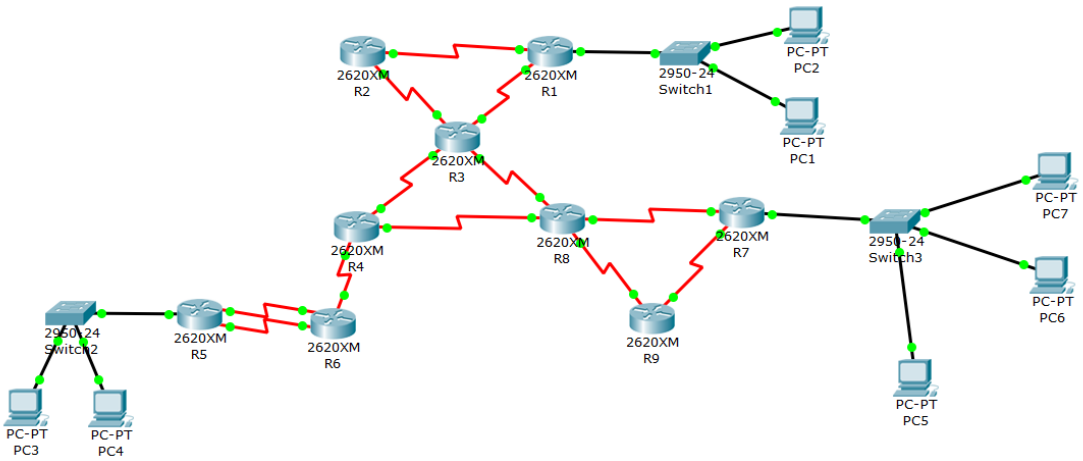
네트워크실험 프로젝트

1. 위의 그림과 같이 네트워크 토폴로지를 구성하라.

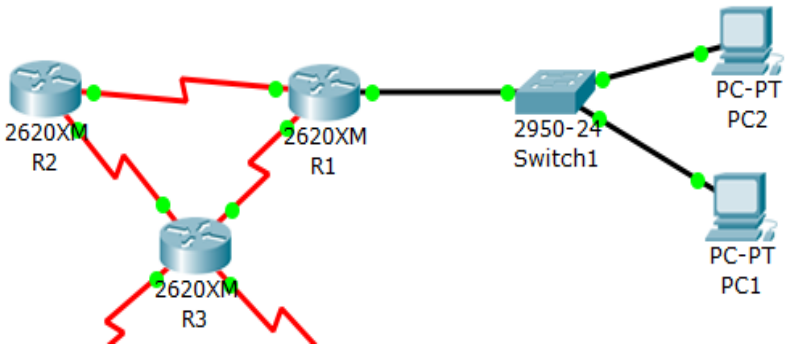
➔



2. 각 AS에서 다음과 같은 라우팅 프로토콜을 설정하고 동작을 확인하라.

2-1) AS 100에 RIP를 설정 후에 연결을 확인

➔



➔ R1 설정

```
Router>en
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#int fa 0/0
R1(config-if)#ip address 10.1.10.1 255.255.255.0
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state t
o up

R1(config-if)#exit
R1(config)#int se 0/0
R1(config-if)#ip address 10.1.20.1 255.255.255.0
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0, changed state to down
R1(config-if)#exit
R1(config)#int se 0/1
R1(config-if)#ip address 10.1.40.1 255.255.255.0
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1, changed state to down
R1(config-if)#exit
R1(config)#router rip
R1(config-router)#network 10.0.0.0
```

R2 설정

```
Router>en
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#int fa 0/0
R2(config-if)#ip address 10.1.10.1 255.255.255.0
R2(config-if)#no shutdown


%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
R2(config-if)#exit
R2(config)#int se 0/0
R2(config-if)#ip address 10.1.20.2 255.255.255.0
R2(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0, changed state to up

R2(config-if)#exit
R2(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed state to up

R2(config)#int se 0/2
R2(config-if)#ip address 10.1.30.1 255.255.255.0
R2(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/2, changed state to up

R2(config-if)#exit
R2(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/2, changed state to up

R2(config)#router rip
R2(config-router)#network 10.0.0.0
```

R3 설정

```
Router>en
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R3
R3(config)#int fa 0/0
R3(config-if)#ip address 10.1.10.1 255.255.255.0
R3(config-if)#no shutdown


%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
R3(config-if)#exit
R3(config)#int se 0/0
R3(config-if)#ip address 40.1.10.1 255.255.255.0
R3(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0, changed state to down
R3(config-if)#exit
R3(config)#int se 0/1
R3(config-if)#ip address 10.1.40.2 255.255.255.0
R3(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1, changed state to down
R3(config-if)#exit
R3(config)#int se 0/2
R3(config-if)#ip address 10.1.30.2 255.255.255.0
R3(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/2, changed state to up

R3(config-if)#exit
R3(config)#int se 0/3

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/2, changed state to up
R3(config-if)#ip address 40.1.20.1 255.255.255.0
R3(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/3, changed state to down
R3(config-if)#exit
R3(config)#router rip
R3(config-router)#network 10.0.0.0
```

➔ Router 확인

R1

```
     10.0.0.0/24 is subnetted, 4 subnets
C       10.1.10.0 is directly connected, FastEthernet0/0
C       10.1.20.0 is directly connected, Serial0/0
R       10.1.30.0 [120/1] via 10.1.20.2, 00:00:24, Serial0/0
                  [120/1] via 10.1.40.2, 00:00:01, Serial0/1
C       10.1.40.0 is directly connected, Serial0/1
```

R2

```
     10.0.0.0/24 is subnetted, 4 subnets
R       10.1.10.0 [120/1] via 10.1.20.1, 00:00:27, Serial0/0
C       10.1.20.0 is directly connected, Serial0/0
C       10.1.30.0 is directly connected, Serial0/2
R       10.1.40.0 [120/1] via 10.1.20.1, 00:00:27, Serial0/0
                  [120/1] via 10.1.30.2, 00:00:08, Serial0/2
```

R3

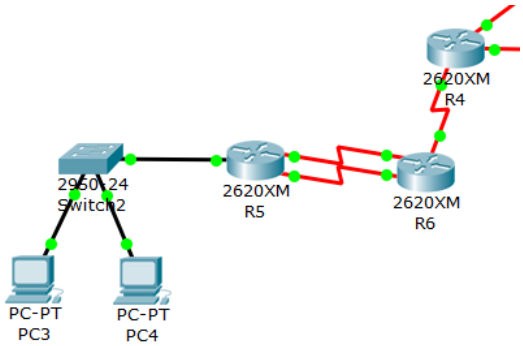
```
     10.0.0.0/24 is subnetted, 4 subnets
R       10.1.10.0 [120/1] via 10.1.40.1, 00:00:25, Serial0/1
R       10.1.20.0 [120/1] via 10.1.30.1, 00:00:03, Serial0/2
                  [120/1] via 10.1.40.1, 00:00:25, Serial0/1
C       10.1.30.0 is directly connected, Serial0/2
C       10.1.40.0 is directly connected, Serial0/1
```

➔ **Ping 테스트 (pc1 에서 R3로 ping 전송)**

```
PC>ping 10.1.30.2

Pinging 10.1.30.2 with 32 bytes of data:

Reply from 10.1.30.2: bytes=32 time=125ms TTL=254
Reply from 10.1.30.2: bytes=32 time=94ms TTL=254
Reply from 10.1.30.2: bytes=32 time=110ms TTL=254
Reply from 10.1.30.2: bytes=32 time=93ms TTL=254

Ping statistics for 10.1.30.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 93ms, Maximum = 125ms, Average = 105ms
```

2-2) AS 200에 EIGRP를 설정 후에 연결을 확인

➔



➔ **R4설정**

```
Router>en
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R4
R4(config)#int fa 0/0
R4(config-if)#ip address 20.1.10.1 255.255.255.0
R4(config-if)#no shutdown


%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
R4(config-if)#exit
R4(config)#int se 0/0
R4(config-if)#ip address 40.1.10.2 255.255.255.0
R4(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0, changed state to down
R4(config-if)#exit
R4(config)#int se 0/1
R4(config-if)#ip address 40.1.30.1 255.255.255.0
R4(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1, changed state to down
R4(config-if)#exit
R4(config)#int se 0/2
R4(config-if)#no ip address
R4(config-if)#shutdown
R4(config-if)#exit
R4(config)#int se 0/3
R4(config-if)#ip address 20.1.40.1 255.255.255.0
R4(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/3, changed state to up

R4(config-if)#exit
R4(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/3, changed state to up

R4(config-router)#router eigrp 200
R4(config-router)#network 20.1.40.0 0.0.0.255
R4(config-router)#
```

R5 설정

```
Router>en
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R5
R5(config)#int fa 0/0
R5(config-if)#ip address 20.1.10.1 255.255.255.0
R5(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state t
o up

R5(config-if)#exit
R5(config)#int se 0/0
R5(config-if)#bandwidth 64
R5(config-if)#ip address 20.1.20.2 255.255.255.0
R5(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0, changed state to down
R5(config-if)#exit
R5(config)#int se 0/1
R5(config-if)#bandwidth 128
R5(config-if)#ip address 20.1.30.2 255.255.255.0
R5(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1, changed state to down
R5(config-if)#exit
R5(config)#route eigrp 200
R5(config-router)#network 20.1.10.0 0.0.0.255
R5(config-router)#network 20.1.20.0 0.0.0.255
R5(config-router)#network 20.1.30.0 0.0.0.255
```

R6 설정

```
Router>en
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa 0/0
Router(config-if)#ip address 20.1.10.1 255.255.255.0
Router(config-if)#no shutdown


%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
Router(config-if)#exit
Router(config)#int se 0/0
Router(config-if)#bandwidth 64
Router(config-if)#ip address 20.1.20.1 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0, changed state to down
Router(config-if)#exit
Router(config)#int se 0/1
Router(config-if)#bandwidth 128
Router(config-if)#ip address 20.1.30.1 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1, changed state to down
Router(config-if)#exit
Router(config)#int se 0/2
Router(config-if)#no ip address
Router(config-if)#shutdown
Router(config-if)#exit
Router(config)#int se 0/3
Router(config-if)#ip address 20.1.40.2 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/3, changed state to down
Router(config-if)#exit
Router(config)#router eigrp 200
Router(config-router)#network 20.1.20.0 0.0.0.255
Router(config-router)#network 20.1.30.0 0.0.0.255
Router(config-router)#network 20.1.40.0 0.0.0.255
Router(config-router)#exit
Router(config)#hostname R6
```

➔ **Router 확인**

R4

```
     20.0.0.0/24 is subnetted, 4 subnets
D       20.1.10.0 [90/21026560] via 20.1.40.2, 00:03:28, Serial0/3
D       20.1.20.0 [90/41024000] via 20.1.40.2, 00:03:28, Serial0/3
D       20.1.30.0 [90/21024000] via 20.1.40.2, 00:03:28, Serial0/3
C       20.1.40.0 is directly connected, Serial0/3
```

R5

```
     20.0.0.0/24 is subnetted, 4 subnets
C       20.1.10.0 is directly connected, FastEthernet0/0
C       20.1.20.0 is directly connected, Serial0/0
C       20.1.30.0 is directly connected, Serial0/1
D       20.1.40.0 [90/21024000] via 20.1.30.1, 00:04:06, Serial0/1
```

R6

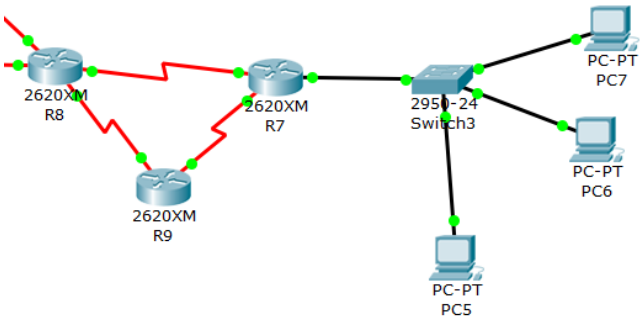
```
     20.0.0.0/24 is subnetted, 4 subnets
D       20.1.10.0 [90/20514560] via 20.1.30.2, 00:08:46, Serial0/1
C       20.1.20.0 is directly connected, Serial0/0
C       20.1.30.0 is directly connected, Serial0/1
C       20.1.40.0 is directly connected, Serial0/3
```

➔ **Ping 테스트 (pc3에서 R4로 핑 전송)**

```
PC>ping 20.1.40.1

Pinging 20.1.40.1 with 32 bytes of data:

Reply from 20.1.40.1: bytes=32 time=172ms TTL=253
Reply from 20.1.40.1: bytes=32 time=124ms TTL=253
Reply from 20.1.40.1: bytes=32 time=95ms TTL=253
Reply from 20.1.40.1: bytes=32 time=109ms TTL=253

Ping statistics for 20.1.40.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 95ms, Maximum = 172ms, Average = 125ms
```

2-3) AS 300에 OSPG를 설정 후에 연결을 확인

➔



➔ **R7 설정**

```
Router>en
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa 0/0
Router(config-if)#ip address 30.1.10.1 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state t
o up

Router(config-if)#exit
Router(config)#int se 0/0
Router(config-if)#ip address 30.1.20.2 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0, changed state to down
Router(config-if)#exit
Router(config)#int se 0/1
Router(config-if)#ip address 30.1.40.1 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1, changed state to down
Router(config-if)#exit
Router(config)#int se 0/2
Router(config-if)#no ip address
Router(config-if)#shutdown
Router(config-if)#exit
Router(config)#int se 0/3
Router(config-if)#no ip address
Router(config-if)#shutdown
Router(config-if)#exit
Router(config)#router ospf 300
Router(config-router)#network 30.1.10.0 0.0.0.255 area 0
Router(config-router)#network 30.1.11.0 0.0.0.255 area 0
Router(config-router)#network 30.1.20.0 0.0.0.255 area 0
Router(config-router)#network 30.1.40.0 0.0.0.255 area 0
```

R8 설정

```
Router>en
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa 0/0
Router(config-if)#ip address 30.1.10.1 255.255.255.0
Router(config-if)#no shutdown


%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to
Router(config-if)#exit
Router(config)#int se 0/0
Router(config-if)#ip address 30.1.20.1 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0, changed state to down
Router(config-if)#exit
Router(config)#int se 0/1
Router(config-if)#ip address 40.1.30.2 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1, changed state to down
Router(config-if)#int se 0/2
Router(config-if)#ip address 30.1.30.1 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/2, changed state to down
Router(config-if)#exit
Router(config)#int se 0/3
Router(config-if)#ip address 40.1.20.2 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/3, changed state to down
Router(config-if)#exit
Router(config)#router ospf 300
Router(config-router)#network 30.1.20.0 0.0.0.255 area 0
Router(config-router)#network 30.1.30.0 0.0.0.255 area 0
Router(config-router)#exit
Router(config)#hostname R8
R8(config)#
```

R9 설정

```
Router>EN
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa 0/0
Router(config-if)#ip address 30.1.10.1 255.255.255.0
Router(config-if)#no shutdown


%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
Router(config-if)#exit
Router(config)#int se 0/1
Router(config-if)#ip address 30.1.40.2 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1, changed state to down
Router(config-if)#exit
Router(config)#int se 0/2
Router(config-if)#ip address 30.1.30.2 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/2, changed state to down
Router(config-if)#exit
Router(config)#int se 0/3
Router(config-if)#no ip address
Router(config-if)#shutdown
Router(config-if)#exit
Router(config)#router ospf 300
Router(config-router)#network 30.1.30.0 0.0.0.255 area 0
Router(config-router)#network 30.1.40.0 0.0.0.255 area 0
Router(config-router)#exit
Router(config)#hostname R9
R9(config)#
```

➔ **Router 확인**

R7

```
     30.0.0.0/24 is subnetted, 4 subnets
C       30.1.10.0 is directly connected, FastEthernet0/0
C       30.1.20.0 is directly connected, Serial0/0
O       30.1.30.0 [110/128] via 30.1.20.1, 00:00:08, Serial0/0
                  [110/128] via 30.1.40.2, 00:00:08, Serial0/1
C       30.1.40.0 is directly connected, Serial0/1
```

R8

```
     30.0.0.0/24 is subnetted, 4 subnets
O       30.1.10.0 [110/65] via 30.1.20.2, 00:02:25, Serial0/0
C       30.1.20.0 is directly connected, Serial0/0
C       30.1.30.0 is directly connected, Serial0/2
O       30.1.40.0 [110/128] via 30.1.20.2, 00:00:44, Serial0/0
                  [110/128] via 30.1.30.2, 00:00:44, Serial0/2
```

R9

```
     30.0.0.0/24 is subnetted, 4 subnets
O       30.1.10.0 [110/65] via 30.1.40.1, 00:01:19, Serial0/1
O       30.1.20.0 [110/128] via 30.1.40.1, 00:01:19, Serial0/1
                  [110/128] via 30.1.30.1, 00:01:19, Serial0/2
C       30.1.30.0 is directly connected, Serial0/2
C       30.1.40.0 is directly connected, Serial0/1
```

➔ **Ping 테스트 (PC5 에서 R8로 핑 전송)**

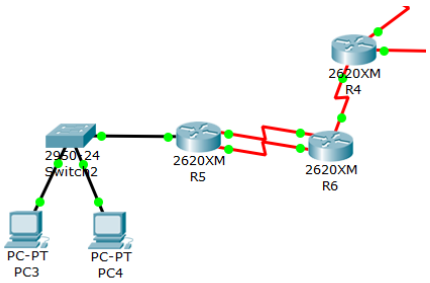
```
PC>ping 30.1.30.1

Pinging 30.1.30.1 with 32 bytes of data:

Reply from 30.1.30.1: bytes=32 time=156ms TTL=254
Reply from 30.1.30.1: bytes=32 time=93ms TTL=254
Reply from 30.1.30.1: bytes=32 time=51ms TTL=254
Reply from 30.1.30.1: bytes=32 time=88ms TTL=254

Ping statistics for 30.1.30.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 51ms, Maximum = 156ms, Average = 97ms
```

➔ **Ping 테스트 (PC6 에서 R8로 핑 전송)**

```
C:\>ping 30.1.20.1

Pinging 30.1.20.1 with 32 bytes of data:

Reply from 30.1.20.1: bytes=32 time=1ms TTL=254
Reply from 30.1.20.1: bytes=32 time<1ms TTL=253
Reply from 30.1.20.1: bytes=32 time=1ms TTL=254
Request timed out.

Ping statistics for 30.1.20.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

3. **AS 200의 EIGRP의 경우 Router 5와 Router 6이 2개의 경로로 연결되어 있다. 각 회선의 대역폭을 그림과 동일하게 수정하고 variance 명령어를 이용해 다중 경로 설정을 하라. 설정 후에 로드 밸런싱이 되는지 패킷 캡쳐를 통해 확인하라**

➔



➔ **R5 대역폭 설정**

```
R5(config)#int se 0/0
R5(config-if)#bandwidth 64
R5(config-if)#exit
R5(config)#int se 0/1
R5(config-if)#bandwidth 128
R5(config-if)#exit
```

R6 대역폭 설정

```
R6(config)#int se 0/0
R6(config-if)#bandwidth 64
R6(config-if)#exit
R6(config)#int se 0/1
R6(config-if)#bandwidth 128
R6(config-if)#exit
```

➔ **R5, R6 variance 조정 (variance = 3)**

```
R5(config)#router eigrp 200
R5(config-router)#variance 2
```

→

```
R5(config)#router eigrp 200
R5(config-router)#variance 3
R5(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 200: Neighbor 20.1.20.1 (Serial0/0)
is up: new adjacency

%DUAL-5-NBRCHANGE: IP-EIGRP 200: Neighbor 20.1.30.1 (Serial0/1)
is up: new adjacency
```

```
R6(config)#router eigrp 200
R6(config-router)#variance 2
```

→

```
R6(config)#router eigrp 200
R6(config-router)#variance 3
R6(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 200: Neighbor 20.1.40.1 (Serial0/3)
is up: new adjacency

%DUAL-5-NBRCHANGE: IP-EIGRP 200: Neighbor 20.1.20.2 (Serial0/0)
is up: new adjacency

%DUAL-5-NBRCHANGE: IP-EIGRP 200: Neighbor 20.1.30.2 (Serial0/1)
is up: new adjacency
```

➔ **다중경로 확인**

R5

```
D       20.1.40.0 [90/21024000] via 20.1.30.1, 00:02:01,
Serial0/1
                  [90/41024000] via 20.1.20.1, 00:02:01,
Serial0/0
```

R6

```
D       20.1.10.0 [90/20514560] via 20.1.30.2, 00:03:07,
Serial0/1
                  [90/40514560] via 20.1.20.2, 00:03:07,
Serial0/0
```

: EIGRP는 **bandwidth가 큰 경로로 패킷이 이동**하게 된다. 즉 bandwidth 128인 se 0/1쪽으로 이동하게 된다. **하지만 variance를 조정하여 다중경로로 패킷을 전송할 수 있는데 variance를 3으로 주어 최적 경로의 3배 범위 내에 있을 경우 로드밸런싱이 가능해 진다.** 즉, 64kbps의 3배인 192kbps 내의 경로는 모두 보낼 수 있으므로 **다중 경로로 전송**이 가능해집니다.

➔ **다중경로 테스트 (R5 에서 R6로 경로 테스트)**

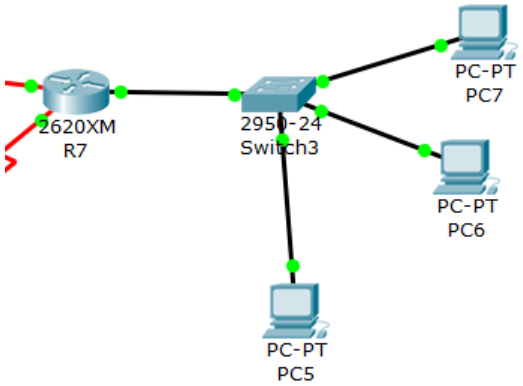
```
R5#traceroute 20.1.40.1
Type escape sequence to abort.
Tracing the route to 20.1.40.1

  1    20.1.30.1       2 msec    1 msec    1 msec
  2    20.1.40.1       5 msec    1 msec    4 msec
```

다중경로 테스트 (R6 에서 PC4로 경로 테스트)

```
R6#traceroute 20.1.10.3
Type escape sequence to abort.
Tracing the route to 20.1.10.3

  1    20.1.30.2       1 msec    0 msec    2 msec
  2    20.1.10.3       0 msec    0 msec    0 msec
```

4. Router 7 과 Switch 3에 VLAN을 그림과 같이 설정하고 동작을 확인하라.

➔



➔ **연결**

```
Switch>en
Switch#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname SW3
SW3(config)#int fa 0/2
SW3(config-if)#switchport access vlan 10
% Access VLAN does not exist. Creating vlan 10
SW3(config-if)#switchport mode access
SW3(config-if)#exit
SW3(config)#int fa 0/3
SW3(config-if)#switchport access vlan 20
% Access VLAN does not exist. Creating vlan 20
SW3(config-if)#switchport mode access
SW3(config-if)#exit
SW3(config)#int fa 0/4
SW3(config-if)#switchport access vlan 20
SW3(config-if)#switchport mode access
SW3(config-if)#exit
```

: 라우터 콘솔에서 vlan10과 vlan20을 생성하고 trunk포트를 설정해준다. 스위치 콘솔에서도 vlan10, vlan20 을 생성 한다.

➔ 상태 확인

```
SW3#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                Fa0/21, Fa0/22, Fa0/23, Fa0/24
10   VLAN0010                         active    Fa0/2
20   VLAN0020                         active    Fa0/3, Fa0/4
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
```

: Vlan 10은 fa0/2, Vlan20은 fa0/3, fa0/4에서 설정되고 활성화 상태 확인.

➔ 라우터의 서브 인터페이스 구성

```
Router(config)#int fa 0/0.20
Router(config-subif)#encapsulation dot1q 20
Router(config-subif)#ip address 30.1.12.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#int fa 0/0.10
Router(config-subif)#encapsulation dot1q 10
Router(config-subif)#ip address 30.1.11.1 255.255.255.0
Router(config-subif)#no shutdown
Router(config-subif)#exit
```

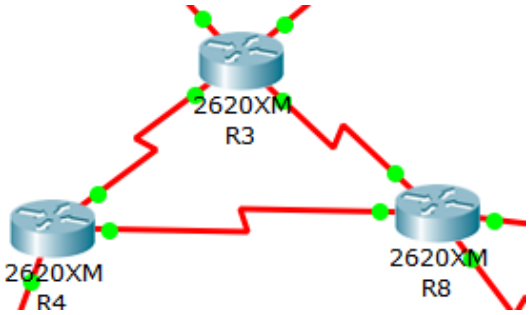
: 라우터는 fa0/0 포트로 두개의 서브 인터페이스 구성. (0/0.10 , 0/0.20)

➔ Ping 테스트 (pc5 에서 pc6, pc7로 핑 전송)

```
PC>ping 30.1.12.2

Pinging 30.1.12.2 with 32 bytes of data:

Reply from 30.1.12.2: bytes=32 time=21ms TTL=127
Reply from 30.1.12.2: bytes=32 time=18ms TTL=127
Reply from 30.1.12.2: bytes=32 time=10ms TTL=127
Reply from 30.1.12.2: bytes=32 time=21ms TTL=127

Ping statistics for 30.1.12.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 10ms, Maximum = 21ms, Average = 17ms

PC>ping 30.1.12.3

Pinging 30.1.12.3 with 32 bytes of data:

Reply from 30.1.12.3: bytes=32 time=21ms TTL=127
Reply from 30.1.12.3: bytes=32 time=14ms TTL=127
Reply from 30.1.12.3: bytes=32 time=18ms TTL=127
Reply from 30.1.12.3: bytes=32 time=24ms TTL=127

Ping statistics for 30.1.12.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 14ms, Maximum = 24ms, Average = 19ms
```

5. 각 AS마다 경계 라우터(R3, R4, R8)를 External BGP를 설정하고, 이렇게 External BGP로 학습한 경로를 AS 내부의 다른 라우터에도 전달하기 위해 Internal BGP를 설정한다. 그런데, 현재 패킷 트레이서에서는 Internal BGP를 지원하지 않으므로 다른 방법을 써야 한다. 본 프로젝트에서는 이것을 해결하기 위한 방법으로, AS 내부의 모든 라우터에게 Default Routing으로 각각의 경계 라우터의 IP를 입력하여, 라우팅 테이블에 없는 IP는 경계 라우터에서 처리하도록 하는 방식을 사용한다. (예: PC1에서 PC3으로 ping을 할 때 AS100과 AS200에 속해 있는 라우터를 거쳐 패킷이 전송되어야 한다.)

➔



➔ BGP 설정

R3 설정

```
R3>en
R3#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#router bgp 100
R3(config-router)#no synchronization
R3(config-router)#bgp log-neighbor-changes
R3(config-router)#network 10.1.10.0 mask 255.255.255.0
R3(config-router)#network 10.1.20.0 mask 255.255.255.0
R3(config-router)#network 10.1.30.0 mask 255.255.255.0
R3(config-router)#network 10.1.40.0 mask 255.255.255.0
R3(config-router)#neighbor 40.1.10.2 remote-as 200
R3(config-router)#neighbor 40.1.20.2 remote-as 300
R3(config-router)#%BGP-5-ADJCHANGE: neighbor 40.1.10.2 Up
%BGP-5-ADJCHANGE: neighbor 40.1.20.2 Up
```

R4 설정

```
R4>en
R4#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#router bgp 200
R4(config-router)#no synchronization
R4(config-router)#bgp log-neighbor-changes
R4(config-router)#network 20.1.10.0 mask 255.255.255.0
R4(config-router)#network 20.1.20.0 mask 255.255.255.0
R4(config-router)#network 20.1.30.0 mask 255.255.255.0
R4(config-router)#network 20.1.40.0 mask 255.255.255.0
R4(config-router)#neighbor 40.1.10.1 remote-as 100
R4(config-router)#%BGP-5-ADJCHANGE: neighbor 40.1.10.1 Up

R4(config-router)#neighbor 40.1.30.2 remote-as 300
R4(config-router)#%BGP-5-ADJCHANGE: neighbor 40.1.30.2 Up
```

R8 설정

```
R8>en
R8#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R8(config)#router bgp 300
R8(config-router)#no synchronization
R8(config-router)#bgp log-neighbor-changes
R8(config-router)#network 30.1.10.0 mask 255.255.255.0
R8(config-router)#network 30.1.11.0 mask 255.255.255.0
R8(config-router)#network 30.1.20.0 mask 255.255.255.0
R8(config-router)#network 30.1.30.0 mask 255.255.255.0
R8(config-router)#network 30.1.40.0 mask 255.255.255.0
R8(config-router)#network 30.1.12.0 mask 255.255.255.0
R8(config-router)#neighbor 40.1.20.1 remote-as 100
R8(config-router)#%BGP-5-ADJCHANGE: neighbor 40.1.20.1 Up

R8(config-router)#neighbor 40.1.30.1 remote-as 200
R8(config-router)#%BGP-5-ADJCHANGE: neighbor 40.1.30.1 Up
```

➔ BGP table 확인

R3

```
R3#show ip bgp
BGP table version is 25, local router ID is 40.1.20.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.20.0/24     0.0.0.0                  0      0      0 100 i
*> 10.1.30.0/24     0.0.0.0                  0      0 32768 i
*> 10.1.40.0/24     0.0.0.0                  0      0      0 100 i
*> 20.1.10.0/24     40.1.10.2                0      0      0 200 i
*                   40.1.20.2                0      0      0 300 200 i
*> 20.1.20.0/24     40.1.10.2                0      0      0 200 i
*                   40.1.20.2                0      0      0 300 200 i
*> 20.1.30.0/24     40.1.10.2                0      0      0 200 i
*                   40.1.20.2                0      0      0 300 200 i
*> 20.1.40.0/24     40.1.10.2                0      0      0 200 i
*                   40.1.20.2                0      0      0 300 200 i
*> 30.1.10.0/24     40.1.20.2                0      0      0 300 i
*                   40.1.10.2                0      0      0 200 300 i
*> 30.1.11.0/24     40.1.20.2                0      0      0 300 i
*                   40.1.10.2                0      0      0 200 300 i
*> 30.1.20.0/24     40.1.20.2                0      0      0 300 i
```

R4

```
R4#show ip bgp
BGP table version is 31, local router ID is 40.1.30.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.10.0/24     40.1.10.1                0      0      0 100 i
*                   40.1.30.2                0      0      0 300 100 i
*> 10.1.20.0/24     40.1.10.1                0      0      0 100 i
*                   40.1.30.2                0      0      0 300 100 i
*> 10.1.30.0/24     40.1.10.1                0      0      0 100 i
*                   40.1.30.2                0      0      0 300 100 i
*> 10.1.40.0/24     40.1.10.1                0      0      0 100 i
*                   40.1.30.2                0      0      0 300 100 i
*> 20.1.10.0/24     0.0.0.0                  0      0      0 200 i
*> 20.1.20.0/24     0.0.0.0                  0      0      0 200 i
*> 20.1.30.0/24     0.0.0.0                  0      0      0 200 i
*> 20.1.40.0/24     0.0.0.0                  0      0 32768 i
*  30.1.10.0/24     40.1.10.1                0      0      0 100 300 i
*>                  40.1.30.2                0      0      0 300 i
*  30.1.11.0/24     40.1.10.1                0      0      0 100 300 i
*>                  40.1.30.2                0      0      0 300 i
```

R8

```
R3#show ip bgp
BGP table version is 25, local router ID is 40.1.20.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.20.0/24     0.0.0.0                  0      0      0 100 i
*> 10.1.30.0/24     0.0.0.0                  0      0 32768 i
*> 10.1.40.0/24     0.0.0.0                  0      0      0 100 i
*> 20.1.10.0/24     40.1.10.2                0      0      0 200 i
*                   40.1.20.2                0      0      0 300 200 i
*> 20.1.20.0/24     40.1.10.2                0      0      0 200 i
*                   40.1.20.2                0      0      0 300 200 i
*> 20.1.30.0/24     40.1.10.2                0      0      0 200 i
*                   40.1.20.2                0      0      0 300 200 i
*> 20.1.40.0/24     40.1.10.2                0      0      0 200 i
*                   40.1.20.2                0      0      0 300 200 i
*> 30.1.10.0/24     40.1.20.2                0      0      0 300 i
*                   40.1.10.2                0      0      0 200 300 i
*> 30.1.11.0/24     40.1.20.2                0      0      0 300 i
*                   40.1.10.2                0      0      0 200 300 i
*> 30.1.20.0/24     40.1.20.2                0      0      0 300 i
```

➔ External BGP 연결 확인(R3에서 R4로 핑 전송)

```
R3#ping 40.1.10.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 40.1.10.2, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max =
1/4/15 ms
```

➔ Default Routing 설정 및 확인

R1

```
R1>en
R1#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ip route 0.0.0.0 0.0.0.0 10.1.20.2
R1(config)#ip route 0.0.0.0 0.0.0.0 10.1.40.2
S*    0.0.0.0/0 [1/0] via 10.1.20.2
                [1/0] via 10.1.40.2
```

R2

```
R2>en
R2#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#ip route 0.0.0.0 0.0.0.0 10.1.20.1
R2(config)#ip route 0.0.0.0 0.0.0.0 10.1.30.2
S*    0.0.0.0/0 [1/0] via 10.1.20.1
                [1/0] via 10.1.30.2
```

R3

```
R3#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#ip route 0.0.0.0 0.0.0.0 10.1.40.1
R3(config)#ip route 0.0.0.0 0.0.0.0 10.1.30.1
S*    0.0.0.0/0 [1/0] via 10.1.40.1
                [1/0] via 10.1.30.1
```

R4

```
R4#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R4(config)#ip route 0.0.0.0 0.0.0.0 20.1.40.2
S*    0.0.0.0/0 [1/0] via 20.1.40.2
```

R5

```
R5>en
R5#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R5(config)#ip route 0.0.0.0 0.0.0.0 20.1.20.1
R5(config)#ip route 0.0.0.0 0.0.0.0 20.1.30.1
S*    0.0.0.0/0 [1/0] via 20.1.20.1
                [1/0] via 20.1.30.1
```

R6

```
R6>en
R6#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R6(config)#ip route 0.0.0.0 0.0.0.0 20.1.40.1
R6(config)#ip route 0.0.0.0 0.0.0.0 20.1.30.2
R6(config)#ip route 0.0.0.0 0.0.0.0 20.1.20.2
S*    0.0.0.0/0 [1/0] via 20.1.40.1
                [1/0] via 20.1.30.2
                [1/0] via 20.1.20.2
```

R7

```
R7#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R7(config)#ip route 0.0.0.0 0.0.0.0 30.1.20.1
R7(config)#ip route 0.0.0.0 0.0.0.0 30.1.30.1
S*    0.0.0.0/0 [1/0] via 30.1.20.1
                [1/0] via 30.1.30.1
```

R8

```
R8#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R8(config)#ip route 0.0.0.0 0.0.0.0 30.1.20.2
R8(config)#ip route 0.0.0.0 0.0.0.0 30.1.30.2
S*    0.0.0.0/0 [1/0] via 30.1.20.2
                [1/0] via 30.1.30.2
```

R9

```
R9>en
R9#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R9(config)#ip route 0.0.0.0 0.0.0.0 30.1.30.1
R9(config)#ip route 0.0.0.0 0.0.0.0 30.1.40.1
S*    0.0.0.0/0 [1/0] via 30.1.30.1
                [1/0] via 30.1.40.1
```

➔ **Ping 테스트 (PC1에서 PC3로 핑 전송)**

```
C:\>ping 20.1.10.2

Pinging 20.1.10.2 with 32 bytes of data:

Reply from 20.1.10.2: bytes=32 time=13ms TTL=123
Request timed out.
Request timed out.
Reply from 20.1.10.2: bytes=32 time=13ms TTL=121

Ping statistics for 20.1.10.2:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 13ms, Maximum = 13ms, Average = 13ms
```

6. Router 1에 Access Control List를 아래와 같이 설정하고 동작을 확인하라.

6-1) 20.1.10.0/24 네트워크가 10.1.10.0/24 네트워크로 접근하는 것을 차단

➔ **설정**

```
R1>en
R1#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#access-list 10 deny 20.1.10.0 0.0.0.255
R1(config)#access-list 10 permit any
R1(config)#int se 0/0
R1(config-if)#ip access-group 10 in
R1(config-if)#exit
R1(config)#int se 0/1
R1(config-if)#ip access-group 10 in
```

: Access-list 10번 목록을 사용한다. 20.1.10.0의 네트워크 접근은 거부하지만 나머지 다른 경로의 네트워크는 허용한다.

➔ **차단 확인 (PC3에서 PC1로 핑 전송)**

```
C:\>ping 10.1.10.2

Pinging 10.1.10.2 with 32 bytes of data:

Reply from 10.1.40.1: Destination host unreachable.
Reply from 10.1.20.1: Destination host unreachable.
Reply from 10.1.40.1: Destination host unreachable.
Request timed out.

Ping statistics for 10.1.10.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

6-2) 30.1.10.0/24 네트워크가 PC5만 10.1.10.0/24 네트워크로 접근하는 것을 허용

➔ **설정**

```
R1(config)#access-list 10 permit 30.1.11.2 0.0.0.255
R1(config)#access-list 10 deny any
R1(config)#int se 0/0
R1(config-if)#ip access-group 10 in
R1(config-if)#exit
R1(config)#int se 0/1
R1(config-if)#ip access-group 10 in
```

: Access-list 10번 목록을 사용한다. PC5의 네트워크 주소인 30.1.11.2 만 접근을 허용하지만 나머지 다른 경로의 네트워크는 거부한다.

➔ **허용 확인 (PC5 에서 PC1로 핑 전송)**

```
C:\>ping 10.1.20.2

Pinging 10.1.20.2 with 32 bytes of data:

Reply from 10.1.20.2: bytes=32 time=14ms TTL=252
Reply from 10.1.20.2: bytes=32 time=11ms TTL=251
Reply from 10.1.20.2: bytes=32 time=14ms TTL=252
Request timed out.

Ping statistics for 10.1.20.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 11ms, Maximum = 14ms, Average = 13ms
```

6-3) 10.1.10.0/24 네트워크의 PC2에서 외부로 나가는 패킷을 차단

➔ **설정**

```
R1(config-if)#ip access-group 10 in
R1(config-if)#exit
R1(config)#int se 0/1
R1(config-if)#ip access-group 10 in
R1(config-if)#exit
R1(config)#access-list 10 deny 10.1.10.3 0.0.0.255
R1(config)#access-list 10 permit any
R1(config)#int fa 0/0
R1(config-if)#ip access-group 10 in
```

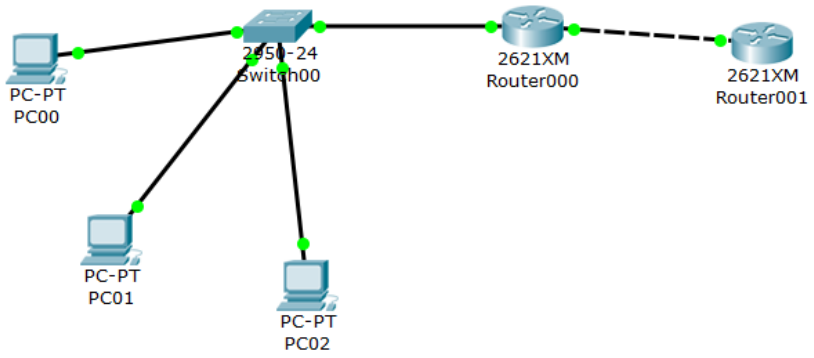
: Access-list 10번 목록을 사용한다. PC2의 네트워크 주소인 10.1.10.3 에서 패킷 전송을 거부하지만 나머지 다른 경로의 네트워크는 허용한다.

➔ **거부 확인 (PC2에서 PC3로 핑 테스트)**

```
C:\>ping 20.1.10.2

Pinging 20.1.10.2 with 32 bytes of data:

Reply from 10.1.10.1: Destination host unreachable.
Reply from 10.1.10.1: Destination host unreachable.
Reply from 10.1.10.1: Destination host unreachable.
Reply from 10.1.10.1: Destination host unreachable.

Ping statistics for 20.1.10.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

7. NAT 실습

➔



➔ **NAT : 사설 IP를 공인 IP로 변환하여 외부 네트워크와 통신하는 것 이다.**

➔ 라우터 및 NAT 설정

R0

```
Router>en
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa 0/0
Router(config-if)#ip address 172.69.232.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#int fa 0/1
Router(config-if)#ip address 10.1.1.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
```

R0 NAT 설정

```
Router(config-if)#ip nat pool bban 172.69.232.222
172.69.232.222 netmask 255.255.255.0
Router(config)#access-list 10 permit 10.1.1.0 0.0.0.255
Router(config)#ip nat inside source list 10 pool bban
Router(config)#int fa 0/1
Router(config-if)#ip nat inside
Router(config-if)#exit
Router(config)#int fa 0/0
Router(config-if)#ip nat outside
Router(config-if)#exit
```

: 동적 NAT 설정, 그룹 이름 : bban

글로벌 address : 172.69.232.209 ~ 172.69.232.222

Access-list 10 이용하여 주소범위 지정 및 pool 이름을 매치

int fa0/1이 내부 네트워크로 연결된 포트, int fa0/0이 외부 네트워크로 연결된 포트

R1

```
Router>en
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa 0/0
Router(config-if)#ip address 172.69.232.2 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

Router(config-if)#exit
```

➔ **Pc0에서 Router로의 연결 확인**

```
C:\>ping 172.69.232.2

Pinging 172.69.232.2 with 32 bytes of data:

Request timed out.
Request timed out.
Reply from 172.69.232.2: bytes=32 time=10ms TTL=254
Reply from 172.69.232.2: bytes=32 time=10ms TTL=254

Ping statistics for 172.69.232.2:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 10ms, Maximum = 10ms, Average = 10ms
```

: 동적 NAT 설정 전

```
C:\>ping 172.69.232.2

Pinging 172.69.232.2 with 32 bytes of data:

Reply from 172.69.232.2: bytes=32 time=1ms TTL=254
Reply from 172.69.232.2: bytes=32 time=15ms TTL=254
Reply from 172.69.232.2: bytes=32 time<1ms TTL=254
Reply from 172.69.232.2: bytes=32 time<1ms TTL=254

Ping statistics for 172.69.232.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 15ms, Average = 4ms
```

: 동적 NAT 설정 후

➔ **NAT 설정 확인**

```
Router>en
Router#show ip nat translations
Pro  Inside global     Inside local       Outside local
Outside global
icmp 172.69.232.222:10 10.1.1.4:10        172.69.232.2:10
172.69.232.2:10
icmp 172.69.232.222:11 10.1.1.4:11        172.69.232.2:11
172.69.232.2:11
icmp 172.69.232.222:12 10.1.1.4:12        172.69.232.2:12
172.69.232.2:12
icmp 172.69.232.222:9  10.1.1.4:9         172.69.232.2:9
172.69.232.2:9
```

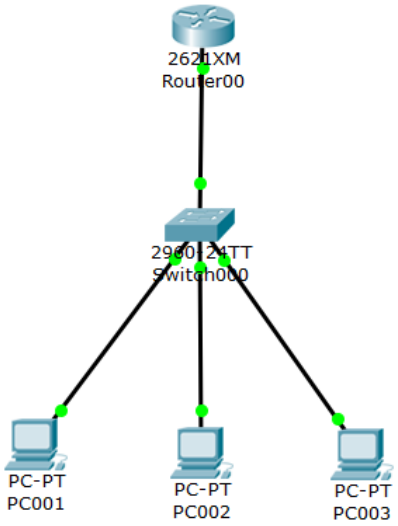
: PC들이 추가되었을 때 나가는 IP주소 변경 확인

➔ **내부 PC0에서 외부 router1로 핑 테스트**

```
Router#debug ip nat
IP NAT debugging is on
Router#
NAT: s=10.1.1.2->172.69.232.222, d=172.69.232.2 [9]

NAT*: s=172.69.232.2, d=172.69.232.222->10.1.1.2 [16]

NAT: s=10.1.1.2->172.69.232.222, d=172.69.232.2 [10]

NAT*: s=172.69.232.2, d=172.69.232.222->10.1.1.2 [17]

NAT: s=10.1.1.2->172.69.232.222, d=172.69.232.2 [11]

NAT*: s=172.69.232.2, d=172.69.232.222->10.1.1.2 [18]

NAT: s=10.1.1.2->172.69.232.222, d=172.69.232.2 [12]

NAT*: s=172.69.232.2, d=172.69.232.222->10.1.1.2 [19]
```

8. DHCP 실습

➔

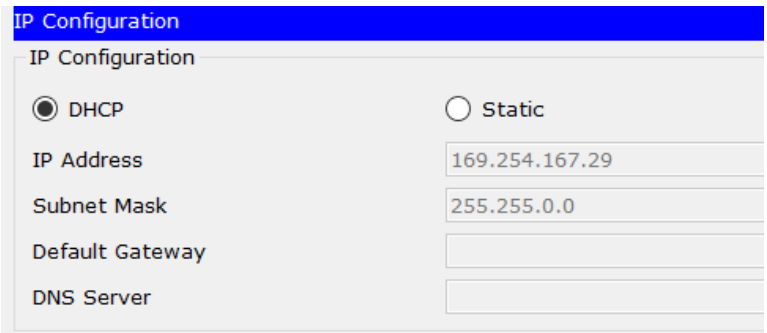


➔ **R0 설정**

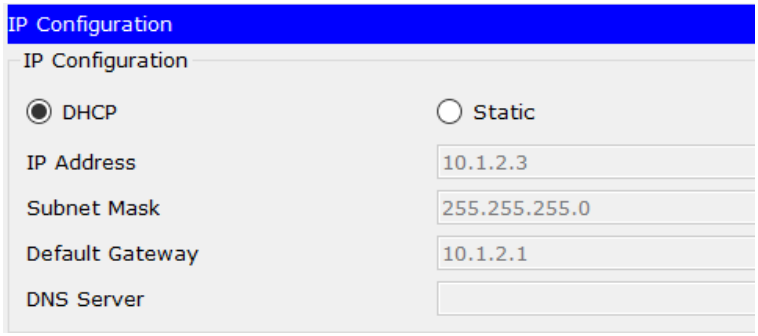
```
Router>en
Router#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa 0/0
Router(config-if)#ip address 10.1.2.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#ip dhcp excluded-address 10.1.2.1
Router(config)#ip dhcp pool DHCP01
Router(dhcp-config)#default-router 10.1.2.1
Router(dhcp-config)#network 10.1.2.1 255.255.255.0
Router(dhcp-config)#exit
```

➔ **각 PC 확인**

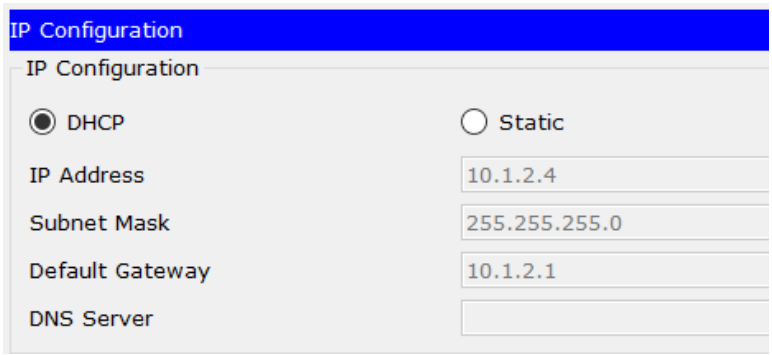
PC0



PC1


IP Configuration
IP Configuration
DHCP
Static
IP Address
10.1.2.3
Subnet Mask
255.255.255.0
Default Gateway
10.1.2.1
DNS Server

PC2


IP Configuration
IP Configuration
DHCP
Static
IP Address
10.1.2.4
Subnet Mask
255.255.255.0
Default Gateway
10.1.2.1
DNS Server