Configuring Static and Dynamic NAT Translation

This chapter contains the following sections:

Network Address Translation Overview

Network Address Translation (NAT) enables private IP internetworks that use nonregistered IP addresses to connect to the Internet. NAT operates on a device, usually connecting two networks, and translates private (not globally unique) IP addresses in the internal network into legal IP addresses before packets are forwarded to another network. You can configure NAT to advertise only one IP address for the entire network to the outside world. This ability provides additional security, effectively hiding the entire internal network behind one IP address.

A device configured with NAT has at least one interface to the inside network and one to the outside network. In a typical environment, NAT is configured at the exit router between a stub domain and a backbone. When a packet leaves the domain, NAT translates the locally significant source IP address into a globally unique IP address. When a packet enters the domain, NAT translates the globally unique destination IP address into a local IP address. If more than one exit point exists, NAT configured at each point must have the same translation table.

NAT is described in RFC 1631.

Information About Static NAT

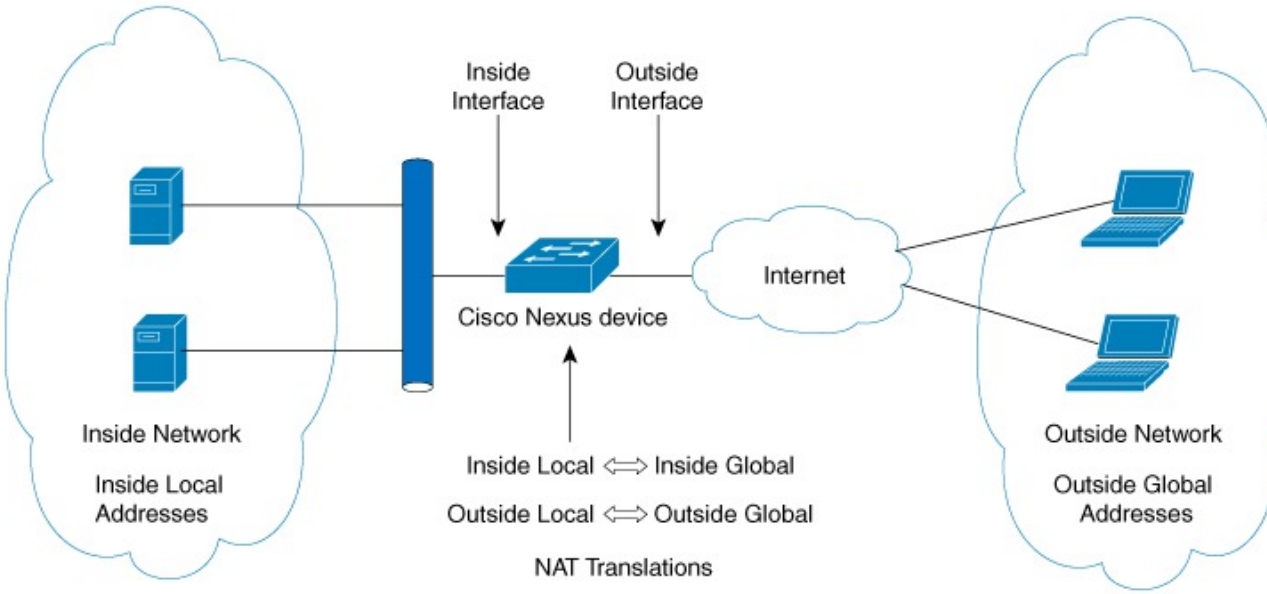
Static Network Address Translation (NAT) allows the user to configure one-to-one translations of the inside local addresses to the outside global addresses. It allows both IP addresses and port number translations from the inside to the outside traffic and the outside to the inside traffic. The Cisco Nexus device supports Hitless NAT, which means that you can add or remove a NAT translation in the NAT configuration without affecting the existing NAT traffic flows.

Static NAT creates a fixed translation of private addresses to public addresses. Because static NAT assigns addresses on a one-to-one basis, you need an equal number of public addresses as private addresses. Because the public address is the same for each consecutive connection with static NAT, and a persistent translation rule exists, static NAT enables hosts on the destination network to initiate traffic to a translated host if an access list exists that allows it .

With dynamic NAT and Port Address Translation (PAT), each host uses a different address or port for each subsequent translation. The main difference between dynamic NAT and static NAT is that static NAT allows a remote host to initiate a connection to a translated host if an access list exists that allows it, while dynamic NAT does not.

The figure shows a typical static NAT scenario. The translation is always active so both translated and remote hosts can originate connections, and the mapped address is statically assigned by the **static** command.

Figure 1: Static NAT



These are key terms to help you understand static NAT:

- NAT inside interface—The Layer 3 interface that faces the private network.
- NAT outside interface—The Layer 3 interface that faces the public network.
- Local address—Any address that appears on the inside (private) portion of the network.
- Global address—Any address that appears on the outside (public) portion of the network.

- Legitimate IP address—An address that is assigned by the Network Information Center (NIC) or service provider.
- Inside local address—The IP address assigned to a host on the inside network. This address does not need to be a legitimate IP address.
- Outside local address—The IP address of an outside host as it appears to the inside network. It does not have to be a legitimate address, because it is allocated from an address space that can be routed on the inside network.
- Inside global address—A legitimate IP address that represents one or more inside local IP addresses to the outside world.
- Outside global address—The IP address that the host owner assigns to a host on the outside network. The address is a legitimate address that is allocated from an address or network space that can be routed.

Dynamic NAT Overview

Dynamic Network Address Translation (NAT) translates a group of real IP addresses into mapped IP addresses that are routable on a destination network. Dynamic NAT establishes a one-to-one mapping between unregistered and registered IP addresses; however, the mapping can vary depending on the registered IP address that is avkailable at the time of communication.

A dynamic NAT configuration automatically creates a firewall between your internal network and outside networks or the Internet. Dynamic NAT allows only connections that originate inside the stub domain—a device on an external network cannot connect to devices in your network, unless your device has initiated the contact.

Dynamic NAT translations do not exist in the NAT translation table until a device receives traffic that requires translation. Dynamic translations are cleared or timed out when not in use to make space for new entries. Usually, NAT translation entries are cleared when the ternary content addressable memory (TCAM) entries are limited. The default minimum timeout for dynamic NAT translations is 30 minutes. In Cisco NX-OS Release 6.0(2)A1(1e), the minimum value of the sampling-timeout in the **ip nat translation sampling-timeout** command was reduced from 30 minutes to 15 minutes.

Timeout of a dynamic NAT translation involves both the sampling-timeout value and the TCP or UDP timeout value. The sampling-timeout specifies the time after which the device checks for dynamic translation activity. It has a default value of 12 hours. All the other timeouts start only after the sample-timeout times out. After the sampling-timeout, the device inspects the packets that are hitting this translation. The checking happens for the TCP or UDP timeout period. If there are no packets for the TCP or UDP timeout period, the translation is cleared. If activity is detected on the translation, then the checking is stopped immediately and a sampling-timeout period begins.

After waiting for this new sampling-timeout period, the device checks for dynamic translation activity again. During an activity check the TCAM sends a copy of the packet that matches the dynamic NAT translation to the CPU. If the Control Plane Policing (CoPP) is configured at a low threshold, the TCP or UDP packets might not reach the CPU, and the CPU considers this as inactivity of the NAT translation.

Dynamic NAT supports Port Address Translation (PAT) and access control lists (ACLs). PAT, also known as overloading, is a form of dynamic NAT that maps multiple unregistered IP addresses to a single registered IP address by using different ports. Your NAT configuration can have multiple dynamic NAT translations with same or different ACLs. However, for a given ACL, only one interface can be specified.

Timeout Mechanisms

After dynamic NAT translations are created, they must be cleared when not in use so that newer translations can be created, especially because the number of TCAM entries is limited. Cisco NX-OS Release 6.0(2)A4(1) adds support for **syn-timeout** and **finrst-timeout**. The following NAT translation timeout timers are supported on the switch:

- **syn-timeout**—Timeout value for TCP data packets that send the SYN request, but do not receive a SYN-ACK reply.

  The timeout value ranges from 1 second to 172800 seconds. The default value is 60 seconds.

- **finrst-timeout**—Timeout value for the flow entries when a connection is terminated by receiving RST or FIN packets. Use the same keyword to configure the behavior for both RST and FIN packets.
  - If an RST packet is received after the connection is established, SYN-->SYN-ACK-->RST, the flows are expired after the configured timeout value.
  - If a FIN packet is received after the connection is established, SYN-->SYN-ACK-->FIN, the finrst timer starts.
  - If a FIN-ACK is received from the other side, the translation entry is cleared immediately, else it clears after the timeout value completes.

  Note If dynamic pool-based configuration is used and a FIN-ACK is received, the translation entry is not cleared.

  The timeout value ranges from 1 second to 172800 seconds. The default value is 60 seconds.

- **tcp-timeout**—Timeout value for TCP translations for which connections have been established after a three-way handshake (SYN, SYN-ACK, ACK). If no active flow occurs after the connection has been established, the translations expire as per the configured timeout value. This timeout value starts after the sampling timeout value completes.

  The timeout value ranges from 60 seconds to 172800 seconds, including the sampling-timeout.

- **udp-timeout**—Timeout value for all NAT UDP packets.

  The timeout value ranges from 60 seconds to 172800 seconds, including the sampling-timeout.

- **timeout**—Timeout value for dynamic NAT translations.

  The timeout value ranges from 60 seconds to 172800 seconds, including the sampling-timeout.

- **sampling-timeout**—Time after which the device checks for dynamic translation activity.

  The timeout value ranges from 120 seconds to 172800 seconds.

The **tcp-timeout**, **udp-timeout**, and the **timeout** value timers are triggered after the timeout configured for the **ip nat translation sampling-timeout** command expires.

The SYN, FIN and RST timers are not used for dynamic pool-based NAT.

Note All the above timers will take additional time (01 to 30 seconds) to expire. This additional time is to randomize the timer expiry events for performance and optimization.

NAT Inside and Outside Addresses

NAT inside refers to networks owned by an organization that must be translated. When NAT is configured, hosts within this network will have addresses in one space (known as the local address space) that will appear to those outside the network as being in another space (known as the global address space).

Similarly, NAT outside refers to those networks to which the stub network connects. They are not generally under the control of the organization. Hosts in outside networks can be subject to translation and can have local and global addresses.

NAT uses the following definitions:

- Local address—A local IP address that appears on the inside of a network.
- Global address—A global IP address that appears on the outside of a network.
- Inside local address—The IP address that is assigned to a host on the inside network. The address is probably not a legitimate IP address assigned by the Internet Network Information Center (InterNIC) or a service provider.
- Inside global address—A legitimate IP address (assigned by InterNIC or a service provider) that represents one or more inside local IP addresses to the outside world.
- Outside local address—The IP address of an outside host as it appears to the inside network. The address is not necessarily legitimate; it was allocated from the address space that is routable on the inside.
- Outside global address—The IP address that is assigned to a host on the outside network by the owner of the host. The address was allocated from a globally routable address or a network space.

Pool Support for Dynamic NAT

Cisco NX-OS Release 6.0(2)A3(1) introduces pool support for dynamic NAT. Dynamic NAT allows the configuration of a pool of global addresses that can be used to dynamically allocate a global address from the pool for every new translation. The addresses are returned to the pool after the session ages out or is closed. This allows for a more efficient use of addresses based on requirements.

Support for PAT includes the use of the global address pool. This further optimizes IP address utilization. PAT exhausts one IP address at a time with the use of port numbers. If no port is available from the appropriate group and more than one IP address is configured, PAT moves to the next IP address and tries to allocate the original source port again. This process continues until PAT runs out of available ports and IP addresses.

With dynamic NAT and PAT, each host uses a different address or port for each subsequent translation. The main difference between dynamic NAT and static NAT is that static NAT allows a remote host to initiate a connection to a translated host if an access list exists that allows it, while dynamic NAT does not.

Static and Dynamic Twice NAT Overview

When both the source IP address and the destination IP address are translated as a single packet that goes through a Network Address Translation (NAT) device, it is referred to as twice NAT. Twice NAT is supported for static and dynamic translations.

Twice NAT allows you to configure two NAT translations (one inside and one outside) as part of a group of translations. These translations can be applied to a single packet as it flows through a NAT device. When you add two translations as part of a group, both the individual translations and the combined translation take effect.

A NAT inside translation modifies the source IP address and port number when a packet flows from inside to outside. It modifies the destination IP address and port number when the packet returns from outside to inside. NAT outside translation modifies the source IP address and port number when the packet flows from outside to inside, and it modifies the destination IP address and port number when the packet returns from inside to outside.

Without twice NAT, only one of the translation rules is applied on a packet, either the source IP address and port number or the destination IP address and port number.

Static NAT translations that belong to the same group are considered for twice NAT configuration. If a static configuration does not have a configured group ID, the twice NAT configuration will not work. All inside and outside NAT translations that belong to a single group that is identified by the group ID are paired to form twice NAT translations.

Dynamic twice NAT translations dynamically select the source IP address and port number information from pre-defined **ip nat pool** or **interface overload** configurations. Packet filtration is done by configuring ACLs, and traffic must originate from the dynamic NAT translation rule direction such that source translation is done by using dynamic NAT rules.

Dynamic twice NAT allows you to configure two NAT translations (one inside and one outside) as part of a group of translations. One translation must be dynamic and other translation must be static. When these two translations are part of a group of translations, both the translations can be applied on a single packet as it goes through the NAT device either from inside to outside or from outside to inside.

Licensing Requirements for Static NAT

This table shows the licensing requirements for static NAT.

Product	License Requirement
Cisco NX-OS	Static NAT requires a LAN Base license and an Algo Boost license. For a complete explanation of the Cisco NX-OS licensing scheme and how to obtain and apply licenses, see the Cisco NX-OS Licensing Guide. **Note** Make sure the LAN Base Services license is installed on the switch to enable Layer 3 interfaces.

Guidelines and Limitations for Static NAT

Static NAT has the following configuration guidelines and limitations:

- NAT supports up to 1024 translations which include both static and dynamic NAT.
- Cisco Nexus 3500 Series switches do not support static and dynamic NAT on vPC topology.
- The Cisco Nexus device supports NAT on the following interface types:
  - Switch Virtual Interfaces (SVIs)
  - Routed ports
  - Layer 3 port channels
- NAT is supported for IPv4 Unicast only.
- The Cisco Nexus device does not support the following:
  - Application layer translation. Layer 4 and other embedded IPs are not translated, including FTP, ICMP failures, IPSec, and HTTPs.
  - NAT and VLAN Access Control Lists (VACLs) that are configured on an interface at the same time.
  - PAT translation of fragmented IP packets.
  - NAT translation on software forwarded packets. For example, packets with IP-options are not NAT translated.
- Egress ACLs are applied to the original packets and not the NAT translated packets.
- By default, NAT can go up to 127 translations with 256 TCAM entries. If you need more NAT translations, you need to reduce the TCAM region allocation in other areas and then increase the NAT TCAM region using the **hardware profile tcam region nat** command.
- HSRP and VRRP are supported on NAT inside address and not on NAT outside addresses.
- Warp mode latency performance is not supported on packets coming from the outside to the inside domain.
- If an IP address is used for Static NAT or PAT translations, it cannot be used for any other purpose. For example, it cannot be assigned to an interface.
- For Static NAT, the outside global IP address should be different from the outside interface IP address.
- If the translated IP is part of the outside interface subnet, then use the **ip local-proxy-arp** command on the NAT outside interface.
- NAT statistics are not available.
- When configuring a large number of translations (more than 100), it is faster to configure the translations before configuring the NAT interfaces.
- Only one of the following features can be enabled on an interface at a time. If more than one of these features is enabled on an interface, only the feature that is enabled last will work:

- NAT
- DHCP Relay
- VACL

Restrictions for Dynamic NAT

The following restrictions apply to dynamic Network Address Translation (NAT):

- Fragmented packets are not supported.
- Application layer gateway (ALG) translations are not supported. ALG, also known as application-level gateway, is an application that translates IP address information inside the payload of an application packet.
- NAT and VLAN Access Control Lists (VACLs) are not supported together on an interface. You can configure either NAT or VACLs on an interface.
- Egress ACLs are not applied to translated packets.
- MIBs are not supported.
- Cisco Data Center Network Manager (DCNM) is not supported.
- Dynamic NAT translations are not synchronized with active and standby devices.
- Stateful NAT is not supported. However, NAT and Hot Standby Router Protocol (HSRP) can coexist.
- Normally, ICMP NAT flows time out after the expiration of the configured sampling-timeout and translation-timeout. However, when ICMP NAT flows present in the switch become idle, they time out immediately after the expiration of the sampling-timeout configured.
- If the translated IP is part of the outside interface subnet, then use the **ip local-proxy-arp** command on the NAT outside interface.
- When creating a new translation on a Cisco Nexus 3548 Series switch, the flow is software forwarded until the translation is programmed in the hardware, which might take a few seconds. During this period, there is no translation entry for the inside global address. Therefore, returning traffic is dropped. To overcome this limitation, create a loopback interface and give it an IP address that belongs to the NAT pool.

Guidelines and Limitations for Dynamic Twice NAT

See the following guidelines for configuring dynamic twice NAT:

- In dynamic twice NAT, if dynamic NAT flows are not created before creating static NAT flows, dynamic twice NAT flows are not created correctly.
- When an empty ACL is created, the default rule of **permit ip any any** is configured. The NAT-ACL does not match further ACL entries if the first ACL is blank.
- The maximum number of supported ICMP translations or flow entries is 176 for an optimal utilization of the TCAM space.

- Starting from Cisco NXOS Release 6.0(2)A8(3), NAT is ECMP aware and it supports a maximum of 24 ECMP paths.
- Starting from Cisco NX-OS Release 6.0(2)A8(9), Network Address Translation (NAT) statistics on Cisco Nexus 3548 switches.
- Traceroute is not supported on static and dynamic NAT

Configuring Static NAT

Enabling Static NAT

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **feature nat**	Enables the static NAT feature on the device.
Step 3	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Configuring Static NAT on an Interface

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **interface** *type slot*/*port*	Specifies an interface to configure, and enters interface configuration mode.
Step 3	switch(config-if)# **ip nat** {**inside** | **outside**}	Specifies the interface as inside or outside. **Note** Only packets that arrive on a marked interface can be translated.
Step 4	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to configure an interface with static NAT from the inside:

```
switch# configure terminal
switch(config)# interface ethernet 1/4
switch(config-if)# ip nat inside
```

Enabling Static NAT for an Inside Source Address

For inside source translation, the traffic flows from inside interface to the outside interface. NAT translates the inside local IP address to the inside global IP address. On the return traffic, the destination inside global IP address gets translated back to the inside local IP address.

Note When the Cisco Nexus device is configured to translate an inside source IP address (Src:ip1) to an outside source IP address (newSrc:ip2), the Cisco Nexus device implicitly adds a translation for an outside destination IP address (Dst: ip2) to an inside destination IP address (newDst: ip1).

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **ip nat inside source static** *local-ip-address global-ip-address* [**group** *group-id*]	Configures static NAT to translate the inside global address to the inside local address or to translate the opposite (the inside local traffic to the inside global traffic).
Step 3	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to configure static NAT for an inside source address:

```
switch# configure terminal
switch(config)# ip nat inside source static 1.1.1.1 5.5.5.5
switch(config)# copy running-config startup-config
```

Enabling Static NAT for an Outside Source Address

For outside source translation, the traffic flows from the outside interface to the inside interface. NAT translates the outside global IP address to the outside local IP address. On the return traffic, the destination outside local IP address gets translated back to outside global IP address.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.

	Command or Action	Purpose
Step 2	switch(config)# **ip nat outside source static** *global-ip-address local-ip-address* [**group** *group-id*] [**add-route**]	Configures static NAT to translate the outside global address to the outside local address or to translate the opposite (the outside local traffic to the outside global traffic).
Step 3	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example show how to configure static NAT for an outside source address:

```
switch# configure terminal
switch(config)# ip nat outside source static 2.2.2.2 6.6.6.6
switch(config)# copy running-config startup-config
```

Configuring Static PAT for an Inside Source Address

You can map services to specific inside hosts using Port Address Translation (PAT).

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **ip nat inside source static** {*inside-local-address outside-local-address* | {**tcp**| **udp**} *inside-local-address* {*local-tcp-port* | *local-udp-port*} *inside-global-address* {*global-tcp-port* | *global-udp-port*}} **group** *group-id*	Maps static NAT to an inside local port to an inside global port.
Step 3	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to map UDP services to a specific inside source address and UDP port:

```
switch# configure terminal
switch(config)#  ip nat inside source static udp 20.1.9.2 63 35.48.35.48 130
switch(config)# copy running-config startup-config
```

Configuring Static PAT for an Outside Source Address

You can map services to specific outside hosts using Port Address Translation (PAT).

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **ip nat outside source static** {*outside-global-address outside-local-address* | {**tcp** | **udp**} *outside-global-address* {*global-tcp-port* | *global-udp-port*} *outside-local-address* {*global-tcp-port* | *global-udp-port*}}**group** *group-id* **add-route**	Maps static NAT to an outside global port to an outside local port.
Step 3	(Optional) switch(config)# **copy running-config startup-config**	Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

Example

This example shows how to map TCP services to a specific outside source address and TCP port:

```
switch# configure terminal
switch(config)#  ip nat outside source static tcp 20.1.9.2 63 35.48.35.48 130
switch(config)# copy running-config startup-config
```

Configuring Static Twice NAT

All translations within the same group are considered for creating static twice Network Address Translation (NAT) rules.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `switch> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `switch# configure terminal`	Enters privileged EXEC mode.

	Command or Action	Purpose
Step 3	**ip nat inside source static** *inside-local-ip-address inside-global-ip-address* [**group** *group-id*] **Example:** `switch(config)# ip nat inside source static 10.1.1.1 192.168.34.4 group 4`	Configures static twice NAT to translate an inside local IP address to the corresponding inside global IP address. • The **group** keyword determines the group to which a translation belongs.
Step 4	**ip nat outside source static** *outside-global-ip-address outside-local-ip-address* [**group** *group-id*] [**add-route**] **Example:** `switch(config)# ip nat outside source static 209.165.201.1 10.3.2.42 group 4 add-route`	Configures static twice NAT to translate an outside global IP address to the corresponding outside local IP address. • The **group** keyword determines the group to which a translation belongs.
Step 5	**interface** *type number* **Example:** `switch(config)# interface ethernet 1/2`	Configures an interface and enters interface configuration mode.
Step 6	**ip address** *ip-address mask* **Example:** `switch(config-if)# ip address 10.2.4.1 255.255.255.0`	Sets a primary IP address for an interface.
Step 7	**ip nat inside** **Example:** `switch(config-if)# ip nat inside`	Connects the interface to an inside network, which is subject to NAT.
Step 8	**exit** **Example:** `switch(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 9	**interface** *type number* **Example:** `switch(config)# interface ethernet 1/1`	Configures an interface and enters interface configuration mode.
Step 10	**ip address** *ip-address mask* **Example:** `switch(config-if)# ip address 10.5.7.9 255.255.255.0`	Sets a primary IP address for an interface.
Step 11	**ip nat outside** **Example:** `switch(config-if)# ip nat outside`	Connects the interface to an outside network, which is subject to NAT.

	Command or Action	Purpose
Step 12	**end** **Example:** `switch(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Configuration Example for Static NAT and PAT

This example shows the configuration for static NAT:

```
ip nat inside source static 103.1.1.1 11.3.1.1
ip nat inside source static 139.1.1.1 11.39.1.1
ip nat inside source static 141.1.1.1 11.41.1.1
ip nat inside source static 149.1.1.1 95.1.1.1
ip nat inside source static 149.2.1.1 96.1.1.1
ip nat outside source static 95.3.1.1 95.4.1.1
ip nat outside source static 96.3.1.1 96.4.1.1
ip nat outside source static 102.1.2.1 51.1.2.1
ip nat outside source static 104.1.1.1 51.3.1.1
ip nat outside source static 140.1.1.1 51.40.1.1
```

This example shows the configuration for static PAT:

```
ip nat inside source static tcp 10.11.1.1 1 210.11.1.1 101
ip nat inside source static tcp 10.11.1.1 2 210.11.1.1 201
ip nat inside source static tcp 10.11.1.1 3 210.11.1.1 301
ip nat inside source static tcp 10.11.1.1 4 210.11.1.1 401
ip nat inside source static tcp 10.11.1.1 5 210.11.1.1 501
ip nat inside source static tcp 10.11.1.1 6 210.11.1.1 601
ip nat inside source static tcp 10.11.1.1 7 210.11.1.1 701
ip nat inside source static tcp 10.11.1.1 8 210.11.1.1 801
ip nat inside source static tcp 10.11.1.1 9 210.11.1.1 901
ip nat inside source static tcp 10.11.1.1 10 210.11.1.1 1001
ip nat inside source static tcp 10.11.1.1 11 210.11.1.1 1101
ip nat inside source static tcp 10.11.1.1 12 210.11.1.1 1201
```

Example: Configuring Static Twice NAT

The following example shows how to configure the inside source and outside source static twice NAT configurations:

```
Switch> enable
Switch# configure terminal
Switch(config)# ip nat inside source static 10.1.1.1 192.168.34.4 group 4
Switch(config)# ip nat outside source static 209.165.201.1 10.3.2.42 group 4
Switch(config)# interface ethernet 1/2
Switch(config-if)# ip address 10.2.4.1 255.255.255.0
Switch(config-if)# ip nat inside
switch(config-if)# exit
switch(config)# interface ethernet 1/1
switch(config-if)# ip address 10.5.7.9 255.255.255.0
switch(config-if)# ip nat outside
Switch(config-if)# end
```

Verifying the Static NAT Configuration

To display the static NAT configuration, perform this task:

Procedure

	Command or Action	Purpose
Step 1	switch# **show ip nat translations**	Shows the translations for the inside global, inside local, outside local, and outside global IP addresses.

Example

This example shows how to display the static NAT configuration:

```
switch# show ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
any ---                ---                20.4.4.40          220.2.2.20
tcp ---                ---                23.1.1.133:333     210.3.3.33:555
any 160.200.1.140      10.1.1.40          ---                ---
any 160.200.1.140      10.1.1.40          20.4.4.40          220.2.2.20
tcp 172.9.9.142:777    12.2.2.42:444      ---                ---
tcp 172.9.9.142:777    12.2.2.42:444      23.1.1.133:333     210.3.3.33:555
```

Configuring Dynamic NAT

Configuring Dynamic Translation and Translation Timeouts

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Switch> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 3	**ip access-list** *access-list-name* **Example:** `Switch(config)# ip access-list acl1`	Defines an access list and enters access-list configuration mode.
Step 4	**permit** *protocol source source-wildcard* **any** **Example:**	Sets conditions in an IP access list that permit traffic matching the conditions.

	Command or Action	Purpose
	`Switch(config-acl)# permit ip 10.111.11.0/24 any`	
Step 5	**deny** *protocol source source-wildcard* **any** **Example:** `Switch(config-acl)# deny udp 10.111.11.100/32 any`	Sets conditions in an IP access list that deny packets from entering a network. The **deny** rule is treated as a **permit** rule, and the packets matching the criteria mentioned in the deny rule are forwarded without NAT translation.
Step 6	**exit** **Example:** `Switch(config-acl)# exit`	Exits access-list configuration mode and returns to global configuration mode.
Step 7	**ip nat inside source list** *access-list-name* **interface** *type number* **overload** **Example:** `Switch(config)# ip nat inside source list acl1 interface ethernet 1/1 overload`	Establishes dynamic source translation by specifying the access list defined in Step 3.
Step 8	**interface** *type number* **Example:** `Switch(config)# interface ethernet 1/4`	Configures an interface and enters interface configuration mode.
Step 9	**ip address** *ip-address mask* **Example:** `Switch(config-if)# ip address 10.111.11.39 255.255.255.0`	Sets a primary IP address for the interface.
Step 10	**ip nat inside** **Example:** `Switch(config-if)# ip nat inside`	Connects the interface to an inside network, which is subject to NAT.
Step 11	**exit** **Example:** `Switch(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 12	**interface** *type number* **Example:** `Switch(config)# interface ethernet 1/1`	Configures an interface and enters interface configuration mode.
Step 13	**ip address** *ip-address mask* **Example:** `Switch(config-if)# ip address 172.16.232.182 255.255.255.240`	Sets a primary IP address for an interface.

	Command or Action	Purpose
Step 14	**ip nat outside** **Example:** `Switch(config-if)# ip nat outside`	Connects the interface to an outside network.
Step 15	**exit** **Example:** `Switch(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 16	**ip nat translation tcp-timeout** *seconds* **Example:** `Switch(config)# ip nat translation tcp-timeout 50000`	Specifies the timeout value for TCP-based dynamic NAT entries. • Dynamically created NAT translations are cleared when the configured timeout limit is reached. All configured timeouts are triggered after the timeout configured for the **ip nat translation sampling-timeout** command expires.
Step 17	**ip nat translation max-entries [all-host]** *number-of-entries* **Example:** `Switch(config)# ip nat translation max-entries 300`	Specifies the maximum number of dynamic NAT translations. The number of entries can be between 1 and 1023.
Step 18	**ip nat translation udp-timeout** *seconds* **Example:** `Switch(config)# ip nat translation udp-timeout 45000`	Specifies the timeout value for UDP-based dynamic NAT entries. • Dynamically created NAT translations are cleared when the configured timeout limit is reached. All configured timeouts are triggered after the timeout configured for the **ip nat translation sampling-timeout** command expires.
Step 19	**ip nat translation timeout** *seconds* **Example:** `switch(config)# ip nat translation timeout 13000`	Specifies the timeout value for dynamic NAT translations.
Step 20	**ip nat translation syn-timeout** {*seconds* | **never**} **Example:** `switch(config)# ip nat translation syn-timeout 20`	Specifies the timeout value for TCP data packets that send the SYN request, but do not receive a SYN-ACK reply. The timeout value ranges from 1 second to 172800 seconds. The default value is 60 seconds. The **never** keyword specifies that the SYN timer will not be run.

	Command or Action	Purpose
Step 21	**ip nat translation finrst-timeout** {*seconds* | **never**} **Example:** `switch(config)# ip nat translation finrst-timeout 30`	Specifies the timeout value for the flow entries when a connection is terminated by receiving finish (FIN) or reset (RST) packets. Use the same keyword to configure the behavior for both RST and FIN packets. The timeout value ranges from 1 second to 172800 seconds. The default value is 60 seconds. The **never** keyword specifies that the FIN or RST timer will not be run.
Step 22	**end** **Example:** `Switch(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.

Configuring Dynamic NAT Pool

You can create a NAT pool by either defining the range of IP addresses in a single **ip nat pool** command or by using the **ip nat pool** and **address** commands

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **feature nat**	Enables the NAT feature on the device.
Step 3	switch(config)# **ip nat pool** *pool-name* [*startip endip*] {**prefix** *prefix-length* | **netmask** *network-mask*}	Creates a NAT pool with a range of global IP addresses. The IP addresses are filtered by using either a prefix length or a network mask.
Step 4	(Optional) switch(config-ipnat-pool)# **address** *startip endip*	Specifies the range of global IP addresses if they were not specified during creation of the pool.
Step 5	(Optional) switch(config)# **no ip nat pool** *pool-name*	Deletes the specified NAT pool.

Example

This example shows how to create a NAT pool with a prefix length:

```
switch# configure terminal
switch(config)# ip nat pool pool1 30.1.1.1 30.1.1.2 prefix-length 24
switch(config)#
```

This example shows how to create a NAT pool with a network mask:

```
switch# configure terminal
switch(config)# ip nat pool pool5 20.1.1.1 20.1.1.5 netmask 255.0.255.0
switch(config)#
```

This example shows how to create a NAT pool and define the range of global IP addresses using the **ip nat pool** and **address** commands:

```
switch# configure terminal
switch(config)# ip nat pool pool7 netmask 255.255.0.0
switch(config-ipnat-pool)# address 40.1.1.1 40.1.1.5
switch(config-ipnat-pool)#
```

This example shows how to delete a NAT pool:

```
switch# configure terminal
switch(config)# no ip nat pool pool4
switch(config)#
```

Configuring Source Lists

You can configure a source list of IP addresses for the inside interface and the outside interface.

Before you begin

Ensure that you configure a pool before configuring the source list for the pool.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	(Optional) switch# **ip nat inside source list** *list-name* **pool** *pool-name* [**overload**]	Creates a NAT inside source list with pool with or without overloading.
Step 3	(Optional) switch# **ip nat outside source list** *list-name* **pool** *pool-name* [**add-route**]	Creates a NAT outside source list with pool without overloading.

Example

This example shows how to create a NAT inside source list with pool without overloading:

```
switch# configure terminal
switch(config)# ip nat inside source list list1 pool pool1
switch(config)#
```

This example shows how to create a NAT inside source list with pool with overloading:

```
switch# configure terminal
switch(config)# ip nat inside source list list2 pool pool2 overload
```

```
switch(config)#
```

This example shows how to create a NAT outside source list with pool without overloading:

```
switch# configure terminal
switch(config)# ip nat outside source list list3 pool pool3
switch(config)#
```

Configuring Dynamic Twice NAT for an Inside Source Address

For an inside source address translation, the traffic flows from the inside interface to the outside interface. You can configure dynamic twice NAT for an inside source address.

Before you begin

Ensure that you enable NAT on the switch.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **ip nat outside source static** *outside-global-ip-address outside-local-ip-address* | [**tcp** | **udp**] *outside-global-ip-address outside-global-port outside-local-ip-address outside-local-port* [**group** *group-id*] [**add-route**] [**dynamic**]	Configures static NAT to translate an outside global address to an inside local address or to translate inside local traffic to inside global traffic. The **group** keyword determines the group to which a translation belongs.
Step 3	switch(config)# **ip nat inside source list** *access-list-name* [**interface** *type slot/port* **overload** | **pool** *pool-name*] [**group** *group-id*] [**dynamic**]]	Establishes dynamic source translation by creating a NAT inside source list with pool with or without overloading. The **group** keyword determines the group to which a translation belongs.
Step 4	switch(config)# **ip nat pool** *pool-name* [*startip endip*] {**prefix** *prefix-length* | **netmask** *network-mask*}	Creates a NAT pool with a range of global IP addresses. The IP addresses are filtered by using either a prefix length or a network mask.
Step 5	switch(config)# **interface** *type slot/port*	Configures an interface and enters interface configuration mode.
Step 6	switch(config-if)# **ip nat outside**	Connects the interface to an outside network.
Step 7	switch(config-if)# **exit**	Exits interface configuration mode and returns to global configuration mode.
Step 8	switch(config)# **interface** *type slot/port*	Configures an interface and enters interface configuration mode.

	Command or Action	Purpose
Step 9	switch(config-if)# **ip nat inside**	Connects the interface to an inside network, which is subject to NAT.

Example

This example shows how to configure dynamic twice NAT for an inside source address:

```
switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# ip nat outside source static 2.2.2.2 4.4.4.4 group 20 dynamic
switch(config)# ip nat inside source list acl_1 pool pool_1 overload group 20 dynamic
switch(config)# ip nat pool pool_1 3.3.3.3 3.3.3.10 prefix-length 24
switch(config)# interface Ethernet1/8
switch(config-if)# ip nat outside
switch(config-if)# exit
switch(config)# interface Ethernet1/15
switch(config-if)# ip nat inside
```

Configuring Dynamic Twice NAT for an Outside Source Address

For an outside source address translation, the traffic flows from the outside interface to the inside interface. You can configure dynamic twice NAT for an outside source address.

Before you begin

Ensure that you enable NAT on the switch.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **ip nat inside source static** *inside-local-ip-address inside-global-ip-address* | [**tcp** | **udp**] *inside-local-ip-address local-port inside-global-ip-address global-port* [**group** *group-id*] [**dynamic**]	Configures static NAT to translate an inside global address to an inside local address or to translate inside local traffic to inside global traffic. The **group** keyword determines the group to which a translation belongs.
Step 3	switch(config)# **ip nat outside source list** *access-list-name* [**interface** *type slot/port* **pool** *pool-name*] [**group** *group-id*] [**add-route**] [**dynamic**]	Establishes dynamic source translation by creating a NAT outside source list with pool.
Step 4	switch(config)# **ip nat pool** *pool-name* [*startip endip*] {**prefix** *prefix-length* | **netmask** *network-mask*}	Creates a NAT pool with a range of global IP addresses. The IP addresses are filtered by using either a prefix length or a network mask.
Step 5	switch(config)# **interface** *type slot/port*	Configures an interface and enters interface configuration mode.

	Command or Action	Purpose
Step 6	switch(config-if)# **ip nat outside**	Connects the interface to an outside network.
Step 7	switch(config-if)# **exit**	Exits interface configuration mode and returns to global configuration mode.
Step 8	switch(config)# **interface** *type slot/port*	Configures an interface and enters interface configuration mode.
Step 9	switch(config-if)# **ip nat inside**	Connects the interface to an inside network, which is subject to NAT.

Example

This example shows how to configure dynamic twice NAT for an outside source address:

```
switch# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
switch(config)# ip nat inside source static 7.7.7.7 5.5.5.5 group 30 dynamic
switch(config)# ip nat outside source list acl_2 pool pool_2 group 30 dynamic
switch(config)# ip nat pool pool_2 4.4.4.4 4.4.4.10 prefix-length 24
switch(config)# interface Ethernet1/6
switch(config-if)# ip nat outside
switch(config-if)# exit
switch(config)# interface Ethernet1/11
switch(config-if)# ip nat inside
```

Clearing Dynamic NAT Translations

To clear dynamic translations, perform the following task:

Command	Purpose
clear ip nat translation [**all** | **inside** *global-ip-address local-ip-address* [**outside** *local-ip-address global-ip-address*] | **outside** *local-ip-address global-ip-address*]	Deletes all or specific dynamic NAT translations.

Example

This example shows how to clear all dynamic translations:

```
switch# clear ip nat translation all
```

This example shows how to clear dynamic translations for inside and outside addresses:

```
switch# clear ip nat translation inside 2.2.2.2 4.4.4.4 outside 5.5.5.5 7.7.7.7
```

Verifying Dynamic NAT Configuration

To display dynamic NAT configuration, perform the following tasks:

Command	Purpose
show ip nat translations	Displays active Network Address Translation (NAT) translations including dynamic translations. Displays additional information for each translation table entry, including when an entry was created and used.
show ip nat translations verbose	Displays active Network Address Translation (NAT) translations including dynamic translations in a more readable format.
show ip nat translations vrf all	Displays active Network Address Translation (NAT) translations including dynamic translations along with its VRF name.
show run nat	Displays NAT configuration.

Example

This example shows how to display running configuration for NAT:

```
switch# show run nat

!Command: show running-config nat
!Time: Wed Apr 23 11:17:43 2014

version 6.0(2)A3(1)
feature nat

ip nat inside source list list1 pool pool1
ip nat inside source list list2 pool pool2 overload
ip nat inside source list list7 pool pool7 overload
ip nat outside source list list3 pool pool3
ip nat pool pool1 30.1.1.1 30.1.1.2 prefix-length 24
ip nat pool pool2 10.1.1.1 10.1.1.2 netmask 255.0.255.0
ip nat pool pool3 30.1.1.1 30.1.1.8 prefix-length 24
ip nat pool pool5 20.1.1.1 20.1.1.5 netmask 255.0.255.0
ip nat pool pool7 netmask 255.255.0.0
  address 40.1.1.1 40.1.1.5
```

This example shows how to display active NAT translations:

Inside pool with overload

```
switch# show ip nat translation
Pro  Inside global      Inside local       Outside local      Outside global
icmp 20.1.1.3:64762     10.1.1.2:133       20.1.1.1:0         20.1.1.1:0
icmp 20.1.1.3:64763     10.1.1.2:134       20.1.1.1:0         20.1.1.1:0
```

```
switch# show ip nat translations verbose
Pro Inside global Inside local Outside local Outside global
any 1.1.1.1 10.1.1.2 --- ---
    Vrf: default    Group_id:0
icmp 101.1.0.1:65351 101.0.0.1:0 102.1.0.1:231 102.1.0.1:231
    VRF: red   Group_id:0
```

```
 Format(H:M:S) Time-left:12:0:9
udp 101.1.0.1:65383 101.0.0.1:63 102.1.0.1:63 102.1.0.1:63
    VRF: red   Group_id:0
 Format(H:M:S) Time-left:12:0:9
tcp 101.1.0.1:64549 101.0.0.1:8809 102.1.0.1:9087 102.1.0.1:9087
    VRF: red   Group_id:0
 Format(H:M:S) Time-left:12:0:9
```

Verifying NAT Statistics

To display Network Address Translation (NAT) statistics, perform the following task:

Command	Purpose
show ip nat statistics	Display Network Address Translation (NAT) statistics.

Example

This example shows the sample output from the **show ip nat statistics** command:

```
switch# show ip nat statistics

IP NAT Statistics
==================================================
Total active translations: 2
No.Static: 2
No.Dyn:    0
No.ICMP:   0
--------------------------------------------------
Total expired Translations: 0
SYN timer expired:          0
FIN-RST timer expired:      0
Inactive timer expired:     0
--------------------------------------------------
Total Hits:  0                  Total Misses:  3
In-Out Hits: 0                  In-Out Misses: 0
Out-In Hits: 0                  Out-In Misses: 3
--------------------------------------------------
Total SW Translated Packets: 0
In-Out SW Translated: 0
Out-In SW Translated: 0
--------------------------------------------------
Total SW Dropped Packets: 0
In-Out SW Dropped: 0
Out-In SW Dropped: 0

Address alloc. failure drop:      0
Port alloc.  failure drop:        0
Dyn. Translation max limit drop:  0
ICMP max limit drop:              0
Allhost max limit drop:           0
--------------------------------------------------
NAT Inside Interfaces:  1
Ethernet1/1

NAT Outside Interfaces: 1
Ethernet1/3
--------------------------------------------------
```

```
Inside source list:
++++++++++++++++++++

Access list: ACL1
RefCount: 0
Pool: pool1     Overload
Total addresses: 200
Allocated: 0    percentage: 0%
Missed: 0
```

Clearing NAT Statistics

To clear Network Address Translation (NAT) statistics, perform the following task:

Command	Purpose
clear ip nat Statistics	Clear Network Address Translation (NAT) statistics entries. This command clears only the following parameters: • Total Hits • In-Out Hits • Out-In Hits • Total Misses • In-Out Misses • Out-In Misses • Total SW Translated Packets • In-Out SW Translated • Out-In SW Translated • Total SW Dropped Packets • In-Out SW Dropped • Address alloc. failure drop • Port alloc. failure drop • Dyn. Translation max limit drop • ICMP max limit drop • Allhost max limit drop • Inside / Outside source list • Missed

Example: Configuring Dynamic Translation and Translation Timeouts

The following example shows how to configure dynamic overload Network Address Translation (NAT) by specifying an access list:

```
Switch> enable
Switch# configure terminal
Switch(config)# ip access-list acl1
Switch(config-acl)# permit ip 10.111.11.0/24 any
Switch(config-acl)# deny udp 10.111.11.100/32 any
Switch(config-acl)# exit
Switch(config)# ip nat inside source list acl1 interface ethernet 1/1 overload
Switch(config)# interface ethernet 1/4
Switch(config-if)# ip address 10.111.11.39 255.255.255.0
Switch(config-if)# ip nat inside
Switch(config-if)# exit
Switch(config)# interface ethernet 1/1
Switch(config-if)# ip address 172.16.232.182 255.255.255.240
Switch(config-if)# ip nat outside
Switch(config-if)# exit
Switch(config)# ip nat translation tcp-timeout 50000
Switch(config)# ip nat translation max-entries 300
Switch(config)# ip nat translation udp-timeout 45000
Switch(config)# ip nat translation timeout 13000
Switch(config)# end
```

Information About VRF Aware NAT

VRF aware NAT is supported by static and dynamic NAT configurations. When the traffic is configured to flow from a non-default VRF (inside) to the same non-default VRF (outside), the match-in-vrf option of the IP NAT command must be specified.

When the traffic is configured to flow from a non-default VRF (inside) to a default VRF (outside), the match-in-vrf option of the IP NAT command cannot be specified. A NAT outside configuration is not supported on a non-default VRF interface when the NAT inside is configured on a default VRF interface.

When overlapping addresses are configured across different VRFs for a NAT inside interface, a NAT outside interface should not be the default VRF interface. For example, vrfA and vrfB are configured as NAT inside interfaces with same source subnets and a NAT outside interface is configured as the default VRF. NAT is not supported in a configuration like this because of the ambiguity in routing packets from a NAT outside interface to NAT inside interface.

Configuring VRF Aware NAT

Before you begin

Ensure that you enable NAT on the switch.

Procedure

	Command or Action	Purpose
Step 1	switch# **configure terminal**	Enters global configuration mode.
Step 2	switch(config)# **[no] ip nat** *inside* | *outside* **source list** *ACL_NAME* [*interface INTERFACE NAME* **overload**][*pool POOL NAME* **overload**] [**group** *group-id*] [**dynamic**] [**vrf** <*vrf-name*> [**match-in-vrf**]]	Creates or deletes dynamic NAT with VRF specific. The **group** keyword determines the group to which a translation belongs.
Step 3	switch(config)# **[no] ip nat** *inside* | *outside* **source static** *LOCAL IP GLOBAL IP* | [*tcp* | *udp LOCAL IP LOCAL PORT GLOBAL IP GLOBAL PORT*] [**group** *group-id*] [**dynamic**] [**vrf** <*vrf-name*> [**match-in-vrf**]]	Creates or deletes a VRF specific static NAT. The **group** keyword determines the group to which a translation belongs.
Step 4	switch(config)# **interface** *type slot/port* [**vrf** <*vrf-name* **ip nat** *inside* | *outside*	Enables NAT on a VRF-aware interface.

See the output of **show run nat** command.

```
#show run nat
….
feature nat
ip nat inside source static 1.1.1.1 1.1.1.100 vrf red match-in-vrf
ip nat outside source static 2.2.2.200 2.2.2.2 vrf red match-in-vrf add-route
ip nat inside source list nat-acl-in1 pool pool-in1 vrf red match-in-vrf overload
ip nat outside source list nat-acl-out1 pool pool-out1 vrf red match-in-vrf add-route
interface Ethernet1/3
  ip nat outside
interface Ethernet1/5
  ip nat inside
```

See the output of **show ip nat translation verbose** command.

```
switch# show ip nat translation verbose
Pro Inside global Inside local Outside local Outside global
any 1.1.1.1 10.1.1.2 --- ---
    Vrf: default    Group_id:0
icmp 101.1.0.1:65351 101.0.0.1:0 102.1.0.1:231 102.1.0.1:231
    VRF: red   Group_id:0
 Format(H:M:S) Time-left:12:0:9
udp 101.1.0.1:65383 101.0.0.1:63 102.1.0.1:63 102.1.0.1:63
    VRF: red   Group_id:0
 Format(H:M:S) Time-left:12:0:9
tcp 101.1.0.1:64549 101.0.0.1:8809 102.1.0.1:9087 102.1.0.1:9087
    VRF: red   Group_id:0
 Format(H:M:S) Time-left:12:0:9
```

See the output of **show ip nat translations vrf all** command.

```
switch# show ip nat translations vrf all
Pro Inside global      Inside local       Outside local      Outside global       Vrf
udp ---                ---                3.3.3.30:100       3.3.3.3:30         default
udp 2.1.1.10:200       2.1.1.1:100        3.3.3.30:100       3.3.3.3:30         default
```

```
icmp 70.1.1.1:65276    10.1.1.2:0         20.1.1.2:0         20.1.1.2:0         default
udp  101.1.0.1:65383   101.0.0.1:63       102.1.0.1:63       102.1.0.1:63       red
```