NAT & PAT

Scaling Networks with NAT and PAT
Private addressing

- Blocks of private IP addresses:
  - **1 Class A address**
  - **16 Class B addresses**
  - **256 Class C addresses**

Private IP Addresses

Class	RFC 1918 Internal Address Range	CIDR Prefix
A	10.0.0.0 - 10.255.255.255	10.0.0.0/8
B	172.16.0.0 - 172.31.255.255	172.16.0.0/12
C	192.168.0.0 - 192.168.255.255	192.168.0.0/16

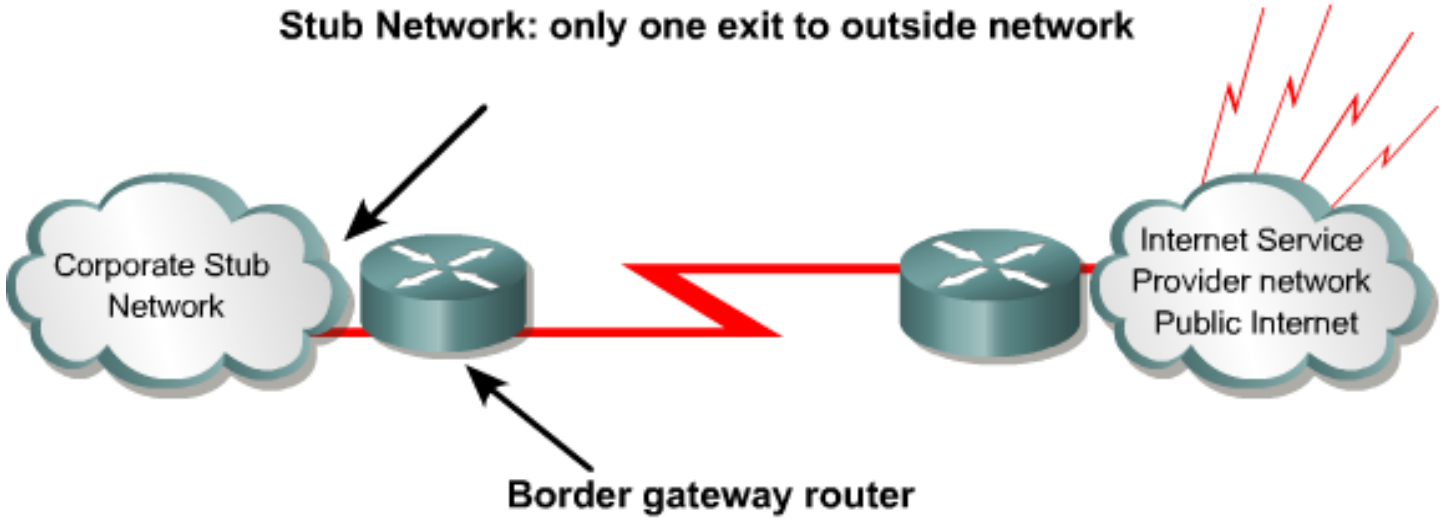
For internal network use only.

- American Registry for Internet Numbers (ARIN)
- Internet Network Information Center (InterNIC)
- The public Internet addresses can also be leased from an ISP
- Two or two million networks, can use the same private address.

Notes: ISPs typically configure the border routers to prevent privately addressed traffic from being forwarded.

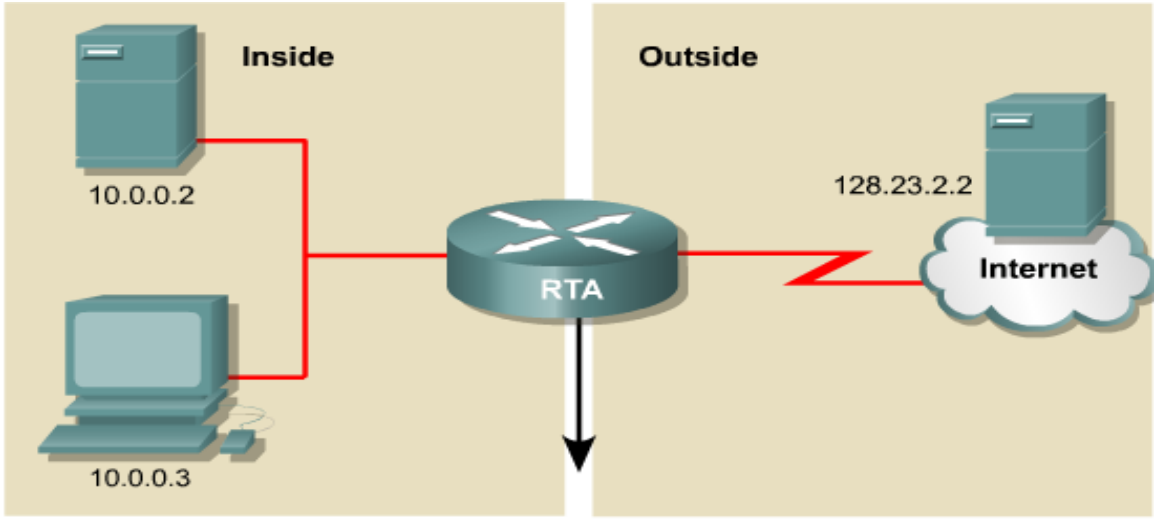
Introducing NAT and PAT

- Before NAT, a host with a private address could not access the Internet.



- **Network Address Translation (NAT)**
  - to conserve/ protect IP addresses.
  - can increase network privacy by hiding internal IP addresses.
  - border gateway router perform the NAT process.

Introducing NAT and PAT (Cont.)



NAT Table		
Inside Local IP Address	Inside Global IP Address	Outside Global IP Address
10.0.0.3	179.9.8.80	128.23.2.2

- Cisco defines the following NAT terms:
- **Inside local address**
- **Inside global address**
- **Outside local address**
- **Outside global address**

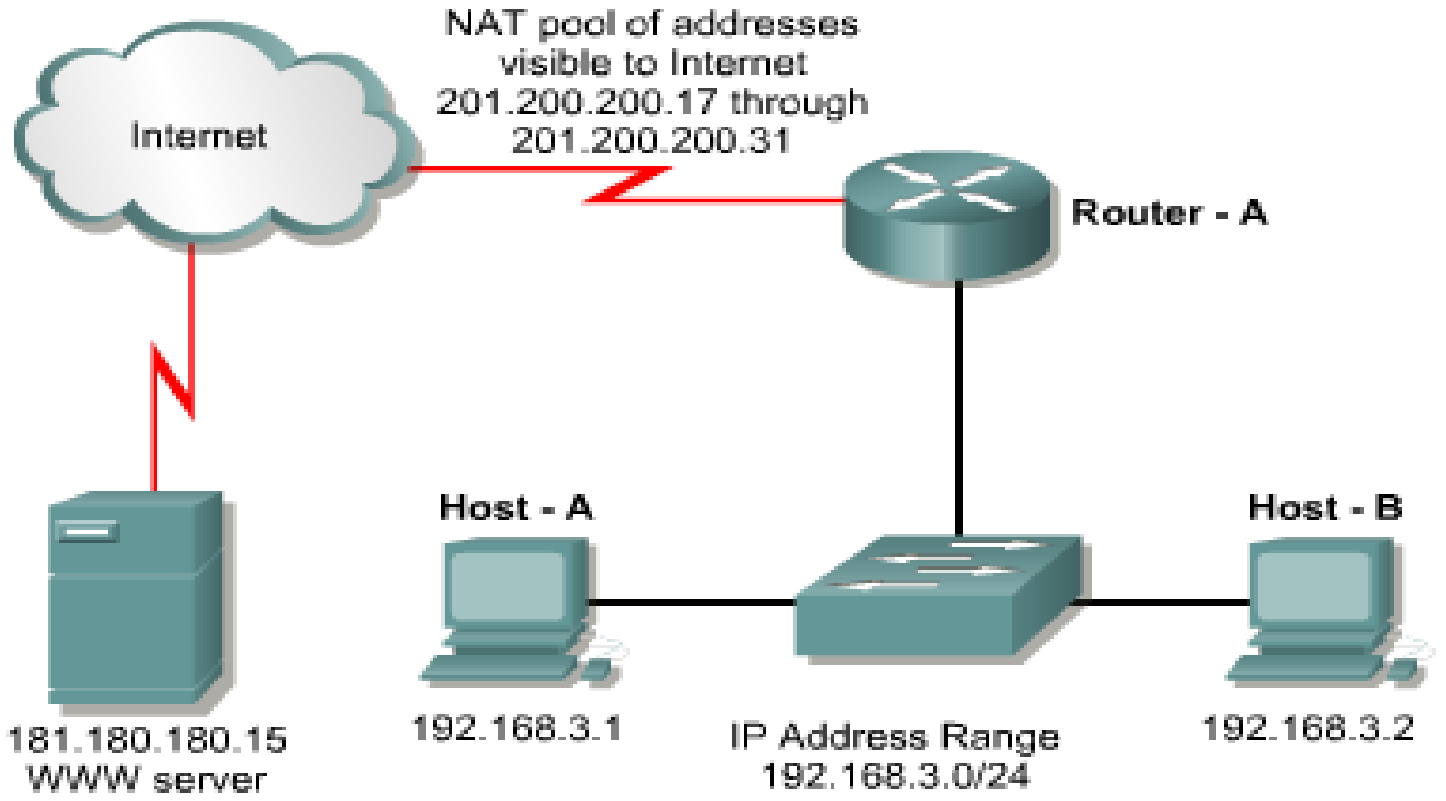
Inside local address—The IP address assigned to a host on the inside network. This is the address configured as a parameter of the computer OS or received via dynamic address allocation protocols such as DHCP. The address is likely not a legitimate IP address assigned by the Network Information Center (InterNIC) or service provider.

Inside global address—A legitimate IP address assigned by the (InterNIC) or service provider that represents one or more inside local IP addresses to the outside world.

Outside local address—The IP address of an **outside host** as it appears to the **inside network**. **Not necessarily a legitimate address**, it is allocated from an address space routable on the inside.

Outside global address—The IP address assigned to a host on the outside network by the host owner. **The address is allocated from a globally routable address or network space.**

Introducing NAT and PAT (Cont.)



Inside Local IP ADDRESS	Inside Global IP ADDRESS	Outside Global IP ADDRESS
192.168.3.1	201.200.200.17	181.180.180.15
192.168.3.2	201.200.200.18	181.180.180.15

Introducing NAT and PAT (Cont.)

NAT, Network Address Translation in simple terms translates an IP address into another. Network Address Translation is one of different types like:

- Static NAT (One to One)
- Dynamic NAT (Many to Many)
- Overloading (Many to One)

We will focus on Overloading form of NAT. This is called as Port Address Translation (PAT). NAT Overloading translates **many private IP addresses** from a Local Area Network (LAN) **onto a single registered legal Public IP address**.

Major NAT and PAT features

NAT ⇒ static or dynamic

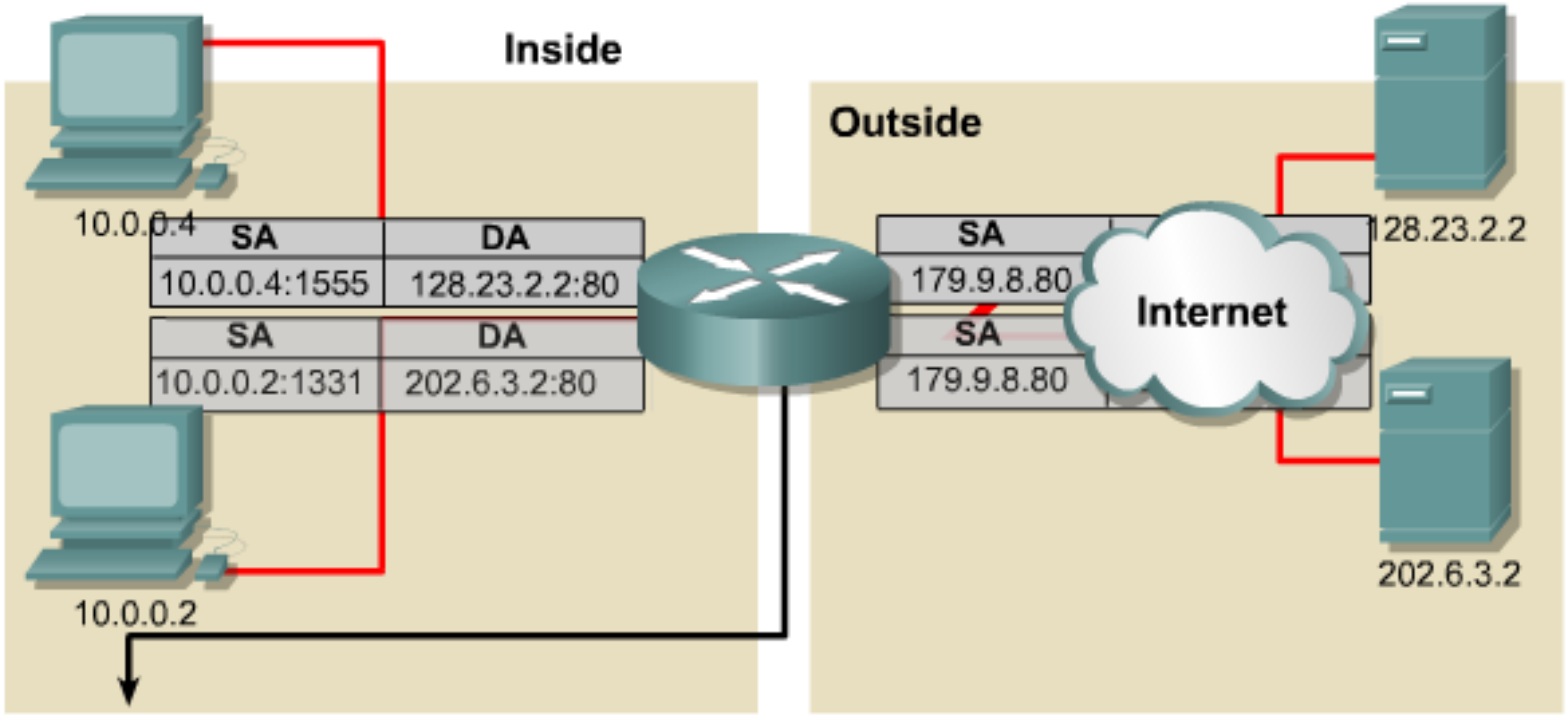
- Static NAT ⇒ allow one-to-one mapping of local and global addresses.
  ⇒ These internal hosts may be enterprise servers or networking devices.

- Dynamic NAT ⇒ any IP address from a pool of public IP addresses is assigned to a host.

PAT ⇒

- **PAT:** Overloading, or Port Address Translation (PAT), maps multiple private IP addresses to a single public IP address. Multiple addresses can be mapped to a single address because each private address is tracked by a port number.
- During PAT, each computer on LAN is translated to the same IP address, but with a different port number assignment.

Major NAT and PAT features (Cont.)



NAT Table with Overload			
Inside Local IP Address	Inside Global IP Address	Outside Local IP Address	Outside Global Address
10.0.0.2:1331 10.0.0.4:1555	179.9.8.80:1331 179.9.8.80:1555	202.6.3.2:80 128.23.2.2:80	202.6.3.2:80 128.23.2.2:80

- Overloading ⇒ Port Address Translation (PAT) ⇒ maps multiple private IP addresses to a single public IP address.

Major NAT and PAT features (Cont.)

- Port number - 16 bits.
- Theoretically, 65,536 internal addresses per Ex. IP address.
- Realistically, 4000.
- PAT will attempt to preserve the original source port.
- If already used - available port number starting from the beginning of the appropriate port group 0-511, 512-1023, or 1024-65535.

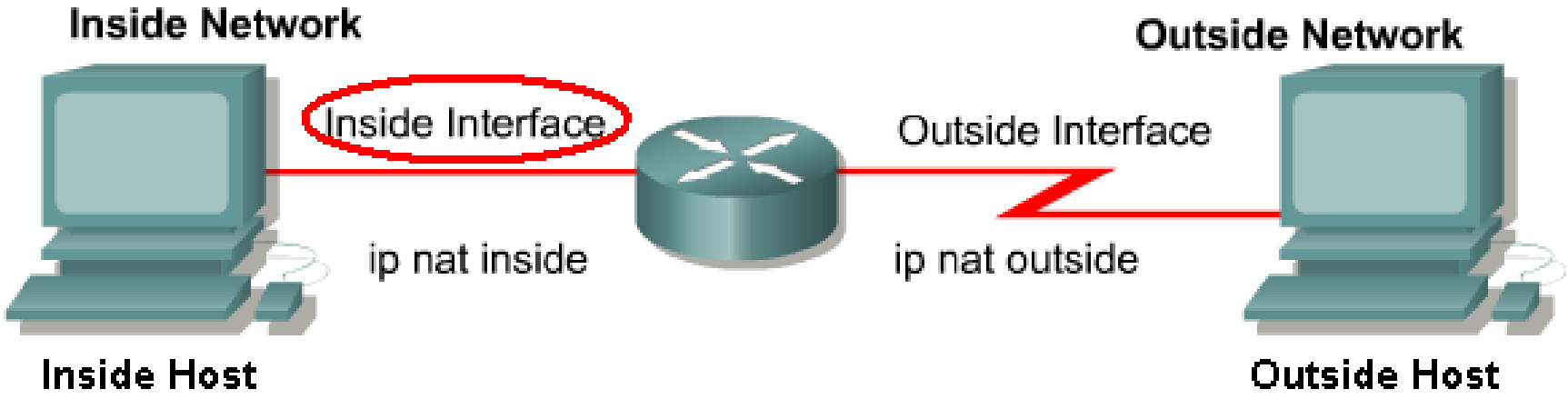
Configuring NAT

```
Router(config)#ip nat inside source static 10.6.1.20 171.69.68.10
```

- Static translations are entered directly into the configuration and are always in the translation table

Step	Action	Notes
1	Establish static translation between an inside local address and an inside global address. `Router(config)#ip nat inside source static local-ip global-ip`	Enter the global command `no ip nat inside source static` to remove the static source translation.
2	Specify the inside interface. `Router(config)#interface type number`	Enter the `interface` command. The CLI prompt will change from `(config)#` to `(config-if)#`.
3	Mark the interface as connected to the inside. `Router(config-if)#ip nat inside`	
4	Exit interface configuration mode. `Router(config-if)# exit`	
5	Specify the outside interface. `Router(config)#interface type number`	
6	Mark the interface as connected to the outside. `Router(config-if)#ip nat outside`	

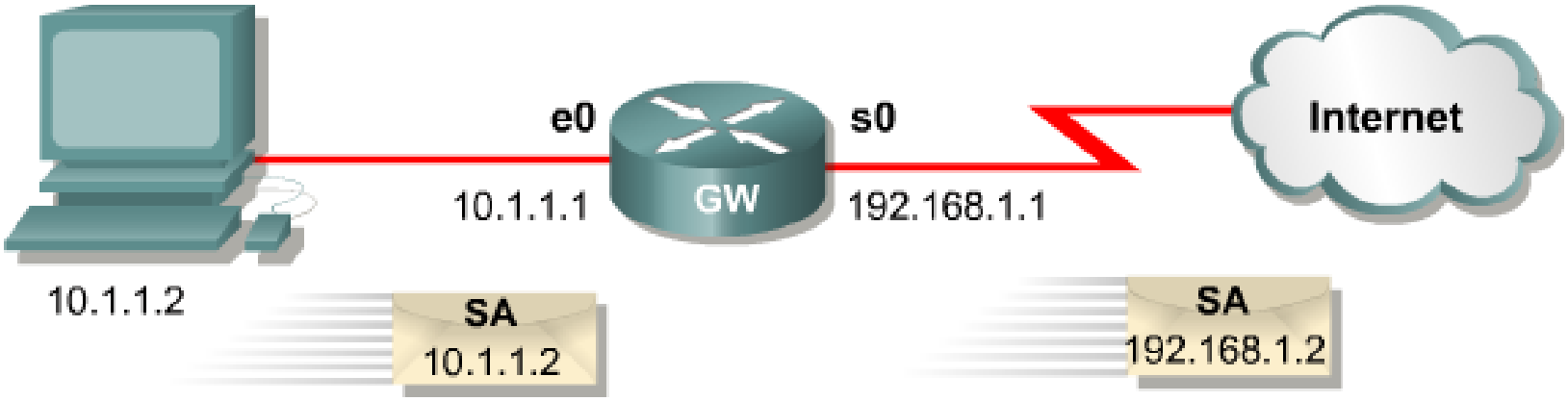
Configuring NAT (Cont.)




```
Router(config-if)#ip nat inside
```

- An interface on the router can be defined as inside or outside.
- Translations occur between inside and outside interfaces.

Configuring NAT (Cont.)




```
hostname GW
!
ip nat inside source static 10.1.1.2 192.168.1.2
!
interface ethernet 0
  ip address 10.1.1.1 255.255.255.0
  ip nat inside
!
interface serial 0
  ip address 192.168.1.1 255.255.255.0
  ip nat outside
!
```

Configuring NAT (Cont.)

```
Router(config)#access-list 1 permit 10.0.0.0 0.0.255.255
```

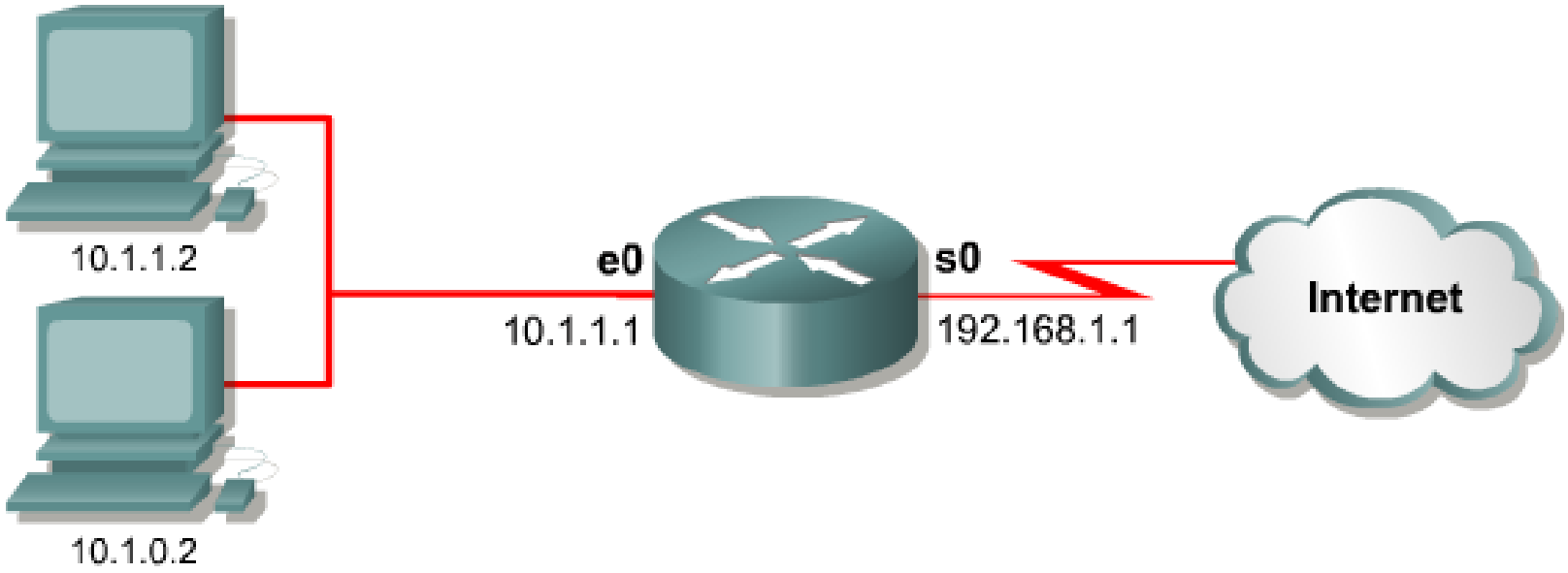
- Access lists are used by NAT to select addresses for dynamic translation

```
Router(config)#ip nat inside source list 1 pool nat-pool
```

- Dynamic translation uses the addresses permitted by the access list to be translated.

Step	Action	Notes
	Define a pool of global addresses to be allocated as needed. `Router(config)#ip nat pool name start-ip end-ip {netmask netmask|prefix-length prefix-length}`	Enter the global command **no ip nat pool** *name* to remove the pool of global addresses.
	Define a standard access list permitting those addresses that are to be translated. `Router(config)#access-list access-list-number permit source [source-wildcard]`	Enter the global command **no access-list** *access-list-number* to remove the access list.
	Establish dynamic source translation, specifying the access list defined in the prior step. `Router(config)#ip nat inside source list access-list-number pool name`	Enter the global command **no ip nat inside source** to remove the dynamic source translation.
	Mark the interface as connected to the inside. `Router(config-if)#ip nat inside`	
	Mark the interface as connected to the outside. `Router(config-if)#ip nat outside`	

Configuring NAT (Cont.)




```
ip nat pool nat-pool1 179.9.8.80 179.9.8.95 netmask 255.255.255.0
ip nat inside source list 1 pool nat-pool1
!
interface ethernet 0
  ip address 10.1.1.1 255.255.0.0
  ip nat inside
!
interface serial 0
  ip address 192.168.1.1 255.255.255.0
  ip nat outside
!
access-list 1 permit 10.1.0.0 0.0.0.255
```

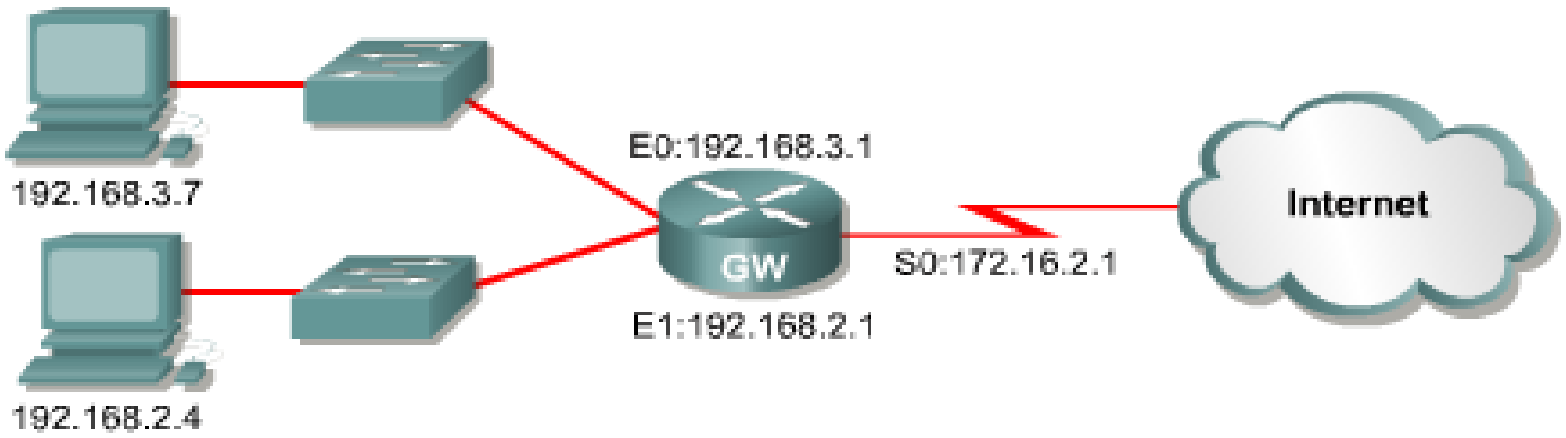
Configuring PAT

1. **<u>If only one public IP address</u>**: Assigned to the outside interface which connects to the ISP.
2. **<u>If one or more public IP address:</u>** we have to use NAT pool.

1. <u>If only one public IP address</u>: Assigned to the outside interface which connects to the ISP.

Step	Action	Notes
1	Define a standard access list permitting those addresses that are to be translated. `Router(config)#access-list acl-number source [source-wildcard]`	Enter the global command **`no access-list`** *`access-list-number`* to remove the access list.
2A	Establish dynamic source translation, specifying the access list defined in the prior step. `Router(config)#ip nat inside source list acl-number interface interface overload`	Enter the global command **`no ip nat inside source`** to remove the dynamic source translation. The overload keyword enables PAT.
3	Specify the inside interface. `Router(config)#interface type number Router(config-if)#ip nat inside`	Enter the **`interface`** command. The CLI prompt will change from `(config)#` to `(config-if)#`.
4	Specify the outside interface. `Router(config-if)#interface type number Router(config-if)#ip nat outside`	

Example:




```
interface ethernet 0
  ip address 192.168.3.1 255.255.255.0
  ip nat inside
!
interface ethernet 1
  ip address 192.168.2.1 255.255.255.0
  ip nat inside
!
interface serial 0
  ip address 172.16.2.1 255.255.255.0
  ip nat outside
!
ip nat inside source list 1 interface serial 0 overload
!
access-list 1 permit 192.168.2.0 0.0.0.255
access-list 1 permit 192.168.3.0 0.0.0.255
```

Configuring PAT

2. <u>If one or more public IP address:</u> we have to use NAT pool.

Step	Action	Notes
1	Define a standard access list permitting those addresses that are to be translated. `Router(config)#access-list acl-number source [source-wildcard]`	Enter the global command `no access-list access-list-number` to remove the access list.
2B	Specify the global address, as a pool, to be used for overloading. `Router(config)#ip nat pool name start-ip end-ip {netmask netmask | prefix-length prefix-length}` Establish overload translation. `Router (config)#ip nat inside source list acl-number pool name overload`	
3	Specify the inside interface. `Router(config)#interface type number Router(config-if)#ip nat inside`	Enter the `interface` command. The CLI prompt will change from `(config)#` to `(config-if)#`.
4	Specify the outside interface. `Router(config-if)#interface type number Router(config-if)#ip nat outside`	

Verifying PAT configuration

```
Router#clear ip nat translation *
```

- Clears all dynamic address translation entries

```
Router#clear ip nat translation inside global-ip local-ip [outside
local-ip global-ip]
```

- Clears a simple dynamic translation entry

```
Router#clear ip nat translation protocol inside global-ip global-port
local-ip local-port [outside local-ip local-port global-ip
global-port]
```

- Clears an extended dynamic translation entry

Notes: By default, dynamic address translations will time out from the NAT translation table after a period of non-use. When port translation is not configured, translation entries time out after 24 hours, unless the timers are reconfigured with the **ip nat translation timeout***timeout_seconds* command from global configuration mode.

Verifying PAT configuration (Cont.)

```
Router#show ip nat translations [verbose]
```

- **verbose** (optional) Displays additional information for each translation table entry, including how long ago the entry was created and used

```
Router#show ip nat translations
Pro Inside global     Inside local       Outside local      Outside global
172.16.131.1          10.10.10.1              ---                ---
```

```
Router#show ip nat statistics
```

- Displays translation statistics

```
Router#show ip nat statistics
Total active translations: 1 (1 static, 0 dynamic; 0 extended)
Outside interfaces:
Serial0
Inside interfaces:
Ethernet0, Ethernet1
Hits: 5 Misses:0
```

Thank You all !!!