2	0	1

If the predefined categories within FortiGuard are not suitable for the situation, you can add additional customized categories.

These custom categories can be added and deleted as needed, so long as they are not in use.

## Web Profile Overrides

- Change web filter profile for a:
  - User
  - User group
  - Source IP
- Require authentication
  - FortiGuard block page link
- Customize override expiration
- Only for proxy-based

FortiGate VM64 Local

Interim

admin

Security Profiles

AntiVirus

Web Filter

DNS Filter

Edit Web Filter Profile

Name

Comments

Default web filtering.

22:05

New Administrative Override

Scope Range

User

User Group

Source IP

User

Student

Original Profile

default

New Profile

monitor-all

Expires

0

0

15

Days

Hours

Minutes

(Expires: 4/27/2016, 10:16:00 AM)

OK

Cancel

FortiGate VM64 Local

Interim

admin

Security Profiles

AntiVirus

Web Filter

DNS Filter

Application Control

Cloud Access Security Inspection

Intrusion Protection

FortiClient Profiles

Proxy Options

SSL/SSH Inspection

Web Rating Overrides

Web Profile Overrides

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You can also override the filter profile. Web profile overrides change the rules that are used to inspect traffic. It authorizes some users, user groups, or predefined source IPs, to use a different web filter profile to inspect their traffic.

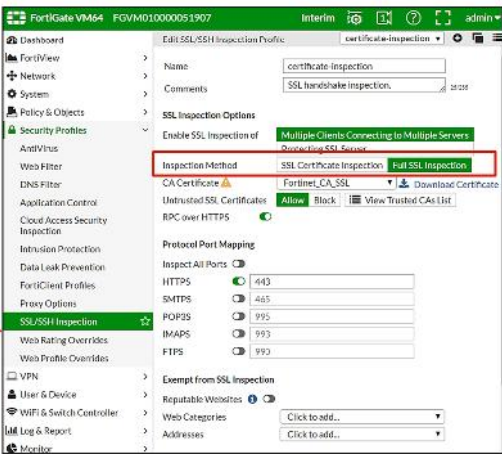
In the example shown here, the new profile applied to the user **Student** inspects all of their web traffic from that point on, until the timer expires. To use this, an override authentication must be enabled. Once the web profile override is enabled, the FortiGuard block page will show a link that users can select to activate the override.

This feature is available only if FortiGate is set to perform proxy-based inspection.

## HTTPS Scanning

HTTPS traffic is HTTP traffic encased on an SSL encrypted tunnel

- Encrypted point-to-point
  - Port 443 (instead of 80).
- Is handled by SSL inspection profile
  - **SSL Certificate Inspection**
    - Reads only unencrypted details
    - SNI details (if they are present)
    - Certificate CA
  - **Full SSL Inspection**
    - Breaks SSL communications by a proxy
    - Allows full content scanning



FortiGate VM64 FGVMD10000091907 Interim admin

Dashboard  
FortiView  
Network  
System  
Policy & Objects  
Security Profiles  
Antivirus  
Web Filter  
DNS Filter  
Application Control  
Cloud Access Security Inspection  
Intrusion Protection  
Data Leak Prevention  
FortiClient Profiles  
Proxy Options  
SSL/SSH Inspection  
Web Rating Overrides  
Web Profile Overrides  
VPN  
User & Device  
WiFi & Switch Controller  
Log & Report  
Monitor

Edit SSL/SSH Inspection Profile: certificate-inspection

Name: certificate-inspection  
Comments: SSL handshake inspection, 2020

SSL Inspection Options

Enable SSL Inspection of: Multiple Clients Connecting to Multiple Servers, Protecting SSL Server

Inspection Method: SSL Certificate Inspection, Full SSL Inspection

CA Certificate: Fortinet\_CA\_SSL, Download Certificate

Untrusted SSL Certificates: Allow, Block, View Trusted CAs List

RPC over HTTPS: 0

Protocol Port Mapping

Inspect All Ports: 0

HTTPS: 443  
SMTPS: 465  
POP3S: 995  
IMAPS: 993  
FTPS: 992

Exempt from SSL Inspection

Reputable Websites: 0

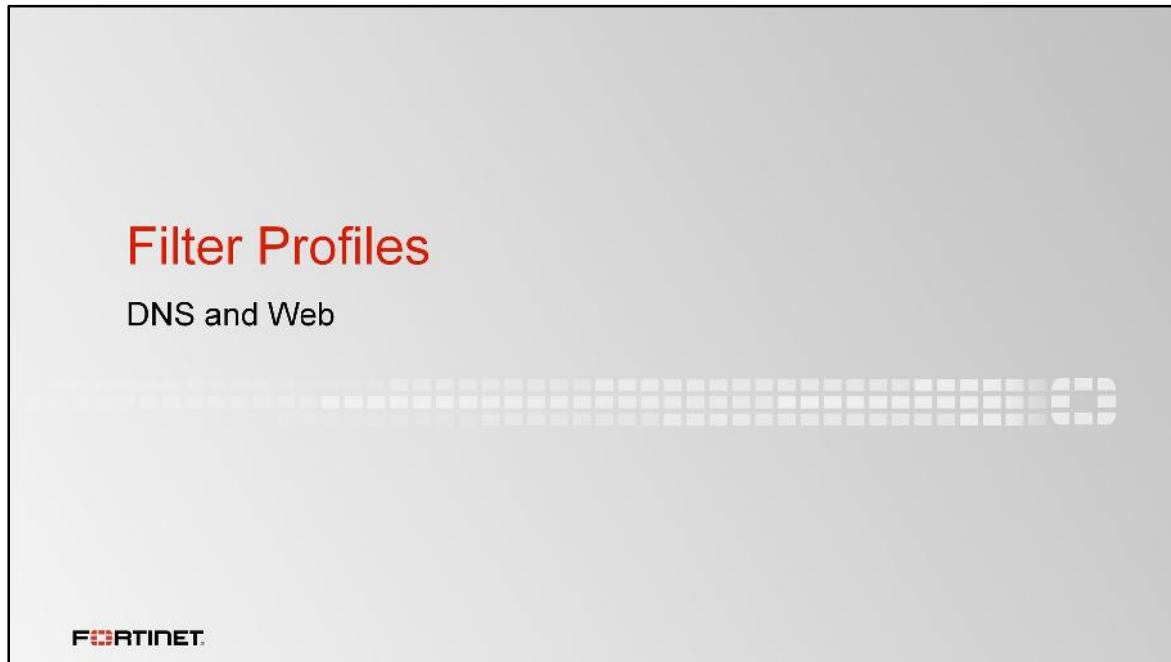
Web Categories: Click to add...  
Addresses: Click to add...

As you have noticed so far, web filtering only applies to the HTTP protocol. So, how does FortiGate scan traffic over HTTPS?

FortiGate scans HTTPS sites through the SSL inspection profile settings. This security profile must to be applied to the firewall policy too.

The **SSL Certificate Inspection** method reads only unencrypted data from the `hello` message, whereas the **Full SSL Inspection** method will proxy SSL, allowing for full content inspection.

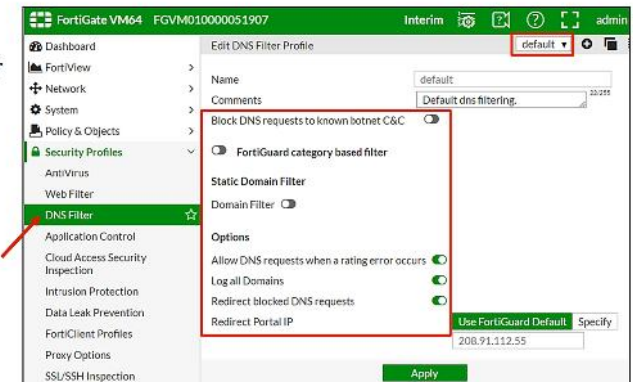
SSL and certificates are covered in more detail in the *FortiGate II: Certificate Operations* lesson.



Let's examine the DNS and web filter security profiles, which allow you to perform individual and local filtering actions, rather than use the FortiGuard categories.

## DNS filter

- DNS filter settings:
  - Enable/disable FortiGuard category based filter
  - Enable/disable static domain filter
  - Block DNS request to known botnet command and control
  - Allow access when rating error occurs
  - Redirect blocked requests to a specific portal
- Only proxy-based inspection
- Apply profile to firewall policy



Here's a look at the new DNS filter profile. This security profile is only available when FortiGate is set to perform proxy-based inspection.

The DNS filter includes various configuration settings. You can enable or disable the FortiGuard category-based filter and the static domain filter. You also have the option to:

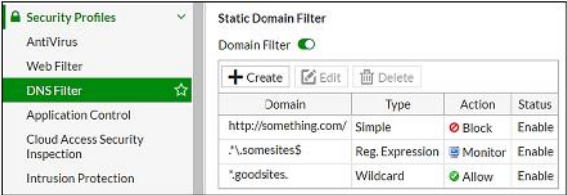
- block DNS requests to known botnet command and control,
- allow DNS requests when a rating error occurs from the FortiGuard web filter service, and
- redirect blocked requests to a specific portal (the **Use FortiGuard Default** setting is recommended).

Once you have enabled and saved the settings you require, remember to apply this profile to your firewall policy to activate the options. Any traffic being examined by the policy will have those operations applied to it.

## Static Domain Filter

Look into DNS packets

- Actions to DNS requests
  - Block, allow, or monitor
- Patterns
  - Simple, wildcards, and regex



Domain	Type	Action	Status
http://something.com/	Simple	Block	Enable
*.somesites\$	Reg. Expression	Monitor	Enable
*goodsites.	Wildcard	Allow	Enable

```
config dnsfilter urlfilter
edit 1
set name "default"
config entries
edit 1
set url "http://something.com/"
set type simple
set action block
set status enable
next
end
next
end
```

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You can configure DNS filtering to allow, block, or monitor access to web content through the static domain filter. Entries in the domain list are checked against the visited websites. If a match is found, the configured action is taken.

Patterns set to the type **Simple** are exact text matches. Patterns set to **Wildcard** allow for some flexibility in the text pattern by allowing wildcard characters and partial matching to occur. Patterns set to **Reg Expression** allow for the use of PCRE regular expressions.

With this feature you can prevent lots of HTTP requests from ever being made, because the initial lookup fails. That's the performance tradeoff.

## DNS - Botnet Command and Control Database

The screenshot shows the FortiGate VM64 interface. On the left, the 'FortiGuard' menu is expanded, showing 'License Information' and 'Botnet Domains'. The 'Botnet Domains' section is highlighted, showing 'Version 1.00392' and a 'View List' button. A red box highlights the 'Botnet Domains' section. On the right, the 'Botnet C&C Definitions' table is shown, listing various domains and their names. A red box highlights the 'Botnet C&C Definitions' table. Below the table, a red box highlights the 'Block DNS requests to known botnet C&C' checkbox, which is checked. A red box also highlights the '33027 domains in botnet package' text.

- Block botnet command and control
  - Import FortiGuard botnet database
  - Requires FortiGuard web filtering license

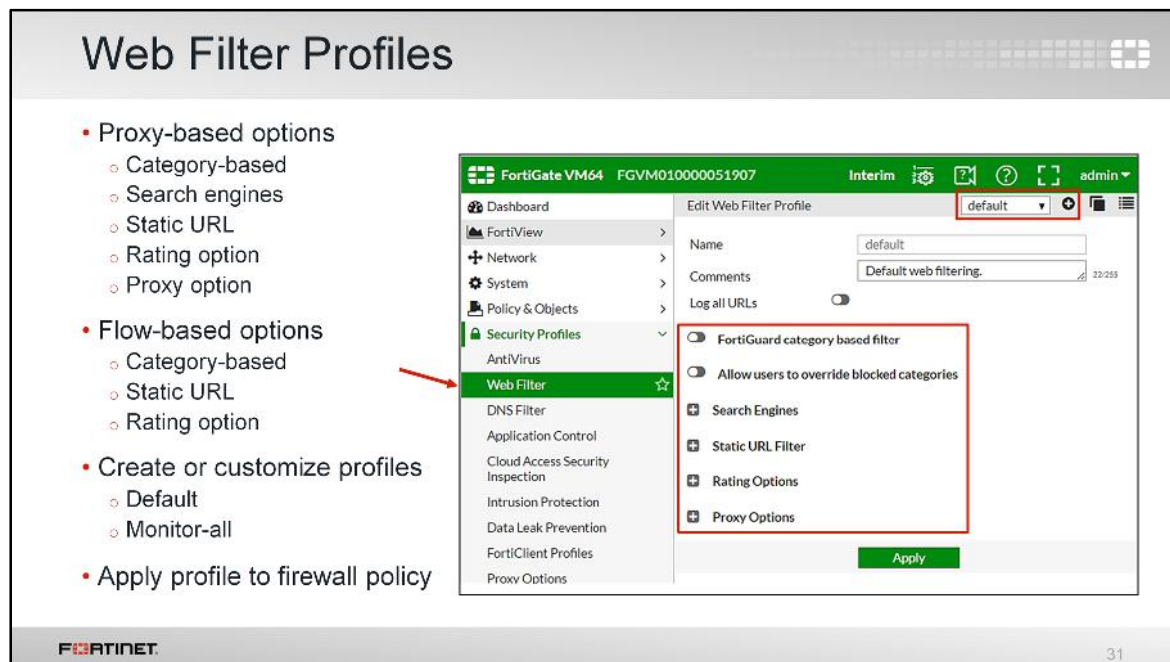
FQDN	Name
akzvorjbdtxsgrobydhirojbiz	Other
laughcontinue.net	Other
karateandbox.com	Other
talcaldone.com	Other
citorjobzone.com	Other
yourxbalance.su	Other
ferdzo.com.mk	Other
candidate-refuse.com	Other
fefezptkirkvzplfmbmwtoibnj.net	Other
becauselabor.net	Other
article-strike.com	Other
002mom.com	Other
traflabius-go.ru	Other

When you enable **Block DNS request to known botnet C&C** from your DNS filter profile, DNS lookups are checked against the botnet command and control database. This database is dynamically updated from FortiGuard and stored on FortiGate.

All matching DNS lookups are blocked. Matching uses a reverse prefix match, thus all subdomains are also blocked.

This service requires an active web filtering license.





Now let's look at the web filter profile.

This security profile supports both proxy-based and flow-based inspection modes. However, depending on the mode you select, the available settings are different. The flow-based inspection has fewer available options.

In this example, FortiGate is set to perform a proxy-based inspection. The FortiGuard category-based filter divides the websites based on categories and sub-categories by FortiGuard, as explained previously. Other local options (which we'll discuss over the next few slides) include:

- **Search Engines**
- **Static URL Filter**
- **Rating Options**
- **Proxy Options**

Once your filter is configured, apply this profile to your firewall policy so the filter is applied to your web traffic.




## Search Engines

- Restrict websites/images from search results
  - Rewrites the search URL to enable Safe Search
    - For Google, Yahoo, Bing, and Yandex
- YouTube EDU available
  - Needs the ID provided by YouTube
  - Does not append the URL, adds HTTP headers instead
- Log all search keywords

### Search Engines

- Enforce 'Safe Search' on Google, Yahoo!, Bing, Yandex ☒
- YouTube Education Filter ☒
- Custom YouTube ID
- Log all search keywords ☒

```
config webfilter profile
edit default
config web
set safe-search url
set safe-search header
end
end
```



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Search engines filtering provide two important features: safe search and YouTube EDU filtering.

- Safe search is an option that some browsers have to apply internal filters to the search results. When you enable safe search for the supported search sites, code is appended to the URL to enforce its use. For example, on a Google search it would mean adding the string `&safe=active` to the URL in the search. So, even if it is not locally enabled in the browser, FortiGate will apply it to the requests when it passes through. It supports safe search for Google, Yahoo, Bing, and Yandex.
- YouTube EDU filtering is a service offered by YouTube to educational institutions. Unlike normal safe search, this does not append the URL, but adds an HTTP header into the packets. FortiGates requires the YouTube ID provided when you created your account, as this identifies your institution to YouTube when people visit. Within your YouTube EDU account, you can configure the filters and settings in order to limit video access.

## URL Filtering

Check against configured URLs in URL filter

- Entries are checked from top to bottom
- Four possible actions:
  - exempt, allow, block, or monitor
- Type of URL patterns:
  - Simple, wildcards, or regular expressions

URL: `www.somesite.com/someurl`

Block

Internet

FORTINET

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(slide contains animations)

Static URL filtering is another web filter feature. Similar to static domain filter, configured URLs in the URL filter are checked against the visited websites. If a match is found, the configured action is taken. URL filtering has the same patterns as static domain filtering: simple, wildcard, and regular expressions.

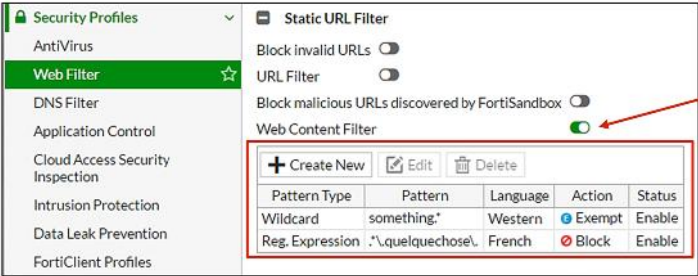
Let's see an example of how it works.  
(click)

When a user visits a website, FortiGate looks at the URL list for a matching entry. In this example, the website matches the third entry in the table, which is set up as type **Simple**. This type means that the match must be exact—there is no option for a partial match with this pattern. Also, the action is set up to **Block**, thus FortiGate will display a block page message.

## Web Content Filtering

Control access to webpages containing specific patterns

- Scan the content of every website accepted by security policies
- Match content from wildcards or Perl regular expressions
- The maximum number of web content patterns in a list is 5000
- Actions:
  - Exempt
  - Block



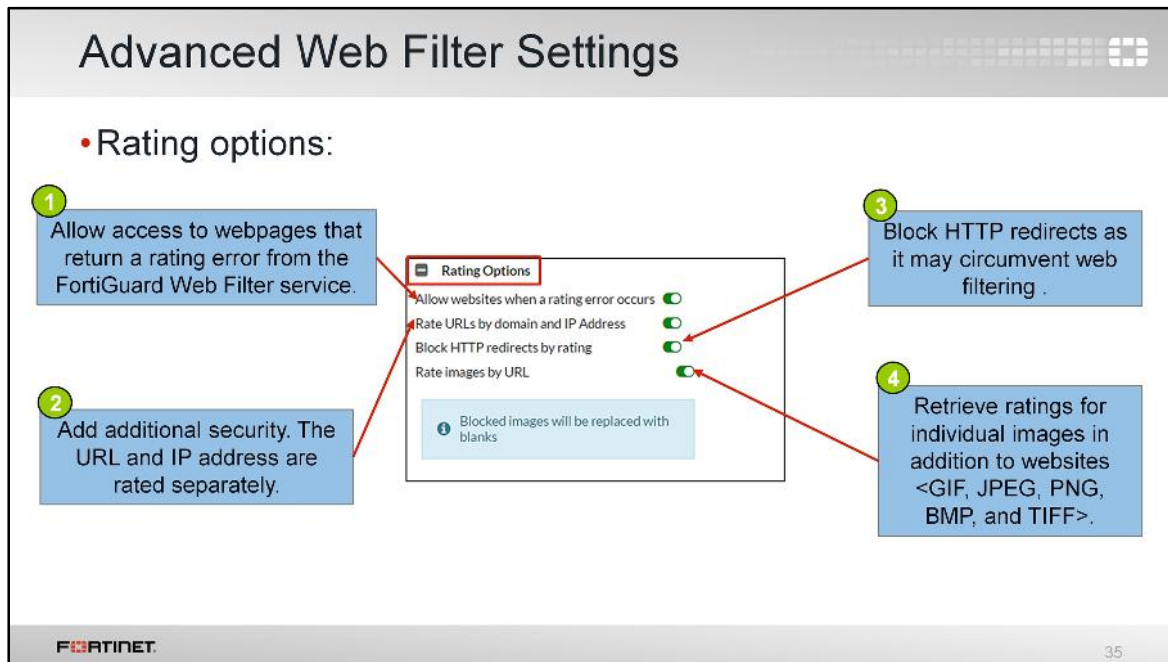
Pattern Type	Pattern	Language	Action	Status
Wildcard	something.*	Western	Exempt	Enable
Reg. Expression	.*quelquechose.*	French	Block	Enable

You can also control web content in the web filter profile by blocking access to webpages containing specific words or patterns. This helps to prevent access to pages with questionable material.

You can also add words, phrases, patterns, wildcards, and Perl regular expressions to match content on webpages. This feature is configured per web filter profile, not at the global level. So it is possible to add multiple web content filter lists and then select the best list for each web filter profile.

The system administrator can specify banned words and phrases and attach a numerical value, or score, to the importance of those words and phrases. When the web content filter scan detects banned content, it adds the scores of banned words and phrases in the page. If the sum is higher than a threshold set in the web filter profile, FortiGate blocks the page.

The maximum number of web content patterns in a list is 5000.



You can use the advanced web filtering settings to improve the web filter.

The rating options are:

1. If a rating error occurs from the FortiGuard Web Filter service, users will have full unfiltered access to all websites (`error-allow`)
2. Rate URLs by domain and IP Address. This option sends both the URL and the IP address of the requested site for checking, providing additional security against attempts to bypass the FortiGuard system (`rate-server-ip`)
3. Block HTTP redirect to avoid websites designed to circumvent web filtering.
4. Rate images by URL. This option replaces blocked images with blanks, even if they are part of a site in an allowed category (`rate-image-urls`)

## Advanced Web Filter Settings

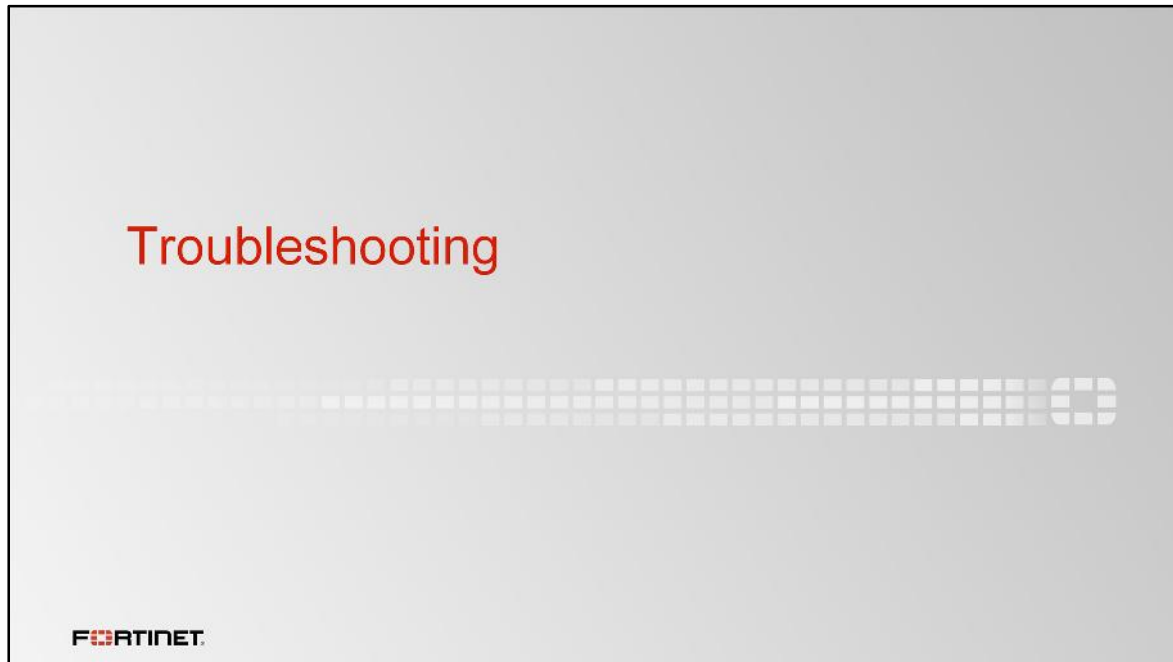
• Proxy options:

- 1 Restrict Google account usage to specific domains by configuring the Google domains you want to allow.
- 2 FortiGate displays a detailed replacement message for 400 and 500-series HTTP errors.
- 3 Limit users from sending information and files to websites.
- 4 Filter ActiveX, Java Applets, and Cookies from web traffic.

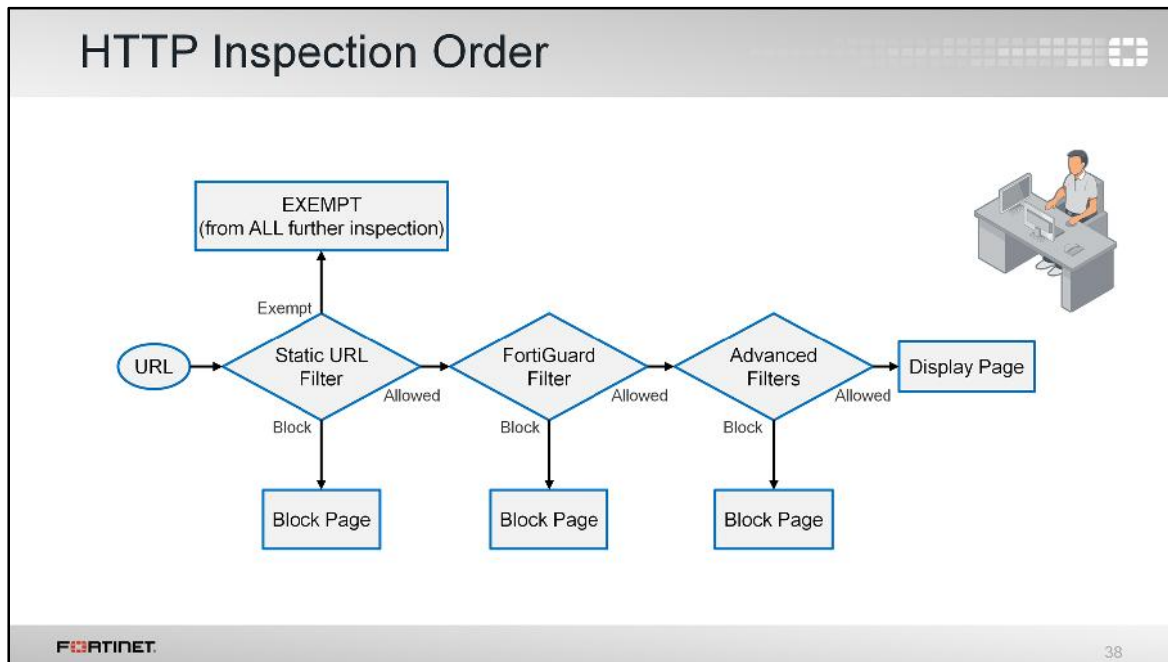
The screenshot shows the 'Proxy Options' configuration page in FortiGate. It includes a table for domain restrictions, a section for HTTP POST actions, and checkboxes for filtering Java Applets, ActiveX, and Cookies. Red arrows point from the numbered list items to the corresponding settings in the interface.

The advanced proxy option settings for web filtering are:

1. Block access to some Google accounts and services. You can include an exception list.
2. FortiGate displays its own replacement message for 400 and 500-series HTTP errors. If the server error is allowed through, some sites can use these common error pages to circumvent web filtering.
3. Filter Cookies, Java Applets, and ActiveX scripts from web traffic.
4. HTTP POST is the command used by your browser when you send information, so you can limit users from sending information and files to websites. The allow option prevents a server time-out when scanning or when other filtering processes are performed for outgoing traffic.



Finally, let's examine how to monitor the web filtering features and troubleshoot any issues.



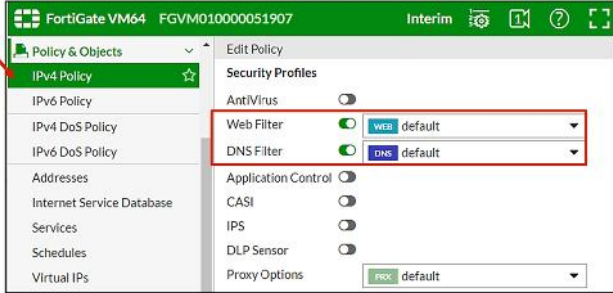
Remember that the web filtering profile has several features. So if you have enabled many of them, the inspection order flows as follow:

1. The local static URL filter
2. FortiGuard category filtering (to determine a rating)
3. Advanced filters (such as safe search or removing Active X components)

For each step, if there is no match, FortiGate will move on to the next check enabled.

## Apply the Filters

- It's not working? Why?
  - Did you apply the security profiles to the firewall policies?



```
config firewall policy
  edit 1
    set dnsfilter-profile <profile>
    set webfilter-profile <profile>
  next
end
config firewall profile-group
  edit <group name>
    set dnsfilter-profile <profile>
    set webfilter-profile <profile>
  next
end
```

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You have configured your security profiles, but they are not performing web or DNS inspection. Why?

Check to see if you have applied the security profiles to your firewall policies.



## FortiGuard Connection

- FortiGuard Category filtering requires live connection
- Weight Calculation: Default = (Difference in time zone) x 10
  - Goes down over time (never below default)
  - Goes up in packets are lost

```
Local # diagnose debug rating
Locale      : english
License     : Contract
== Server List (Tue Jun  7 10:41:32 2016) ==
```

IP	Weight	RTT	Flags	TZ	Packets	Curr Lost	Total Lost
96.45.33.65	0	72		-8	868	0	114
96.45.33.64	0	72		-8	868	0	114
208.91.112.196	0	106	DI	-8	859	0	80
208.91.112.198	0	118	D	-8	867	0	32
64.26.151.37	30	17		-5	769	0	1

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Category-based filtering requires a live connection.


You can verify the connection to FortiGuard servers by running the `diagnose debug rating` CLI command. This displays a list of FortiGuard IP gateways you can connect to, including the following information:

- **Weight:** Based on the difference in time zone between the FortiGate and this server (modified by traffic)
- **RTT:** Return Trip Time
- **Flags:** D (IP returned from DNS), I (Contract server contacted), T (being timed), F (failed)
- **TZ:** Server time zone
- **Curr Lost:** Current number of consecutive lost packets (in a row, resets to 0 when one packet succeeds)
- **Total Lost:** Total number of lost packets

The list is of variable length depending on the FortiGuard Distribution Network, but it displays approximately 10 IPs.

## Web Filter Log

- Record HTTP traffic activity, such as:
  - Action, Profile used, Category, URL, Quota info, etc.



#	Date/Time	User	Source	URL	Action	Category Description
1	16:52:15		10.0.1.10	youtube.com/favicon.ico	blocked	Streaming Media and Download
2	16:52:15		10.0.1.10	youtube.com/favicon.ico	blocked	Streaming Media and Download
3	16:52:14		10.0.1.10	youtube.com/	blocked	Streaming Media and Download
4	16:51:33		10.0.1.10	pokerstar.com/favicon.ico	blocked	Gambling
5	16:51:33		10.0.1.10	pokerstar.com/favicon.ico	blocked	Gambling
6	16:51:33		10.0.1.10	pokerstar.com/	blocked	Gambling
7	16:50:52		10.0.1.10	tiles.services.mozilla.com	passthrough	Unknown

```
date=2016-04-20 time=16:52:15 logid=0316013057 type=utm subtype=webfilter
eventtype=ftgd blk level=warning vd=root policyid=4 sessionid=1632 user=""
srcip=10.0.1.10 srcport=49616 srcintf="port3" dstip=216.58.192.238 dstport=80
dstintf="port1" proto=6 service="HTTP" hostname="youtube.com" profile="default"
action=blocked reqtype=direct url="/favicon.ico" sentbyte=296 rcvdbyte=0
direction=outgoing msg="URL belongs to a category with warnings enabled"
method=domain cat=25 catdesc="Streaming Media and Download" crscore=30
crlevel=high
```

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Now let's take a look at the web filter log and report feature.

This is an example of a log message. Access details include information about the FortiGuard quota and category (if those are enabled), which web filter profile was used to inspect the traffic, the URL, and more details about the event.

You can also view the raw log data by selecting the **download raw log** button at the top of the GUI. The file downloaded is a plain text file in a syslog format.

## Review

- ✓ Web and DNS filtering overview
- ✓ Static URL and domain filtering
- ✓ Forcing safe search
- ✓ FortiGuard category filter
- ✓ FortiGuard quotas
- ✓ Fortinet bar
- ✓ Website rating submissions
- ✓ FortiGuard and static filtering actions
- ✓ Website rating overrides
- ✓ Custom categories
- ✓ HTTP inspection order
- ✓ Web profile overrides
- ✓ Basic HTTPS scanning

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To review, these are the topics that we just talked about:


- Web and DNS filtering overview
- Static URL and domain filtering
- Forcing safe search
- FortiGuard category filter
- FortiGuard quotas
- Fortinet bar
- Website rating submissions
- FortiGuard and static filtering actions
- Website rating overrides
- Custom categories
- HTTP inspection order
- Web profile overrides
- Basic HTTPS scanning




In this lesson, you will learn how to monitor and control network applications that may use standard or non-standard protocols and ports – beyond simply blocking or allowing a protocol, port number, or IP address.

## Objectives

- Control and monitor application-based traffic using application control
- Update the application control database using FortiGuard
- Configure traffic shaping for application control traffic
- Configure Cloud Access Security Inspection (CASI)
- Search logs for application control events
- Monitor applications from FortiView






2

After completing this lesson, you should have these practical skills to apply application control, keep it up-to-date, and monitor what applications are being used on your network.

## What is Application Control?

- Detects and acts on network applications' traffic
  - Facebook, Skype, Gmail, LogMeIn etc.
  - Supports many applications and categories, including P2P and proxy
  - Even can scan secure protocols
    - Requires SSL/SSH inspection profile in the firewall policy
- How does it work?
  - Uses IPS engine
  - **Flow-based scan** (not proxy-based)
  - Compares traffic to known application patterns
    - Only reports packets match for an enabled pattern
    - **Can detect even if users try to circumvent via an external proxy**



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Application control detects applications – often, ones that consume more bandwidth – and allows you to take appropriate actions related to application traffic, such as monitoring, blocking, or applying traffic shaping.

A particular application, such as Google Talk, is identified by matching known patterns to the application's transmission patterns. So, obviously, an application can only be accurately identified if its transmission pattern is unique somehow. However, not every application behaves in a unique way. Many re-use pre-existing, standard protocols and communications methods. For example, many video games such as *World of Warcraft* now use the BitTorrent protocol to distribute game patches.

Application control can be configured in proxy-based and flow-based virtual domains, but inspection is always flow-based because it uses the IPS engine which is flow-based inspection. By comparison, when applying web filtering and antivirus through an HTTP proxy, the proxy first parses HTTP and removes the protocol, and then scans only the payload inside.



Why does FortiGate use a flow-based scan for application control?

Unlike other forms of security profiles, such as web filtering or antivirus, application control is not applied by a proxy. It uses an IPS engine to analyze network traffic and detect application traffic, even if the application is using standard or non-standard protocols and ports. It doesn't operate using built-in protocol states. It matches patterns in the entire byte stream of the packet, and then looks for patterns.

## Detecting Peer-to-Peer Applications

### Why is peer-to-peer (P2P) traffic so difficult to detect?

- Traditional protocols (HTTP, FTP) have a *client-server architecture*
  - Single server with large bandwidth for many clients
  - Requires predictable port numbers, NAT/PAT, and firewall policies
- Peer-to-peer protocols (BitTorrent, Skype) have distributed architecture
  - Each peer is a server with small bandwidth to share
  - Difficult to manage multiple firewall policies to block them
  - Does not depend on port forwarding
    - Uses evasive techniques to bypass these limitations



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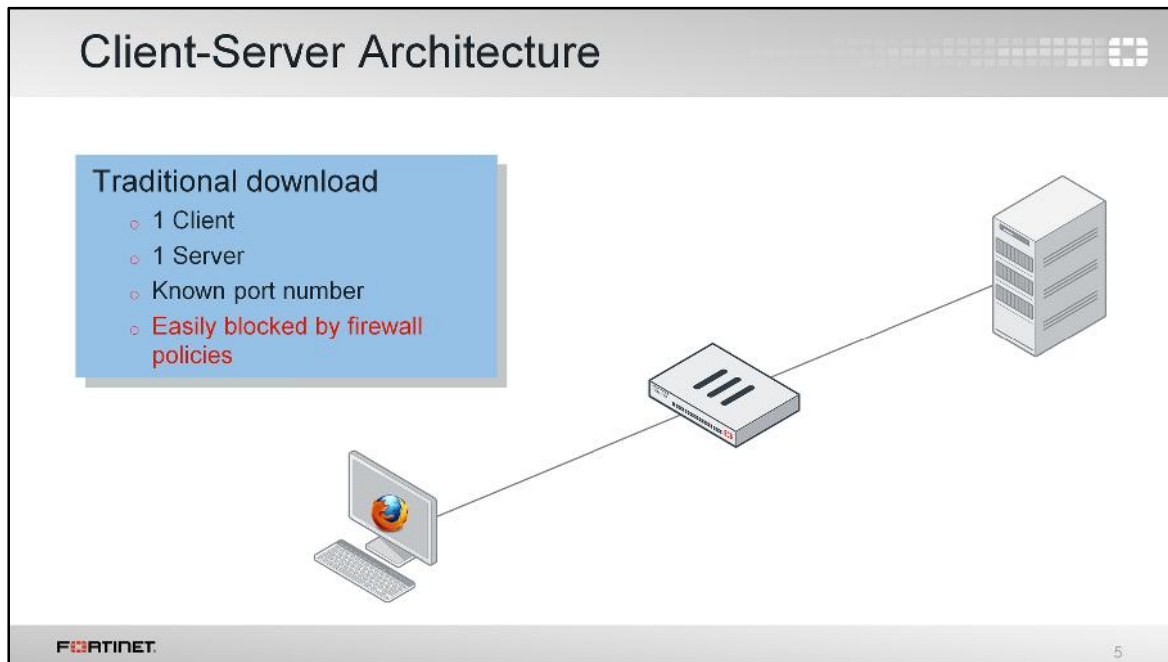
When HTTP and other protocols were designed, they were designed to be easy to trace. In that way, administrators could easily give access to single servers behind NAT devices, such as routers and, later, firewalls.

But when P2P applications were designed, they had to be able to work without assistance – or cooperation – from network administrators. In order to achieve this, the designers made P2P applications able to bypass firewalls and incredibly hard to detect. Port randomization, pinholes, and changing encryption patterns are some of the techniques that P2P protocols use.

These techniques make P2P applications difficult to block using a firewall policy, and also make them difficult to detect by proxy-based inspection.

Flow-based inspection using the IPS engine can analyze packets for pattern matching and then look for patterns to detect P2P applications.



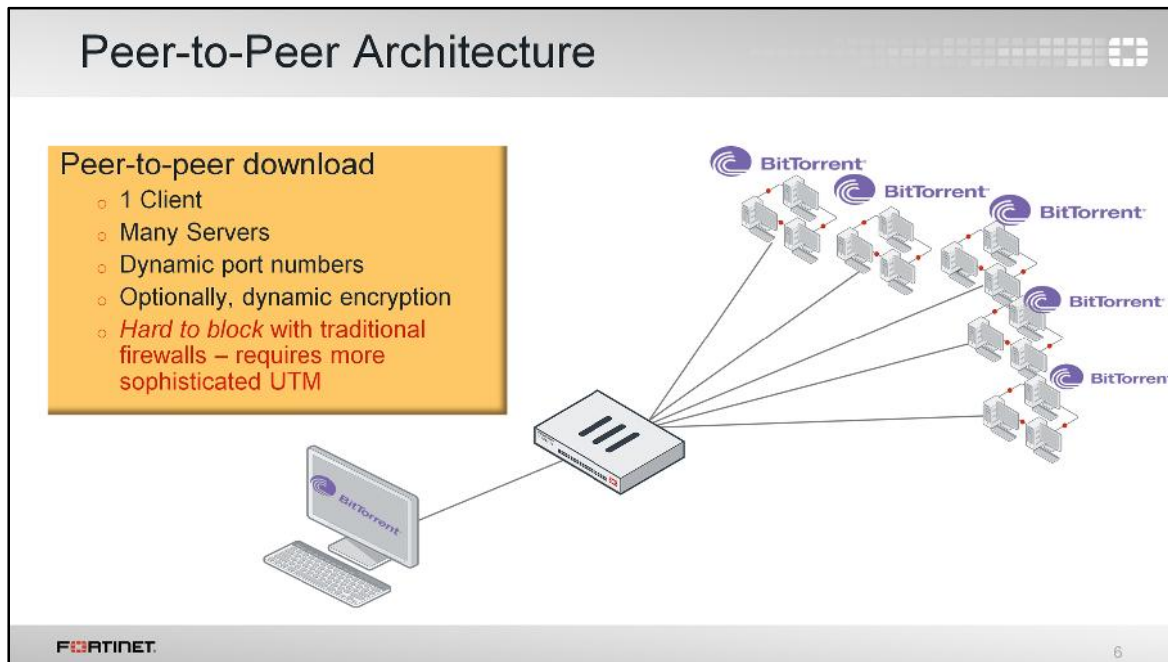


Here is a traditional, client-server architecture. There may be many clients of popular sites, but often, such as with an office file server, it's just one client and one server.

Traditional downloads use a defined protocol over a standard port number. Whether it's from a web or FTP site, the download is from a single IP address, to a single IP address. So blocking this kind of traffic is easy: you only need one firewall policy.

But it's more difficult for peer-to-peer downloads. Why?





P2P downloads divide each file among multiple (theoretically unlimited) peers. Each peer delivers part of the file. While having many clients is a disadvantage in client-server architectures, it is an advantage for P2P architecture because, as the number of peers increases to  $n$ , the file is delivered  $n$  times faster.

Because popularity increases the speed of delivery – unlike traditional client-server architecture, where popularity could effectively cause a denial of service attack on the server – some software, such as BitTorrent distributions of Linux, and games distributing new patches, leverage this advantage. Even if each client has little bandwidth, together, they can offer more bandwidth for the download than many powerful servers.

Conversely, in order to download the file, the requesting peer can consume much more bandwidth per second than it would from only a single server. Even if there is only one peer on your network, it can consume unusually large amounts of bandwidth. As the protocols are usually evasive, and there will be many sessions to many peers, they are difficult to completely block.

## Application Control Signatures

- Requires subscription to FortiGuard IPS and Application Control
- Updated through FortiGuard IPS
- **System > FortiGuard**

Configuring schedule updates

License and IPS version

License Information	
IPS & Application Control	✓ Licensed (Expires on 201...)
IPS Definitions	⌚ Version 6.00
IPS Engine	⌚ Version 3.00

Before you try to control applications, it's important to understand the signatures used by application control.

How does application control detect the newest applications and changes to application protocols?

Because application control uses an IPS engine, FortiGuard updates are crucial. You can configure your FortiGate to automatically update its IPS & Application Control signature database under the **FortiGuard** page. It also shows the current version of IPS definitions and engine. You can also manually trigger the database update by clicking **Update AV & IPS Definitions**.

## Understanding Signatures

- Searchable list of signatures, with descriptions on FortiGuard <http://www.fortiguard.com>

Icon	Risk Level	Description	Example
	Critical	Applications that are used to conceal activity to evade detection	Tor, SpyBlox
	High	Applications that can cause data leakage, or prone to vulnerabilities or downloading malware	Remote Desktop, File Sharing, P2P
	Medium	Applications that can be misused	VoIP, Instant Messaging, File Storage, WebEx, Gmail
	Elevated	Applications are used for personal communications or can lower productivity	Gaming, Facebook, Youtube
	Low	Business Related Applications or other harmless applications	Windows Updates

**Ultrasurf\_9.6+**

**Risk:**

**Popularity:**

**Category:** Proxy

**Description:** This indicates an attempt to use the Ultra Surf web proxy. Ultra Surf is a software that helps defend against traffic filtering. In some network policy may restrict the use of Ultra Surf because it allows users to bypass network activities.

**Impact:** Security Bypass: Remote attackers can bypass security checks of vulnerable

**Affected:**

**Recommended Action:** The signature can be set to "Block" if this type of traffic is against the network. Please note that this signature requires SSL inspection.

**References:** <http://www.ultrasurf.org/>

You can view the latest application control database version from the FortiGuard website <http://www.fortiguard.com>, or by clicking **View Application Signatures** in the application control profile.

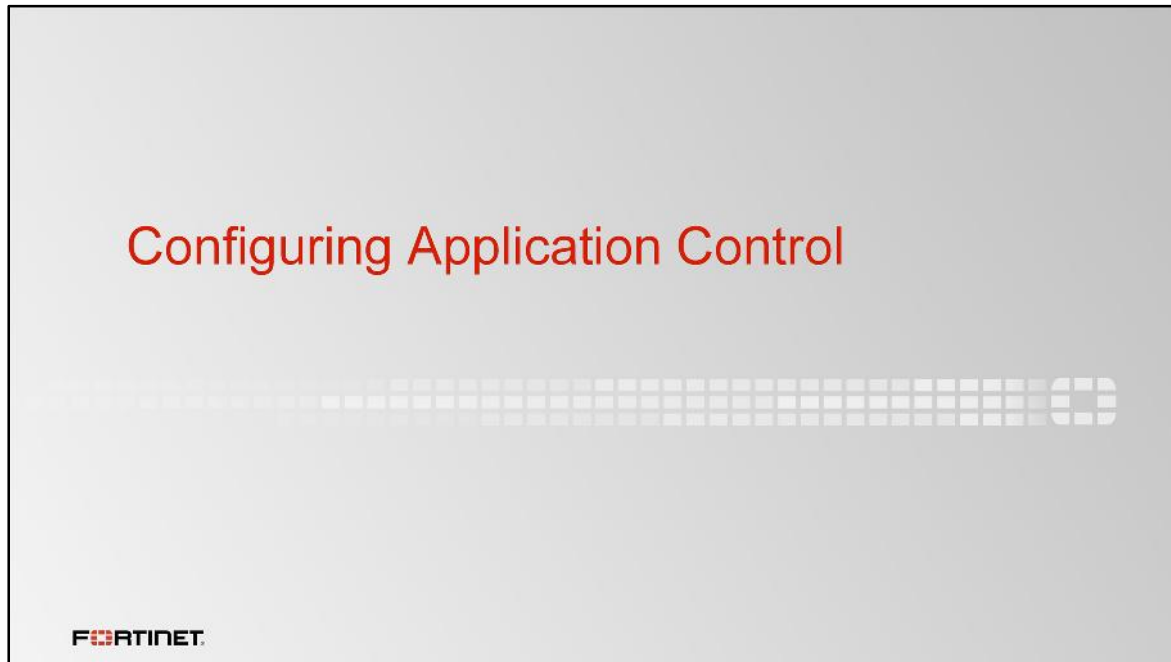
The application control database provides the details about application control signatures based on category, technology, and risk to name a few.

When building an application control signature, the FortiGuard security research team evaluates the application and assigns a risk level. The assigned risk level is based on the type of security risk. The rating is Fortinet-specific, and not related to Common Vulnerability Scoring System (CVSS) or other external systems. If you aren't aware of the specific application, this information can help you to decide if it would be wise to block an application or not.

On the FortiGuard website, you can read details about each signature's related application. Let's look at an example.

In the slide, you can see an example article for Ultrasurf\_9.6+. Ultrasurf\_9.6+ is a web proxy, so it falls in the proxy category. If there are any special requirements for scanning or blocking the application, the article provides some advice. It is always wise to make test policies and use them to observe the behavior first.


If there are new applications that you need to control, and the latest update includes definitions for them, you can go to the FortiGuard website and submit a request to have the new applications added.



Now you know what application control is and how it works. In this section, you will learn how to configure an application control profile to match traffic with applications and take appropriate action.

## Application Control Profile

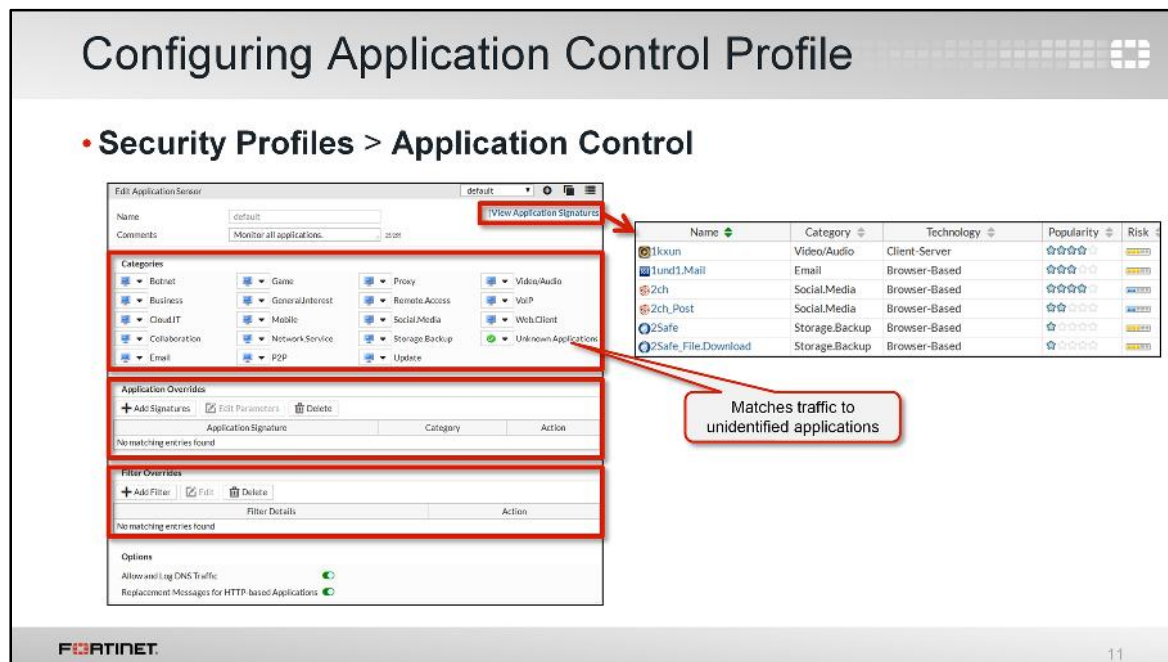
- Allows you to filter traffic based on
  - Categories
    - Similar applications are grouped together
    - Can view application control signatures for that category
    - Can configure actions for predefined categories
  - Application Overrides
    - Allows you to configure action for specific signatures/applications
  - Filter Overrides
    - Provides a more flexible way to create application categorization based on: behaviour, popularity, protocol, risk and so on.



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The application control profile consists of three different types of filters:

- **Categories:** It consist of applications that are grouped based on similarity. For example, all applications that are capable of providing remote access are grouped in the Remote Access category. You can view the signatures of all applications in a category or apply an action to the category as a whole.
- **Application Overrides:** It provides the flexibility to control specific signatures and applications.
- **Filter Overrides:** It can be useful when a predefined category does not meet your requirements, and you would like to block all the applications based on criteria that is not available in categories. You can configure the categorization of applications based on behaviour, popularity, protocol, risk, vendor, and/or the technology used by the applications, and take action based on that.



The application control profile is configured from the **Application Control** page. You can configure actions based on categories, application overrides, and filter overrides. You can also view the list of application control signatures by clicking **View Application Signatures**.

**Unknown Applications** matches traffic that could not be matched to any application control signature and identifies the traffic as *Unknown Application* in the logs. Whether or not traffic is identified as *Unknown Application* depends on:

- how many rare applications your users have, and
- which IPS database version you are using.

Identifying traffic as unknown might cause many log entries—and frequent log entries decrease performance.

If you choose to enable **Allow and Log DNS Traffic**, be aware that you should only do it for short periods, such as during an investigation. So, depending on the application, and how often it queries DNS servers, this can use significant system resources. **Replacement Messages for HTTP-based Applications** allows you to replace blocked content with an explanation (for the user's benefit). With non-HTTP/HTTPS applications, however, you can only drop the packets or reset the TCP connection. Once you've configured the application control profile, select the sensor in the firewall policy. Like any other security profile, these settings are not global. FortiGate will only apply them to traffic governed by the firewall policy where you've selected an application control profile. This allows granular control.

## Order of Operations

- IPS engine identifies the application
- Application control applies action
  1. Application Overrides
  2. Filter Overrides
  3. Categories

The screenshot shows the 'Edit Application Sensor' configuration page. It includes fields for Name (default), Comments (Monitor all applications), and Categories (Botnet, Business, Game, General Interest). Below these are sections for Application Overrides and Filter Overrides, both showing 'No matching entries found'. The order of operations is indicated by green circles 1, 2, and 3 next to the respective sections.

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The IPS engine examines the traffic stream for a signature match. Then, FortiGate scans packets for matches in this specific order, for the application control profile:

1. **Application Overrides:** If you have configured any **Application Overrides**, the application control profile considers those first. It looks for a matching override starting at the top of the list, like firewall policies.
2. **Filter Overrides:** If no matching application override exists, then the application control profile applies the action based on configured **Filter Overrides**.
3. **Categories.** Finally, the application control profile applies the action that you've configured for applications in your selected **Categories**.

It is also worth mentioning that multiple overrides for the same signature cannot be created.



## Actions

- **Allow**
  - Continue to next scan/feature
  - Do not log
- **Monitor**
  - Allow but log
  - Good for initial study of your network traffic
- **Block**
  - Drop packets and log
- **Quarantine**
  - Blocks and log traffic from attacker IP address until the expiration time
  - Can set duration to days, hours, or minutes

Categories

Botnet

- Allow
- Monitor
- Block
- Quarantine
- View Signatures

View signature from specific category

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For each filter in the application control profile, you must indicate an **Action** – what FortiGate does when traffic matches.

- **Allow** – Simply passes the traffic and does not generate a log.
- **Monitor** – Passes the traffic, but also generates a log message.
- **Block** – Drops the detected traffic and generates a log message.
- **Quarantine** – Blocks the traffic from an attacker IP until expiration time has been reached. It also generates a log message.

The **View Signature** only allows you to view signatures from a particular category and *is not* a configurable action.

Which is the correct action to select?

If you're not sure which action to choose, **Monitor** can be useful initially, while you study your network. Once you have taken some time to study your network traffic, you can later fine-tune your filter selection by choosing the most appropriate action. It also depends on the application. If an application requires feedback to prevent instability or other unwanted behavior, then you might use **Quarantine** instead of **Block**. Otherwise, the most efficient use of FortiGate resources is simply to block.



## How Scan Order Effects Blocking Behavior

1. Application overrides — Battle.Net and Dailymotion set to monitor
2. Filter overrides — Excessive bandwidth consuming applications set to block
  - Can contain applications from different categories — Bittorent (P2P), Adobe.Update (Update), FaceTime (VOIP), Flickr (Social.Media)
3. Categories — Game, Video/Audio set to block and all other categories set to monitor

Application Signature	Category	Action
Battle.Net	Game	Monitor
Dailymotion	Video/Audio	Monitor

Filter Override	Action
Behavior: Excessive-Bandwidth	Block

In this example profile, application control blocks the **Game** and **Video/Audio** categories. For applications in these categories, FortiGate responds with application control's HTTP block message. (It is slightly different than web filtering's HTTP block message.) All other categories are set to monitor, and are allowed to pass traffic.

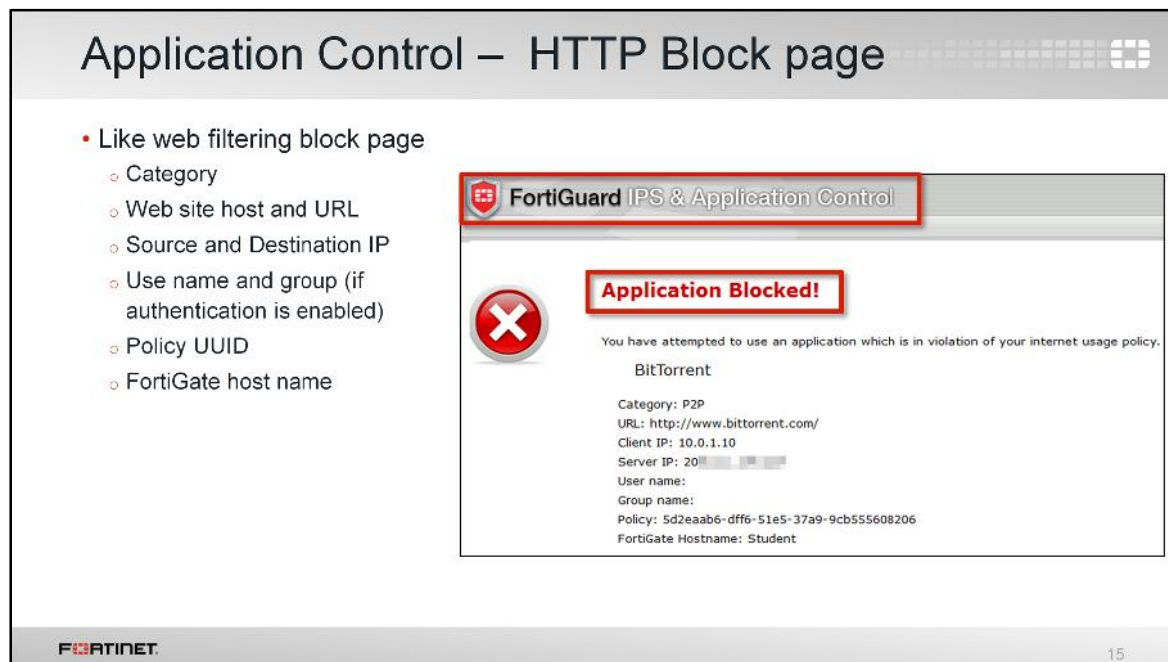
In the section **Application Overrides**, you can see that some exceptions are specified. Instead of being set to block, **Battle.Net (Game)** and **Dailymotion (Video/Audio)** are set to monitor. Because application overrides are applied first in the scan, these two applications will be allowed, and will generate logs.

Next, the scan will check for **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 any categories that allow these applications.

Here is an example of how several UTM features could work together, overlap, or work as substitutes, on the same traffic.

After the application control scan is done, FortiGate begins other scans, such as web filtering. This scan could block Battle.Net and Dailymotion, but it would use its own block message. Also, web filtering doesn't check the list of application control overrides. *So even if an application control override allows an application, web filtering could still block it.*

Similarly, static URL filtering has its own exempt action, which bypasses all subsequent security checks. However, application control occurs before web filtering, so that web filtering exemption *cannot* bypass application control.



For HTTP-based applications, application control can provide feedback to the user about why their application was blocked. This is called a block page, and it is similar to the one you can configure for URLs that you block through FortiGuard web filtering.

It is also worth mentioning that, if deep inspection is enabled in the firewall policy, all HTTPS-based applications will also provide this block page.

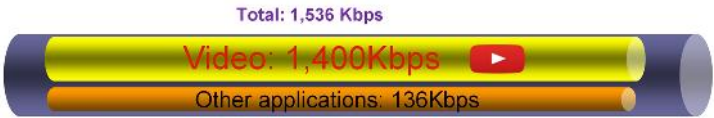
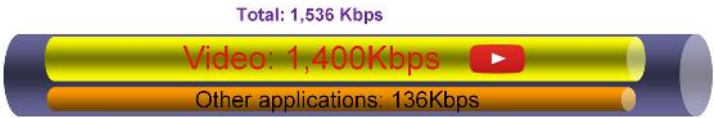
The block page contains this information:

- the signature that detected the application (in this case, BitTorrent)
- the signature's category (P2P)
- the URL that was specifically blocked (in this case, the index page of `bittorrent.com`), since a web page can be assembled from multiple URLs
- the client's source IP (10.0.1.10)
- the server's destination IP (20.x.x.x)
- user name (if authentication is enabled)
- the UUID of the policy governing the traffic
- the FortiGate's host name

The last two pieces of information listed can help you to determine which FortiGate blocked the page, even if you have a large network with many FortiGates securing different segments.

## Application Control Traffic Shaping

- Granular control of bandwidth usage
- Some traffic can't be distinguished by port number / IP
  - Example: YouTube video URLs – don't say whether it is a text comment or a video  
<https://www.youtube.com/watch?v=eO2vyJDoP3M>
- Only traffic that matches the signature is shaped
  - Won't interfere with other apps on same port/protocol
  - Useful for managing bandwidth-intensive apps



Total: 1,536 Kbps

Video: 1,400Kbps

Other applications: 136Kbps

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If an application is necessary, but you need to prevent it from impacting bandwidth, then instead of blocking it entirely, you can apply a rate limit to the application. For example, you can rate limit applications used for storage or backup leaving enough bandwidth for more sensitive streaming applications, such as video conferencing.

Applying traffic shaping to applications is very useful when you're trying to limit traffic that uses the same TCP or UDP port numbers as mission-critical applications. Some high-traffic web sites, such as YouTube, can be throttled in this way.

Let's examine the details of how throttling works. Not all URL requests to `www.youtube.com` are for video. Your browser makes several HTTPS requests for:

- the web page itself
- images
- scripts and style sheets
- video

All of these items have separate URLs. If you analyze a site like YouTube, the web pages themselves don't use much bandwidth; it is the video content that uses the most bandwidth. But, since all content is transported using the same protocol (HTTPS), and the URLs contain dynamically generated alphanumeric strings, traditional firewall policies can't block or throttle the traffic by port number or protocol, because they are the same. Using application control, you can rate limit only videos. Doing this prevents users from saturating your network bandwidth while still allowing them to access the other content on the site, such as for comments or sharing links.

## Configuring Application Control Traffic Shaping Policy

- *Must* ensure matching criteria aligns with the settings in your firewall policy
  - *Must* apply application control profile to firewall policy
- Can shape traffic for application control based on:
  - Application category
  - Application

Policy & Objects > Traffic Shaping Policy

New Shaping Policy

Matching Criteria

Source	STUDENT_INTERNAL
Destination	all
Service	ALL
Application Category	
Application	YouTube

URL Category

Apply shaper

Outgoing Interface	port3
Shared Shaper	
Reverse Shaper	Youtube
Per-IP Shaper	

Enable this policy

Used for web filtering

The selected applications will not match any policy traffic as no firewall policies have application control enabled.

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You can limit the bandwidth of an application category or specific application by configuring a traffic shaping policy. Starting in FortiOS 5.4, you can also apply traffic shaping to FortiGuard web filter categories.

You must ensure that the *matching criteria* aligns with the firewall policy or policies to which you want to apply shaping. It does not have to match outright. For example, if the source in the firewall policy is set to **all** (0.0.0.0/0.0.0.0), the source in the traffic shaping policy can be set to any source that is included in **all**, for example, **STUDENT\_INTERNAL** (10.0.1.0/24).

If the traffic shaping policy is not visible in the GUI, you can enable it through the **Feature Select** page.


Note that the outgoing interface is usually the egress interface (WAN). The **Shared Shaper** is applied to ingress-to-egress traffic, which is useful for restricting bandwidth for uploading. The **Reverse Shaper** is also a shared shaper, but it is applied to traffic in the reverse direction (egress-to-ingress traffic). This is useful for restricting bandwidth for downloading or streaming, because it limits the bandwidth from the external interface to the internal interface.

There are two types of shapers that can be configured from the **Traffic Shaping Policy** page, and you can apply them in the traffic shaping policy.

- **Shared Shaper:** A shared shaper applies a total bandwidth to all traffic using that shaper. The scope can be per-policy or for all policies referencing that shaper.
- **Per-IP Shaper:** A per-IP shaper allows you to apply traffic shaping to all source IP addresses in the security policy, and bandwidth is equally divided among the group.

## Cloud Access Security Inspection (CASI)

- Allows granular control over popular cloud applications
  - YouTube, Netflix, Dropbox, Hulu, Facebook, and others
  - Log entries for cloud applications have more details
    - File transferred (or video title), user (if service has login), size of file
- Applies deep inspection to traffic-related to cloud services
  - Requires full SSL/SSH inspection in firewall policy



Netflix	
Login	Monitor
Video Access	Allow
Video Play	Block

Starting in FortiOS 5.4, all cloud-based applications are grouped under a Cloud Access Security Inspection (CASI) profile, which allows fine-grained control over cloud applications, such as YouTube, Dropbox, and Netflix, to name a few.

You can configure a new CASI profile or edit an existing CASI profile under the **Security Profiles** menu. However, if the CASI profile is not visible in the GUI, you can enable it from the **Feature Select** page.

The CASI profile can be configured in proxy-based and flow-based virtual domains, but inspection is always flow-based, because it uses an IPS engine (the same as the application control profile). Note that it requires a subscription to FortiGuard IPS and Application Control.

Many applications are switching to HTTPS-only, so remember that for those, you will also need an SSL/SSH inspection profile. When applying a CASI profile to a firewall policy, enable **deep inspection** (full SSL/SSH inspection) in the firewall policy as CASI is basically doing deep inspection of cloud applications.

For the selected cloud application, you can configure an individual action on each feature:

- **Allow:** Pass the traffic and do not log.
- **Monitor:** Pass the traffic and generate a log.
- **Block:** Block the traffic and generate a log.



## Logs: Application Control

• Log & Report > Application Control

#	Date/Time	Source	Destination	Application	Action
37	12:15:53	10.0.1.10	4.2.2.2	DNS	pass
38	12:15:52	10.0.1.10	4.2.2.2	DNS	pass
39	12:15:52	10.0.1.10	172.217.3.78	YouTube	pass
40	12:15:52	10.0.1.10	172.217.3.67	GoogleAccounts	pass
41	12:15:51	10.0.1.10	172.217.3.78	YouTube	pass
42	12:15:51	10.0.1.10	172.217.3.78	YouTube	pass
43	12:15:51	10.0.1.10	172.217.3.78	HTTPBROWSER, Firefox	pass
44	12:15:46	10.0.1.10	69.28.188.36	BitTorrent	pass
45	12:15:46	10.0.1.10	69.28.188.36	HTTPBROWSER, Firefox	pass
46	12:15:21	10.0.1.10	69.28.188.36	BitTorrent	pass
47	12:15:20	10.0.1.10	69.28.188.36	BitTorrent	pass
48	12:14:27	10.0.1.10	205.178.187.13	HTTPS.BROWSER	pass
49	12:13:44	10.0.1.10	69.171.239.11	DNS	pass

**Log Details**

- General**
  - Date: 06/13/2016
  - Time: 12:15:46
  - SessionID: 26585
  - Virtual Domain: root
- Source**
  - IP: 10.0.1.10
  - Port: 63318
  - Interface: port3
- Destination**
  - IP: 69.28.188.36
  - Host Name: bittorrent-1.hs.llnwd.net
  - Port: 80
  - Interface: port1
  - Hostname: www.bittorrent.com
  - URL: www.bittorrent.com/
- Application**
  - Sensor: default
  - Name: BitTorrent
  - Category: P2P
  - Protocol: tcp
  - Service: HTTP
  - Message: P2P, BitTorrent, HTTPTrack
- Action**
  - Action: pass
  - Policy: 1
- Security**
  - Level:
  - Threat Level: low
  - Threat Score: 5

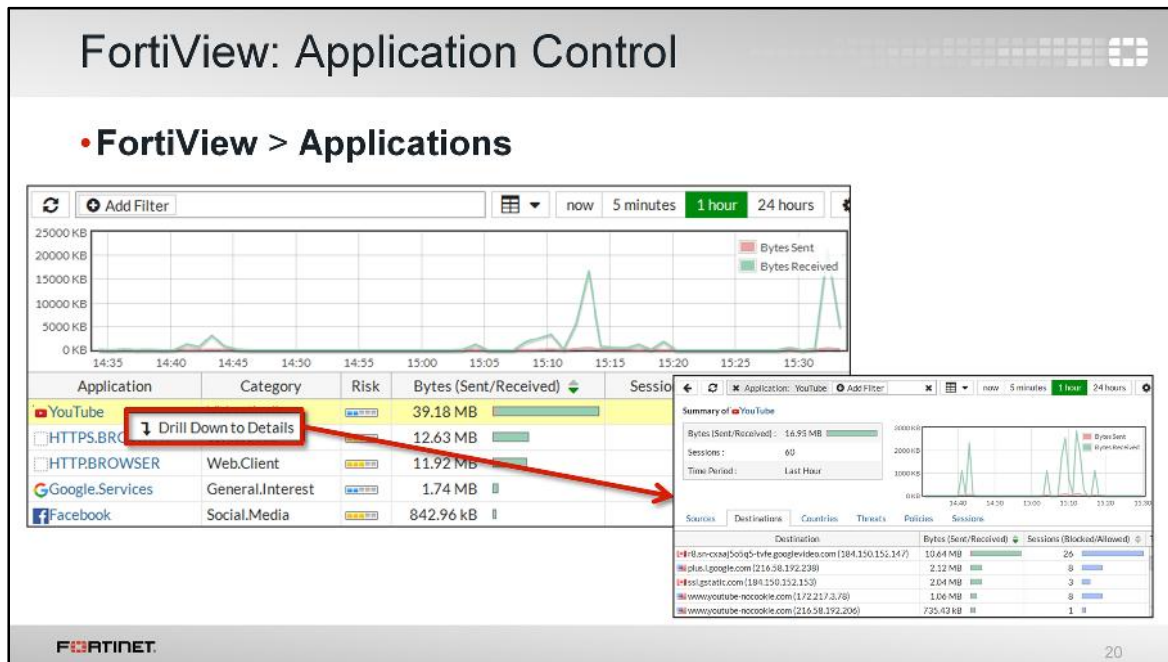
If you have logging enabled, you can use it to discover which applications are being used on your network, and see details about them through the **Log & Report** menu.

In the example, application control detected a client attempting to access BitTorrent. The configured action was to monitor the traffic. We know this because the **Action** field indicates **pass**, so we know FortiGate didn't block the traffic. But, the action wasn't to simply allow the traffic without logging, either, which we know because the log message exists.

You can view the details of the log message by clicking its log entry. The log entry provides detailed information, such as the application category, application sensor name, action, and policy ID, to name a few.

You can also view the details through the **Forward Traffic** logs. This is where firewall policies record activity. You'll also find a summary of the traffic to which FortiGate applied application control. Again, this is because application control is applied by a firewall policy. To find out which policy applied application control, you can review either the **Policy ID** or the **Policy UUID** fields of this log message.


What if you need to find out which application is using most of the bandwidth during certain hours of the day?



Under the **FortiView** menu, the **Applications** page provides details of each application, such as the application name, category, and bandwidth. You can drilldown further to see more granular details by right-clicking the application and clicking **Drill Down to Details**. This view provides information about sources, destinations, policies, or sessions for that selected application.

## Review

- ✓ How does application control work?
- ✓ When is application control necessary?
- ✓ Five point application risk rating
- ✓ Submitting new/revised definitions
- ✓ Configuring an application control profile
- ✓ Order of operations for scans
- ✓ Actions, including traffic shaping
- ✓ Configuring CASI
- ✓ Reading application control logs



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To review, we discussed the following topics:

- How application control identifies traffic
- Why some traffic, especially peer-to-peer, is hard to block without application control
- FortiGuard's five-point rating system for application control signatures
- How to submit requests for additional applications
- How to configure an application control profile
- The order of operations for the application control and IPS engine processes
- When to shape traffic
- How to configure CASI
- How to read logs to discover which applications have been detected, and which action FortiGate applied