Instructor Materials
Chapter 9: NAT for IPv4

CCNA Routing and Switching

Routing and Switching Essentials v6.0

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Chapter 9: NAT for IPv4

Routing and Switching Essentials v6.0

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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.

9.1 NAT Operation

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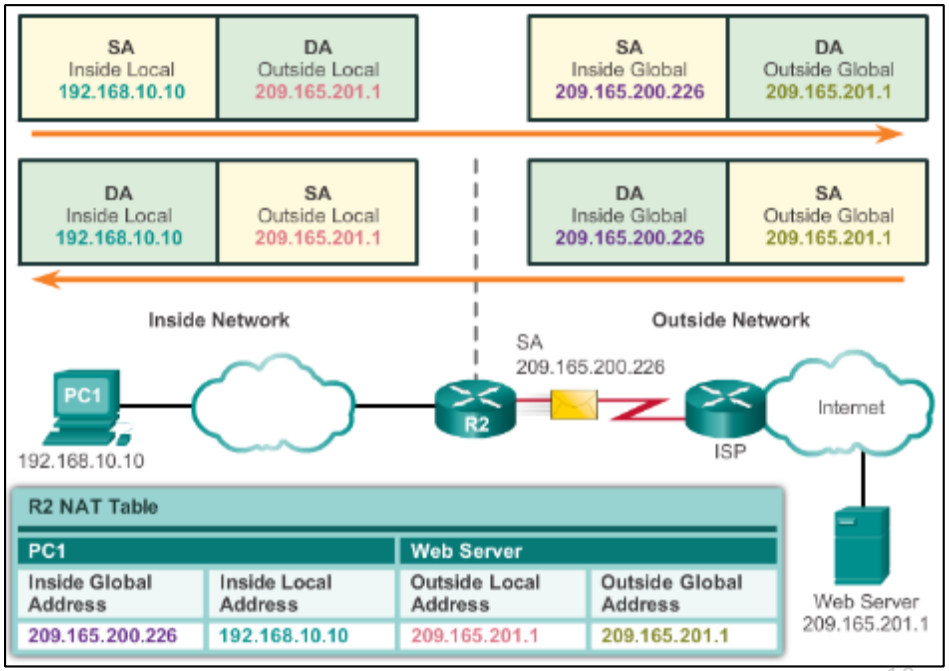
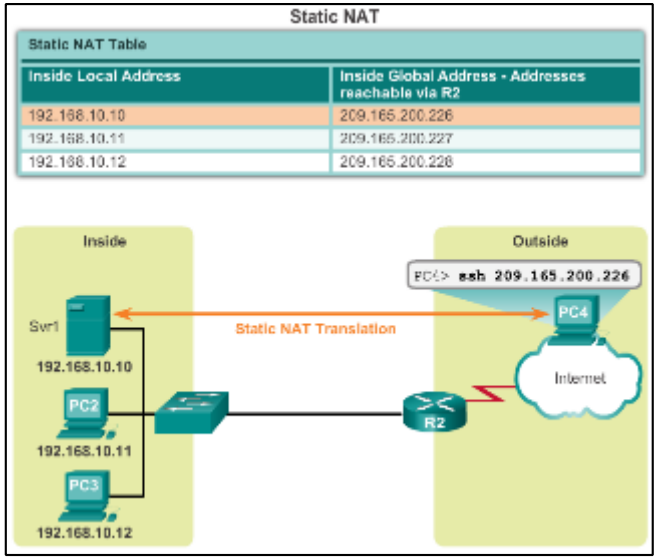
NAT Characteristics

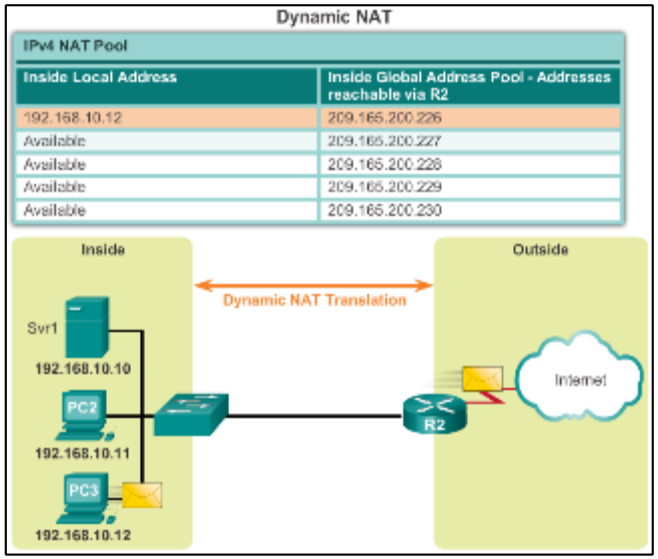
- IPv4 Private Address Space
  - 10.0.0.0 /8, 172.16.0.0 /12, and 192.168.0.0 /16
- What is NAT?
  - Process to translate network IPv4 address
  - Conserve public IPv4 addresses
  - Configured at the border router for translation
- NAT Terminology
  - Inside address
  - Inside local address
  - Inside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



Types of NAT

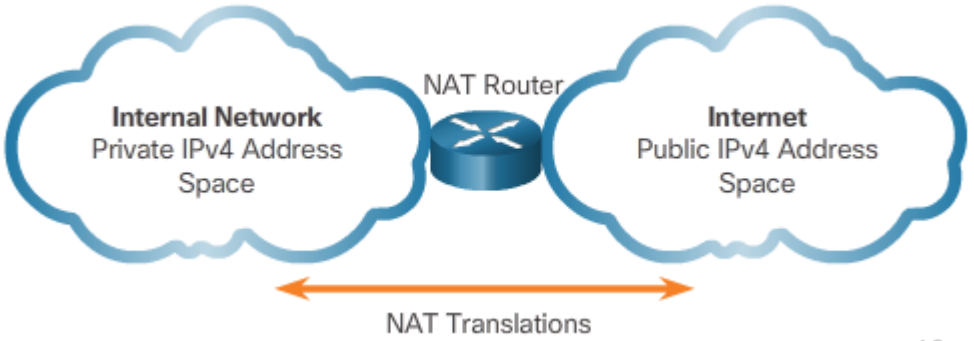
- Static NAT
  - One-to-one mapping of local and global addresses
  - Configured by the network administrator and remain constant.
- Dynamic NAT
  - Uses a pool of public addresses and assigns them on a first-come, first-served basis
  - Requires that enough public addresses for the total number of simultaneous 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 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



9.2 Configuring NAT

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Configuring Static NAT

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

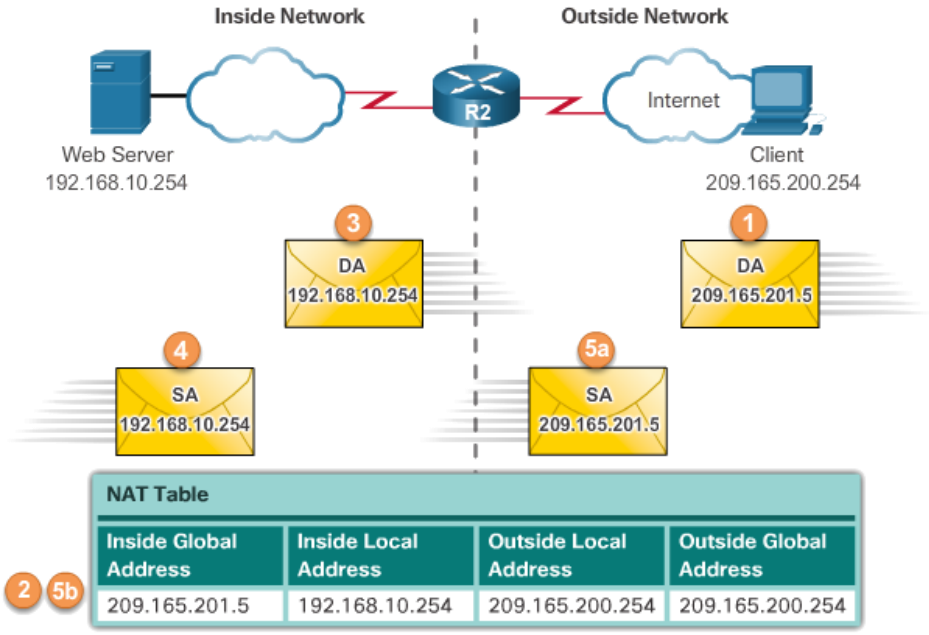
```
ip nat inside source static local-ip global-ip
```

  - 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 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, first-served 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 Dynamic NAT (Cont.)

- Configuring Dynamic NAT
  - 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

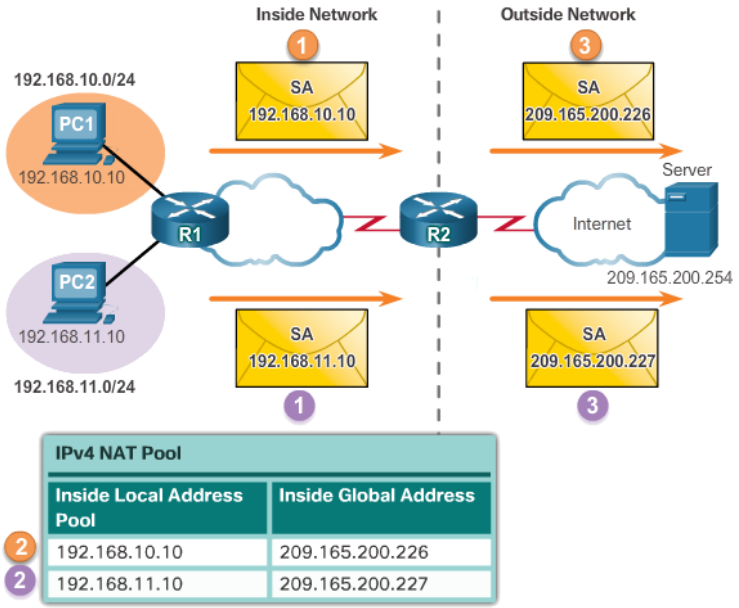
    ip nat inside

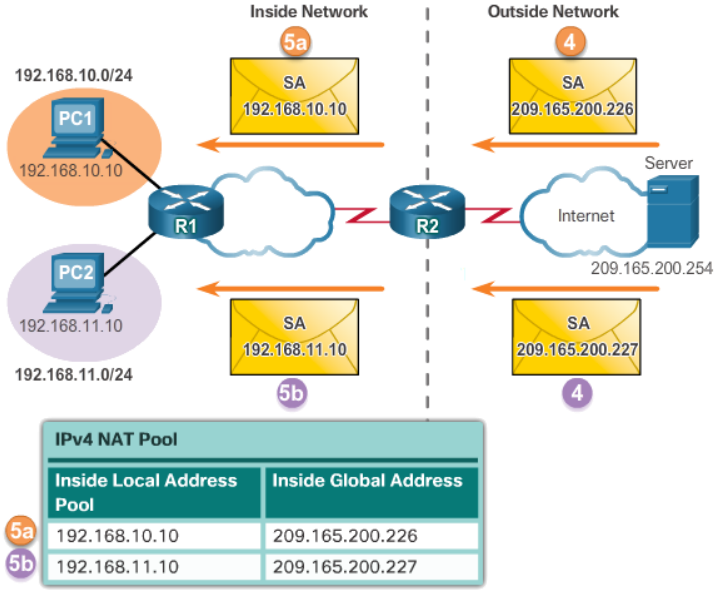
    ip nat outside

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 Port Address Translations (PAT)

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

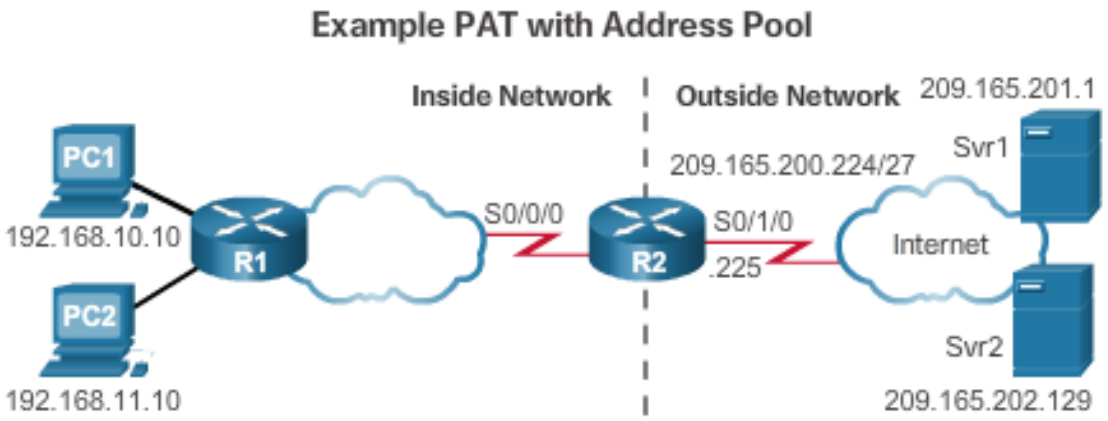
    ip nat pool name *start-ip end-ip* {**netmask** *netmask* | **prefix-length** *prefix-length*}
  - Create a standard ACL to permit those addresses to be translated

    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



Configuring Port Address Translations (PAT) (Cont.)

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

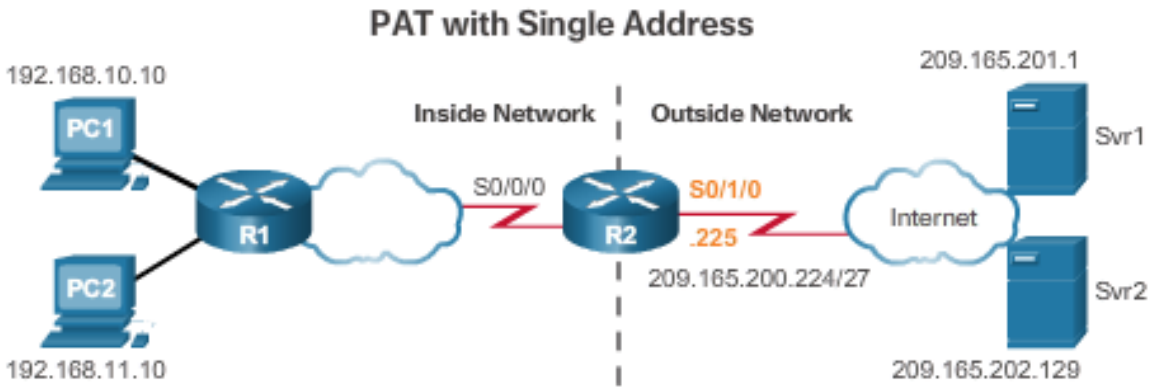
```
access-list access-list-number permit source
[source-wildcard]
```

  - 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

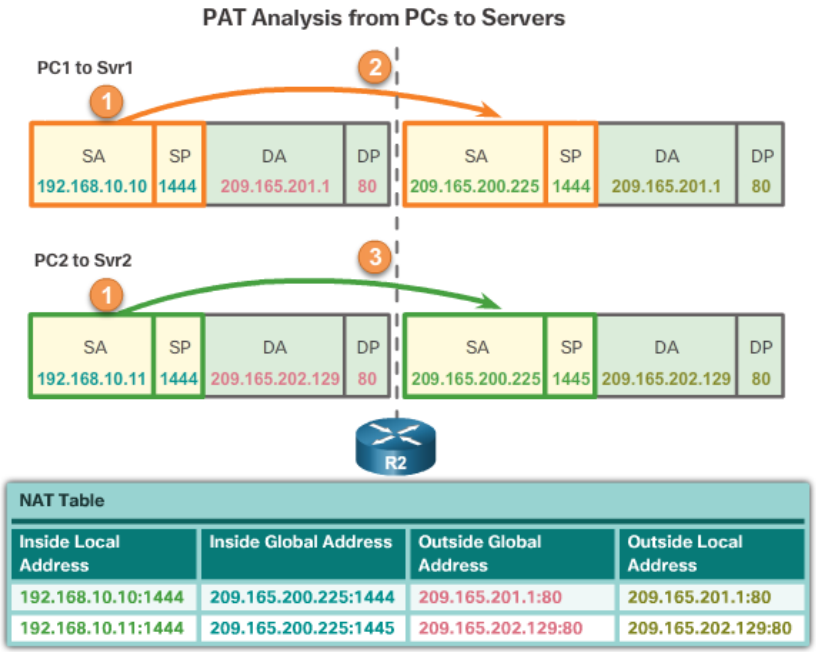
```
ip nat inside

ip nat outside
```



Configuring Port Address Translations (PAT) (Cont.)

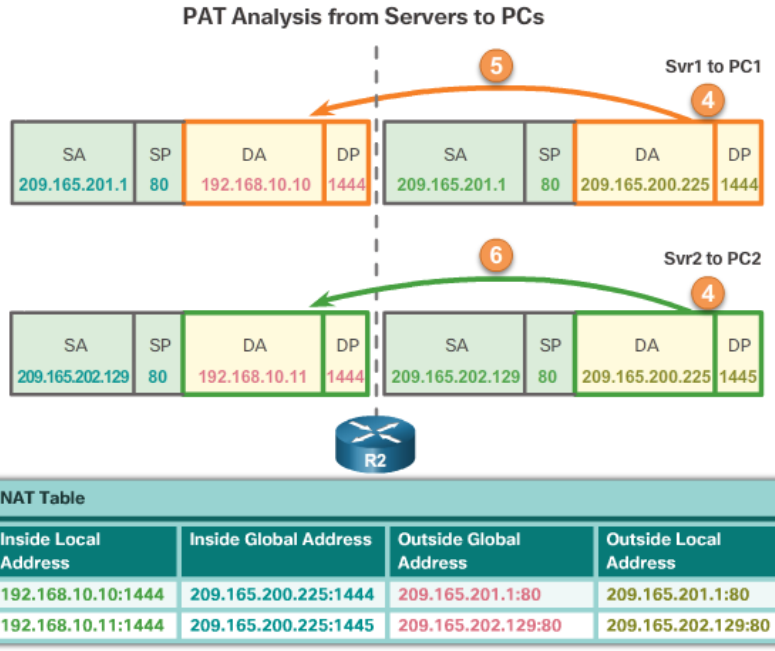
- Analyzing PAT
- Verifying PAT

```
show ip nat translations
show ip nat statistics
slear ip nat statistics
```



NAT Table

Inside Local Address	Inside Global Address	Outside Global Address	Outside Local Address
192.168.10.10:1444	209.165.200.225:1444	209.165.201.1:80	209.165.201.1:80
192.168.10.11:1444	209.165.200.225:1445	209.165.202.129:80	209.165.202.129:80



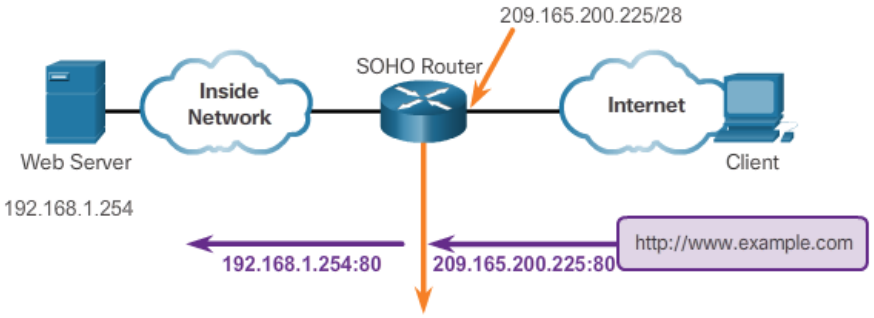
NAT Table

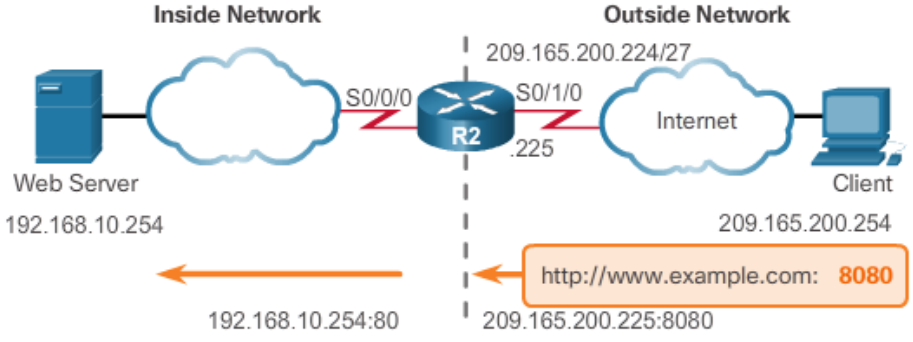
Inside Local Address	Inside Global Address	Outside Global Address	Outside Local Address
192.168.10.10:1444	209.165.200.225:1444	209.165.201.1:80	209.165.201.1:80
192.168.10.11:1444	209.165.200.225:1445	209.165.202.129:80	209.165.202.129:80

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

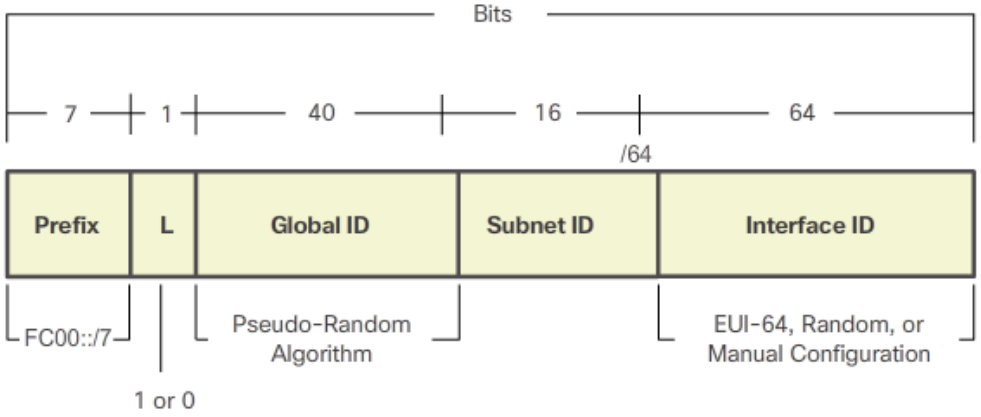
```
ip nat inside source [static {tcp | udp local-ip local-port
global-ip global-port} [extendable]
```





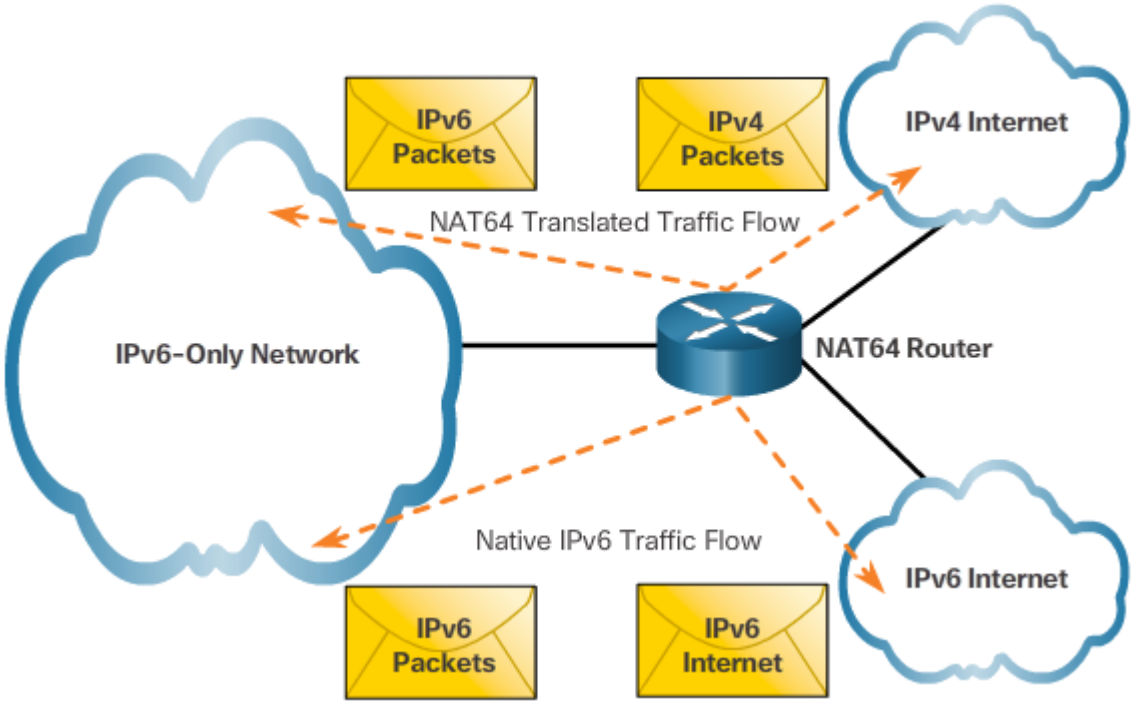
Configuring NAT and IPv6

- 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 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 NAT-based transition mechanism for IPv6, but is now deprecated by IETF.
  - NAT64 is now recommended.



9.3 Troubleshooting NAT

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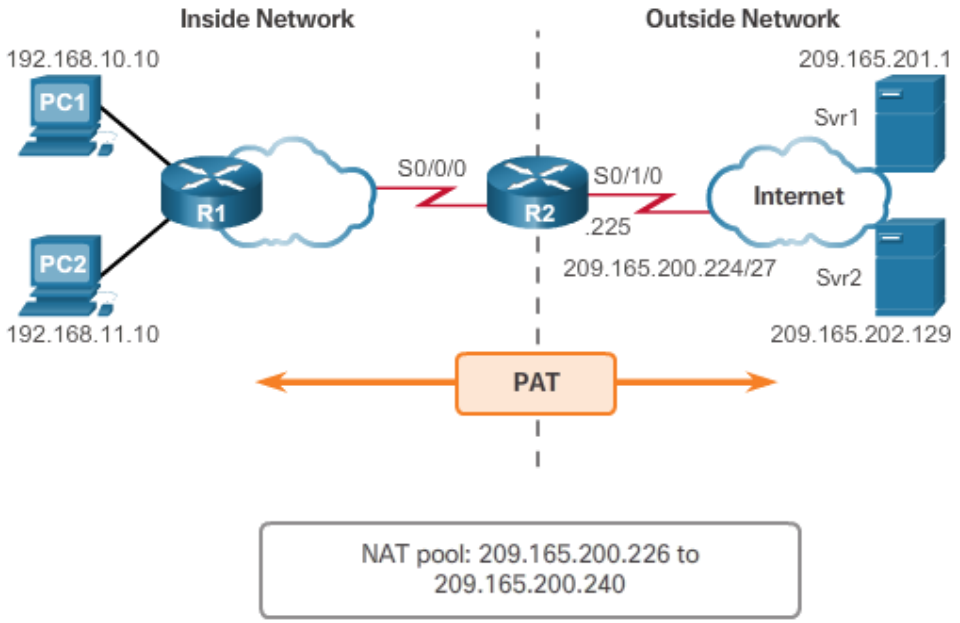
Troubleshooting NAT Configurations

- 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

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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.