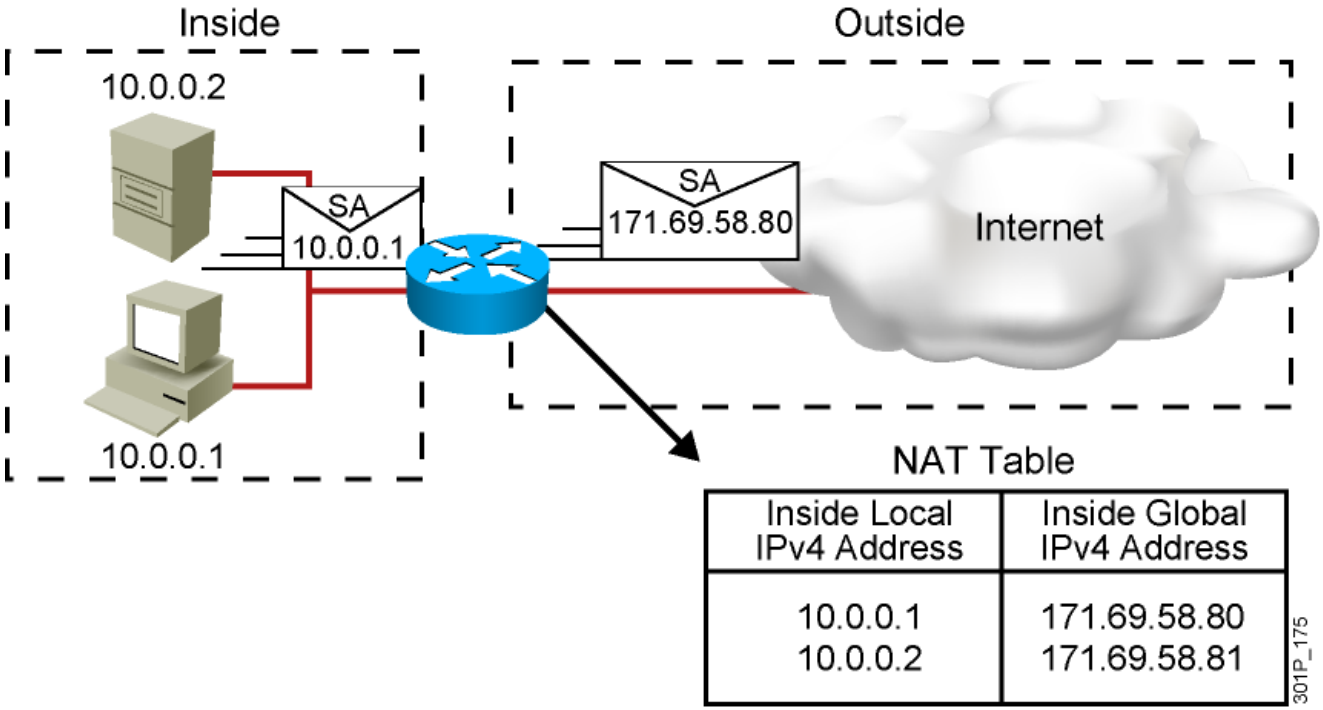
Address Space Management

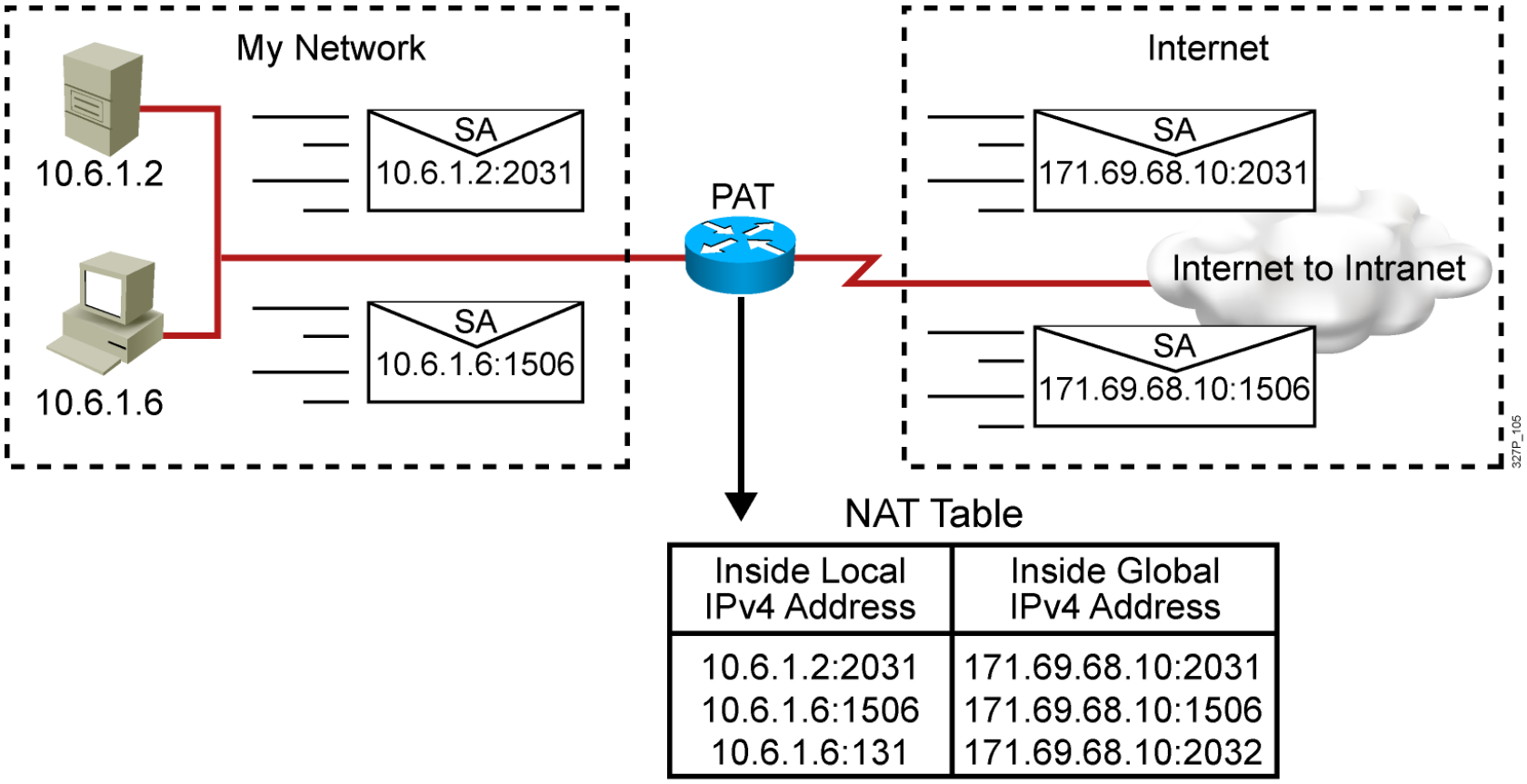
Scaling the Network with NAT and PAT

Network Address Translation

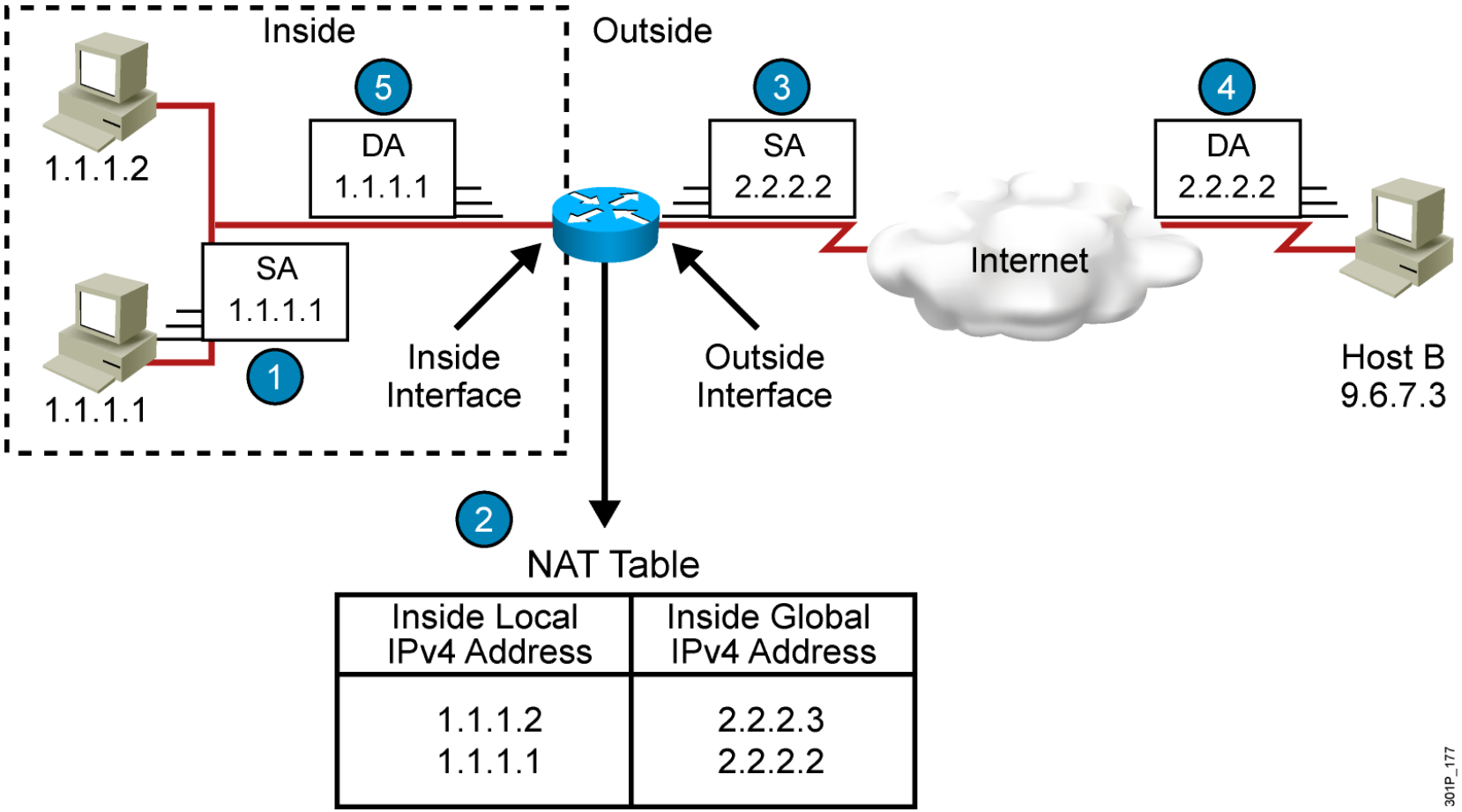


- An IP address is either local or global.
- Local IPv4 addresses are seen in the inside network.
- Global IPv4 addresses are seen in the outside network.

Port Address Translation



Translating Inside Source Addresses



Configuring and Verifying Static Translation

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

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

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

- Marks the interface as connected to the inside

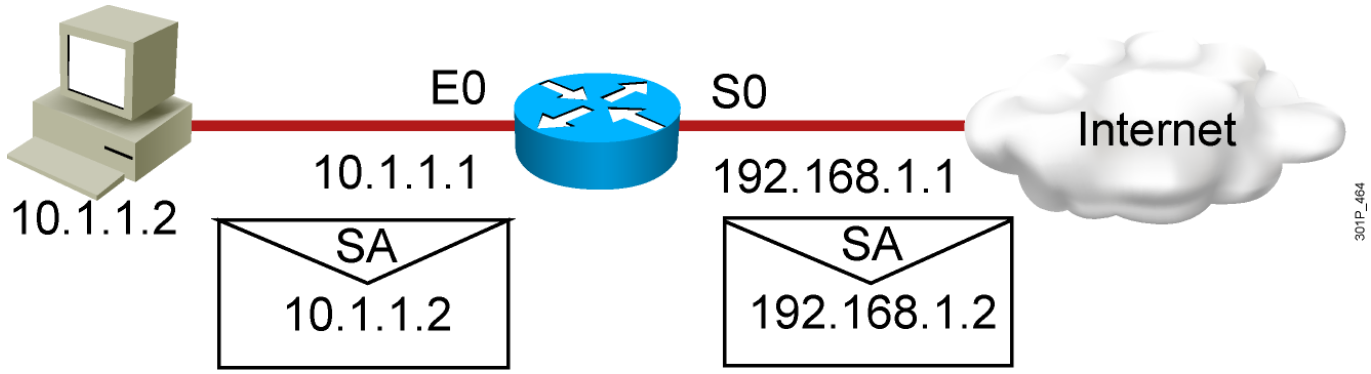
```
RouterX(config-if)# ip nat outside
```

- Marks the interface as connected to the outside

```
RouterX# show ip nat translations
```

- Displays active translations

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
```

```
RouterX# show ip nat translations
    Pro Inside global   Inside local   Outside local   Outside global
    --- 192.168.1.2     10.1.1.2       ---             ---
```

Configuring and Verifying Dynamic Translation

```
RouterX(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

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

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

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

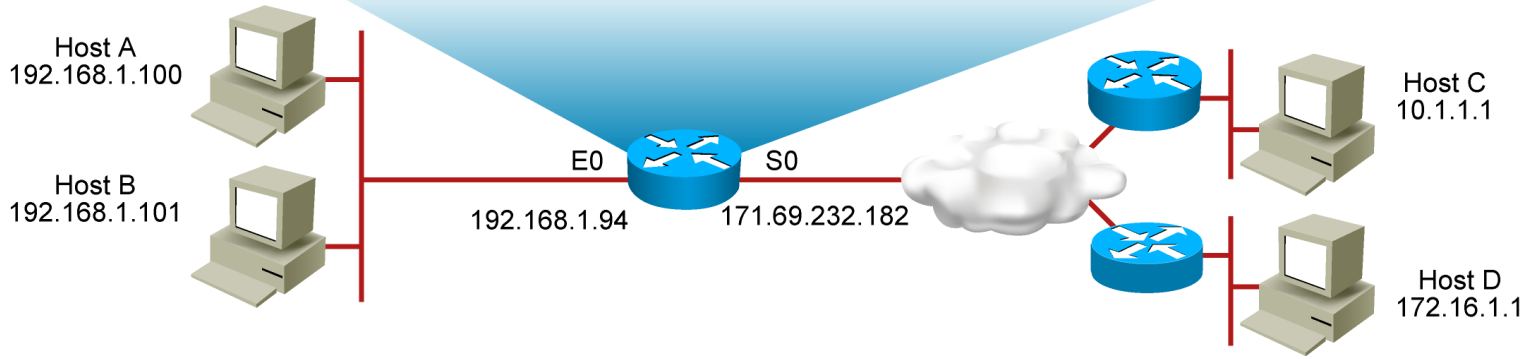
- Establishes dynamic source translation, specifying the ACL that was defined in the previous step

```
RouterX# show ip nat translations
```

- Displays active translations

Dynamic Address Translation Example

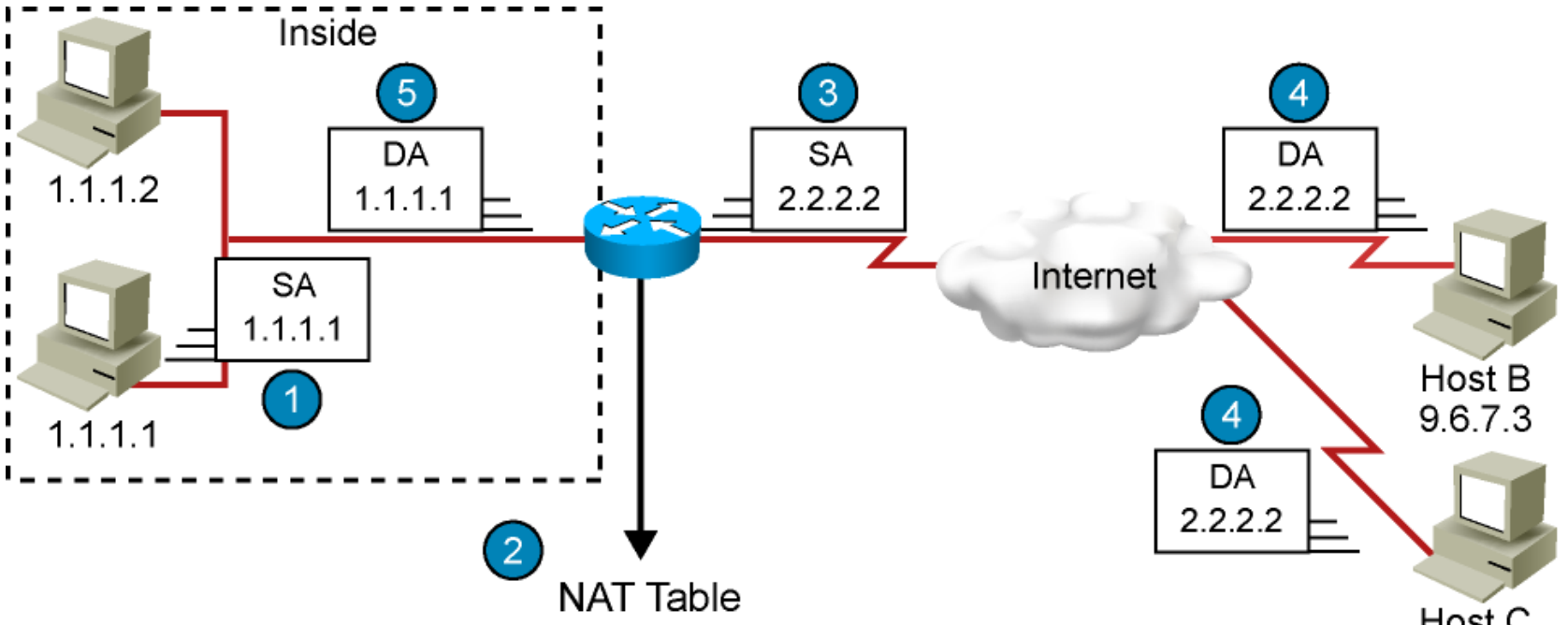
```
ip nat pool net-208 171.69.233.209 171.69.233.222 netmask
255.255.255.240
ip nat inside source list 1 pool net-208
!
interface serial 0
 ip address 171.69.232.182 255.255.255.240
 ip nat outside
!
interface ethernet 0
 ip address 192.168.1.94 255.255.255.0
 ip nat inside
!
access-list 1 permit 192.168.1.0 0.0.0.255
```



RouterX# show ip nat translations

Pro	Inside global	Inside local	Outside local	Outside global
---	171.69.233.209	192.168.1.100	---	---
---	171.69.233.210	192.168.1.101	---	---

Overloading an Inside Global Address



Protocol	Inside Local IPv4 Address:Port	Inside Global IPv4 Address:Port	Outside Global IPv4 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

Configuring Overloading

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

- Defines a standard IP ACL that will permit the inside local addresses that are to be translated

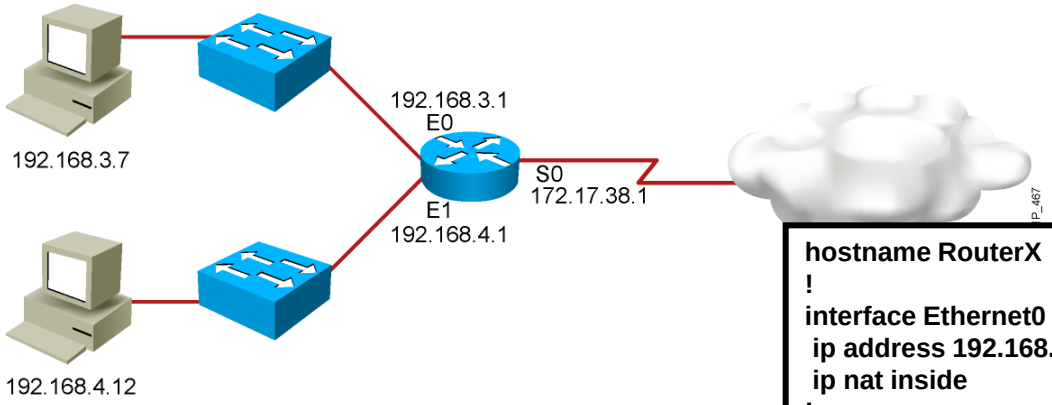
```
RouterX(config)# ip nat inside source list
access-list-number interface interface overload
```

- Establishes dynamic source translation, specifying the ACL that was defined in the previous step

```
RouterX# show ip nat translations
```

- Displays active translations

Overloading an Inside Global Address Example




```
hostname RouterX
!
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
!
```

```
RouterX# show ip nat translations
    Pro Inside global     Inside local       Outside local      Outside global
    TCP 172.17.38.1:1050  192.168.3.7:1050   10.1.1.1:23        10.1.1.1:23
    TCP 172.17.38.1:1776  192.168.4.12:1776  10.2.2.2:25        10.2.2.2:25
```

Clearing the NAT Translation Table

```
RouterX# clear ip nat translation *
```

- Clears all dynamic address translation entries

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

- Clears a simple dynamic translation entry that contains an inside translation or both an inside and outside translation

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

- Clears a simple dynamic translation entry that contains an outside translation

```
RouterX# 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 (PAT entry)

Translation Not Occurring: Translation Not Installed in the Table

Verify that:

- **There are no inbound ACLs that are denying the packets entry to the NAT router**
- **The ACL 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**

Displaying Information with show and debug Commands

```
RouterX# 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 [23312]
NAT*: s=172.31.1.161, d=172.31.233.209->192.168.1.95 [23313]
```

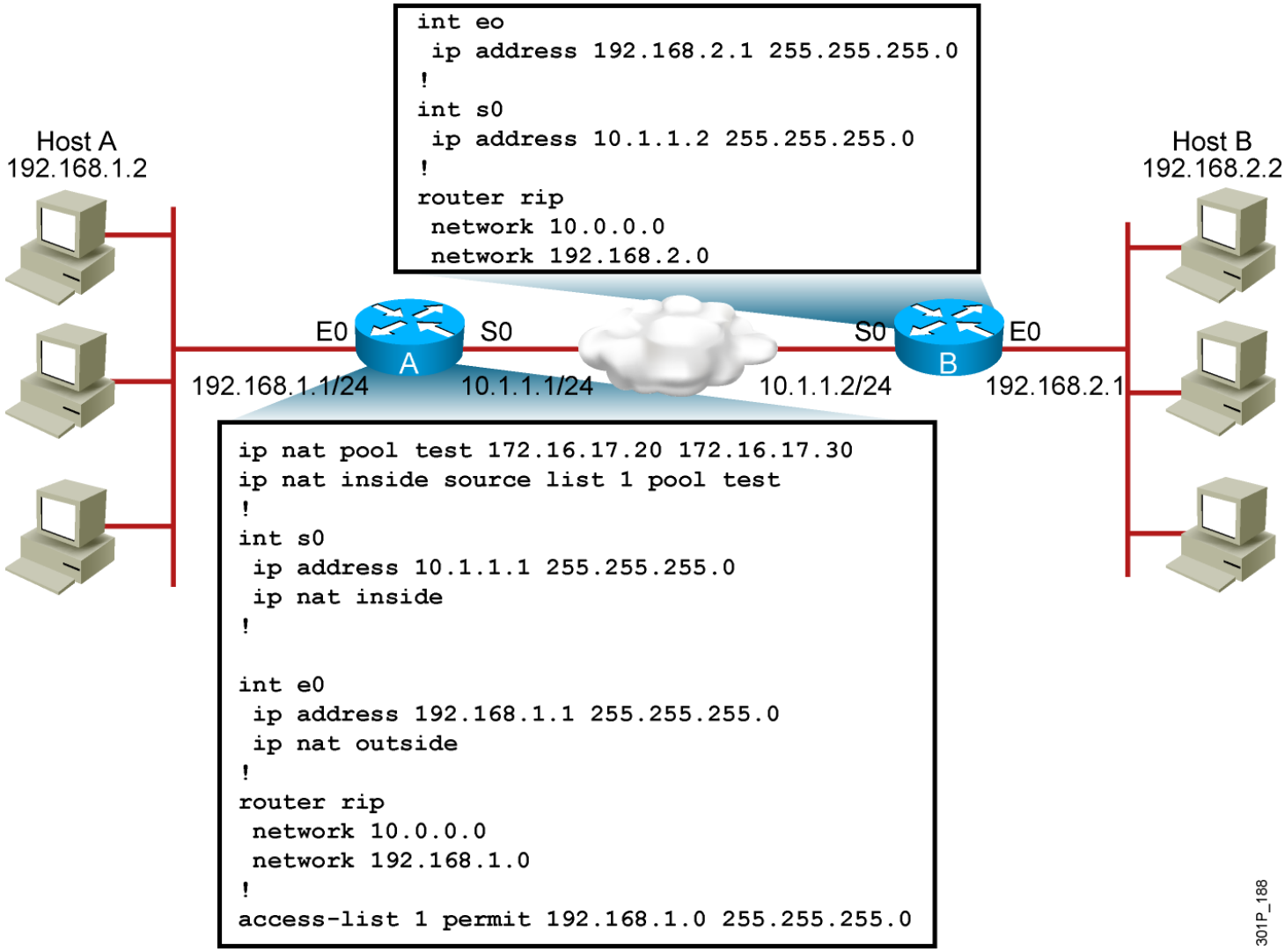
```
RouterX# show ip nat statistics
    Total active translations: 1 (1 static, 0 dynamic; 0 extended)
    Outside interfaces:
    Ethernet0, Serial2
    Inside interfaces:
    Ethernet1
    Hits: 5  Misses: 0
    …
```

Translation Occurring: Installed Translation Entry Not Being Used

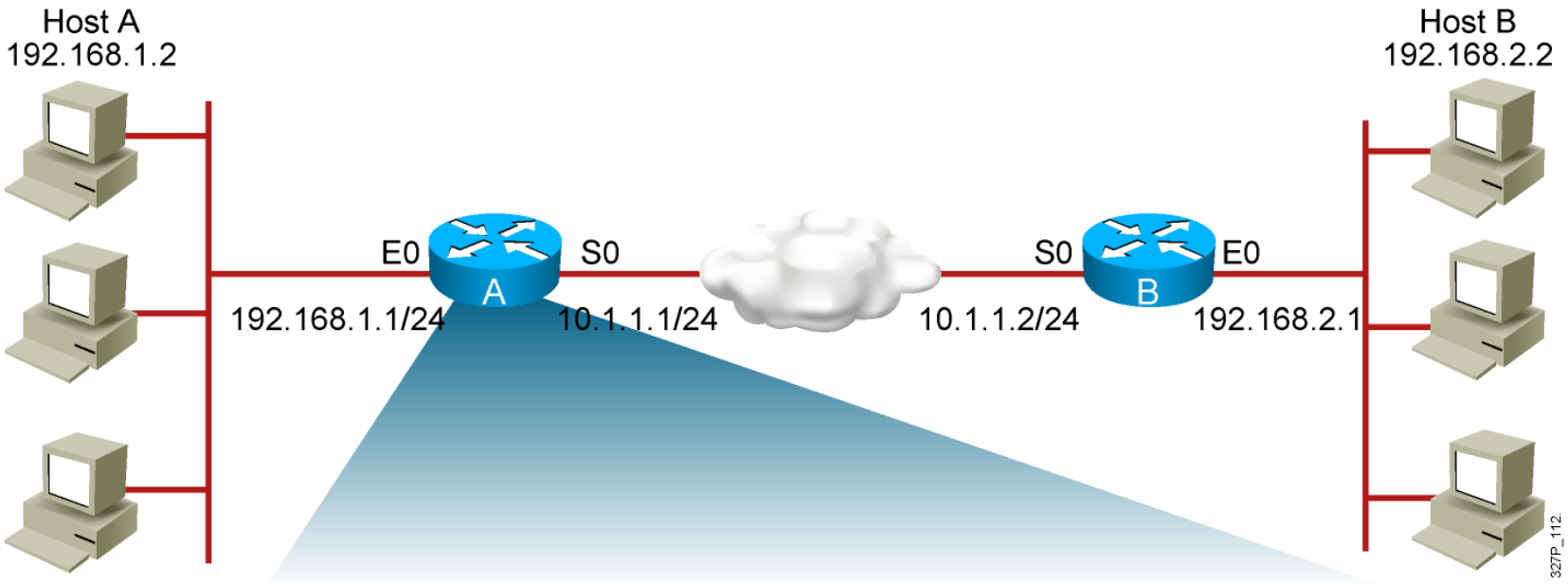
Verify:

- **What the NAT configuration is supposed to accomplish**
- **That the NAT entry exists in the translation table and that it is accurate**
- **That the translation is actually taking place by monitoring the NAT process or statistics**
- **That the NAT router has the appropriate route in the routing table if the packet is going from inside to outside**
- **That all necessary routers have a return route back to the translated address**

Sample Problem: Cannot Ping Remote Host



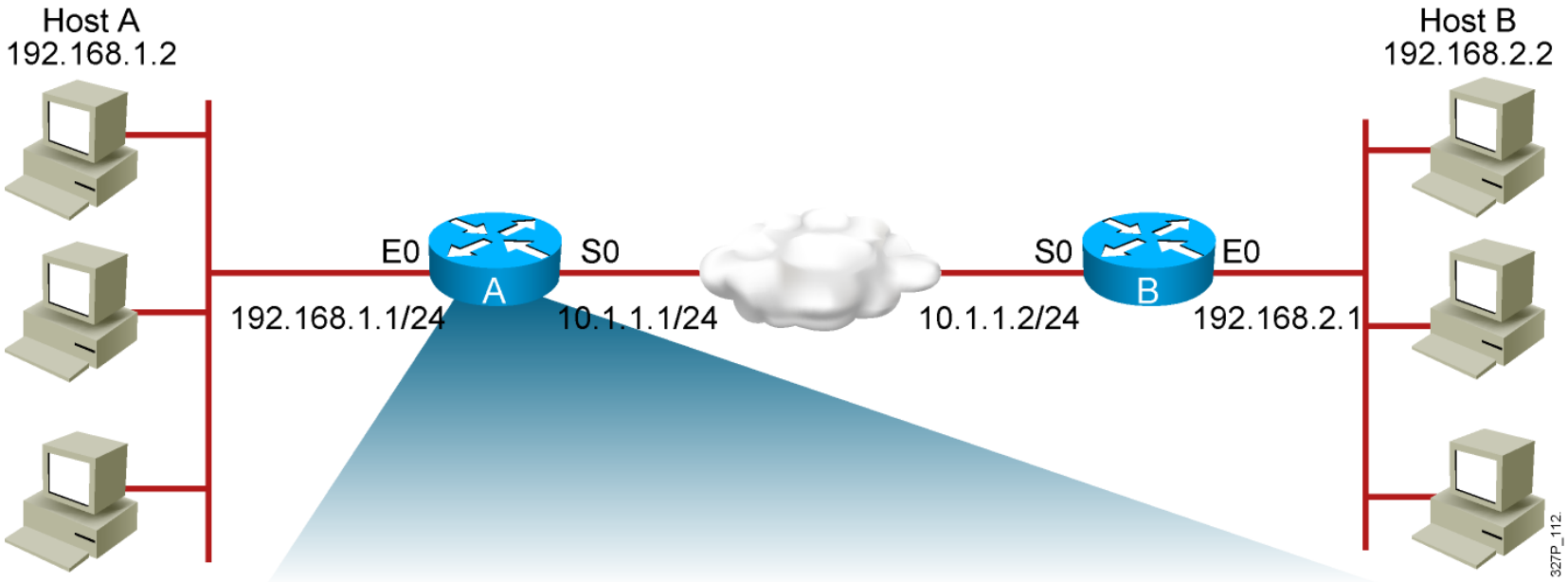
Sample Problem: Cannot Ping Remote Host (Cont.)




```
RouterA# show ip nat translations
    Pro Inside global     Inside local       Outside local      Outside global
    ---                   ---                ---
    ---                   ---                ---
```

There are no translations in the table.

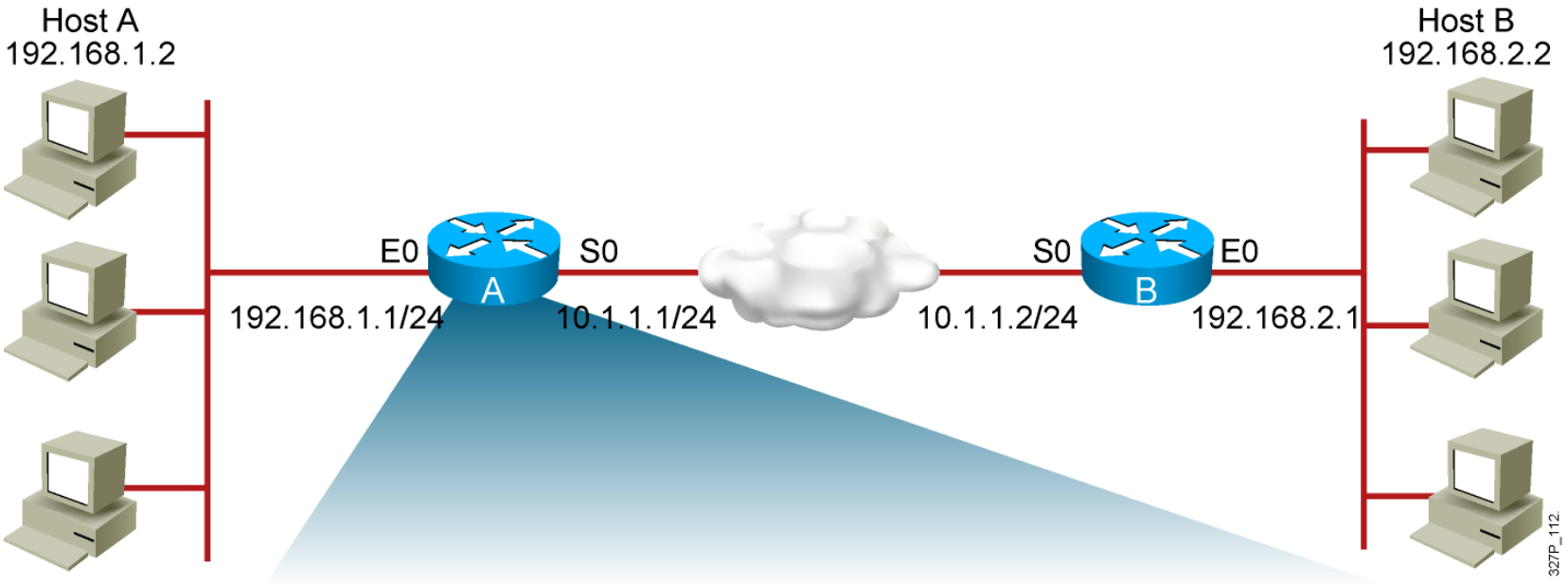
Sample Problem: Cannot Ping Remote Host (Cont.)




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

The router interfaces are inappropriately defined as NAT inside and NAT outside.

Sample Problem: Cannot Ping Remote Host (Cont.)

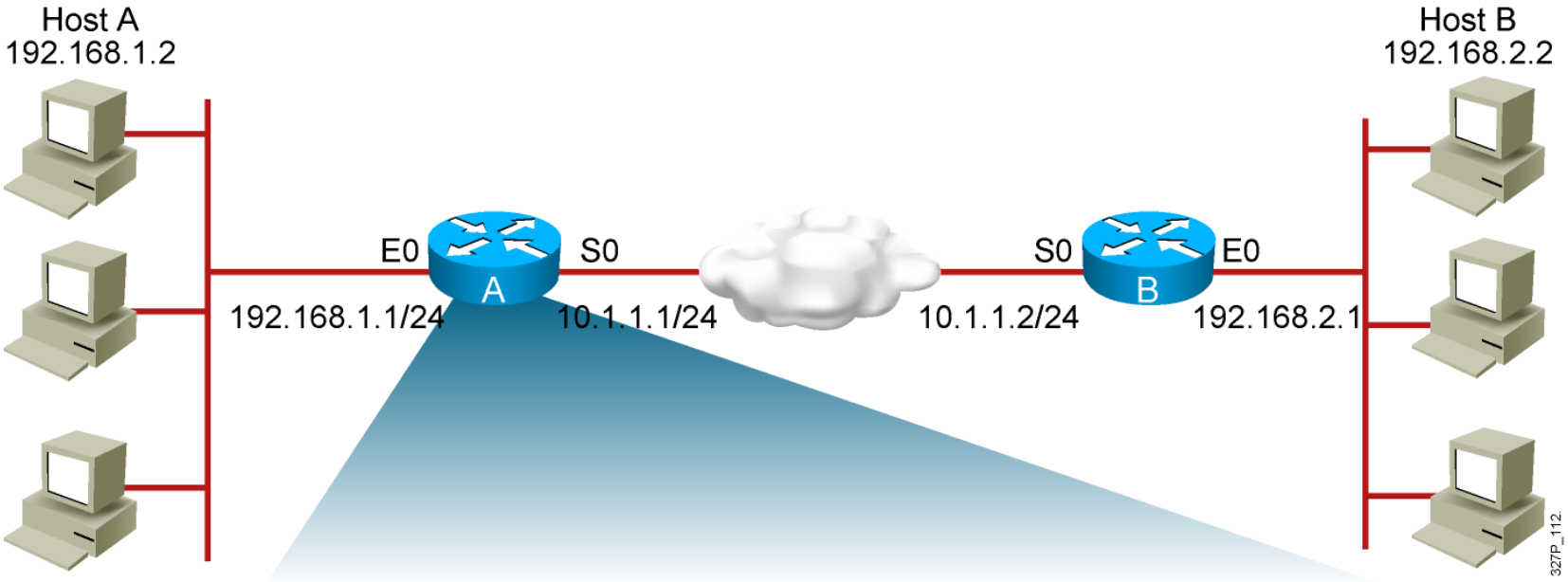


RouterA# show access-list

Standard IP access list 20
10 permit 0.0.0.0, wildcard bits 255.255.255.0

- **Pings are still failing and there are still no translations in the table.**
- **There is an incorrect wildcard bit mask in the ACL that defines the addresses to be translated.**

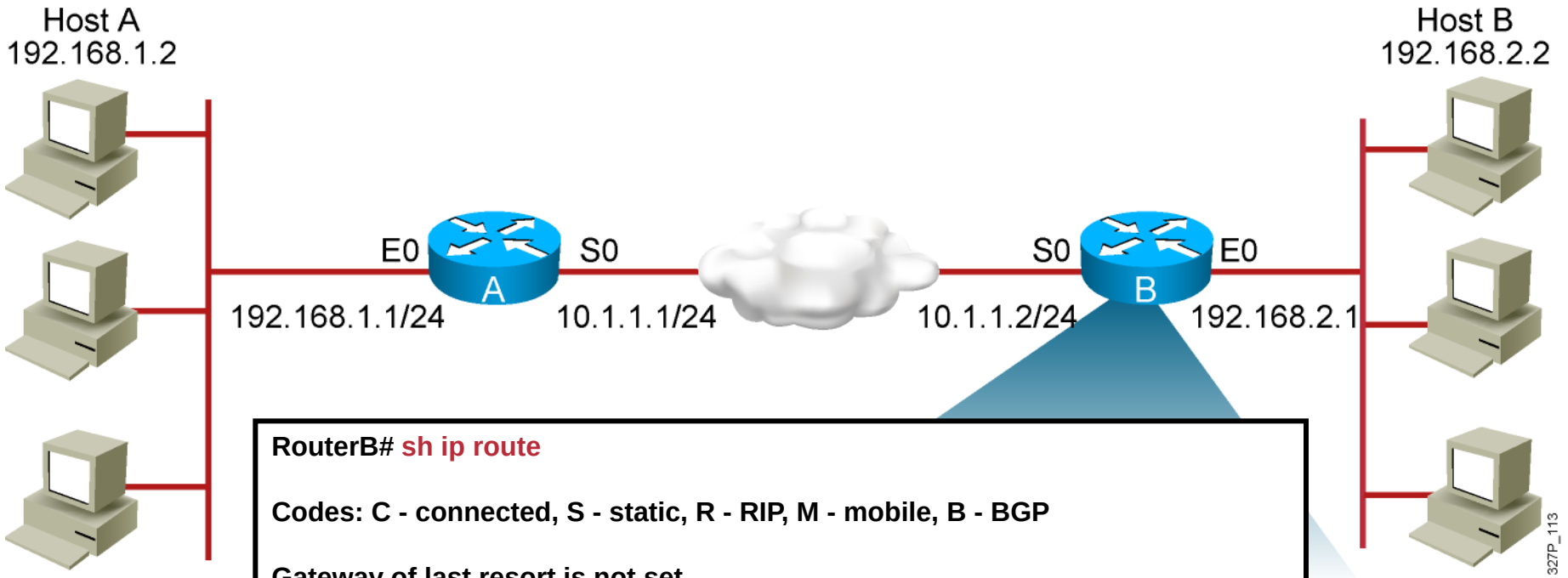
Sample Problem: Cannot Ping Remote Host (Cont.)




```
RouterA# show ip nat translations
    Pro Inside global     Inside local       Outside local      Outside global
    ---  172.16.17.20     192.168.1.2         ---                ---
```

- **Translations are now occurring.**
- **Pings are still failing.**

Sample Problem: Cannot Ping Remote Host (Cont.)



RouterB# sh ip route

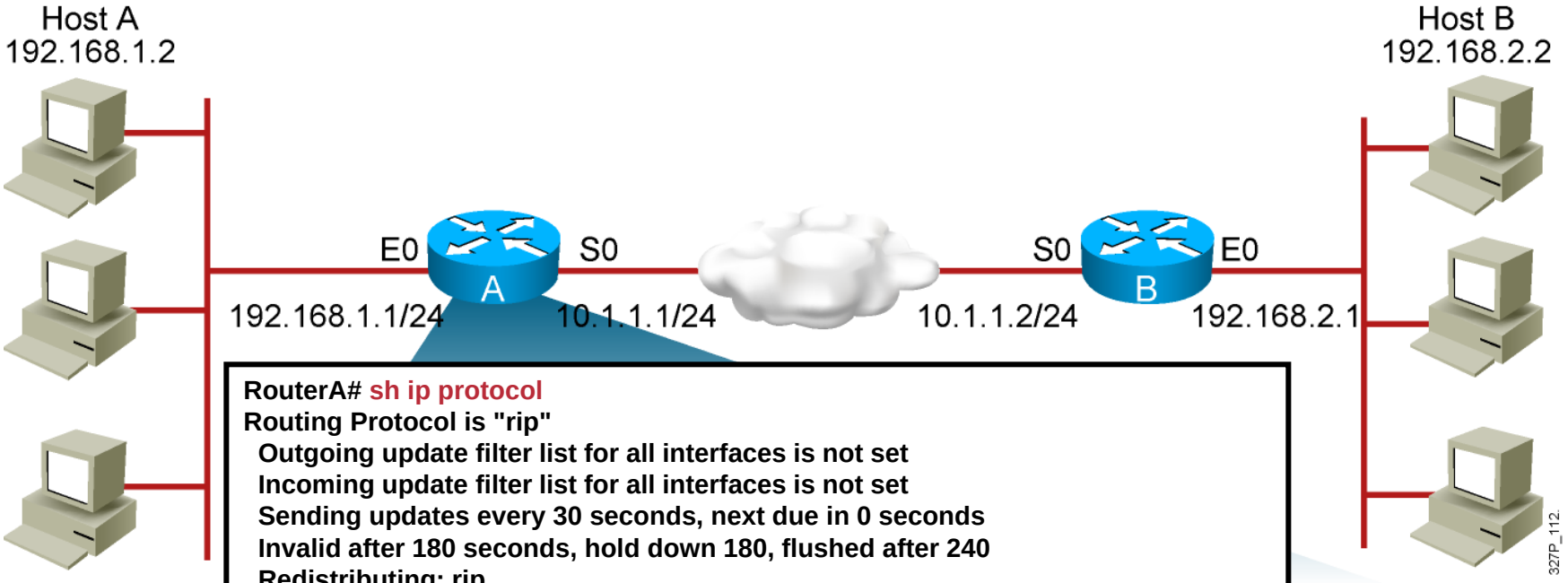
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP

Gateway of last resort is not set

10.0.0.0/24 is subnetted, 1 subnets
C 10.1.1.0/24 is directly connected, Serial0
192.168.2.0/24 is subnetted, 1 subnets
R 192.168.2.0/24 is directly connected, Ethernet0
192.168.1.0/24 is variably subnetted, 3 subnets, 2 masks
R 192.168.1.0/24 [120/1] via 10.1.1.1, 2d19h, Serial0

Router B has no route to the translated network address of 172.16.0.0.

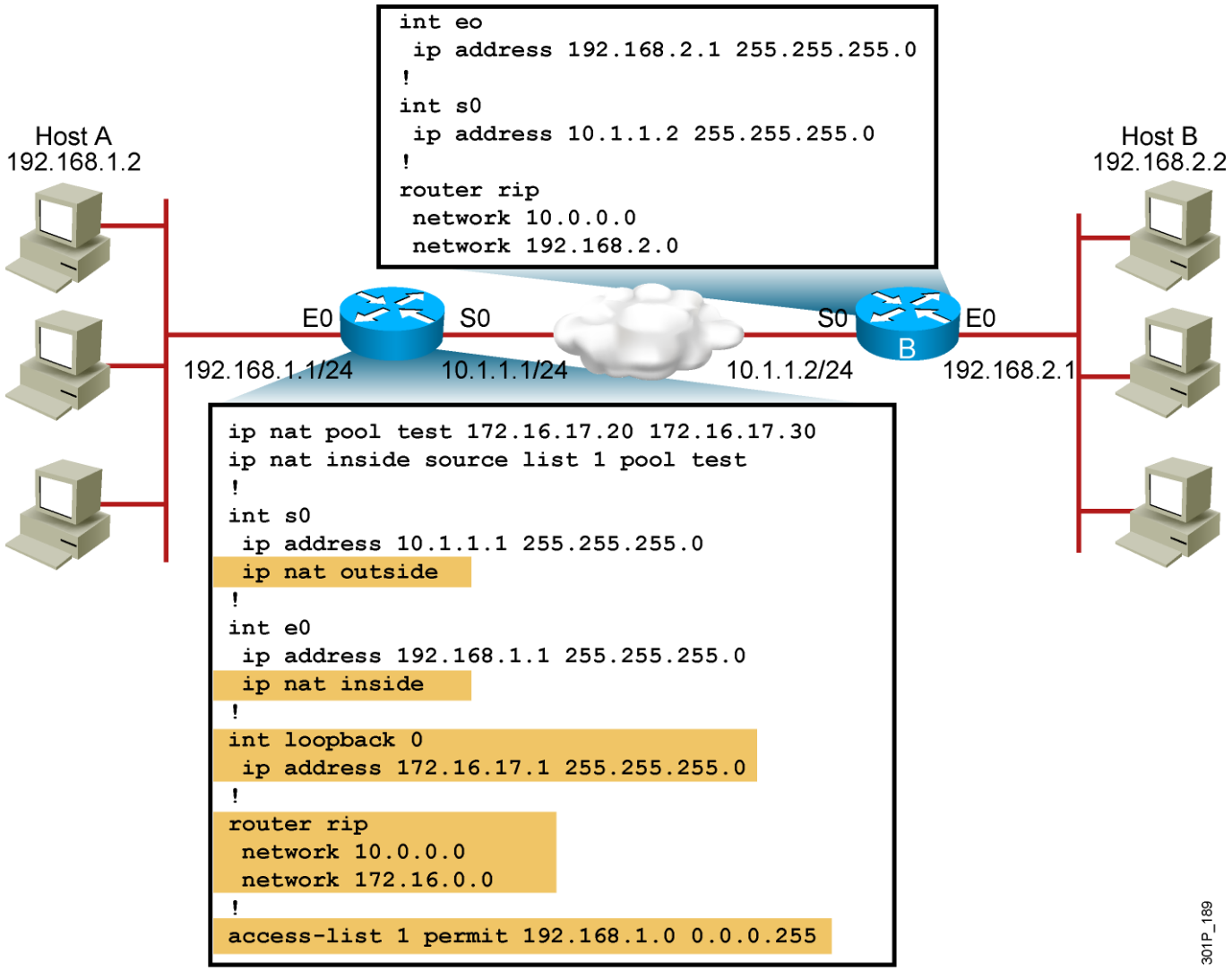
Sample Problem: Cannot Ping Remote Host (Cont.)



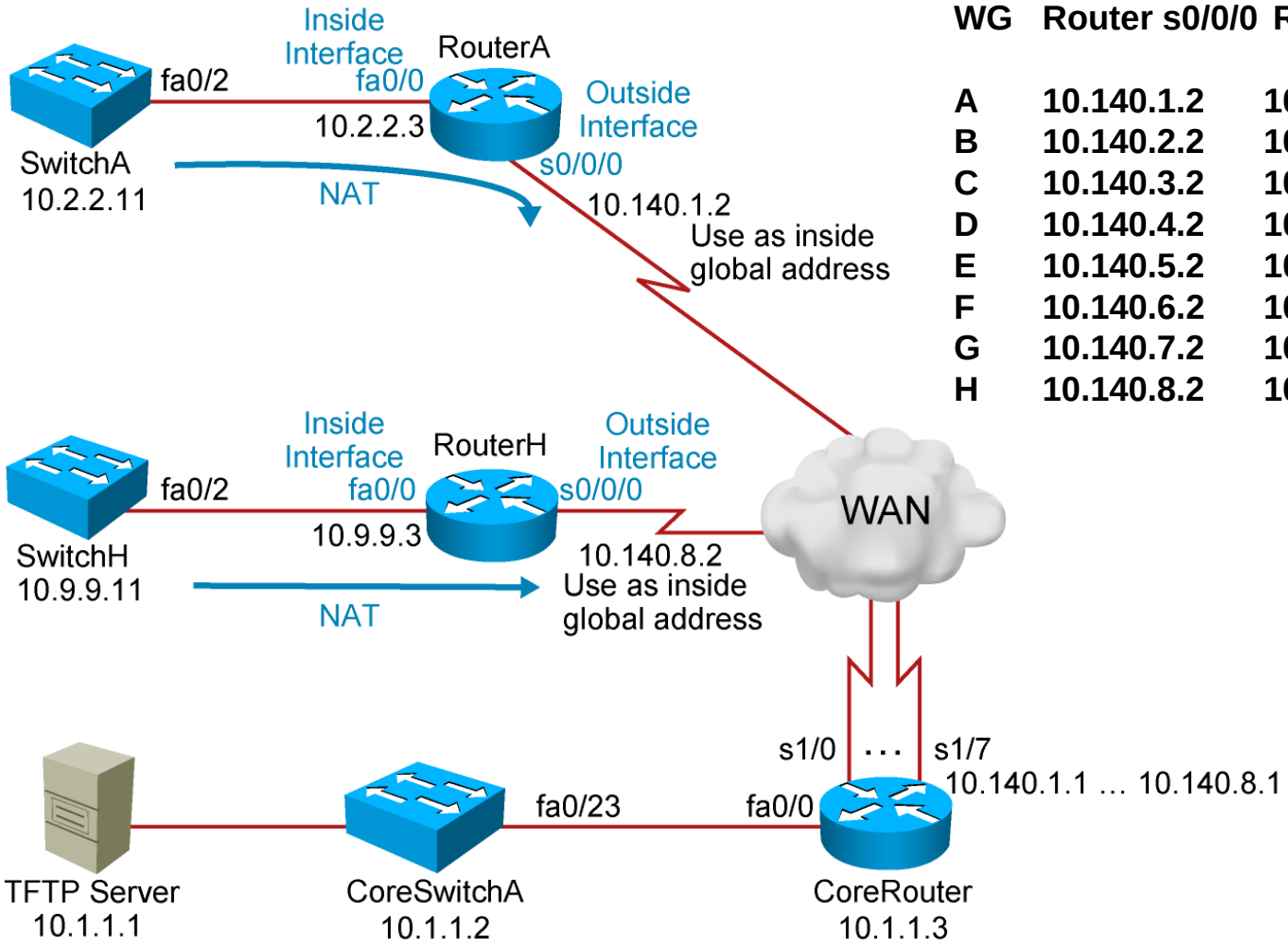

```
RouterA# sh ip protocol
Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 0 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 1, receive any version
  Automatic network summarization is in effect
  Maximum path: 4
  Routing for Networks:
    192.168.0.0
  Routing Information Sources:
    Gateway         Distance      Last Update
  Distance: (default is 120)
```

Router A is advertising the network that is being translated, 192.168.1.0, instead of the network address the router is translating into,172.16.0.0.

Solution: Corrected Configuration



Visual Objective 7-1: Configuring NAT and PAT



WG	Router s0/0/0	Router fa0/0	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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