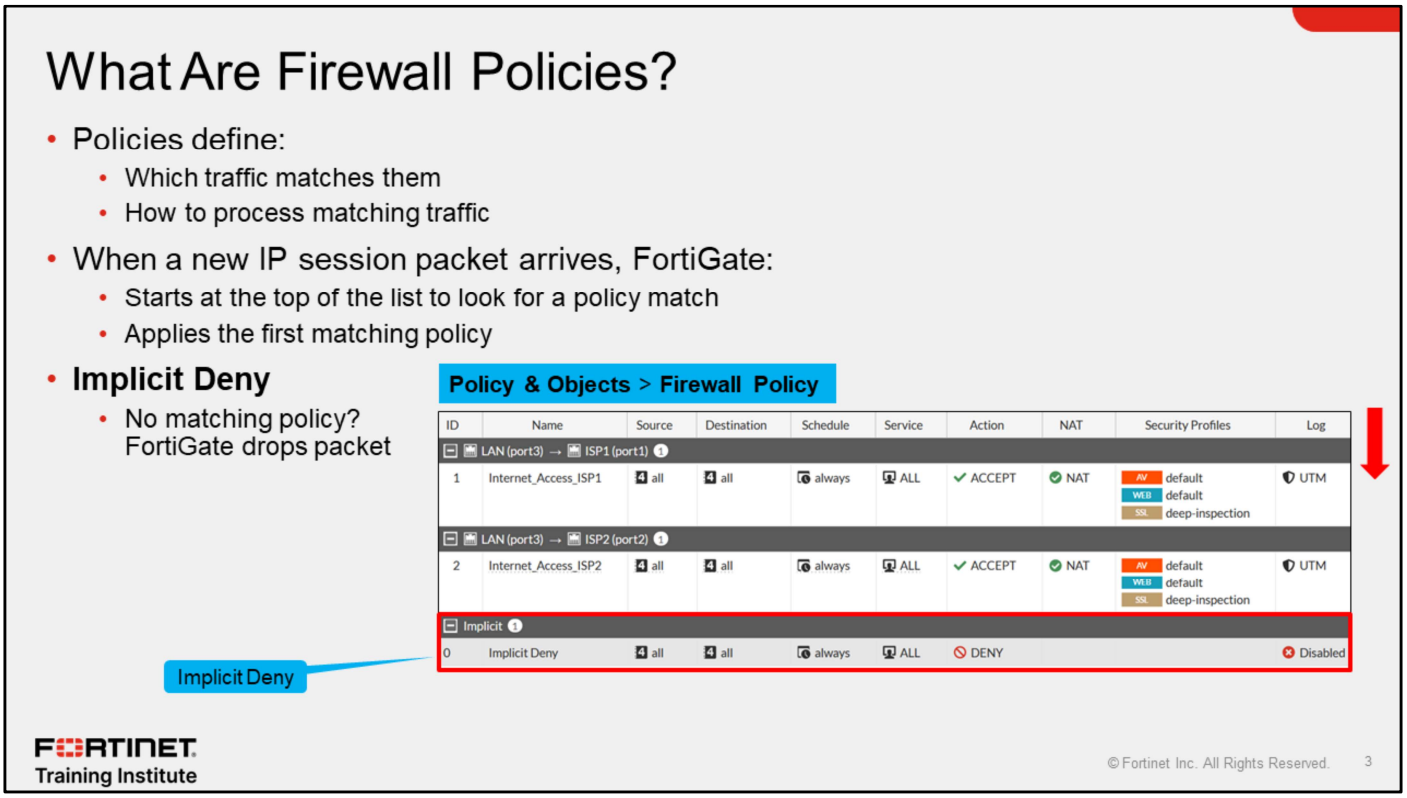
In this lesson, you will learn about firewall policies and how to apply them to allow and deny traffic passing through FortiGate. At its core, FortiGate is a firewall, so almost everything that it does to your traffic is linked to your firewall policies.

In this lesson, you will learn how to configure network address translation (NAT) and use it to implement source NAT (SNAT) and destination NAT (DNAT) for the traffic passing through FortiGate.

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

By demonstrating competence in identifying the different components of firewall policies, and recognizing how FortiGate matches traffic with firewall policies and takes appropriate action, you will have a better understanding of how firewall policies interact with network traffic.



To begin, you will learn what firewall policies are.

Any traffic passing through a FortiGate must be associated with a firewall policy. A policy is a set of instructions that controls traffic flow through the FortiGate. These instructions determine where the traffic goes, how it's handled, and whether it's allowed to pass through the FortiGate. In summary, firewall policies are sets of rules that specify which traffic is allowed through the FortiGate and what FortiGate should do when traffic matches a policy.

Should the traffic be allowed? FortiGate bases this decision on simple criteria. FortiGate analyzes the source of the traffic, the destination IP address, and the service. If the policy does not block the traffic, FortiGate begins a more computationally expensive security profile inspection—often known as Unified Threat Management (UTM)—such as antivirus, application control, and web filtering, if you've chosen it in the policy. These inspections block the traffic if there is a security risk, for example, if the traffic contains a virus. Otherwise, the traffic is allowed.

Will network address translation (NAT) be applied? Is authentication required? Firewall policies also determine the answers to these questions. After processing is finished, FortiGate forwards the packet toward its destination.

FortiGate looks for the matching firewall policy from *top to bottom* and, if a match is found, the traffic is processed based on the firewall policy. If no match is found, the traffic is dropped by the default **Implicit Deny** firewall policy.

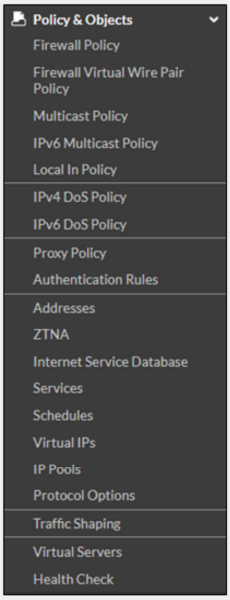
Components and Policy Types

Objects used by policies

- Interface and zone
- Address, user, and internet service objects
- Service definitions
- Schedules
- NAT rules
- Security profiles

Policy types

- Firewall Policy (IPv4, IPv6)
- Firewall Virtual Wire Pair Policy (IPv4, IPv6)
- Proxy Policy
- Multicast Policy (IPv4, IPv6)
- Local-in Policy
- DoS Policy (IPv4, IPv6)
- Traffic Shaping



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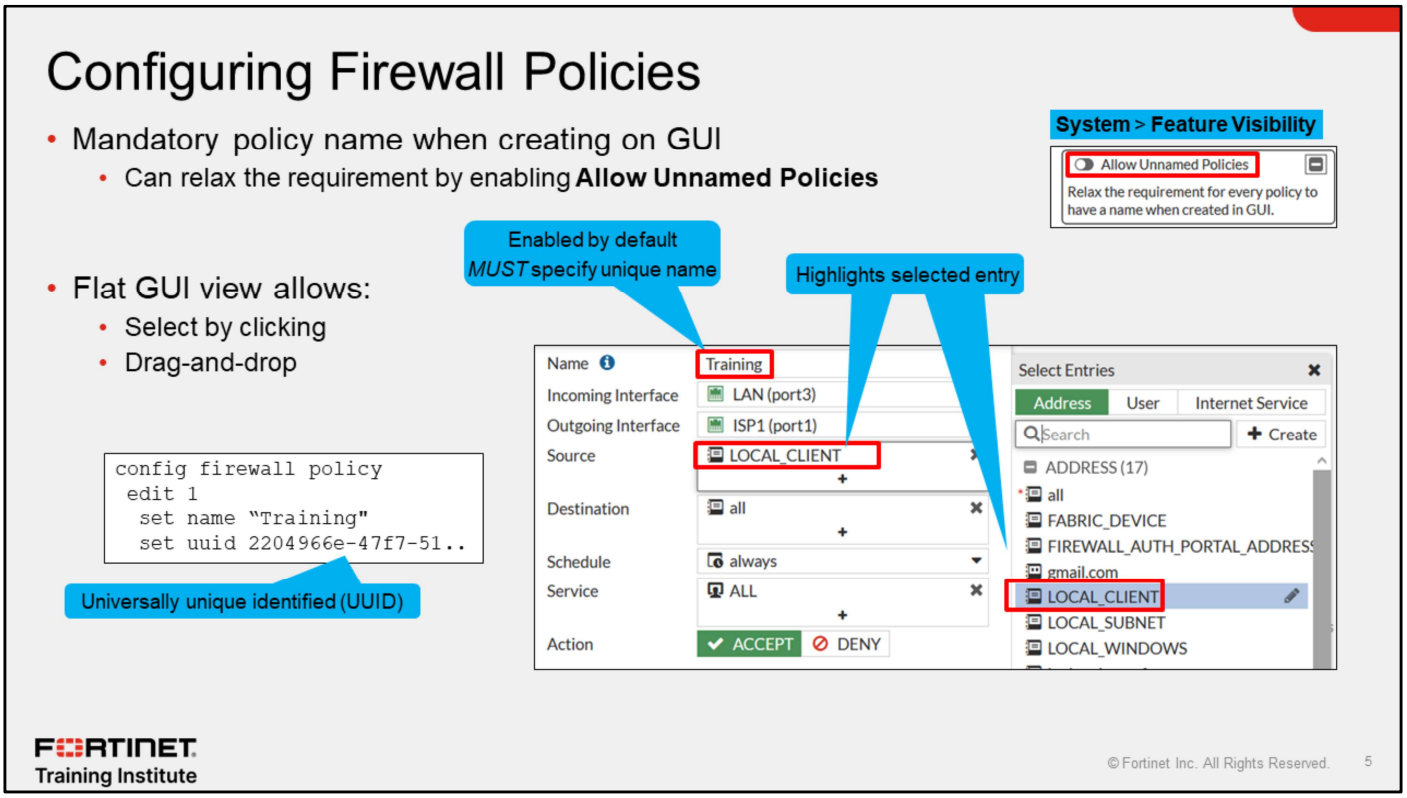
Each policy matches traffic and applies security by referring to the objects that you've defined, such as addresses and profiles.

Common policy types are:

- Firewall Policy: A firewall policy consists of set of rules that control traffic flow through FortiGate.
- Firewall Virtual Wire Pair Policy: A virtual wire pair policy is used to control the traffic between the interfaces in a virtual wire pair.
- Multicast Policy: A multicast policy allows multicast packets to pass from one interface to another.
- Local-In-Policy: A local-in policy controls the traffic to a FortiGate interface and can be used to restrict administrative access.
- DoS Policy: A denial-of-service (DoS) policy checks for the anomalous patterns in the network traffic that arrives at a FortiGate interface.

By default, only **Firewall Policy** is visible under **Policy and Object**. Other policies are available based on the interface configurations and advanced features enabled through **Feature Visibility**.
In this lesson, you will learn about IPv4 firewall policies, because they are the most commonly used policies.



When you configure a new firewall policy on the GUI, you *must* specify a unique name for the firewall policy because it is enabled by default, while it is optional on the CLI. This helps the administrator to quickly identify the policy that they are looking for. However, you can make this feature optional on the GUI on the **Feature Visibility** page by enabling **Allow Unnamed Policies**.

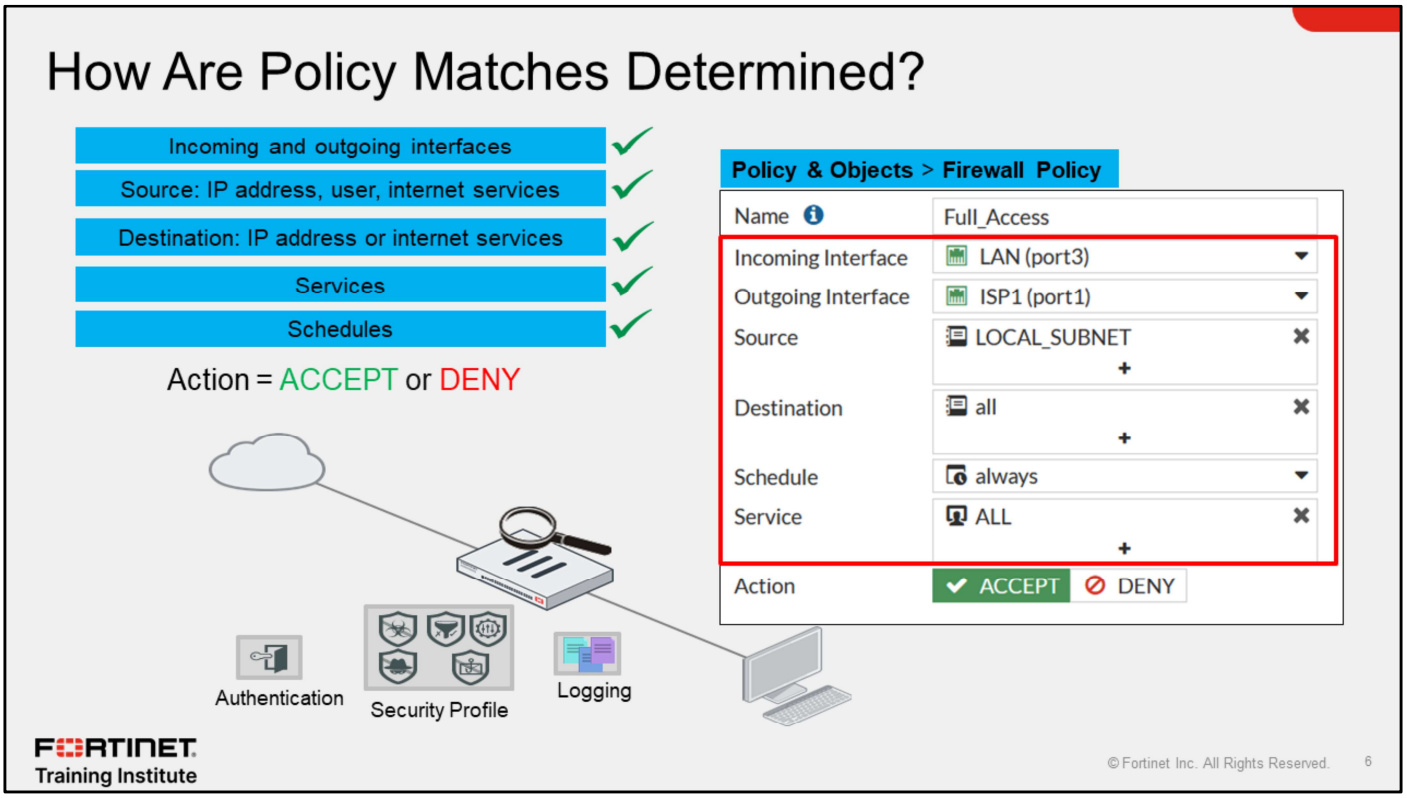
Note that if a policy is configured without a policy name on the CLI, and you modify that existing policy on the GUI, you *must* specify a unique name. The FortiGate flat GUI view allows you to select interfaces and other objects by clicking or dragging and dropping from the list populated on the right side.

You can select **Internet Service** as the source. **Internet Service** is a combination of one or more addresses and one or more services associated with a service found on the internet, such as an update service for software.

You can configure many other options that you can configure in the firewall policy, such as firewall and network options, security profiles, logging options, and enabling or disabling a policy.

When creating firewall objects or policies, a universally unique identifier (UUID) attribute is added so that logs can record these UUIDs and improve functionality when integrating with FortiManager or FortiAnalyzer.

When creating firewall policies, remember that FortiGate is a stateful firewall. As a result, you need to create only one firewall policy that matches the direction of the traffic that initiates the session. FortiGate will automatically remember the source-destination pair and allow replies.



When a packet arrives, how does FortiGate find a matching policy? Each policy has match criteria, which you can define using the following objects:

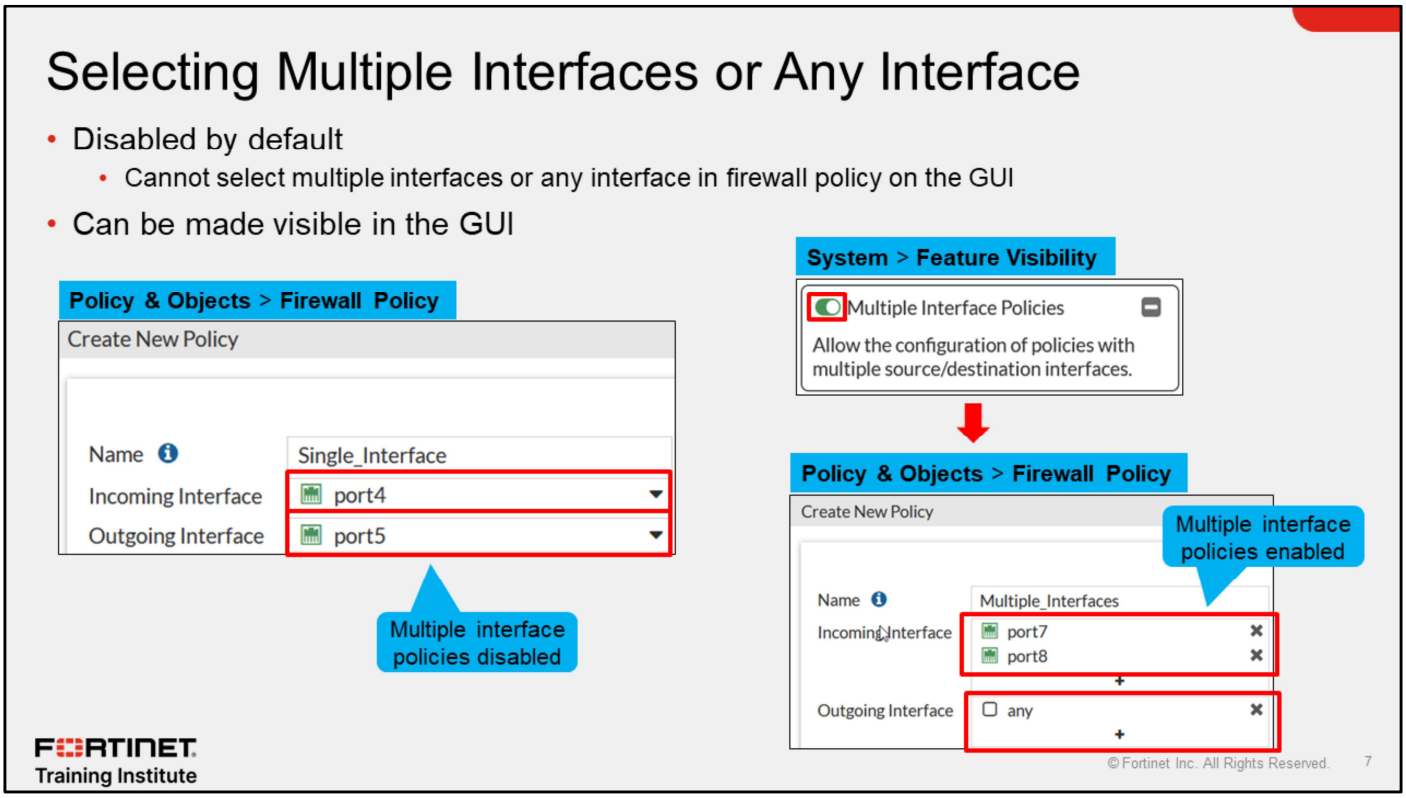
- **Incoming Interface**
- **Outgoing Interface**
- **Source**: IP address, user, internet services
- **Destination**: IP address or internet services
- **Schedule**: Specific times to apply policy
- **Service**: IP protocol and port number

If the traffic matches a firewall policy, FortiGate applies the action configured in the firewall policy:

- If the **Action** is set to **DENY**, FortiGate drops the session.
- If the **Action** is set to **ACCEPT**, FortiGate allows the session and applies other configured settings for packet processing, such as user authentication, source NAT, antivirus scanning, web filtering, and so on.

When FortiGate receives traffic, it evaluates the packet's source IP address, destination IP address, and the requested service (protocol and port number). It also checks the incoming interface and the outgoing interface it needs to use. Based on this information, FortiGate identifies the firewall policy and evaluates the traffic. If the traffic matches the policy, then FortiGate applies the action (Accept/Deny) defined in the policy.

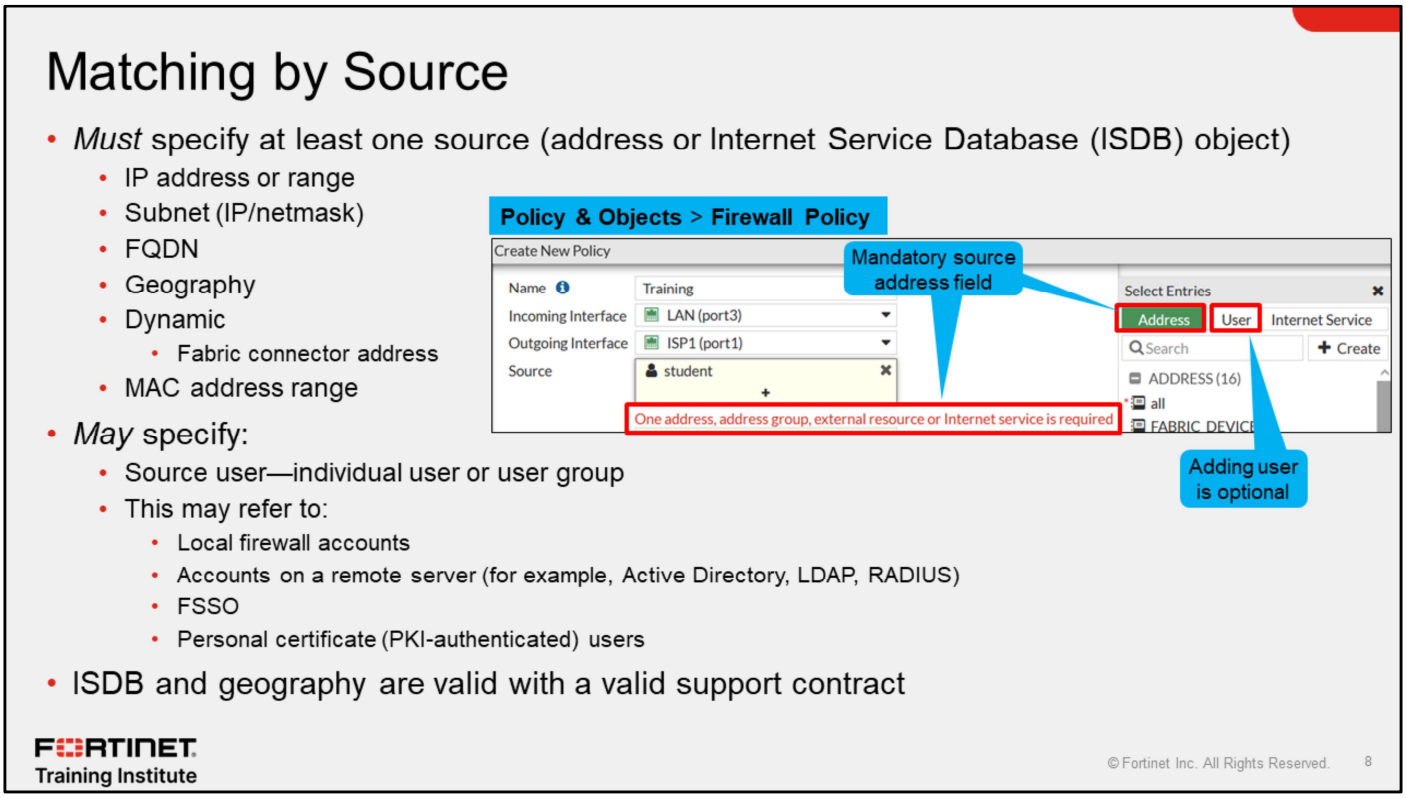
For example, to block incoming FTP traffic to all but a few FTP servers, define the addresses of the FTP servers as the destination, and select FTP as the service. You probably *wouldn't* specify a source (often any location on the internet is allowed) or schedule (FTP servers are usually always available, day or night). Finally, set the **Action** setting to **ACCEPT**.



By default, you can select only a single interface as the incoming interface and a single interface as the outgoing interface. This is because the option to select multiple interfaces, or **any** interface in a firewall policy, is disabled on the GUI. However, you can enable the **Multiple Interface Policies** option on the **Feature Visibility** page to disable the single interface restriction.

You can also specify multiple interfaces, or use the `any` option, if you configure a firewall policy on the CLI, regardless of the default GUI setting.

It is also worth mentioning that when you choose the **any** interface option, you cannot select multiple interfaces for that interface. In the example shown on this slide, because **any** is selected as the outgoing interface, you cannot add any additional interfaces, because **any** interface implies that all interfaces have already been selected.

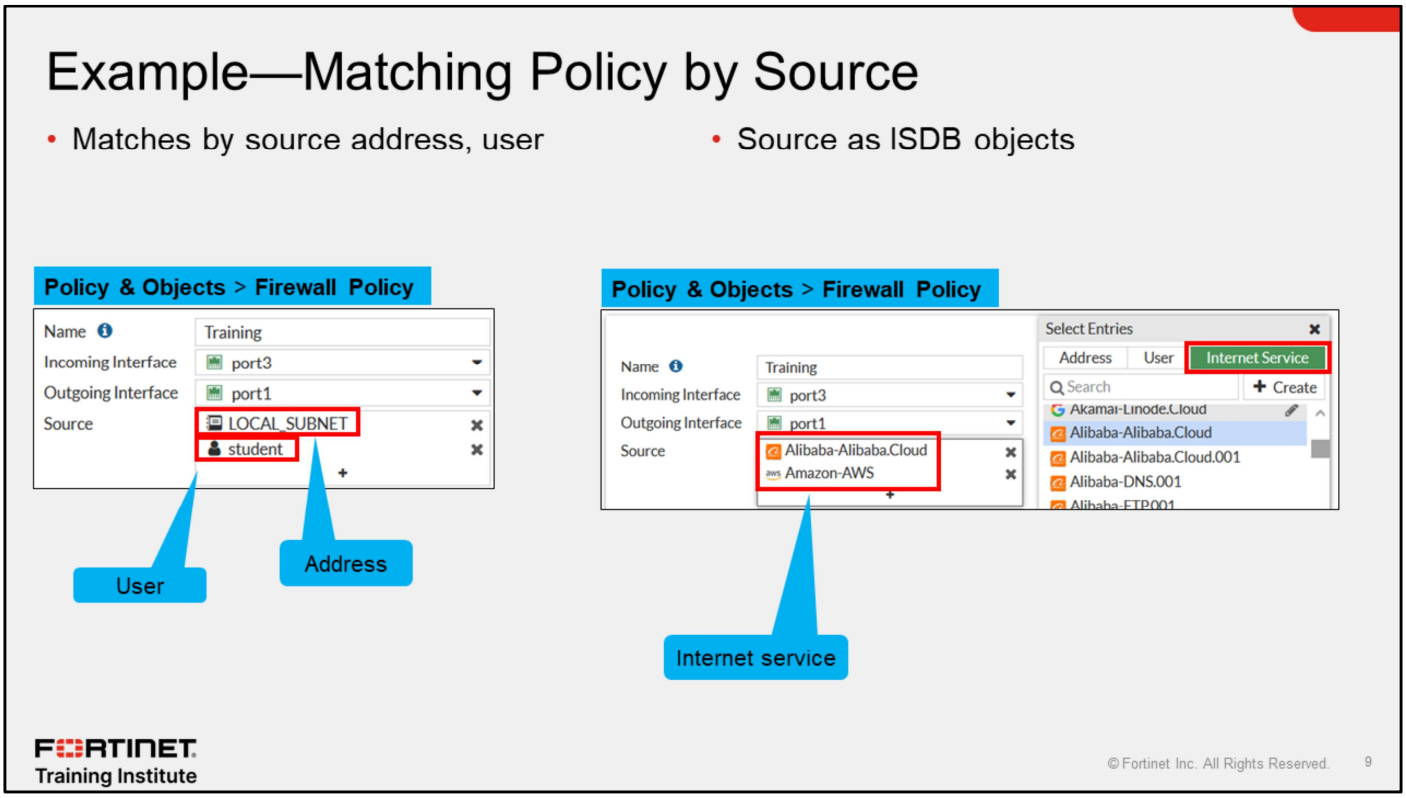


The next match criteria that FortiGate considers is the packet's source.

In each firewall policy, you *must* select a source address object. Optionally, you can refine your definition of the source address by *also* selecting a user, or a user group, which provides a much more granular match, for increased security. You can also select ISDB objects as the source in the firewall policy, which you will learn about later in this lesson.

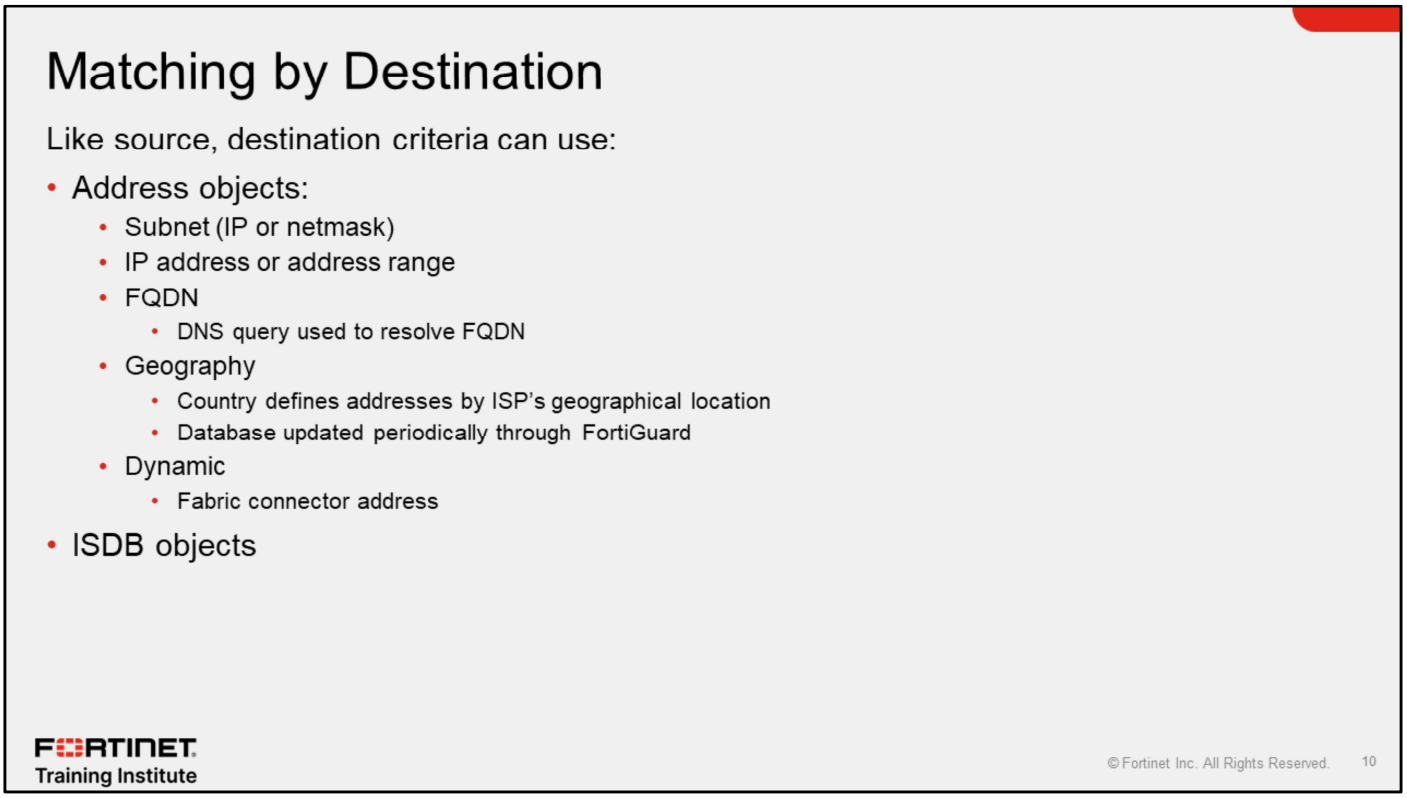
When selecting a fully qualified domain name (FQDN) as the source address, it must be resolved by DNS and cached in FortiGate. Make sure FortiGate is configured properly for DNS settings. If FortiGate is not able to resolve an FQDN address, it will present a warning message, and a firewall policy configured with that FQDN may not function properly.

FortiGate devices with valid FortiCare support contract receive up-to-date information to use the ISDB and geography database and use them as firewall objects.



In the example shown on this slide, source selectors identify the specific subnet and user group. Remember, user is an optional object. The user object is used here to make the policy more specific. If you wanted the policy to match more traffic, you would leave the user object undefined.

You can also use ISDB objects as a source in the firewall policy. There is an either/or relationship between ISDB objects and source address objects in firewall policies. This means that you can select either a source address or an internet service, but not both.

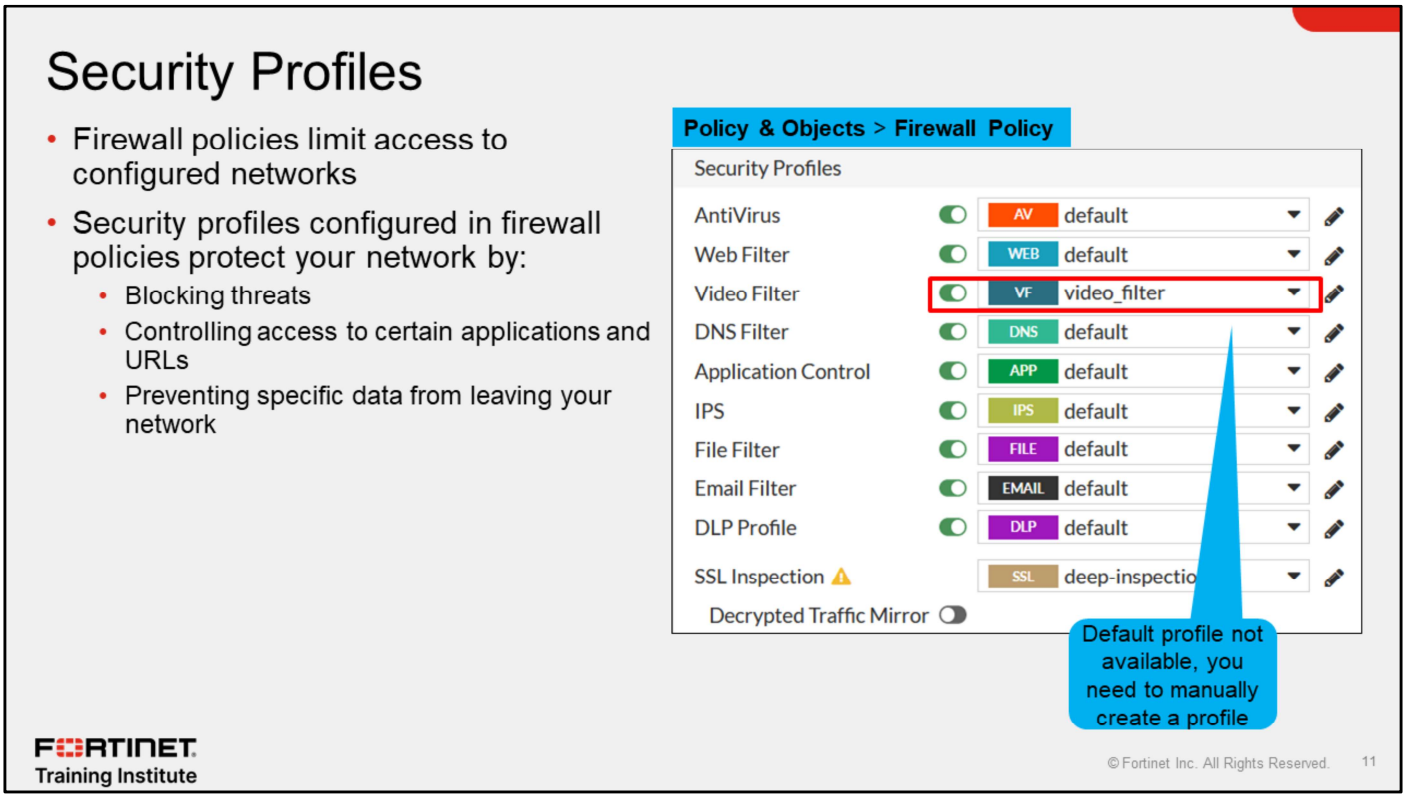


Like the packet's source, FortiGate also checks the destination address for a match.

You can use address objects or ISDB objects as destinations in the firewall policy. The address object may be a host name, IP subnet, or range. If you enter an FQDN as the address object, make sure that you've configured your FortiGate device with DNS servers. FortiGate uses DNS to resolve those FQDN host names to IP addresses, that appear in the IP header.

You can also choose geographic addresses, which are groups or ranges of addresses that are assigned to a country. FortiGuard is used to update these objects.

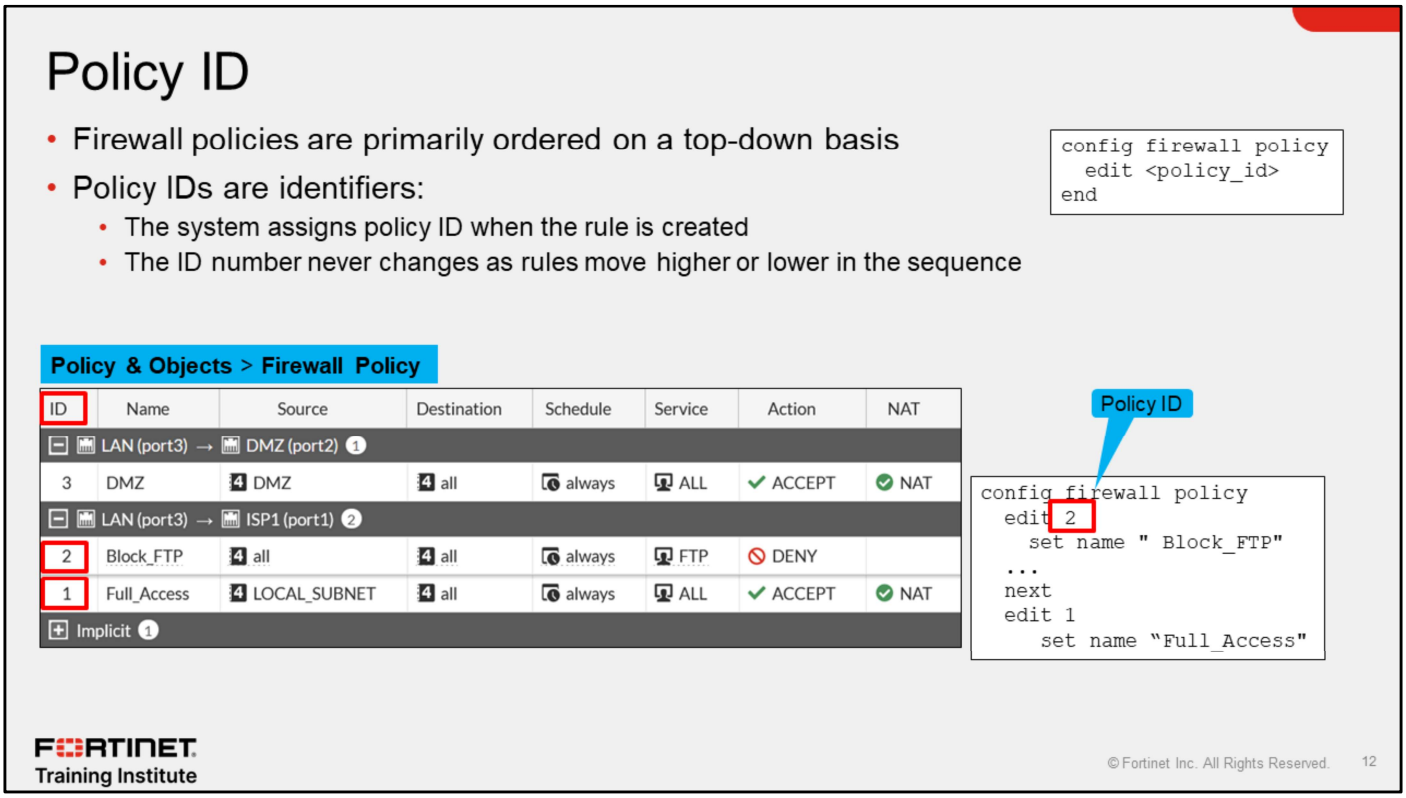
Why is there is no option to select a user? The user identification is determined at the ingress interface, and packets are forwarded only to the egress interface after the user is successfully authenticated.



One of the most important features that a firewall policy can apply is security profiles, such as IPS and antivirus. A security profile inspects each packet in the traffic flow, where the session has already been conditionally accepted by the firewall policy.

When inspecting traffic, FortiGate can use one of two methods: flow-based inspection or proxy-based inspection. Different security features are supported by each inspection type.

Note that by default, the **Video Filter**, **VOIP**, **and Web Application Firewall** security profile options are not visible on the policy page on the GUI. You need to enable them on the **Feature Visibility** page.



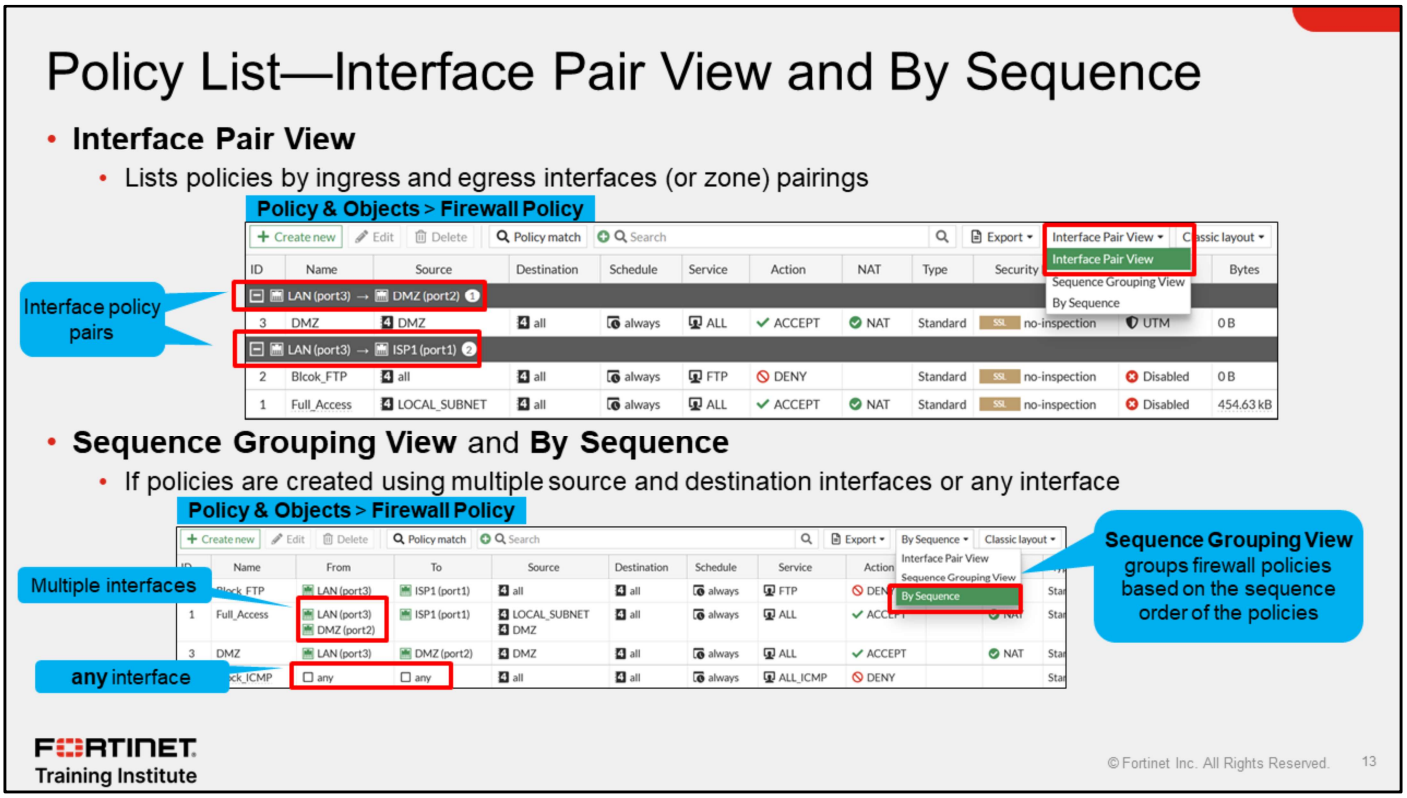
An important concept to understand about how firewall policies work is the precedence of order, or, if you prefer a more recognizable term, first come, first served.

Policy IDs are identifiers. You can add or remove the policy **ID** column using the **Configure Table** settings icon.

FortiGate automatically assigns a policy ID when you create a new firewall policy on the GUI. The policy ID never changes, even if you move the rule higher or lower in the sequence.

If you enable **Policy Advanced Options,** then you can manually assign a policy ID, while creating a new policy. If a duplicate entry is found, the system produces an error, so you can assign a different available policy ID number.

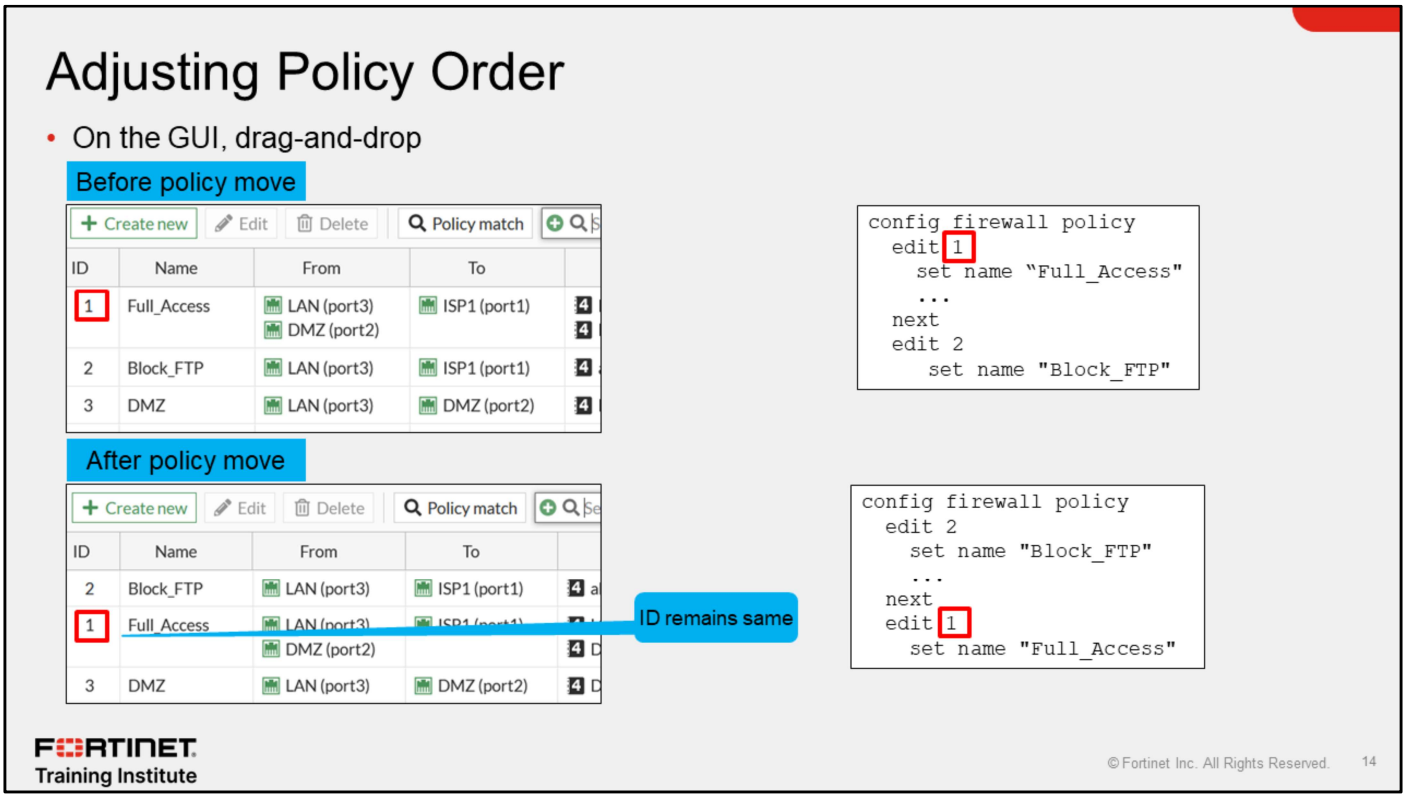
Policy Advanced Options is not available on the GUI by default, you must enable it on the **Feature Visibility** page.



Firewall policies appear in an organized list. The list is organized as one of **Interface Pair View**, **Sequence Grouping View**, or **By Sequence**.

By default, the policy list appears in **Interface Pair View**. Each section contains policies in the order that they are evaluated for matching traffic and are arranged by ingress-egress interface pair. Alternatively, you can view your policies as a single, comprehensive list by selecting **Sequence Grouping View** or **By Sequence** at the top of the page. In these two views, the policies are also listed in the order in which they are evaluated for traffic matching—they are grouped as uncategorized in **Sequence Grouping View** layout. You can create new labels to group firewall policies as necessary to organize the firewall policies with the sequence order in mind.

To help you remember the use of each interface, you add aliases by editing the interface on the **Network** page. For example, you could call port1 *ISP1*. This can help to make your list of policies easier to understand.

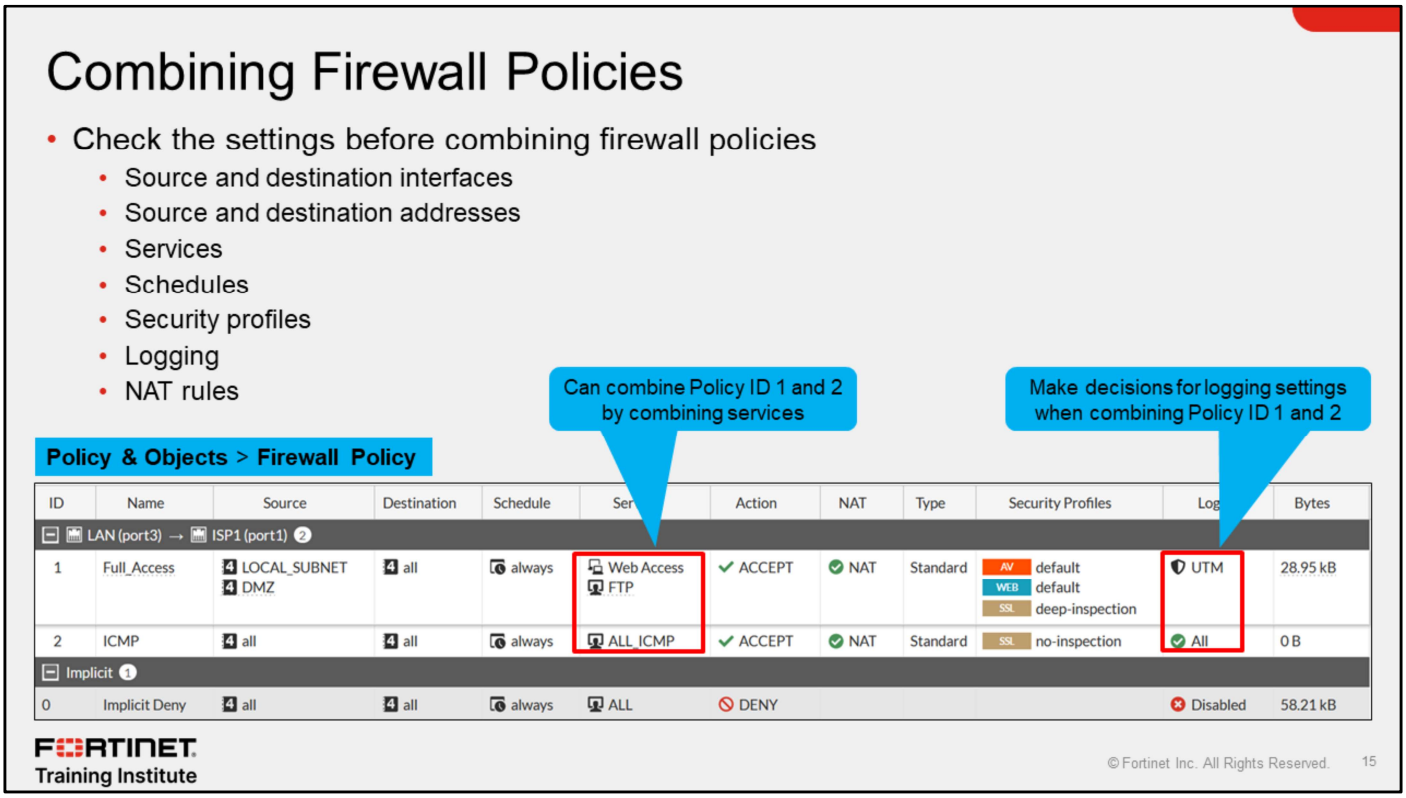


Remember you learned that only the first matching policy applies? Arranging your policies in the *correct position* is important. It affects which traffic is blocked or allowed. In the section of the applicable interface pair, FortiGate looks for a matching policy, beginning at the top. So, you should put more specific policies at the top; otherwise, more general policies will match the traffic first, and more granular policies will never be applied.

In the example shown on this slide, you're moving the **Block_FTP** policy (ID 2) that matches only FTP traffic, to a position above a more general **Full_Access** (accept everything from everywhere*)* policy. Otherwise, FortiGate would always apply the first matching policy in the applicable interface pairs—**Full_Access—**and never reach the **Block_FTP** policy.

When moving the policies across the policy list, policy IDs remain unchanged.

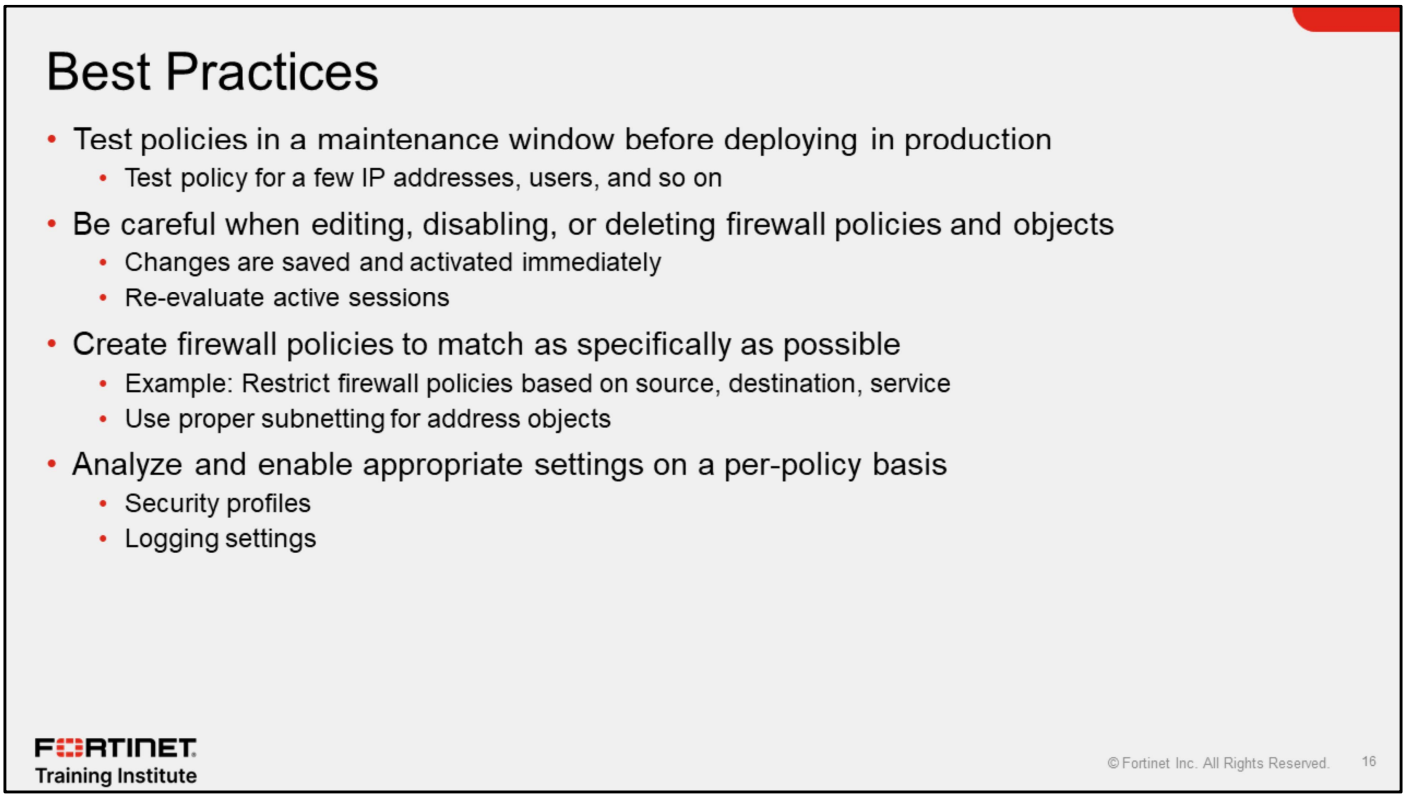
Note that FortiGate assigns the next highest available ID number as policies are created.



In order to optimize and consolidate firewall policies, always check all configured settings. In the example shown on this slide, the two firewall policies have differences in terms of services, security profiles, and logging settings. You can consolidate these two firewall policies by combining services and choosing appropriate logging settings.

If you select **Security Events** (UTM) for the logging settings, traffic logs will not be generated for **ALL_ICMP** traffic.

Note that the **ALL_ICMP** service is not subject to web filter and antivirus scans, which means that applying these security profiles to the ICMP traffic will result in the traffic passing through without being inspected.



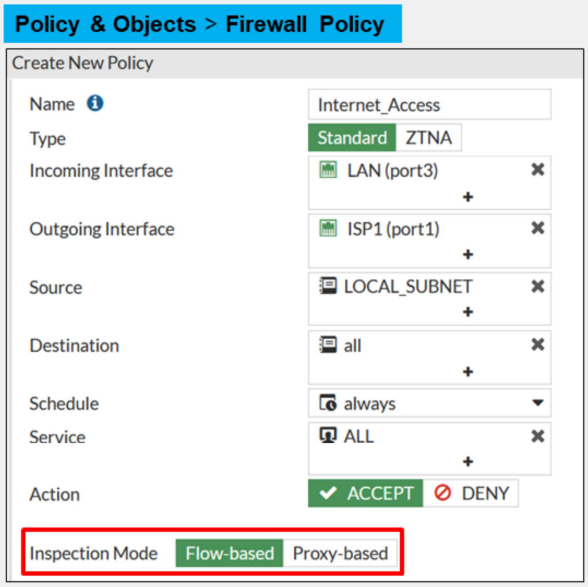
Always plan a maintenance window and create a test case for a few IP addresses and users, before implementing configuration changes in the production network. Any configuration changes made using the GUI or CLI take effect immediately, and can interrupt service.

As a best practice, try to configure firewall policies as specifically as possible. This helps to restrict access to only those resources. For example, use correct subnets when configuring address objects.

Another setting worth mentioning is security profiles. Security profiles help to provide appropriate security for your network. Proper logging configuration can also help you to analyze, diagnose, and resolve common network issues.

Inspection Modes on Firewall Policies

- Enabling profiles has an impact on firewall throughput
- FortiGate kernel inspect sessions to enforce filtering (for example, web filter)
- Selecting the FortiGate inspection modes on firewall policies:
  - Flow-based
    - Default mode
    - Optimize performance
  - Proxy-based
    - Processed by CPU
    - Provides thorough inspection
    - Support advanced features like *safe search*



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Enabling the security profiles on the FortiGate impacts on firewall resources and throughput. Packets are sent to the kernel or main CPU to enforce filtering. FortiOS supports flow-based and proxy-based inspection in firewall policies and security profiles.

Depending on your requirements, you can select inspection mode, but it is useful to know some differences and how it can impact the firewall performance. Flow-based inspection identifies and blocks threats in real time as FortiOS identifies them typically requires lower processing resources than proxy-based inspection. It is recommended to apply flow-based inspection to policies that prioritize traffic throughput

Proxy-based inspection involves buffering traffic and examining it as a whole before determining an action. Having all the data to analyze allows for the examination of more data points than flow-based inspection. Some advanced features like usage quota, safe search, and web-profile override are also supported in proxy-based inspection.

Inspection Modes—Proxy-based Visibility

- Proxy-based inspection mode is available on most FortiGate devices
- Some security profiles are available only in proxy-based inspection mode, such as:
  - Video Filter
  - Inline CASB
  - ICAP
  - Web Application Firewall
  - Data Leak Prevention (available on CLI)
- Low-end platforms with 2 GB of RAM or less do not display the option on the GUI
  - Firewall inspection mode setting is not available on GUI—only on CLI
  - GUI option is available on low-end platforms when enabled on CLI:

```
config system settings
    set gui-proxy-inspection enable
end
```

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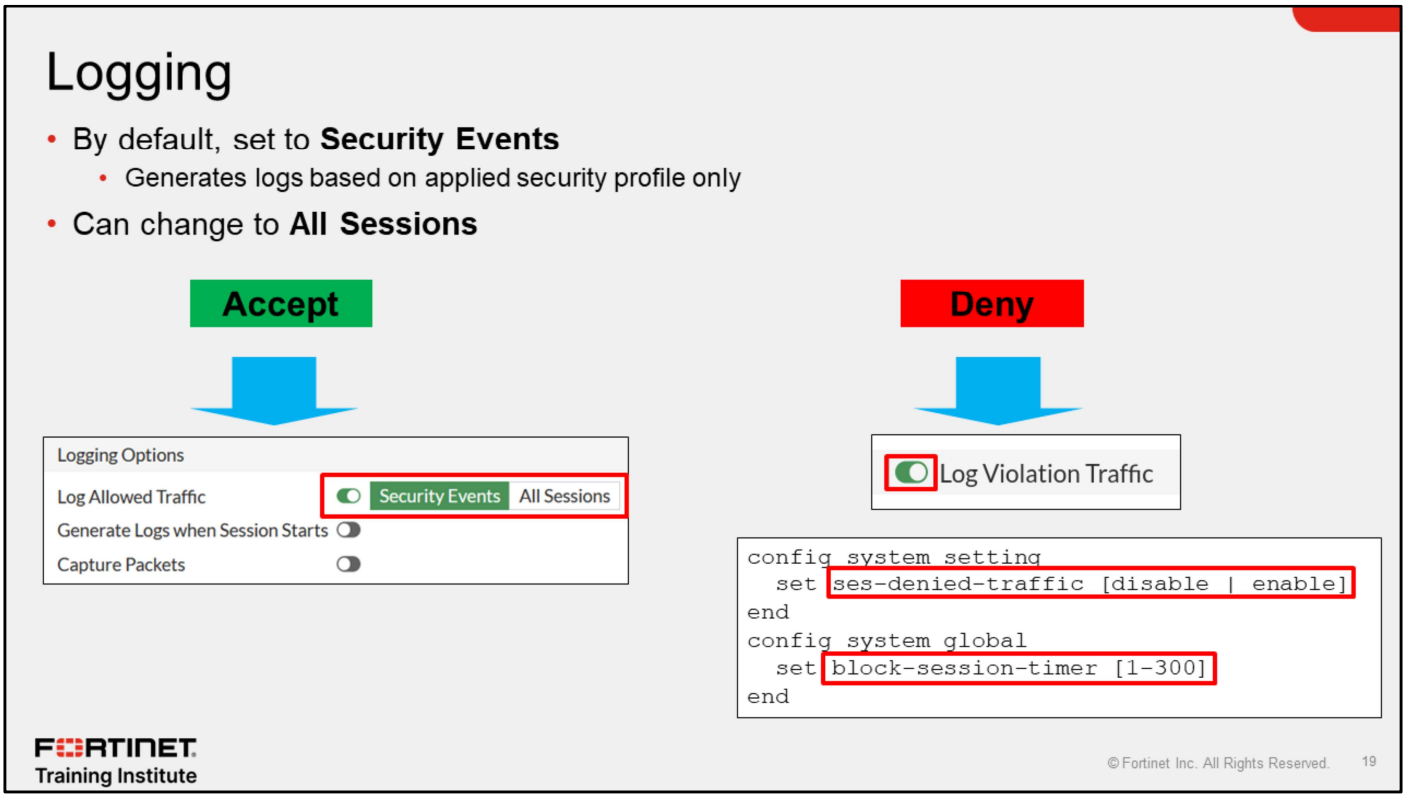
By default, low-end FortiGate platforms with RAM of 2 GB or less do not show proxy-based settings on the GUI for firewall policies and security profiles. This is to reduce memory usage on these platforms as the RAM is designed to serve the purpose of the low-end FortiGate and also to maximize security using flow-based security inspection across FortiGate.

The option to configure proxy-based inspection mode on firewall policies and security profiles is available using the CLI command `config system settings`.



If you have enabled logging in the policy, FortiGate generates traffic logs after a firewall policy closes an IP session.

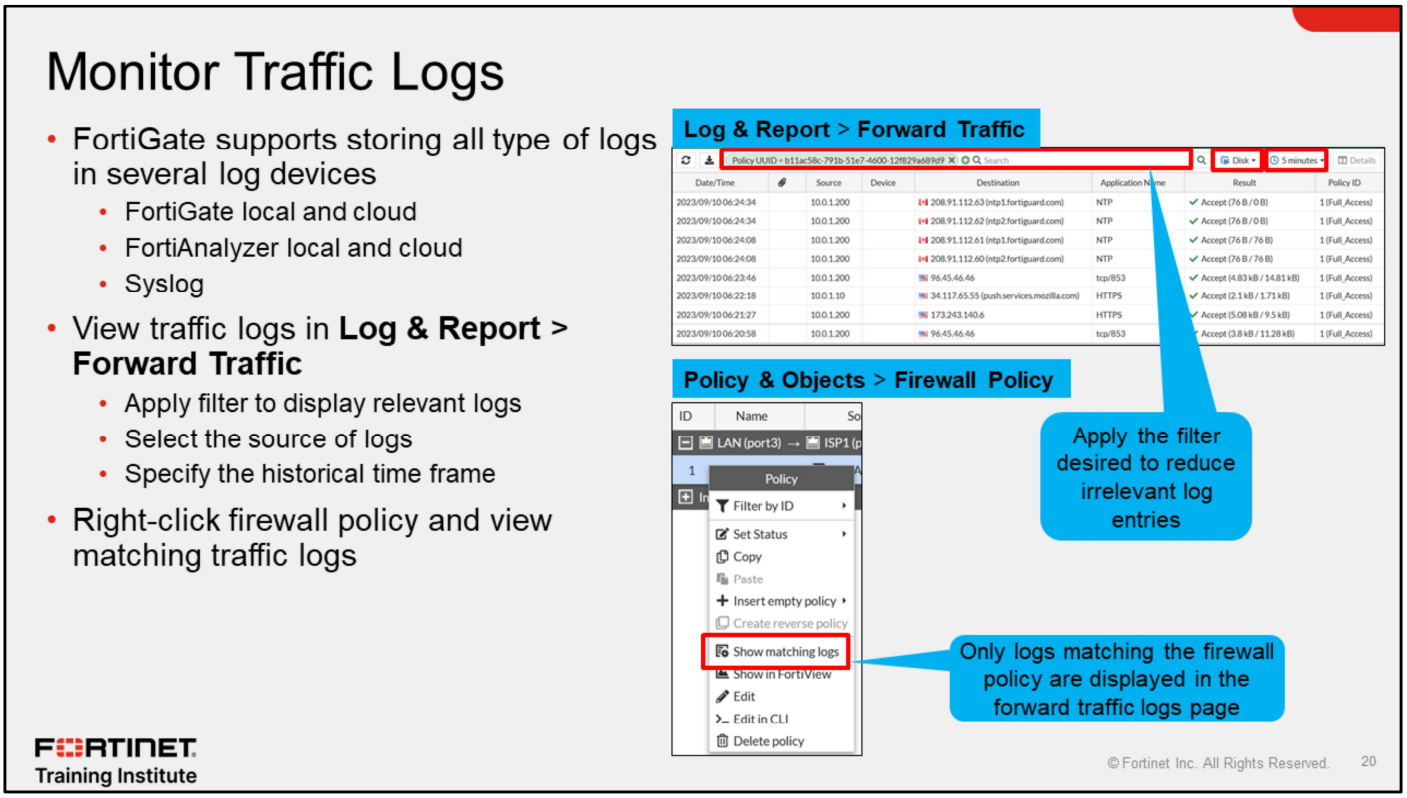
By default, **Log Allowed Traffic** is enabled and set to **Security Events** and generates logs only for the applied security profiles in the firewall policy. However, you can change the setting to **All Sessions**, which generates logs for all sessions.

If you enable **Generate Logs when Session Starts**, FortiGate creates a traffic log when the session begins. FortiGate also generates a second log for the same session when it is closed. But remember that increasing logging decreases performance, so use it only when necessary.

During the session, if a security profile detects a violation, FortiGate records the attack log immediately. To reduce the number of log messages generated and improve performance, you can enable a session table entry of dropped traffic. This creates the denied session in the session table and, if the session is denied, all packets of that session are also denied. This ensures that FortiGate does not have to perform a policy lookup for each new packet matching the denied session, which reduces CPU usage and log generation.

The CLI command is `ses-denied-traffic`. You can also set the duration for block sessions. This determines how long a session will be kept in the session table by setting `block-session-timer` in the CLI. By default, it is set to 30 seconds.

If the GUI option **Generate Logs when Session Starts** is not displayed, this means that your FortiGate device does not have internal storage. Regardless of internal storage, the CLI command is `set logtraffic-start enable`.



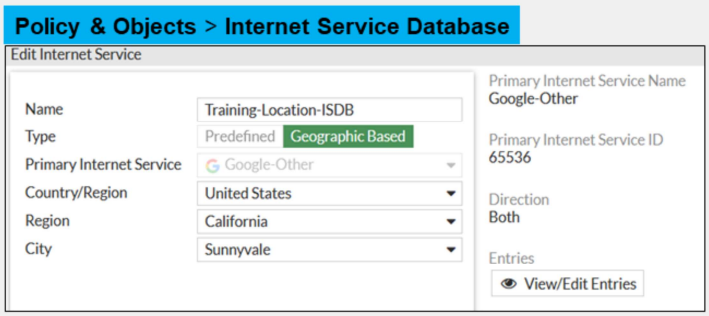
Logging on FortiGate records the traffic that passes through, starts from, or ends on FortiGate. It records the actions during the traffic scanning process. FortiGate supports sending all log types to several log devices including its local storage which is subject to the disk available on different FortiGate models.

You can view traffic logs in **Log & Report** > **Forward Traffic**. Apply the filter needed to display the logs and then enter the policy UUID in the filter field to display records that match the firewall policy. Select the source of the logs and specify the historical time frame to reduce irrelevant log entries.

You can also view the logs by right-clicking the firewall policy, and then clicking on **Show matching logs**.

Geographic-Based Internet Service Database

- By default, ISDB updates are enabled
- Allows users to define ISDB objects based on a country, region, and city
- Objects can be used in firewall policies for more granular control over the location of the parent ISDB object



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Geographic-based ISDB objects allow users to define a country, region, and city. These objects can be used in firewall policies for more granular control over the location of the parent ISDB object.

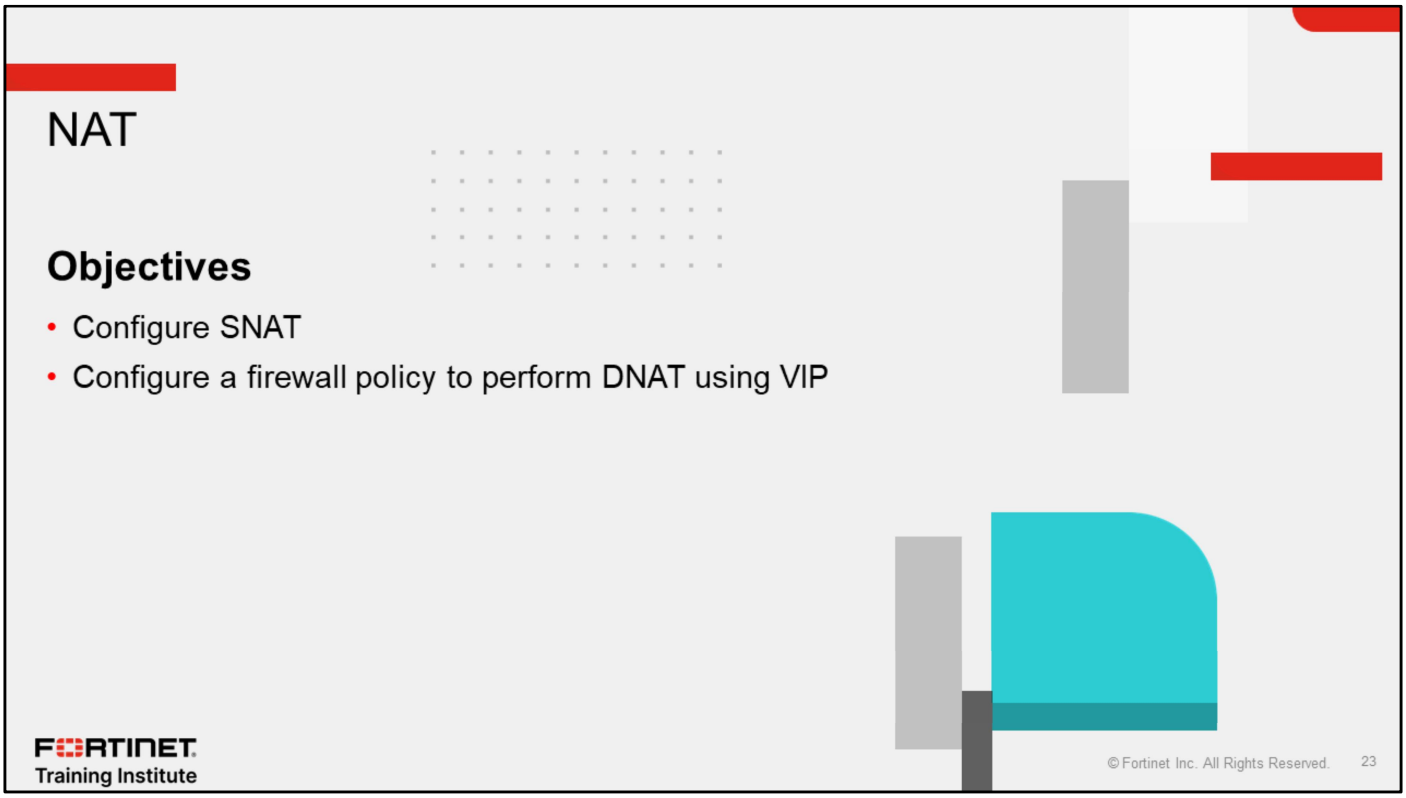
ISDB objects are referenced in policies by name, instead of by ID.

Knowledge Check

1. Which criteria does FortiGate use to match traffic to a firewall policy?
   - ✓A. Source and destination interfaces
   - B. Security profiles

2. What must be selected in the **Source** field of a firewall policy?
   - ✓A. At least one address object
   - B. At least one source user and one source address object

3. What is the purpose of applying security profiles to a firewall policy?
   - A. To allow access to specific subnets
   - ✓B. To protect your network from threats, and control access to specific applications and URLs



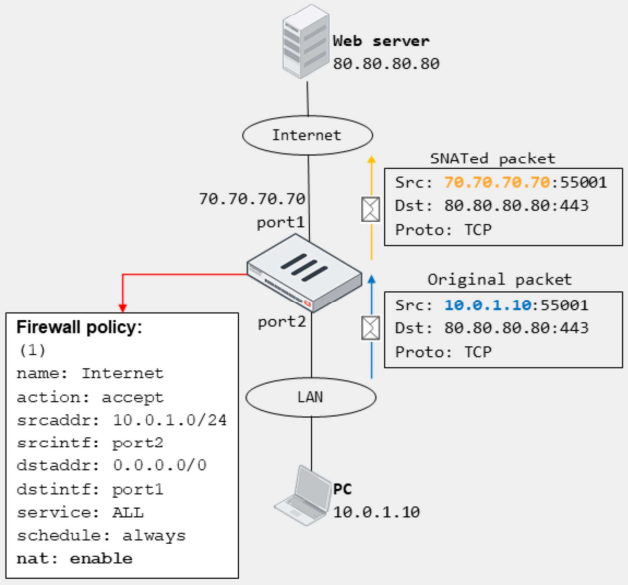
Now, you'll learn about NAT with firewall policies.

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.

NAT

- Method of translating IP addresses in a packet
  - If ports are also translated, it is called PAT
- Benefits:
  - Real address is hidden from external networks
  - Prevents depletion of public IP address space
  - Private address space flexibility
- Types:
  - SNAT
    - Translates source IP address and source port
    - Enabled on firewall policy
  - DNAT
    - Translates destination IP address and destination port
    - Requires VIP object on firewall policy



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NAT is a method that enables a NAT device such as a firewall or router, to translate (or map) the IP address in a packet to another IP address, usually for connectivity purposes. If the port information in the packet is also translated, then the translation method is called PAT. NAT provides the following benefits:

- Security: The real address of a device is hidden from external networks.
- Public address depletion prevention: Hundreds of computers can share the same public IPv4 address.
- Private address flexibility: The addresses can stay the same, even if ISPs change. You can reuse private addresses in multiple networks.

There are two types of NAT: SNAT and DNAT. In SNAT, a NAT device translates the source IP address and source port in a packet. In DNAT, a NAT device translates the destination IP address and destination port. You can configure FortiGate to perform SNAT and DNAT as follows:

- For SNAT, you enable NAT on the matching firewall policy.
- For DNAT, you configure virtual IPs (VIPs) and then reference them on the matching firewall policy.

The example on this slide shows the most common use case for NAT: SNAT. FortiGate, acting as a NAT device, translates the private IP address assigned to the PC to the public address assigned by your ISP. The private-to-public source address translation is needed for the PC to access the internet web server.

Firewall Policy SNAT

- There are two ways to SNAT traffic:
  - Using the outgoing interface address
  - Using the dynamic IP pool

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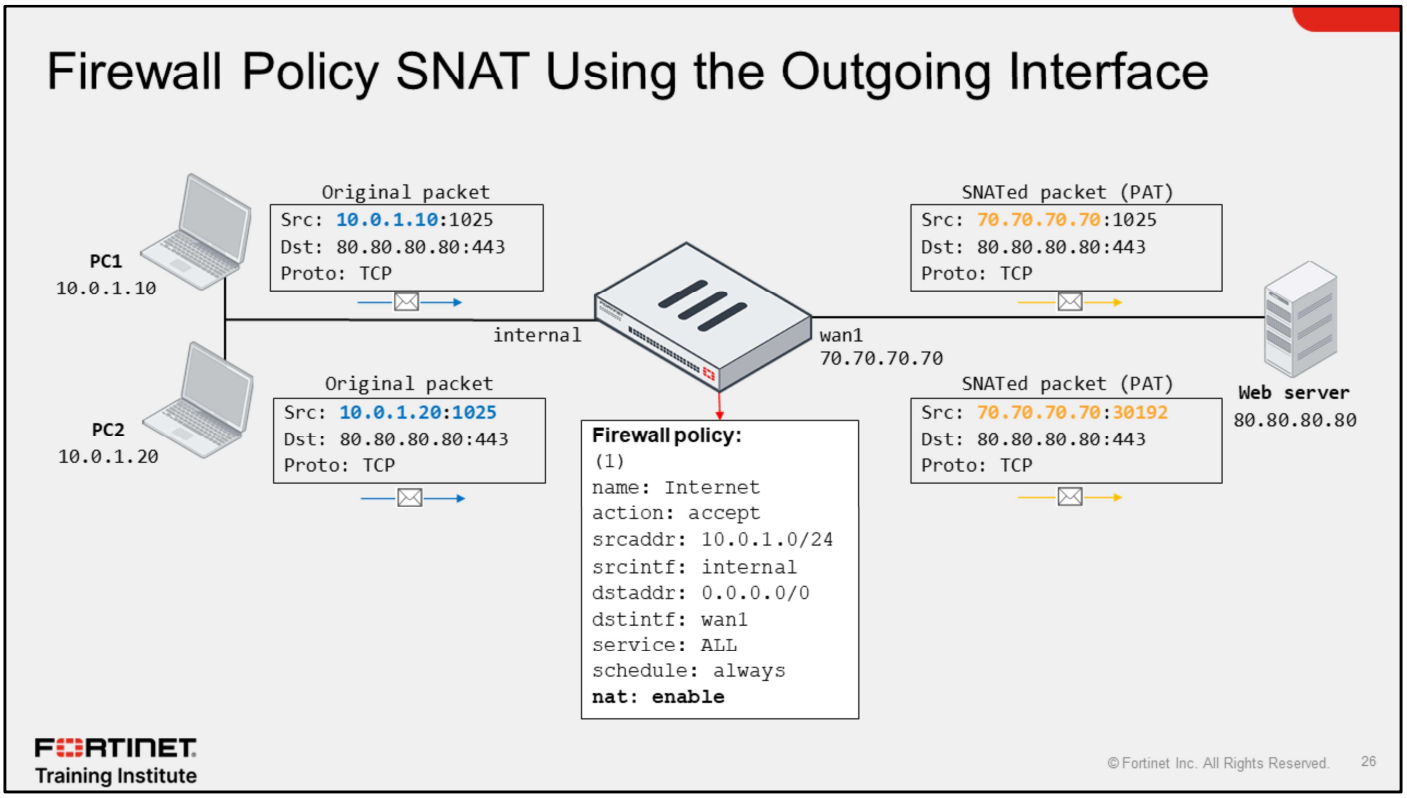
To configure a firewall policy, you can enable SNAT in the firewall and network options section. There are two options to select and choose how SNAT should work:

1. To use the outgoing interface IP address: Packets matching the firewall policy translate the IP address in a packet to another IP address, usually for connectivity purposes.
2. To use the dynamic IP pool: This is dynamic SNAT which allows FortiGate to map private IP addresses to the first available public address from a pool of addresses.

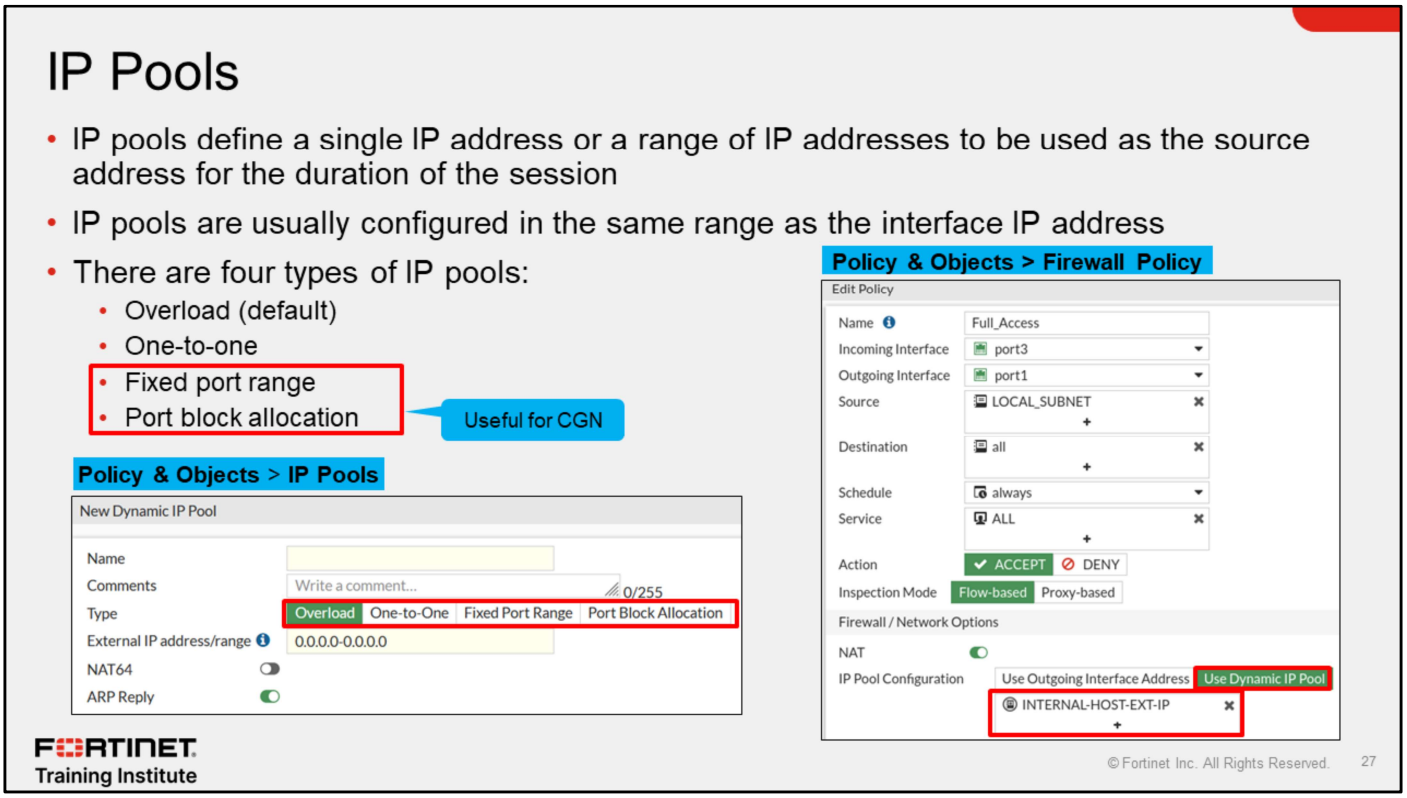


When you select **Use Outgoing Interface Address** on the matching firewall policy, FortiGate uses the egress interface address as the NAT IP for performing SNAT.

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.



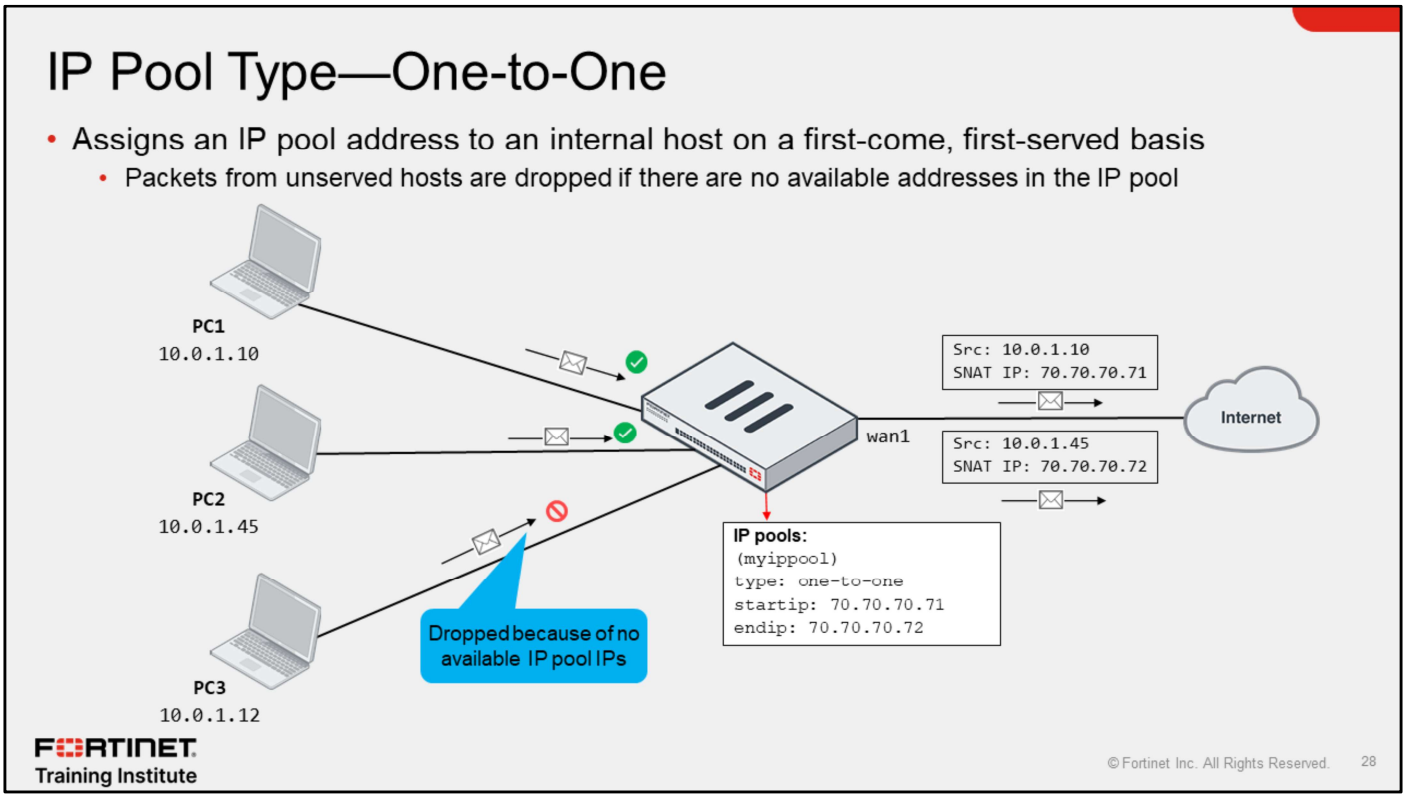
IP pools allow sessions leaving the FortiGate firewall to use NAT. An IP pool defines a single IP address or a range of IP addresses to be used as the source address for the duration of the session. These assigned addresses are used instead of the IP address assigned to that FortiGate interface.

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 interfaces, 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 you configure appropriate routing.

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

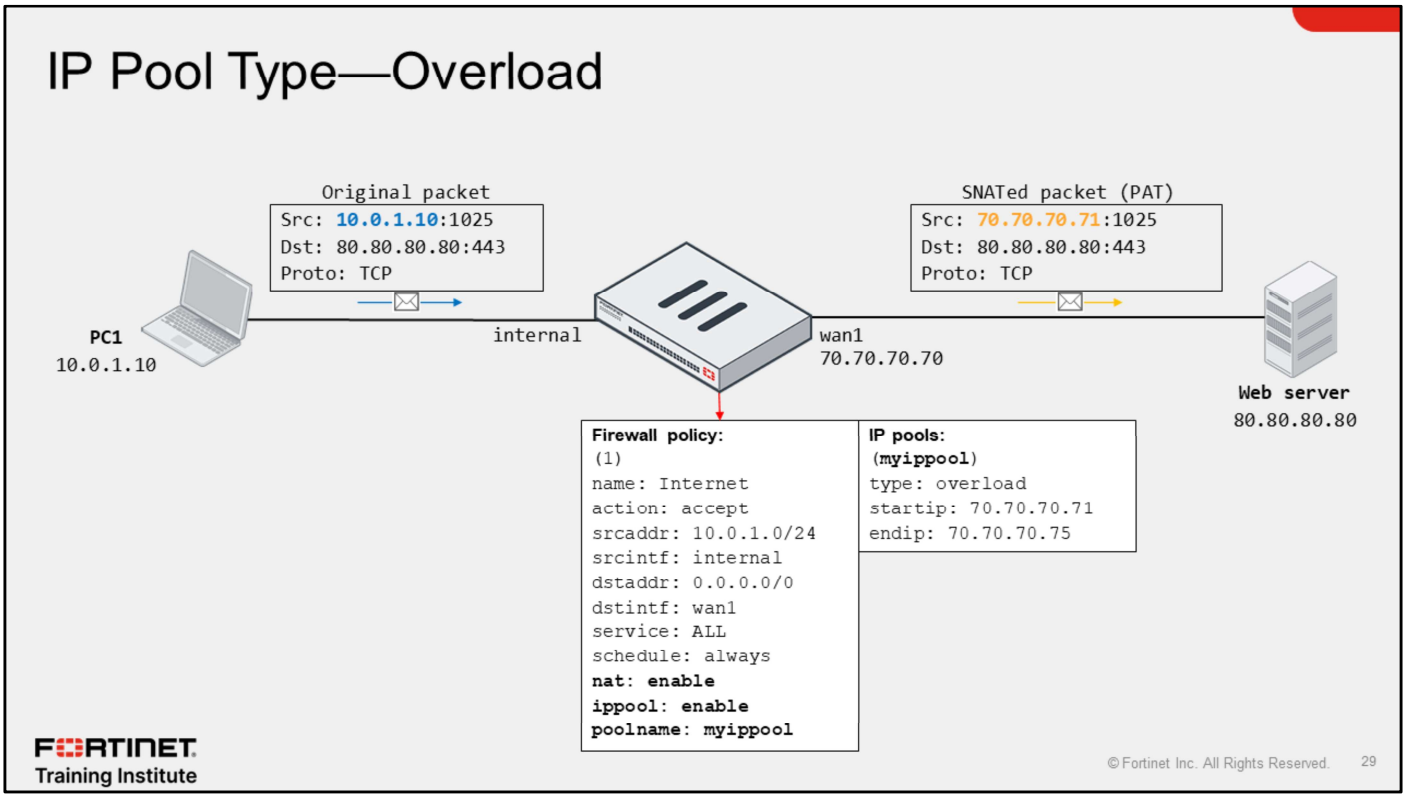
The fixed port range and port block allocation types are more common carrier-grade NAT (CGN) deployments.



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.

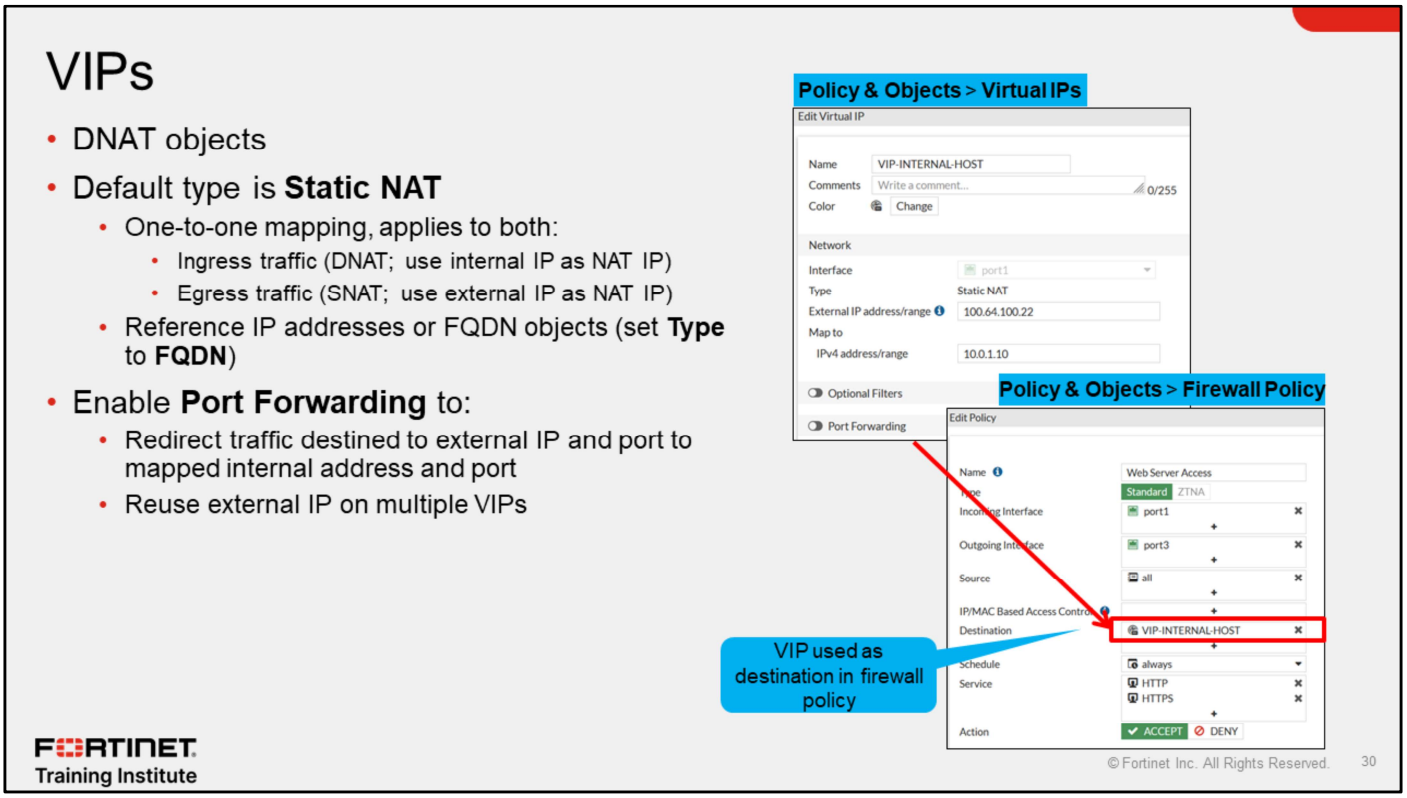
The example on this slide shows three internal hosts accessing the internet. PC1 and PC2 packets are received first by FortiGate and, therefore, served with addresses `70.70.70.71` and `70.70.70.72`, respectively. However, FortiGate drops packets sourced from PC3 because they arrived last, which is when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



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`).



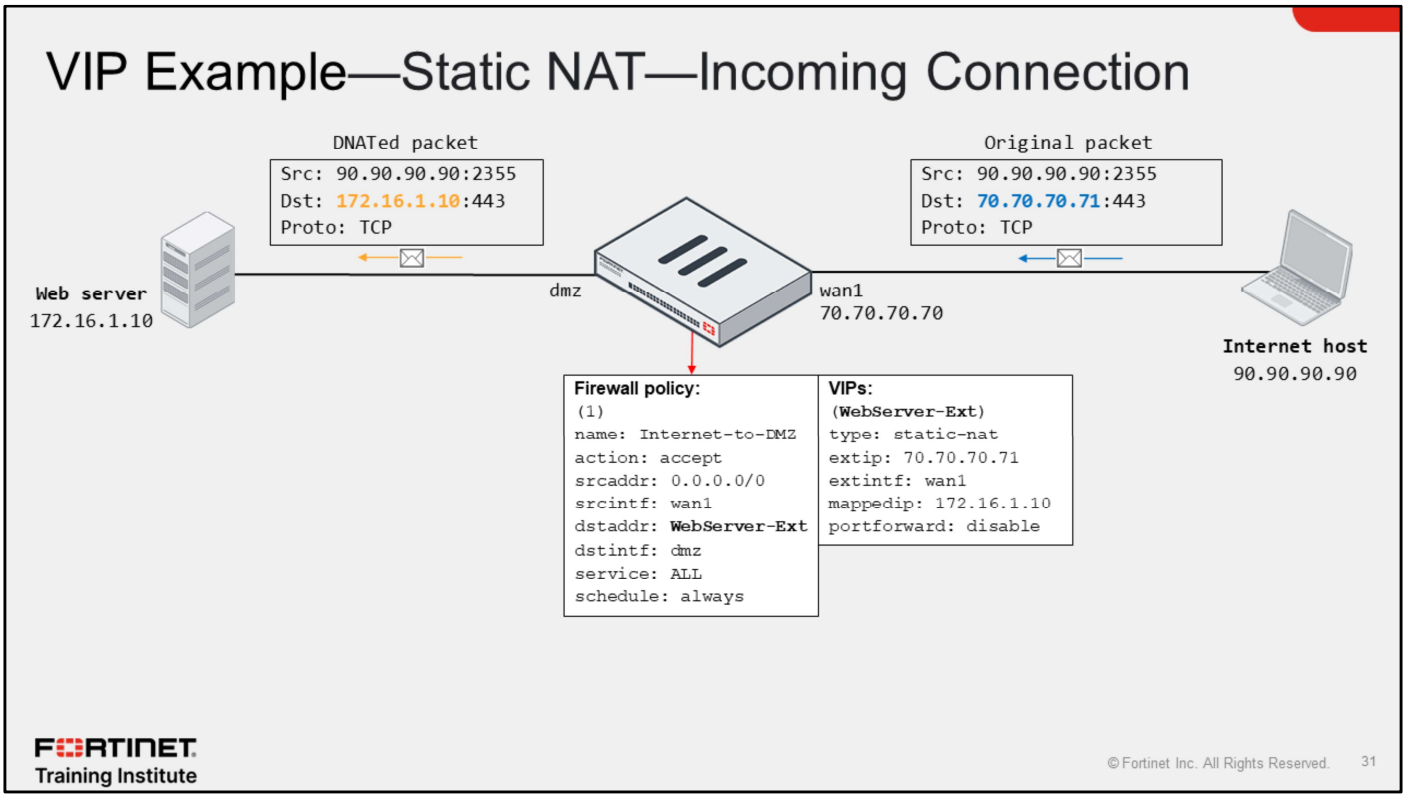
VIPs are DNAT objects. For sessions matching a VIP, the destination address is translated; usually a public internet address is translated to the private network address of a server. VIPs are selected in the firewall policy **Destination** field.

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.

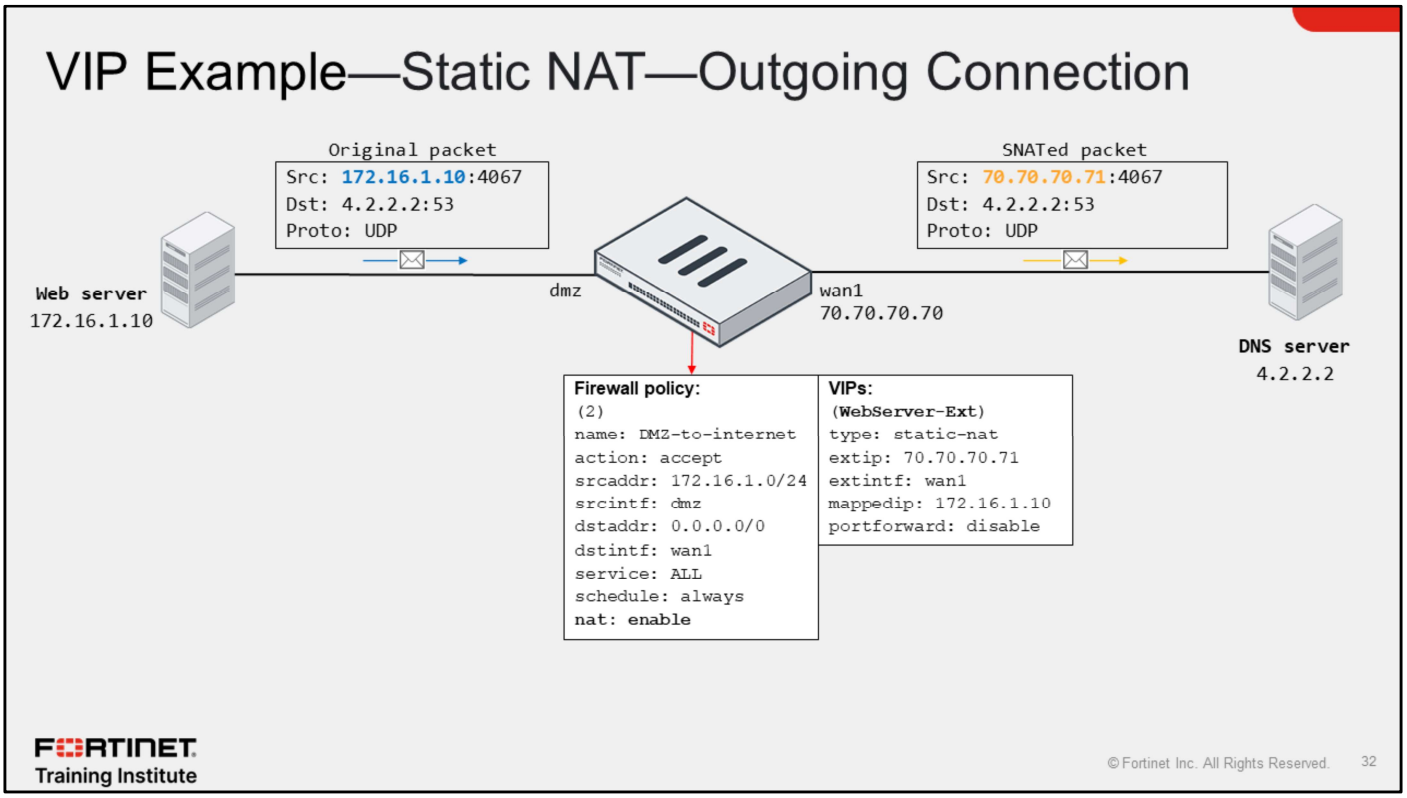
Note that you can override the behavior described in step 2 by using an IP pool. You can also select **FQDN** as **Type**. When you select **FQDN**, you can configure FQDN address objects as external and internal IP addresses. This enables FortiGate to automatically update the external and internal IP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



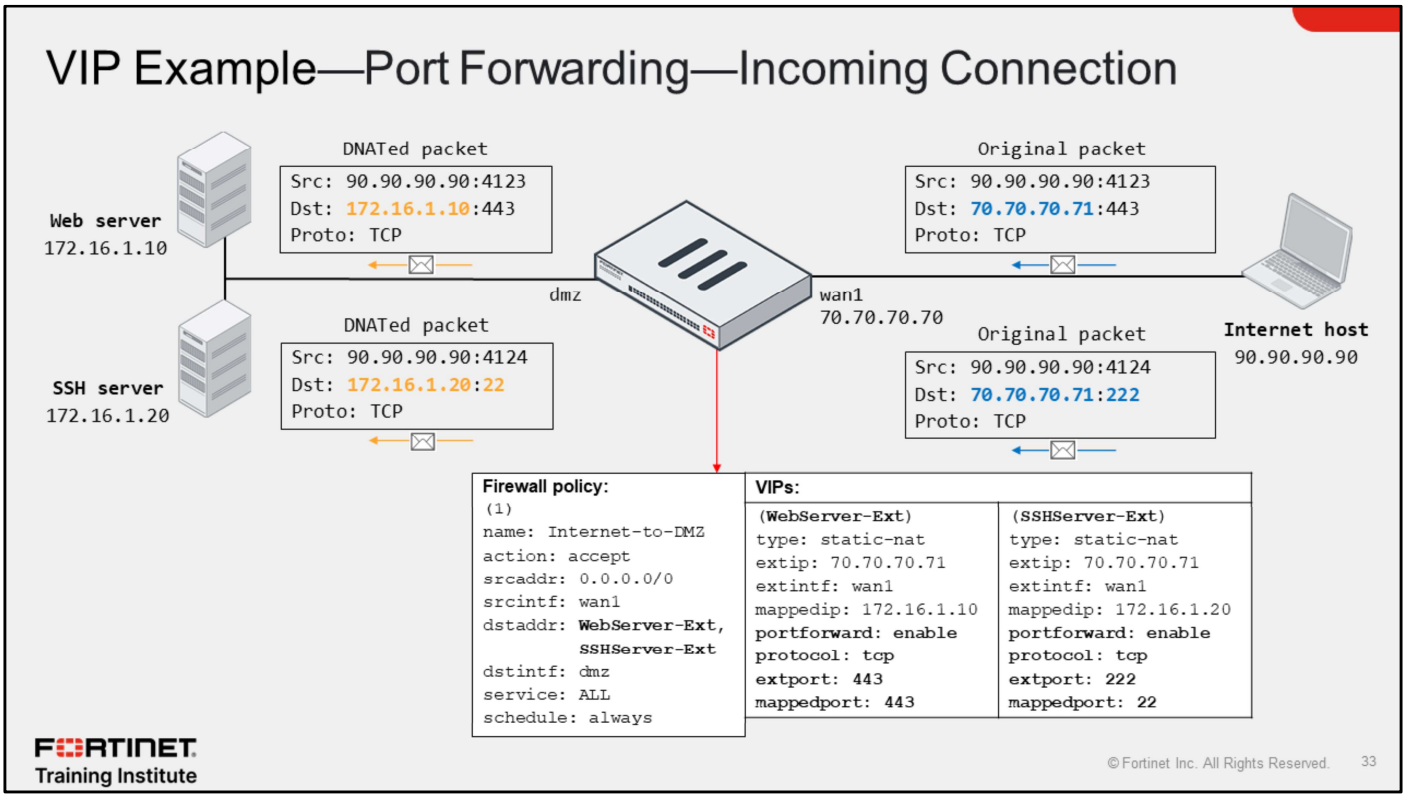
In the example shown on this slide, the internet host initiates a connection to `70.70.70.71` on TCP port 443. On FortiGate, the traffic matches the firewall policy ID 1, which references the `WebServer-Ext` VIP as destination. Because the VIP is configured as static NAT and has port forwarding disabled, 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.

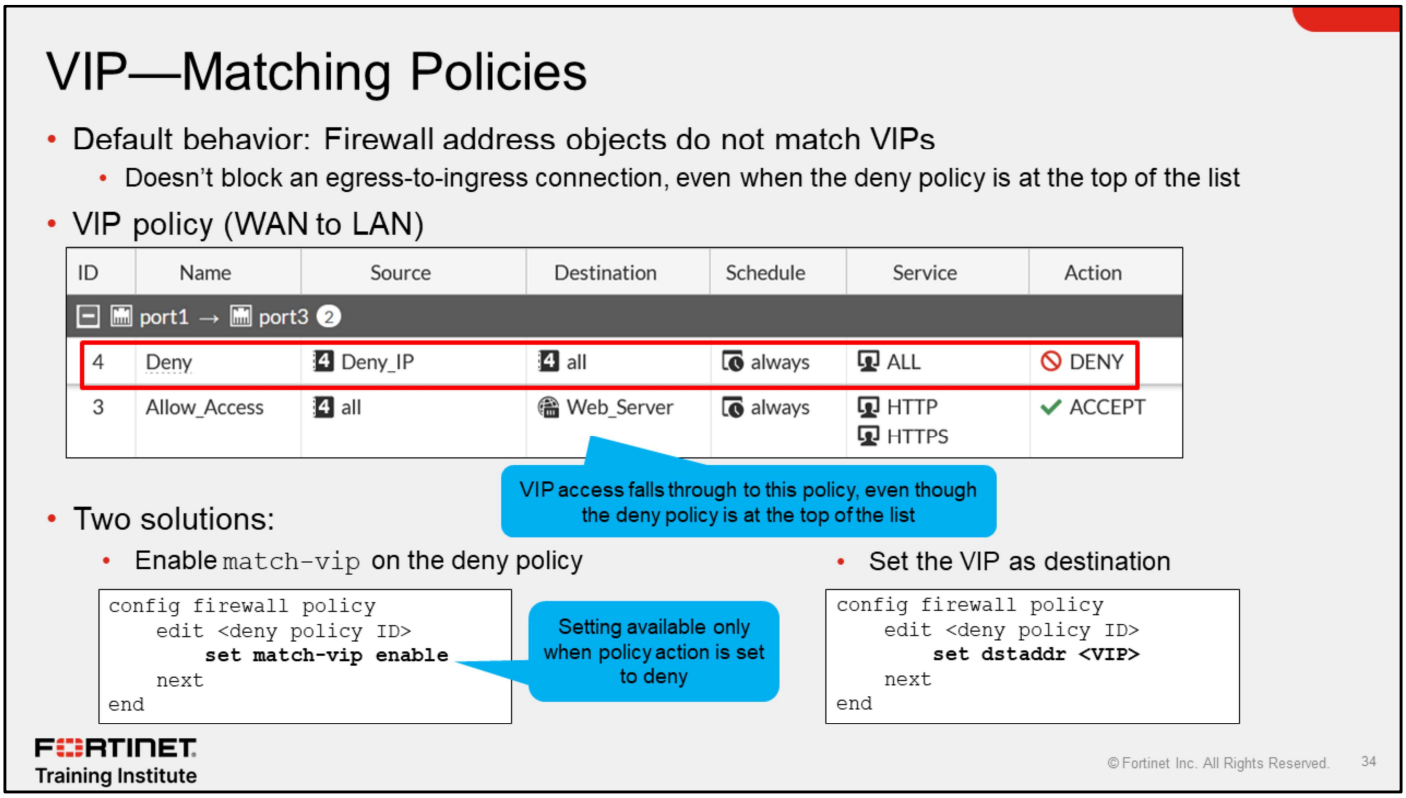
Also note that FortiGate uses the VIP external address for SNAT if the VIP is referenced in an incoming firewall policy. That is, if you don't configure firewall policy ID 1, which is shown on the previous slide, or if you disable the firewall policy, then FortiGate doesn't automatically use the external 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.

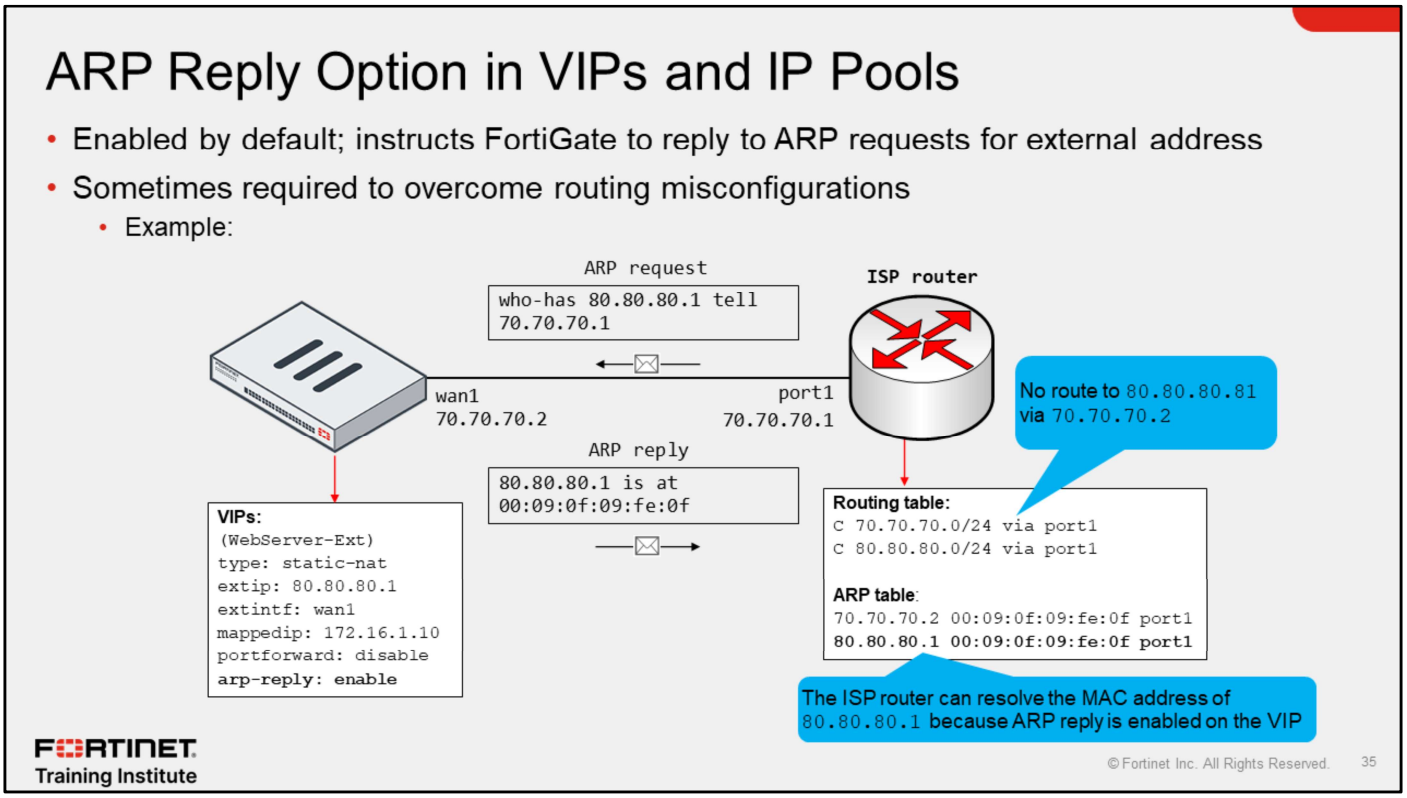


In FortiOS, VIPs and firewall address objects are completely different. They are stored separately with no overlap. This means that, by default, firewall address objects do not match VIPs.

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.



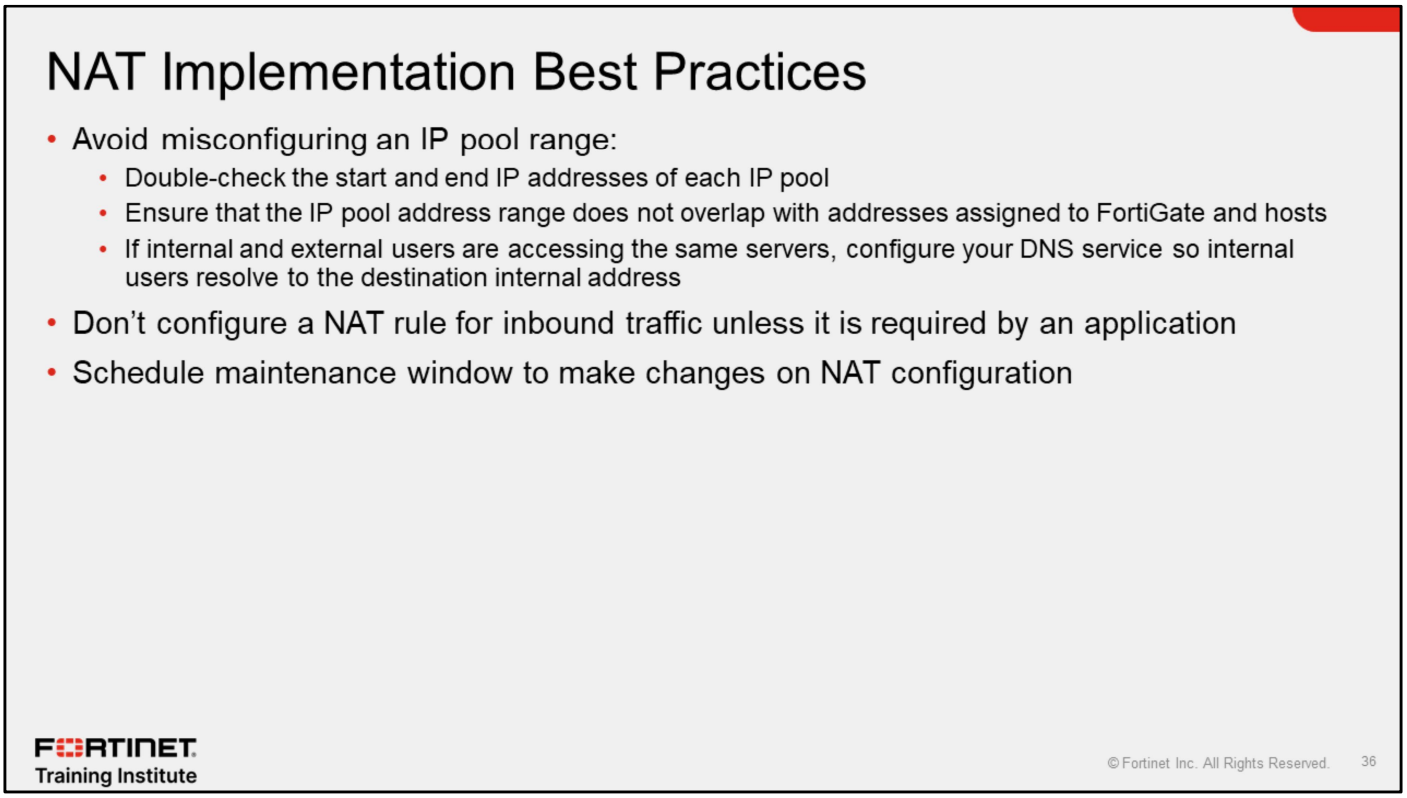
When you configure a VIP or an IP pool, ARP reply is enabled by default. When ARP reply is enabled, FortiGate replies to incoming ARP requests for the external address configured in the VIP and IP pools.

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.



Use the following best practices when implementing NAT:

- Avoid misconfiguring an IP pool range:
  - Double-check the start and end IP addresses 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 when making changes to NAT mode configuration since making changes could create a network outage.

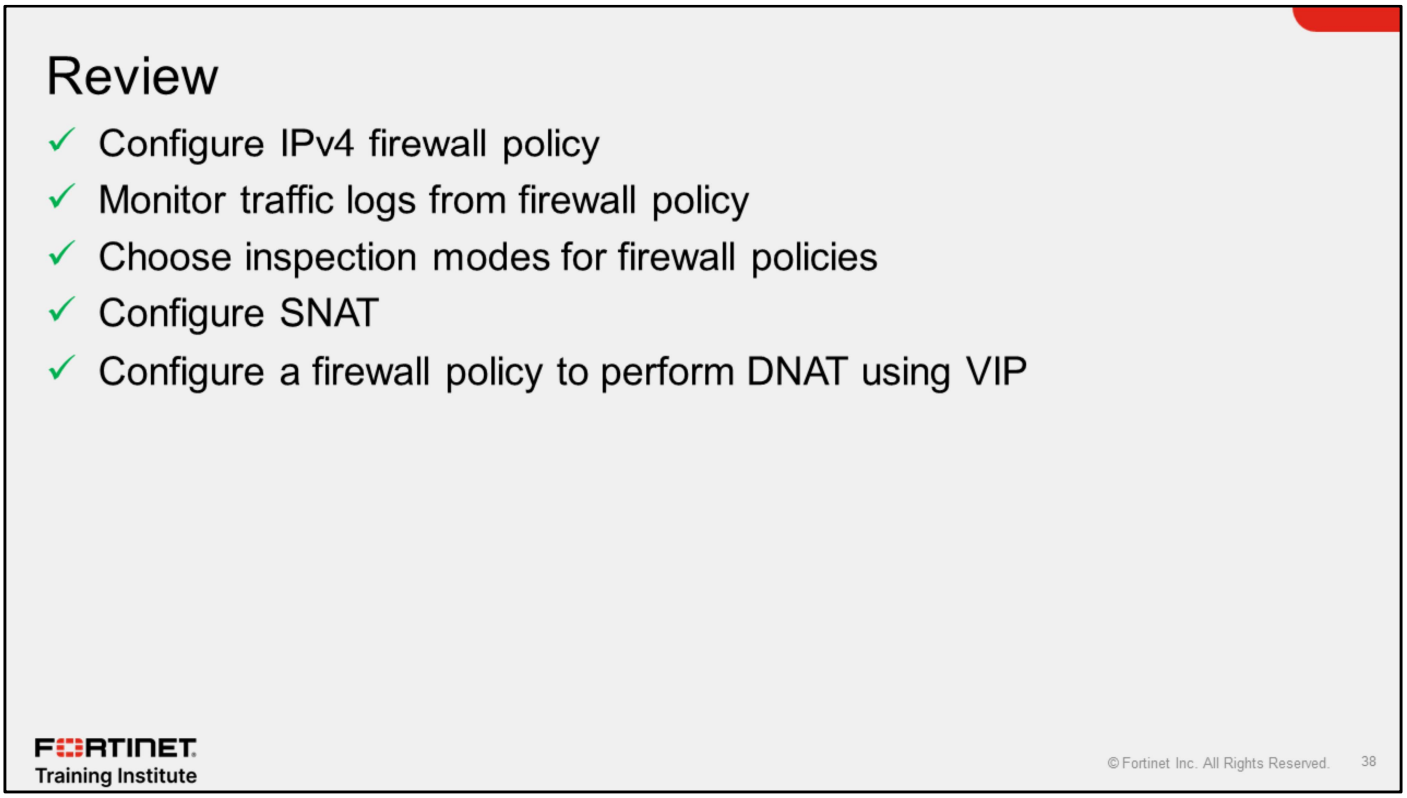
Knowledge Check

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`



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

By mastering the objectives covered in this lesson, you learned how to configure, use, and manage firewall policies and NAT on FortiGate.