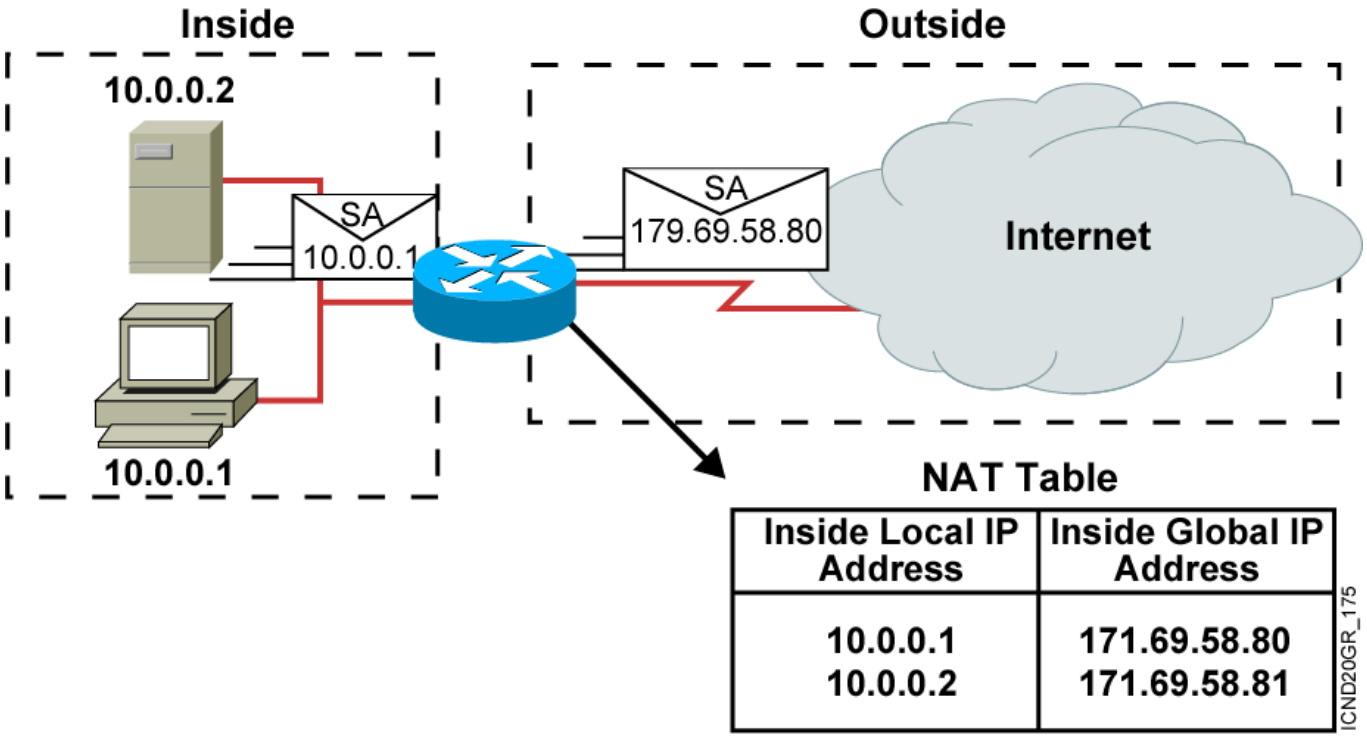
Scaling the Network with NAT and PAT

Objectives

Upon completing this lesson, you will be able to:

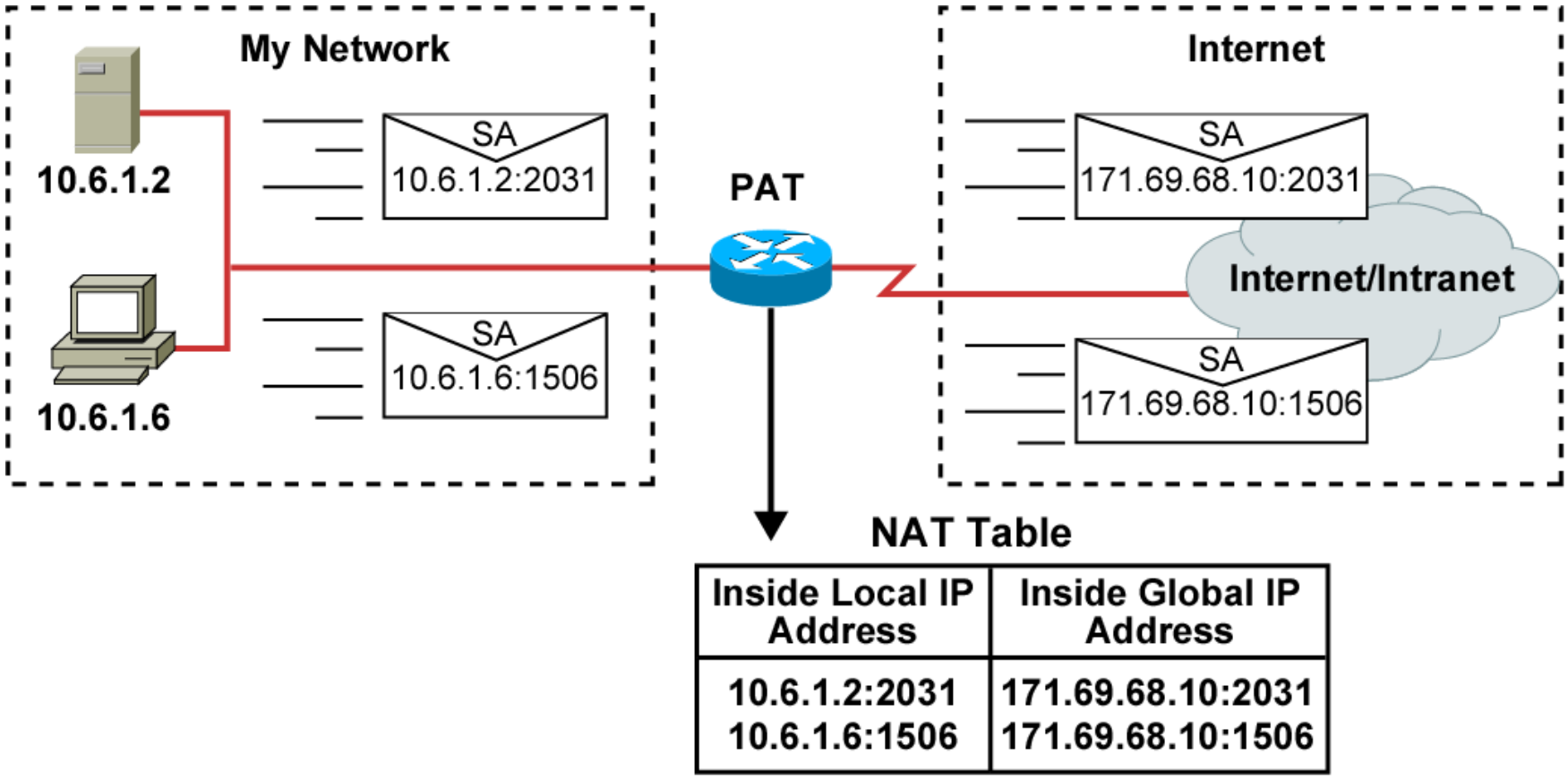
- Describe the features and operation of NAT on Cisco routers
- Use Cisco IOS commands to configure NAT, given a functioning router
- Use show commands to identify anomalies in the NAT configuration, given an operational router
- Use debug commands to identify events and anomalies in the NAT configuration, given an operational router

Network Address Translation

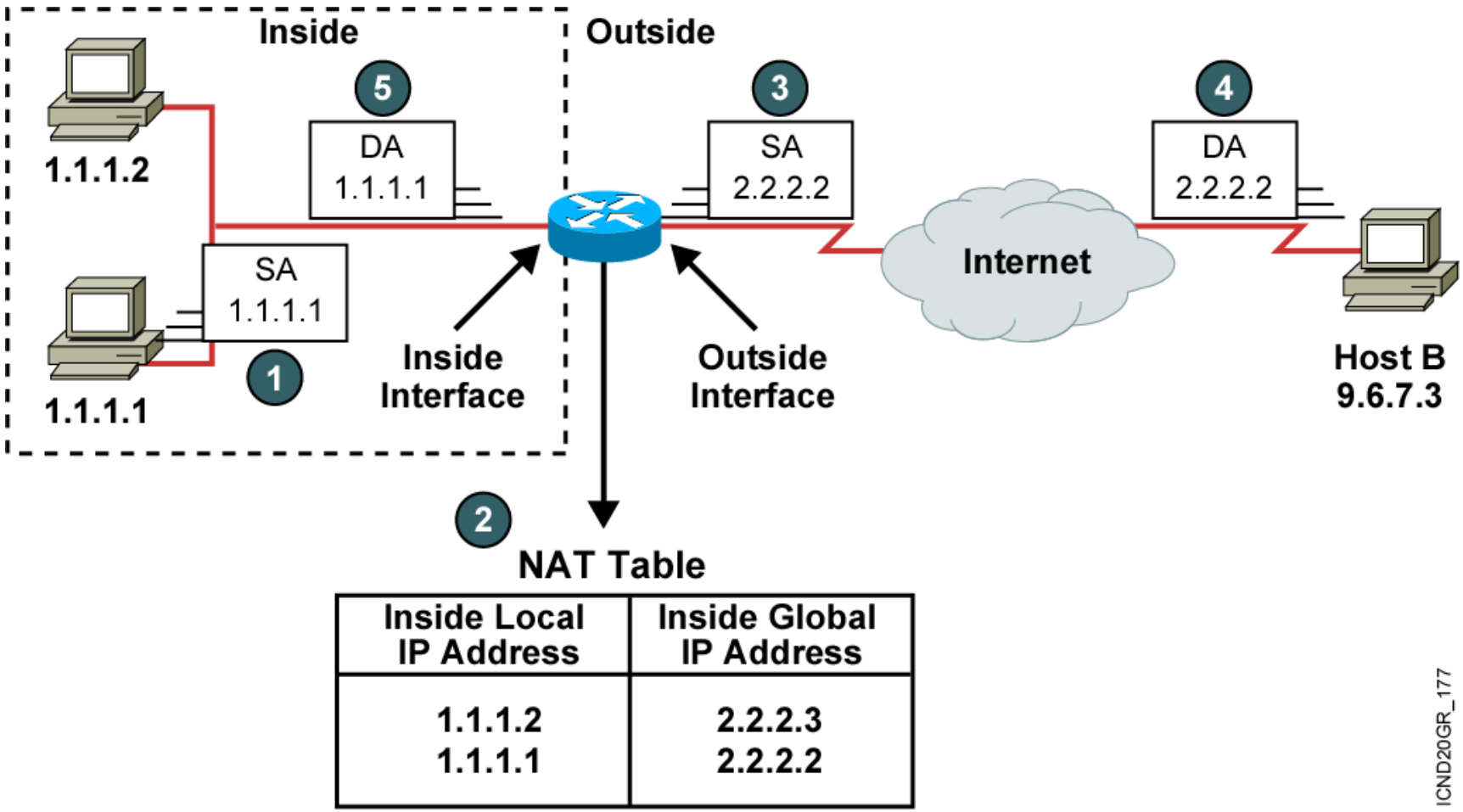


- An IP address is either local or global.
- Local IP addresses are seen in the inside network.

Port Address Translation



Translating Inside Source Addresses



Configuring Static Translation

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```
Router(config)#ip nat inside source static local-ip global-ip
```

- **Establishes static translation between an inside local address and an inside global address**

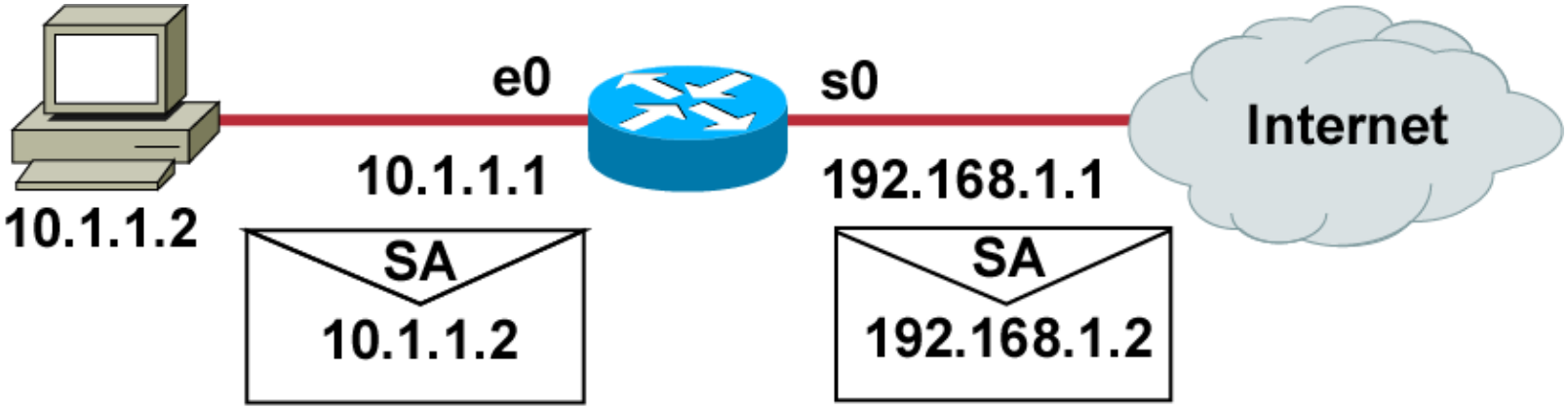
```
Router(config-if)#ip nat inside
```

- **Marks the interface as connected to the inside**

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

- **Marks the interface as connected to the outside**

Enabling Static NAT Address Mapping Example




```
interface s0
ip address 192.168.1.1 255.255.255.0
ip nat outside
!
interface e0
ip address 10.1.1.1 255.255.255.0
ip nat inside
!
ip nat inside source static 10.1.1.2 192.168.1.2
```

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Configuring Dynamic Translation


```
Router(config)#ip nat pool name start-ip end-ip
{netmask netmask | prefix-length prefix-length}
```

- Defines a pool of global addresses to be allocated as needed

```
Router(config)#access-list access-list-number permit
source [source-wildcard]
```

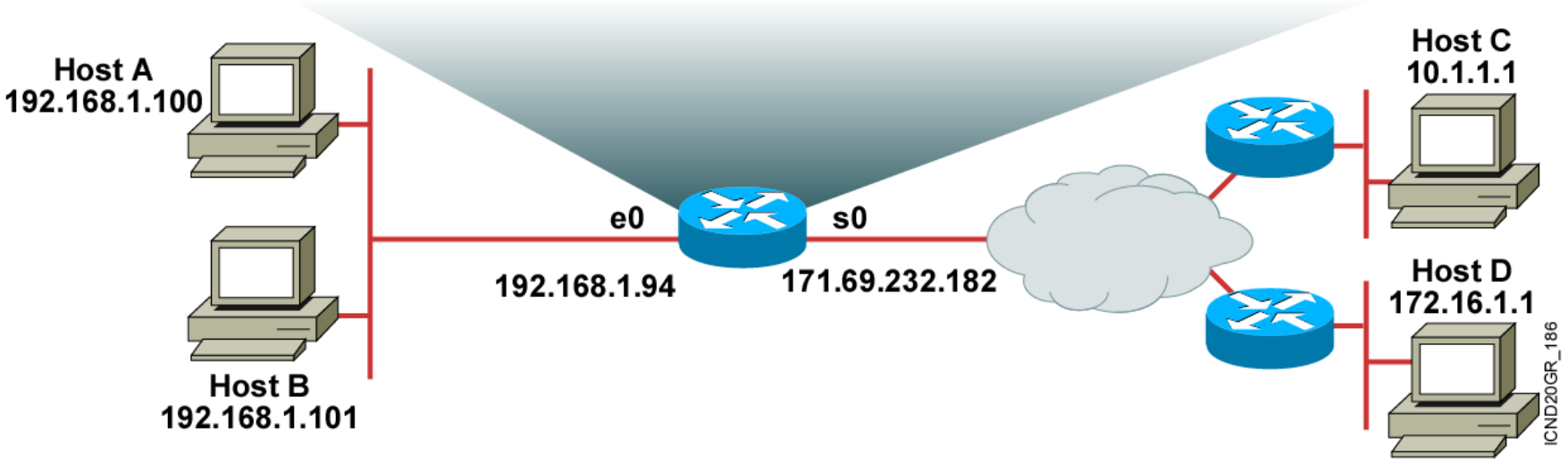
- Defines a standard IP access list permitting those inside local addresses that are to be translated

```
Router(config)#ip nat inside source list
access-list-number pool name
```

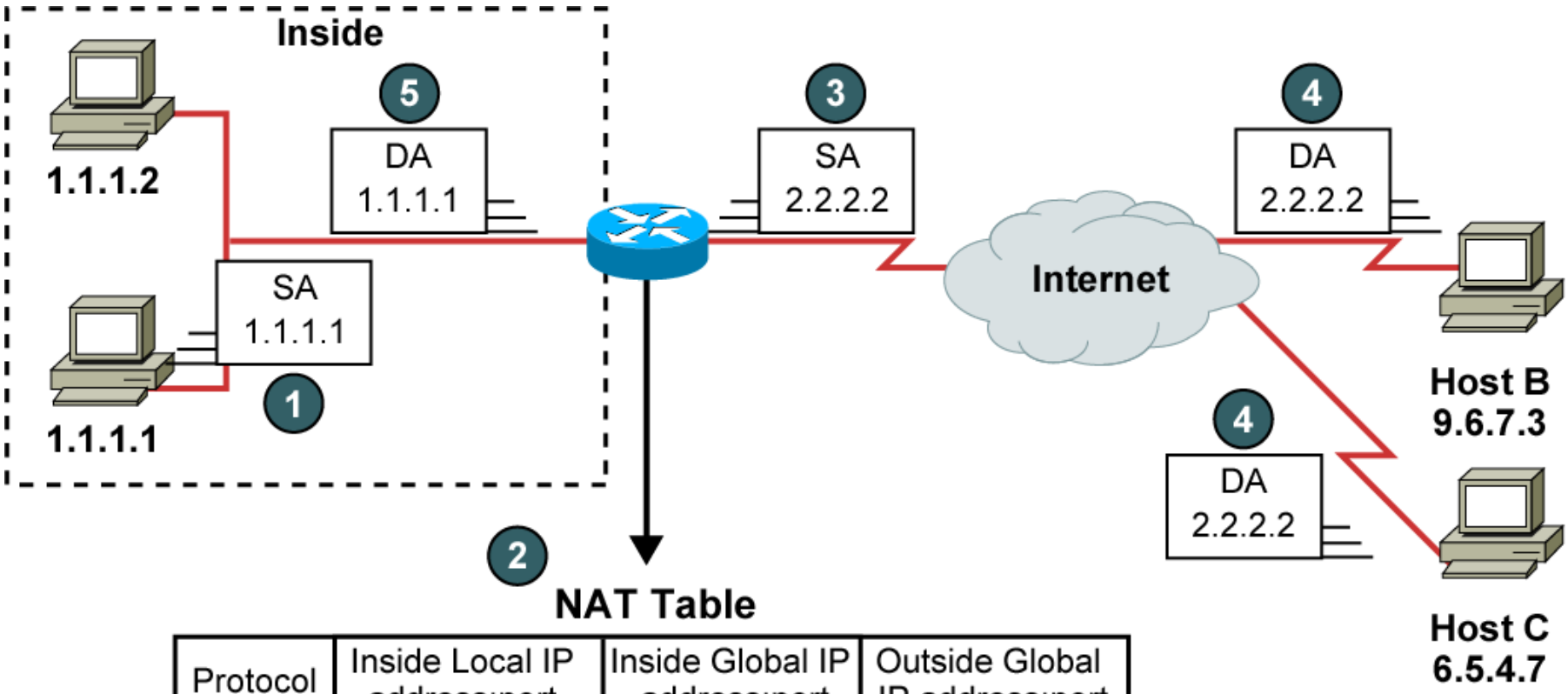
- Establishes dynamic source translation, specifying the access list defined in the prior step

Dynamic Address Translation Example


```
ip nat pool net-208 171.69.233.209 171.69.233.222 netmask
255.255.255.240
ip nat inside source list 1 pool net-208
!
interface serial 0
 ip address 171.69.232.182 255.255.255.240
 ip nat outside
!
interface ethernet 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
```



Overloading an Inside Global Address



Protocol	Inside Local IP address:port	Inside Global IP address:port	Outside Global IP address:port
TCP	1.1.1.2:1723	2.2.2.2:1723	6.5.4.7:23
TCP	1.1.1.1:1024	2.2.2.2:1024	9.6.7.3:23

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Configuring Overloading

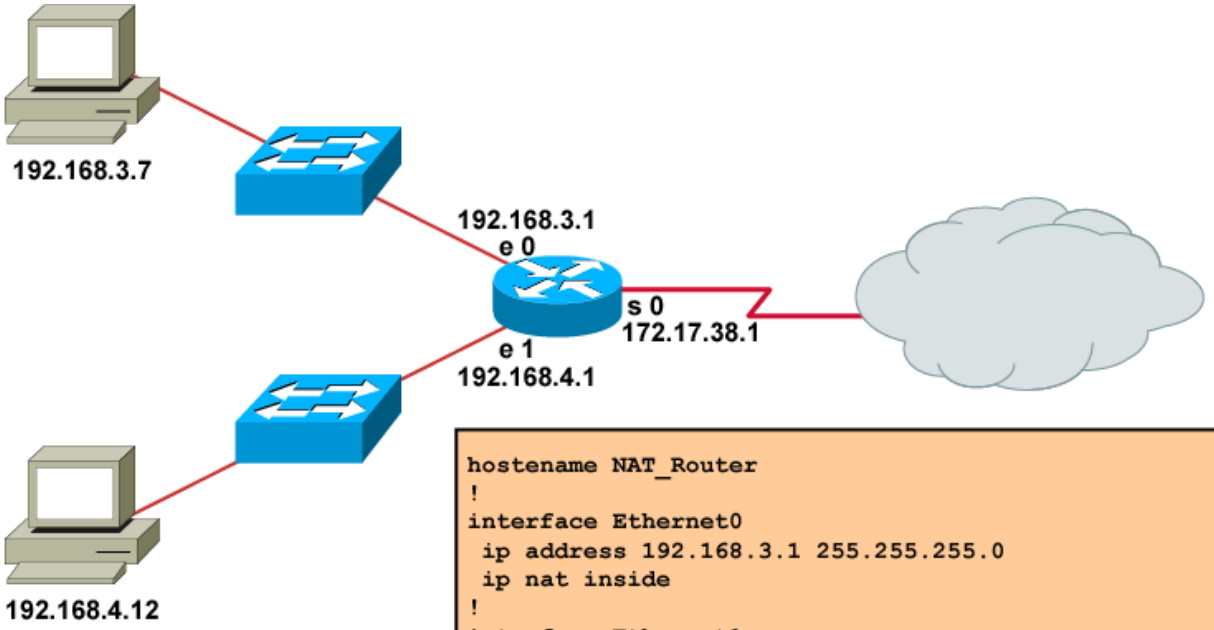

```
Router(config)#access-list access-list-number permit
source source-wildcard
```

- **Defines a standard IP access list permitting those inside local addresses that are to be translated**

```
Router(config)#ip nat inside source list
access-list-number interface interface overload
```

- **Establishes dynamic source translation, specifying the access list defined in the prior step**

Overloading an Inside Global Address Example




```
hostename NAT_Router
!
interface Ethernet0
 ip address 192.168.3.1 255.255.255.0
 ip nat inside
!
interface Ethernet1
 ip address 192.168.4.1 255.255.255.0
 ip nat inside
!
interface Serial0
 description To ISP
 ip address 172.17.38.1 255.255.255.0
 ip nat outside
!
ip nat inside source list 1 interface Serial0 overload
!
ip route 0.0.0.0 0.0.0.0 Serial0
!
access-list 1 permit 192.168.3.0 0.0.0.255
access-list 1 permit 192.168.4.0 0.0.0.255
!
```

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Clearing the NAT Translation Table

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```
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 containing an inside translation, or both inside and outside translation

```
Router#clear ip nat translation outside
local-ip global-ip
```

- Clears a simple dynamic translation entry containing an outside translation

```
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

Displaying Information with show Commands


```
Router#show ip nat translations
```

- Displays active translations

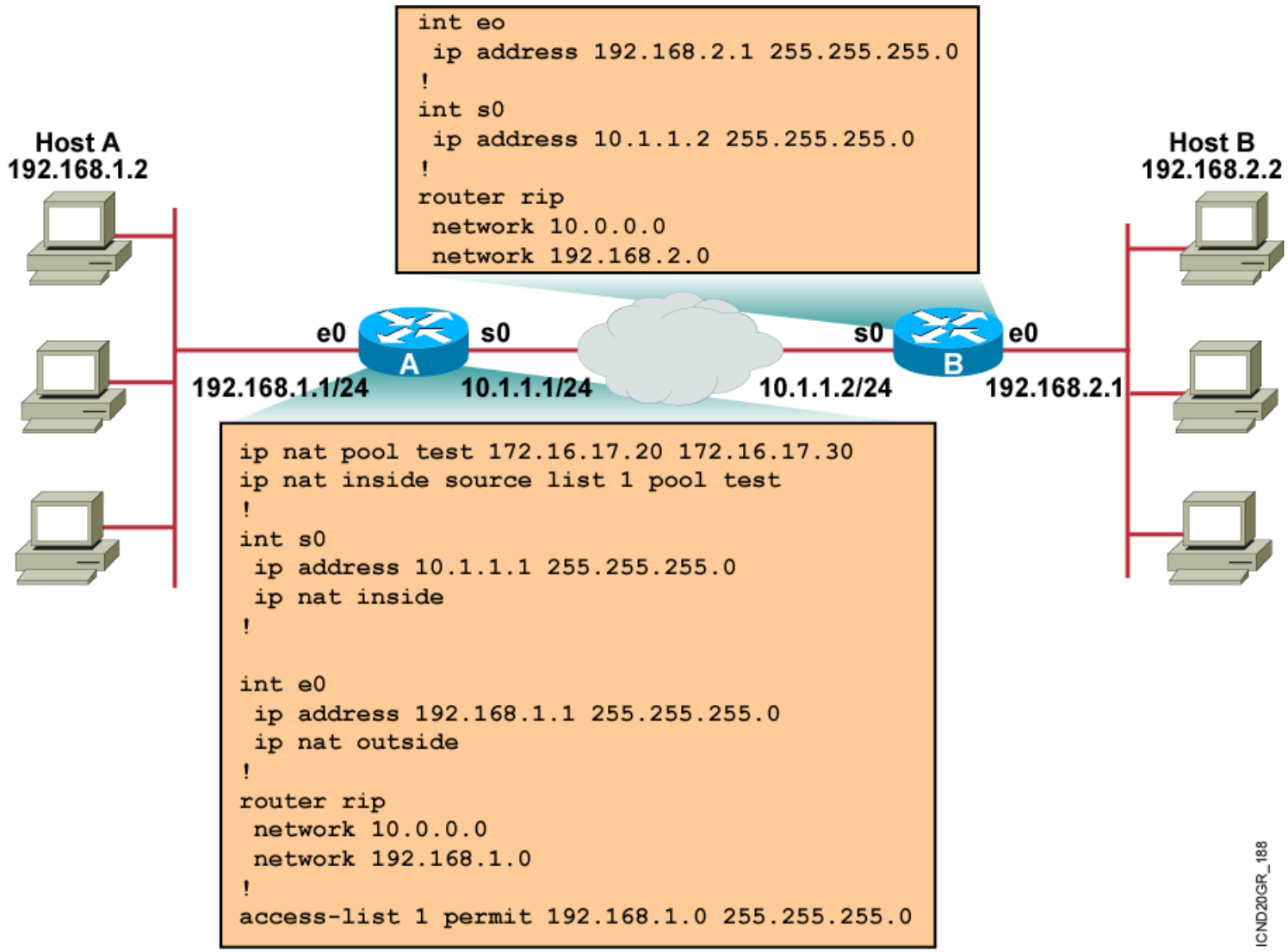
```
Router#show ip nat translation
     Pro Inside global      Inside local       Outside local      Outside global
     --- 172.16.131.1        10.10.10.1         ---                ---
```

```
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:
      Ethernet0, Serial2.7
      Inside interfaces:
      Ethernet1
      Hits: 5  Misses: 0
      …
```

Sample Problem: Cannot Ping Remote Host



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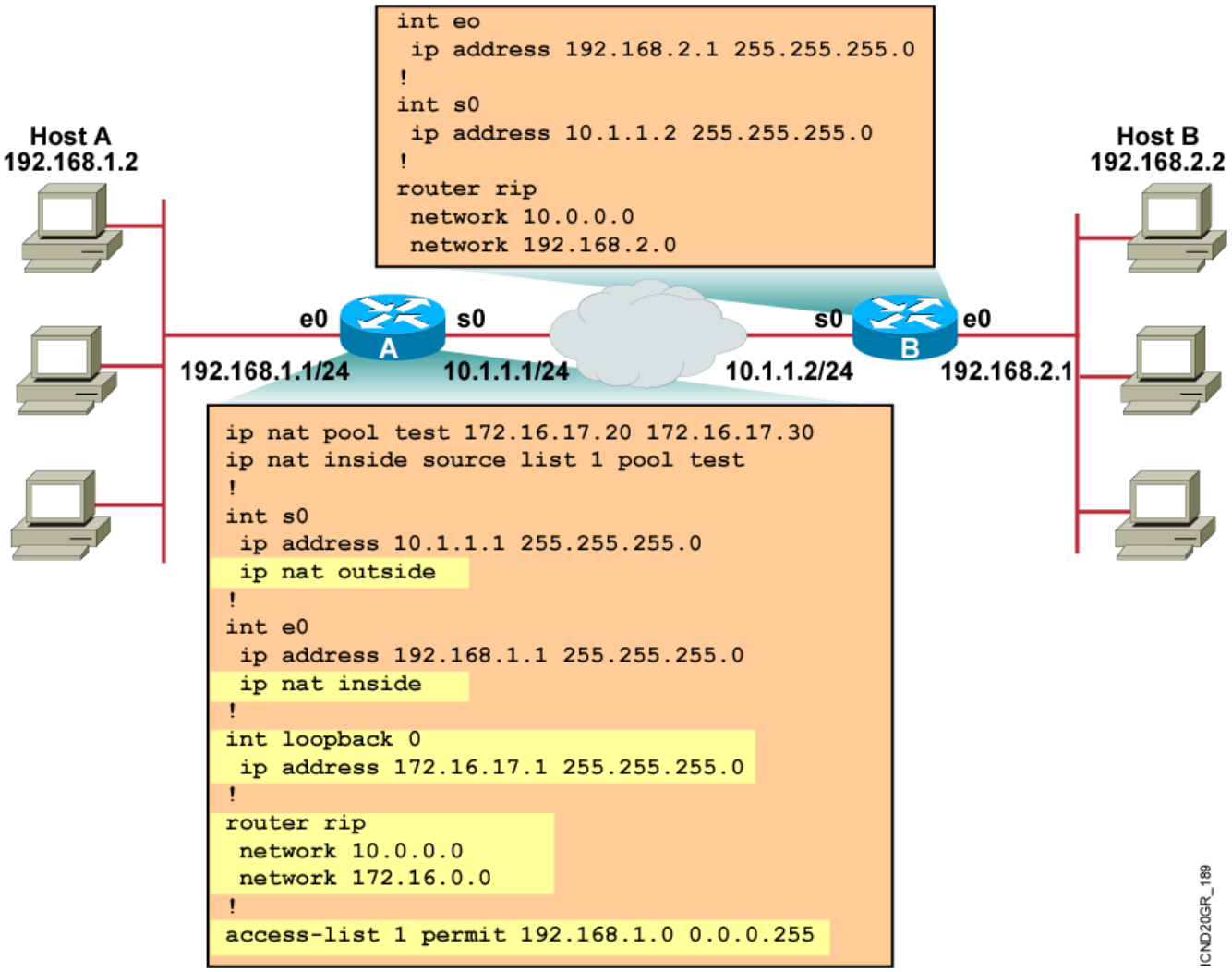
Solution: New Configuration



Using the debug ip nat Command

Cisco.com

```
Router#debug ip nat

NAT: s=192.168.1.95->172.31.233.209, d=172.31.2.132 [6825]
NAT: s=172.31.2.132, d=172.31.233.209->192.168.1.95 [21852]
NAT: s=192.168.1.95->172.31.233.209, d=172.31.1.161 [6826]
NAT*: s=172.31.1.161, d=172.31.233.209->192.168.1.95 [23311]
NAT*: s=192.168.1.95->172.31.233.209, d=172.31.1.161 [6827]
NAT*: s=192.168.1.95->172.31.233.209, d=172.31.1.161 [6828]
NAT*: s=172.31.1.161, d=172.31.233.209->192.168.1.95 [23313]
NAT*: s=172.31.1.161, d=172.31.233.209->192.168.1.95 [23325]
```

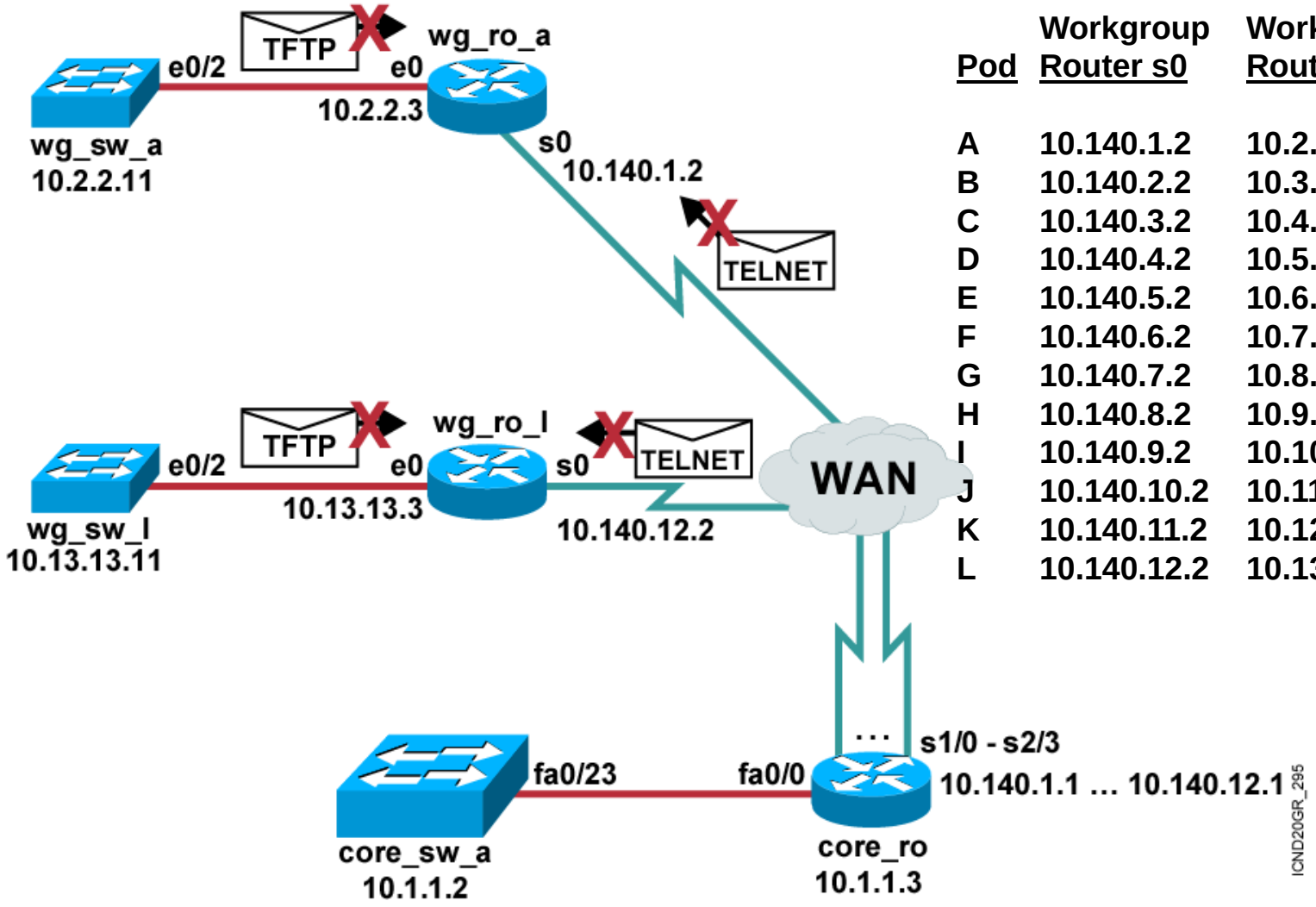
Translation Not Installed in the Translation Table?

- Verify that:
  - The configuration is correct.
  - There are not any inbound access lists denying the packets from entering the NAT router.
  - The access list referenced by the NAT command is permitting all necessary networks.
  - There are enough addresses in the NAT pool.
  - The router interfaces are appropriately defined as NAT inside or NAT outside.

Summary

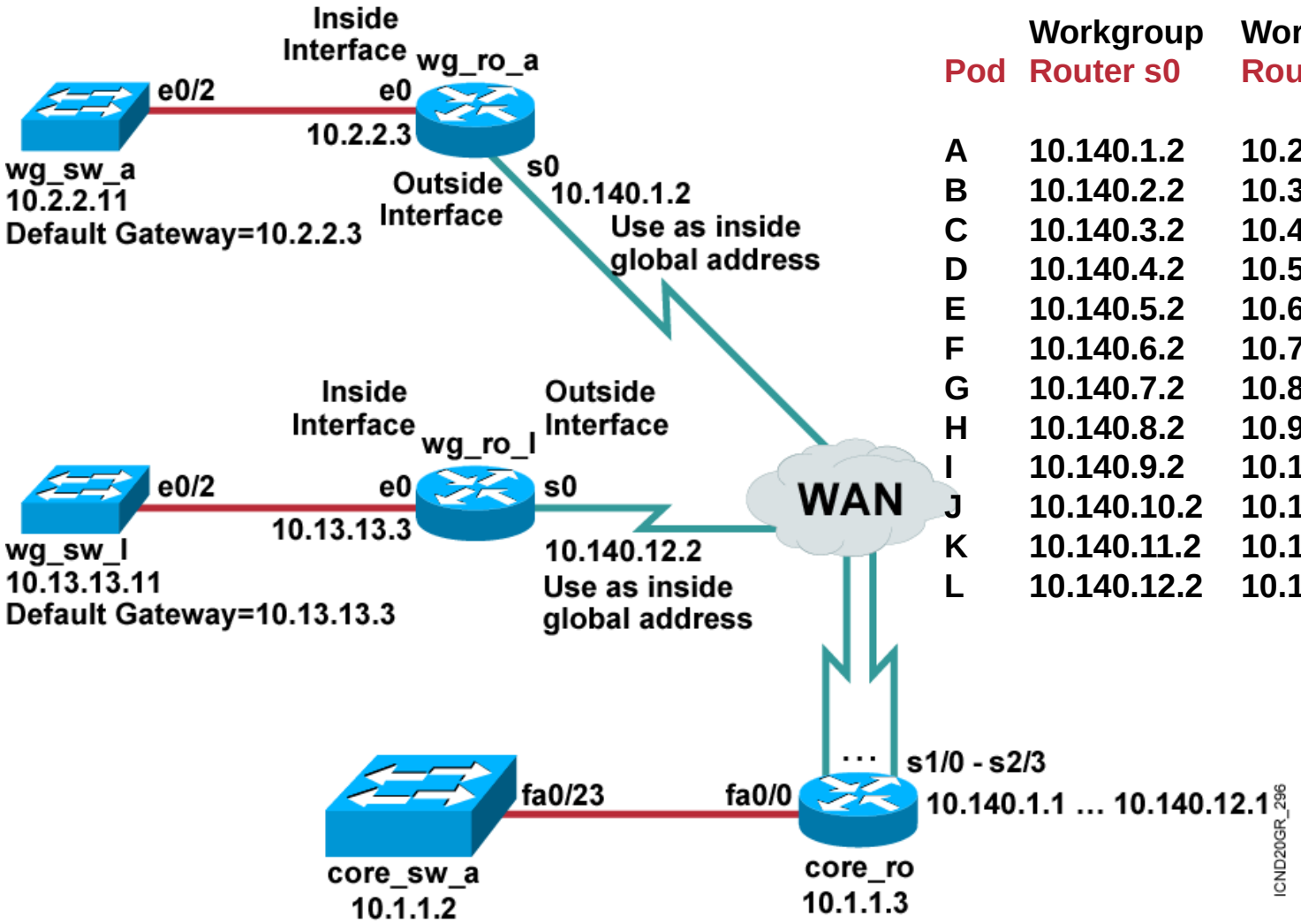
- Cisco IOS NAT allows an organization with unregistered private addresses to connect to the Internet by translating those addresses into globally registered IP addresses.
- You can translate your own IP addresses into globally unique IP addresses when communicating outside of your network.
- Overloading is a form of dynamic NAT that maps multiple unregistered IP addresses to a single registered IP address (many-to-one) by using different ports, known also as PAT.
- Once you have configured NAT, verify that it is operating as expected using the clear and show commands.
- Sometimes NAT is blamed for IP connectivity problems when there is actually a routing problem.

Visual Objective 6-1: Configuring IP Access Lists



Pod	Workgroup Router s0	Workgroup Router e0	Workgroup Switch
A	10.140.1.2	10.2.2.3	10.2.2.11
B	10.140.2.2	10.3.3.3	10.3.3.11
C	10.140.3.2	10.4.4.3	10.4.4.11
D	10.140.4.2	10.5.5.3	10.5.5.11
E	10.140.5.2	10.6.6.3	10.6.6.11
F	10.140.6.2	10.7.7.3	10.7.7.11
G	10.140.7.2	10.8.8.3	10.8.8.11
H	10.140.8.2	10.9.9.3	10.9.9.11
I	10.140.9.2	10.10.10.3	10.10.10.11
J	10.140.10.2	10.11.11.3	10.11.11.11
K	10.140.11.2	10.12.12.3	10.12.12.11
L	10.140.12.2	10.13.13.3	10.13.13.11

Visual Objective 6-2: Configuring Port Address Translation



Pod	Workgroup Router s0	Workgroup Router e0	Workgroup Switch
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B	10.140.2.2	10.3.3.3	10.3.3.11
C	10.140.3.2	10.4.4.3	10.4.4.11
D	10.140.4.2	10.5.5.3	10.5.5.11
E	10.140.5.2	10.6.6.3	10.6.6.11
F	10.140.6.2	10.7.7.3	10.7.7.11
G	10.140.7.2	10.8.8.3	10.8.8.11
H	10.140.8.2	10.9.9.3	10.9.9.11
I	10.140.9.2	10.10.10.3	10.10.10.11
J	10.140.10.2	10.11.11.3	10.11.11.11
K	10.140.11.2	10.12.12.3	10.12.12.11
L	10.140.12.2	10.13.13.3	10.13.13.11


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