

Routing and Switching Essentials v6.0



Chapter 9 - Sections & Objectives

- 9.1 Network Layer Protocols
 - Explain how NAT provides IPv4 address scalability in a small to medium-sized business network.
- 9.2 Configuring NAT
 - Configure NAT services on the edge router to provide IPv4 address scalability in a small to medium-sized business network.
- 9.3 Troubleshoot NAT Configurations
 - Troubleshoot NAT issues in a small to medium-sized business network.





NAT Operation NAT Characteristics

- IPv4 Private Address Space
 - 10.0.0.0 /8, 172.16.0.0 /12, and 192.168.0.0 /16
- What is NAT?
 - Process to translate network IPv4 address
 - Conserve public IPv4 addresses
 - Configured at the border router for translation
- NAT Terminology
 - Inside address
 - Inside local address
 - Inside global address
 - Outside address
 - Outside local address
 - Outside global address



NAT Operation Types of NAT

Static NAT

- One-to-one mapping of local and global addresses
- Configured by the network administrator and remain constant.
- Dynamic NAT
 - Uses a pool of public addresses and assigns them on a first-come, first-served basis
 - Requires that enough public addresses for the total number of simultaneous user sessions
- Port Address Translation (PAT)
 - Maps multiple private IPv4 addresses to a single public IPv4 address or a few addresses
 - Also known as NAT overload
 - Validates that the incoming packets were requested
 - Uses port numbers to forward the response packets to the correct internal device





NAT Operation NAT Advantages

Advantages of NAT

- Conserves the legally registered addressing scheme
- Increases the flexibility of connections to the public network
- Provides consistency for internal network addressing schemes
- Provides network security
- Disadvantages of NAT
 - Performance is degraded
 - End-to-end functionality is degraded
 - End-to-end IP traceability is lost
 - Tunneling is more complicated
 - Initiating TCP connections can be disrupted







Configuring NAT Configuring Static NAT

- Configuring Static NAT
 - Create the mapping between the inside local and outside local addresses

```
ip nat inside source static local-ip global-ip
```

 Define which interfaces belong to the inside network and which belong to the outside network

ip nat inside
ip nat outside

- Analyzing Static NAT
- Verifying Static NAT show ip nat translations show ip nat statistics clear ip nat statistics



Configuring NAT Configuring Dynamic NAT

- Dynamic NAT Operation
 - The pool of public IPv4 addresses (inside global address pool) is available to any device on the inside network on a first-come, firstserved basis.
 - With dynamic NAT, a single inside address is translated to a single outside address.
 - The pool must be large enough to accommodate all inside devices.
 - A device is unable to communicate to any external networks if no addresses are available in the pool.

Configuring NAT Configuring Dynamic NAT (Cont.)

- Configuring Dynamic NAT
 - Create the mapping between the inside local and outside local addresses

Create a standard ACL to permit those addresses to be translated

```
access-list access-list-number permit source
[source-wildcard]
```

• Bind the ACL to the pool

ip nat inside source list access-list-number pool
name

- Identify the inside and outside interfaces
 - ip nat inside
 - ip nat outside

Configuring NAT Configuring Dynamic NAT (Cont.)

- Analyzing Dynamic NAT
- Verifying Dynamic NAT show ip nat translations show ip nat translations verbose clear ip nat statistics clear ip nat translations *





Configuring NAT

Configuring Port Address Translations (PAT)

- Configuring PAT: Address Pool
 - Create the mapping between the inside local and outside local addresses

```
ip nat pool name start-ip end-ip {netmask netmask |
prefix-length prefix-length}
```

Create a standard ACL to permit those addresses to be translated

```
access-list access-list-number permit source [source-
wildcard]
```

• Bind the ACL to the pool

```
ip nat inside source list access-list-number pool name
```

- Identify the inside and outside interfaces
 - ip nat inside
 - ip nat outside





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Configuring Port Address Translations (PAT) (Cont.)

- Configuring PAT: Single Address
 - Define a standard ACL to permit those addresses to be translated

```
access-list access-list-number permit source
[source-wildcard]
```

 Establish dynamic source translation, specify the ACL, exit interface, and overload option

```
ip nat inside source list access-list-number
interface type name overload
```

Identify the inside and outside interfaces

ip nat inside

ip nat outside



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Configuring Port Address Translations (PAT) (Cont.)

- Analyzing PAT
- Verifying PAT show ip nat translations
 - show ip nat statistics
 - slear ip nat statistics





Configuring NAT Port Forwarding

- Port Forwarding
 - Port forwarding is the act of forwarding a network port from one network node to another.
 - A packet sent to the public IP address and port of a router can be forwarded to a private IP address and port in inside network.
 - Port forwarding is helpful in situations where servers have private addresses, not reachable from the outside networks.
- Wireless Router Example
- Configuring Port Forwarding with IOS

```
ip nat inside source [static {tcp | udp local-ip local-port
global-ip global-port} [extendable]
```



Configuring NAT Configuring NAT and IPv6

- NAT for IPv6?
 - IPv6 with a 128-bit address provides 340 undecillion addresses.
 - Address space is not an issue for IPv6.
 - IPv6 makes IPv4 public-private NAT unnecessary by design; however, IPv6 does implement a form of private addresses, and it is implemented differently than they are for IPv4.
- IPv6 Unique Local Address
 - IPv6 unique local addresses (ULAs) are designed to allow IPv6 communications within a local site.
 - ULAs are not meant to provide additional IPv6 address space.
 - ULAs have the prefix FC00::/7, which results in a first hextet range of FC00 to FDFF.
 - ULAs are also known as local IPv6 addresses (not to be confused with IPv6 link-local addresses).



Configuring NAT Configuring NAT and IPv6 (Cont.)

- NAT for IPv6
 - IPv6 also uses NAT, but in a much different context.
 - In IPv6, NAT is used to provide transparent communication between IPv6 and IPv4.
 - NAT64 is not intended to be a permanent solution; it is meant to be a transition mechanism.
 - Network Address Translation-Protocol Translation (NAT-PT) was another NATbased transition mechanism for IPv6, but is now deprecated by IETF.
 - NAT64 is now recommended.



9.3 Troubleshooting NAT





Troubleshooting NAT Configurations

- Troubleshooting NAT: show commands
 - clear ip nat statistics
 - clear ip nat translations *
 - show ip nat statistics
 - Show ip nat translations
- Troubleshooting NAT: debug commands

debug ip nat



9.4 Chapter Summary





Chapter Summary Summary

- How NAT is used to help alleviate the depletion of the IPv4 address space.
- NAT conserves public address space and saves considerable administrative overhead in managing adds, moves, and changes.
- NAT for IPv4, including:
 - NAT characteristics, terminology, and general operations
 - Different types of NAT, including static NAT, dynamic NAT, and NAT with overloading
 - Benefits and disadvantages of NAT
- The configuration, verification, and analysis of static NAT, dynamic NAT, and NAT with overloading.
- How port forwarding can be used to access an internal devices from the Internet.
- Troubleshooting NAT using show and debug commands.
- How NAT for IPv6 is used to translate between IPv6 addresses and IPv4 addresses.

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