Configuring NAT for IP Address Conservation

This module describes how to configure Network Address Translation (NAT) for IP address conservation and how to configure the inside and outside source addresses. This module also provides information about the benefits of configuring NAT for IP address conservation.

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 the private (not globally unique) addresses in the internal network into legal addresses before packets are forwarded to the corresponding network.

NAT can be configured to advertise to the outside world only one address for the entire network. This provides additional security by effectively hiding the entire internal network behind that one address.

NAT is also used at the enterprise edge to allow internal users access to the Internet and to allow Internet access to internal devices such as mail servers.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the “Feature Information for NAT” section.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Configuring NAT for IP Address Conservation

- This feature is supported only on the following PIDs of the Cisco ASR 901 Router: A901-6CZ-FS-D and A901-6CZ-FS-A.

Restrictions for Configuring NAT for IP Address Conservation

The following limitations and configuration guidelines apply when configuring NAT on the Cisco ASR 901 Router:

- NAT-T is not supported.
- Dynamic NAT with pools in the same network as on the NAT interfaces.
- Port channel for NAT and Port Address Translation (PAT) are not supported.
- Simple Network Management Protocol (SNMP) MIB is not supported for NAT.
- Dynamic NAT with Extended ACL is not supported.
- This feature is available only on the new software image named *asr901sec-universalk9.mz*. (This feature is not available on the standalone software image named *asr901-universalk9.mz*. If you use asr901sec-universalk9.mz in an unsupported Cisco ASR 901 PID, the router issues a warning message and loads the software with basic features.)
- Maximum bidirectional throughput supported for ESP-NAT traffic is 250 Mbps.

Note Throughput is low with fragmentation (around 300 Kbps).

Information About Configuring NAT for IP Address Conservation

The following features are supported on the Cisco ASR 901 Routers from Cisco IOS Release 15.4(2)S onwards.

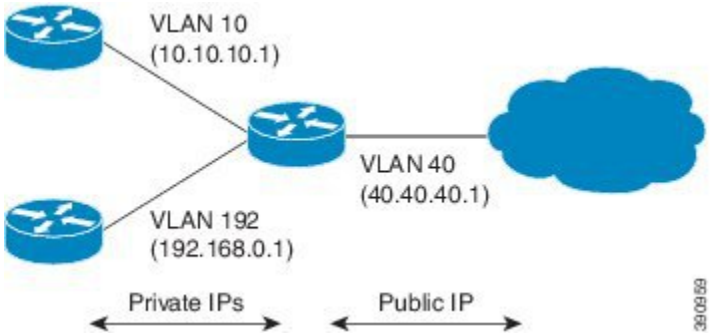
Overview

You can translate IP addresses into globally unique IP addresses when communicating outside your network.

You can configure static or dynamic inside-source address translation as follows:

- Static translation establishes a one-to-one mapping between an inside local address and an inside global address. Static translation is useful when a host on the inside has to be accessed by a fixed address from the outside.
- Dynamic translation establishes mapping between an inside local address and a pool of global addresses.

The following figure shows the translation of a source address inside a network to a source address outside the network.



You can conserve addresses in the inside global address pool by allowing a device to use one global address for many local addresses. This type of Network Address Translation (NAT) configuration is called overloading. When overloading is configured, the device maintains enough information from higher-level protocols (for example, TCP or UDP port numbers) to translate the global address back to the correct local address. When multiple local addresses map to one global address, the TCP or UDP port numbers of each inside host distinguish between local addresses.

How NAT Works

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

If NAT cannot allocate an address because it has run out of addresses, it drops the packet and sends an Internet Control Message Protocol (ICMP) host unreachable packet to the destination.

Types of NAT

NAT operates on a router—generally connecting only two networks—and translates the private (inside local) addresses within the internal network into public (inside global) addresses before packets are forwarded to another network. This functionality gives you the option to configure NAT such that it will advertise only a single address for your entire network to the outside world. Doing this effectively hides the internal network from the world, giving you additional security.

The types of NAT include:

- Static address translation (static NAT)—Allows one-to-one mapping between local and global addresses.
- Dynamic address translation (dynamic NAT)—Maps unregistered IP addresses to registered IP addresses from a pool of registered IP addresses.
- Overloading—Maps multiple unregistered IP addresses to a single registered IP address (many to one) using different ports. This method is also known as PAT. By using overloading, thousands of users can be connected to the Internet by using only one real global IP address.

NAT Inside and Outside Addresses

The term *inside* in NAT context refers to networks owned by an organization, and which 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, the term *outside* refers to those networks to which the stub network connects, and which are generally not under the control of an organization. Hosts in outside networks can also be subject to translation, and can thus have local and global addresses.

NAT uses the following definitions:

- Inside local address—An IP address that is assigned to a host on the inside network. The address is probably not a valid IP address assigned by the Network Information Center (NIC) or service provider.
- Inside global address—A valid IP address (assigned by the NIC or 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. Not necessarily a valid address, it is allocated from the address space that is routable on the inside.
- Outside global address—The IP address assigned to a host on the outside network by the owner of the host. The address is allocated from a globally routable address or network space.

Static IP Address Support

A public wireless LAN provides users of mobile computing devices with wireless connections to a public network, such as the Internet.

The NAT Static IP Address Support feature extends the capabilities of public wireless LAN providers to support users configured with a static IP address. By configuring a device to support users with a static IP address, public wireless LAN providers extend their services to a greater number of users.

Users with static IP addresses can use services of the public wireless LAN provider without changing their IP address. NAT entries are created for static IP clients, and a routable address is provided.

Supported Components

The following components are supported as part of the NAT feature:

- Static NAT and PAT
- Dynamic NAT and PAT with overload
- NAT and PAT support for Layer 3-forwarded traffic.
- Maximum number of inside and outside addresses is 10.
- Coexistence with Layer 2 and Layer 3 traffic

How to Configure NAT for IP Address Conservation

The tasks described in this section configure NAT for IP address conservation. You must configure at least one of the tasks described in this section. Based on your configuration, you may have to configure more than one task.

Configuring an Inside Source Address

Inside source addresses can be configured for static or dynamic translations. Based on your requirements, you can configure either static or dynamic translations.

Note You must configure different IP addresses for an interface on which NAT is configured and for inside addresses that are configured, by using the **ip nat inside source static** command.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface vlan 10`	Specifies an interface type and number, and enters interface configuration mode.
Step 4	**ip address** *ip_address mask* **Example:** `Router(config-if)# ip address 10.10.10.1 255.255.255.0`	Sets a primary IP address for an interface.
Step 5	ip nat inside **Example:** `Router(config-if)# ip nat inside`	Connects the interface to the inside network, which is subject to NAT.
Step 6	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 7	**interface** *type number* **Example:** `Router(config)# interface vlan 40`	Specifies an interface type and number, and enters interface configuration mode.
Step 8	**ip address** *ip_address mask* **Example:** `Router(config-if)# ip address 40.40.40.1 255.255.255.0`	Sets a primary IP address for an interface.
Step 9	ip nat outside **Example:** `Router(config-if)# ip nat outside`	Connects the interface to the outside network.
Step 10	**ip nat inside source static** *ilocal-ip global-ip* **Example:** `Router(config)# ip nat inside source static 10.10.10.2 40.40.40.1`	Establishes static translation between an inside local address and an inside global address.
Step 11	end **Example:** `Router(config)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Configuring Dynamic Translation of Inside Source Addresses Without Overload

Dynamic translation establishes a mapping between an inside local addresses and a pool of global addresses. Dynamic translation is useful when multiple users on a private network have to access the Internet. The dynamically configured pool IP address can be used as required, and is released for use by other users when access to the Internet is no longer required.

Note Cisco ASR 901 Router does not differentiate between the dynamic translation with overload and dynamic translation without overload. By default, overloading is considered if translation exceeds the given pool.

Note When inside global or outside local addresses belong to a directly connected subnet on a NAT device, the device adds IP aliases for them so that it can answer Address Resolution Protocol (ARP) requests. However, a situation where the device answers packets that are not destined for it, possibly causing a security issue, may arise. This may happen when an incoming Internet Control Message Protocol (ICMP) packet or a UDP packet that is destined for one of the alias addresses does not have a corresponding NAT translation in the NAT table, and the device itself runs a corresponding service, for example, Network Time Protocol (NTP). Such a situation might cause minor security risks.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface vlan 10`	Specifies an interface type and number, and enters interface configuration mode.
Step 4	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.10.10.1 255.255.255.0`	Sets a primary IP address for the interface.
Step 5	**ip nat inside** **Example:** `Router(config-if)# ip nat inside`	Connects the interface to the inside network, that is subject to NAT.
Step 6	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to the global configuration mode.
Step 7	**interface** *type number* **Example:** `Router(config)# interface vlan 40`	Specifies an interface type and number, and enters interface configuration mode.
Step 8	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 40.40.40.1 255.255.255.0`	Sets a primary IP address for the interface.
Step 9	**ip nat outside** **Example:** `Router(config-if)# ip nat outside`	Connects the interface to the outside network.
Step 10	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 11	**ip nat pool name start-ip end-ip {netmask netmask | prefix-length prefix-length}** **Example:** `Router(config)# ip nat pool net-208 50.50.50.1 50.50.50.10 netmask 255.255.255.0`	Defines a pool of global addresses to be allocated as required.
Step 12	**access-list access-list-number permit source [source-wildcard]** **Example:** `Router(config)# access-list 1 permit 10.10.10.2 0.0.0.0`	Defines a standard access list permitting those addresses that are to be translated.
Step 13	**ip nat inside source list access-list-number pool** *name* **Example:** `Router(config)# ip nat inside source list 1 pool net-208`	Establishes dynamic source translation, specifying the access list defined in Step 12.
Step 14	**end** **Example:** `Router(config)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Configuring Dynamic Translation of Inside Source Addresses with Overload

You can conserve addresses in the inside global address pool by allowing a device to use one global address for many local addresses. This type of NAT configuration is called overloading. When overloading is configured, the device maintains enough information from higher-level protocols (for example, TCP or UDP port numbers) to translate the global address back to the correct local address. When multiple local addresses map to one global address, the TCP or UDP port numbers of each inside host distinguish between local addresses.

Procedure

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

	Command or Action	Purpose
Step 3	**interface** *type number* **Example:** `Router(config)# interface vlan 10`	Specifies an interface type and number, and enters the interface configuration mode.
Step 4	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.10.10.1 255.255.255.0`	Sets a primary IP address for the interface.
Step 5	**ip nat inside** **Example:** `Router(config-if)# ip nat inside`	Connects the interface to the inside network, that is subject to NAT.
Step 6	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 7	**interface** *type number* **Example:** `Router(config)# interface vlan 40`	Specifies an interface type and number, and enters interface configuration mode.
Step 8	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 40.40.40.1 255.255.255.0`	Sets a primary IP address for the interface.
Step 9	**ip nat outside** **Example:** `Router(config-if)# ip nat outside`	Connects the interface to the outside network.
Step 10	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 11	**ip nat pool name start-ip end-ip {netmask netmask | prefix-length prefix-length}** **Example:** `Router(config)# ip nat pool net-208 50.50.50.1 50.50.50.10 netmask 255.255.255.0`	Defines a pool of global addresses to be allocated as required.
Step 12	**access-list access-list-number permit source** *[source-wildcard]* **Example:** `Router(config)# access-list 1 permit 10.10.10.2 0.0.0.0`	Defines a standard access list permitting those addresses that are to be translated.

	Command or Action	Purpose
Step 13	**ip nat inside source list access-list-number pool** *name* **overload** **Example:** `Router(config)# ip nat inside source list 1 pool net-208 overload`	Establishes dynamic source translation, specifying the access list defined in Step 12.
Step 14	**end** **Example:** `Router(config)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Configuring Static PAT

To configure a static PAT, complete the following steps:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface vlan 10`	Specifies an interface type and number, and enters interface configuration mode.
Step 4	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.10.10.1 255.255.255.0`	Sets a primary IP address for an interface.
Step 5	**ip nat inside** **Example:** `Router(config-if)# ip nat inside`	Connects the interface to the inside network, that is subject to NAT.
Step 6	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 7	**interface** *type number* **Example:** `Router(config)# interface vlan 40`	Specifies an interface type and number, and enters interface configuration mode.
Step 8	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 40.40.40.1 255.255.255.0`	Sets a primary IP address for an interface.
Step 9	**ip nat outside** **Example:** `Router(config-if)# ip nat outside`	Connects the interface to the outside network.
Step 10	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.

Step 11	**ip nat outside source static tcp** *local-ip local-port global-ip global-port*
	
	Example:
	`Router(config)# ip nat outside source`
	
	`static tcp 10.10.10.2 23 40.40.40.10 2023`
		Establishes static translation for outside network. Also, enables the use of Telnet to the device from the outside.

Step 12	**end** **Example:** `Router(config)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Verifying Configuration of NAT for IP Address Conservation

To verify the NAT configuration, use the **show ip nat translation** command:

```
Router# show ip nat translation
SNAT: Proto udp Inside local ip is 10.10.10.2 Inside global ip 40.40.40.10 input 1146 output
 0
DNAT: Proto tcp Outside local ip is 40.40.40.10 Outside global ip 10.10.10.2 input 8 output
 5
```

Configuration Examples for NAT for IP Address Conservation

Example: Configuring Inside Source Address

The following is a sample configuration of static NAT:

```
interface vlan10
ip address 10.10.10.1 255.255.255.0
ip nat inside
int vlan40
ip address 40.40.40.1 255.255.255.0
ip nat outside
ip nat inside source static 10.10.10.2 40.40.40.1
ip nat inside source static 192.168.1.2 40.40.40.2
```

Example: Configuring Dynamic Translation of Inside Source Addresses Without Overload

The following is a sample configuration of dynamic NAT without overload:

```
interface vlan10
ip address 10.10.10.1 255.255.255.0
ip nat inside
interface vlan192
ip address 192.168.0.1 255.255.255.0
ip nat inside
interface vlan40
ip address 40.40.40.1 255.255.255.0
ip nat outside
ip nat pool no-overload 50.50.50.10 50.50.50.10 netmask 255.255.255.0
access-list 7 permit 10.10.10.0 0.0.0.255
ip nat inside source list 7 pool no-overload
```

Example: Configuring Dynamic Translation of Inside Source Addresses with Overload

The following is a sample configuration of dynamic NAT with overload:

```
interface vlan10
ip address 10.10.10.1 255.255.255.0
ip nat inside
interface vlan192
ip address 192.168.0.1 255.255.255.0
ip nat inside
interface vlan40
ip address 40.40.40.1 255.255.255.0
ip nat outside
ip nat pool overld 50.50.50.10 50.50.50.10 netmask 255.255.255.0
access-list 7 permit 10.10.10.0 0.0.0.255
ip nat inside source list 7 pool overld overload
```

Example: Configuring Static PAT

The following is a sample configuration of static PAT:

```
interface vlan10
ip address 10.10.10.1 255.255.255.0
ip nat inside
interface vlan192
ip address 192.168.0.1 255.255.255.0
ip nat inside
interface vlan40
ip address 40.40.40.1 255.255.255.0
ip nat outside
ip nat inside source static tcp 10.10.10.2 23 40.40.40.1 2323
```

Additional References

The following sections provide references related to Configuring NAT for IP Address Conservation feature.

Related Documents

Related Topic	Document Title
Cisco IOS Commands	Cisco IOS Master Commands List, All Releases
Cisco ASR 901 Command Reference	Cisco ASR 901 Series Aggregation Services Router Command Reference
Cisco IOS Interface and Hardware Component Commands	Cisco IOS Interface and Hardware Component Command Reference

Standards

Standard	Title
None	—

RFCs

RFC	Title
None	—

Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport

Feature Information for Configuring NAT for IP Address Conservation

The following table lists the features in this module and provides links to specific configuration information.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn . An account on Cisco.com is not required.

Note The following table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 1: Feature Information for NAT

Feature Name	Releases	Feature Information
Configuring NAT for IP Address Conservation	15.4(2)S	This feature was introduced on the Cisco ASR 901 Routers.