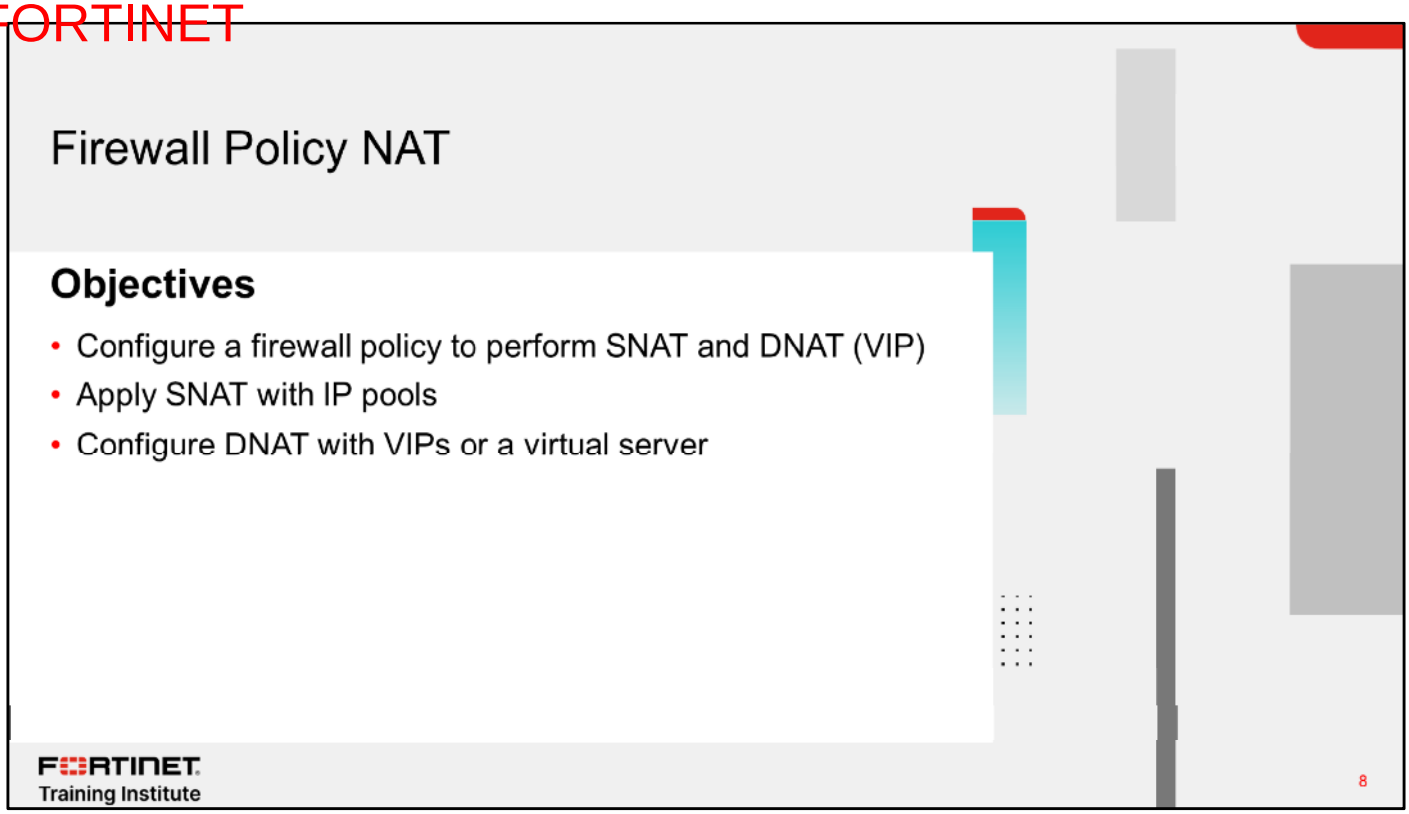
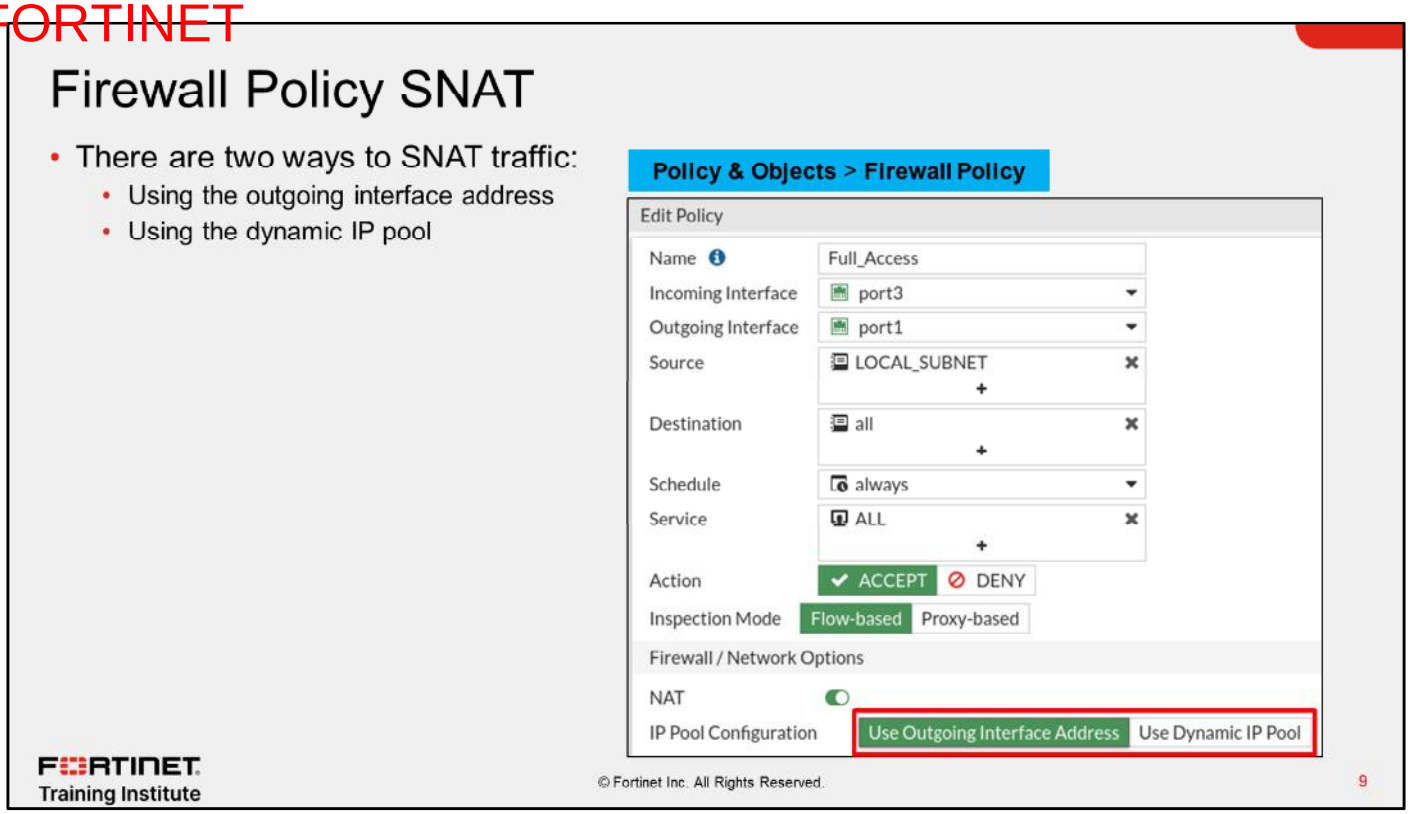


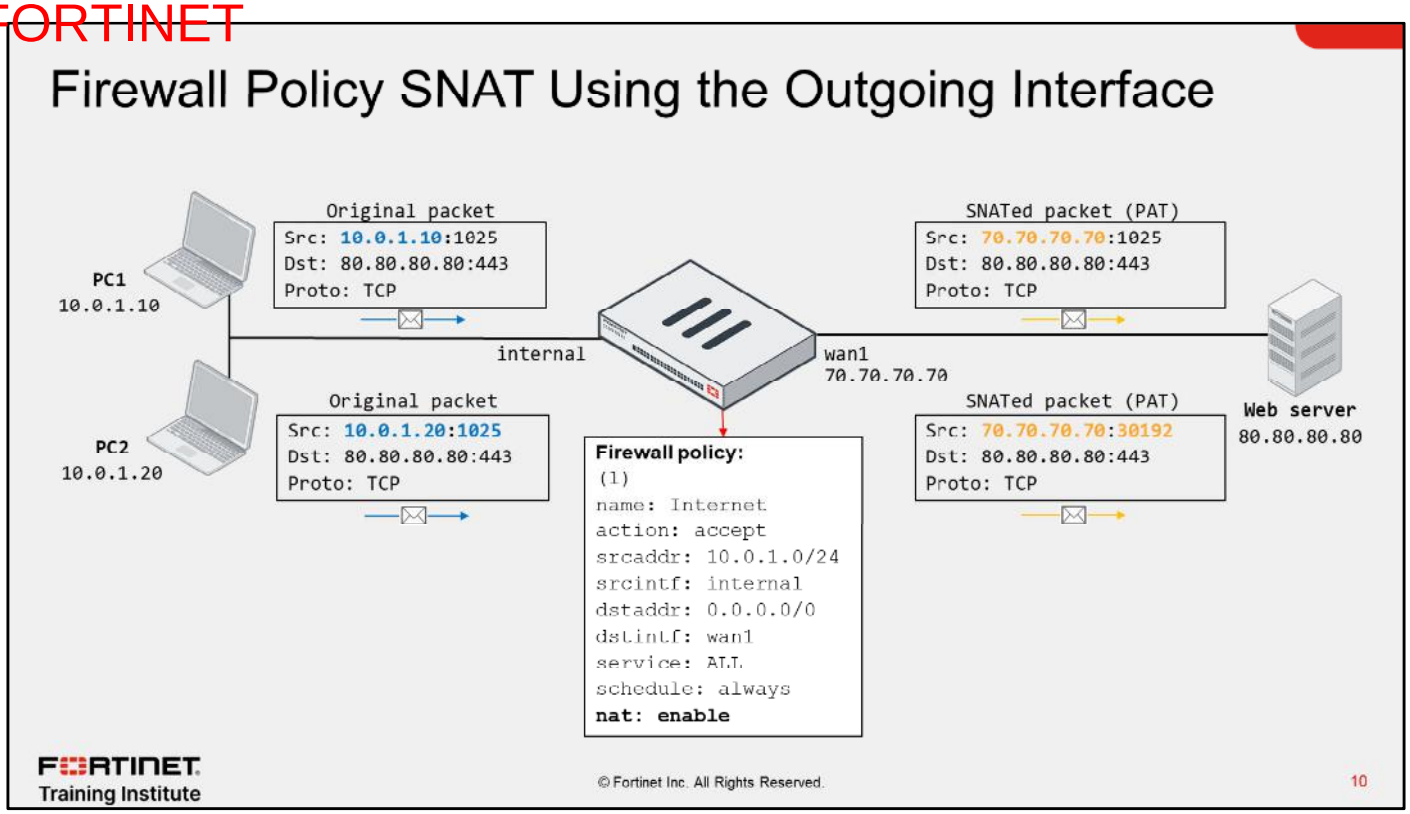
After completing this section, you should be able to achieve the objectives shown on this slide.

By demonstrating competence in these areas, you will be able to configure firewall policies and apply appropriate SNAT and DNAT, and understand how it is applied to the traffic traversing through FortiGate.



There are two ways to configure firewall policy SNAT:

- Use the outgoing interface address.
- Use the dynamic IP pool.

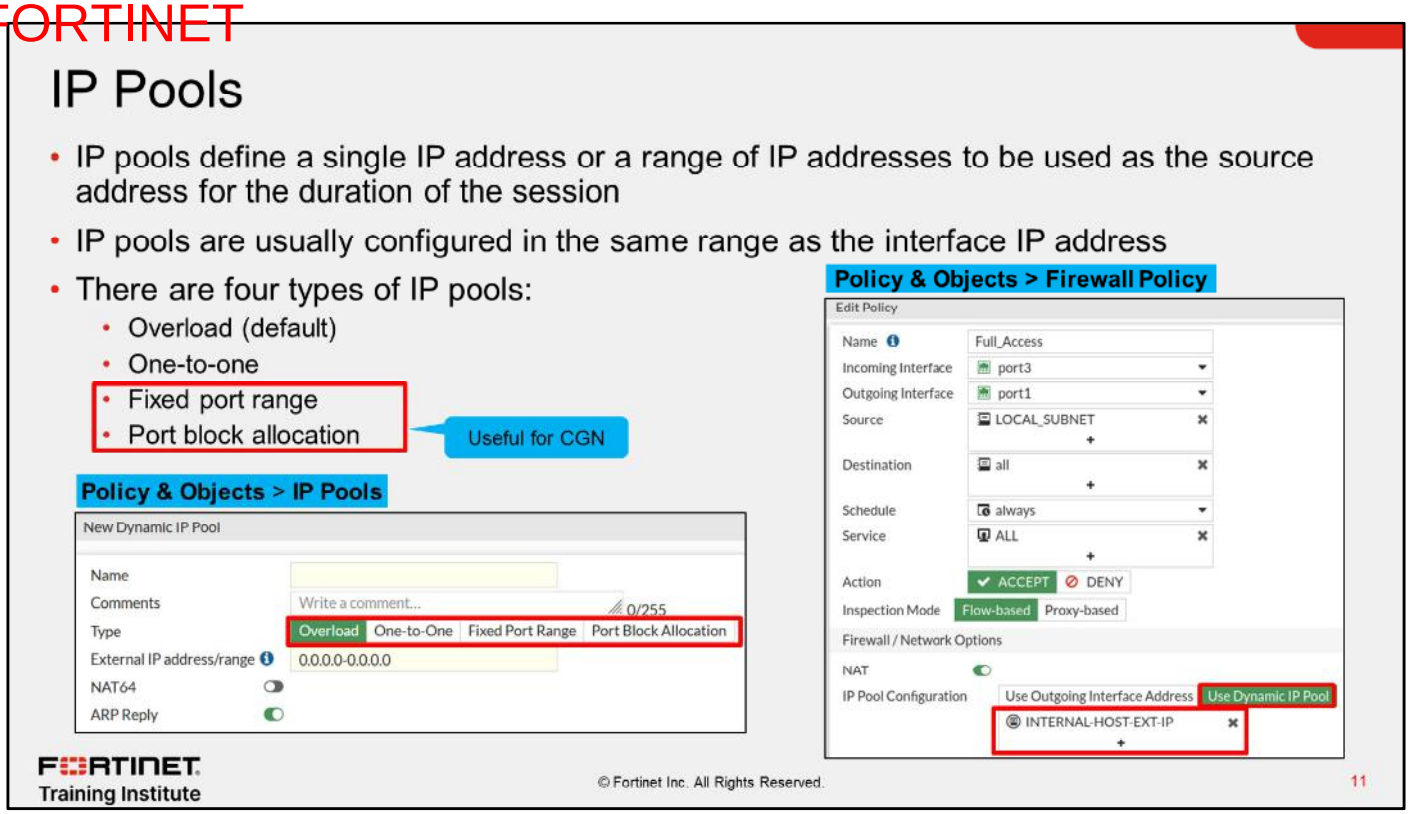


When you select **Use Outgoing Interface Address** on the matching firewall policy, FortiGate uses the egress interface address as the NAT IP for performing SNAT.

If there are multiple devices behind FortiGate, FortiGate performs many-to-one NAT. This is also known as PAT. FortiGate assigns to each connection sharing the egress interface address a port number from a pool of available ports. The assignment of a port enables FortiGate to identify packets associated with the connection and then perform the corresponding translation. This is the same behavior as the overload IP pool type, which you will also learn about.

Optionally, you may select a fixed port, in which case the source port translation is disabled. With a fixed port, if two or more connections require the same source port for a single IP address, only one connection is established.

The example on this slide shows two PCs behind FortiGate that share the same public IP address (`70.70.70.70`) to access the internet web server `80.80.80.80`. Because **Use Outgoing Interface Address** is enabled on the firewall policy—`set nat enable` on the CLI—the source IP address of the PCs is translated to the egress interface address. The source port, however, is not always translated. It depends on the available ports and the connection 5-tuple. In the example shown on this slide, FortiGate translates the source port of the connection from PC2 only. Otherwise, the two connections would have the same information on the session table for the reply traffic, which would result in a session clash.



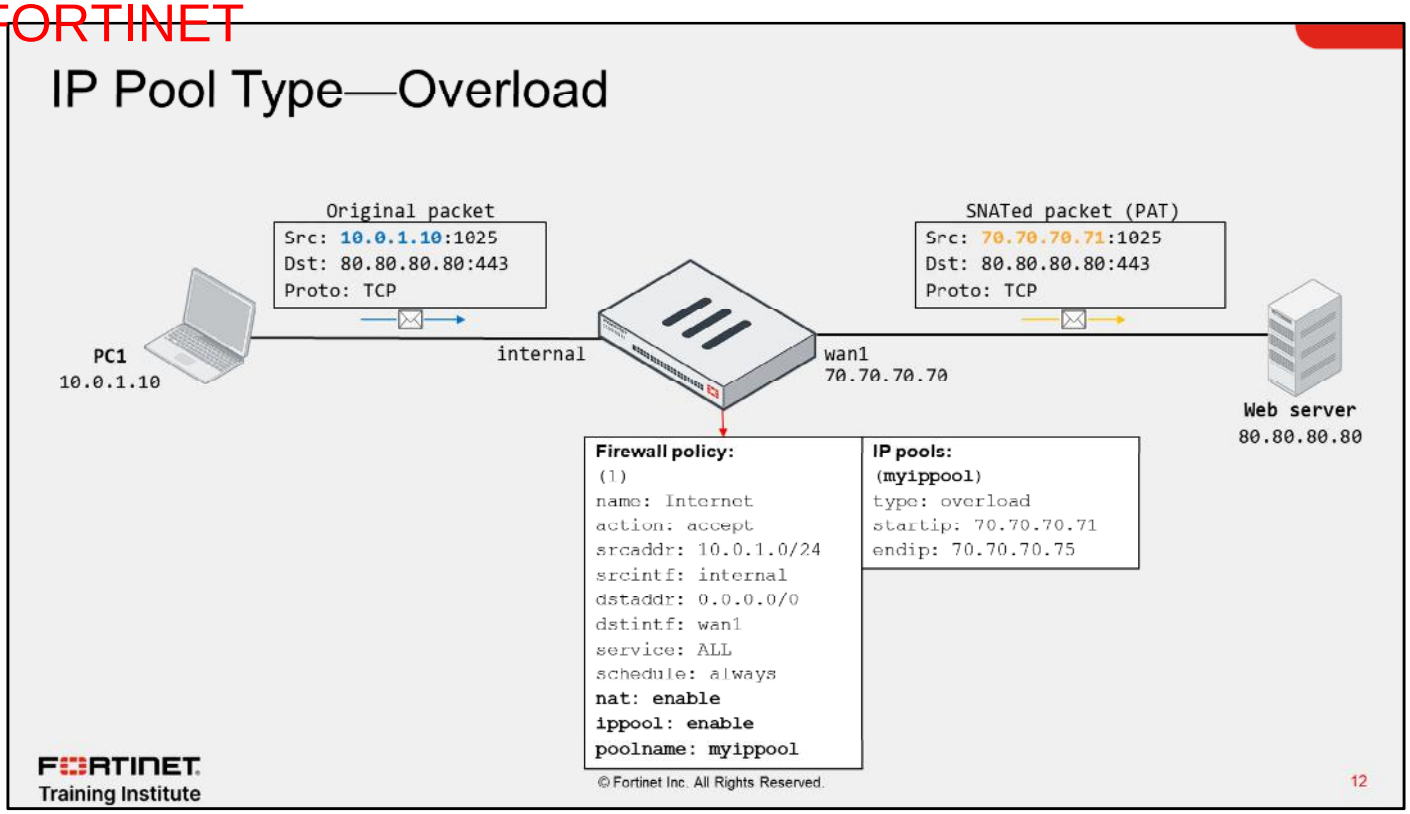
IP pools are a mechanism that allow sessions leaving the FortiGate firewall to use NAT. An IP pool defines a single IP address or a range of IP addresses to be used as the source address for the duration of the session. These assigned addresses are used instead of the IP address assigned to that FortiGate interface.

IP pools are usually configured in the same range as the interface IP address.

When you configure the IP pools that will be used for NAT, there is a limitation that you must take into account. If the IP addresses in the IP pool are different from the IP addresses that are assigned to the interface(s), communications based on those IP addresses *may* fail *if the routing is not properly configured.* For example, if the IP address assigned to an interface is `172.16.100.1/24`, you cannot choose `10.10.10.1` to `10.10.10.50` for the IP pool unless appropriate routing is configured.

There are four types of IP pools that you can configure on the FortiGate firewall:
- Overload
- One-to-one
- Fixed port range
- Port block allocation

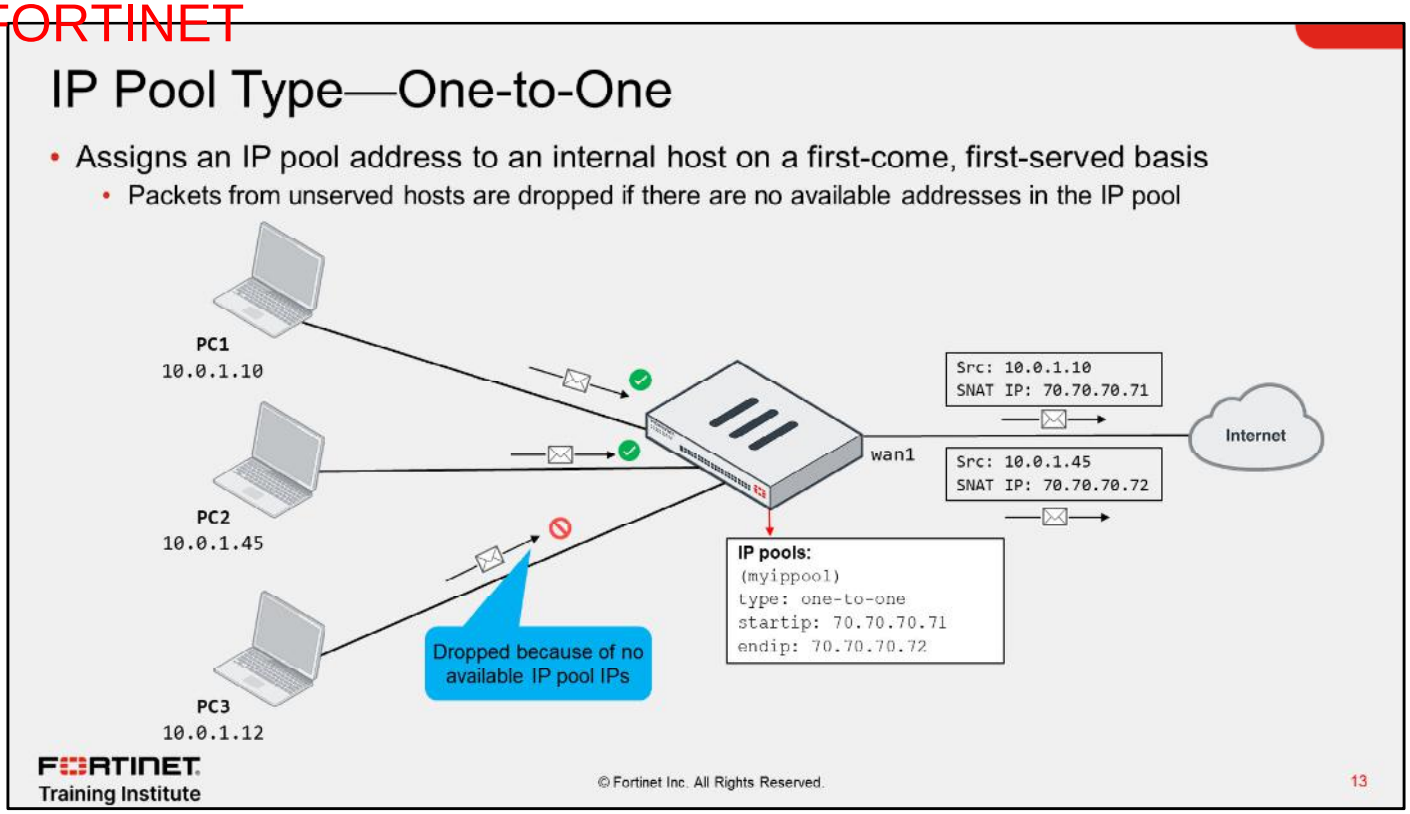
The fixed port range and port block allocation types are more common carrier-grade NAT (CGN) deployments.



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 the pool can support.

The default IP pool type is overload. In the overload IP pool type, a many-to-one or many-to-few relationship and port translation is used.

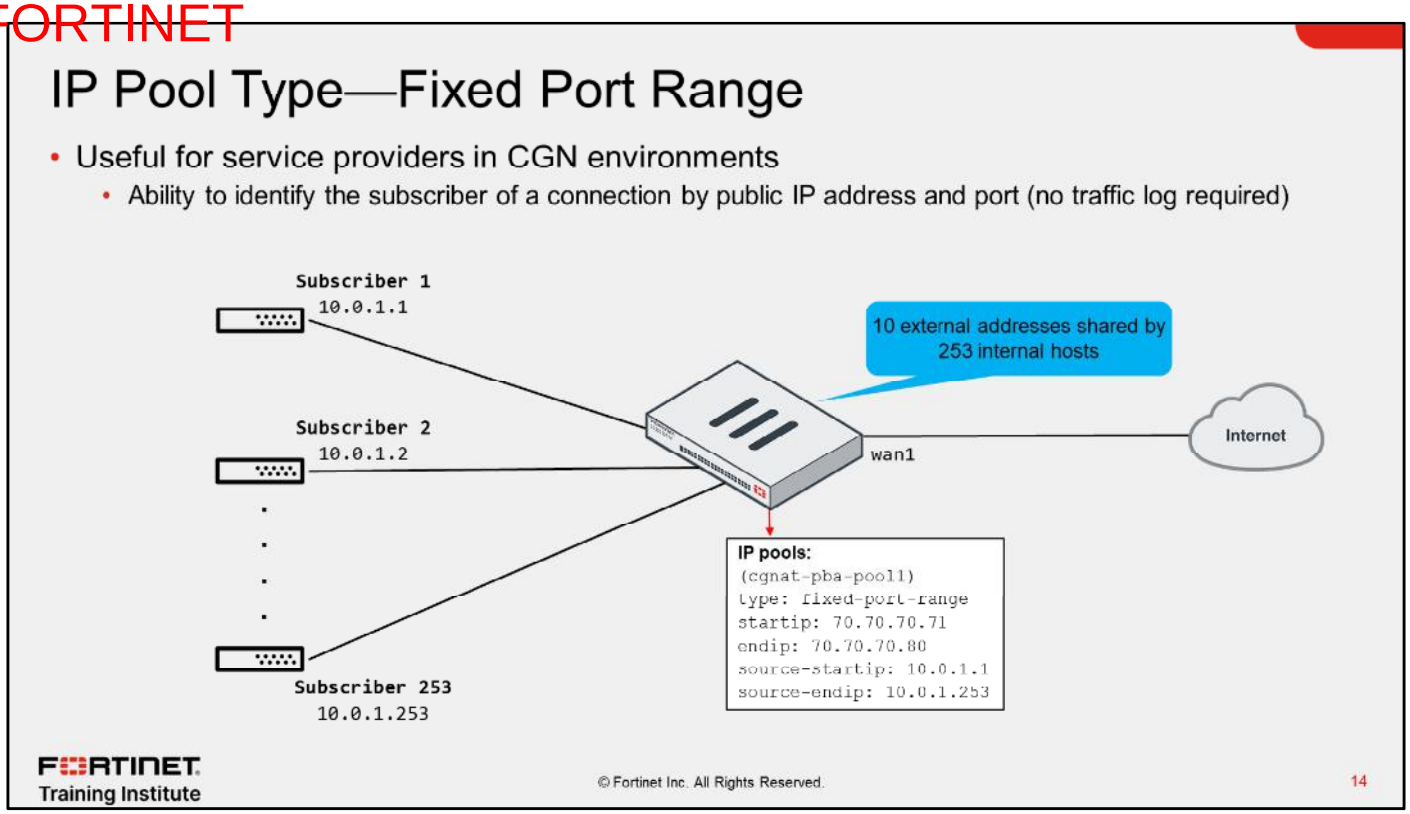
In the example shown on this slide, source IP `10.0.1.10` is translated to the address `70.70.70.71`, which is one of the addresses defined in the IP pool (`70.70.70.71 – 70.70.70.75`).



In the one-to-one pool type, FortiGate assigns an IP pool address to an internal host on a first-come, first-served basis.

There is a single mapping of an internal address to an external address. That is, an IP pool address is not shared with any other internal host, thus the name one-to-one. If there are no more addresses available in the IP pool, FortiGate drops packets from unserved hosts.

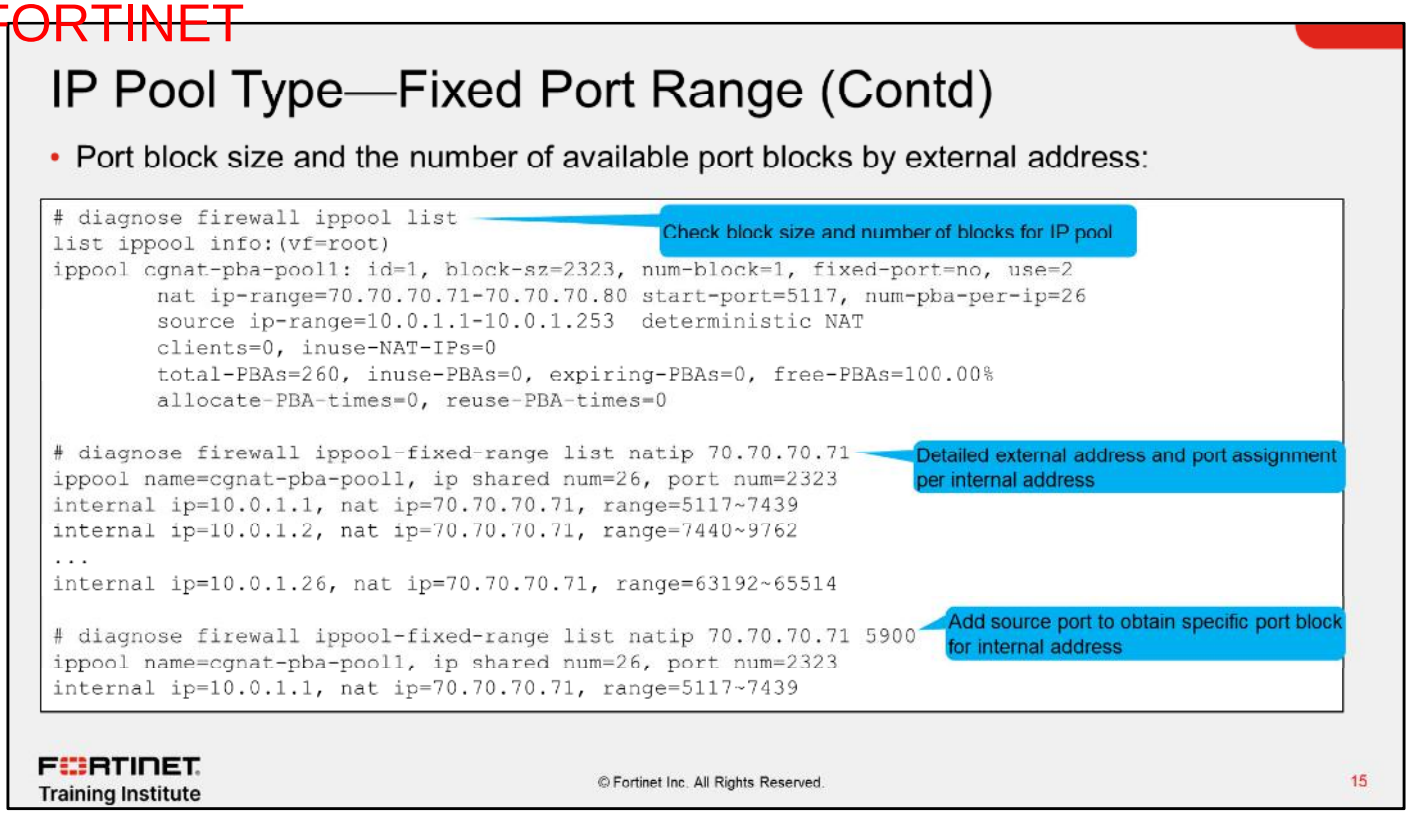
The example on this slide shows three internal hosts accessing the internet. PC1 and PC2 packets are received first by FortiGate and, therefore, served with addresses `70.70.70.71` and `70.70.70.72`, respectively. However, FortiGate drops packets sourced from PC3 because they arrived last, which is when there are no more available addresses in the IP pool to choose from.



ISPs must be able to identify the subscriber responsible for a given connection should authorities require it. If the ISP performs NAT to subscriber traffic, then the traffic will share one or more public addresses. One way to track the traffic and, therefore, the NAT details for each connection, is by logging them. However, this can result in a huge number of resources that the ISP needs to dedicate for logging purposes only.

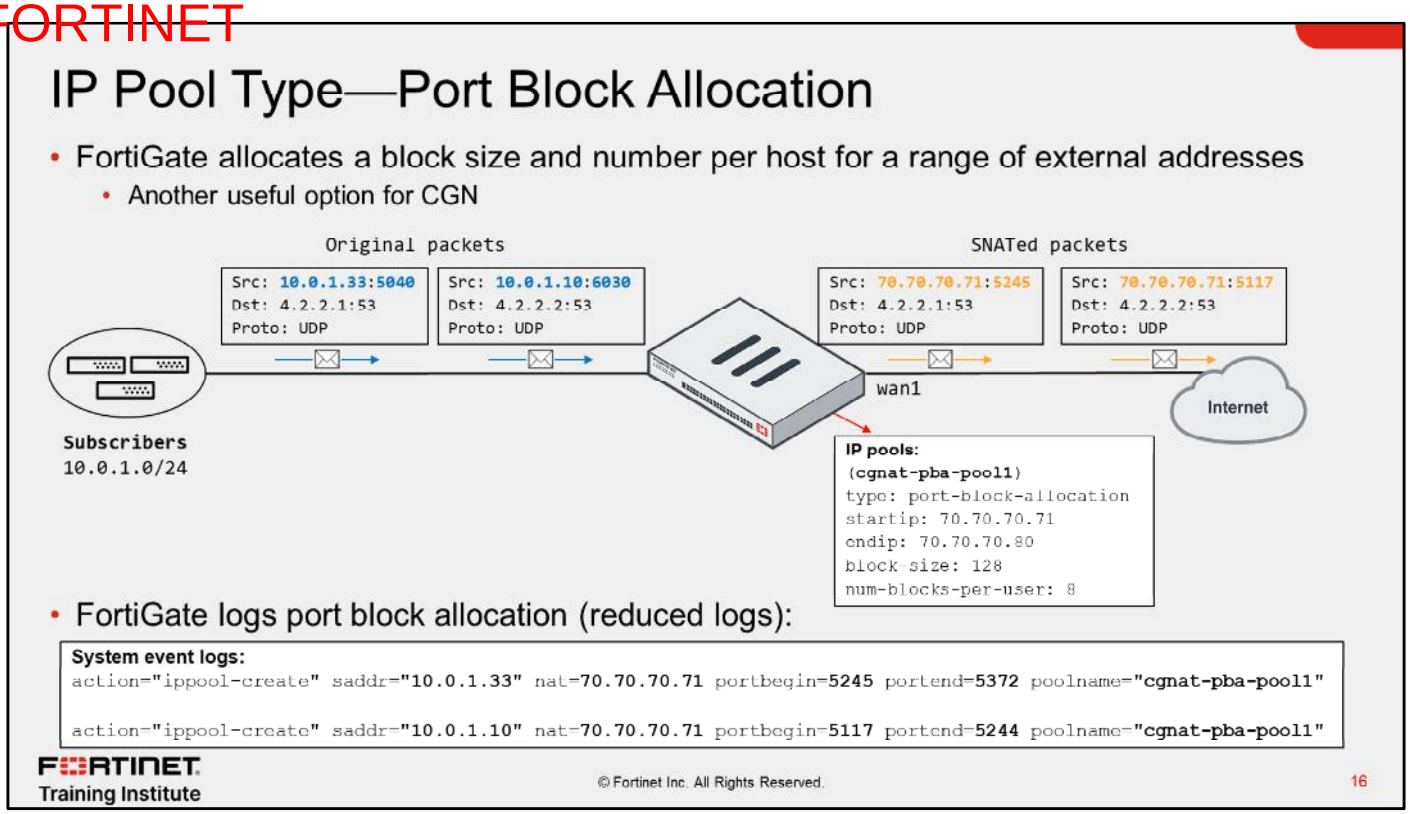
Another option is to deploy a CGN-focused feature such as a fixed port range IP pool. Fixed port range IP pools enable administrators to track connections by public address and port without having to log every session. When you configure a fixed port range IP pool, you indicate a range of external IP addresses that FortiGate uses to perform NAT on traffic sourced from a range of internal IP addresses. It is called fixed port range because FortiGate calculates the port block size and the number of available port blocks for the IP pool based on the number of configured internal and external IP addresses. FortiGate then allocates one or more port blocks to internal hosts when performing NAT, which is what enables the administrator to track connections without having to log them.

The example on this slide shows a fixed port range IP pool. The internal address range `10.0.1.1` to `10.0.1.253` maps to the external address range `70.70.70.71` to `70.70.70.80`. That is, FortiGate shares ten external addresses with 253 internal addresses.



You can use the `diagnose firewall ippool list` command to identify the block size and number of blocks assigned to each external address in the fixed port range IP pool.

You can also use the `diagnose firewall ippool-fixed-range list natip` command to view detailed external address and port assignment information per internal address, as shown on this slide. The result is that you can identify subscribers by providing the public address and port of a connection.

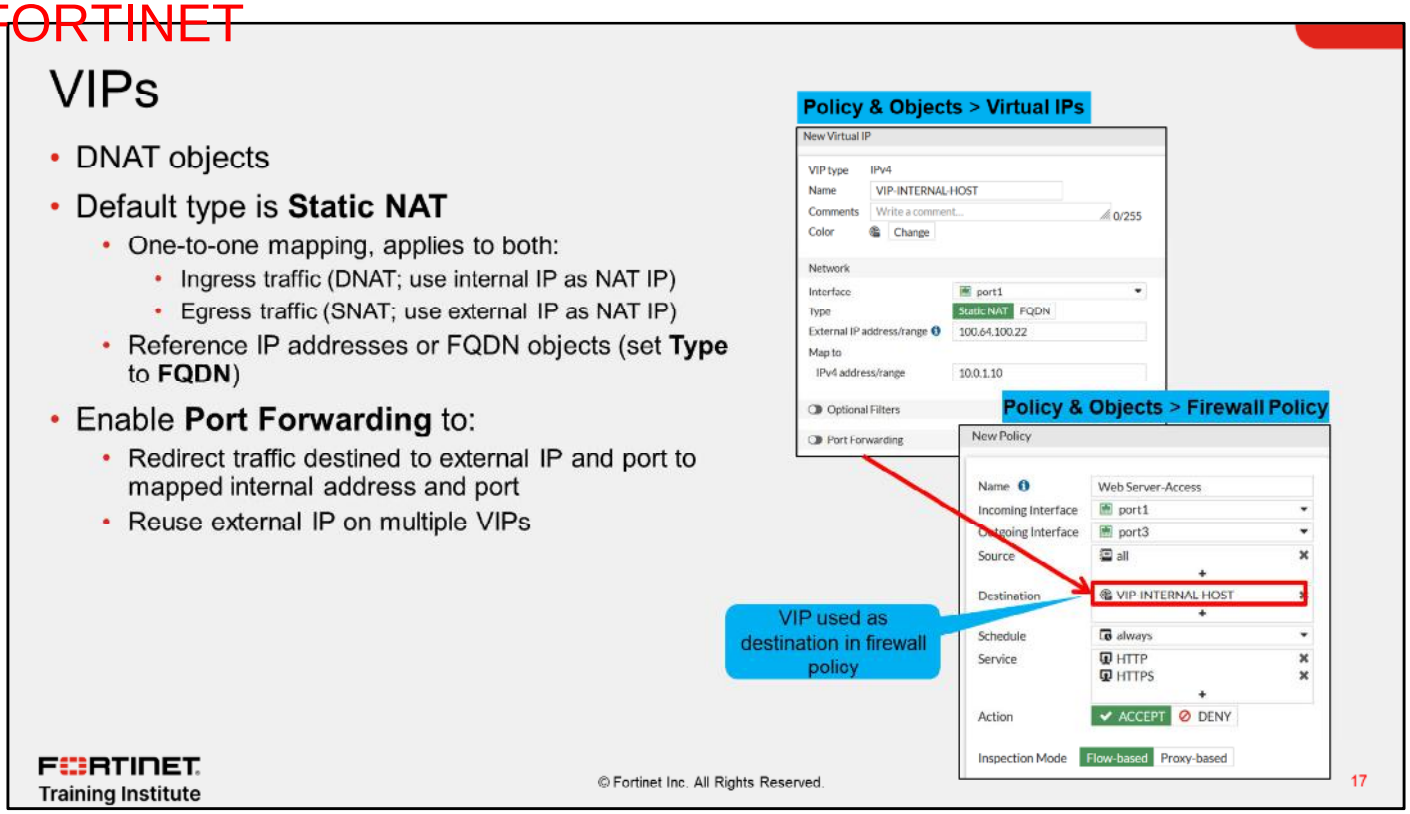


The port block allocation IP pool is also a useful option for CGN. It give administrators a more flexible way to control user port allocation for NAT. Unlike the fixed port range IP pool, which requires you to define internal and external IP address ranges, with port block allocation, you define the external IP address range only. You must also indicate the block port size and the number of blocks that FortiGate allocates to each host (or source IP address). The result is that each source IP address is limited to the number of blocks and ports configured in the IP pool, thus preventing port exhaustion caused by a few hosts.

For logging purposes, when FortiGate allocates a port block to a host, it generates a system event log to inform the administrator. The administrator can then look at the system event logs to identify internet connections made by a device should the authorities require such information. That is, like the fixed port block case, the administrator doesn't have to log the traffic for connection identification purposes.

The example on this slide shows how port block allocation assignment takes place. FortiGate allocates port blocks on a first-come, first-served basis. The port block allocation is made when FortiGate receives a packet from unserved hosts. In the example, `10.0.1.10` and `10.0.1.33` are unserved hosts that try to access the internet. FortiGate then allocates the port blocks to each host and performs the respective SNAT on traffic. Upon allocation, FortiGate also generates system event logs with the port block allocation details to inform the administrator.

Note that the system event logs shown on this slide have been cut to fit the slide.



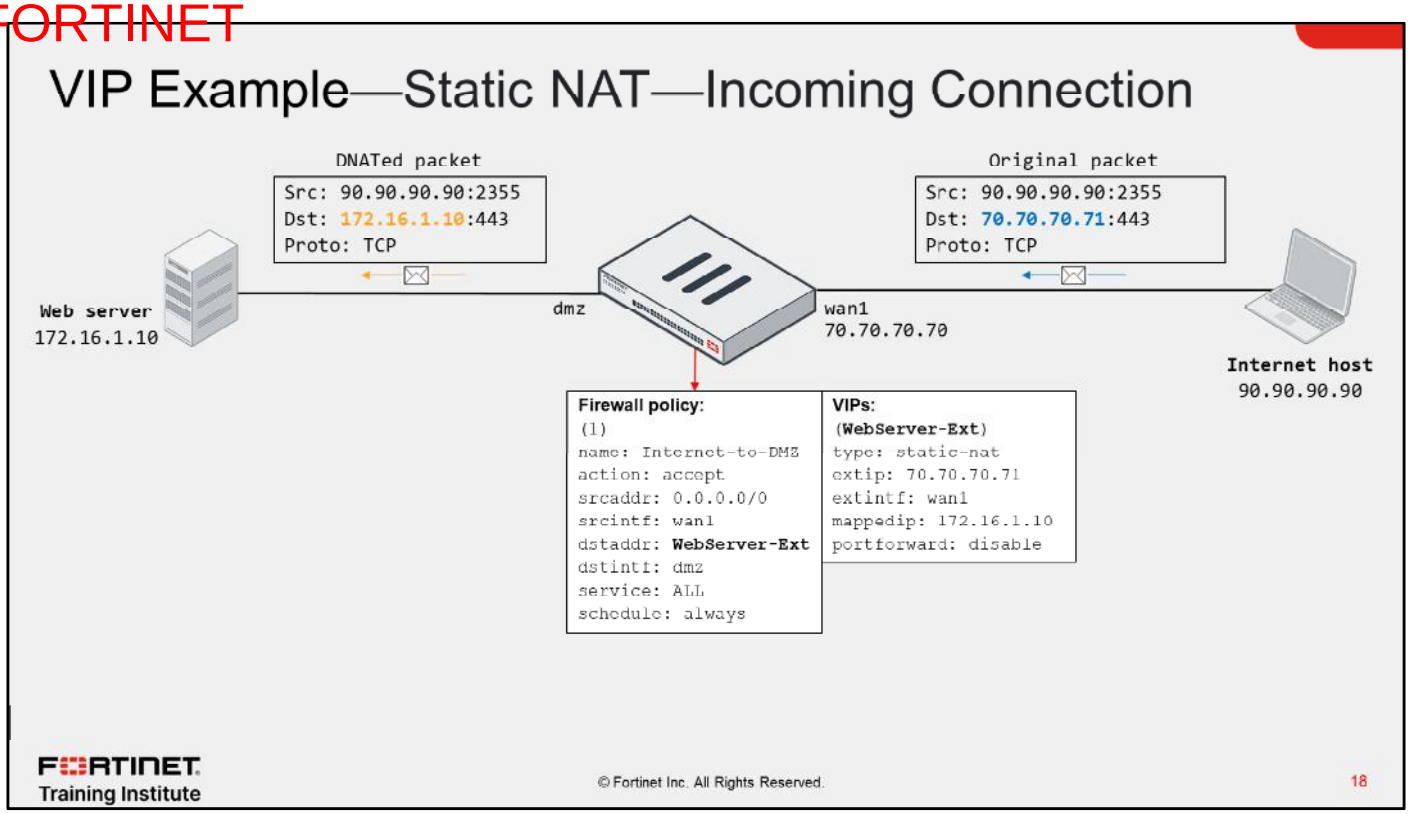
VIPs are DNAT objects. For sessions matching a VIP, the destination address is translated; usually a public internet address is translated to the private network address of a server. VIPs are selected in the firewall policy **Destination** field.

The default VIP type is **Static NAT**. This is a one-to-one mapping. This means that:

1. FortiGate performs DNAT on ingress traffic destined to the external IP address defined in the VIP, regardless of the protocol and port of the connection, provided the matching firewall policy references the VIP as **Destination**.
2. FortiGate uses as NAT IP the external IP address defined in the VIP when performing SNAT on all egress traffic sourced from the mapped address in the VIP, provided the matching firewall policy has NAT enabled. That is, FortiGate doesn't use the egress interface address as NAT IP.

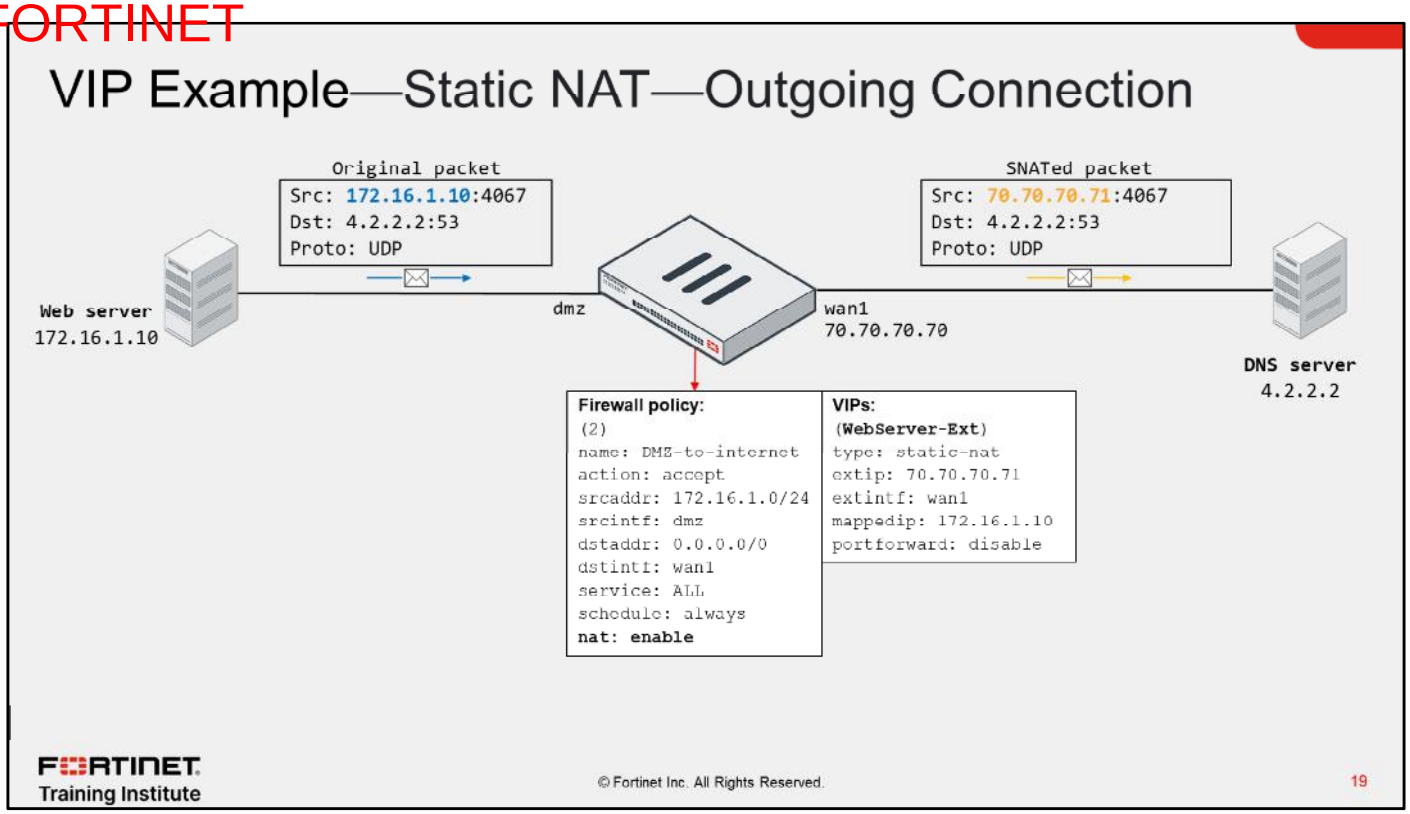
Note that you can override the behavior described in step 2 by using an IP pool. You can also select **FQDN** as **Type**. When you select **FQDN**, you can configure FQDN address objects as external and internal IP addresses. This enables FortiGate to automatically update the external and internal IP addresses used by the VIP in case the FQDN resolved address change.

Optionally, you can enable **Port Forwarding** on the VIP to instruct FortiGate to redirect the traffic matching the external address and port in the VIP to the mapped internal address and port. When you enable port forwarding, FortiGate no longer performs one-to-one mapping. This means that you can reuse the same external address and map it to different internal addresses and ports provided the external port is unique. For example, you can configure a VIP so connections to the external IP 70.70.70.70 on port 8080 map to the internal IP 192.168.0.70 on port 80. You can then configure another VIP so connections to the external IP 70.70.70.70 on port 8081 map to the internal IP 192.168.0.71 on port 80.



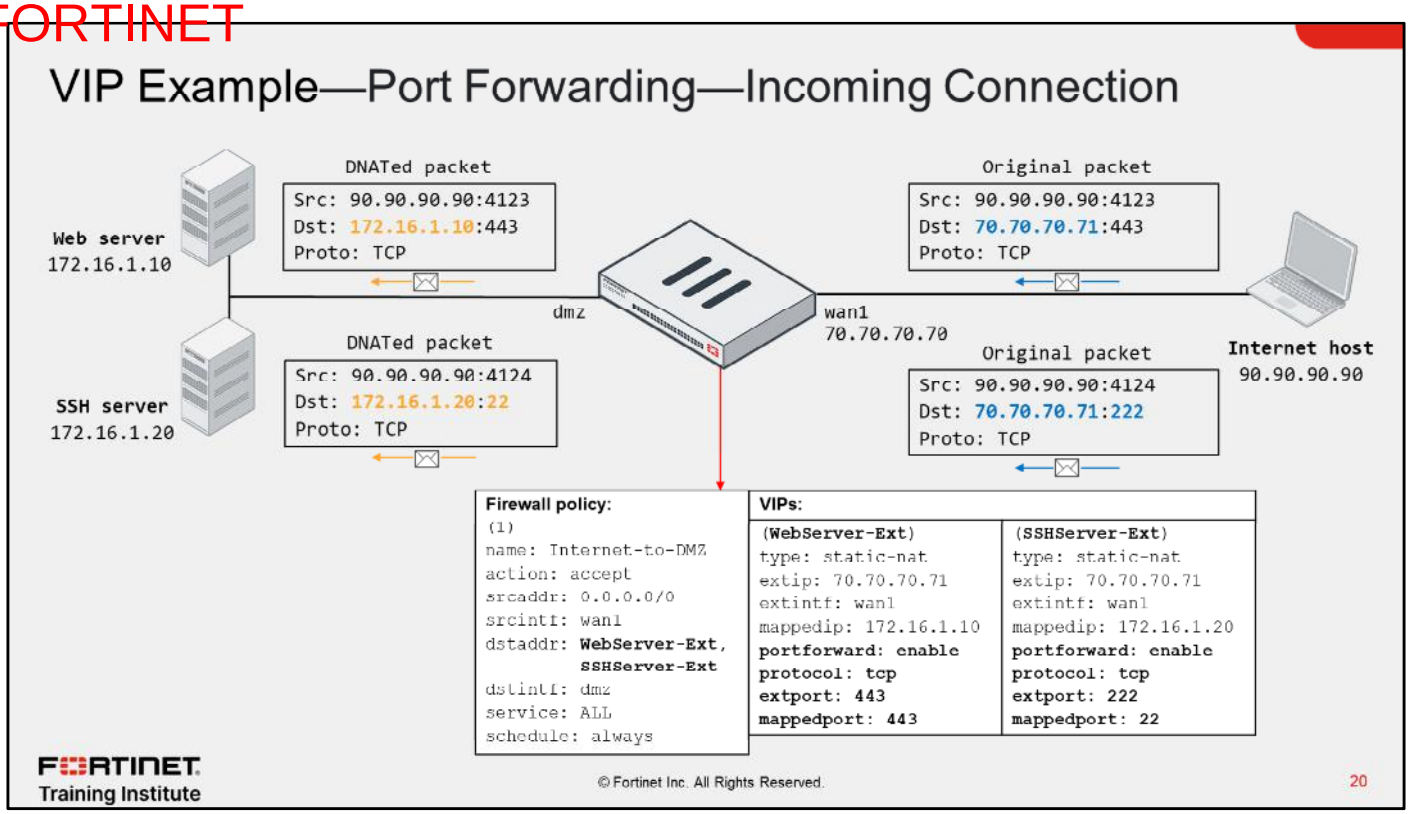
In the example shown on this slide, the internet host initiates a connection to `70.70.70.71` on TCP port 443. On FortiGate, the traffic matches the firewall policy ID 1, which references the `WebServer-Ext` VIP as destination. Because the VIP is configured as static NAT and has port forwarding disabled, then FortiGate translates the destination address of the packet to `172.16.1.10` from `70.70.70.71`. Note that the destination port doesn't change because port forwarding is disabled.

Also note that the external interface address is different from the external address configured in the VIP. This is not a problem as long as the upstream network has its routing properly set. You can also enable ARP reply on the VPN (enabled by default) to facilitate routing on the upstream network. You will learn more about ARP reply in this lesson.



Now, suppose that the internal web server (`172.16.1.10`) initiates a DNS connection to the internet DNS server (`4.2.2.2`). On FortiGate, the traffic matches the firewall policy ID 2, which has `nat` enabled. Because the source address matches the internal address of the VIP, and because the VIP is configured as static NAT with port forwarding disabled, FortiGate translates the source address of the packet to `70.70.70.71` from `172.16.1.10`. Note that FortiGate doesn't have to perform PAT because the static NAT VIP equals one-to-one mapping. That is, the external IP is used by the web server only for SNAT.

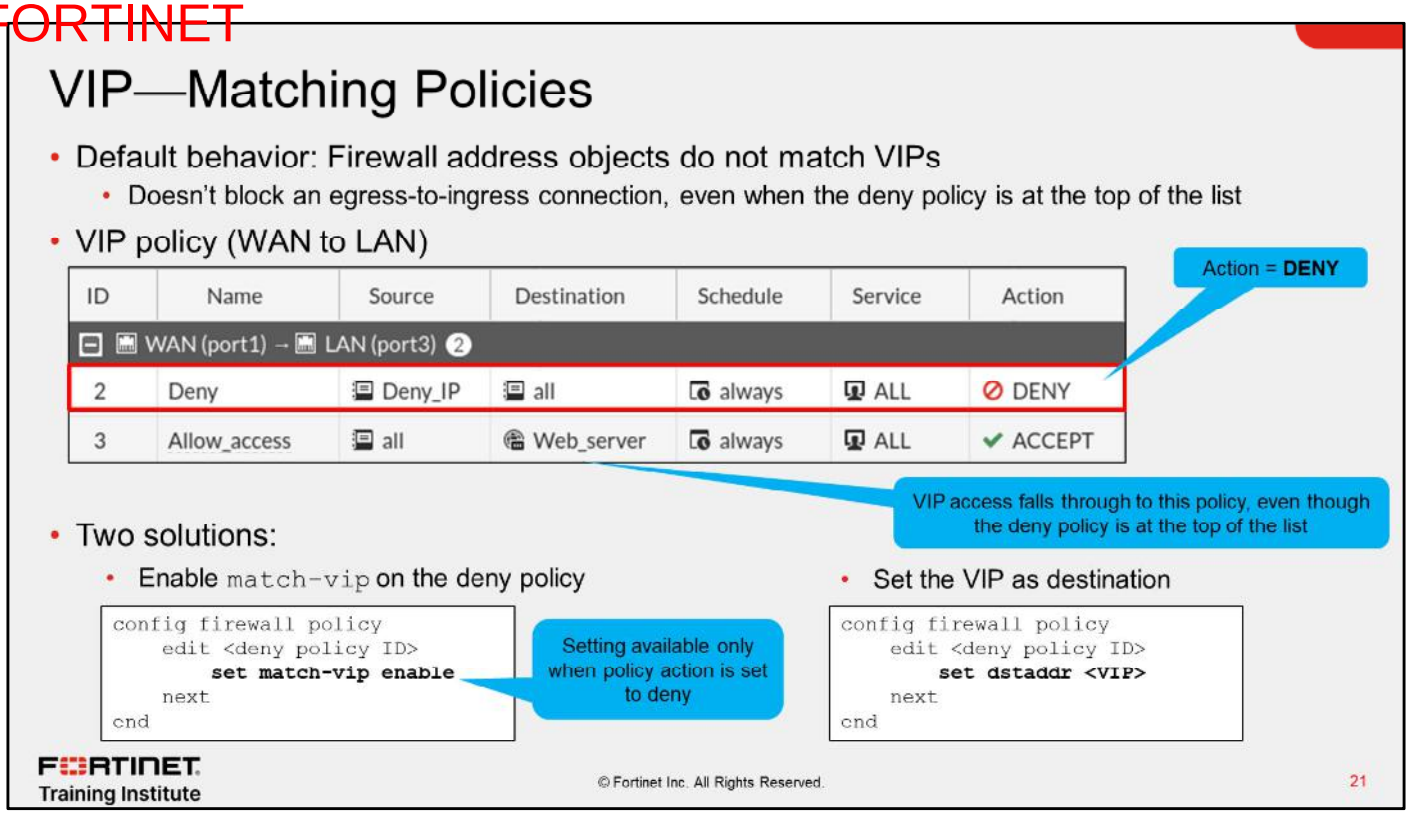
Also note that FortiGate uses the VIP external address for SNAT if the VIP is referenced in an incoming firewall policy. That is, if you don't configure firewall policy ID 1, which is shown on the previous slide, or if you disable the firewall policy, then FortiGate doesn't automatically use the external IP for translating the source address of the web server. Instead, FortiGate uses the egress interface address (`70.70.70.70`).



The example on this slide shows how FortiGate handles two incoming connections to the same external address, but on different ports. FortiGate forwards each connection to a different internal host based on the VIP mapping settings. This is possible because port forwarding is enabled on the VIPs, which enables FortiGate to redirect the external traffic to the corresponding internal address and port, while using the same external address.

Both connections match the firewall policy ID, which references two VIPs as destination. The HTTPS connection matches the `WebServer-Ext` VIP, and the SSH connection matches the `SSHServer-Ext` VIP. Note that for the SSH connection, FortiGate also translates the destination port to 22 from 222.

Although not shown on this slide, outgoing connections sourced from the web and SSH server would result in FortiGate using as NAT IP the egress interface address for SNAT, providing there is a matching firewall policy with `nat` enabled.

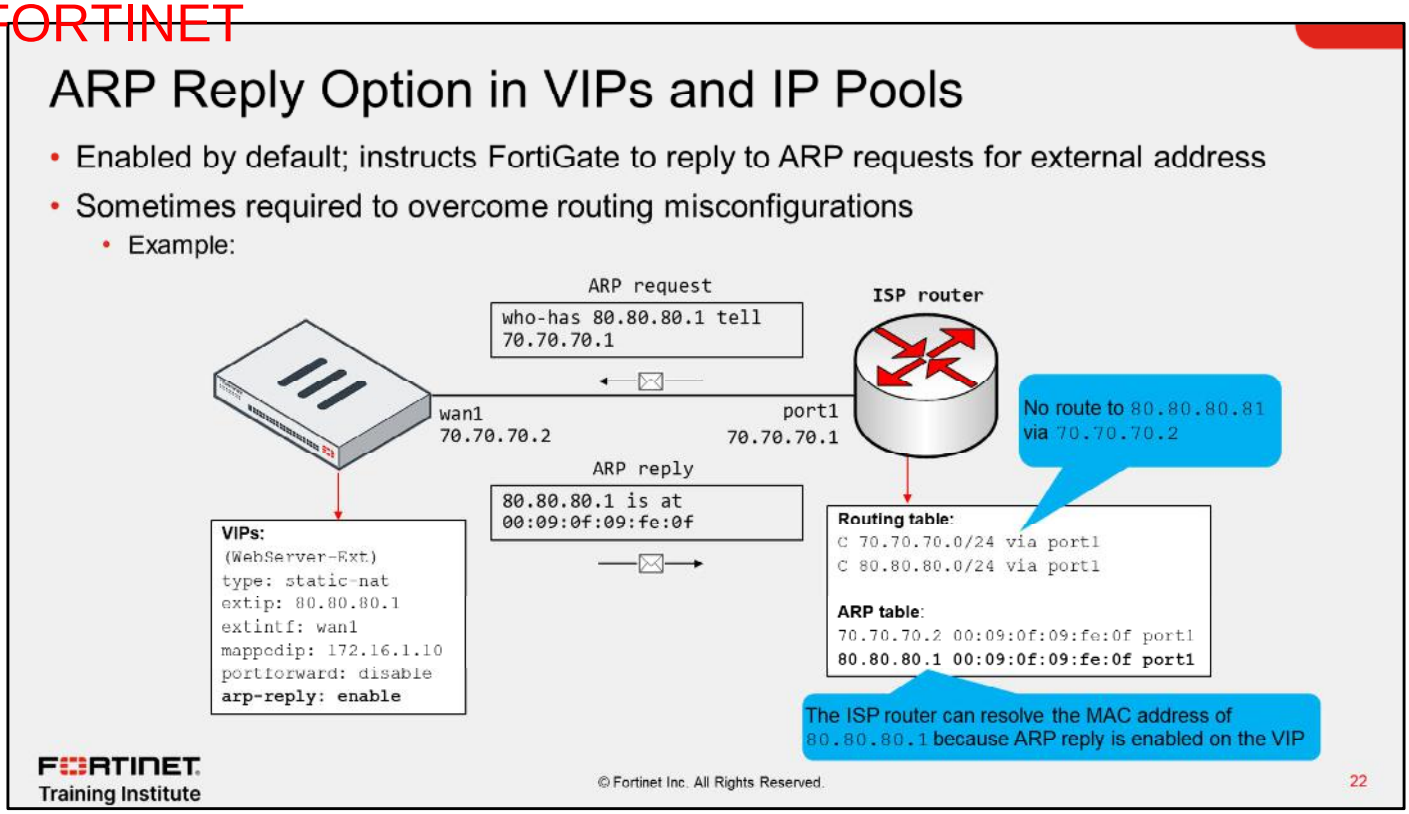


In FortiOS, VIPs and firewall address objects are completely different. They are stored separately with no overlap. This means that, by default, firewall address objects do not match VIPs.

In the example shown on this slide, the destination of the first firewall policy is set to **all**. Even though this means all destination addresses (`0.0.0.0/0`), by default, this doesn't include the external addresses defined on the VIPs. The result is that traffic destined to the external address defined on the **Web_server** VIP skips the first policy and matches the second policy instead.

But what if you want the first policy to block all incoming traffic to all destinations, including the traffic destined to any VIPs?. This is useful if your network is under attack, and you want to temporarily block all incoming external traffic. You can do this by enabling `match-vip` on the first firewall policy. Enabling `match-vip` instructs FortiGate to also check for VIPs during policy evaluation. Note that the `match-vip` setting is available only when the firewall policy action is set to **DENY**.

In case you want to block only traffic destined to one or more VIPs, you can reference the VIPs as the destination address on the deny firewall policy.



When you configure a VIP or an IP pool, ARP reply is enabled by default. When ARP reply is enabled, FortiGate replies to incoming ARP requests for the external address configured in the VIP and IP pools.

Enabling ARP reply is usually not required in most networks because the routing tables on the adjacent devices contain the correct next hop information, so the networks are reachable. However, sometimes the routing configuration is not fully correct, and having ARP reply enabled can solve the issue for you. For this reason, it's a best practice to keep ARP reply enabled.

Consider the example shown on this slide, which shows an internet connection between FortiGate and an ISP router. The example also shows a simplified version of the ISP router routing table and ARP table.

The ISP assigns the FortiGate administrator the public subnet `80.80.80.0/24` to deploy internet-facing services. The administrator configured the VIP shown on this slide to provide internet users with access to the company web server. While testing, the administrator confirms that internet users can reach the web server at `80.80.80.1`.

However, the administrator is likely unaware that having ARP reply enabled was key for a successful connectivity. The reason is that the ISP router doesn't have a route in its routing table to access the `80.80.80.0/24` subnet through the `70.70.70.2` gateway. Instead, the routing table contains a connected route for the subnet through port1. The result is that the ISP router generates ARP requests out of port1 to resolve the MAC address of any of the addresses in the `80.80.80.0/24` subnet. Nonetheless, because FortiGate responds to ARP requests for the external address in the VIP, the ISP router is able to resolve the MAC address successfully.

Knowledge Check

1. What is the default IP pool type?
   A. One-to-one
   ✓B. Overload

2. Which of the following is the default VIP type?
   ✓A. `static-nat`
   B. `load-balance`

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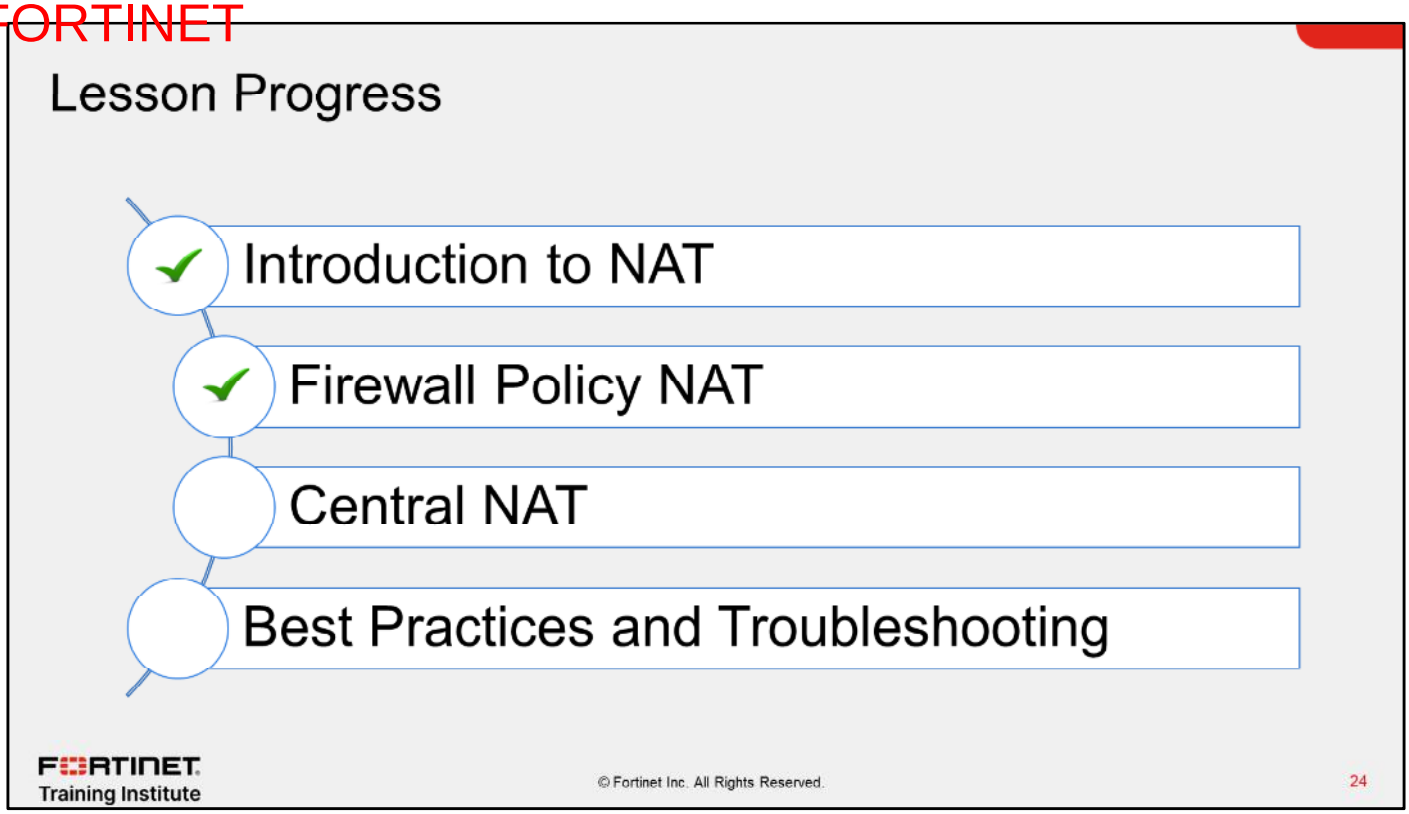
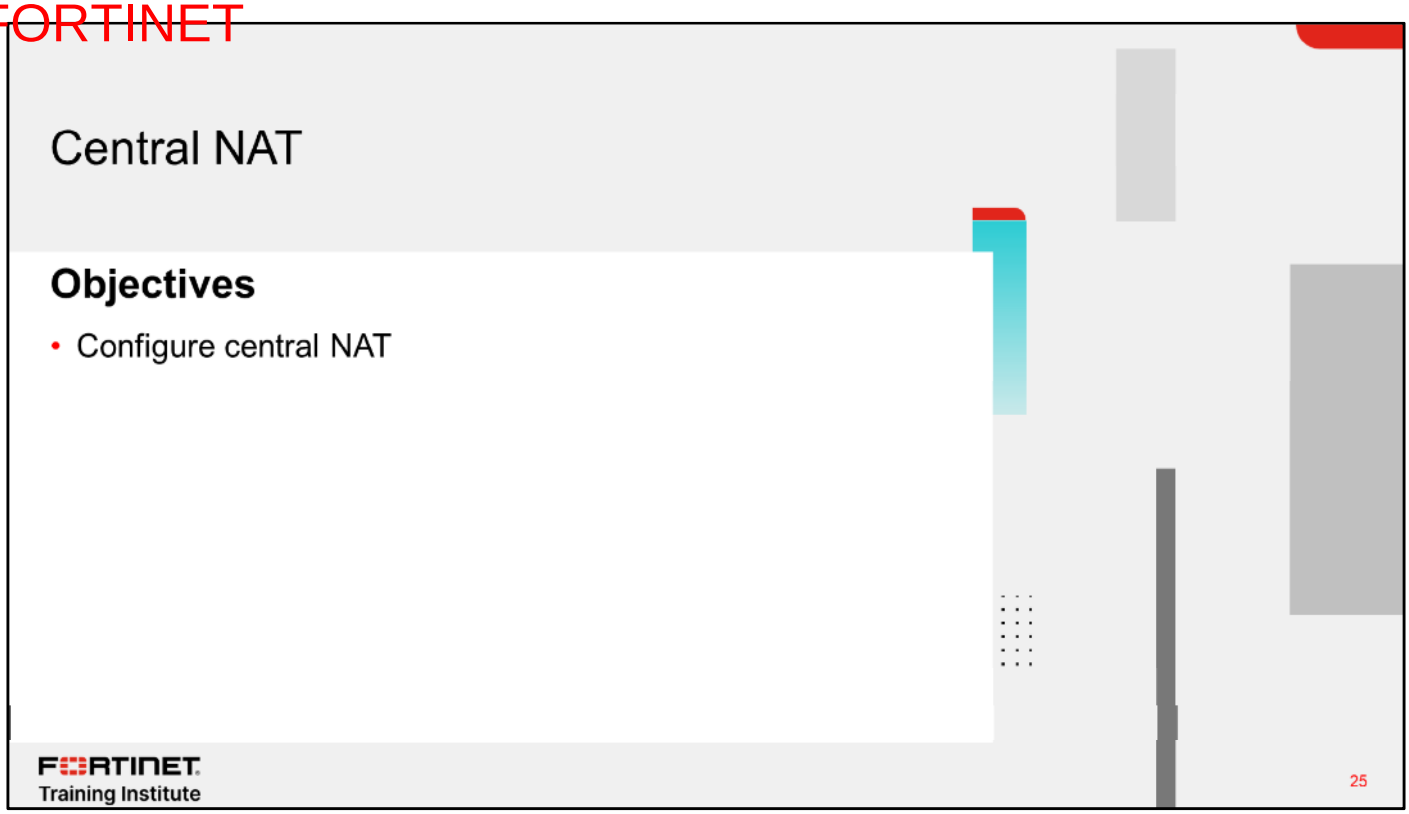


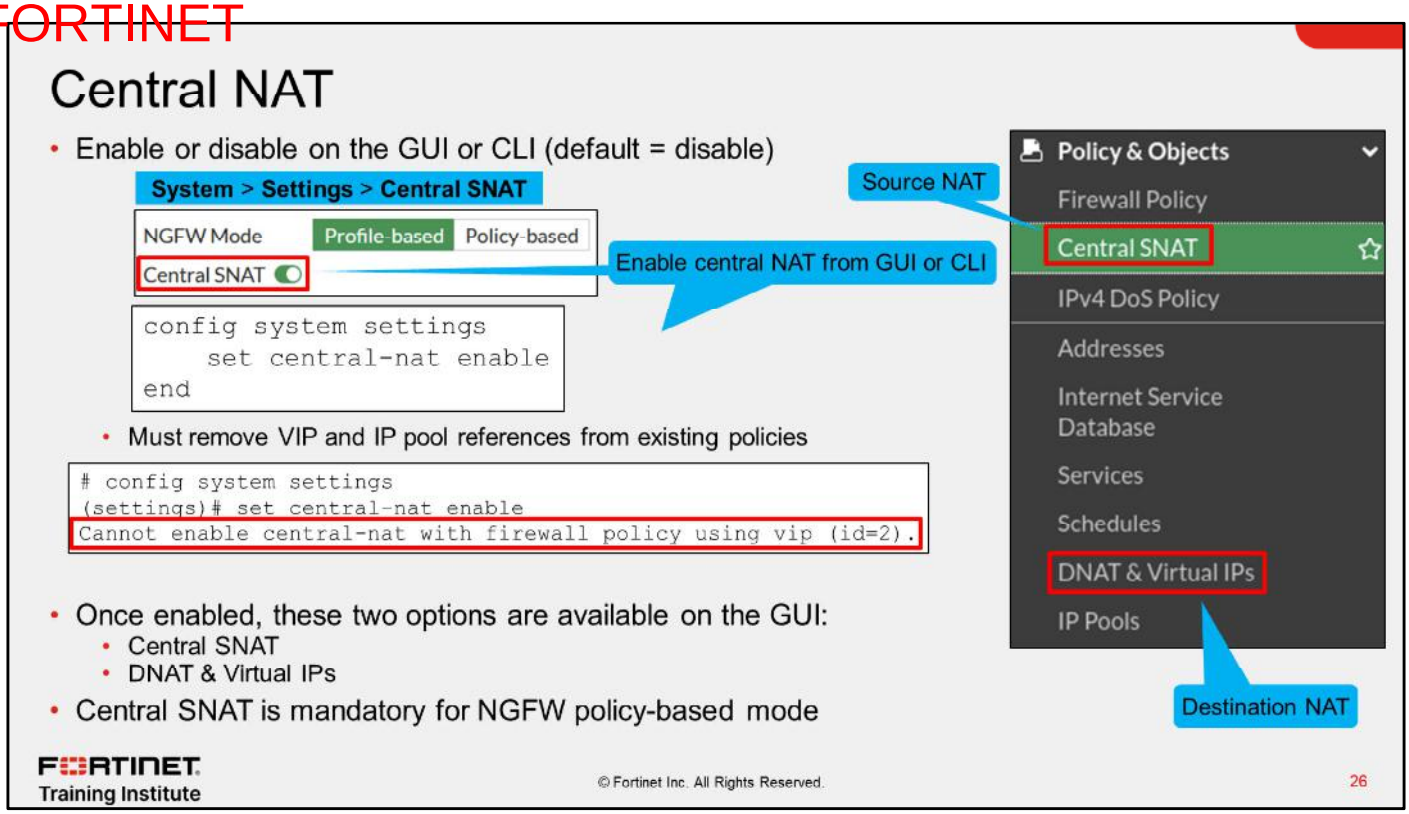
Good job! You now understand firewall policy NAT.

Now, you'll learn about central NAT.



After completing this section, you should be able to achieve the objective shown on this slide.

By demonstrating competence in configuring central NAT to perform SNAT and DNAT, you will be able to use NAT on a more granular level to control IP address, protocol, and port translation.



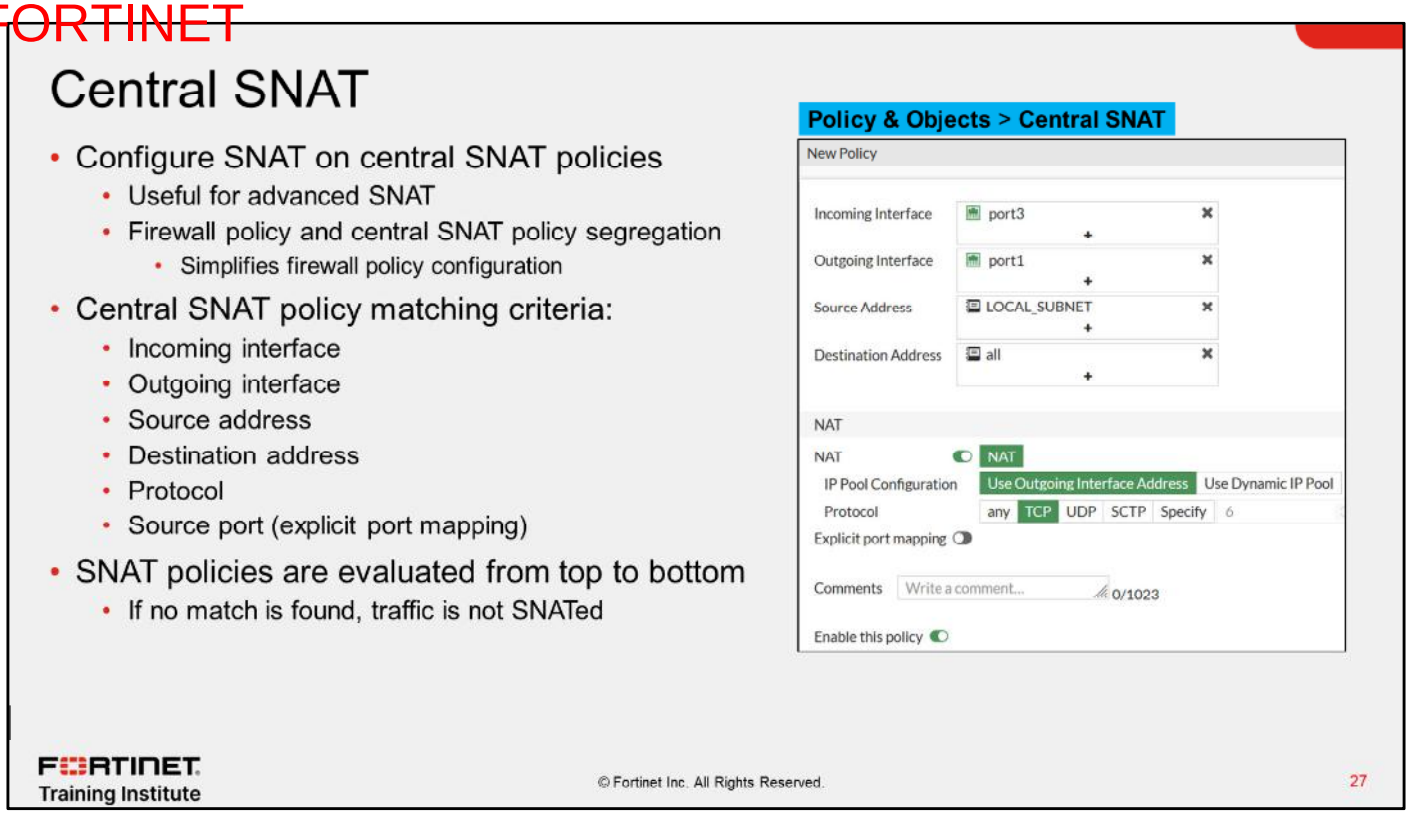
By default, central NAT is disabled. You can enable it on the CLI or the GUI. After central NAT is enabled, the following two options are available to be configured on the GUI:

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

What happens if you try to enable central NAT, but there are still IP pools or VIPs configured in firewall policies?

The CLI does not allow this and presents a message referencing the firewall policy ID with the VIP or IP pool. You *must* remove VIP or IP pool references from existing firewall policies in order to enable central NAT.

Central SNAT is mandatory for the new NGFW policy-based mode. This means SNAT behaves only according to the NAT settings found by clicking **Policy & Objects** > **Central SNAT**.



When you enable central NAT, you configure SNAT on the central SNAT page on the FortiGate GUI.

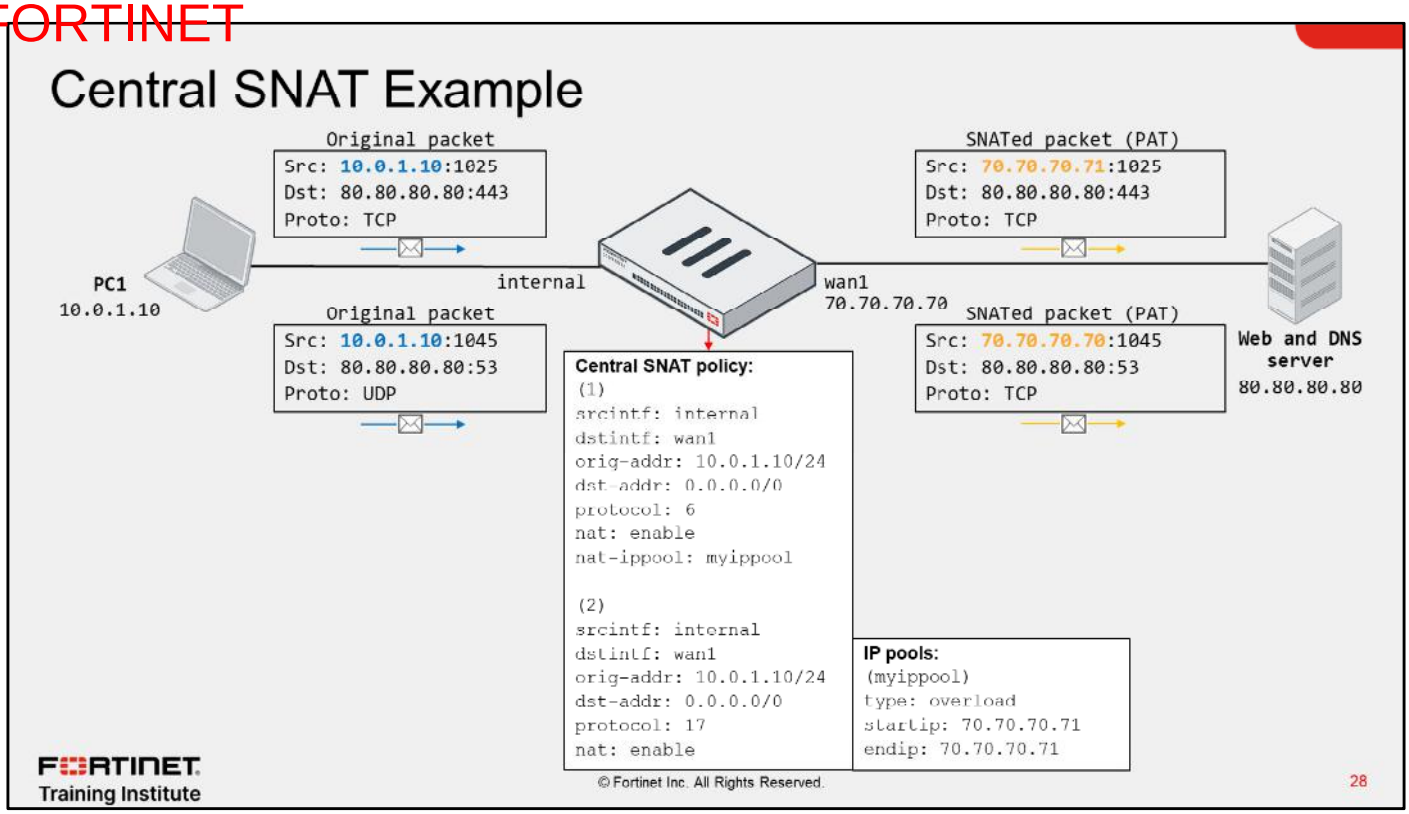
The main benefit of using central NAT for SNAT is firewall policy and central SNAT policy segregation. This is particularly useful for advanced SNAT configurations comprising multiple networks and IP pools. Instead of enabling NAT and selecting IP pools on firewall policies, you configure SNAT policies for all the accepted traffic by the firewall policies. This way, you focus your firewall policy configuration on what kind of traffic to accept, and your SNAT policies on what portion of the accepted traffic to translate and the SNAT mapping to follow. The result is that you simplify your firewall policy configuration by removing the SNAT settings from it.

When you configure SNAT policies, you can configure the following matching criteria:

- Incoming interface
- Outgoing interface
- Source address
- Destination address
- Protocol
- Source port (explicit port mapping)

You must also indicate whether you want to perform SNAT using the outgoing interface address or an IP pool. Note that if you enable central NAT mode, FortiGate doesn't perform SNAT on traffic unless you configure the corresponding matching central SNAT policy. Similarly, if the traffic doesn't match any of the configured SNAT policies, FortiGate doesn't perform SNAT on the traffic either.

Like firewall policies, SNAT policies are processed from *top to bottom* and, if a match is found, the source address and source port are translated based on the central SNAT policy mapping settings.



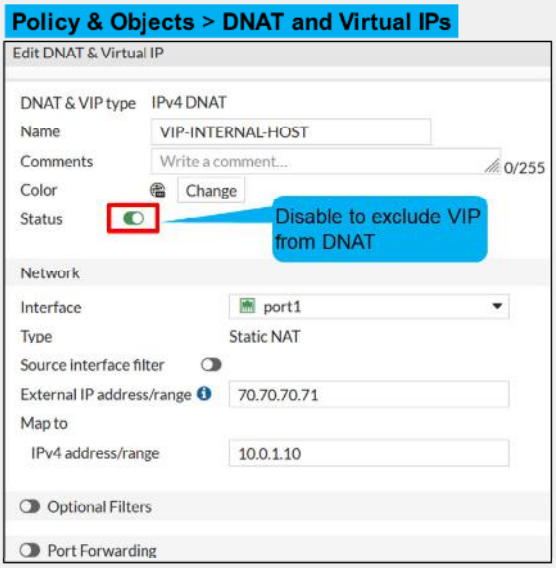
In the example shown on this slide, PC1 (`10.0.1.10`) initiates two connections to the external server (`80.80.80.80`). The HTTPS connection matches central SNAT policy ID 1 and, therefore, the source address is translated to the IP pool address (`70.70.70.71`). The DNS connection matches central SNAT policy ID 2, which doesn't reference an IP pool. The result is that the source address of the DNS connection is translated to the external interface address (`70.70.70.70`).

Although not shown on this slide, there are firewall policies configured that accept both connections.

Now, what if PC1 initiates an ICMP connection to the server? Because there is no matching central SNAT policy, then FortiGate wouldn't perform SNAT for the ICMP connection.

Central DNAT and VIPs

- Kernel has DNAT rules based on configured VIPs
  - You no longer reference VIPs in firewall policies
- Firewall policy
  - Destination address must match the VIP mapped address
    - DNAT takes place before firewall policy lookup



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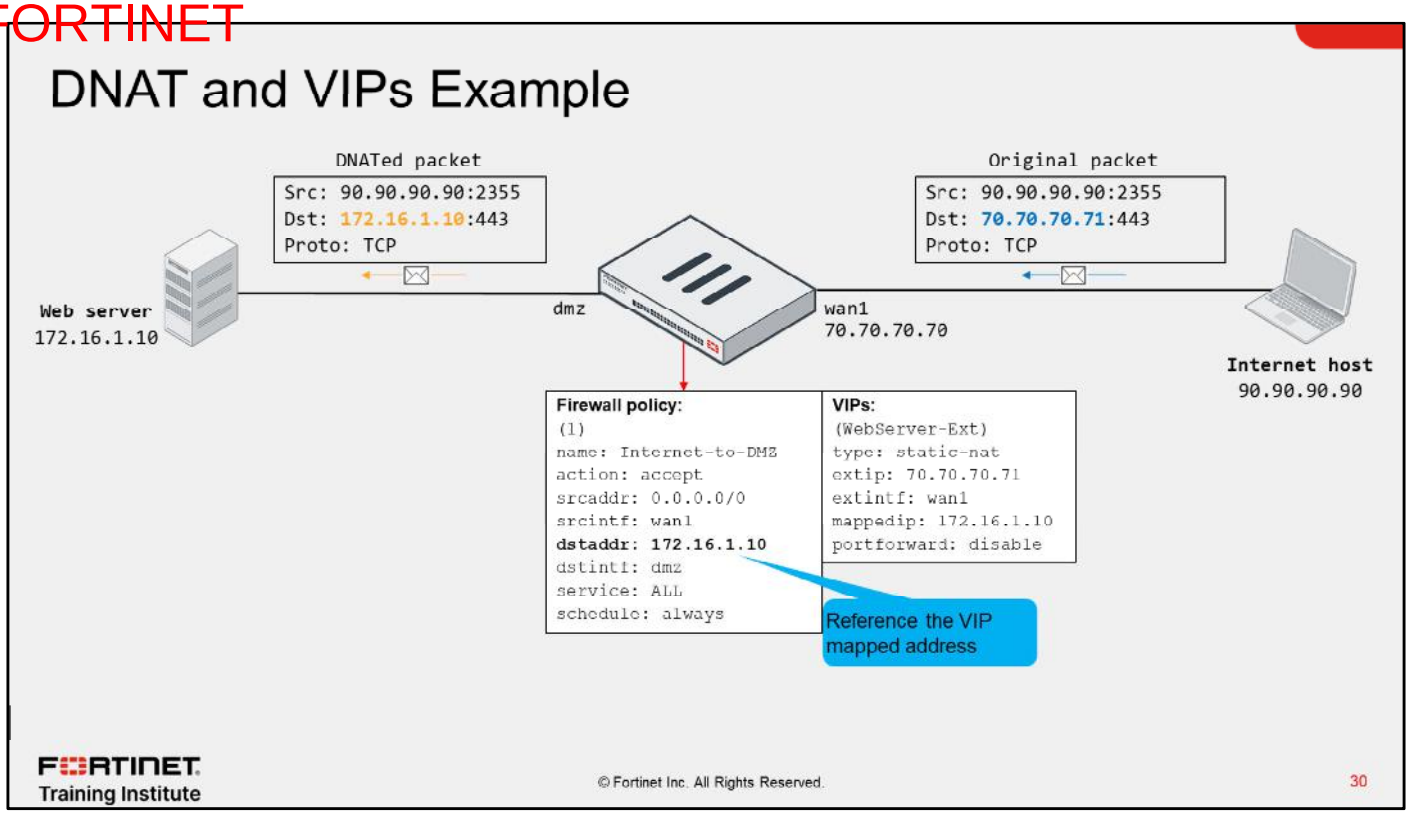
When you enable central NAT, you no longer reference VIPs on firewall policies. Instead, FortiGate automatically creates a rule in the kernel to perform DNAT for the matching traffic based on the configured VIPs. You configure the VIPs on the **DNAT and Virtual IPs** page.

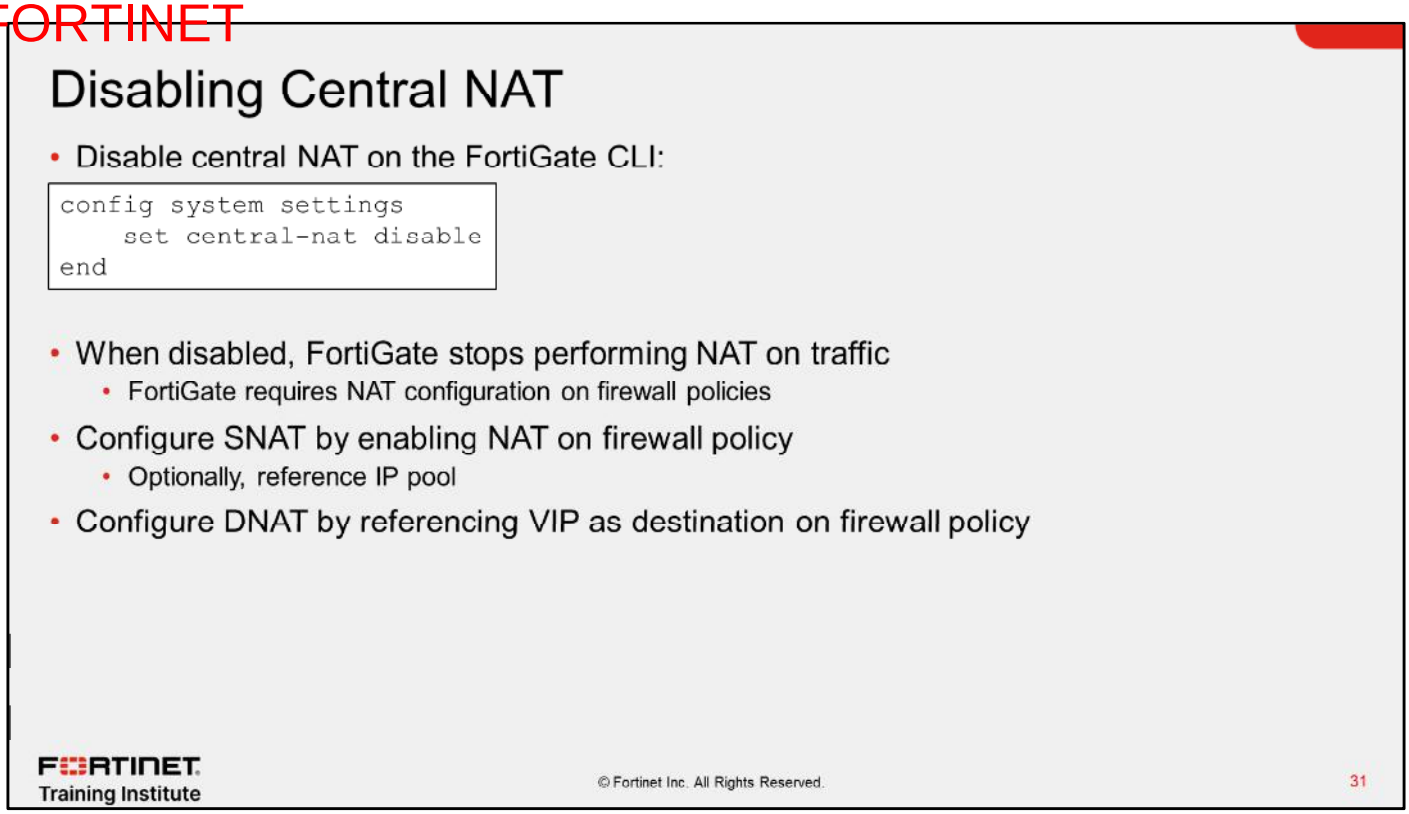
Like in the central SNAT case, you must also have a matching firewall policy that accepts the traffic you want to DNAT. However, instead of referencing the VIP, you reference the mapped internal address as destination in the firewall, and *not* the external address. This is because for ingress traffic, DNAT takes place before the firewall policy lookup. That is, FortiGate considers the translated destination address during the firewall policy lookup process.

In central NAT mode, VIPs take effect right after you create them. In case you want to exclude a VIP from DNAT, you can disable the object on the FortiGate GUI by using the **Status** button.



In the example shown on this slide, the internet host initiates a connection to `70.70.70.71` on TCP port 443. On FortiGate, the traffic matches the firewall policy ID 1, which references the web server internal address (`172.16.1.10`) as the destination. Because the VIP is configured as static NAT and has port forwarding disabled, then FortiGate translates the destination address of the packet to `172.16.1.10` from `70.70.70.71`.

Note that you configure the firewall policy to match the VIP mapped address as the destination, and *not* the VIP external address.



You can disable central NAT on the FortiGate CLI by disabling `central-nat` under `config system settings`.

However, note that when you disable central NAT, FortiGate stops performing NAT on traffic because it now requires the NAT configuration to be applied on the corresponding firewall policies. For FortiGate to perform SNAT, you must enable NAT on the respective firewall policy and, optionally, reference the IP pool. For DNAT, you must reference the VIP object as the destination on the corresponding firewall policies.

Knowledge Check

1. Which statement is true?
   - ✓ A. Central NAT is not enabled by default.
   - B. Both central NAT and firewall policy NAT can be enabled together.

2. What happens if there is no matching central SNAT policy or no central SNAT policy configured?
   - A. The egress interface IP is used.
   - ✓ B. NAT is not be applied to the firewall session.

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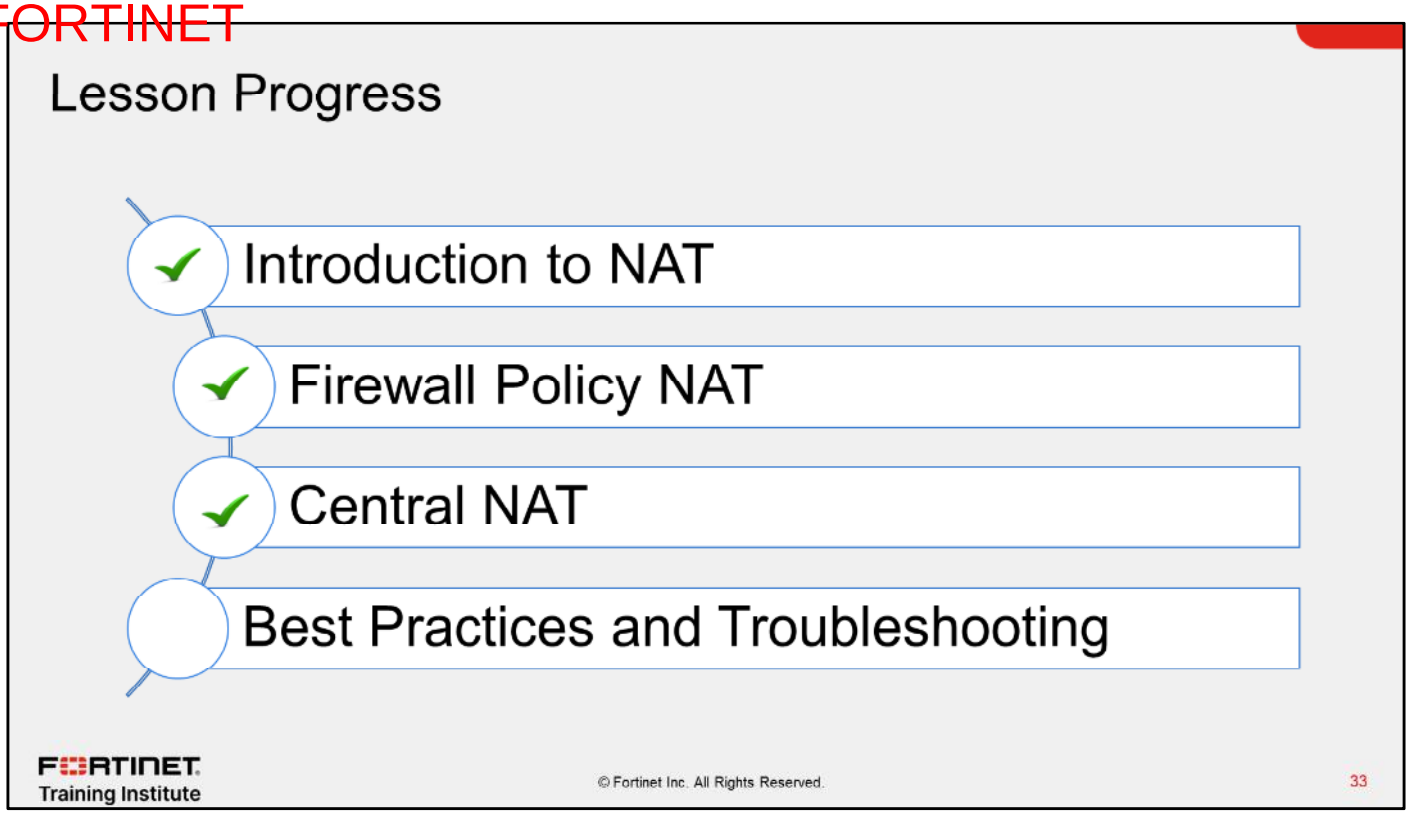
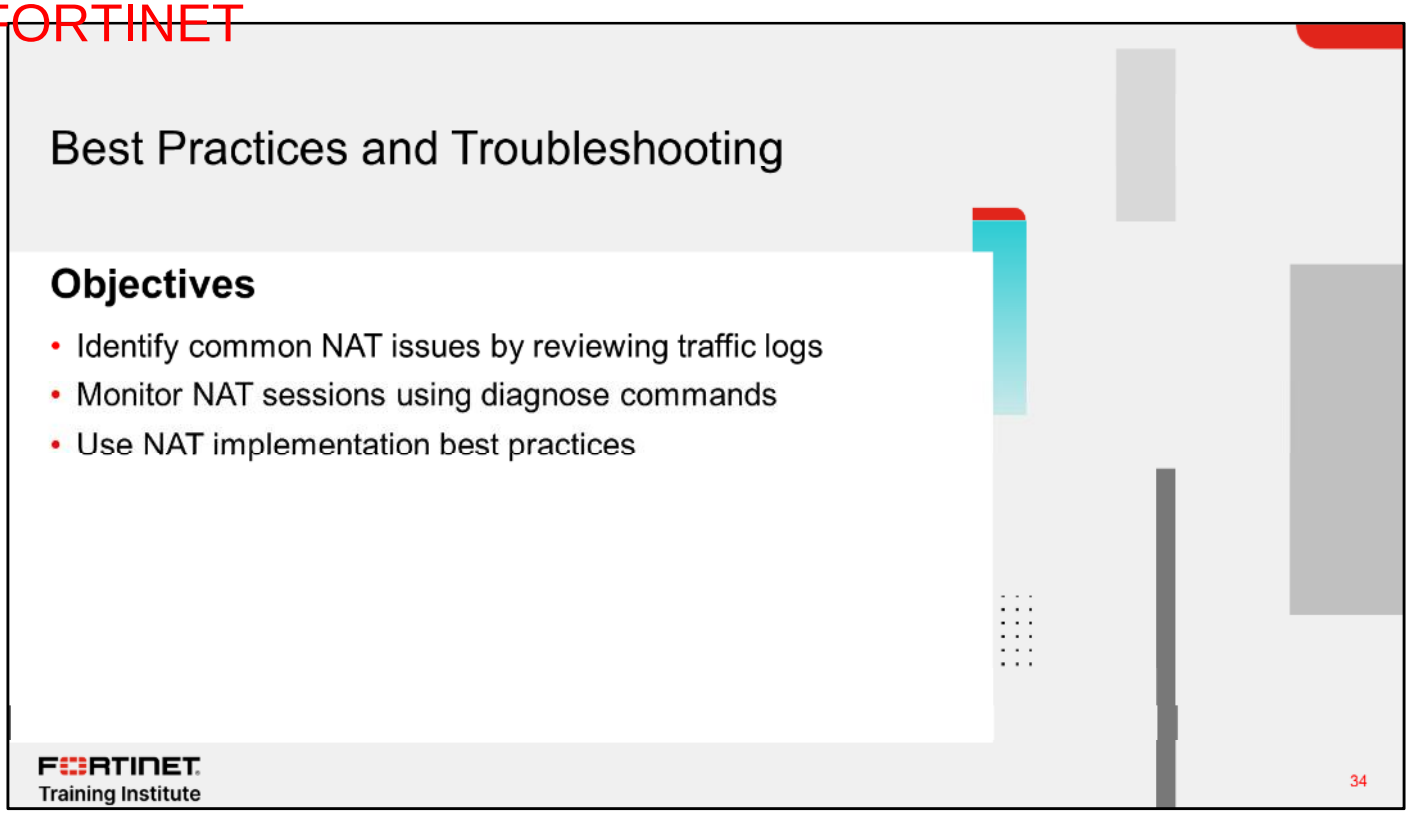


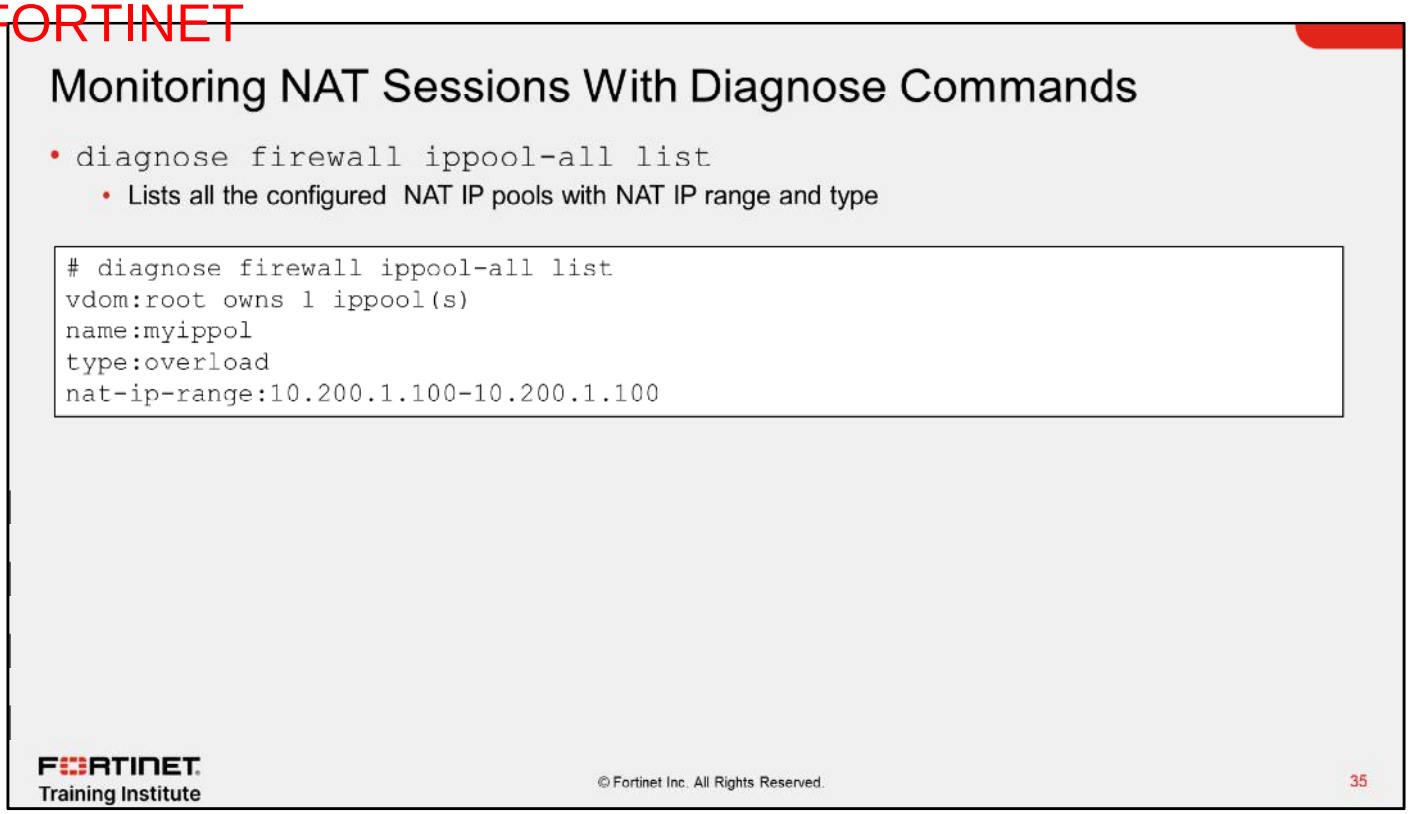
Good job! You now understand central NAT.

Now, you'll learn about best practices and troubleshooting NAT.

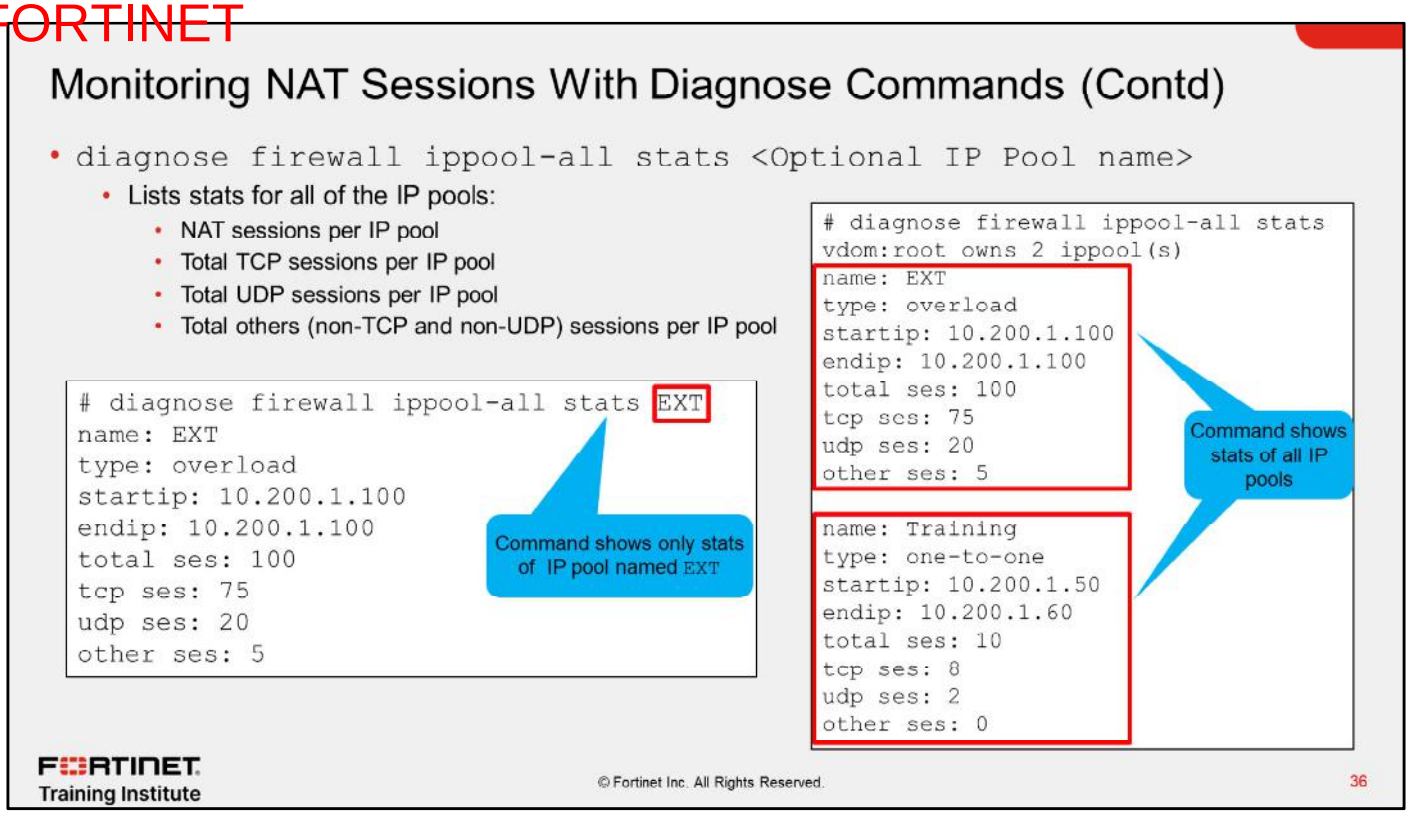


After completing this section, you should be able to achieve the objectives shown on this slide.

By demonstrating competence in using traffic logs, diagnose commands, and best practices for NAT implementation, you should be able to monitor and troubleshoot common NAT issues, and successfully implement NAT in your network.



You can run the `diagnose firewall ippool-all list` command to display the configured IP pools and their settings.

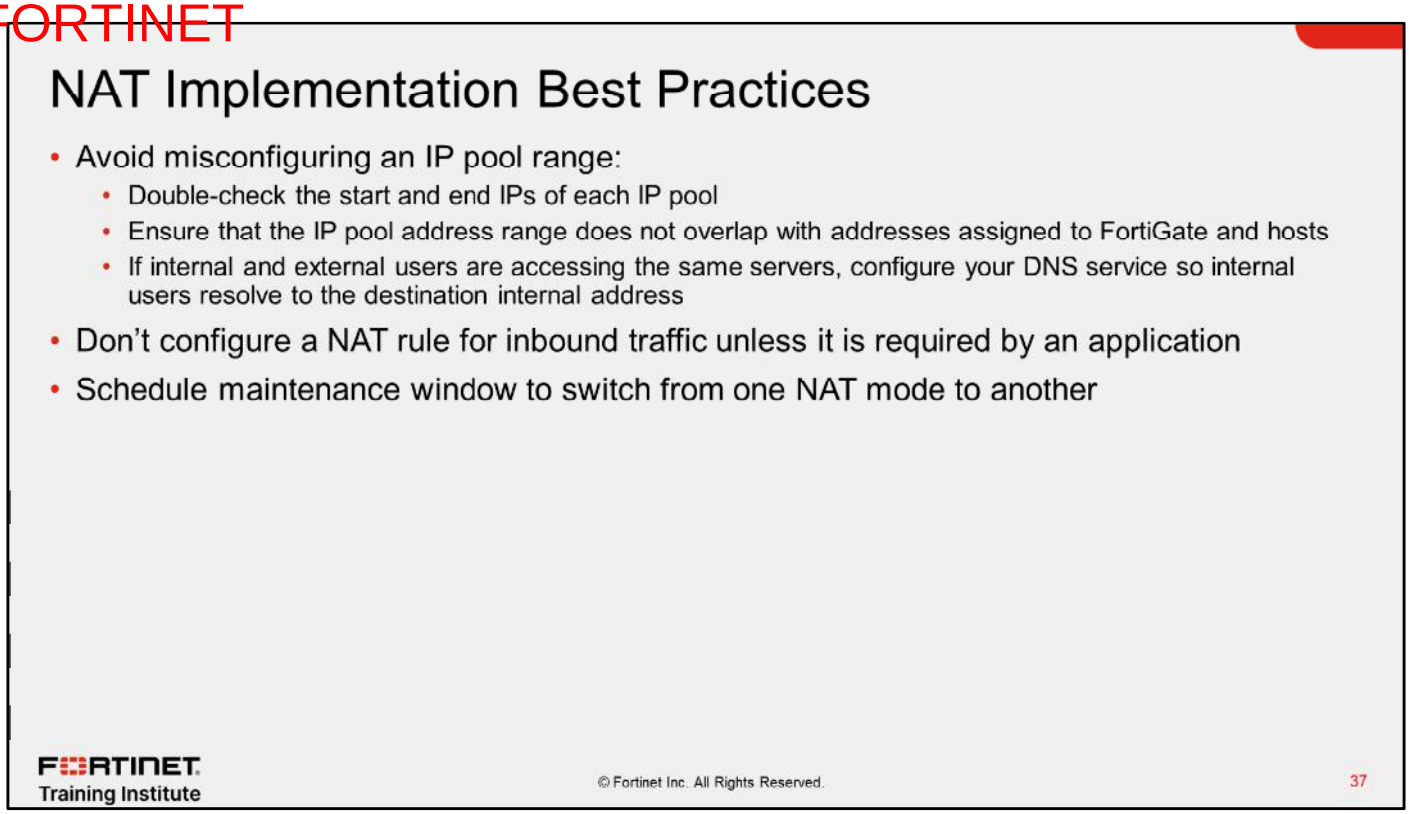


The `diagnose firewall ippool-all stats` command shows the stats for all IP pools.

The `stats` command provides the following data and information:

- NAT sessions per IP pool
- Total TCP sessions per IP pool
- Total UDP sessions per IP pool
- Total others (non-TCP and non-UDP) sessions per IP pool

Optionally, you can filter the output for a specific IP pool by using the name of the IP pool.



Use the following best practices when implementing NAT:

- Avoid misconfiguring an IP pool range:
  - Double-check the start and end IPs of each IP pool.
  - Ensure that the IP pool address range does not overlap with addresses assigned to FortiGate interfaces or to any hosts on directly connected networks.
  - If you have internal and external users accessing the same servers, configure your DNS services so internal users resolve to use the destination internal address instead of its external address defined in the VIP.
- Don't configure a NAT rule for inbound traffic unless it is required by an application. For example, if there is a matching NAT rule for inbound SMTP traffic, the SMTP server might act as an open relay.
- You must schedule a maintenance window to switch from central NAT mode to firewall policy NAT mode, or from firewall policy NAT mode to central NAT mode. Switching between NAT modes can create a network outage.

Knowledge Check

1. An administrator wants to check the total number of TCP sessions for an IP pool named `INTERNAL`. Which CLI command should the administrator use?

✓ A. `diagnose firewall ippool-all stats INTERNAL`
B. `diagnose firewall ippool-all list INTERNAL`

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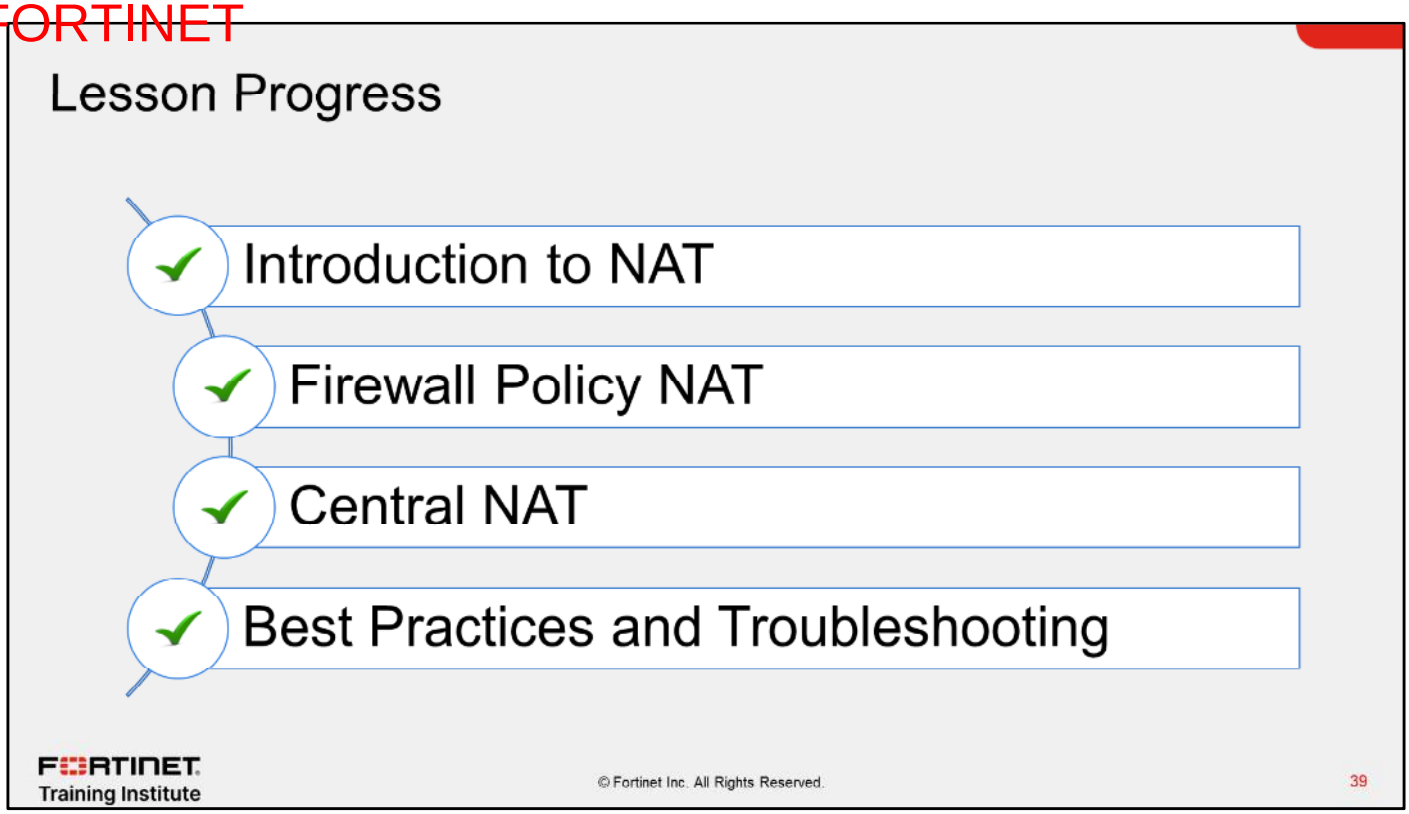
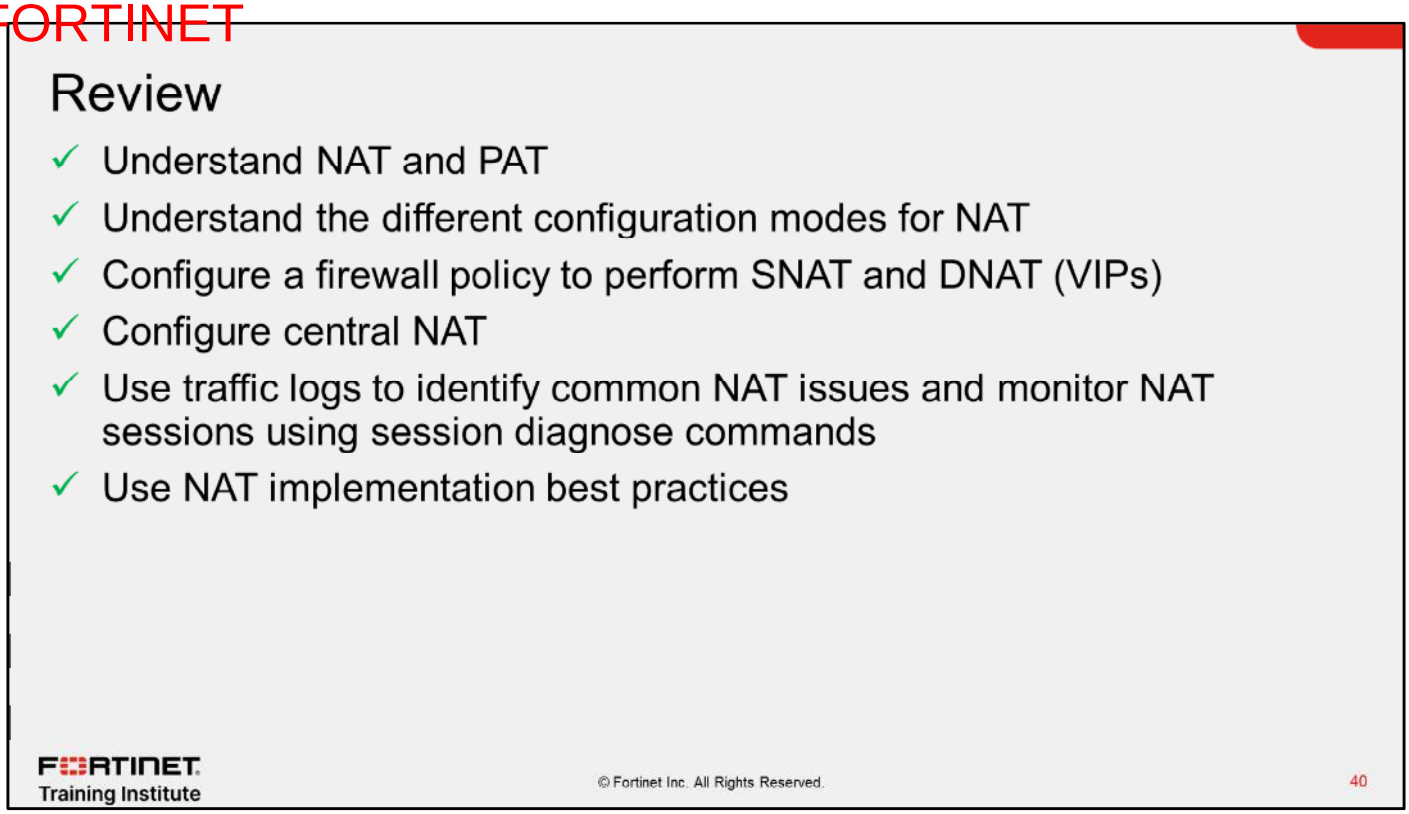


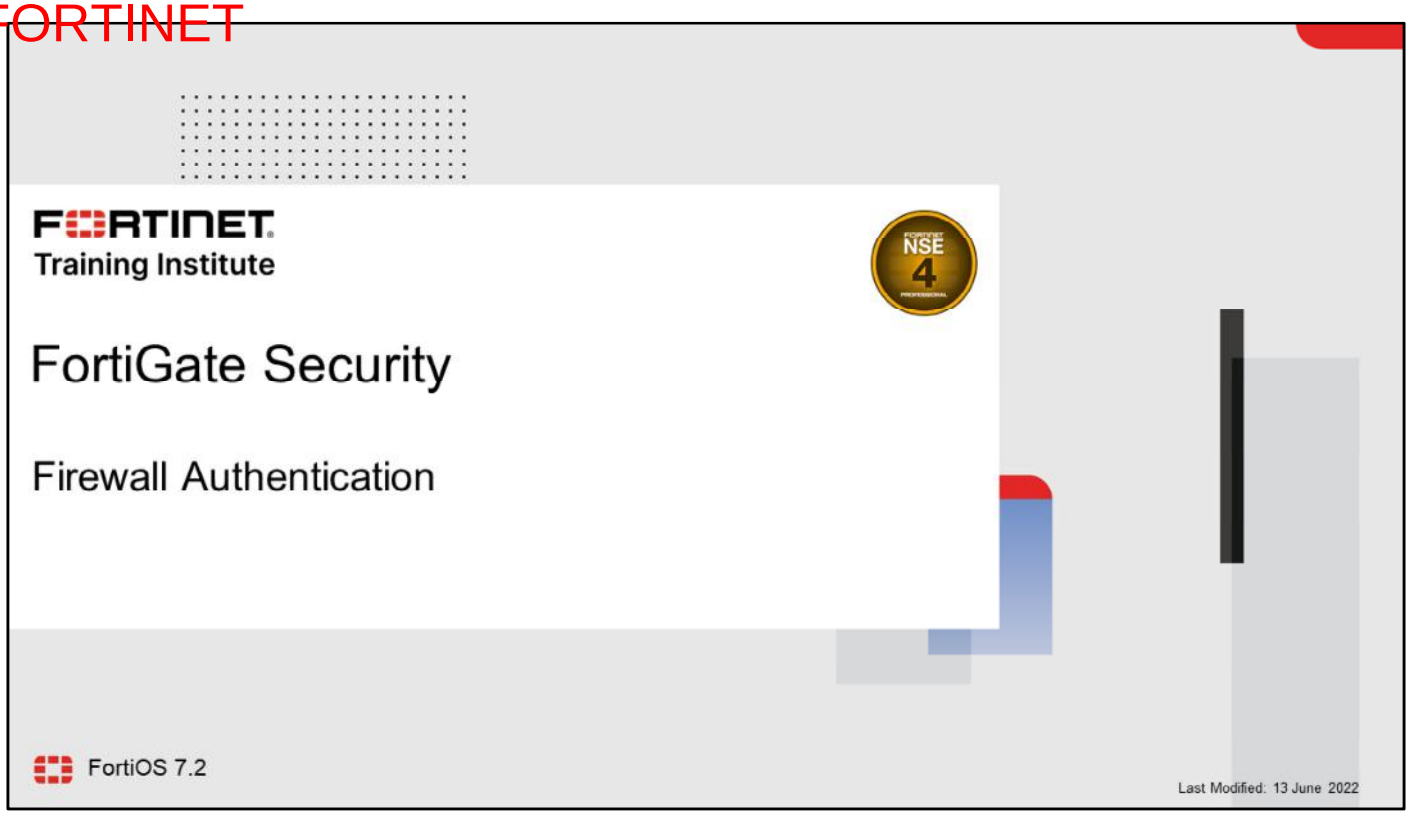
Congratulations! You have completed this lesson.

Now, you will review the objectives that you covered in this lesson.

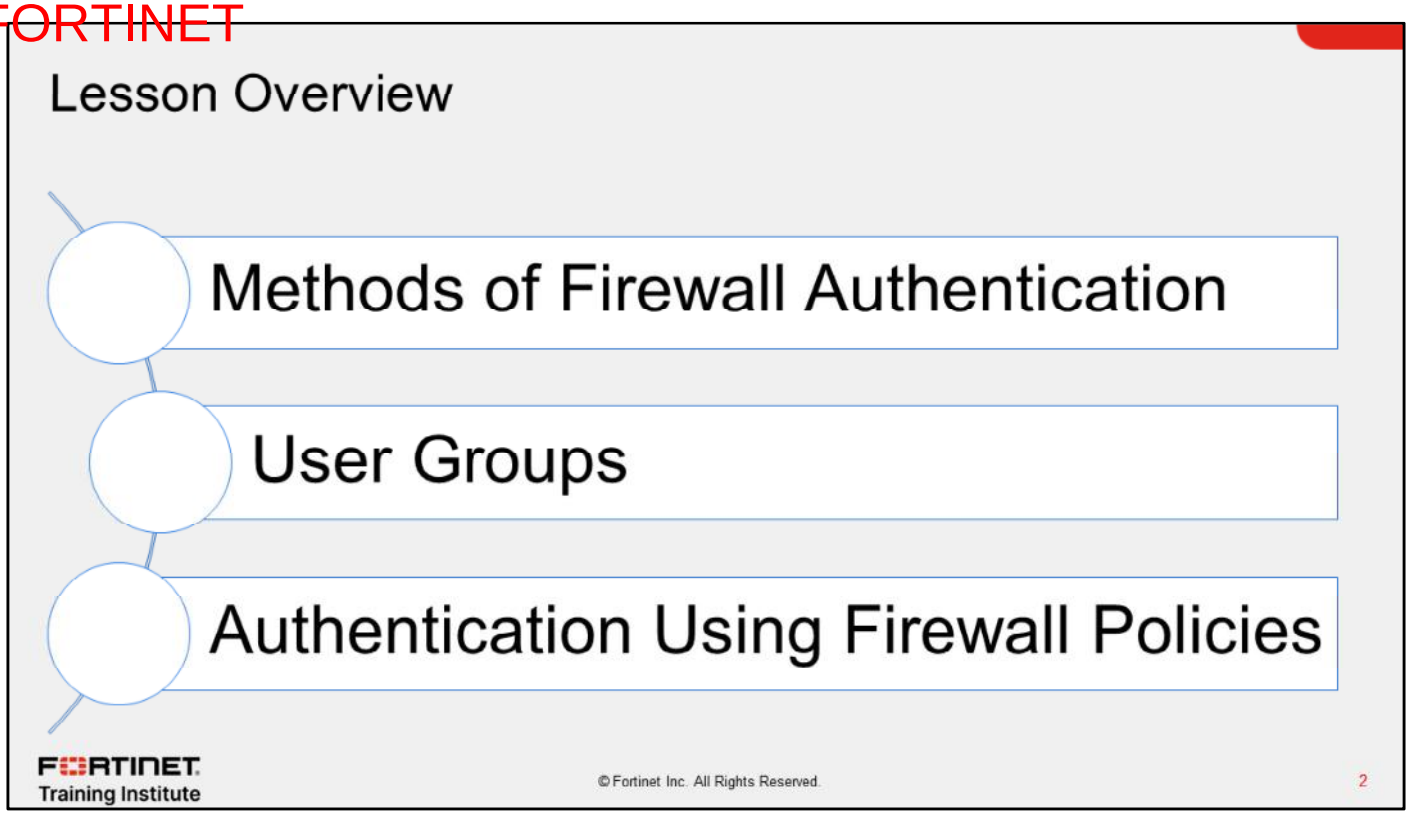


This slide shows the objectives that you covered in this lesson.

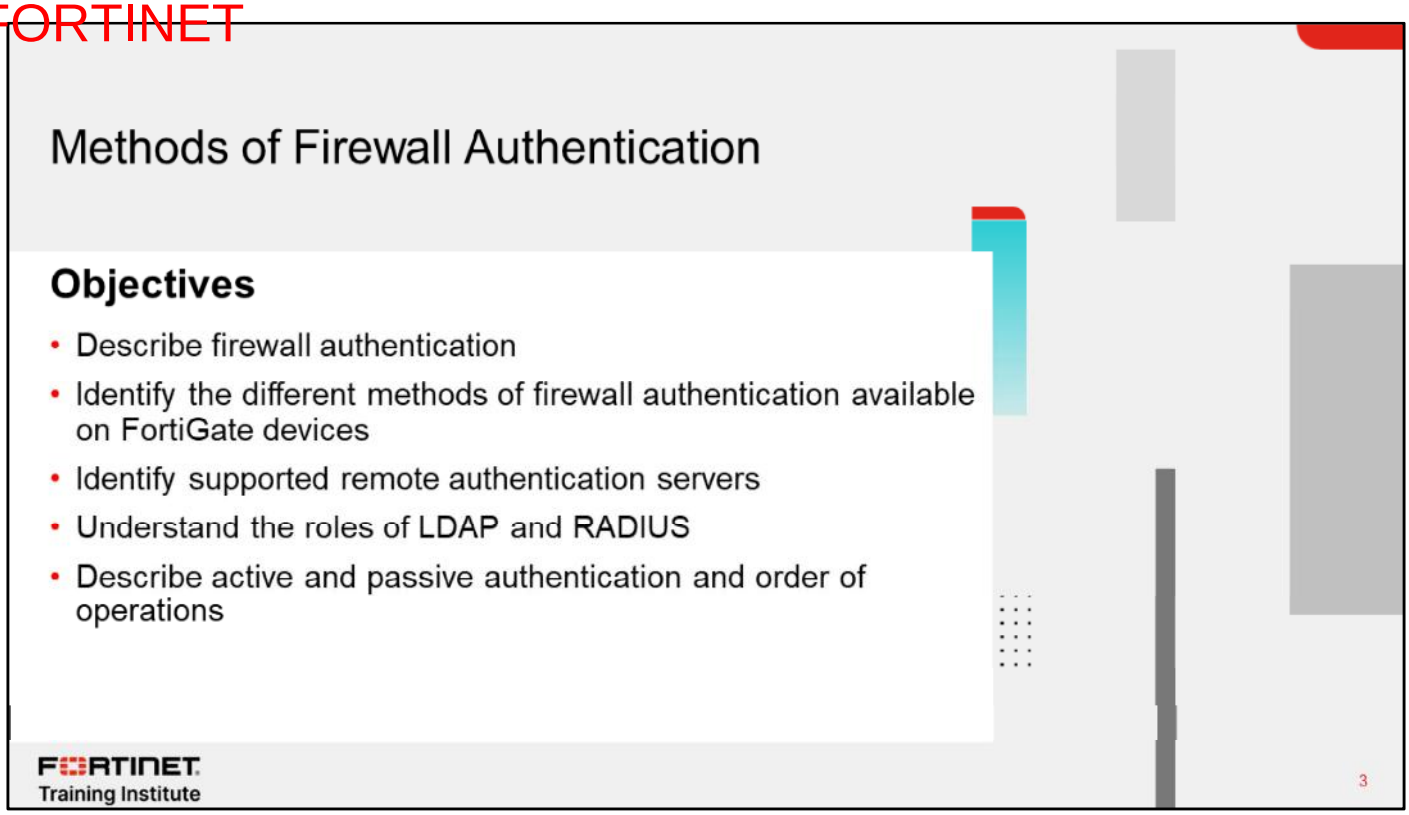
By mastering the objectives covered in this lesson, you learned how to understand and configure NAT so that you can use it in your network.



In this lesson, you will learn about using authentication on the firewall policies of FortiGate.

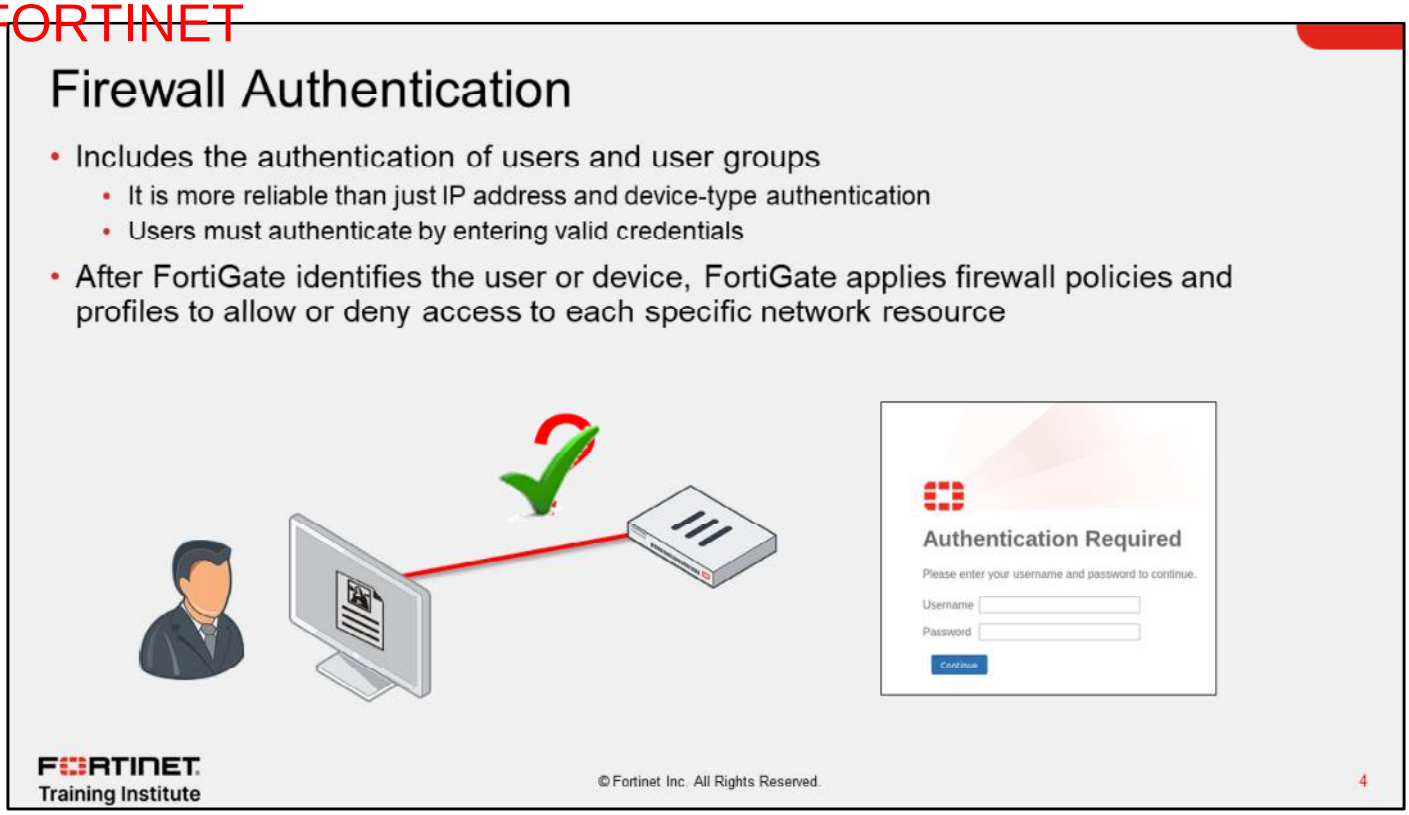


In this lesson, you will learn about the topics shown on this slide.



After completing this section, you should be able to achieve the objectives shown on this slide.

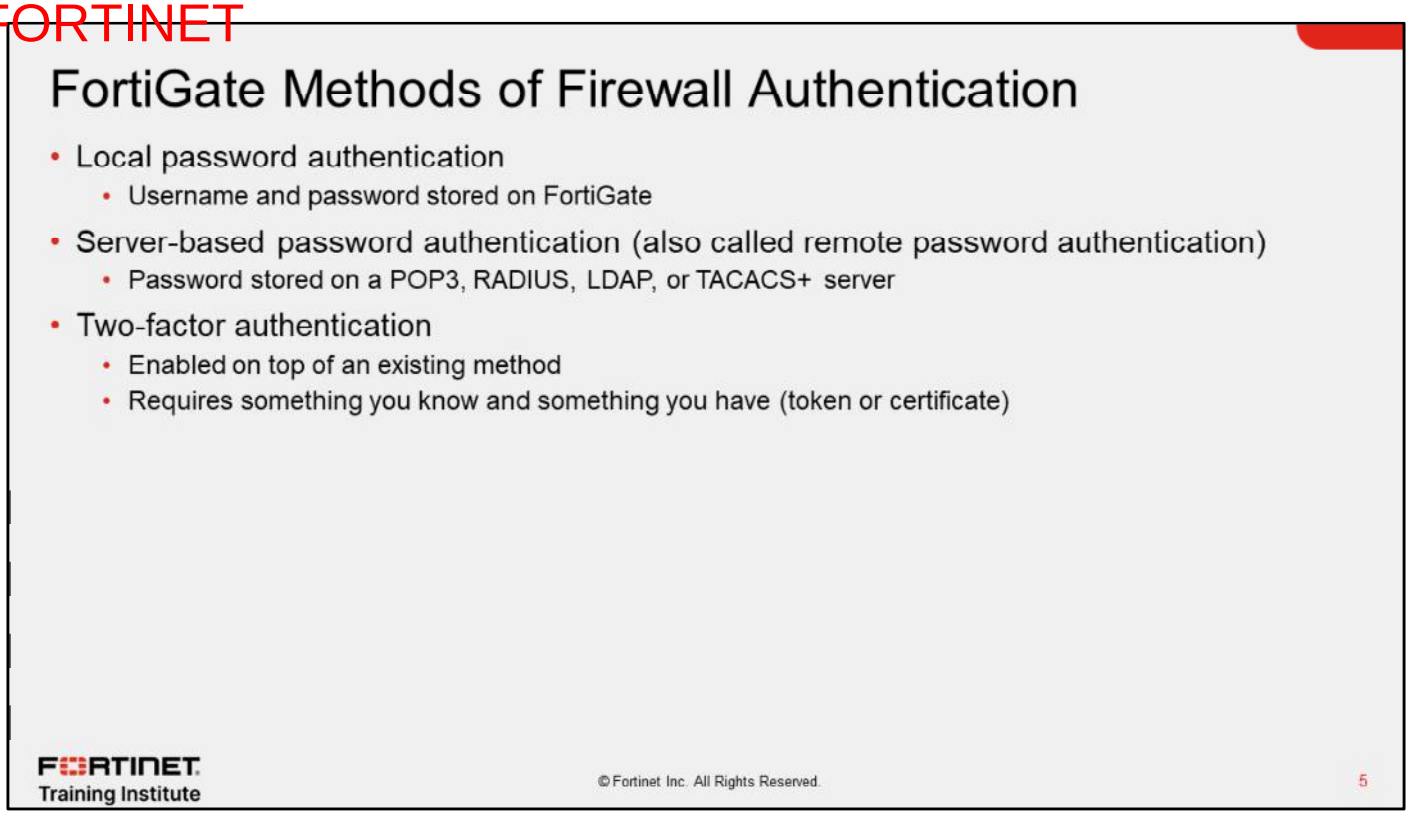
By demonstrating competence in methods of firewall authentication, you will be able to describe and identify the supported methods of firewall authentication available on FortiGate.



Traditional firewalling grants network access by verifying the source IP address and device. This is inadequate and can pose a security risk because 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.

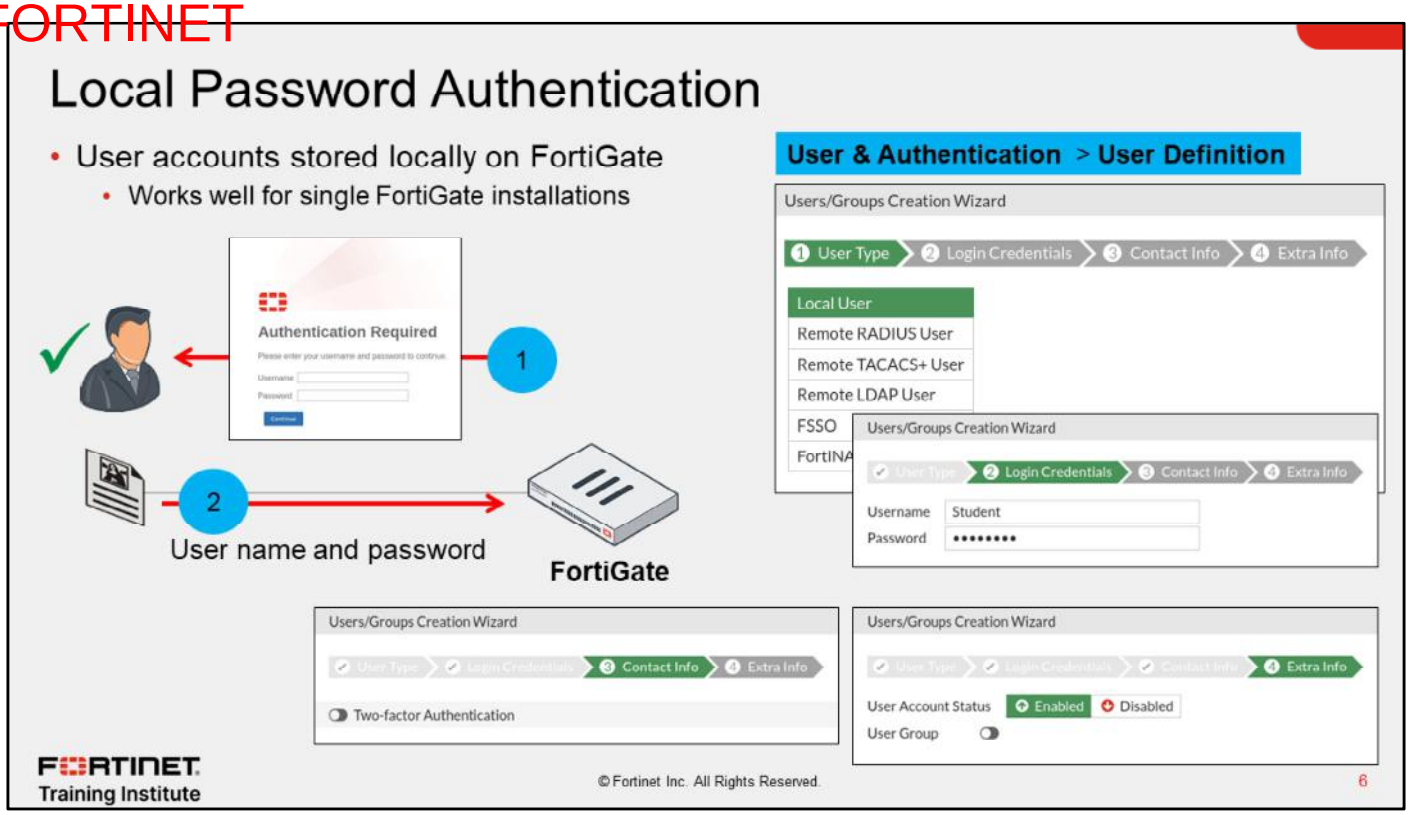
Where access is controlled by a user or user group, users must authenticate by entering valid credentials (such as username and password). After FortiGate validates the user, FortiGate applies firewall policies and profiles to allow or deny access to specific network resources.



FortiGate supports multiple methods of firewall authentication:

- Local password authentication
- Server-based password authentication (also called remote password authentication)
- Two-factor authentication
  This is a system 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.

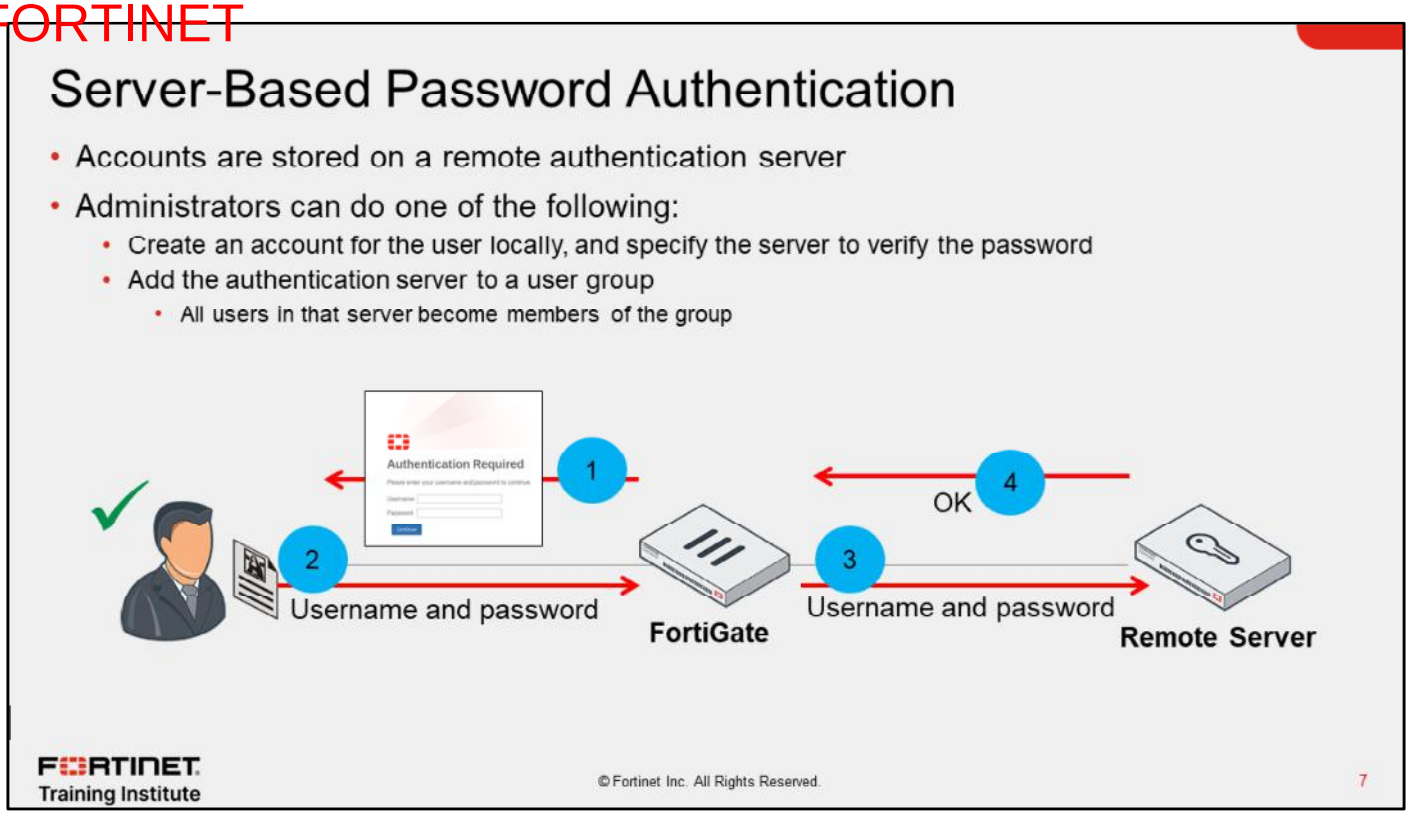
During this lesson, you will learn about each method of firewall authentication in detail.



The simplest method of authentication is local password authentication. User account information (username and password) is stored locally on the FortiGate device. This method works well for a single FortiGate installation.

Local accounts are created on 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 username 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 preconfigured user group.

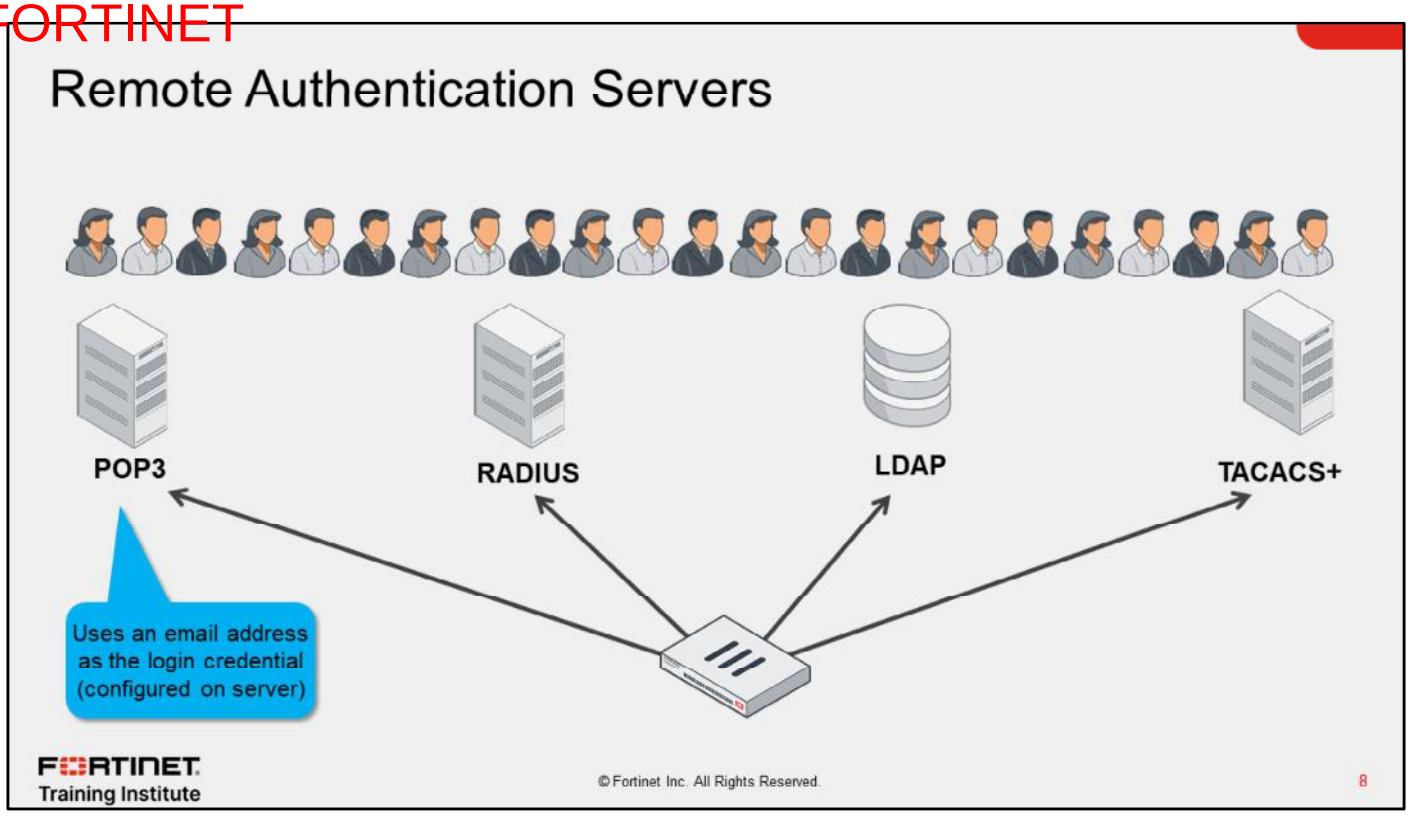
After you create the user, you can add the user—or any preconfigured user group in which the user is a member—to a firewall policy, in order to authenticate. You will learn about user groups and firewall policies in this lesson.



When server-based password authentication is used, a remote authentication server authenticates users. This method is desirable when multiple FortiGate devices need to authenticate the same users or user groups, or when adding FortiGate to a network that already contains an authentication server.

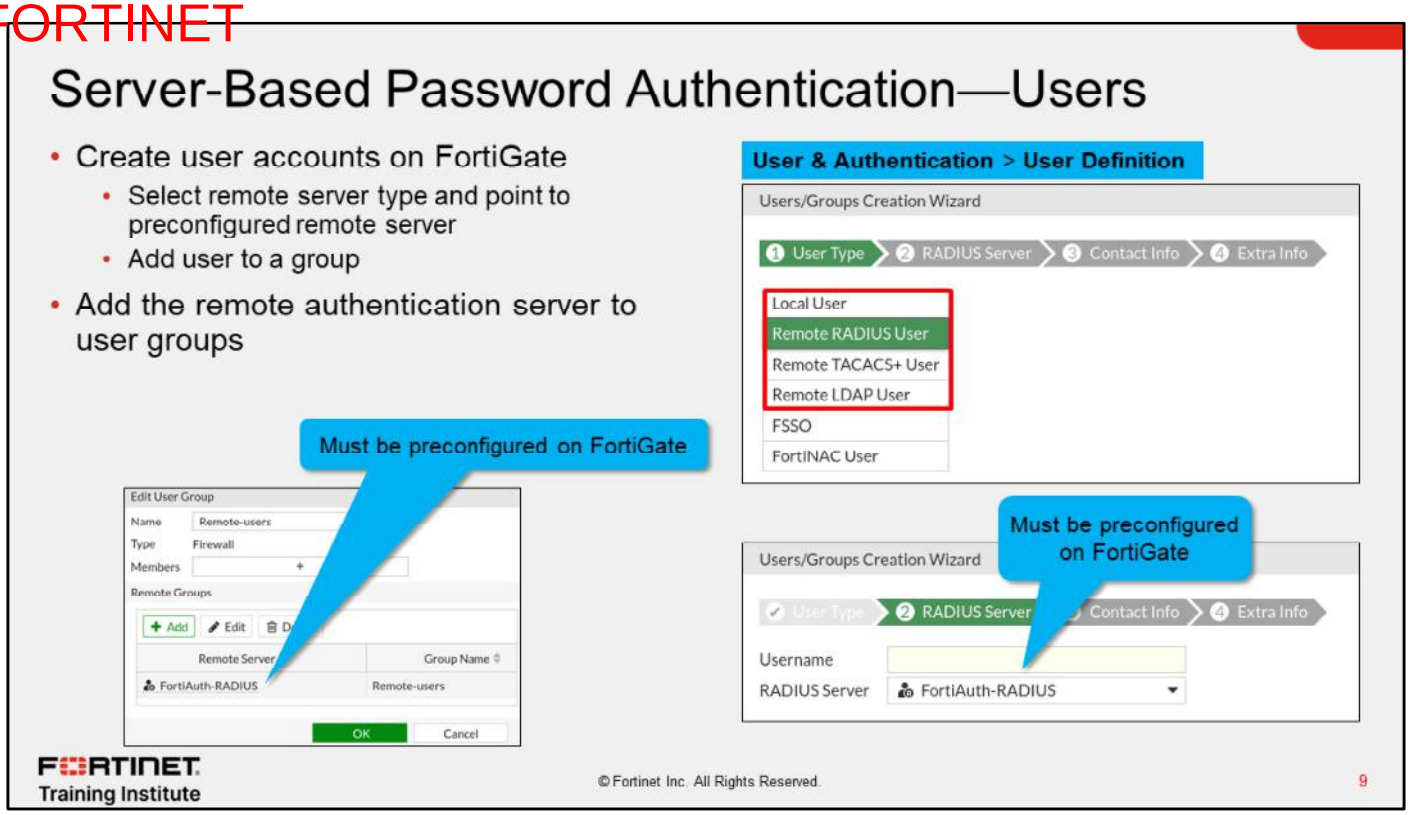
When you use a remote authentication server to authenticate users, FortiGate sends the user's entered credentials to the remote authentication server. The remote authentication server responds by indicating whether the credentials are valid or not. If valid, FortiGate consults its configuration to deal with the traffic. Note that it is the remote authentication server—not FortiGate—that evaluates the user credentials.

When the server-based password authentication method is used, 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+.

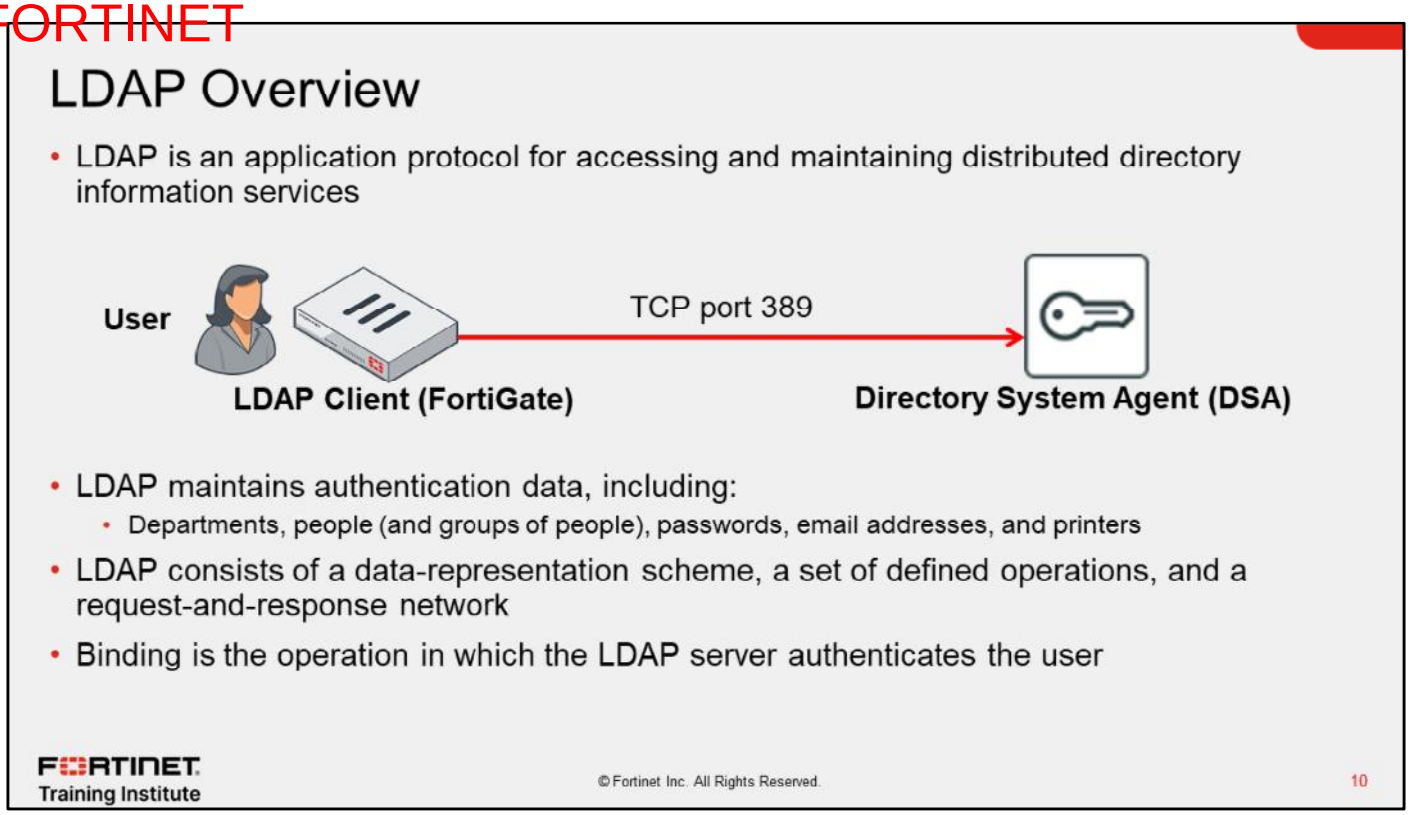
POP3 is the only server that requires an email address as the login credential. All other remote authentication servers use the user name. Some POP3 servers require the full email with domain (user@example.com), others require the suffix only, while still others accept both formats. This requirement is determined by the configuration of the server and is not a setting on FortiGate. You can configure POP3 authentication only though the CLI. Note that you can configure LDAP to validate with email, rather than the user name.



You can configure FortiGate to use external authentication servers in the following two ways:

- Create user accounts on FortiGate. With this method, you must select the remote authentication server type (RADIUS, TACACS+, or LDAP), point FortiGate to your preconfigured remote authentication server, and add the user to an appropriate group. This is usually done when you want to add two-factor authentication to your remote users. 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 preconfigured remote server to the group. Accordingly, any user who has an account on the remote authentication server can authenticate. If you are using other types of remote servers, such as an LDAP server, as the remote authentication server, you can control access to specific LDAP groups, as defined on the LDAP server.

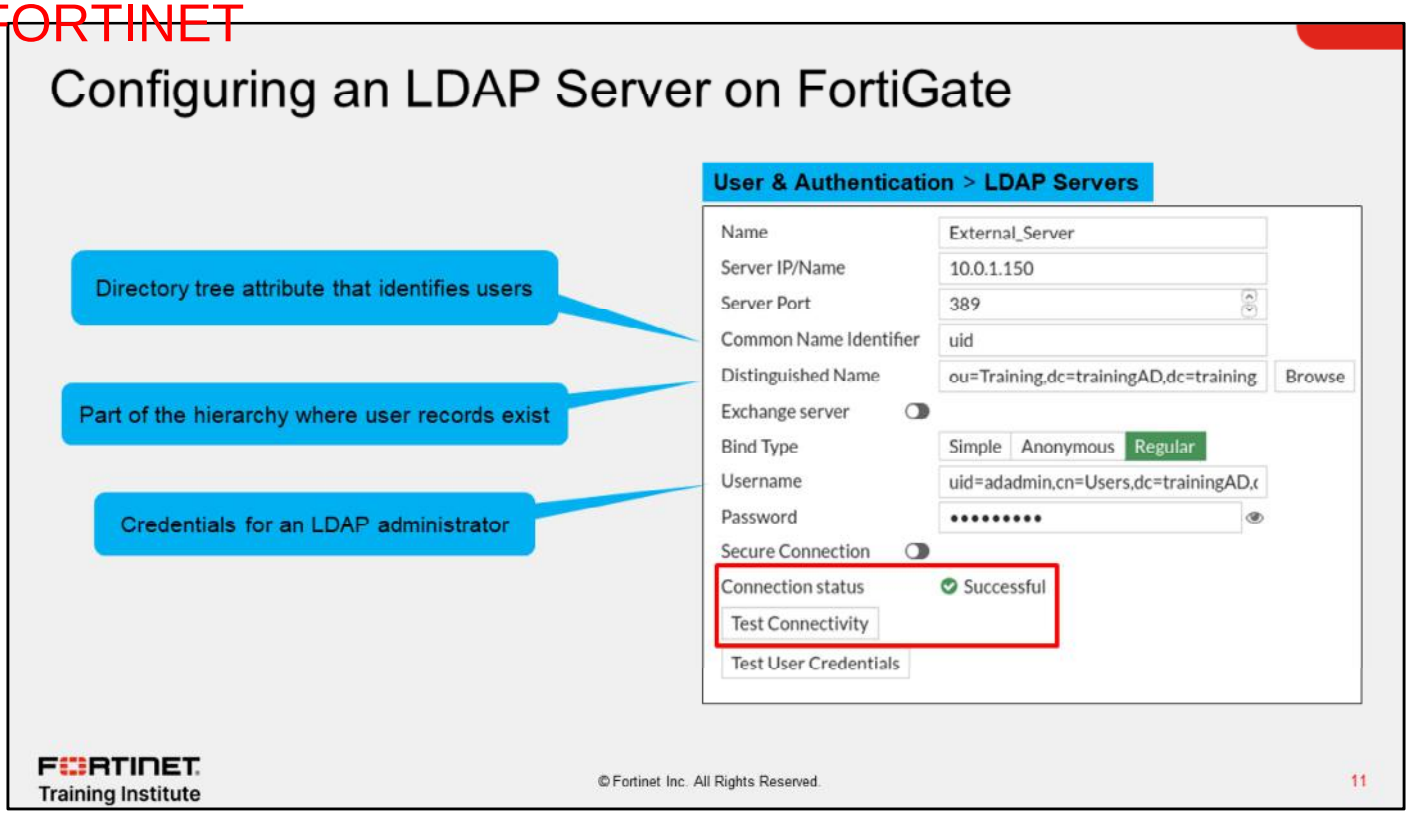
Similar to local password authentication, you must then add the preconfigured user group (in which the user is a member) to a firewall policy in order to authenticate. You will learn about user groups and firewall policies later in this lesson.



Lightweight Directory Access Protocol (LDAP) is an application protocol used 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.

The LDAP protocol includes a number of operations that a client can request, such as search, compare, and add or delete an entry. Binding is the operation in which 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.



On the **LDAP Servers** page, you can configure FortiGate to point to an LDAP server for server-based password authentication. The configuration depends heavily on the server's schema and security settings. Windows Active Directory (AD) is very common.

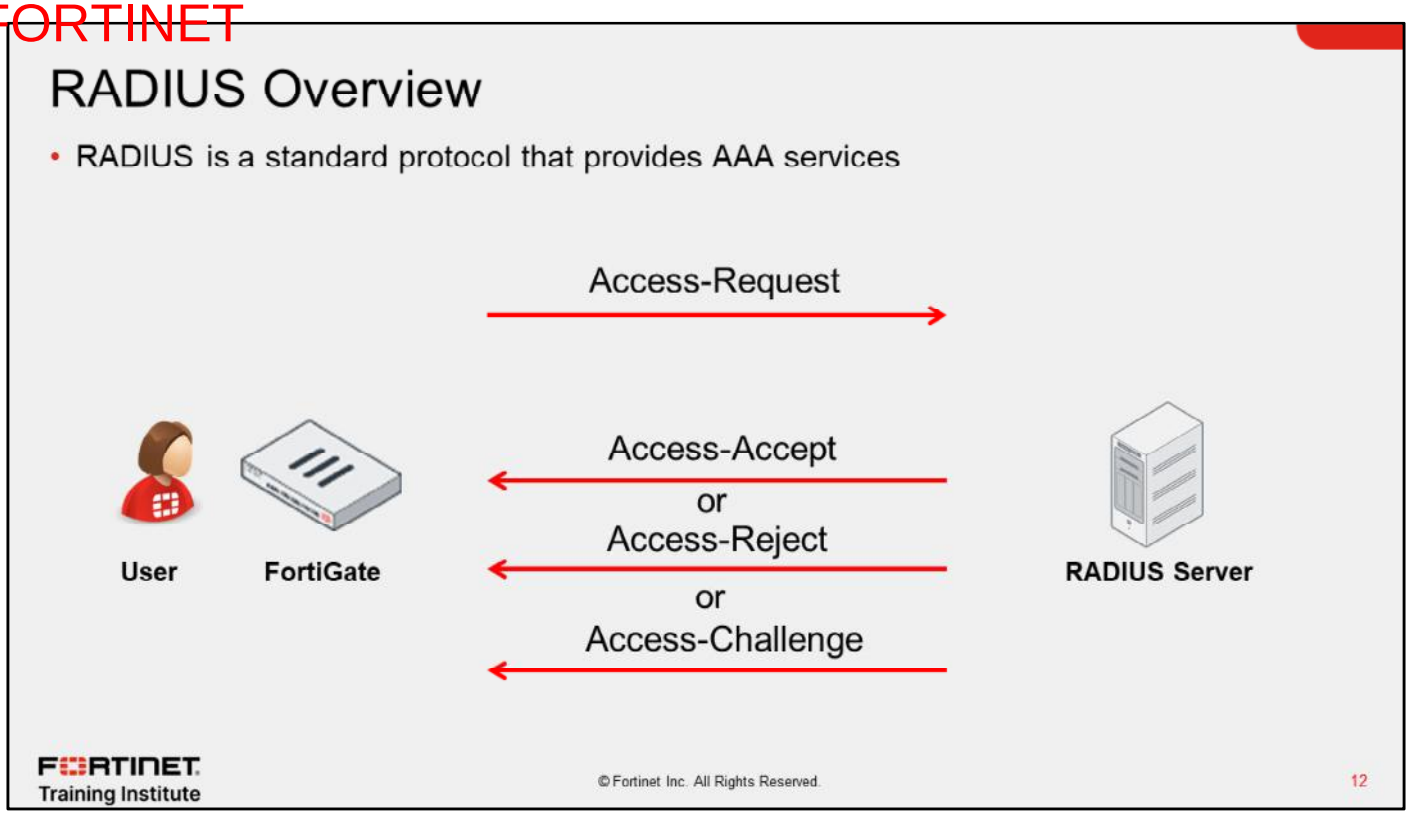
The **Common Name Identifier** setting is the attribute name you use to find the user name. Some schemas allow you to use the attribute userid. AD most commonly uses `sAMAccountName` or `cn`, but can use others as well.

The **Distinguished Name** setting identifies the top of the tree where the users are located, which is generally the dc value; however, it can be a specific container or ou. You must use the correct X.500 or LDAP format.

The **Bind Type** setting depends on the security settings of the LDAP server. You must use the setting **Regular** (to specify a regular bind) if you are searching across multiple domains and require the credentials of a user that is authorized to 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. LDAPS uses port 636 for communication.

The **Test Connectivity** button tests only whether the connection to the LDAP server is successful or not. To test whether a user's credentials can successfully authenticate, you can use the **Test User Credentials** button or use the CLI.

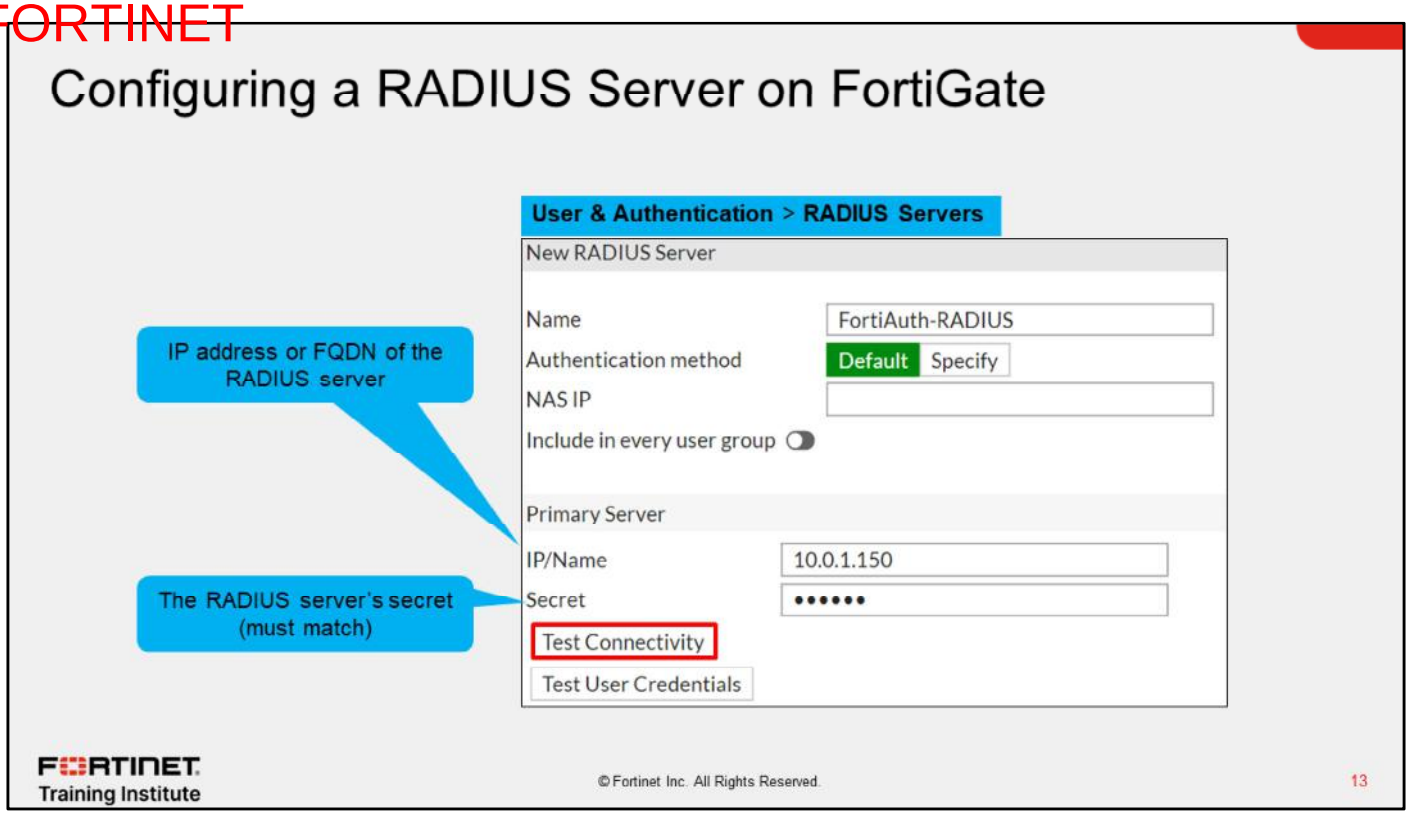


RADIUS is much different from LDAP, because there is no directory tree structure to consider. RADIUS is a standard protocol that provides authentication, authorization, and accounting (AAA) services.

When a user is authenticating, the client (FortiGate) sends an `ACCESS-REQUEST` packet to the RADIUS server. The reply from the server is one of the following:

- `ACCESS-ACCEPT`, which means that the user credentials are ok
- `ACCESS-REJECT`, which means that the credentials are wrong
- `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.



You can configure FortiGate to point to a RADIUS server for server-based password authentication through the **RADIUS Servers** page.

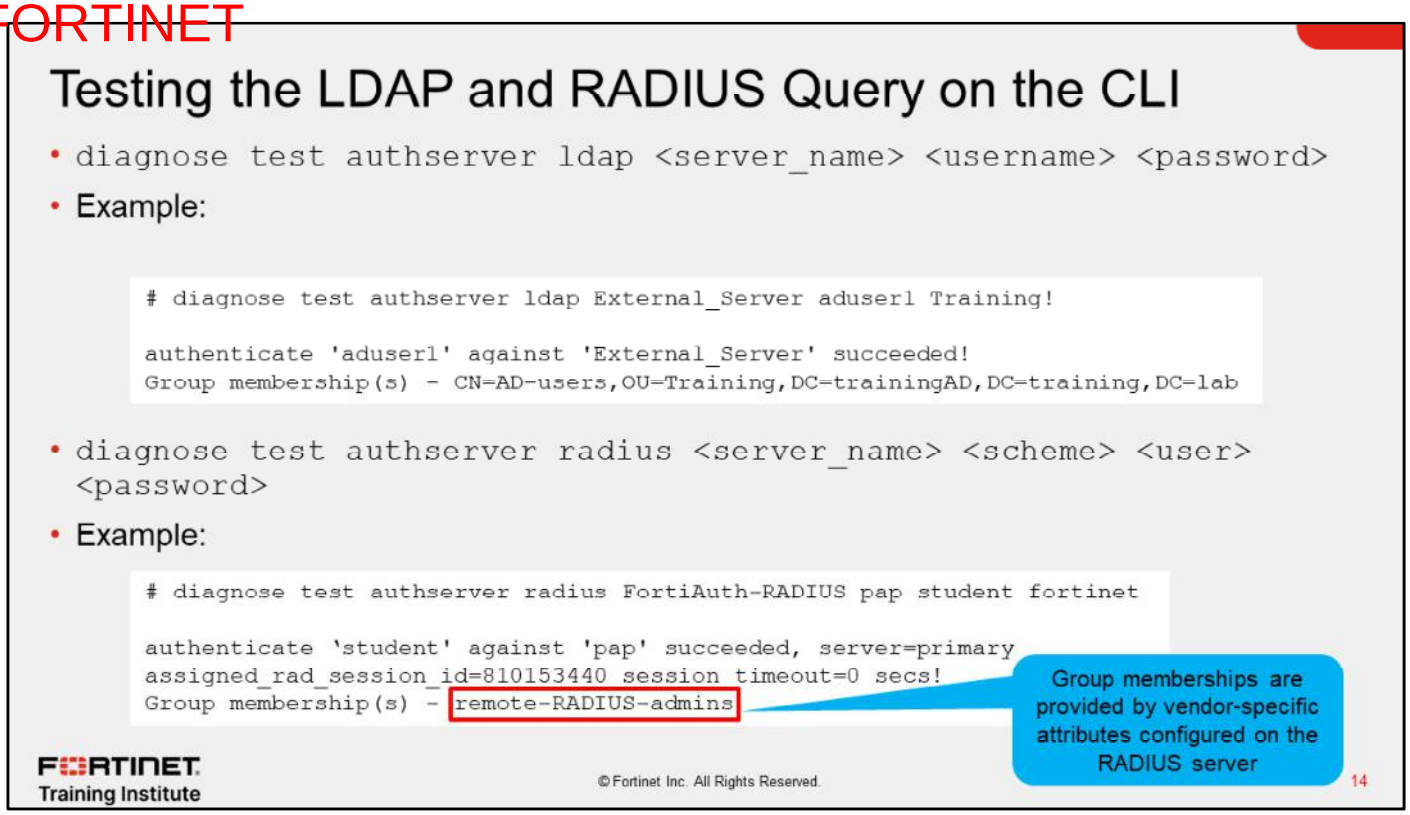
The **Primary Server IP/Name** setting is the IP address or FQDN of the RADIUS server.

The **Primary Server Secret** setting is the secret that was set up on the RADIUS server in order to allow remote queries from this client. Backup servers (with separate secrets) can be defined in case the primary server fails. Note that FortiGate must be listed on the RADIUS server as a client of that RADIUS server or else the server will not reply to queries done by FortiGate.

The **Authentication Method** setting refers to the authentication protocol that the RADIUS server supports. Options include chap, pap, mschap, and mschap2. If you select **Default**, FortiGate will use pap, mschap2, and chap (in that order).

Unlike LDAP configurations, the **Test Connectivity** button used in the example shown on this slide can test actual user credentials, but, like LDAP, you can also test this using the CLI.

The **Include in every User Group** option adds the RADIUS server and all users that can authenticate against it, to every user group created on FortiGate. So, you should enable this option only in very specific scenarios (for example, when only administrators can authenticate against the RADIUS server and policies are ordered from least restrictive to most restrictive).



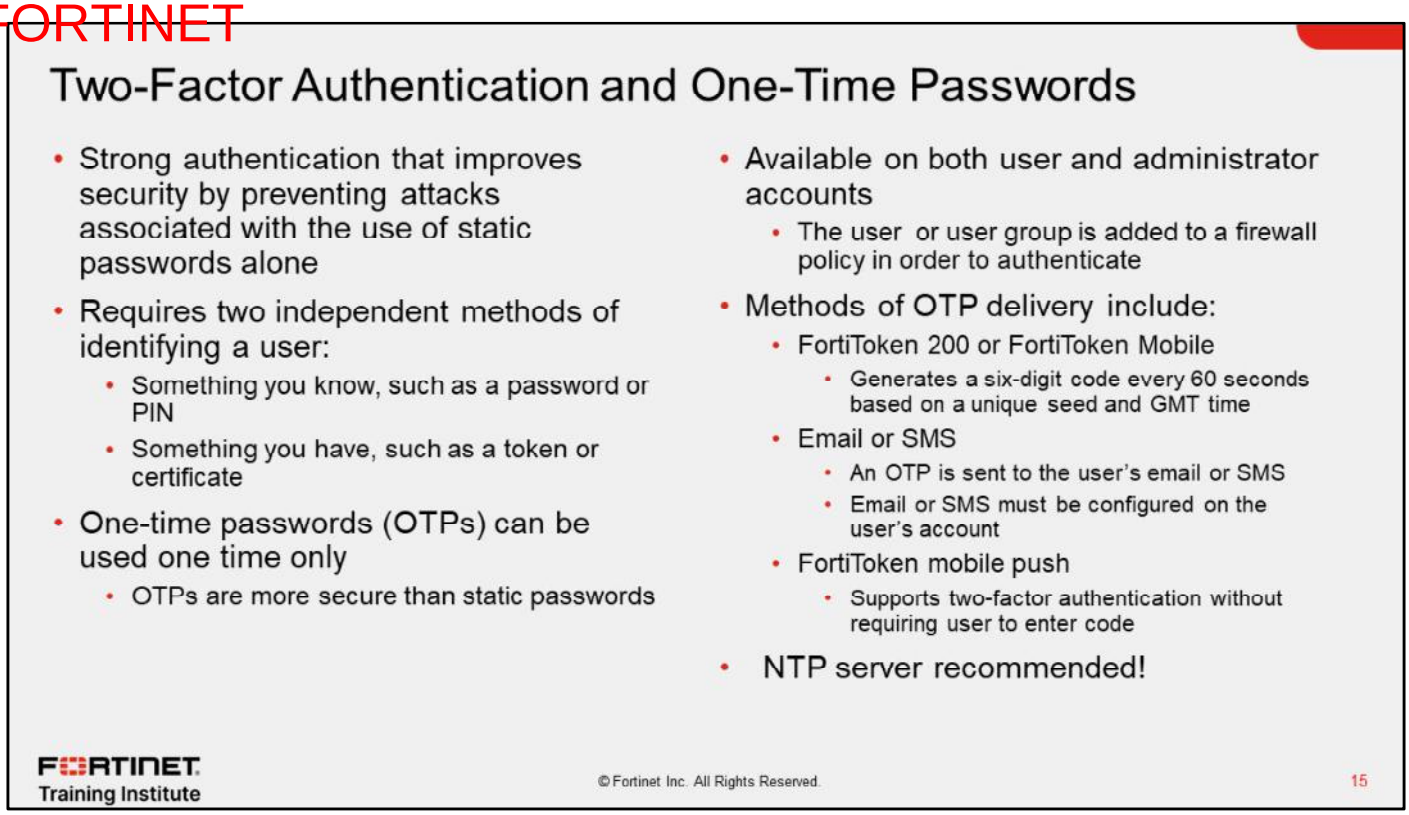
Use the `diagnose test authserver` command on the CLI to test whether a user's credentials can successfully authenticate. You want to ensure that authentication is successful, before implementing it on any of your firewall policies.

The response from the server reports success, failure, and group membership details.

Testing RADIUS is much the same as testing LDAP. Use the `diagnose test authserver` command on the CLI to test whether a user's credentials can successfully authenticate. Again, you should do this to ensure authentication is successful before 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 usually requires RADIUS server access.

Note that Fortinet has a vendor-specific attributes (VSA) dictionary to identify the Fortinet-proprietary RADIUS attributes. This capability allows you to extend the basic functionality of RADIUS. You can obtain the Fortinet VSA dictionary from the Fortinet Knowledge Base (`kb.fortinet.com`).

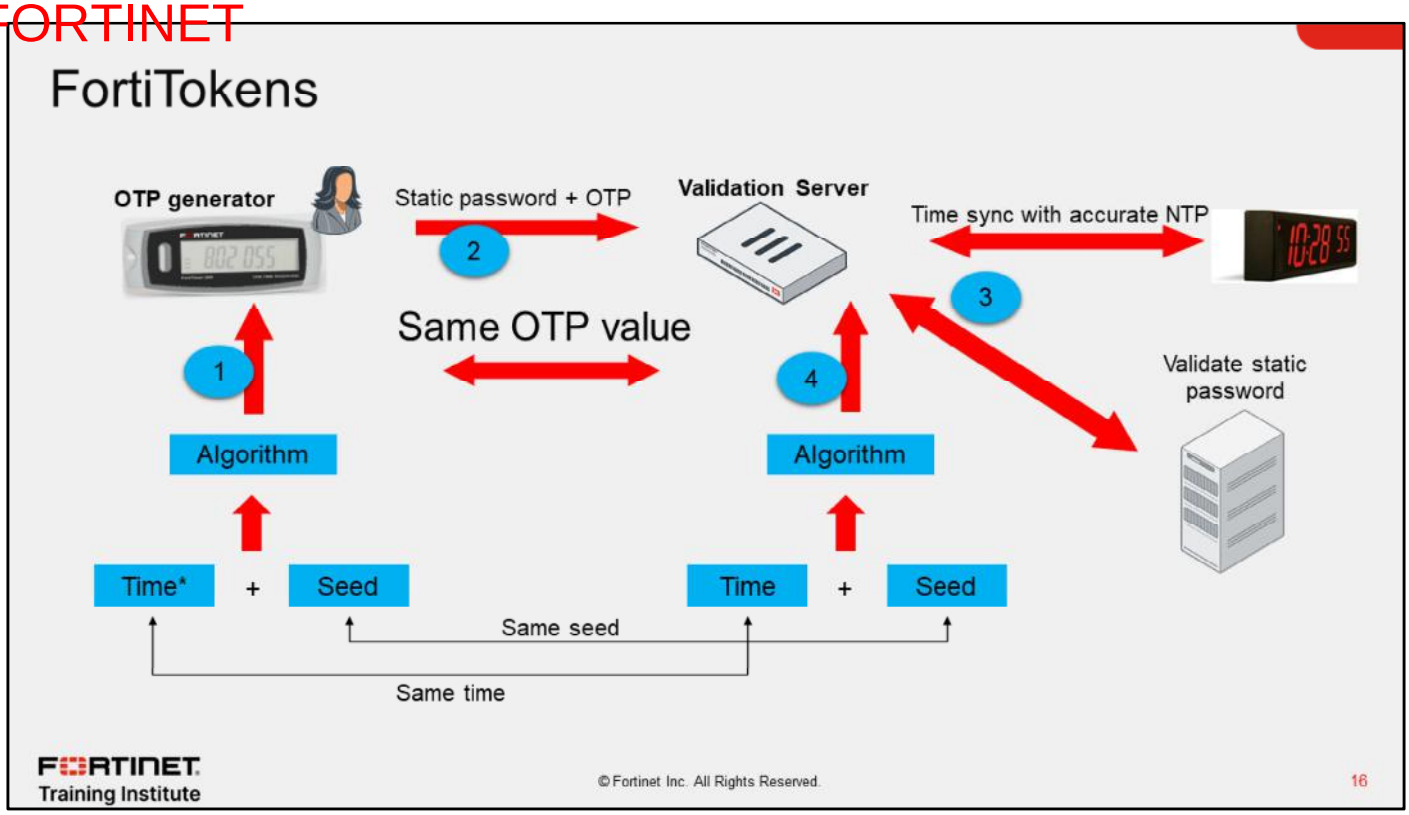


Traditional user authentication requires your user name plus something you know, such as a password. The weakness in this traditional method of authentication is that if someone obtains your username, they need only your password to compromise your account. Furthermore, since people tend to use the same 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. Because this method places less importance on often vulnerable passwords, it makes compromising the account more complex for an attacker. You can use two-factor authentication on FortiGate with both user and administrator accounts. 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.

You can use one-time passwords (OTPs) as your second factor. OTPs are more secure than static passwords because the passcode changes at regular intervals and is valid for only a short amount of time. Once you use the OTP, you can't use it 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. To deliver an OTP over email or SMS, the user account must contain user contact information.

FortiTokens and OTPs delivered through email and SMS are time based. FortiTokens, for example, generate a new, six-digit password every 60 seconds (by default). An NTP server is highly recommended to ensure the OTPs remain in sync. FortiToken Mobile Push allows users to accept the authorization request from their FortiToken mobile app, without the need to enter an additional code.

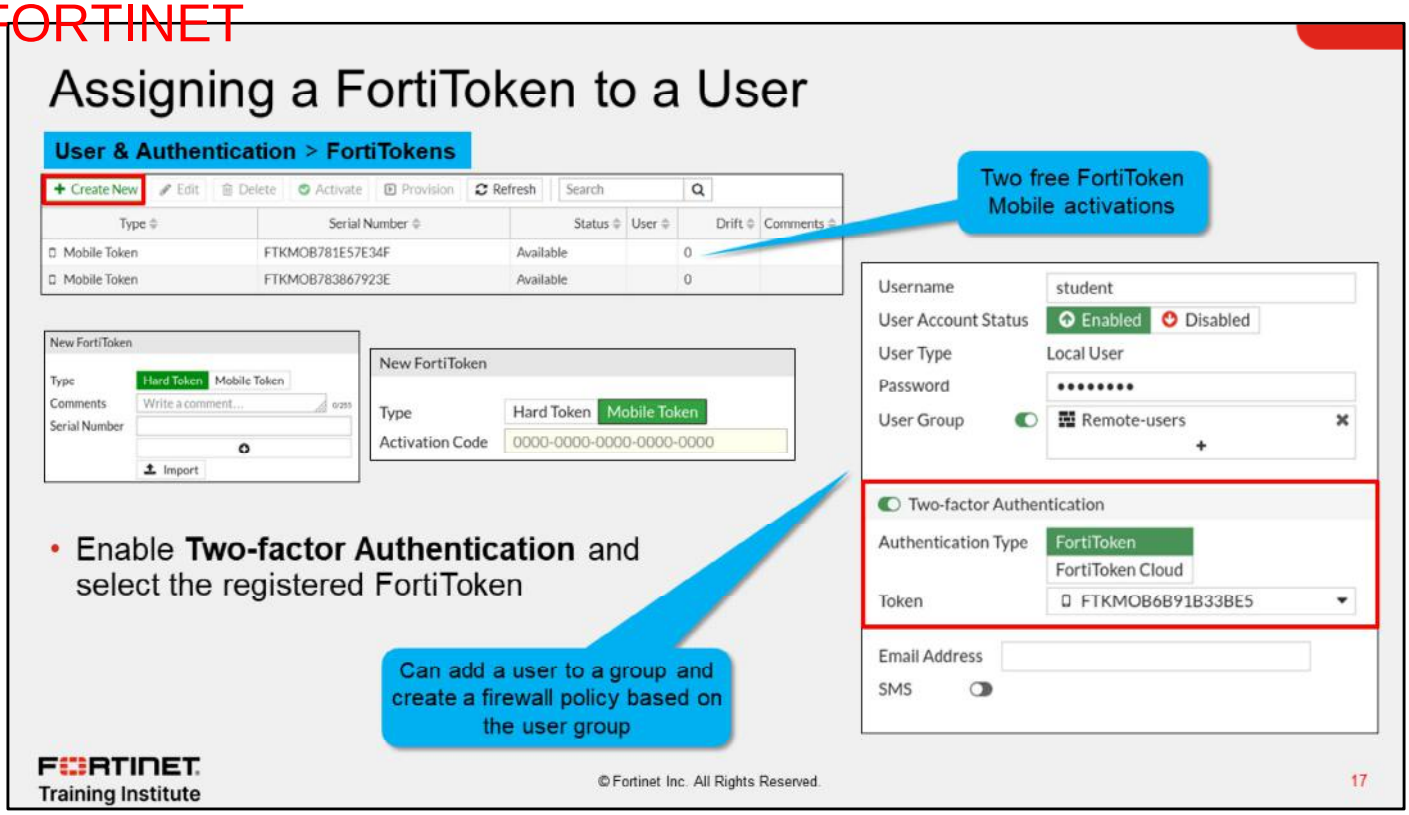


Tokens use a specific algorithm to generate an OTP. The algorithm consists of:

- A seed: a unique, randomly-generated number that does not change over time
- The time: obtained from an accurate internal clock

Both seed and time go through an algorithm that generates an OTP (or passcode) on the token. The passcode has a short life span, usually measured in seconds (60 seconds for FortiToken 200, possibly more or less for other RSA key generators). Once the life span ends, a new passcode generates.

When using 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 regenerating 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 OTP 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 correctly on FortiGate, or link it to an NTP server (which is recommended).



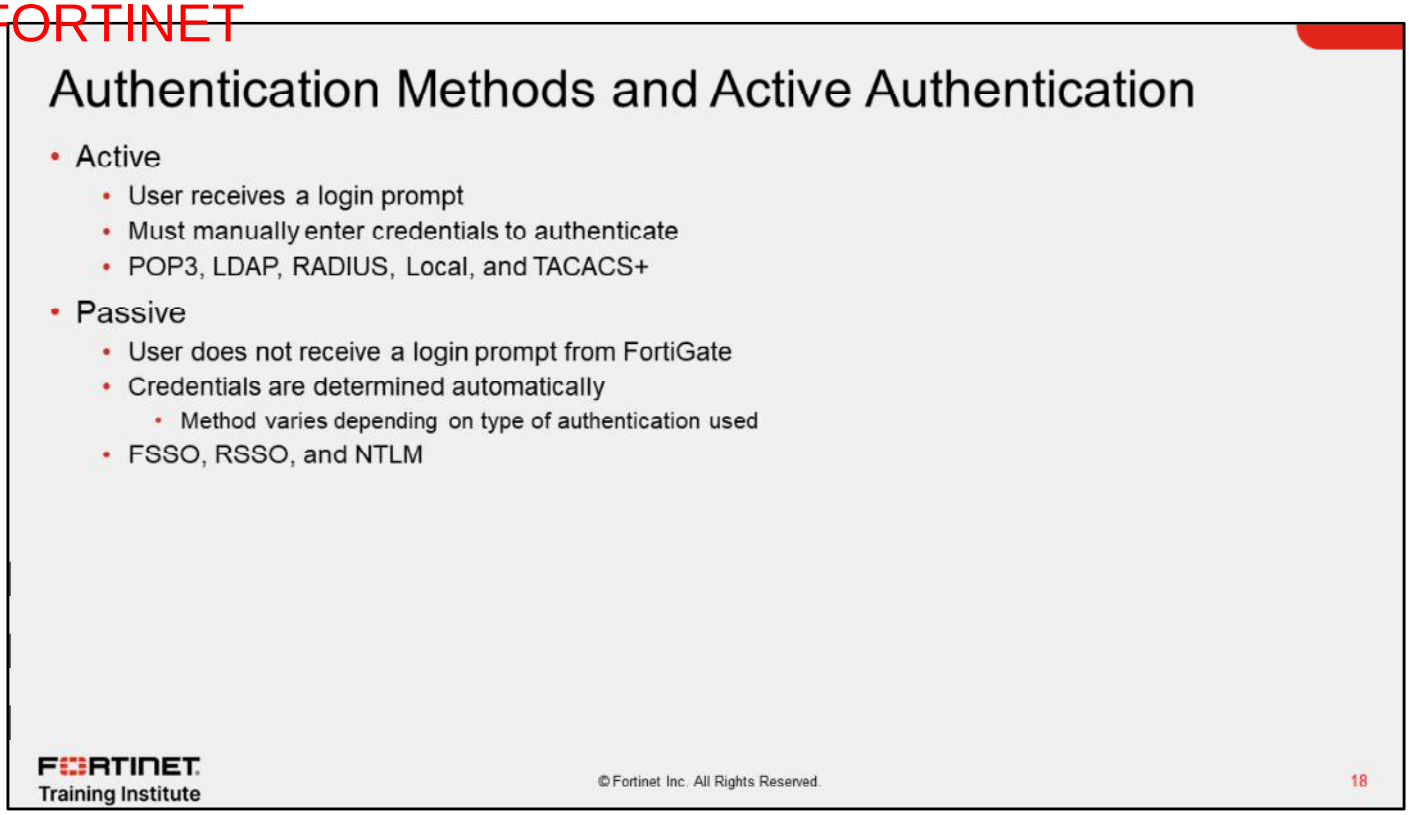
You can add a FortiToken 200 or FortiToken Mobile to FortiGate on the **FortiTokens** page.

A hard token has a serial number that provides 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.

A soft token requires an activation code. Note that each FortiGate (and FortiGate VM) provides two free FortiToken Mobile activations. You must purchase any additional tokens from Fortinet.

You cannot register the same FortiToken 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 and assigned to users on FortiAuthenticator, and FortiGate uses FortiAuthenticator as its validation server.

After you have registered the FortiToken devices 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**. On the **Token** drop-down list, select the registered token you want to assign.



All the authentication methods you've learned about—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, because user information is determined without 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.

Knowledge Check

1. Which firewall authentication method does FortiGate support?
   - ✓ A. Local password authentication
   - B. Biometric authentication

2. A remote LDAP user is trying to authenticate with a username and password. How does FortiGate verify the login credentials?
   - A. FortiGate queries its own database for user credentials.
   - ✓ B. FortiGate sends the user-entered credentials to the remote server for verification.

3. When FortiGate uses a RADIUS server for remote authentication, which statement about RADIUS is true?
   - A. FortiGate must query the remote RADIUS server using the distinguished name (dn).
   - ✓ B. RADIUS group memberships are provided by vendor-specific attributes (VSAs) configured on the RADIUS server

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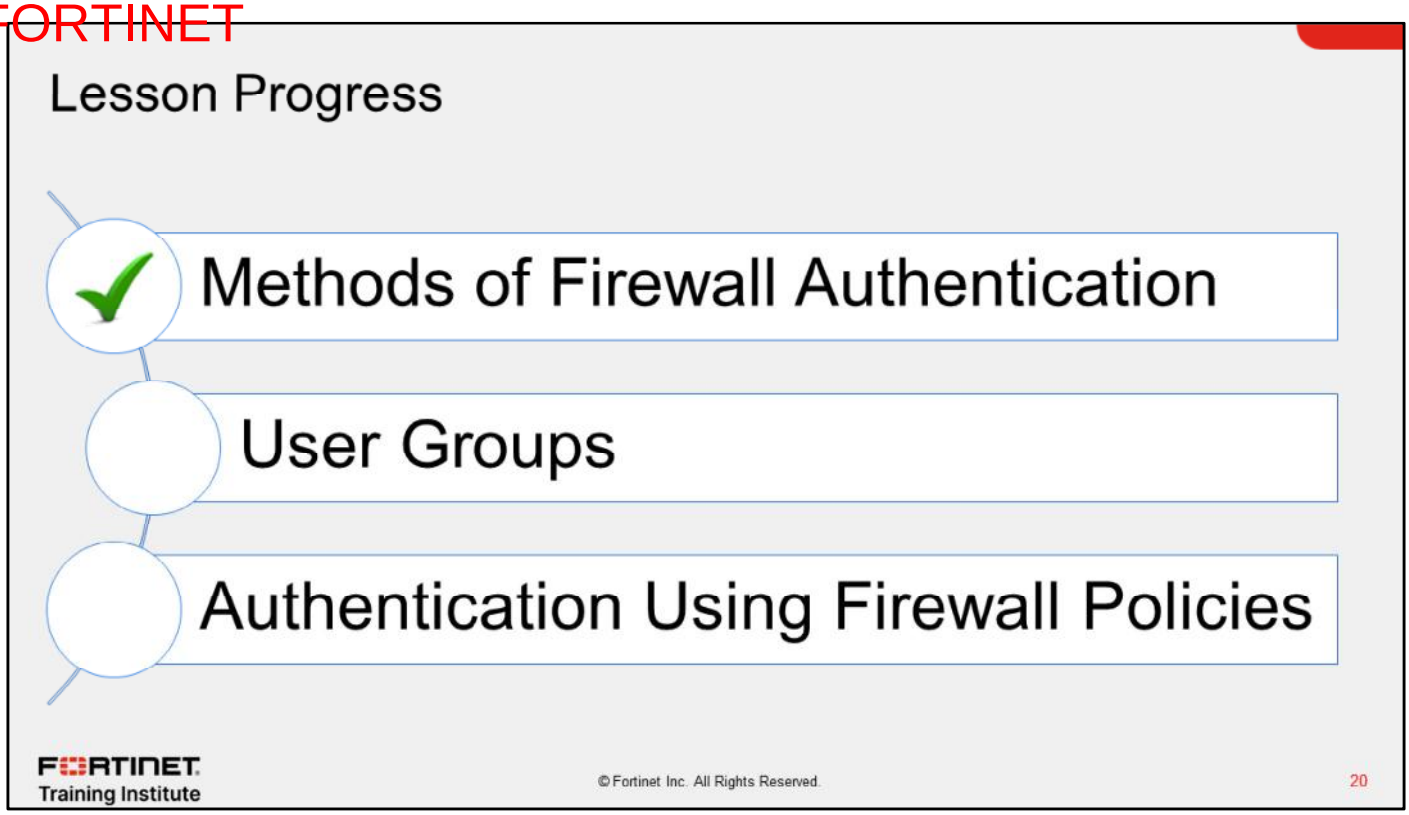
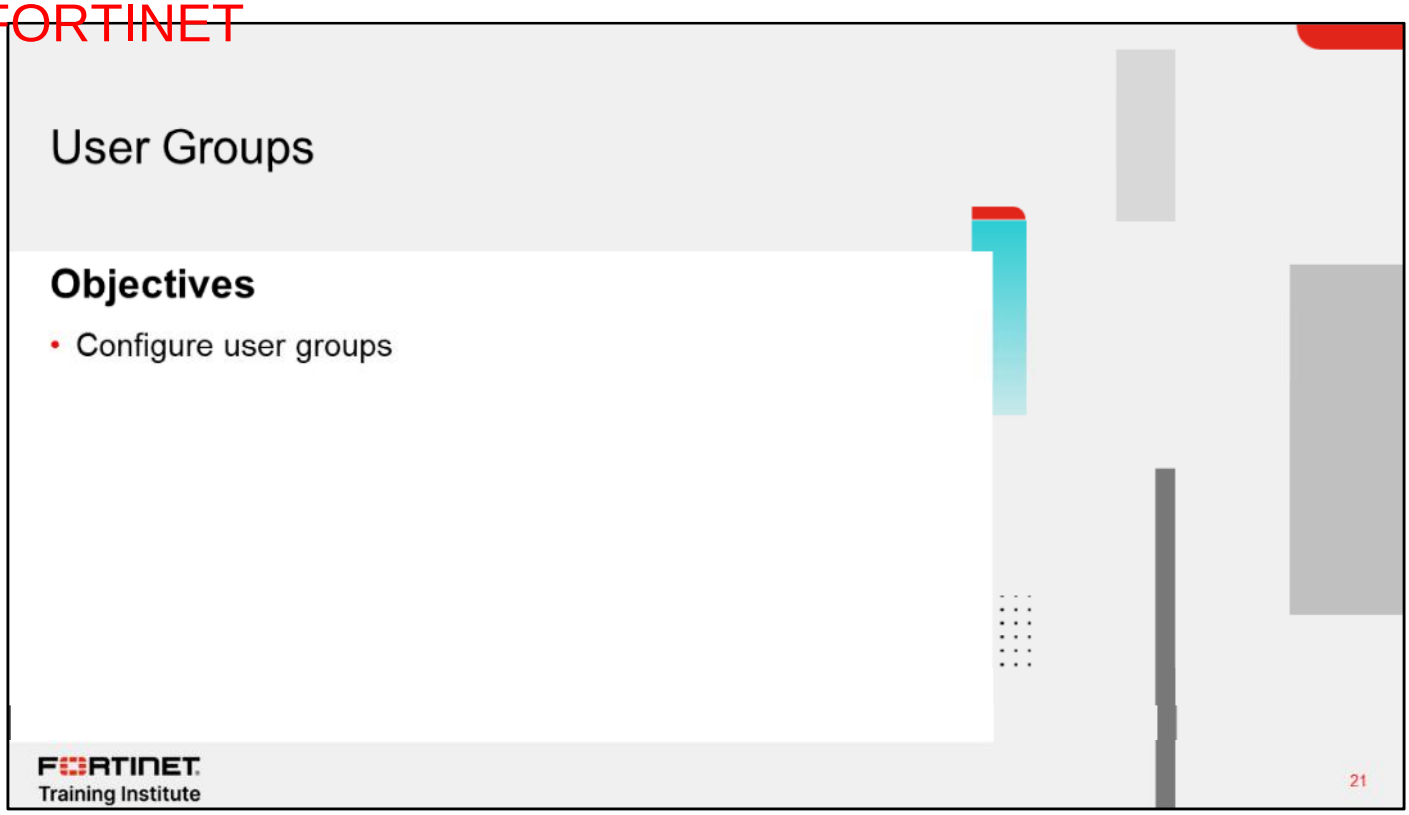


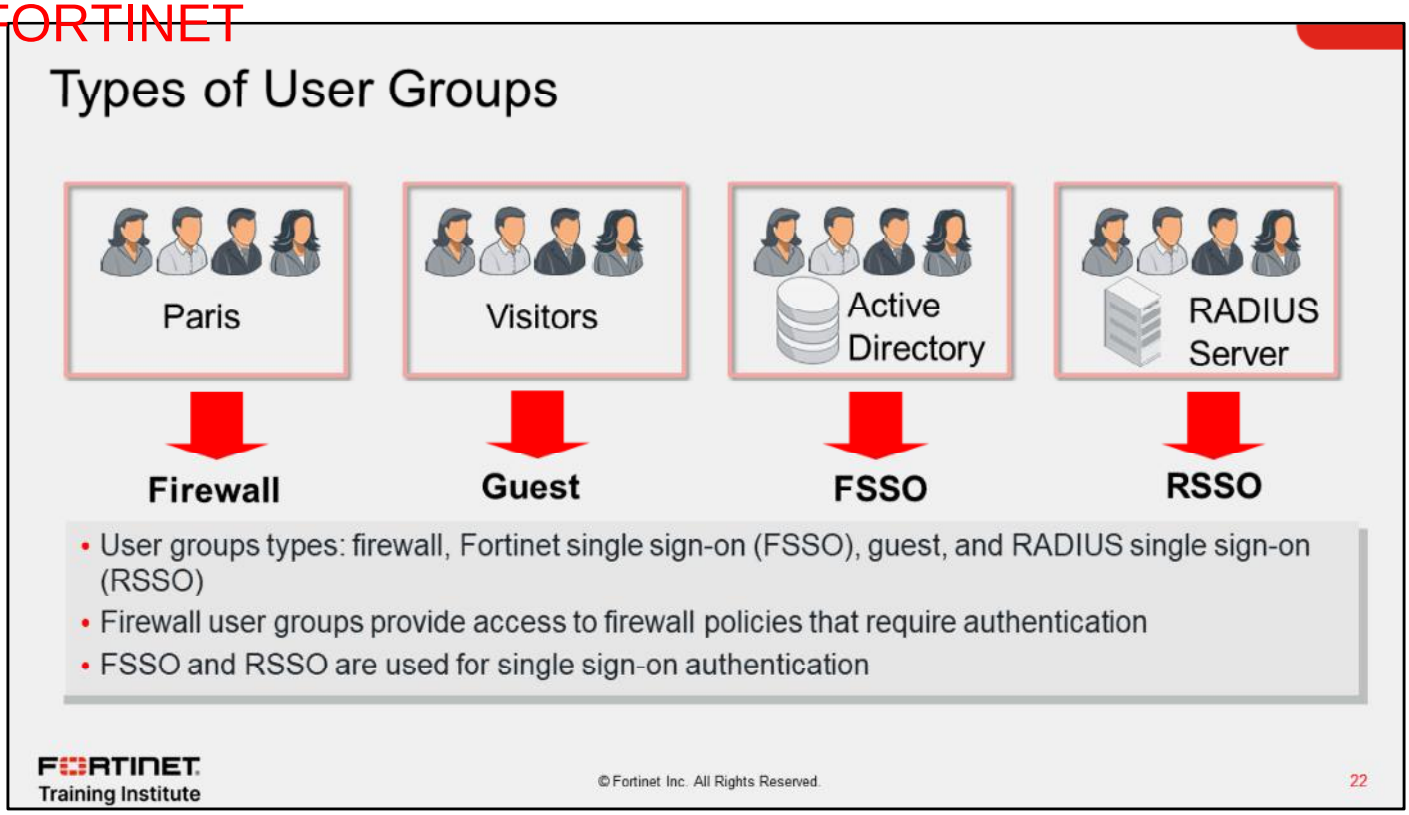
Good job! You now understand the basics of firewall authentication.

Now, you will learn about user groups.



After completing this section, you should be able to achieve the objective shown on this slide.

By demonstrating competence in user groups, you will be able to configure user groups to efficiently manage firewall policies.



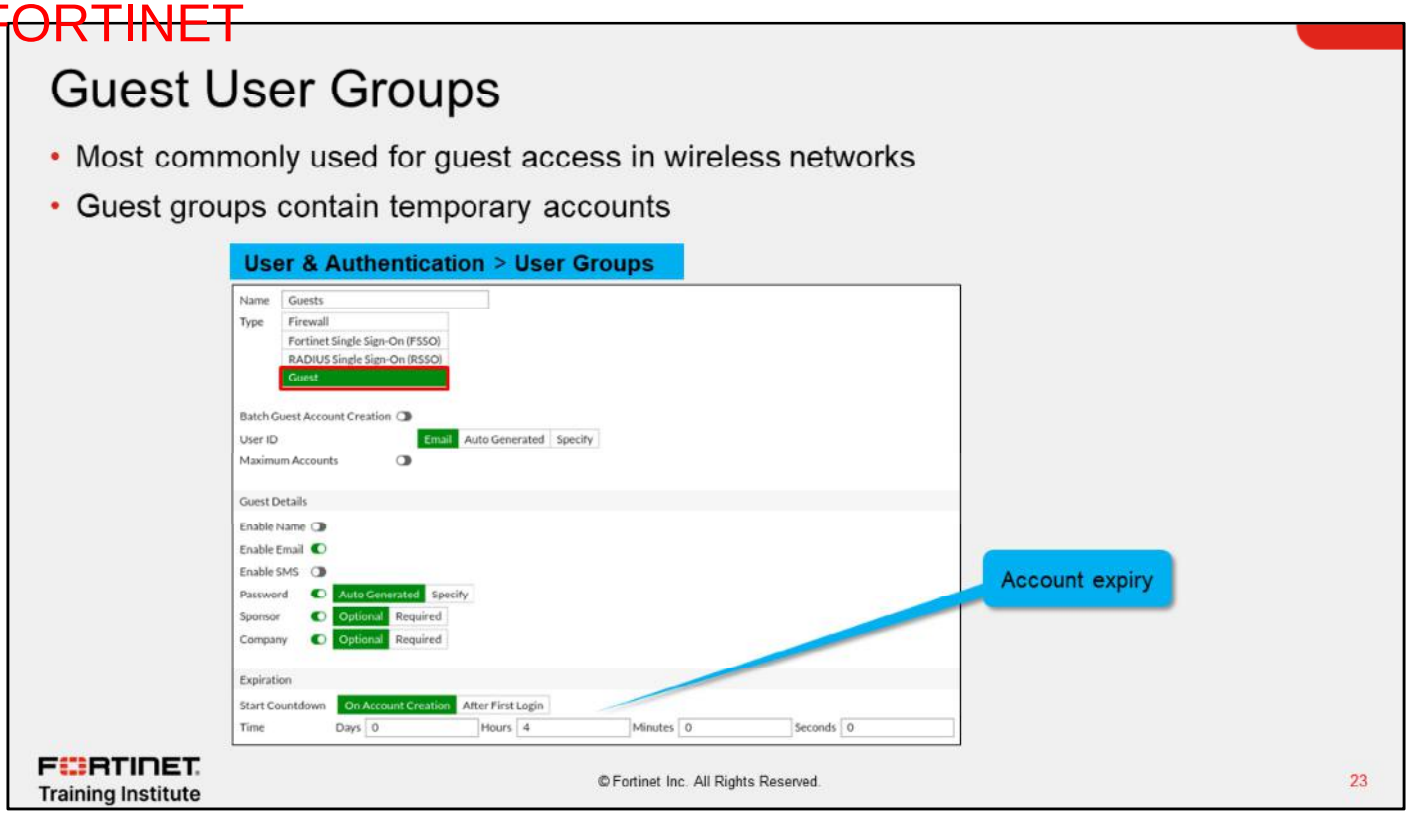
FortiGate allows administrators to assign users to groups. Usually, groups are used to more effectively manage individuals that have some kind of shared relationship. You might want to group employees by business area, such as finance or HR, or by employee type, such as contractors or guests.

After you create user groups, you can add them to firewall policies. This allows you to control access to network resources because 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 on FortiGate do not need to match any type of group that may already exist on an external server, such as an LDAP server. The firewall user groups exist solely to make configuration of firewall policies easier.

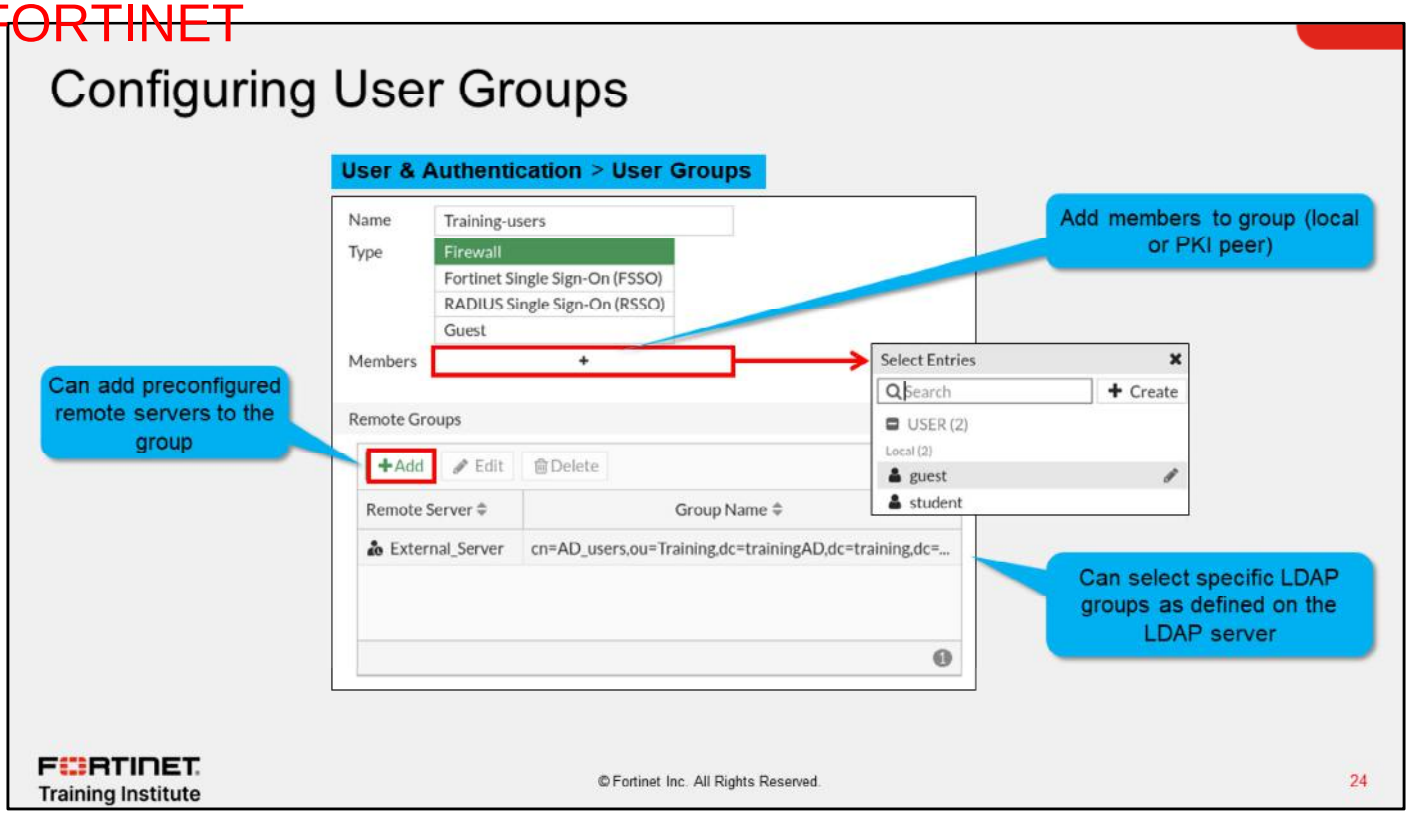
Most authentication types have the option to make decisions based on the individual user, rather than just user groups.



Guest user groups are different from firewall user groups because they contain exclusively temporary guest user accounts (the whole account, not just the password). Guest user groups 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 with a firewall policy.

You can create guest management administrators who have access only to create and manage guest user accounts.



You can configure user groups on the **User Groups** page. You must specify the user group type and add users to the group. Depending on the group you create, you require different configurations. 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 the Fortinet Knowledge Base at kb.fortinet.com).

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 need to add all users to firewall policies separately.

Knowledge Check

1. Which statement about guest user groups is true?
   - ✓ A. Guest user group accounts are temporary.
   - B. Guest user group account passwords are temporary.

2. Guest accounts are most commonly used for which purposes?
   - A. To provide temporary visitor access to corporate network resources
   - ✓ B. To provide temporary visitor access to wireless networks

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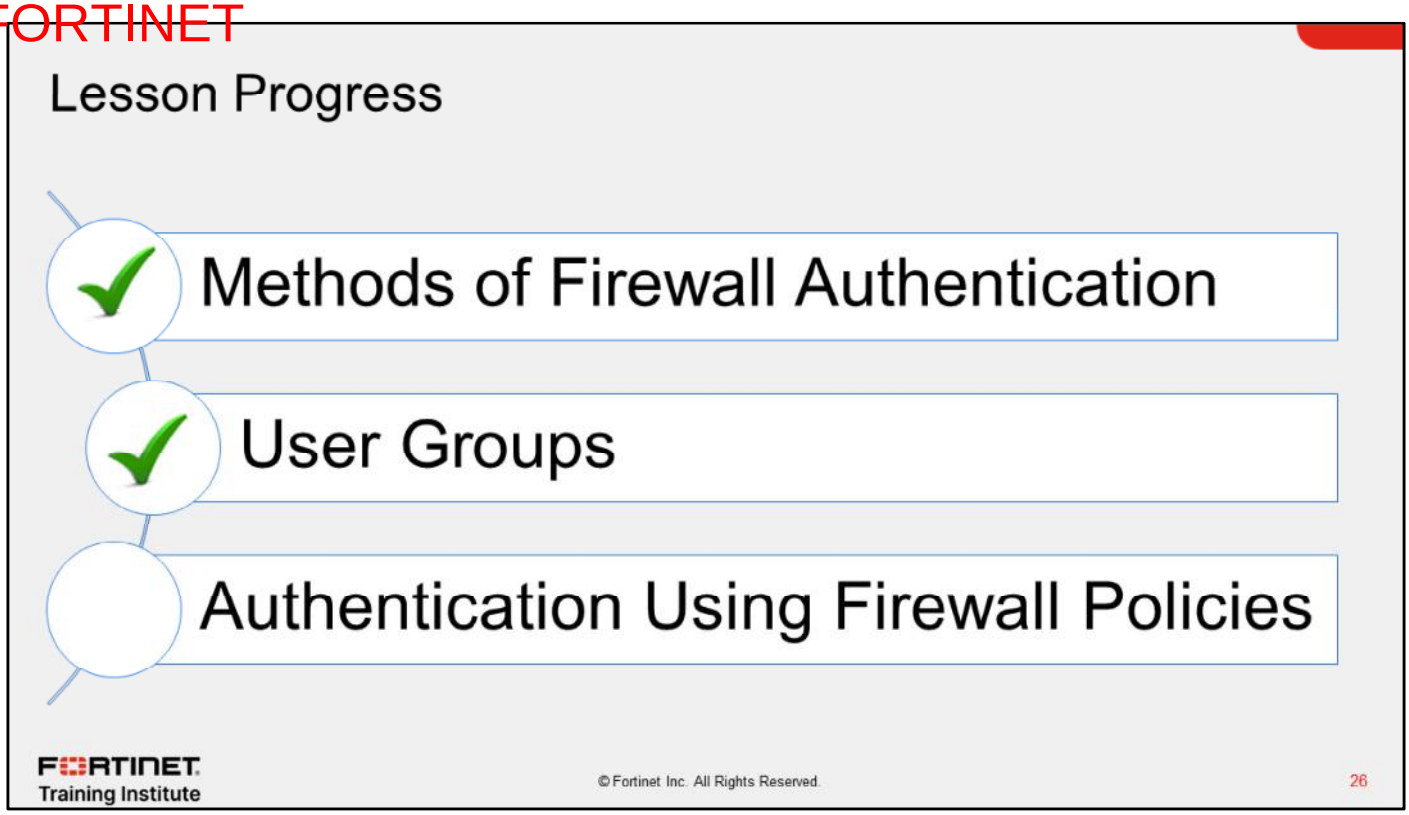
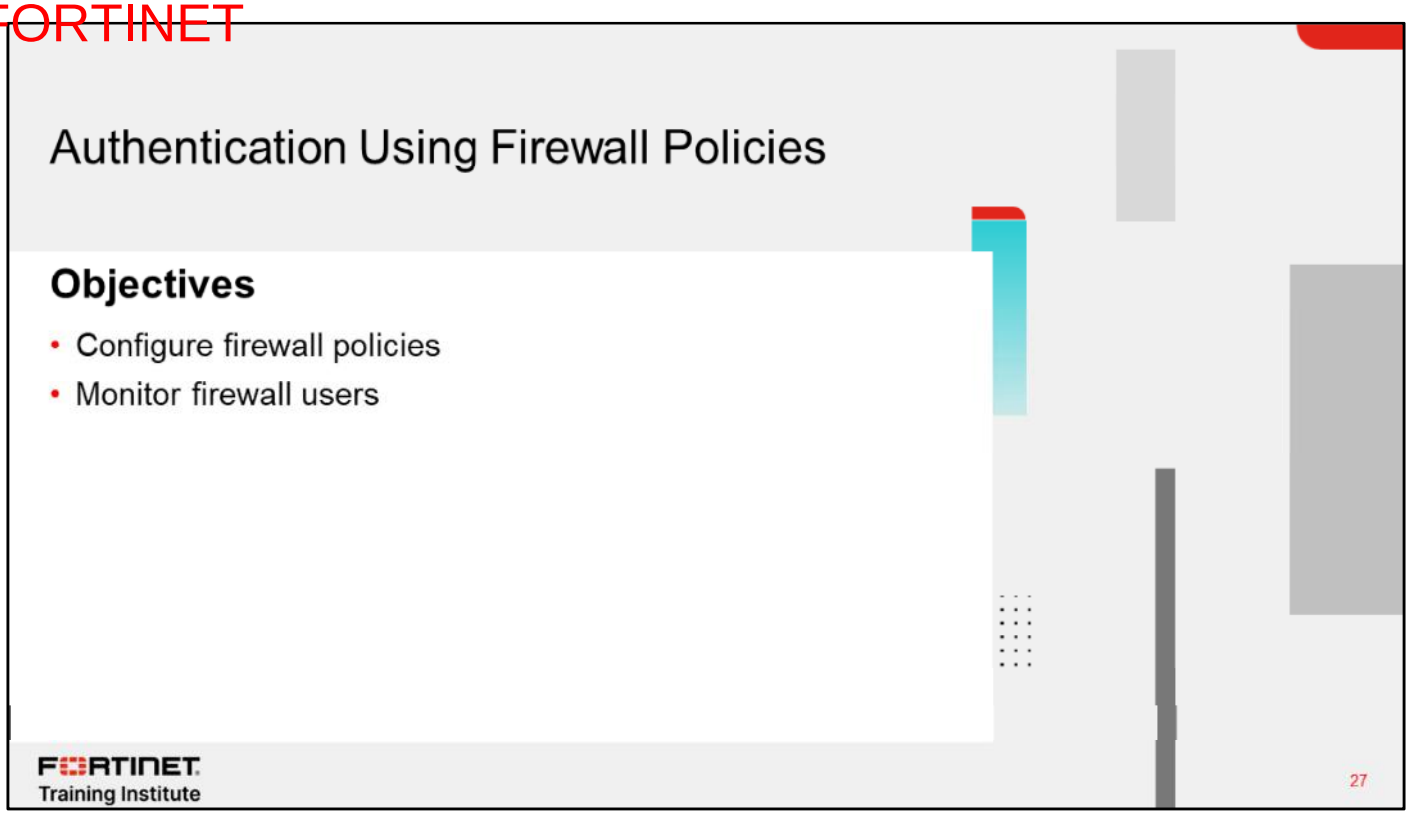


Good job! You now understand the basics of user groups.

Now, you will learn about using firewall policies for authentication.

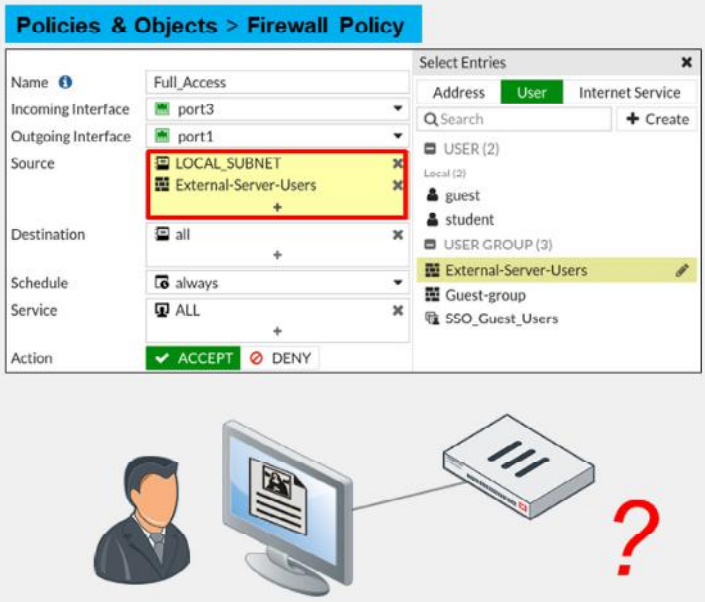


After completing this section, you should be able to achieve the objectives shown on this slide.

By demonstrating competence in firewall policies, you will be able to configure firewall policies to enforce authentication on specific users and user groups.

Firewall Policy—Source

- Firewall policies can use user and user group objects to define the source. The objects include:
  - Local firewall accounts
  - External (remote) server accounts
  - PKI (certificate) users
  - FSSO users
- Anyone who belongs to the group and provides correct information will have a successful authentication



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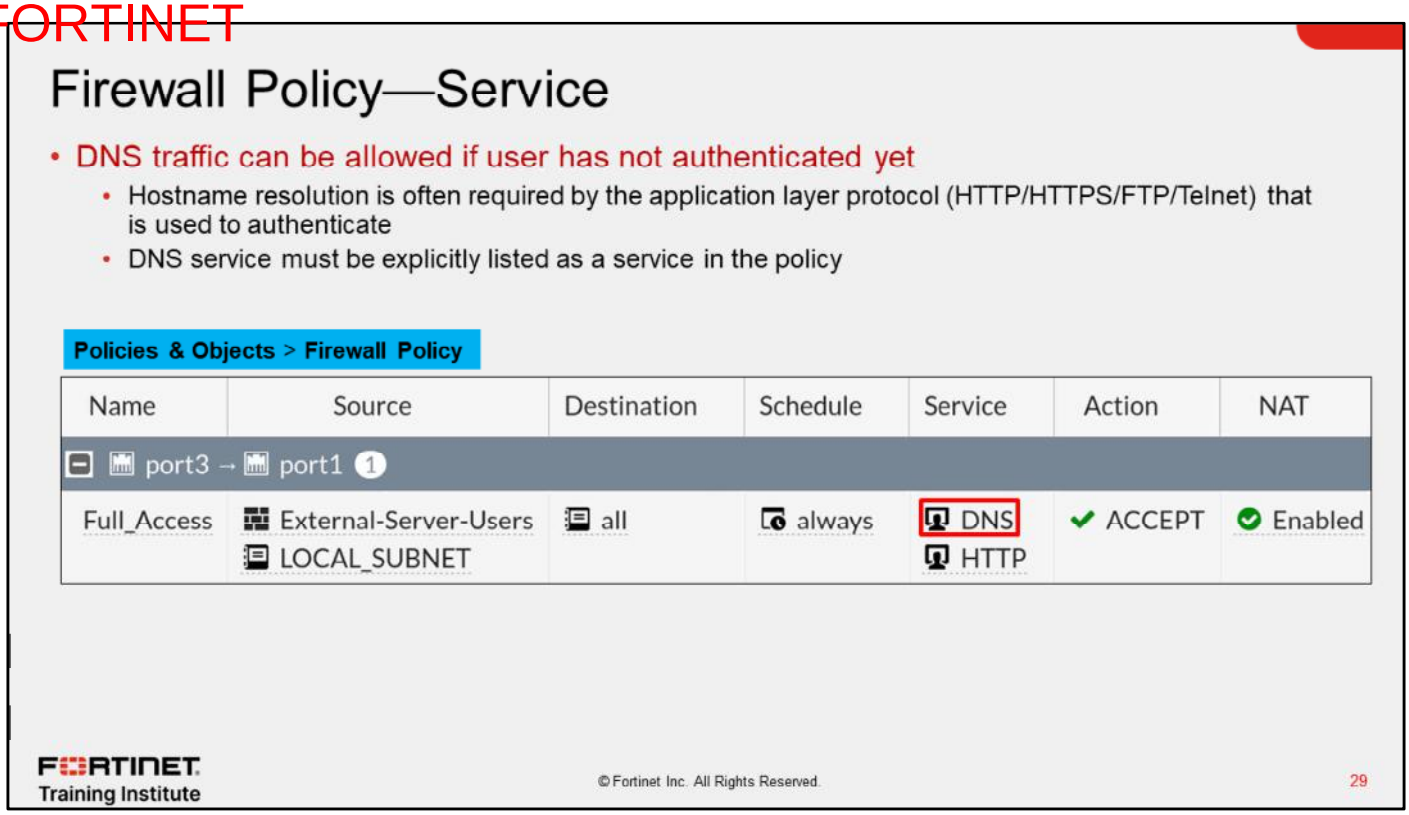
A firewall policy consists of access and inspection rules (compartmentalized sets of instructions) that tell FortiGate how to handle traffic on the interface whose traffic they filter. After the user makes an initial connection attempt, FortiGate checks the firewall policies to determine whether to accept 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 and user group. In this way, any user, or user group that is included in the source definition for the firewall policy can successfully authenticate.

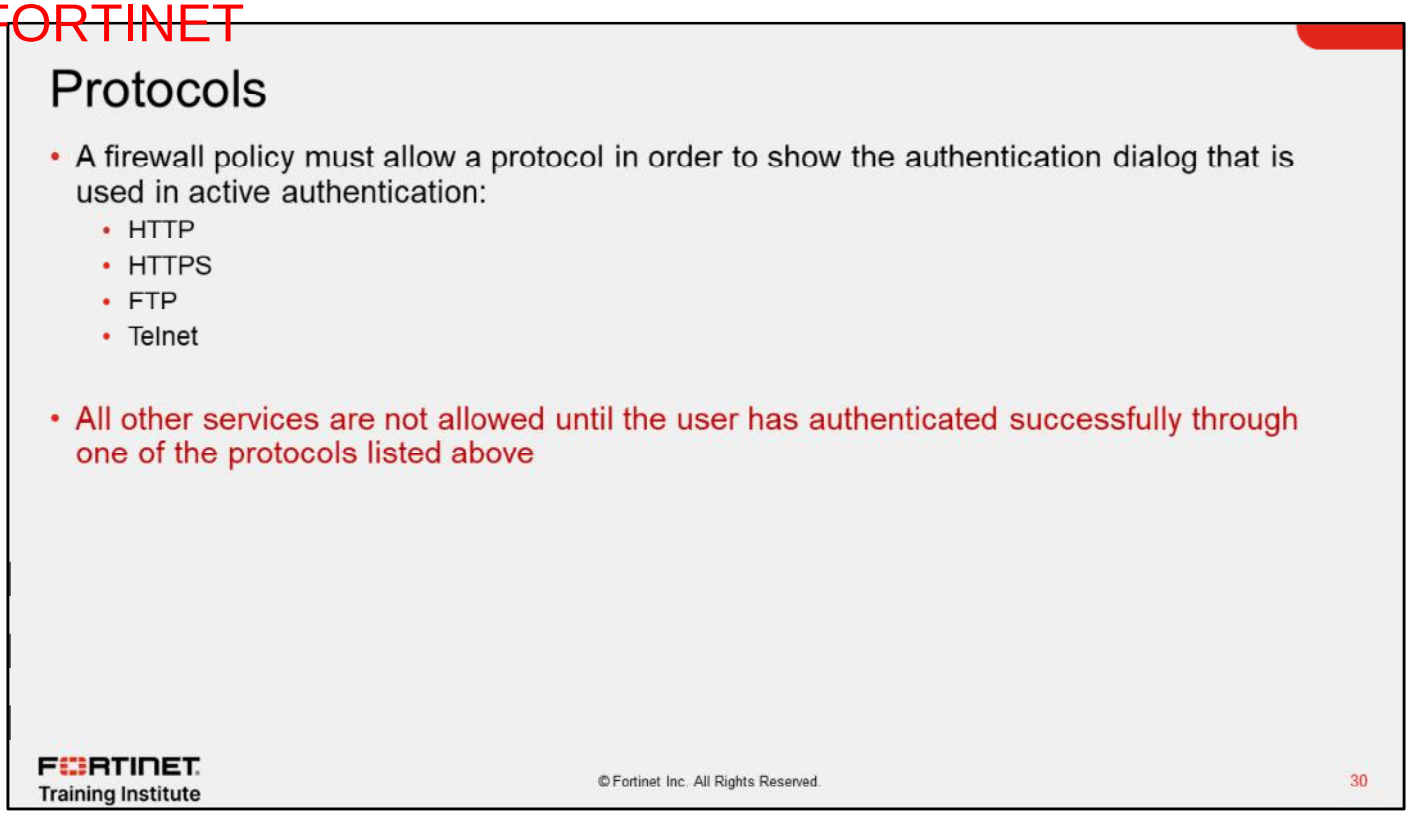
User and user group objects can consist of local firewall accounts, external server accounts, PKI users, and FSSO users.



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 before 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 in the policy as allowed, in order for it to pass.

In the example shown on this slide, policy sequence 1 (Full_Access) allows users to use external DNS servers in order to resolve host names, before 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).

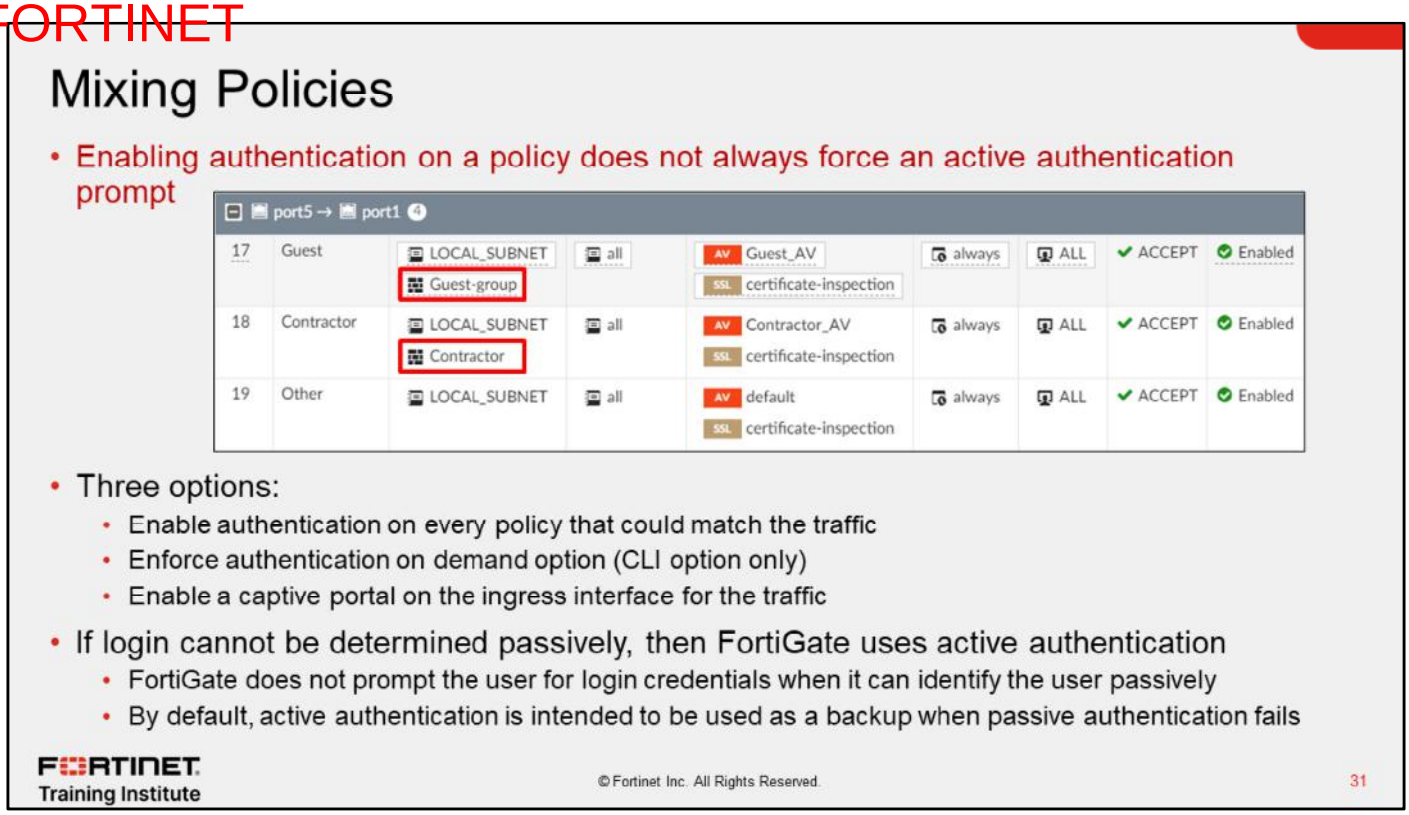


As well as the DNS service, the firewall policy must specify the allowed protocols, such as HTTP, HTTPS, FTP, and Telnet. If the firewall policy that has authentication enabled does not allow at least one of the supported protocols used for obtaining user credentials, the user will not be able to authenticate.

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 following:

- The protocol of the traffic
- 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.



In the example shown on this slide, assuming active authentication is used, any initial traffic from LOCAL_SUBNET will not match policy sequence 17 (Guest). Policy sequence 17 looks for both IP and user, and user group information (LOCAL_SUBNET and Guest-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 continues its search down the sequence list, to see if there is a complete match.

Next, FortiGate evaluates policy sequence 18 to see if the traffic matches. It will not for the same reason it did not match 17.

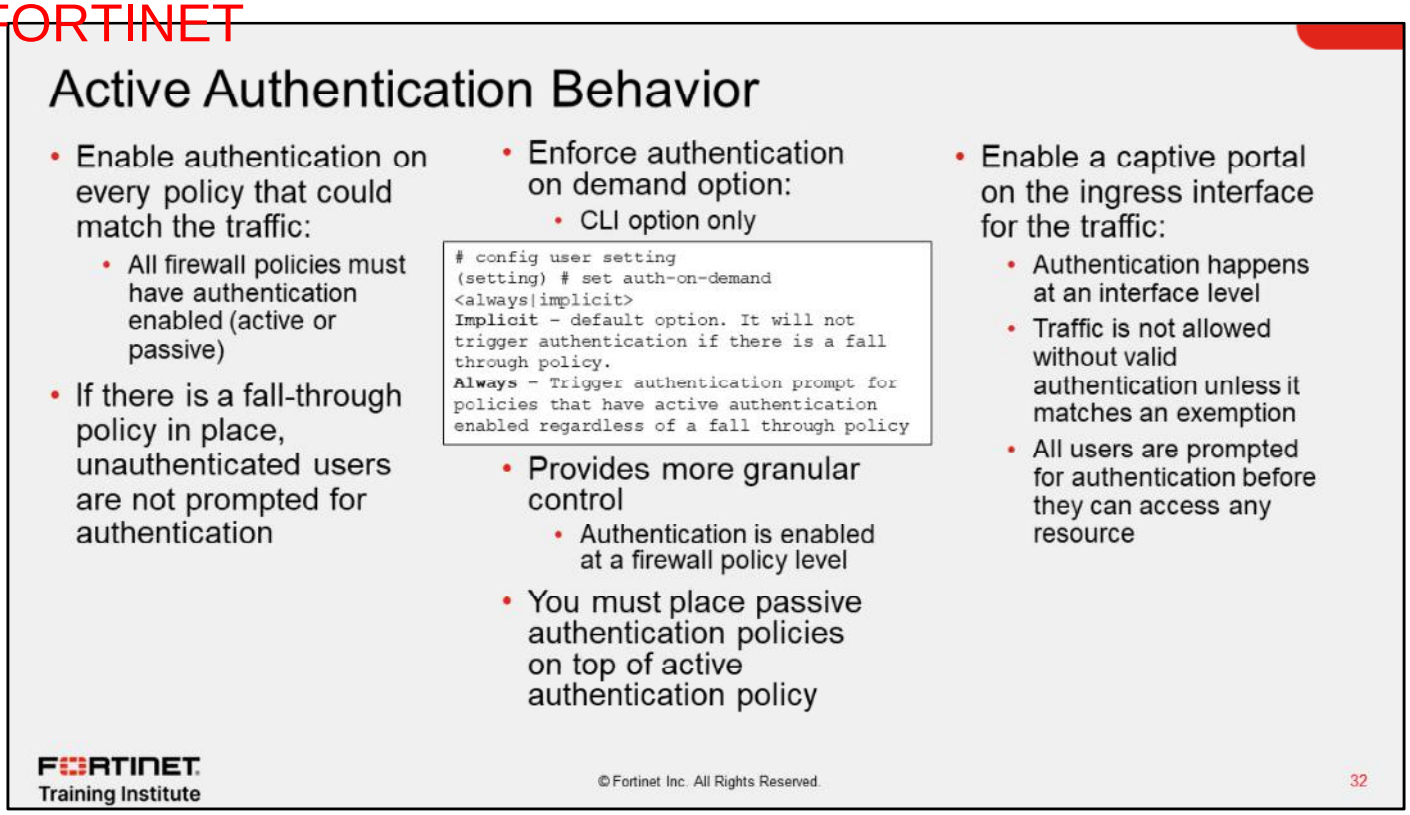
Finally, FortiGate evaluates policy sequence 19 to see if the traffic matches. It matches all criteria, so traffic is allowed with no need to authenticate.

When you use only active authentication, 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 19 also had authentication enabled, the users would receive login prompts.

If you use passive authentication and it can successfully obtain user details, then traffic from LOCAL_SUBNET with users that belong to Guest-group will apply to policy sequence 17, even though policy sequence 19 does not have authentication enabled.

If you use both active and passive authentication, and FortiGate can identify a user's credentials through passive authentication, the user never receives 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 identify who the user is passively. When you combine active and passive authentication methods, active authentication is

intended to be used as a backup, to be used only when passive authentication fails.



As mentioned earlier, there are three different ways you can alter active authentication behavior. If you have an active authentication firewall policy followed by a fall-through policy that does not have authentication enabled on it, then all traffic will use the fall-through policy. This means that users are not asked to authenticate. By default, all traffic passes through the catch-all policy without being authenticated. You can alter this behavior by enabling authentication on all firewall policies. When you enable authentication, all the systems must authenticate before traffic is placed on the egress interface.

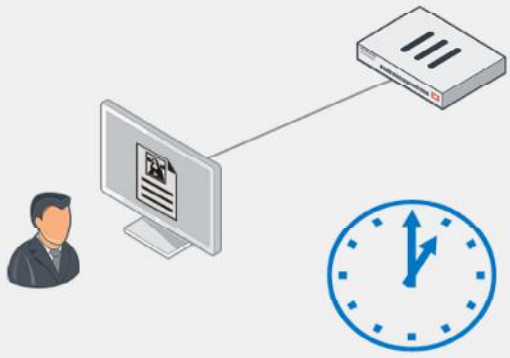
Alternatively, only on the CLI, you can change the `auth-on-demand` option to `always`. This instructs FortiGate to trigger an authentication request, if there is a firewall policy with active authentication enabled. In this case, the traffic is allowed until authentication is successful.

If you want to have all users connect to a specific interface, then it is better to enable captive portal authentication at the interface level. This way, all devices must authenticate before they are allowed to access any resources.

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 five 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 in that amount of time



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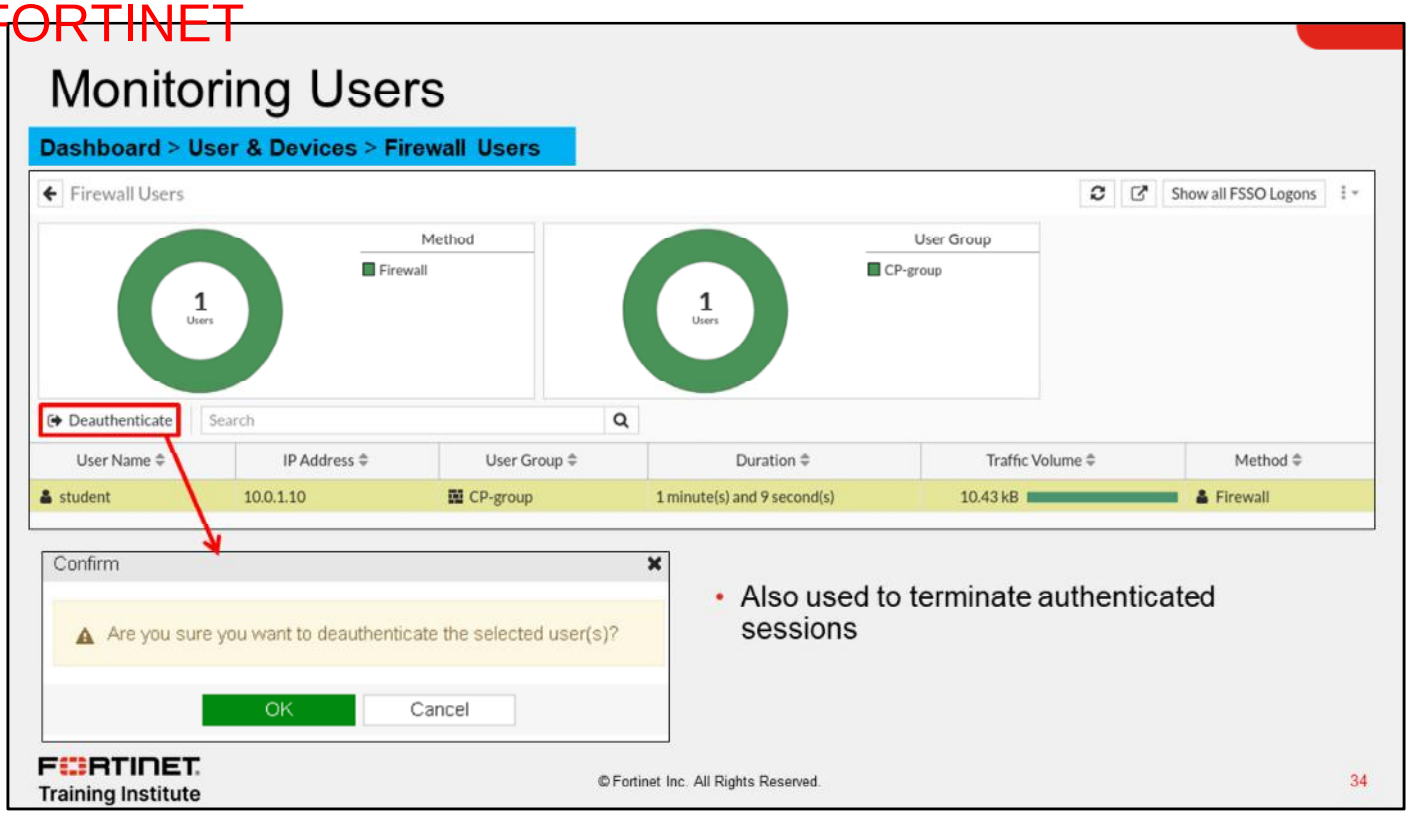
An authentication timeout is useful for security purposes. It minimizes the risk of someone using the IP of the legitimate authenticated user. It also ensures users do not authenticate and then stay in memory indefinitely. If users stayed in memory forever, it would eventually lead to memory exhaustion.

There are three options for timeout behavior:

- **Idle**: looks at the packets from the host 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 authentication needs of your environment.



You can monitor users who authenticate through your firewall policies using the **Dashboard** > **User & Devices** > **Firewall Users** page. It displays the user, user group, duration, IP address, traffic volume, and authentication method.

It does not include administrators, because they are not authenticating through firewall policies that allow traffic. They are logging in directly on FortiGate.

This page also allows you to disconnect a user, or multiple users, at the same time.

Knowledge Check

1. Firewall policies dictate whether a user or device can or cannot authenticate on a network. Which statement about firewall authentication is true?
   - ✓ A. Firewall policies can be configured to authenticate certificate users.
   - B. The order of the firewall policies always determines whether a user's credentials are determined actively or passively.
2. Which statement about active authentication is true?
   - A. Active authentication is always used before passive authentication.
   - ✓ B. The firewall policy must allow the HTTP, HTTPS, FTP, and/or Telnet protocols in order for the user to be prompted for credentials.
3. Which statement best describes the authentication idle timeout feature on FortiGate?
   - A. The length of time FortiGate waits for the user to enter their authentication credentials
   - ✓ B. The length of time an authenticated user is allowed to remain authenticated without any packets being generated by the host device

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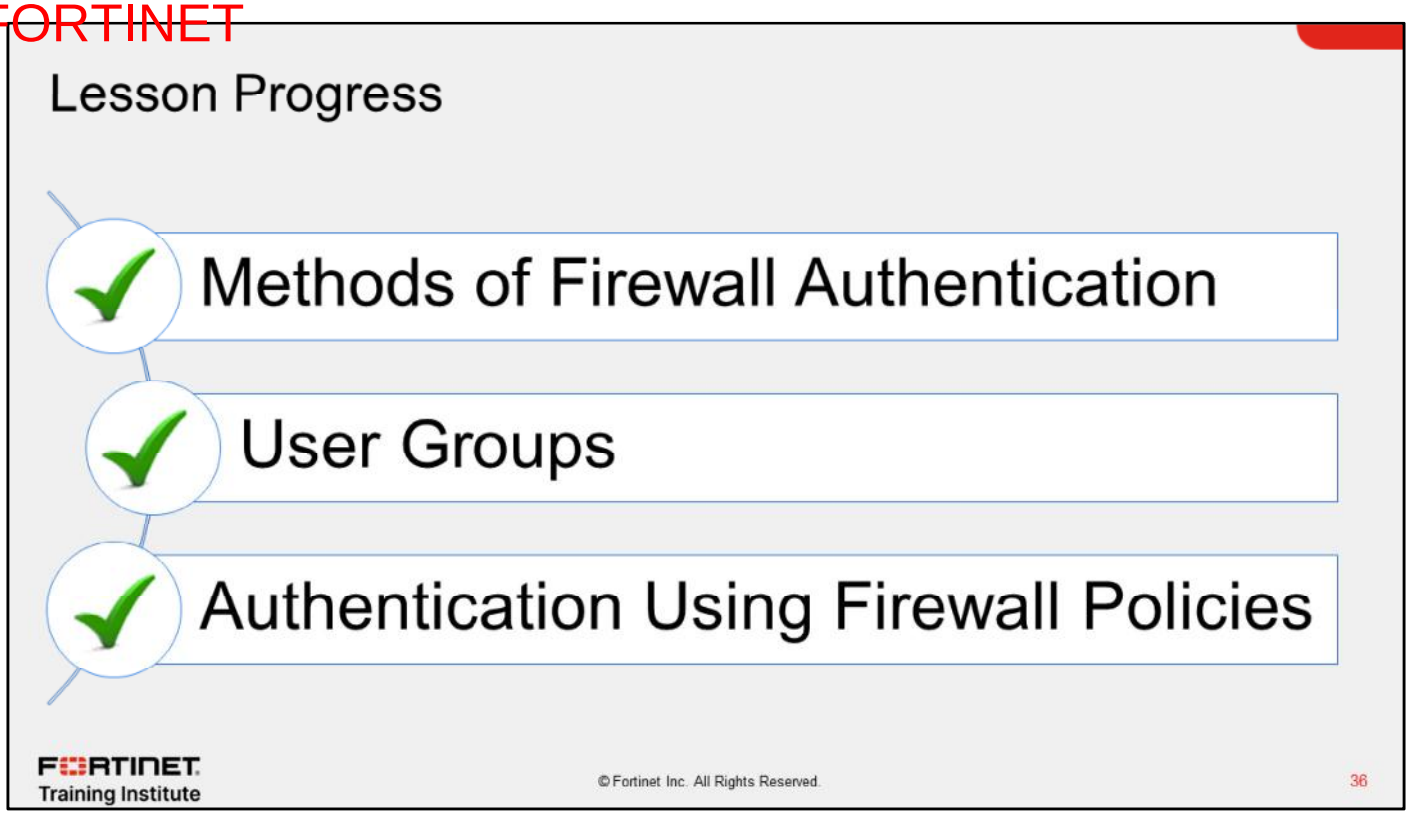
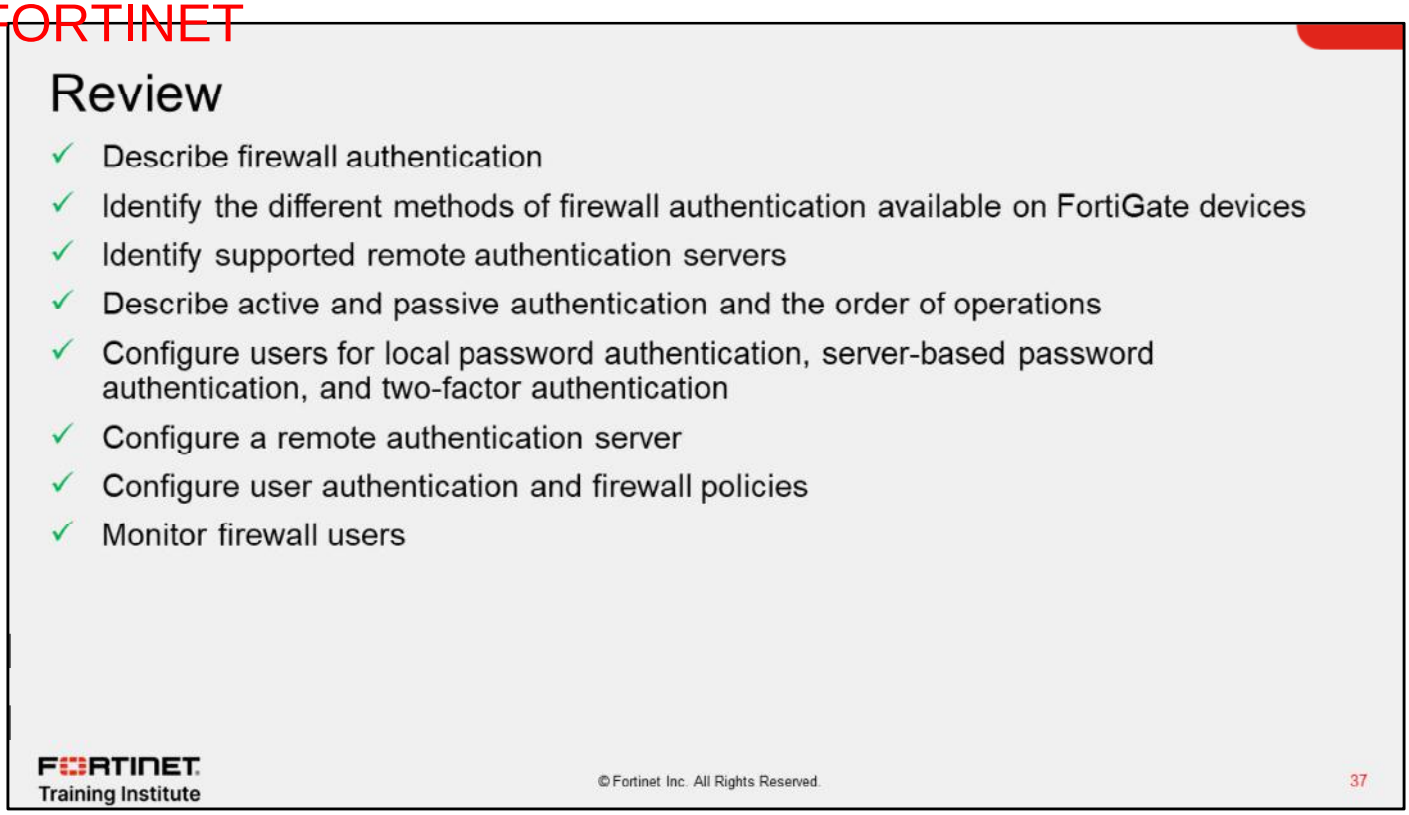


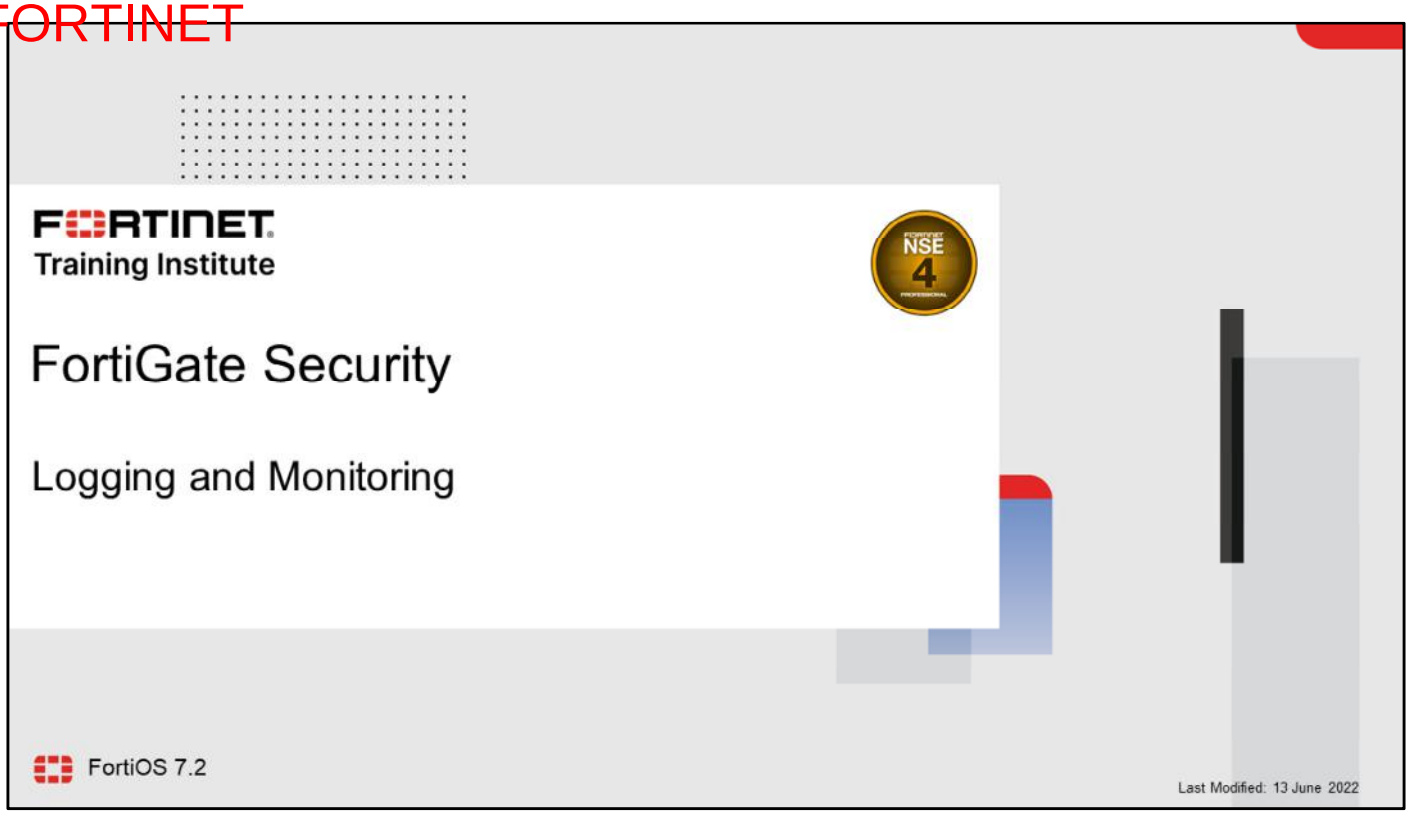
Congratulations! You have completed this lesson.

Now, you will review the objectives that you covered in this lesson.

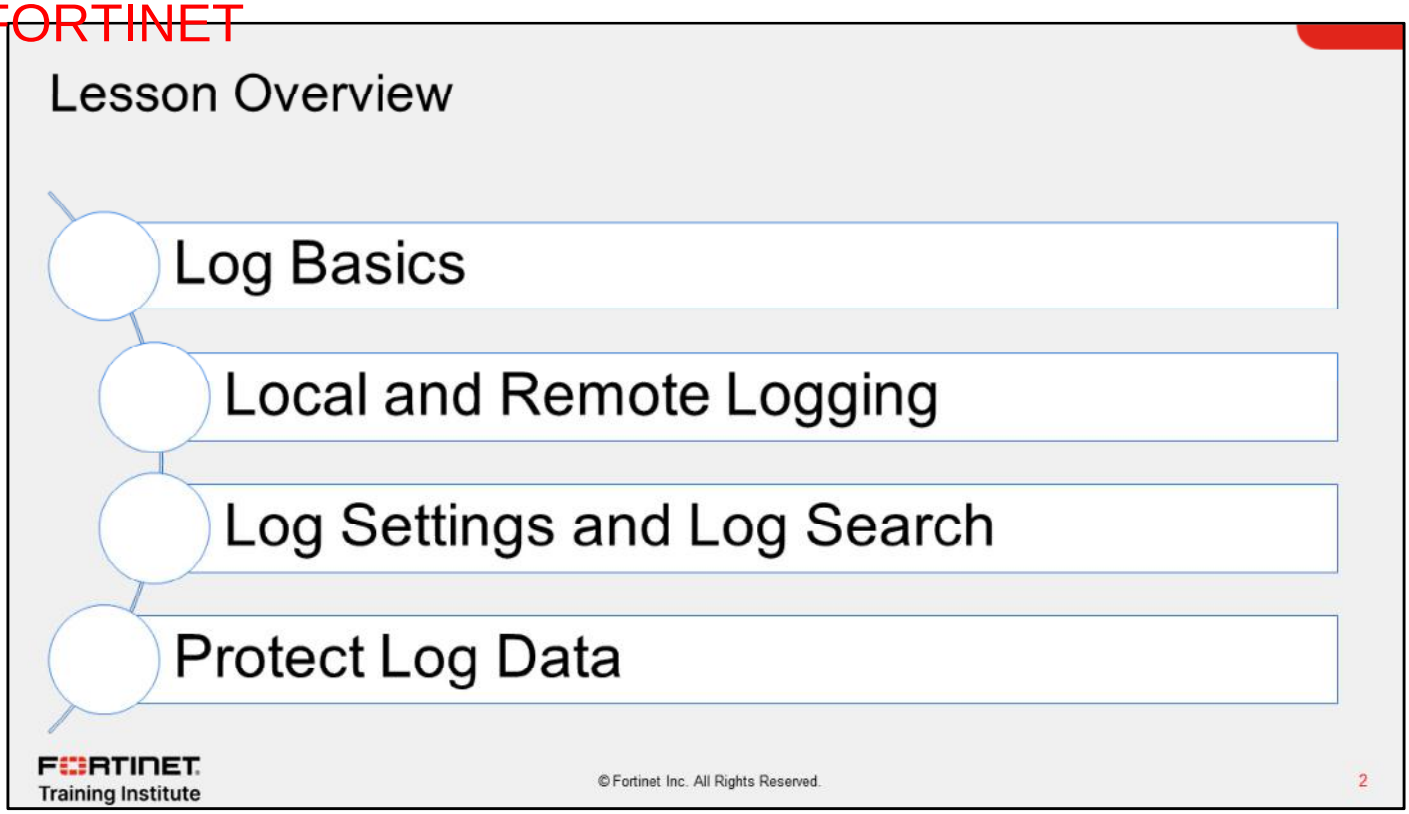


This slide shows the objectives that you covered in this lesson.

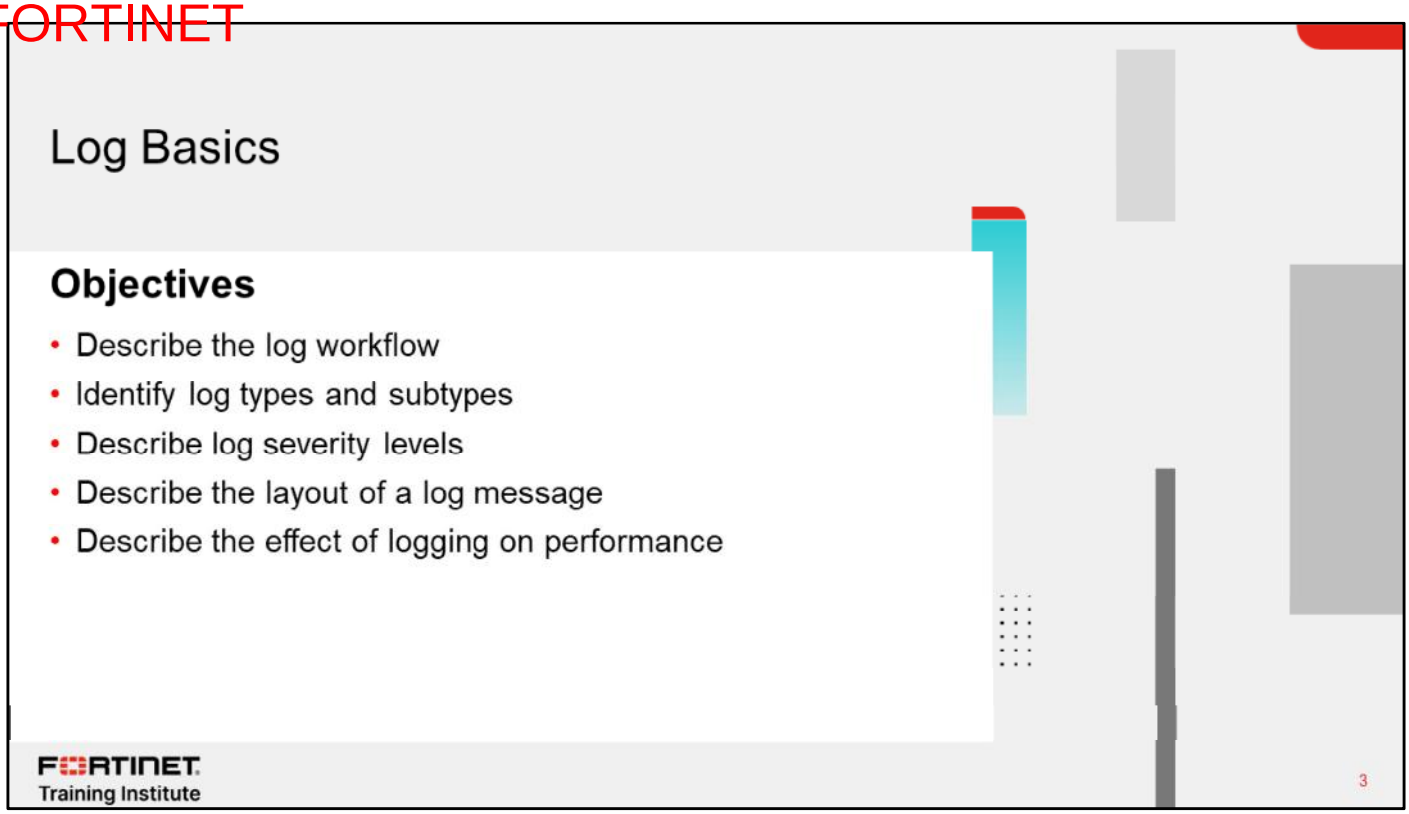
By mastering the objectives covered in this lesson, you learned how to use authentication on the firewall policies of FortiGate.



In this lesson, you will learn how to configure local and remote logging on FortiGate; view, search, and monitor logs; and protect your log data.

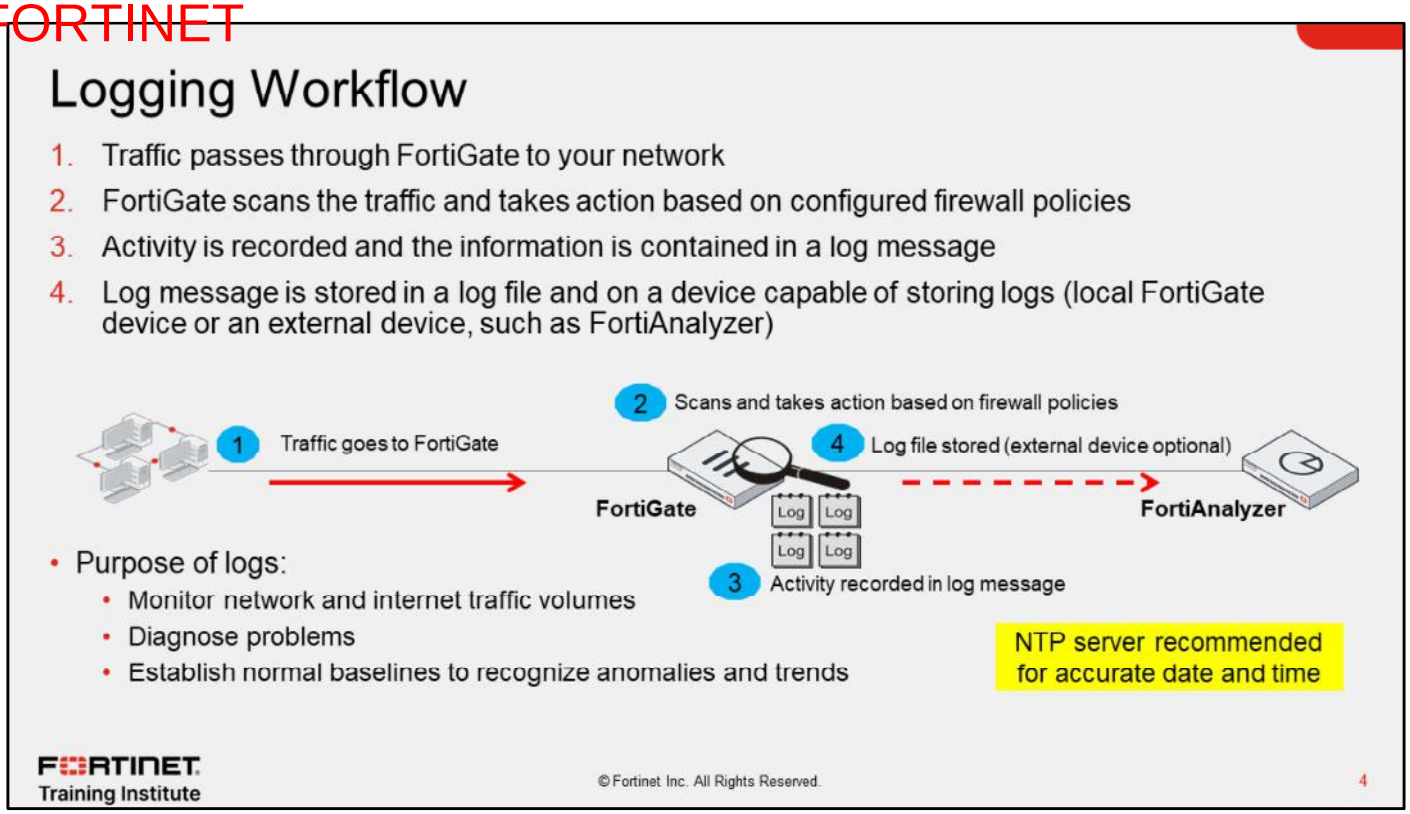


In this lesson, you will learn about the topics shown on this slide.



After completing this section, you should be able to achieve the objectives shown on this slide.

By demonstrating competence in log basics, you will be able to more effectively analyze log data from your database.

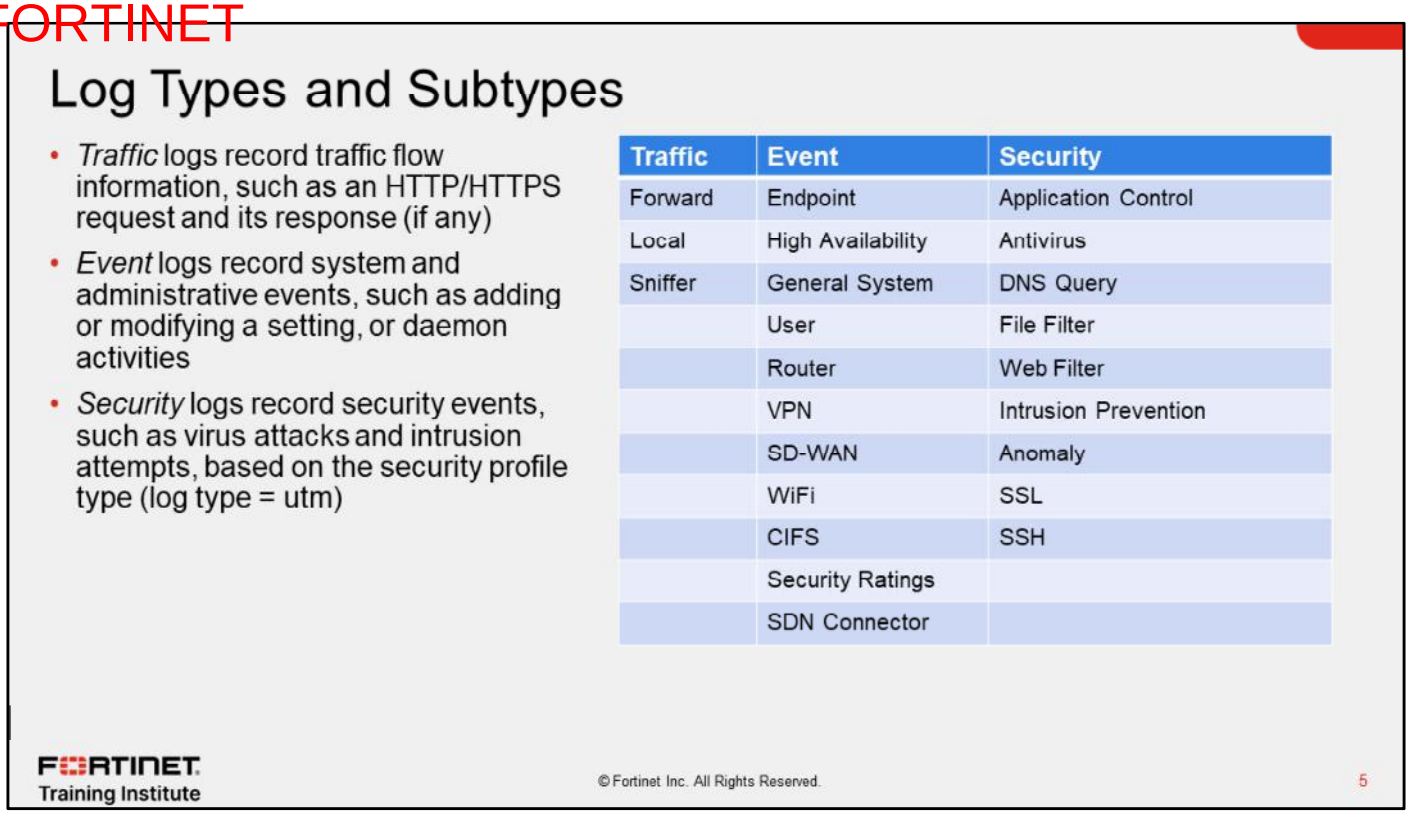


When traffic passes through FortiGate to your network, FortiGate scans the traffic, and then takes action based on the firewall policies in place. This activity is recorded, and the information is contained in a log message. The log message is stored in a log file. The log file is then stored on a device capable of storing logs. FortiGate can store logs locally on its own disk space, or can send logs to an external storage device, such as FortiAnalyzer.

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 adjust your network security settings 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.

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 keep its time correct automatically by synchronizing with a Network Time Protocol (NTP) server. An NTP server is highly recommended.



To FortiGate, there are three different types of logs: traffic logs, event logs, and security logs. Each type is further divided into subtypes.

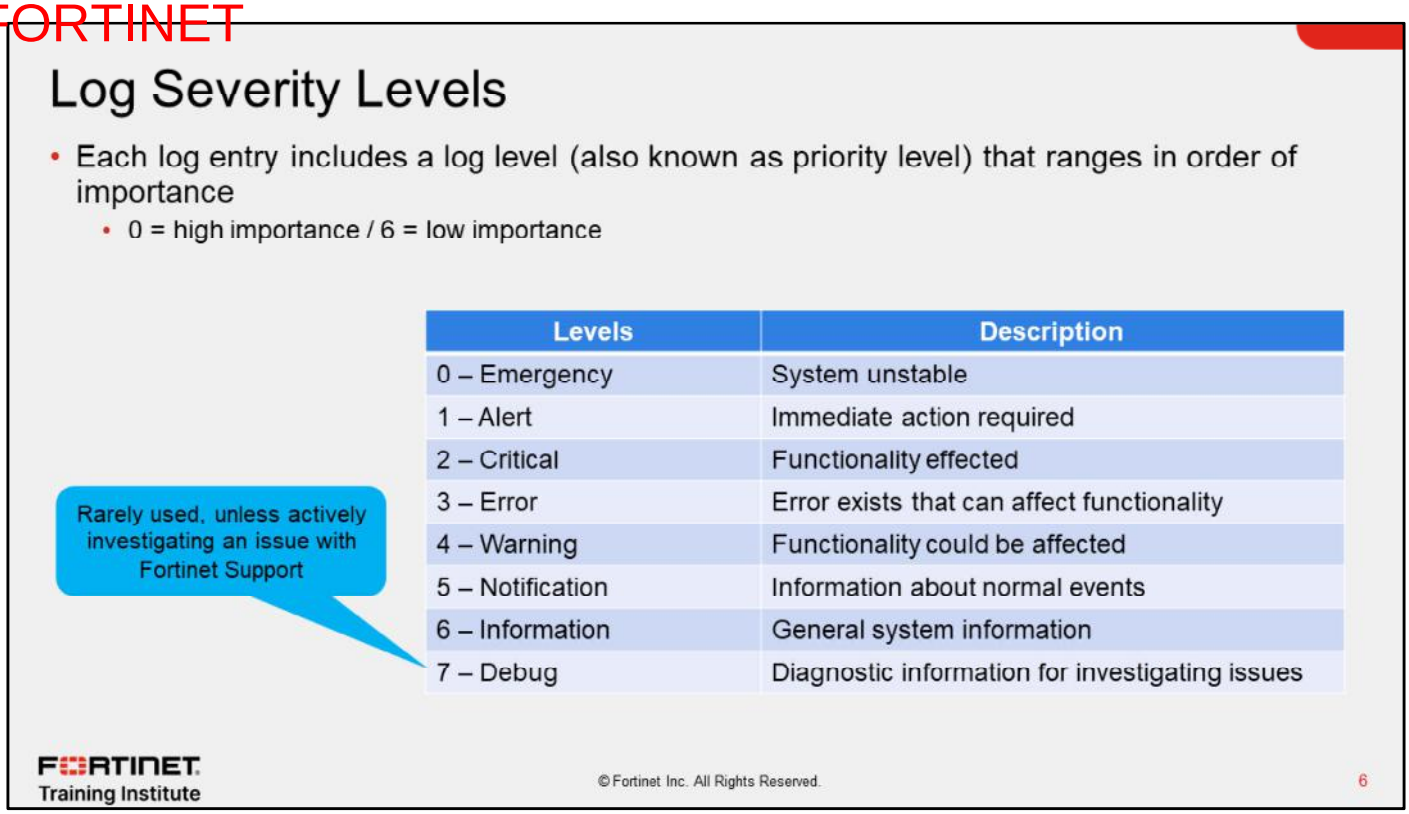
Traffic logs record traffic flow information, such as an HTTP/HTTPS request and its response, if any. It contains subtypes named forward, local, and sniffer.

- 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 management IP addresses. They also include connections to the GUI and FortiGuard queries.
- Sniffer logs contain information related to traffic seen by the one-arm sniffer.

Event logs record system and administrative events, such as adding or modifying a setting, or daemon activities. It contains the subtypes listed on the slide.

- System event logs contain information related to operations, such as automatic FortiGuard updates and GUI logins.
- User logs contain login and logout events for firewall policies with user authentication.
- Router, VPN, and wireless subtypes include logs for those features. For example, VPN contains IPsec and SSL VPN log entries.

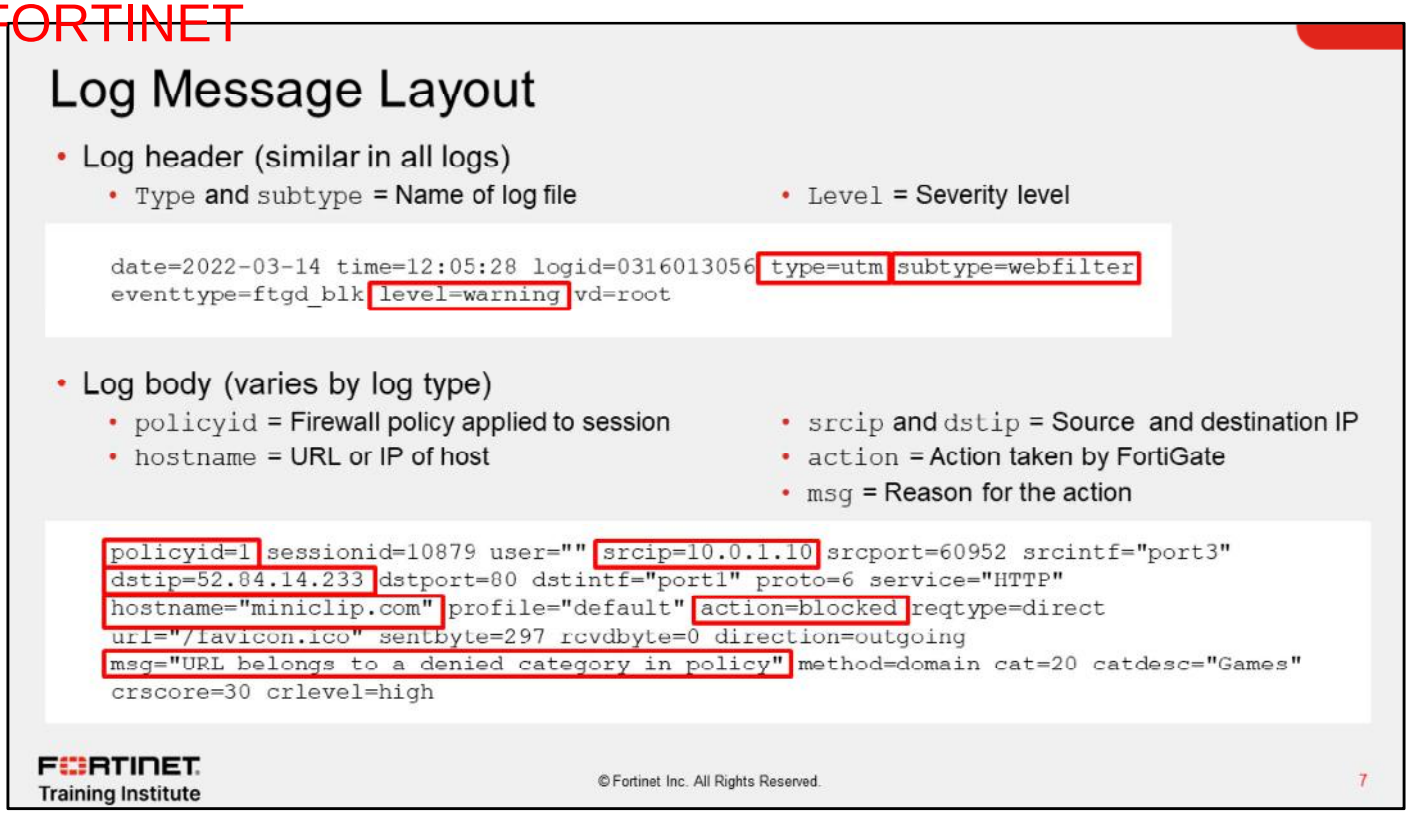
Finally, security logs record security events, such as virus attacks and intrusion attempts. They contain log entries based on the security profile type (log type = utm), including the subtype listed on the slide.



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 that includes diagnostic information into the event log. The debug level is rarely used, unless you are actively investigating an issue with Fortinet Support. Generally, the lowest level you want to use is information, but even this level generates many logs and can 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.



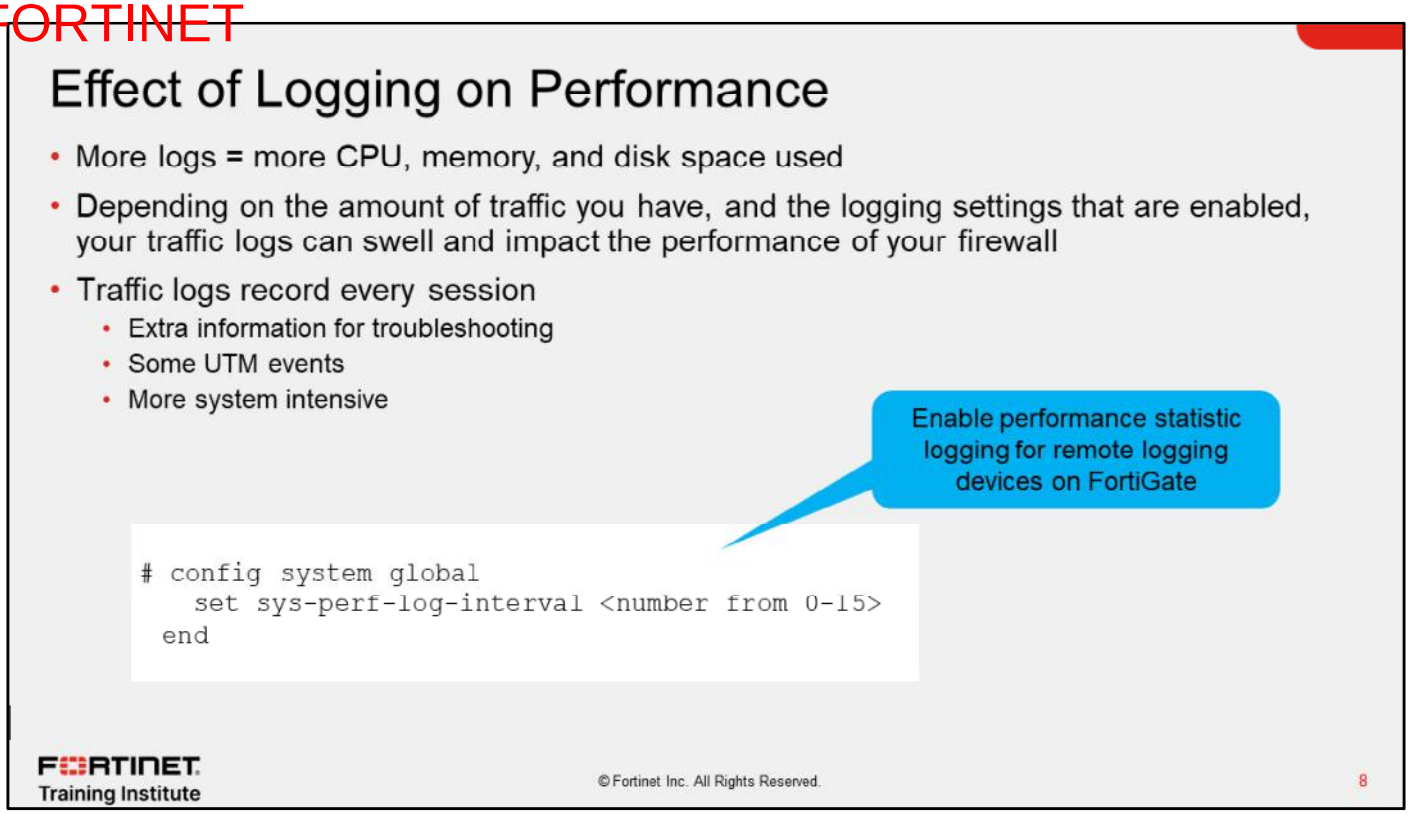
Every log message has a standard layout comprising two sections: a header and a body.

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. In the raw log entry example shown on this slide, 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 the actions taken by FortiGate. These fields vary by log type. In the example shown on this slide, the fields are as follows:

- 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` field indicates the URL or IP of the host
- The `action` field indicates what FortiGate did when it found a policy that matched the traffic
- The `msg` field 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.



It is important to remember that the more logs that get generated, the heavier the toll on your CPU, memory, and disk 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 the logging behavior with security profiles. Security profiles can, depending on the logging settings, create log events when a traffic matching the profile is detected. Depending on the amount of traffic you have, and the logging settings that are enabled, your traffic logs can swell and, ultimately, impact the performance of your firewall.

When using remote logging devices, such as FortiAnalyzer and syslog, you can enable performance statistic logging to occur every 1-15 minutes (0 to disable). This is not available for local disk logging or FortiCloud.

Knowledge Check

1. Which type of logs are application control, web filter, and antivirus?
   A. Event
   ✓B. Security

2. The log _____ contains fields that are common to all log types, such as originating date and time, log identifier, log category, and VDOM.
   ✓A. header
   B. body

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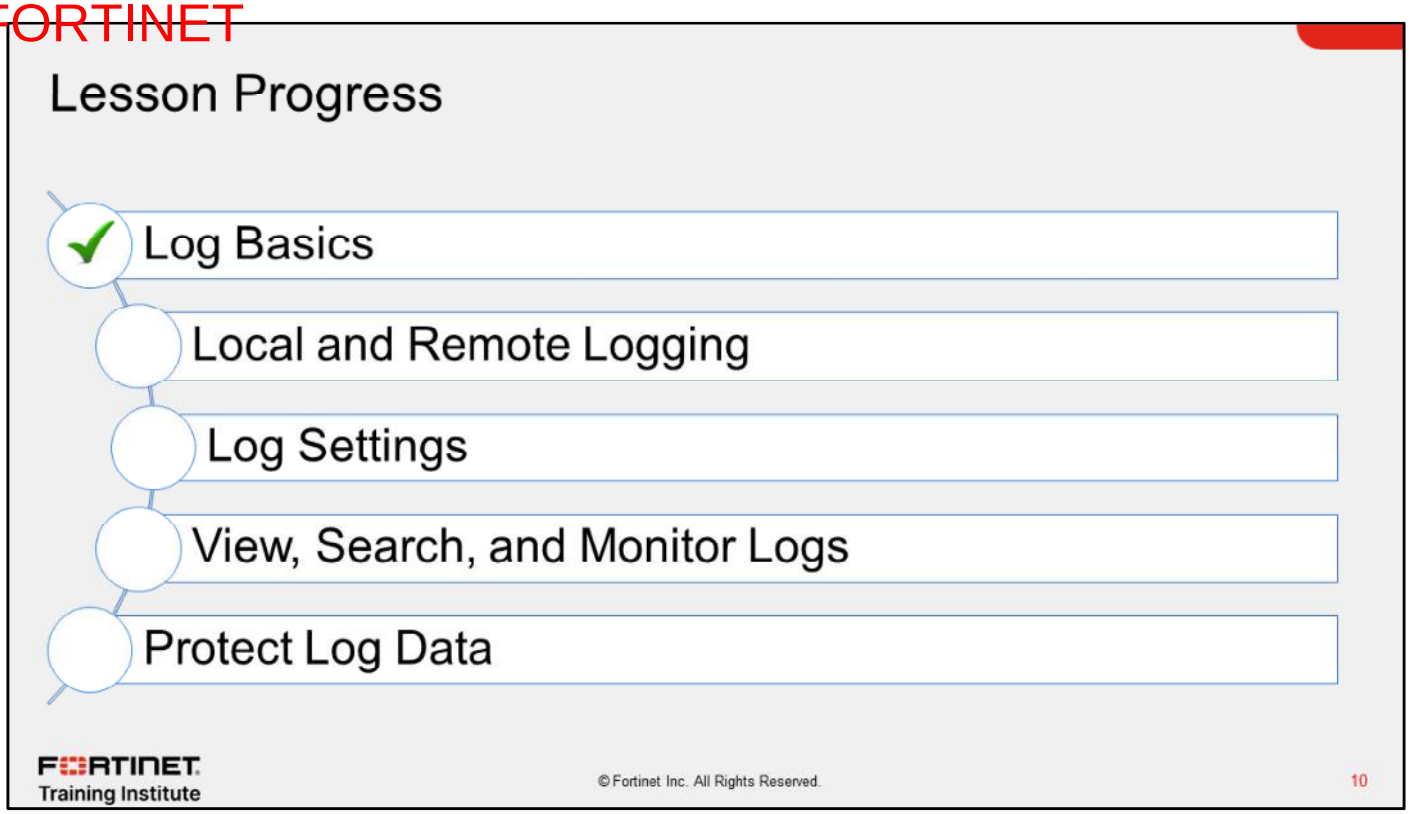
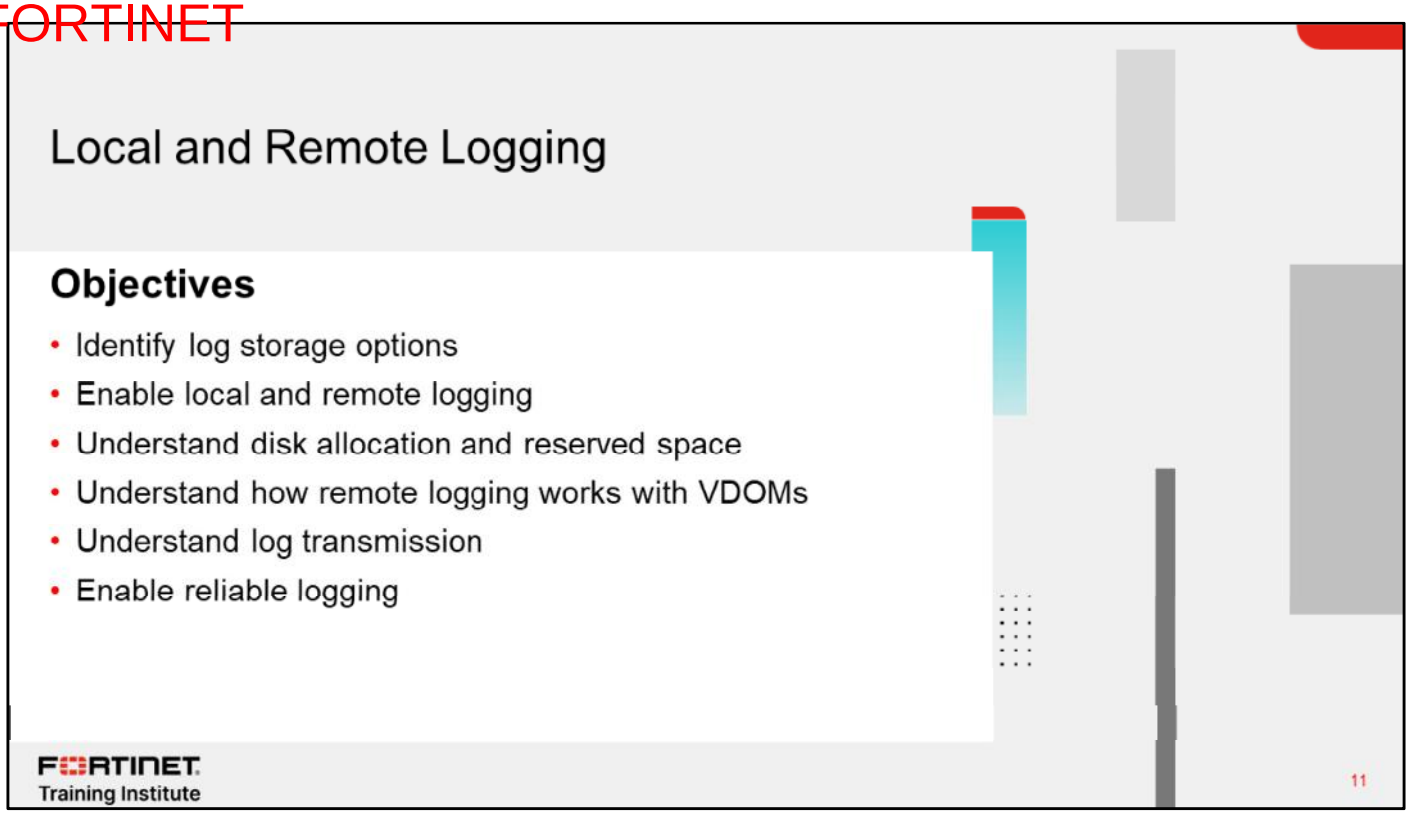


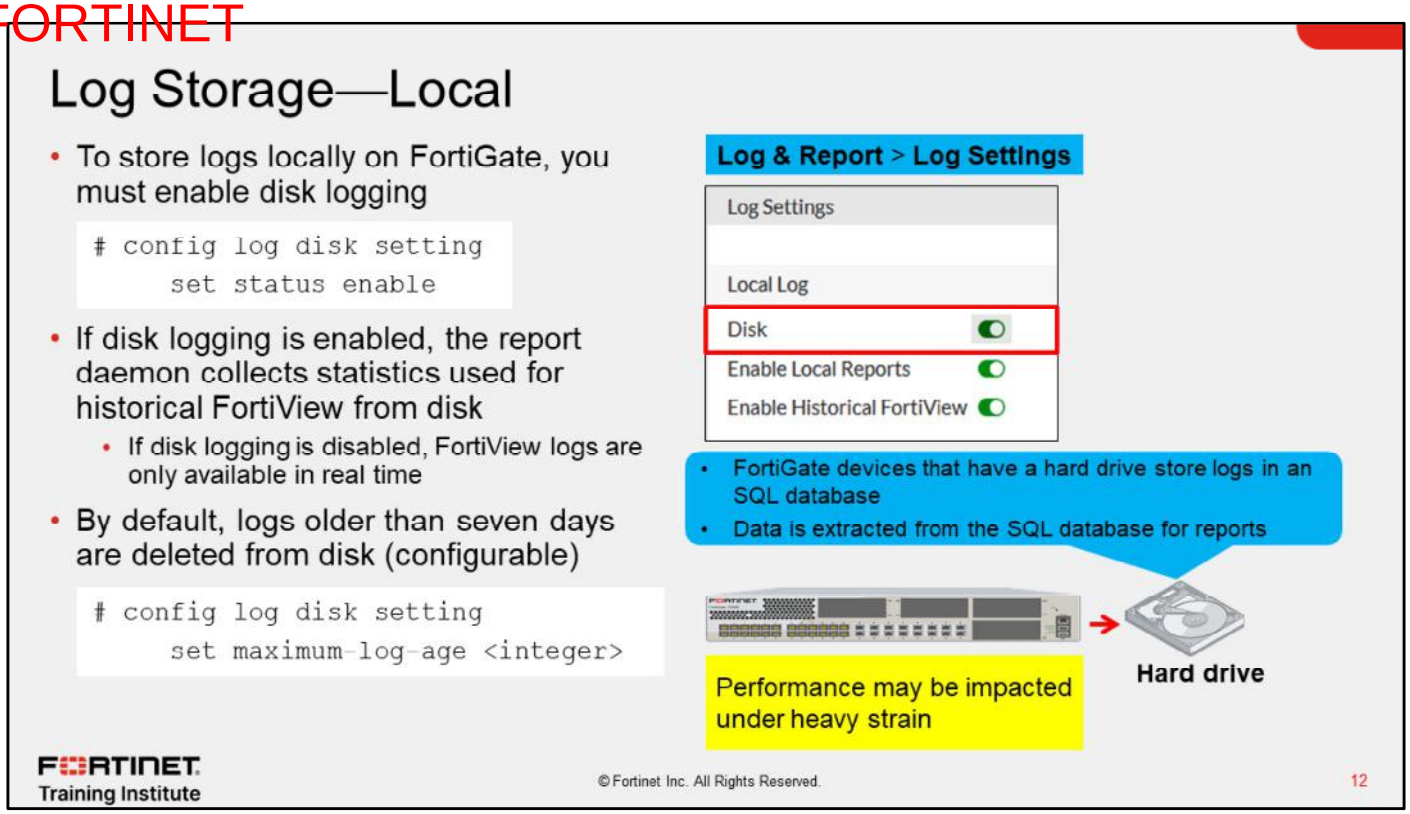
Good job! You now understand log basics.

Now, you will learn about local logging.



After completing this section, you should be able to achieve the objectives shown on this slide.

By demonstrating competence in local logging, you will be able to successfully store logs to local disk and retain those logs, based on your requirements.



Typically, mid-level to high-end FortiGate models have a hard drive. FortiGate can store logs on its hard drive. This operation is known as local logging or disk logging. Depending on the model series, disk logging may be enabled by default.

FortiGate can store all log types, including log archives and traffic logs, locally. Traffic logs and log archives are larger files, and need a lot of room when being logged by FortiGate.

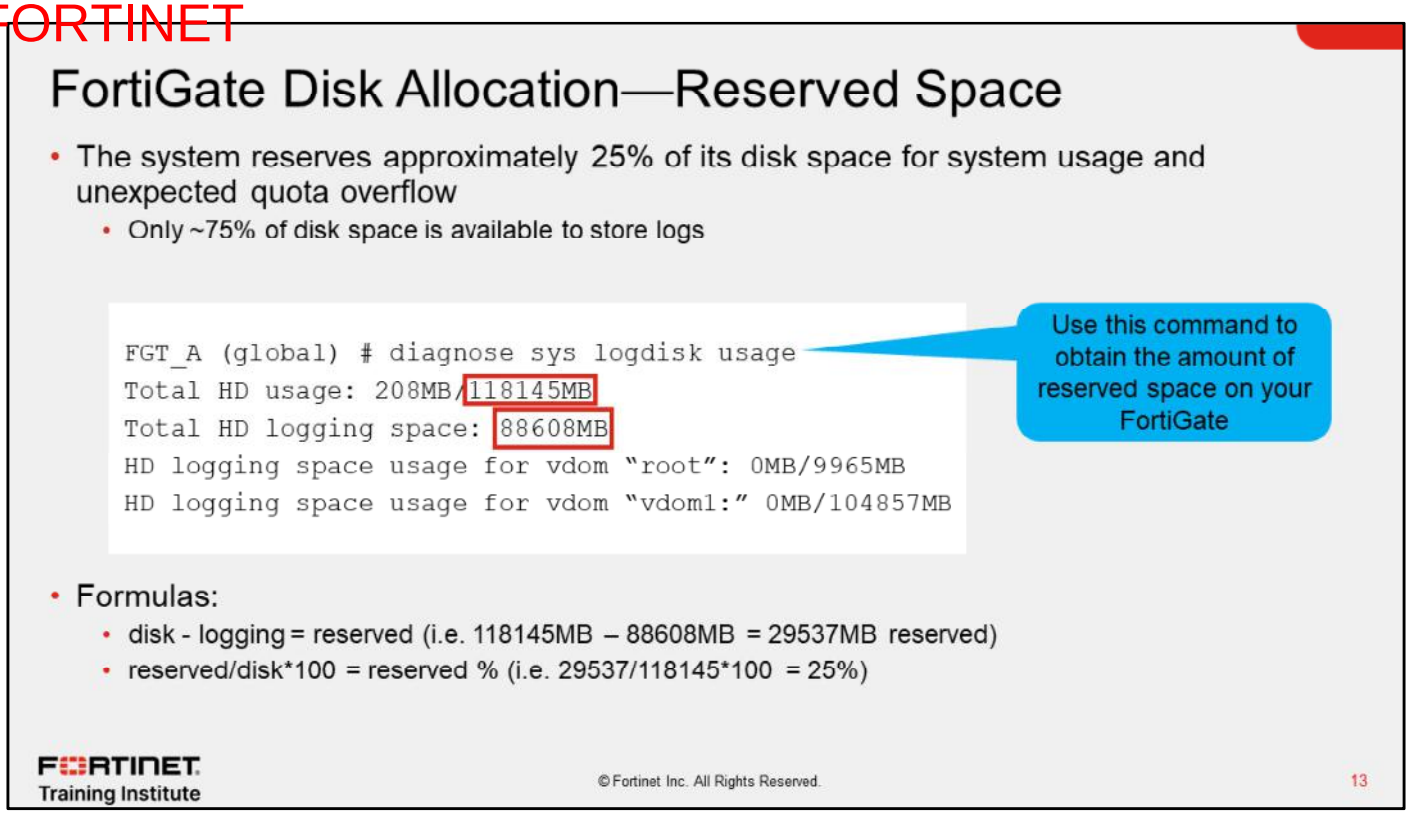
Under heavy log usage, disk logging will result in a performance impact.

If you are using the local hard disk on a device for WAN optimization, you cannot also log to disk, unless your device has two separate disks. If your device has two separate disks, you can use one for WAN optimization and the other for logging. If you are using the local hard disk for WAN optimization, and only one disk is available, you can log to remote FortiAnalyzer devices or syslog servers.

If you want to store logs locally on FortiGate, you must enable disk logging on the **Log Settings** page. Only some FortiGate models support disk logging. If your FortiGate does not support disk logging, you can log to an external device instead.

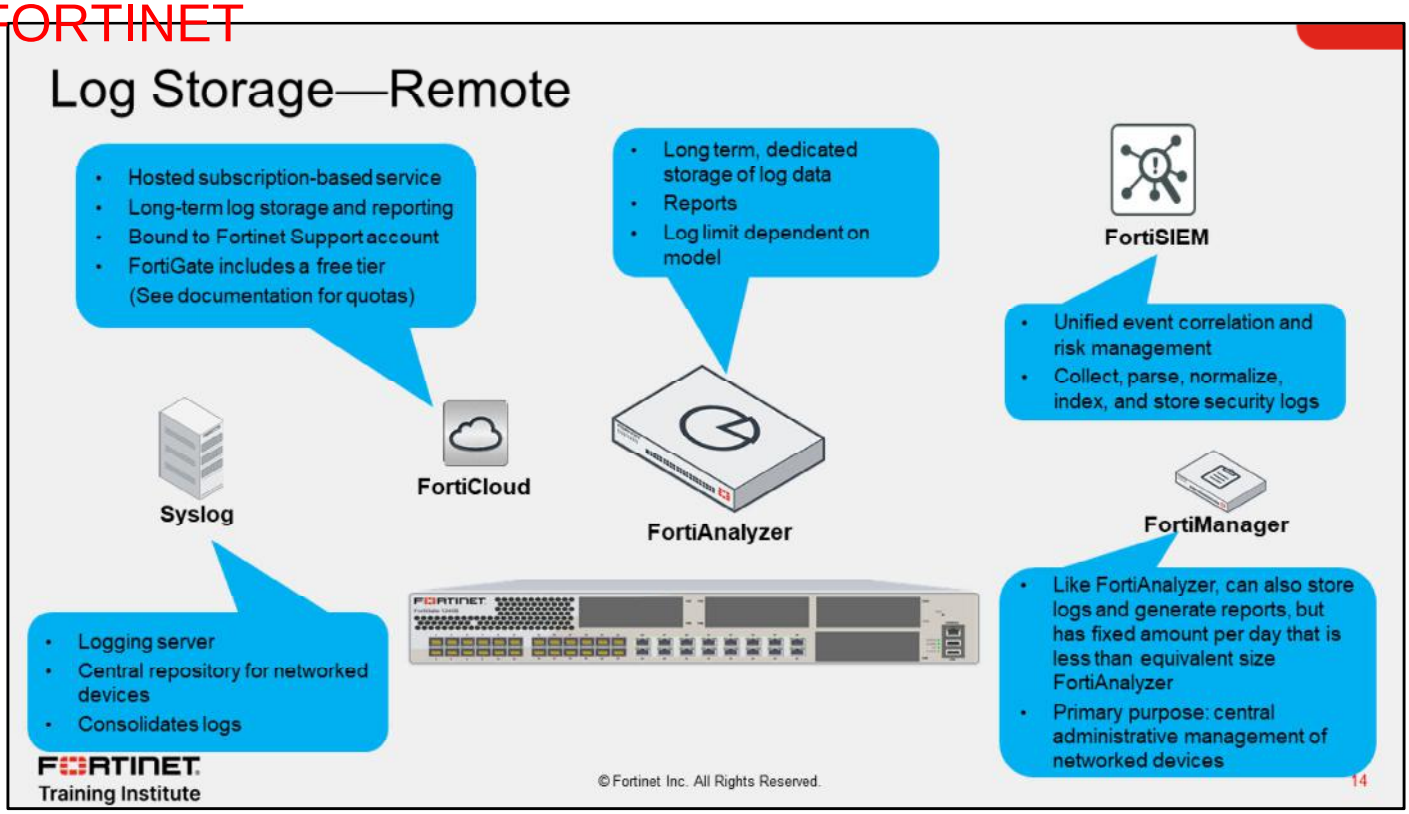
You must enable disk logging in order for information to appear on the FortiView dashboards. If disabled, logs display in real-time only. You can also enable this setting using the CLI `config log disk setting` command.

By default, logs older than seven days are deleted from the disk. This value is configurable.



If you decide to log locally on FortiGate, be aware that the entire disk space is not available to store logs. The FortiGate system reserves approximately 25% of its disk space for system usage and unexpected quota overflow.

To determine the amount of reserved space on your FortiGate, use the CLI command `diagnose sys logdisk usage`. Subtract the total logging space from the total disk space to calculate the reserved space.



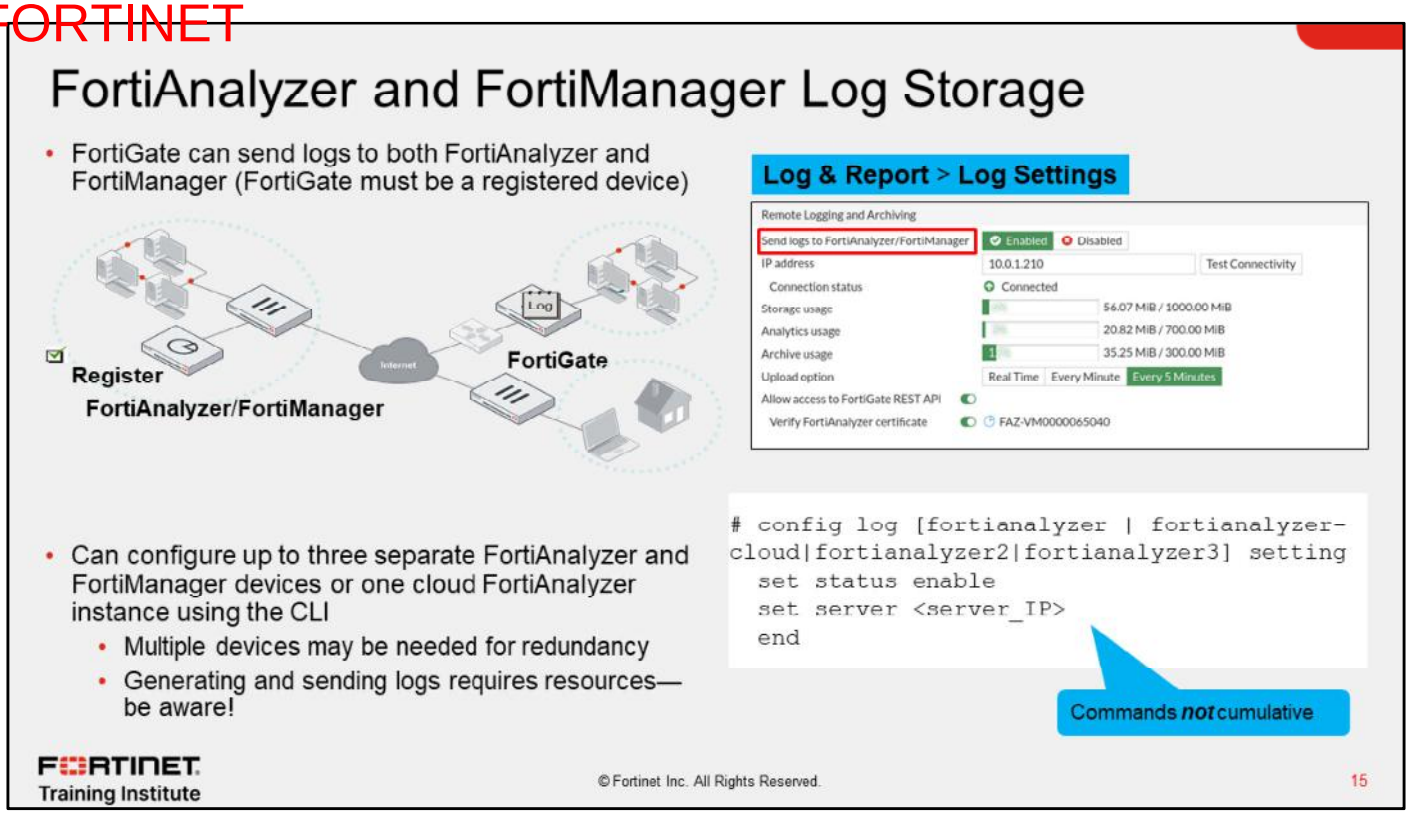
You can configure FortiGate to store logs on syslog servers, FortiCloud, FortiSIEM, FortiAnalyzer, or FortiManager. These logging devices can also be used as a backup solution. Whenever possible, it is preferred to store logs externally.

Syslog is a logging server that is used as a central repository for networked devices.

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 device. Note that every FortiGate offers a free tier and will keep logs for seven days. You must upgrade to the paid service to retain logs for one year.

FortiSIEM provides unified event correlation and risk management that can collect, parse, normalize, index, and store security logs.

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. While FortiAnalyzer and FortiManager share a common hardware and software platform and can both take log entries, FortiAnalyzer and FortiManager actually have different capabilities that are worth noting. 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 the equivalent size 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). Note that local logging is not required for you to configure logging to FortiAnalyzer or FortiManager.



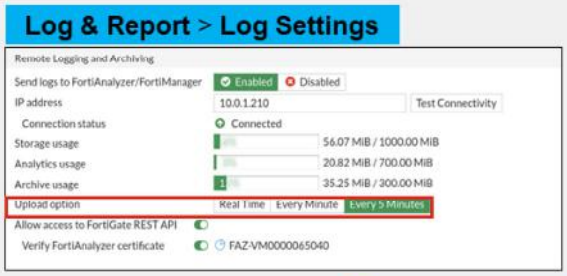
The process to configure FortiGate to send logs to FortiAnalyzer or FortiManager is identical. For FortiGate to send logs to either device, you must register FortiGate with FortiAnalyzer or FortiManager. After it is registered, FortiAnalyzer or FortiManager can begin to accept incoming logs from FortiGate.

You can configure remote logging to FortiAnalyzer or FortiManager using both the GUI and CLI.

Note that the **Test Connectivity** function on the GUI will report as failing until FortiGate is registered on FortiAnalyzer or FortiManager, because it is not yet authorized to send logs.

Upload Option

- Near real-time uploading and consistent high-speed compression and analysis
- Configure logging options:
  - `store-and-upload` (CLI configuration only)
  - **Real Time**
  - **Every Minute**
  - **Every 5 Minutes** (default)




```
# configure log fortianalyzer setting
     set upload-option [store-and-upload |realtime/1-minute/5-minute]
```

`store-and-upload` only available to FortiGates with an internal hard drive

- By default, if the FortiAnalyzer disk is full, the oldest logs are overwritten; however, you can configure FortiAnalyzer to stop logging

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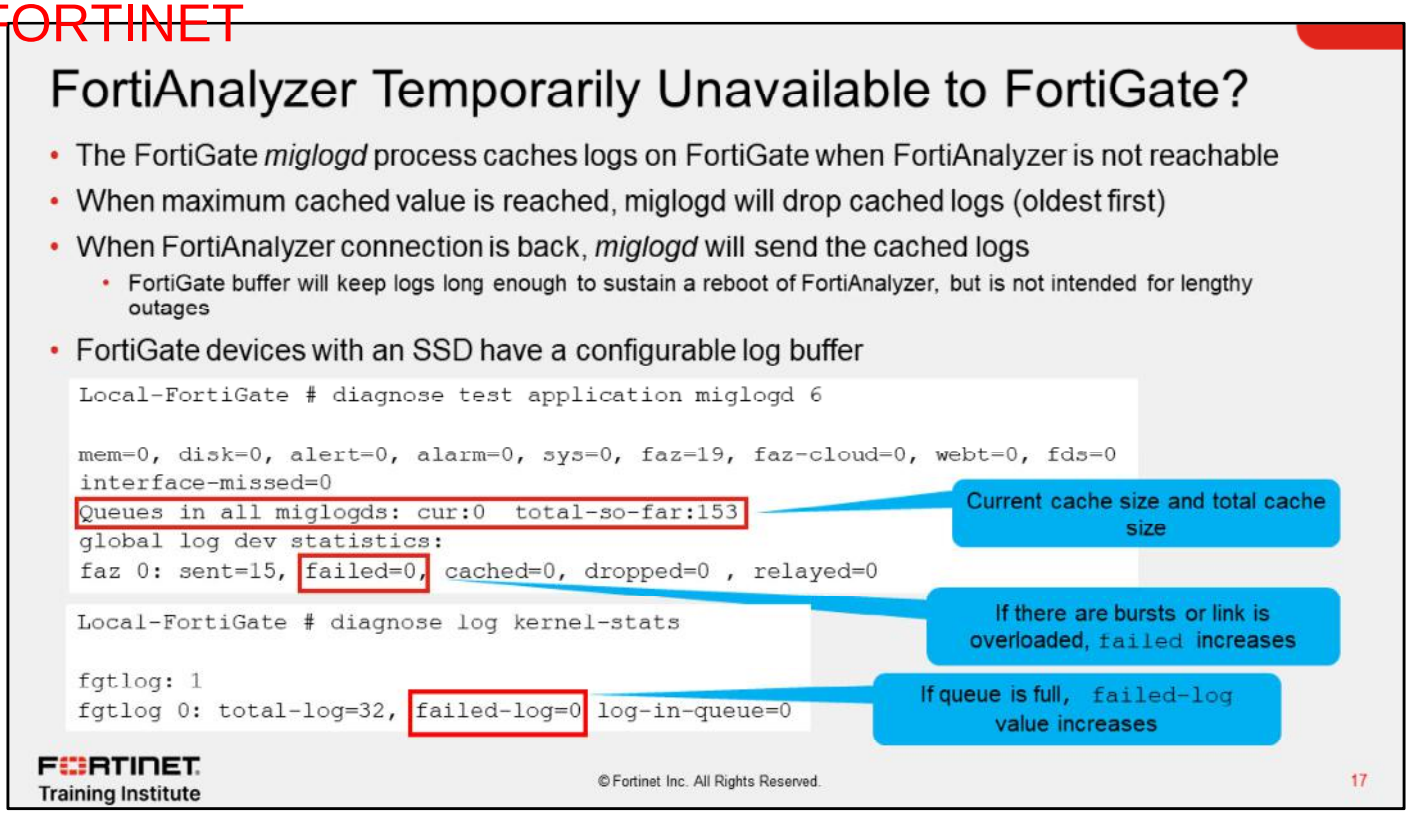
FortiGate allows near real-time uploading and consistent high-speed compression and analysis to FortiAnalyzer and FortiManager.

On the GUI, upload options include **Real Time**, **Every Minute**, and **Every 5 Minutes** (default).

If your FortiGate model includes an internal hard drive, you also have the `store-and-upload` option. This allows you to store logs to disk and then upload to FortiAnalyzer or FortiManager at a scheduled time (usually a low bandwidth time). You can configure the `store-and-upload` option, as well as a schedule, on the CLI only.

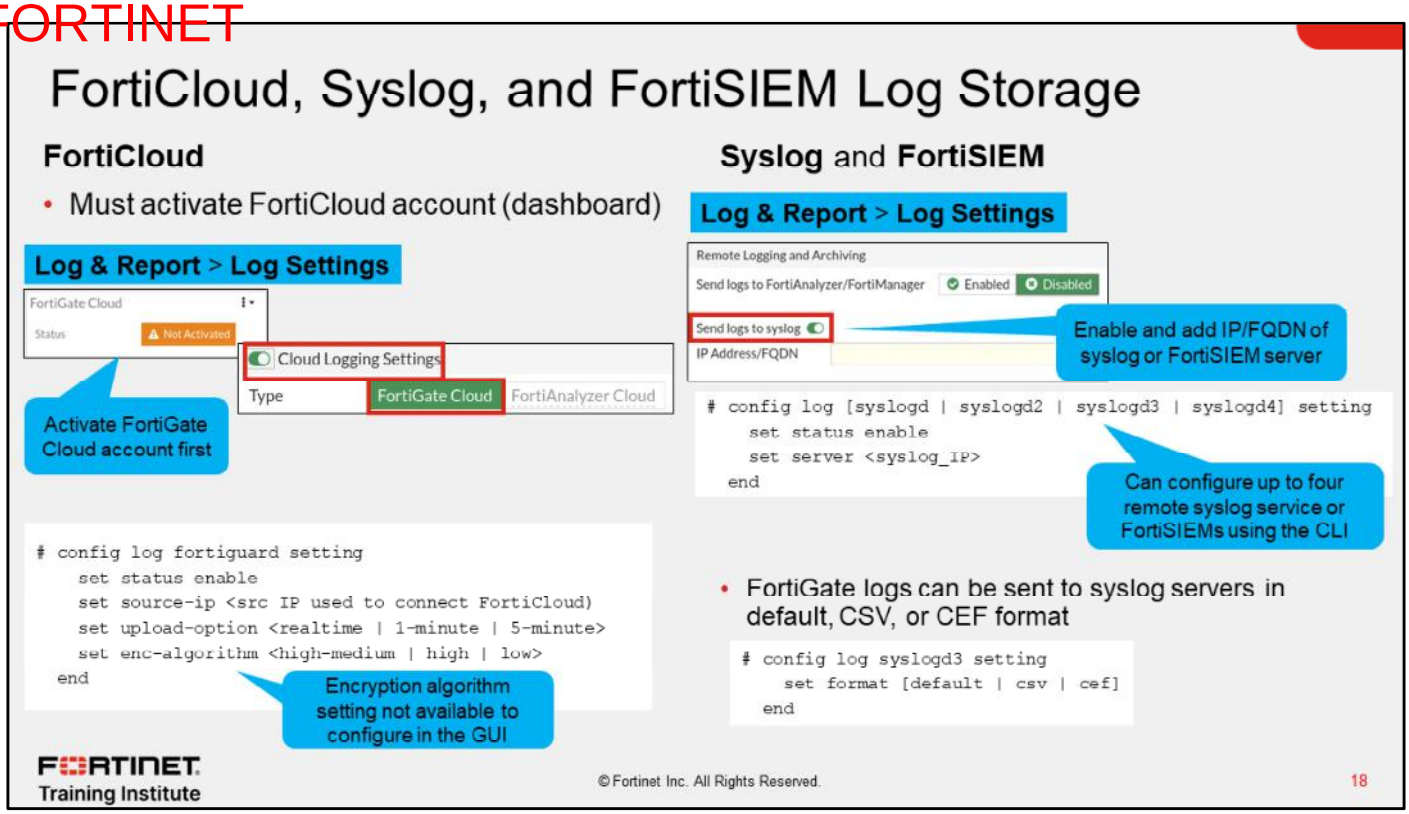


If FortiAnalyzer becomes unavailable to FortiGate for any reason, FortiGate uses its *miglogd* process to cache the logs. There is a maximum value to the cache size, and the *miglogd* process will begin dropping cached logs (oldest first) once this value is reached. When the connection between the two devices is restored, the miglogd process begins to send the cached logs to FortiAnalyzer. Therefore, the FortiGate buffer keeps logs long enough to sustain a reboot of your FortiAnalyzer (if you are upgrading the firmware, for example), but it is not intended for a lengthy FortiAnalyzer outage.

On FortiGate, the CLI command `diagnose test application miglogd 6` displays statistics for the miglogd process, including the total cache size and current cache size.

The CLI command `diagnose log kernel-stats` will show an increase in `failed-log` if the cache is full and needs to drop logs.

FortiGate devices with an SSD disk have a configurable log buffer. When the connection to FortiAnalyzer is unreachable, FortiGate can buffer logs on disk if the memory log buffer is full. The logs queued on the disk buffer can be sent successfully after the connection to FortiAnalyzer is restored.

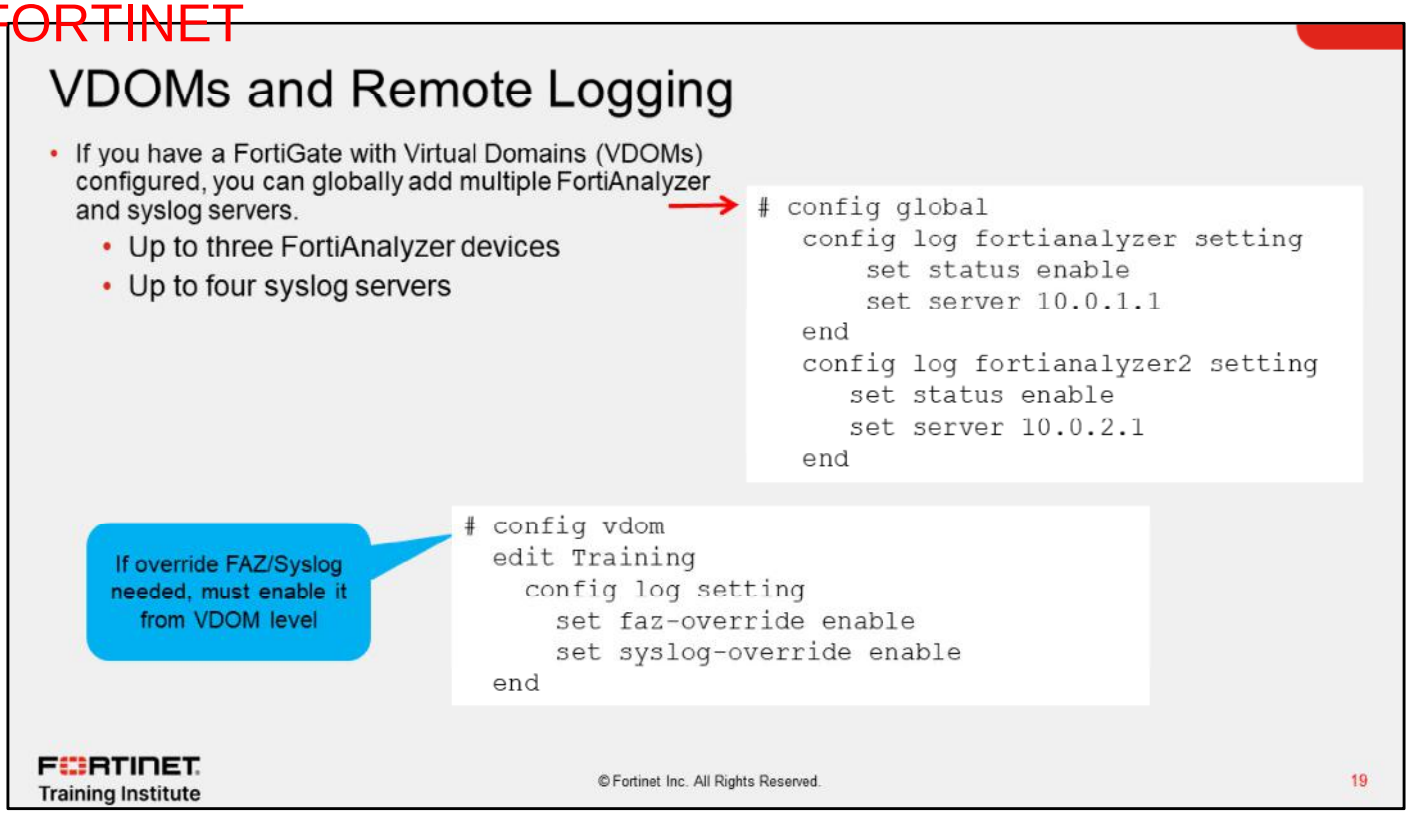


Similar to FortiAnalyzer and FortiManager, you can configure remote logging to FortiCloud on the **Log Settings** page or the CLI. However, you must first activate your FortiCloud account, so FortiGate can communicate with your FortiCloud account. Once complete, you can enable FortiCloud logging and set the upload option. If you want to store your logs to disk first and then upload to FortiCloud, you must specify a schedule. When disk usage is set to WAN optimization (`wanopt`), the store and upload option for logging to FortiCloud is removed.

You can also configure remote logging to syslog and FortiSIEM on the **Log Settings** page or the CLI. You can configure FortiGate to send logs to up to four syslog servers or FortiSIEM devices using the `config log syslogd` CLI command.

FortiGate supports sending logs to syslog in CSV and CEF format, which is an open log management standard that provides interoperability of security-related information between different network devices and applications. CEF data can be collected and aggregated for analysis by enterprise management or Security Information and Event Management (SIEM) systems, such as FortiSIEM. You can configure each syslog server separately to send log messages in CEF or CSV format.

You can configure an individual syslog to use CSV and CEF format using the CLI. The example shown on this slide is for syslogd3. All other syslog settings can be configured as required independently of the log message format, including the server address and transport (UDP or TCP) protocol.

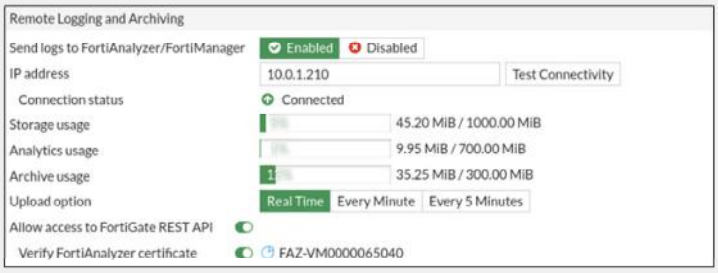


If you have a FortiGate with virtual domains (VDOMs) configured, you can globally add multiple FortiAnalyzer and syslog servers. You can configure up to three FortiAnalyzer devices and up to four syslog servers under global settings.

Log Transmission

- FortiGate uses UDP 514 for log transmission by default

```
config log fortianalyzer setting
    set status enable
    set server "10.0.1.210"
    set serial "FAZ-VM0000065040"
    set enc-algorithm high-medium
    set upload-option realtime
end
```



- Log messages are stored on disk and transmitted to FortiAnalyzer as plain text in LZ4 compressed format
  - Reduces disk log size and reduces log transmission time and bandwidth usage

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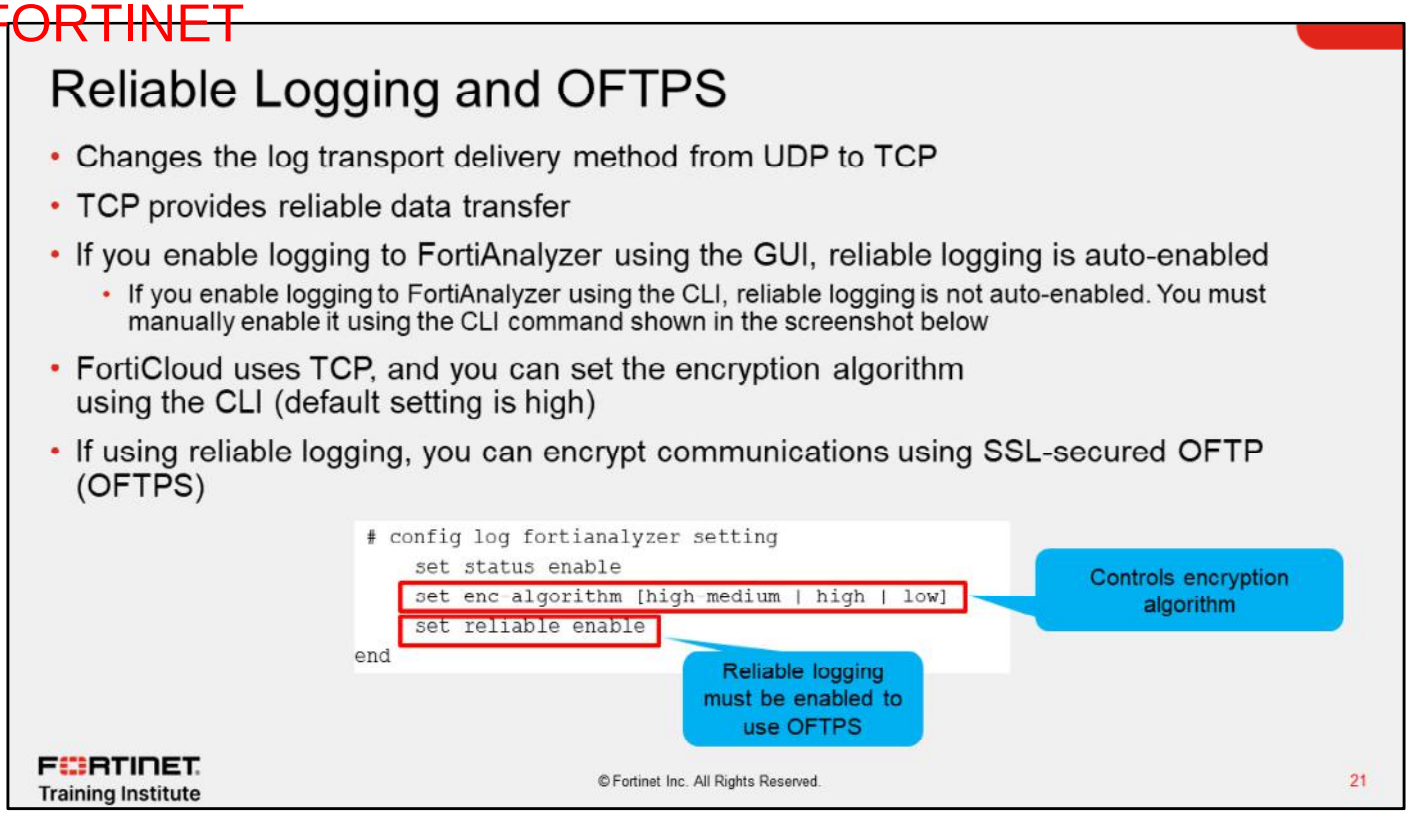
FortiGate uses UDP port 514 for log transmission by default .

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.



When you enable reliable logging on FortiGate, the log transport delivery method changes from User Datagram Protocol (UDP) to Transmission Control Protocol (TCP). TCP provides reliable data transfer, guaranteeing that the transferred data remains intact and arrives in the same order in which it was sent.

If you enable logging to FortiAnalyzer or FortiManager using the GUI, reliable logging is automatically enabled. If you enable logging using the CLI, you must enable reliable logging using the CLI command shown on this slide.

Logging to FortiCloud uses TCP, and you can set the encryption algorithm using the CLI. The default encryption setting is high.

Optionally, if using reliable logging, you can encrypt communications using SSL-encrypted OFTP traffic, so when a log message is generated, it is safely transmitted across an unsecure network. You can choose the level of SSL protection used by configuring the `enc-algorithm` setting on the CLI.

When both FortiGate and FortiAnalyzer are running version 7.2 or later, and reliable logging is configured, FortiGate keeps logs in a *confirm queue* until it verifies those logs were received by FortiAnalyzer. This is achieved by using sequence numbers (`seq_no`) to track the logs received. FortiOS periodically queries FortiAnalyzer for the latest `seq_no` of the last log received, and clears logs from the *confirm queue* up to the `seq_no`.

Knowledge Check

1. Which storage type is preferred for logging?
   - ✓ A. Remote logging
   - B. Hard drive

2. Which protocol does FortiGate use to send encrypted logs to FortiAnalyzer?
   - ✓ A. OFTPS
   - B. SSL

3. If you enable reliable logging, which transport protocol will FortiGate use?
   - A. UDP
   - ✓ B. TCP

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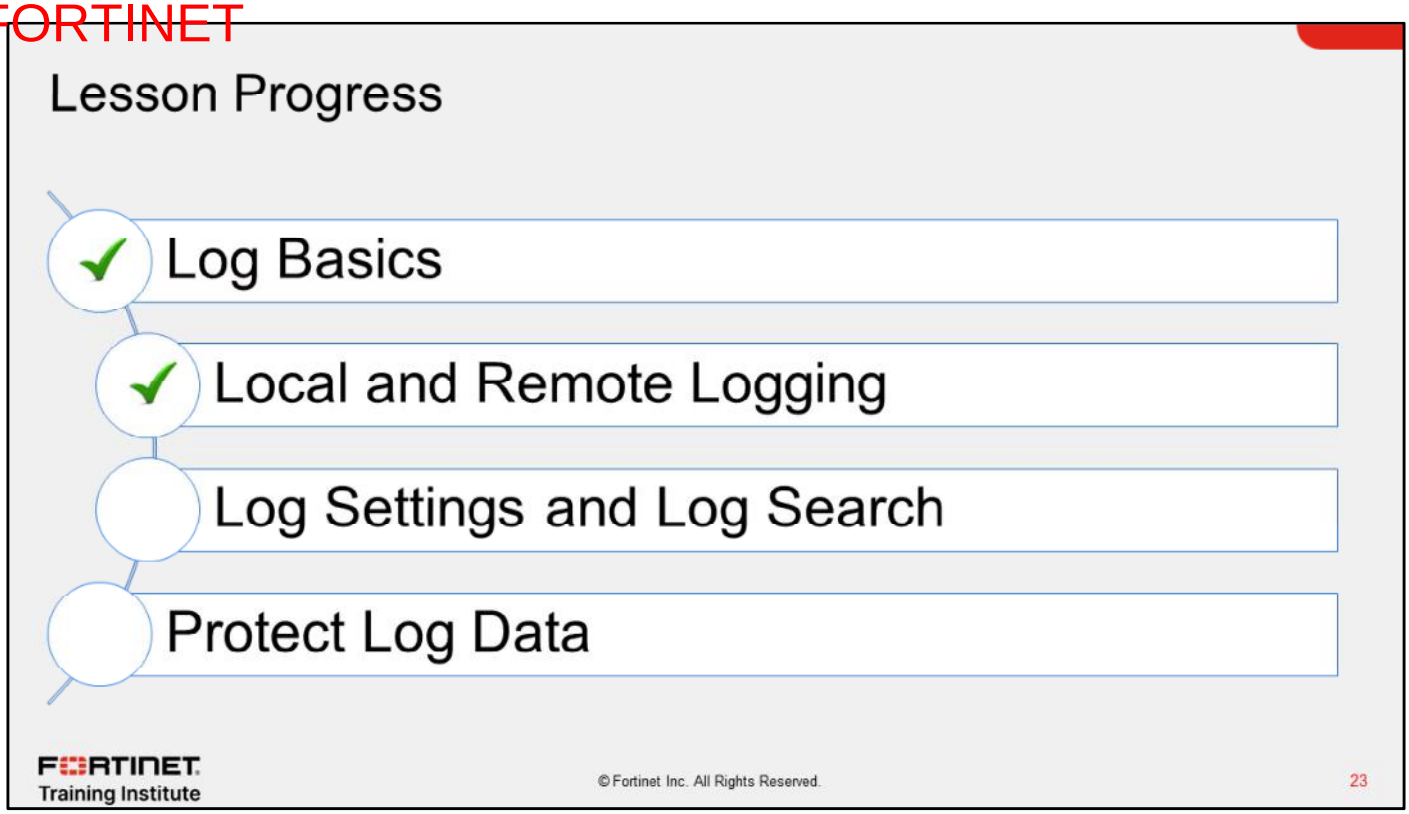
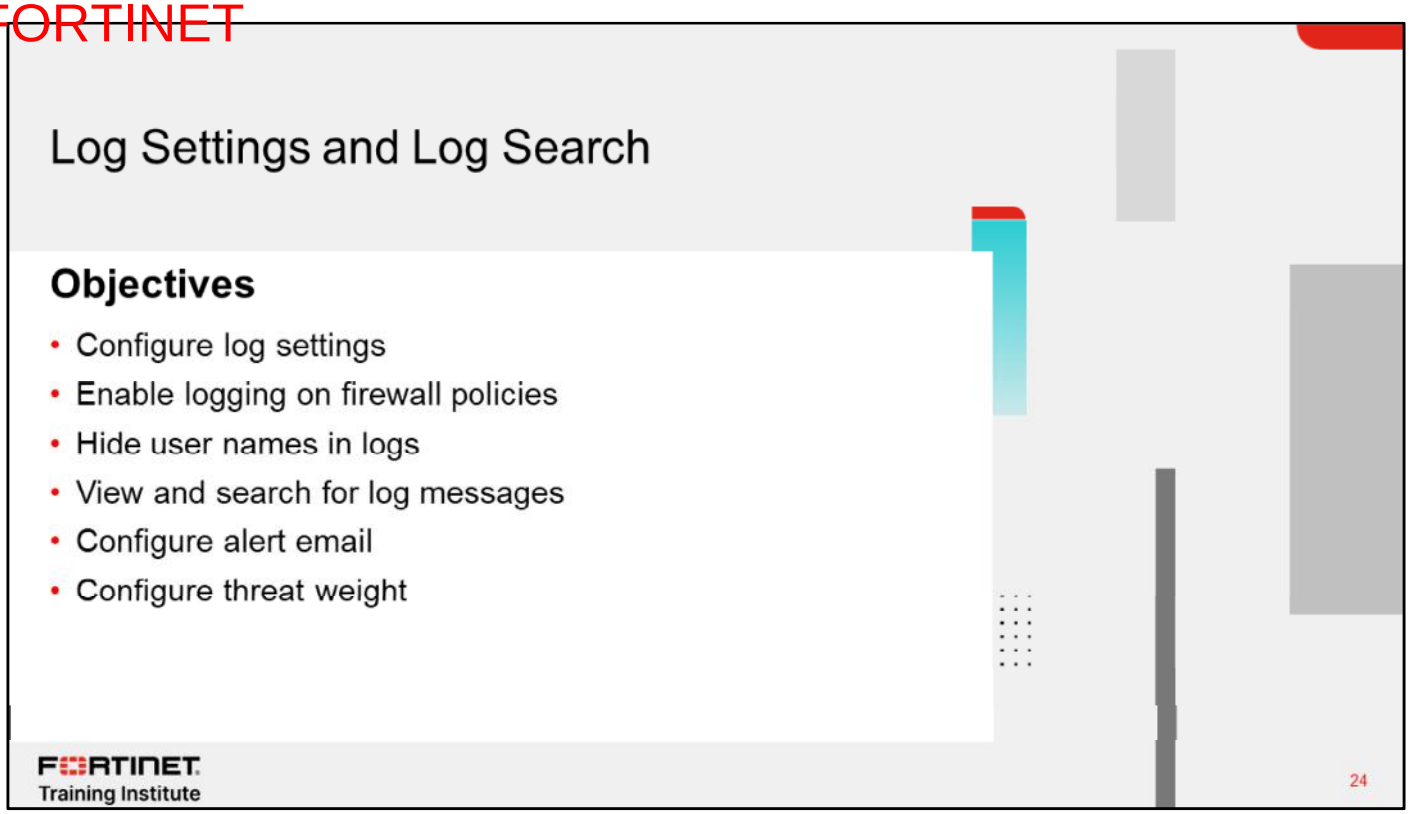


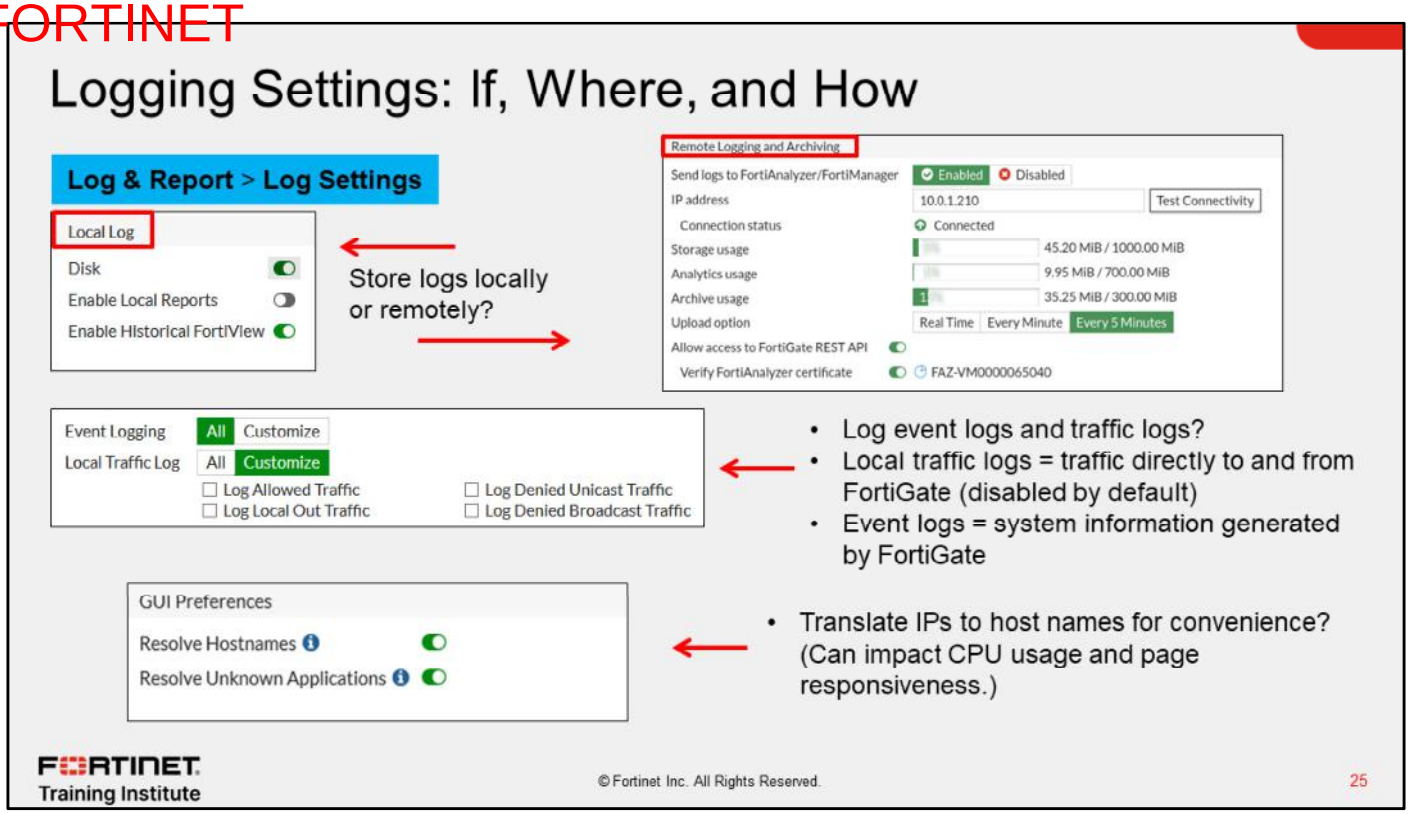
Good job! You now understand remote logging.

Now, you will learn about log settings.



After completing this section, you should be able to achieve the objectives shown on this slide.

By demonstrating competence in log settings, you will be able to successfully enable logging on your FortiGate, and ensure logs are generated on traffic caused by traffic passing through your firewall policies.



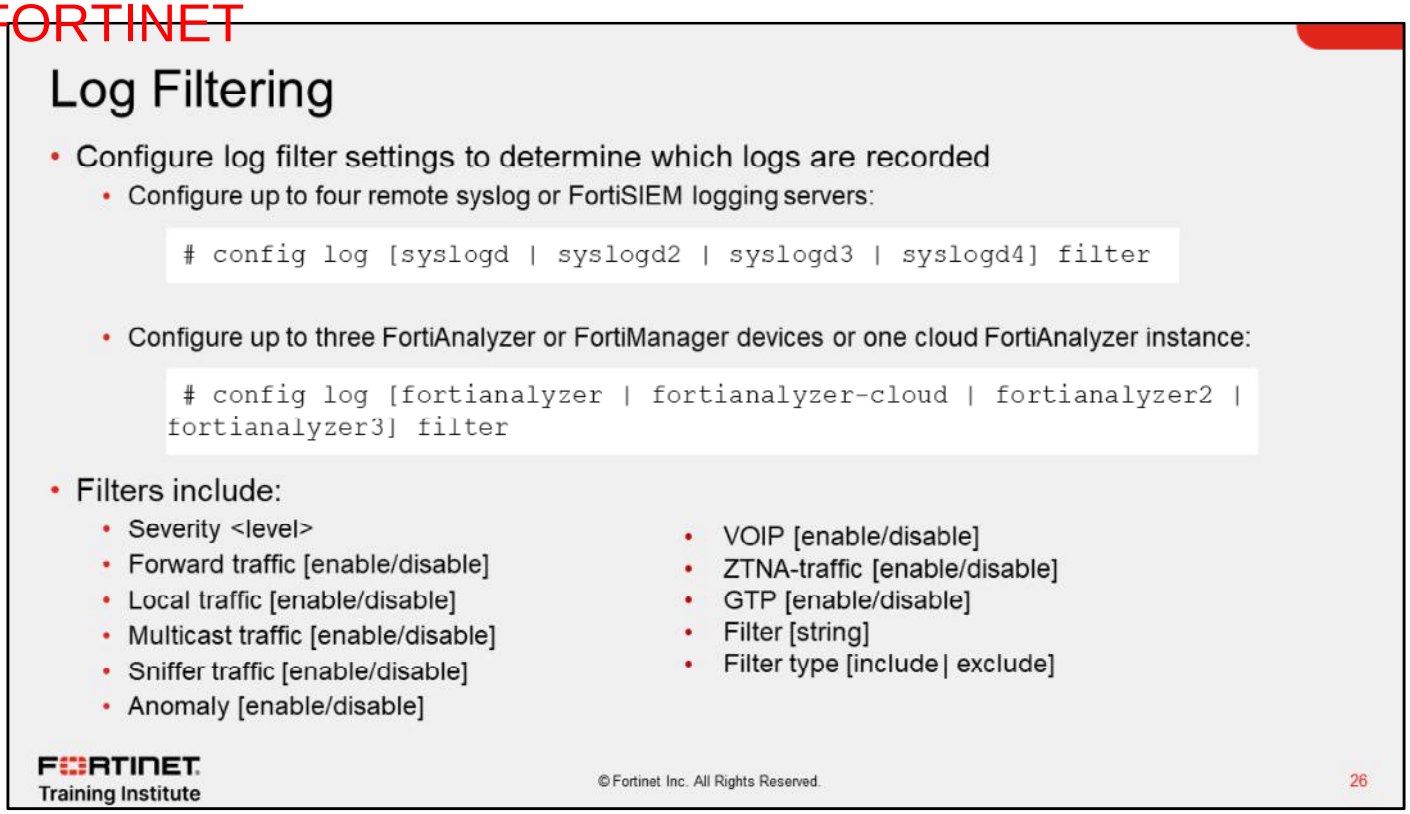
The **Log Settings** page allows you to decide if, where, and how a log is stored.

As previously discussed, you must configure whether to store logs locally on your FortiGate disk, or remotely to an external device, such as FortiAnalyzer.

You must also configure what event logs and local traffic logs to capture. By default, this option is disabled because of the large number of logs they can generate.

Event logs provide all of the system information generated by FortiGate, such as administrator logins, configuration changes made by administrators, user activity, and daily operations of the device—they are not directly caused by traffic passing through firewall policies. The event logs you choose to enable depend on what features you are implementing and what information you need to get from the logs.

The **Resolve Hostnames** feature resolves IP addresses to host names. This requires FortiGate to perform reverse DNS lookups for all IP addresses. If your DNS server is not available, or is slow to reply, it can impact your ability to look through the logs, because the requests will time out.



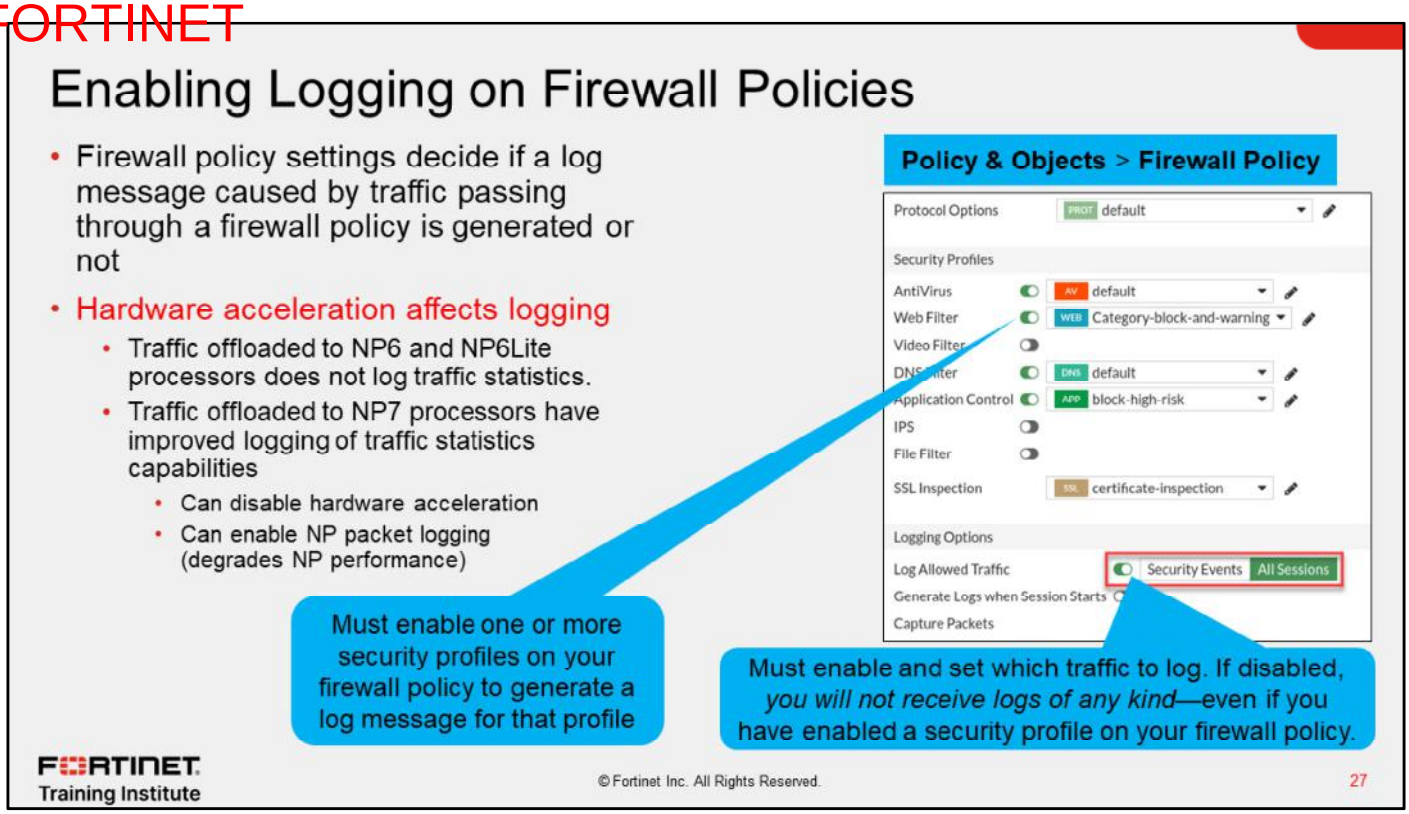
While you use the log settings on the GUI to configure which event logs and local traffic logs to capture, you can set more granular options using the CLI.

You can configure FortiGate to send logs to external servers. You can control which logs are sent to each of these devices separately, using the command `config log syslogd filter` for remote syslog or FortiSIEM, and the command `config log fortianalyzer filter` for FortiAnalyzer or FortiManager devices.

In this way, you can set devices to different logging levels and/or send only certain types of logs to one device and other types (or all logs) to others. For example, you can send all logs at information level and above to `fortianalyzer`, alert level and above to `fortianalyzer2`, and only traffic logs to `fortianalyzer3`.

For example, the following commands configure the log filter for the first syslog server to include only logs related to traffic directly to and from the FortiGate management IP addresses, with a severity level of *critical* or higher*:*

```
#config log syslogd filter
#(filter) set severity critical
#(filter) set local-traffic enable
```

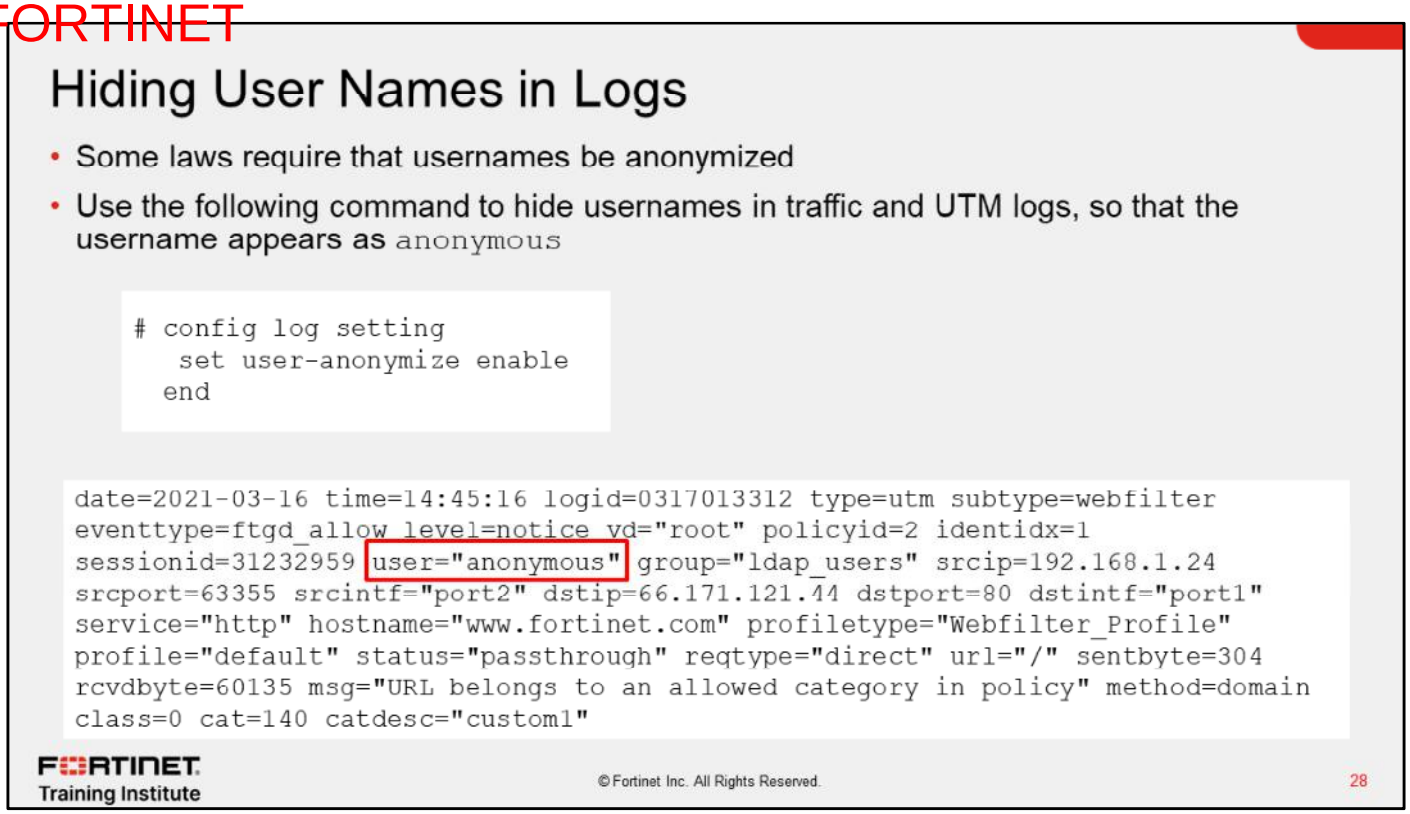


After you configure all logging settings, you can enable logging on your firewall policies. Only when enabled on a firewall policy can a log message—caused by traffic passing through that firewall policy—generate.

Generally, if you configure 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, you'll want to know if FortiGate is blocking attacks. Most attacks don't result 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 traffic passing through a firewall policy, you must do the following:

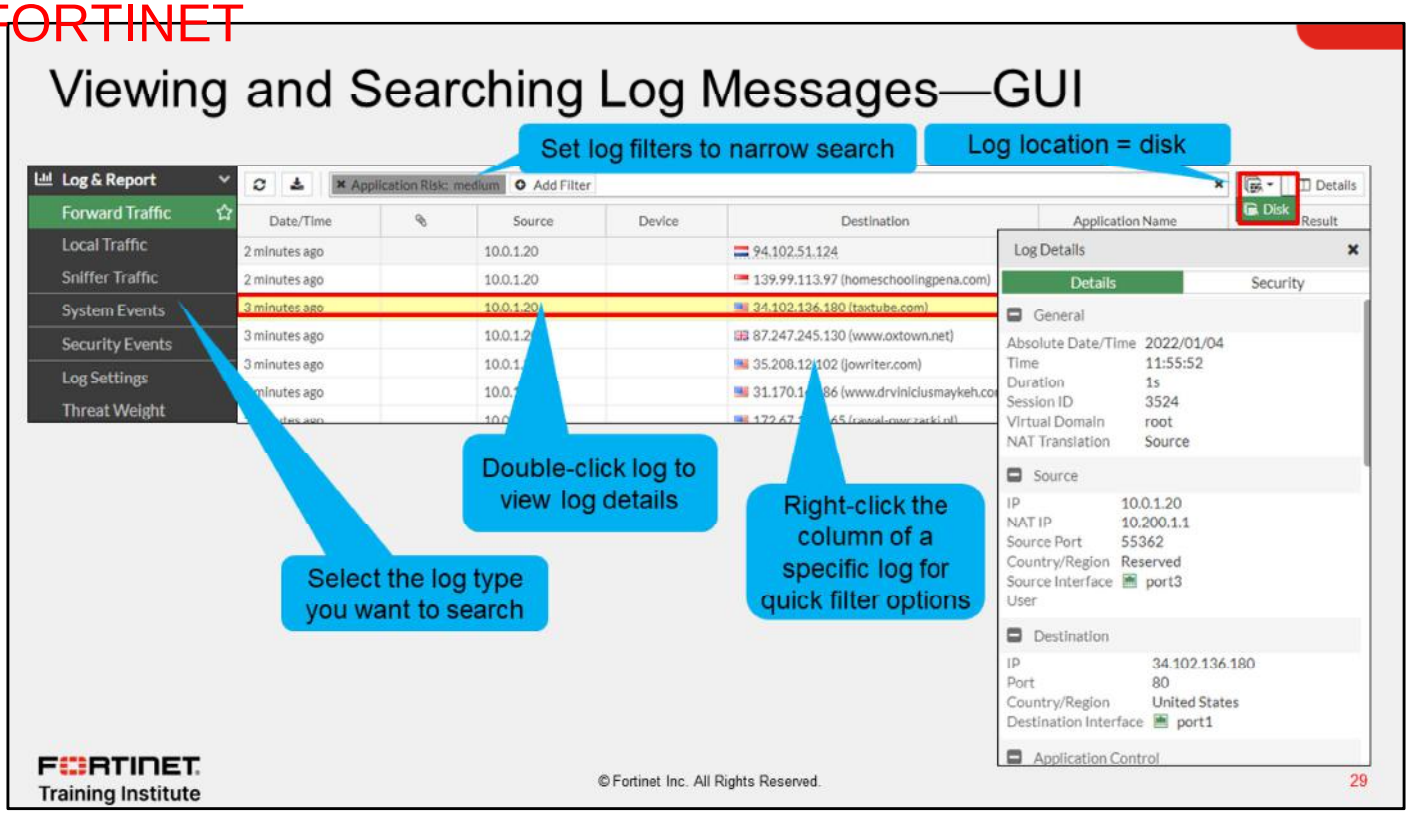
1. Enable the desired security profile(s) on your firewall policy.
2. Enable **Log Allowed Traffic** on that firewall policy. This setting is vital. If disabled, you will not receive logs of any kind—even if you have enabled a security profile on your firewall policy. You can choose to log only security events, or log all sessions:
    - **Security Events**: If enabled (along with one or more security profiles), security log events appear in the forward traffic log and security log. A forward traffic log generates for packets causing a security event.
    - **All Sessions**: If enabled, a forward traffic log generates for every single session. If one or more security profiles are also enabled, security log events appear in the forward traffic log and security log.



On FortiGate, you can hide usernames in traffic logs and UTM logs, so that the username appears as `anonymous`. This is useful, because some countries do not permit non-anonymized logging.

To anonymize usernames, use the `set user-anonymize enable` CLI command.

It is assumed that logging is enabled in firewall policies and security profiles, and that identity-based policies are configured on FortiGate.



You can access your logs on the GUI in the **Log & Report** menu.

Select the type of log you want to view, such as **Forward Traffic**. Logs on the GUI appear in a formatted table view. The formatted view is easier to read than the raw view, and it enables you to filter information when viewing log messages. To view the log details, select the log in the table. The log details then appear in the **Log Details** pane on the right side of the window.

If archiving is enabled on security profiles that support it (such as DLP), archived information appears in the **Log Details** pane in the **Archived Data** section. Archived logs are also recorded when using FortiAnalyzer or FortiCloud.

If you configure FortiGate to log to multiple locations, you can change the log display location in this section. In the example shown on this slide, the log location is set to **Disk**. If logging to a syslog, you must view logs on the syslog instead.

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 on the display. Click **Add Filter** to select the filter in the drop-down list that appears. If you see data that you want to filter on in a log that is already in the table, you can right-click that data to select the quick filter option. For example, if you see an antivirus log in the table with a specific botnet name, right-click the botnet name in the table, and a quick filter option opens, allowing you to filter on all logs with that botnet name.

By default, the most common columns are shown and less common columns are hidden. To add columns, right-click any column field and, in the pop-up menu that opens, select the column in the **Available Columns** section.