Configuring NAT for IP Address Conservation

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This module describes how to configure Network Address Translation (NAT) for IP address conservation and configure 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 router, usually connecting two networks, and translates the private (not globally unique) addresses in the internal network into legal addresses before packets are forwarded onto another network. NAT can be configured to advertise only one address for the entire network to the outside world. This ability provides additional security, 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 caveats and feature information, see Bug Search Tool and 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 table at the end of this module.

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

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Prerequisites for Configuring NAT for IP Address Conservation

Access Lists

All access lists required for use with the tasks in this module should be configured prior to beginning the configuration task. For information about how to configure an access list, refer to the *IP Access List Sequence Numbering* document.

Note If you specify an access list to use with a NAT command, NAT will not support the commonly used **permit ip any any** command in the access list.

NAT Requirements, Objectives, and Interfaces

Before configuring NAT in your network, you should understand on which interfaces NAT will be configured and for what purposes. The following requirements will help you to decide how to configure and use NAT:

1. Define NAT inside and outside interfaces if:
   - Users exist off multiple interfaces.
   - Multiple interfaces connect to the Internet.
2. Define what you need NAT to accomplish:
   - Allow internal users to access the Internet.
   - Allow the Internet to access internal devices such as a mail server.
   - Allow overlapping networks to communicate.
   - Allow networks with different address schemes to communicate.
   - Allow the use of an application-level gateway (ALG).
   - Redirect TCP traffic to another TCP port or address.
   - Use NAT during a network transition.

Restrictions for Configuring NAT for IP Address Conservation

- NAT Virtual Interfaces (NVIs) are not supported in the Cisco IOS XE software.
- Network Address Translation (NAT) is not practical if large numbers of hosts in the stub domain communicate outside of the domain.
- Some applications use embedded IP addresses in such a way that translation by a NAT device is impractical. These applications may not work transparently or at all through a NAT device.
- By default, support for the Session Initiation Protocol (SIP) is enabled on port 5060. Therefore, NAT-enabled devices interpret all packets on this port as SIP call messages. If other applications in the system use port 5060 to send packets, the NAT service may corrupt the packet as it attempts to interpret the packet as a SIP call message.
- NAT hides the identity of hosts, which may be an advantage or a disadvantage depending on the desired result.

- A device configured with NAT must not advertise the local networks to the outside. However, routing information that NAT receives from the outside can be advertised in the stub domain as usual.
- If you specify an access list to use with a NAT command, NAT does not support the **permit ip any any** command that is commonly used in the access list.
- An access list with a port range is not supported on the Cisco ASR 1000 Series Aggregation Services Routers.
- NAT configuration is not supported on the access side of the Intelligent Services Gateway (ISG).
- Using the physical interface address of a device as an address pool is not supported. NAT can share the physical interface address of a device only by using the NAT interface overload configuration. A device uses the ports of its physical interface and NAT must receive communication about the ports that it can safely use for translation. This communication happens only when the NAT interface overload is configured.
- The output of **show ip nat statistics** command displays information about all IP address pools and NAT mappings that you have configured. If your NAT configuration has a high number of IP address pools and NAT mappings (for example 1000 to 4000), the update rate of the pool and mapping statistics in the **show ip nat statistics** is very slow.

Information About Configuring NAT for IP Address Conservation

Benefits of Configuring NAT for IP Address Conservation

NAT allows organizations to resolve the problem of IP address depletion when they have existing networks and need to access the Internet. Sites that do not yet possess Network Information Center (NIC)-registered IP addresses must acquire them, and if more than 254 clients are present or planned, the scarcity of Class B addresses becomes a serious issue. Cisco IOS XE NAT addresses these issued by mapping thousands of hidden internal addresses to a range of easy-to-get Class C addresses.

Sites that already have registered IP addresses for clients on an internal network may want to hide those addresses from the Internet so that hackers cannot directly attack the clients. With client addresses hidden, a degree of security is established. Cisco IOS XE NAT gives LAN administrators complete freedom to expand Class A addressing, which is drawn from the reserve pool of the Internet Assigned Numbers

Authority (RFC 1597). This expansion occurs within the organization without concern for addressing changes at the LAN/Internet interface.

The Cisco IOS XE software can selectively or dynamically perform NAT. This flexibility allows the network administrator to use a mix of RFC 1597 and RFC 1918 addresses or registered addresses. NAT is designed for use on a variety of routers for IP address simplification and conservation. In addition, Cisco IOS XE NAT allows the selection of which internal hosts are available for NAT.

A significant advantage of NAT is that it can be configured without requiring changes to hosts or routers other than those few routers on which NAT will be configured.

Purpose of NAT

Two key problems facing the Internet are depletion of IP address space and scaling in routing. NAT is a feature that allows the IP network of an organization to appear from the outside to use different IP address space than what it is actually using. Thus, NAT allows an organization with nonglobally routable addresses to connect to the Internet by translating those addresses into globally routable address space. NAT also allows a graceful renumbering strategy for organizations that are changing service providers or voluntarily renumbering into classless interdomain routing (CIDR) blocks. NAT is described in RFC 1631.

How NAT Works

A router 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 router between a stub domain and a 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.

Uses of NAT

NAT can be used for the following applications:

- When you want to connect to the Internet, but not all your hosts have globally unique IP addresses. NAT enables private IP internetworks that use nonregistered IP addresses to connect to the Internet. NAT is configured on the router at the border of a stub domain (referred to as the *inside network*) and a public network such as the Internet (referred to as the *outside network*). NAT translates the internal local addresses to globally unique IP addresses before sending packets to the outside network. As a solution to the connectivity problem, NAT is practical only when relatively few hosts in a stub domain communicate outside of the domain at the same time. When this is the case, only a small subset of the IP addresses in the domain must be translated into globally unique IP addresses when outside communication is necessary, and these addresses can be reused when no longer in use.
- When you must change your internal addresses. Instead of changing them, which can be a considerable amount of work, you can translate them by using NAT.
- When you want to do basic load sharing of TCP traffic. You can map a single global IP address to many local IP addresses by using the TCP load distribution feature.

NAT Inside and Outside Addresses

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

NAT uses the following definitions:

- 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 NIC or service provider.
- Inside global address--A legitimate 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. The address is not necessarily legitimate; it was allocated from the address space 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 network space.

- Inside Source Address Translation, page 5
- Inside Global Addresses Overloading, page 6

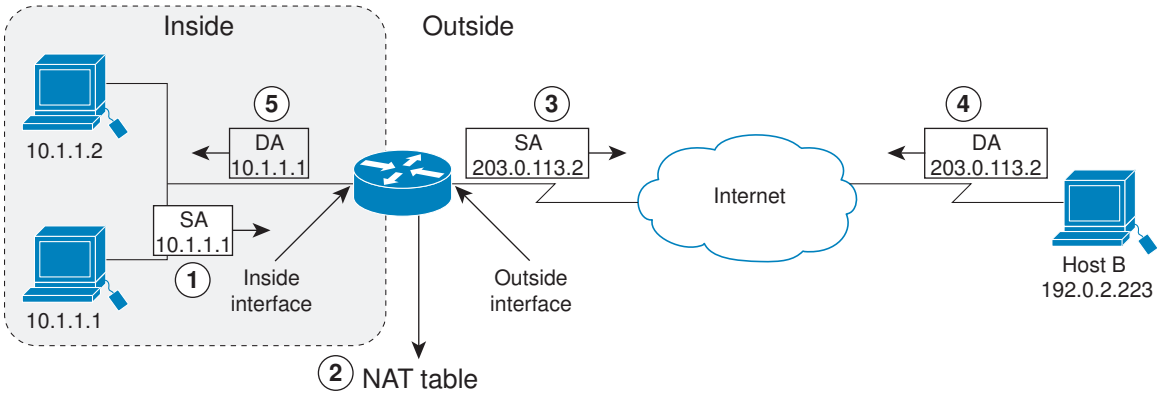
Inside Source Address Translation

You can translate your own IP addresses into globally unique IP addresses when communicating outside of your network. You can configure static or dynamic inside source translation as follows:

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

The figure below illustrates a router that is translating a source address inside a network to a source address outside the network.

Figure 1 NAT Inside Source Translation



Protocol	Inside Local IP Address	Inside Global IP Address	Outside Global IP Address	Outside Local IP Address
-- -- -- --	10.1.1.2 10.1.1.1	203.0.113.3 203.0.113.2	-- -- -- -- -- -- -- --	-- -- -- -- -- -- -- --

The following process describes inside source address translation, as shown in the figure above:

1. The user at host 10.1.1.1 opens a connection to host B.
2. The first packet that the router receives from host 10.1.1.1 causes the router to check its NAT table:
   - If a static translation entry was configured, the router goes to Step 3.
   - If no translation entry exists, the router determines that source address (SA) 10.1.1.1 must be translated dynamically, selects a legal, global address from the dynamic address pool, and creates a translation entry. This type of entry is called a *simple entry*.
3. The router replaces the inside local source address of host 10.1.1.1 with the global address of the translation entry and forwards the packet.
4. Host B receives the packet and responds to host 10.1.1.1 by using the inside global IP destination address (DA) 203.0.113.2.
5. When the router receives the packet with the inside global IP address, it performs a NAT table lookup by using the inside global address as a key. It then translates the address to the inside local address of host 10.1.1.1 and forwards the packet to host 10.1.1.1.

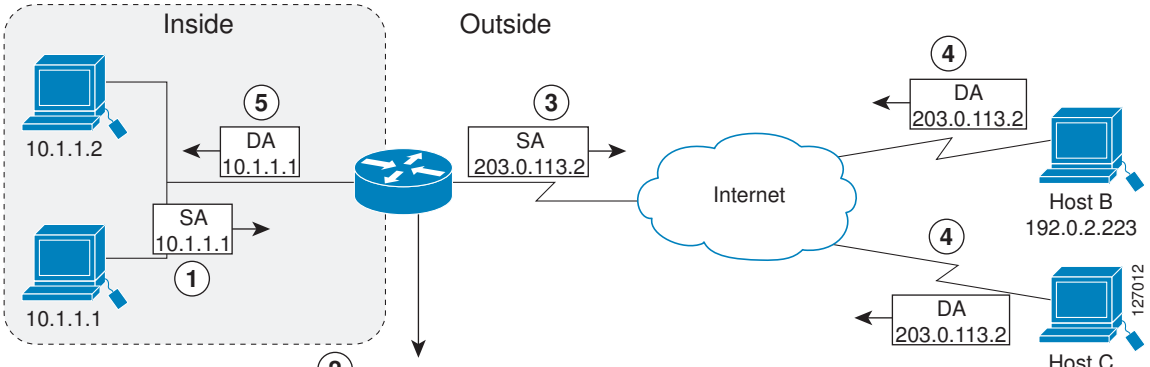
Host 10.1.1.1 receives the packet and continues the conversation. The router performs Steps 2 through 5 for each packet.

Inside Global Addresses Overloading

You can conserve addresses in the inside global address pool by allowing the router to use one global address for many local addresses. When this overloading is configured, the router 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 the local addresses.

The figure below illustrates a NAT operation when one inside global address represents multiple inside local addresses. The TCP port numbers act as differentiators.

Figure 2 NAT Overloading Inside Global Addresses



Protocol	Inside Local IP address:port	Inside Global IP address:port	Outside Global IP address:port	Outside Local IP address
TCP	10.1.1.2:1723	203.0.113.2:1723	198.51.100.4:23	198.51.100.4:23
TCP	10.1.1.1:1024	203.0.113.2:1024	192.0.2.223:23	192.0.2.223:23

The router performs the following process in overloading inside global addresses, as shown in the figure above. Both host B and host C believe that they are communicating with a single host at address

203.0.113.2. They are actually communicating with different hosts; the port number is the differentiator. In fact, many inside hosts could share the inside global IP address by using many port numbers.

1. The user at host 10.1.1.1 opens a connection to host B.
2. The first packet that the router receives from host 10.1.1.1 causes the router to check its NAT table:
   - If no translation entry exists, the router determines that address 10.1.1.1 must be translated, and sets up a translation of inside local address 10.1.1.1 to a legal global address.
   - If overloading is enabled, and another translation is active, the router reuses the global address from that translation and saves enough information to be able to translate the global address back. This type of entry is called an *extended entry*.
3. The router replaces the inside local source address 10.1.1.1 with the selected global address and forwards the packet.
4. Host B receives the packet and responds to host 10.1.1.1 by using the inside global IP address 203.0.113.2.
5. When the router receives the packet with the inside global IP address, it performs a NAT table lookup, using the protocol, the inside global address and port, and the outside address and port as a key; translates the address to inside local address 10.1.1.1; and forwards the packet to host 10.1.1.1.

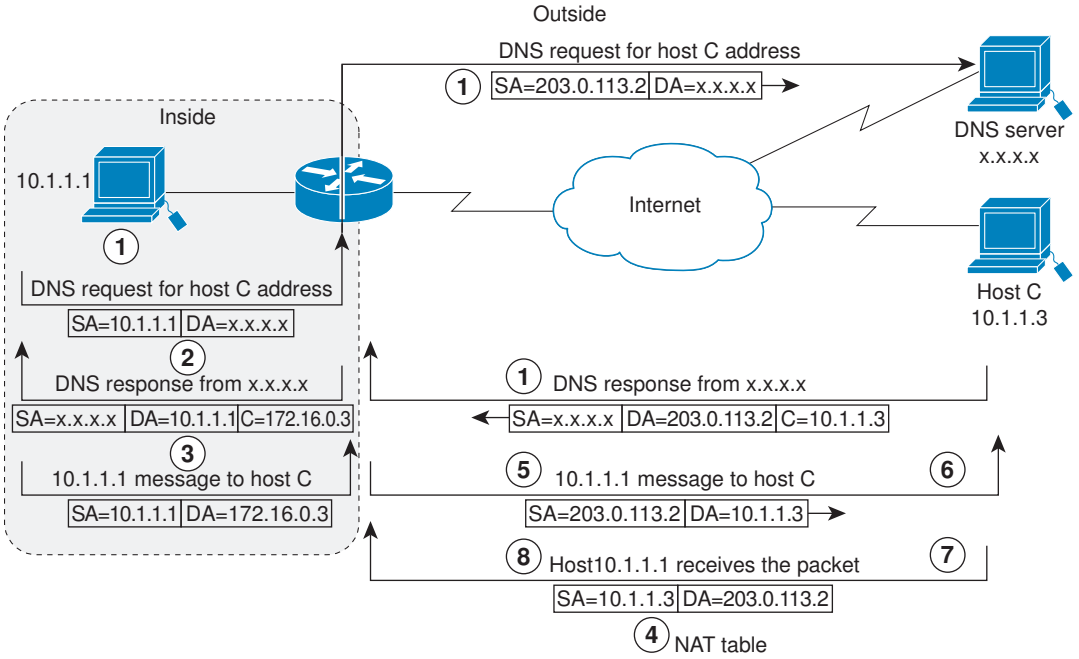
Host 10.1.1.1 receives the packet and continues the conversation. The router performs Steps 2 through 5 for each packet.

Address Translation of Overlapping Networks

NAT is used to translate your IP addresses, which could occur because your IP addresses are not legal, officially assigned IP addresses. Perhaps you chose IP addresses that officially belong to another network. The case of an address used both illegally and legally is called *index overlapping*. You can use NAT to translate inside addresses that overlap with outside addresses.

The figure below shows how NAT translates overlapping networks.

Figure 3 NAT Translating Overlapping Addresses



Protocol	Inside Local IP Address	Inside Global IP Address	Outside Global IP Address	Outside Local IP Address
-- -- -- --	10.1.1.1	203.0.113.2	10.1.1.3	172.16.0.3

127013

The router performs the following process when translating overlapping addresses:

1. The user at host 10.1.1.1 opens a connection to host C by name, requesting a name-to-address lookup from a Domain Name System (DNS) server.
2. The router intercepts the DNS reply and translates the returned address if there is an overlap (that is, the resulting legal address resides illegally in the inside network). To translate the return address, the router creates a simple translation entry mapping the overlapping address 10.1.1.3 to an address from a separately configured, outside local address pool.

The router examines every DNS reply from everywhere, ensuring that the IP address is not in the stub network. If it is, the router translates the address.

1. Host 10.1.1.1 opens a connection to 172.16.0.3.
2. The router sets up translations mapping inside local and global addresses to each other, and outside global and local addresses to each other.
3. The router replaces the SA with the inside global address and replaces the DA with the outside global address.
4. Host C receives the packet and continues the conversation.
5. The router does a lookup, replaces the DA with the inside local address, and replaces the SA with the outside local address.
6. Host 10.1.1.1 receives the packet and the conversation continues using this translation process.

Types of NAT

NAT operates on a router--generally connecting only two networks--and translates your private (inside local) addresses within the internal network, into public (inside global) addresses before any packets are forwarded to another network. This functionality give you the option to configure NAT so 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 some additional security.

NAT types include:

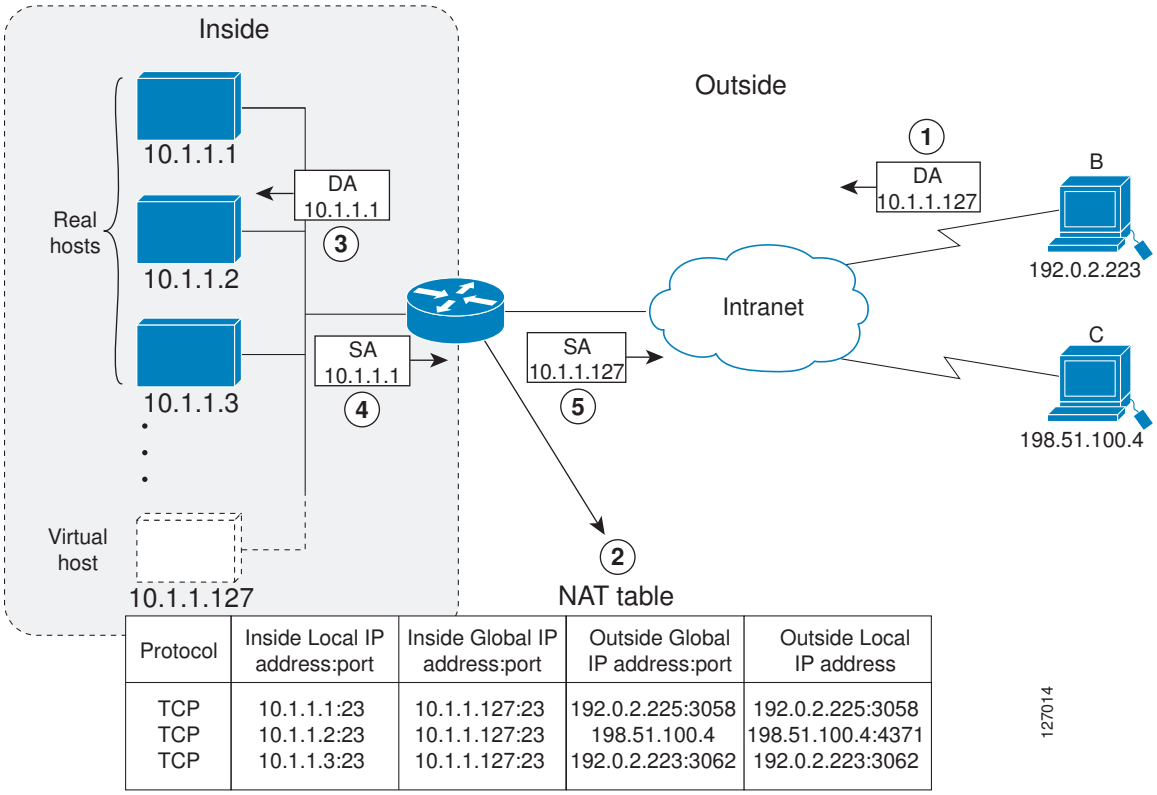
- Static address translation (static NAT)--allows one-to-one mapping between local and global addresses.
- Dynamic address translation (dynamic NAT)--maps unregistered IP addresses to registered IP addresses of out of a pool of registered IP addresses.
- Overloading--a form of dynamic NAT that maps multiple unregistered IP addresses to a single registered IP address (many to one) using different ports. This method is also known as Port Address Translation (PAT). By using PAT (NAT Overload), thousands of users can be connected to the Internet using only one real global IP address.

TCP Load Distribution for NAT

Your organization may have multiple hosts that must communicate with a heavily used host. Using NAT, you can establish a virtual host on the inside network that coordinates load sharing among real hosts. DAs that match an access list are replaced with addresses from a rotary pool. Allocation is done on a round-

robin basis, and only when a new connection is opened from the outside to the inside. Non-TCP traffic is passed untranslated (unless other translations are in effect). The figure below illustrates this feature.

Figure 4 NAT TCP Load Distribution



Protocol	Inside Local IP address:port	Inside Global IP address:port	Outside Global IP address:port	Outside Local IP address
TCP	10.1.1.1:23	10.1.1.127:23	192.0.2.225:3058	192.0.2.225:3058
TCP	10.1.1.2:23	10.1.1.127:23	198.51.100.4	198.51.100.4:4371
TCP	10.1.1.3:23	10.1.1.127:23	192.0.2.223:3062	192.0.2.223:3062

The router performs the following process when translating rotary addresses:

1. The user on host B (192.0.2.223) opens a connection to the virtual host at 10.1.1.127.
2. The router receives the connection request and creates a new translation, allocating the next real host (10.1.1.1) for the inside local IP address.
3. The router replaces the destination address with the selected real host address and forwards the packet.
4. Host 10.1.1.1 receives the packet and responds.
5. The router receives the packet, performs a NAT table lookup using the inside local address and port number, and the outside address and port number as the key. The router then translates the source address to the address of the virtual host and forwards the packet.
6. The next connection request will cause the router to allocate 10.1.1.2 for the inside local address.

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 router to support users with a static IP

address, public wireless LAN providers extend their services to a greater number of potential users, which can lead to greater user satisfaction and additional revenue.

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.

RADIUS

Remote Authentication Dial-In User Service (RADIUS) is a distributed client/server system that secures networks against unauthorized access. Communication between a network access server (NAS) and a RADIUS server is based on the User Datagram Protocol (UDP). Generally, the RADIUS protocol is considered a connectionless service. Issues related to server availability, retransmission, and timeouts are handled by RADIUS-enabled devices rather than the transmission protocol.

RADIUS is a client/server protocol. The RADIUS client is typically a NAS, and the RADIUS server is usually a daemon process running on a UNIX or Windows NT machine. The client passes user information to designated RADIUS servers and acts on the response that is returned. RADIUS servers receive user connection requests, authenticate the user, and then return the configuration information necessary for the client to deliver service to the user. A RADIUS server can act as a proxy client to other RADIUS servers or other kinds of authentication servers.

Viruses and Worms that Target NAT

Viruses and worms are malicious programs designed to attack computer and networking equipment. Although viruses are typically embedded in discrete applications and run only when executed, worms self-propagate and can quickly spread on their own. Although a specific virus or worm may not expressly target NAT, it might use NAT resources to propagate itself. The Rate Limiting NAT Translation feature can be used to limit the impact of viruses and worms that originate from specific hosts and access control lists.

Denial-of-Service Attacks

A denial-of-service (DoS) attack typically involves the misuse of standard protocols or connection processes with the intent to overload and disable a target, such as a router or web server. DoS attacks can come from a malicious user or from a computer infected with a virus or worm. An attack that comes from many different sources at once, such as when a virus or worm has infected many computers, is known as a distributed DoS attack. Such distributed DoS attacks can spread rapidly and involve thousands of systems.

Creating NAT Half Entries

How to Configure NAT for IP Address Conservation

The tasks described in this section configure NAT for IP address conservation. No single task in this section is required; however, at least one of the tasks must be performed. More than one of the tasks may need to be performed.

- Configuring Inside Source Addresses, page 11
- Using NAT to Allow Internal Users Access to the Internet, page 16
- Configuring Address Translation Timeouts, page 19
- Allowing Overlapping Networks to Communicate Using NAT, page 21

Configuring Inside Source Addresses

Inside source address can be configured for static or dynamic translation. Perform one of the following tasks depending on your requirements:

Configuring Static Translation of Inside Source Addresses

Configure static translation of inside source addresses when you want to allow one-to-one mapping between your inside local address and an inside global address. Static translation is useful when a host on the inside must be accessible by a fixed address from the outside.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nat inside source static** *local-ip global-ip*
4. **interface** *type number*
5. **ip address** *ip-address mask* [**secondary**]
6. **ip nat inside**
7. **exit**
8. **interface** *type number*
9. **ip address** *ip-address mask*
10. **ip nat outside**
11. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip nat inside source static** *local-ip global-ip* **Example:** `Router(config)# ip nat inside source static 10.10.10.1 172.16.131.1`	Establishes static translation between an inside local address and inside global address.
Step 4	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/0/0`	Specifies an interface and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* [**secondary**] **Example:** `Router(config-if)# ip address 10.114.11.39 255.255.255.0`	Sets a primary IP address for an interface.
Step 6	**ip nat inside** **Example:** `Router(config-if)# ip nat inside`	Marks the interface as connected to the inside.
Step 7	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 8	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/0/1`	Specifies a different interface and returns to interface configuration mode.

	Command or Action	Purpose
Step 9	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 172.31.232.182 255.255.255.240`	Sets a primary IP address for an interface.
Step 10	**ip nat outside** **Example:** `Router(config-if)# ip nat outside`	Marks the interface as connected to the outside.
Step 11	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and enters privileged EXEC mode.

Configuring Dynamic Translation of Inside Source Addresses

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

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

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nat pool** *name start-ip end-ip* {**netmask** *netmask* | **prefix-length** *prefix-length*} [**type** {**match-host** | **rotary**}]
4. **access-list** *access-list-number* **permit** *source* [*source-wildcard*]
5. **ip nat inside source list** *access-list -number* **pool** *name*
6. **interface** *type number*
7. **ip address** *ip-address mask*
8. **ip nat inside**
9. **exit**
10. **interface** *type number*
11. **ip address** *ip-address mask*
12. **ip nat outside**
13. **end**

DETAILED STEPS

	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	**ip nat pool** *name start-ip end-ip* {**netmask** *netmask*	**prefix-length** *prefix-length*} [**type** {**match-host**	**rotary**}] **Example:** `Router(config)# ip nat pool net-208 172.16.233.208 172.16.233.223 prefix-length 28`	Defines a pool of global addresses to be allocated as needed.
Step 4	**access-list** *access-list-number* **permit** *source* [*source-wildcard*] **Example:** `Router(config)# access-list 1 permit 192.168.34.0 0.0.0.255`	Defines a standard access list permitting those addresses that are to be translated.

	Command or Action	Purpose
Step 5	**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 the prior step.
Step 6	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/0/0`	Specifies an interface and enters interface configuration mode.
Step 7	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.114.11.39 255.255.255.0`	Sets a primary IP address for the interface.
Step 8	**ip nat inside** **Example:** `Router(config-if)# ip nat inside`	Marks the interface as connected to the inside.
Step 9	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 10	**interface** *type number* **Example:** `Router(config-if)# interface GigabitEthernet 0/0/1`	Specifies a different interface and returns to interface configuration mode.
Step 11	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 172.16.232.182 255.255.255.240`	Sets a primary IP address for the interface.

	Command or Action	Purpose
Step 12	**ip nat outside** **Example:** `Router(config-if)# ip nat outside`	Marks the interface as connected to the outside.
Step 13	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and enters privileged EXEC mode.

Troubleshooting Tips

Before removing or changing a mapping or NAT pool of global addresses, you must remove the associated access list or remove NAT from the interface. Then, you must use the **clear ip nat translation *** command option to clear all dynamic translations from the translation table.

Using NAT to Allow Internal Users Access to the Internet

Perform this task to allow your internal users access to the Internet and conserve addresses in the inside global address pool using NAT overloading of global addresses.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nat pool** *name start-ip end-ip* {**netmask** *netmask* | **prefix-length** *prefix-length*}
4. **access-list** *access-list-number* **permit** *source* [*source-wildcard*]
5. **ip nat inside source list** *access-list -number* **pool** *name* **overload**
6. **interface** *type number*
7. **ip address** *ip-address mask*
8. **ip nat inside**
9. **exit**
10. **interface** *type number*
11. **ip address** *ip-address mask*
12. **ip nat outside**
13. **end**

DETAILED STEPS

	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	**ip nat pool** *name start-ip end-ip* {**netmask** *netmask* | **prefix-length** *prefix-length*} **Example:** `Router(config)# ip nat pool net-208 192.168.202.129 192.168.202.158 netmask 255.255.255.240`	Defines a pool of global addresses to be allocated as needed.
Step 4	**access-list** *access-list-number* **permit** *source* [*source-wildcard*] **Example:** `Router(config)# access-list 1 permit 192.168.201.30 0 0.0.0.255`	Defines a standard access list permitting those addresses that are to be translated. • The access list must permit only those addresses that are to be translated. (Remember that there is an implicit “deny all” at the end of each access list.) Use of an access list that is too permissive can lead to unpredictable results.
Step 5	**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 with overloading, specifying the access list defined in the prior step.
Step 6	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/0/0`	Specifies an interface and enters interface configuration mode.

	Command or Action	Purpose
Step 7	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 192.168.201.1 255.255.255.0`	Sets a primary IP address for the interface.
Step 8	**ip nat inside** **Example:** `Router(config-if)# ip nat inside`	Marks the interface as connected to the inside.
Step 9	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and enters global configuration mode.
Step 10	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/0/1`	Specifies a different interface and returns to interface configuration mode.
Step 11	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 192.168.201.29 255.255.255.240`	Sets a primary IP address for the interface.
Step 12	**ip nat outside** **Example:** `Router(config-if)# ip nat outside`	Marks the interface as connected to the outside.
Step 13	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and enters privileged EXEC mode.

Configuring Address Translation Timeouts

You can configure address translation timeouts based on your specific configuration of NAT.

By default, dynamic address translations time out after some period of nonuse. You can change the default values on timeouts, if necessary. When overloading is not configured, simple translation entries time out after 24 hours. Use the **ip nat translation timeout** command to change the timeout value for dynamic address translations that do not use overloading.

You can use the **ip nat translation max-entries** command to change the default global NAT translation limit.

- Changing the Default Timeouts for Protocol-Based Translations, page 19

Changing the Default Timeouts for Protocol-Based Translations

If you have configured overloading, you can control the translation entry timeout because each translation entry contains more context about the traffic using it.

Based on your configuration, you can change the timeouts described in this section. If you need to quickly free your global IP address for a dynamic configuration, you should configure a shorter timeout than the default by using the **ip nat translation timeout** command. However, the configured timeout should be longer than the other timeouts configured by using the commands specified in the following task. If a TCP session is not properly closed by a finish (FIN) packet from both sides or during a reset, you should change the default TCP timeout by using the **ip nat translation tcp-timeout** command.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nat translation** *seconds*
4. **ip nat translation udp-timeout** *seconds*
5. **ip nat translation dns-timeout** *seconds*
6. **ip nat translation tcp-timeout** *seconds*
7. **ip nat translation finrst-timeout** *seconds*
8. **ip nat translation icmp-timeout** *seconds*
9. **ip nat translation syn-timeout** *seconds*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

Command or Action	Purpose
Step 2 **configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3 **ip nat translation** *seconds* **Example:** `Device(config)# ip nat translation 300`	(Optional) Changes the amount of time after which NAT translations time out. • The default timeout is 24 hours and it applies to the aging time for half-entries.
Step 4 **ip nat translation udp-timeout** *seconds* **Example:** `Device(config)# ip nat translation udp-timeout 300`	(Optional) Changes the UDP timeout value.
Step 5 **ip nat translation dns-timeout** *seconds* **Example:** `Device(config)# ip nat translation dns-timeout 45`	(Optional) Changes the Domain Name System (DNS) timeout value.
Step 6 **ip nat translation tcp-timeout** *seconds* **Example:** `Device(config)# ip nat translation tcp-timeout 2500`	(Optional) Changes the TCP timeout value.
Step 7 **ip nat translation finrst-timeout** *seconds* **Example:** `Device(config)# ip nat translation finrst-timeout 45`	(Optional) Changes the Finish and Reset (FINRST) timeout value. • **finrst-timeout**—The aging time after a TCP session receives both finish-in (FIN-IN) and finish-out (FIN-OUT) messages or after the reset of a TCP session.
Step 8 **ip nat translation icmp-timeout** *seconds* **Example:** `Device(config)# ip nat translation icmp-timeout 45`	(Optional) Changes the ICMP timeout value.

	Command or Action	Purpose
Step 9	**ip nat translation syn-timeout** *seconds* **Example:** `Device(config)# ip nat translation syn-timeout 45`	(Optional) Changes the synchronous (SYN) timeout value. • The synchronous timeout or the aging time is used only when a SYN is received on a TCP session. When a synchronous acknowledgment (SYNACK) is received, the timeout changes to TCP timeout.

Allowing Overlapping Networks to Communicate Using NAT

The tasks in this section are grouped because they perform the same action but are executed differently depending on the type of translation that is implemented: static or dynamic.

Perform the task that applies to the translation type that is implemented:

- Configuring Static Translation of Overlapping Networks, page 21
- Configuring Dynamic Translation of Overlapping Networks, page 23

Configuring Static Translation of Overlapping Networks

Configure static translation of overlapping networks if your IP addresses in the stub network are legitimate IP addresses belonging to another network and you want to communicate with those hosts or routers using static translation.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nat inside source static** *local-ip global-ip*
4. **interface** *type number*
5. **ip address** *ip-address mask*
6. **ip nat inside**
7. **exit**
8. **interface** *type number*
9. **ip address** *ip-address mask*
10. **ip nat outside**
11. **end**

DETAILED STEPS

	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	**ip nat inside source static** *local-ip global-ip* **Example:** `Router(config)# ip nat inside source static 192.168.121.33 10.2.2.1`	Establishes static translation between an inside local address and inside global address.
Step 4	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/0/1`	Specifies an interface and enters interface configuration mode.
Step 5	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.114.11.39 255.255.255.0`	Sets a primary IP address for the interface.
Step 6	**ip nat inside** **Example:** `Router(config-if)# ip nat inside`	Marks the interface as connected to the inside.
Step 7	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.

	Command or Action	Purpose
Step 8	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/0/0`	Specifies a different interface and returns to interface configuration mode.
Step 9	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 172.16.232.182 255.255.255.240`	Sets a primary IP address for the interface.
Step 10	**ip nat outside** **Example:** `Router(config-if)# ip nat outside`	Marks the interface as connected to the outside.
Step 11	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and enters privileged EXEC mode.

Configuring Dynamic Translation of Overlapping Networks

Configure dynamic translation of overlapping networks if your IP addresses in the stub network are legitimate IP addresses belonging to another network and you want to communicate with those hosts or routers using dynamic translation.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nat pool** *name start-ip end-ip* {**netmask** *netmask* | **prefix-length** *prefix-length*}
4. **access-list** *access-list-number* **permit** *source* [*source-wildcard*]
5. **ip nat outside source list** *access-list-number* **pool** *name*
6. **interface** *type number*
7. **ip address** *ip-address mask*
8. **ip nat inside**
9. **exit**
10. **interface** *type number*
11. **ip address** *ip-address mask*
12. **ip nat outside**
13. **end**

DETAILED STEPS

	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	**ip nat pool** *name start-ip end-ip* {**netmask** *netmask* | **prefix-length** *prefix-length*} **Example:** `Router(config)# ip nat pool net-10 10.0.1.0 10.0.1.255 prefix-length 24`	Defines a pool of global addresses to be allocated as needed.

	Command or Action	Purpose
Step 4	**access-list** *access-list-number* **permit** *source* [*source-wildcard*] **Example:** `Router(config)# access-list 1 permit 10.114.11.0 0.0.0.255`	Defines a standard access list permitting those addresses that are to be translated. • The access list must permit only those addresses that are to be translated. (Remember that there is an implicit "deny all" at the end of each access list.) Use of an access list that is too permissive can lead to unpredictable results.
Step 5	**ip nat outside source list** *access-list-number* **pool** *name* **Example:** `Router(config)# ip nat outside source list 1 pool net-10`	Establishes dynamic outside source translation, specifying the access list defined in Step 4.
Step 6	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/0/1`	Specifies an interface and enters interface configuration mode.
Step 7	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 10.114.11.39 255.255.255.0`	Sets a primary IP address for the interface.
Step 8	**ip nat inside** **Example:** `Router(config-if)# ip nat inside`	Marks the interface as connected to the inside.
Step 9	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 10	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/2/0`	Specifies a different interface and returns to interface configuration mode.

	Command or Action	Purpose
Step 11	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 172.16.232.182 255.255.255.240`	Sets a primary IP address for the interface.
Step 12	**ip nat outside** **Example:** `Router(config-if)# ip nat outside`	Marks the interface as connected to the outside.
Step 13	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Configuring Sever TCP Load Balancing

Perform this task to configure server TCP load balancing by way of destination address rotary translation. These commands allow you to map one virtual host to many real hosts. Each new TCP session opened with the virtual host will be translated into a session with a different real host.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nat pool** *name start-ip end-ip* {**netmask** *netmask* | **prefix-length** *prefix-length*} **type rotary**
4. **access-list** *access-list-number* **permit** *source* [*source-wildcard*]
5. **ip nat inside destination-list** *access-list-number* **pool** *name*
6. **interface** *type number*
7. **ip address** *ip-address mask*
8. **ip nat inside**
9. **exit**
10. **interface** *type number*
11. **ip address** *ip-address mask*
12. **ip nat outside**
13. **end**

DETAILED STEPS

	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	**ip nat pool** *name start-ip end-ip* {**netmask** *netmask* | **prefix-length** *prefix-length*} **type rotary** **Example:** `Router(config)# ip nat pool real-hosts 192.168.201.2 192.168.201.5 prefix-length 28 type rotary`	Defines a pool of addresses containing the addresses of the real hosts.
Step 4	**access-list** *access-list-number* **permit** *source* [*source-wildcard*] **Example:** `Router(config)# access-list 1 permit 192.168.201.30 0 0.0.0.255`	Defines an access list permitting the address of the virtual host.
Step 5	**ip nat inside destination-list** *access-list-number* **pool** *name* **Example:** `Router(config)# ip nat inside destination-list 2 pool real-hosts`	Establishes dynamic inside destination translation, specifying the access list defined in the prior step.
Step 6	**interface** *type number* **Example:** `Router(config)# interface GigabitEthernet 0/0/1`	Specifies an interface and enters interface configuration mode.

	Command or Action	Purpose
Step 7	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 192.168.201.1 255.255.255.240`	Sets a primary IP address for the interface.
Step 8	**ip nat inside** **Example:** `Router(config-if)# ip nat inside`	Marks the interface as connected to the inside.
Step 9	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 10	**interface** *type number* **Example:** `Router(config)# interface Serial 0/0/0`	Specifies a different interface and returns to interface configuration mode.
Step 11	**ip address** *ip-address mask* **Example:** `Router(config-if)# ip address 192.168.15.129 255.255.255.240`	Sets a primary IP address for the interface.
Step 12	**ip nat outside** **Example:** `Router(config-if)# ip nat outside`	Marks the interface as connected to the outside.
Step 13	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode and enters privileged EXEC mode.

Enabling Route Maps on Inside Interfaces

For NAT, a route map can be processed instead of an access list. A route map allows you to match any combination of access-list, next-hop IP address, and output interface to determine which pool to use. The ability to use route maps with static translations enables NAT multihoming capability with static address translations. Multihomed internal networks can now host common services such as the Internet and DNS, which are accessed from different outside networks.

Benefits of Using Route Maps on Inside Interfaces

The benefits of using router maps are as follows:

- The ability to configure route map statements provides the option of using IPSec with NAT.
- Translation decisions can be made based on the destination IP address when static translation entries are used.

All route maps required for use with this task should be configured before you begin the configuration task.

Note Cisco IOS XE software supports only the following commands for using route maps with NAT:

- **match ip address** (with an ACL)
- **match ip next-hop**
- **match interface**

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nat inside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** *local-ip global-ip* **route-map** *map-name*}
4. **exit**
5. **show ip nat translations** [**verbose**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip nat inside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** *local-ip global-ip* **route-map** *map-name*} **Example:** `Router(config)# ip nat inside source static 192.168.201.6 192.168.201.21 route-map isp2`	Enables route mapping with static NAT configured on the NAT inside interface.
Step 4	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode and returns to privileged EXEC mode.
Step 5	**show ip nat translations** [**verbose**] **Example:** `Router# show ip nat translations`	(Optional) Displays active NAT.

Enabling NAT Route Maps Outside-to-Inside Support

The NAT Route Maps Outside-to-Inside Support feature enables the deployment of a NAT route map configuration that will allow IP sessions to be initiated from the outside to the inside. Perform this task to enable the NAT Route Maps Outside-to-Inside Support feature.

- Route Maps Outside-to-Inside Support Design, page 30

Route Maps Outside-to-Inside Support Design

An initial session from the inside to the outside host is required to trigger a NAT. New translation sessions can then be initiated from outside to the inside host that triggered the initial translation.

When route maps are used to allocate global addresses, the global address can allow return traffic, and the return traffic is allowed only if the return traffic matches the defined route map in the reverse direction. The outside-to-inside functionality remains unchanged (by not creating additional entries to allow the return traffic for a route-map-based dynamic entry) unless you configure the **reversible** keyword with the **ip nat inside source** command.

Note

- Access lists with reversible route maps must be configured to match the inside-to-outside traffic.
- Only IP hosts that are part of the route-map configuration will allow outside sessions.
- Outside-to-inside support is not available with PAT.
- Outside sessions must use an access list.
- The **match interface** and **match ip next-hop** commands are not supported for reversible route maps.
- Reversible route maps are not supported for static NAT.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nat pool** *name start-ip end-ip* **netmask** *netmask*
4. **ip nat inside source route-map** *name* **pool** *name* **reversible**
5. **exit**

DETAILED STEPS

	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(config)# configure terminal`	Enters global configuration mode.
Step 3	**ip nat pool** *name start-ip end-ip* **netmask** *netmask* **Example:** `Router(config)# ip nat pool POOL-A 192.168.201.4 192.168.201.6 netmask 255.255.255.128`	Defines a pool of network addresses for NAT.
Step 4	**ip nat inside source route-map** *name* **pool** *name* **reversible** **Example:** `Router(config)# ip nat inside source route-map MAP-A pool POOL-A reversible`	Enables outside-to-inside initiated sessions to use route maps for destination-based NAT.

	Command or Action	Purpose
Step 5	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode and enters privileged EXEC mode.

Configuring NAT of External IP Addresses Only

When you configure NAT of external IP addresses only, NAT can be configured to ignore all embedded IP addresses for any application and traffic type. Traffic between a host and the traffic outside an enterprise's network flows through the internal network. A router configured for NAT translates the packet to an address that can be routed inside the internal network. If the intended destination is outside an enterprise's network, the packet gets translated back to an external address and sent out.

- Benefits of Configuring NAT of External IP Addresses Only, page 32

Benefits of Configuring NAT of External IP Addresses Only

- Supports public and private network architecture with no specific route updates.
- Gives the end client a usable IP address at the starting point. This address will be the address used for IP Security connections and traffic.
- Allows the use of network architecture that requires only the header translation.
- Allows an enterprise to use the Internet as its enterprise backbone network.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip nat inside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static network** *local-ip global-ip* **no-payload**}
4. **ip nat inside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** {**tcp** | **upd**} *local-ip local-port global-ip global-port* **no-payload**}
5. **ip nat inside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** [**network**] *local-network-mask global-network-mask* **no-payload**}
6. **ip nat outside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** *local-ip global-ip* **no-payload**}
7. **ip nat outside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** {**tcp** | **upd**} *local-ip local-port global-ip global-port* **no-payload**}
8. **ip nat outside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** [**network**] *local-network-mask global-network-mask* **no-payload**}
9. **exit**
10. **show ip nat translations** [**verbose**]

DETAILED STEPS

	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	**ip nat inside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static network** *local-ip global-ip* **no-payload**} **Example:** `Router(config)# ip nat inside source static network 10.1.1.1 192.168.251.0/24 no-payload`	Disables the network packet translation on the inside host router.
Step 4	**ip nat inside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** {**tcp** | **upd**} *local-ip local-port global-ip global-port* **no-payload**} **Example:** `Router(config)# ip nat inside source static tcp 10.1.1.1 2000 192.168.1.1 2000 no-payload`	Disables port packet translation on the inside host router.
Step 5	**ip nat inside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** [**network**] *local-network-mask global-network-mask* **no-payload**} **Example:** `Router(config)# ip nat inside source static 10.1.1.1 192.168.1.1 no-payload`	Disables the packet translation on the inside host router.
Step 6	**ip nat outside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** *local-ip global-ip* **no-payload**} **Example:** `Router(config)# ip nat outside source static 10.1.1.1 192.168.1.1 no-payload`	Disables packet translation on the outside host router.

	Command or Action	Purpose
Step 7	**ip nat outside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** {**tcp** | **upd**} *local-ip local-port global-ip global-port* **no-payload**} **Example:** `Router(config)# ip nat outside source static tcp 10.1.1.1 20000 192.168.1.1 20000 no-payload`	Disables port packet translation on the outside host router.
Step 8	**ip nat outside source** {**list** {*access-list-number* | *access-list-name*} **pool** *pool-name* [**overload**] | **static** [**network**] *local-network-mask global-network-mask* **no-payload**} **Example:** `Router(config)# ip nat outside source static network 10.1.1.0 192.168.251.0/24 no-payload`	Disables network packet translation on the outside host router.
Step 9	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode and returns to privileged EXEC mode.
Step 10	**show ip nat translations** [**verbose**] **Example:** `Router# show ip nat translations`	Displays active NAT.

Configuring Support for Users with Static IP Addresses

Configuring support for users with static IP addresses enables those users to establish an IP session in a Public Wireless LAN environment.

The NAT Static IP Support feature extends the capabilities of Public Wireless LAN providers to support users configured with a static IP address. By configuring a router to support users with a static IP address, Public Wireless LAN providers extend their services to a greater number of potential users, which can lead to greater user satisfaction and additional revenue.

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.

This section contains the following procedures:

- Prerequisites, page 35
- Configuring Static IP Support, page 35

Prerequisites

Before configuring support for users with static IP addresses for NAT, you must first enable NAT on your router and configure a RADIUS server host. For additional information on NAT and RADIUS configuration, see the "Additional References, page 41" section.

Configuring Static IP Support

Perform this task to configure the NAT Static IP Support feature.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip nat inside**
5. **exit**
6. **ip nat allow-static-host**
7. **ip nat pool** *name start-ip end-ip* **netmask** *netmask* **accounting** *list-name*
8. **ip nat inside source list** *access-list-number* **pool** *name*
9. **access-list** *access-list-number* **deny ip** *source*
10. **exit**
11. **show ip nat translations verbose**

DETAILED STEPS

	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 GigabitEthernet 0/0/0`	Specifies the interface to be configured and enters interface configuration mode.

	Command or Action	Purpose
Step 4	**ip nat inside** **Example:** `Router(config-if)# ip nat inside`	Marks the interface as connected to the inside.
Step 5	**exit** **Example:** `Router(config-if)# exit`	Exits interface configuration mode and returns to global configuration mode.
Step 6	**ip nat allow-static-host** **Example:** `Router(config)# ip nat allow-static-host`	Enables static IP address support. • Dynamic Address Resolution Protocol (ARP) learning will be disabled on this interface, and NAT will control the creation and deletion of ARP entries for the static IP host.
Step 7	**ip nat pool** *name start-ip end-ip* **netmask** *netmask* **accounting** *list-name* **Example:** `Router(config)# ip nat pool pool1 172.16.1.1 172.16.255.255 netmask 255.255.255.0 accounting WLAN-ACCT`	Specifies an existing RADIUS profile name to be used for authentication of the static IP host.
Step 8	**ip nat inside source list** *access-list-number* **pool** *name* **Example:** `Router(config)# ip nat inside source list 1 pool net-208`	Specifies the access list and pool to be used for static IP support. • The specified access list must permit all traffic.
Step 9	**access-list** *access-list-number* **deny ip** *source* **Example:** `Router(config)# access-list 1 deny ip 192.168.196.51`	Removes the router's own traffic from NAT. • The *source* argument is the IP address of the router that supports the NAT Static IP Support feature.
Step 10	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode and enters privileged EXEC mode.

	Command or Action	Purpose
Step 11	**show ip nat translations verbose** **Example:** `Router# show ip nat translations verbose`	(Optional) Displays active NAT translations and additional information for each translation table entry, including how long ago the entry was created and used.

Configuring the Rate Limiting NAT Translation Feature

Limiting the number of concurrent NAT operations using the Rate Limiting NAT Translation feature provides users more control over how NAT addresses are used. The Rate Limiting NAT Translation feature can be used to limit the effects of viruses, worms, and DoS attacks.

Because NAT is a CPU-intensive process, router performance can be adversely affected by DoS attacks, viruses, and worms that target NAT. The Rate Limiting NAT Translation feature allows you to limit the maximum number of concurrent NAT requests on a router.

Prerequisites for configuring the Rate Limiting NAT Translation feature

- Classify current NAT usage and determine the sources of requests for NAT. A specific host or access control list generating an unexpectedly high number of NAT requests may be the source of a malicious virus or worm attack.
- Once you have identified the source of excess NAT requests, you can set a NAT rate limit that contains a specific host or access control list, or you can set a general limit for the maximum number of NAT requests allowed regardless of their source.

SUMMARY STEPS

1. **enable**
2. **show ip nat translations**
3. **configure terminal**
4. **ip nat translation max-entries** {*number* | **all-vrf** *number* | **host** *ip-address number* | **list** *listname number* | **vrf** *name number*}
5. **end**
6. **show ip nat statistics**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**show ip nat translations** **Example:** `Router# show ip nat translations`	(Optional) Displays active NAT. • A specific host or access control list generating an unexpectedly high number of NAT requests may be the source of a malicious virus or worm attack.
Step 3	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 4	**ip nat translation max-entries** {*number* | **all-vrf** *number* | **host** *ip-address number* | **list** *listname number* | **vrf** *name number*} **Example:** `Router(config)# ip nat translation max-entries 300`	Configures the maximum number of NAT entries allowed from the specified source. • The maximum number of allowed NAT entries is 2147483647, although a typical range for a NAT rate limit is from 100 to 300 entries.
Step 5	**end** **Example:** `Router(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.
Step 6	**show ip nat statistics** **Example:** `Router# show ip nat statistics`	(Optional) Displays current NAT usage information, including NAT rate limit settings. • After setting a NAT rate limit, use the **show ip nat statistics** command to verify current NAT rate limit settings.

Configuration Examples for Configuring NAT for IP Address Conservation

- Example: Configuring NAT of External IP Addresses Only , page 41
- Example: Configuring Support for Users with Static IP Addresses, page 41

Example: Configuring Static Translation of Inside Source Addresses

The following example shows how the inside hosts addressed from the 10.114.11.0 network are translated to the globally unique 172.31.233.208/28 network. Further, packets from outside hosts addressed from the 10.114.11.0 network (the true 10.114.11.0 network) are translated to appear to be from the 10.0.1.0/24 network.

```
ip nat pool net-208 172.31.233.208 172.31.233.223 prefix-length 28
ip nat pool net-10 10.0.1.0 10.0.1.255 prefix-length 24
ip nat inside source list 1 pool net-208
ip nat outside source list 1 pool net-10
!
interface GigabitEthernet 0/0/0
 ip address 172.31.232.182 255.255.255.240
 ip nat outside
!
interface GigabitEthernet 0/0/1
 ip address 10.114.11.39 255.255.255.0
 ip nat inside
!
access-list 1 permit 10.114.11.0 0.0.0.255
```

The following example shows NAT configured on the router with a static route. NAT is configured as inside source static one-to-one translations.

```
ip nat pool outside 10.4.4.1 10.4.4.254 netmask 255.255.255.0
ip nat outside source list 1 pool mypool
access-list 1 permit 172.16.18.0 0.0.0.255
ip nat inside source static 192.168.121.33 2.2.2.1
ip nat inside source static 192.169.121.33.2.2.2.2
```

Example: Configuring Dynamic Translation of Inside Source Addresses

The following example shows how inside hosts addressed from either the 192.168.1.0 or 192.168.2.0 network are translated to the globally unique 172.31.233.208/28 network:

```
ip nat pool net-208 172.31.233.208 172.31.233.223 prefix-length 28
ip nat inside source list 1 pool net-208
!
interface GigabitEthernet 0/0/0
 ip address 172.31.232.182 255.255.255.240
 ip nat outside
!
interface GigabitEthernet 0/0/1
 ip address 192.168.1.94 255.255.255.0
 ip nat inside
!
access-list 1 permit 192.168.1.0 0.0.0.255
access-list 1 permit 192.168.2.0 0.0.0.255
```

Example: Overloading Inside Global Addresses

The following example creates a pool of addresses named net-208. The pool contains addresses from 172.31.233.208 to 172.31.233.233. Access list 1 allows packets having the SA from 192.168.1.0 to 192.168.1.255. If no translation exists, packets matching access list 1 are translated to an address from the pool. The router allows multiple local addresses (192.168.1.0 to 192.168.1.255) to use the same global address. The router retains port numbers to differentiate the connections.

```
ip nat pool net-208 172.31.233.208 172.31.233.233 netmask 255.255.255.240
```

```
ip nat inside source list 1 pool net-208 overload
!
interface serial 0/0/0
 ip address 172.31.232.182 255.255.255.240
 ip nat inside
!
interface GigabitEthernet 0/0/0
 ip address 192.168.1.94 255.255.255.0
 ip nat outside
!
access-list 1 permit 192.168.1.0 0.0.0.255
```

Example: Using NAT to Allow Overlapping Networks to Communicate

In the following example, the addresses in the local network are being used legitimately by someone else on the Internet. An extra translation is required to access that external network. Pool net-10 is a pool of outside local IP addresses. The **ip nat outside source list 1 pool net-10** statement translates the addresses of hosts from the outside overlapping network to addresses in that pool.

```
ip nat pool net-208 171.69.233.208 171.69.233.223 prefix-length 28
ip nat pool net-10 10.0.1.0 10.0.1.255 prefix-length 24
ip nat inside source list 1 pool net-208
ip nat outside source list 1 pool net-10
!
interface serial 0/0/0
 ip address 171.69.232.192 255.255.255.240
 ip nat outside
!
interface GigabitEthernet 0/0/0
 ip address 192.168.1.94 255.255.255.0
 ip nat inside
!
access-list 1 permit 192.168.1.0 0.0.0.255
```

Example: Configuring TCP Load Balancing

In the following example, the goal is to define a virtual address, connections to which are distributed among a set of real hosts. The pool defines the addresses of the real hosts. The access list defines the virtual address. If a translation does not already exist, TCP packets from serial interface 0 (the outside interface), whose destination matches the access list, are translated to an address from the pool.

```
ip nat pool real-hosts 192.168.15.2 192.168.15.15 prefix-length 28 type rotary
ip nat inside destination list 2 pool real-hosts
!
interface serial 0/0/0
 ip address 192.168.15.129 255.255.255.240
 ip nat inside
!
interface GigabitEthernet 0/0/1
 ip address 192.168.15.17 255.255.255.240
 ip nat outside
!
access-list 2 permit 192.168.15.1
```

Example: Configuring NAT Route Maps Outside-to-Inside Support

The following example shows how to configure route map A and route map B to allow outside-to-inside translation for a destination-based NAT:

```
ip nat pool POOL-A 10.1.10.1 10.1.10.126 netmask 255.255.255.128
ip nat pool POOL-B 10.1.20.1 10.1.20.126 netmask 255.255.255.128
ip nat inside source route-map MAP-A pool POOL-A reversible
ip nat inside source route-map MAP-B pool POOL-B reversible
```

```
!
ip access-list extended ACL-A
 permit ip any 10.1.10.128 0.0.0.127
ip access-list extended ACL-B
 permit ip any 10.1.20.128 0.0.0.127
!
route-map MAP-A permit 10
 match ip address ACL-A
!
route-map MAP-B permit 10
 match ip address ACL-B
```

Example: Configuring NAT of External IP Addresses Only

The following example shows how to translate the packet to an address that can be routed inside the internal network:

```
configure terminal
 ip nat inside source static network 10.1.1.1 192.168.251.0/24 no-payload
 ip nat inside source static tcp 10.1.1.1 2000 192.168.1.1 2000 no-payload
 ip nat inside source static 10.1.1.1 192.168.1.1 no-payload
 ip nat outside source static 10.1.1.1 192.168.1.1 no-payload
 ip nat outside source static tcp 10.1.1.1 20000 192.168.1.1 20000 no-payload
 ip nat outside source static network 4.1.1.0 192.168.251.0/24 no-payload
```

Example: Configuring Support for Users with Static IP Addresses

The following example shows how to enable static IP address support for the router at 192.168.196.51:

```
interface GigabitEthernet 0/0/1
 ip nat inside
ip nat allow-static-host
ip nat pool pool1 172.16.1.1 171.1.1.10 netmask 255.255.255.0 accounting WLAN-ACCT
ip nat inside source list 1 pool net-208
access-list 1 deny ip 192.168.196.51
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	*Cisco IOS Master Commands List, All Releases*
NAT commands: complete command syntax, command mode command history, defaults, usage guidelines, and examples	*Cisco IOS IP Addressing Services Command Reference*
NAT concepts, configuration tasks, and examples	*Cisco IOS XE IP Addressing Services Configuration Guide*
IP access list sequence numbering	"IP Access List Entry Sequence Numbering" module in the *Securing the Data Plane Configuration Guide*

Related Topic	Document Title
RADIUS attributes overview	"RADIUS Attributes Overview and RADIUS IETF Attributes" module in the *Securing User Services Configuration Guide*

Standards and RFCs

Standard/RFC	Title
RFC 1597	*Internet Assigned Numbers Authorit* y
RFC 1631	*The IP Network Address Translation (NAT)*
RFC 1918	*Address Allocation for Private Internets*
RFC 2663	*IP Network Address Translation (NAT) Terminology and Considerations*
RFC 3022	*Traditional IP Network Address Translation (Traditional NAT)*

MIBs

MIBs	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco IOS XE software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Configuring NAT for IP Address Conservation

The following table provides release information about the feature or features described in this module. This 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.

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

Table 1 Feature Information for Configuring NAT for IP Address Conservation

Feature Name	Releases	Feature Information
Destination-Based NAT Using Route Maps	Cisco IOS XE Release 2.1	The Destination-Based NAT Using Route Maps feature adds support for destination-based NAT using route maps.
NAT Duplicate Inside Global Address	Cisco IOS XE Release 2.1	The Cisco IOS XE software supports the NAT Duplicate Inside Global Addresses feature.
NAT Host Number Preservation	Cisco IOS XE Release 2.1	For ease of network management, some sites prefer to translate prefixes rather than addresses. These sites want the translated address to have the same host number as the original address. The two prefixes must be of the same length. The NAT Host Number Preservation feature can be enabled by configuring dynamic translation with the address pool of the type, match-host.
NAT Performance Enhancement--Translation Table Optimization	Cisco IOS XE Release 2.1	The NAT Performance Enhancement--Translation Table Optimization feature provides greater structure for storing translation table entries and an optimized lookup in the table for associating table entries to IP connections.

Feature Name	Releases	Feature Information
NAT Route Maps Outside-to-Inside Support	Cisco IOS XE Release 2.2	The NAT Route Maps Outside-to-Inside Support feature enables the deployment of a NAT route map configuration that will allow IP sessions to be initiated from the outside to the inside.
NAT Static IP Support	Cisco IOS XE Release 2.1	The NAT Static IP Support feature provides support for users with static IP addresses, enabling those users to establish an IP session in a public wireless LAN environment.
NAT Timers	Cisco IOS XE Release 2.1	The NAT Timers feature allows you to change the amount of time after which NAT translations time out.
NAT Translation of External IP Addresses Only	Cisco IOS XE Release 2.1	You can use the NAT Translation of External IP Address Only feature to configure NAT to ignore all embedded IP addresses for any application and traffic type.
Rate Limiting NAT Translation	Cisco IOS XE Release 2.1	The Rate Limiting NAT Translation feature provides the ability to limit the maximum number of concurrent NAT operations on a router. In addition to giving users more control over how NAT addresses are used, the Rate Limiting NAT Translation feature can be used to limit the effects of viruses, worms, and DoS attacks.