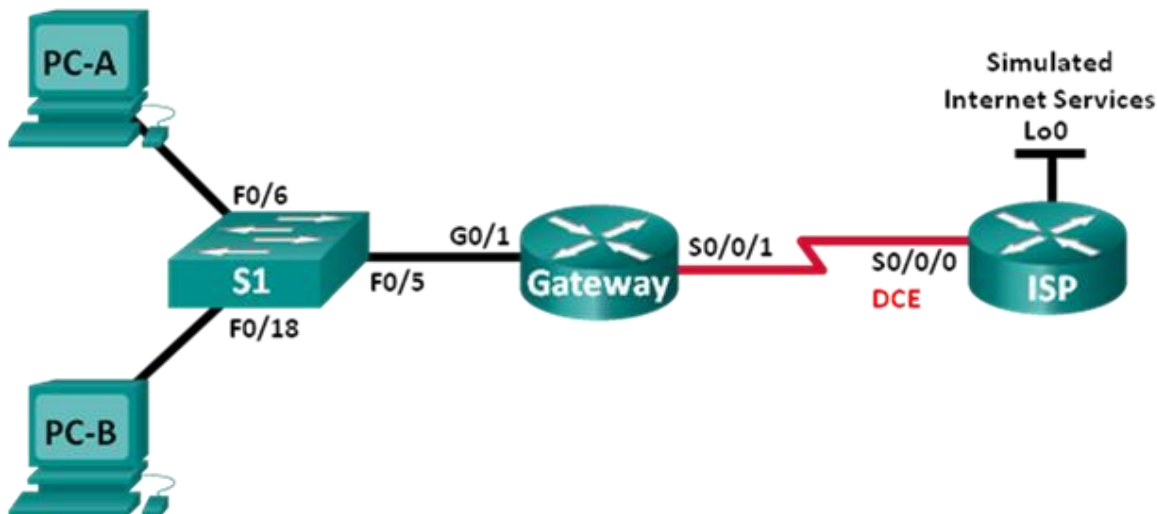


Lab - Troubleshooting NAT Configurations (Instructor Version)

Instructor Note: Red font color or Gray highlights indicate text that appears in the instructor copy only.

Topology



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
Gateway	G0/1	192.168.1.1	255.255.255.0	N/A
	S0/0/1	209.165.200.225	255.255.255.252	N/A
ISP	S0/0/0 (DCE)	209.165.200.226	255.255.255.252	N/A
	Lo0	198.133.219.1	255.255.255.255	N/A
PC-A	NIC	192.168.1.3	255.255.255.0	192.168.1.1
PC-B	NIC	192.168.1.4	255.255.255.0	192.168.1.1

Objectives

Part 1: Build the Network and Configure Basic Device Settings

Part 2: Troubleshoot Static NAT

Part 3: Troubleshoot Dynamic NAT

Background / Scenario

In this lab, the Gateway router was configured by an inexperienced network administrator at your company. Several errors in the configuration have resulted in NAT issues. Your boss has asked you to troubleshoot and correct the NAT errors and document your work. Ensure that the network supports the following:

- PC-A acts as a web server with a static NAT and will be reachable from the outside using the 209.165.200.254 address.

- PC-B acts as a host computer and dynamically receives an IP address from the created pool of addresses called NAT_POOL, which uses the 209.165.200.240/29 range.

Note: The routers used with CCNA hands-on labs are Cisco 1941 Integrated Services Routers (ISRs) with Cisco IOS Release 15.2(4)M3 (universalk9 image). The switches used are Cisco Catalyst 2960s with Cisco IOS Release 15.0(2) (lanbasek9 image). Other routers, switches and Cisco IOS versions can be used. Depending on the model and Cisco IOS version, the commands available and output produced might vary from what is shown in the labs. Refer to the Router Interface Summary Table at the end of this lab for the correct interface identifiers.

Note: Make sure that the routers and switch have been erased and have no startup configurations. If you are unsure, contact your instructor.

Instructor Note: Refer to the Instructor Lab Manual for the procedures to initialize and reload devices.

Required Resources

- 2 Routers (Cisco 1941 with Cisco IOS Release 15.2(4)M3 universal image or comparable)
- 1 Switch (Cisco 2960 with Cisco IOS Release 15.0(2) lanbasek9 image or comparable)
- 2 PCs (Windows 7, Vista, or XP with terminal emulation program, such as Tera Term)
- Console cables to configure the Cisco IOS devices via the console ports
- Ethernet and serial cables as shown in the topology

Part 1: Build the Network and Configure Basic Device Settings

In Part 1, you will set up the network topology and configure the routers with basic settings. Additional NAT-related configurations are provided. The NAT configurations for the Gateway router contains errors that you will identify and correct as you proceed through the lab.

Step 1: Cable the network as shown in the topology.

Step 2: Configure PC hosts.

Step 3: Initialize and reload the switch and routers.

Step 4: Configure basic settings for each router.

- Disable DNS lookup.
- Configure device name as shown in the topology.
- Configure IP addresses as listed in the Address Table.
- Set the clock rate to **128000** for DCE serial interfaces.
- Assign **cisco** as the console and vty password.
- Assign **class** as the encrypted privileged EXEC mode password.
- Configure **logging synchronous** to prevent console messages from interrupting the command entry.

Step 5: Configure static routing.

- Create a static route from the ISP router to the Gateway router-assigned public network address range 209.165.200.224/27.

```
ISP(config)# ip route 209.165.200.224 255.255.255.224 s0/0/0
```

- b. Create a default route from the Gateway router to the ISP router.

```
Gateway(config)# ip route 0.0.0.0 0.0.0.0 s0/0/1
```

Step 6: Load router configurations.

The configurations for the routers are provided for you. There are errors with the configuration for the Gateway router. Identify and correct the configurations errors.

Gateway Router Configuration

```
interface g0/1
  ip nat outside
  ! ip nat inside
  no shutdown
interface s0/0/0
  ip nat outside
  ! no ip nat outside
interface s0/0/1
  ! ip nat outside
  no shutdown
ip nat inside source static 192.168.2.3 209.165.200.254
! ip nat inside source static 192.168.1.3 209.165.200.254
ip nat pool NAT_POOL 209.165.200.241 209.165.200.246 netmask 255.255.255.248
ip nat inside source list NAT_ACL pool NATPOOL
! ip nat inside source list NAT_ACL pool NAT_POOL
ip access-list standard NAT_ACL
  permit 192.168.10.0 0.0.0.255
! permit 192.168.1.0 0.0.0.255
banner motd $AUTHORIZED ACCESS ONLY$
end
```

Step 7: Save the running configuration to the startup configuration.

Part 2: Troubleshoot Static NAT

In Part 2, you will examine the static NAT for PC-A to determine if it is configured correctly. You will troubleshoot the scenario until the correct static NAT is verified.

- a. To troubleshoot issues with NAT, use the **debug ip nat** command. Turn on NAT debugging to see translations in real-time across the Gateway router.

```
Gateway# debug ip nat
```

- b. From PC-A, ping Lo0 on the ISP router. Do any NAT debug translations appear on the Gateway router?

No.

- c. On the Gateway router, enter the command that allows you to see all current NAT translations on the Gateway router. Write the command in the space below.

show ip nat translations

```
Gateway# show ip nat translations
```

```
Pro Inside global      Inside local      Outside local      Outside global
```

Lab - Troubleshooting NAT Configurations

--- 209.165.200.254 192.168.2.3 --- ---

Why are you seeing a NAT translation in the table, but none occurred when PC-A pinged the ISP loopback interface? What is needed to correct the issue?

The static translation is for an incorrect inside local address.

- d. Record any commands that are necessary to correct the static NAT configuration error.

```
Gateway(config)# no ip nat inside source static 192.168.2.3 209.165.200.254
```

```
Gateway(config)# ip nat inside source static 192.168.1.3 209.165.200.254
```

- e. From PC-A, ping Lo0 on the ISP router. Do any NAT debug translations appear on the Gateway router?

No

- f. On the Gateway router, enter the command that allows you to observe the total number of current NATs. Write the command in the space below.

show ip nat statistics

```
Gateway# show ip nat statistics
```

```
Total active translations: 1 (1 static, 0 dynamic; 0 extended)
```

```
Peak translations: 1, occurred 00:08:12 ago
```

```
Outside interfaces:
```

```
  GigabitEthernet0/1, Serial0/0/0
```

```
Inside interfaces:
```

```
Hits: 0 Misses: 0
```

```
CEF Translated packets: 0, CEF Punted packets: 0
```

```
Expired translations: 0
```

```
Dynamic mappings:
```

```
-- Inside Source
```

```
[Id: 1] access-list NAT_ACL pool NATPOOL refcount 0
```

```
Total doors: 0
```

```
Appl doors: 0
```

```
Normal doors: 0
```

```
Queued Packets: 0
```

Is the static NAT occurring successfully? Why?

No NAT translation is occurring because both of G0/1 and S0/0/0 interfaces are configured with the **ip nat outside** command. No active interfaces area assigned as inside.

- g. On the Gateway router, enter the command that allows you to view the current configuration of the router. Write the command in the space below.

show running-config

```
Gateway# show running-config
Building configuration...

Current configuration : 1806 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Gateway
!
boot-start-marker
boot-end-marker
!
!
enable secret 4 06YFDUHH6lwAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2
!
no aaa new-model
!
no ip domain lookup
ip cef
no ipv6 cef
!
multilink bundle-name authenticated
!
redundancy
!
interface GigabitEthernet0/0
  no ip address
  shutdown
  duplex auto
  speed auto
!
interface GigabitEthernet0/1
  ip address 192.168.1.1 255.255.255.0
  ip nat outside
  ip virtual-reassembly in
  duplex auto
  speed auto
!
interface Serial0/0/0
  no ip address
  ip nat outside
  ip virtual-reassembly in
  shutdown
  clock rate 2000000
!
interface Serial0/0/1
```

```
ip address 209.165.200.225 255.255.255.252
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
ip nat pool NAT_POOL 209.165.200.241 209.165.200.246 netmask 255.255.255.248
ip nat inside source list NAT_ACL pool NATPOOL
ip nat inside source static 192.168.1.3 209.165.200.254
ip route 0.0.0.0 0.0.0.0 Serial0/0/1
!
ip access-list standard NAT_ACL
 permit 192.168.10.0 0.0.0.255
!
!
!
!
control-plane
!
!
banner motd ^AUTHORIZED ACCESS ONLY^C
!
line con 0
 password cisco
 logging synchronous
 login
line aux 0
line 2
 no activation-character
 no exec
 transport preferred none
 transport input all
 transport output pad telnet rlogin lapb-ta mop udptn v120 ssh
 stopbits 1
line vty 0 4
 password cisco
 login
 transport input all
!
scheduler allocate 20000 1000
!
end
```

- h. Are there any problems with the current configuration that prevent the static NAT from occurring?

Yes. The inside and outside NAT interfaces are incorrectly configured.

- i. Record any commands that are necessary to correct the static NAT configuration errors.

```
Gateway(config)# interface g0/1
Gateway(config-if)# no ip nat outside
Gateway(config-if)# ip nat inside
Gateway(config-if)# exit
Gateway(config)# interface s0/0/0
Gateway(config-if)# no ip nat outside
Gateway(config-if)# exit
Gateway(config)# interface s0/0/1
Gateway(config-if)# ip nat outside
Gateway(config-if)# exit
```

- j. From PC-A, ping Lo0 on the ISP router. Do any NAT debug translations appear on the Gateway router?

Yes

```
*Mar 18 23:53:50.707: NAT*: s=192.168.1.3->209.165.200.254, d=198.133.219.1 [187]
*Mar 18 23:53:50.715: NAT*: s=198.133.219.1, d=209.165.200.254->192.168.1.3 [187]
Gateway#
*Mar 18 23:53:51.711: NAT*: s=192.168.1.3->209.165.200.254, d=198.133.219.1 [188]
*Mar 18 23:53:51.719: NAT*: s=198.133.219.1, d=209.165.200.254->192.168.1.3 [188]
*Mar 18 23:53:52.707: NAT*: s=192.168.1.3->209.165.200.254, d=198.133.219.1 [189]
Gateway#
*Mar 18 23:53:52.715: NAT*: s=198.133.219.1, d=209.165.200.254->192.168.1.3 [189]
*Mar 18 23:53:53.707: NAT*: s=192.168.1.3->209.165.200.254, d=198.133.219.1 [190]
Gateway#
*Mar 18 23:53:53.715: NAT*: s=198.133.219.1, d=209.165.200.254->192.168.1.3 [190]
```

- k. Use the **show ip nat translations verbose** command to verify static NAT functionality.

Note: The timeout value for ICMP is very short. If you do not see all the translations in the output, redo the ping.

```
Gateway# show ip nat translations verbose
Pro Inside global      Inside local      Outside local      Outside global
icmp 209.165.200.254:1  192.168.1.3:1     198.133.219.1:1   198.133.219.1:1
      create 00:00:04, use 00:00:01 timeout:60000, left 00:00:58,
      flags:
extended, use_count: 0, entry-id: 12, lc_entries: 0
--- 209.165.200.254      192.168.1.3      ---              ---
      create 00:30:09, use 00:00:04 timeout:0,
      flags:
static, use_count: 1, entry-id: 2, lc_entries: 0
```

Is the static NAT translation occurring successfully? Yes

If static NAT is not occurring, repeat the steps above to troubleshoot the configuration.

Part 3: Troubleshoot Dynamic NAT

- a. From PC-B, ping Lo0 on the ISP router. Do any NAT debug translations appear on the Gateway router?
- _____ **No**
- b. On the Gateway router, enter the command that allows you to view the current configuration of the router. Are there any problems with the current configuration that prevent dynamic NAT from occurring?

Yes. The NAT pool is incorrectly identified in the source statement. The NAT access list has an incorrect network statement.

- c. Record any commands that are necessary to correct the dynamic NAT configuration errors.

```
Gateway(config)# no ip nat inside source list NAT_ACL pool NATPOOL
Gateway(config)# ip nat inside source list NAT_ACL pool NAT_POOL
Gateway(config)# ip access-list standard NAT_ACL
Gateway(config-std-nacl)# no permit 192.168.10.0 0.0.0.255
Gateway(config-std-nacl)# permit 192.168.1.0 0.0.0.255
```

- d. From PC-B, ping Lo0 on the ISP router. Do any NAT debug translations appear on the Gateway router?

Yes

```
*Mar 19 00:01:17.303: NAT*: s=192.168.1.4->209.165.200.241, d=198.133.219.1 [198]
*Mar 19 00:01:17.315: NAT*: s=198.133.219.1, d=209.165.200.241->192.168.1.4 [198]
Gateway#
*Mar 19 00:01:18.307: NAT*: s=192.168.1.4->209.165.200.241, d=198.133.219.1 [199]
*Mar 19 00:01:18.315: NAT*: s=198.133.219.1, d=209.165.200.241->192.168.1.4 [199]
*Mar 19 00:01:19.303: NAT*: s=192.168.1.4->209.165.200.241, d=198.133.219.1 [200]
Gateway#
*Mar 19 00:01:19.315: NAT*: s=198.133.219.1, d=209.165.200.241->192.168.1.4 [200]
*Mar 19 00:01:20.303: NAT*: s=192.168.1.4->209.165.200.241, d=198.133.219.1 [201]
*Mar 19 00:01:20.311: NAT*: s=198.133.219.1, d=209.165.200.241->192.168.1.4 [201]
```

- e. Use the **show ip nat statistics** to view NAT usage.

```
Gateway# show ip nat statistics
Total active translations: 2 (1 static, 1 dynamic; 0 extended)
Peak translations: 3, occurred 00:02:58 ago
Outside interfaces:
  Serial0/0/1
Inside interfaces:
  GigabitEthernet0/1
Hits: 24 Misses: 0
CEF Translated packets: 24, CEF Punted packets: 0
Expired translations: 3
Dynamic mappings:
-- Inside Source
```


Lab - Troubleshooting NAT Configurations

```
[Id: 2] access-list NAT_ACL pool NAT_POOL refcount 1
pool NAT_POOL: netmask 255.255.255.248
start 209.165.200.241 end 209.165.200.246
type generic, total addresses 6, allocated 1 (16%), misses 0
```

Total doors: 0

Appl doors: 0

Normal doors: 0

Queued Packets: 0

Is the NAT occurring successfully? _____ Yes

What percentage of dynamic addresses has been allocated? _____ 16%

- f. Turn off all debugging using the **undebug all** command.

Reflection

1. What is the benefit of a static NAT?

A static NAT translation allows users from outside the LAN access to the computer or server on the internal network.

2. What issues would arise if 10 host computers in this network were attempting simultaneous Internet communication?

Not enough public addresses exist in the NAT pool to satisfy 10 simultaneous user sessions, but as hosts drop off different hosts will be able to claim the pool addresses to access the Internet.

Router Interface Summary Table

Router Interface Summary				
Router Model	Ethernet Interface #1	Ethernet Interface #2	Serial Interface #1	Serial Interface #2
1800	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
1900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2801	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/1/0 (S0/1/0)	Serial 0/1/1 (S0/1/1)
2811	Fast Ethernet 0/0 (F0/0)	Fast Ethernet 0/1 (F0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)
2900	Gigabit Ethernet 0/0 (G0/0)	Gigabit Ethernet 0/1 (G0/1)	Serial 0/0/0 (S0/0/0)	Serial 0/0/1 (S0/0/1)

Note: To find out how the router is configured, look at the interfaces to identify the type of router and how many interfaces the router has. There is no way to effectively list all the combinations of configurations for each router class. This table includes identifiers for the possible combinations of Ethernet and Serial interfaces in the device. The table does not include any other type of interface, even though a specific router may contain one. An example of this might be an ISDN BRI interface. The string in parenthesis is the legal abbreviation that can be used in Cisco IOS commands to represent the interface.

Device Config

Router Gateway

```
Gateway#show run
Building configuration...

Current configuration : 1805 bytes
!
version 15.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Gateway
!
boot-start-marker
boot-end-marker
!
!
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2
!
no aaa new-model
!
!
no ip domain lookup
```

Lab - Troubleshooting NAT Configurations

```
ip cef
no ipv6 cef
!
multilink bundle-name authenticated
!
!
redundancy
!
!
!
!
!
interface Embedded-Service-Engine0/0
no ip address
shutdown
!
interface GigabitEthernet0/0
no ip address
shutdown
duplex auto
speed auto
!
interface GigabitEthernet0/1
ip address 192.168.1.1 255.255.255.0
ip nat inside
ip virtual-reassembly in
duplex auto
speed auto
!
interface Serial0/0/0
no ip address
shutdown
!
interface Serial0/0/1
ip address 209.165.200.225 255.255.255.252
ip nat outside
ip virtual-reassembly in
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
!
ip nat pool NAT_POOL 209.165.200.241 209.165.200.246 netmask 255.255.255.248
ip nat inside source list NAT_ACL pool NAT_POOL
ip nat inside source static 192.168.1.3 209.165.200.254
ip route 0.0.0.0 0.0.0.0 Serial0/0/1
!
ip access-list standard NAT_ACL
permit 192.168.1.0 0.0.0.255
```

Lab - Troubleshooting NAT Configurations

```
!  
!  
!  
!  
control-plane  
!  
!  
banner motd ^AUTHORIZED ACCESS ONLY^C  
!  
line con 0  
  password cisco  
  logging synchronous  
  login  
line aux 0  
line 2  
  no activation-character  
  no exec  
  transport preferred none  
  transport input all  
  transport output pad telnet rlogin lapb-ta mop udptn v120 ssh  
  stopbits 1  
line vty 0 4  
  password cisco  
  login  
  transport input all  
!  
scheduler allocate 20000 1000  
!  
end
```

Router ISP

```
ISP#show run  
Building configuration...  
  
Current configuration : 1482 bytes  
!  
version 15.2  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname ISP  
!  
boot-start-marker  
boot-end-marker  
!  
!  
enable secret 4 06YFDUHH61wAE/kLkDq9BGho1QM5EnRtoyr8cHAUg.2  
!
```

Lab - Troubleshooting NAT Configurations

```
no aaa new-model
memory-size iomem 15
!
no ip domain lookup
ip cef
!
!
!
!
!
!
no ipv6 cef
multilink bundle-name authenticated
!
!
!
!
!
!
!
!
interface Loopback0
 ip address 198.133.219.1 255.255.255.255
!
interface Embedded-Service-Engine0/0
 no ip address
 shutdown
!
interface GigabitEthernet0/0
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface GigabitEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 ip address 209.165.200.226 255.255.255.252
 clock rate 128000
!
interface Serial0/0/1
 no ip address
 shutdown
!
ip forward-protocol nd
```

Lab - Troubleshooting NAT Configurations

```
!  
no ip http server  
no ip http secure-server  
!  
ip route 209.165.200.224 255.255.255.224 Serial10/0/0  
!  
!  
!  
!  
control-plane  
!  
!  
!  
line con 0  
  password cisco  
  logging synchronous  
  login  
line aux 0  
line 2  
  no activation-character  
  no exec  
  transport preferred none  
  transport input all  
  transport output pad telnet rlogin lapb-ta mop udptn v120 ssh  
  stopbits 1  
line vty 0 4  
  password cisco  
  login  
  transport input all  
line vty 5 15  
  password cisco  
  login  
  transport input all  
!  
scheduler allocate 20000 1000  
!  
end
```