version 4

IEWB-RS Technology Labs
NAT

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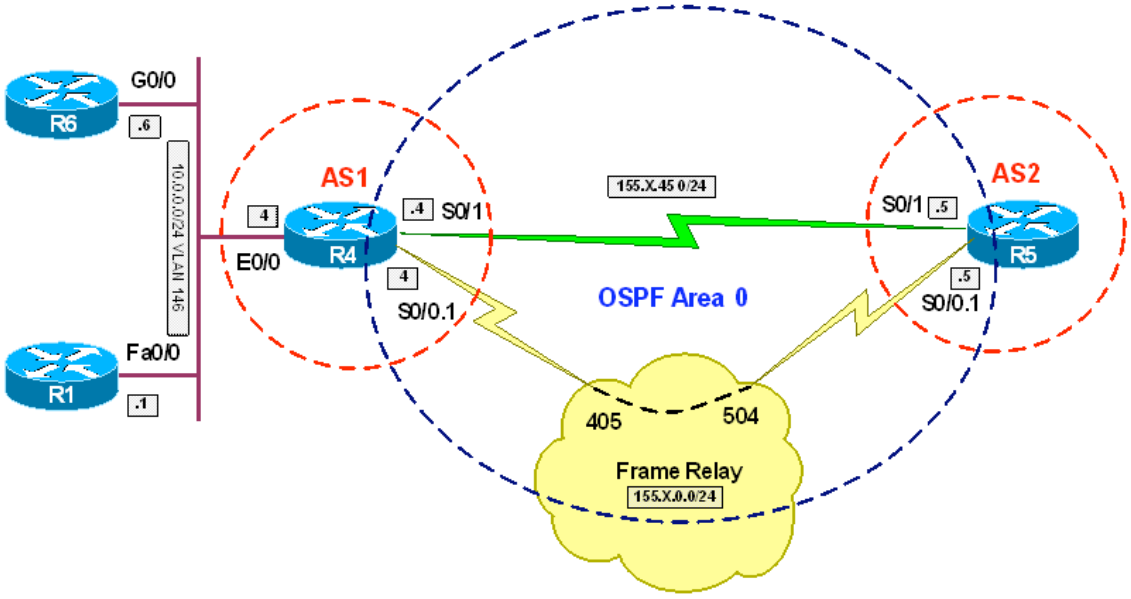
Common Configuration

Objective: Configure the network for NAT scenarios



Directions

- Create VLAN 146 on SW1 and SW2, and configure the respective switchports in this VLAN (SW1: Fa 0/1, SW2: Fa 0/4 and Fa 0/6)
- Configure interface Fa 0/13 on both SW1 and SW2 as 802.1q trunk
- Configure IP addressing on VLAN146 interfaces as per diagram
- Configure static default route to 10.0.0.4 on R1 and R6
- Configure Frame-Relay and Serial interfaces. Use HDLC for Serial link encapsulation. Use Point-to-Point Frame-Relay subinterfaces and DLCIs depicted on the diagram
- Configure Addressing on FR and Serial interfaces as per diagram
- Create Loopback0 interfaces on R4 and R5 with IP addresses 150.X.4.4/24 and 150.X.5.5/24 respectively. Configure this interface as OSPF point-to-point links in order to advertise full /24 prefix
- Configure OSPF Area 0 on FR and Serial interfaces. Advertise Loopback0 interfaces on R4 and R5 into OSPF
- Configure BGP AS1 on R4 and BGP AS2 on R5. Peer R5 and R4 over BGP. Use Loopback0 as eBGP source interfaces
- R5 should advertise default route to R4 via BGP

Final Configuration

SW1:

```
vlan 146
interface Fa 0/1
 switchport host
 switchport access vlan 146
!
interface fastEthernet 0/13
 switchport trunk encaps dot1q
 switchport mode trunk
```

SW2:

```
vlan 146
interface range Fa 0/4 , Fa 0/6
switchport host
 switchport access vlan 146
!
interface fastEthernet 0/13
 switchport trunk encaps dot1q
 switchport mode trunk
```

R1:

```
inter fa 0/0
 ip address 10.0.0.1 255.255.255.0
 no shut
!
ip route 0.0.0.0 0.0.0.0 10.0.0.4
```

R4:

```
inter ethernet 0/0
 ip address 10.0.0.4 255.255.255.0
 no shut
!
inter Loopback0
 ip add 150.1.4.4 255.255.255.0
 ip ospf network point-to-point
!
interface Serial 0/0
 encaps frame-relay
 no shutdown
!
interface Serial 0/0.1 point-to-point
 ip address 155.1.0.4 255.255.255.0
 frame-relay interface-dlci 405
!
interface Serial 0/1
 no shutdown
 ip address 155.1.45.4 255.255.255.0
!
router ospf 1
 router-id 150.1.4.4
 network 155.1.0.4 0.0.0.0 area 0
 network 155.1.45.4 0.0.0.0 area 0
 network 150.1.4.4 0.0.0.0 area 0
!
router bgp 1
 bgp router-id 150.1.4.4
 neighbor 150.1.5.5 remote-as 2
 neighbor 150.1.5.5 update-source Loopback0
 neighbor 150.1.5.5 ebgp-multihop
```


R5:

```
interface Loopback0
 ip address 150.1.5.5 255.255.255.0
 ip ospf network point-to-point
!
interface Serial 0/0
 encapsulation frame-relay
 no shut
!
interface Serial 0/0.1 point-to-point
 ip address 155.1.0.5 255.255.255.0
 frame-relay interface-dlci 504
!
interface Serial 0/1
 no shutdown
 clockrate 64000
 ip address 155.1.45.5 255.255.255.0
!
router ospf 1
 router-id 150.1.5.5
 network 155.1.0.5 0.0.0.0 area 0
 network 155.1.45.5 0.0.0.0 area 0
 network 150.1.5.5 0.0.0.0 area 0
!
router bgp 2
 bgp router-id 150.1.5.5
 neighbor 150.1.4.4 remote-as 1
 neighbor 150.1.4.4 update-source Loopback0
 neighbor 150.1.4.4 ebgp-multihop
 neighbor 150.1.4.4 default-originate
```

R6:

```
inter gig 0/0
 ip address 10.0.0.6 255.255.255.0
 no shut
!
ip route 0.0.0.0 0.0.0.0 10.0.0.4
```

Verification

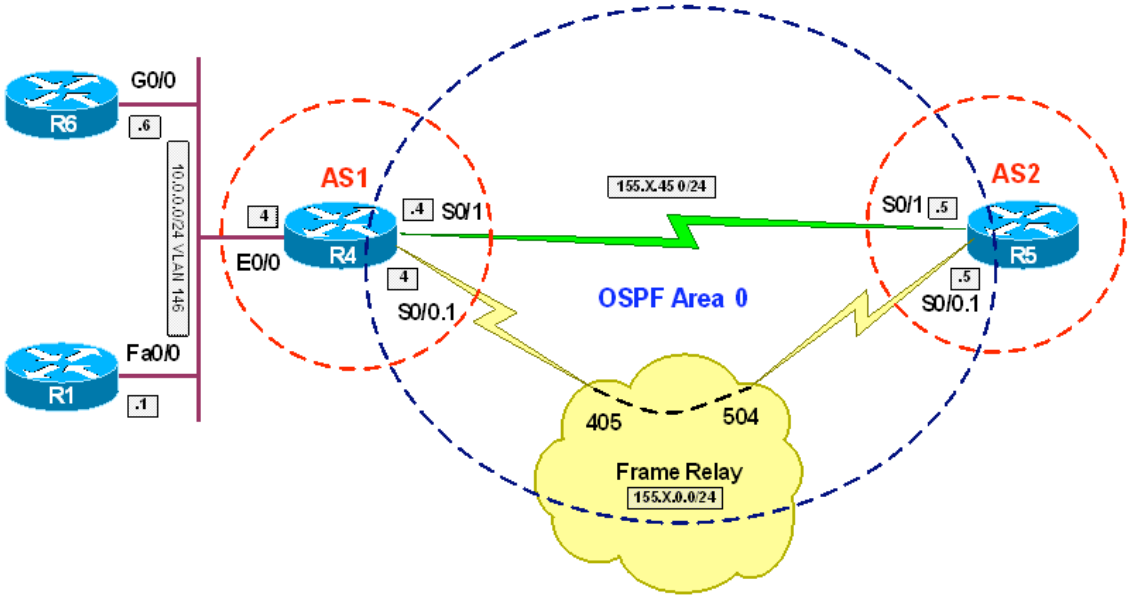
```
R4#ping 10.0.0.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

R4#ping 10.0.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.0.0.1, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/2/4 ms

R4#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
150.1.5.5         0   FULL/  -        00:00:33    155.1.45.5      Serial0/1
150.1.5.5         0   FULL/  -        00:00:33    155.1.0.5       Serial0/0.1
```



```
R4#show ip bgp sum
BGP router identifier 150.1.4.4, local AS number 1
BGP table version is 2, main routing table version 2
1 network entries using 117 bytes of memory
1 path entries using 52 bytes of memory
2/1 BGP path/bestpath attribute entries using 248 bytes of memory
1 BGP AS-PATH entries using 24 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 441 total bytes of memory
BGP activity 1/0 prefixes, 1/0 paths, scan interval 60 secs

Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down State/PfxRcd
150.1.5.5       4     2      17      16        2    0    0 00:13:22        1

R4#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is 150.1.5.5 to network 0.0.0.0

     155.1.0.0/24 is subnetted, 3 subnets
C       155.1.146.0 is directly connected, Ethernet0/0
C       155.1.0.0 is directly connected, Serial0/0.1
C       155.1.45.0 is directly connected, Serial0/1
     150.1.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       150.1.4.0/24 is directly connected, Loopback0
O       150.1.5.5/32 [110/65] via 155.1.45.5, 00:02:11, Serial0/1
                     [110/65] via 155.1.0.5, 00:02:11, Serial0/0.1
B*   0.0.0.0/0 [20/0] via 150.1.5.5, 00:00:33
```


Standard NAT Configuration

Objective: Configure router to perform source NAT translation of inside addresses



Directions

- Configure routers as per the NAT scenario “Common Configuration”.
- Create pool of global addresses NAT_POOL with range 150.X.4.100-150.X.4.254 on R4
- Create standard access list INSIDE_NETWORK on R4 and match network 10.0.0.0/24
- Configure interface Ethernet 0/0 as NAT inside and interfaces Serial 0/0.1 and Serial 0/1 as NAT outside
- Create NAT rules to translate source addresses for hosts matched by access-list INSIDE_NETWORK using NAT pool NAT_POOL

Final Configuration

R4:

```
interface Ethernet 0/0
 ip nat inside
!
interface Serial 0/1
 ip nat outside
!
interface Serial 0/0.1
 ip nat outside
!
ip nat pool NAT_POOL 150.1.4.100 150.1.4.254 prefix 24
ip access-list standard INSIDE_NETWORK
 permit 10.0.0.0 0.0.0.255
!
ip nat inside source list INSIDE_NETWORK pool NAT_POOL
```

Verification

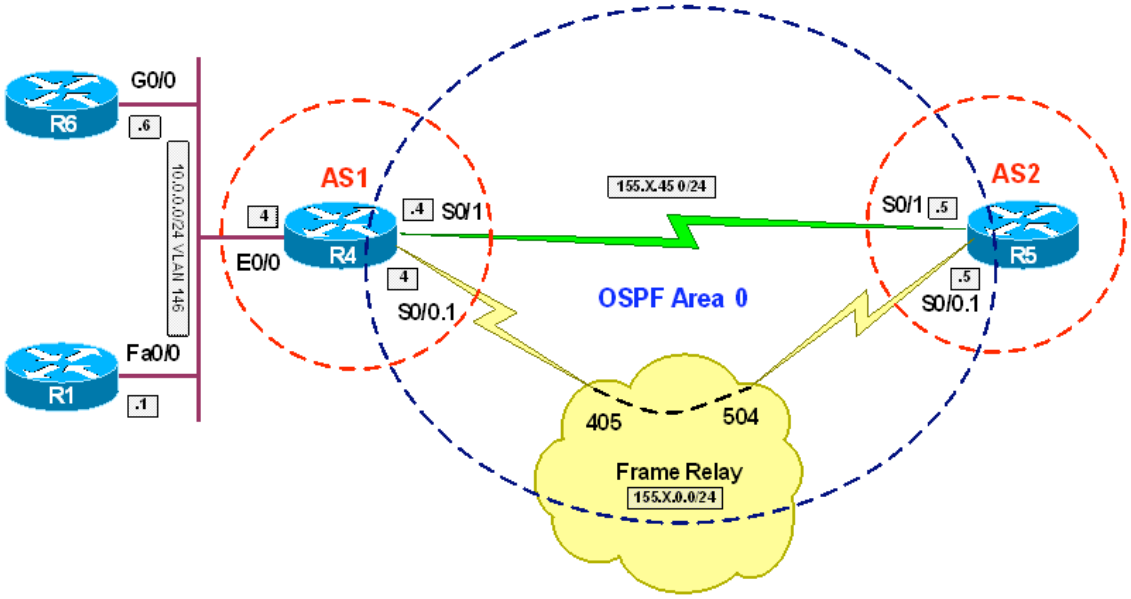
```
R4#show ip nat statistics
Total active translations: 0 (0 static, 0 dynamic; 0 extended)
Outside interfaces:
  Serial0/1, Serial0/0.1
Inside interfaces:
  Ethernet0/0
Hits: 0  Misses: 0
CEF Translated packets: 0, CEF Punted packets: 0
Expired translations: 0
Dynamic mappings:
-- Inside Source
[Id: 1] access-list INSIDE_NETWORK pool NAT_POOL refcount 0
 pool NAT_POOL: netmask 255.255.255.0
        start 150.1.4.100 end 150.1.4.254
        type generic, total addresses 155, allocated 0 (0%), misses 0
Queued Packets: 0

R4#debug ip nat detailed
IP NAT detailed debugging is on

R1#ping 150.1.5.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 150.1.5.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/46/48 ms

R4#
NAT*: i: icmp (10.0.0.1, 6) -> (150.1.5.5, 6) [125]
NAT*: i: icmp (10.0.0.1, 6) -> (150.1.5.5, 6) [125]
NAT*: s=10.0.0.1->150.1.4.101, d=150.1.5.5 [125]
NAT: installing alias for address 150.1.4.101
NAT*: o: icmp (150.1.5.5, 6) -> (150.1.4.101, 6) [125]
NAT*: s=150.1.5.5, d=150.1.4.101->10.0.0.1 [125]
NAT*: i: icmp (10.0.0.1, 6) -> (150.1.5.5, 6) [126]
NAT*: s=10.0.0.1->150.1.4.101, d=150.1.5.5 [126]
NAT*: o: icmp (150.1.5.5, 6) -> (150.1.4.101, 6) [126]
NAT*: s=150.1.5.5, d=150.1.4.101->10.0.0.1 [126]
```



```
NAT*: i: icmp (10.0.0.1, 6) -> (150.1.5.5, 6) [127]
NAT*: s=10.0.0.1->150.1.4.101, d=150.1.5.5 [127]
NAT*: o: icmp (150.1.5.5, 6) -> (150.1.4.101, 6) [127]
NAT*: s=150.1.5.5, d=150.1.4.101->10.0.0.1 [127]
NAT*: i: icmp (10.0.0.1, 6) -> (150.1.5.5, 6) [128]
NAT*: s=10.0.0.1->150.1.4.101, d=150.1.5.5 [128]
NAT*: o: icmp (150.1.5.5, 6) -> (150.1.4.101, 6) [128]
NAT*: s=150.1.5.5, d=150.1.4.101->10.0.0.1 [128]
NAT*: i: icmp (10.0.0.1, 6) -> (150.1.5.5, 6) [129]
NAT*: s=10.0.0.1->150.1.4.101, d=150.1.5.5 [129]
NAT*: o: icmp (150.1.5.5, 6) -> (150.1.4.101, 6) [129]
NAT*: s=150.1.5.5, d=150.1.4.101->10.0.0.1 [129]

R4#show ip nat trans
Pro Inside global      Inside local       Outside local      Outside global
icmp 150.1.4.101:6     10.0.0.1:6         150.1.5.5:6        150.1.5.5:6
--- 150.1.4.101        10.0.0.1           ---                ---
```

Standard NAT with Overloading (PAT)

Objective: Configure NAT to use single global IP address to translate all inside addresses



Directions

- Configure routers as per the NAT scenario "Common Configuration"
- Create standard access list INSIDE_NETWORK on R4 and match network 10.0.0.0/24
- Configure interface Ethernet 0/0 as NAT inside and interfaces Serial 0/0.1 and Serial 0/1 as NAT outside
- Create NAT rules to translate source addresses for hosts matched by access-list INSIDE_NETWORK using Loopback0 interface in overload mode

Final Configuration

R4:

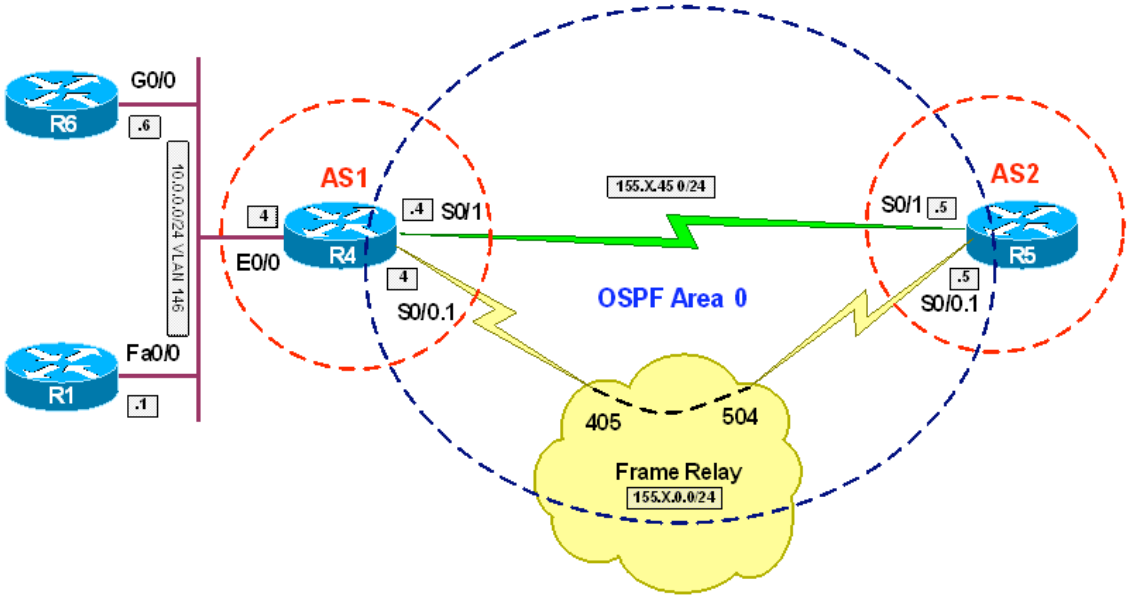
```
interface Ethernet 0/0
 ip nat inside
!
interface Serial 0/1
 ip nat outside
!
interface Serial 0/0.1
 ip nat outside
!
ip access-list standard INSIDE_NETWORK
 permit 10.0.0.0 0.0.0.255
!
ip nat inside source list INSIDE_NETWORK interface Loop0 overload
```


Verification

```
R1#ping 150.1.5.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 150.1.5.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/61/64 ms

R1#telnet 150.1.5.5
Trying 150.1.5.5 ... Open


Password required, but none set

[Connection to 150.1.5.5 closed by foreign host]

R4#show ip nat tra
Pro Inside global      Inside local       Outside local      Outside global
icmp 150.1.4.4:7       10.0.0.1:7         150.1.5.5:7        150.1.5.5:7
icmp 150.1.4.4:8       10.0.0.1:8         150.1.5.5:8        150.1.5.5:8
tcp 150.1.4.4:52968    10.0.0.1:52968     150.1.5.5:23       150.1.5.5:23
```


NAT Redundancy with Route-Maps

Objective: Configure router to use active outside interface for outgoing packets translation



Directions

- Configure routers as per the NAT scenario "Common Configuration".
- Create standard access list INSIDE_NETWORK on R4 and match network 10.0.0.0/24
- Configure interface Ethernet 0/0 as NAT inside and interfaces Serial 0/0.1 and Serial 0/1 as NAT outside
- The goal is to translate source addresses using currently active outside interface for PAT
- Create route-map FR_INTERFACE and match interface Serial 0/0.1 as well as access-list INSIDE_NETWORK with it
- Create route-map SERIAL_INTERFACE and match interface Serial 0/1 as well as access-list INSIDE_NETWORK with it
- Create NAT rule to translate IP addresses using the route-map FR_INTERFACE and using interface Serial 0/0.1 for NAT overload
- Create NAT rule to translate IP addresses using the route-map SERIAL_INTERFACE and using interface Serial 0/1 for NAT overload

Final Configuration

R4:

```
interface Ethernet 0/0
 ip nat inside
!
interface Serial 0/1
```



```
 ip nat outside
!
interface Serial 0/0.1
 ip nat outside
!
ip access-list standard INSIDE_NETWORK
 permit 10.0.0.0 0.0.0.255
!
route-map FR_INTERFACE
 match interface Serial 0/0.1
 match ip address INSIDE_NETWORK
!
route-map SERIAL_INTERFACE
 match interface Serial 0/1
 match ip address INSIDE_NETWORK
!
ip nat inside source route-map FR_INTERFACE int Serial 0/0.1 overload
ip nat inside source route-map SERIAL_INTERFACE int Serial 0/1 overload
```

Verification

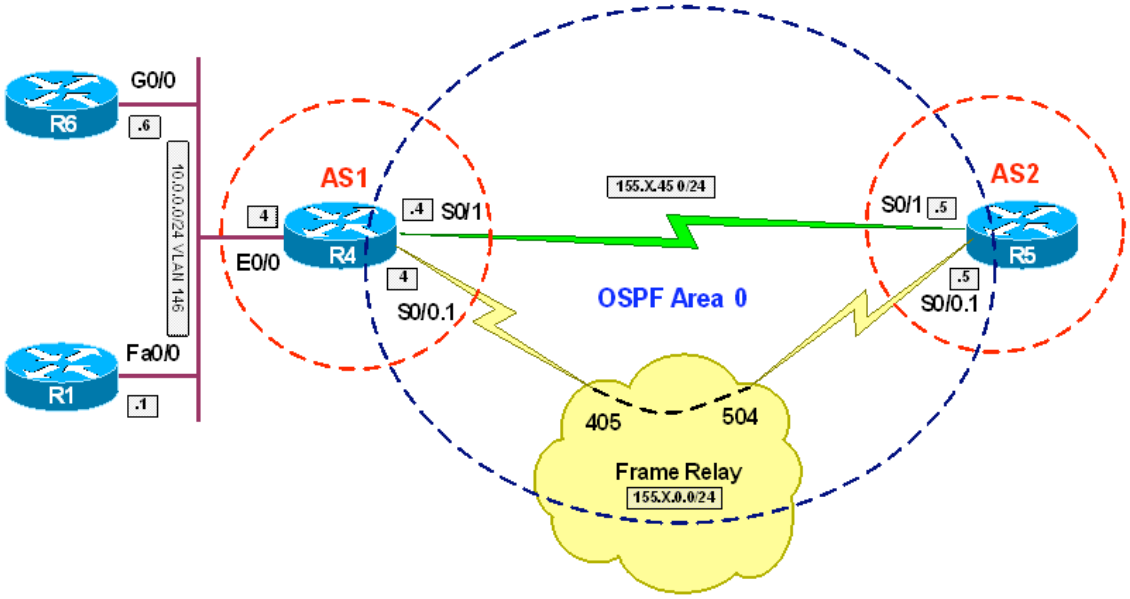
```
R4#show ip nat statistics
Total active translations: 0 (0 static, 0 dynamic; 0 extended)
Outside interfaces:
  Serial0/0.1, Serial0/1
Inside interfaces:
  Ethernet0/0
Hits: 0  Misses: 0
CEF Translated packets: 0, CEF Punted packets: 0
Expired translations: 0
Dynamic mappings:
-- Inside Source
[Id: 1] route-map FR_INTERFACE interface Serial0/0.1 refcount 0
[Id: 2] route-map SERIAL_INTERFACE interface Serial0/1 refcount 0
Queued Packets: 0

R1#ping 150.1.5.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 150.1.5.5, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 60/60/61 ms
R1#

R4#show ip nat tra
Pro Inside global      Inside local       Outside local      Outside global
icmp 155.1.0.4:9       10.0.0.1:9         150.1.5.5:9        150.1.5.5:9

R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#int se 0/0
R4(config-if)#shut
R4(config-if)#^Z
R4#

R1#ping 150.1.5.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 150.1.5.5, timeout is 2 seconds:
!!!!!
```



```
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/31/32 ms

R4#show ip nat tra
Pro Inside global      Inside local       Outside local      Outside global
icmp 155.1.0.4:9       10.0.0.1:9         150.1.5.5:9        150.1.5.5:9
icmp 155.1.45.4:10     10.0.0.1:10        150.1.5.5:10       150.1.5.5:10
```


Policy NAT with Route-Maps

Objective: Translate source addresses differently based on destination port numbers



Directions

- Configure routers as per the NAT scenario “Common Configuration”.
- The goal is to translate outbound telnet sessions using the FR interface, and everything else going outbound – using the Serial interface IP address
- Create extended access list INSIDE_TELNET on R4 and match telnet traffic from 10.0.0.0/24
- Create extended access list INSIDE_OTHER on R4 and match everything else sourcing from 10.0.0.0/24 with it
- Configure interface Ethernet 0/0 as NAT inside and interfaces Serial 0/0.1 and Serial 0/1 as NAT outside
- Create route-map FR_INTERFACE; set interface Serial 0/0.1 and match access-list INSIDE_TELNET with it
- Create route-map SERIAL_INTERFACE; set interface Serial 0/1 and match access-list INSIDE_OTHER with it
- Create NAT rule to translate IP addresses using the route-map FR_INTERFACE and using interface Serial 0/0.1 for NAT overload
- Create NAT rule to translate IP addresses using the route-map SERIAL_INTERFACE and using interface Serial 0/1 for NAT overload

Final Configuration

R4:

```
interface Ethernet 0/0
 ip nat inside
```



```
!
interface Serial 0/1
 ip nat outside
!
interface Serial 0/0.1
 ip nat outside
!
ip access-list ext INSIDE_TELNET
 permit tcp 10.0.0.0 0.0.0.255 any eq 23
!
ip access-list ext INSIDE_OTHER
 deny tcp 10.0.0.0 0.0.0.255 any eq 23
 permit ip 10.0.0.0 0.0.0.255 any
!
route-map FR_INTERFACE
 set interface Serial 0/0.1
 match ip address INSIDE_TELNET
!
route-map SERIAL_INTERFACE
 set interface Serial 0/1
 match ip address INSIDE_OTHER
!
ip nat inside source route-map FR_INTERFACE int Serial 0/0.1 overload
ip nat inside source route-map SERIAL_INTERFACE int Serial 0/1 overload
```

Verification

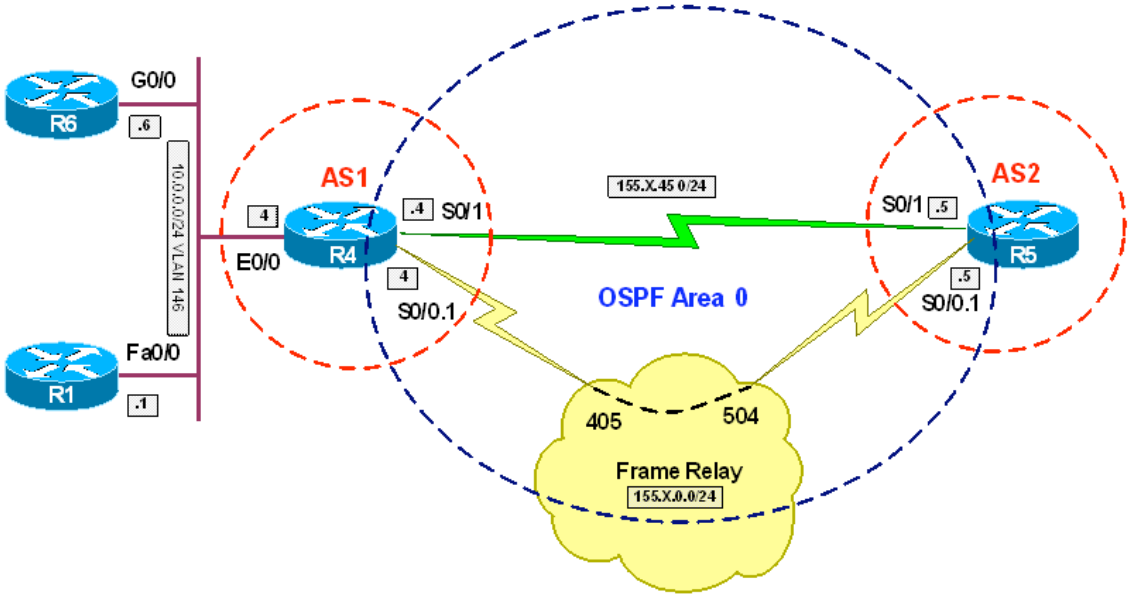
```
R4#debug ip nat detailed
IP NAT detailed debugging is on

R1#ping 150.1.5.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 150.1.5.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/47/53 ms

NAT: map match SERIAL_INTERFACE
NAT: creating portlist proto 1 globaladdr 155.1.45.4
NAT: Allocated Port for 10.0.0.1 -> 155.1.45.4: wanted 14 got 14
NAT*: i: icmp (10.0.0.1, 14) -> (150.1.5.5, 14) [165]
NAT*: i: icmp (10.0.0.1, 14) -> (150.1.5.5, 14) [165]
NAT*: s=10.0.0.1->155.1.45.4, d=150.1.5.5 [165]
NAT*: o: icmp (150.1.5.5, 14) -> (155.1.45.4, 14) [165]
NAT*: s=150.1.5.5, d=155.1.45.4->10.0.0.1 [165]
NAT*: i: icmp (10.0.0.1, 14) -> (150.1.5.5, 14) [166]
NAT*: s=10.0.0.1->155.1.45.4, d=150.1.5.5 [166]
NAT*: o: icmp (150.1.5.5, 14) -> (155.1.45.4, 14) [166]
NAT*: s=150.1.5.5, d=155.1.45.4->10.0.0.1 [166]
NAT*: i: icmp (10.0.0.1, 14) -> (150.1.5.5, 14) [167]
NAT*: s=10.0.0.1->155.1.45.4, d=150.1.5.5 [167]
NAT*: o: icmp (150.1.5.5, 14) -> (155.1.45.4, 14) [167]
NAT*: s=150.1.5.5, d=155.1.45.4->10.0.0.1 [167]
NAT*: i: icmp (10.0.0.1, 14) -> (150.1.5.5, 14) [168]
NAT*: s=10.0.0.1->155.1.45.4, d=150.1.5.5 [168]
NAT*: o: icmp (150.1.5.5, 14) -> (155.1.45.4, 14) [168]
NAT*: s=150.1.5.5, d=155.1.45.4->10.0.0.1 [168]
NAT*: i: icmp (10.0.0.1, 14) -> (150.1.5.5, 14) [169]
NAT*: s=10.0.0.1->155.1.45.4, d=150.1.5.5 [169]
NAT*: o: icmp (150.1.5.5, 14) -> (155.1.45.4, 14) [169]
```



```
NAT*: s=150.1.5.5, d=155.1.45.4->10.0.0.1 [169]

R4#show ip nat tra
Pro Inside global      Inside local       Outside local      Outside global
icmp 155.1.45.4:14     10.0.0.1:14        150.1.5.5:14       150.1.5.5:14

R1#telnet 150.1.5.5
Trying 150.1.5.5 ... Open


Password required, but none set

R4#

NAT: map match FR_INTERFACE
NAT: Allocated Port for 10.0.0.1 -> 155.1.0.4: wanted 23080 got 23080
NAT*: i: tcp (10.0.0.1, 23080) -> (150.1.5.5, 23) [47527]
NAT*: i: tcp (10.0.0.1, 23080) -> (150.1.5.5, 23) [47527]
NAT*: s=10.0.0.1->155.1.0.4, d=150.1.5.5 [47527]
NAT*: o: tcp (150.1.5.5, 23) -> (155.1.0.4, 23080) [0]
NAT*: s=150.1.5.5, d=155.1.0.4->10.0.0.1 [0]
NAT*: i: tcp (10.0.0.1, 23080) -> (150.1.5.5, 23) [47528]
NAT*: s=10.0.0.1->155.1.0.4, d=150.1.5.5 [47528]
NAT*: i: tcp (10.0.0.1, 23080) -> (150.1.5.5, 23) [47529]
NAT*: s=10.0.0.1->155.1.0.4, d=150.1.5.5 [47529]
NAT*: i: tcp (10.0.0.1, 23080) -> (150.1.5.5, 23) [47530]
NAT*: s=10.0.0.1->155.1.0.4, d=150.1.5.5 [47530]
NAT*: o: tcp (150.1.5.5, 23) -> (155.1.0.4, 23080) [1]
NAT*: s=150.1.5.5, d=155.1.0.4->10.0.0.1 [1]
NAT*: i: tcp (10.0.0.1, 23080) -> (150.1.5.5, 23) [47531]
NAT*: s=10.0.0.1->155.1.0.4, d=150.1.5.5 [47531]
NAT*: i: tcp (10.0.0.1, 23080) -> (150.1.5.5, 23) [47532]
NAT*: s=10.0.0.1->155.1.0.4, d=150.1.5.5 [47532]
NAT*: i: tcp (10.0.0.1, 23080) -> (150.1.5.5, 23) [47533]
NAT*: s=10.0.0.1->155.1.0.4, d=150.1.5.5 [47533]
NAT*: o: tcp (150.1.5.5, 23) -> (155.1.0.4, 23080) [2]
NAT*: s=150.1.5.5, d=155.1.0.4->10.0.0.1 [2]
NAT*: o: tcp (150.1.5.5, 23) -> (155.1.0.4, 23080) [3]
NAT*: s=150.1.5.5, d=155.1.0.4->10.0.0.1 [3]
NAT*: i: tcp (10.0.0.1, 23080) -> (150.1.5.5, 23) [47534]
NAT*: s=10.0.0.1->155.1.0.4, d=150.1.5.5 [47534]
NAT*: o: tcp (150.1.5.5, 23) -> (155.1.0.4, 23080) [4]
NAT*: s=150.1.5.5, d=155.1.0.4->10.0.0.1 [4]
NAT*: i: tcp (10.0.0.1, 23080) -> (150.1.5.5, 23) [47535]
NAT*: s=10.0.0.1->155.1.0.4, d=150.1.5.5 [47535]
NAT*: i: tcp (10.0.0.1, 23080) -> (150.1.5.5, 23) [47536]
NAT*: s=10.0.0.1->155.1.0.4, d=150.1.5.5 [47536]
NAT*: o: tcp (150.1.5.5, 23) -> (155.1.0.4, 23080) [5]
NAT*: s=150.1.5.5, d=155.1.0.4->10.0.0.1 [5]

R4#show ip nat tra
Pro Inside global      Inside local       Outside local      Outside global
tcp 155.1.0.4:23080    10.0.0.1:23080     150.1.5.5:23       150.1.5.5:23
```

Configuring Static NAT

Objective: Make selected inside addresses available on outside network



Directions

- Configure routers as per the NAT scenario "Common Configuration"
- The goal is to make R1 and R6 available on outside as 150.X.4.1 and 150.X.4.6 respectively
- Configure interface Ethernet 0/0 as NAT inside and interfaces Serial 0/0.1 and Serial 0/1 as NAT outside
- Create static NAT entry to map 10.0.0.1 to 150.X.4.1
- Create static NAT entry to map 10.0.0.6 to 150.X.4.6

Final Configuration

```
R4:
interface Ethernet 0/0
 ip nat inside
!
interface Serial 0/1
 ip nat outside
!
interface Serial 0/0.1
 ip nat outside
!
ip nat inside source static 10.0.0.1 150.1.4.1
ip nat inside source static 10.0.0.6 150.1.4.6
```

Verification

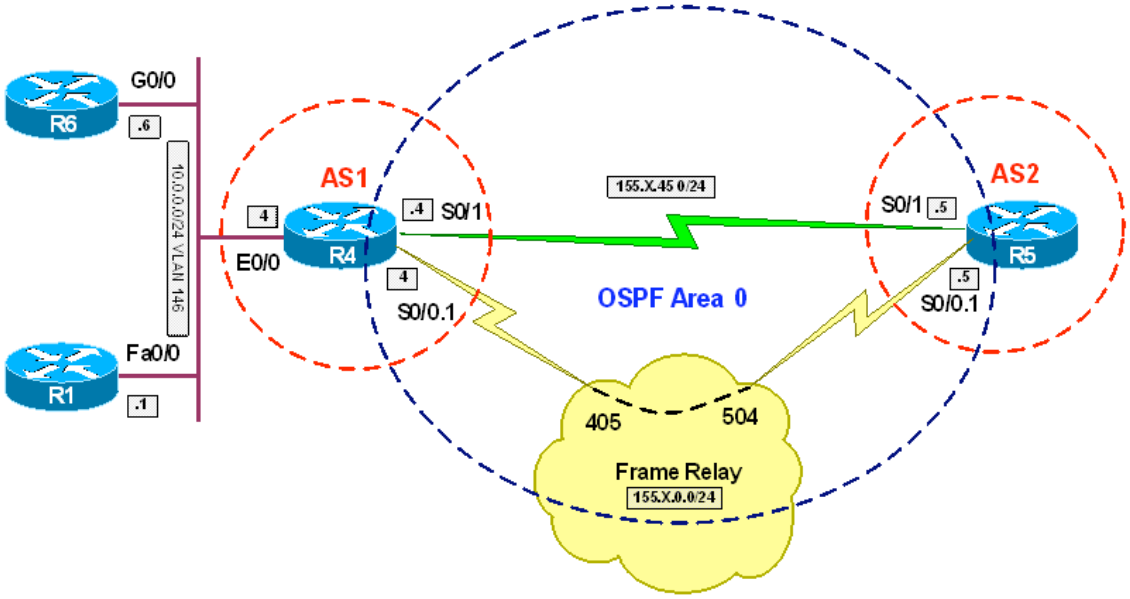
```
R1#debug ip icmp
ICMP packet debugging is on
```



```
R6#debug ip icmp
ICMP packet debugging is on

R5#ping 150.1.4.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 150.1.4.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/45/48 ms

R5#ping 150.1.4.6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 150.1.4.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/44/48 ms

R6#
*Nov 13 11:21:21.182: ICMP: echo reply sent, src 10.0.0.6, dst 155.1.45.5
*Nov 13 11:21:21.226: ICMP: echo reply sent, src 10.0.0.6, dst 155.1.45.5
*Nov 13 11:21:21.274: ICMP: echo reply sent, src 10.0.0.6, dst 155.1.45.5
*Nov 13 11:21:21.318: ICMP: echo reply sent, src 10.0.0.6, dst 155.1.45.5
*Nov 13 11:21:21.362: ICMP: echo reply sent, src 10.0.0.6, dst 155.1.45.5

R1#
*Mar  1 04:46:42.347: ICMP: echo reply sent, src 10.0.0.1, dst 155.1.45.5
*Mar  1 04:46:42.395: ICMP: echo reply sent, src 10.0.0.1, dst 155.1.45.5
*Mar  1 04:46:42.439: ICMP: echo reply sent, src 10.0.0.1, dst 155.1.45.5
*Mar  1 04:46:42.487: ICMP: echo reply sent, src 10.0.0.1, dst 155.1.45.5
*Mar  1 04:46:42.531: ICMP: echo reply sent, src 10.0.0.1, dst 155.1.45.5
```


Configuring Static PAT

Objective: Configure R4 to redirect connections to single IP on different ports to different inside addresses



Directions

- Configure routers as per the NAT scenario "Common Configuration"
- The goal is to redirect connection on R4 Loopback0 port 1023 to R1 port 23 and connection on R4 Loopback0 port 6023 to R6 port 23
- Configure interface Ethernet 0/0 as NAT inside and interfaces Serial 0/0.1 and Serial 0/1 as NAT outside
- Configure static PAT entry to map Loopback0 port 1023 to 10.0.0.1 port 23
- Configure static PAT entry to map Loopback0 port 6023 to 10.0.0.6 port 23

Final Configuration

R4:

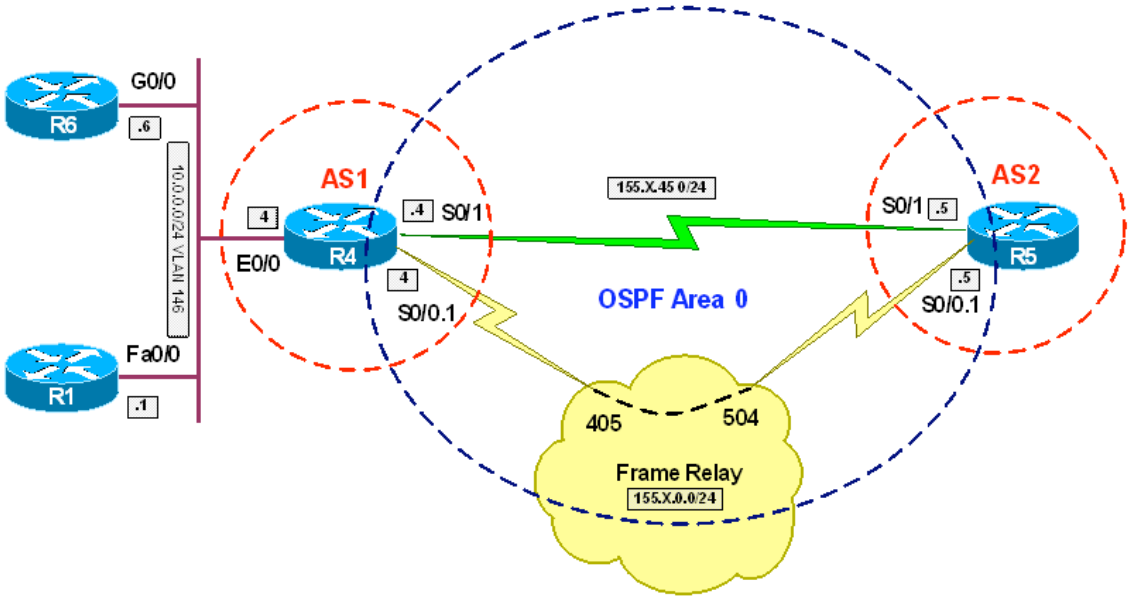
```
interface Ethernet 0/0
 ip nat inside
!
interface Serial 0/1
 ip nat outside
!
interface Serial 0/0.1
 ip nat outside
!
ip nat inside source static tcp 10.0.0.1 23 interf Loopback0 1023
ip nat inside source static tcp 10.0.0.6 23 interf Loopback0 6023
```


Verification

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#line vty 0 4
R1(config-line)#no login

R6#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R6(config)#line vty 0 4
R6(config-line)#no login

R5#telnet 150.1.4.4 1023
Trying 150.1.4.4, 1023 ... Open

R1>exit

[Connection to 150.1.4.4 closed by foreign host]

R5#telnet 150.1.4.4 6023
Trying 150.1.4.4, 6023 ... Open

R6>exit

[Connection to 150.1.4.4 closed by foreign host]
```


Configuring Static Policy NAT

Objective: Make inside addressee globally available via different outside interface for different global networks



Directions

- The goal it to make NAT translations accessible via different outside interfaces for different outside network configure on R5
- Configure routers as per the NAT scenario “Common Configuration”
- Create additional Loopback1 on R5 and assign it IP address 150.1.55.55/24 and advertise it into OSPF
- Configure interface Ethernet 0/0 as NAT inside and interfaces Serial 0/0.1 and Serial 0/1 as NAT outside on R4
- Create extended access-list TO_LOOBACK0 on R4 and permit traffic from 10.0.0.0/24 to Loopback0 of R5
- Create extended access-list TO_LOOBACK1 on R4 and permit traffic from 10.0.0.0/24 to Loopback1 of R5
- Create route-map DIVERT section 10: match ip address TO_LOOBACK0 with it and send interface Serial 0/0.1
- Create route-map DIVERT section 20; match ip address TO_LOOBACK1 with it and send interface Serial 0/1
- Create static mapping of R1’s IP to 150.X.4.1 and associate it with route-map DIVERT

Final Configuration

R4:

```
interface Ethernet 0/0
 ip nat inside
!
interface Serial 0/1
 ip nat outside
!
interface Serial 0/0.1
 ip nat outside
!
ip access-list extended TO_LOOPBACK0
 permit ip 10.0.0.0 0.0.0.255 150.1.5.0 0.0.0.255
!
ip access-list extended TO_LOOPBACK1
 permit ip 10.0.0.0 0.0.0.255 150.1.55.0 0.0.0.255
!
route-map DIVERT permit 10
 match ip address TO_LOOPBACK0
 set ip next-hop 155.1.0.5
!
route-map DIVERT permit 20
 match ip address TO_LOOPBACK1
 set ip next-hop 155.1.45.5
!
ip nat inside source static 10.0.0.1 150.1.4.1 route-map DIVERT
!
interface Loopback0
 ip ospf network point-to-point
```

R5:

```
interface Loopback1
 ip address 150.1.55.55 255.255.255.0
!
router ospf 1
 network 150.1.55.55 0.0.0.0 area 0
```

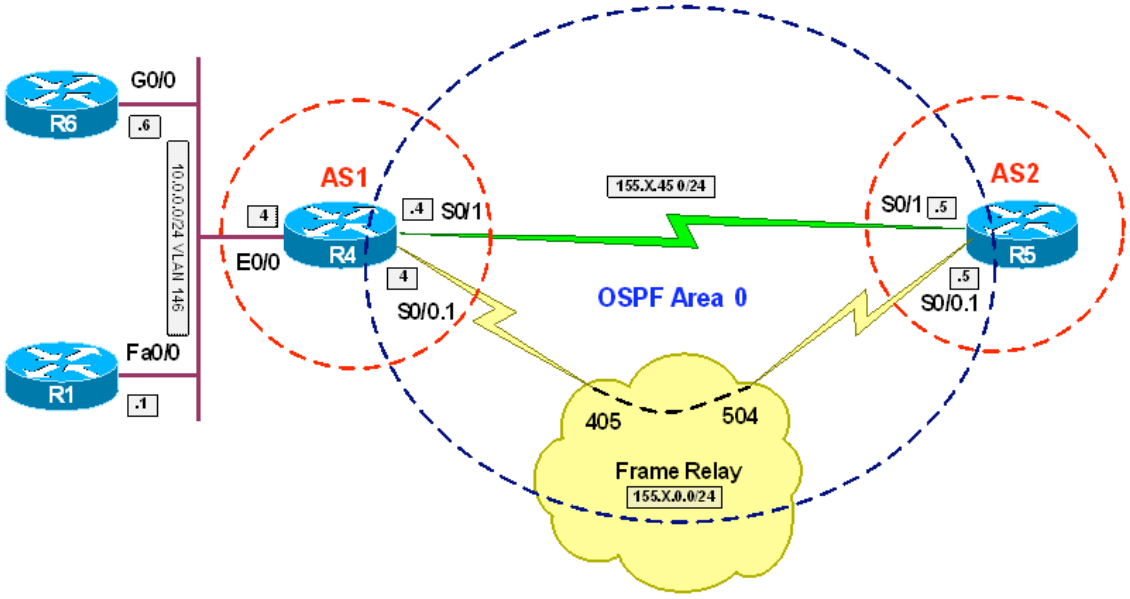
Verification

Verification in courier 10 with grey highlights and **commands in bold**

If a show command doesn't fit you can use courier 9

Overlapping Networks and Outside NAT

Objective: Enable connectivity between overlapping IP subnets



Directions

- Create additional Loopback10 on R5 and assign it IP address 10.0.0.5/24
- The idea is to NAT ovelapping networks on R4, and configure additonal static routes to new networks (post-NAT) on R4 and R5
- Configure routers as per the NAT scenario “Common Configuration”
- Configure interface Ethernet 0/0 as NAT inside and interfaces Serial 0/0.1 and Serial 0/1 as NAT outside on R4
- Configure static route on R4 to network 55.55.55.0/24 with next-hop of 150.1.5.5
- Configure static route on R5 to network 44.44.44.0/24 with next-hop of 150.1.4.4
- Configure inside static network NAT on R4 and map 10.0.0.0/24 to 44.44.44.0/24
- Configure outside static network NAT on R4 and map 10.0.0.0/24 to 55.55.55.0/24

Final Configuration

R4:

```
interface Ethernet 0/0
 ip nat inside
!
interface Serial 0/1
 ip nat outside
!
interface Serial 0/0.1
 ip nat outside
!
ip route 55.55.55.0 255.255.255.0 150.1.5.5
!
ip nat inside source static network 10.0.0.0 44.44.44.0 /24
ip nat outside source static network 10.0.0.0 55.55.55.0 /24
```

R5:

```
ip route 44.44.44.0 255.255.255.0 150.1.4.4
!
interface Loopback10
 ip address 10.0.0.5 255.255.255.0
```

Verification

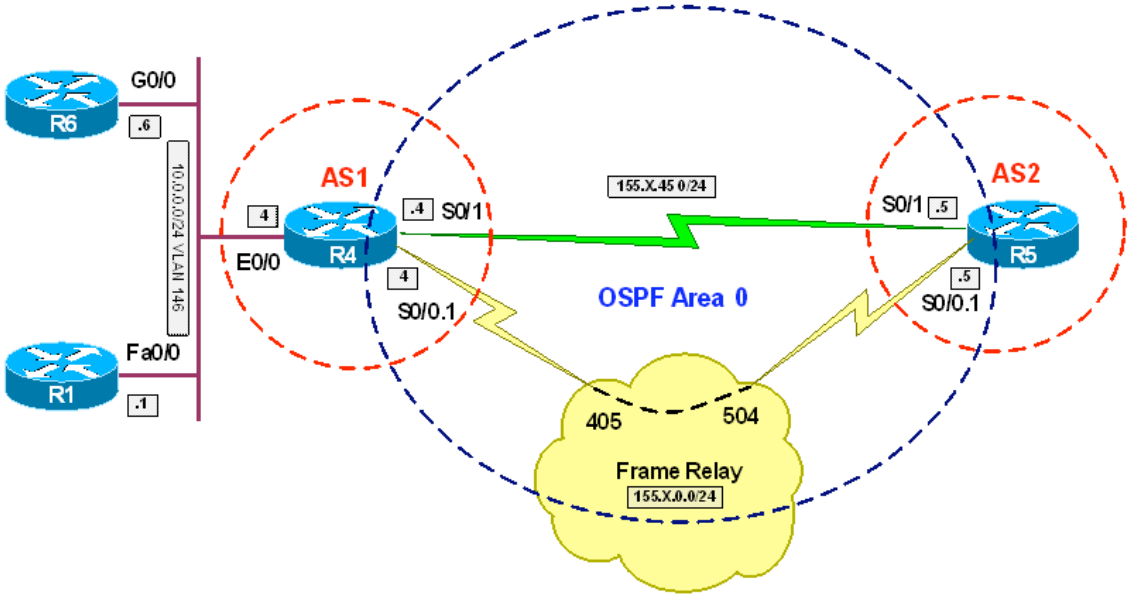
```
R4#deb ip nat detailed
IP NAT detailed debugging is on

R5#debug ip icmp
ICMP packet debugging is on

R1#ping 55.55.55.5 repeat 100

Type escape sequence to abort.
Sending 100, 100-byte ICMP Echos to 55.55.55.5, timeout is 2 seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 100 percent (100/100), round-trip min/avg/max = 32/33/64 ms

R4#
NAT*: i: icmp (10.0.0.1, 16) -> (55.55.55.5, 16) [358]
NAT*: s=10.0.0.1->44.44.44.1, d=55.55.55.5 [358]
NAT*: s=44.44.44.1, d=55.55.55.5->10.0.0.5 [358]
NAT*: o: icmp (10.0.0.5, 16) -> (44.44.44.1, 16) [358]
NAT*: s=10.0.0.5->55.55.55.5, d=44.44.44.1 [358]
NAT*: s=55.55.55.5, d=44.44.44.1->10.0.0.1 [358]
NAT*: i: icmp (10.0.0.1, 16) -> (55.55.55.5, 16) [359]
NAT*: s=10.0.0.1->44.44.44.1, d=55.55.55.5 [359]
NAT*: s=44.44.44.1, d=55.55.55.5->10.0.0.5 [359]
NAT*: o: icmp (10.0.0.5, 16) -> (44.44.44.1, 16) [359]
NAT*: s=10.0.0.5->55.55.55.5, d=44.44.44.1 [359]
NAT*: s=55.55.55.5, d=44.44.44.1->10.0.0.1 [359]
NAT*: i: icmp (10.0.0.1, 16) -> (55.55.55.5, 16) [360]
NAT*: s=10.0.0.1->44.44.44.1, d=55.55.55.5 [360]
NAT*: s=44.44.44.1, d=55.55.55.5->10.0.0.5 [360]
NAT*: o: icmp (10.0.0.5, 16) -> (44.44.44.1, 16) [360]

R5#
```



```
*Mar 18 22:04:41.426: ICMP: echo reply sent, src 10.0.0.5, dst 44.44.44.1
*Mar 18 22:04:41.458: ICMP: echo reply sent, src 10.0.0.5, dst 44.44.44.1
*Mar 18 22:04:41.494: ICMP: echo reply sent, src 10.0.0.5, dst 44.44.44.1
*Mar 18 22:04:41.530: ICMP: echo reply sent, src 10.0.0.5, dst 44.44.44.1
*Mar 18 22:04:41.562: ICMP: echo reply sent, src 10.0.0.5, dst 44.44.44.1
*Mar 18 22:04:41.602: ICMP: echo reply sent, src 10.0.0.5, dst 44.44.44.1
*Mar 18 22:04:41.634: ICMP: echo reply sent, src 10.0.0.5, dst 44.44.44.1
*Mar 18 22:04:41.670: ICMP: echo reply sent, src 10.0.0.5, dst 44.44.44.1
*Mar 18 22:04:41.706: ICMP: echo reply sent, src 10.0.0.5, dst 44.44.44.1
*Mar 18 22:04:41.738: ICMP: echo reply sent, src 10.0.0.5, dst 44.44.44.1

R4#show ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
--- ---                ---                55.55.55.5         10.0.0.5
--- ---                ---                55.55.55.0         10.0.0.0
icmp 44.44.44.1:18     10.0.0.1:18        55.55.55.5:18      10.0.0.5:18
--- 44.44.44.1         10.0.0.1           ---                ---
--- 44.44.44.0         10.0.0.0           ---                ---
```


Using Destination NAT for Load-Balancing

Objective: Configure router to perform load-balancing for incoming telnet connections



Directions

- Configure routers as per the NAT scenario "Common Configuration"
- Configure interface Ethernet 0/0 as NAT inside and interfaces Serial 0/0.1 and Serial 0/1 as NAT outside on R4
- Create extended access-list INBOUND_TELNET and match telnet traffic to R4's Loopback0
- Create rotary NAT pool SERVERS and add IP addresses of R1 and R6 to this pool
- Create outside destination NAT translation entry to redirect telnet requests on R4 Loopback0 to hosts in pool SERVERS

Final Configuration

R4:

```
interface Ethernet 0/0
 ip nat inside
!
interface Serial 0/1
 ip nat outside
!
interface Serial 0/0.1
 ip nat outside
!
ip nat pool SERVERS prefix-length 24 type rotary
 address 10.0.0.1 10.0.0.1
```



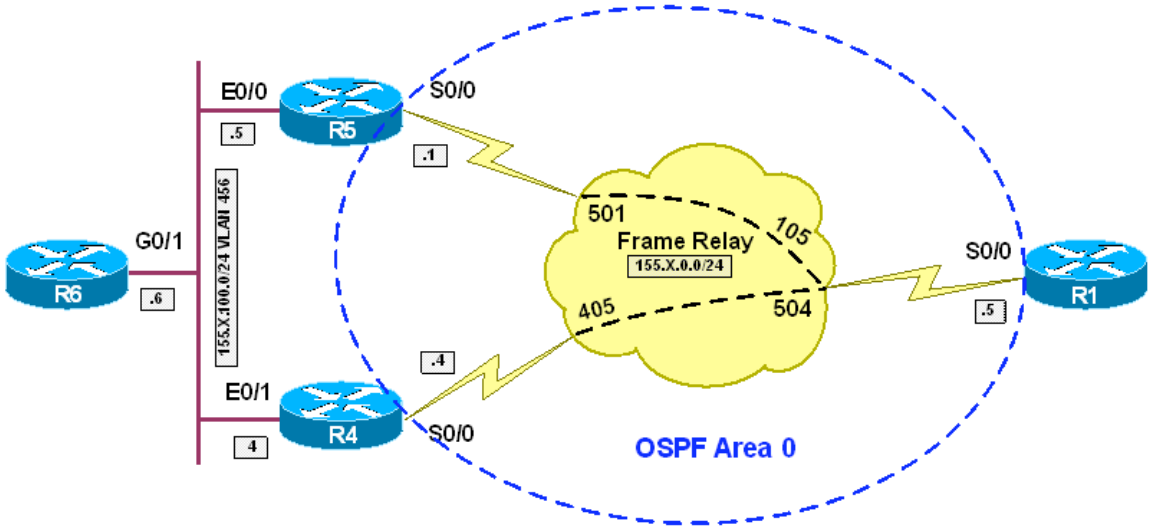
```
 address 10.0.0.6 10.0.0.6
!
ip access-list extended INBOUND_TELNET
 permit tcp any host 150.1.4.4 eq 23
!
ip nat inside destination list INBOUND_TELNET pool SERVERS
```

Verification

```
R4#show ip nat statistics
Total active translations: 0 (0 static, 0 dynamic; 0 extended)
Outside interfaces:
  Serial0/0.1, Serial0/1
Inside interfaces:
  Ethernet0/0
Hits: 0  Misses: 0
CEF Translated packets: 0, CEF Punted packets: 0
Expired translations: 0
Dynamic mappings:
-- Inside Destination
[Id: 1] access-list INBOUND_TELNET pool SERVERS refcount 0
 pool SERVERS: netmask 255.255.255.0
        start 10.0.0.1 end 10.0.0.1
        start 10.0.0.6 end 10.0.0.6
        type rotary, total addresses 2, allocated 0 (0%), misses 0
Queued Packets: 0

R5#telnet 150.1.4.4
Trying 150.1.4.4 ... Open

R1>exit

[Connection to 150.1.4.4 closed by foreign host]

R5#telnet 150.1.4.4
Trying 150.1.4.4 ... Open

R6>exit

[Connection to 150.1.4.4 closed by foreign host]

R5#

R4#show ip nat tra
Pro Inside global      Inside local       Outside local      Outside global
tcp 150.1.4.4:23       10.0.0.1:23        155.1.45.5:24192   155.1.45.5:24192
tcp 150.1.4.4:23       10.0.0.6:23        155.1.45.5:31287   155.1.45.5:31287
```


Stateful NAT with HSRP

Objective: Configure routers for stateful NAT using HSRP



Directions

- Create VLAN 456 on all switches involved in the scenario
- Configure the respective switchports for R4, R5 and R6 in VLAN 456
- Configure IP addressing on VLAN 456 interfaces as per diagram
- Configure IP addressing on Frame-Relay interfaces. Use only physical FR interfaces, and use static mappings
- Map broadcast to the hub router (R1) and from hub to spokes. Use DLCI numbers specified on diagram
- Configure FR mappings on R5 and R4 so that they can reach each other via R1
- Configure FR interfaces in OSPF Area 0. Use OSPF network type broadcast for this link
- Configure FR interface on R5 and R4 to have OSPF priority of zero, so that they never could become DR
- Create Loopback0 interfaces on R4, R5 with IP address 150.X.45.Y/24. This is the intended configuration – Loopback0 on both routers should have the same subnet
- Redistribute the connected subnets on R4 and R5 into OSPF. R5 should use metric 500 and R4 should use metric 400. This way, R1 will prefer R4 to reach VLAN456
- Configure HSRP on R4 and R5 Ethernet interfaces. Use HSRP group 1, name GROUP1 and virtual IP 155.X.100.254
- R4 should have priority 110 and R5 should have the default priority 100. Configure HSRP for preemption
- Configure HSRP on R4 to track FR interface state with decrement value of 20
- Configure static default route on R6 to point at HSRP IP 155.X.100.254

- Create NAT pool POOL on R4 and R5. This pool should cover address range 155.X.45.1-254
- Configure Ethernet interfaces on R4 and R5 to be NAT inside, and FR interfaces to be NAT outside
- Create access-list 100 on R1 and R4 and permit traffic from VLAN456 with it
- Create stateful NAT entry with ID 1 on R4 and R5, and associate it with HSRP group named GROUP1. Use Mapping-Id value 100 on both routers
- Create NAT rules on R4 and R5 to translate everything that matches access-list 100 using previously created NAT pool POOL. The redundancy for this pool should be provided by stateful NAT with Mapping ID 100

Final Configuration

SW1-SW4:
```
vlan 456
```

SW1:
```
interface Fa 0/5
 switchport host
 switchport access vlan 456
```

SW2:
```
interface Fa 0/6
 switchport host
 switchport access vlan 456
```

SW4:
```
interface Fa 0/4
 switchport host
 switchport access vlan 456
```

R1:
```
interface Serial 0/0
 encapsulation frame-relay
 no frame-relay inverse-arp
 ip address 155.1.0.1 255.255.255.0
 frame-relay map ip 155.1.0.5 105 broadcast
 frame-relay map ip 155.1.0.4 104 broadcast
 ip ospf network broadcast
 no shutdown
!
router ospf 1
 router-id 150.1.1.1
 network 155.1.0.1 0.0.0.0 area 0
```

R4:
```
interface Eth 0/1
 ip address 155.1.100.4 255.255.255.0
 standby 1 name GROUP1
 standby 1 ip 155.1.100.254
 standby 1 preempt
 standby 1 priority 110
 standby 1 track Serial 0/0 20
 no shutdown
!
interface Serial 0/0
```



```
 encapsulation frame-relay
 no frame-relay inverse-arp
 ip address 155.1.0.4 255.255.255.0
 frame-relay map ip 155.1.0.5 401 broadcast
 frame-relay map ip 155.1.0.1 401
 ip ospf priority 0
 ip ospf network broadcast
 no shutdown
!
interface Loopback0
 ip address 150.1.45.4 255.255.255.0
!
router ospf 1
 router-id 150.1.4.4
 redistribute connected subnets metric 400
 network 155.1.0.4 0.0.0.0 area 0
```

R5:

```
interface Ethernet 0/0
 ip address 155.1.100.5 255.255.255.0
 standby 1 name GROUP1
 standby 1 ip 155.1.100.254
 standby 1 preempt
 standby 1 priority 100
 no shut
!
interface Serial 0/0
 encapsulation frame-relay
 no frame-relay inverse-arp
 ip address 155.1.0.5 255.255.255.0
 frame-relay map ip 155.1.0.1 501 broadcast
 frame-relay map ip 155.1.0.4 501
 ip ospf network broadcast
 ip ospf priority 0
 no shutdown
!
interface Loopback0
 ip address 150.1.45.5 255.255.255.0
!
router ospf 1
 router-id 150.1.5.5
 network 155.1.0.5 0.0.0.0 area 0
 redistribute connected subnets metric 500
```

R6:

```
interface Gig 0/0
 ip address 155.1.100.6 255.255.255.0
 no shutdown
!
ip route 0.0.0.0 0.0.0.0 155.1.100.254
```

NAT Configuration

R5:

```
interface Eth 0/0
 ip nat inside
!
interface Serial 0/0
 ip nat outside
!
access-list 100 permit ip 155.1.100.0 0.0.0.255 any
!
```



```
ip nat pool POOL 150.1.45.1 150.1.45.254 prefix 24
!
ip nat stateful id 1
  redundancy GROUP1
    mapping-id 100
!
ip nat inside source list 100 pool POOL mapping-id 100
```

R4:

```
interface Ethernet 0/1
 ip nat inside
!
interface Serial 0/0
 ip nat outside
!
access-list 100 permit ip 155.1.100.0 0.0.0.255 any
!
ip nat pool POOL 150.1.45.1 150.1.45.254 prefix 24
!
ip nat stateful id 1
  redundancy GROUP1
    mapping-id 100
!
ip nat inside source list 100 pool POOL mapping-id 100
```

Verification

```
R4#show ip snat distributed

Stateful NAT Connected Peers

SNAT: Mode IP-REDUNDANCY :: ACTIVE
    : State READY
    : Local Address 155.1.100.4
    : Local NAT id 1
    : Peer Address 155.1.100.5
    : Peer NAT id 1
    : Mapping List 100

R5#show ip snat distributed

Stateful NAT Connected Peers

SNAT: Mode IP-REDUNDANCY :: STANDBY
    : State READY
    : Local Address 155.1.100.5
    : Local NAT id 1
    : Peer Address 155.1.100.4
    : Peer NAT id 1
    : Mapping List 100

R6#telnet 155.1.0.1
Trying 155.1.0.1 ... Open

R1>

R4#show ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
tcp 150.1.45.1:33932   155.1.100.6:33932  155.1.0.1:23       155.1.0.1:23
```



```
--- 150.1.45.1         155.1.100.6        ---                ---
R4#

R5#show ip snat peer 155.1.100.4

Show NAT Entries created by peer: 155.1.100.4

Pro Inside global      Inside local       Outside local      Outside global
--- 150.1.45.1         155.1.100.6        ---                ---
tcp 150.1.45.1:33932   155.1.100.6:33932  155.1.0.1:23       155.1.0.1:23

R5#show ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
tcp 150.1.45.1:33932   155.1.100.6:33932  155.1.0.1:23       155.1.0.1:23
--- 150.1.45.1         155.1.100.6        ---                ---

R4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#interface serial 0/0
R4(config-if)#shutdown

R5#show standby
Ethernet0/0 - Group 1
  State is Active
    2 state changes, last state change 00:00:26
  Virtual IP address is 155.1.100.254
  Active virtual MAC address is 0000.0c07.ac01
    Local virtual MAC address is 0000.0c07.ac01 (v1 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.024 secs
  Preemption enabled
  Active router is local
  Standby router is 155.1.100.4, priority 90 (expires in 8.020 sec)
  Priority 100 (default 100)
  IP redundancy name is "GROUP1" (cfgd)

R5#show ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
tcp 150.1.45.1:33932   155.1.100.6:33932  155.1.0.1:23       155.1.0.1:23
--- 150.1.45.1         155.1.100.6        ---                ---
R5#

Rack1AS>6
[Resuming connection 6 to r6 ... ]

R1>
R1>
R1>
```