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"VIDYALANKAR SCHOOL OF INFORMATION TECHNOLOGY, WADALA"

AFFILIATED TO UNIVERSITY OF MUMBAI

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CERTIFICATE

This is to certify that, **Santosh Parse** of M.Sc. (I.T.) Semester - II with Application ID **1 1 3 3 6 6** has completed the practical of **'Modern Networking'** in this college during the academic year **2022 - 2023**.

Subject In-Charge **Coordinator -In-Charge**

Prof. Mithila Satham

Examined By:

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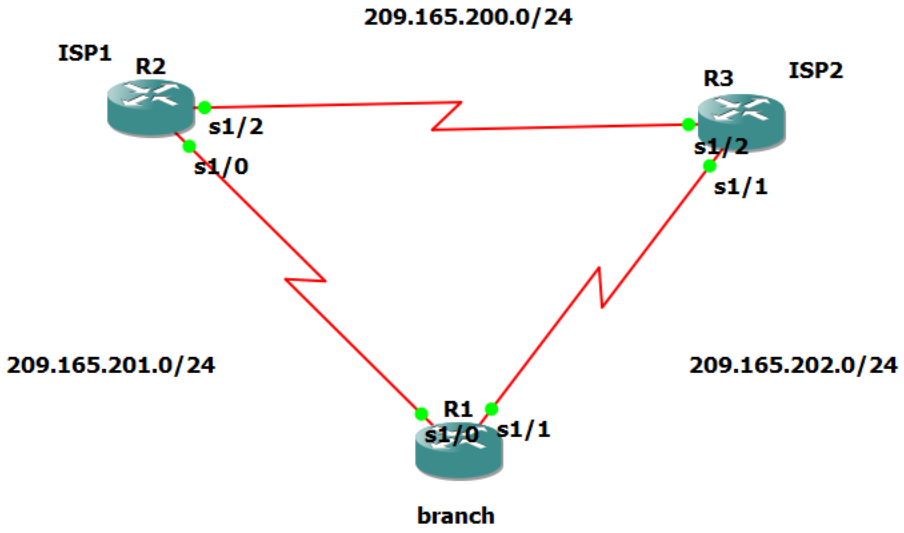
Practical No: 1

Aim: Configure IP SLA tracking and path control topology.

Topology:



Steps/Commands:

Step1: Configure routers and connect serial links.

R1# conf t
(config) int s1/0
(config-if) ip add 209.165.201.1 255.255.255.0
no sh
int s1/1
ip add 209.165.202.1 255.255.255.0
no sh
int lo0
ip add 192.168.1.1 255.255.255.0
do sh ip int br | include up

R2# conf t
(config) int s1/0
(config-if) ip add 209.165.201.2 255.255.255.0
no sh
int s1/2
ip add 209.165.200.2 255.255.255.0
no sh
do sh ip int br | include up

R3# conf t
(config) int s1/1
(config-if) ip add 209.165.202.3 255.255.255.0
no sh
int s1/2
ip add 209.165.200.3 255.255.255.0
no sh
do sh ip int br | include up

Step 2: Configure static routing in branch router and dynamic routing using EIGRP (Enhanced Interior Gateway Routing Protocol) on ISP1 & ISP2 router.
(To not sum common IP address headers, use no auto-summary)

R1> exit
(config) ip route 0.0.0.0 0.0.0.0 209.165.201.0

R2> exit
(config) router eigrp 1
network 209.165.200.0 0.0.0.255
network 209.165.201.0 0.0.0.255
no auto-summary

R3> exit
(config) router eigrp 1
network 209.165.202.0 0.0.0.255
network 209.165.200.0 0.0.0.255
no auto-summary

R2> exit
ip route 192.168.1.0 255.255.255.0 209.165.201.1

R3> exit
ip route 192.168.1.0 255.255.255.0 209.165.202.1

R1> exit
do ping 209.165.200.3

R3> (config)
do ping 209.165.201.1

R2> do ping 192.168.1.1
R3> do ping 192.168.1.1

Task3: Configure IP SLA probes at branch routers.

R3> hostname isp2
R2> hostname isp1
R1> hostname branch
branch> (config)
ip sla 11
icmp-echo 209.165.201.2
frequency 10
exit

ip sla schedule 11 life forever start-time now
do sh ip sla configuration 11
do sh ip sla statistics

ON ALL ROUTERS (to save config):
do wr

Output:

```
R1(config)#do ping 209.165.200.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 209.165.200.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/65/76 ms
R1(config)#do ping 192.168.1.1
```

```
R2(config)#do ping 192.168.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/31/40 ms
R2(config)#
```

```
R3(config)#do ping 209.165.201.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 209.165.201.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/62/80 ms
R3(config)#do ping 192.168.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/31/40 ms
R3(config)#
```

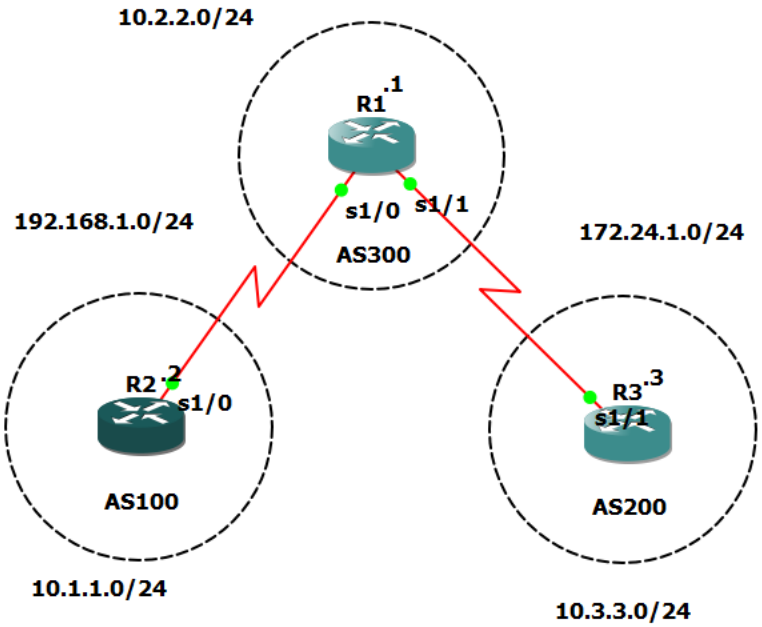
```
branch(config)#do sh ip sla configuration 11
IP SLAs, Infrastructure Engine-II.
Entry number: 11
Owner:
Tag:
Type of operation to perform: icmp-echo
Target address/Source address: 209.165.201.2/0.0.0.0
Operation timeout (milliseconds): 5000
Type Of Service parameters: 0x0
Vrf Name:
Request size (ARR data portion): 28
Verify data: No
Schedule:
   Operation frequency (seconds): 10  (not considered if randomly scheduled)
   Next Scheduled Start Time: Start Time already passed
   Group Scheduled : FALSE
   Randomly Scheduled : FALSE
   Life (seconds): Forever
   Entry Ageout (seconds): never
   Recurring (Starting Everyday): FALSE
   Status of entry (SNMP RowStatus): Active
Threshold (milliseconds): 5000
Distribution Statistics:
   Number of statistic hours kept: 2
```

```
branch(config)#do sh ip sla statistics

Round Trip Time (RTT) for       Index 11
        Latest RTT: 44 milliseconds
Latest operation start time: *00:15:54.815 UTC Fri Mar 1 2002
Latest operation return code: OK
Number of successes: 8
Number of failures: 0
Operation time to live: Forever
```

Practical No: 2

Aim: Implementation of BGP using AS_path attribute.

Topology:



Steps/Commands:

Step1: Configuration

R2# conf t
int s1/0
ip add 192.168.1.2 255.255.255.0
no sh

R1# conf t
int s1/0
ip add 192.168.1.1 255.255.255.0
no sh
int s1/1
ip add 172.24.1.1 255.255.255.0
no sh

R3# conf t
int s1/1
ip add 172.24.1.3 255.255.255.0
no sh

Step2: Loopback

R2# int lo0
ip add 10.1.1.1 255.255.255.0

R1# int lo0
ip add 10.2.2.2 255.255.255.0

R3# int lo0
ip add 10.3.3.3 255.255.255.0

Step3: Configure as-bgp

R2# router bgp 100
neighbor 192.168.1.1 remote-as 300
network 10.1.1.0 mask 255.255.255.0

R1# router bgp 300
neighbor 192.168.1.2 remote-as 100
neighbor 172.24.1.3 remote-as 200
network 10.2.2.0 mask 255.255.255.0

R3# router bgp 200
neighbor 172.24.1.1 remote-as 300
network 10.3.3.0 mask 255.255.255.0

ON ALL ROUTERS:

do sh ip route

Step4: ping routers

R1#do ping 10.3.3.3 source lo0

R3#do ping 10.2.2.2 source lo0

Output:

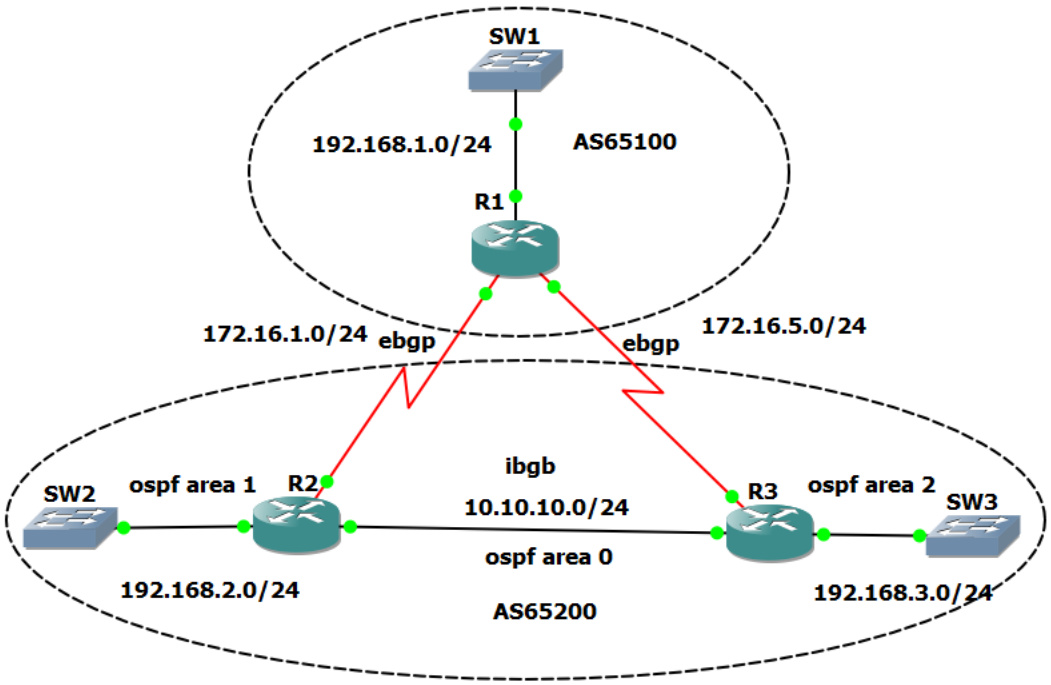
```
R3(config)#do ping 10.2.2.2 source lo0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.2.2.2, timeout is 2 seconds:
Packet sent with a source address of 10.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/30/32 ms
R3(config)#
```

```
R2(config-router)#exit
R2(config)#do ping 10.3.3.3 source lo0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 10.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/59/68 ms
R2(config)#
```

Practical No: 3

Aim: Configuring IBGP and EBGP sessions.

Topology:



Steps/Commands:

Step 1: Drag and drop R1, R2 and R3; take 3 Ethernet switch and perform configurations on given routers.

R1# conf t
int f0/1
ip add 192.168.1.1 255.255.255.0
no sh
int s1/0
ip add 172.16.1.1 255.255.255.0
no sh
int s1/1
ip add 172.16.5.1 255.255.255.0
no sh

R2# conf t
int f0/0
ip add 10.10.10.2 255.255.255.0
no sh
int f0/1
ip add 192.168.2.2 255.255.255.0
no sh
int s1/0
ip add 172.16.1.2 255.255.255.0
no sh

R3# conf t
int f0/0
ip add 10.10.10.3 255.255.255.0
no sh
int f0/1
ip add 192.168.3.3 255.255.255.0

no sh
int s1/1
ip add 172.16.5.3 255.255.255.0
no sh

ON ALL ROUTERS:
do sh ip int br | include up

Step 2: Configure IRP(Interior Routing Protocol [using OSPF]) in autonomous system 65200 (AS65200)

R2(config)
router ospf 1
network 10.10.10.0 0.0.0.255 area 0
network 192.168.2.0 0.0.0.255 area 1

R3#(config)
router ospf 1
network 10.10.10.0 0.0.0.255 area 0
network 192.168.3.0 0.0.0.255 area 2

ON BOTH ROUTERS:

R3>(config)
do ping 192.168.2.2
R2>(config)
do ping 192.168.3.3

Step 3: IBGP and EBGP configurations

R1>(config)
router bgp 65100
network 192.168.1.0
network 172.16.1.0 mask 255.255.255.0
network 172.16.5.0 mask 255.255.255.0
neighbor 172.16.1.2 remote-as 65200
neighbor 172.16.5.3 remote-as 65200

R2>(config)
router bgp 65200
network 172.16.1.0 mask 255.255.255.0
redistribute ospf 1
neighbor 172.16.1.1 remote-as 65100
neighbor 10.10.10.3 remote-as 65200

R3>(config)
router bgp 65200
network 172.16.5.0 mask 255.255.255.0
redistribute ospf 1
neighbor 172.16.5.1 remote-as 65100
neighbor 10.10.10.2 remote-as 65200

Step 4: Final output:

(ON ALL ROUTERS)
(config) do sh ip route

(DO THIS ONLY WHEN EXAMINER ASKS)
R1> (config)
do ping 192.168.2.2
do ping 192.168.3.3

Output:

```
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#do sh ip int br | include up
FastEthernet0/0            10.10.10.2      YES NVRAM  up                    up
FastEthernet0/1            192.168.2.2     YES NVRAM  up                    up
Serial1/0                  172.16.1.2      YES NVRAM  up                    up
```

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#do sh ip int br | include up
FastEthernet0/1            192.168.1.1     YES NVRAM  up                    up
Serial1/0                  172.16.1.1      YES NVRAM  up                    up
Serial1/1                  172.16.5.1      YES NVRAM  up                    up
```

```
R1(config)#do sh 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 not set

     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.5.0 is directly connected, Serial1/1
C       172.16.1.0 is directly connected, Serial1/0
     10.0.0.0/24 is subnetted, 1 subnets
B       10.10.10.0 [20/0] via 172.16.5.3, 00:19:37
C    192.168.1.0/24 is directly connected, FastEthernet0/1
B    192.168.2.0/24 [20/0] via 172.16.1.2, 00:19:37
B    192.168.3.0/24 [20/0] via 172.16.5.3, 00:19:37
R1(config)#
```

```
R2(config)#do sh 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 not set

     172.16.0.0/24 is subnetted, 2 subnets
B       172.16.5.0 [200/0] via 10.10.10.3, 00:19:44
C       172.16.1.0 is directly connected, Serial1/0
     10.0.0.0/24 is subnetted, 1 subnets
C       10.10.10.0 is directly connected, FastEthernet0/0
B    192.168.1.0/24 [20/0] via 172.16.1.1, 00:19:44
C    192.168.2.0/24 is directly connected, FastEthernet0/1
O IA 192.168.3.0/24 [110/20] via 10.10.10.3, 00:20:01, FastEthernet0/0
```

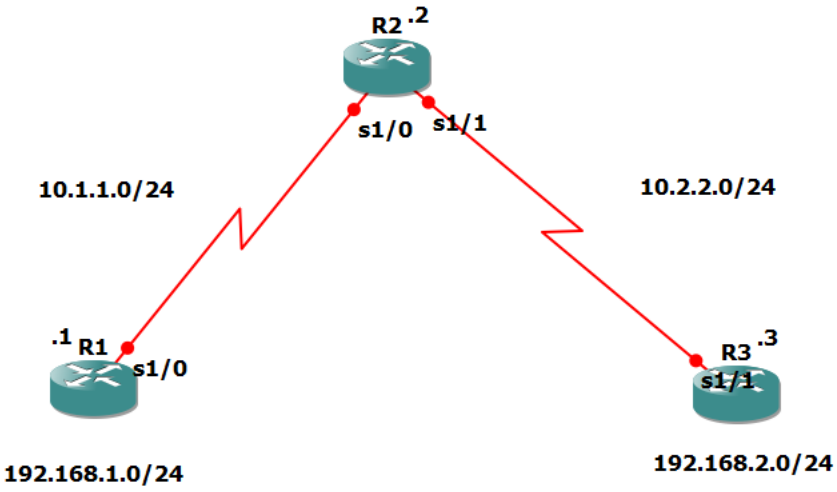
```
R3(config)#do sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - 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 not set

     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.5.0 is directly connected, Serial1/1
B       172.16.1.0 [200/0] via 10.10.10.2, 00:19:31
     10.0.0.0/24 is subnetted, 1 subnets
C       10.10.10.0 is directly connected, FastEthernet0/0
B    192.168.1.0/24 [20/0] via 172.16.5.1, 00:19:31
O IA 192.168.2.0/24 [110/20] via 10.10.10.2, 00:19:49, FastEthernet0/0
C    192.168.3.0/24 is directly connected, FastEthernet0/1
```

```
R1(config)#do ping 192.168.2.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.2.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/27/40 ms
R1(config)#do ping 192.168.3.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.3.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/32/40 ms
```

Practical No: 4

Aim: Secure management plane.

Topology:



Steps/Commands:

Step 1: Configure routers.

R1> conf t
int s1/0
ip add 10.1.1.1 255.255.255.0
no sh
int lo1
ip add 192.168.1.1 255.255.255.0

R2> conf t
int s1/0
ip add 10.1.1.2 255.255.255.0
no sh
int s1/1
ip add 10.2.2.2 255.255.255.0
no sh

R3> conf t
int s1/1
ip add 10.2.2.3 255.255.255.0
no sh
int lo1
ip add 192.168.2.1 255.255.255.0

Step2: Configure Routing:

R1> ip route 0.0.0.0 0.0.0.0 10.1.1.2

R2> ip route 192.168.1.0 255.255.255.0 10.1.1.1
ip route 192.168.2.0 255.255.255.0 10.2.2.3

R3> ip route 0.0.0.0 0.0.0.0 10.2.2.2

R1> do ping 192.168.2.1
R3> do ping 192.168.1.1

(START ONLY WHEN 100% SUCCESS ON PING)

Step3: Secure management access

R1> (config)
hostname r1
security password min-length 10
enable secret class12345
line console 0
password ciscoconpass
exec-timeout 5 0
login
logging synchronous
exit
line vty 0 4
password ciscovtypass
exec-timeout 5 0
login
exit
line aux 0
no exec
end
do wr
conf t
service password-encryption
banner motd $Unauthorized access not allowed$
exit

R3> (config)
hostname r3
security password min-length 10
enable secret class12345
line console 0
password ciscoconpass
exec-timeout 5 0
login
logging synchronous
exit
line vty 0 4
password ciscovtypass
exec-timeout 5 0
login
exit
line aux 0
no exec
end
do wr
conf t
(config)
service password-encryption
banner motd $Unauthorized access not allowed$
exit

r2> telnet 10.1.1.1

Output:

```
R1(config)#do ping 192.168.2.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.2.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 48/60/76 ms
R1(config)#
```

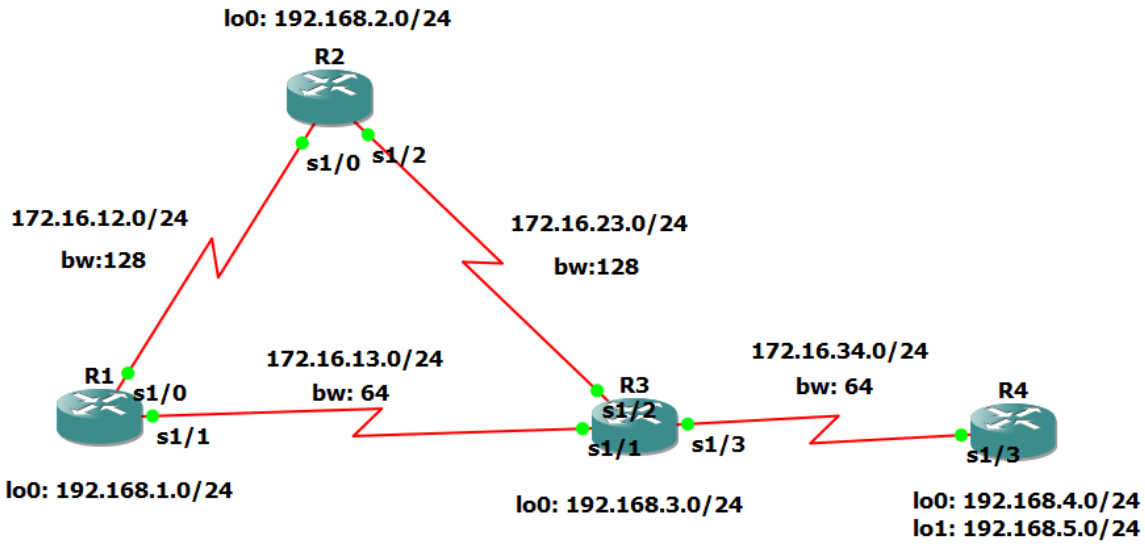
```
R3(config)#do ping 192.168.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/62/68 ms
R3(config)#
```

```
R2#telnet 10.1.1.1
Trying 10.1.1.1 ... Open
Unauthorized access not allowed

User Access Verification

Password:
*Mar  1 00:16:33.175: %SYS-5-CONFIG_I: Configured from console by console
Password:
r1>exit

[Connection to 10.1.1.1 closed by foreign host]
R2#telnet 10.2.2.3
Trying 10.2.2.3 ... Open
Unauthorized access not allowed

User Access Verification

Password:
Password:
r3>
```

Practical No: 5

Aim: Configure and verify path control using PBR.

Topology:



Steps/Commands:

Step1: Perform IP configuration.

R1> #conf t
hostname r1
int s1/0
ip add 172.16.12.1 255.255.255.0
bandwidth 128
no sh
int s1/1
ip add 172.16.13.1 255.255.255.0
bandwidth 64
no sh
int lo0
ip add 192.168.1.1 255.255.255.0
exit
do sh ip int br | include up

R2> #conf t
hostname r2
int s1/0
ip add 172.16.12.2 255.255.255.0
bandwidth 128
no sh
int s1/2
ip add 172.16.23.2 255.255.255.0
bandwidth 128
no sh
int lo0
ip add 192.168.2.2 255.255.255.0
exit
do sh ip int br | include up

R3> #conf t
hostname r3
int s1/1
ip add 172.16.13.3 255.255.255.0
bandwidth 64
no sh
int s1/2
ip add 172.16.23.3 255.255.255.0
bandwidth 128
no sh
int s1/3
ip add 172.16.34.3 255.255.255.0
bandwidth 64
no sh
int lo0
ip add 192.168.3.3 255.255.255.0
do sh ip int br | include up

R4> #conf t
int s1/3
ip add 172.16.34.4 255.255.255.0
bandwidth 64
no sh
int lo0
ip add 192.168.4.1 255.255.255.0
int lo1
ip add 192.168.5.1 255.255.255.0
exit
do sh ip int br | include up

Step 2: Configure EIGRP on all routers.

R1> (config) router eigrp 1
network 172.16.12.0 0.0.0.255
network 172.16.13.0 0.0.0.255
network 192.168.1.0
no auto-summary

R2> (config) router eigrp 1
network 172.16.12.0 0.0.0.255
network 172.16.23.0 0.0.0.255
network 192.168.2.0
no auto-summary

R3> (config) router eigrp 1
network 172.16.13.0 0.0.0.255
network 172.16.23.0 0.0.0.255
network 172.16.34.0 0.0.0.255
network 192.168.3.0
no auto-summary

R4> (config) router eigrp 1
network 172.16.34.0 0.0.0.255
network 192.168.4.0
network 192.168.5.0
no auto-summary

Step 3: check the network:
'do sh ip route' on all routers

R1> do ping 192.168.4.1
R4> do ping 192.168.1.1

USE TRACE ROUTE COMMAND TO VERIFY PATH from R4 to R1 using loopback.

R4> do traceroute 192.168.1.1 source 192.168.4.1
R4> do traceroute 192.168.1.1 source 192.168.5.1

Step 4: Configure PBR to providepath control all traffic from source 192.168.5.1 should take the path r4 -> R3 -> R1, whereas traffic from 192.168.4.1 should take the path R4 -> R3 -> R2 -> R1

Step4: Perform PBR on RECEIVING ROUTER

R3# (config) ip access-list standard pbr-acl
permit 192.168.5.0 0.0.0.255
exit
route-map r3-to-r1 permit
match ip address pbr-acl
set ip next-hop 172.16.13.1
exit
int s1/3
ip policy route-map r3-to-r1
end

R4> do traceroute 192.168.1.1 source 192.168.4.1
R4> do traceroute 192.168.1.1 source 192.168.5.1

Output:

```
r1(config-if)#exit
r1(config)#do sh ip int br | include up
Serial1/0                  172.16.12.1     YES manual up                    down
Serial1/1                  172.16.13.1     YES manual up                    up
Loopback0                  192.168.1.1     YES manual up                    up
r1(config)#
```

```
r2(config-if)#exit
r2(config)#do sh ip int br | include up
Serial1/0                  172.16.12.2     YES manual up                    up
Serial1/2                  172.16.23.2     YES manual up                    up
Loopback0                  192.168.2.2     YES manual up                    up
r2(config)#
*Mar  1 00:04:31.795: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/2, changed state to down
r2(config)#
```

```
r3(config-if)#do sh ip int br | include up
Serial1/1                  172.16.13.3     YES manual up                    up
Serial1/2                  172.16.23.3     YES manual up                    up
Serial1/3                  172.16.34.3     YES manual up                    down
Loopback0                  192.168.3.3     YES manual up                    up
r3(config-if)#
*Mar  1 00:06:21.807: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1/3, changed state to down
r3(config-if)#
```

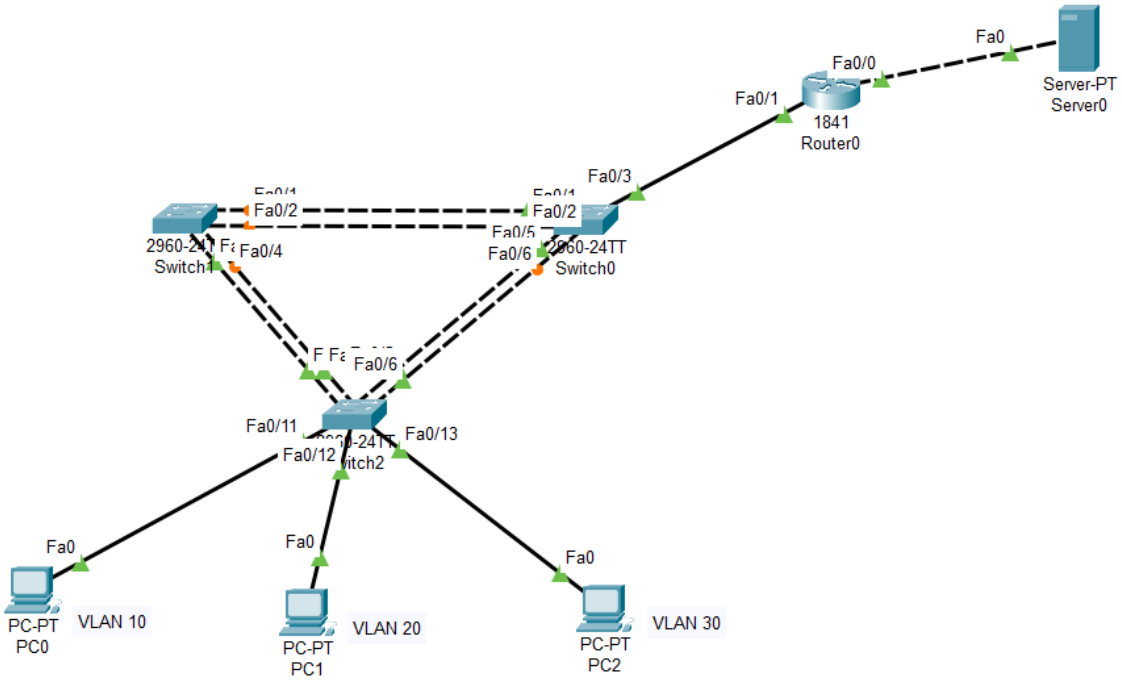
```
*Mar  1 00:11:51.567: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback1, changed state to up
R4(config-if)#do sh ip int br | include up
Serial1/3                  172.16.34.4     YES manual up                    up
Loopback0                  192.168.4.1     YES manual up                    up
Loopback1                  192.168.5.1     YES manual up                    up
R4(config-if)#
```

```
r1(config)#do ping 192.168.4.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.4.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/62/76 ms
r1(config)#


Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 68/80/88 ms
R4(config)#


R4(config)#do traceroute 192.168.1.1 source 192.168.4.1

Type escape sequence to abort.
Tracing the route to 192.168.1.1

  1 172.16.34.3 20 msec 32 msec 36 msec
  2 172.16.23.2 52 msec 68 msec 60 msec
  3 172.16.12.1 88 msec 80 msec 76 msec
R4(config)#do traceroute 192.168.1.1 source 192.168.5.1

Type escape sequence to abort.
Tracing the route to 192.168.1.1

  1 172.16.34.3 20 msec 28 msec 40 msec
  2 172.16.23.2 64 msec 48 msec 64 msec
  3 172.16.12.1 92 msec 76 msec 76 msec


R4(config)#do traceroute 192.168.1.1 source 192.168.4.1

Type escape sequence to abort.
Tracing the route to 192.168.1.1

  1 172.16.34.3 28 msec 28 msec 36 msec
  2 172.16.23.2 64 msec 60 msec 64 msec
  3 172.16.12.1 76 msec 80 msec 76 msec
R4(config)#do traceroute 192.168.1.1 source 192.168.5.1

Type escape sequence to abort.
Tracing the route to 192.168.1.1

  1 172.16.34.3 36 msec 28 msec 36 msec
  2 172.16.13.1 56 msec 68 msec 68 msec
R4(config)#
```

Practical No: 6

Aim: Demonstrate inter vlan routing.

Topology:



Steps/Commands:
(CISCO packet tracer)

Goto options -> preferences and check for link lights and port labels

Step1: check VLAN config in each switch

type command for all switches:
en
show vlan br

CHECK IF ALL SWITCHES HAVE SAME VLAN (1002,1003,1004,1005...)

Step2: disable all ports on all the switches.

commands for all switches:
conf t
interface range fa0/1-24
shutdown
interface range gi0/1-2
shutdown

Step3: Perform basic switch configurations like assign name to switches, password to switches as well
as gateways.

hostnames: s0, s1 and s2
commands for all switches:

exit
(config)
hostname s0
enable secret class
no ip domain-lookup
ip default-gateway 172.17.99.1
line console 0
password cisco
login
line vty 0 15
password cisco
login
end

Step4: On the interfaces of the switch 2 connect it to the PCs, configure access mode and enable them.

commands for s2:
(config)
int fa0/11
(config-if)
switchport mode access
no shutdown
int fa0/12
switchport mode access
no shutdown
int fa0/13
switchport mode access
no shutdown

Step5: Configure IP addresses on the three PCs and the server.

PC0-> Desktop -> IP config
IP: 172.17.10.21 255.255.255.0
Default gateway: 172.17.10.1

PC1-> Desktop -> IP config
IP: 172.17.20.22 255.255.255.0
Default gateway: 172.17.20.1

PC2-> Desktop -> IP config
IP: 172.17.30.23 255.255.255.0
Default gateway: 172.17.30.1

Server -> Desktop -> IP config
IP: 172.17.50.254 255.255.255.0
Default gateway: 172.17.50.1

Step6: Configure VTP protocol on the switches.

s0 will be VTP server, s1 & s2 will be VTP client
s0:
Password: cisco
en Password: class

en
(#)
Password:
conf t
(config)
vtp mode server
vtp domain vsit
vtp password cisco
s1:
Password:

en
#
Password:
conf t
(config)
vtp mode client
vtp domain vsit
vtp password cisco
s2:
Password:

en
#
Password:
conf t
(config)
vtp mode client
vtp domain vsit
vtp password cisco

Step7: Configure trunking codes on all connections between switches and enable them.

s0:
(config)
int range fa0/1-3
(config-if)
switchport mode trunk
switchport trunk native vlan 99
no shutdown
int range fa0/5-6
switchport mode trunk
switchport trunk native vlan 99
no shutdown

s2:
(config)
int range fa0/3-6
(config-if)
switchport mode trunk
switchport trunk native vlan 99
no sh

s1:
(config)
int range fa0/1-4

(config-if)
switchport mode trunk
switchport trunk native vlan 99
no sh

s0:
(config-if-range)
exit
(config)
hostname management
(config-vlan)
vlan 10
name staff
vlan 20
name students
vlan 30
name guests
exit
do sh vlan br (On s0 and s2)

Step8: Configure interface vlan 99 on all the switches.

s0:
(config)
int vlan 99
(config-if)
ip add 172.17.99.11 255.255.255.0
end

s2:
(config)
int vlan 99
(config-if)
ip add 172.17.99.12 255.255.255.0
end

s1:
(config)
int vlan 99
(config-if)
ip add 172.17.99.13 255.255.255.0
end

Step9: Configure vlan 10, vlan 20 and vlan 30 on switch 2.

s2:
(config)
int fa0/11
(config-if)
switchport access vlan 10
int fa0/12
switchport access vlan 20
int fa0/13
switchport access vlan 30

Step10: perform configuration on router.
First set on R1 f0/0 with 172.17.50.1 and subnet mask and click 'on'.

Router:
en
conf t
hostname r1
no ip domain-lookup
line console 0
(config-line)
password cisco
login
line vty 0 15
password cisco
login
end
conf t
(config)
enable secret class
int fa0/1
no sh
int fa0/1.1
(config-subif)
encapsulation dot1q 1
ip add 172.17.1.1 255.255.255.0
int fa0/1.10

encapsulation dot1q 10
ip add 172.17.10.1 255.255.255.0
int fa0/1.20
encapsulation dot1q 20
ip add 172.17.20.1 255.255.255.0
int fa0/1.30
encapsulation dot1q 30
ip add 172.17.30.1 255.255.255.0
int fa0/1.99
encapsulation dot1q 99 native
ip add 172.17.99.1 255.255.255.0

Step11: ping/deliver packets.

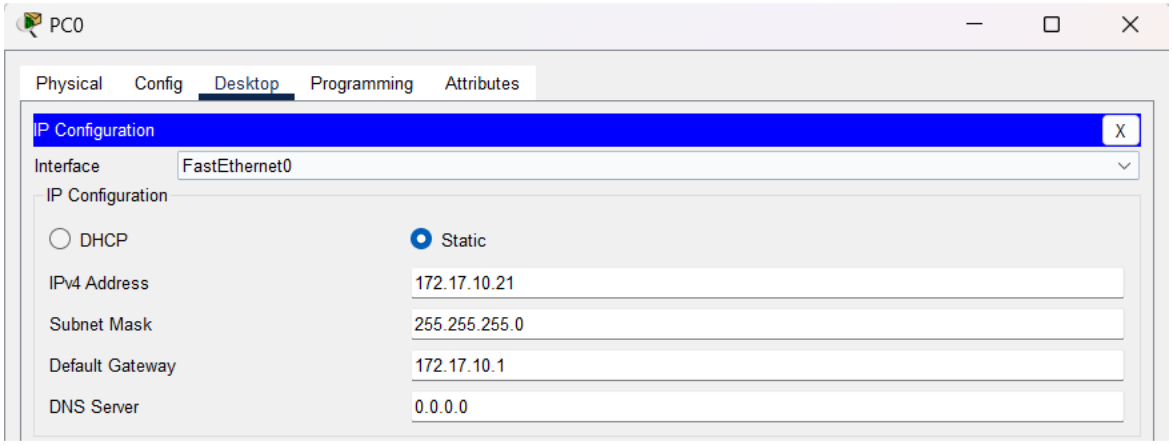
from PCs to Server

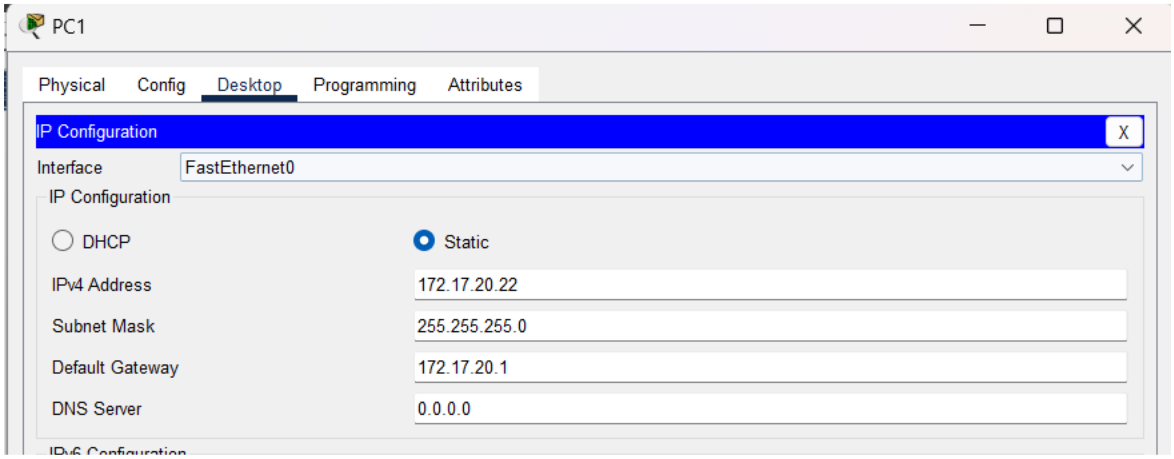
Output:

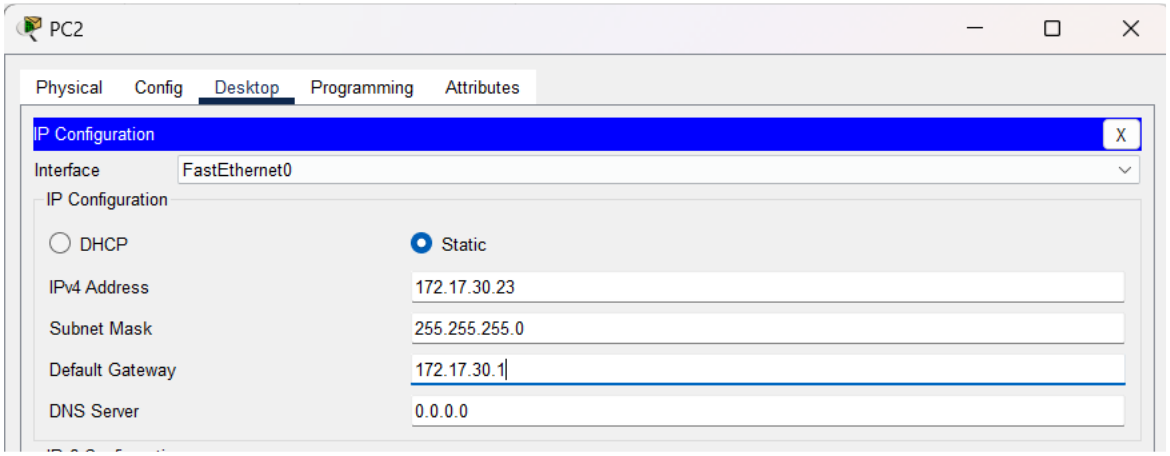
```
Switch>en
Switch#show vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                 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
                                                 Gig0/1, Gig0/2
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
Switch#
```

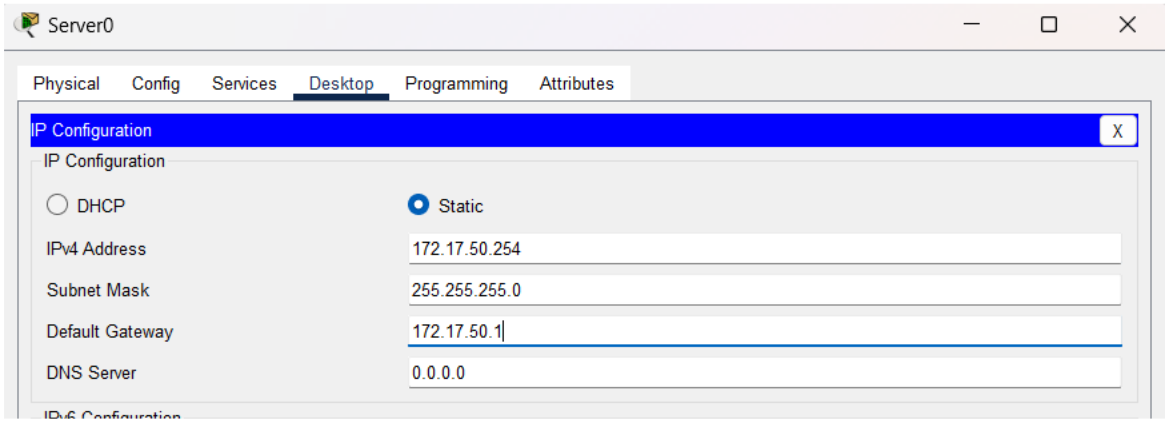
```
Switch>en
Switch#show vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                 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
                                                 Gig0/1, Gig0/2
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
Switch#
```

```
Switch>en
Switch#show vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                 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
                                                 Gig0/1, Gig0/2
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
Switch#
```










```
s0(config)#do sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/3, Fa0/4, 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
                                                 Gig0/1, Gig0/2
10   staff                             active
20   students                          active
30   guests                            active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
s0(config)#
```

```
s2(config)#do sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/1, Fa0/2, 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
                                                 Gig0/1, Gig0/2
10   staff                             active
20   students                          active
30   guests                            active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
s2(config)#
```

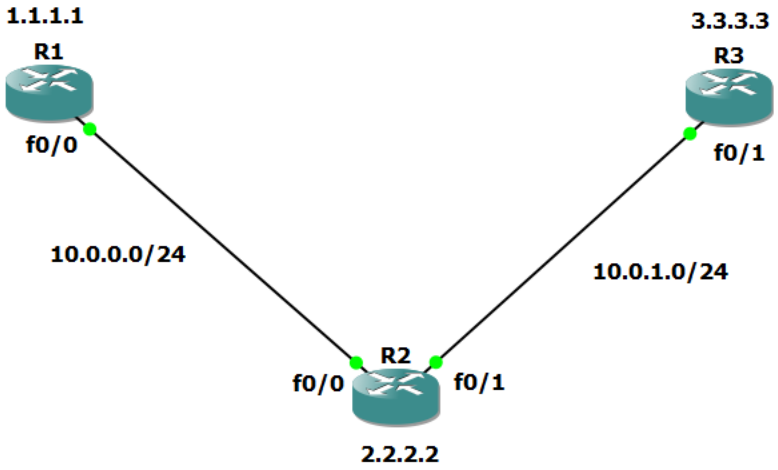
Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit	Delete
	Successful	Server0	PC1	ICMP		0.000	N	1	(edit)	(delete)
	Successful	Server0	PC2	ICMP		0.000	N	2	(edit)	(delete)
	Successful	Server0	PC0	ICMP		0.000	N	3	(edit)	(delete)

Practical No: 7

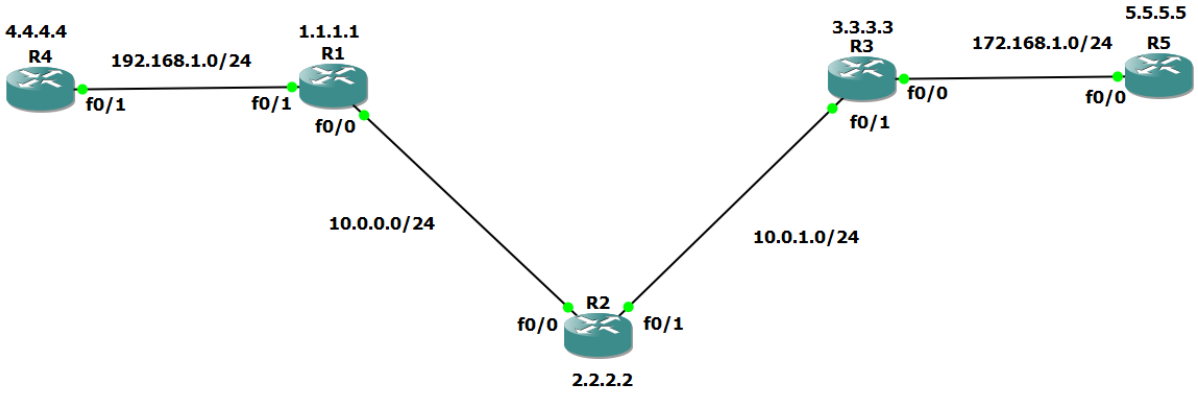
Aim: Simulating MPLS environment

Topology:

(Before)



(After)



Steps/Commands:

Step 1: Configure routers

R1> conf t
int lo0
ip add 1.1.1.1 255.255.255.255
ip ospf 1 area 0
int f0/0
ip add 10.0.0.1 255.255.255.0
no sh
ip ospf 1 area 0

R2> conf t
int lo0
ip add 2.2.2.2 255.255.255.255
ip ospf 1 area 0
int f0/0
ip add 10.0.0.2 255.255.255.0

```
no sh
exit
ip ospf 1 area 0
int f0/1
ip add 10.0.1.2 255.255.255.0
no sh
ip ospf 1 area 0

R3> conf t
int lo0
ip add 3.3.3.3 255.255.255.255
ip ospf 1 area 0
int f0/1
ip add 10.0.1.3 255.255.255.0
no sh
ip ospf 1 area 0
```

Step 2: Verify connections.

```
R1>(config) do sh ip ospf int br
do sh ip int br include up
do ping 3.3.3.3 source lo0

R3>(config) do sh ip ospf int br
do sh ip int br | include up
do ping 1.1.1.1 source lo0
```

Step 3: Configure MPLS

(On ALL routers R1, R2 and R3)

```
R1,R2,R3> router ospf 1
mpls ldp autoconfig

R2> do sh mpls interface
do sh mpls ldp neigh
```

Step 4: Configuring VPN

```
R1> do traceroute 3.3.3.3
router bgp 1
neighbor 3.3.3.3 remote-as 1
neighbor 3.3.3.3 update-source lo0
no auto-summary
address-family vpnv4
neighbor 3.3.3.3 activate

R3> do traceroute 1.1.1.1
router bgp 1
neighbor 1.1.1.1 remote-as 1
neighbor 1.1.1.1 update-source lo0
no auto-summary
address-family vpnv4
neighbor 1.1.1.1 activate
```

(on R1 and R3)

R1,R3> do sh bgp vpnv4 unicast all summary
(On R1 and R2)

R1,R2,> do sh ip route

Outputs:

```
R1(config)#do sh ip ospf int br
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Fa0/0        1     0               10.0.0.1/24        10    DR    1/1
Lo0          1     0               1.1.1.1/32         1     LOOP  0/0
```

```
R1(config)#do sh ip int br | include up
FastEthernet0/0            10.0.0.1        YES manual up                    up
Loopback0                  1.1.1.1         YES manual up                    up
```

R1

```
Connected to Dynamips VM "R1" (ID 0, type c3725) - Console port
Press ENTER to get the prompt.

R1(config-router)#do ping 3.3.3.3 source lo0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.3.3.3, timeout is 2 seconds:
Packet sent with a source address of 1.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/60/68 ms
R1(config-router)#
```

```
R1(config)#do traceroute 3.3.3.3

Type escape sequence to abort.
Tracing the route to 3.3.3.3

  1 10.0.0.2 [MPLS: Label 17 Exp 0] 60 msec 72 msec 48 msec
  2 10.0.1.3 68 msec 64 msec 64 msec
```

```
R3(config)#do sh ip ospf int br
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Fa0/1        1     0               10.0.1.3/24        10    DR    1/1
Lo0          1     0               3.3.3.3/32         1     LOOP  0/0
```

```
R3(config)#do sh ip int br | include up
FastEthernet0/1            10.0.1.3        YES manual up                    up
Loopback0                  3.3.3.3         YES manual up                    up
R3(config)#
```

R3

```
Connected to Dynamips VM "R3" (ID 2, type c3725) - Console port
Press ENTER to get the prompt.

R3(config)#do ping 1.1.1.1 source lo0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
Packet sent with a source address of 3.3.3.3
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 60/64/72 ms
R3(config)#
```

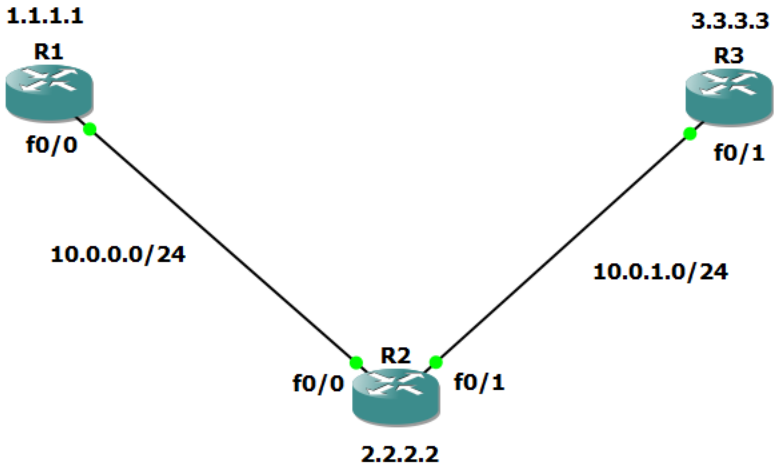
```
R3(config)#do traceroute 1.1.1.1

Type escape sequence to abort.
Tracing the route to 1.1.1.1

  1 10.0.1.2 [MPLS: Label 16 Exp 0] 64 msec 60 msec 60 msec
  2 10.0.0.1 60 msec 64 msec 56 msec


R1(config)#do sh bgp vpnv4 unicast all summary
BGP router identifier 1.1.1.1, local AS number 1
BGP table version is 1, main routing table version 1

Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
3.3.3.3         4     1      10      10        1    0    0 00:07:03        0
R3(config)#do sh bgp vpnv4 unicast all summary
BGP router identifier 3.3.3.3, local AS number 1
BGP table version is 1, main routing table version 1

Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
1.1.1.1         4     1      10      10        1    0    0 00:07:50        0
```

Practical No: 8

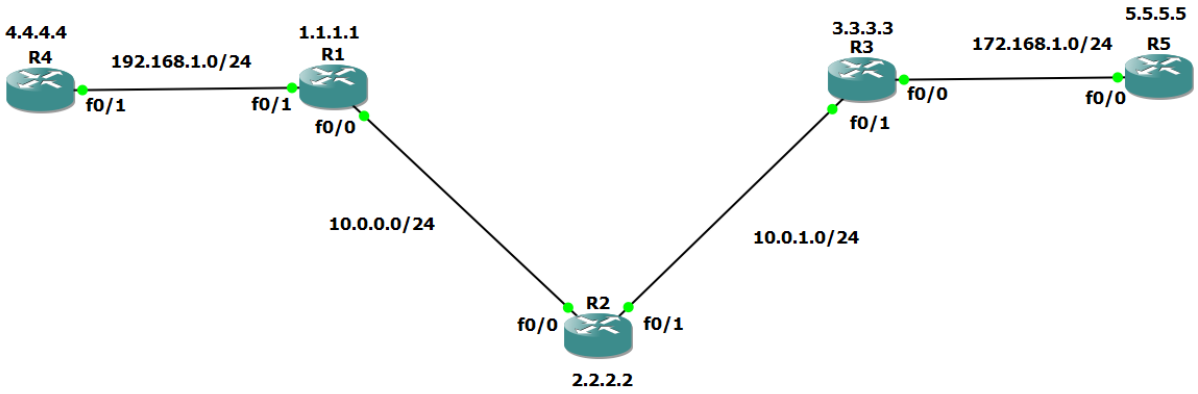
Aim: Simulating VRF (Virtual Routing and Forwarding).

Topology:

(Before)



(After)



Steps/Commands:

(Perform MPLS)

Step 1: Adding Routers and Configuring VRF (Virtual Routing and Forwarding)

DRAG & DROP router R4, R5
R1>
int f0/1
ip add 192.168.1.1 255.255.255.0
no sh
exit
ip vrf RED
rd 4:4
route-target both 4:4
int f0/1
ip vrf forwarding RED
int f0/1
ip add 192.168.1.1 255.255.255.0
ip ospf 2 area 2
do sh ip ospf int br
do sh ip int br | include up

```
R3>
int f0/0
ip add 172.168.1.3 255.255.255.0
no sh
exit
ip vrf BLUE
rd 5:5
route-target both 5:5
int f0/0
ip vrf forwarding BLUE
int f0/0
ip add 172.168.1.3 255.255.255.0
ip ospf 3 area 3
do sh ip ospf int br
do sh ip int br | include up

R4> conf t
int lo0
ip add 4.4.4.4 255.255.255.255
ip ospf 2 area 2
int f0/1
ip add 192.168.1.4 255.255.255.0
no sh
ip ospf 2 area 2
int lo0
ip ospf 2 area 2
do sh ip ospf int br
do sh ip int br | include up

R5> conf t
int lo0
ip add 5.5.5.5 255.255.255.255
ip ospf 3 area 3
int f0/0
ip add 172.168.1.5 255.255.255.0
no sh
ip ospf 3 area 3
int lo0
ip ospf 3 area 3
do sh ip ospf int br
do sh ip int br | include up
```

Step 2: Verfiy connection

```
R1>(config) do sh ip route vrf RED
R3>(config) do sh ip route vrf BLUE
```

Outputs:

```
R4(config-if)#do sh ip ospf int br
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Fa0/1        2     2               192.168.1.4/24     10    WAIT  0/0
Lo0          2     2               4.4.4.4/32         1     LOOP  0/0
R4(config-if)#do sh ip int br | include up
FastEthernet0/1            192.168.1.4     YES manual up                    up
Loopback0                  4.4.4.4         YES manual up                    up
```

```
R1(config-if)#do sh ip int br | include up
FastEthernet0/0            10.0.0.1        YES manual up                    up
FastEthernet0/1            192.168.1.1     YES manual up                    up
Loopback0                  1.1.1.1         YES manual up                    up
```

```
R3(config-if)#do sh ip int br | include up
FastEthernet0/0            172.168.1.3     YES manual up                    up
FastEthernet0/1            10.0.1.3        YES manual up                    up
Loopback0                  3.3.3.3         YES manual up                    up
```

```
R4(config-if)#do sh ip ospf int br
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Fa0/1        2     2               192.168.1.4/24     10    DR    0/0
Lo0          2     2               4.4.4.4/32         1     LOOP  0/0
R4(config-if)#do sh ip int br | include up
FastEthernet0/1            192.168.1.4     YES manual up                    up
Loopback0                  4.4.4.4         YES manual up                    up
```

```
R5(config-if)#do sh ip ospf int br
Interface    PID   Area            IP Address/Mask    Cost  State Nbrs F/C
Fa0/0        3     3               172.168.1.5/24     10    BDR   1/1
Lo0          3     3               5.5.5.5/32         1     LOOP  0/0
R5(config-if)#do sh ip int br | include up
FastEthernet0/0            172.168.1.5     YES manual up                    up
FastEthernet0/1            unassigned      YES manual up                    up
Loopback0                  5.5.5.5         YES manual up                    up
```

```
R1(config)#do sh ip route vrf RED

Routing Table: RED
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 not set

     4.0.0.0/32 is subnetted, 1 subnets
O       4.4.4.4 [110/11] via 192.168.1.4, 00:04:47, FastEthernet0/1
C    192.168.1.0/24 is directly connected, FastEthernet0/1
```

```
R3(config-if)#do sh ip route vrf BLUE

Routing Table: BLUE
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 not set

     5.0.0.0/32 is subnetted, 1 subnets
O       5.5.5.5 [110/11] via 172.168.1.5, 00:00:56, FastEthernet0/0
     172.168.0.0/24 is subnetted, 1 subnets
C       172.168.1.0 is directly connected, FastEthernet0/0
```