

**ZOOM**  
TECHNOLOGIES



**CCNP**

Cisco Certified  
Network Professional

Lab Manual



# **CCNP**

(Cisco Certified Network Professional)

**Certification Mapped Course**

**Route, Switch and Troubleshoot**

**Lab Manual**

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# **Introduction**

This lab manual is designed as a supplement to the CCNP (Route and Switch) mapped course offered by Zoom Technologies.

All the three modules of the CCNP mapped course - Route, Switch and Troubleshoot have been bundled into a single, easy to use lab manual.

We have completely redesigned and revamped the lab exercises, and also included a number of new exercises to give the student a comprehensive guide to building scalable and robust multi layered networks. The exercises are arranged in order of complexity, beginning from the basic to the most advanced configuration.

We have adopted the same approach that we did in the CCNA mapped lab manual. The exercises are divided into five sections:

1. Objective
2. Topology
3. Tasks
4. Configuration steps
5. Verification

We have ensured that the verification section includes several different ways of confirming that the configuration was correctly done - including specific show commands, ping and trace route and sometimes using debug commands to look at various phases.

We hope that the students derive benefit from this lab manual. Any suggestions or feedback about the book would be greatly appreciated.

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## TROUBLESHOOT

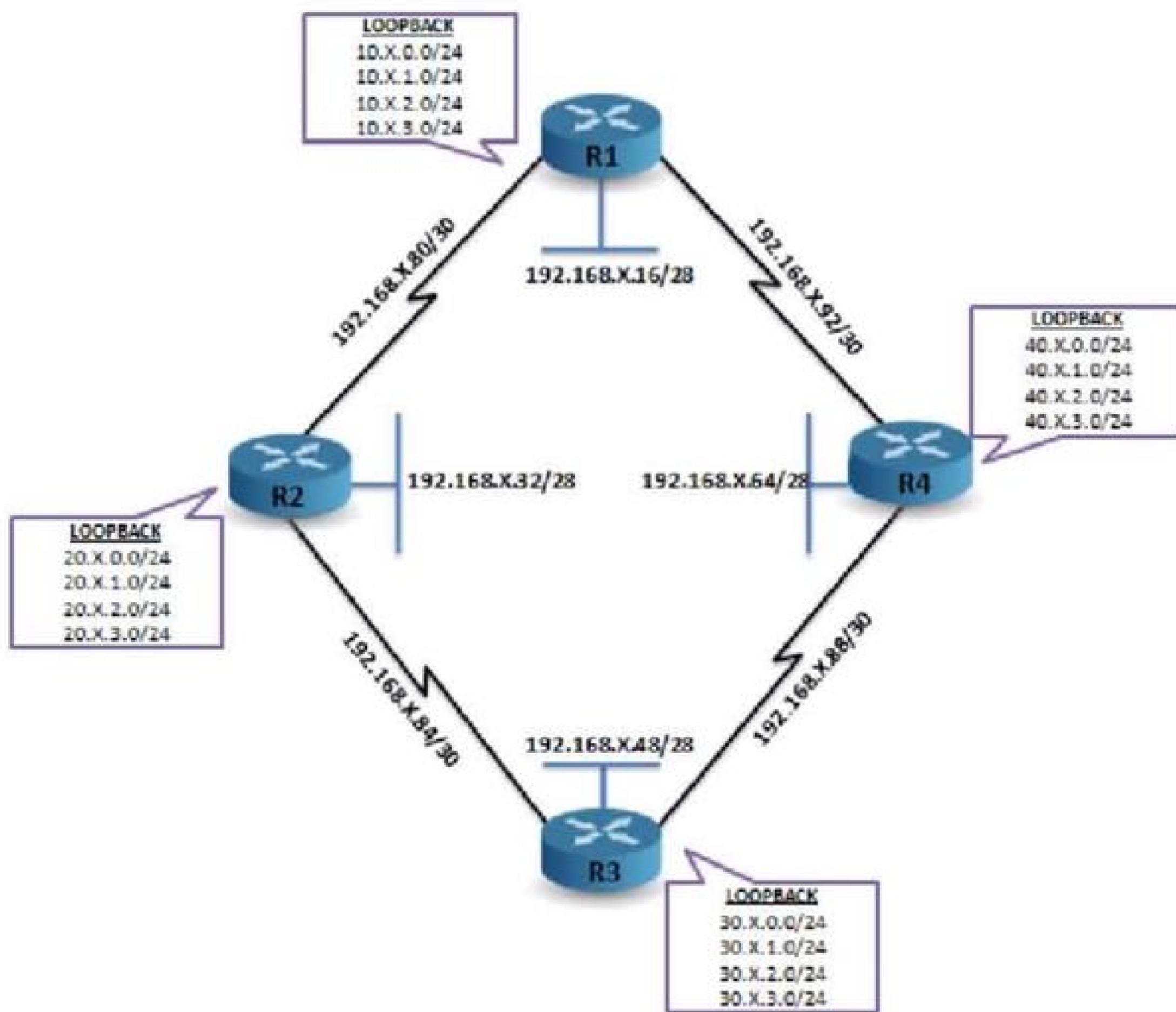
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## LAB 1: CONFIGURING AND INVESTIGATING BASIC EIGRP

### OBJECTIVE:

To establish connectivity between networks by configuring EIGRP on all routers

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring EIGRP on all the routers.
- 3) Configure EIGRP in all routers by using AS number 100
- 4) Verify Tables in EIGRP
- 5) Verify the connectivity using Ping command.

## STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure EIGRP on all routers using AS number 100

```
R1 (config)#router eigrp 100
R1 (config-router)# network 10.0.0.0
R1 (config-router)#network 192.168.X.0
R2 (config)#router eigrp 100
R2(config-router)#network 20.0.0.0
R2(config-router)#network 192.168.X.0
R3(config)#router eigrp 100
R3(config-router)#network 192.168.X.0
R4(Config)# router eigrp 100
R4(config-router)#network 20.0.0.0
R4(config-router)#network 192.168.X.0
```

## VERIFICATION:

Check the EIGRP neighbor table, Topology table and Routing Table on all the routers.

- To check Neighbor Table use the following command in all routers

**R1, R2, R3, R4#show ip eigrp neighbors**

**R1#show ip eigrp neighbors**

EIGRP-IPv4 Neighbors for AS(100)							
H	Address	Interface	Hold	Uptime	SRTT	RTO	Q Seq
(sec)	(ms)	Cnt Num					
1	192.168.1.93	Se0/1/0	11 0	0:11:43	5	200	0 9
0	192.168.1.82	Se0/1/1	14	00:12:09	46	276	0 16

- To check Topology Table use following command in all routers

**R1, R2, R3, R4#show ip eigrp topology**

**R1#show ip eigrp topology**

EIGRP-IPv4 Topology Table for AS(100)/ID(10.1.3.1)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,  
r - reply Status, s - sia Status

P 20.1.1.0/24, 1 successors, FD is 2297856

via 192.168.1.82 (2297856/128256), Serial0/1/1

P 30.1.1.0/24, 2 successors, FD is 2809856

via 192.168.1.82 (2809856/2297856), Serial0/1/1

via 192.168.1.93 (2809856/2297856), Serial0/1/0

P 40.1.0.0/24, 1 successors, FD is 2297856

via 192.168.1.93 (2297856/128256), Serial0/1/0  
P 192.168.1.48/28, 2 successors, FD is 2684416  
via 192.168.1.82 (2684416/2172416), Serial0/1/1  
via 192.168.1.93 (2684416/2172416), Serial0/1/0  
P 30.1.0.0/24, 2 successors, FD is 2809856  
via 192.168.1.82 (2809856/2297856), Serial0/1/1  
via 192.168.1.93 (2809856/2297856), Serial0/1/0  
P 10.1.3.0/24, 1 successors, FD is 128256  
via Connected, Loopback3  
P 10.1.0.0/24, 1 successors, FD is 128256  
via Connected, Loopback0  
P 20.1.0.0/24, 1 successors, FD is 2297856  
via 192.168.1.82 (2297856/128256), Serial0/1/1  
P 10.1.2.0/24, 1 successors, FD is 128256  
via Connected, Loopback2  
P 192.168.1.64/28, 1 successors, FD is 2172416  
via 192.168.1.93 (2172416/28160), Serial0/1/0  
P 192.168.1.16/28, 1 successors, FD is 28160  
via Connected, FastEthernet0/0  
P 192.168.1.84/30, 1 successors, FD is 2681856  
via 192.168.1.82 (2681856/2169856), Serial0/1/1  
P 192.168.1.32/28, 1 successors, FD is 2172416  
via 192.168.1.82 (2172416/28160), Serial0/1/1  
P 192.168.1.80/30, 1 successors, FD is 2169856  
via Connected, Serial0/1/1  
P 192.168.1.92/30, 1 successors, FD is 2169856  
via Connected, Serial0/1/0  
P 40.1.3.0/24, 1 successors, FD is 2297856  
via 192.168.1.93 (2297856/128256), Serial0/1/0  
P 40.1.1.0/24, 1 successors, FD is 2297856  
via 192.168.1.93 (2297856/128256), Serial0/1/0  
P 20.1.2.0/24, 1 successors, FD is 2297856  
via 192.168.1.82 (2297856/128256), Serial0/1/1  
P 40.1.2.0/24, 1 successors, FD is 2297856  
via 192.168.1.93 (2297856/128256), Serial0/1/0  
P 192.168.1.88/30, 1 successors, FD is 2681856  
via 192.168.1.93 (2681856/2169856), Serial0/1/0  
P 10.1.1.0/24, 1 successors, FD is 128256  
via Connected, Loopback1  
P 20.1.3.0/24, 1 successors, FD is 2297856  
via 192.168.1.82 (2297856/128256), Serial0/1/1  
P 30.1.3.0/24, 2 successors, FD is 2809856  
via 192.168.1.82 (2809856/2297856), Serial0/1/1  
via 192.168.1.93 (2809856/2297856), Serial0/1/0  
P 30.1.2.0/24, 2 successors, FD is 2809856  
via 192.168.1.82 (2809856/2297856), Serial0/1/1  
via 192.168.1.93 (2809856/2297856), Serial0/1/0

→ To check Routing Table use following command in all routers

R1, R2, R3, R4#show ip route

**R1#show ip route**

Codes: L - local, 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, H - NHRP, I – LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

    10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

    C    10.1.0.0/24 is directly connected, Loopback0

    L    10.1.0.1/32 is directly connected, Loopback0

    C    10.1.1.0/24 is directly connected, Loopback1

    L    10.1.1.1/32 is directly connected, Loopback1

    C    10.1.2.0/24 is directly connected, Loopback2

    L    10.1.2.1/32 is directly connected, Loopback2

    C    10.1.3.0/24 is directly connected, Loopback3

    L    10.1.3.1/32 is directly connected, Loopback3

    20.0.0.0/24 is subnetted, 4 subnets

    D    20.1.0.0 [90/2297856] via 192.168.1.82, 00:18:22, Serial0/1/1

    D    20.1.1.0 [90/2297856] via 192.168.1.82, 00:18:22, Serial0/1/1

    D    20.1.2.0 [90/2297856] via 192.168.1.82, 00:18:22, Serial0/1/1

    D    20.1.3.0 [90/2297856] via 192.168.1.82, 00:18:22, Serial0/1/1

    30.0.0.0/24 is subnetted, 4 subnets

    D    30.1.0.0 [90/2809856] via 192.168.1.93, 00:18:00, Serial0/1/0

[90/2809856] via 192.168.1.82, 00:18:00, Serial0/1/1

    D    30.1.1.0 [90/2809856] via 192.168.1.93, 00:18:00, Serial0/1/0

[90/2809856] via 192.168.1.82, 00:18:00, Serial0/1/1

    D    30.1.2.0 [90/2809856] via 192.168.1.93, 00:18:00, Serial0/1/0

[90/2809856] via 192.168.1.82, 00:18:00, Serial0/1/1

    D    30.1.3.0 [90/2809856] via 192.168.1.93, 00:18:00, Serial0/1/0

[90/2809856] via 192.168.1.82, 00:18:00, Serial0/1/1

    40.0.0.0/24 is subnetted, 4 subnets

    D    40.1.0.0 [90/2297856] via 192.168.1.93, 00:17:56, Serial0/1/0

    D    40.1.1.0 [90/2297856] via 192.168.1.93, 00:17:56, Serial0/1/0

    D    40.1.2.0 [90/2297856] via 192.168.1.93, 00:17:56, Serial0/1/0

    D    40.1.3.0 [90/2297856] via 192.168.1.93, 00:17:56, Serial0/1/0

    192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks

    C    192.168.1.16/28 is directly connected, FastEthernet0/0

    L    192.168.1.17/32 is directly connected, FastEthernet0/0

    D    192.168.1.32/28 [90/2172416] via 192.168.1.82, 00:18:25, Serial0/1/1

    D    192.168.1.48/28 [90/2684416] via 192.168.1.93, 00:18:00, Serial0/1/0

[90/2684416] via 192.168.1.82, 00:18:00, Serial0/1/1

    D    192.168.1.64/28 [90/2172416] via 192.168.1.93, 00:00:19, Serial0/1/0

    C    192.168.1.80/30 is directly connected, Serial0/1/1

    L    192.168.1.81/32 is directly connected, Serial0/1/1

    D    192.168.1.84/30 [90/2681856] via 192.168.1.82, 00:18:00, Serial0/1/1

    D    192.168.1.88/30 [90/2681856] via 192.168.1.93, 00:18:00, Serial0/1/0

    C    192.168.1.92/30 is directly connected, Serial0/1/0

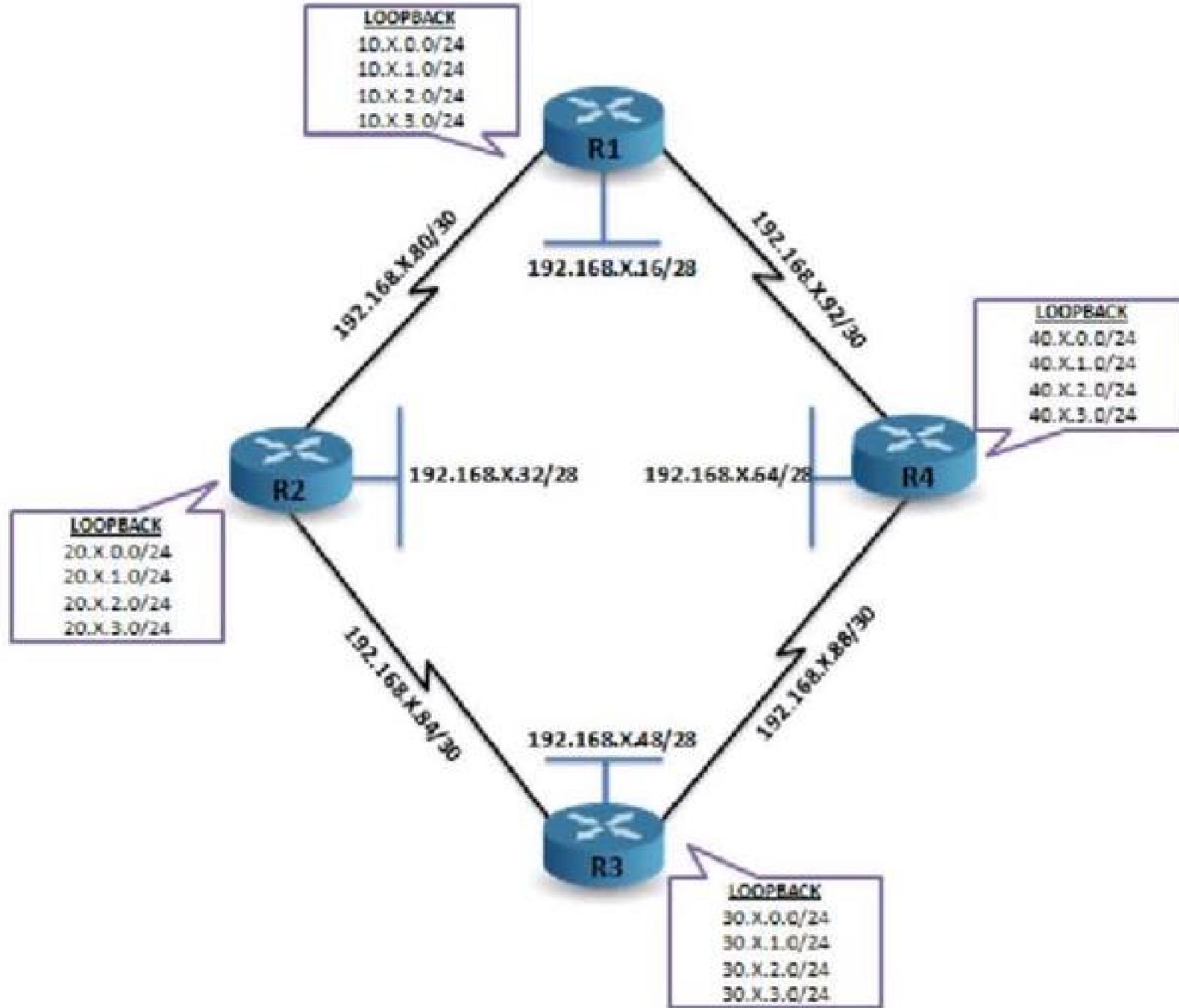
    L    192.168.1.94/32 is directly connected, Serial0/1/0

## LAB 2: EIGRP SUMMARIZATION

### OBJECTIVE:

To configure summarization on all routers so that 4 loopback addresses are represented by a single EIGRP entry in routing table.

### TOPOLOGY:



Pre-requisite: Basic EIGRP configuration to be done on all routers (LAB – 1)

### TASKS:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring EIGRP on all the routers.
- 3) Configure EIGRP on all routers by using AS number 100
- 4) Configure Manual Summarization on a per interface basis
- 5) Verify the output

## STEPS:

- Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- Check the routing table on all the routers before configuring the EIGRP on all the routers by using the command.

**Router#show ip route**

- Configure EIGRP with AS 100 on all the routers as did in previous lab.
- Disable Auto Summarization in all the routers before configuring Manual Summarization.

**Router(config)# router eigrp 100**

**Router(config-router)# no auto-summary**

- Configure Manual Summarization. This is configured on the interfaces which are connected to EIGRP neighbors. To know the interfaces which are connected to EIGRP neighbors execute the following command :

**R1#show ip eigrp neighbors**

EIGRP-IPv4 Neighbors for AS(100)

H	Address	Interface	Hold	Uptime	SRTT	RTO	Q	Seq
	(sec)	(ms)	Cnt	Num				
1	192.168.1.93	Se0/1/0	11	0 0:11:43	5	200	0	9
0	192.168.1.82	Se0/1/1	14	00:12:09	46	276	0	16

- Configure Manual summarization on the interfaces shown as a result of the above command.

Use **ip summary-address eigrp** command.

**R1 (config)#interface serial 0/1/0**

**R1 (config-if)# ip summary-address eigrp 100 10.X.0.0 255.255.252.0**

**R1 (config)#interface serial 0/1/1**

**R1 (config-if)# ip summary-address eigrp 100 10.X.0.0 255.255.252.0**

- Repeat these steps on all the other routers to configure Manual summarization.

## VERIFICATION:

After summarization, the local router will show a NULL0 interface and summary address will be available in all the neighbor routers.

**R1#show ip route**

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 9 subnets, 3 masks

- D 10.1.0.0/22 is a summary, 00:00:16, Null0
- C 10.1.0.0/24 is directly connected, Loopback0
- L 10.1.0.1/32 is directly connected, Loopback0
- C 10.1.1.0/24 is directly connected, Loopback1
- L 10.1.1.1/32 is directly connected, Loopback1
- C 10.1.2.0/24 is directly connected, Loopback2
- L 10.1.2.1/32 is directly connected, Loopback2
- C 10.1.3.0/24 is directly connected, Loopback3
- L 10.1.3.1/32 is directly connected, Loopback3
  
- 20.0.0.0/24 is subnetted, 4 subnets
- D 20.1.0.0 [90/2297856] via 192.168.1.82, 00:28:02, Serial0/1/1
- D 20.1.1.0 [90/2297856] via 192.168.1.82, 00:28:02, Serial0/1/1
- D 20.1.2.0 [90/2297856] via 192.168.1.82, 00:28:02, Serial0/1/1
- D 20.1.3.0 [90/2297856] via 192.168.1.82, 00:28:02, Serial0/1/1
  
- 30.0.0.0/24 is subnetted, 4 subnets
- D 30.1.0.0 [90/2809856] via 192.168.1.93, 00:27:40, Serial0/1/0  
[90/2809856] via 192.168.1.82, 00:27:40, Serial0/1/1
- D 30.1.1.0 [90/2809856] via 192.168.1.93, 00:27:40, Serial0/1/0  
[90/2809856] via 192.168.1.82, 00:27:40, Serial0/1/1
- D 30.1.2.0 [90/2809856] via 192.168.1.93, 00:27:40, Serial0/1/0  
[90/2809856] via 192.168.1.82, 00:27:40, Serial0/1/1
- D 30.1.3.0 [90/2809856] via 192.168.1.93, 00:27:40, Serial0/1/0  
[90/2809856] via 192.168.1.82, 00:27:40, Serial0/1/1
  
- 40.0.0.0/24 is subnetted, 4 subnets
- D 40.1.0.0 [90/2297856] via 192.168.1.93, 00:27:36, Serial0/1/0
- D 40.1.1.0 [90/2297856] via 192.168.1.93, 00:27:36, Serial0/1/0
- D 40.1.2.0 [90/2297856] via 192.168.1.93, 00:27:36, Serial0/1/0
- D 40.1.3.0 [90/2297856] via 192.168.1.93, 00:27:36, Serial0/1/0
  
- 192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
- C 192.168.1.16/28 is directly connected, FastEthernet0/0
- L 192.168.1.17/32 is directly connected, FastEthernet0/0
- D 192.168.1.32/28 [90/2172416] via 192.168.1.82, 00:28:05, Serial0/1/1
- D 192.168.1.48/28 [90/2684416] via 192.168.1.93, 00:27:40, Serial0/1/0  
[90/2684416] via 192.168.1.82, 00:27:40, Serial0/1/1
- D 192.168.1.64/28 [90/2172416] via 192.168.1.93, 00:09:59, Serial0/1/0
- C 192.168.1.80/30 is directly connected, Serial0/1/1
- L 192.168.1.81/32 is directly connected, Serial0/1/1
- D 192.168.1.84/30 [90/2681856] via 192.168.1.82, 00:27:40, Serial0/1/1
- D 192.168.1.88/30 [90/2681856] via 192.168.1.93, 00:27:40, Serial0/1/0
- C 192.168.1.92/30 is directly connected, Serial0/1/0
- L 192.168.1.94/32 is directly connected, Serial0/1/0

### R2#show ip route

Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

10.0.0.0/22 is subnetted, 1 subnets

D 10.1.0.0 [90/2297856] via 192.168.1.81, 00:02:15, Serial0/0/1

20.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

C 20.1.0.0/24 is directly connected, Loopback0

L 20.1.0.1/32 is directly connected, Loopback0

C 20.1.1.0/24 is directly connected, Loopback1

L 20.1.1.1/32 is directly connected, Loopback1

C 20.1.2.0/24 is directly connected, Loopback2

L 20.1.2.1/32 is directly connected, Loopback2

C 20.1.3.0/24 is directly connected, Loopback3

L 20.1.3.1/32 is directly connected, Loopback3

30.0.0.0/24 is subnetted, 4 subnets

D 30.1.0.0 [90/2297856] via 192.168.1.86, 00:30:14, Serial0/0/0

D 30.1.1.0 [90/2297856] via 192.168.1.86, 00:30:14, Serial0/0/0

D 30.1.2.0 [90/2297856] via 192.168.1.86, 00:30:14, Serial0/0/0

D 30.1.3.0 [90/2297856] via 192.168.1.86, 00:30:14, Serial0/0/0

40.0.0.0/24 is subnetted, 4 subnets

D 40.1.0.0 [90/2809856] via 192.168.1.86, 00:29:44, Serial0/0/0

[90/2809856] via 192.168.1.81, 00:29:44, Serial0/0/1

D 40.1.1.0 [90/2809856] via 192.168.1.86, 00:29:44, Serial0/0/0

[90/2809856] via 192.168.1.81, 00:29:44, Serial0/0/1

D 40.1.2.0 [90/2809856] via 192.168.1.86, 00:29:44, Serial0/0/0

[90/2809856] via 192.168.1.81, 00:29:44, Serial0/0/1

D 40.1.3.0 [90/2809856] via 192.168.1.86, 00:29:44, Serial0/0/0

[90/2809856] via 192.168.1.81, 00:29:44, Serial0/0/1

192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks

D 192.168.1.16/28 [90/2172416] via 192.168.1.81, 00:30:14, Serial0/0/1

C 192.168.1.32/28 is directly connected, FastEthernet0/0

L 192.168.1.33/32 is directly connected, FastEthernet0/0

D 192.168.1.48/28 [90/2172416] via 192.168.1.86, 00:30:14, Serial0/0/0

D 192.168.1.64/28 [90/2684416] via 192.168.1.86, 00:12:07, Serial0/0/0

[90/2684416] via 192.168.1.81, 00:12:07, Serial0/0/1

C 192.168.1.80/30 is directly connected, Serial0/0/1

L 192.168.1.82/32 is directly connected, Serial0/0/1

C 192.168.1.84/30 is directly connected, Serial0/0/0

L 192.168.1.85/32 is directly connected, Serial0/0/0

D 192.168.1.88/30 [90/2681856] via 192.168.1.86, 00:29:48, Serial0/0/0

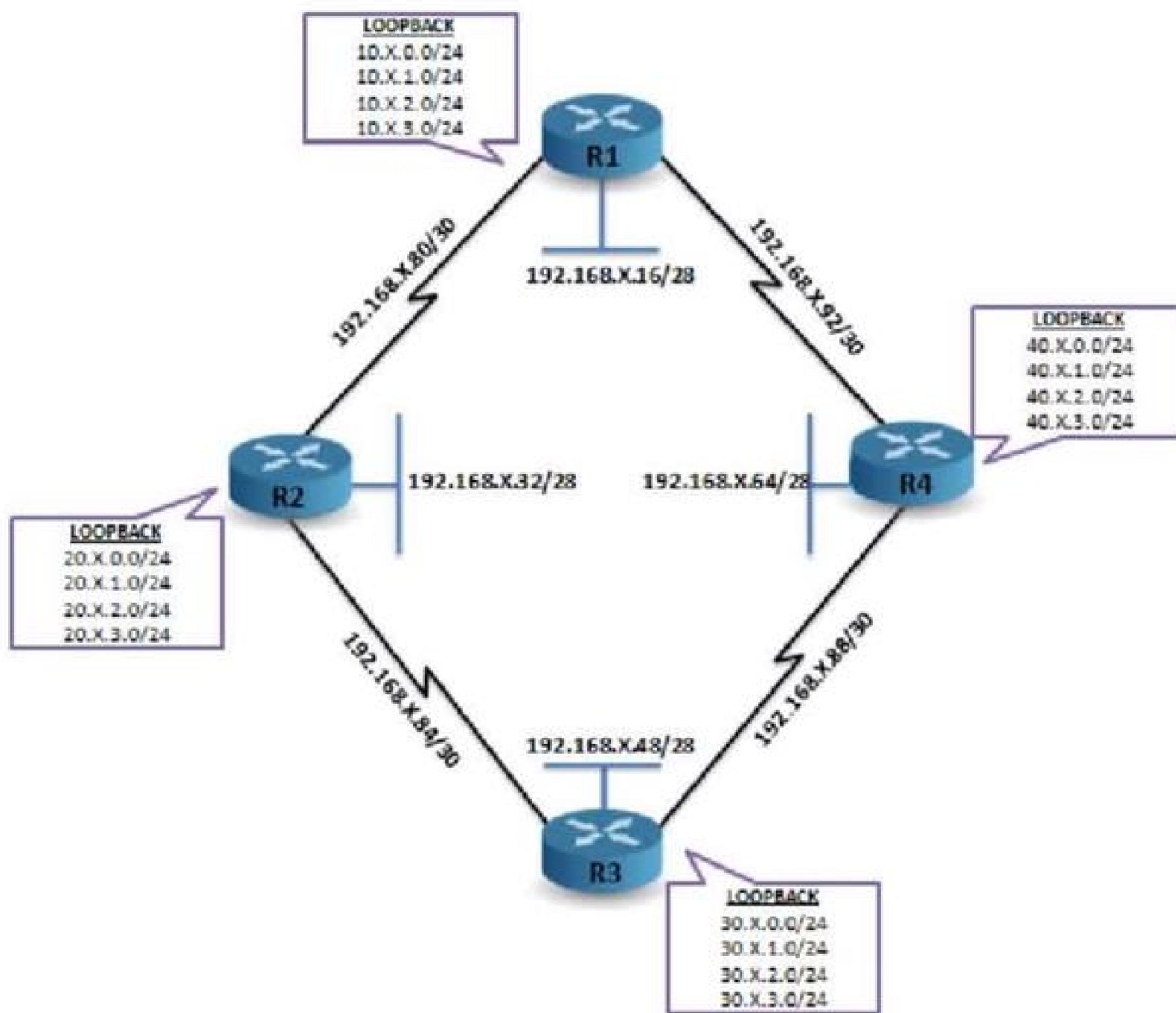
D 192.168.1.92/30 [90/2681856] via 192.168.1.81, 00:29:48, Serial0/0/1

## LAB 3: EIGRP AUTHENTICATION

### OBJECTIVE:

To configure EIGRP authentication between R1 and R2 routers

### TOPOLOGY:



### TASK:

- 1) Verify the interface status on all the routers
- 2) Check the routing table before configuring EIGRP on all the routers.
- 3) Configure EIGRP in all routers by using AS number 100
- 4) Verify Tables in EIGRP
- 5) Configure authentication between R1 router and R2 router. The key-chain name should be "zoom" and password should be "ccnp".

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers before configuring EIGRP on all the routers by using the command.

**Router#show ip route**

- 3) Configure EIGRP with AS 100 on all the routers as done in previous lab.
- 4) Configure Key Chain on the routers where you want to implement authentication.

```
R1(config)# key chain zoom
R1(config-keychain)#key 1
R1(config-keychain-key)#key-string ccnp
R1(config-keychain-key)#exit
R2(config)# key chain zoom
R2(config-keychain)#key 1
R2(config-keychain-key)#key-string ccnp
R2(config-keychain-key)#exit
```

- 5) Implement authentication on the serial interfaces between R1 and R2

**R1#show cdp neighbours**

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge  
 S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,  
 D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
R2	Ser 0/1/1	153	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	173	R S I	2811	Ser 0/0/0

```
R1(config)#interface serial 0/1/1
R1(config-if)#ip authentication mode eigrp 100 md5
R1(config-if)#ip authentication key-chain eigrp 100 zoom
```

**R2#show cdp neighbors**

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge  
 S - Switch, H - Host, I - IGMP, r - Repeater

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
R3	Ser 0/0/0	169	R S I	2811	Ser 0/0/1
R1	Ser 0/0/1	174	R S I	2811	Ser 0/1/1

```
R2(config)#interface serial 0/0/1
R2(config-if)#ip authentication mode eigrp 100 md5
R2(config-if)#ip authentication key-chain eigrp 100 zoom
```

**VERIFICATION:**

R1#show keychain

Key-chain zoom:

key 1 -- text "ccnp"

accept lifetime (always valid) - (always valid) [valid now]

send lifetime (always valid) - (always valid) [valid now]

R2#show keychain

Key-chain zoom:

key 1 -- text "ccnp"

accept lifetime (always valid) - (always valid) [valid now]

send lifetime (always valid) - (always valid) [valid now]

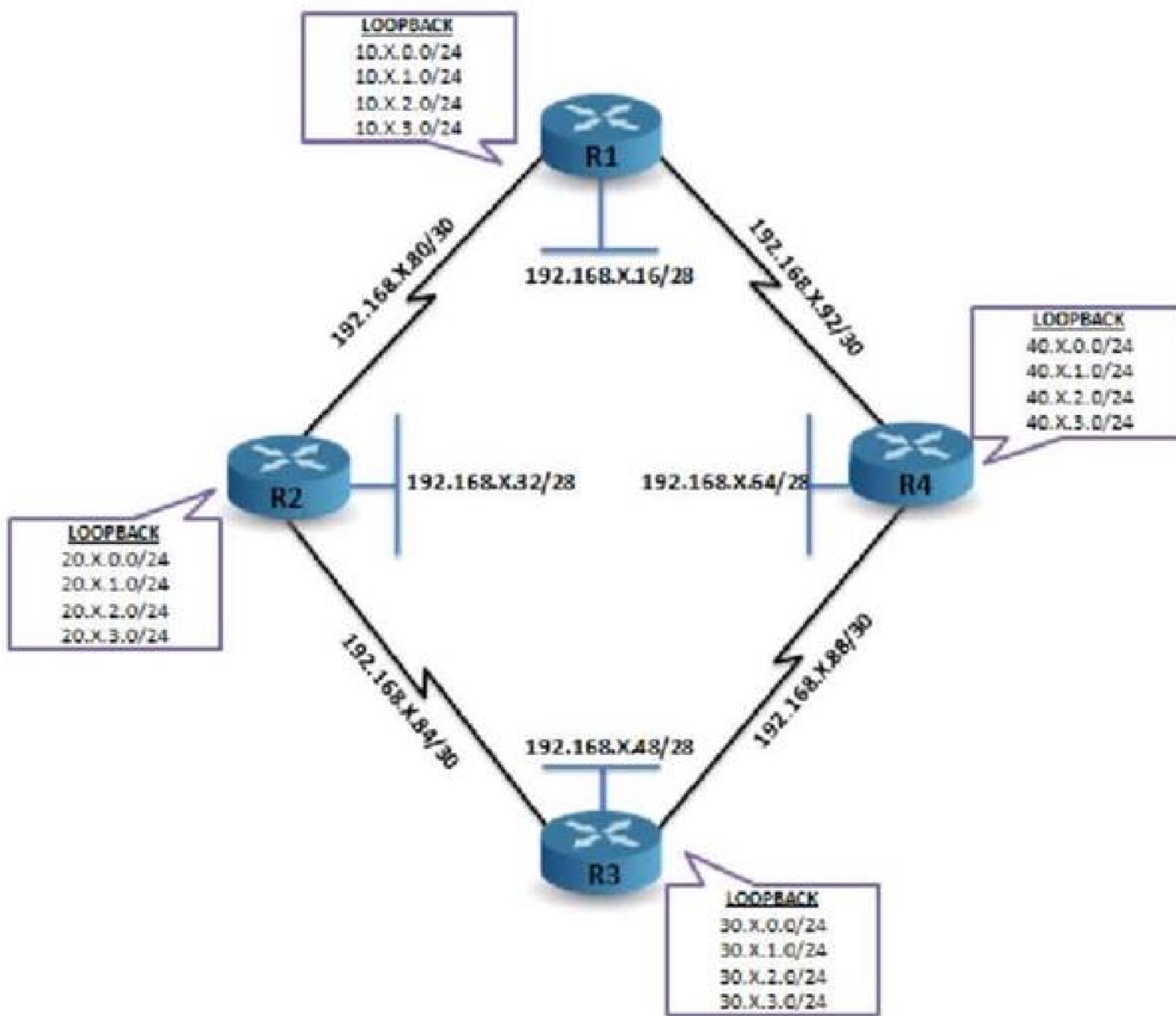
Zoom Technologies

## LAB 4: LOAD BALANCING IN EIGRP

### OBJECTIVE:

To configure EIGRP Load Balancing for reaching all the 10.0.0.0/24 networks from R3 router.

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring EIGRP on all the routers.
- 3) Configure EIGRP in all routers by using AS number 100
- 4) Verify Tables in EIGRP
- 5) Verify Load Balancing in EIGRP

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers before configuring the EIGRP on all the routers by using the command.

**Router# show ip route**

- 3) Configure EIGRP with AS 100 on all the routers as done in previous lab.
- 4) Configure Bandwidth on serial interfaces of all the routers.

```
R1(config)# interface serial 0/1/0
R1(config-if)# bandwidth 128
R1(config)# interface serial 0/1/1
R1(config-if)# bandwidth 128
R2(config)# interface serial 0/0/1
R2 (config-if)# bandwidth 128
R2(config)# interface serial 0/0/0
R2 (config-if)# bandwidth 64
R3(config)# interface serial 0/0/1
R3 (config-if)# bandwidth 64
R3(config)# interface serial 0//0/0
R3 (config-if)# bandwidth 128
R4(config)# interface serial 0/0/1
R4 (config-if)# bandwidth 128
R4(config)# interface serial 0/0/0
R4 (config-if)# bandwidth 128
```

**Note:** Names of the serial interface may vary, use **show cdp neighbours** to find serial interfaces of the router.

- 5) You will find successor and Feasible successor in the topology table of the R3 router but only the successor routes in the routing table.
- 6) Before configuring variance

**R3# show ip eigrp topology**

EIGRP-IPv4 Topology Table for AS(100)/ID(30.1.3.1)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,

r - reply Status, s - sia Status

P 20.1.1.0/24, 1 successors, FD is 21664000

    via 192.168.1.90 (21664000/21152000), Serial0/0/0

    via 192.168.1.85 (40640000/128256), Serial0/0/1

P 30.1.1.0/24, 1 successors, FD is 128256      via Connected, Loopback1

P 40.1.0.0/24, 1 successors, FD is 2297856      via 192.168.1.90 (20640000/128256), Serial0/0/0

P 192.168.1.48/28, 1 successors, FD is 28160      via Connected, FastEthernet0/0

P 30.1.0.0/24, 1 successors, FD is 128256      via Connected, Loopback0

P 10.1.3.0/24, 1 successors, FD is 21152000      via 192.168.1.90 (21152000/20640000), Serial0/0/0

```

via 192.168.1.85 (41152000/20640000), Serial0/0/1
P 10.1.0.0/24, 1 successors, FD is 21152000 via 192.168.1.90 (21152000/20640000), Serial0/0/0
via 192.168.1.85 (41152000/20640000), Serial0/0/1
P 10.1.2.0/24, 1 successors, FD is 21152000 via 192.168.1.90 (21152000/20640000), Serial0/0/0
via 192.168.1.85 (41152000/20640000), Serial0/0/1
P 192.168.1.64/28, 1 successors, FD is 2172416 via 192.168.1.90 (20514560/28160), Serial0/0/0
P 192.168.1.16/28, 1 successors, FD is 21026560 via 192.168.1.90 (21026560/20514560),
Serial0/0/0 via 192.168.1.85 (41026560/20514560), Serial0/0/1
P 192.168.1.84/30, 1 successors, FD is 40512000 via Connected, Serial0/0/1
P 192.168.1.32/28, 1 successors, FD is 21538560 via 192.168.1.90 (21538560/21026560),
Serial0/0/0 via 192.168.1.85 (40514560/28160), Serial0/0/1
P 192.168.1.80/30, 1 successors, FD is 21536000 via 192.168.1.90 (21536000/21024000),
Serial0/0/0 via 192.168.1.85 (41024000/20512000), Serial0/0/1
P 192.168.1.92/30, 1 successors, FD is 21024000 via 192.168.1.90 (21024000/20512000),
Serial0/0/0, serno 133
P 40.1.3.0/24, 1 successors, FD is 2297856 via 192.168.1.90 (20640000/128256), Serial0/0/0
P 40.1.1.0/24, 1 successors, FD is 2297856 via 192.168.1.90 (20640000/128256), Serial0/0/0
P 20.1.2.0/24, 1 successors, FD is 21664000 via 192.168.1.90 (21664000/21152000),
Serial0/0/0 via 192.168.1.85 (40640000/128256), Serial0/0/1
P 40.1.2.0/24, 1 successors, FD is 2297856 via 192.168.1.90 (20640000/128256), Serial0/0/0
P 192.168.1.88/30, 1 successors, FD is 20512000 via Connected, Serial0/0/0
P 10.1.1.0/24, 1 successors, FD is 21152000 via 192.168.1.90 (21152000/20640000),
Serial0/0/0 via 192.168.1.85 (41152000/20640000), Serial0/0/1
P 20.1.3.0/24, 1 successors, FD is 21664000 via 192.168.1.90 (21664000/21152000),
Serial0/0/0 via 192.168.1.85 (40640000/128256), Serial0/0/1
P 30.1.3.0/24, 1 successors, FD is 128256 via Connected, Loopback3
P 30.1.2.0/24, 1 successors, FD is 128256 via Connected, Loopback2

```

### R3#show ip route

Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

10.0.0.0/24 is subnetted, 4 subnets

```

D 10.1.0.0 [90/21152000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 10.1.1.0 [90/21152000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 10.1.2.0 [90/21152000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 10.1.3.0 [90/21152000] via 192.168.1.90, 00:01:56, Serial0/0/0

```

20.0.0.0/24 is subnetted, 4 subnets

```

D 20.1.0.0 [90/21664000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 20.1.1.0 [90/21664000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 20.1.2.0 [90/21664000] via 192.168.1.90, 00:01:56, Serial0/0/0
D 20.1.3.0 [90/21664000] via 192.168.1.90, 00:01:56, Serial0/0/0

```

```

C 30.1.0.0/24 is directly connected, Loopback0
L 30.1.0.1/32 is directly connected, Loopback0
C 30.1.1.0/24 is directly connected, Loopback1
L 30.1.1.1/32 is directly connected, Loopback1
C 30.1.2.0/24 is directly connected, Loopback2
L 30.1.2.1/32 is directly connected, Loopback2
C 30.1.3.0/24 is directly connected, Loopback3
L 30.1.3.1/32 is directly connected, Loopback3
    40.0.0.0/24 is subnetted, 4 subnets
D 40.1.0.0 [90/20640000] via 192.168.1.90, 00:04:04, Serial0/0/0
D 40.1.1.0 [90/20640000] via 192.168.1.90, 00:04:04, Serial0/0/0
D 40.1.2.0 [90/20640000] via 192.168.1.90, 00:04:04, Serial0/0/0
D 40.1.3.0 [90/20640000] via 192.168.1.90, 00:04:04, Serial0/0/0
    192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
D 192.168.1.16/28 [90/21026560] via 192.168.1.90, 00:01:56, Serial0/0/0
D 192.168.1.32/28 [90/21538560] via 192.168.1.90, 00:01:56, Serial0/0/0
C 192.168.1.48/28 is directly connected, FastEthernet0/0
L 192.168.1.49/32 is directly connected, FastEthernet0/0
D 192.168.1.64/28 [90/20514560] via 192.168.1.90, 00:04:04, Serial0/0/0
D 192.168.1.80/30 [90/21536000] via 192.168.1.90, 00:01:56, Serial0/0/0
C 192.168.1.84/30 is directly connected, Serial0/0/1
L 192.168.1.86/32 is directly connected, Serial0/0/1
C 192.168.1.88/30 is directly connected, Serial0/0/0
L 192.168.1.89/32 is directly connected, Serial0/0/0
D 192.168.1.92/30 [90/21024000] via 192.168.1.90, 00:02:06, Serial0/0/0

```

- 7) To use feasible successors also in the routing table use variance command.

```

R3(config)# router eigrp 100
R3( config-router)# variance 2

```

#### VERIFICATION:

##### → After Configuring Variance

```
R3#show ip route
```

Codes: L - local, 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, + - replicated route  
Gateway of last resort is not set

```

10.0.0.0/24 is subnetted, 4 subnets
D 10.1.0.0 [90/21152000] via 192.168.1.90, 00:00:03, Serial0/0/0
    [90/41152000] via 192.168.1.85, 00:00:03, Serial0/0/1
D 10.1.1.0 [90/21152000] via 192.168.1.90, 00:00:03, Serial0/0/0
    [90/41152000] via 192.168.1.85, 00:00:03, Serial0/0/1
D 10.1.2.0 [90/21152000] via 192.168.1.90, 00:00:03, Serial0/0/0
    [90/41152000] via 192.168.1.85, 00:00:03, Serial0/0/1

```

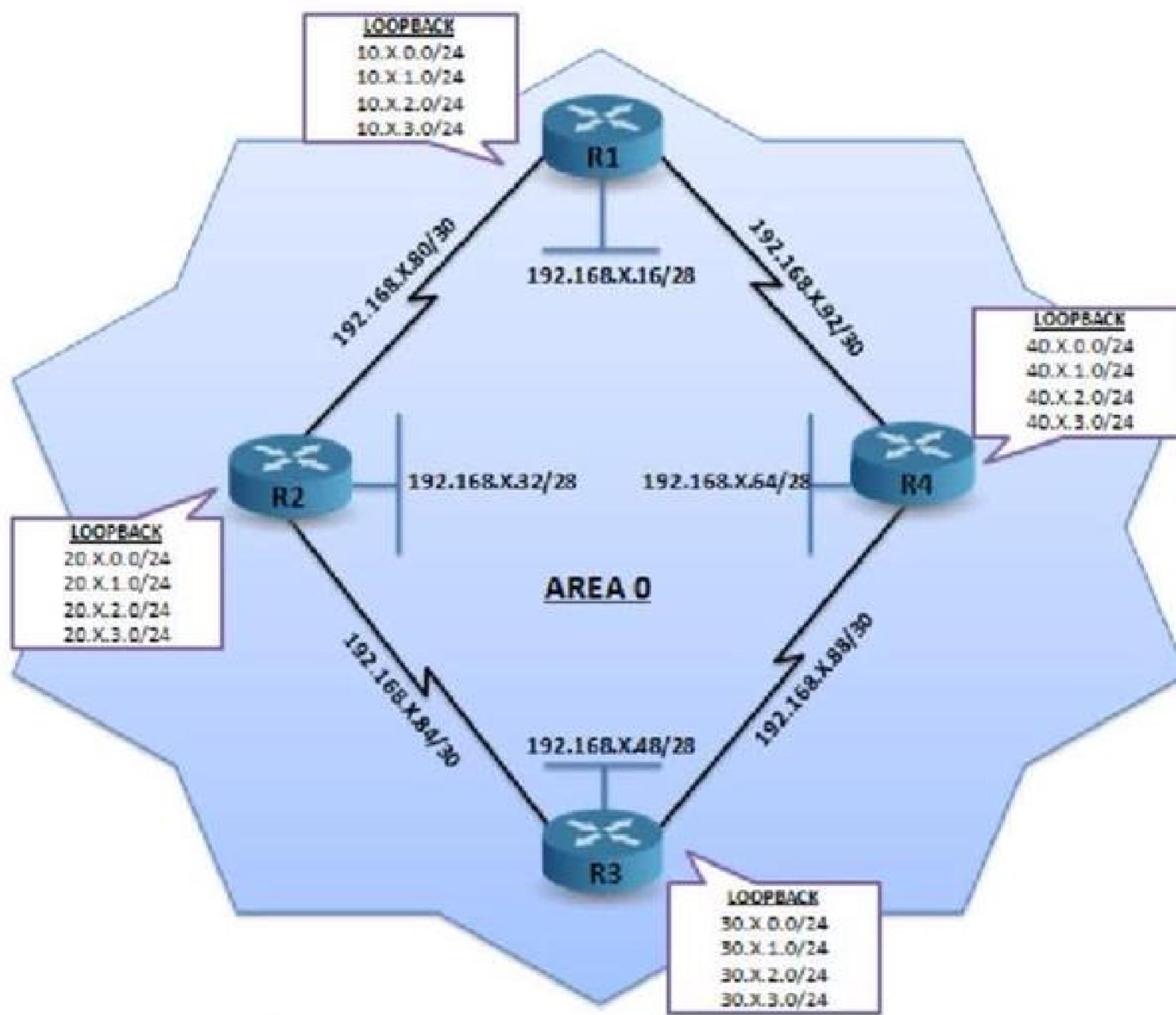
- D 10.1.3.0 [90/21152000] via 192.168.1.90, 00:00:03, Serial0/0/0  
[90/41152000] via 192.168.1.85, 00:00:03, Serial0/0/1
  - 20.0.0.0/24 is subnetted, 4 subnets
- D 20.1.0.0 [90/21664000] via 192.168.1.90, 00:00:03, Serial0/0/0  
[90/40640000] via 192.168.1.85, 00:00:03, Serial0/0/1
- D 20.1.1.0 [90/21664000] via 192.168.1.90, 00:00:03, Serial0/0/0  
[90/40640000] via 192.168.1.85, 00:00:03, Serial0/0/1
- D 20.1.2.0 [90/21664000] via 192.168.1.90, 00:00:03, Serial0/0/0  
[90/40640000] via 192.168.1.85, 00:00:03, Serial0/0/1
- D 20.1.3.0 [90/21664000] via 192.168.1.90, 00:00:03, Serial0/0/0  
[90/40640000] via 192.168.1.85, 00:00:03, Serial0/0/1
  - 30.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
- C 30.1.0.0/24 is directly connected, Loopback0
- L 30.1.0.1/32 is directly connected, Loopback0
- C 30.1.1.0/24 is directly connected, Loopback1
- L 30.1.1.1/32 is directly connected, Loopback1
- C 30.1.2.0/24 is directly connected, Loopback2
- L 30.1.2.1/32 is directly connected, Loopback2
- C 30.1.3.0/24 is directly connected, Loopback3
- L 30.1.3.1/32 is directly connected, Loopback3
  - 40.0.0.0/24 is subnetted, 4 subnets
- D 40.1.0.0 [90/20640000] via 192.168.1.90, 00:00:03, Serial0/0/0
- D 40.1.1.0 [90/20640000] via 192.168.1.90, 00:00:03, Serial0/0/0
- D 40.1.2.0 [90/20640000] via 192.168.1.90, 00:00:03, Serial0/0/0
- D 40.1.3.0 [90/20640000] via 192.168.1.90, 00:00:03, Serial0/0/0
  - 192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
- D 192.168.1.16/28 [90/21026560] via 192.168.1.90, 00:00:03, Serial0/0/0  
[90/41026560] via 192.168.1.85, 00:00:03, Serial0/0/1
- D 192.168.1.32/28 [90/21538560] via 192.168.1.90, 00:00:03, Serial0/0/0  
[90/40514560] via 192.168.1.85, 00:00:03, Serial0/0/1
- C 192.168.1.48/28 is directly connected, FastEthernet0/0
- L 192.168.1.49/32 is directly connected, FastEthernet0/0
- D 192.168.1.64/28 [90/20514560] via 192.168.1.90, 00:00:03, Serial0/0/0
- D 192.168.1.80/30 [90/21536000] via 192.168.1.90, 00:00:03, Serial0/0/0  
[90/41024000] via 192.168.1.85, 00:00:03, Serial0/0/1
- C 192.168.1.84/30 is directly connected, Serial0/0/1
- L 192.168.1.86/32 is directly connected, Serial0/0/1
- C 192.168.1.88/30 is directly connected, Serial0/0/0
- L 192.168.1.89/32 is directly connected, Serial0/0/0
- D 192.168.1.92/30 [90/21024000] via 192.168.1.90, 00:00:03, Serial0/0/0

## LAB 5: BASIC OSPF

### OBJECTIVE:

To establish connectivity between networks by configuring single area( area 0) OSPF on all routers.

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure OSPF in all routers on AREA 0.
- 4) Verify Tables in OSPF
- 5) Verify the connectivity using Ping command.

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF in all the routers

**R1 (config)#router ospf 100**

**R1 (config-router)# network 10.X.0.0 0.0.255.255 area 0**

**R1 (config-router)# network 192.168.X.16 0.0.0.15 area 0**

**R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0**

**R1 (config-router)# network 192.168.X.92 0.0.0.3 area 0**

**R2 (config)#router ospf 100**

**R2 (config-router)#network 20.X.0.0 0.0.255.255 area 0**

**R2 (config-router) #network 192.168.X.32 0.0.0.15 area 0**

**R2(config-router) #network 192.168.X.80 0.0.0.3 area 0**

**R2(config-router) #network 192.168.X.84 0.0.0.3 area 0**

**R3(config)#router ospf 100**

**R3(config-router)# network 30.X.0.0 0.0.255.255 area 0**

**R3(config-router)#network 192.168.X.48 0.0.0.15 area 0**

**R3(config-router) #network 192.168.X.84 0.0.0.3 area 0**

**R3(config-router) #network 192.168.X.88 0.0.0.3 area 0**

**R4(Config)# router ospf 100**

**R4(Config-router)# network 40.X.0.0 0.0.255.255 area 0**

**R4(Config-router)# network 192.168.X.64 0.0.0.15 area 0**

**R4 (Config-router)# network 192.168.X.88 0.0.0.3 area 0**

**R4(Config-router)# network 192.168.X.92 0.0.0.3 area 0**

**VERIFICATION:**

- Check the OSPF neighbor table, Database table and Routing Table on all the routers.

To check Neighbor Table use following command in all routers

**R1, R2, R3, R4#show ip ospf neighbor**

**R1#show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
20.1.3.1	0	FULL/ -	00:00:35	192.168.1.82	Serial0/1/1
40.1.3.1	0	FULL/ -	00:00:31	192.168.1.93	Serial0/1/0

To check Database Table use following command in all routers

**R1, R2, R3, R4#show ip ospf database**

**R1# show ip ospf database**

**OSPF Router with ID (10.1.3.1) (Process ID 1)**

**Router Link States (Area 0)**

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	136	0x80000002	0x002B5C 8	
20.1.3.1	20.1.3.1	150	0x80000003	0x0087C2 8	
30.1.3.1	30.1.3.1	138	0x80000002	0x0073D4 6	

**40.1.3.1 40.1.3.1 132 0x80000002 0x005D2C 9**

To check Routing Table use following command in all routers

R1, R2, R3, R4#show ip route

R1#show ip route

Codes: L - local, 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, H - NHRP, I – LISP

+ - replicated route, % - next hop override

10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks

C 10.1.1.0/24 is directly connected, Loopback1

L 10.1.1.1/32 is directly connected, Loopback1

C 10.1.2.0/24 is directly connected, Loopback2

L 10.1.2.1/32 is directly connected, Loopback2

C 10.1.3.0/24 is directly connected, Loopback3

L 10.1.3.1/32 is directly connected, Loopback3

20.0.0.0/32 is subnetted, 3 subnets

O 20.1.0.1 [110/782] via 192.168.1.82, 00:03:12, Serial0/1/1

O 20.1.1.1 [110/782] via 192.168.1.82, 00:03:12, Serial0/1/1

O 20.1.3.1 [110/782] via 192.168.1.82, 00:03:12, Serial0/1/1

30.0.0.0/32 is subnetted, 1 subnets

O 30.1.3.1 [110/1563] via 192.168.1.93, 00:02:58, Serial0/1/0

**40.0.0.0/32 is subnetted, 4 subnets**

O 40.1.0.1 [110/782] via 192.168.1.93, 00:02:58, Serial0/1/0

O 40.1.1.1 [110/782] via 192.168.1.93, 00:02:58, Serial0/1/0

O 40.1.2.1 [110/782] via 192.168.1.93, 00:02:58, Serial0/1/0

O 40.1.3.1 [110/782] via 192.168.1.93, 00:02:58, Serial0/1/0

192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks

C 192.168.1.16/28 is directly connected, FastEthernet0/0

L 192.168.1.17/32 is directly connected, FastEthernet0/0

O 192.168.1.32/28 [110/782] via 192.168.1.82, 00:03:12, Serial0/1/1

O 192.168.1.48/28 [110/1563] via 192.168.1.93, 00:02:58, Serial0/1/0

O 192.168.1.64/28 [110/782] via 192.168.1.93, 00:02:48, Serial0/1/0

C 192.168.1.80/30 is directly connected, Serial0/1/1

L 192.168.1.81/32 is directly connected, Serial0/1/1

O 192.168.1.84/30 [110/2343] via 192.168.1.82, 00:03:12, Serial0/1/1

O 192.168.1.88/30 [110/1562] via 192.168.1.93, 00:02:58, Serial0/1/0

C 192.168.1.92/30 is directly connected, Serial0/1/0

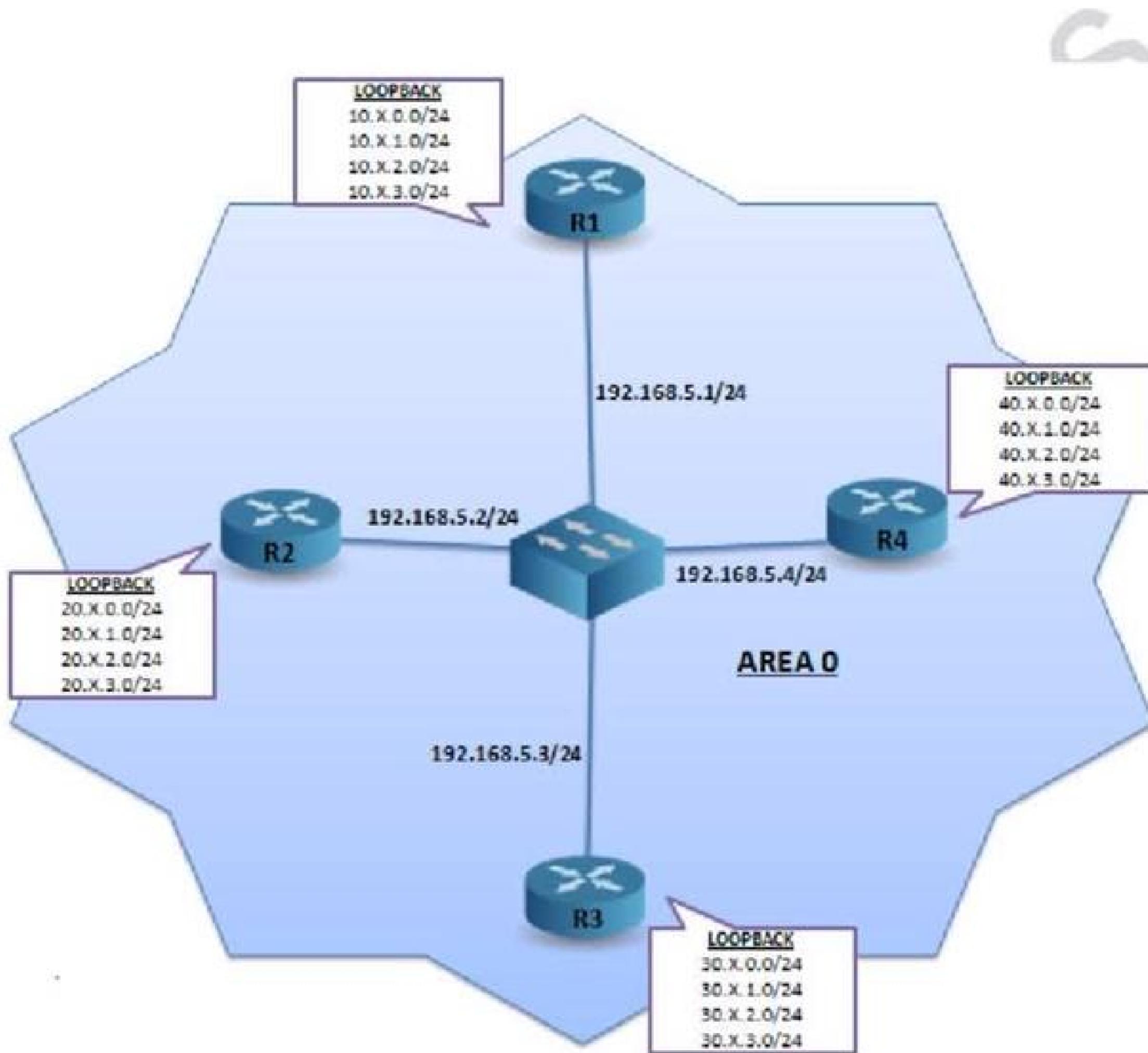
L 192.168.1.94/32 is directly connected, Serial0/1/0

## LAB 6: OSPF DR/BDR election

### OBJECTIVE:

To connect multiple OSPF routers in a broadcast multi-access network & To observe and control the OSPF DR/BDR election process.

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure OSPF in all routers by using AREA 0.
- 4) Verify Tables in OSPF
- 5) Make Sure that R1 becomes DR router and R2 becomes BDR router by changing the priority.

**STEPS:**

1. Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers and advertise only 192.168.5.0 network

**R1 (config)#router ospf 100**

**R1 (config-router)# network 192.168.5.0 0.0.0.255 area 0**

**R2 (config)#router ospf 100**

**R2 (config-router)#network 192.168.5.0 0.0.0.255 area 0**

**R3(config)#router ospf 100**

**R3(config-router)# network 192.168.5.0 0.0.0.255 area 0**

**R4(Config)# router ospf 100**

**R4(Config-router)# network 192.168.5.0 0.0.0.255 area 0**

- 4) Verify which router becomes a DR and BDR by executing the following command on all routers

**Router# show ip ospf neighbor**

- 5) Assign Priority to the routers in such a way that R1 router becomes DR and R2 router becomes BDR

**R1(config)# interface fastethernet 0/0**

**R1(config-if)# ip ospf priority 150**

**R2(config)# interface fastethernet 0/0**

**R2(config-if)# ip ospf priority 100**

**R3(config)# interface fastethernet 0/0**

**R3(config-if)# ip ospf priority 70**

**R4(config)# interface fastethernet 0/0**

**R4(config-if)# ip ospf priority 60**

**VERIFICATION:**

- To verify neighbour router status

**R3# show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.3.1	150	FULL/DR	00:00:38	192.168.5.1	FastEthernet0/0
20.1.1.1	100	FULL/BDR	00:00:32	192.168.5.2	FastEthernet0/0
40.1.3.1	60	2WAY/DROTHER	00:00:39	192.168.5.4	FastEthernet0/0

**To verify your router status****R3#show ip ospf interface fastethernet 0/0**

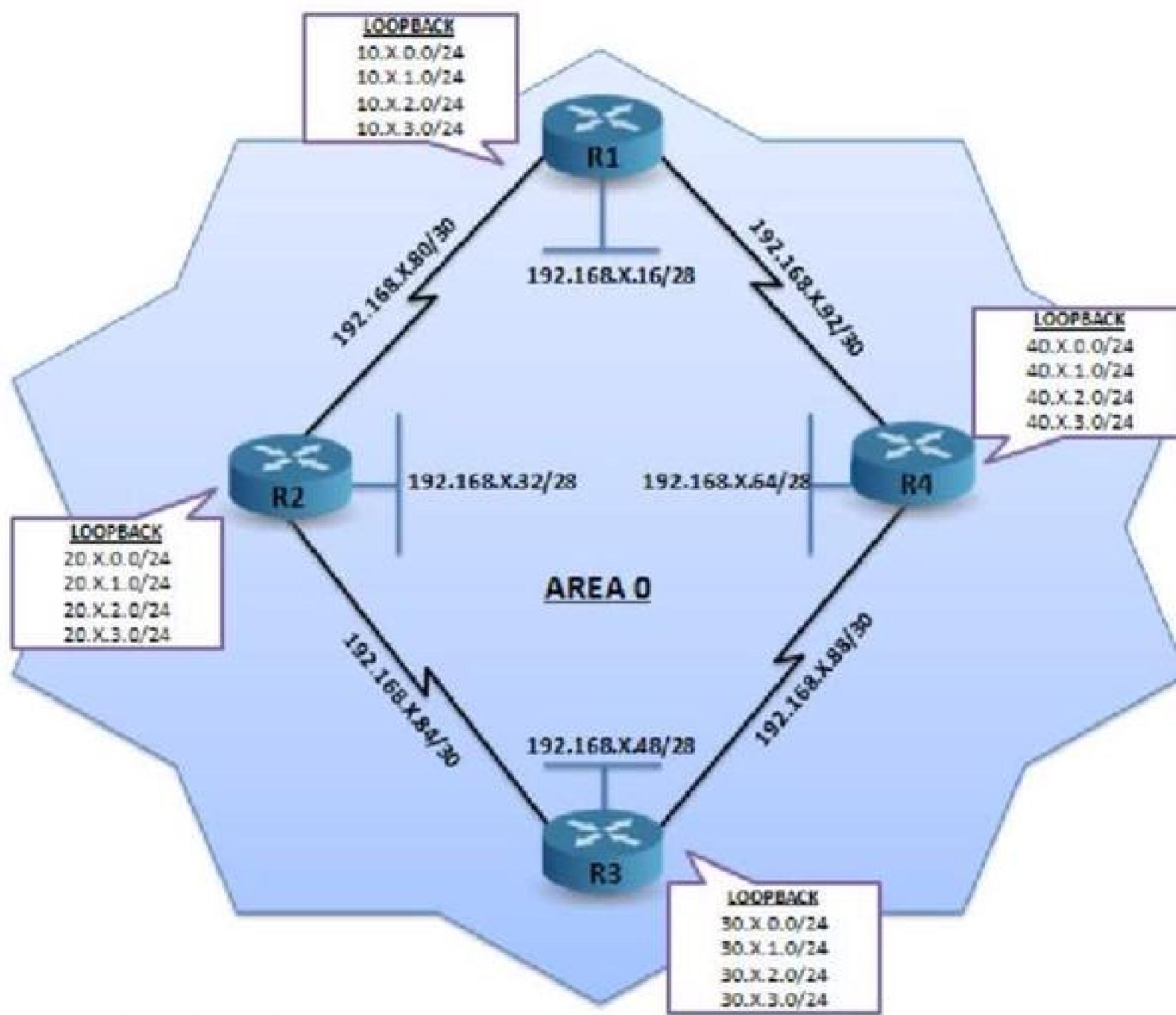
FastEthernet0/0 is up, line protocol is up  
Internet Address 192.168.5.3/24, Area 0  
Process ID 100, Router ID 30.1.3.1, Network Type BROADCAST, Cost: 1  
**Topology-MTID Cost Disabled Shutdown Topology Name**  
0 1 no no Base  
Transmit Delay is 1 sec, **State DROTHER**, Priority 70  
Designated Router (ID) 10.1.3.1, Interface address 192.168.5.1  
Backup Designated router (ID) 20.1.1.1, Interface address 192.168.5.2  
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5  
oob-resync timeout 40  
Hello due in 00:00:08  
Supports Link-local Signaling (LLS)  
Cisco NSF helper support enabled  
IETF NSF helper support enabled  
Index 1/1, flood queue length 0  
Next 0x0(0)/0x0(0)  
Last flood scan length is 0, maximum is 2  
Last flood scan time is 0 msec, maximum is 0 msec  
Neighbor Count is 3, Adjacent neighbor count is 2  
Adjacent with neighbor 10.1.3.1 (Designated Router)  
Adjacent with neighbor 20.1.1.1 (Backup Designated Router)  
Suppress hello for 0 neighbor(s)

## LAB 7: OSPF CLEAR TEXT AUTHENTICATION

### OBJECTIVE:

To configure OSPF Clear Text authentication between R1 and R2 routers

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure OSPF in all routers by using AREA 0
- 4) Verify Tables in OSPF
- 5) Configure clear text authentication between R1 router and R2 router. The password should be zoom.

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers

**R1 (config)#router ospf 100**

**R1 (config-router)# network 10.X.0.0 0.0.255.255 area 0**

**R1 (config-router)# network 192.168.X.16 0.0.0.15 area 0**

**R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0**

**R1 (config-router)# network 192.168.X.92 0.0.0.3 area 0**

**R2 (config)#router ospf 100**

**R2 (config-router)#network 20.X.0.0 0.0.255.255 area 0**

**R2 (config-router) #network 192.168.X.32 0.0.0.15 area 0**

**R2(config-router) #network 192.168.X.80 0.0.0.3 area 0**

**R2(config-router) #network 192.168.X.84 0.0.0.3 area 0**

**R3(config)#router ospf 100**

**R3(config-router)# network 30.X.0.0 0.0.255.255 area 0**

**R3(config-router)#network 192.168.X.48 0.0.0.15 area 0**

**R3(config-router) #network 192.168.X.84 0.0.0.3 area 0**

**R3(config-router) #network 192.168.X.88 0.0.0.3 area 0**

**R4(Config)# router ospf 100**

**R4(Config-router)# network 40.X.0.0 0.0.255.255 area 0**

**R4(Config-router)# network 192.168.X.64 0.0.0.15 area 0**

**R4 (Config-router)# network 192.168.X.88 0.0.0.3 area 0**

**R4(Config-router)# network 192.168.X.92 0.0.0.3 area 0**

- 4) Verify Tables in OSPF before configuring authentication in all the routers

**Router# show ip ospf neighbor**

**Router# show ip ospf database**

**Router# show ip route**

- 5) Configure clear text authentication on the serial interfaces between R1 router and R2 router.

The password should be zoom.

**R1#show cdp neighbors**

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge

S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,

D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
R2	Ser 0/1/1	153	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	173	R S I	2811	Ser 0/0/0

**R1(config)#interface serial 0/1/1**

**R1(config-if)# ip ospf authentication**

R1(config-if)# ip ospf authentication-key zoom

R2#show cdp neighbors

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge

S - Switch, H - Host, I - IGMP, r - Repeater

Device ID	Local Intrfce	Holddme	Capability	Platform	Port ID
R3	Ser 0/1/1	153	R S I	2811	Ser 0/0/1
R1	Ser 0/1/0	173	R S I	2811	Ser 0/0/0

R2(config)#interface serial 0/0/1

R2(config-if)#ip ospf authentication

R2(config-if)#ip ospf authentication-key zoom

#### VERIFICATION:

- To check whether OSPF authentication is enabled or not

R2#show ip ospf interface serial 0/0/1

Serial0/0/1 is up, line protocol is up

Internet Address 192.168.1.82/30, Area 0

Process ID 100, Router ID 20.1.3.1, Network Type POINT\_TO\_POINT, Cost: 781

Topology-MTID	Cost	Disabled	Shutdown	Topology Name
0	781	no	no	Base

Transmit Delay is 1 sec, State POINT\_TO\_POINT

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5 oob-resync timeout 40

Hello due in 00:00:05

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 4/4, flood queue length 0

Next 0x0(0)/0x0(0)

Last flood scan length is 1, maximum is 2

Last flood scan time is 0 msec, maximum is 0 msec

Neighbor Count is 1, Adjacent neighbor count is 1

Adjacent with neighbor 10.1.3.1

Suppress hello for 0 neighbor(s)

Simple password authentication enabled

R1#show ip ospf interface serial 0/1/1

Serial0/1/1 is up, line protocol is up

Internet Address 192.168.1.81/30, Area 0

Process ID 100, Router ID 10.1.3.1, Network Type POINT\_TO\_POINT, Cost: 781

Topology-MTID	Cost	Disabled	Shutdown	Topology Name
0	781	no	no	Base

Transmit Delay is 1 sec, State POINT\_TO\_POINT

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5 oob-resync timeout 40

Hello due in 00:00:01

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 3/3, flood queue length 0

Next 0x0(0)/0x0(0)

Last flood scan length is 1, maximum is 2  
Last flood scan time is 0 msec, maximum is 4 msec  
Neighbor Count is 1, Adjacent neighbor count is 1  
Adjacent with neighbor 20.1.3.1  
Suppress hello for 0 neighbor(s)  
**Simple password authentication enabled**

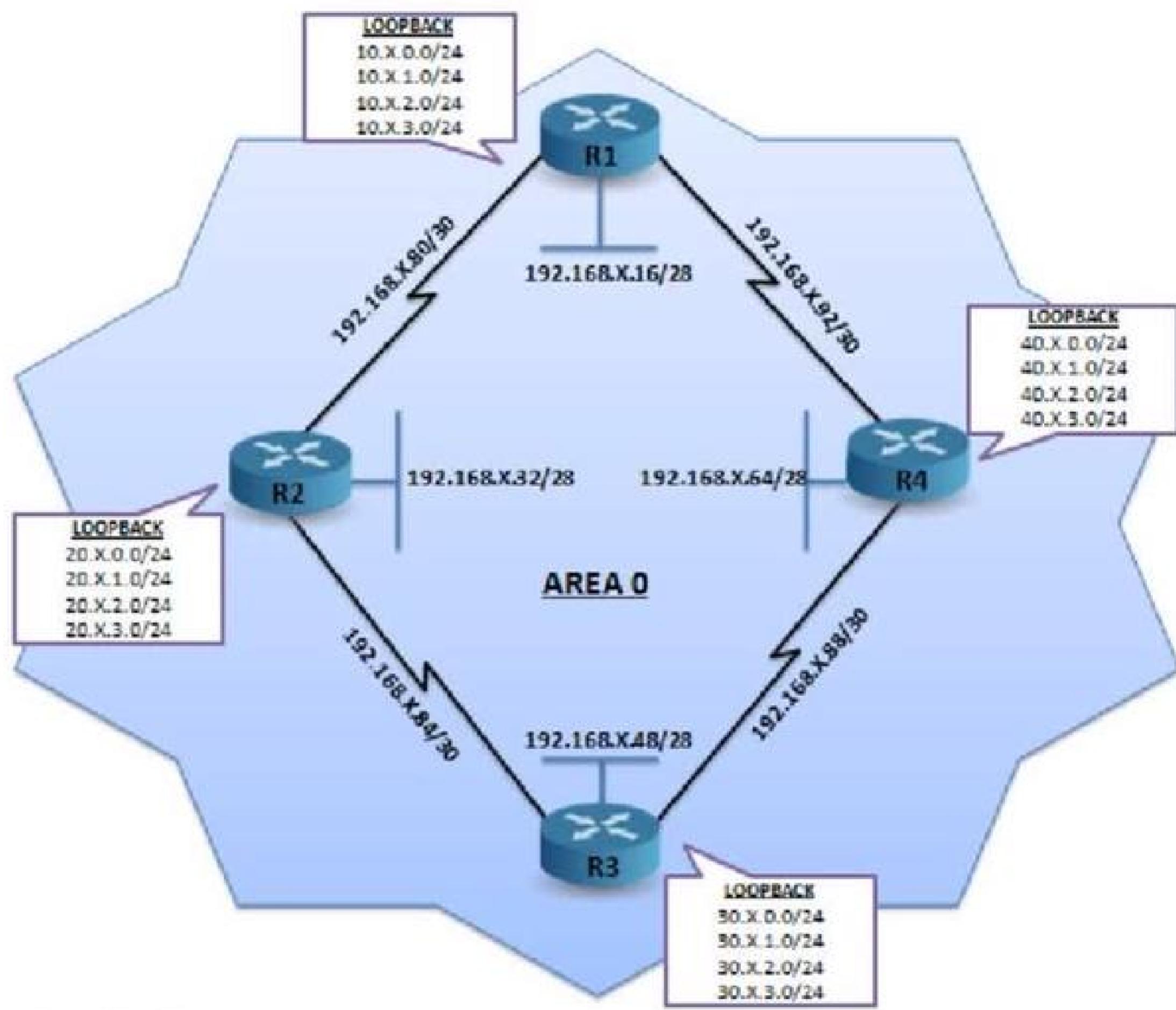
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## LAB 8: OSPF MD-5 AUTHENTICATION

### OBJECTIVE:

To configure OSPF MD-5 authentication between R1 and R2 routers

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure OSPF in all routers by using AREA 0
- 4) Verify Tables in OSPF
- 5) Configure Message Digest authentication between R1 router and R2 router. The key number is 1 and Key name should be zoom.

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers

```
R1 (config)#router ospf 100
R1 (config-router)# network 10.X.0.0 0.0.255.255 area 0
R1 (config-router)# network 192.168.X.16 0.0.0.15 area 0
R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0
R1 (config-router)# network 192.168.X.92 0.0.0.3 area 0
R2 (config)#router ospf 100
R2 (config-router)#network 20.X.0.0 0.0.255.255 area 0
R2 (config-router) #network 192.168.X.32 0.0.0.15 area 0
R2(config-router) #network 192.168.X.80 0.0.0.3 area 0
R2(config-router) #network 192.168.X.84 0.0.0.3 area 0
R3(config)#router ospf 100
R3(config-router)# network 30.X.0.0 0.0.255.255 area 0
R3(config-router)#network 192.168.X.48 0.0.0.15 area 0
R3(config-router) #network 192.168.X.84 0.0.0.3 area 0
R3(config-router) #network 192.168.X.88 0.0.0.3 area 0
R4(Config)# router ospf 100
R4(Config-router)# network 40.X.0.0 0.0.255.255 area 0
R4(Config-router)# network 192.168.X.64 0.0.0.15 area 0
R4 (Config-router)# network 192.168.X.88 0.0.0.3 area 0
R4(Config-router)# network 192.168.X.92 0.0.0.3 area 0
```

- 4) Verify Tables in OSPF before configuring authentication in all the routers

**Router# show ip ospf neighbor**

**Router# show ip ospf database**

**Router# show ip route**

- 5) Configure Message Digest authentication on the serial interfaces between R1 and R2. The key number should be 1 and Key name should be zoom.

**R1#show cdp neighbors**

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge

S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,

D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID	Local Intrfce	Holddtme	Capability	Platform	Port ID
R2	Ser 0/1/1	153	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	173	R S I	2811	Ser 0/0/0

```
R1(config)#interface serial 0/1/1
R1(config-if)# ip ospf authentication message-digest
R1(config-if)# ip ospf message-digest-key 1 md5 zoom
```

#### R2#show cdp neighbors

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge

S - Switch, H - Host, I - IGMP, r - Repeater

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
R3	Ser 0/1/1	153	R S I	2811	Ser 0/0/1
R1	Ser 0/0/1	173	R S I	2811	Ser 0/1/1

```
R2(config)#interface serial 0/0/1
R2(config-if)#ip ospf authentication message-digest
R2(config-if)#ip ospf messege-digest-key 1 md5 zoom
```

#### VERIFICATION:

- To check whether OSPF authentication is enabled or not

```
R2#show ip ospf interface serial 0/0/1
```

```
Serial0/0/1 is up, line protocol is up
Internet Address 192.168.1.82/30, Area 0
Process ID 100, Router ID 20.1.3.1, Network Type POINT_TO_POINT, Cost: 781
Topology-MTID Cost Disabled Shutdown Topology Name
      0      781    no    no      Base
Transmit Delay is 1 sec, State POINT_TO_POINT
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5 oob-resync timeout 40
Hello due in 00:00:05
Supports Link-local Signaling (LLS)
Cisco NSF helper support enabled
IETF NSF helper support enabled
Index 4/4, flood queue length 0
Next 0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 2
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 1, Adjacent neighbor count is 1
Adjacent with neighbor 10.1.3.1
Suppress hello for 0 neighbor(s)
Message digest authentication enabled
Youngest key id is 1
```

```
R1#show ip ospf interface serial 0/1/1
```

Serial0/1/1 is up, line protocol is up

Internet Address 192.168.1.81/30, Area 0

Process ID 100, Router ID 10.1.3.1, Network Type POINT\_TO\_POINT, Cost: 781

Topology-MTID Cost Disabled Shutdown Topology Name

0 781 no no Base

Transmit Delay is 1 sec, State POINT\_TO\_POINT

Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5 oob-resync timeout 40

Hello due in 00:00:01

Supports Link-local Signaling (LLS)

Cisco NSF helper support enabled

IETF NSF helper support enabled

Index 3/3, flood queue length 0

Next 0x0(0)/0x0(0)

Last flood scan length is 1, maximum is 2

Last flood scan time is 0 msec, maximum is 4 msec

Neighbor Count is 1, Adjacent neighbor count is 1

Adjacent with neighbor 20.1.3.1

Suppress hello for 0 neighbor(s)

**Message digest authentication enabled**

**Youngest key id is 1**

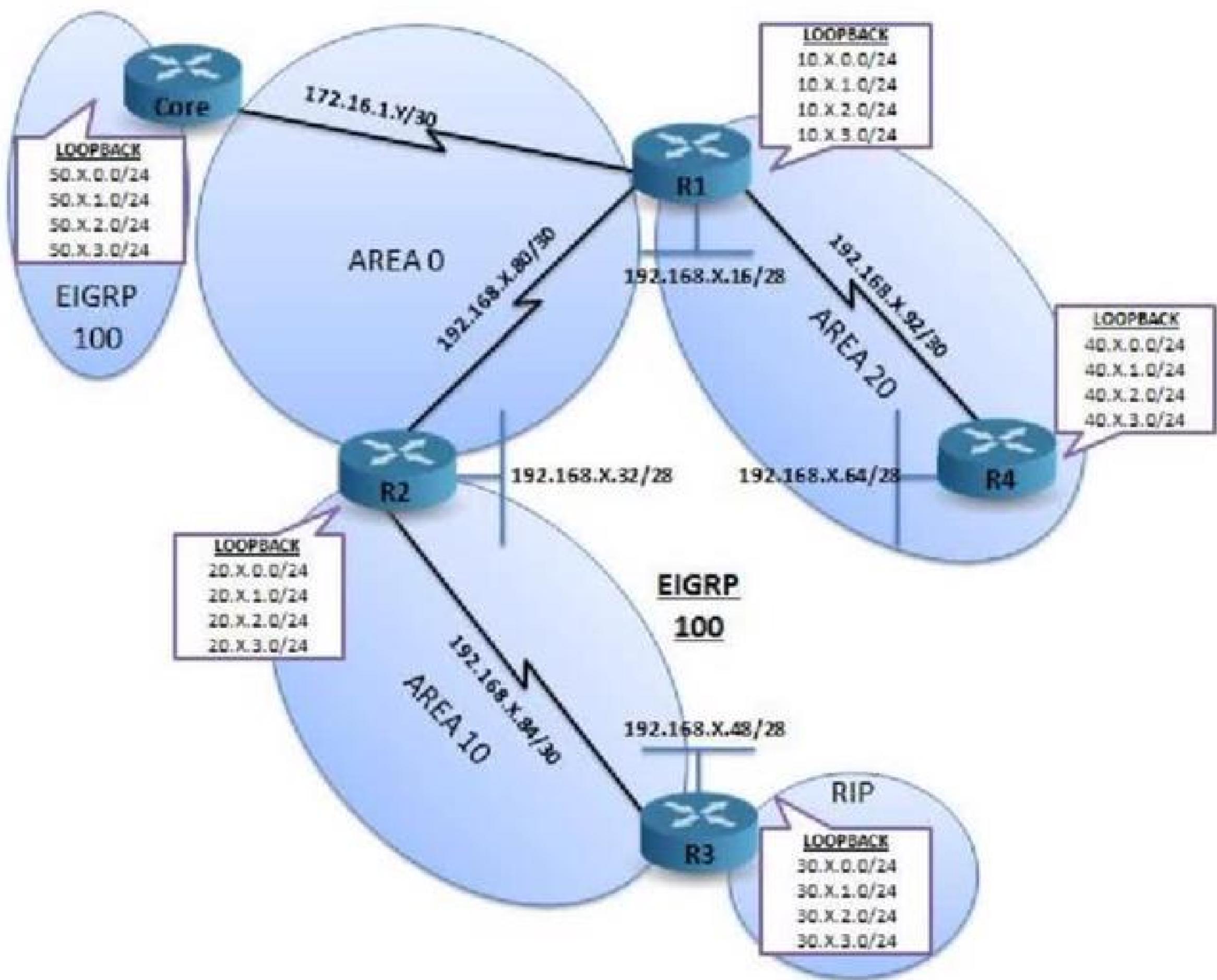
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## LAB 9: MULTI AREAOSPF

### OBJECTIVE:

To configure OSPF routers in multiple areas with a central backbone area (area 0)

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure Routers in Multi Area OSPF as per given topology.
- 4) Configure redistribution from RIP and EIGRP
- 5) Verify Tables in OSPF.

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.  
**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers

```
R1(config)# router ospf 100
R1(config-router)#network 192.168.X.16 0.0.0.15 area 20
R1(config-router)#network 192.168.X.80 0.0.0.3 area 0
R1(config-router)#network 192.168.X.92 0.0.0.3 area 20
R1(config-router)# network 10.X.0.0 0.0.0.255.255 area 20
R1(config-router)#exit
R2(config)#router ospf 100
R2(Config-router)#network 192.168.X.80 0.0.0.3 area 0
R2(Config-router)#network 192.168.X.32 0.0.0.15 area 10
R2(Config-router)#network 192.168.X.84 0.0.0.3 area 10
R2(Config-router)#network 20.X.0.0 0.0.0.255.255 area 10
R2(Config-router)#exit
R3(config)#router ospf 100
R3(config-router)# network 192.168.X.0 0.0.0.255 area 10
R3(config-router)#exit
R3(config)#router rip
R3(config-router)#version 2
R3(config-router)#network 30.0.0.0
R3(config-router)#no auto-summary
R3(config-router)#exit
R4(config)#router ospf 100
R4(config-router)# network 192.168.X.0 0.0.0.255 area 20
R4(config-router)#network 40.X.0.0 0.0.0.255.255 area 20
R4(config-router)#end
Core(config)# router ospf 100
Core(config-router)# network 172.16.X.0 0.0.0.3 area 0
core(config)#router eigrp 100
core(config-router)#no auto-summary
core(config-router)#network 50.0.0.0
core(config-router)#exit
```

- 4) Configure redistribution of RIP routes from R3 Router and EIGRP router from Core into OSPF.

```
R3(config)#router ospf 100
R3(config-router)#redistribute rip subnets
Core(config)# router ospf 100
Core(config-router)#redistribute eigrp 100 subnets
```

#### **VERIFICATION:**

- Check OSPF Neighbor Table in all the routers.

**R1,R2,R3,R4# show ip ospf neighbour**

**R4# show ip ospf neighbor**

Neighbor ID	Pri	State	Dead Time	Address	Interface
10.1.3.1	0	FULL/-	00:00:37	192.168.1.94	Serial0/0/0

->Check OSPF Database Table in all the routers.

**R1,R2,R3, R4#show ip ospf database**

**R4#show ip ospf database**

OSPF Router with ID (40.1.3.1) (Process ID 1)					
Router Link States (Area 20)					
Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	564	0x80000003	0x00E768	6
40.1.3.1	40.1.3.1	142	0x80000004	0x00E2AA	8
Summary Net Link States (Area 20)					
Link ID	ADV Router	Age	Seq#	Checksum	
20.1.0.1	10.1.3.1	199	0x80000001	0x00986E	
20.1.1.1	10.1.3.1	199	0x80000001	0x008D78	
20.1.3.1	10.1.3.1	199	0x80000001	0x00778C	
172.16.1.0	10.1.3.1	759	0x80000001	0x00FD32	
172.16.1.3	10.1.3.1	759	0x80000001	0x006BB4	
192.168.1.32	10.1.3.1	199	0x80000001	0x005B46	
192.168.1.80	10.1.3.1	759	0x80000001	0x00B7AE	
192.168.1.84	10.1.3.1	199	0x80000001	0x00CA77	
Summary ASB Link States (Area 20)					
Link ID	ADV Router	Age	Seq#	Checksum	
30.1.3.1	10.1.3.1	199	0x80000001	0x0018C1	
40.1.3.1	10.1.3.1	22	0x80000001	0x003F80	
Type-5 AS External Link States					
Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	84	0x80000001	0x00015A	0
50.1.0.0	40.1.3.1	3606	0x80000006	0x00EF5F	0
50.1.1.0	40.1.3.1	3606	0x80000006	0x00E469	0
50.1.2.0	40.1.3.1	3606	0x80000006	0x00D973	0
50.1.3.0	40.1.3.1	3606	0x80000006	0x00CE7D	0

→ Check Routing Table in all the routers.

R1,R2,R3,R4# show ip route

R1# show ip route

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks

C 10.1.1.0/24 is directly connected, Loopback1

L 10.1.1.1/32 is directly connected, Loopback1

C 10.1.2.0/24 is directly connected, Loopback2

L 10.1.2.1/32 is directly connected, Loopback2

C 10.1.3.0/24 is directly connected, Loopback3

L 10.1.3.1/32 is directly connected, Loopback3

20.0.0.0/32 is subnetted, 3 subnets

O IA 20.1.0.1 [110/782] via 192.168.1.82, 00:34:44, Serial0/1/1

O IA 20.1.1.1 [110/782] via 192.168.1.82, 00:34:44, Serial0/1/1

O IA 20.1.3.1 [110/782] via 192.168.1.82, 00:34:44, Serial0/1/1

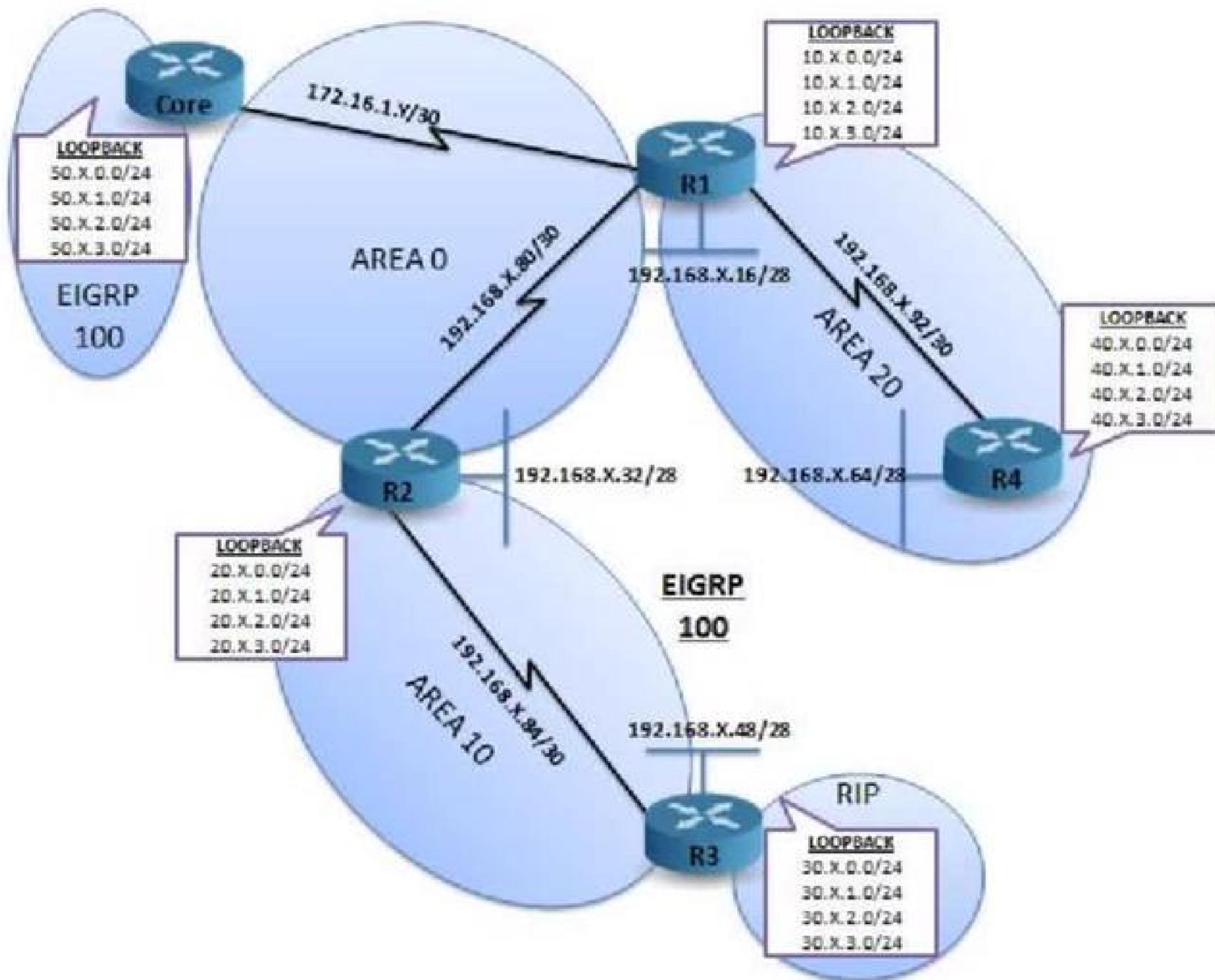
30.0.0.0/24 is subnetted, 1 subnets  
O E2 30.1.3.0 [110/20] via 192.168.1.82, 00:32:47, Serial0/1/1  
40.0.0.0/32 is subnetted, 4 subnets  
O 40.1.0.1 [110/782] via 192.168.1.93, 00:40:45, Serial0/1/0  
O 40.1.1.1 [110/782] via 192.168.1.93, 00:40:45, Serial0/1/0  
O 40.1.2.1 [110/782] via 192.168.1.93, 00:40:45, Serial0/1/0  
O 40.1.3.1 [110/782] via 192.168.1.93, 00:40:45, Serial0/1/0  
50.0.0.0/24 is subnetted, 4 subnets  
O E2 50.1.0.0 [110/20] via 172.16.1.1, 00:00:04, Serial0/3/1  
O E2 50.1.1.0 [110/20] via 172.16.1.1, 00:00:04, Serial0/3/1  
O E2 50.1.2.0 [110/20] via 172.16.1.1, 00:00:04, Serial0/3/1  
O E2 50.1.3.0 [110/20] via 172.16.1.1, 00:00:03, Serial0/3/1  
172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks  
C 172.16.1.0/24 is directly connected, Serial0/3/1  
O 172.16.1.0/30 [110/845] via 172.16.1.1, 00:44:04, Serial0/3/1  
L 172.16.1.2/32 is directly connected, Serial0/3/1  
192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks  
C 192.168.1.16/28 is directly connected, FastEthernet0/0  
L 192.168.1.17/32 is directly connected, FastEthernet0/0  
O IA 192.168.1.32/28 [110/782] via 192.168.1.82, 00:34:44, Serial0/1/1  
O 192.168.1.64/28 [110/782] via 192.168.1.93, 00:33:43, Serial0/1/0  
C 192.168.1.80/30 is directly connected, Serial0/1/1  
L 192.168.1.81/32 is directly connected, Serial0/1/1  
O IA 192.168.1.84/30 [110/2343] via 192.168.1.82, 00:34:44, Serial0/1/1  
O 192.168.1.88/30 [110/1562] via 192.168.1.93, 00:40:45, Serial0/1/0  
C 192.168.1.92/30 is directly connected, Serial0/1/0  
L 192.168.1.94/32 is directly connected, Serial0/1/0

## LAB 10: OSPF INTERNAL SUMMARIZATION

### OBJECTIVE:

To configure and verify Internal Summarization in OSPF

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure Routers in Multi Area OSPF as per given topology.
- 4) Verify Tables in OSPF.
- 5) Verify the Internal Summarization in OSPF

**STEPS:**

- 1) Verify the interface status by using Show ip interface brief command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers as done in Multi Area OSPF lab.

- 4) Verify Tables in OSPF before configuring authentication in all the routers

**Router# show ip ospf neighbor**

**Router# show ip ospf database**

**Router# show ip route**

- 5) Before Summarization

**R2# show ip route**

Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

10.0.0.0/32 is subnetted, 3 subnets

O IA 10.1.1.1 [110/782] via 192.168.1.81, 00:43:40, Serial0/0/1

O IA 10.1.2.1 [110/782] via 192.168.1.81, 00:43:40, Serial0/0/1

O IA 10.1.3.1 [110/782] via 192.168.1.81, 00:43:40, Serial0/0/1

20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks

C 20.1.0.0/24 is directly connected, Loopback0

L 20.1.0.1/32 is directly connected, Loopback0

C 20.1.1.0/24 is directly connected, Loopback1

L 20.1.1.1/32 is directly connected, Loopback1

C 20.1.3.0/24 is directly connected, Loopback3

L 20.1.3.1/32 is directly connected, Loopback3

30.0.0.0/24 is subnetted, 1 subnets

O E2 30.1.3.0 [110/20] via 192.168.1.86, 00:41:44, Serial0/0/0

40.0.0.0/32 is subnetted, 4 subnets

O IA 40.1.0.1 [110/1563] via 192.168.1.81, 00:43:40, Serial0/0/1

O IA 40.1.1.1 [110/1563] via 192.168.1.81, 00:43:40, Serial0/0/1

O IA 40.1.2.1 [110/1563] via 192.168.1.81, 00:43:40, Serial0/0/1

O IA 40.1.3.1 [110/1563] via 192.168.1.81, 00:43:40, Serial0/0/1

172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks

O 172.16.1.0/24 [110/845] via 192.168.1.81, 00:43:40, Serial0/0/1

O 172.16.1.0/30 [110/1626] via 192.168.1.81, 00:43:40, Serial0/0/1

192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks

O IA 192.168.1.16/28 [110/782] via 192.168.1.81, 00:43:40, Serial0/0/1

C 192.168.1.32/28 is directly connected, FastEthernet0/0

L 192.168.1.33/32 is directly connected, FastEthernet0/0

```
O IA 192.168.1.64/28 [110/1563] via 192.168.1.81, 00:42:40, Serial0/0/1
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
C 192.168.1.84/30 is directly connected, Serial0/0/0
L 192.168.1.85/32 is directly connected, Serial0/0/0
O IA 192.168.1.88/30 [110/2343] via 192.168.1.81, 00:43:40, Serial0/0/1
O IA 192.168.1.92/30 [110/1562] via 192.168.1.81, 00:43:40, Serial0/0/1
```

- 6) Configure Internal Summarization in R1 router for 40.0.0.0 networks.

```
R1 (config)# router ospf 100
R1 (config-router)#area 20 range 40.X.0.0 255.255.252.0
```

Note: Internal Summarization should be configured only on Area Border Routers.

#### VERIFICATION:

##### → After Summarization

**R2#show ip route**

Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

```
10.0.0.0/32 is subnetted, 3 subnets
O IA 10.1.1.1 [110/782] via 192.168.1.81, 00:44:29, Serial0/0/1
O IA 10.1.2.1 [110/782] via 192.168.1.81, 00:44:29, Serial0/0/1
O IA 10.1.3.1 [110/782] via 192.168.1.81, 00:44:29, Serial0/0/1
20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C 20.1.0.0/24 is directly connected, Loopback0
L 20.1.0.1/32 is directly connected, Loopback0
C 20.1.1.0/24 is directly connected, Loopback1
L 20.1.1.1/32 is directly connected, Loopback1
C 20.1.3.0/24 is directly connected, Loopback3
L 20.1.3.1/32 is directly connected, Loopback3
30.0.0.0/24 is subnetted, 1 subnets
O E2 30.1.3.0 [110/20] via 192.168.1.86, 00:42:33, Serial0/0/0
```

#### 40.0.0.0/22 is subnetted, 1 subnets

```
O IA 40.1.0.0 [110/1563] via 192.168.1.81, 00:00:07, Serial0/0/1
172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
O 172.16.1.0/24 [110/845] via 192.168.1.81, 00:44:29, Serial0/0/1
O 172.16.1.0/30 [110/1626] via 192.168.1.81, 00:44:29, Serial0/0/1
192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
O IA 192.168.1.16/28 [110/782] via 192.168.1.81, 00:44:29, Serial0/0/1
C 192.168.1.32/28 is directly connected, FastEthernet0/0
L 192.168.1.33/32 is directly connected, FastEthernet0/0
O IA 192.168.1.64/28 [110/1563] via 192.168.1.81, 00:43:29, Serial0/0/1
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
```

C 192.168.1.84/30 is directly connected, Serial0/0/0  
L 192.168.1.85/32 is directly connected, Serial0/0/0  
O IA 192.168.1.88/30 [110/2343] via 192.168.1.81, 00:44:29, Serial0/0/1  
O IA 192.168.1.92/30 [110/1562] via 192.168.1.81, 00:44:29, Serial0/0/1

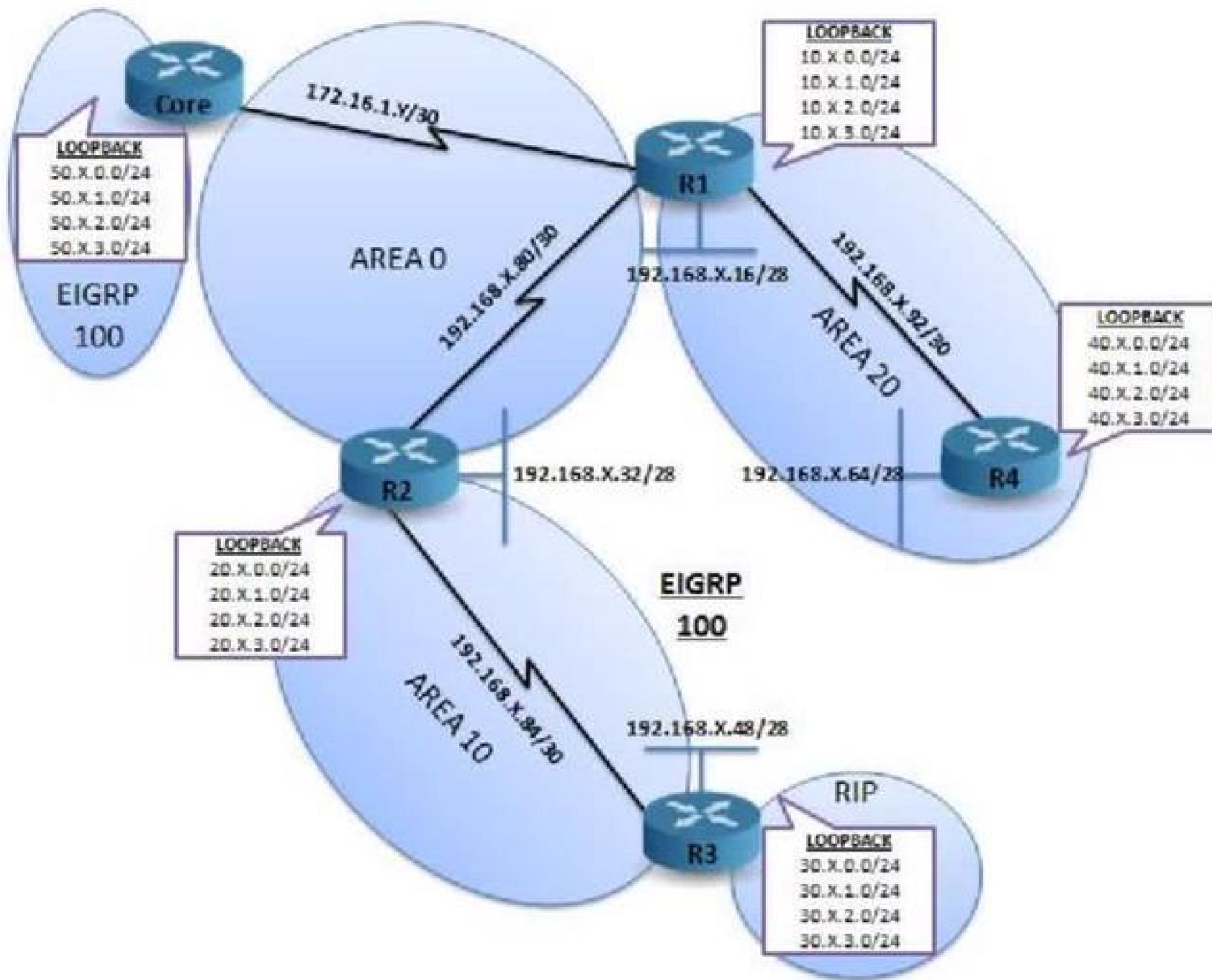
Zoom Technologies

## LAB 11: OSPF EXTERNAL SUMMARIZATION

### OBJECTIVE:

To configure and verify External Summarization in OSPF

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure Routers in Multi Area OSPF as per given topology.
- 4) Verify Tables in OSPF.
- 5) Check routing tables before summarization
- 6) Verify the External Summarization in OSPF

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers as done in Multi Area OSPF Lab.

- 4) Verify Tables in OSPF before configuring authentication in all the routers

**Router# show ip ospf neighbor**

**Router# show ip ospf database**

**Router# show ip route**

- 5) Verify routing tables before summarization

→ **Before Summarization**

**R1# show ip route**

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks

C 10.1.1.0/24 is directly connected, Loopback1

L 10.1.1.1/32 is directly connected, Loopback1

C 10.1.2.0/24 is directly connected, Loopback2

L 10.1.2.1/32 is directly connected, Loopback2

C 10.1.3.0/24 is directly connected, Loopback3

L 10.1.3.1/32 is directly connected, Loopback3

20.0.0.0/32 is subnetted, 3 subnets

O IA 20.1.0.1 [110/782] via 192.168.1.82, 00:04:42, Serial0/1/1

O IA 20.1.1.1 [110/782] via 192.168.1.82, 00:04:42, Serial0/1/1

O IA 20.1.3.1 [110/782] via 192.168.1.82, 00:04:42, Serial0/1/1

30.0.0.0/24 is subnetted, 1 subnets

O E2 30.1.3.0 [110/20] via 192.168.1.82, 00:04:42, Serial0/1/1

40.0.0.0/8 is variably subnetted, 5 subnets, 2 masks

O 40.1.0.0/22 is a summary, 00:04:42, Null0

O 40.1.0.1/32 [110/782] via 192.168.1.93, 00:04:42, Serial0/1/0

O 40.1.1.1/32 [110/782] via 192.168.1.93, 00:04:42, Serial0/1/0

O 40.1.2.1/32 [110/782] via 192.168.1.93, 00:04:42, Serial0/1/0

40.1.3.1/32 [110/782] via 192.168.1.93, 00:04:42, Serial0/1/0

```

50.0.0.0/24 is subnetted, 4 subnets
O E2  50.1.0.0 [110/20] via 172.16.1.1, 00:00:05, Serial0/3/1
O E2  50.1.1.0 [110/20] via 172.16.1.1, 00:00:01, Serial0/3/1
O E2  50.1.2.0 [110/20] via 172.16.1.1, 00:00:02, Serial0/3/1
O E2  50.1.3.0 [110/20] via 172.16.1.1, 00:00:01, Serial0/3/1
    172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks
C    172.16.1.0/24 is directly connected, Serial0/3/1
O    172.16.1.0/30 [110/845] via 172.16.1.1, 00:04:42, Serial0/3/1
L    172.16.1.2/32 is directly connected, Serial0/3/1
    192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
C    192.168.1.16/28 is directly connected, FastEthernet0/0
L    192.168.1.17/32 is directly connected, FastEthernet0/0
O IA  192.168.1.32/28 [110/782] via 192.168.1.82, 00:04:42, Serial0/1/1
O    192.168.1.64/28 [110/782] via 192.168.1.93, 00:04:42, Serial0/1/0
C    192.168.1.80/30 is directly connected, Serial0/1/1
L    192.168.1.81/32 is directly connected, Serial0/1/1
O IA  192.168.1.84/30 [110/2343] via 192.168.1.82, 00:04:42, Serial0/1/1
O    192.168.1.88/30 [110/1562] via 192.168.1.93, 00:04:42, Serial0/1/0
C    192.168.1.92/30 is directly connected, Serial0/1/0
L    192.168.1.94/32 is directly connected, Serial0/1/0

```

- 6) Configure External Summarization in Core router.

```

Core (config)# router ospf 100
Core (config-router)#summary-address 50.X.0.0 255.255.252.0

```

Note: External Summarization should be configured on Autonomous System Boundary Routers only.

## VERIFICATION:

### → After Summarization

```
R1#show ip route
```

Codes: L - local, 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, H - NHRP, I - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is not set

```

10.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C    10.1.1.0/24 is directly connected, Loopback1
L    10.1.1.1/32 is directly connected, Loopback1
C    10.1.2.0/24 is directly connected, Loopback2
L    10.1.2.1/32 is directly connected, Loopback2
C    10.1.3.0/24 is directly connected, Loopback3
L    10.1.3.1/32 is directly connected, Loopback3
    20.0.0.0/32 is subnetted, 3 subnets
O IA  20.1.0.1 [110/782] via 192.168.1.82, 00:04:50, Serial0/1/1

```

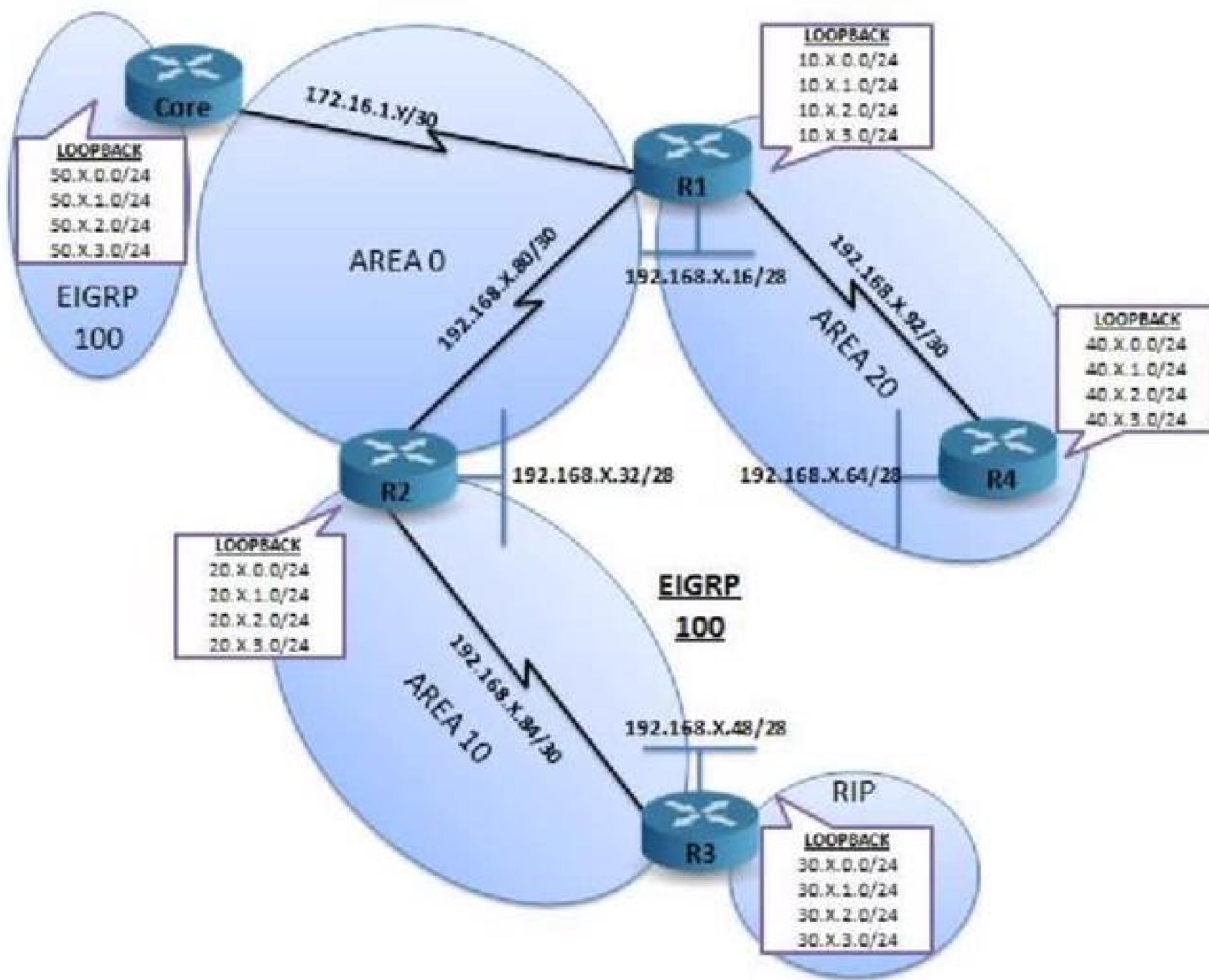
O IA 20.1.1.1 [110/782] via 192.168.1.82, 00:04:50, Serial0/1/1  
O IA 20.1.3.1 [110/782] via 192.168.1.82, 00:04:50, Serial0/1/1  
    30.0.0.0/24 is subnetted, 1 subnets  
O E2 30.1.3.0 [110/20] via 192.168.1.82, 00:04:50, Serial0/1/1  
    40.0.0.0/8 is variably subnetted, 5 subnets, 2 masks  
O    40.1.0.0/22 is a summary, 00:04:50, Null0  
O    40.1.0.1/32 [110/782] via 192.168.1.93, 00:04:50, Serial0/1/0  
O    40.1.1.1/32 [110/782] via 192.168.1.93, 00:04:50, Serial0/1/0  
O    40.1.2.1/32 [110/782] via 192.168.1.93, 00:04:50, Serial0/1/0  
O    40.1.3.1/32 [110/782] via 192.168.1.93, 00:04:50, Serial0/1/0  
50.0.0.0/24 is subnetted, 2 subnets  
O E2 50.1.0.0 [110/20] via 172.16.1.1, 00:00:13, Serial0/3/1  
    172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks  
C    172.16.1.0/24 is directly connected, Serial0/3/1  
O    172.16.1.0/30 [110/845] via 172.16.1.1, 00:04:50, Serial0/3/1  
L    172.16.1.2/32 is directly connected, Serial0/3/1  
    192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks  
C    192.168.1.16/28 is directly connected, FastEthernet0/0  
L    192.168.1.17/32 is directly connected, FastEthernet0/0  
O IA 192.168.1.32/28 [110/782] via 192.168.1.82, 00:04:50, Serial0/1/1  
O 192.168.1.64/28 [110/782] via 192.168.1.93, 00:04:50, Serial0/1/0  
C 192.168.1.80/30 is directly connected, Serial0/1/1  
L 192.168.1.81/32 is directly connected, Serial0/1/1  
O IA 192.168.1.84/30 [110/2343] via 192.168.1.82, 00:04:50, Serial0/1/1  
O 192.168.1.88/30 [110/1562] via 192.168.1.93, 00:04:50, Serial0/1/0  
C 192.168.1.92/30 is directly connected, Serial0/1/0  
L 192.168.1.94/32 is directly connected, Serial0/1/0

## LAB 12: OSPF STUB AREA

### OBJECTIVE:

To configure and verify STUB AREA in OSPF

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure Routers in Multi Area OSPF as per given topology.
- 4) Verify Tables in OSPF
- 5) Configure Area 20 as STUB Area

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers as in Multi Area OSPF exercise.

- 4) Verify Tables in OSPF before configuring authentication in all the routers

**Router# show ip ospf neighbor**

**Router# show ip ospf database**

**Router# show ip route**

- 5) Check OSPF database before configuring area 20 as stub

**R4#show ip ospf database**

OSPF Router with ID (40.1.3.1) (Process ID 1)

Router Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	242	0x80000005	0x00E36A	6
40.1.3.1	40.1.3.1	354	0x80000009	0x00D8AF	8

Summary Net Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum
20.1.0.1	10.1.3.1	1986	0x80000002	0x00966F
20.1.1.1	10.1.3.1	1986	0x80000002	0x008B79
20.1.3.1	10.1.3.1	1986	0x80000002	0x00758D
172.16.1.0	10.1.3.1	500	0x80000003	0x00F934
172.16.1.3	10.1.3.1	500	0x80000003	0x0067B6
192.168.1.32	10.1.3.1	1986	0x80000002	0x005947
192.168.1.80	10.1.3.1	500	0x80000003	0x00B3B0
192.168.1.84	10.1.3.1	1986	0x80000002	0x00C878

Summary ASB Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum
30.1.3.1	10.1.3.1	1986	0x80000002	0x0016C2
40.1.3.1	10.1.3.1	1736	0x80000002	0x003D81

Type-5 AS External Link States

Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	1885	0x80000002	0x00FE5B	0
50.1.0.0	40.1.3.1	3606	0x80000306	0x00D777	0

- 6) Configure AREA 20 as STUB AREA

**R1(config)# router ospf 100**

**R1(config-router)# area 20 stub**

```
R4(config)# router ospf 100  
R4(config-router)# area 20 stub
```

**VERIFICATION:**

- After making the area 20 as stub area,

```
R4#show ip ospf database  
OSPF Router with ID (40.1.3.1) (Process ID 1)
```

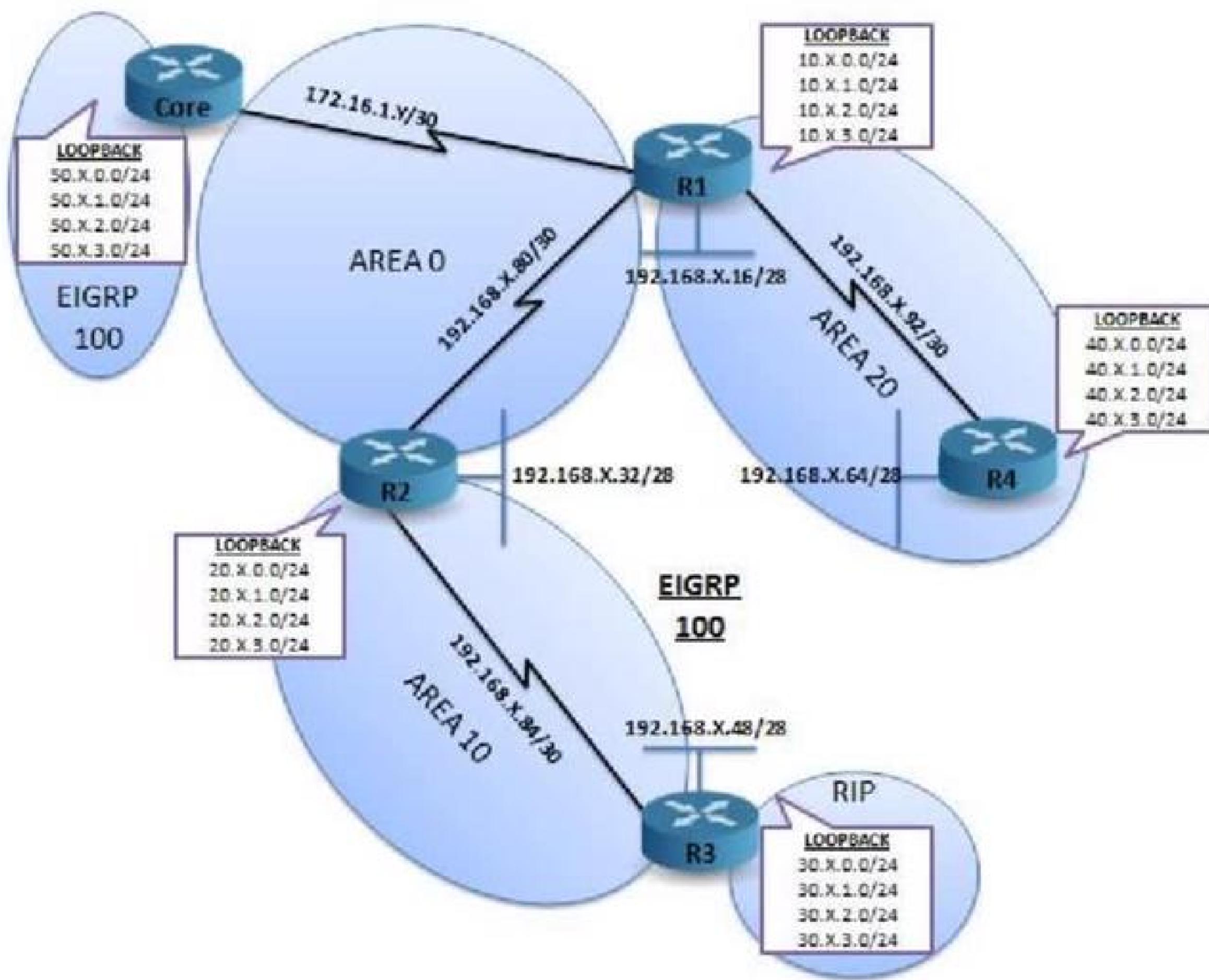
Router Link States (Area 20)					
Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	7	0x80000007	0x00FD50	6
40.1.3.1	40.1.3.1	4	0x8000000B	0x00F295	8
Summary Net Link States (Area 20)					
Link ID	ADV Router	Age	Seq#	Checksum	
0.0.0.0	10.1.3.1	23	0x80000001	0x0034FA	
20.1.0.1	10.1.3.1	23	0x80000004	0x00B055	
20.1.1.1	10.1.3.1	23	0x80000004	0x00A55F	
20.1.3.1	10.1.3.1	23	0x80000004	0x008F73	
172.16.1.0	10.1.3.1	23	0x80000004	0x001619	
172.16.1.3	10.1.3.1	23	0x80000004	0x00839B	
192.168.1.32	10.1.3.1	23	0x80000004	0x00732D	
192.168.1.80	10.1.3.1	23	0x80000004	0x00CF95	
192.168.1.84	10.1.3.1	23	0x80000004	0x00E25E	

## LAB 13: OSPF TOTALLY STUBBY AREA

### OBJECTIVE:

To configure and verify TOTALLY STUBBY AREA in OSPF

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure Routers in Multi Area OSPF as per given topology.
- 4) Verify Tables in OSPF.
- 5) Configure Area 20 as Totallystubby Area

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers as did in Multi Area OSPF Lab.

- 4) Verify Tables in OSPF before configuring authentication in all the routers

**Router# show ip ospf neighbor**

**Router# show ip ospf database**

**Router# show ip route**

- 5) Check the OSPF database before making AREA 20 a Totally stubby area

**R4#show ip ospf database**

OSPF Router with ID (40.1.3.1) (Process ID 1)

Router Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	242	0x80000005	0x00E36A	6
40.1.3.1	40.1.3.1	354	0x80000009	0x00D8AF	8

Summary Net Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum
20.1.0.1	10.1.3.1	1986	0x80000002	0x00966F
20.1.1.1	10.1.3.1	1986	0x80000002	0x008B79
20.1.3.1	10.1.3.1	1986	0x80000002	0x00758D
172.16.1.0	10.1.3.1	500	0x80000003	0x00F934
172.16.1.3	10.1.3.1	500	0x80000003	0x0067B6
192.168.1.32	10.1.3.1	1986	0x80000002	0x005947
192.168.1.80	10.1.3.1	500	0x80000003	0x00B3B0
192.168.1.84	10.1.3.1	1986	0x80000002	0x00C878

Summary ASB Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum
30.1.3.1	10.1.3.1	1986	0x80000002	0x0016C2
40.1.3.1	10.1.3.1	1736	0x80000002	0x003D81

Type-5 AS External Link States

Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	1885	0x80000002	0x00FE5B	0
50.1.0.0	40.1.3.1	3606	0x80000306	0x00D777	0

- 6) Configure AREA 20 as a Totally stubby area

**R1(config)# router ospf 100**

**R1(config-router)# area 20 stub no-summary**

**R4(config)# router ospf 100**

**R4(config-router)# area 20 stub**

**VERIFICATION:**

- After making the area 20 a Totally stubby area

R4#show ip ospf database

OSPF Router with ID (40.1.3.1) (Process ID 1)

Router Link States (Area 20)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
10.1.3.1	10.1.3.1	7	0x80000007	0x00FD50	6
40.1.3.1	40.1.3.1	4	0x8000000B	0x00F295	8

Summary Net Link States (Area 20)

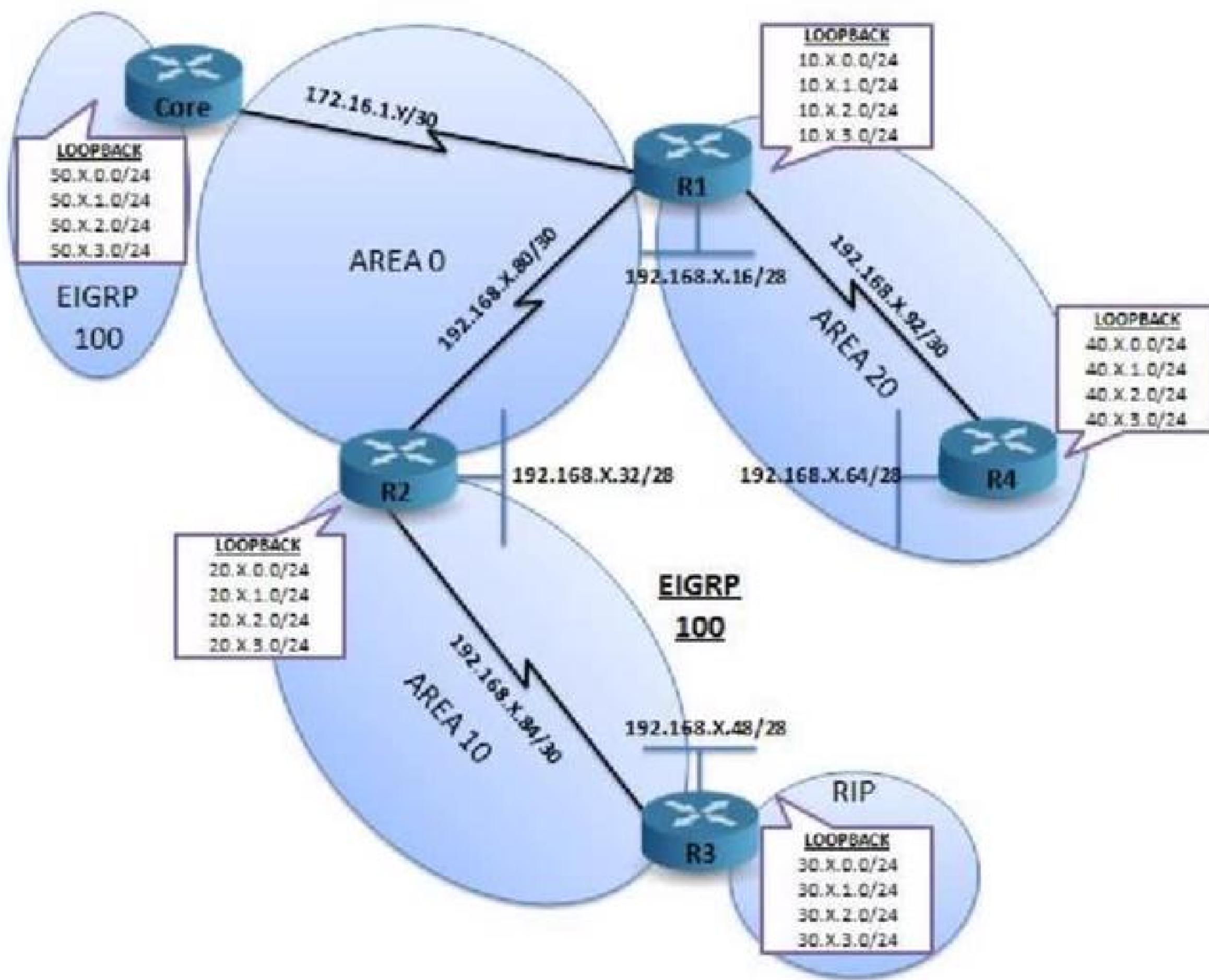
Link ID	ADV Router	Age	Seq#	Checksum
0.0.0.0	10.1.3.1	23	0x80000001	0x0034FA

## LAB 14: OSPF NSSA

### OBJECTIVE:

To configure and verify Not So Stubby Areas (NSSA) in OSPF

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure Routers in Multi Area OSPF as per given topology.
- 4) Verify Tables in OSPF.
- 5) Configure Area 10 as NSSA.

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers as did in Multi Area OSPF lab.
- 4) Verify Tables in OSPF before configuring authentication in all the routers

**Router# show ip ospf neighbor**

**Router# show ip ospf database**

**Router# show ip route**

- 5) Before Making AREA 10 as NSSA

**R3#show ip ospf database**

OSPF Router with ID (30.1.3.1) (Process ID 100)

Router Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
20.1.3.1	20.1.3.1	802	0x80000006	0x00C344	6
30.1.3.1	30.1.3.1	760	0x80000005	0x007290	2

Summary Net Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum
10.1.1.1	20.1.3.1	542	0x80000003	0x00B152
10.1.2.1	20.1.3.1	542	0x80000003	0x00A65C
10.1.3.1	20.1.3.1	542	0x80000003	0x009B66
40.1.0.0	20.1.3.1	131	0x80000001	0x00D10B
172.16.1.0	20.1.3.1	542	0x80000003	0x003DD6
172.16.1.3	20.1.3.1	542	0x80000003	0x00AA59
192.168.1.16	20.1.3.1	542	0x80000003	0x009D08
192.168.1.64	20.1.3.1	131	0x80000001	0x005D0A
192.168.1.80	20.1.3.1	1066	0x80000003	0x005901
192.168.1.88	20.1.3.1	131	0x80000001	0x0048EB
192.168.1.92	20.1.3.1	542	0x80000003	0x007EBF

Summary ASB Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum
40.1.3.1	20.1.3.1	542	0x80000003	0x007E25

Type-5 AS External Link States

Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	508	0x80000003	0x00FC5C	0
50.1.0.0	40.1.3.1	162	0x8000031F	0x006EB3	0

- 6) Configure AREA 10 as NSSA

**R2(config)# router ospf 100**

**R2(config-router)# area 20 nssa**

**R3(config)# router ospf 100**

**R3(config-router)# area 20 nssa**

**VERIFICATION:**

→ After making the area 10 as NSSA

R3#show ip ospf database

OSPF Router with ID (30.1.3.1) (Process ID 1)

Router Link States (Area 10)					
Link ID	ADV Router	Age	Seq#	Checksum	Link count
20.1.3.1	20.1.3.1	13	0x80000008	0x006B92	6
30.1.3.1	30.1.3.1	15	0x80000007	0x0014E6	2

Summary Net Link States (Area 10)				
Link ID	ADV Router	Age	Seq#	Checksum
10.1.1.1	20.1.3.1	18	0x80000004	0x0055A7
10.1.2.1	20.1.3.1	18	0x80000004	0x004AB1
10.1.3.1	20.1.3.1	18	0x80000004	0x003FBB
40.1.0.0	20.1.3.1	18	0x80000002	0x007560
172.16.1.0	20.1.3.1	18	0x80000004	0x00E02C
172.16.1.3	20.1.3.1	18	0x80000004	0x004EAE
192.168.1.16	20.1.3.1	18	0x80000004	0x00415D
192.168.1.64	20.1.3.1	18	0x80000002	0x00015F
192.168.1.80	20.1.3.1	18	0x80000004	0x00FC56
192.168.1.88	20.1.3.1	18	0x80000002	0x00EB41
192.168.1.92	20.1.3.1	18	0x80000004	0x002215

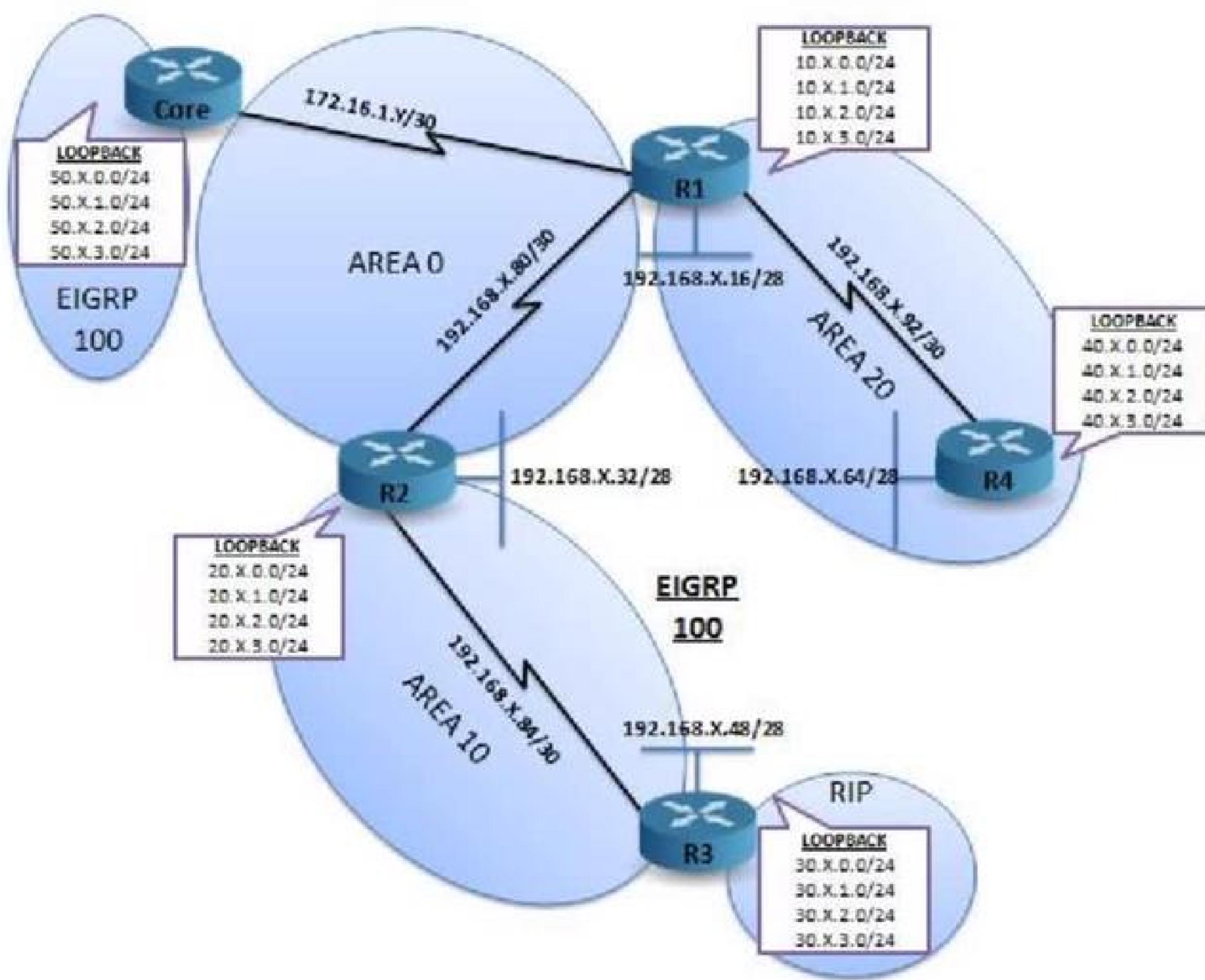
Type-7 AS External Link States (Area 10)					
Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	32	0x80000001	0x00622E	0

## LAB 15: OSPF TOTALLY NSSA

### OBJECTIVE:

To configure and verify Totally NSSA AREA in OSPF

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure Routers in Multi Area OSPF as per given topology.
- 4) Verify Tables in OSPF.
- 5) Configure Area 10 as Totally NSSA.

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers as did in Multi Area OSPF lab

- 4) Before making AREA 10 as Totally NSSA

**R3#show ip ospf database**

**OSPF Router with ID (30.1.3.1) (Process ID 100)**

**Router Link States (Area 10)**

Link ID	ADV Router	Age	Seq#	Checksum	Link count
20.1.3.1	20.1.3.1	802	0x80000006	0x00C344	6
30.1.3.1	30.1.3.1	760	0x80000005	0x007290	2

**Summary Net Link States (Area 10)**

Link ID	ADV Router	Age	Seq#	Checksum
10.1.1.1	20.1.3.1	542	0x80000003	0x00B152
10.1.2.1	20.1.3.1	542	0x80000003	0x00A65C
10.1.3.1	20.1.3.1	542	0x80000003	0x009B66
40.1.0.0	20.1.3.1	131	0x80000001	0x00D10B
172.16.1.0	20.1.3.1	542	0x80000003	0x003DD6
172.16.1.3	20.1.3.1	542	0x80000003	0x00AA59
192.168.1.16	20.1.3.1	542	0x80000003	0x009D08
192.168.1.64	20.1.3.1	131	0x80000001	0x005D0A
192.168.1.80	20.1.3.1	1066	0x80000003	0x005901
192.168.1.88	20.1.3.1	131	0x80000001	0x0048EB
192.168.1.92	20.1.3.1	542	0x80000003	0x007EBF

**Summary ASB Link States (Area 10)**

Link ID	ADV Router	Age	Seq#	Checksum
40.1.3.1	20.1.3.1	542	0x80000003	0x007E25

**Type-5 AS External Link States**

Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	508	0x80000003	0x00FC5C	0
50.1.0.0	40.1.3.1	162	0x8000031F	0x006EB3	0

- 5) Configure AREA 10 as Totally NSSA

**R2(config)# router ospf 100**

**R2(config-router)# area 20 nssa no-summary**

**R3(config)# router ospf 100**

**R3(config-router)# area 20 nssa**

**VERIFICATION:**

- After making the area 10 as Totally NSSA

R3#show ip ospf database

OSPF Router with ID (30.1.3.1) (Process ID 100)

Router Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum	Link count
20.1.3.1	20.1.3.1	16	0x8000000B	0x006595	6
30.1.3.1	30.1.3.1	136	0x80000007	0x0014E6	2

Summary Net Link States (Area 10)

Link ID	ADV Router	Age	Seq#	Checksum
0.0.0.0	20.1.3.1	21	0x80000001	0x0061BB

Type-7 AS External Link States (Area 10)

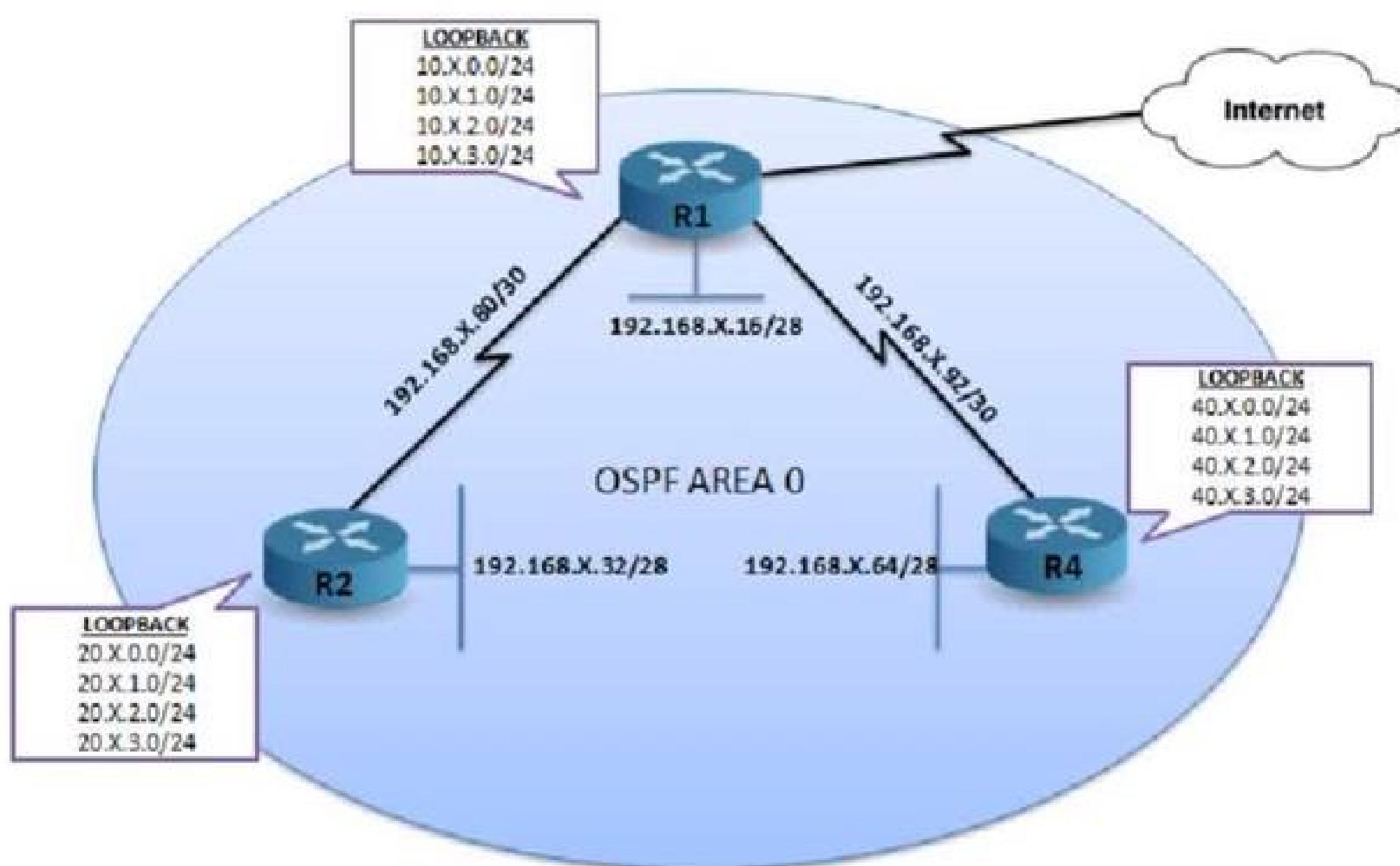
Link ID	ADV Router	Age	Seq#	Checksum	Tag
30.1.3.0	30.1.3.1	15	0x80000002	0x00602F	0

## LAB 16: DEFAULT ROUTE IN OSPF

### OBJECTIVE:

To configure the OSPF process to advertise a default route

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure Routers in OSPF as per given topology.
- 4) Verify the functionality of **Default-information originate** command.

### STEPS:

- 1) Verify the interface status by using **Show interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers

**R1 (config)#router ospf 100**

**R1 (config-router)# network 0.0.0.0 0.0.0.0 area 0**

```
R2 (config)#router ospf 100
R2 (config-router)#network 0.0.0.0 0.0.0.0 area 0
R4(config)#router ospf 100
R4(config-router)# network 0.0.0.0 0.0.0.0 area 0
```

→ Verify the routing table before giving the Default-Information Originate command

R2# show ip route

Codes: L - local, 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, + - replicated route  
Gateway of last resort is 192.168.1.81 to network 0.0.0.0

```
10.0.0.0/32 is subnetted, 3 subnets
O 10.1.1.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
O 10.1.2.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
O 10.1.3.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C 20.1.0.0/24 is directly connected, Loopback0
L 20.1.0.1/32 is directly connected, Loopback0
C 20.1.1.0/24 is directly connected, Loopback1
L 20.1.1.1/32 is directly connected, Loopback1
C 20.1.3.0/24 is directly connected, Loopback3
L 20.1.3.1/32 is directly connected, Loopback3
40.0.0.0/32 is subnetted, 4 subnets
O 40.1.0.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O 40.1.1.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O 40.1.2.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O 40.1.3.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
172.16.0.0/24 is subnetted, 1 subnets
O 172.16.1.0 [110/845] via 192.168.1.81, 00:07:18, Serial0/0/1
192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
O 192.168.1.16/28 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
C 192.168.1.32/28 is directly connected, FastEthernet0/0
L 192.168.1.33/32 is directly connected, FastEthernet0/0
O 192.168.1.64/28 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
C 192.168.1.84/30 is directly connected, Serial0/0/0
L 192.168.1.85/32 is directly connected, Serial0/0/0
O 192.168.1.88/30 [110/2343] via 192.168.1.81, 00:07:18, Serial0/0/1
O 192.168.1.92/30 [110/1562] via 192.168.1.81, 00:07:18, Serial0/0/1
```

- 4) Configure Static Default route on the router that is connected to Internet

R1(config)# ip route 0.0.0.0 0.0.0.0 serial 0/1/1

- 5) Let the OSPF process advertise this default route to other routers.

```
R1(config)# router ospf 1
R1(config-router)# default-information originate
```

**VERIFICATION:**

## → After Default-Information Originate

```
R2# show ip route
```

Codes: L - local, 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, + - replicated route  
Gateway of last resort is 192.168.1.81 to network 0.0.0.0

**O\*E2 0.0.0.0/0 [110/1] via 192.168.1.81, 00:00:25, Serial0/0/1**

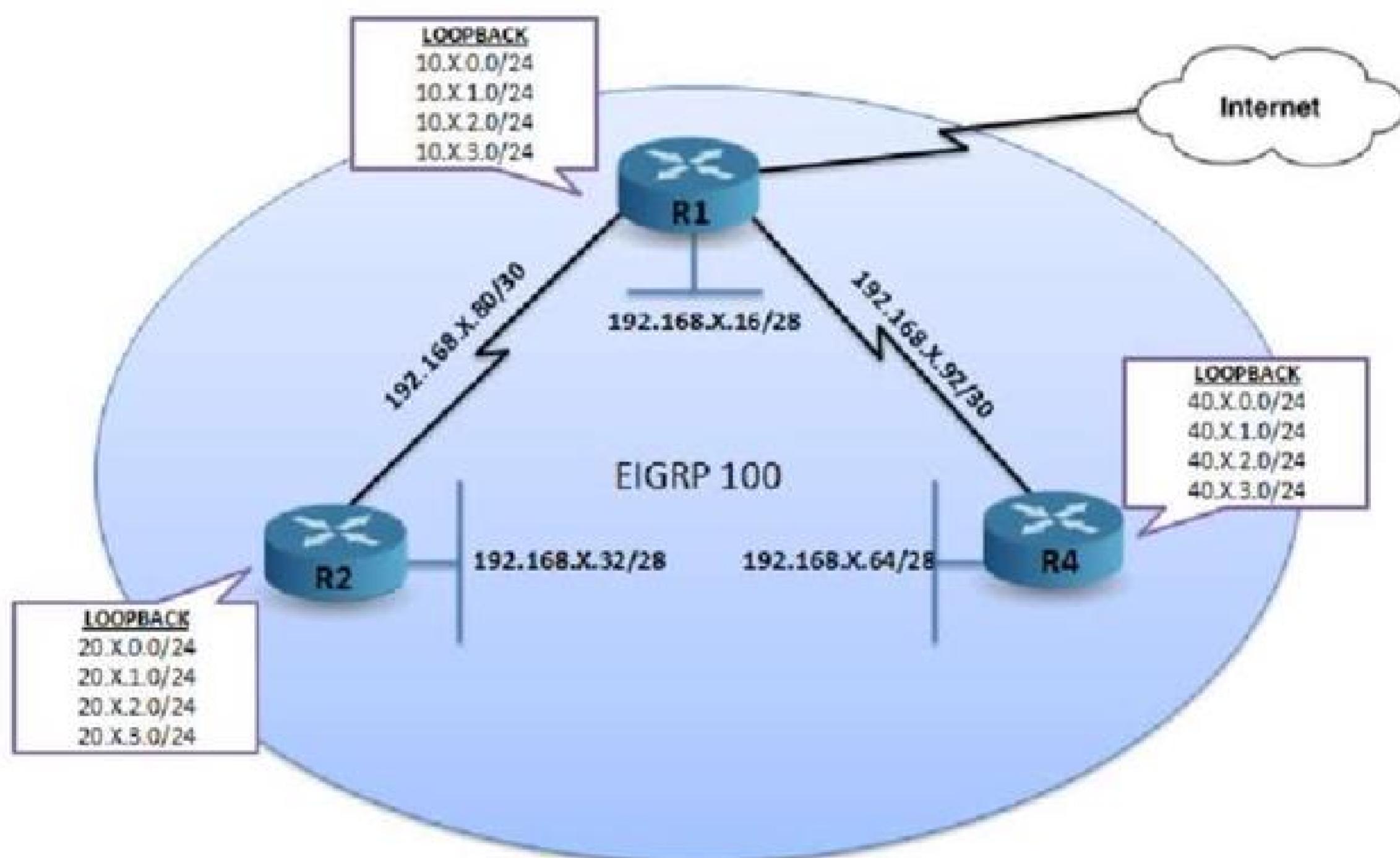
```
10.0.0.0/32 is subnetted, 3 subnets
O 10.1.1.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
O 10.1.2.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
O 10.1.3.1 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C 20.1.0.0/24 is directly connected, Loopback0
L 20.1.0.1/32 is directly connected, Loopback0
C 20.1.1.0/24 is directly connected, Loopback1
L 20.1.1.1/32 is directly connected, Loopback1
C 20.1.3.0/24 is directly connected, Loopback3
L 20.1.3.1/32 is directly connected, Loopback3
40.0.0.0/32 is subnetted, 4 subnets
O 40.1.0.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O 40.1.1.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O 40.1.2.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
O 40.1.3.1 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
172.16.0.0/24 is subnetted, 1 subnets
O 172.16.1.0 [110/845] via 192.168.1.81, 00:07:18, Serial0/0/1
192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
O 192.168.1.16/28 [110/782] via 192.168.1.81, 00:07:18, Serial0/0/1
C 192.168.1.32/28 is directly connected, FastEthernet0/0
L 192.168.1.33/32 is directly connected, FastEthernet0/0
O 192.168.1.64/28 [110/1563] via 192.168.1.81, 00:07:18, Serial0/0/1
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
C 192.168.1.84/30 is directly connected, Serial0/0/0
L 192.168.1.85/32 is directly connected, Serial0/0/0
O 192.168.1.88/30 [110/2343] via 192.168.1.81, 00:07:18, Serial0/0/1
192.168.1.92/30 [110/1562] via 192.168.1.81, 00:07:18, Serial0/0/1
```

## LAB 17: DEFAULT ROUTE IN EIGRP

### OBJECTIVE:

To configure the EIGRP process to advertise a default route to other routers

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring EIGRP on all the routers.
- 3) Configure EIGRP on routers as per given topology.
- 4) Verify the functionality of Default route in EIGRP

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure EIGRP on all routers

```
R1 (config)#router eigrp 100
R1 (config-router)# network 0.0.0.0
```

```
R2 (config)#router eigrp 100
R2 (config-router)#network 0.0.0.0
R4(config)#router eigrp 100
R4(config-router)# network 0.0.0.0
```

→ Verify the routing table before Configuring Static Default Route

**R4# show ip route**

Codes: L - local, 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, H - NHRP, I - LISP  
 + - replicated route, % - next hop override

Gateway of last resort is not set

```
10.0.0.0/24 is subnetted, 3 subnets
D 10.1.1.0 [90/20640000] via 192.168.1.94, 00:01:34, Serial0/0/0
D 10.1.2.0 [90/20640000] via 192.168.1.94, 00:01:34, Serial0/0/0
D 10.1.3.0 [90/20640000] via 192.168.1.94, 00:01:34, Serial0/0/0

20.0.0.0/24 is subnetted, 3 subnets
D 20.1.0.0 [90/21152000] via 192.168.1.94, 00:01:26, Serial0/0/0
D 20.1.1.0 [90/21152000] via 192.168.1.94, 00:01:26, Serial0/0/0
D 20.1.3.0 [90/21152000] via 192.168.1.94, 00:01:26, Serial0/0/0

40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 40.1.0.0/24 is directly connected, Loopback0
L 40.1.0.1/32 is directly connected, Loopback0
C 40.1.1.0/24 is directly connected, Loopback1
L 40.1.1.1/32 is directly connected, Loopback1
C 40.1.2.0/24 is directly connected, Loopback2
L 40.1.2.1/32 is directly connected, Loopback2
C 40.1.3.0/24 is directly connected, Loopback3
L 40.1.3.1/32 is directly connected, Loopback3

172.16.0.0/24 is subnetted, 1 subnets
D 172.16.1.0 [90/21024000] via 192.168.1.94, 00:01:34, Serial0/0/0

192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
D 192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:01:34, Serial0/0/0
D 192.168.1.32/28 [90/21026560] via 192.168.1.94, 00:01:26, Serial0/0/0
C 192.168.1.64/28 is directly connected, FastEthernet0/0
L 192.168.1.65/32 is directly connected, FastEthernet0/0
D 192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:01:34, Serial0/0/0
D 192.168.1.84/30 [90/41536000] via 192.168.1.94, 00:01:26, Serial0/0/0
C 192.168.1.88/30 is directly connected, Serial0/0/1
L 192.168.1.90/32 is directly connected, Serial0/0/1
C 192.168.1.92/30 is directly connected, Serial0/0/0
L 192.168.1.93/32 is directly connected, Serial0/0/0
```

4) Configure Static Default route on the router that is connected to Internet

**R1(config)# ip route 0.0.0.0 0.0.0.0 serial 0/1/1**

**VERIFICATION:**

## → After configuring Static Default Route

**R4#show ip route**

Codes: L - local, 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, H - NHRP, I - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is 192.168.1.94 to network 0.0.0.0

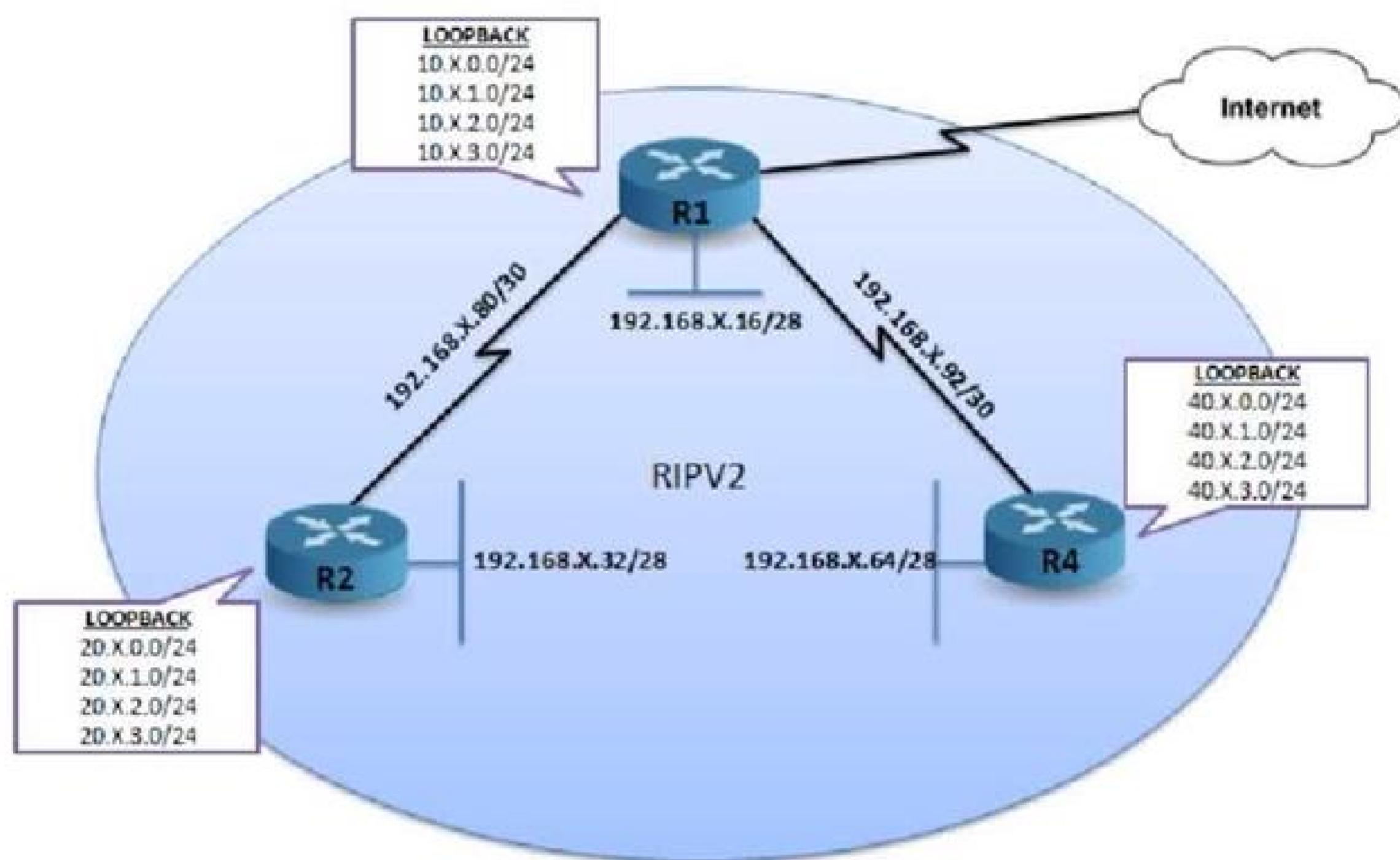
```
D* 0.0.0.0/0 [90/21024000] via 192.168.1.94, 00:00:02, Serial0/0/0
  10.0.0.0/24 is subnetted, 3 subnets
    D  10.1.1.0 [90/20640000] via 192.168.1.94, 00:01:46, Serial0/0/0
    D  10.1.2.0 [90/20640000] via 192.168.1.94, 00:01:46, Serial0/0/0
    D  10.1.3.0 [90/20640000] via 192.168.1.94, 00:01:46, Serial0/0/0
      20.0.0.0/24 is subnetted, 3 subnets
        D  20.1.0.0 [90/21152000] via 192.168.1.94, 00:01:38, Serial0/0/0
        D  20.1.1.0 [90/21152000] via 192.168.1.94, 00:01:38, Serial0/0/0
        D  20.1.3.0 [90/21152000] via 192.168.1.94, 00:01:38, Serial0/0/0
          40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
            C  40.1.0.0/24 is directly connected, Loopback0
            L  40.1.0.1/32 is directly connected, Loopback0
            C  40.1.1.0/24 is directly connected, Loopback1
            L  40.1.1.1/32 is directly connected, Loopback1
            C  40.1.2.0/24 is directly connected, Loopback2
            L  40.1.2.1/32 is directly connected, Loopback2
            C  40.1.3.0/24 is directly connected, Loopback3
            L  40.1.3.1/32 is directly connected, Loopback3
              172.16.0.0/24 is subnetted, 1 subnets
                D  172.16.1.0 [90/21024000] via 192.168.1.94, 00:01:46, Serial0/0/0
                  192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
                    D  192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:01:46, Serial0/0/0
                    D  192.168.1.32/28 [90/21026560] via 192.168.1.94, 00:01:38, Serial0/0/0
                    C  192.168.1.64/28 is directly connected, FastEthernet0/0
                    L  192.168.1.65/32 is directly connected, FastEthernet0/0
                    D  192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:01:46, Serial0/0/0
                    D  192.168.1.84/30 [90/41536000] via 192.168.1.94, 00:01:38, Serial0/0/0
                    C  192.168.1.88/30 is directly connected, Serial0/0/1
                    L  192.168.1.90/32 is directly connected, Serial0/0/1
                    C  192.168.1.92/30 is directly connected, Serial0/0/0
                    L  192.168.1.93/32 is directly connected, Serial0/0/0
```

## LAB 18: DEFAULT ROUTE IN RIP

### OBJECTIVE:

To configure the RIP process to advertise a default route to its neighboring routers.

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring RIP on all the routers.
- 3) Configure Routers in RIP as per given topology.
- 4) Advertise a default route via RIP

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.  
**Router# show ip interface brief**
- 2) Check the routing table on all the routers  
**Router# show ip route**
- 3) Configure RIP on all routers  
**R1 (config)#router rip**

```
R1 (config-router)# network 0.0.0.0
R1(config-router)# version 2
R1(config-router)#no auto-summary
R2 (config)#router rip
R2 (config-router)#network 0.0.0.0
R2(config-router)# version 2
R2(config-router)#no auto-summary
R4(config)#router rip
R4(config-router)# network 0.0.0.0
R4(config-router)# version 2
R4(config-router)#no auto-summary
```

- 4) Configure Static Default route on the router that is connected to Internet

```
R1(config)# ip route 0.0.0.0 0.0.0.0 serial 0/1/1
```

- 5) Configure Default-Information originate on R1 router.

```
R1(config)# router rip
R1(config-router)# default-information originate
```

#### VERIFICATION:

- Before Configuring default-information originate command

```
R4# show ip route
```

Codes: L - local, 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, + - replicated route  
 10.0.0.0/24 is subnetted, 3 subnets

R	10.1.1.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
R	10.1.2.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
R	10.1.3.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1

20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks

C	20.1.0.0/24 is directly connected, Loopback0
L	20.1.0.1/32 is directly connected, Loopback0
C	20.1.1.0/24 is directly connected, Loopback1
L	20.1.1.1/32 is directly connected, Loopback1
C	20.1.3.0/24 is directly connected, Loopback3
L	20.1.3.1/32 is directly connected, Loopback3

40.0.0.0/24 is subnetted, 4 subnets

R	40.1.0.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R	40.1.1.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R	40.1.2.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R	40.1.3.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1

172.16.0.0/24 is subnetted, 1 subnets

R	172.16.1.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
---	--

192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks

R	192.168.1.16/28 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
---	---

```
C 192.168.1.32/28 is directly connected, FastEthernet0/0
L 192.168.1.33/32 is directly connected, FastEthernet0/0
R 192.168.1.64/28 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
C 192.168.1.84/30 is directly connected, Serial0/0/0
L 192.168.1.85/32 is directly connected, Serial0/0/0
R 192.168.1.88/30 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R 192.168.1.92/30 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
```

→ After Configuring default-information originate command

R4# show ip route

Codes: L - local, 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, + - replicated route  
Gateway of last resort is 192.168.1.81 to network 0.0.0.0

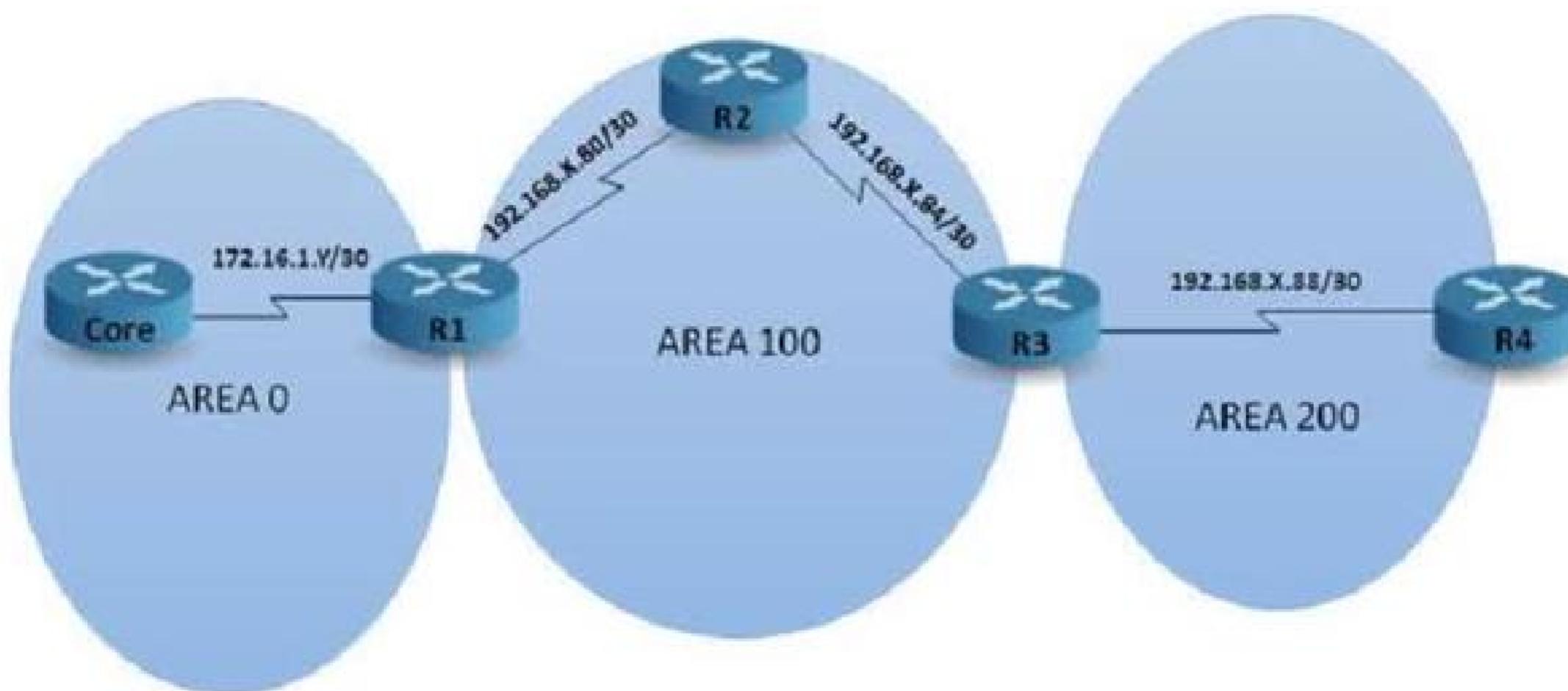
```
R* 0.0.0.0/0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
10.0.0.0/24 is subnetted, 3 subnets
R 10.1.1.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
R 10.1.2.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
R 10.1.3.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C 20.1.0.0/24 is directly connected, Loopback0
L 20.1.0.1/32 is directly connected, Loopback0
C 20.1.1.0/24 is directly connected, Loopback1
L 20.1.1.1/32 is directly connected, Loopback1
C 20.1.3.0/24 is directly connected, Loopback3
L 20.1.3.1/32 is directly connected, Loopback3
40.0.0.0/24 is subnetted, 4 subnets
R 40.1.0.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R 40.1.1.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R 40.1.2.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R 40.1.3.0 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
172.16.0.0/24 is subnetted, 1 subnets
R 172.16.1.0 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
R 192.168.1.16/28 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
C 192.168.1.32/28 is directly connected, FastEthernet0/0
L 192.168.1.33/32 is directly connected, FastEthernet0/0
R 192.168.1.64/28 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
C 192.168.1.84/30 is directly connected, Serial0/0/0
L 192.168.1.85/32 is directly connected, Serial0/0/0
R 192.168.1.88/30 [120/2] via 192.168.1.81, 00:00:08, Serial0/0/1
R 192.168.1.92/30 [120/1] via 192.168.1.81, 00:00:08, Serial0/0/1
```

## LAB 19: OSPF VIRTUAL LINK

### OBJECTIVE:

To configure an OSPF virtual link to connect disjointed OSPF areas to the backbone area

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring OSPF on all the routers.
- 3) Configure Routers in OSPF as per given topology.
- 4) Verify the functionality of Virtual Link

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure OSPF on all routers as per topology

```
Core(config)#router ospf 100
Core(config-router)#router-id 1.1.1.1
Core(config-router)#network 50.1.0.0 0.0.255.255 area 0
Core(config-router)#network 172.16.0.0 0.0.255.255 area 100
R1(config)# router ospf 100
R1(config-router)#router-id 2.2.2.2
```

```
R1(config-router)#network 172.16.0.0 0.0.255.255 area 0
R1(config-router)#network 192.168.X.80 0.0.0.3 area 100
R2(config)# router ospf 100
R2(config-router)#router-id 3.3.3.3
R2(config-router)# network 192.168.X.80 0.0.0.3 area 100
R2(Config-router)#network 192.168.X.84 0.0.0.3 area 100
R3(config)# router ospf 100
R3(config-router)#router-id 4.4.4.4
R3(Config-router)#network 192.168.X.88 0.0.0.3 area 100
R3(Config-router)#network 192.168.X.92 0.0.0.3 area 200
R4(config)# router ospf 100
R4(config-router)#router-id 5.5.5.5
R4(Config-router)#network 192.168.X.92 0.0.0.3 area 200
```

#### → Before Configuring Virtual Link

**R4# show ip route**

Codes: L - local, 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, H - NHRP, I - LISP  
 + - replicated route, % - next hop override

Gateway of last resort is not set

40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks	
C 40.1.0.0/24 is directly connected, Loopback0	
L 40.1.0.1/32 is directly connected, Loopback0	
C 40.1.1.0/24 is directly connected, Loopback1	
L 40.1.1.1/32 is directly connected, Loopback1	
C 40.1.2.0/24 is directly connected, Loopback2	
L 40.1.2.1/32 is directly connected, Loopback2	
C 40.1.3.0/24 is directly connected, Loopback3	
L 40.1.3.1/32 is directly connected, Loopback3	
192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks	
C 192.168.1.64/28 is directly connected, FastEthernet0/0	
L 192.168.1.65/32 is directly connected, FastEthernet0/0	
C 192.168.1.88/30 is directly connected, Serial0/0/1	
L 192.168.1.90/32 is directly connected, Serial0/0/1	
C 192.168.1.92/30 is directly connected, Serial0/0/0	
L 192.168.1.93/32 is directly connected, Serial0/0/0	

- 4) Configure Virtual link on R1 and R3 routers.

```
R1(config)#router ospf 100
R1(config-router)# area 100 virtual-link 4.4.4.4
R3(config)#router ospf 100
R3(config-router)# area 100 virtual-link 1.1.1.1
```

**VERIFICATION:**

## → After Configuring Virtual Link

**R4#show ip route**

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

20.0.0.0/32 is subnetted, 3 subnets

O IA 20.1.0.1 [110/2344] via 192.168.1.89, 00:00:15, Serial0/0/1

O IA 20.1.1.1 [110/2344] via 192.168.1.89, 00:00:15, Serial0/0/1

O IA 20.1.3.1 [110/2344] via 192.168.1.89, 00:00:15, Serial0/0/1

40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

C 40.1.0.0/24 is directly connected, Loopback0

L 40.1.0.1/32 is directly connected, Loopback0

C 40.1.1.0/24 is directly connected, Loopback1

L 40.1.1.1/32 is directly connected, Loopback1

C 40.1.2.0/24 is directly connected, Loopback2

L 40.1.2.1/32 is directly connected, Loopback2

C 40.1.3.0/24 is directly connected, Loopback3

L 40.1.3.1/32 is directly connected, Loopback3

50.0.0.0/32 is subnetted, 4 subnets

O IA 50.1.0.1 [110/3189] via 192.168.1.89, 00:00:11, Serial0/0/1

O IA 50.1.1.1 [110/3189] via 192.168.1.89, 00:00:11, Serial0/0/1

O IA 50.1.2.1 [110/3189] via 192.168.1.89, 00:00:11, Serial0/0/1

O IA 50.1.3.1 [110/3189] via 192.168.1.89, 00:00:11, Serial0/0/1

172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks

O IA 172.16.1.0/24 [110/3188] via 192.168.1.89, 00:00:11, Serial0/0/1

O IA 172.16.1.0/30 [110/3969] via 192.168.1.89, 00:00:11, Serial0/0/1

O IA 192.168.0.0/24 [110/3189] via 192.168.1.89, 00:00:11, Serial0/0/1

192.168.1.0/24 is variably subnetted, 9 subnets, 3 masks

O IA 192.168.1.32/28 [110/2344] via 192.168.1.89, 00:00:15, Serial0/0/1

C 192.168.1.64/28 is directly connected, FastEthernet0/0

L 192.168.1.65/32 is directly connected, FastEthernet0/0

O IA 192.168.1.80/30 [110/3124] via 192.168.1.89, 00:00:15, Serial0/0/1

O IA 192.168.1.84/30 [110/2343] via 192.168.1.89, 00:00:15, Serial0/0/1

C 192.168.1.88/30 is directly connected, Serial0/0/1

L 192.168.1.90/32 is directly connected, Serial0/0/1

C 192.168.1.92/30 is directly connected, Serial0/0/0

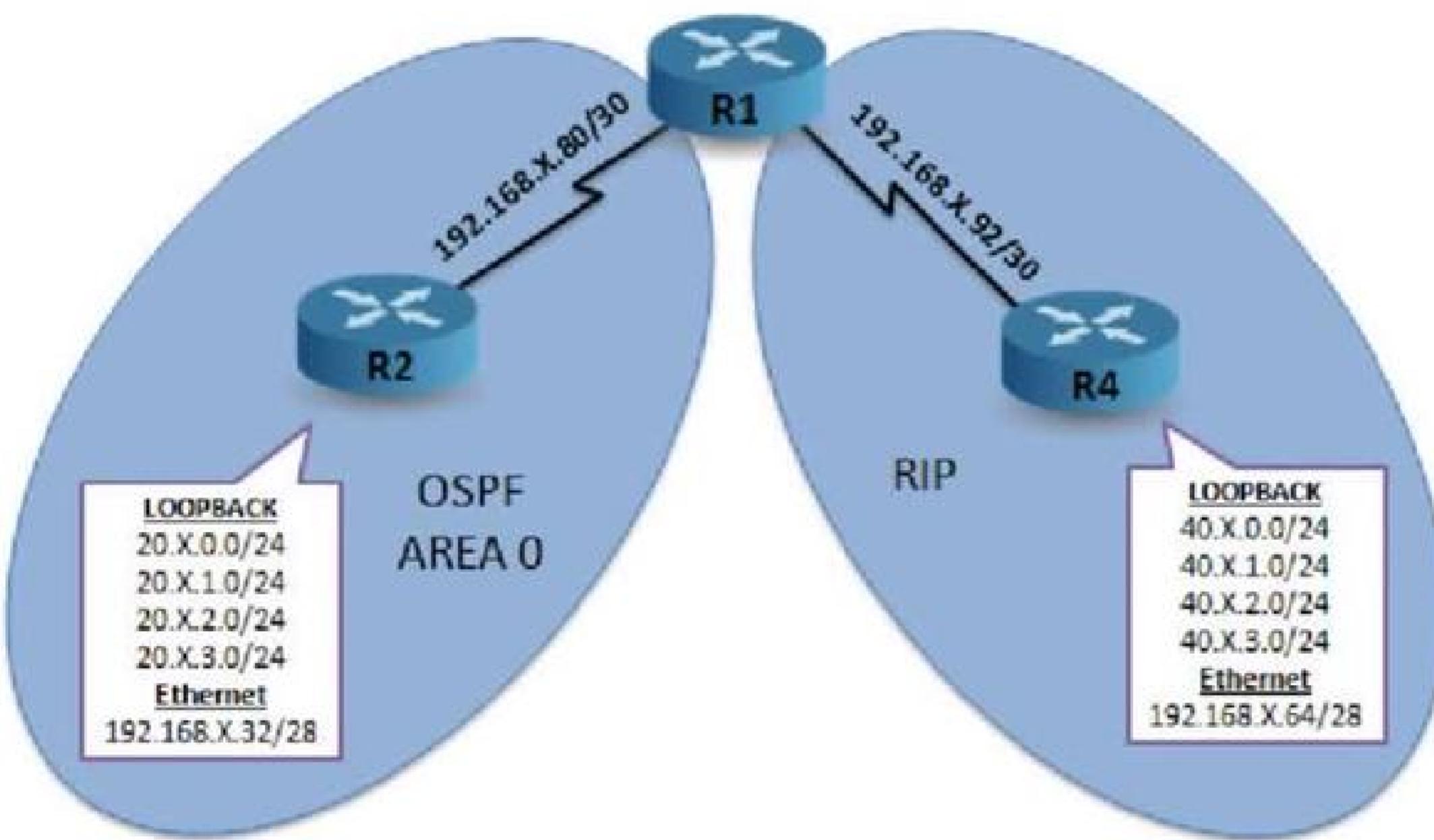
L 192.168.1.93/32 is directly connected, Serial0/0/0

## LAB 20: REDISTRIBUTION BETWEEN RIP and OSPF

### OBJECTIVE:

To configure and verify Route Redistribution between RIP and OSPF

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Configure OSPF and RIP on routers as per given topology.
- 3) Configure Redistribution.

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure RIP between R1 and R4 routers

```
R1(config)#router rip
R1(config-router)#version 2
R1(config-router)#network 192.168.X.92
R1(config-router)# no auto-summary
R4(Config)# router rip
```

```
R4(Config-router)# network 40.0.0.0
R4(Config-router)# network 192.168.X.0
R4(config-router)# no auto-summary
```

- 4) Configure OSPF AREA 0 in R1 and R2 routers.

```
R1(config)# router ospf 100
R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0
R2 (config)#router ospf 100
R2(config-router)#network 20.X.0.0 0.0.255.255 area 0
R2(config-router) #network 192.168.X.32 0.0.0.15 area 0
R2(config-router) #network 192.168.X.80 0.0.0.3 area 0
R2(config-router) #network 192.168.X.84 0.0.0.3 area 0
```

- 5) Configure Route Redistribution on R1 router

```
R1(config)#router rip
R1(config-router)#redistribute ospf 100 metric 5 subnets
R1(config)#router ospf 100
R1(config-router)# redistribute rip subnets metric 10
```

#### VERIFICATION:

##### → Before Configuring Redistribution

**R2# show ip route**

Codes: L - local, 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, + - replicated route  
Gateway of last resort is not set

20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks  
C 20.1.0.0/24 is directly connected, Loopback0  
L 20.1.0.1/32 is directly connected, Loopback0  
C 20.1.1.0/24 is directly connected, Loopback1  
L 20.1.1.1/32 is directly connected, Loopback1  
C 20.1.3.0/24 is directly connected, Loopback3  
L 20.1.3.1/32 is directly connected, Loopback3  
192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks  
C 192.168.1.32/28 is directly connected, FastEthernet0/0  
L 192.168.1.33/32 is directly connected, FastEthernet0/0  
C 192.168.1.80/30 is directly connected, Serial0/0/1  
L 192.168.1.82/32 is directly connected, Serial0/0/1  
C 192.168.1.84/30 is directly connected, Serial0/0/0  
L 192.168.1.85/32 is directly connected, Serial0/0/0

**R4# show ip route**

Codes: L - local, 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, H - NHRP, I - LISP  
 + - replicated route, % - next hop override

Gateway of last resort is not set

```

40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 40.1.0.0/24 is directly connected, Loopback0
L 40.1.0.1/32 is directly connected, Loopback0
C 40.1.1.0/24 is directly connected, Loopback1
L 40.1.1.1/32 is directly connected, Loopback1
C 40.1.2.0/24 is directly connected, Loopback2
L 40.1.2.1/32 is directly connected, Loopback2
C 40.1.3.0/24 is directly connected, Loopback3
L 40.1.3.1/32 is directly connected, Loopback3

192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks
R 192.168.1.16/28 [120/1] via 192.168.1.94, 00:00:09, Serial0/0/0
C 192.168.1.64/28 is directly connected, FastEthernet0/0
L 192.168.1.65/32 is directly connected, FastEthernet0/0
R 192.168.1.80/30 [120/1] via 192.168.1.94, 00:00:09, Serial0/0/0
C 192.168.1.88/30 is directly connected, Serial0/0/1
L 192.168.1.90/32 is directly connected, Serial0/0/1
C 192.168.1.92/30 is directly connected, Serial0/0/0
L 192.168.1.93/32 is directly connected, Serial0/0/0

```

#### → After Configuring Redistribution from RIP into OSPF

R2 # show ip route

Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

```

20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C 20.1.0.0/24 is directly connected, Loopback0
L 20.1.0.1/32 is directly connected, Loopback0
C 20.1.1.0/24 is directly connected, Loopback1
L 20.1.1.1/32 is directly connected, Loopback1
C 20.1.3.0/24 is directly connected, Loopback3
L 20.1.3.1/32 is directly connected, Loopback3

40.0.0.0/24 is subnetted, 4 subnets
O E2 40.1.0.0 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
O E2 40.1.1.0 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
O E2 40.1.2.0 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
O E2 40.1.3.0 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1

192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
O E2 192.168.1.16/28 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
C 192.168.1.32/28 is directly connected, FastEthernet0/0
L 192.168.1.33/32 is directly connected, FastEthernet0/0
O E2 192.168.1.64/28 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1

```

```

C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
C 192.168.1.84/30 is directly connected, Serial0/0/0
L 192.168.1.85/32 is directly connected, Serial0/0/0
O E2 192.168.1.88/30 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1
O E2 192.168.1.92/30 [110/20] via 192.168.1.81, 00:00:04, Serial0/0/1

```

→ After Configuring Redistribution from OSPF into RIP

R4# show ip route

Codes: L - local, 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, H - NHRP, I - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is not set

```

20.0.0.0/32 is subnetted, 3 subnets
R 20.1.0.1 [120/5] via 192.168.1.94, 00:00:01, Serial0/0/0
R 20.1.1.1 [120/5] via 192.168.1.94, 00:00:01, Serial0/0/0
R 20.1.3.1 [120/5] via 192.168.1.94, 00:00:01, Serial0/0/0
40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 40.1.0.0/24 is directly connected, Loopback0
L 40.1.0.1/32 is directly connected, Loopback0
C 40.1.1.0/24 is directly connected, Loopback1
L 40.1.1.1/32 is directly connected, Loopback1
C 40.1.2.0/24 is directly connected, Loopback2
L 40.1.2.1/32 is directly connected, Loopback2
C 40.1.3.0/24 is directly connected, Loopback3
L 40.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
R 192.168.1.16/28 [120/1] via 192.168.1.94, 00:00:01, Serial0/0/0
R 192.168.1.32/28 [120/5] via 192.168.1.94, 00:00:01, Serial0/0/0
C 192.168.1.64/28 is directly connected, FastEthernet0/0
L 192.168.1.65/32 is directly connected, FastEthernet0/0
R 192.168.1.80/30 [120/1] via 192.168.1.94, 00:00:01, Serial0/0/0
R 192.168.1.84/30 [120/5] via 192.168.1.94, 00:00:01, Serial0/0/0
C 192.168.1.88/30 is directly connected, Serial0/0/1
L 192.168.1.90/32 is directly connected, Serial0/0/1
C 192.168.1.92/30 is directly connected, Serial0/0/0
L 192.168.1.93/32 is directly connected, Serial0/0/0

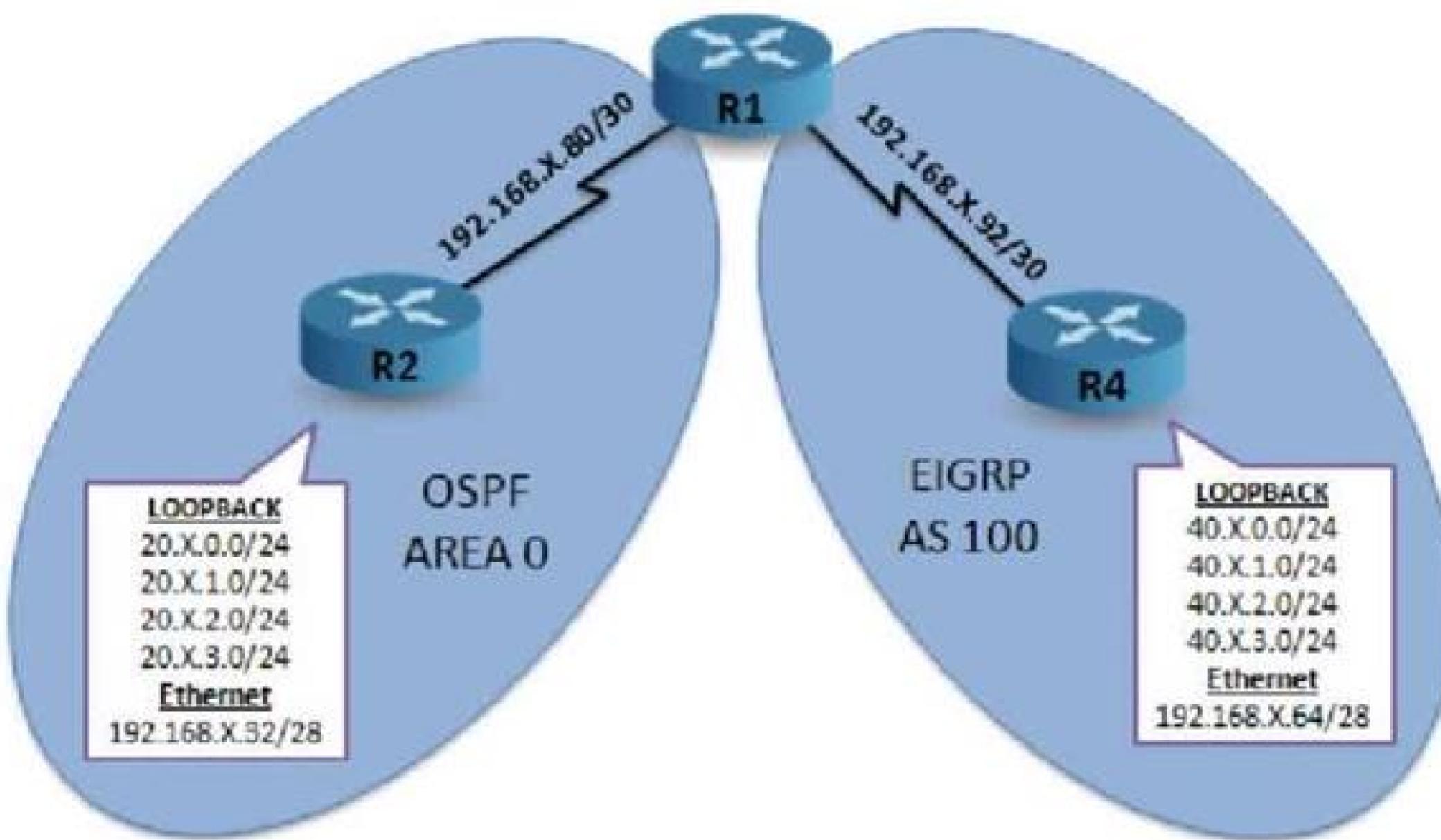
```

## LAB 21: REDISTRIBUTION BETWEEN EIGRP AND OSPF

### OBJECTIVE:

To configure and verify Route Redistribution between EIGRP and OSPF

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Configure OSPF and EIGRP on routers as per given topology.
- 3) Configure Redistribution.

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure EIGRP between R1 and R4 routers

```
R1(config)#router eigrp 100
R1(config-router)#network 192.168.X.92
R1(config-router)# no auto-summary
R4(Config)# router eigrp 100
R4(Config-router)# network 40.0.0.0
R4(Config-router)# network 192.168.X.0
R4(config-router)# no auto-summary
```

- 4) Configure OSPF AREA 0 in R1 and R2 routers.

```
R1(config)# router ospf 100
R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0
R2 (config)#router ospf 100
R2(config-router)#network 20.X.0.0 0.0.255.255 area 0
R2(config-router) #network 192.168.X.32 0.0.0.15 area 0
R2(config-router) #network 192.168.X.80 0.0.0.3 area 0
R2(config-router) #network 192.168.X.84 0.0.0.3 area 0
```

- 5) Configure Route Redistribution on R1 router

```
R1(config)#router eigrp 100
R1(config-router)#redistribute ospf 100 metric 1000 1000 100 100 1500
R1(config)#router ospf 100
R1(config-router)# redistribute eigrp 100 subnets
```

#### VERIFICATION:

##### → Before Configuring Redistribution

**R2# show ip route**

Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

```
20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C 20.1.0.0/24 is directly connected, Loopback0
L 20.1.0.1/32 is directly connected, Loopback0
C 20.1.1.0/24 is directly connected, Loopback1
L 20.1.1.1/32 is directly connected, Loopback1
C 20.1.3.0/24 is directly connected, Loopback3
L 20.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
C 192.168.1.32/28 is directly connected, FastEthernet0/0
L 192.168.1.33/32 is directly connected, FastEthernet0/0
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
C 192.168.1.84/30 is directly connected, Serial0/0/0
L 192.168.1.85/32 is directly connected, Serial0/0/0
```

**R4# show ip route**

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override  
40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

- C 40.1.0.0/24 is directly connected, Loopback0
  - L 40.1.0.1/32 is directly connected, Loopback0
  - C 40.1.1.0/24 is directly connected, Loopback1
  - L 40.1.1.1/32 is directly connected, Loopback1
  - C 40.1.2.0/24 is directly connected, Loopback2
  - L 40.1.2.1/32 is directly connected, Loopback2
  - C 40.1.3.0/24 is directly connected, Loopback3
  - L 40.1.3.1/32 is directly connected, Loopback3
- 192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
- D 192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:02:05, Serial0/0/0
  - D 192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:02:05, Serial0/0/0
  - C 192.168.1.88/30 is directly connected, Serial0/0/1
  - L 192.168.1.90/32 is directly connected, Serial0/0/1
  - C 192.168.1.92/30 is directly connected, Serial0/0/0
  - L 192.168.1.93/32 is directly connected, Serial0/0/0

#### → After Configuring Redistribution from EIGRP into OSPF

R2 # show ip route

Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks

- C 20.1.0.0/24 is directly connected, Loopback0
- L 20.1.0.1/32 is directly connected, Loopback0
- C 20.1.1.0/24 is directly connected, Loopback1
- L 20.1.1.1/32 is directly connected, Loopback1
- C 20.1.3.0/24 is directly connected, Loopback3
- L 20.1.3.1/32 is directly connected, Loopback3

40.0.0.0/24 is subnetted, 4 subnets

- O E2 40.1.0.0 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
- O E2 40.1.1.0 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
- O E2 40.1.2.0 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
- O E2 40.1.3.0 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1

192.168.1.0/24 is variably subnetted, 9 subnets, 3 masks

- O E2 192.168.1.16/28 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
- C 192.168.1.32/28 is directly connected, FastEthernet0/0
- L 192.168.1.33/32 is directly connected, FastEthernet0/0
- C 192.168.1.80/30 is directly connected, Serial0/0/1
- L 192.168.1.82/32 is directly connected, Serial0/0/1
- C 192.168.1.84/30 is directly connected, Serial0/0/0
- L 192.168.1.85/32 is directly connected, Serial0/0/0
- O E2 192.168.1.88/30 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1
- O E2 192.168.1.92/30 [110/20] via 192.168.1.81, 00:00:43, Serial0/0/1

## → After Configuring Redistribution from OSPF into EIGRP

**R4# show ip route**

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

20.0.0.0/32 is subnetted, 3 subnets

D EX 20.1.0.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0

D EX 20.1.1.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0

D EX 20.1.3.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0

40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

C 40.1.0.0/24 is directly connected, Loopback0

L 40.1.0.1/32 is directly connected, Loopback0

C 40.1.1.0/24 is directly connected, Loopback1

L 40.1.1.1/32 is directly connected, Loopback1

C 40.1.2.0/24 is directly connected, Loopback2

L 40.1.2.1/32 is directly connected, Loopback2

C 40.1.3.0/24 is directly connected, Loopback3

L 40.1.3.1/32 is directly connected, Loopback3

192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks

D 192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:03:01, Serial0/0/0

D EX 192.168.1.32/28

[170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0

D 192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:03:01, Serial0/0/0

D EX 192.168.1.84/30 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0

C 192.168.1.88/30 is directly connected, Serial0/0/1

L 192.168.1.90/32 is directly connected, Serial0/0/1

C 192.168.1.92/30 is directly connected, Serial0/0/0

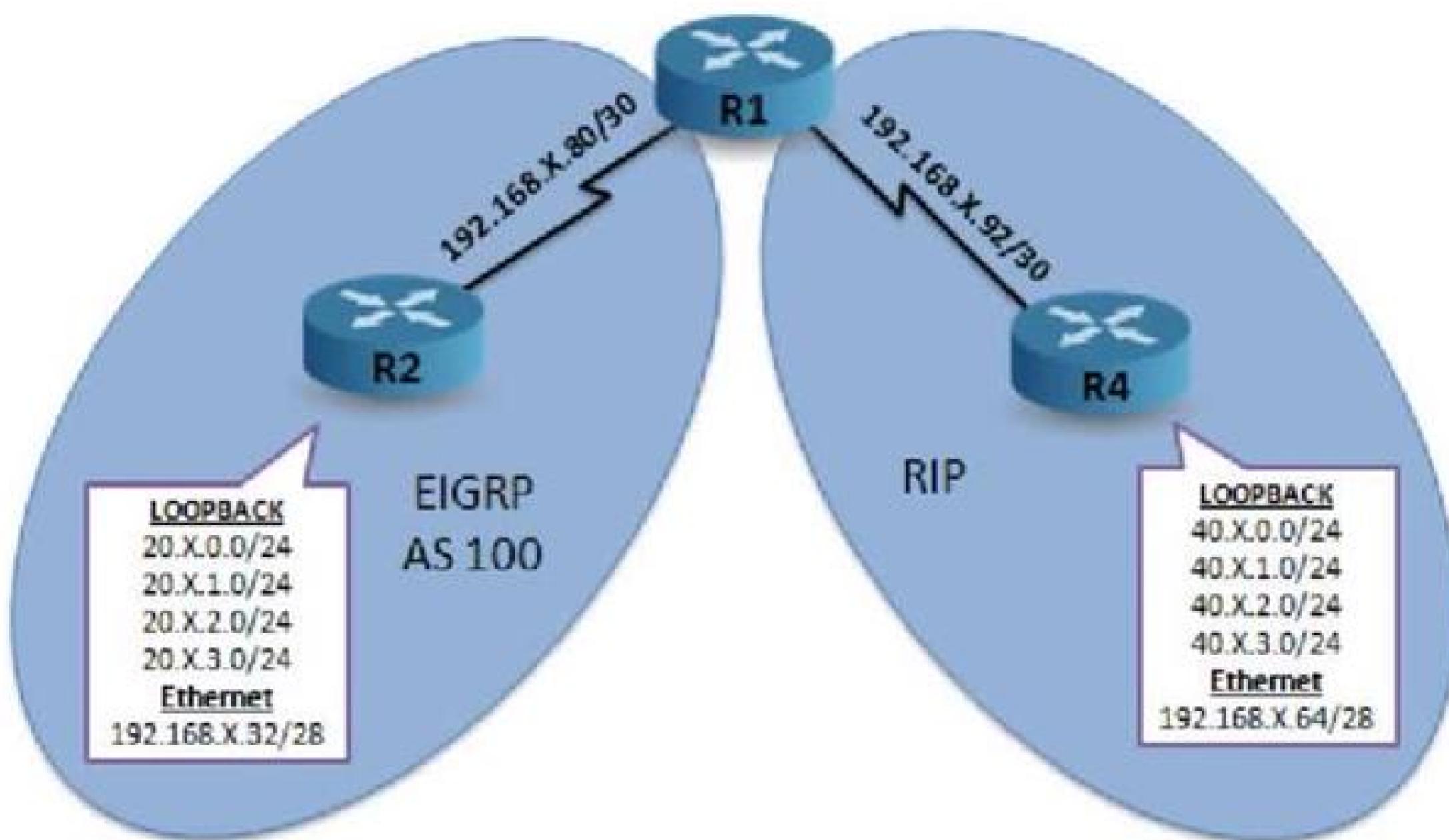
L 192.168.1.93/32 is directly connected, Serial0/0/0

## LAB 22: REDISTRIBUTION BETWEEN RIP AND EIGRP

### OBJECTIVE:

To configure and verify Route Redistribution between EIGRP and RIP

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Configure Routers in RIP and EIGRP as per given topology.
- 3) Configure Redistribution.

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure EIGRP between R1 and R4 routers

```
R1(config)#router eigrp 100
R1(config-router)#network 192.168.X.92
R1(config-router)# no auto-summary
```

```
R4(Config)# router eigrp 100
R4(Config-router)# network 40.0.0.0
R4(Config-router)# network 192.168.X.0
R4(config-router)# no auto-summary
```

- 4) Configure RIP in R1 and R2 routers.

```
R1(config)# router RIP
R1 (config-router)# network 192.168.X.80
R1 (config-router)#version 2
R1 (config-router)#no auto-summary
R2 (config)#router rip
R2(config-router)#network 0.0.0.0
R2 (config-router)#version 2
R2 (config-router)#no auto-summary
```

- 5) Configure Route Redistribution on R1 router

```
R1(config)#router eigrp 100
R1(config-router)#redistribute rip metric 1000 1000 100 100 1500
R1(config)#router rip
R1(config-router)# redistribute eigrp 100 metric 5
```

#### VERIFICATION:

→ Before Configuring Redistribution

**R2# show ip route**

Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

```
20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks
C    20.1.0.0/24 is directly connected, Loopback0
L    20.1.0.1/32 is directly connected, Loopback0
C    20.1.1.0/24 is directly connected, Loopback1
L    20.1.1.1/32 is directly connected, Loopback1
C    20.1.3.0/24 is directly connected, Loopback3
L    20.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
C    192.168.1.32/28 is directly connected, FastEthernet0/0
L    192.168.1.33/32 is directly connected, FastEthernet0/0
C    192.168.1.80/30 is directly connected, Serial0/0/1
L    192.168.1.82/32 is directly connected, Serial0/0/1
C    192.168.1.84/30 is directly connected, Serial0/0/0
L    192.168.1.85/32 is directly connected, Serial0/0/0
```

**R4# show ip route**

Codes: L - local, 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, H - NHRP, I - LISP  
 + - replicated route, % - next hop override  
 40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks  
 C 40.1.0.0/24 is directly connected, Loopback0  
 L 40.1.0.1/32 is directly connected, Loopback0  
 C 40.1.1.0/24 is directly connected, Loopback1  
 L 40.1.1.1/32 is directly connected, Loopback1  
 C 40.1.2.0/24 is directly connected, Loopback2  
 L 40.1.2.1/32 is directly connected, Loopback2  
 C 40.1.3.0/24 is directly connected, Loopback3  
 L 40.1.3.1/32 is directly connected, Loopback3  
 192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks  
 D 192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:02:05, Serial0/0/0  
 D 192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:02:05, Serial0/0/0  
 C 192.168.1.88/30 is directly connected, Serial0/0/1  
 L 192.168.1.90/32 is directly connected, Serial0/0/1  
 C 192.168.1.92/30 is directly connected, Serial0/0/0  
 L 192.168.1.93/32 is directly connected, Serial0/0/0

→ After Configuring Redistribution from EIGRP into RIP

**R2 # show ip route**

Codes: L - local, 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, + - replicated route  
 Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

20.0.0.0/8 is variably subnetted, 6 subnets, 2 masks  
 C 20.1.0.0/24 is directly connected, Loopback0  
 L 20.1.0.1/32 is directly connected, Loopback0  
 C 20.1.1.0/24 is directly connected, Loopback1  
 L 20.1.1.1/32 is directly connected, Loopback1  
 C 20.1.3.0/24 is directly connected, Loopback3  
 L 20.1.3.1/32 is directly connected, Loopback3

```

40.0.0.0/24 is subnetted, 4 subnets
R  40.1.0.0 [120/5] via 192.168.1.81, 00:00:20, Serial0/0/1
R  40.1.1.0 [120/5] via 192.168.1.81, 00:00:20, Serial0/0/1
R  40.1.2.0 [120/5] via 192.168.1.81, 00:00:20, Serial0/0/1
R  40.1.3.0 [120/5] via 192.168.1.81, 00:00:20, Serial0/0/1

192.168.1.0/24 is variably subnetted, 9 subnets, 3 masks
R  192.168.1.16/28 [120/1] via 192.168.1.81, 00:00:20, Serial0/0/1
C  192.168.1.32/28 is directly connected, FastEthernet0/0
L  192.168.1.33/32 is directly connected, FastEthernet0/0
C  192.168.1.80/30 is directly connected, Serial0/0/1
L  192.168.1.82/32 is directly connected, Serial0/0/1
C  192.168.1.84/30 is directly connected, Serial0/0/0
L  192.168.1.85/32 is directly connected, Serial0/0/0
R  192.168.1.88/30 [120/5] via 192.168.1.81, 00:00:20, Serial0/0/1
R  192.168.1.92/30 [120/1] via 192.168.1.81, 00:00:20, Serial0/0/1

```

→ After Configuring Redistribution from RIP into EIGRP

R4# show ip route

Codes: L - local, 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, H - NHRP, I - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is not set

```

20.0.0.0/32 is subnetted, 3 subnets
D EX  20.1.0.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
D EX  20.1.1.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
D EX  20.1.3.1 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0

40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C  40.1.0.0/24 is directly connected, Loopback0
L  40.1.0.1/32 is directly connected, Loopback0
C  40.1.1.0/24 is directly connected, Loopback1
L  40.1.1.1/32 is directly connected, Loopback1
C  40.1.2.0/24 is directly connected, Loopback2
L  40.1.2.1/32 is directly connected, Loopback2
C  40.1.3.0/24 is directly connected, Loopback3
L  40.1.3.1/32 is directly connected, Loopback3

192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks
D  192.168.1.16/28 [90/20514560] via 192.168.1.94, 00:03:01, Serial0/0/0
D EX  192.168.1.32/28 [170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
D  192.168.1.80/30 [90/21024000] via 192.168.1.94, 00:03:01, Serial0/0/0
D EX  192.168.1.84/30[170/20537600] via 192.168.1.94, 00:00:02, Serial0/0/0
C  192.168.1.88/30 is directly connected, Serial0/0/1
L  192.168.1.90/32 is directly connected, Serial0/0/1
C  192.168.1.92/30 is directly connected, Serial0/0/0
L  192.168.1.93/32 is directly connected, Serial0/0/0

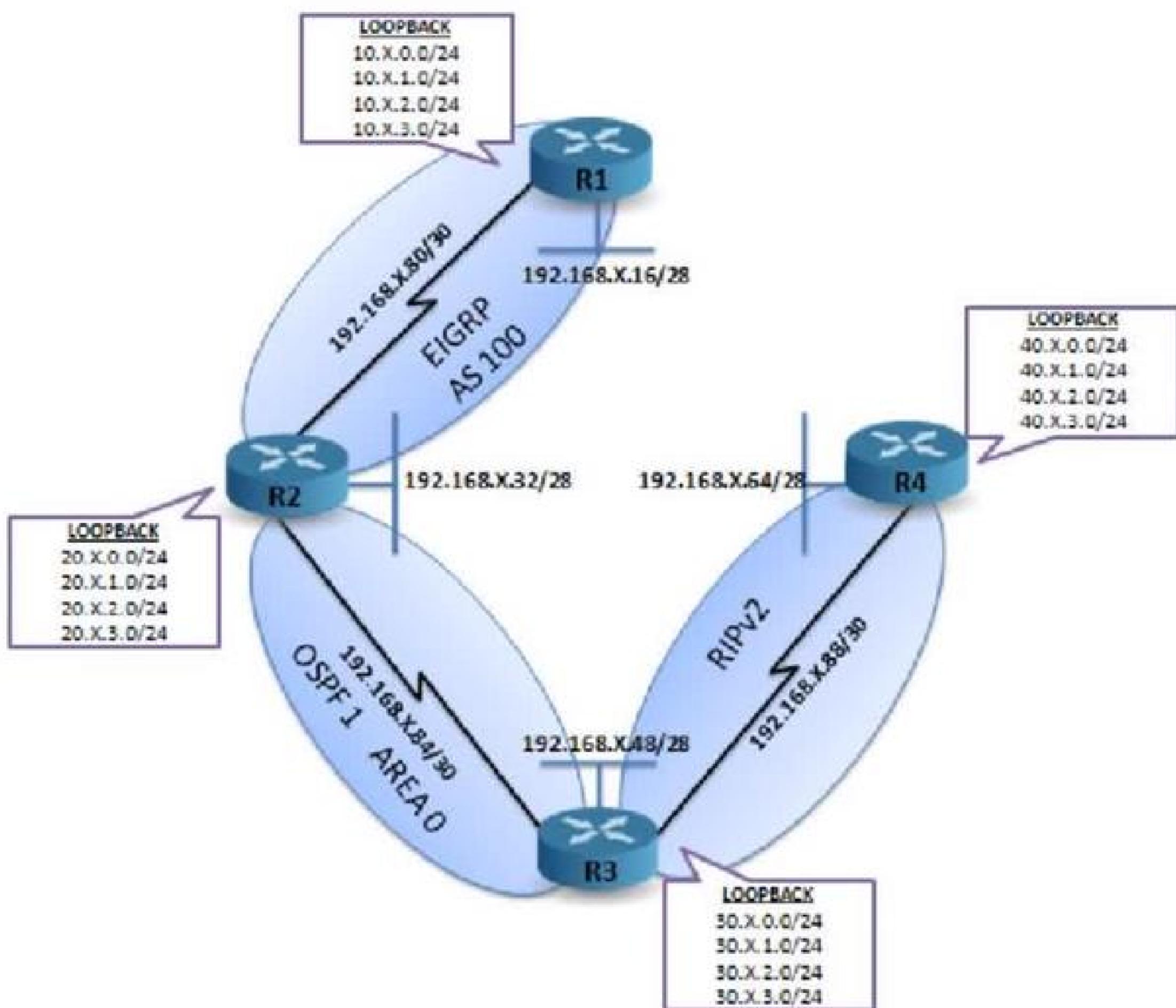
```

## LAB 23: ADVANCED REDISTRIBUTION

### OBJECTIVE:

To configure and verify Route Redistribution between EIGRP, OSPF and RIP

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Configure RIP,EIGRP and OSPF on routers as per given topology.
- 3) Configure Redistribution.

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

```
Router# show ip interface brief
```

- 2) Check the routing table on all the routers

```
Router# show ip route
```

- 3) Configure EIGRP between R1 and R2 routers

```
R1(config)# router eigrp 100
R1(config-router)#network 10.0.0.0 0.0.255.255
R1(config-router)#network 192.168.X.16 0.0.0.15
R1(config-router)#network 192.168.X.80 0.0.0.3
R1(config-router)#no auto-summary
R1(config-router)#exit
R2(config)# router eigrp 100
R2(config-router)# network 192.168.X.80 0.0.0.3
R2(config-router)#no auto-summary
R2(config-router)#exit
```

- 4) Configure OSPF AREA 0 between R2 and R3 routers.

```
R2(config)# router ospf 1
R2(config-router)#network 192.168.X.84 0.0.0.3 area 0
R2(config-router)#network 192.168.X.32 0.0.0.15 area 0
R2(config-router)#network 20.0.0.0 0.0.255.255 area 0
R2(config-router)#exit
R3(config)# router ospf 1
R3(config-router)#network 192.168.X.84 0.0.0.3 area 0
R3(config-router)#network 30.0.0.0 0.0.255.255 area 0
R3(config-router)#exit
```

- 5) Configure RIPV2 between R3 and R4 routers.

```
R3(config)# router rip
R3(config-router)#version 2
R3(config-router)#network 192.168.X.0
R3(config-router)#no auto-summary
R3(config-router)#exit
R4(config)# router rip
R4(config-router)#version 2
R4(config-router)#network 192.168.X.0
R4(config-router)#network 40.0.0.0
R4(config-router)#no auto-summary
R4(config-router)#exit
```

- 6) Configure Redistribution on R2 router to redistribute from EIGRP to OSPF and vice versa.

```
R2(config)# router eigrp 100
R2(config-router)#redistribute ospf 1 metric 1500 2000 255 1 1500
R2(config)# router ospf 1
R2(config-router)#redistribute eigrp 100 subnets
```

7) Configure Redistribution on R3 router to redistribute from OSPF to RIP and vice versa.

```
R3(config)# router ospf 1
R3(config-router)#redistribute rip subnets
R3(config)# router rip
R3(config-router)#redistribute ospf 1 metric 5
```

#### VERIFICATION:

##### → Before Configuring Redistribution

**R4#show ip route**

Codes: L - local, 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, H - NHRP, I - LISP  
 + - replicated route, % - next hop override  
 Gateway of last resort is not set

```
30.0.0.0/24 is subnetted, 1 subnets
R  30.1.3.0 [120/1] via 192.168.1.89, 00:00:12, Serial0/0/1
40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C  40.1.0.0/24 is directly connected, Loopback0
L  40.1.0.1/32 is directly connected, Loopback0
C  40.1.1.0/24 is directly connected, Loopback1
L  40.1.1.1/32 is directly connected, Loopback1
C  40.1.2.0/24 is directly connected, Loopback2
L  40.1.2.1/32 is directly connected, Loopback2
C  40.1.3.0/24 is directly connected, Loopback3
L  40.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks
R  192.168.1.48/28 [120/1] via 192.168.1.89, 00:00:12, Serial0/0/1
C  192.168.1.64/28 is directly connected, FastEthernet0/0
L  192.168.1.65/32 is directly connected, FastEthernet0/0
R  192.168.1.84/30 [120/1] via 192.168.1.89, 00:00:12, Serial0/0/1
C  192.168.1.88/30 is directly connected, Serial0/0/1
L  192.168.1.90/32 is directly connected, Serial0/0/1
C  192.168.1.92/30 is directly connected, Serial0/0/0
L  192.168.1.93/32 is directly connected, Serial0/0/0
```

##### → After Configuring Redistribution

**R4#show ip route**

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

10.0.0.0/24 is subnetted, 3 subnets

R 10.1.1.0 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1

R 10.1.2.0 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1

R 10.1.3.0 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1

20.0.0.0/32 is subnetted, 3 subnets

R 20.1.0.1 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1

R 20.1.1.1 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1

R 20.1.3.1 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1

30.0.0.0/24 is subnetted, 1 subnets

R 30.1.3.0 [120/1] via 192.168.1.89, 00:00:09, Serial0/0/1

40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

C 40.1.0.0/24 is directly connected, Loopback0

L 40.1.0.1/32 is directly connected, Loopback0

C 40.1.1.0/24 is directly connected, Loopback1

L 40.1.1.1/32 is directly connected, Loopback1

C 40.1.2.0/24 is directly connected, Loopback2

L 40.1.2.1/32 is directly connected, Loopback2

C 40.1.3.0/24 is directly connected, Loopback3

L 40.1.3.1/32 is directly connected, Loopback3

192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks

R 192.168.1.16/28 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1

R 192.168.1.32/28 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1

R 192.168.1.48/28 [120/1] via 192.168.1.89, 00:00:09, Serial0/0/1

C 192.168.1.64/28 is directly connected, FastEthernet0/0

L 192.168.1.65/32 is directly connected, FastEthernet0/0

R 192.168.1.80/30 [120/5] via 192.168.1.89, 00:00:04, Serial0/0/1

R 192.168.1.84/30 [120/1] via 192.168.1.89, 00:00:09, Serial0/0/1

C 192.168.1.88/30 is directly connected, Serial0/0/1

L 192.168.1.90/32 is directly connected, Serial0/0/1

C 192.168.1.92/30 is directly connected, Serial0/0/0

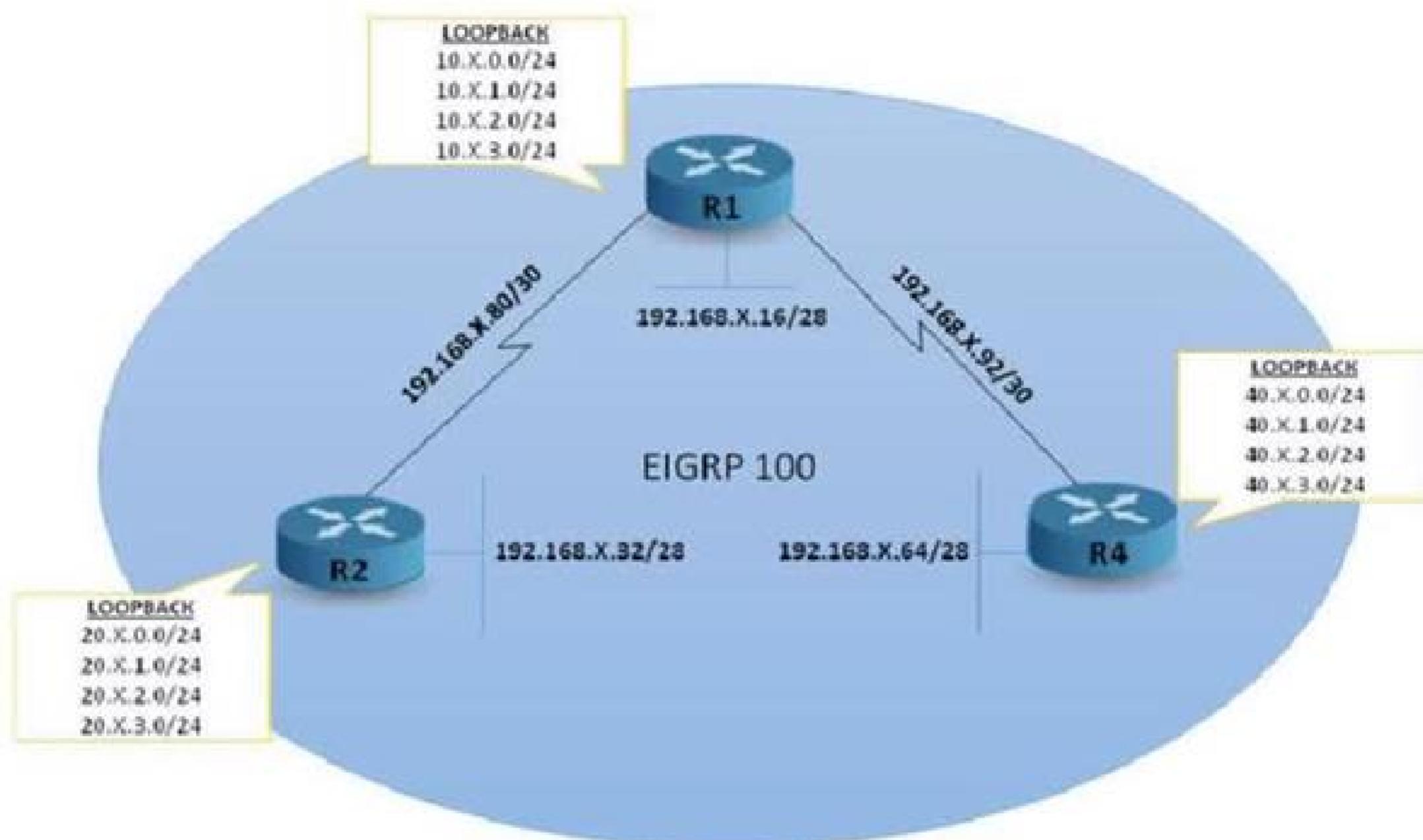
L 192.168.1.93/32 is directly connected, Serial0/0/0

## LAB 24: DISTRIBUTE LISTS

### OBJECTIVE:

To configure distribute-lists to control which networks are to be advertised to which router

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Configure EIGRP in all routers.
- 3) Configure Distribute-list to prevent the 20.0.0.0/24 network from being advertised to R4 router.
- 4) Verify the output in the routing table of R4 Router.

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure EIGRP in all routers.

```
R1 (config)#router eigrp 100
R1 (config-router)# network 0.0.0.0
R2 (config)#router eigrp 100
R2 (config-router)#network 0.0.0.0
```

```
R4(config)#router eigrp 100
R4(config-router)# network 0.0.0.0
```

#### → Before Configuring Distribute Lists

R4# show ip route

Codes: L - local, 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, H - NHRP, I - LISP  
 + - replicated route, % - next hop override

Gateway of last resort is not set

20.0.0.0/24 is subnetted, 3 subnets

```
D  20.1.0.0 [90/21152000] via 192.168.1.94, 00:03:00, Serial0/0/0
D  20.1.1.0 [90/21152000] via 192.168.1.94, 00:03:00, Serial0/0/0
D  20.1.3.0 [90/21152000] via 192.168.1.94, 00:03:00, Serial0/0/0

40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C  40.1.0.0/24 is directly connected, Loopback0
L  40.1.0.1/32 is directly connected, Loopback0
C  40.1.1.0/24 is directly connected, Loopback1
L  40.1.1.1/32 is directly connected, Loopback1
C  40.1.2.0/24 is directly connected, Loopback2
L  40.1.2.1/32 is directly connected, Loopback2
C  40.1.3.0/24 is directly connected, Loopback3
L  40.1.3.1/32 is directly connected, Loopback3

192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
C  192.168.1.64/28 is directly connected, FastEthernet0/0
L  192.168.1.65/32 is directly connected, FastEthernet0/0
C  192.168.1.88/30 is directly connected, Serial0/0/1
L  192.168.1.90/32 is directly connected, Serial0/0/1
C  192.168.1.92/30 is directly connected, Serial0/0/0
L  192.168.1.93/32 is directly connected, Serial0/0/0
```

- 4) Configure Access-list on R1 router to Identify Traffic

```
R1(config)# access-list 10 deny 20.1.0.0 0.0.255.255
R1(config)# access-list 10 permit any
```

- 5) Configure Distribute List on R1 router to stop the 20.0.0./24 network from being advertised to R4

```
R1(config)# router eigrp 100
R1(config-router)# distribute-list 10 out serial 0/1/0
```

**VERIFICATION:**

After Configuring Distribute Lists

R4# show ip route

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

C 40.1.0.0/24 is directly connected, Loopback0

L 40.1.0.1/32 is directly connected, Loopback0

C 40.1.1.0/24 is directly connected, Loopback1

L 40.1.1.1/32 is directly connected, Loopback1

C 40.1.2.0/24 is directly connected, Loopback2

L 40.1.2.1/32 is directly connected, Loopback2

C 40.1.3.0/24 is directly connected, Loopback3

L 40.1.3.1/32 is directly connected, Loopback3

192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks

C 192.168.1.64/28 is directly connected, FastEthernet0/0

L 192.168.1.65/32 is directly connected, FastEthernet0/0

C 192.168.1.88/30 is directly connected, Serial0/0/1

L 192.168.1.90/32 is directly connected, Serial0/0/1

C 192.168.1.92/30 is directly connected, Serial0/0/0

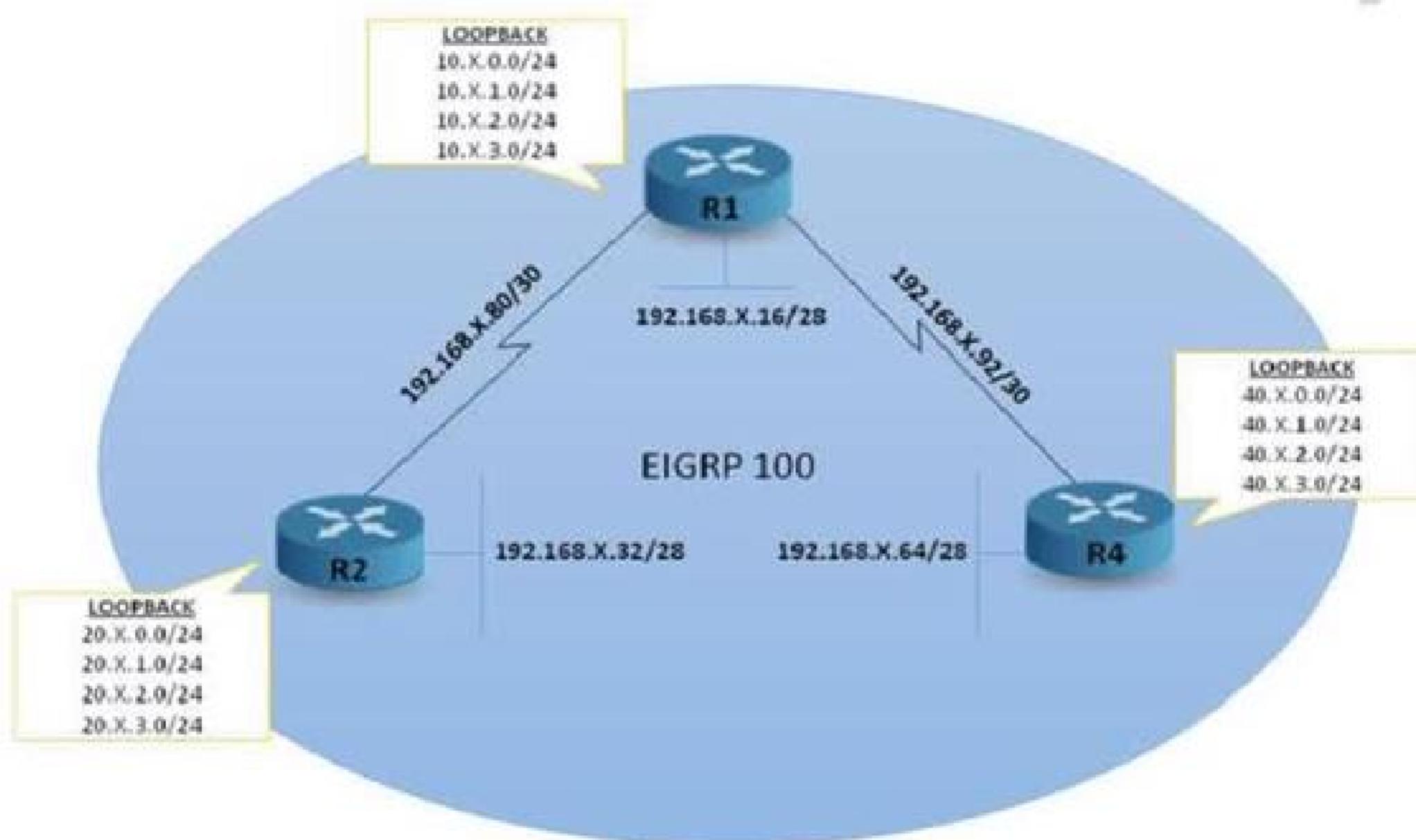
L 192.168.1.93/32 is directly connected, Serial0/0/0

## LAB 25: PASSIVE INTERFACE

### OBJECTIVE:

To configure passive interfaces so that hello packets are not sent on interfaces where they are not required.

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Configure EIGRP in all routers.
- 3) Configure and Verify Passive-Interface

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure EIGRP in all routers.

```
R1 (config)#router eigrp 100
R1 (config-router)# network 0.0.0.0
R2 (config)#router eigrp 100
R2 (config-router)#network 0.0.0.0
```

```
R4(config)#router eigrp 100  
R4(config-router)# network 0.0.0.0
```

→ Before Configuring Passive Interface

```
R4# debug eigrp packets hello
```

```
*Jul 23 06:04:26.687: EIGRP: Sending HELLO on Loopback0  
*Jul 23 06:04:26.687: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u  
n/rely 0/0  
*Jul 23 06:04:26.687: EIGRP: Received HELLO on Loopback0 nbr 40.1.0.1  
*Jul 23 06:04:26.687: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0  
*Jul 23 06:04:27.067: EIGRP: Sending HELLO on Loopback3  
*Jul 23 06:04:27.067: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u  
n/rely 0/0  
*Jul 23 06:04:27.067: EIGRP: Received HELLO on Loopback3 nbr 40.1.3.1  
*Jul 23 06:04:27.067: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0  
*Jul 23 06:04:27.619: EIGRP: Sending HELLO on FastEthernet0/0  
*Jul 23 06:04:27.619: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u  
n/rely 0/0  
*Jul 23 06:04:27.963: EIGRP: Sending HELLO on Serial0/0/0  
*Jul 23 06:04:27.963: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u  
n/rely 0/0  
*Jul 23 06:04:29.143: EIGRP: Sending HELLO on Serial0/0/1  
*Jul 23 06:04:29.143: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u  
n/rely 0/0
```

- 4) Configure Passive-Interface on the interface that is connected to switch on all routers.

```
R4(config)# router eigrp 100  
R4(config-router)# passive-interface fastethernet 0/0
```

**VERIFICATION:**

→ After Configuring Passive Interface

```
R4#debug eigrp packets hello
```

```
(HELLO)
```

```
EIGRP Packet debugging is on  
R4#  
*Jul 23 06:04:49.051: EIGRP: Sending HELLO on Loopback1  
*Jul 23 06:04:49.051: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u  
n/rely 0/0  
*Jul 23 06:04:49.051: EIGRP: Received HELLO on Loopback1 nbr 40.1.1.1  
*Jul 23 06:04:49.051: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0  
*Jul 23 06:04:49.255: EIGRP: Sending HELLO on Loopback0  
*Jul 23 06:04:49.255: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iidbQ u  
n/rely 0/0  
*Jul 23 06:04:49.255: EIGRP: Received HELLO on Loopback0 nbr 40.1.0.1  
*Jul 23 06:04:49.255: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0
```

\*Jul 23 06:04:50.203: EIGRP: Sending HELLO on Loopback3  
\*Jul 23 06:04:50.203: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iedbQ u  
n/rely 0/0  
\*Jul 23 06:04:50.203: EIGRP: Received HELLO on Loopback3 nbr 40.1.3.1  
\*Jul 23 06:04:50.203: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0  
\*Jul 23 06:04:51.239: EIGRP: Sending HELLO on Serial0/0/1  
\*Jul 23 06:04:51.239: AS 100, Flags 0x0:(NULL), Seq 0/0 interfaceQ 0/0 iedbQ u  
n/rely 0/0

**To Verify Which Interface is Passive-Interface****R4# show ip protocols****\*\*\* IP Routing is NSF aware \*\*\***

Routing Protocol is "eigrp 100"

Outgoing update filter list for all interfaces is not set

Incoming update filter list for all interfaces is not set

Default networks flagged in outgoing updates

Default networks accepted from incoming updates

EIGRP-IPv4 Protocol for AS(100)

Metric weight K1=1, K2=0, K3=1, K4=0, K5=0

NSF-aware route hold timer is 240

Router-ID: 40.1.3.1

Topology : 0 (base)

Active Timer: 3 min

Distance: internal 90 external 170

Maximum path: 4

Maximum hopcount 100

Maximum metric variance 1

Automatic Summarization: disabled

Maximum path: 4

Routing for Networks:

0.0.0.0

Passive Interface(s):

FastEthernet0/0

Routing Information Sources:

Gateway Distance Last Update

192.168.1.94 90 00:06:16

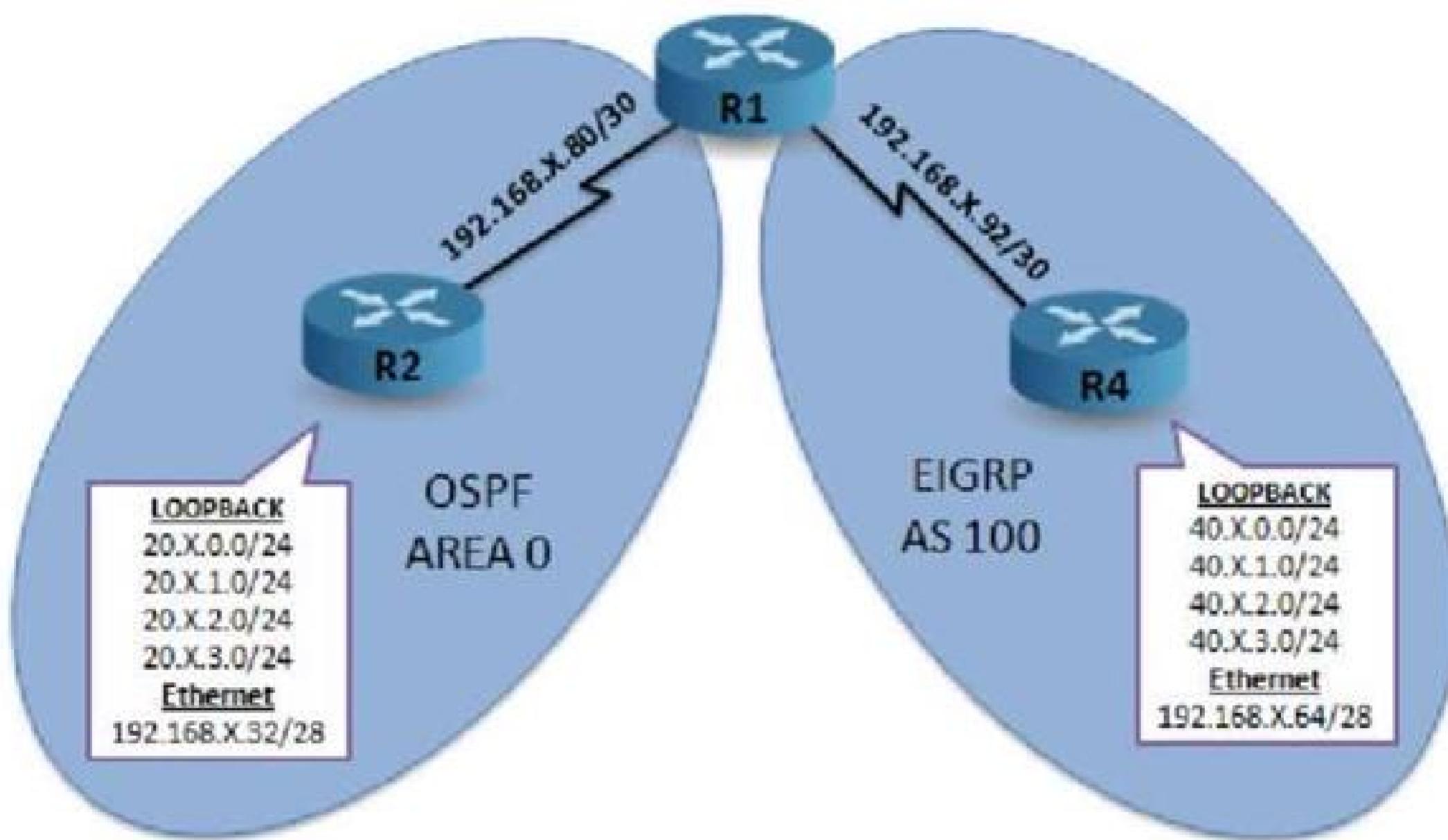
Distance: internal 90 external 170

## LAB 26: Redistribution with Route-Map

### OBJECTIVE:

To configure a Route Map to influence how routes get redistributed

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Configure OSPF and EIGRP on routers as per given topology.
- 3) Configure Redistribution.
- 4) Configure Route – Maps in such a way that 40.0.0.0 networks will be redistributed into OSPF with different metrics.

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure EIGRP between R1 and R4 routers

```
R1(config)#router eigrp 100
R1(config-router)#network 192.168.X.92
```

```
R1(config-router)# no auto-summary  
R4(Config)# router eigrp 100  
R4(Config-router)# network 40.0.0.0  
R4(Config-router)# network 192.168.X.0  
R4(config-router)# no auto-summary
```

- 4) Configure OSPF AREA 0 in R1 and R2 routers.

```
R1(config)# router ospf 100  
R1 (config-router)# network 192.168.X.80 0.0.0.3 area 0  
R2 (config)#router ospf 100  
R2(config-router)#network 20.X.0.0 0.0.255.255 area 0  
R2(config-router) #network 192.168.X.32 0.0.0.15 area 0  
R2(config-router) #network 192.168.X.80 0.0.0.3 area 0  
R2(config-router) #network 192.168.X.84 0.0.0.3 area 0
```

- 5) Configure access-list to identify the traffic

```
R1(config)#access-list 10 permit 40.1.0.0 0.0.255.255  
R1(config)#access-list 11 permit 40.1.1.0 0.0.255.255  
R1(config)# access-list 12 permit 40.1.2.0 0.0.255.255  
R1(config)#access-list 13 permit 40.1.3.0 0.0.255.255
```

- 6) Configure Route Maps

```
R1(config)# route-map zoom permit 1  
R1(config-route-map)#match ip address 10  
R1(config-route-map)#set metric 100  
R1(config-route-map)#exit  
R1(config)#route-map zoom permit 2  
R1(config-route-map)#match ip address 11  
R1(config-route-map)#set metric 200  
R1(config-route-map)#exit  
R1(config)#route-map zoom permit 3  
R1(config-route-map)#match ip address 12  
R1(config-route-map)#set metric 300  
R1(config-route-map)#exit  
R1(config)#route-map zoom permit 4  
R1(config-route-map)#match ip address 13  
R1(config-route-map)#set metric 400  
R1(config-route-map)#exit
```

- 7) Configure Redistribution from OSPF into EIGRP with route-map

```
R1(config)#router ospf 1  
R1(config-router)#redistribute eigrp 100 route-map zoom subnets
```

#### VERIFICATION:

R2#show ip route

Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

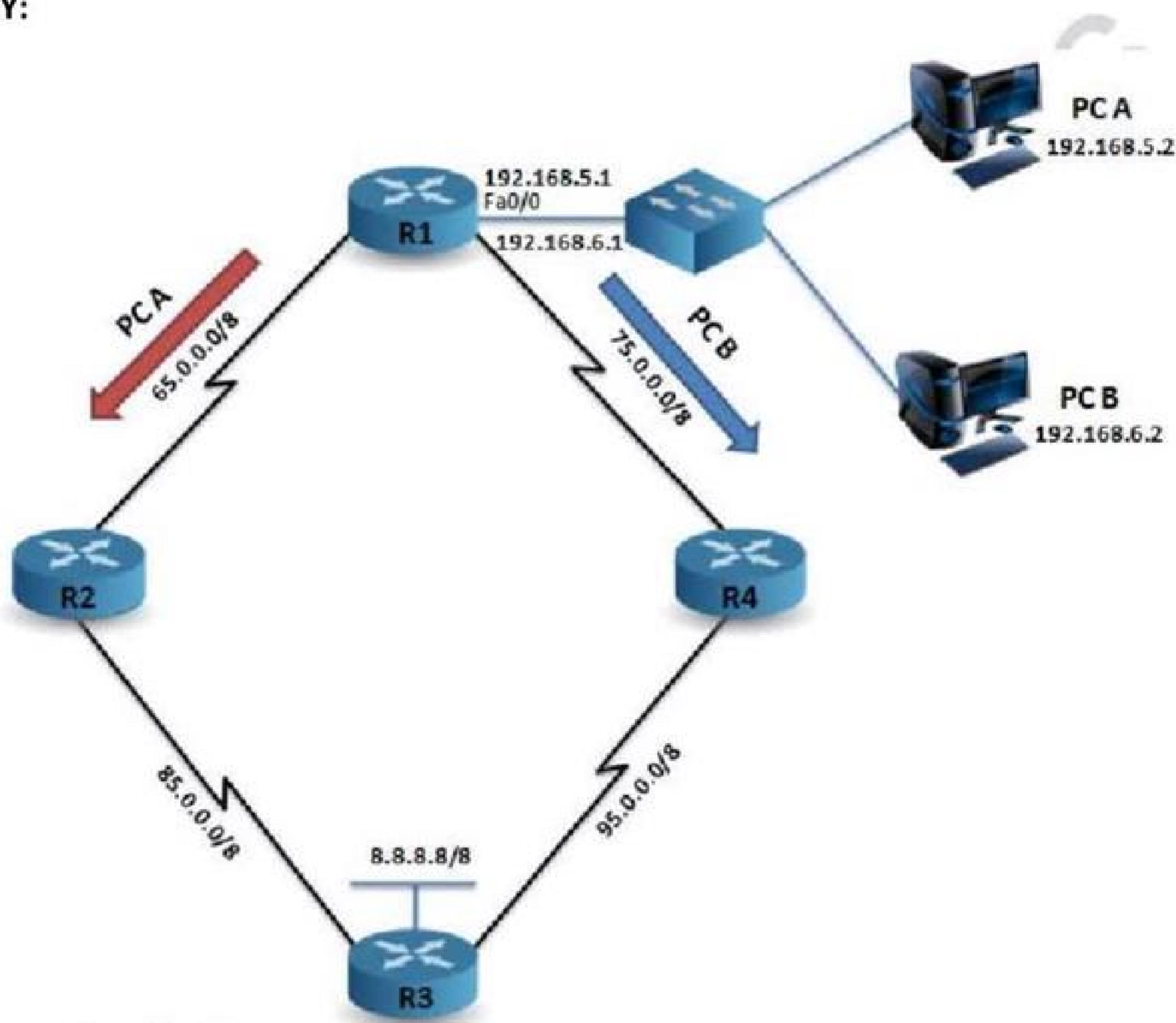
- 10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
  - C 10.1.20.0/24 is directly connected, FastEthernet0/1
  - L 10.1.20.1/32 is directly connected, FastEthernet0/1
- 20.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
  - C 20.1.0.0/24 is directly connected, Loopback0
  - L 20.1.0.1/32 is directly connected, Loopback0
  - C 20.1.1.0/24 is directly connected, Loopback1
  - L 20.1.1.1/32 is directly connected, Loopback1
  - C 20.1.2.0/24 is directly connected, Loopback2
  - L 20.1.2.1/32 is directly connected, Loopback2
  - C 20.1.3.0/24 is directly connected, Loopback3
  - L 20.1.3.1/32 is directly connected, Loopback3
- 40.0.0.0/24 is subnetted, 4 subnets
  - O E2 40.1.0.0 [110/100] via 192.168.1.81, 00:00:05, Serial0/0/1
  - O E2 40.1.1.0 [110/200] via 192.168.1.81, 00:00:05, Serial0/0/1
  - O E2 40.1.2.0 [110/300] via 192.168.1.81, 00:00:05, Serial0/0/1
  - O E2 40.1.3.0 [110/400] via 192.168.1.81, 00:00:05, Serial0/0/1
- 192.168.1.0/24 is variably subnetted, 6 subnets, 3 masks
  - C 192.168.1.32/28 is directly connected, FastEthernet0/0
  - L 192.168.1.33/32 is directly connected, FastEthernet0/0
  - C 192.168.1.80/30 is directly connected, Serial0/0/1
  - L 192.168.1.82/32 is directly connected, Serial0/0/1
  - C 192.168.1.84/30 is directly connected, Serial0/0/0
  - L 192.168.1.85/32 is directly connected, Serial0/0/0

## LAB 27: POLICY BASED ROUTING

### OBJECTIVE:

Configure Policy Based Routing in R1 router such that PC A traffic should go via R2 and PC B traffic should go via R4 router.

### TOPOLOGY:



### TASK:

- 1) Assign IP addresses on Lan interface of R1 router
- 2) Configure Access-lists to Identify traffic
- 3) Implement Policy Based Routing using Route-Map.

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Assign IP address on the LAN interface (Fa0/0) of the R1 router.

```
R1(config)#interface fastethernet0/0  
R1(config-if)#ip address 192.168.5.1 255.255.255.0  
R1(config-if)#ip address 192.168.6.1 255.255.255.0 secondary
```

- 3) Configure Access-list to match the traffic generated by PC A and PC B.

```
R1(config)# access-list 11 permit 192.168.5.0 0.0.0.255  
R1(config)# access-list 12 permit 192.168.6.0 0.0.0.255
```

- 4) Configure Route-Map to implement Policy Based Routing.

```
R1 (config)# route-map zoom permit 10  
R1 (config-route-map) # match ip address 11  
R1 (config-route-map) # set interface serial 1/0  
R1 (config-route-map) #exit  
R1 (config)# route-map zoom permit 20  
R1 (config-route-map) # match ip address 12  
R1(config-route-map) # set interface serial 1/1  
R1(config-route-map) #exit
```

- 5) Implement Route-Map on the LAN interface of the R1 Router.

```
R1(config)#interface fastethernet0/0  
R1(config-if)#ip policy route-map zoom
```

#### VERIFICATION:

```
R1#show ip policy  
Interface    Route map  
Fa0/0        zoom  
R1#show route-map  
route-map zoom, permit, sequence 1  
Match clauses:  
    ip address (access-lists): 11  
Set clauses:  
    interface Serial0/1/0  
Policy routing matches: 0 packets, 0 bytes  
route-map zoom, permit, sequence 2  
Match clauses:  
    ip address (access-lists): 12  
Set clauses:  
    interface Serial0/1/1  
Policy routing matches: 0 packets, 0 bytes
```

**PC A Traceroute output**

```
root@box:~# traceroute 8.8.8.8
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 38 byte packets
 1  192.168.5.1 (192.168.5.1)  22.441 ms  21.744 ms  10.406 ms
 2  65.0.0.2 (65.0.0.2)  61.659 ms  31.065 ms  23.289 ms
 3  85.0.0.2 (85.0.0.2)  52.732 ms  34.668 ms  49.872 ms
root@box:~#
```

**PC B Traceroute output**

```
root@box:~# traceroute 8.8.8.8
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 38 byte packets
 1  192.168.5.1 (192.168.5.1)  34.957 ms  13.117 ms  41.513 ms
 2  75.0.0.2 (75.0.0.2)  29.573 ms  27.041 ms  66.985 ms
 3  95.0.0.2 (95.0.0.2)  45.920 ms  46.816 ms  79.911 ms
```

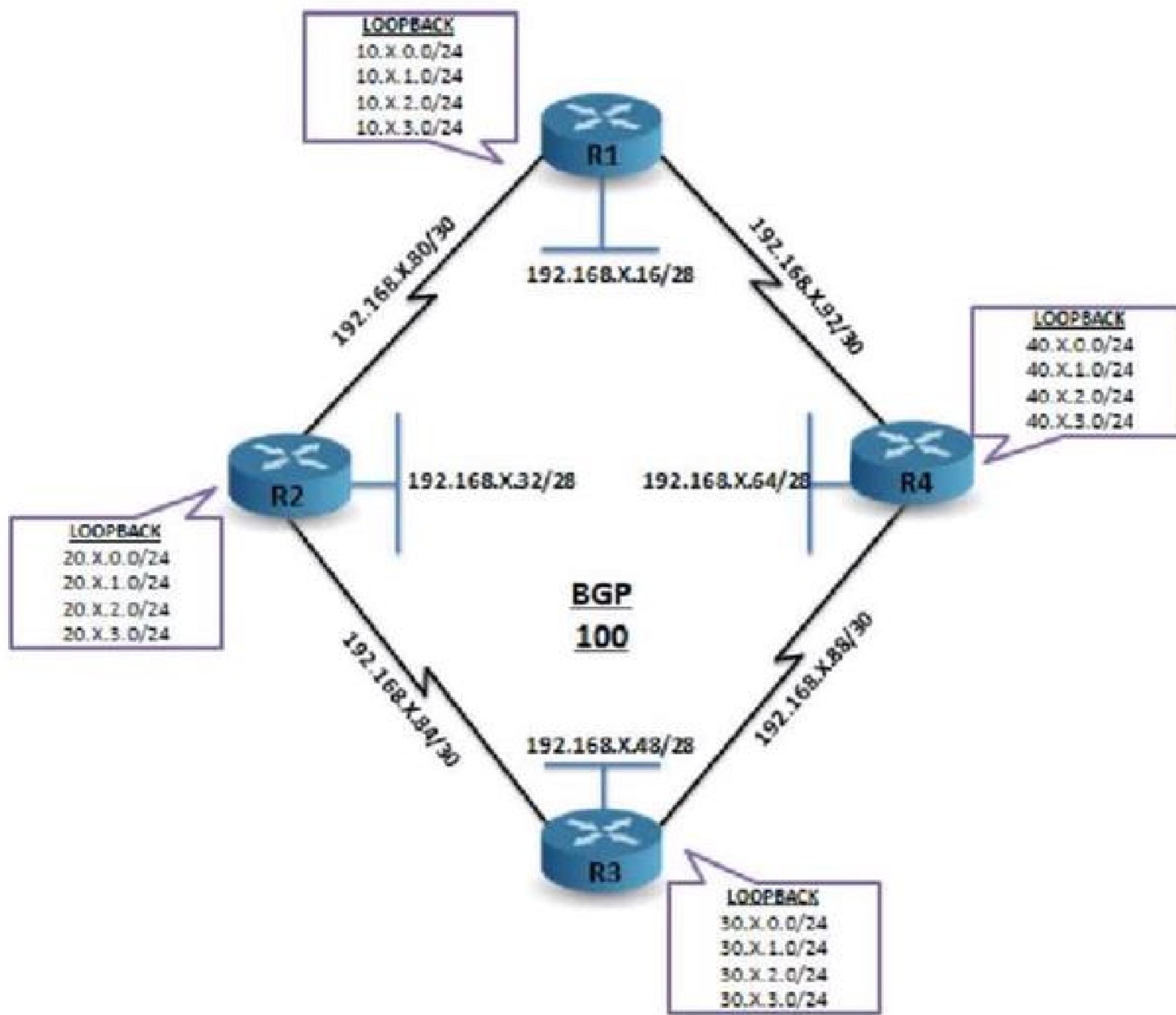
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## LAB 28: BGP

### OBJECTIVE:

To establish connectivity between networks by configuring BGP on all routers

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring BGP on all the routers.
- 3) Configure BGP in all routers by using AS number 100
- 4) Verify Tables in BGP
- 5) Verify the connectivity using Ping command.

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure BGP on all routers using AS number 100

```
R1(config)#router bgp 100
R1(config-router)#neighbor 192.168.X.82 remote-as 100
R1(config-router)#neighbor 192.168.X.93 remote-as 100
R1(config-router)#neighbor 192.168.X.86 remote-as 100
R1(config-router)#network 192.168.X.16 mask 255.255.255.240
R1(config-router)#network 192.168.X.92 mask 255.255.255.252
R1(config-router)#network 192.168.X.80 mask 255.255.255.252
R1(config-router)#network 10.1.0.0 mask 255.255.255.0
R1(config-router)#network 10.1.1.0 mask 255.255.255.0
R1(config-router)#network 10.1.2.0 mask 255.255.255.0
R1(config-router)#network 10.1.3.0 mask 255.255.255.0
R1(config-router)#no synchronization
R1(config-router)#end
R2(config)# router bgp 100
R2(config-router)#neighbor 192.168.X.81 remote-as 100
R2(config-router)#neighbor 192.168.X.86 remote-as 100
R2(config-router)#neighbor 192.168.X.93 remote-as 100
R2(config-router)#network 192.168.X.80 mask 255.255.255.252
R2(config-router)#network 192.168.X.84 mask 255.255.255.252
R2(config-router)#network 192.168.X.32 mask 255.255.255.240
R2(config-router)#network 20.1.0.0 mask 255.255.255.0
R2(config-router)#network 20.1.1.0 mask 255.255.255.0
R2(config-router)#network 20.1.2.0 mask 255.255.255.0
R2(config-router)#network 20.1.3.0 mask 255.255.255.0
R2(config-router)#no synchronization
R2(config-router)#end
```

```
R4(config-router)#neighbor 192.168.X.89 remote-as 100
R4(config-router)#neighbor 192.168.X.82 remote-as 100
R4(config-router)#network 192.168.X.64 mask 255.255.255.240
R4(config-router)#network 192.168.X.88 mask 255.255.255.252
R4(config-router)#network 192.168.X.92 mask 255.255.255.252
R4(config-router)#network 40.1.0.0 mask 255.255.255.0
R4(config-router)#network 40.1.1.0 mask 255.255.255.0
R4(config-router)#network 40.1.2.0 mask 255.255.255.0
R4(config-router)#network 40.1.3.0 mask 255.255.255.0
R4(config-router)#no synchronization
R4(config-router)#end
```

#### VERIFICATION:

Check the BGP neighbor table, Database table and Routing Table on all the routers.

→ To check Neighbor Table use following command in all routers

```
R1, R2, R3, R4#show ip bgp summary
R1#show ip bgp summary
BGP router identifier 10.1.3.1, local AS number 100
BGP table version is 7, main routing table version 7
6 network entries using 816 bytes of memory
8 path entries using 416 bytes of memory
2/2 BGP path/bestpath attribute entries using 248 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 1480 total bytes of memory
BGP activity 6/0 prefixes, 8/0 paths, scan interval 60 secs
```

Neighbor	V	AS	MsgRcvd	MsgSent	TblVer	InQ	OutQ	Up/Down	State
<i>/PfxRcd</i>									
192.168.1.82	4	100	15	15	32	0	0	00:07:50	7
192.168.1.86	4	100	4	5	32	0	0	00:00:15	7
192.168.1.93	4	100	14	15	32	0	0	00:07:13	7

→ To check Database Table use following command in all routers

```
R1, R2, R3, R4#show ip bgp
R1#show ip bgp
BGP table version is 8, local router ID is 10.1.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale, m multipath, b backup-path, x best-external
Origin codes: i - IGP, e - EGP, ? - incomplete
```

Network	Next Hop	Metric	LocPrf	Weight	Path
*> 10.1.0.0/24	0.0.0.0	0	32768	i	
*> 10.1.1.0/24	0.0.0.0	0	32768	i	
*> 10.1.2.0/24	0.0.0.0	0	32768	i	
*> 10.1.3.0/24	0.0.0.0	0	32768	i	
*>i20.1.0.0/24	192.168.1.82	0	100	0	i
*>i20.1.1.0/24	192.168.1.82	0	100	0	i
*>i20.1.2.0/24	192.168.1.82	0	100	0	i
*>i20.1.3.0/24	192.168.1.82	0	100	0	i

```
*>i30.1.0.0/24 192.168.1.86    0 100 0 i
*>i30.1.1.0/24 192.168.1.86    0 100 0 i
*>i30.1.2.0/24 192.168.1.86    0 100 0 i
*>i30.1.3.0/24 192.168.1.86    0 100 0 i
*>i40.1.0.0/24 192.168.1.93    0 100 0 i
```

→ To check Routing Table use following command in all routers

R1, R2, R3, R4#show ip route

R1#show ip route

Codes: L - local, 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, H - NHRP, I - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

- C 10.1.0.0/24 is directly connected, Loopback0
- L 10.1.0.1/32 is directly connected, Loopback0
- C 10.1.1.0/24 is directly connected, Loopback1
- L 10.1.1.1/32 is directly connected, Loopback1
- C 10.1.2.0/24 is directly connected, Loopback2
- L 10.1.2.1/32 is directly connected, Loopback2
- C 10.1.3.0/24 is directly connected, Loopback3
- L 10.1.3.1/32 is directly connected, Loopback3

20.0.0.0/24 is subnetted, 4 subnets

- B 20.1.0.0 [200/0] via 192.168.1.82, 00:03:35
- B 20.1.1.0 [200/0] via 192.168.1.82, 00:03:31
- B 20.1.2.0 [200/0] via 192.168.1.82, 00:03:27
- B 20.1.3.0 [200/0] via 192.168.1.82, 00:03:22

30.0.0.0/24 is subnetted, 4 subnets

- B 30.1.0.0 [200/0] via 192.168.1.86, 00:01:25
- B 30.1.1.0 [200/0] via 192.168.1.86, 00:01:25
- B 30.1.2.0 [200/0] via 192.168.1.86, 00:01:25
- B 30.1.3.0 [200/0] via 192.168.1.86, 00:01:25

40.0.0.0/24 is subnetted, 4 subnets

- B 40.1.0.0 [200/0] via 192.168.1.93, 00:03:58
- B 40.1.1.0 [200/0] via 192.168.1.93, 00:03:55
- B 40.1.2.0 [200/0] via 192.168.1.93, 00:03:52
- B 40.1.3.0 [200/0] via 192.168.1.93, 00:03:49

172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks

- C 172.16.1.0/30 is directly connected, Serial0/3/1
- L 172.16.1.2/32 is directly connected, Serial0/3/1

192.168.1.0/24 is variably subnetted, 9 subnets, 3 masks

- B 192.168.1.32/28 [200/0] via 192.168.1.82, 00:07:49
- B 192.168.1.48/28 [200/0] via 192.168.1.86, 00:01:25
- B 192.168.1.64/28 [200/0] via 192.168.1.93, 00:07:15
- C 192.168.1.80/30 is directly connected, Serial0/1/1

- L 192.168.1.81/32 is directly connected, Serial0/1/1
- B 192.168.1.84/30 [200/0] via 192.168.1.82, 00:07:49
- B 192.168.1.88/30 [200/0] via 192.168.1.86, 00:01:25
- C 192.168.1.92/30 is directly connected, Serial0/1/0
- L 192.168.1.94/32 is directly connected, Serial0/1/0
  - 192.168.5.0/24 is variably subnetted, 2 subnets, 2 masks
- C 192.168.5.0/24 is directly connected, FastEthernet0/0
- L 192.168.5.1/32 is directly connected, FastEthernet0/0
  - 192.168.6.0/24 is variably subnetted, 2 subnets, 2 masks
- C 192.168.6.0/24 is directly connected, FastEthernet0/0
- L 192.168.6.1/32 is directly connected, FastEthernet0/0

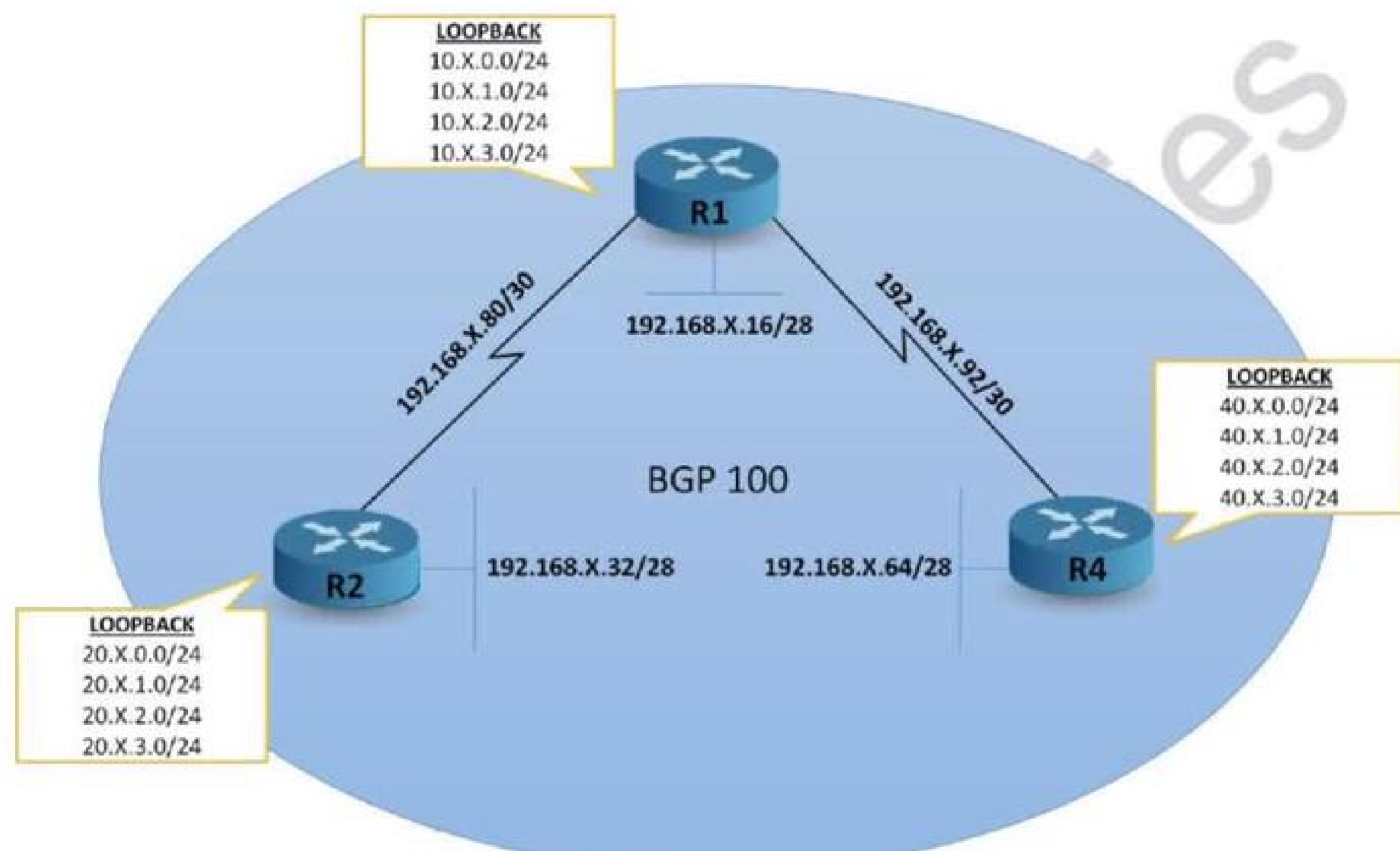
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## LAB 29: BGP SPLIT HORIZON

### OBJECTIVE:

To configure and verify the behaviour of BGP Split Horizon

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring BGP on all the routers.
- 3) Configure BGP in all routers by using AS number 100
- 4) Verify Tables in BGP
- 5) Verify Split Horizon

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure BGP on all routers using AS number 100

```
R1(config)#router bgp 100
R1(config-router)#neighbor 192.168.X.82 remote-as 100
R1(config-router)#neighbor 192.168.X.93 remote-as 100
R1(config-router)#network 192.168.X.16 mask 255.255.255.240
R1(config-router)#network 192.168.X.92 mask 255.255.255.252
R1(config-router)#network 192.168.X.80 mask 255.255.255.252
R1(config-router)#no synchronization
R1(config-router)#end
R2(config)# router bgp 100
R2(config-router)#neighbor 192.168.X.81 remote-as 100
R2(config-router)#network 192.168.X.80 mask 255.255.255.252
R2(config-router)#network 192.168.X.32 mask 255.255.255.240
R2(config-router)#no synchronization
R2(config-router)#end
R4(config)# router bgp 100
R4(config-router)#neighbor 192.168.X.94 remote-as 100
R4(config-router)#network 192.168.X.64 mask 255.255.255.240
R4(config-router)#network 192.168.X.92 mask 255.255.255.252
R4(config-router)#no synchronization
R4(config-router)#end
```

- 4) Verify BGP tables in all routers

```
R1,R2,R3,R4# show ip bgp summary
R1,R2,R3,R4# show ip bgp
R1,R2,R3,R4# show ip route
```

#### VERIFICATION:

- Verify the output in each router. R1 router gets update from both R2 and R4, but R2 and R4 cannot see updates of each other's LAN in their routing table. This is split horizon.

R1# show ip route

Codes: L - local, 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 rout  
 o - ODR, P - periodic downloaded static route, H - NHRP, I - LISP  
 +- replicated route, % - next hop override

Gateway of last resort is not set

- 10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
- C 10.1.0.0/24 is directly connected, Loopback0
- L 10.1.0.1/32 is directly connected, Loopback0
- C 10.1.1.0/24 is directly connected, Loopback1
- L 10.1.1.1/32 is directly connected, Loopback1
- C 10.1.2.0/24 is directly connected, Loopback2
- L 10.1.2.1/32 is directly connected, Loopback2
- C 10.1.3.0/24 is directly connected, Loopback3
- L 10.1.3.1/32 is directly connected, Loopback3

```

172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.16.1.0/30 is directly connected, Serial0/3/1
L 172.16.1.2/32 is directly connected, Serial0/3/1
192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
C 192.168.1.16/28 is directly connected, FastEthernet0/0
L 192.168.1.17/32 is directly connected, FastEthernet0/0
B 192.168.1.32/28 [200/0] via 192.168.1.82, 00:01:42
B 192.168.1.64/28 [200/0] via 192.168.1.93, 00:01:41
C 192.168.1.80/30 is directly connected, Serial0/1/1
L 192.168.1.81/32 is directly connected, Serial0/1/1
B 192.168.1.84/30 [200/0] via 192.168.1.82, 00:01:42
B 192.168.1.88/30 [200/0] via 192.168.1.93, 00:01:41
C 192.168.1.92/30 is directly connected, Serial0/1/0
L 192.168.1.94/32 is directly connected, Serial0/1/0

```

#### R2# show ip route

Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

```

10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C 10.1.20.0/24 is directly connected, FastEthernet0/1
L 10.1.20.1/32 is directly connected, FastEthernet0/1
20.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 20.1.0.0/24 is directly connected, Loopback0
L 20.1.0.1/32 is directly connected, Loopback0
C 20.1.1.0/24 is directly connected, Loopback1
L 20.1.1.1/32 is directly connected, Loopback1
C 20.1.2.0/24 is directly connected, Loopback2
L 20.1.2.1/32 is directly connected, Loopback2
C 20.1.3.0/24 is directly connected, Loopback3
L 20.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks
B 192.168.1.16/28 [200/0] via 192.168.1.81, 00:00:24
C 192.168.1.32/28 is directly connected, FastEthernet0/0
L 192.168.1.33/32 is directly connected, FastEthernet0/0
C 192.168.1.80/30 is directly connected, Serial0/0/1
L 192.168.1.82/32 is directly connected, Serial0/0/1
C 192.168.1.84/30 is directly connected, Serial0/0/0
L 192.168.1.85/32 is directly connected, Serial0/0/0
B 192.168.1.92/30 [200/0] via 192.168.1.81, 00:01:15

```

#### R4# show ip route

Codes: L - local, 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, H - NHRP, I - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is not set

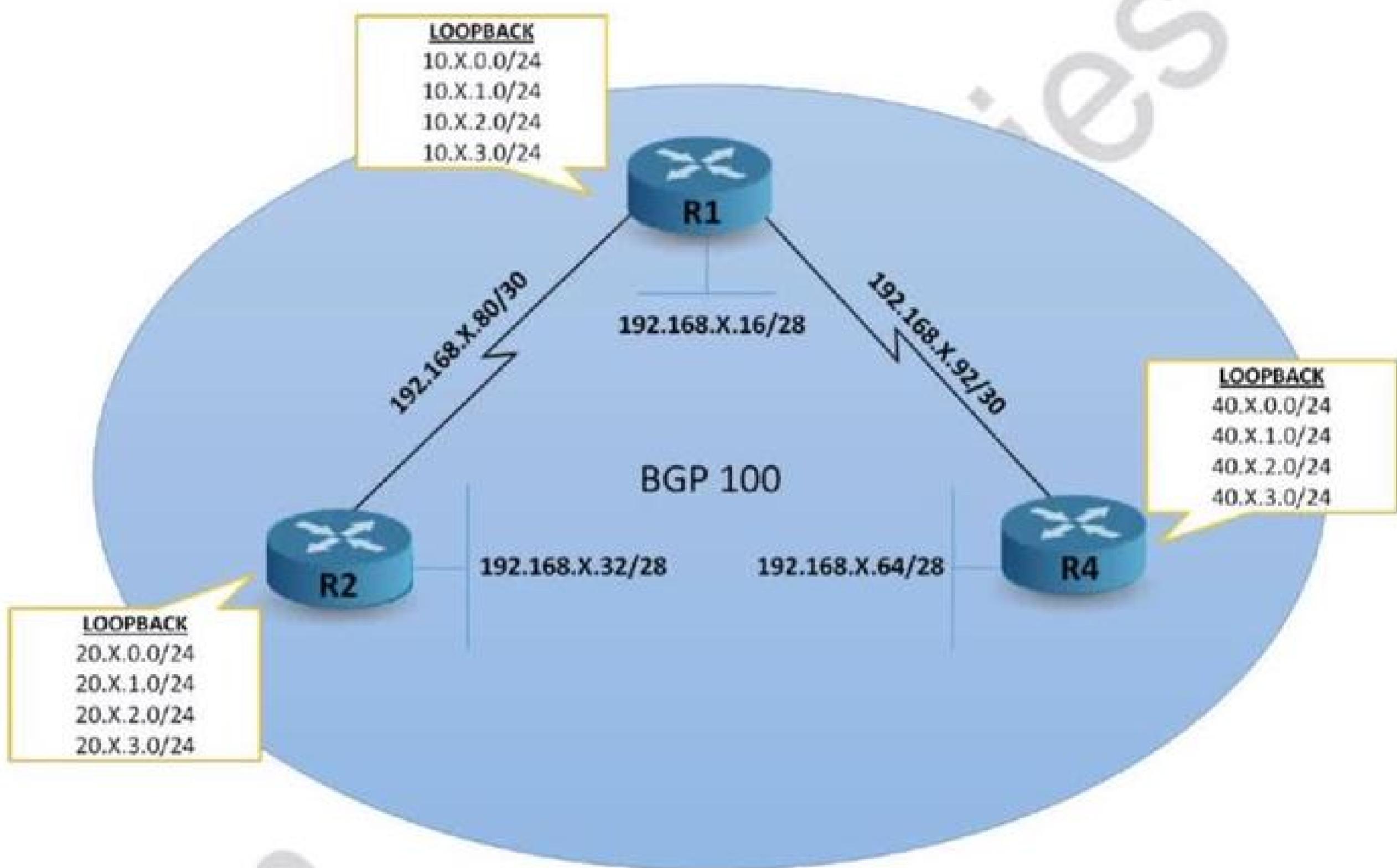
- 40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
  - C 40.1.0.0/24 is directly connected, Loopback0
  - L 40.1.0.1/32 is directly connected, Loopback0
  - C 40.1.1.0/24 is directly connected, Loopback1
  - L 40.1.1.1/32 is directly connected, Loopback1
  - C 40.1.2.0/24 is directly connected, Loopback2
  - L 40.1.2.1/32 is directly connected, Loopback2
  - C 40.1.3.0/24 is directly connected, Loopback3
  - L 40.1.3.1/32 is directly connected, Loopback3
- 192.168.1.0/24 is variably subnetted, 8 subnets, 3 masks
  - B 192.168.1.16/28 [200/0] via 192.168.1.94, 00:00:13
  - C 192.168.1.64/28 is directly connected, FastEthernet0/0
  - L 192.168.1.65/32 is directly connected, FastEthernet0/0
  - B 192.168.1.80/30 [200/0] via 192.168.1.94, 00:01:03
  - C 192.168.1.88/30 is directly connected, Serial0/0/1
  - L 192.168.1.90/32 is directly connected, Serial0/0/1
  - C 192.168.1.92/30 is directly connected, Serial0/0/0
  - L 192.168.1.93/32 is directly connected, Serial0/0/0

## LAB 30: ROUTE REFLECTOR

### OBJECTIVE:

To configure route reflector so that all internal routers in the AS get BGP updates only from the route reflector

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring BGP on all the routers.
- 3) Configure BGP in all routers by using AS number 100
- 4) Verify Tables in BGP
- 5) Configure R1 router as Route Reflector Server and R2,R4 router as Route Reflector Clients.

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure BGP on all routers using AS number 100

```
R1(config)#router bgp 100
R1(config-router)#neighbor 192.168.X.82 remote-as 100
R1(config-router)#neighbor 192.168.X.93 remote-as 100
R1(config-router)#network 192.168.X.16 mask 255.255.255.240
R1(config-router)#network 192.168.X.92 mask 255.255.255.252
R1(config-router)#network 192.168.X.80 mask 255.255.255.252
R1(config-router)#no synchronization
R1(config-router)#end
R2(config)# router bgp 100
R2(config-router)#neighbor 192.168.X.81 remote-as 100
R2(config-router)#network 192.168.X.80 mask 255.255.255.252
R2(config-router)#network 192.168.X.32 mask 255.255.255.240
R2(config-router)#no synchronization
R2(config-router)#end
R4(config)# router bgp 100
R4(config-router)#neighbor 192.168.X.94 remote-as 100
R4(config-router)#network 192.168.X.64 mask 255.255.255.240
R4(config-router)#network 192.168.X.92 mask 255.255.255.252
R4(config-router)#no synchronization
R4(config-router)#end
```

- 4) Verify BGP tables in all routers

```
R1,R2,R3,R4# show ip bgp summary
R1,R2,R3,R4# show ip bgp
R1,R2,R3,R4# show ip route
```

- 5) Configure R1 as Route Reflector Server and R2, R4 as Route Reflector Clients.

```
R1(config)#router bgp 100
R1(config-router)#neighbor 192.168.X.82 route-reflector-client
R1(config-router)#neighbor 192.168.X.93 route-reflector-client
R1(config-router)#end
```

#### VERIFICATION:

- Verify the output in R2 and R4, R2 Should get the update of LAN network of R4 and R4 should get the update of LAN network of R2.

```
R2#show ip bgp
BGP table version is 12, local router ID is 20.1.3.1
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
*>i192.168.1.16/28	192.168.1.81	0	100	0	i
*> 192.168.1.32/28	0.0.0.0	0		32768	i
*>i192.168.1.64/28	192.168.1.93	0	100	0	i
* i192.168.1.80/30	192.168.1.81	0	100	0	i
*>	0.0.0.0	0		32768	i

```
*>i192.168.1.92/30 192.168.1.81      0 100 0i
```

**R4#show ip bgp**

BGP table version is 12, local router ID is 40.1.3.1  
 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
*>i192.168.1.16/28	192.168.1.94	0	100	0i	
<b>*&gt;i192.168.1.32/28</b>	<b>192.168.1.82</b>	<b>0</b>	<b>100</b>	<b>0i</b>	
*> 192.168.1.64/28	0.0.0.0	0		32768	i
*>i192.168.1.80/30	192.168.1.94	0	100	0i	
* i192.168.1.92/30	192.168.1.94	0	100	0i	
*>	0.0.0.0	0		32768	i

**R4# show ip route**

Codes: L - local, 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, H - NHRP, I - LISP  
 + - replicated route, % - next hop override

Gateway of last resort is not set

40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 40.1.0.0/24 is directly connected, Loopback0
L 40.1.0.1/32 is directly connected, Loopback0
C 40.1.1.0/24 is directly connected, Loopback1
L 40.1.1.1/32 is directly connected, Loopback1
C 40.1.2.0/24 is directly connected, Loopback2
L 40.1.2.1/32 is directly connected, Loopback2
C 40.1.3.0/24 is directly connected, Loopback3
L 40.1.3.1/32 is directly connected, Loopback3
192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks
B 192.168.1.16/28 [200/0] via 192.168.1.94, 00:00:07
B 192.168.1.32/28 [200/0] via 192.168.1.82, 00:00:07
C 192.168.1.64/28 is directly connected, FastEthernet0/0
L 192.168.1.65/32 is directly connected, FastEthernet0/0
B 192.168.1.80/30 [200/0] via 192.168.1.94, 00:00:07
B 192.168.1.84/30 [200/0] via 192.168.1.82, 00:00:07
C 192.168.1.88/30 is directly connected, Serial0/0/1
L 192.168.1.90/32 is directly connected, Serial0/0/1
C 192.168.1.92/30 is directly connected, Serial0/0/0
L 192.168.1.93/32 is directly connected, Serial0/0/0

**R2# show ip route**

Codes: L - local, 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, + - replicated route

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks

C 10.1.20.0/24 is directly connected, FastEthernet0/1

L 10.1.20.1/32 is directly connected, FastEthernet0/1

20.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

C 20.1.0.0/24 is directly connected, Loopback0

L 20.1.0.1/32 is directly connected, Loopback0

C 20.1.1.0/24 is directly connected, Loopback1

L 20.1.1.1/32 is directly connected, Loopback1

C 20.1.2.0/24 is directly connected, Loopback2

L 20.1.2.1/32 is directly connected, Loopback2

C 20.1.3.0/24 is directly connected, Loopback3

L 20.1.3.1/32 is directly connected, Loopback3

192.168.1.0/24 is variably subnetted, 10 subnets, 3 masks

B 192.168.1.16/28 [200/0] via 192.168.1.81, 00:01:01

C 192.168.1.32/28 is directly connected, FastEthernet0/0

L 192.168.1.33/32 is directly connected, FastEthernet0/0

B 192.168.1.64/28 [200/0] via 192.168.1.93, 00:00:51

C 192.168.1.80/30 is directly connected, Serial0/0/1

L 192.168.1.82/32 is directly connected, Serial0/0/1

C 192.168.1.84/30 is directly connected, Serial0/0/0

L 192.168.1.85/32 is directly connected, Serial0/0/0

B 192.168.1.88/30 [200/0] via 192.168.1.93, 00:00:51

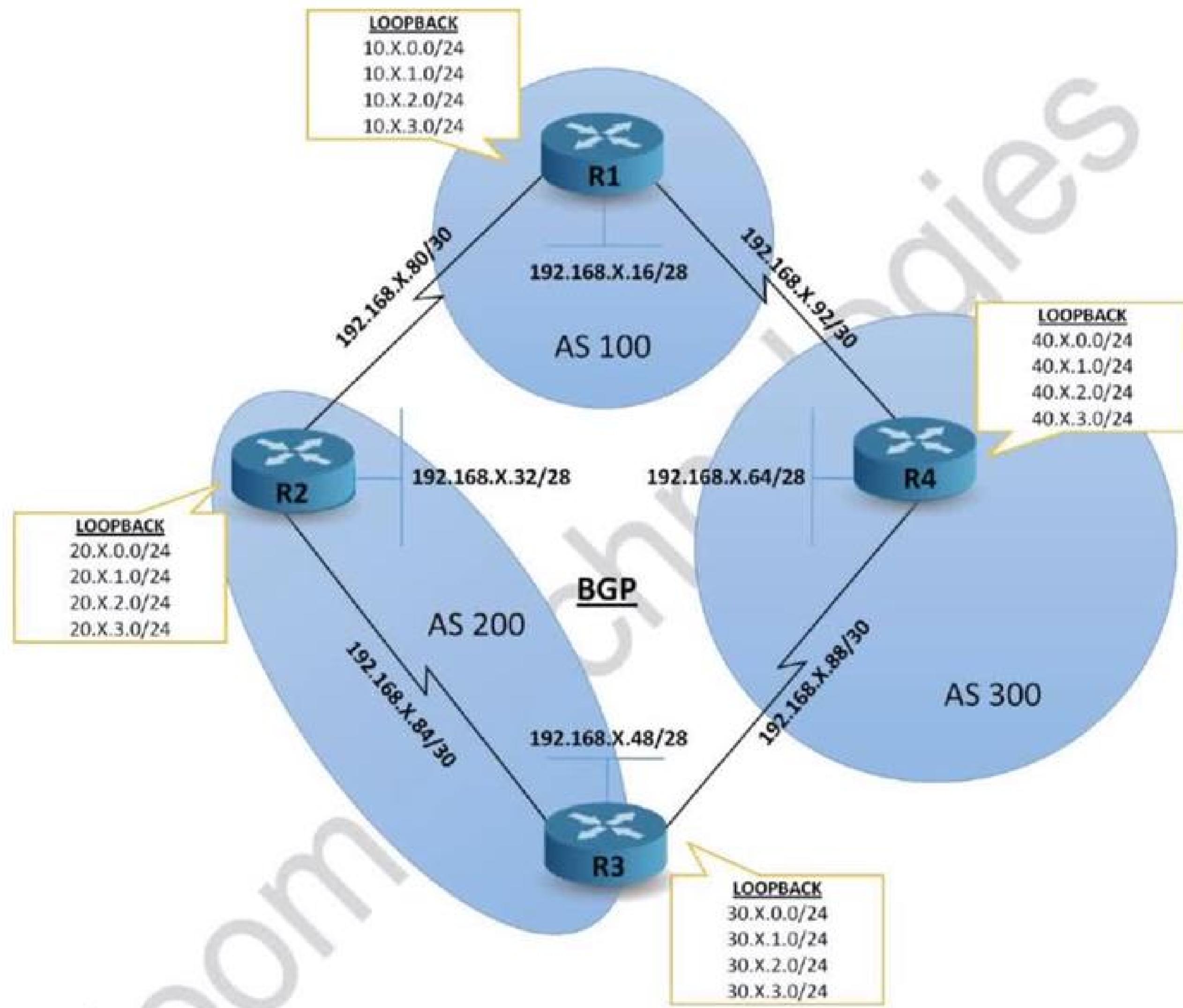
B 192.168.1.92/30 [200/0] via 192.168.1.81, 00:01:01

## LAB 31: EBGP (External BGP)

### OBJECTIVE:

To configure BGP over multiple ASs ( external BGP )

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring BGP on all the routers.
- 3) Configure BGP in all routers as shown in topology
- 4) Check that all routers form neighbor relationships and BGP routes show up in their routing tables

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure BGP in all the routers

```
R1(config)#router bgp 100
R1(config-router)#neighbor 192.168.X.82 remote-as 200
R1(config-router)#neighbor 192.168.X.93 remote-as 300
R1(config-router)#network 192.168.X.16 mask 255.255.255.240
R1(config-router)#network 10.X.0.0 mask 255.255.255.0
R1(config-router)#network 10.X.1.0 mask 255.255.255.0
R1(config-router)#network 10.X.2.0 mask 255.255.255.0
R1(config-router)#network 10.X.3.0 mask 255.255.255.0
R1(config-router)#no synchronization
R2(config)# router bgp 200
R2(config-router)# neighbor 192.168.X.81 remote-as 100
R2(config-router)# neighbor 192.168.X.86 remote-as 200
R2(config-router)#network 192.168.X.84 mask 255.255.255.252
R2(config-router)# network 192.168.X.32 mask 255.255.255.240
R2(config-router)#network 20.X.0.0 mask 255.255.255.0
R2(config-router)#network 20.X.1.0 mask 255.255.255.0
R2(config-router)#network 20.X.2.0 mask 255.255.255.0
R2(config-router)#network 20.X.3.0 mask 255.255.255.0
R2(config-router)#neighbor 192.168.X.86 next-hop-self
R2(config-router)# no synchronization
R3(config)# router bgp 200
R3(config-router)# neighbor 192.168.X.85 remote-as 200
R3(config-router)# neighbor 192.168.X.90 remote-as 300
R3(config-router)#network 30.X.0.0 mask 255.255.255.0
R3(config-router)#network 30.X.1.0 mask 255.255.255.0
R3(config-router)#network 30.X.2.0 mask 255.255.255.0
R3(config-router)#network 30.X.3.0 mask 255.255.255.0
R3(config-router)#neighbor 192.168.X.85 next-hop-self
R3(config-router)#no synchronization
R4(config)#router bgp 300
R4(config-router)#neighbor 192.168.X.94 remote 100
R4(config-router)#neighbor 192.168.X.89 remote-as 200
R4(config-router)# network 40.X.0.0 mask 255.255.255.0
R4(config-router)# network 40.X.1.0 mask 255.255.255.0
R4(config-router)# network 40.X.2.0 mask 255.255.255.0
R4(config-router)# network 40.X.3.0 mask 255.255.255.0
R4(config-router)#no synchronization
```

- 4) Verify BGP tables in all routers

**R1,R2,R3,R4# show ip bgp summary**

R1,R2,R3,R4# show ip bgp  
 R1,R2,R3,R4# show ip route

**VERIFICATION:**

- ➔ Check the routing table in all the routers.

R1,R2,R3,R4#show ip route

R1# show ip route

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

C 10.1.0.0/24 is directly connected, Loopback0

L 10.1.0.1/32 is directly connected, Loopback0

C 10.1.1.0/24 is directly connected, Loopback1

L 10.1.1.1/32 is directly connected, Loopback1

C 10.1.2.0/24 is directly connected, Loopback2

L 10.1.2.1/32 is directly connected, Loopback2

C 10.1.3.0/24 is directly connected, Loopback3

L 10.1.3.1/32 is directly connected, Loopback3

20.0.0.0/24 is subnetted, 4 subnets

B 20.1.0.0 [20/0] via 192.168.1.82, 00:09:30

B 20.1.1.0 [20/0] via 192.168.1.82, 00:09:30

B 20.1.2.0 [20/0] via 192.168.1.82, 00:09:30

B 20.1.3.0 [20/0] via 192.168.1.82, 00:09:30

30.0.0.0/24 is subnetted, 4 subnets

B 30.1.0.0 [20/0] via 192.168.1.82, 00:08:33

B 30.1.1.0 [20/0] via 192.168.1.82, 00:08:33

B 30.1.2.0 [20/0] via 192.168.1.82, 00:08:33

B 30.1.3.0 [20/0] via 192.168.1.82, 00:08:33

40.0.0.0/24 is subnetted, 4 subnets

B 40.1.0.0 [20/0] via 192.168.1.93, 00:00:11

B 40.1.1.0 [20/0] via 192.168.1.93, 00:00:11

B 40.1.2.0 [20/0] via 192.168.1.93, 00:00:11

B 40.1.3.0 [20/0] via 192.168.1.93, 00:00:11

172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks

C 172.16.1.0/30 is directly connected, Serial0/3/1

L 172.16.1.2/32 is directly connected, Serial0/3/1

192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks

C 192.168.1.16/28 is directly connected, FastEthernet0/0

L 192.168.1.17/32 is directly connected, FastEthernet0/0

C 192.168.1.80/30 is directly connected, Serial0/1/1

L 192.168.1.81/32 is directly connected, Serial0/1/1

B 192.168.1.84/30 [20/0] via 192.168.1.82, 00:09:30

C 192.168.1.92/30 is directly connected, Serial0/1/0

L 192.168.1.94/32 is directly connected, Serial0/1/0

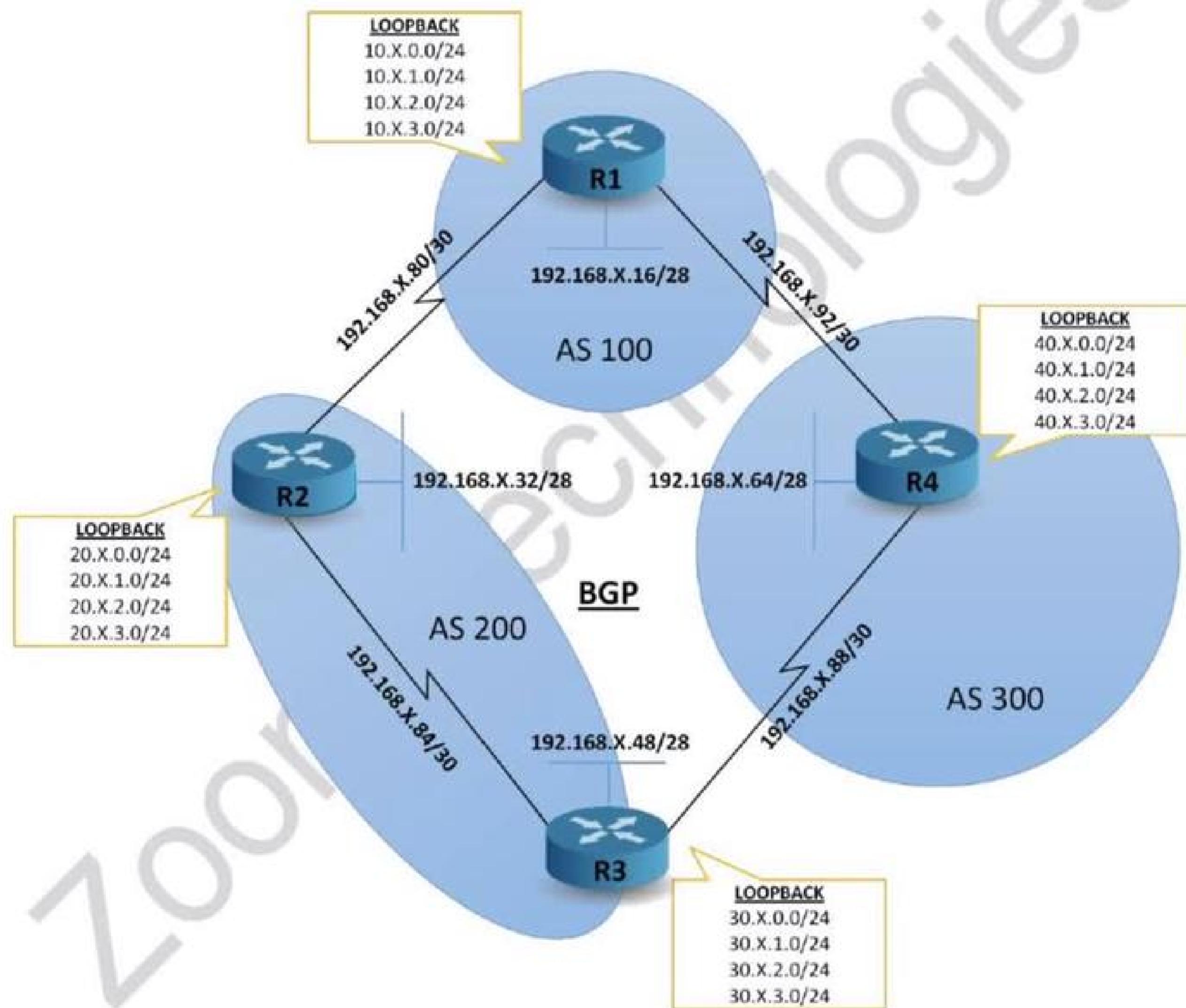
## LAB 32: BGP LOCAL PREFERENCE

### OBJECTIVE:

To change the local preference BGP attribute to influence which path is used for outbound traffic.

To make packets from R1 to R4's loopback interface go via R2 and R3 , instead of the direct connection , by changing LOCAL\_PREF.

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring BGP on all the routers.
- 3) Configure BGP in all routers as shown in topology

- 4) Configure a route map on R1 to identify the networks for which the traffic should take a different path (in this case, 40.0.0.0/24, the loopback network of R4)
- 5) Change the local preference on R1 for the route to 40.0.0.0/24 learnt via R2, so that the path via R2 is chosen.

#### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure BGP in all the routers as done in previous lab

- 4) Configure route map on R1 to identify the traffic which needs to take a different path and set the local preference to 800.

**R1(config)# access-list 40 permit 40.1.0.0 0.0.255.255**

**R1(config)# route-map zoom permit 10**

**R1(config-route-map)#match ip address 40**

**R1(config-route-map)# set local preference 800**

**R1(config-route-map)#exit**

- 5) Use this route map for a neighbour relationship with R2, so that routes via R2 to 40.0.0.0/24 have a higher local preference.

**R1(config)#router bgp 100**

**R1(config-router)#neighbor 192.168.X.82 route-map zoom in**

#### VERIFICATION:

##### → Before Configuring Local Preference

**R1# show ip bgp**

BGP table version is 18, local router ID is 10.1.3.1

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
*> 10.1.0.0/24	0.0.0.0	0	32768	i	
*> 10.1.1.0/24	0.0.0.0	0	32768	i	
*> 10.1.2.0/24	0.0.0.0	0	32768	i	
*> 10.1.3.0/24	0.0.0.0	0	32768	i	
* 20.1.0.0/24	192.168.1.93	0	300 200	i	
*>	192.168.1.82	0	0 200	i	
* 20.1.1.0/24	192.168.1.93		0 300 200	i	
*>	192.168.1.82	0	0 200	i	

```
* 20.1.2.0/24 192.168.1.93      0 300 200 i
*>           192.168.1.82      0 200 i
* 20.1.3.0/24 192.168.1.93      0 300 200 i
*>           192.168.1.82      0 200 i
* 30.1.0.0/24 192.168.1.93      0 300 200 i
*>           192.168.1.82      0 200 i
* 30.1.1.0/24 192.168.1.93      0 300 200 i
*>           192.168.1.82      0 200 i
* 30.1.2.0/24 192.168.1.93      0 300 200 i
*>           192.168.1.82      0 200 i
* 30.1.3.0/24 192.168.1.93      0 300 200 i
*>           192.168.1.82      0 200 i
* 40.1.0.0/24 192.168.1.82      0 200 300 i
*>           192.168.1.93      0 300 i
* 40.1.1.0/24 192.168.1.82      0 200 300 i
*>           192.168.1.93      0 300 i
* 40.1.2.0/24 192.168.1.82      0 200 300 i
*>           192.168.1.93      0 300 i
* 40.1.3.0/24 192.168.1.82      0 200 300 i
*>           192.168.1.93      0 300 i
```

**R1 # show ip route**

```
10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C   10.1.0.0/24 is directly connected, Loopback0
L   10.1.0.1/32 is directly connected, Loopback0
C   10.1.1.0/24 is directly connected, Loopback1
L   10.1.1.1/32 is directly connected, Loopback1
C   10.1.2.0/24 is directly connected, Loopback2
L   10.1.2.1/32 is directly connected, Loopback2
C   10.1.3.0/24 is directly connected, Loopback3
L   10.1.3.1/32 is directly connected, Loopback3
20.0.0.0/24 is subnetted, 4 subnets
B   20.1.0.0 [20/0] via 192.168.1.82, 00:09:30
B   20.1.1.0 [20/0] via 192.168.1.82, 00:09:30
B   20.1.2.0 [20/0] via 192.168.1.82, 00:09:30
B   20.1.3.0 [20/0] via 192.168.1.82, 00:09:30
30.0.0.0/24 is subnetted, 4 subnets
B   30.1.0.0 [20/0] via 192.168.1.82, 00:08:33
B   30.1.1.0 [20/0] via 192.168.1.82, 00:08:33
B   30.1.2.0 [20/0] via 192.168.1.82, 00:08:33
B   30.1.3.0 [20/0] via 192.168.1.82, 00:08:33
40.0.0.0/24 is subnetted, 4 subnets
B   40.1.0.0 [20/0] via 192.168.1.93, 00:00:11
B   40.1.1.0 [20/0] via 192.168.1.93, 00:00:11
B   40.1.2.0 [20/0] via 192.168.1.93, 00:00:11
B   40.1.3.0 [20/0] via 192.168.1.93, 00:00:11
172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C   172.16.1.0/30 is directly connected, Serial0/3/1
L   172.16.1.2/32 is directly connected, Serial0/3/1
192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
C   192.168.1.16/28 is directly connected, FastEthernet0/0
L   192.168.1.17/32 is directly connected, FastEthernet0/0
```

```
C 192.168.1.80/30 is directly connected, Serial0/1/1
L 192.168.1.81/32 is directly connected, Serial0/1/1
B 192.168.1.84/30 [20/0] via 192.168.1.82, 00:09:30
C 192.168.1.92/30 is directly connected, Serial0/1/0
L 192.168.1.94/32 is directly connected, Serial0/1/0
```

#### R1#traceroute 40.1.0.1

```
Type escape sequence to abort.
Tracing the route to 40.1.0.1
 1 192.168.1.93 96 msec 36 msec 24 msec
```

#### → After Configuring Local Preference

```
R1# clear ip bgp * soft
```

```
R1# show ip bgp
```

```
BGP table version is 31, local router ID is 10.1.3.1
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
*> 10.1.0.0/24	0.0.0.0	0	32768	i	
*> 10.1.1.0/24	0.0.0.0	0	32768	i	
*> 10.1.2.0/24	0.0.0.0	0	32768	i	
*> 10.1.3.0/24	0.0.0.0	0	32768	i	
*> 20.1.0.0/24	192.168.1.93	0	300	200	i
*> 20.1.1.0/24	192.168.1.93	0	300	200	i
*> 20.1.2.0/24	192.168.1.93	0	300	200	i
*> 20.1.3.0/24	192.168.1.93	0	300	200	i
*> 30.1.0.0/24	192.168.1.93	0	300	200	i
*> 30.1.1.0/24	192.168.1.93	0	300	200	i
*> 30.1.2.0/24	192.168.1.93	0	300	200	i
*> 30.1.3.0/24	192.168.1.93	0	300	200	i
*> 40.1.0.0/24	192.168.1.82	800	0	200	300 i
*	192.168.1.93	0	0	300	i
*> 40.1.1.0/24	192.168.1.82	800	0	200	300 i
*	192.168.1.93	0	0	300	i
*> 40.1.2.0/24	192.168.1.82	800	0	200	300 i
*	192.168.1.93	0	0	300	i
*> 40.1.3.0/24	192.168.1.82	800	0	200	300 i
*	192.168.1.93	0	0	300	i
*> 192.168.1.84/30	192.168.1.93	0	300	200	i

#### R1 # show ip route

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

```

10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 10.1.0.0/24 is directly connected, Loopback0
L 10.1.0.1/32 is directly connected, Loopback0
C 10.1.1.0/24 is directly connected, Loopback1
L 10.1.1.1/32 is directly connected, Loopback1
C 10.1.2.0/24 is directly connected, Loopback2
L 10.1.2.1/32 is directly connected, Loopback2
C 10.1.3.0/24 is directly connected, Loopback3
L 10.1.3.1/32 is directly connected, Loopback3
    20.0.0.0/24 is subnetted, 4 subnets
B 20.1.0.0 [20/0] via 192.168.1.93, 00:00:01
B 20.1.1.0 [20/0] via 192.168.1.93, 00:00:01
B 20.1.2.0 [20/0] via 192.168.1.93, 00:00:01
B 20.1.3.0 [20/0] via 192.168.1.93, 00:00:01
    30.0.0.0/24 is subnetted, 4 subnets
B 30.1.0.0 [20/0] via 192.168.1.93, 00:00:01
B 30.1.1.0 [20/0] via 192.168.1.93, 00:00:01
B 30.1.2.0 [20/0] via 192.168.1.93, 00:00:01
B 30.1.3.0 [20/0] via 192.168.1.93, 00:00:01
    40.0.0.0/24 is subnetted, 4 subnets
B 40.1.0.0 [20/0] via 192.168.1.82, 00:00:01
B 40.1.1.0 [20/0] via 192.168.1.82, 00:00:01
B 40.1.2.0 [20/0] via 192.168.1.82, 00:00:01
B 40.1.3.0 [20/0] via 192.168.1.82, 00:00:01
    172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.16.1.0/30 is directly connected, Serial0/3/1
L 172.16.1.2/32 is directly connected, Serial0/3/1
    192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
C 192.168.1.16/28 is directly connected, FastEthernet0/0
L 192.168.1.17/32 is directly connected, FastEthernet0/0
C 192.168.1.80/30 is directly connected, Serial0/1/1
L 192.168.1.81/32 is directly connected, Serial0/1/1
B 192.168.1.84/30 [20/0] via 192.168.1.93, 00:00:01
C 192.168.1.92/30 is directly connected, Serial0/1/0
L 192.168.1.94/32 is directly connected, Serial0/1/0

```

**R1#traceroute 40.1.0.1**

Type escape sequence to abort.

Tracing the route to 40.1.0.1

```

1 192.168.1.82 52 msec 28 msec 32 msec
2 192.168.1.86 [AS 200] 24 msec 28 msec 88 msec
3 192.168.1.90 [AS 300] 68 msec 16 msec 44 msec

```

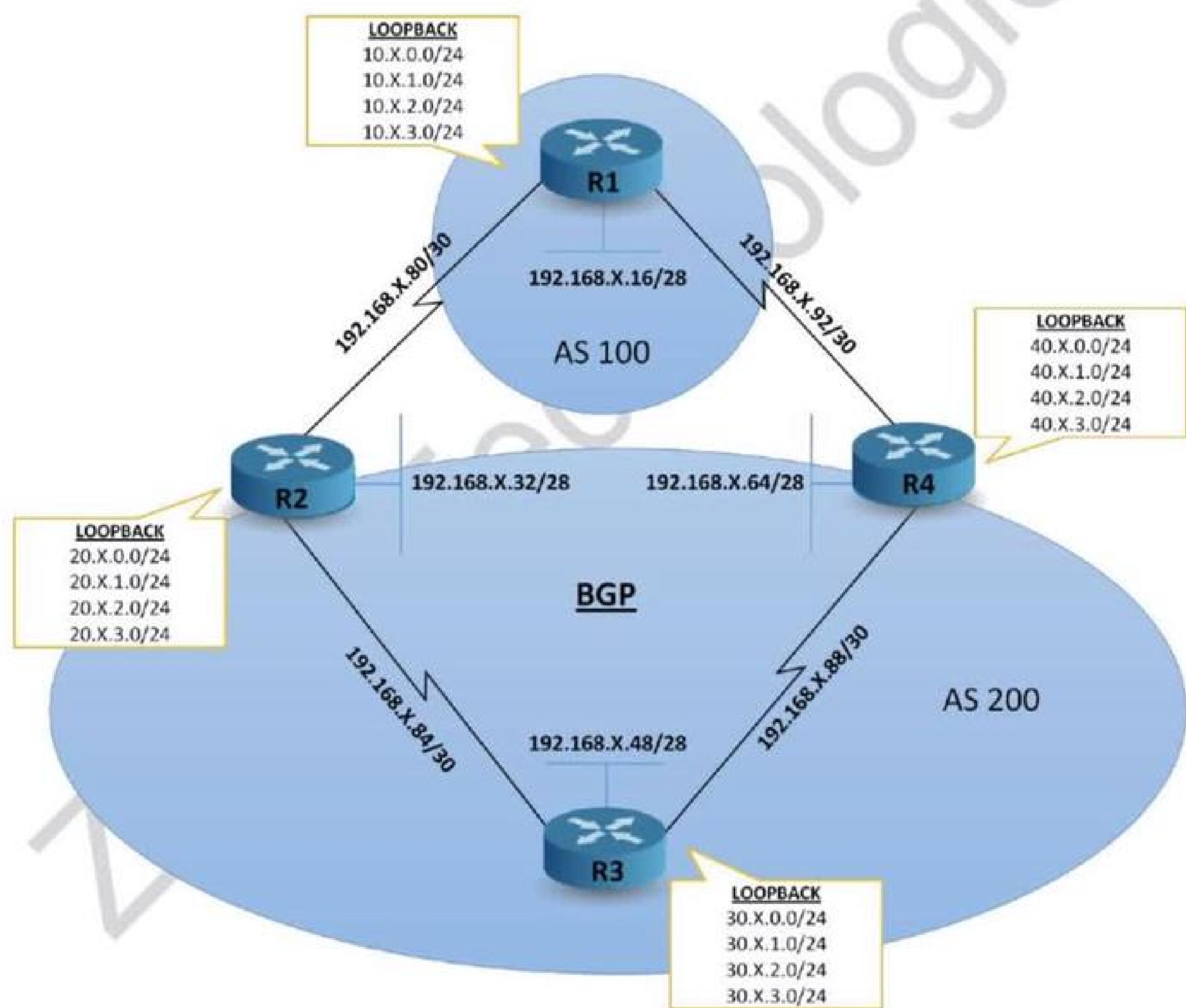
## LAB 33: BGP MED (Multi Exit Discriminator)

### OBJECTIVE:

To change the MED path attribute to influence inbound routing (which path traffic takes to come into your network).

To influence R1 to send traffic to R3's loopback interface via R4, instead of R2, because of the higher MED received from R2.

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring BGP on all the routers.
- 3) Configure BGP in all routers as shown in topology
- 4) Identify the interesting traffic on R2 with a route map and increase its MED from the default 0

- 5) Use the route map in the neighbor relationship with R1

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure BGP in all routers

**R1(config)# router bgp 100**

**R1(config-router)#network 192.168.X.16 mask 255.255.255.240**

**R1(config-router)#neighbor 192.168.X.82 remote-as 200**

**R1(config-router)#neighbor 192.168.X.93 remote-as 200**

**R1(config-router)#end**

**R2(config)#router bgp 200**

**R2(config-router)#network 192.168.X.32 mask 255.255.255.240**

**R2(config-router)#network 192.168.X.84 mask 255.255.255.252**

**R2(config-router)#neighbor 192.168.X.81 remote-as 100**

**R2(config-router)#neighbor 192.168.X.86 remote-as 200**

**R2(config-router)#end**

**R3(config)#router bgp 200**

**R3(config-router)# network 192.168.X.84 mask 255.255.255.252**

**R3(config-router)#network 192.168.X.88 mask 255.255.255.252**

**R3(config-router)#network 192.168.X.48 mask 255.255.255.240**

**R3(config-router)#neighbor 192.168.X.85 remote-as 200**

**R3(config-router)#neighbor 192.168.X.90 remote-as 200**

**R3(config-router)#network 30.X.0.0 mask 255.255.255.0**

**R3(config-router)#network 30.X.1.0 mask 255.255.255.0**

**R3(config-router)#network 30.X.2.0 mask 255.255.255.0**

**R3(config-router)#network 30.X.3.0 mask 255.255.255.0**

**R4(config)# router bgp 200**

**R4(config-router)#neighbor 192.168.X.89 remote-as 200**

**R4(config-router)#neighbor 192.168.X.94 remote-as 100**

**R4(config-router)#network 192.168.X.64 mask 255.255.255.240**

**R4(config-router)#network 192.168.X.88 mask 255.255.255.252**

**R4 (config-router)#end**

- 4) Increase the MED value on R2 for the route to 30.0.0.0 /8 from the default value of 0 so that the other route via R4 is preferred

**R2(config)#access-list 10 permit 30.1.0.0 0.0.255.255**

**R2(config)#route-map zoom permit 1**

**R2(config-route-map)#match ip address 10**

**R2(config-route-map)#set metric 50**

**R2(config-route-map)#exit**

**R2(config)#route-map zoom permit 2**

**R2(config-route-map)#exit**

- 5) Use this route map for the neighbor relationship with R1.

```
R2(config)#router bgp 100
R2(config-router)#neighbor 192.168.X.81 route-map zoom out
```

#### VERIFICATION:

##### → Before Configuring MED

```
R1# show ip bgp
```

BGP table version is 22, local router ID is 10.1.3.1  
 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
*> 10.1.0.0/24	0.0.0.0	0	32768	i	
*> 10.1.1.0/24	0.0.0.0	0	32768	i	
*> 10.1.2.0/24	0.0.0.0	0	32768	i	
*> 10.1.3.0/24	0.0.0.0	0	32768	i	
*> 20.1.0.0/24	192.168.1.82	0	0 200	i	
*> 20.1.1.0/24	192.168.1.82	0	0 200	i	
*> 20.1.2.0/24	192.168.1.82	0	0 200	i	
*> 20.1.3.0/24	192.168.1.82	0	0 200	i	
* 30.1.0.0/24	192.168.1.93		0 200	i	
*>	192.168.1.82		0 200	i	
* 30.1.1.0/24	192.168.1.93		0 200	i	
*>	192.168.1.82		0 200	i	
* 30.1.2.0/24	192.168.1.93		0 200	i	
*>	192.168.1.82		0 200	i	
* 30.1.3.0/24	192.168.1.93		0 200	i	
*>	192.168.1.82		0 200	i	
*> 40.1.0.0/24	192.168.1.93	0	0 200	i	
*> 40.1.1.0/24	192.168.1.93	0	0 200	i	
*> 40.1.2.0/24	192.168.1.93	0	0 200	i	
*> 40.1.3.0/24	192.168.1.93	0	0 200	i	

```
R1#traceroute 30.1.0.1
```

Type escape sequence to abort.

Tracing the route to 30.1.0.1

```
1 192.168.1.82 52 msec 28 msec 32 msec
2 192.168.1.86 [AS 200] 22 msec 26 msec 88 msec
```

```
R1# show ip route
```

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

- 10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
- C 10.1.0.0/24 is directly connected, Loopback0
- L 10.1.0.1/32 is directly connected, Loopback0
- C 10.1.1.0/24 is directly connected, Loopback1
- L 10.1.1.1/32 is directly connected, Loopback1
- C 10.1.2.0/24 is directly connected, Loopback2
- L 10.1.2.1/32 is directly connected, Loopback2
- C 10.1.3.0/24 is directly connected, Loopback3
- L 10.1.3.1/32 is directly connected, Loopback3
- 30.0.0.0/24 is subnetted, 4 subnets
- B 30.1.0.0 [20/0] via 192.168.1.82, 00:02:50
- B 30.1.1.0 [20/0] via 192.168.1.82, 00:02:50
- B 30.1.2.0 [20/0] via 192.168.1.82, 00:02:50
- B 30.1.3.0 [20/0] via 192.168.1.82, 00:02:50

172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks

- C 172.16.1.0/30 is directly connected, Serial0/3/1
- L 172.16.1.2/32 is directly connected, Serial0/3/1
- 192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks
- C 192.168.1.16/28 is directly connected, FastEthernet0/0
- L 192.168.1.17/32 is directly connected, FastEthernet0/0
- B 192.168.1.32/28 [20/0] via 192.168.1.82, 00:04:21
- B 192.168.1.48/28 [20/0] via 192.168.1.82, 00:03:20
- B 192.168.1.64/28 [20/0] via 192.168.1.93, 00:01:29
- C 192.168.1.80/30 is directly connected, Serial0/1/1
- L 192.168.1.81/32 is directly connected, Serial0/1/1
- B 192.168.1.84/30 [20/0] via 192.168.1.82, 00:04:21
- B 192.168.1.88/30 [20/0] via 192.168.1.82, 00:03:20
- C 192.168.1.92/30 is directly connected, Serial0/1/0
- L 192.168.1.94/32 is directly connected, Serial0/1/0

After configuring MED

R1# clear ip bgp \* soft

R1# show ip bgp

BGP table version is 32, local router ID is 10.1.3.1

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
*> 10.1.0.0/24	0.0.0.0	0	32768	i	
*> 10.1.1.0/24	0.0.0.0	0	32768	i	
*> 10.1.2.0/24	0.0.0.0	0	32768	i	
*> 10.1.3.0/24	0.0.0.0	0	32768	i	
*> 30.1.0.0/24	192.168.1.93		0200	i	
*	192.168.1.82	50	0	200	i
*> 30.1.1.0/24	192.168.1.93		0200	i	
*	192.168.1.82	50	0	200	i
*> 30.1.2.0/24	192.168.1.93		0200	i	
*	192.168.1.82	50	0	200	i
*> 30.1.3.0/24	192.168.1.93		0200	i	
*	192.168.1.82	50	0	200	i
*> 40.1.0.0/24	192.168.1.93	0	0	200	i

```
*> 40.1.1.0/24 192.168.1.93    0      0 200 i
*> 40.1.2.0/24 192.168.1.93    0      0 200 i
*> 40.1.3.0/24 192.168.1.93    0      0 200 i
*> 192.168.1.84/30 192.168.1.93          0 200 i
*> 192.168.1.88/30 192.168.1.93    0      0 200 i
```

R1#

**R1#show ip route**

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

C 10.1.0.0/24 is directly connected, Loopback0

L 10.1.0.1/32 is directly connected, Loopback0

C 10.1.1.0/24 is directly connected, Loopback1

L 10.1.1.1/32 is directly connected, Loopback1

C 10.1.2.0/24 is directly connected, Loopback2

L 10.1.2.1/32 is directly connected, Loopback2

C 10.1.3.0/24 is directly connected, Loopback3

L 10.1.3.1/32 is directly connected, Loopback3

30.0.0.0/24 is subnetted, 4 subnets

B 30.1.0.0 [20/0] via 192.168.1.93, 00:01:37

B 30.1.1.0 [20/0] via 192.168.1.93, 00:01:37

B 30.1.2.0 [20/0] via 192.168.1.93, 00:01:37

B 30.1.3.0 [20/0] via 192.168.1.93, 00:01:37

172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks

C 172.16.1.0/30 is directly connected, Serial0/3/1

L 172.16.1.2/32 is directly connected, Serial0/3/1

192.168.1.0/24 is variably subnetted, 11 subnets, 3 masks

C 192.168.1.16/28 is directly connected, FastEthernet0/0

L 192.168.1.17/32 is directly connected, FastEthernet0/0

B 192.168.1.32/28 [20/50] via 192.168.1.82, 00:01:37

B 192.168.1.48/28 [20/0] via 192.168.1.93, 00:01:37

B 192.168.1.64/28 [20/0] via 192.168.1.93, 00:04:50

C 192.168.1.80/30 is directly connected, Serial0/1/1

L 192.168.1.81/32 is directly connected, Serial0/1/1

B 192.168.1.84/30 [20/0] via 192.168.1.93, 00:01:37

B 192.168.1.88/30 [20/0] via 192.168.1.93, 00:01:37

C 192.168.1.92/30 is directly connected, Serial0/1/0

L 192.168.1.94/32 is directly connected, Serial0/1/0

**R1#traceroute 30.1.0.1**

Type escape sequence to abort.

Tracing the route to 30.1.0.1

1 192.168.1.93 42 msec 28 msec 22 msec

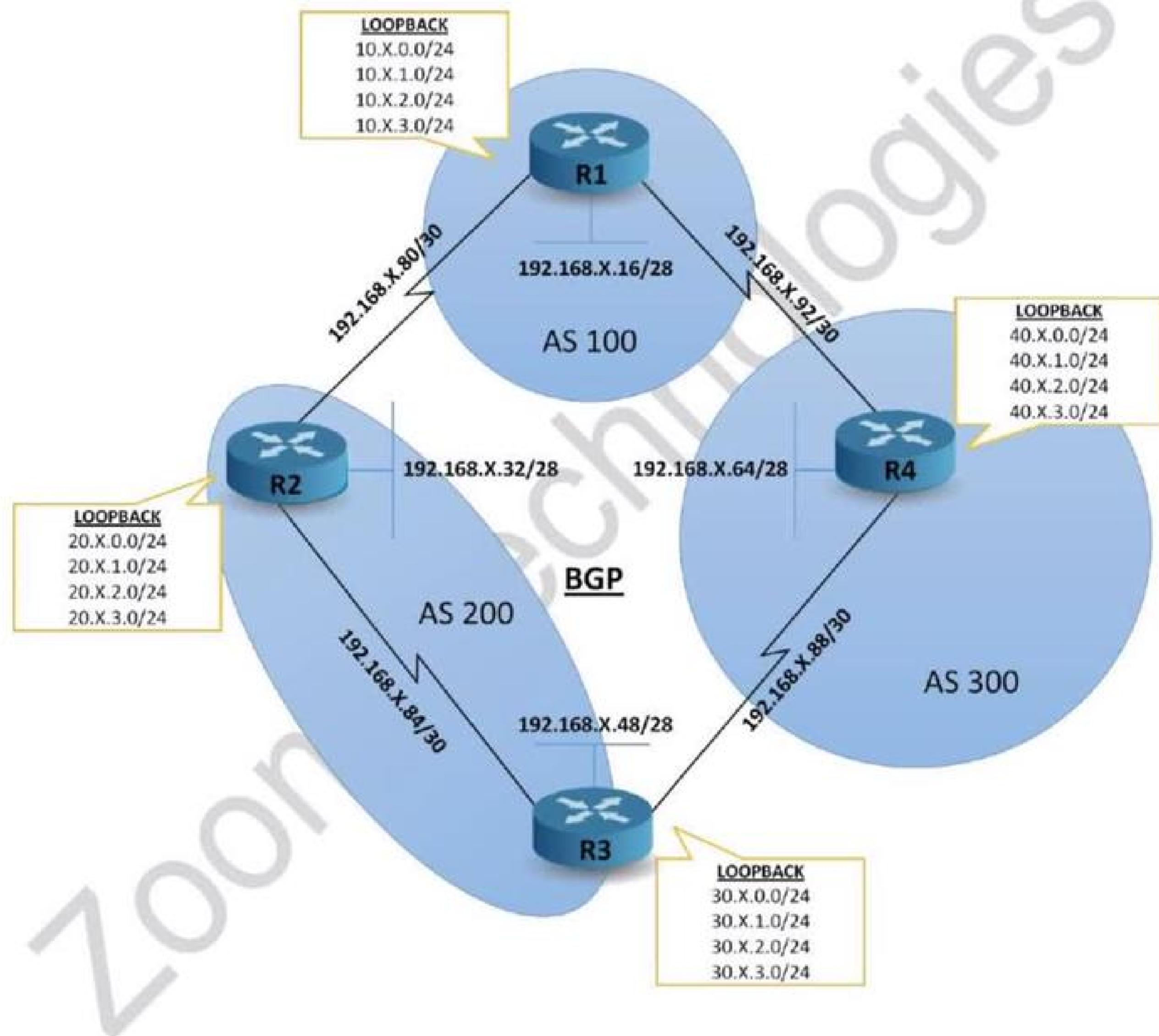
2 192.168.1.89 [AS 200]22 msec 26 msec 88 msec

## LAB 34: BGP WEIGHT

### OBJECTIVE:

To change the Weight BGP attribute to influence which path is used for outbound traffic.  
 To make packets from R3 to R4's loopback interface go via R2 , instead of the direct connection , by changing the weight.

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring BGP on all the routers.
- 3) Configure BGP in all routers as shown in topology

- 4) Configure a route map on R3 to identify the networks for which the traffic should take a different path (in this case, 40.0.0.0/24, the loopback network of R4)
- 5) Change the weight on R3 for the route to 40.0.0.0/24 learnt via R2, so that the path via R2 is chosen.

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure BGP in all the routers as done in EBGP Lab.

- 4) Configure route map on R3 to identify the traffic which needs to take a different path and set the weight to 45000.

```
R3(config)# access-list 40 permit 40.1.0.0 0.0.255.255
R3(config)# route-map zoom permit 10
R3(config-route-map)#match ip address 40
R3(config-route-map)# set weight 45000
R3(config-route-map)#exit
```

- 5) Use this route map for a neighbour relationship with R2, so that routes via R2 to 40.0.0.0/24 have a higher weight.

**R3(config)#router bgp 200**

**R3(config-router)#neighbor 192.168.X.85 route-map zoom in**

**VERIFICATION:**

→ **Before Configuring Weight**

**R3# show ip bgp**

BGP table version is 14, local router ID is 30.1.3.1

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
*> 10.1.0.0/24	192.168.1.90	0	300	100	i
*> 10.1.1.0/24	192.168.1.90	0	300	100	i
*> 10.1.2.0/24	192.168.1.90	0	300	100	i
*> 10.1.3.0/24	192.168.1.90	0	300	100	i
*> 30.1.0.0/24	0.0.0.0	0		32768	i
*> 30.1.1.0/24	0.0.0.0	0		32768	i
*> 30.1.2.0/24	0.0.0.0	0		32768	i

```
*> 30.1.3.0/24 0.0.0.0      0      32768 i
*> 40.1.0.0/24 192.168.1.90 0      0 300 i
*i          192.168.1.85    0      100 300 i
*> 40.1.1.0/24 192.168.1.90 0      0 300 i
*i          192.168.1.85    0      100 300 i
*> 40.1.2.0/24 192.168.1.90 0      0 300 i
*i          192.168.1.85    0      100 300 i
*> 40.1.3.0/24 192.168.1.90 0      0 300 i
*i          192.168.1.85    0      100 300 i
*> 192.168.1.84/30 0.0.0.0 0      32768 i
```

### R3#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 not set

```
40.0.0.0/24 is subnetted, 4 subnets
B  40.1.1.0 [20/0] via 192.168.1.90, 00:00:01
B  40.1.0.0 [20/0] via 192.168.1.90, 00:00:01
B  40.1.3.0 [20/0] via 192.168.1.90, 00:00:01
B  40.1.2.0 [20/0] via 192.168.1.90, 00:00:01

10.0.0.0/24 is subnetted, 4 subnets
B  10.1.3.0 [20/0] via 192.168.1.90, 00:05:51
B  10.1.2.0 [20/0] via 192.168.1.90, 00:05:51
B  10.1.1.0 [20/0] via 192.168.1.90, 00:05:51
B  10.1.0.0 [20/0] via 192.168.1.90, 00:05:51

192.168.1.0/24 is variably subnetted, 3 subnets, 2 masks
C  192.168.1.88/30 is directly connected, Serial1/1
L  192.168.1.89/32 is directly connected, Serial1/1
C  192.168.1.84/30 is directly connected, Serial1/0
L  192.168.1.86/32 is directly connected, Serial1/0
C  192.168.1.48/28 is directly connected, FastEthernet0/0
L  192.168.1.49/28 is directly connected, FastEthernet0/0

30.0.0.0/24 is subnetted, 4 subnets
C  30.1.3.0 is directly connected, Loopback3
L  30.1.3.1/32 is directly connected, Loopback3
C  30.1.2.0 is directly connected, Loopback2
L  30.1.2.1/32 is directly connected, Loopback2
C  30.1.1.0 is directly connected, Loopback1
L  30.1.1.1/32 is directly connected, Loopback1
C  30.1.0.0 is directly connected, Loopback0
L  30.1.1.1/32 is directly connected, Loopback4
```

### R1#traceroute 40.1.0.1

Type escape sequence to abort.

Tracing the route to 40.1.0.1

1 192.168.1.90 96 msec 36 msec 24 msec

#### After Configuring Weight

R3# clear ip bgp \* soft

R3# show ip bgp

BGP table version is 14, local router ID is 30.1.3.1

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
*> 10.1.0.0/24	192.168.1.90	0	300	100	i
*> 10.1.1.0/24	192.168.1.90	0	300	100	i
*> 10.1.2.0/24	192.168.1.90	0	300	100	i
*> 10.1.3.0/24	192.168.1.90	0	300	100	i
*> 30.1.0.0/24	0.0.0.0	0		32768	i
*> 30.1.1.0/24	0.0.0.0	0		32768	i
*> 30.1.2.0/24	0.0.0.0	0		32768	i
*> 30.1.3.0/24	0.0.0.0	0		32768	i
* 40.1.0.0/24	192.168.1.90	0		0	300 i
*>i	192.168.1.85	0		45000	100 300 i
* 40.1.1.0/24	192.168.1.90	0		0	300 i
*>i	192.168.1.85	0		45000	100 300 i
* 40.1.2.0/24	192.168.1.90	0		0	300 i
*>i	192.168.1.85	0		45000	100 300 i
* 40.1.3.0/24	192.168.1.90	0		0	300 i
*>i	192.168.1.85	0		45000	100 300 i
*> 192.168.1.84/30	0.0.0.0	0		32768	i

R3 # 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 not set

40.0.0.0/24 is subnetted, 4 subnets

B 40.1.1.0 [200/0] via 192.168.1.85, 00:04:01

B 40.1.0.0 [200/0] via 192.168.1.85, 00:04:01

B 40.1.3.0 [200/0] via 192.168.1.85, 00:04:01

B 40.1.2.0 [200/0] via 192.168.1.85, 00:04:01

10.0.0.0/24 is subnetted, 4 subnets

B 10.1.3.0 [20/0] via 192.168.1.90, 00:04:01

B 10.1.2.0 [20/0] via 192.168.1.90, 00:04:01

B 10.1.1.0 [20/0] via 192.168.1.90, 00:04:01

B 10.1.0.0 [20/0] via 192.168.1.90, 00:04:01

192.168.1.0/24 is variably subnetted, 3 subnets, 2 masks

192.168.1.0/24 is variably subnetted, 3 subnets, 2 masks  
C 192.168.1.88/30 is directly connected, Serial1/1  
L 192.168.1.89/32 is directly connected, Serial1/1  
C 192.168.1.84/30 is directly connected, Serial1/0  
L 192.168.1.86/32 is directly connected, Serial1/0  
C 192.168.1.48/28 is directly connected, FastEthernet0/0  
L 192.168.1.49/28 is directly connected, FastEthernet0/0  
30.0.0.0/24 is subnetted, 4 subnets  
C 30.1.3.0 is directly connected, Loopback3  
L 30.1.3.1/32 is directly connected, Loopback3  
C 30.1.2.0 is directly connected, Loopback2  
L 30.1.2.1/32 is directly connected, Loopback2  
C 30.1.1.0 is directly connected, Loopback1  
L 30.1.1.1/32 is directly connected, Loopback1  
C 30.1.0.0 is directly connected, Loopback0  
L 30.1.1.1/32 is directly connected, Loopback4

R3#

**R1#traceroute 40.1.0.1**

Type escape sequence to abort.

Tracing the route to 40.1.0.1

1 192.168.1.85 4 msec 40 msec 44 msec  
2 192.168.1.81 [AS 100]68 msec 16 msec 48 msec  
3 192.168.1.93 [AS 300]76 msec 12 msec 36 msec

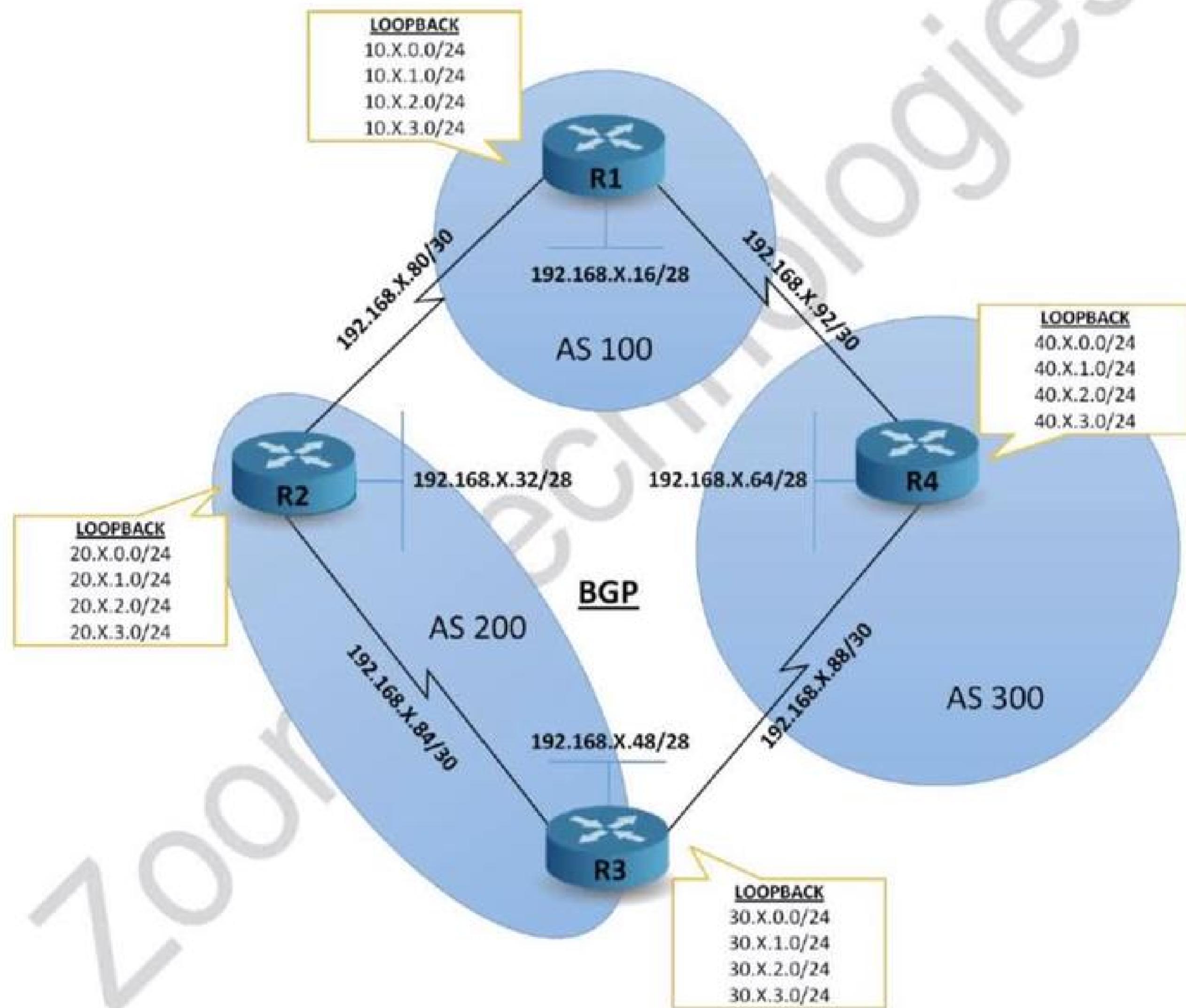
## LAB 35: AS PATH PREPEND

### OBJECTIVE:

To change the AS PATH BGP attribute to influence which path is used for outbound traffic.

To make packets from R1 to R4's loopback interface go via R2 and R3 , instead of the direct connection , by changing AS PATH.

### TOPOLOGY:



**TASK:**

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring BGP on all the routers.
- 3) Configure BGP in all routers as shown in topology
- 4) Configure a route map on R1 to identify the networks for which the traffic should take a different path ( in this case , 40.0.0.0/24 , the loopback network of R4)
- 5) Change the AS Path on R1 for the route to 40.0.0.0/24 learnt via R4 , so that the path via R2 is chosen.

**STEPS:**

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure BGP in all the routers as done in previous lab
- 4) Configure route map on R1 to identify the traffic which needs to take a different path and set the as path to higher value.

```
R1(config)# access-list 40 permit 40.1.0.0 0.0.255.255  
R1(config)# route-map zoom permit 10  
R1(config-route-map)#match ip address 40  
R1(config-route-map)# set as-path prepend 400 400 400  
R1(config-route-map)#exit
```

- 5) Use this route map for a neighbour relationship with R4 , so that routes via R2 to 40.0.0.0/24 have a lower AS Path.

**R1(config)#router bgp 100**

**R1(config-router)#neighbor 192.168.X.93 route-map zoom in**

**VERIFICATION:**

- Before Configuring AS PATH PREPEND

**R1# show ip bgp**

**R1#show ip bgp**

BGP table version is 18, local router ID is 10.1.3.1

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
*> 10.1.0.0/24	0.0.0.0	0	32768	i	
*> 10.1.1.0/24	0.0.0.0	0	32768	i	
*> 10.1.2.0/24	0.0.0.0	0	32768	i	
*> 10.1.3.0/24	0.0.0.0	0	32768	i	
* 20.1.0.0/24	192.168.1.93	0	300	200	i
*>	192.168.1.82	0	0	200	i
* 20.1.1.0/24	192.168.1.93	0	300	200	i
*>	192.168.1.82	0	0	200	i
* 20.1.2.0/24	192.168.1.93	0	300	200	i

! output omitted

* 40.1.0.0/24	192.168.1.82	0	200	300	i
*>	192.168.1.93	0	0	300	i
* 40.1.1.0/24	192.168.1.82	0	200	300	i
*>	192.168.1.93	0	0	300	i
* 40.1.2.0/24	192.168.1.82	0	200	300	i
*>	192.168.1.93	0	0	300	i
* 40.1.3.0/24	192.168.1.82	0	200	300	i
*>	192.168.1.93	0	0	300	i

### R1 # show ip route

10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

- C 10.1.0.0/24 is directly connected, Loopback0
- L 10.1.0.1/32 is directly connected, Loopback0
- C 10.1.1.0/24 is directly connected, Loopback1
- L 10.1.1.1/32 is directly connected, Loopback1
- C 10.1.2.0/24 is directly connected, Loopback2
- L 10.1.2.1/32 is directly connected, Loopback2
- C 10.1.3.0/24 is directly connected, Loopback3
- L 10.1.3.1/32 is directly connected, Loopback3

20.0.0.0/24 is subnetted, 4 subnets

- B 20.1.0.0 [20/0] via 192.168.1.82, 00:09:30
- B 20.1.1.0 [20/0] via 192.168.1.82, 00:09:30
- B 20.1.2.0 [20/0] via 192.168.1.82, 00:09:30
- B 20.1.3.0 [20/0] via 192.168.1.82, 00:09:30

30.0.0.0/24 is subnetted, 4 subnets

- B 30.1.0.0 [20/0] via 192.168.1.82, 00:08:33
- B 30.1.1.0 [20/0] via 192.168.1.82, 00:08:33
- B 30.1.2.0 [20/0] via 192.168.1.82, 00:08:33
- B 30.1.3.0 [20/0] via 192.168.1.82, 00:08:33

40.0.0.0/24 is subnetted, 4 subnets

- B 40.1.0.0 [20/0] via 192.168.1.93, 00:00:11
- B 40.1.1.0 [20/0] via 192.168.1.93, 00:00:11
- B 40.1.2.0 [20/0] via 192.168.1.93, 00:00:11
- B 40.1.3.0 [20/0] via 192.168.1.93, 00:00:11

172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks

- C 172.16.1.0/30 is directly connected, Serial0/3/1
- L 172.16.1.2/32 is directly connected, Serial0/3/1

192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks

```
C 192.168.1.16/28 is directly connected, FastEthernet0/0
L 192.168.1.17/32 is directly connected, FastEthernet0/0
C 192.168.1.80/30 is directly connected, Serial0/1/1
L 192.168.1.81/32 is directly connected, Serial0/1/1
B 192.168.1.84/30 [20/0] via 192.168.1.82, 00:09:30
C 192.168.1.92/30 is directly connected, Serial0/1/0
L 192.168.1.94/32 is directly connected, Serial0/1/0
```

#### After Configuring AS PATH PREPEND

R1# clear ip bgp \* soft

R1# show ip bgp

R1#show ip bgp

BGP table version is 22, local router ID is 10.1.3.1

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
*> 10.1.0.0/24	0.0.0.0	0	32768	i	
*> 10.1.1.0/24	0.0.0.0	0	32768	i	
*> 10.1.2.0/24	0.0.0.0	0	32768	i	
*> 10.1.3.0/24	0.0.0.0	0	32768	i	
*> 20.1.0.0/24	192.168.1.82	0	0	200	i
*> 20.1.1.0/24	192.168.1.82	0	0	200	i
*> 20.1.2.0/24	192.168.1.82	0	0	200	i
*> 20.1.3.0/24	192.168.1.82	0	0	200	i
*> 30.1.0.0/24	192.168.1.82			0	200 i
*> 30.1.1.0/24	192.168.1.82			0	200 i
*> 30.1.2.0/24	192.168.1.82			0	200 i
*> 30.1.3.0/24	192.168.1.82			0	200 i
*> 40.1.0.0/24	192.168.1.82			0	200 300 i
*	192.168.1.93	0	0	400 400 400 300	i
*> 40.1.1.0/24	192.168.1.82			0	200 300 i
*	192.168.1.93	0	0	400 400 400 300	i
*> 40.1.2.0/24	192.168.1.82			0	200 300 i
*	192.168.1.93	0	0	400 400 400 300	i
*> 40.1.3.0/24	192.168.1.82			0	200 300 i
*	192.168.1.93	0	0	400 400 400 300	i

R1 # show ip route

Codes: L - local, 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, H - NHRP, I - LISP

+ - replicated route, % - next hop override

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks

C 10.1.0.0/24 is directly connected, Loopback0

L 10.1.0.1/32 is directly connected, Loopback0

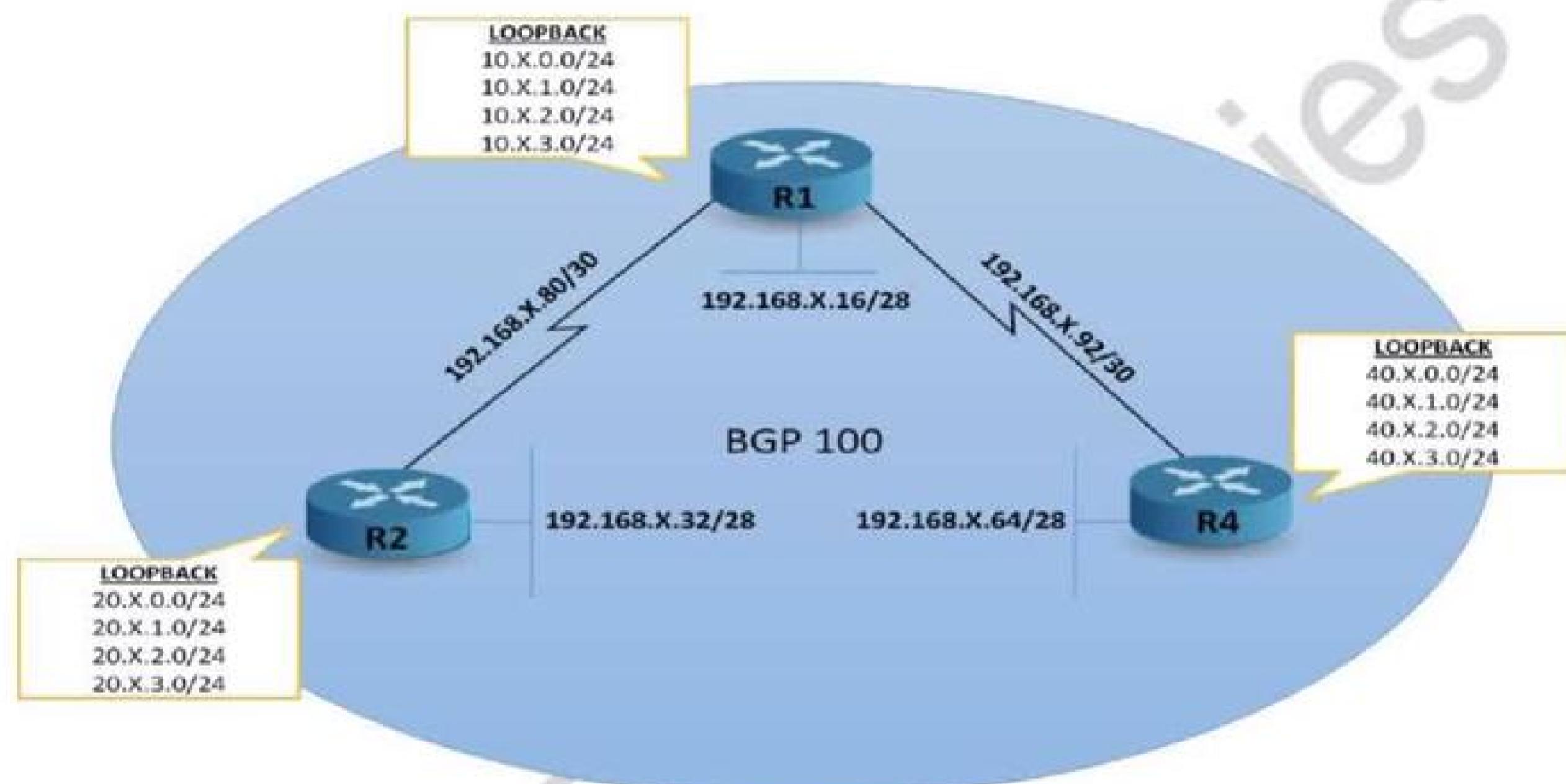
- C 10.1.1.0/24 is directly connected, Loopback1
- L 10.1.1.1/32 is directly connected, Loopback1
- C 10.1.2.0/24 is directly connected, Loopback2
- L 10.1.2.1/32 is directly connected, Loopback2
- C 10.1.3.0/24 is directly connected, Loopback3
- L 10.1.3.1/32 is directly connected, Loopback3
  - 20.0.0.0/24 is subnetted, 4 subnets
    - B 20.1.0.0 [20/0] via 192.168.1.93, 00:00:01
    - B 20.1.1.0 [20/0] via 192.168.1.93, 00:00:01
    - B 20.1.2.0 [20/0] via 192.168.1.93, 00:00:01
    - B 20.1.3.0 [20/0] via 192.168.1.93, 00:00:01
  - 30.0.0.0/24 is subnetted, 4 subnets
    - B 30.1.0.0 [20/0] via 192.168.1.93, 00:00:01
    - B 30.1.1.0 [20/0] via 192.168.1.93, 00:00:01
    - B 30.1.2.0 [20/0] via 192.168.1.93, 00:00:01
    - B 30.1.3.0 [20/0] via 192.168.1.93, 00:00:01
  - 40.0.0.0/24 is subnetted, 4 subnets
    - B 40.1.0.0 [20/0] via 192.168.1.82, 00:00:01
    - B 40.1.1.0 [20/0] via 192.168.1.82, 00:00:01
    - B 40.1.2.0 [20/0] via 192.168.1.82, 00:00:01
    - B 40.1.3.0 [20/0] via 192.168.1.82, 00:00:01
- 172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
- C 172.16.1.0/30 is directly connected, Serial0/3/1
- L 172.16.1.2/32 is directly connected, Serial0/3/1
  - 192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
- C 192.168.1.16/28 is directly connected, FastEthernet0/0

## LAB 36: BGP SUMMARIZATION

### OBJECTIVE:

To configure summarization on R1 router so that 4 loopback addresses are represented by a single BGP entry in routing table.

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring BGP on all the routers.
- 3) Configure BGP in all routers as shown in topology
- 4) Configure Summarization in all routers.

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure BGP in all routers

```
R1(config)#router bgp 100
R1(config-router)#neighbor 192.168.X.82 remote-as 100
R1(config-router)#neighbor 192.168.X.93 remote-as 100
```

```
R1(config-router)#network 192.168.X.16 mask 255.255.255.240
R1(config-router)#network 192.168.X.92 mask 255.255.255.252
R1(config-router)#network 192.168.X.80 mask 255.255.255.252
R1(config-router)#neighbor 192.168.X.82 route-reflector-client
R1(config-router)#neighbor 192.168.X.93 route-reflector-client
R1(config-router)#no synchronization
R1(config-router)#end
R2(config)# router bgp 100
R2(config-router)#neighbor 192.168.X.81 remote-as 100
R2(config-router)#network 192.168.X.80 mask 255.255.255.252
R2(config-router)#network 192.168.X.32 mask 255.255.255.240
R2(config-router)#no synchronization
R2(config-router)#end
R4(config)# router bgp 100
R4(config-router)#neighbor 192.168.X.94 remote-as 100
R4(config-router)#network 192.168.X.64 mask 255.255.255.240
R4(config-router)#network 192.168.X.92 mask 255.255.255.252
R4(config-router)#no synchronization
R4(config-router)#end
4) Configure Manual Summarization on R1. Summarize the looback interfaces.
R1(conf)# router bgp 100
R1(conf-router)#aggregate-address 10.X.0.0 255.255.252.0 summary-only
```

#### VERIFICATION:

- Check the routing table on R4 before summarization

**R4#sh ip route**

Codes: L - local, 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, H - NHRP, I - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is not set

```
10.0.0.0/24 is subnetted, 4 subnets
B 10.1.0.0 [200/0] via 192.168.1.94, 00:00:40
B 10.1.1.0 [200/0] via 192.168.1.94, 00:00:40
B 10.1.2.0 [200/0] via 192.168.1.94, 00:00:40
B 10.1.3.0 [200/0] via 192.168.1.94, 00:00:40
40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C 40.1.0.0/24 is directly connected, Loopback0
L 40.1.0.1/32 is directly connected, Loopback0
C 40.1.1.0/24 is directly connected, Loopback1
L 40.1.1.1/32 is directly connected, Loopback1
C 40.1.2.0/24 is directly connected, Loopback2
L 40.1.2.1/32 is directly connected, Loopback2
```

```
C  40.1.3.0/24 is directly connected, Loopback3
L  40.1.3.1/32 is directly connected, Loopback3
    192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
C  192.168.1.64/28 is directly connected, FastEthernet0/0
L  192.168.1.65/32 is directly connected, FastEthernet0/0
B  192.168.1.80/30 [200/0] via 192.168.1.94, 00:00:40
C  192.168.1.88/30 is directly connected, Serial0/0/1
L  192.168.1.90/32 is directly connected, Serial0/0/1
C  192.168.1.92/30 is directly connected, Serial0/0/0
L  192.168.1.93/32 is directly connected, Serial0/0/0
```

→ After Performing Summarization

R4#show ip route

Codes: L - local, 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, H - NHRP, I - LISP  
+ - replicated route, % - next hop override

Gateway of last resort is not set

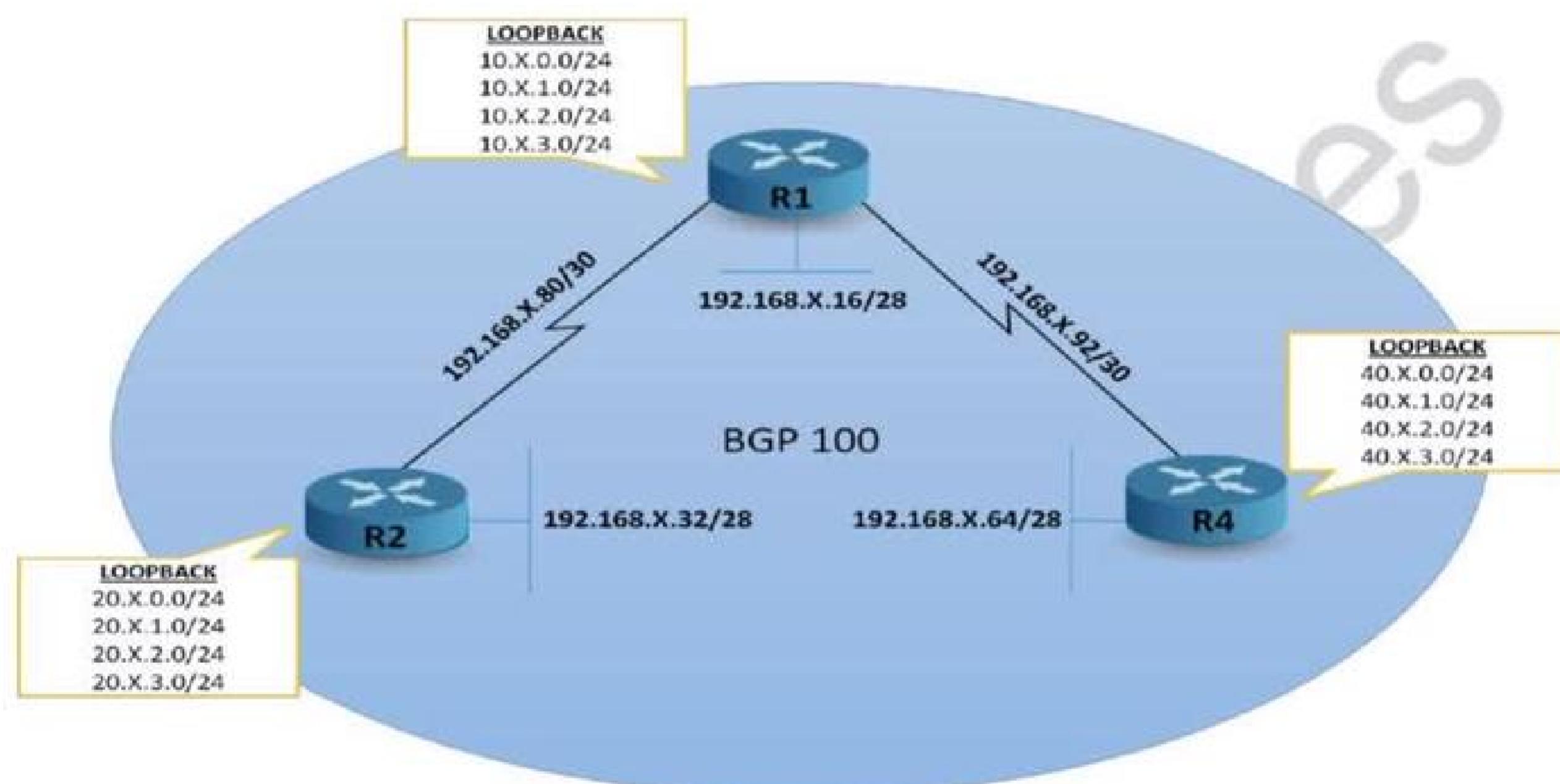
```
10.0.0.0/22 is subnetted, 1 subnets
B  10.1.0.0 [200/0] via 192.168.1.94, 00:00:04
    40.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C  40.1.0.0/24 is directly connected, Loopback0
L  40.1.0.1/32 is directly connected, Loopback0
C  40.1.1.0/24 is directly connected, Loopback1
L  40.1.1.1/32 is directly connected, Loopback1
C  40.1.2.0/24 is directly connected, Loopback2
L  40.1.2.1/32 is directly connected, Loopback2
C  40.1.3.0/24 is directly connected, Loopback3
L  40.1.3.1/32 is directly connected, Loopback3
    192.168.1.0/24 is variably subnetted, 7 subnets, 3 masks
C  192.168.1.64/28 is directly connected, FastEthernet0/0
L  192.168.1.65/32 is directly connected, FastEthernet0/0
B  192.168.1.80/30 [200/0] via 192.168.1.94, 00:02:01
C  192.168.1.88/30 is directly connected, Serial0/0/1
L  192.168.1.90/32 is directly connected, Serial0/0/1
C  192.168.1.92/30 is directly connected, Serial0/0/0
L  192.168.1.93/32 is directly connected, Serial0/0/0
```

## LAB 37: BGP AUTHENTICATION

### OBJECTIVE:

To configure BGP MD-5 authentication between R1 and R2 routers

### TOPOLOGY:



### TASK:

- 1) Verify the interface status in all the routers
- 2) Check the routing table before configuring BGP on all the routers.
- 3) Configure BGP in all routers as shown in topology
- 4) Configure Md-5 Authentication between R1 and R2 routers.

### STEPS:

- 1) Verify the interface status by using **Show ip interface brief** command. All the interfaces must be in UP/UP state.

**Router# show ip interface brief**

- 2) Check the routing table on all the routers

**Router# show ip route**

- 3) Configure BGP in all routers as done in previous lab.

- 4) Configure MD-5 authentication between R1 and R2 routers.

**R1(config)# router bgp 100**

**R1(config-router)# neighbor 192.168.X.82 password cisco**

**R2(config)# router bgp 100**

R2(config-router)# neighbor 192.168.X.81 password cisco

**VERIFICATION:**

R1#show ip bgp neighbor 192.168.X.82 | i established | md5

Connections established 1; dropped 0

Option Flags: nagle, md5

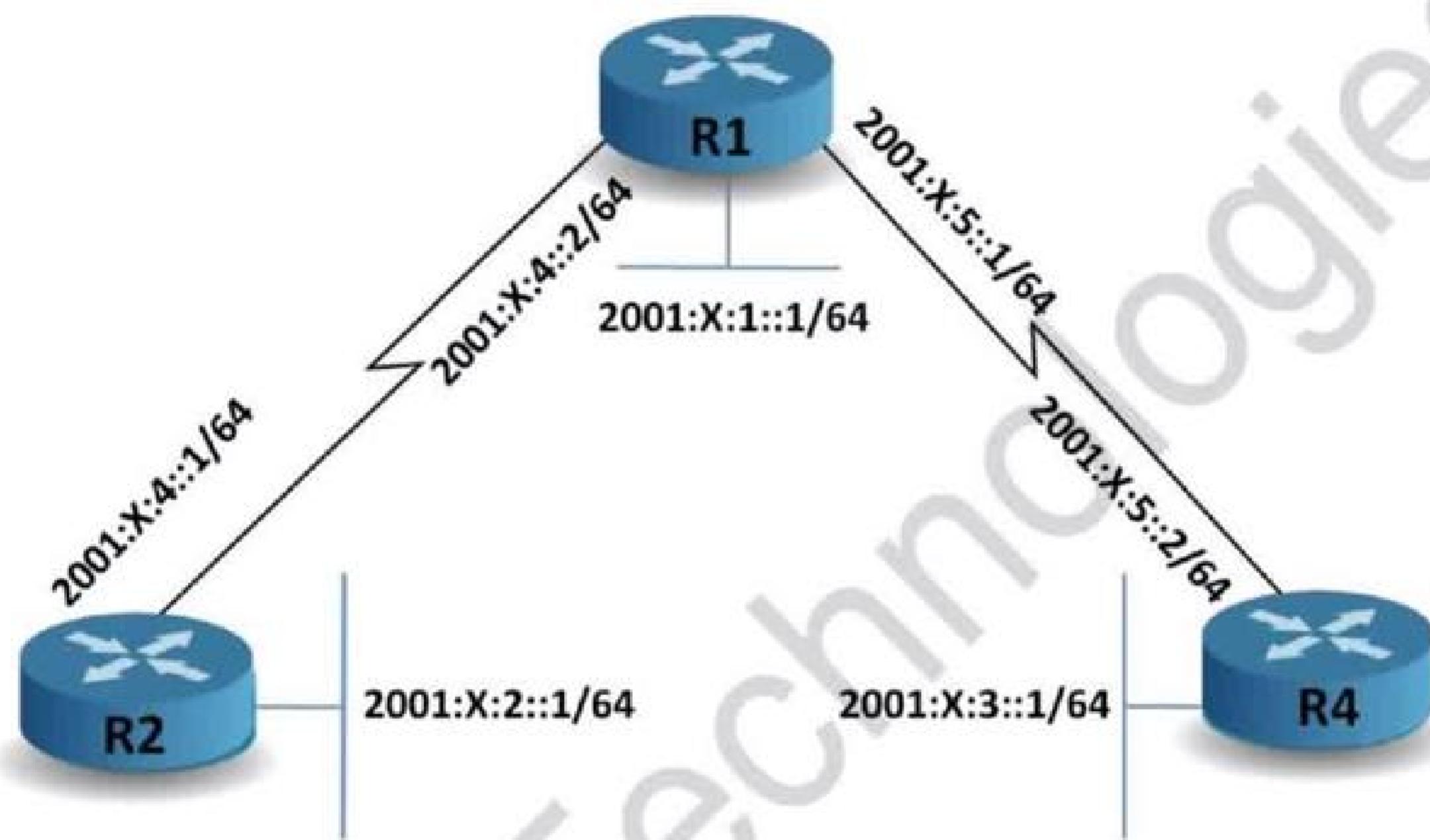
Zoom Technologies

## LAB 38: BASIC IPv6 CONFIGURATION

### OBJECTIVE:

To configure IPV6 on all routers

### TOPOLOGY:



### TASK:

- 1) Configure Basic IPV6 configuration in R1,R2 and R4 routers.
- 2) Verify the configuration using show commands.

### STEPS:

- 1) Verify Serial Interface connectivity by using following command in all routers.

```

Router# show cdp neighbors
R1#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay
  
```

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
P1SW2	Fas 0/0	155	S	WS-C3560-	Fas 0/5
R2	Ser 0/1/1	129	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	150	R S I	2811	Ser 0/0/0

- 2) Configure IPV6 addresses on all routers as shown in the topology

```

R1(config)#interface s0/1/1
R1(config-if)#ipv6 address 2001:X:4::2/64
  
```

```
R1(config-if)# no shutdown
R1(config)#interface s0/1/0
R1(config-if)#ipv6 address 2001:X:5::1/64
R1(config-if)# no shutdown
R1(config)#interface fastethernet0/0
R1(config-if)#ipv6 address 2001:X:1::1/64
R1(config-if)# no shutdown
R2(config)#interface s 0/0/1
R2(config-if)#ipv6 address 2001:X:4::1/64
R2(config-if)# no shutdown
R2(config)#interface fastethernet0/0
R2(config-if)#ipv6 address 2001:X:2::1/64
R2(config-if)# no shutdown
R4(config)#interface s0/0/0
R4(config-if)#ipv6 address 2001:X:5::2/64
R4(config-if)# no shutdown
R4(config)#interface fastethernet0/0
R4(config-if)#ipv6 address 2001:X:3::1/64
R4(config-if)# no shutdown
```

#### VERIFICATION:

- Verify Interface status in all the routers.

```
Router# show ipv6 interface brief
R1#show ipv6 interface brief

FastEthernet0/0 [up/up]
  FE80::219:AFF:FEBA:F590
  2001:1:1::1

FastEthernet0/1 [administratively down/down]
  unassigned

Serial0/1/0 [up/up]
  FE80::219:AFF:FEBA:F590
  2001:1:5::1

Serial0/1/1 [up/up]
  FE80::219:AFF:FEBA:F590
  2001:1:4::2

Serial0/3/0 [administratively down/down]
  unassigned

Serial0/3/1 [administratively down/down]
  unassigned

Loopback0 [up/up]
  unassigned

Loopback1 [up/up]
  unassigned

Loopback2 [up/up]
  unassigned

Loopback3 [up/up]

Unassigned
```

## → Verify Routing Table in all the routers.

**Router # show ipv6 route**

R1# show ipv6 route

IPv6 Routing Table - default - 8 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

S ::/0 [2/0]

via FE80::219:55FF:FE35:3C29, FastEthernet0/0

C 2001:1:1::/64 [0/0]

via FastEthernet0/0, directly connected

L 2001:1:1::1/128 [0/0]

via FastEthernet0/0, receive

C 2001:1:4::/64 [0/0]

via Serial0/1/1, directly connected

L 2001:1:4::2/128 [0/0]

via Serial0/1/1, receive

C 2001:1:5::/64 [0/0]

via Serial0/1/0, directly connected

L 2001:1:5::1/128 [0/0]

via Serial0/1/0, receive

L FF00::/8 [0/0]

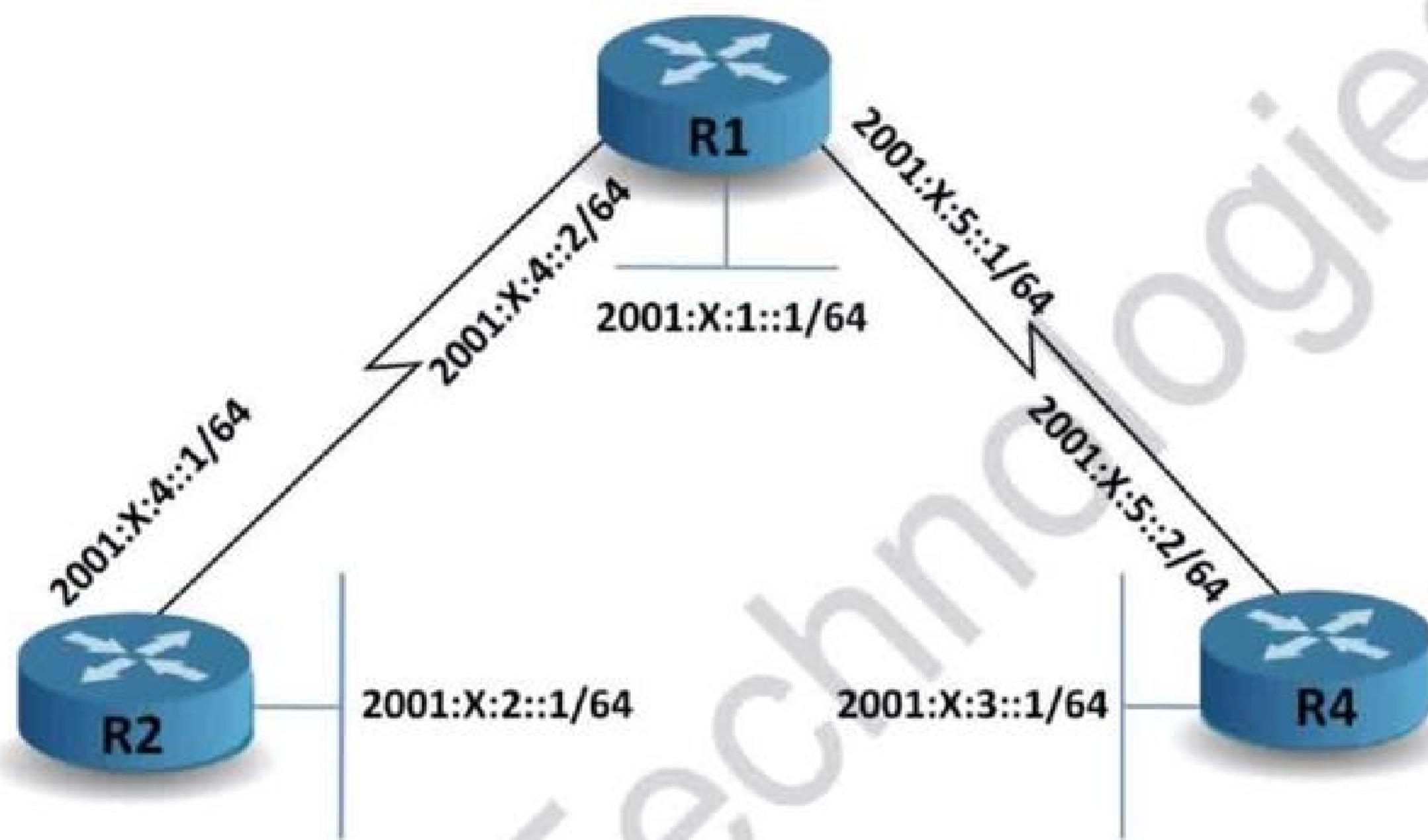
via Null0, receive

## LAB 39: RIPng

### OBJECTIVE:

To configure and verify RIPng on all the routers.

### TOPOLOGY:



### TASK:

- 1) Configure Basic IPV6 configuration in R1, R2 and R4 routers.
- 2) Verify the configuration using show commands.
- 3) Configure and verify RIPng in all routers.

### STEPS:

- 1) Verify Serial Interface connectivity by using following command in all routers.

```

Router# show cdp neighbors
R1#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay
  
```

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
P1SW2	Fas 0/0	155	S I	WS-C3560-	Fas 0/5
R2	Ser 0/1/1	129	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	150	R S I	2811	Ser 0/0/0

- 2) Configure IPV6 addresses on all routers as shown in the topology as in previous lab
- 3) Configure RIPng in all routers.

```
R1(config)#no ipv6 unicast-routing
R1(config)#ipv6 unicast-routing
R1(config)# ipv6 router rip zoom
R1(config-router)#exit
R1(config)# interface serial 0/1/1
R1(config-if)#ipv6 rip zoom enable
R1(config)# interface serial 0/1/0
R1(config-if)#ipv6 rip zoom enable
R1(config)# interface fastethernet 0/0
R1(config-if)#ipv6 rip zoom enable
R2(config)#no ipv6 unicast-routing
R2(config)#ipv6 unicast-routing
R2(config)# ipv6 router rip zoom
R2(config-router)#exit
R2(config)# interface serial 0/0/1
R2(config-if)#ipv6 rip zoom enable
R2(config)# interface fastethernet 0/0
R2(config-if)#ipv6 rip zoom enable
R4(config)#no ipv6 unicast-routing
R4(config)#ipv6 unicast-routing
R4(config)# ipv6 router rip zoom
R4(config-router)#exit
R4(config)# interface serial 0/0/0
R4(config-if)#ipv6 rip zoom enable
R4(config)# interface fastethernet 0/0
R4(config-if)#ipv6 rip zoom enable
```

**VERIFICATION:**

- Verify routing table in all the routers.

Router # show ipv6 route

R4# show ipv6 route

IPv6 Routing Table - default - 8 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

I - LISP

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

R 2001:1:1::/64 [120/2]

  via FE80::219:AAFF:FEBA:F590, FastEthernet0/0

  via FE80::219:AAFF:FEBA:F590, Serial0/0/0

R 2001:1:2::/64 [120/2]

  via FE80::219:55FF:FE35:3C28, FastEthernet0/0

C 2001:1:3::/64 [0/0]

  via FastEthernet0/0, directly connected

- L 2001:1:3::1/128 [0/0]  
via FastEthernet0/0, receive
- R 2001:1:4::/64 [120/2]  
via FE80::219:55FF:FE35:3C28, FastEthernet0/0  
via FE80::219:AFF:FEBA:F590, FastEthernet0/0  
via FE80::219:AFF:FEBA:F590, Serial0/0/0
- C 2001:1:5::/64 [0/0]  
via Serial0/0/0, directly connected
- L 2001:1:5::2/128 [0/0]  
via Serial0/0/0, receive
- L FF00::/8 [0/0]  
via Null0, receive

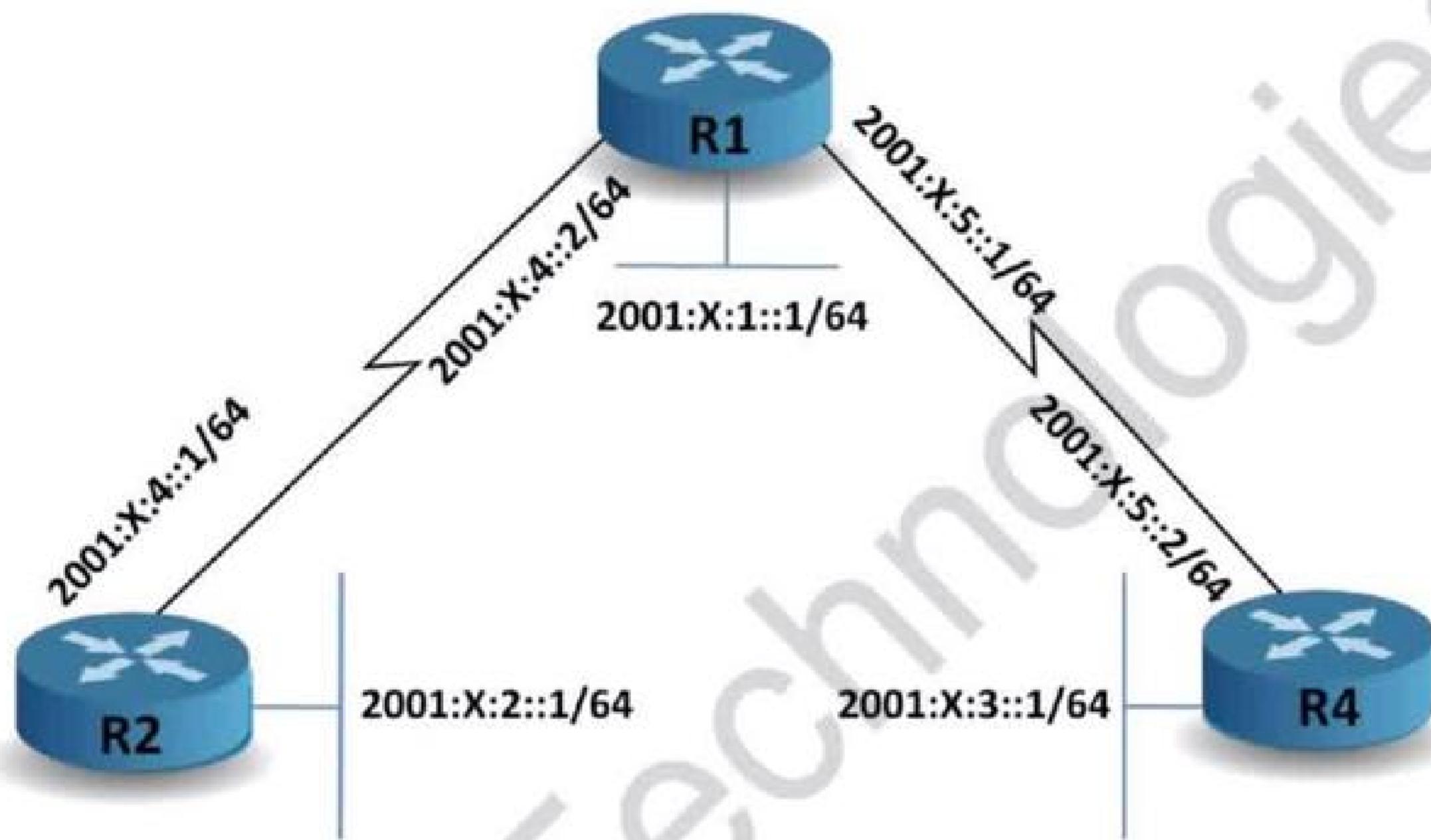
Zoom Technologies

## LAB 40: EIGRPv6

### OBJECTIVE:

To configure and verify EIGRPv6 on all the routers.

### TOPOLOGY:



### TASK:

- 1) Configure Basic IPV6 configuration in R1,R2 and R4 routers.
- 2) Verify the configuration using show commands.
- 3) Configure and verify EIGRPv6 in all routers.

### STEPS:

- 1) Verify Serial Interface connectivity by using following command in all routers.

**Router# show cdp neighbors**

**R1#show cdp neighbors**

**Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge**

**S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,**

**D - Remote, C - CVTA, M - Two-port Mac Relay**

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
P1SW2	Fas 0/0	155	S I	WS-C3560-	Fas 0/5
R2	Ser 0/1/1	129	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	150	R S I	2811	Ser 0/0/0

- 2) Configure IPV6 addresses on all routers as shown in the topology as in previous lab
- 3) Configure EIGRPV6 in all routers.

```
R1(config)#no ipv6 unicast-routing
R1(config)#ipv6 unicast-routing
R1(config)# ipv6 router eigrp 100
R1(config-router)#eigrp router-id 1.1.1.1
R1(config-router)#no shutdown
R1(config-router)#exit
R1(config)# interface serial 0/1/1
R1(config-if)#ipv6 eigrp 100
R1(config)# interface serial 0/1/0
R1(config-if)#ipv6 eigrp 100
R1(config)# interface fastethernet 0/0
R1(config-if)#ipv6 eigrp 100
R2(config)#no ipv6 unicast-routing
R2(config)#ipv6 unicast-routing
R2(config)# ipv6 router eigrp 100
R2(config-router)#eigrp router-id 2.2.2.2
R2(config-router)#no shutdown
R2(config-router)#exit
R2(config)# interface serial 0/0/1
R2(config-if)#ipv6 eigrp 100
R2(config)# interface fastethernet 0/0
R2(config-if)#ipv6 eigrp 100
R4(config)#no ipv6 unicast-routing
R4(config)#ipv6 unicast-routing
R4(config)# ipv6 router eigrp 100
R4(config-router)#eigrp router-id 4.4.4.4
R4(config-router)#no shutdown
R4(config-router)#exit
R4(config)# interface serial 0/0/0
R4(config-if)#ipv6 eigrp 100
R4(config)# interface fastethernet 0/0
R4(config-if)#ipv6 eigrp 100
```

#### VERIFICATION:

- Verify Neighbor table in all the routers.

Router # show ipv6 eigrp neighbors

R4# show ipv6 eigrp neighbors

#### EIGRP-IPv6 Neighbors for AS(100)

H	Address	Interface	Hold (sec)	Uptime (ms)	SRTT	RTO	Q	Seq Num
1	Link-local address: FE80::219:AFF:FEBA:F590	Se0/0/0	14	00:00:14	3	200	0	13

## → Verify Topology table in all the routers.

**Router # show ipv6 eigrp topology****R4# show ipv6 eigrp topology****EIGRP-IPv6 Topology Table for AS(100)/ID(4.4.4.4)**

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,

r - reply Status, s - sia Status

**P 2001:1:2::/64, 1 successors, FD is 2174976**

via FE80::219:AFF:FEBA:F590 (2684416/2172416), Serial0/0/0

**P 2001:1:4::/64, 1 successors, FD is 2172416**

via FE80::219:AFF:FEBA:F590 (2681856/2169856), Serial0/0/0

**P 2001:1:5::/64, 1 successors, FD is 2169856**

via Connected, Serial0/0/0

**P 2001:1:1::/64, 1 successors, FD is 30720**

via FE80::219:AFF:FEBA:F590 (2172416/28160), Serial0/0/0

**P 2001:1:3::/64, 1 successors, FD is 28160**

via Connected, FastEthernet0/0

## → Verify Routing table in all the routers.

**Router # show ipv6 route****R4# show ipv6 route****IPv6 Routing Table - default - 8 entries**

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

I - LISP

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

**D 2001:1:1::/64 [90/2172416]**

via FE80::219:AFF:FEBA:F590, Serial0/0/0

**D 2001:1:2::/64 [90/2684416]**

via FE80::219:AFF:FEBA:F590, Serial0/0/0

**C 2001:1:3::/64 [0/0]**

via FastEthernet0/0, directly connected

**L 2001:1:3::1/128 [0/0]**

via FastEthernet0/0, receive

**D 2001:1:4::/64 [90/2681856]**

via FE80::219:AFF:FEBA:F590, Serial0/0/0

**C 2001:1:5::/64 [0/0]**

via Serial0/0/0, directly connected

**L 2001:1:5::2/128 [0/0]**

via Serial0/0/0, receive

**L FF00::/8 [0/0]**

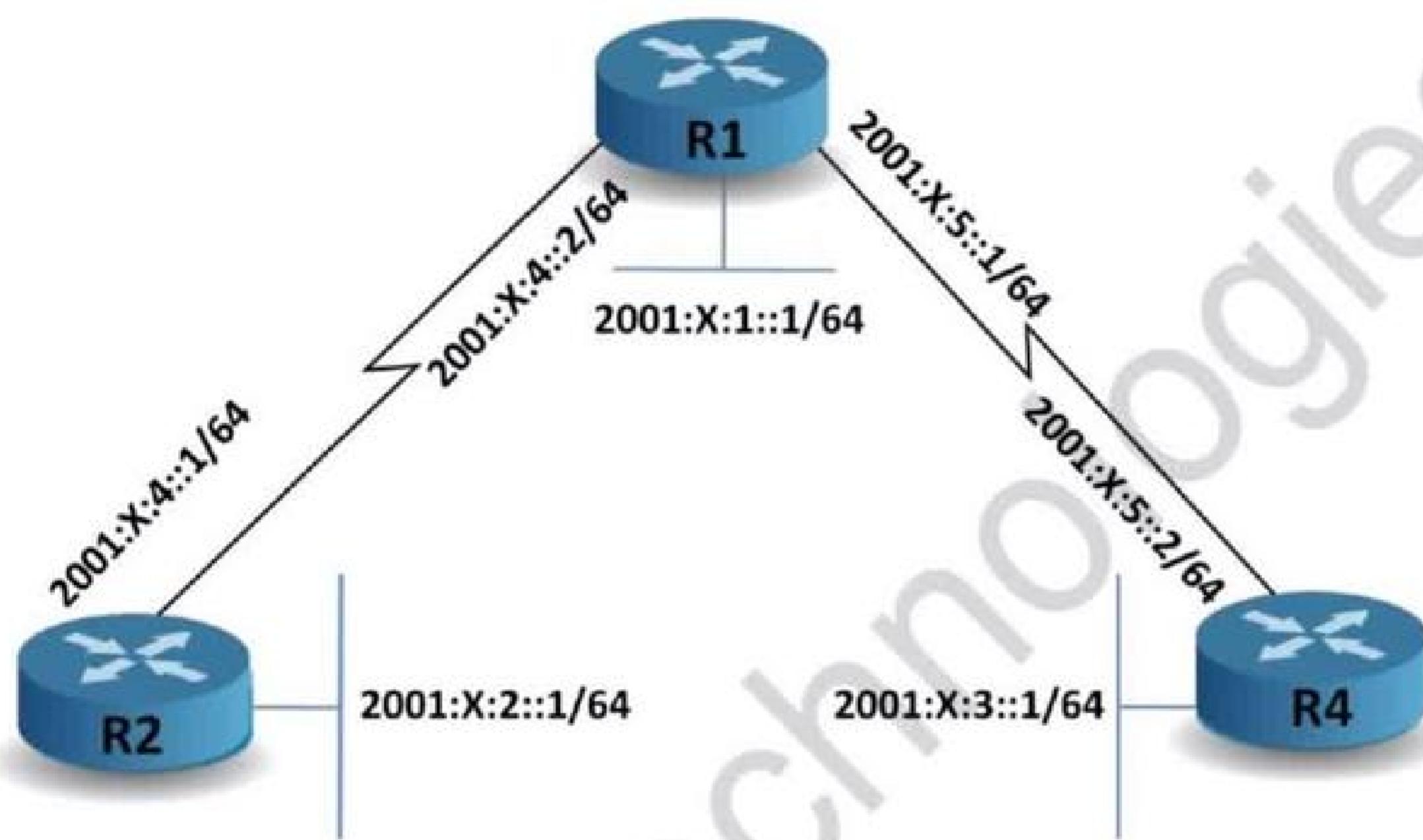
via Null0, receive

## LAB 41: OSPFv3

### OBJECTIVE:

To configure and verify OSPFv3 on all the routers.

### TOPOLOGY:



### TASK:

- 1) Configure Basic IPV6 configuration in R1,R2 and R4 routers.
- 2) Verify the configuration using show commands.
- 3) Configure and verify OSPFv3 in all routers.

### STEPS:

- 1) Verify Serial Interface connectivity by using following command in all routers.

**Router# show cdp neighbors**

**R1#show cdp neighbors**

**Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge**

**S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,**

**D - Remote, C - CVTA, M - Two-port Mac Relay**

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
P1SW2	Fas 0/0	155	S I	WS-C3560-	Fas 0/5
R2	Ser 0/1/1	129	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	150	R S I	2811	Ser 0/0/0

- 2) Configure IPV6 addresses on all routers as in previous lab

- 3) Configure OSPFv3 in all routers.

```
R1(config)#no ipv6 unicast-routing
R1(config)#ipv6 unicast-routing
R1(config)# ipv6 router ospf 100
R1(config-router)#router-id 1.1.1.1
R1(config-router)#passive-interface fastethernet 0/0
R1(config-router)#exit
R1(config)# interface serial 0/1/1
R1(config-if)#ipv6 ospf 100 area 0
R1(config)# interface serial 0/1/0
R1(config-if)#ipv6 ospf 100 area 0
R1(config)# interface fastethernet 0/0
R1(config-if)#ipv6 ospf 100 area 0
R2(config)#no ipv6 unicast-routing
R2(config)#ipv6 unicast-routing
R2(config)# ipv6 router ospf 100
R2(config-router)#router-id 2.2.2.2
R2(config-router)#passive-interface fastethernet 0/0
R2(config-router)#exit
R2(config)# interface serial 0/0/1
R2(config-if)#ipv6 ospf 100 area 0
R2(config)# interface fastethernet 0/0
R2(config-if)#ipv6 ospf 100 area 0
R4(config)#no ipv6 unicast-routing
R4(config)#ipv6 unicast-routing
R4(config)# ipv6 router ospf 100
R4(config-router)#router-id 4.4.4.4
R4(config-router)#passive-interface fastethernet 0/0
R4(config-router)#exit
R4(config)# interface serial 0/0/0
R4(config-if)#ipv6 ospf 100 area 0
R4(config)# interface fastethernet 0/0
R4(config-if)#ipv6 ospf 100 area 0
```

#### VERIFICATION:

- Verify Neighbor table in all the routers.

Router # show ipv6 ospf neighbor

R4# show ipv6 ospf neighbor

Neighbor ID	Pri	State	Dead Time	Interface ID	Interface
1.1.1.1	0	FULL/ -	00:00:36	5	Serial0/0/0

- Verify Database table in all the routers.

Router # show ipv6 ospf database

R4# show ipv6 ospf database

OSPFv3 Router with ID (4.4.4.4) (Process ID 1)

Router Link States (Area 0)

ADV Router	Age	Seq#	Fragment ID	Link count	Bits
1.1.1.1	91	0x80000003		0 2	None
2.2.2.2	91	0x80000002		0 1	None
4.4.4.4	127	0x80000002		0 1	None

Link (Type-8) Link States (Area 0)

ADV Router	Age	Seq#	Link ID	Interface
1.1.1.1	174	0x80000001	5	Se0/0/0
4.4.4.4	128	0x80000001	5	Se0/0/0
4.4.4.4	138	0x80000001	3	Fa0/0

Intra Area Prefix Link States (Area 0)

ADV Router	Age	Seq#	Link ID	Ref-Lsttype	Ref-LSID
1.1.1.1	163	0x80000003	0	0x2001	0
2.2.2.2	91	0x80000002	0	0x2001	0

→ Verify Routing table in all the routers

Router # show ipv6 route

R4# show ipv6 route

IPv6 Routing Table - default - 8 entries

Codes: C - Connected, L - Local, S - Static, U - Per-user Static route

B - BGP, HA - Home Agent, MR - Mobile Router, R - RIP

I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary

D - EIGRP, EX - EIGRP external, NM - NEMO, ND - Neighbor Discovery

I - LISP

O - OSPF Intra, OI - OSPF Inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2

ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2

O 2001:1:1::/64 [110/65]

    via FE80::219:AAFF:FEBA:F590, Serial0/0/0

O 2001:1:2::/64 [110/129]

    via FE80::219:AAFF:FEBA:F590, Serial0/0/0

C 2001:1:3::/64 [0/0]

    via FastEthernet0/0, directly connected

L 2001:1:3::1/128 [0/0]

    via FastEthernet0/0, receive

O 2001:1:4::/64 [110/128]

    via FE80::219:AAFF:FEBA:F590, Serial0/0/0

C 2001:1:5::/64 [0/0]

    via Serial0/0/0, directly connected

L 2001:1:5::2/128 [0/0]

    via Serial0/0/0, receive

L FF00::/8 [0/0]

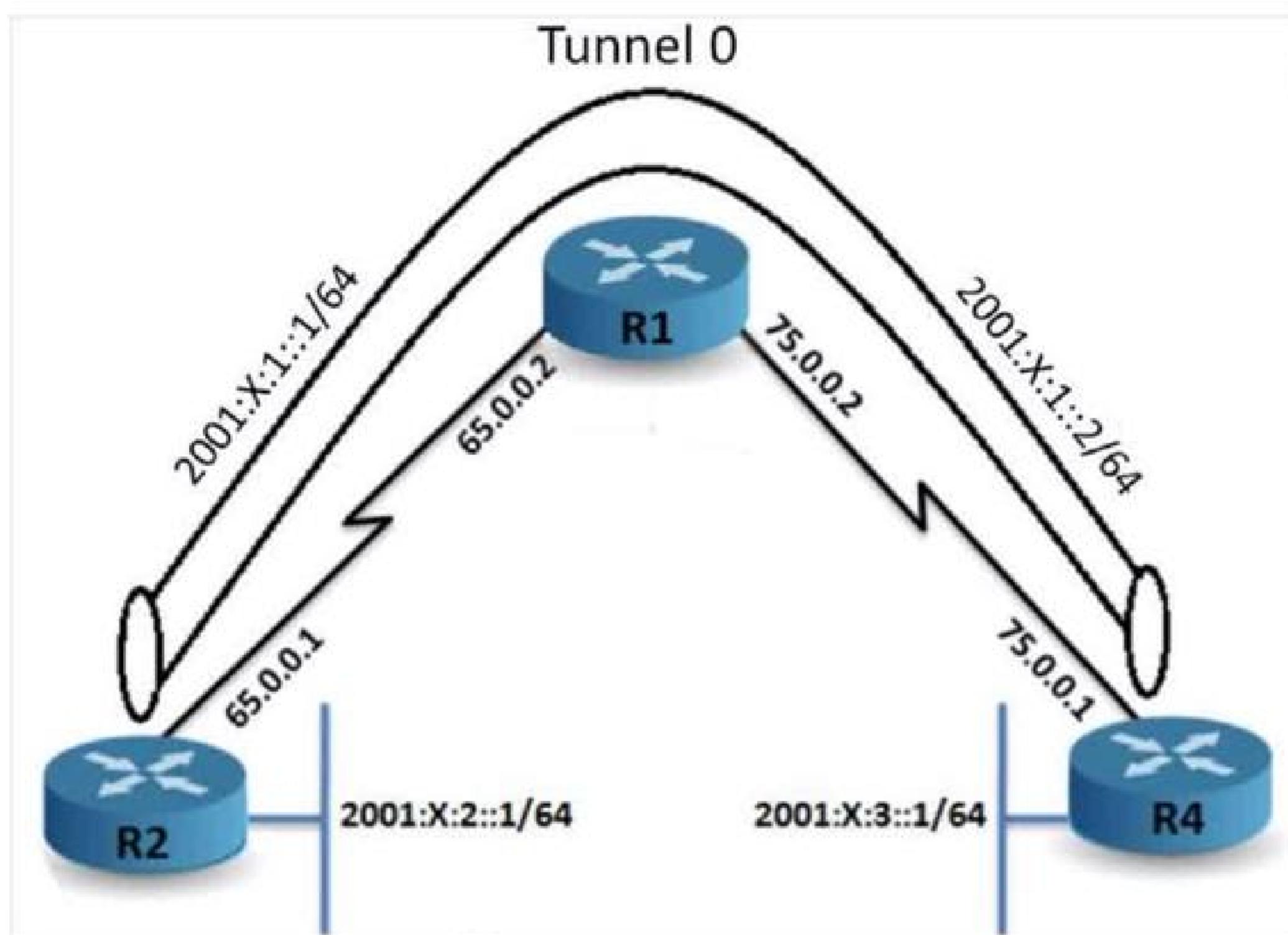
    via Null0, receive

## LAB 42: IPv6- IPv4 TUNNEL

### OBJECTIVE:

To configure and verify IPV6 – IPV4 Tunnel

### TOPOLOGY:



### TASK:

- 1) Configure Basic IPV6 configuration in R1,R2 and R4 routers.
- 2) Verify the configuration using show commands.
- 3) Configure and verify IPV6 – IPV4 Tunnel

### STEPS:

- 1) Verify Serial Interface connectivity by using following command in all routers.

Router# show cdp neighbors

R1#show cdp neighbors

**Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge**

**S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,**

**D - Remote, C - CVTA, M - Two-port Mac Relay**

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
P1SW2	Fas 0/0	155	S I	WS-C3560-	Fas 0/5
R2	Ser 0/1/1	129	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	150	R S I	2811	Ser 0/0/0

- 2) Configure IPV6 addresses on all routers as in previous lab
- 3) Configure IPV6 – IPV4 Tunnel in R2 and R4 routers.

```

R2(config)#no ip routing
R2(config)#ip routing
R2(config)#no ipv6 unicast-routing
R2(config)#ipv6 unicast- routing
R2(config)#int tunnel 0
R2(config-if)#ipv6 address 2001:X:1::1/64
R2(config-if)#tunnel mode ipv6ip
R2(config-if)#tunnel source s0/0/1
R2(config-if)#tunnel destination 75.0.0.1
R2(config-if)#exit
R2(config)#ip route 0.0.0.0 0.0.0.0 serial 0/0/1
R2(config)#ipv6 route 2001:X:3::/64 tunnel 0
R2(config)#end
R4(config)#no ip routing
R4(config)#ip routing
R4(config)#no ipv6 unicast-routing
R4(config)#ipv6 unicast- routing
R4(config)#interface tunnel 0
R4(config-if)#ipv6 address 2001:X:1::2/64
R4(config-if)#tunnel mode ipv6ip
R4(config-if)#tunnel source s 0/0/0
R4(config-if)#tunnel destination 65.0.0.1
R4(config-if)#exit
R4(config)#ip route 0.0.0.0 0.0.0.0 se0/0/0
R4(config)#ipv6 route 2001:X:2::/64 tunnel 0

```

#### VERIFICATION:

- Check Whether tunnel interface is up or not

```

R2,R4# show ipv6 interface brief
R2# show ipv6 interface brief
FastEthernet0/0      [up/up]
FE80::219:55FF:FE35:3C28
    2001:1:2::1
FastEthernet0/1      [up/up]
    FE80::219:55FF:FE35:3C29
    FC00:2::1
Serial0/0/0          [up/up]
    unassigned
Serial0/0/1          [up/up]
    FE80::219:55FF:FE35:3C28
    2001:1:4::1
Loopback0            [up/up]

```

unassigned	
Loopback1	[up/up]
unassigned	
Loopback2	[up/up]
unassigned	
Loopback3	[up/up]
unassigned	
Loopback40	[up/up]
unassigned	
Tunnel0	[up/up]
FE80::4100:1	
2001:1:1::1	

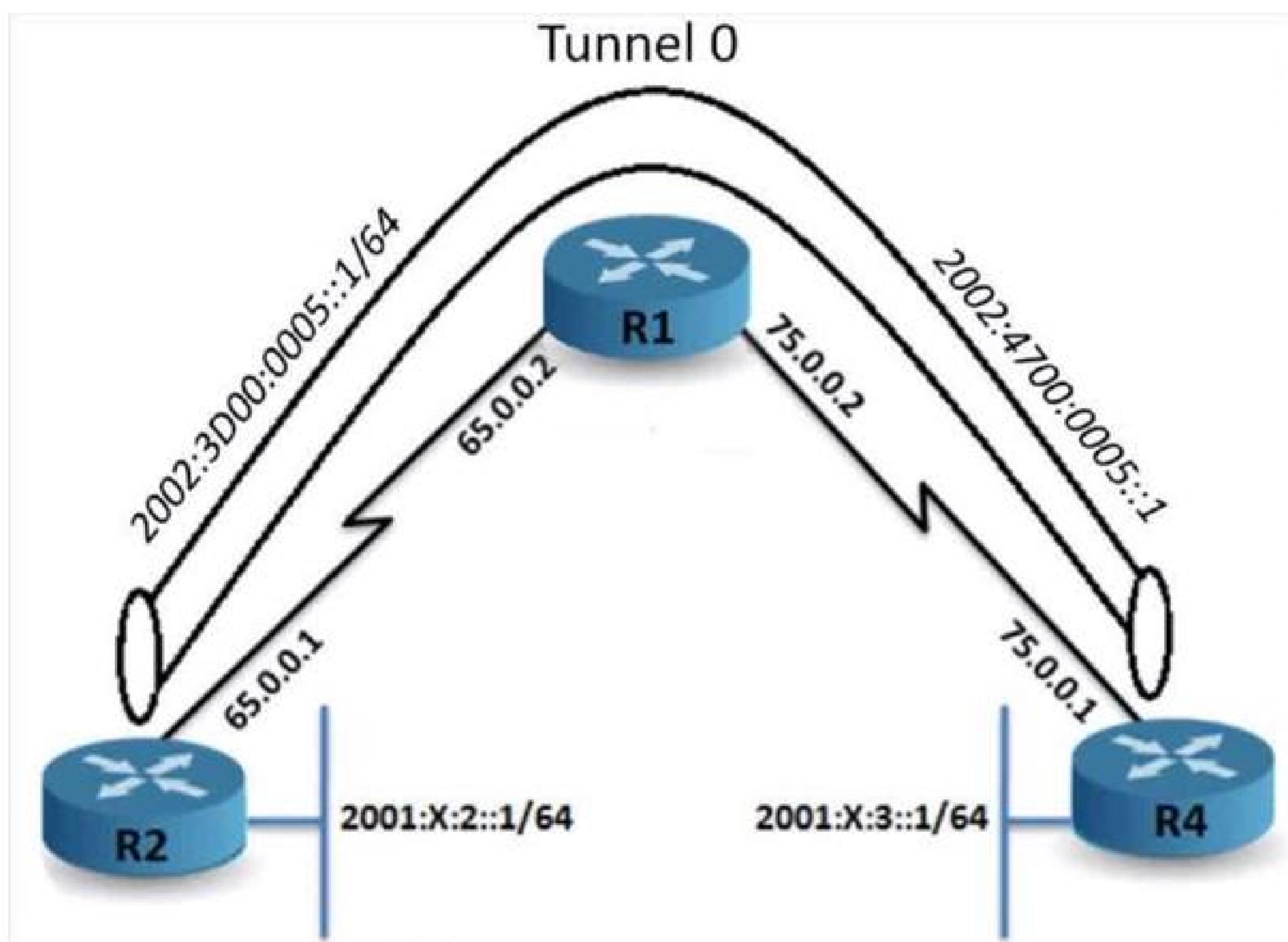
Zoom Technologies

## LAB 43: AUTO IPv6 – IPV4 TUNNEL

### OBJECTIVE:

To set up and verify Auto IPV6 – IPV4 Tunnel

### TOPOLOGY:



### TASK:

- 1) Configure Basic IPV6 configuration in R1,R2 and R4 routers.
- 2) Verify the configuration using show commands.
- 3) Configure and verify IPV6 – IPV4 Tunnel

### STEPS:

- 1) Verify Serial Interface connectivity by using following command in all routers.

```
Router# show cdp neighbors
R1#show cdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
D - Remote, C - CVTA, M - Two-port Mac Relay
```

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
P1SW2	Fas 0/0	155	S I	WS-C3560	Fas 0/5

- |    |           |     |       |      |           |
|----|-----------|-----|-------|------|-----------|
| R2 | Ser 0/1/1 | 129 | R S I | 2811 | Ser 0/0/1 |
| R4 | Ser 0/1/0 | 150 | R S I | 2811 | Ser 0/0/0 |
- 2) Configure IPV6 addresses on all routers as shown in the topology as did in previous lab  
 3) Configure Auto IPV6 – IPV4 Tunnel in R2 and R4 routers.

```

R2(config)#interface tunnel 0
R2(config-if)#ipv6 add 2002:3D00:0005::1/64
R2(config-if)#tunnel mode ipv6ip 6to4
R2(config-if)#tunnel source serial 0/0/1
R2(config-if)#exit
R2(config)#ip route 0.0.0.0 0.0.0.0 s 0/0/1
R2(config)#ipv6 route 2002::/16 tunnel 0
R2(config)#ipv6 route 2001:X:3::/64 tunnel 0
R2(config)#end
R4(config)#int tunnel 0
R4(config-if)#ipv6 add 2002:4700:0005::1/64
R4(config-if)#tunnel mode ipv6ip 6to4
R4(config-if)#tunnel source s0/0/0
R4(config-if)#exit
R4(config)#ip route 0.0.0.0 0.0.0.0 s 0/0/0
R4(config)#ipv6 route 2002::/16 tunnel 0
R4(config)#ipv6 route 2001:X:2::/64 tunnel 0
R4(config)#end
    
```

#### VERIFICATION:

- Check Whether tunnel interface is up or not

```

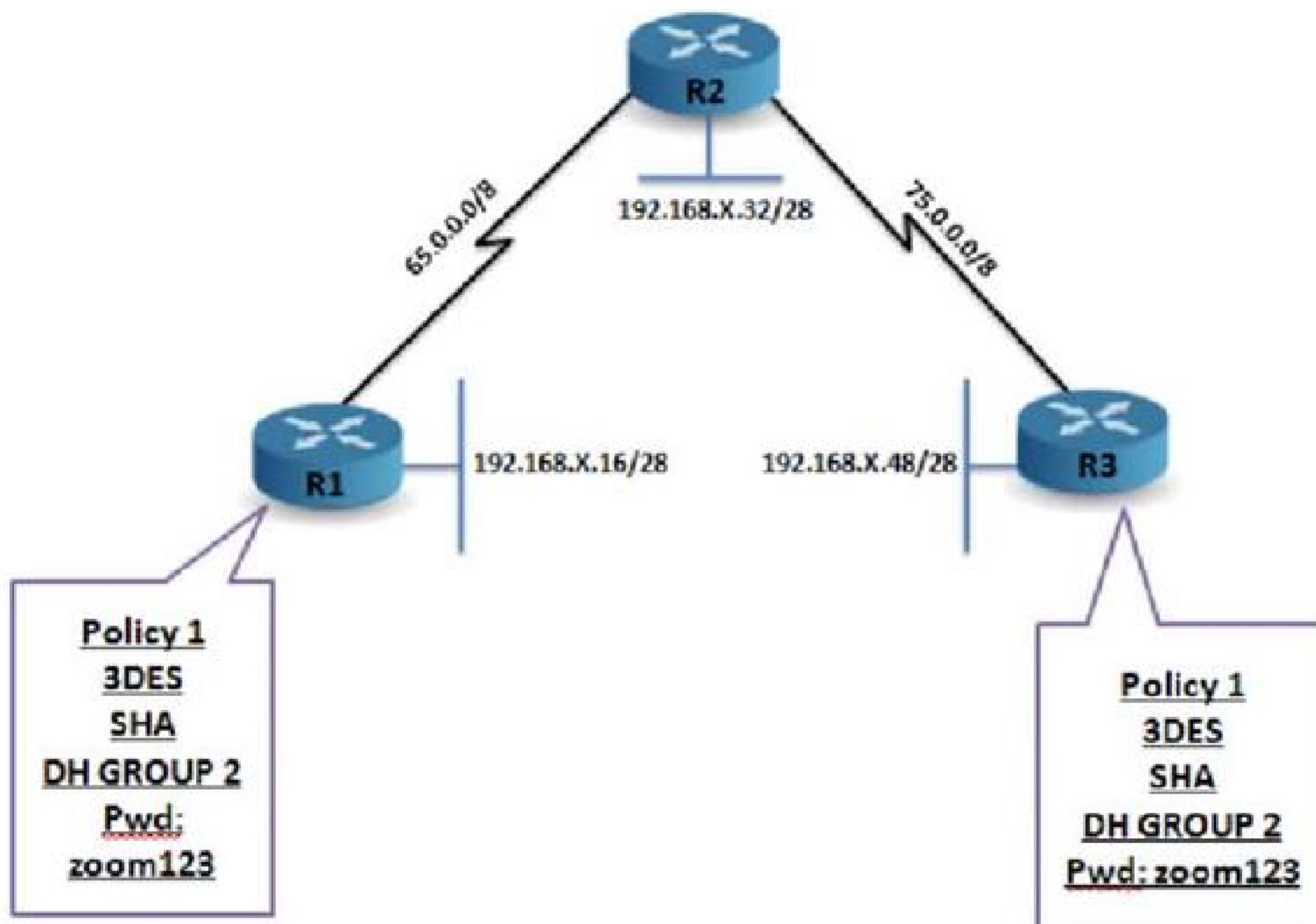
R2,R4# show ipv6 interface brief
R4#show ipv6 interface brief
FastEthernet0/0      [up/up]
    FE80::21E:7AFF:FE61:6C98
    2001:1:3::1
    2001:13::1
FastEthernet0/1      [administratively down/down]
    unassigned
Serial0/0/0          [up/up]
    FE80::21E:7AFF:FE61:6C98
    2001:1:5::2
Serial0/0/1          [up/up]
    unassigned
Loopback0            [up/up]
    unassigned
Loopback1            [up/up]
    unassigned
Loopback2            [up/up]
    unassigned
Loopback3            [up/up]
    unassigned
Tunnel0              [up/up]
    FE80::4B00:1
    2002:4700:5::1
    
```

## LAB 44: IPSEC VPN

### OBJECTIVE:

To configure a site to site IPSec VPN between R1 and R3 routers

### TOPOLOGY:



### TASK:

- 1) Verify connectivity between R1 and R3
- 2) Create an IPsec tunnel between R1 and R3 with the following parameters:
  - Encryption 3DES
  - Hash SHA
  - DH group 2
  - Tunnel mode
  - Preshared key zoom123
- 3) Verify the operation of the tunnel

**STEPS:**

- 1) Verify Serial Interface connectivity by using following command in all routers.

```
Router# show cdp neighbors
```

```
R1#show cdp neighbors
```

**Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge**

**S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,**

**D - Remote, C - CVTA, M - Two-port Mac Relay**

Device ID	Local Intrfce	Holdtme	Capability	Platform	Port ID
P1SW2	Fas 0/0	155	S I	WS-C3560	Fas 0/5
R2	Ser 0/1/1	129	R S I	2811	Ser 0/0/1
R4	Ser 0/1/0	150	R S I	2811	Ser 0/0/0

- 2) Configure IPSEC tunnel

```
R1(config)# interface serial 0/1/1
```

```
R1(config-if)#ip address 65.0.0.1 255.0.0.0
```

```
R1(config-if)#no shut
```

```
R1(config-if)#exit
```

```
R1(config)#ip route 0.0.0.0 0.0.0.0 serial 0/1/1
```

```
R1(config)#crypto isakmp policy 1
```

```
R1(config-isakmp)#authentication pre-share
```

```
R1(config-isakmp)#encryption 3des
```

```
R1(config-isakmp)#hash sha
```

```
R1(config-isakmp)#group 2
```

```
R1(config-isakmp)#exit
```

```
R1(config)#crypto isakmp key zoom123 address 75.0.0.1
```

```
R1(config)#crypto ipsec transform-set zoom esp-des esp-sha-hmac
```

```
R1(config-crypto-trans)#mode tunnel
```

```
R1(config-crypto-trans)#exit
```

```
R1(config)#access-list 100 permit ip 192.168.X.16 0.0.0.15 192.168.X.48 0.0.0.15
```

```
R1(config)#crypto map vpnmap 10 ipsec-isakmp
```

```
R1(config-crypto-map)#match address 100
```

```
R1(config-crypto-map)#set transform-set zoom
```

```
R1(config-crypto-map)#set peer 75.0.0.1
```

```
R1(config)# interface serial 0/1/1
```

```
R1(config-if)#crypto map vpnmap
```

```
R3(config)# interface serial 0/1/0
```

```
R3(config-if)#ip add 75.0.0.1 255.255.255.0
```

```
R3(config-if)#no shut
```

```
R3(config)#exit
```

```
R3(config)#ip route 0.0.0.0 0.0.0.0 s0/1/0
```

```
R3(config)#crypto isakmp policy 1
```

```
R3(config-isakmp)#authentication pre-share
```

```
R3(config-isakmp)#encryption 3des
```

```
R3(config-isakmp)#hash sha
```

```
R3(config-isakmp)#group 2
```

```
R3(config-isakmp)#exit
```

```
R3(config)#crypto isakmp key zoom123 address 65.0.0.1
```

```
R3(config)#crypto ipsec transform-set zoom esp-des esp-sha-hmac
R3(config-crypto-trans)#mode tunnel
R3(config-crypto-trans)#exit
R3(config)#access-list 100 permit ip 192.168.X.48 0.0.0.15 192.168.X.16 0.0.0.15
R3(config)#crypto map vpnmap 10 ipsec-isakmp
R3(config-crypto-map)#match address 100
R3(config-crypto-map)#set transform-set zoom
R3(config-crypto-map)#set peer 65.0.0.1
R3(config)#interface serial 0/1/0
R3(config-if)crypto map vpnmap
R3(config-if)#exit
```

- 3) Configure the IP address on the middle router with appropriate ip addresses.

```
R2(config)#interface serial 0/1/0
R2(config-if)#ip address 65.0.0.2 255.0.0.0
R2(config-if)#no shut
R2(config)#interface serial 0/1/1
R2(config-if)#ip address 75.0.0.2 255.0.0.0
R2(config-if)#no shut
R2(config-if)#exit
R2(config)#no ip routing
R2(config-if)#ip routing
```

#### VERIFICATION:

- Initiate some interesting traffic by using extended ping command from one of the routers to other router.

```
R1#ping [Enter]
Protocol [ip]:
Target IP address:192.168.X.49
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 192.168.X.17
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.X.49, timeout is 2 seconds:
!!!!
Enable debugging for the IPSec tunnel
R1# show crypto ipsec sa
interface: Serial1/1
Crypto map tag: vpntomal, local addr 75.0.0.1
protected vrf: (none)
```

```

local ident (addr/mask/prot/port): (192.168.1.16/255.255.255.240/0/0)
remote ident (addr/mask/prot/port): (192.168.1.48/255.255.255.0/0/0)
current_peer 65.0.0.1 port 500
PERMIT, flags={origin_is_acl,ipsec_sa_request_sent}
#pkts encaps: 4, #pkts encrypt: 4, #pkts digest: 4
#pkts decaps: 4, #pkts decrypt: 4, #pkts verify: 4
% OUTPUT OMITTED

```

**R1#show crypto isakmp sa**

IPv4 Crypto ISAKMP SA

dst	src	state	conn-id	slot	status
65.0.0.1	75.0.0.1	QM_IDLE	1001	0	ACTIVE

R1# debug crypto isakmp

```

00:01:16: ISAKMP:(0): SA request profile is (NULL)
00:01:16: ISAKMP: Created a peer struct for 65.0.0.1, peer port 500
00:01:16: ISAKMP: New peer created peer = 0x672E34D0 peer_handle = 0x80000002
00:01:16: ISAKMP: Locking peer struct 0x672E34D0, refcount 1 for isakmp_initiator
00:01:16: ISAKMP: local port 500, remote port 500
00:01:16: ISAKMP: set new node 0 to QM_IDLE
00:01:16: insert sa successfully sa = 672E275C
00:01:16: ISAKMP:(0):Can not start Aggressive mode, trying Main mode.
00:01:16: ISAKMP:(0):found peer pre-shared key matching 65.0.0.1
00:01:16: ISAKMP:(0): constructed NAT-T vendor-07 ID
00:01:16: ISAKMP:(0): constructed NAT-T vendor-03 ID
00:01:16: ISAKMP:(0): constructed NAT-T vendor-02 ID
00:01:16: ISAKMP:(0):Input = IKE_MESG_FROM_IPSEC, IKE_SA_REQ_MM
00:01:16: ISAKMP:(0):Old State = IKE_READY New State = IKE_I_MM1

00:01:16: ISAKMP:(0): beginning Main Mode exchange
00:01:16: ISAKMP:(0): sending packet to 65.0.0.1 my_port 500 peer_port 500 (I) MM_NO_STATE
00:01:17: ISAKMP (0:0): received packet from 65.0.0.1 dport 500 sport 500 Global (I)
MM_NO_STATE
00:01:17: ISAKMP:(0):Input = IKE_MESG_FROM_PEER, IKE_MM_EXCH
00:01:17: ISAKMP:(0):Old State = IKE_I_MM1 New State = IKE_I_MM2

00:01:17: ISAKMP:(0): processing SA payload. message ID = 0
00:01:17: ISAKMP:(0): processing vendor id payload
00:01:17: ISAKMP:(0): vendor ID seems Unity/DPD but major 245 mismatch
00:01:17: ISAKMP (0:0): vendor ID is NAT-T v7
00:01:17: ISAKMP:(0):found peer pre-shared key matching 65.0.0.1
00:01:17: ISAKMP:(0): local preshared key found
00:01:17: ISAKMP : Scanning profiles for xauth ...
00:01:17: ISAKMP:(0):Checking ISAKMP transform 1 against priority 10 policy
00:01:17: ISAKMP: encryption 3DES-CBC
00:01:17: ISAKMP: hash SHA
00:01:17: ISAKMP: default group 2
00:01:17: ISAKMP: auth pre-share
00:01:17: ISAKMP: life type in seconds
00:01:17: ISAKMP: life duration (VPI) of 0x0 0x1 0x51 0x80
INDIA#AKMP:(0):atts are acceptable. Next payload is 0
00:01:17: ISAKMP:(0): processing vendor id payload

```

```

00:01:17: ISAKMP:(0): vendor ID seems Unity/DPD but major 245 mismatch
00:01:17: ISAKMP (0:0): vendor ID is NAT-T v7
00:01:17: ISAKMP:(0):Input = IKE_MESG_INTERNAL, IKE_PROCESS_MAIN_MODE
00:01:17: ISAKMP:(0):Old State = IKE_I_MM2 New State = IKE_I_MM2

00:01:17: ISAKMP:(0): sending packet to 65.0.0.1 my_port 500 peer_port 500 (I) MM_SA_SETUP
00:01:17: ISAKMP:(0):Input = IKE_MESG_INTERNAL, IKE_PROCESS_COMPLETE
00:01:17: ISAKMP:(0):Old State = IKE_I_MM2 New State = IKE_I_MM3

00:01:17: ISAKMP (0:0): received packet from 65.0.0.1 dport 500 sport 500 Global (I)
MM_SA_SETUP
00:01:17: ISAKMP:(0):Input = IKE_MESG_FROM_PEER, IKE_MM_EXCH
00:01:17: ISAKMP:(0):Old State = IKE_I_MM3 New State = IKE_I_MM4

00:01:17: ISAKMP:(0): processing KE payload. message ID = 0
00:01:17: ISAKMP:(0): processing NONCE payload. message ID = 0
00:01:17: ISAKMP:(0):found peer pre-shared key matching 65.0.0.1
00:01:17: ISAKMP:(1001): processing vendor id payload
00:01:17: ISAKMP:(1001): vendor ID is Unity
00:01:17: ISAKMP:(1001): processing vendor id payload
00:01:17: ISAKMP:(1001): vendor ID is DPD
00:01:17: ISAKMP:(1001): processing vendor id payload
00:01:17: ISAKM
INDIA#P:(1001): speaking to another IOS box!
00:01:17: ISAKMP:(1001):Input = IKE_MESG_INTERNAL, IKE_PROCESS_MAIN_MODE
00:01:17: ISAKMP:(1001):Old State = IKE_I_MM4 New State = IKE_I_MM4

00:01:17: ISAKMP:(1001):Send initial contact
00:01:17: ISAKMP:(1001):SA is doing pre-shared key authentication using id type ID_IPV4_ADDR
00:01:17: ISAKMP (0:1001): ID payload
    next-payload : 8
    type : 1
    address : 75.0.0.1
    protocol : 17
    port : 500
    length : 12
00:01:17: ISAKMP:(1001):Total payload length: 12
00:01:17: ISAKMP:(1001): sending packet to 65.0.0.1 my_port 500 peer_port 500 (I)
MM_KEY_EXCH
00:01:17: ISAKMP:(1001):Input = IKE_MESG_INTERNAL, IKE_PROCESS_COMPLETE
00:01:17: ISAKMP:(1001):Old State = IKE_I_MM4 New State = IKE_I_MM5
00:01:17: ISAKMP (0:1001): received packet from 65.0.0.1 dport 500 sport 500 Global (I)
MM_KEY_EXCH
00:01:17: ISAKMP:(1001): processing ID payload. message ID = 0
00:01:17: ISAKMP (0:1001): ID payload
    next-payload : 8
    type : 1
    address : 65.0.0.1
    protocol : 17
    port : 500
    length : 12

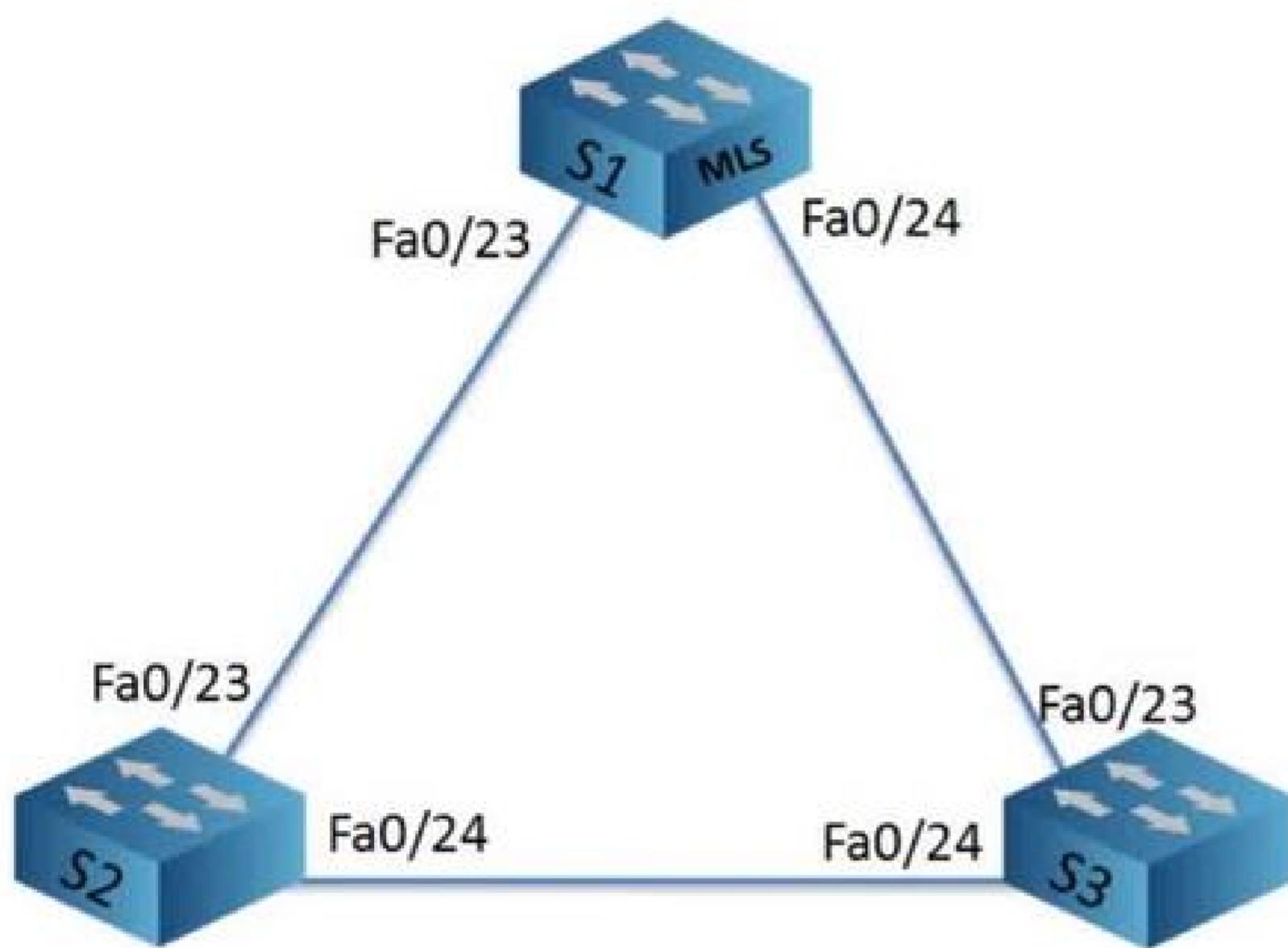
```

00:01:17: ISAKMP:(0):: peer matches \*  
INDIA#none\* of the profiles  
00:01:17: ISAKMP:(1001): processing HASH payload. message ID = 0  
00:01:17: ISAKMP:(1001):SA authentication status:  
    authenticated

Zoom Technologies

**LAB 1: VLAN****OBJECTIVE:**

To configure VLANs in a switched network.

**TOPOLOGY:****TASK:**

- 1) Configure the following VLANs on all the switches.
  - I. VLAN 10 – CCNA
  - II. VLAN 20--- CCNP
  - III. VLAN 30-----CCIE
- 2) Configure the interface between the switches as Trunk interfaces.
- 3) Assign the VLANs to the some of the interfaces of the Switch.

**STEPS:**

- 1) Configure VLAN 10, 20, 30 in all the switches.

```
SW1(config)# VLAN 10
SW1(config-VLAN)#name CCNA
SW1(config)# VLAN 20
SW1(config-VLAN)#name CCNP
SW1(config)# VLAN 30
SW1(config-VLAN)#name CCIE
SW2(config)# VLAN 10
SW2(config-VLAN)#name CCNA
```

```

SW2(config)# VLAN 20
SW2(config-VLAN)#name CCNP
SW2(config)# VLAN 30
SW2(config-VLAN)#name CCIE
SW3(config)# VLAN 10
SW3(config-VLAN)#name CCNA
SW3(config)# VLAN 20
SW3(config-VLAN)#name CCNP
SW3(config)# VLAN 30
SW3(config-VLAN)#name CCIE

```

- 2) Assign VLANs to the interfaces in all switches.

```

SW(config)#interface fastethernet 0/10
SW(config-if)#switchport mode access
SW(config-if)#switchport access VLAN 10
SW(config)#interface fastethernet 0/12
SW(config-if)#switchport mode access
SW(config-if)#switchport access VLAN 20
SW(config)#interface fastethernet 0/15
SW(config-if)#switchport mode access
SW(config-if)#switchport access VLAN 30

```

- 3) Configure the ports connected to other switches as Trunks

```

SW1(config)#interface range fastethernet 0/23 – 24
SW1(config)#switchport mode trunk
SW2(config)#interface range fastethernet 0/23 – 24
SW2(config)#switchport mode trunk
SW3(config)#interface range fastethernet 0/23 – 24
SW3(config)#switchport mode trunk

```

#### VERIFICATION:

- Verify VLAN database in all the switches.

SW3#show VLAN

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, Fa0/11, Fa0/14, Fa0/16 Fa0/17, Fa0/18, Fa0/19, Fa0/20, Fa0/21, Fa0/22 Gi0/1, Gi0/2
10 ccna	active	Fa0/10
20 ccnp	active	Fa0/12
30 ccie	active	Fa0/15
1002 fddi-default	act/unsup	
1003 trcrf-default	act/unsup	
1004 fddinet-default	act/unsup	
1005 trbrf-default	act/unsup	

## LAB 2: VTP CONFIGURATION

### OBJECTIVE:

To configure VTP (VLAN trunking protocol) in a switched network to automate the creation of VLANs

### TOPOLOGY:



### TASK:

- 1) Configure the interface between the switches as Trunk interfaces.
- 2) Configure VTP domain Zoom in all switches
- 3) Make SW1 as Server, SW2 as Client and SW3 as Transparent switch
- 4) Create VLANs on SW1 and verify that these VLANs are learnt by SW2

### STEPS:

- 1) Configure trunk interfaces between the switches as in the previous lab.
- 2) Configure VTP domain name as Zoom in all switches

```
SW1(config)# VTP domain zoom
SW2(config)# VTP domain zoom
SW3(config)# VTP domain zoom
```

- 3) Configure switch 1 as server, switch 2 as client and switch 3 as transparent.

```
SW1(config)#VTP mode server
SW2(config)# VTP mode client
SW3(config)#VTP mode transparent
```

- 4) Configure VLANs in server switch as in previous lab

**VERIFICATION:**

```
SW1#show vtp status
VTP Version : running VTP2
Configuration Revision : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs : 8
VTP Operating Mode : Server
VTP Domain Name : zoom
VTP Pruning Mode : Enabled
VTP V2 Mode : Enabled
VTP Traps Generation : Disabled
MD5 digest : 0xE0 0x04 0x0D 0x7F 0x89 0xA0 0xC7 0xE8
Configuration last modified by 192.168.0.13 at 3-1-93 03:40:15
Local updater ID is 192.168.0.11 on interface VI1 (lowest numbered VLAN interface found)
```

**SW1#show VLAN**

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, Fa0/11, Fa0/14, Fa0/16 Fa0/17, Fa0/18, Fa0/19, Fa0/20 Fa0/21, Fa0/22, Gi0/1, Gi0/2
10 ccna	active	Fa0/10
20 ccnp	active	Fa0/12
30 ccie	active	Fa0/15
1002 fddi-default	act/unsup	
1003 trcrf-default	act/unsup	
1004 fddinet-default	act/unsup	
1005 trbrf-default	act/unsup	

**SW2#show vtp status**

```
VTP Version : 2
Configuration Revision : 0
Maximum VLANs supported locally : 64
Number of existing VLANs : 8
VTP Operating Mode : Client
VTP Domain Name : zoom
VTP Pruning Mode : Enabled
VTP V2 Mode : Enabled
VTP Traps Generation : Disabled
MD5 digest : 0xE0 0x04 0x0D 0x7F 0x89 0xA0 0xC7 0xE8
Configuration last modified by 192.168.0.13 at 3-1-93 03:40:15
```

**SW2#show VLAN**

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, Fa0/11, Fa0/13, Fa0/14 Fa0/16, Fa0/17, Fa0/18, Fa0/19 Fa0/20, Fa0/21, Fa0/22
10 ccna	active	Fa0/10
20 ccnp	active	Fa0/12
30 ccie	active	Fa0/15
1002 fddi-default	act/unsup	
1003 trcrf-default	act/unsup	
1004 fddinet-default	act/unsup	
1005 trbrf-default	act/unsup	

**SW3#show vtp status**

VTP Version	: 2
Configuration Revision	: 0
Maximum VLANs supported locally	: 128
Number of existing VLANs	: 8
VTP Operating Mode	: Transparent
VTP Domain Name	: zoom
VTP Pruning Mode	: Enabled
VTP V2 Mode	: Enabled
VTP Traps Generation	: Disabled
MD5 digest	: 0xE0 0x04 0x0D 0x7F 0x89 0xA0 0xC7 0xE8
Configuration last modified by 192.168.0.13 at 3-1-93 03:40:15	

**SW3#show VLAN**

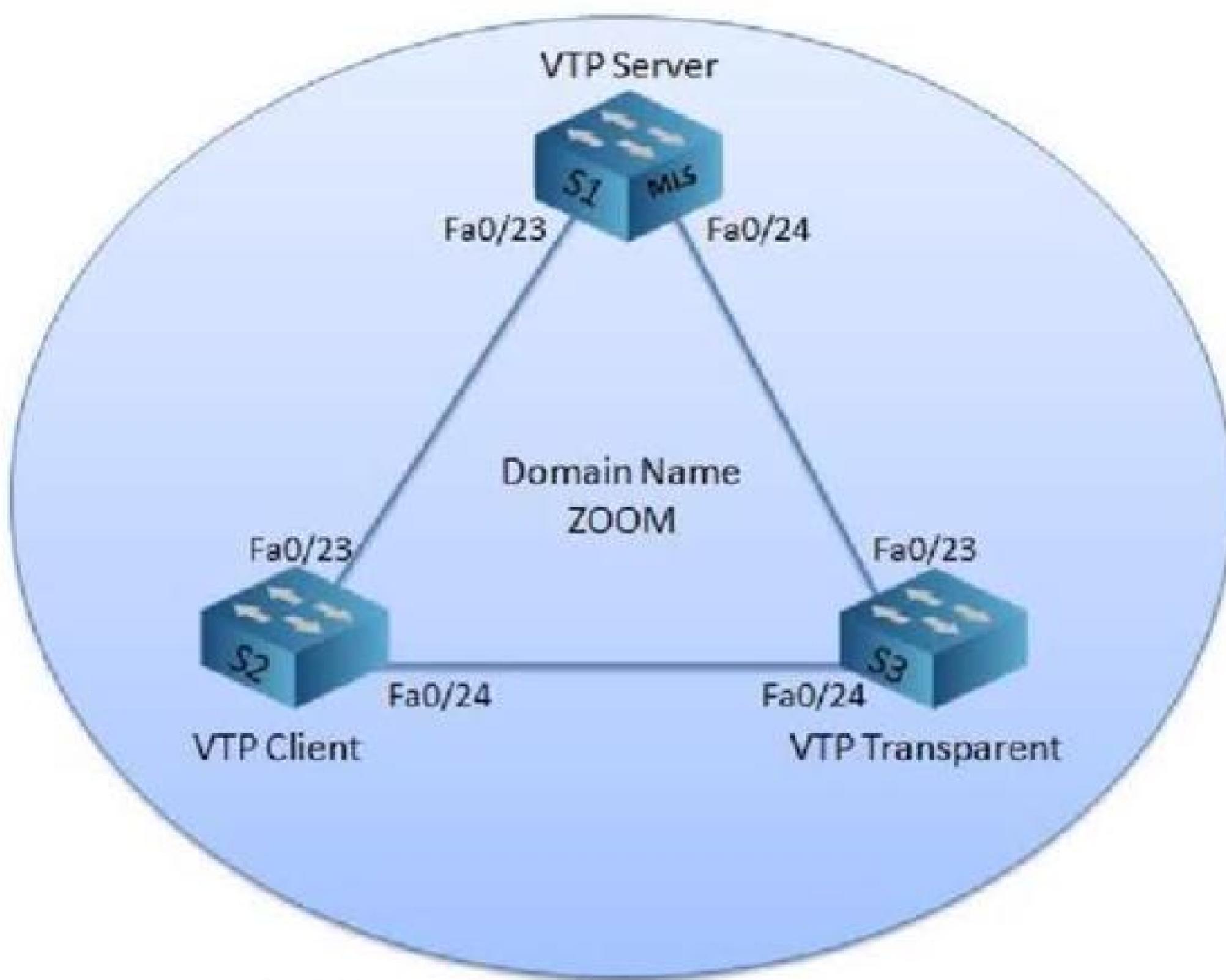
VLAN Name	Status	Ports
1 default	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/6, Fa0/7, Fa0/8 Fa0/9, Fa0/11, Fa0/13, Fa0/14 Fa0/16, Fa0/17, Fa0/18, Fa0/19 Fa0/20, Fa0/21, Fa0/22
10 ccna	active	Fa0/10
20 ccnp	active	Fa0/12
30 ccie	active	Fa0/15
1002 fddi-default	act/unsup	
1003 trcrf-default	act/unsup	
1004 fddinet-default	act/unsup	
1005 trbrf-default	act/unsup	

## LAB 3: VTP ADVANCED

### OBJECTIVE:

To configure VTP version 2 in all switches and avoid unnecessary flooding of VLAN traffic, on the trunk links

### TOPOLOGY:



### TASK:

- 1) Find out VTP version on all switches.
- 2) Enable VTP version 2 in all switches.
- 3) Configure VTP password as zoom in all switches.
- 4) Configure VTP in such a way that no unnecessary VLAN traffic is flooded on the trunk links.

### STEPS:

- 1) “Show vtp status” to verify the running VTP version in SW1, SW2, and SW3.

```
SW1#show vtp status
VTP Version : 2
Configuration Revision : 0
Maximum VLANs supported locally : 64
Number of existing VLANs : 8
VTP Operating Mode : Client
```

```
VTP Domain Name : zoom
VTP Pruning Mode : Enabled
VTP V2 Mode : Enabled
VTP Traps Generation : Disabled
MD5 digest : 0xE0 0x04 0x0D 0x7F 0x89 0xA0 0xC7 0xE8
Configuration last modified by 192.168.0.13 at 3-1-93 03:40:15
```

**NOTE:** VTP version 2 is currently running in SW1, SW2 and SW3.

- 2) Configure VTP password "zoom" in SW1, SW2 and SW3.

```
SW1(config)#vtp password zoom
SW2(config)#vtp password zoom
SW3(config)#vtp password zoom
```

- 3) Configure VTP in such a way that no unnecessary VLAN traffic flooded on the trunk links.

```
SW1 (config)# vtp pruning
```

#### **VERIFICATION:**

In SW1, SW2 and SW3, use commands "show vtp password and show vtp status' and verify.

```
SW1#show vtp password
```

```
VTP Password: zoom
```

```
SW1#show vtp status
```

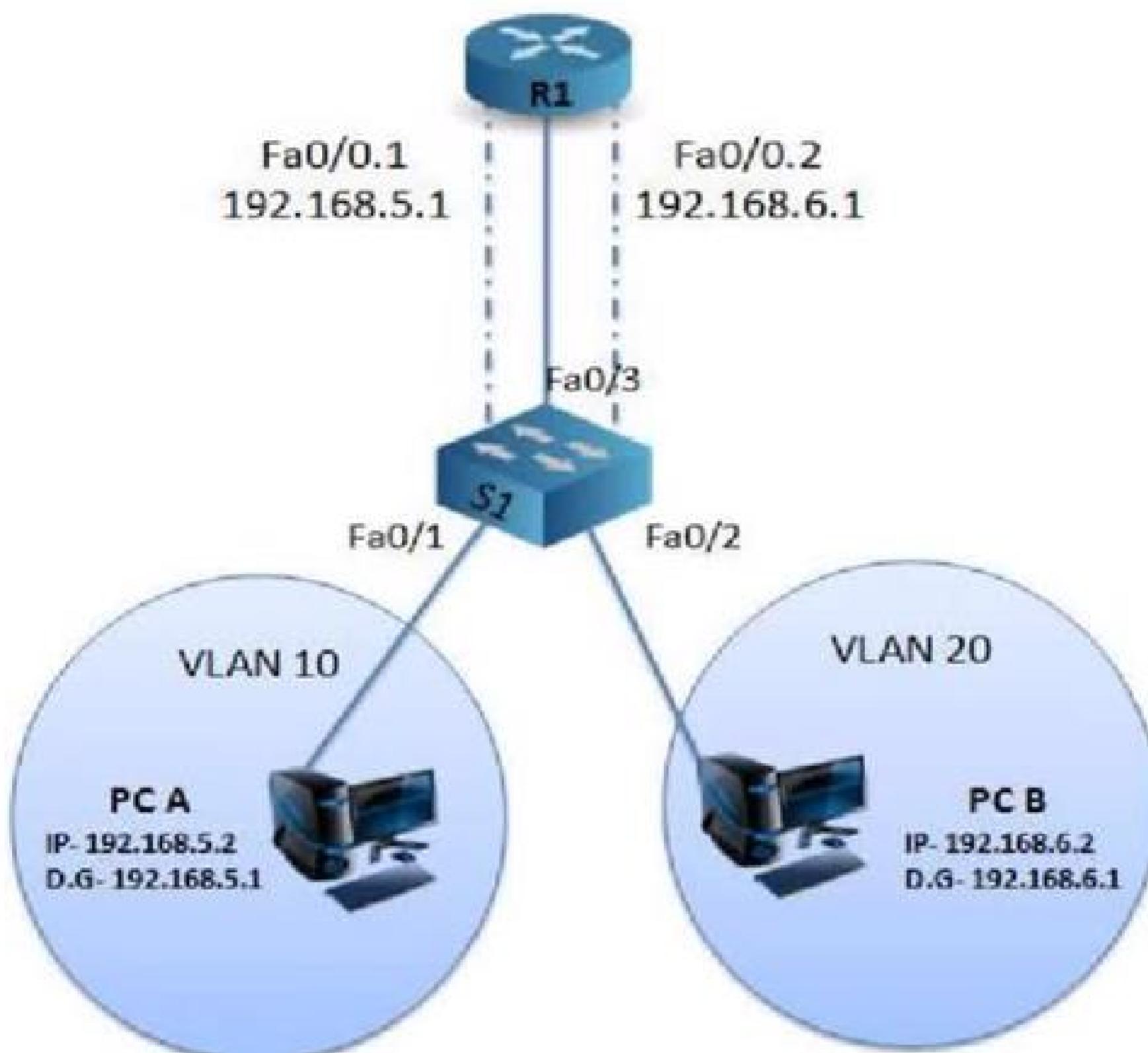
```
VTP Version : running VTP2
Configuration Revision : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs : 8
VTP Operating Mode : Server
VTP Domain Name : zoom
VTP Pruning Mode : Enabled
VTP V2 Mode : Enabled
VTP Traps Generation : Disabled
MD5 digest : 0x58 0x39 0xD9 0x7C 0xA4 0x9A 0x24 0x13
Configuration last modified by 192.168.0.13 at 3-1-93 03:40:15
Local updater ID is 192.168.0.11 on interface VI1 (lowest numbered VLAN interface found)
```

## LAB 4: INTER VLAN ROUTING- Router on a stick

### OBJECTIVE:

To configure inter VLAN routing , by setting up a router with sub interfaces for each VLAN

### TOPOLOGY:



### TASK:

- 1) Create VLANs and assign VLANs to the Interfaces
- 2) Configure the switch port connected to the router as a trunk port
- 3) Create Sub interfaces on the router – one sub interface for each VLAN
- 4) Verify that inter VLAN communication is possible.

### STEPS:

- 1) Create VLANs and assign VLANs to the Interfaces

```

Switch(config)# VLAN 10
Switch(config-VLAN)# name IT
Switch(config-VLAN)#exit
Switch(config)# VLAN 20
Switch(config-VLAN)# name Sales
Switch(config-VLAN)#exit
  
```

```
Switch(config)# interface fastethernet 0/1
Switch(config-if)#switchport mode access
Switch(config)#switchport access VLAN 10
Switch(config)# interface fastethernet 0/2
Switch(config-if)#switchport mode access
Switch(config)#switchport access VLAN20
```

- 2) Configure the switch port connected to router as a trunk port

```
Switch(config)# interface fastethernet 0/3
Switch(config-if)# switchport mode trunk
```

- 3) Create Sub interfaces on the router – one subinterface for each VLAN

```
Router(config)# interface fastethernet 0/0.1
Router(config-if)# encapsulation dot1q 10
Router(config-if)# ip address 192.168.5.1 255.255.255.0
Router(config-if)#exit
Router(config)# interface fastethernet 0/0.2
Router(config-if)# encapsulation dot1q 20
Router(config-if)# ip address 192.168.6.1 255.255.255.0
Router(config-if)#exit
```

#### VERIFICATION:

##### Without configuring Inter vlan routing

```
PCA>ping 192.168.6.2
Pinging 192.168.6.2 with 32 bytes of data:
```

```
Request timed out.
Request timed out.
Request timed out.
Request timed out.
```

```
Ping statistics for 192.168.6.2:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
PCB>ping 192.168.5.2
```

```
Pinging 192.168.6.2 with 32 bytes of data:
```

```
Request timed out.
Request timed out.
Request timed out.
Request timed out.
```

```
Ping statistics for 192.168.5.2:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
After Configuring Inter Vlan routing
PCA>ping 192.168.6.2
```

```
Pinging 192.168.6.2 with 32 bytes of data:
```

Request timed out.

Reply from 192.168.6.2: bytes=32 time=0ms TTL=127

Reply from 192.168.6.2: bytes=32 time=10ms TTL=127

Reply from 192.168.6.2: bytes=32 time=11ms TTL=127

Ping statistics for 192.168.6.2:

packets: Sent = 4, Received = 3, Lost = 1 (25% loss),

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 11ms, Average = 7ms

PCB>ping 192.168.5.2

Pinging 192.168.5.2 with 32 bytes of data:

Reply from 192.168.5.2: bytes=32 time=11ms TTL=127

Reply from 192.168.5.2: bytes=32 time=10ms TTL=127

Reply from 192.168.5.2: bytes=32 time=0ms TTL=127

Reply from 192.168.5.2: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.5.2:

packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 11ms, Average = 5ms

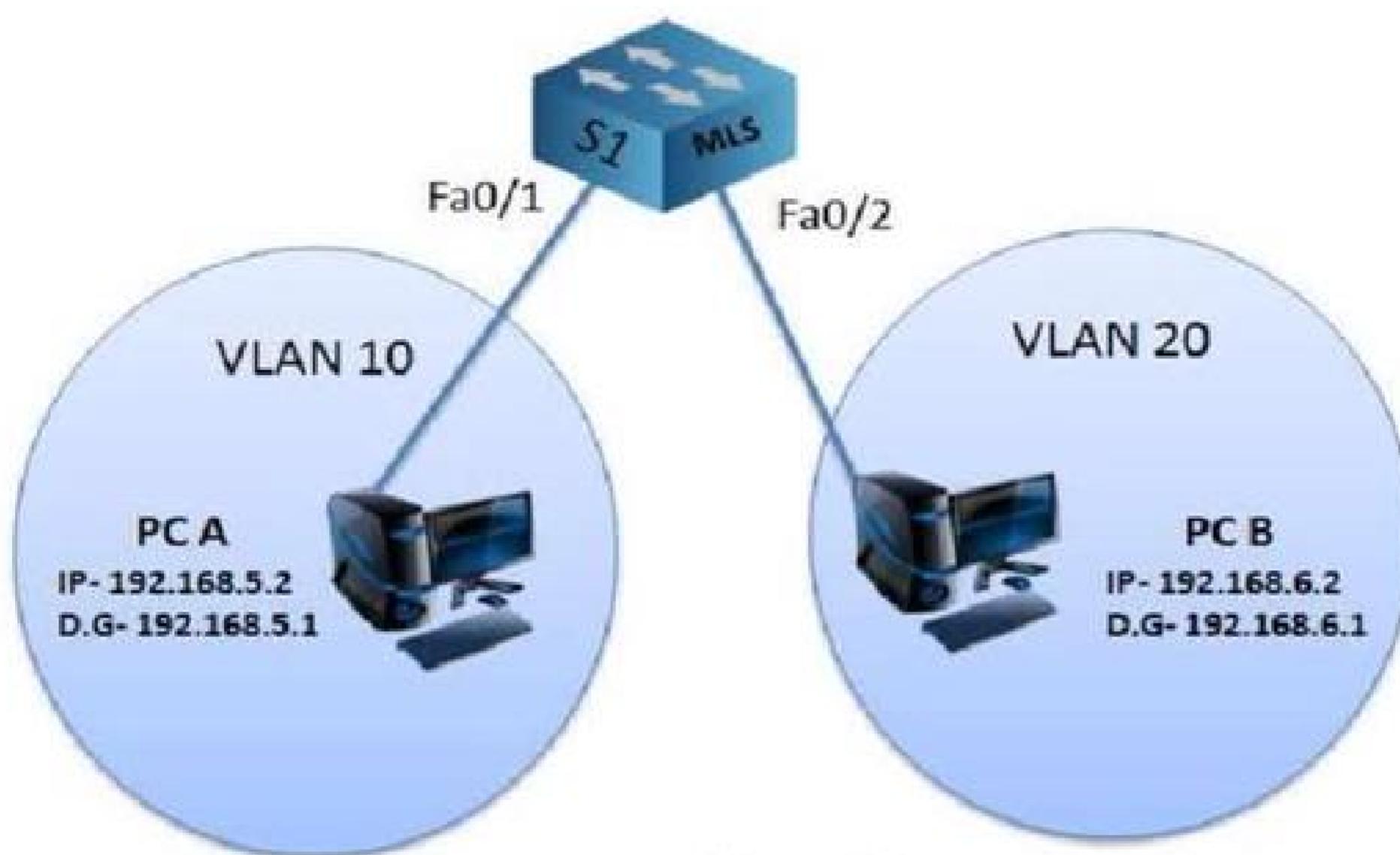
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## LAB 5: INTER VLAN ROUTING USING MLS (multi layer switch)

### OBJECTIVE:

To configure Inter VLAN routing by using a multi layer switching (MLS)

### TOPOLOGY:



### TASK:

- 1) Create VLANs and assign VLANs to the Interfaces
- 2) Create SVI (switched virtual interface) on the MLS.
- 3) Verify that inter VLAN communication is happening

### STEPS:

- 1) Create VLANs and assign VLANs to the Interfaces as done in previous lab. Enable Routing in MLS

```
Switch(config)# ip routing
```

- 2) Create SVI (switched virtual interface )in MLS

```
Switch(config)# interface VLAN 10
Switch(config-VLAN)# ip address 192.168.5.1 255.255.255.0
Switch(config-VLAN)# no shutdown
Switch(config-VLAN)# exit
Switch(config)# interface VLAN 20
Switch(config-VLAN)# ip address 192.168.6.1 255.255.255.0
Switch(config-VLAN)# no shutdown
Switch(config-VLAN)# exit
```

**VERIFICATION:**

**Before Configuring Inter Vlan routing with MLS**

PCA >ping 192.168.6.2

Pinging 192.168.6.2 with 32 bytes of data:

Request timed out.  
Request timed out.  
Request timed out.  
Request timed out.

Ping statistics for 192.168.6.2:

packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

PCB>ping 192.168.5.2

Pinging 192.168.5.2 with 32 bytes of data:

Request timed out.  
Request timed out.  
Request timed out.  
Request timed out.

Ping statistics for 192.168.5.2:

packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

**After Configuring Inter Vlan routing with MLS**

PCA >ping 192.168.6.2

Pinging 192.168.6.2 with 32 bytes of data:

Reply from 192.168.6.2: bytes=32 time=13ms TTL=127  
Reply from 192.168.6.2: bytes=32 time=0ms TTL=127  
Reply from 192.168.6.2: bytes=32 time=0ms TTL=127  
Reply from 192.168.6.2: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.6.2:

packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 13ms, Average = 3ms

PCB>ping 192.168.5.2

Pinging 192.168.5.2 with 32 bytes of data:

Reply from 192.168.5.2: bytes=32 time=1ms TTL=127  
Reply from 192.168.5.2: bytes=32 time=0ms TTL=127  
Reply from 192.168.5.2: bytes=32 time=0ms TTL=127  
Reply from 192.168.5.2: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.5.2:

packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
Approximate round trip times in milli-seconds:  
Minimum = 0ms, Maximum = 1ms, Average = 0ms

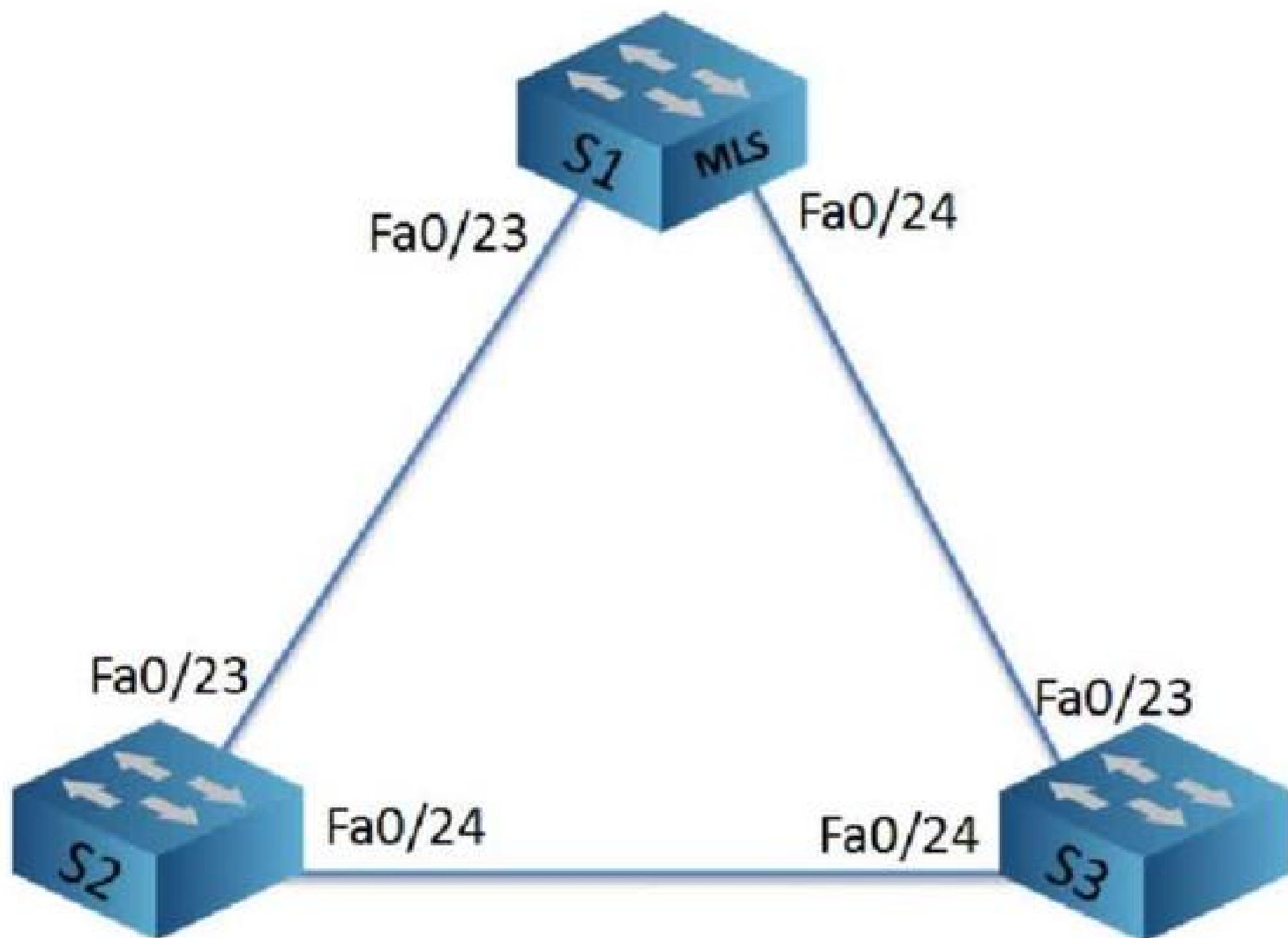
Zoom Technologies

## LAB 6: BASIC SPANNING TREE

### OBJECTIVE:

To verify STP behavior in a switched network.

### TOPOLOGY:



### TASK:

- 1) Find Out the MAC address of the switch
- 2) Observe STP behavior by doing the following :
- 3) Find Out Root Switch / Non Root Switch
- 4) Find Out Root Port, Designated Port and Non Designated Port

### STEPS:

- 1) Find out the MAC address of the switch by using this command in all switches.

**Switch# show version**

```

Cisco IOS Software, C3560 Software (C3560-ADVIPSERVICESK9-M), Version 12.2(46)SE
, RELEASE SOFTWARE (fc2)
Copyright (c) 1986-2008 by Cisco Systems, Inc.
  
```

SWITCH uptime is 4 hours, 40 minutes  
 System returned to ROM by power-on  
 System image file is "flash:/c3560-advpervicesk9-mz.122-46.SE.bin"  
 The password-recovery mechanism is enabled.

```
<output omitted>
512K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address : 00:1A:E3:EE:F4:80
Motherboard assembly number : 73-9897-06
Power supply part number : 341-0097-02
Motherboard serial number : CAT110850X4
Power supply serial number : AZS110410X2
Model revision number : D0
Motherboard revision number : A0
Model number : WS-C3560-24TS-S
System serial number : CAT1108ZJ2K
Top Assembly Part Number : 800-26160-02
Top Assembly Revision Number : C0
Version ID : V02
CLEI Code Number : COMMG00ARB
Hardware Board Revision Number : 0x01
<output omitted>
```

- 2) Find out the Interfaces that are connected to other switches and make those ports as trunks in all switches.

```
SW(config)#interface range fastethernet 0/23 – 24
SW(config)#switchport mode trunk
```

#### **VERIFICATION:**

**Verify the spanning tree on all the switches**

**Find out which switch is the root switch**

```
SW1#sh spanning-tree
VLAN0001
Spanning tree enabled protocol ieee
Root ID Priority : 32769
Address : 000c.8577.1340
Cost : 19
Port : 26 (FastEthernet0/24)
Hello Time : 2 sec
Max Age : 20 sec
Forward Delay : 15 sec
Bridge ID Priority : 32769 (priority 32768 sys-id-ext 1)
Address : 001a.e3ee.f480
Hello Time : 2 sec
Max Age : 20 sec
Forward Delay : 15 sec
Aging Time : 300
```

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/1	Desg	FWD	19	128.3	P2p
Fa0/2	Desg	FWD	19	128.4	P2p

Fa0/3	Desg	FWD 19	128.5	P2p
Fa0/8	Desg	FWD 100	128.10	Shr
Fa0/9	Desg	FWD 19	128.11	P2p
Fa0/11	Desg	FWD 19	128.13	P2p
Fa0/13	Desg	FWD 19	128.15	P2p
Fa0/23	Altn	BLK 19	128.25	P2p
Fa0/24	Root	FWD 19	128.26	P2p

**SW2#show spanning-tree**

VLAN0001

Spanning tree enabled protocol ieee  
 Root ID Priority : 32769  
 Address : 000c.8577.1340  
 Cost : 19  
 Port : 22 (FastEthernet0/22)  
 Hello Time : 2 sec  
 Max Age : 20 sec  
 Forward Delay : 15 sec  
 Bridge ID Priority : 32769 (priority 32768 sys-id-ext 1)  
 Address : 000d.bce0.ec00  
 Aging Time : 300

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/23	Desg	FWD	19	128.21	P2p
Fa0/24	Root	FWD	19	128.22	P2p

**SW3#show spanning-tree**

VLAN0001

Spanning tree enabled protocol ieee  
 Root ID Priority : 32769  
 Address : 000c.8577.1340  
**This bridge is the root**  
 Hello Time : 2 sec  
 Max Age : 20 sec  
 Forward Delay : 15 sec  
 Bridge ID Priority : 32769 (priority 32768 sys-id-ext 1)  
 Address : 000c.8577.1340  
 Aging Time : 300

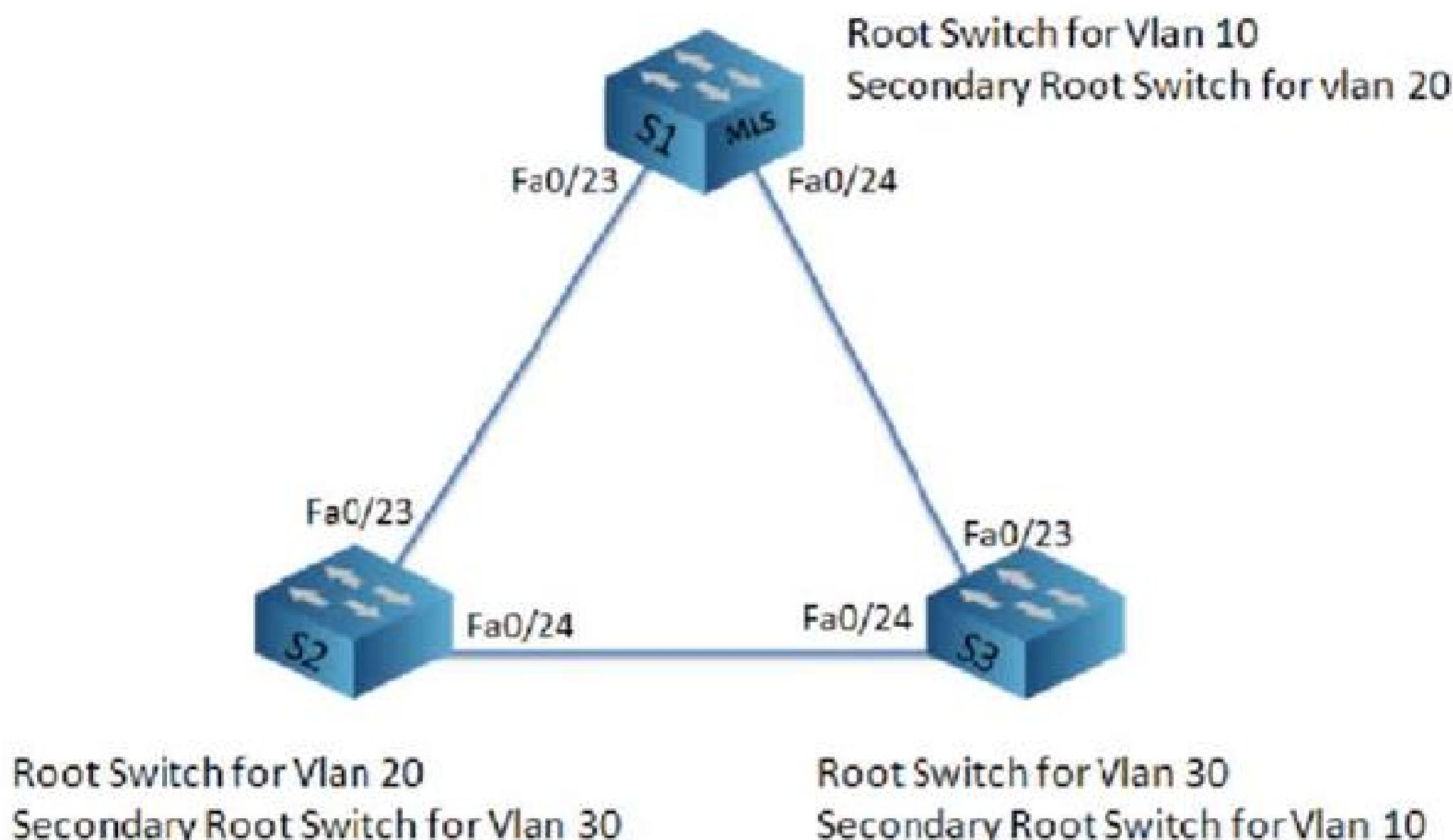
Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/23	Desg	FWD	19	128.21	P2p
Fa0/24	Desg	FWD	19	128.24	P2p

## LAB 7: PVST (Per VLAN Spanning Tree)

### OBJECTIVE:

To configure and observe the behavior of PVST in a switched network

### TOPOLOGY:



### TASK:

- 1) Find Out the MAC address of the switch
- 2) Make SW1 as Root Switch for VLAN 10 and backup Root Switch for VLAN 30
- 3) Make SW2 as Root switch for VLAN 20 and backup Root Switch for VLAN 10
- 4) Make SW3 as Root Switch for VLAN 30 and backup Root switch for VLAN 20
- 5) Find Out Root Port, Designated Port and Non Designated Port

### STEPS:

- 1) Create VLANs in all the switches

```
SW1(config)# VLAN 10
SW1(config-VLAN)#name CCNA
SW1(config)# VLAN 20
SW1(config-VLAN)#name CCNP
SW1(config)# VLAN 30
SW1(config-VLAN)#name CCIE
SW2(config)# VLAN 10
```

```

SW2(config-VLAN)#name CCNA
SW2(config)# VLAN 20
SW2(config-VLAN)#name CCNP
SW2(config)# VLAN 30
SW2(config-VLAN)#name CCIE
SW3(config)# VLAN 10
SW3(config-VLAN)#name CCNA
SW3(config)# VLAN 20
SW3(config-VLAN)#name CCNP
SW3(config)# VLAN 30
SW3(config-VLAN)#name CCIE

```

- 2) Enable PVST in all switches.

```
SW1,SW2,SW3(conf)# spanning-tree mode pvst
```

- 3) Make SW1 as Root Switch for VLAN 10 and backup Root Switch for VLAN 30

```

SW1(config)#spanning-tree VLAN 10 root primary
SW1(config)#spanning-tree VLAN 30 root secondary

```

- 4) Make the SW2 as root switch for VLAN 20 secondary root switch for VLAN 10.

```

SW2(config)#spanning-tree VLAN 20 root primary
SW2(config)#spanning-tree VLAN 10 root secondary

```

- 5) Make SW3 as Root Switch for VLAN 30 and backup Root switch for VLAN 20

```

SW3(config)#spanning-tree VLAN 30 root primary
SW3(config)#spanning-tree VLAN 20 root secondary

```

#### VERIFICATION:

```
SW1#show spanning-tree
```

In SW2 and SW3 also verify with "show spanning-tree" command.

```

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID  Priority  32769
            Address  000c.8577.1340
            Cost       38
            Port      23 (FastEthernet0/21)
            Hello Time 2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID Priority  32769 (priority 32768 sys-id-ext 1)
            Address  001a.e3ee.f480
            Hello Time 2 sec  Max Age 20 sec  Forward Delay 15 sec
            Aging Time 15

```

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/7	Desg	FWD	19	128.9	P2p
Fa0/11	Desg	FWD	19	128.13	P2p
Fa0/12	Desg	FWD	19	128.14	P2p

Fa0/23	Desg FWD 19	128.15	P2p
Fa0/24	Root FWD 19	128.23	P2p

#### VLAN0010

Spanning tree enabled protocol ieee

Root ID Priority 24586

Address 001a.e3ee.f480

This bridge is the root

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 24586 (priority 24576 sys-id-ext 10)

Address 001a.e3ee.f480

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Aging Time 15

Interface	Role	Sts	Cost	Prio.Nbr	Type
-----------	------	-----	------	----------	------

Fa0/23	Desg	FWD	19	128.23	P2p
Fa0/24	Desg	FWD	19	128.26	P2p

#### VLAN0020

Spanning tree enabled protocol ieee

Root ID Priority 24596

Address 000d.bce0.ec00

Cost 19

Port 23 (FastEthernet0/21)

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 28692 (priority 28672 sys-id-ext 20)

Address 001a.e3ee.f480

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Aging Time 15

Interface	Role	Sts	Cost	Prio.Nbr	Type
-----------	------	-----	------	----------	------

Fa0/23	Root	FWD	19	128.23	P2p
Fa0/24	Desg	FWD	19	128.26	P2p

#### VLAN0030

Spanning tree enabled protocol ieee

Root ID Priority 24606

Address 000c.8577.1340

Cost 38

Port 23 (FastEthernet0/21)

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 32798 (priority 32768 sys-id-ext 30)

Address 001a.e3ee.f480

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Aging Time 15

Interface	Role	Sts	Cost	Prio.Nbr	Type
-----------	------	-----	------	----------	------

```
Fa0/23      Altn BLK 19 128.23    P2p
Fa0/24      Root FWD 19 128.26    P2p
```

**SW2#show spanning-tree vlan 20**

VLAN0020

Spanning tree enabled protocol ieee
Root ID Priority 24596
Address 000d.bce0.ec00

This bridge is the root

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 24596 (priority 24576 sys-id-ext 20)

Address 000d.bce0.ec00

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Aging Time 300

Interface Role Sts Cost Prio.Nbr Type

```
-----  
Fa0/23      Desg FWD 19    128.23  P2p
Fa0/24      Desg FWD 19    128.24  P2p
```

**SW3#show spanning-tree vlan 30**

VLAN0030

Spanning tree enabled protocol ieee
Root ID Priority 24606
Address 000c.8577.1340

This bridge is the root

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 24606 (priority 24576 sys-id-ext 30)

Address 000c.8577.1340

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Aging Time 300

Interface Role Sts Cost Prio.Nbr Type

```
-----  
Fa0/22      Desg FWD 19    128.22  P2p
Fa0/24      Desg FWD 19    128.24  P2p
```

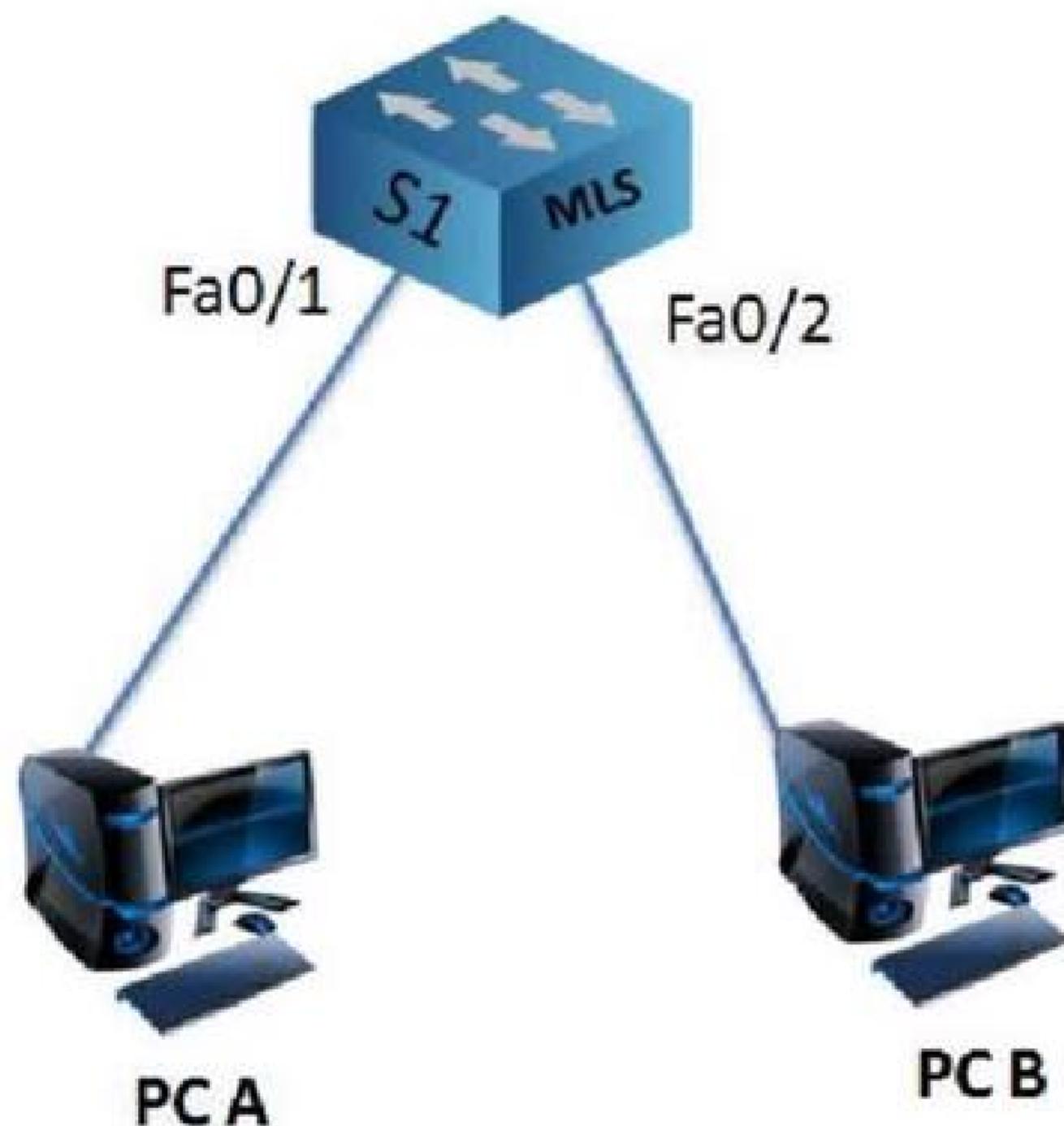
## LAB 8: SPANNING TREE PORTFAST

### OBJECTIVE:

To configure Port Fast , to enable ports to transition immediately to the forwarding state in STP , without going through the listening and learning states

NOTE: It is recommended to configure Port Fast only on ports which are directly connected to a single workstation.

### TOPOLOGY:



### TASK:

- 1) Configure the ports that are connected to PC on switch as Port Fast ports.
- 2) Verify that these ports immediately come to the forwarding state.

### STEPS:

- 1) Find out the ports which are connected to PC's on the switch by using the command

**SW# show mac-address-table dynamic**

Mac Address Table

VLAN	Mac Address	Type	Ports
1	000c.8577.1358	DYNAMIC	Fa0/24

```
1 000c.857d.2d09 DYNAMIC Fa0/13
1 000f.2411.70c0 DYNAMIC Fa0/2
1 000f.90bb.96c0 DYNAMIC Fa0/1
1 0011.928f.68e0 DYNAMIC Fa0/3
1 00d0.586c.23e0 DYNAMIC Fa0/8
1 0cd2.b516.b9dc DYNAMIC Fa0/13
1 3819.2ffa.dafe DYNAMIC Fa0/13
1 b0df.3a1f.a535 DYNAMIC Fa0/13
1 bcae.c5d8.9be7 DYNAMIC Fa0/13
```

Total Mac Addresses for this criterion: 10

- 2) Make those ports as Port Fast ports.

```
Switch (config)# interface range fastethernet 0/1-2
```

```
Switch(Config-if)# spanning-tree portfast
```

#### VERIFICATION:

```
SW1#sh spanning-tree int fa0/2 detail
```

Port 10 (FastEthernet0/8) of VLAN0001 is designated forwarding

Port path cost 100, Port priority 128, Port Identifier 128.10.

Designated root has priority 32769, address 000c.8577.1340

Designated bridge has priority 32769, address 001a.e3ee.f480

Designated port id is 128.10, designated path cost 19

Timers: message age 0, forward delay 0, hold 0

Number of transitions to forwarding state: 1

The port is in the portfast mode

Link type is shared by default

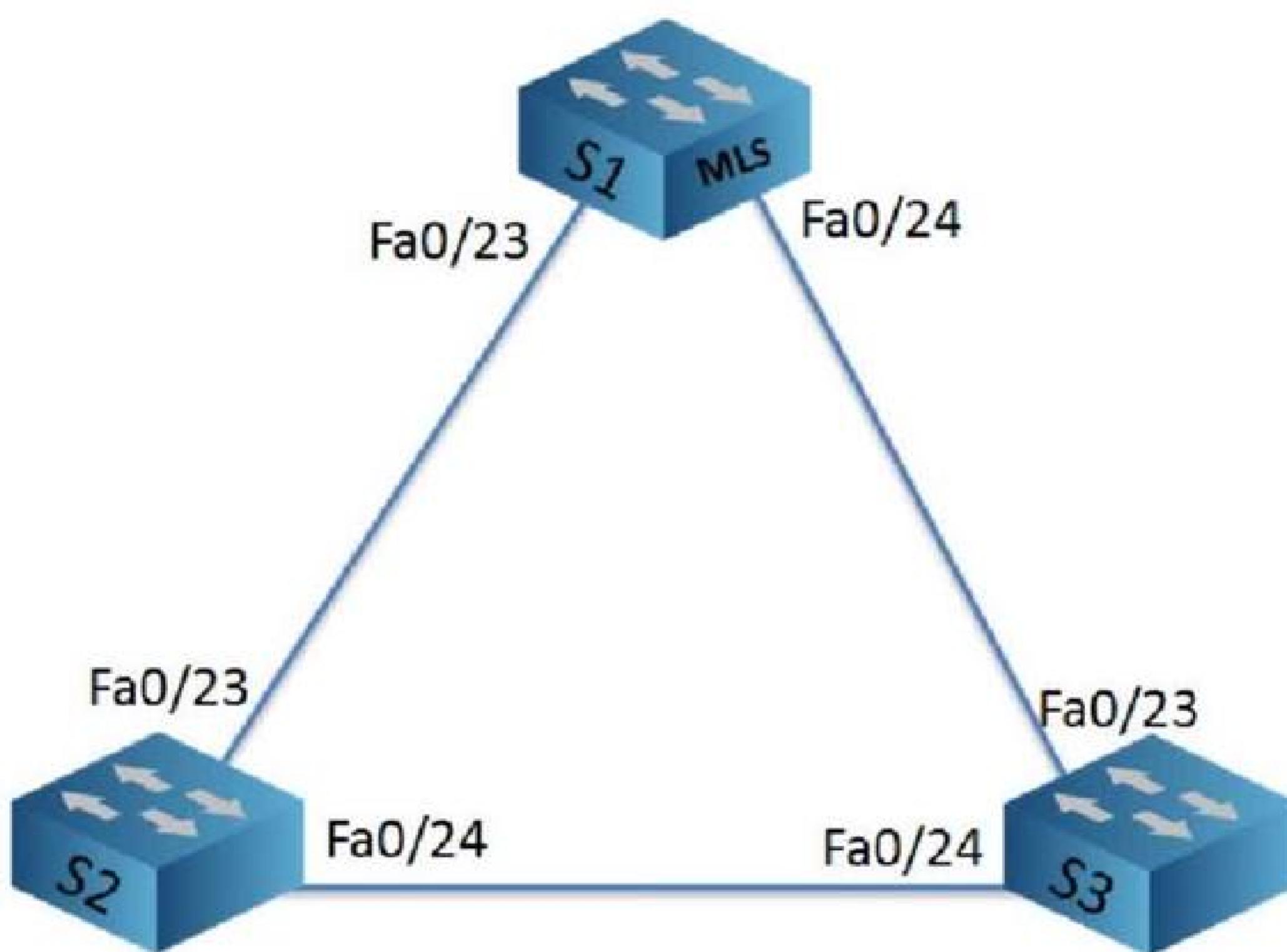
BPDUs sent 4012, received 0

## LAB 9: STP UPLINKFAST

### OBJECTIVE:

To configure Uplink Fast to provide fast convergence in case of a link failure

### TOPOLOGY:



### TASK:

- 1) Configure Uplink fast on the switch that is having non designated port
- 2) Verify that the port immediately goes to forwarding state in the event of a link failure.

### STEPS:

- 1) Find out the switch which has blocked port and configure the switch as Uplink fast.

**Switch1# show spanning-tree summary**

```

VLAN0001
Spanning tree enabled protocol ieee
Root ID  Priority  32769
          Address  000c.8577.1340
          Cost      19
          Port     26 (FastEthernet0/24)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Bridge ID Priority  32769 (priority 32768 sys-id-ext 1)
          Address  001a.e3ee.f480
          Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
  
```

Aging Time 300					
Interface	Role	Sts	Cost	Prio.	Nbr Type
Fa0/1	Desg	FWD	19	128.3	P2p Edge
Fa0/2	Desg	FWD	19	128.4	P2p Edge
Fa0/3	Desg	FWD	19	128.5	P2p
Fa0/8	Desg	FWD	100	128.10	Shr
Fa0/13	Desg	FWD	19	128.15	P2p
Fa0/23	Altn	BLK	19	128.25	P2p
Fa0/24	Root	FWD	19	128.26	P2p

- 2) Configure Uplink Fast

**Switch(config)# spanning-tree uplinkfast**

#### **VERIFICATION:**

**Before Configuring Uplinkfast**

**Shutdown the root port of the switch and try to ping switch IP Address**

Pinging 192.168.0.11 with 32 bytes of data:

```
Reply from 192.168.0.11: bytes=32 time=4ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=4ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Request timed out.
Reply from 192.168.0.11: bytes=32 time=1027ms TTL=255
Reply from 192.168.0.11: bytes=32 time=13ms TTL=255
Reply from 192.168.0.11: bytes=32 time=5ms TTL=255
Reply from 192.168.0.11: bytes=32 time=2ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
```

**After Configuring Uplinkfast**

**Shutdown the root port of the switch and try to ping switch IP Address**

Pinging 192.168.0.11 with 32 bytes of data:

```
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
```

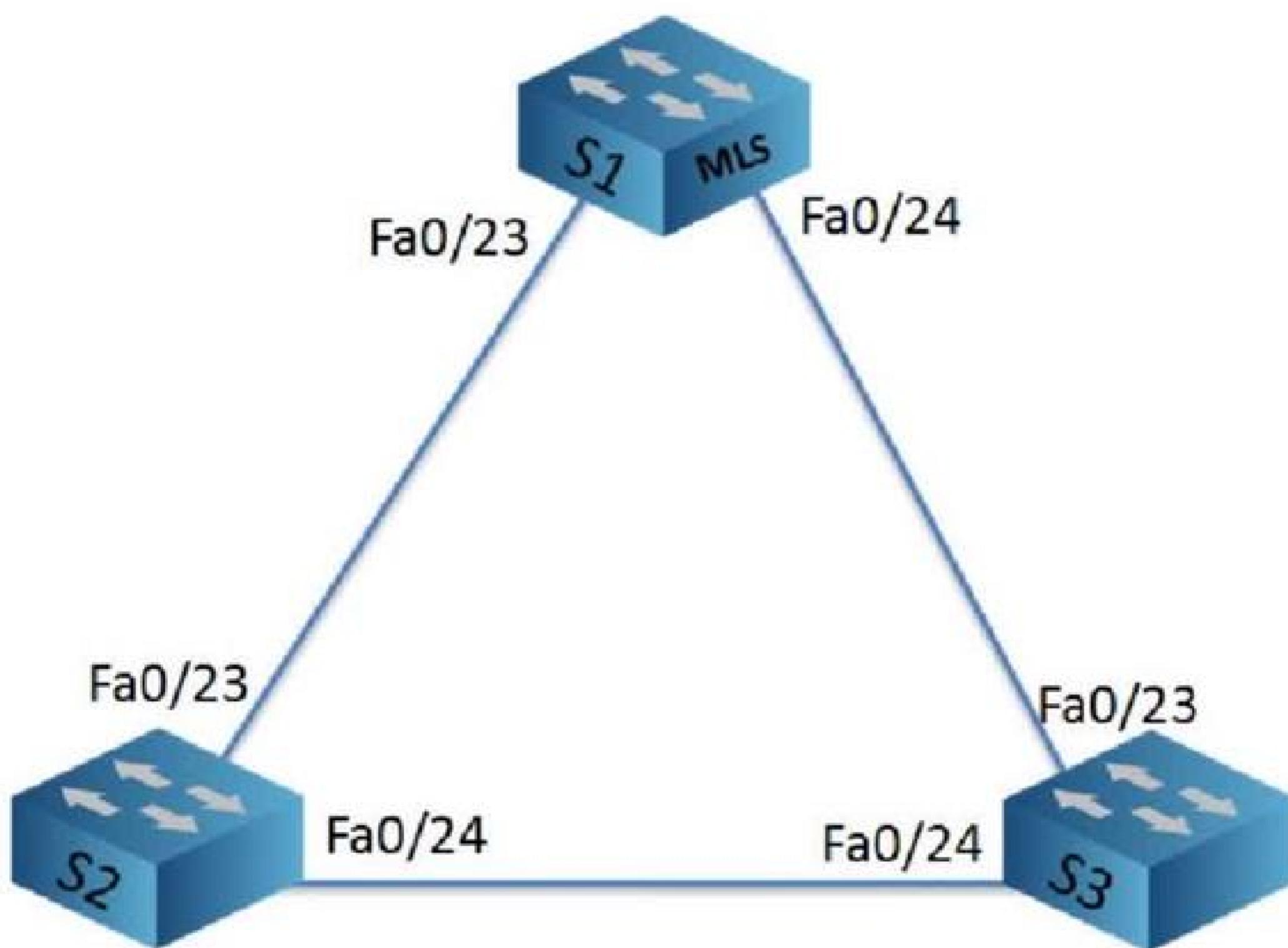
```
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Request timed out.
Reply from 192.168.0.11: bytes=32 time=2ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
Reply from 192.168.0.11: bytes=32 time=1ms TTL=255
SW1#sh spanning-tree summary
Switch is in pvst mode
Root bridge for: none
Ether Channel misconfig guard is : enabled
Extended system ID is : enabled
Portfast Default is : disabled
PortFast BPDU Guard Default is : disabled
Portfast BPDU Filter Default is : disabled
Loopguard Default is : disabled
UplinkFast : enabled
BackboneFast is : disabled
Pathcost method used is : short
Uplink Fast statistics:
Number of transitions via uplinkFast (all VLANs) : 0
Number of proxy multicast addresses transmitted (all VLANs) : 0
```

## LAB 10: STP BACKBONEFAST

### OBJECTIVE:

To configure Backbone Fast for fast convergence of STP in the event of a link failure in a switched network

### TOPOLOGY:



### TASK:

- 1) Configure backbone fast on all the switches
- 2) Observe STP convergence when a link fails ( disconnect one of the cables between the switches)

### STEPS:

- 1) Configure Backbone fast on all the switches  
**Switch(config)# spanning-tree backbonefast**

### VERIFICATION:

```
SW1# show spanning-tree summary
```

Switch is in pvst mode

Root bridge for: VLAN0001, VLAN0010, VLAN0020, VLAN0030  
Extended system ID is enabled

Portfast Default	is disabled
PortFast BPDU Guard Default	is disabled
Portfast BPDU Filter Default	is disabled
Loopguard Default	is disabled
EtherChannel misconfig guard	is enabled
UplinkFast	is disabled
<b>BackboneFast</b>	<b>is enabled</b>
Configured Pathcost method used is short	
BackboneFast statistics	
Number of transition via backboneFast (all VLANs)	: 0
Number of inferior BPDUs received (all VLANs)	: 0
Number of RLQ request PDUs received (all VLANs)	: 0
Number of RLQ response PDUs received (all VLANs)	: 0
Number of RLQ request PDUs sent (all VLANs)	: 0
Number of RLQ response PDUs sent (all VLANs)	: 0

#### **SW2# show spanning-tree summary**

Switch is in pvst mode	
Root bridge for: none	
EtherChannel misconfig guard	is enabled
Extended system ID	is enabled
Portfast Default	is disabled
PortFast BPDU Guard Default	is disabled
Portfast BPDU Filter Default	is disabled
Loopguard Default	is disabled
UplinkFast	is enabled
<b>BackboneFast</b>	<b>is enabled</b>
Pathcost method used	is short

Station update rate set to 150 packets/sec.

UplinkFast statistics	
Number of transitions via uplinkFast (all VLANs)	: 0
Number of proxy multicast addresses transmitted (all VLANs)	: 0
BackboneFast statistics	
Number of transition via backboneFast (all VLANs)	: 0
Number of inferior BPDUs received (all VLANs)	: 0
Number of RLQ request PDUs received (all VLANs)	: 0
Number of RLQ response PDUs received (all VLANs)	: 0
Number of RLQ request PDUs sent (all VLANs)	: 0
Number of RLQ response PDUs sent (all VLANs)	: 0

#### **SW3#sh spanning-tree summary**

Switch is in pvst mode	
Root bridge for: none	
EtherChannel misconfig guard	is enabled
Extended system ID	is enabled
Portfast Default	is disabled
PortFast BPDU Guard Default	is disabled
Portfast BPDU Filter Default	is disabled
Loopguard Default	is disabled

UplinkFast	is disabled
BackboneFast	is enabled
Pathcost method used	is short
BackboneFast statistics	
Number of transition via backboneFast (all VLANs)	: 0
Number of inferior BPDUs received (all VLANs)	: 0
Number of RLQ request PDUs received (all VLANs)	: 0
Number of RLQ response PDUs received (all VLANs)	: 0
Number of RLQ request PDUs sent (all VLANs)	: 0
Number of RLQ response PDUs sent (all VLANs)	: 0

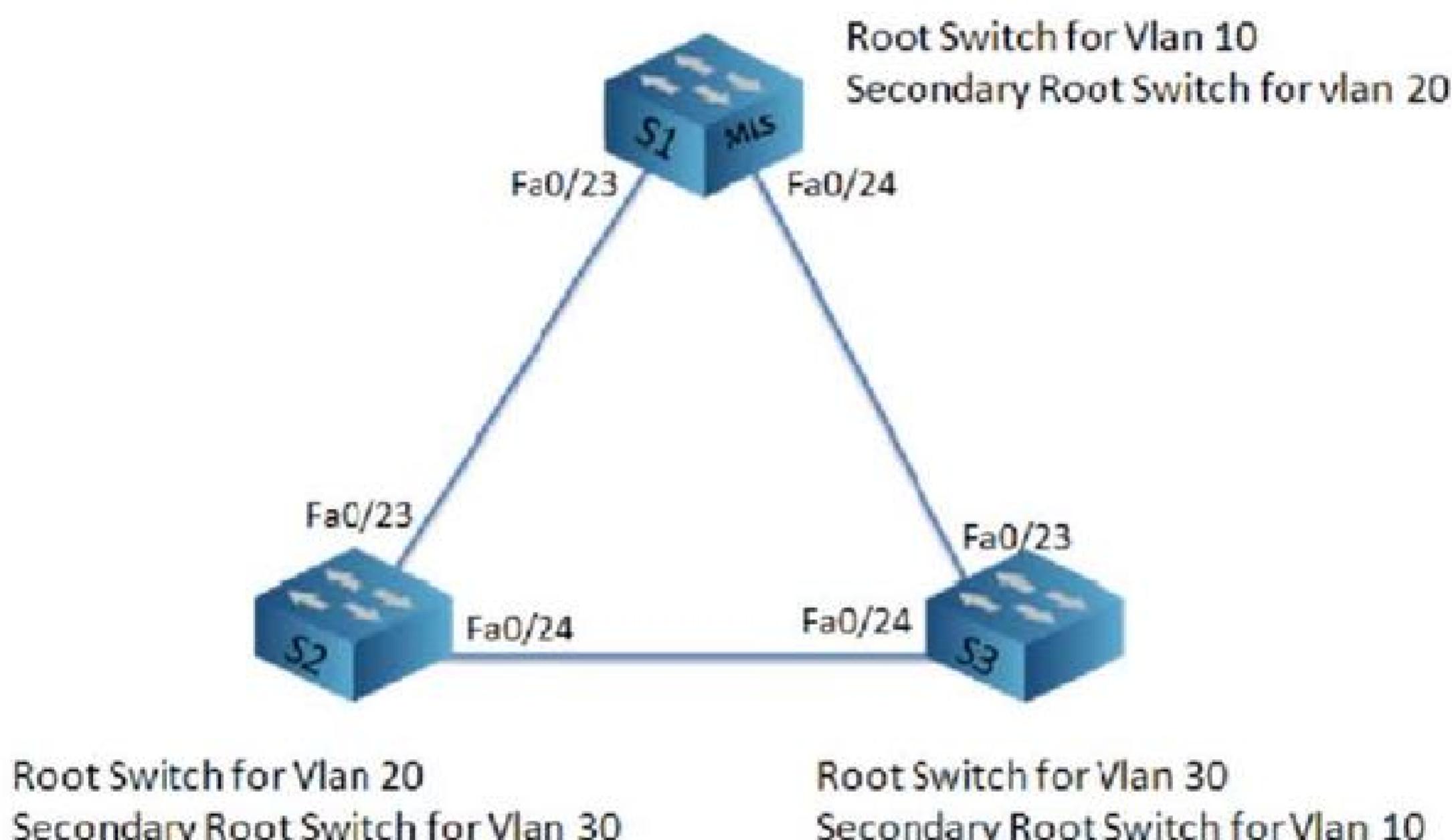
**Note:** Verify the output by shutting down indirectly connected link i.e. any link that is not directly connected to the switch with the blocked port, and note that blocked state immediately comes up. This can be tested by keeping a ping on between two machines on two different PCs.

## LAB 11: RAPID PVST

### OBJECTIVE:

To configure Rapid PVST and observe its behavior

### TOPOLOGY:



### TASK:

- 1) Find Out the MAC address of the switch
- 2) Enable Rapid PVST in all switches
- 3) Make SW1 as Root Switch for VLAN 10 and backup Root Switch for VLAN 30
- 4) Make SW2 as Root switch for VLAN 20 and backup Root Switch for VLAN 10
- 5) Make SW3 as Root Switch for VLAN 30 and backup Root switch for VLAN 20
- 6) Find Out Root Port, Designated Port and Non Designated Port

### STEPS:

- 1) Create VLANs in all the switches

```
SW1(config)# VLAN 10
SW1(config-VLAN)#name CCNA
SW1(config)# VLAN 20
SW1(config-VLAN)#name CCNP
SW1(config)# VLAN 30
```

```

SW1(config-VLAN)#name CCIE
SW2(config)# VLAN 10
SW2(config-VLAN)#name CCNA
SW2(config)# VLAN 20
SW2(config-VLAN)#name CCNP
SW2(config)# VLAN 30
SW2(config-VLAN)#name CCIE
SW3(config)# VLAN 10
SW3(config-VLAN)#name CCNA
SW3(config)# VLAN 20
SW3(config-VLAN)#name CCNP
SW3(config)# VLAN 30
SW3(config-VLAN)#name CCIE

```

- 2) Enable Rapid PVST in all switches.

```
SW1,SW2,SW3(conf)# spanning-tree mode rapid-pvst
```

- 3) Make SW1 as Root Switch for VLAN 10 and backup Root Switch for VLAN 30

```

SW1(config)#spanning-tree VLAN 10 root primary
SW1(config)#spanning-tree VLAN 30 root secondary

```

- 4) Make the SW2 as root switch for VLAN 20 secondary root switch for VLAN 10.

```

SW2(config)#spanning-tree VLAN 20 root primary
SW2(config)#spanning-tree VLAN 10 root secondary

```

- 5) Make SW3 as Root Switch for VLAN 30 and backup Root switch for VLAN 20

```

SW3(config)#spanning-tree VLAN 30 root primary
SW3(config)#spanning-tree VLAN 20 root secondary

```

#### VERIFICATION:

```
SW1#sh spanning-tree
```

```
VLAN0001
```

```

Spanning tree enabled protocol rstp
Root ID Priority 24577
    Address 001a.e3ee.f480
This bridge is the root
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

```

```

Bridge ID Priority 24577 (priority 24576 sys-id-ext 1)
    Address 001a.e3ee.f480
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300

```

Interface	Role Sts	Cost	Prio.Nbr	Type
Fa0/1	Desg FWD	19	128.3	P2p

Fa0/2	Desg FWD	19	128.4	P2p
Fa0/3	Desg FWD	19	128.5	P2p
Fa0/8	Desg FWD	100	128.10	Shr Edge
Fa0/9	Desg FWD	19	128.11	P2p Edge
Fa0/11	Desg FWD	19	128.13	P2p Edge
Fa0/13	Desg FWD	19	128.15	P2p Peer(STP)
Fa0/23	Desg FWD	19	128.25	P2p
Fa0/24	Desg FWD	19	128.26	P2p

### VLAN0010

Spanning tree enabled protocol rstp

Root ID Priority 24586

Address 001a.e3ee.f480

This bridge is the root

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 24586 (priority 24576 sys-id-ext 10)

Address 001a.e3ee.f480

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Aging Time 300

Interface	Role Sts	Cost	Prio.Nbr	Type
Fa0/1	Desg FWD	19	128.3	P2p
Fa0/13	Desg FWD	19	128.15	P2p
Fa0/23	Desg FWD	19	128.25	P2p
Fa0/24	Back BLK	19	128.26	P2p

### SW2#sh spanning-tree VLAN 20

#### VLAN0020

Spanning tree enabled protocol rstp

Root ID Priority 28692

Address 001a.e3ee.f480

This bridge is the root

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 28692 (priority 28672 sys-id-ext 20)

Address 001a.e3ee.f480

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Aging Time 300

Interface	Role Sts	Cost	Prio.Nbr	Type
Fa0/1	Desg FWD	19	128.3	P2p
Fa0/13	Desg FWD	19	128.15	P2p
Fa0/23	Desg FWD	19	128.25	P2p
Fa0/24	Back BLK	19	128.26	P2p

### SW1#sh spanning-tree VLAN 30

#### VLAN0030

Spanning tree enabled protocol rstp

Root ID Priority 28702

Address 001a.e3ee.f480

**This bridge is the root**

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 28702 (priority 28672 sys-id-ext 30)

Address 001a.e3ee.f480

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Aging Time 300

Interface	Role Sts	Cost	Prio.Nbr	Type
Fa0/1	Desg FWD	19	128.3	P2p
Fa0/13	Desg FWD	19	128.15	P2p
Fa0/23	Desg FWD	19	128.25	P2p
Fa0/24	Back BLK	19	128.26	P2p

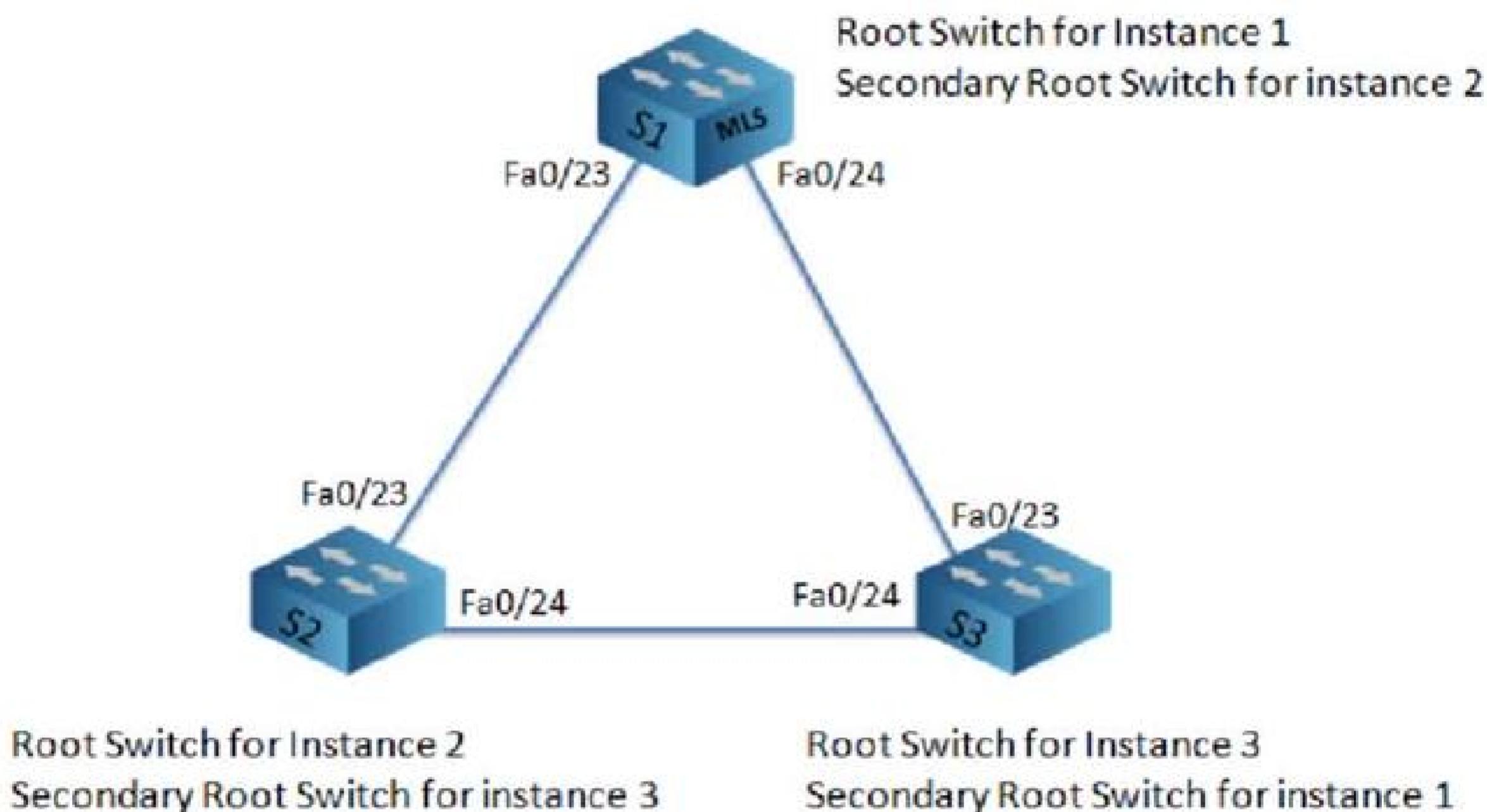
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## LAB 12: Multiple Spanning Tree MST

### OBJECTIVE:

To configure MST and observe its behavior in a switched network

### TOPOLOGY:



### TASK:

- 1) Enable MST in all switches
- 2) Configure MST instances as following in all the switches
  - MST instance 1 (VLAN 1-10)
  - MST instance 2 (VLAN 11-20)
  - MST instance 3 (VLAN 21-30)
- 3) Make SW1 as Root Switch for Instance 1 and backup Root Switch for Instance 2
- 4) Make SW2 as Root switch for Instance 2 and backup Root Switch for Instance 3
- 5) Make SW3 as Root Switch for Instance 3 and backup Root switch for Instance 1
- 6) Find Out Root Port, Designated Port and Non Designated Port

### STEPS:

- 1) Enable MST in all switches

**Switch(config)# spanning-tree mode mst**

- 2) Configure MST instances as following in all the switches

**MST instance 1 (VLAN 1-10)****MST instance 2 (VLAN 11-20)****MST instance 3 (VLAN 21-30)****SW1(config)#spanning-tree mst configuration****SW1(config-mst)#instance 1 VLAN 1-10****SW1(config-mst)#instance 2 VLAN 11-20****SW1(config-mst)#instance 3 VLAN 21-30****SW1(config-mst)#name zoom****SW1(config-mst)#revision 1****SW1(config-mst)#exit****SW2(config)# spanning-tree mst configuration****SW2(config-mst)#instance 1 VLAN 1-10****SW2(config-mst)#instance 2 VLAN 11-20****SW2(config-mst)#instance 3 VLAN 21-30****SW2(config-mst)#name zoom****SW2(config-mst)#revision 1****SW2(config-mst)#exit****SW3(config)#spanning-tree mst configuration****SW3(config-mst)#instance 1 VLAN 1-10****SW3(config-mst)#instance 2 VLAN 11-20****SW3(config-mst)#instance 3 VLAN 21-30****SW3(config-mst)#name zoom****SW3(config-mst)#revision 1****SW3(config-mst)#exit**

- 3) Make SW1 as Root Switch for Instance 1 and backup Root Switch for Instance 2.

**SW1(config)#spanning-tree mst 1 root primary****SW1(config)#spanning-tree mst 2 root secondary**

- 4) Make SW2 as Root switch for Instance 2 and backup Root Switch for Instance 3

**SW2(config)#spanning-tree mst 2 root primary****SW2(config)#spanning-tree mst 2 root secondary**

- 5) Make SW3 as Root Switch for Instance 3 and backup Root switch for Instance 1

**SW3(config)#spanning-tree mst 3 root primary****SW3(config)#spanning-tree mst 1 root secondary****VERIFICATION:****G1SW1#show spanning-tree****MST0****Spanning tree enabled protocol mstp****Root ID Priority 32768****Address 000d.bce0.ec00****Cost 0****Port 25 (FastEthernet0/23)****Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec**

Bridge ID Priority 32768 (priority 32768 sys-id-ext 0)  
 Address 001a.e3ee.f480  
 Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/13	Desg	FWD	200000	128.15	P2p Bound(STP)
Fa0/23	Root	FWD	200000	128.25	P2p Pre-STD-Rx
Fa0/24	Desg	BKN*	200000	128.26	P2p Bound(PVST) *PVST_Inc

### MST1

Spanning tree enabled protocol mstp  
 Root ID Priority 24577  
 Address 001a.e3ee.f480  
 This bridge is the root  
 Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec  
 Bridge ID Priority 24577 (priority 24576 sys-id-ext 1)  
 Address 001a.e3ee.f480  
 Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/13	Desg	FWD	200000	128.15	P2p Bound(STP)
Fa0/23	Desg	FWD	200000	128.25	P2p Pre-STD-Rx
Fa0/24	Desg	BKN*	200000	128.26	P2p Bound(PVST) *PVST_Inc

### MST2

Spanning tree enabled protocol mstp  
 Root ID Priority 24578  
 Address 000d.bce0.ec00  
 Cost 200000  
 Port 25 (FastEthernet0/23)  
 Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec  
 Bridge ID Priority 28674 (priority 28672 sys-id-ext 2)  
 Address 001a.e3ee.f480  
 Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/13	Desg	FWD	200000	128.15	P2p Bound(STP)
Fa0/23	Root	FWD	200000	128.25	P2p Pre-STD-Rx
Fa0/24	Desg	BKN*	200000	128.26	P2p Bound(PVST) *PVST_Inc

### MST3

Spanning tree enabled protocol mstp  
 Root ID Priority 28675  
 Address 000d.bce0.ec00  
 Cost 200000  
 Port 25 (FastEthernet0/23)  
 Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec  
 Bridge ID Priority 32771 (priority 32768 sys-id-ext 3)

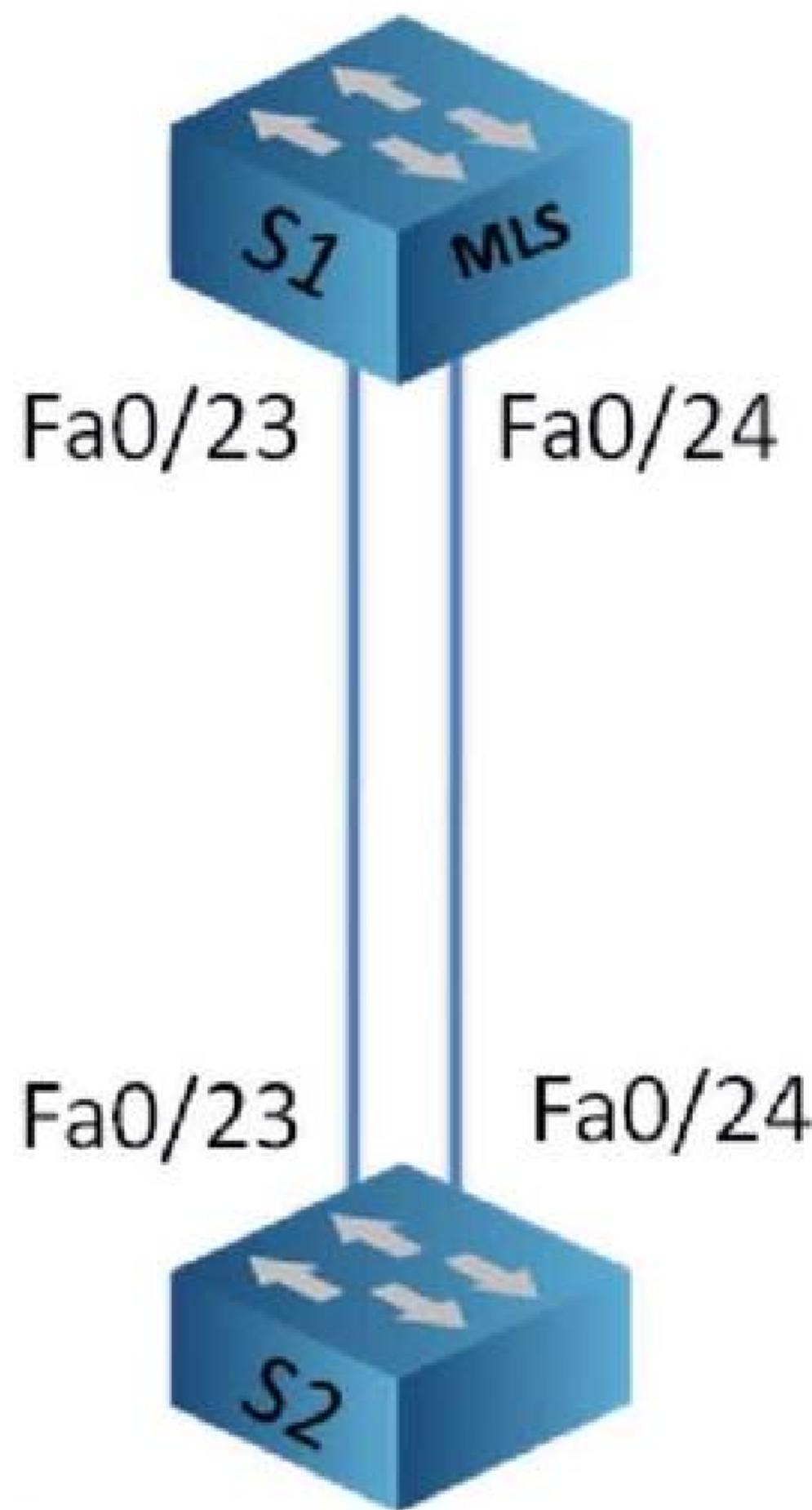
Address 001a.e3ee.f480  
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Interface	Role	Sts	Cost	Prio.Nbr	Type
Fa0/13	Desg	FWD	200000	128.15	P2p Bound(STP)
Fa0/23	Root	FWD	200000	128.25	P2p Pre-STD-Rx
Fa0/24	Desg	BKN*	200000	128.26	P2p Bound(PVST) *PVST_Inc

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**LAB 13: ETHERCHANNEL****OBJECTIVE:**

To configure an Ether Channel to aggregate multiple ports into a single , logical , high speed port

**TOPOLOGY:****TASK:**

- 1) Configure Ether channel by aggregating two ports between SW1 and SW2
- 2) Verify the output

**STEPS:**

- 1) Configure Ether channel in Switch1 and Switch 2.

```
Switch1(config)# interface range fastethernet 0/23-24  
Switch1(config-if)# switchport mode trunk  
Switch1(config-if)# channel-group 1 mode on
```

```
Switch2(config)# interface range fastethernet 0/23-24  
Switch2(config-if)# switchport mode trunk  
Switch2(config-if)# channel-group 1 mode on
```

**VERIFICATION:****Switch1#show etherchannel summary**

Flags: D - down P - bundled in port-channel

I - stand-alone S - suspended

H - Hot-standby (LACP only)

R - Layer3 S - Layer2

U - in use f - failed to allocate aggregator

M - not in use, minimum links not met

u - unsuitable for bundling

w - waiting to be aggregated

d - default port

Number of channel-groups in use: 1

Number of aggregators: 1

Group Port-channel Protocol Ports

Group	Port-channel	Protocol	Ports
1	Po1(SU)	-	Fa0/23(P) Fa0/24(s)

**Switch1#show interfaces port-channel 1**

Port-channel1 is up, line protocol is up (connected)

Hardware is EtherChannel, address is 001a.e3ee.f499 (bia 001a.e3ee.f499)

MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,

reliability 255/255, txload 1/255, rxload 1/255

Encapsulation ARPA, loopback not set

Keepalive set (10 sec)

Full-duplex, 100Mb/s, link type is auto, media type is unknown

input flow-control is off, output flow-control is unsupported

Members in this channel: Fa0/23

ARP type: ARPA, ARP Timeout 04:00:00

Last input 00:00:01, output 00:00:05, output hang never

Last clearing of "show interface" counters never

Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0

Queueing strategy: fifo

Output queue: 0/40 (size/max)

5 minute input rate 0 bits/sec, 0 packets/sec

5 minute output rate 0 bits/sec, 0 packets/sec

1083 packets input, 108072 bytes, 0 no buffer

Received 1506 broadcasts (798 multicasts)

0 runts, 0 giants, 0 throttles

0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored

0 watchdog, 798 multicast, 0 pause input

0 input packets with dribble condition detected

2877 packets output, 235149 bytes, 0 underruns

0 output errors, 0 collisions, 7 interface resets

0 babbles, 0 late collision, 0 deferred

0 lost carrier, 0 no carrier, 0 PAUSE output

0 output buffer failures, 0 output buffers swapped out

**Switch1 #show spanning-tree**

VLAN0001

Spanning tree enabled protocol ieee

Root ID Priority 32768

```

Address 000c.8577.1340
Cost 38
Port 56 (Port-channel1)
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)
Address 001a.e3ee.f480
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300
Interface Role Sts Cost Prio.Nbr Type
-----+-----+-----+-----+
Fa0/13 Desg FWD 19 128.15 P2p
Po1 Root FWD 19 128.56 P2p

```

#### Switch2#show etherchannel summary

Flags: D - down P - in port-channel  
 I - stand-alone s - suspended  
 H - Hot-standby (LACP only)  
 R - Layer3 S - Layer2  
 u - unsuitable for bundling  
 U - in use f - failed to allocate aggregator  
 d - default port

Number of channel-groups in use: 1

Number of aggregators: 1

Group	Port-channel	Protocol	Ports
1	Po1(SU)	-	Fa0/22(D) Fa0/23(Pd)

#### Switch2#show interfaces port-channel 1

Port-channel1 is up, line protocol is up (connected)

Hardware is EtherChannel, address is 000d.bce0.ec17 (bia 000d.bce0.ec17)

MTU 1500 bytes, BW 100000 Kbit, DLY 1000 usec,

reliability 255/255, txload 1/255, rxload 1/255

Encapsulation ARPA, loopback not set

Full-duplex, 100Mb/s, media type is unknown media type

input flow-control is off, output flow-control is off

Members in this channel: Fa0/23

ARP type: ARPA, ARP Timeout 04:00:00

Last input 00:00:00, output 00:00:01, output hang never

Last clearing of "show interface" counters never

Input queue: 1/75/0/0 (size/max/drops/flushes); Total output drops: 0

Queueing strategy: fifo

Output queue: 0/40 (size/max)

5 minute input rate 1000 bits/sec, 2 packets/sec

5 minute output rate 1000 bits/sec, 2 packets/sec

2719 packets input, 208851 bytes, 0 no buffer

Received 2332 broadcasts (0 multicast)

0 runts, 0 giants, 0 throttles

0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored

0 watchdog, 2251 multicast, 0 pause input

0 input packets with dribble condition detected

1126 packets output, 95106 bytes, 0 underruns

0 output errors, 0 collisions, 1 interface resets  
0 babbles, 0 late collision, 0 deferred  
0 lost carrier, 0 no carrier, 0 PAUSE output  
0 output buffer failures, 0 output buffers swapped out

**Switch2#show spanning-tree**

VLAN0001

Spanning tree enabled protocol ieee

Root ID Priority 32768

Address 000c.8577.1340

Cost 19

Port 24 (FastEthernet0/24)

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID Priority 32769 (priority 32768 sys-id-ext 1)

Address 000d.bce0.ec00

Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Aging Time 300

Interface Role Sts Cost Prio.Nbr Type

---

Po1	Desg	FWD	19	128.65	P2p
-----	------	-----	----	--------	-----

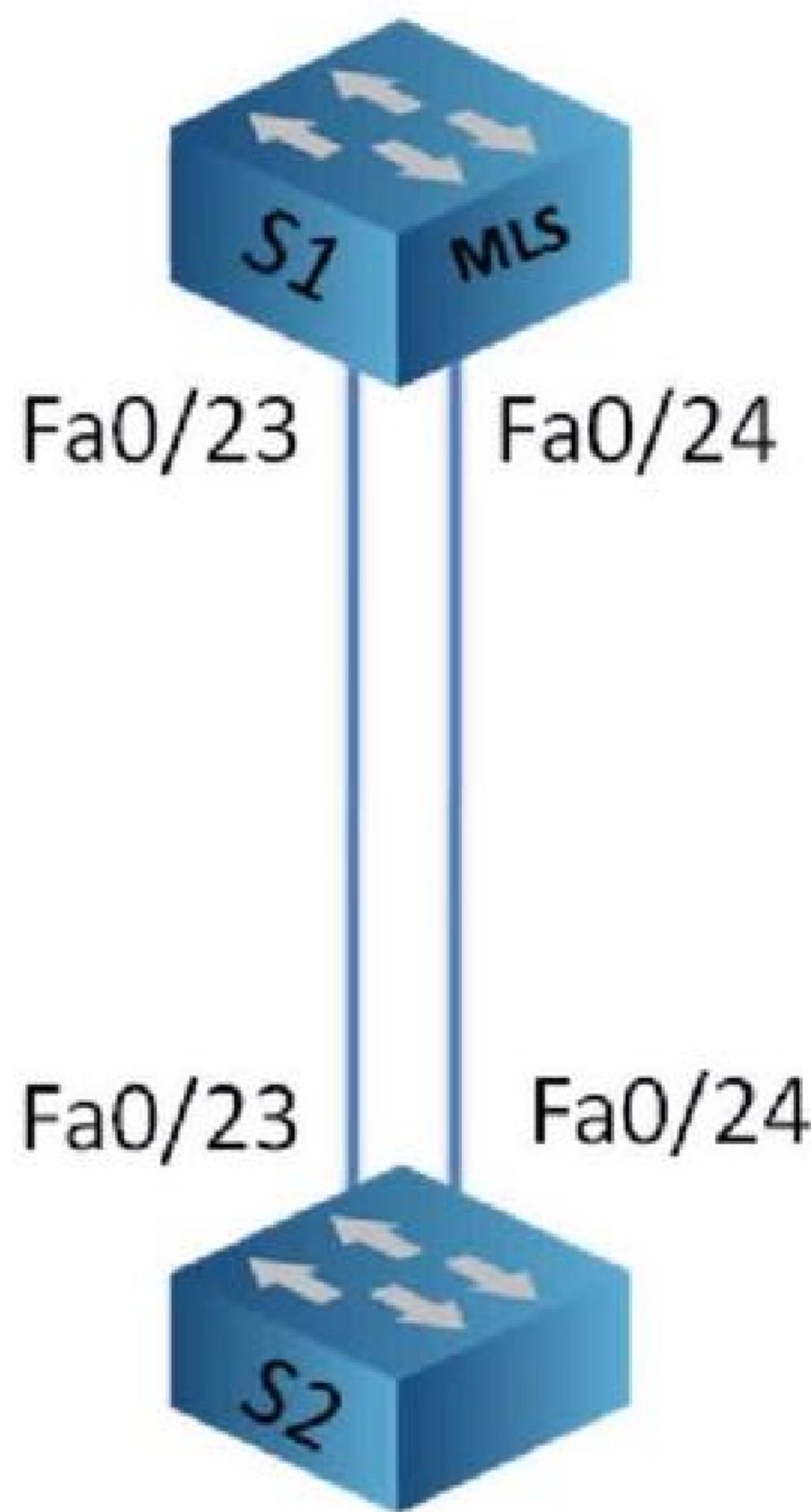
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## LAB 14: PAgP (Port Aggregation Protocol)

### OBJECTIVE:

To configure a dynamic Ether Channel using Port Aggregation protocol (PAgP – Cisco Proprietary)

### TOPOLOGY:



### TASK:

- 1) Configure Ether channel between SW1 and SW2 using PAgP
- 2) Verify the output

### STEPS:

- 1) Configure Etherchannel in Switch1 and Switch 2 with PAgP.

```
Switch1(config)# interface range fastethernet 0/23-24
Switch1(config-if)# switchport mode trunk
Switch1(config-if)# channel-group 1 protocol pagp
Switch1(config-if)# channel-group 1 mode desirable
Switch2(config)# interface range fastethernet 0/23-24
Switch2(config-if)# switchport mode trunk
```

```
Switch2(config-if)# channel-group 1 protocol pagp
Switch2(config-if)# channel-group 1 mode auto
```

**VERIFICATION:**

```
Switch1#show etherchannel load-balance
EtherChannel Load-Balancing Configuration:
src-mac
EtherChannel Load-Balancing Addresses Used Per-Protocol:
Non-IP: Source MAC address
IPv4: Source MAC address
IPv6: Source MAC address
```

```
Switch1#show etherchannel summary
Flags: D - down    P - bundled in port-channel
      I - stand-alone S - suspended
      H - Hot-standby (LACP only)
      R - Layer3   S - Layer2
      U - in use    f - failed to allocate aggregator
      M - not in use, minimum links not met
      u - unsuitable for bundling
      w - waiting to be aggregated
      d - default port
Number of channel-groups in use: 1
Number of aggregators:      1
Group Port-channel Protocol Ports
-----+-----+
1    Po1(SU)     PAgP    Fa0/22(P)  Fa0/23(P)
```

```
Switch1#show interfaces port-channel 1
Port-channel1 is up, line protocol is up (connected)
Hardware is EtherChannel, address is 001a.e3ee.f499 (bia 001a.e3ee.f499)
MTU 1500 bytes, BW 200000 Kbit, DLY 100 usec,
      reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, loopback not set
Keepalive set (10 sec)
Full-duplex, 100Mb/s, link type is auto, media type is unknown
input flow-control is off, output flow-control is unsupported
Members in this channel: Fa0/22 Fa0/23
ARP type: ARPA, ARP Timeout 04:00:00
Last input 00:00:01, output 00:00:00, output hang never
Last clearing of "show interface" counters never
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
      2965 packets input, 270564 bytes, 0 no buffer
      Received 4901 broadcasts (2248 multicasts)
      0 runts, 0 giants, 0 throttles
      0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
```

0 watchdog, 2248 multicast, 0 pause input  
0 input packets with dribble condition detected  
3945 packets output, 340417 bytes, 0 underruns  
0 output errors, 0 collisions, 10 interface resets  
0 babbles, 0 late collision, 0 deferred  
0 lost carrier, 0 no carrier, 0 PAUSE output  
0 output buffer failures, 0 output buffers swapped out

Switch2 #show etherchannel summary

Flags: D - down P - in port-channel

I - stand-alone s - suspended  
H - Hot-standby (LACP only)  
R - Layer3 S - Layer2  
u - unsuitable for bundling  
U - in use f - failed to allocate aggregator  
d - default port

Number of channel-groups in use: 1

Number of aggregators: 1

Group Port-channel Protocol Ports

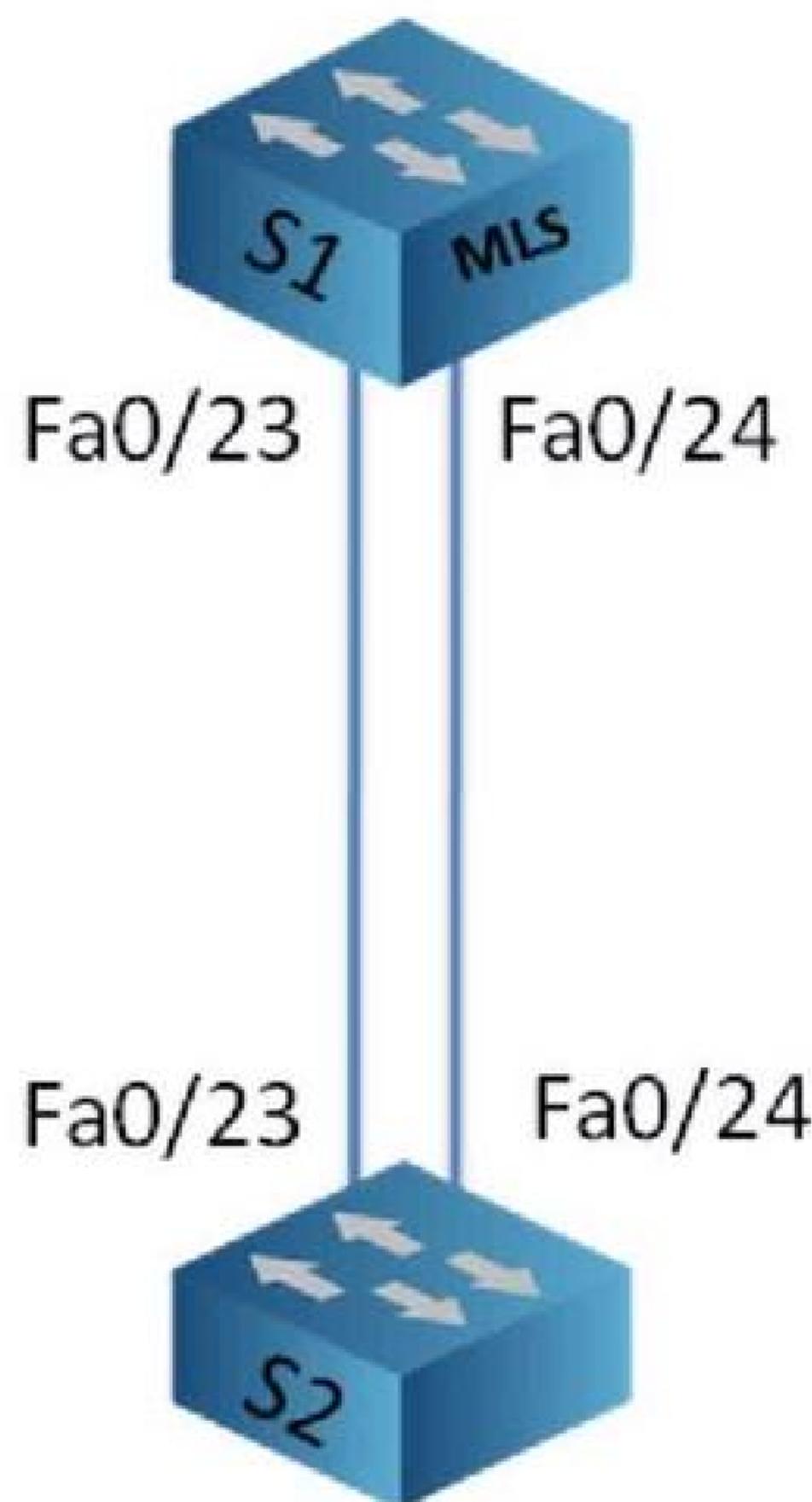
-----	-----	-----	-----
1	Po1(SU)	PAgP	Fa0/22(P) Fa0/23(Pd)

## LAB 15: LACP – Link Aggregation Control Protocol

### OBJECTIVE:

To configure a dynamic Ether Channel using LACP (IEEE Open Standard)

### TOPOLOGY:



### TASK:

- 1) Configure Ether channel between SW1 and SW2 using LACP
- 2) Verify the output

### STEPS:

- 1) Configure Ether channel in Switch1 and Switch 2.

```
Switch1(config)# interface range fastethernet 0/23-24
Switch1(config-if)# switchport mode trunk
Switch1(config-if)# channel-group 1 protocol lacp
Switch1(config-if)# channel-group 1 mode active
Switch2(config)# interface range fastethernet 0/23-24
Switch2(config-if)# switchport mode trunk
Switch2(config-if)# channel-group 1 protocol lacp
Switch2(config-if)# channel-group 1 mode passive
```

**VERIFICATION:****Switch1#show etherchannel summary**

Flags: D - down P - bundled in port-channel

I - stand-alone s - suspended

H - Hot-standby (LACP only)

R - Layer3 S - Layer2

U - in use f - failed to allocate aggregator

M - not in use, minimum links not met

u - unsuitable for bundling

w - waiting to be aggregated

d - default port

Number of channel-groups in use: 1

Number of aggregators: 1

Group Port-channel Protocol Ports

Group	Port-channel	Protocol	Ports
1	Po1(SU)	LACP	Fa0/22(P) Fa0/23(P)

**Switch1#show interfaces port-channel 1**

Port-channel1 is up, line protocol is up (connected)

Hardware is EtherChannel, address is 001a.e3ee.f499 (bia 001a.e3ee.f499)

MTU 1500 bytes, BW 200000 Kbit, DLY 100 usec,

reliability 255/255, txload 1/255, rxload 1/255

Encapsulation ARPA, loopback not set

Keepalive set (10 sec)

Full-duplex, 100Mb/s, link type is auto, media type is unknown

input flow-control is off, output flow-control is unsupported

Members in this channel: Fa0/22 Fa0/23

ARP type: ARPA, ARP Timeout 04:00:00

Last input 00:00:01, output 00:00:00, output hang never

Last clearing of "show interface" counters never

Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0

Queueing strategy: fifo

Output queue: 0/40 (size/max)

5 minute input rate 0 bits/sec, 0 packets/sec

5 minute output rate 0 bits/sec, 0 packets/sec

2965 packets input, 270564 bytes, 0 no buffer

Received 4901 broadcasts (2248 multicasts)

0 runts, 0 giants, 0 throttles

0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored

0 watchdog, 2248 multicast, 0 pause input

0 input packets with dribble condition detected

3945 packets output, 340417 bytes, 0 underruns

0 output errors, 0 collisions, 10 interface resets

0 babbles, 0 late collision, 0 deferred

0 lost carrier, 0 no carrier, 0 PAUSE output

0 output buffer failures, 0 output buffers swapped out

**Switch2 #show etherchannel summary**

Flags: D - down P - in port-channel

I - stand-alone s - suspended

H - Hot-standby (LACP only)

R - Layer3 S - Layer2

u - unsuitable for bundling

U - in use f - failed to allocate aggregator

d - default port

Number of channel-groups in use: 1

Number of aggregators: 1

Group Port-channel Protocol Ports

-----+-----+-----+
1 Po1(SU) Lacp Fa0/22(P) Fa0/23(Pd)

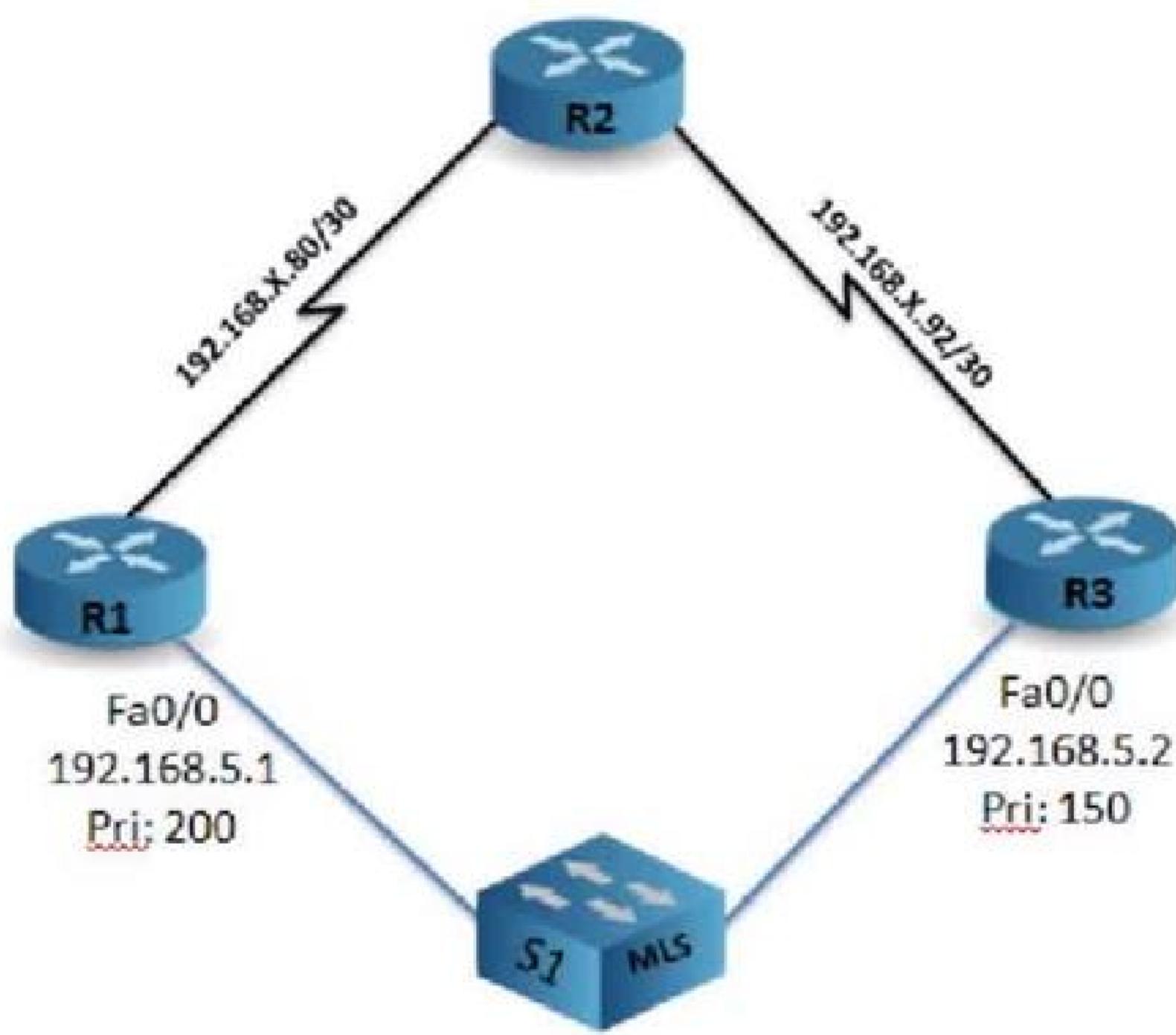
Zoom Technologies

## LAB 16: HSRP- Hot Standby Routing Protocol

### OBJECTIVE:

To configure and verify Default Gateway Redundancy by using HSRP(Cisco Proprietary)

### TOPOLOGY:



### TASK:

- 1) Configure HSRP between R1 and R3 routers to achieve default gateway redundancy
- 2) Make R1 router as Active Router by giving it a priority 200 and R3 router as Standby Router by setting its priority to 150.
- 3) Verify that R3 becomes the gateway in case the connectivity to R1 is lost

### STEPS:

- 1) Configure IP address on LAN Interface of the R2 and R4 router.

```

R1(config)#interface fa0/0
R1(config-if)#ip address 192.168.5.1 255.255.255.0
R1(config-if)#no shutdown
R3(config)#interface fa 0/0
R3(config-if)#ip address 192.168.5.2 255.255.255.0
R3(config-if)#no shutdown
R3(config-if)#exit
  
```

- 2) Make R1 router as active router and R3 router as standby router.

```
R1(config)# interface fastethernet 0/0
R1(config-if)# standby 10 ip 192.168.5.3
R1(config-if)# standby 10 priority 200
R1(config-if)# standby 10 preempt
R1(config-if)# exit
R3(config)# interface fastethernet 0/0
R3(config-if)# standby 10 ip 192.168.5.3
R3(config-if)# standby 10 priority 150
R3(config-if)# standby 10 preempt
R3(config-if)# exit
```

#### VERIFICATION:

```
R1#show standby
FastEthernet0/0 - Group 10
State is Active
2 state changes, last state change 00:00:14
Virtual IP address is 192.168.5.3
Active virtual MAC address is 0000.0c07.ac0a
Local virtual MAC address is 0000.0c07.ac0a (v1 default)
Hello time 3 sec, hold time 10 sec
Next hello sent in 0.207 secs
Preemption enabled
Active router is local
Standby router is 192.168.5.2, priority 150 (expires in 7.764 sec)
Priority 200 (configured 200)
IP redundancy name is "hsrp-Fa0/0-10" (default)
```

```
R3#show standby
Ethernet0/0 - Group 10
Local state is Standby, priority 150, may preempt
Hellotime 3 holdtime 10
Next hello sent in 00:00:01.119
Hot standby IP address is 192.168.5.3 configured
Active router is 192.168.5.1 expires in 00:00:07, priority 200
Standby router is local
4 state changes, last state change 00:04:25
```

Shut down the interfaces of the active (R1) router and verify which router now becomes the active router.

```
R3#show standby
Ethernet0/0 - Group 10
Local state is Active, priority 150, may preempt
Hellotime 3 holdtime 10
Next hello sent in 00:00:02.426
Hot standby IP address is 192.168.5.3 configured
Active router is local
```

Standby router is unknown expired  
Standby virtual mac address is 0000.0c07.ac0a  
5 state changes, last state change 00:00:19

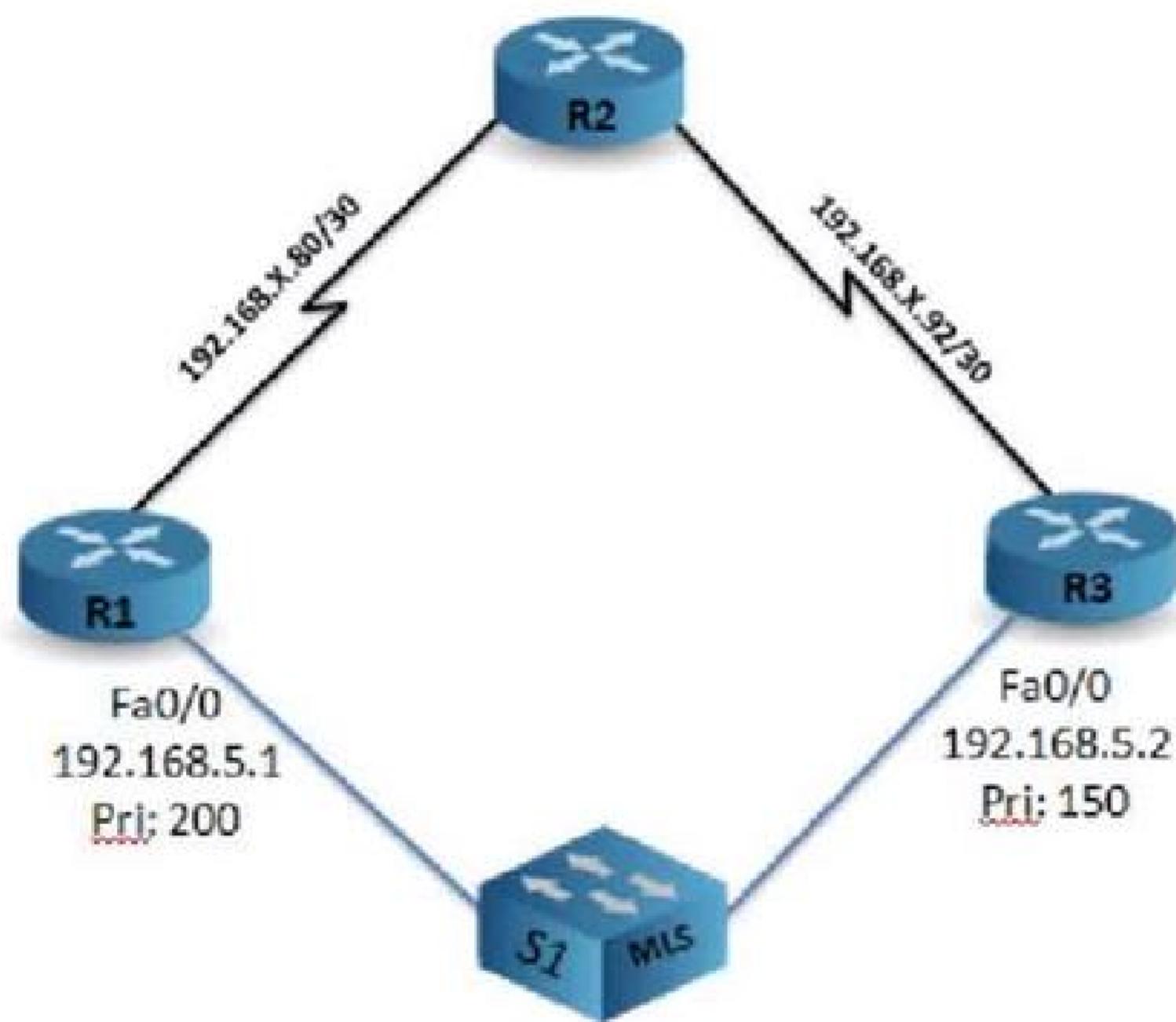
Zoom Technologies

## LAB 17: VRRP – Virtual Router Redundancy Protocol

### OBJECTIVE:

To configure and verify Default Gateway Redundancy by using VRRP (IEEE Open standard)

### TOPOLOGY:



### TASK:

- 1) Configure VRRP between R1 and R3 routers to achieve default gateway redundancy
- 2) Make R1 router as Master Router by giving it a higher priority and R3 router as Backup Router by giving it a lower priority.
- 3) Verify that R3 becomes the default gateway in case R1 becomes unavailable.

### STEPS:

- 1) Configure IP address on LAN Interface of the R1 and R3 router as done in previous lab.
- 2) Make R1 router as Master router (priority 200) and R3 router (priority 150) as Backup router.

```

R1(config)# interface fasteternet 0/0
R1(config-if)#vrrp 10 ip 192.168.5.3
R1(config-if)#vrrp 10 priority 200
R1(config-if)#exit
R3(config)# interface fasteternet 0/0
R3(config-if)#vrrp 10 ip 192.168.5.3
R3(config-if)#vrrp 10 priority 150
R3(config-if)#exit
  
```

**VERIFICATION:**

**R1#show vrrp**  
FastEthernet0/0 - Group 10  
State is Master  
Virtual IP address is 192.168.5.3  
Virtual MAC address is 0000.5e00.010a  
Advertisement interval is 1.000 sec  
Preemption enabled  
Priority is 200  
**Master Router is 192.168.5.1 (local), priority is 200**  
Master Advertisement interval is 1.000 sec  
Master Down interval is 3.218 sec

**R1#show vrrp brief**  
Interface      Grp Pri Time Own Pre State Master addr    Group addr  
Fa0/0            10 200 3218    Y Master 192.168.5.1    192.168.5.3

**R3#show vrrp**  
FastEthernet0/0 - Group 10  
State is Backup  
Virtual IP address is 192.168.5.3  
Virtual MAC address is 0000.5e00.010a  
Advertisement interval is 1.000 sec  
Preemption enabled  
Priority is 150  
Master Router is 192.168.5.1, priority is 200  
Master Advertisement interval is 1.000 sec  
Master Down interval is 3.414 sec (expires in 2.885 sec)

**R3#sh vrrp brief**  
Interface      Grp Pri Time Own Pre State Master addr    Group addr  
Fa0/0            10 150 3414    Y Backup 192.168.5.1    192.168.5.3

Shut down the interfaces of the Master (R1) router and verify which router now becomes the Master router.

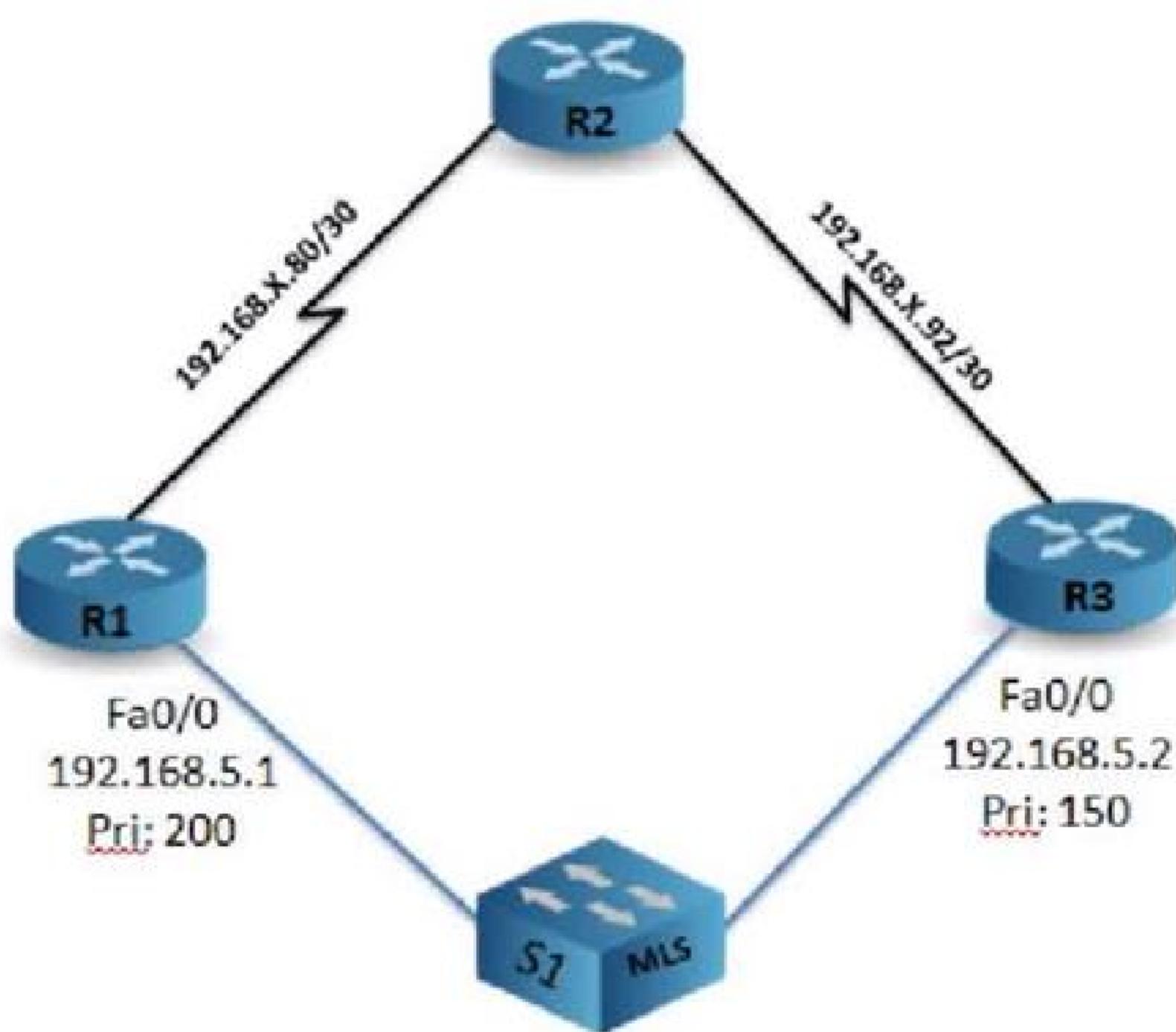
**R3#show vrrp**  
FastEthernet0/0 - Group 10  
State is Master  
Virtual IP address is 192.168.5.3  
Virtual MAC address is 0000.5e00.010a  
Advertisement interval is 1.000 sec  
Preemption enabled  
Priority is 150  
**Master Router is 192.168.5.2 (local), priority is 150**  
Master Advertisement interval is 1.000 sec  
Master Down interval is 3.218 sec

**LAB 18: GLBP –Gateway Load Balancing protocol**

## **OBJECTIVE :**

To configure and verify Default Gateway Redundancy and load balancing by using GLBP

## **TOPOLOGY:**



**TASK:**

- 1) Configure GLBP between R1 and R3 routers to achieve default gateway redundancy and load balancing
  - 2) Make R1 the primary gateway by increasing its priority and R3 the standby by giving it a lower priority.
  - 3) Verify that R3 takes over in case R1 becomes unavailable

### **STEPS:**

- 1) Configure IP address on LAN Interface of the R1 and R3 router as done in previous lab.
  - 2) Configure GLBP in R1 ( priority 200) and R3 routers (priority 150)

```
R1(config)#interface fa0/0
R1(config-if)#ip address 192.168.5.1 255.255.255.0
R1(config-if)#no shut
R1(config-if)#glbp 10 ip 192.168.5.3
```

```
R1(config-if)#glbp 10 priority 200
R1(config-if)#exit
R3(config)#interface fa 0/0
R3(config-if)#ip address 192.168.5.2 255.255.255.0
R3(config-if)#no shut
R3(config-if)#glbp 10 ip 192.168.5.3
R3(config-if)#glbp 10 priority 150
R3(config-if)#glbp 10 preempt
R3(config-if)#exit
```

**VERIFICATION:**

```
R1#show glbp
FastEthernet0/0 - Group 10
  State is Active
    2 state changes, last state change 00:02:00
  Virtual IP address is 192.168.5.3
    Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.852 secs
    Redirect time 600 sec, forwarder time-out 14400 sec
    Preemption disabled
  Active is local
    Standby is 192.168.5.2, priority 150 (expires in 8.638 sec)
    Priority 200 (configured)
    Weighting 100 (default 100), thresholds: lower 1, upper 100
    Load balancing: round-robin
  Group members:
    000f.90bb.96c0 (192.168.5.1) local
    0011.928f.68e0 (192.168.5.2)
  There are 2 forwarders (1 active)
  Forwarder 1
    State is Active
      1 state change, last state change 00:01:50
      MAC address is 0007.b400.0a01 (default)
      Owner ID is 000f.90bb.96c0
      Redirection enabled
      Preemption enabled, min delay 30 sec
      Active is local, weighting 100
  Forwarder 2
    State is Listen
    MAC address is 0007.b400.0a02 (learnt)
    Owner ID is 0011.928f.68e0
    Redirection enabled, 599.936 sec remaining (maximum 600 sec)
    Time to live: 14399.932 sec (maximum 14400 sec)
    Preemption enabled, min delay 30 sec
    Active is 192.168.5.2 (primary), weighting 100 (expires in 9.932 sec)
R3#show glbp
FastEthernet0/0 - Group 10
  State is Standby
    1 state change, last state change 00:00:10
  Virtual IP address is 192.168.5.3
```

Hello time 3 sec, hold time 10 sec  
Next hello sent in 1.782 secs  
Redirect time 600 sec, forwarder time-out 14400 sec  
Preemption enabled, min delay 0 sec  
**Active is 192.168.5.1, priority 200 (expires in 6.991 sec)**  
Standby is local  
Priority 150 (configured)  
Weighting 100 (default 100), thresholds: lower 1, upper 100  
Load balancing: round-robin  
Group members:  
000f.90bb.96c0 (192.168.5.1)  
0011.928f.68e0 (192.168.5.2) local  
There are 2 forwarders (1 active)  
Forwarder 1  
State is Listen  
MAC address is 0007.b400.0a01 (learnt)  
Owner ID is 000f.90bb.96c0  
Time to live: 14396.987 sec (maximum 14400 sec)  
Preemption enabled, min delay 30 sec  
**Active is 192.168.5.1 (primary), weighting 100 (expires in 9.888 sec)**  
Forwarder 2  
State is Active  
1 state change, last state change 00:00:38  
MAC address is 0007.b400.0a02 (default)  
Owner ID is 0011.928f.68e0  
Preemption enabled, min delay 30 sec  
Active is local, weighting 100

#### **Load Balancing in GLBP**

PCA>tracert 8.8.8.8

Tracing route to 8.8.8.8 over a maximum of 30 hops:

1 12 ms 0 ms 0 ms 192.168.5.1  
2 \* 0 ms 0 ms 8.8.8.8

PCB>tracert 8.8.8.8

Tracing route to 8.8.8.8 over a maximum of 30 hops:

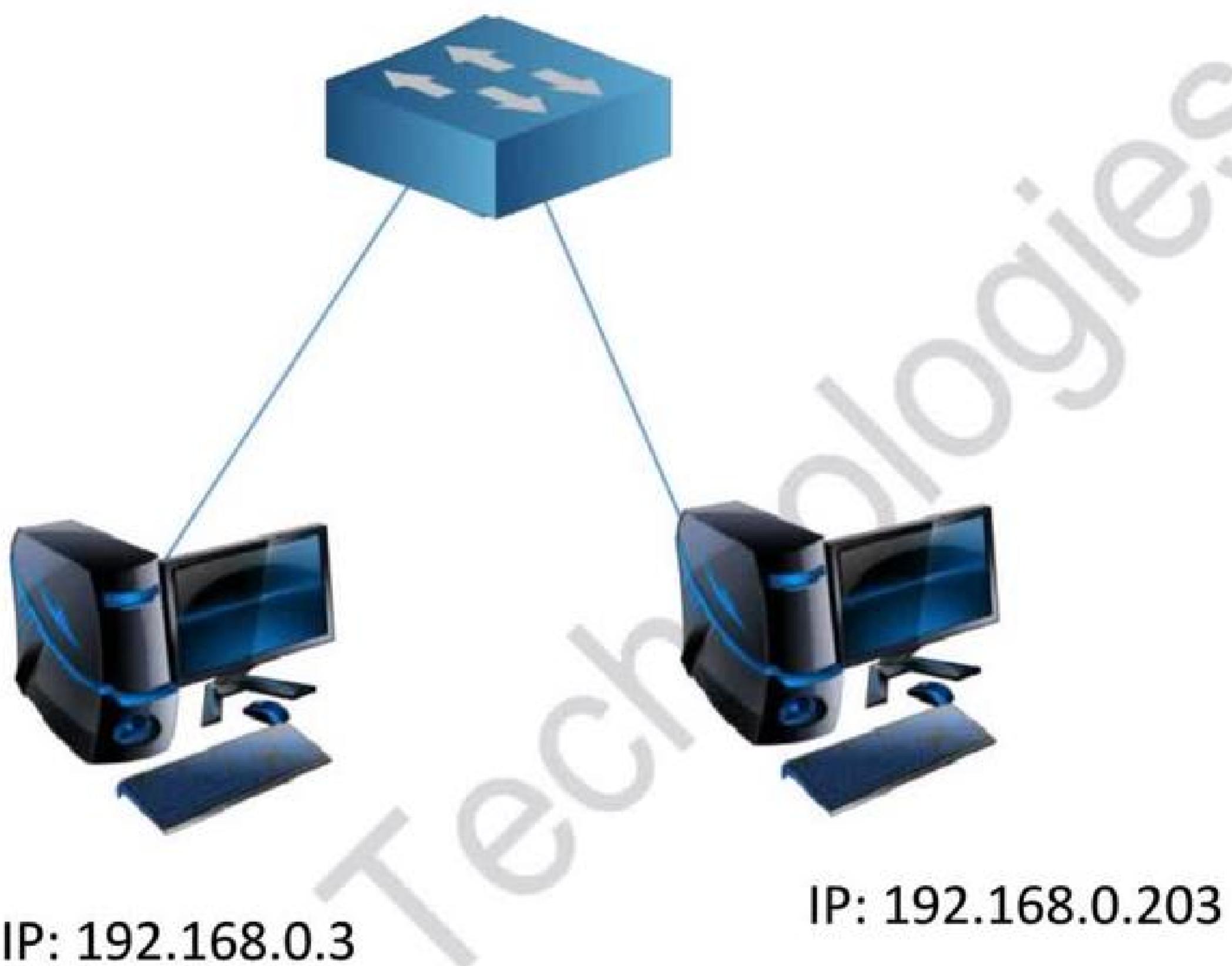
1 12 ms 0 ms 0 ms 192.168.5.2  
2 \* 0 ms 0 ms 8.8.8.8

## LAB 19: VACL – VLAN Access List

### OBJECTIVE:

To configure VLAN Access list to filter traffic within a VLAN

### TOPOLOGY:



### TASK:

- 1) Verify that two PCs on the same VLAN can ping each other
- 2) Configure VACL to stop the communication between the two PC's.
- 3) Verify that communication is no longer possible.

### STEPS:

- 1) Ping from PC1 to PC2

PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

```
Reply from 192.168.0.103: bytes=32 time=2ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
```

Ping statistics for 192.168.0.103:  
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
Approximate round trip times in milli-seconds:  
Minimum = 0ms, Maximum = 2ms, Average = 0ms

- 2) Configure VLAN access filter on SW1 to drop icmp echo requests from PC1 to PC2

```
SW1(config)#access-list 110 permit icmp host 192.168.0.3 host 192.168.0.203 echo  
SW1(config)#VLAN access-map zoom 10  
SW1(config-access-map)#match ip address 110  
SW1(config-access-map)#action drop  
SW1(config-access-map)#exit  
SW1(config)#VLAN access-map zoom 20  
SW1(config-access-map)#exit
```

- 3) Apply the VACL

```
SW1(config)#VLAN filter zoom VLAN-list 10
```

#### VERIFICATION:

```
SW1#Show VLAN access-map  
VLAN access-map "zoom" 10  
Match clauses:  
    ip address: 110  
    Action: drop  
VLAN access-map "zoom" 20  
Match clauses:  
    Action:Forward
```

PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

```
Request timed out.  
Request timed out.  
Request timed out.  
Request timed out.
```

Ping statistics for 192.168.0.103:  
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

## LAB 20: Port Security

### OBJECTIVE:

To configure Port Security on a switch by binding the MAC-address of a PC to a particular port

### TOPOLOGY:



### TASK:

- 1) Configure Port Security
- 2) Verify that the switch will not forward frames if any other PC is connected

### STEPS:

- 1) Configure Port Security on the interface where your pc is connected and enter your own MAC address

```
SW1(config)#interface fa 0/12
SW1(config-if)#switchport mode access
SW1(config-if)#switchport port-security
SW1(config-if)#switchport port-security mac-address xxxx.xxxx.xxxx
SW1(config-if)#switchport port-security violation shutdown
```

**VERIFICATION:**

- Before connecting other pc to the port

**SW1#show interfaces status**

Port	Name	Status	VLAN	Duplex	Speed	Type
Fa0/1		connected	1	a-full	a-100	10/100BaseTX
Fa0/2		connected	1	a-full	a-100	10/100BaseTX
Fa0/3		connected	1	a-full	a-100	10/100BaseTX
Fa0/4		notconnect	1	auto	auto	10/100BaseTX
Fa0/5		notconnect	1	auto	auto	10/100BaseTX
Fa0/6		notconnect	1	auto	auto	10/100BaseTX
Fa0/7		notconnect	1	auto	auto	10/100BaseTX
Fa0/8		connected	1	a-half	a-10	10/100BaseTX
Fa0/9		notconnect	1	auto	auto	10/100BaseTX
Fa0/10		notconnect	1	auto	auto	10/100BaseTX
Fa0/11		connected	1	a-full	a-100	10/100BaseTX
Fa0/12		connected	1	a-full	a-100	10/100BaseTX
Fa0/13		connected	trunk	a-full	a-100	10/100BaseTX
Fa0/14		notconnect	1	auto	auto	10/100BaseTX
Fa0/15		notconnect	1	auto	auto	10/100BaseTX
Fa0/16		notconnect	1	auto	auto	10/100BaseTX
Fa0/17		notconnect	1	auto	auto	10/100BaseTX
Fa0/18		notconnect	1	auto	auto	10/100BaseTX
Fa0/19		notconnect	1	auto	auto	10/100BaseTX
Fa0/20		notconnect	1	auto	auto	10/100BaseTX
Fa0/21		notconnect	1	auto	auto	10/100BaseTX
Fa0/22		connected	trunk	a-full	a-100	10/100BaseTX
Fa0/23		connected	trunk	a-full	a-100	10/100BaseTX
Fa0/24		connected	trunk	a-full	a-100	10/100BaseTX
Gi0/1		notconnect	1	auto	auto	Not Present
Gi0/2		notconnect	1	auto	auto	Not Present

- After connecting other pc to the port

**SW1#show interfaces status**

Port	Name	Status	VLAN	Duplex	Speed	Type
Fa0/1		connected	1	a-full	a-100	10/100BaseTX
Fa0/2		connected	1	a-full	a-100	10/100BaseTX
Fa0/3		connected	1	a-full	a-100	10/100BaseTX
Fa0/4		notconnect	1	auto	auto	10/100BaseTX
Fa0/5		notconnect	1	auto	auto	10/100BaseTX
Fa0/6		notconnect	1	auto	auto	10/100BaseTX
Fa0/7		notconnect	1	auto	auto	10/100BaseTX
Fa0/8		err-disabled	1	a-half	a-10	10/100BaseTX
Fa0/9		notconnect	1	auto	auto	10/100BaseTX
Fa0/10		notconnect	1	auto	auto	10/100BaseTX
Fa0/11		connected	1	a-full	a-100	10/100BaseTX
Fa0/12		connected	1	a-full	a-100	10/100BaseTX

Fa0/13	connected	trunk	a-full	a-100	10/100BaseTX
Fa0/14	notconnect	1	auto	auto	10/100BaseTX
Fa0/15	notconnect	1	auto	auto	10/100BaseTX
Fa0/16	notconnect	1	auto	auto	10/100BaseTX
Fa0/17	notconnect	1	auto	auto	10/100BaseTX
Fa0/18	notconnect	1	auto	auto	10/100BaseTX
Fa0/19	notconnect	1	auto	auto	10/100BaseTX
Fa0/20	notconnect	1	auto	auto	10/100BaseTX
Fa0/21	notconnect	1	auto	auto	10/100BaseTX
Fa0/22	connected	trunk	a-full	a-100	10/100BaseTX
Fa0/23	connected	trunk	a-full	a-100	10/100BaseTX
Fa0/24	connected	trunk	a-full	a-100	10/100BaseTX
Gi0/1	notconnect	1	auto	auto	Not Present
Gi0/2	notconnect	1	auto	auto	Not Present

**SW1#show port-security**

Secure Port	MaxSecureAddr	CurrentAddr	SecurityViolation	Action
(Count)	(Count)	(Count)		

Fa0/8	1	1	1	Shutdown
-------	---	---	---	----------

Total Addresses in System (excluding one mac per port) : 0

Max Addresses limit in System (excluding one mac per port) : 6144

**SW1#show port-security int fa0/8**

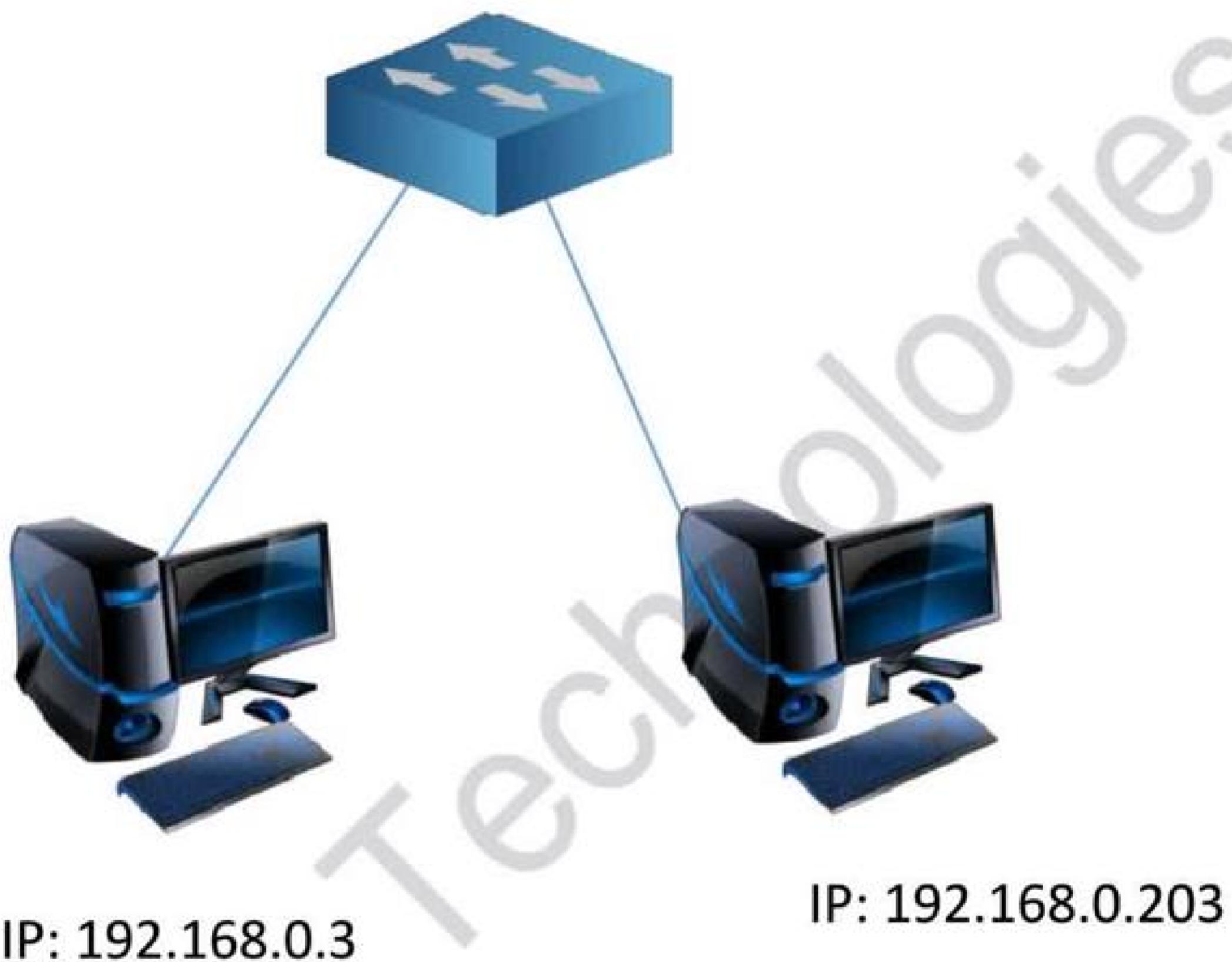
Port Security	: Enabled
Port Status	: Secure-up
Violation Mode	: Shutdown
Aging Time	: 0 mins
Aging Type	: Absolute
SecureStatic Address Aging	: Disabled
Maximum MAC Addresses	: 1
Total MAC Addresses	: 1
Configured MAC Addresses	: 0
Sticky MAC Addresses	: 0
Last Source Address:VLAN	: 00d0.586c.23e0:1
Security Violation Count	: 0

## LAB 21: Private VLAN

### OBJECTIVE:

To configure and verify the behavior of Private VLAN

### TOPOLOGY:



### TASK:

- 1) Configure Private VLANs such that PC1 and PC2 should not communicate with each other
- 2) Verify the output

### STEPS:

1. Before configuring private VLANs, set the switch VTP mode to transparent mode.

**SW1(config)#vtp mode transparent**

2. Create Primary private VLAN with the help of the following command.

**SW1(config)#VLAN 10**

**SW1(config-VLAN)#private-VLAN primary**

3. Create secondary private VLAN with the help of the following command.

**SW1(config)#VLAN 11**

**SW1(config-VLAN)#private-VLAN isolated**

4. Verify the communication between two PC's before assigning to private vlans.

PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

```
Reply from 192.168.0.103: bytes=32 time=2ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
```

Ping statistics for 192.168.0.103:

```
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

5. Now assign our pc ports that should not communicate with each other in the private isolated VLANs.

```
SW1(config)#interface fa0/2
SW1(config-if)#switchport mode private-VLAN host
SW1(config-if)# switchport private-VLAN host-association 10 11
SW1(config)#interface fa0/4
SW1(config-if)#switchport mode private-VLAN host
SW1(config-if)# switchport private-VLAN host-association 10 11
```

#### VERIFICATION:

**SW1#show VLAN private-VLAN**

Primary	Secondary	Type	Ports
10	11	isolated	Fa0/1, Fa0/2

After assigning ports to the private vlans.

PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

```
Request timed out.
Request timed out.
Request timed out.
Request timed out.
```

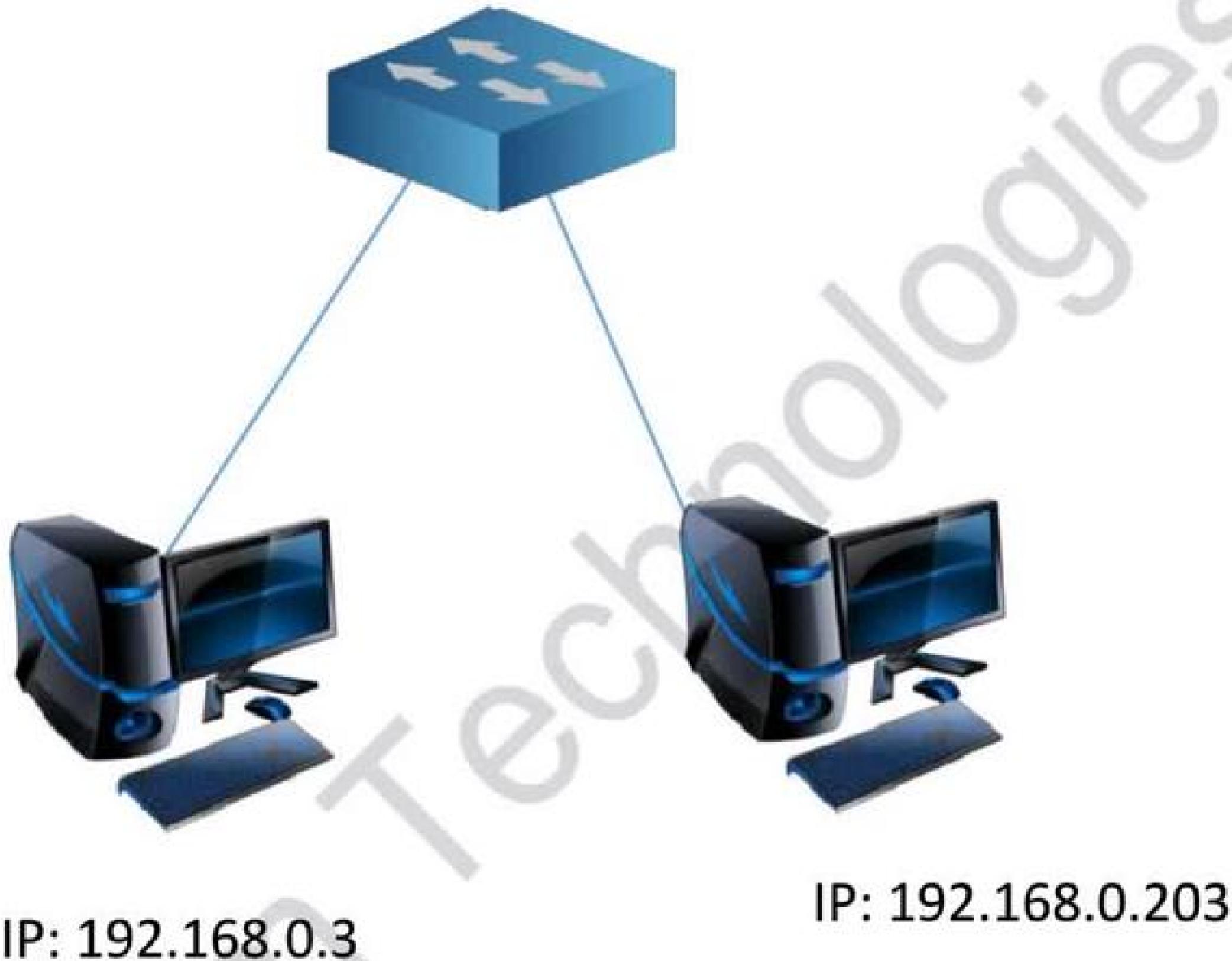
Ping statistics for 192.168.0.103:

```
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

## LAB 22: Protected Ports

**OBJECTIVE:**

To configure protected ports on a switch so that no layer 2 traffic is forwarded between protected ports with the help of a router/ multi layer switch.

**TOPOLOGY:****TASK:**

- 1) Configure Protected Ports such that PC1 and PC2 should not communicate with each other
- 2) Verify that communication is no longer possible

**STEPS:**

- 1) Ping from PC1 to PC2 and check that communication is possible

PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

```
Reply from 192.168.0.103: bytes=32 time=2ms TTL=128
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128
```

Reply from 192.168.0.103: bytes=32 time=0ms TTL=128  
Reply from 192.168.0.103: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.0.103:  
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
Approximate round trip times in milli-seconds:  
Minimum = 0ms, Maximum = 2ms, Average = 0ms

- 2) PC1 and PC2 should not communicate with each other as they are both on protected ports

```
SW1(config)#interface fa0/2
SW1(config-if)#switchport host
SW1(config-if)# switchport mode protected
SW1(config)#interface fa0/4
SW1(config-if)#switchport host
SW1(config-if)# switchport mode protected
```

#### VERIFICATION:

**NOTE:** Protected ports will not communicate with each other. But Protected to Unprotected and Unprotected to Protected ports will communicate with each other.

```
SW1#show interfaces fastEthernet 0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-VLAN host-association: none
Administrative private-VLAN mapping: 10 (ccna) 11 (VLAN0011) 12 (VLAN00
Administrative private-VLAN trunk native VLAN: none
Administrative private-VLAN trunk Native VLAN tagging: enabled
Administrative private-VLAN trunk encapsulation: dot1q
Administrative private-VLAN trunk normal VLANs: none
Administrative private-VLAN trunk associations: none
Administrative private-VLAN trunk mappings: none
Operational private-VLAN: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
```

→ **Protected: true**

Unknown unicast blocked: disabled  
Unknown multicast blocked: disabled  
Appliance trust: none

**SW1#show interfaces fastEthernet 0/2 switchport**

Name: Fa0/2  
Switchport: Enabled  
Administrative Mode: static access  
Operational Mode: static access  
Administrative Trunking Encapsulation: negotiate  
Operational Trunking Encapsulation: native  
Negotiation of Trunking: Off  
Access Mode VLAN: 1 (default)  
Trunking Native Mode VLAN: 1 (default)  
Administrative Native VLAN tagging: enabled  
Voice VLAN: none  
Administrative private-VLAN host-association: 10 (ccna) 11 (VLAN0011)  
Administrative private-VLAN mapping: none  
Administrative private-VLAN trunk native VLAN: none  
Administrative private-VLAN trunk Native VLAN tagging: enabled  
Administrative private-VLAN trunk encapsulation: dot1q  
Administrative private-VLAN trunk normal VLANs: none  
Administrative private-VLAN trunk associations: none  
Administrative private-VLAN trunk mappings: none  
Operational private-VLAN: none  
Trunking VLANs Enabled: ALL  
Pruning VLANs Enabled: 2-1001  
Capture Mode Disabled  
Capture VLANs Allowed: ALL

→ **Protected: true**

Unknown unicast blocked: disabled  
Unknown multicast blocked: disabled  
Appliance trust: none

After Configuring Protected Ports.

PC1>ping 192.168.0.103

Pinging 192.168.0.103 with 32 bytes of data:

Request timed out.  
Request timed out.  
Request timed out.  
Request timed out.

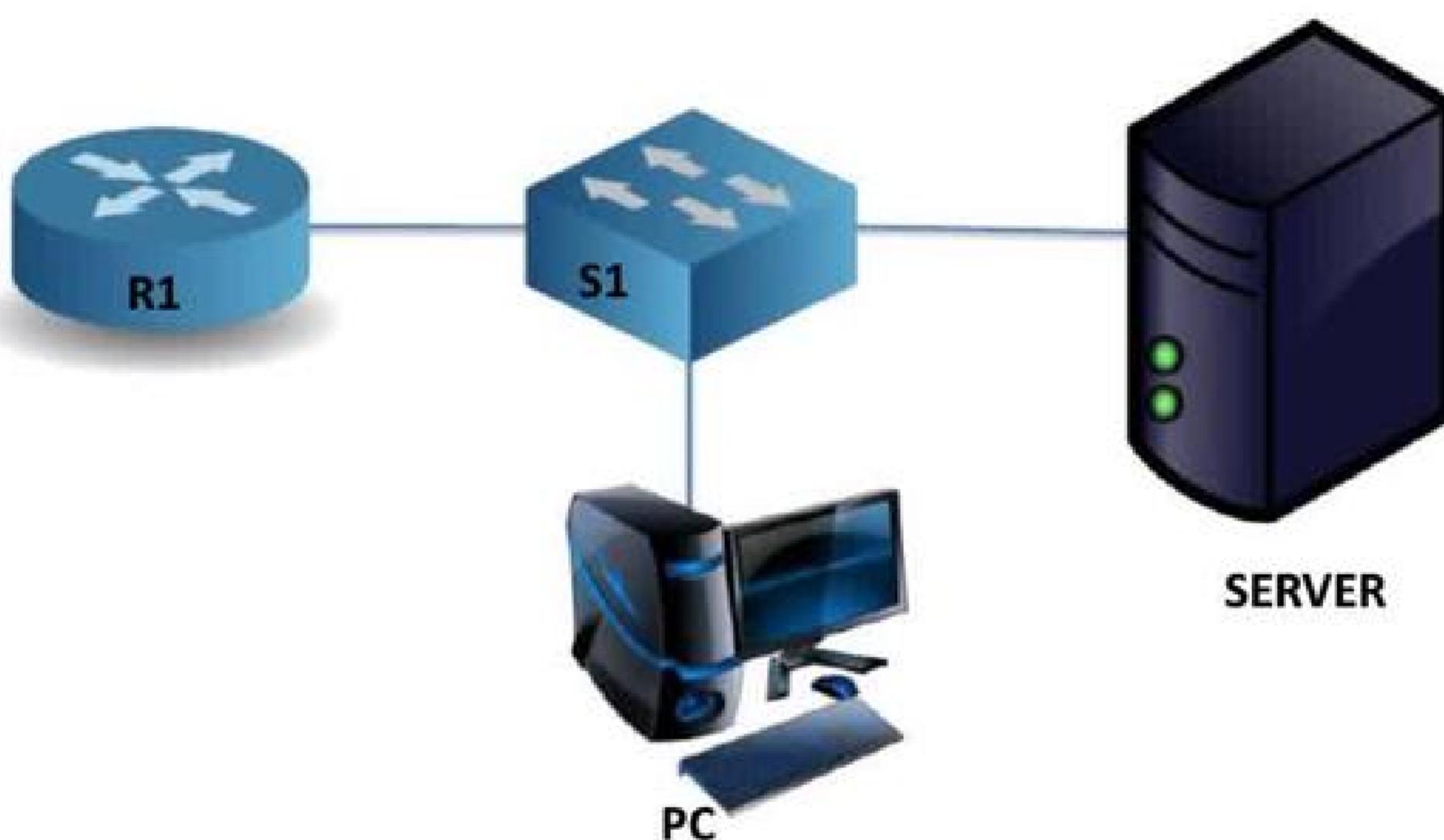
Ping statistics for 192.168.0.103:  
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss)

## LAB 23: AAA - Authentication Authorization Accounting

### OBJECTIVE:

To configure an AAA (Authentication, Authorization and Accounting) server for the users on a network

### TOPOLOGY:



### TASK:

- 1) Configure AAA authentication on R1 by using a RADIUS server.
- 2) Verify that Telnet users are authenticated by the RADIUS server

### STEPS:

- 1) Configure authentication in the router.

```
R1(config)#aaa new-model  
R1(config)#aaa authentication login default group radius  
R1(config)#radius-server host 192.168.0.1 key zoom123  
R1(config-if)#exit
```

- 2) Implement Authentication on Console as well as vty lines.

```
R1(config)#line console 0  
R1(config-line)#login authentication default  
R1(config-line)#exit  
R1(config)#line vty 0 4  
R1(config-line)#login authentication default
```

R1(config-line)#exit

**VERIFICATION:**

Total sessions since last reload: 1

Session Id:1

Unique Id:1

User Name:zoom123

IP Address:192.168.0.3

Idle Time: CT Call Handle: 0

Router#debug aaa authentication

092852: Jan 27 22:19:06.713 CST: AAA/AUTHEN (543609479): status = GETPASS

092853: Jan 27 22:19:07.985 CST: AAA/AUTHEN/CONT (543609479): continue\_login

(user='dial\_tac')

!The NAS receives FAIL from the AAA server for the user.

092854: Jan 27 22:19:07.985 CST: AAA/AUTHEN (543609479): status = GETPASS

092855: Jan 27 22:19:07.985 CST: AAA/AUTHEN (543609479): Method=ADMIN (tacacs+)

092856: Jan 27 22:19:07.985 CST: TAC+: send AUTHEN/CONT packet id=543609479

092857: Jan 27 22:19:08.185 CST: TAC+: ver=192 id=543609479 received AUTHEN

status = FAIL

092858: Jan 27 22:19:08.185 CST: AAA/AUTHEN (543609479): status = FAIL

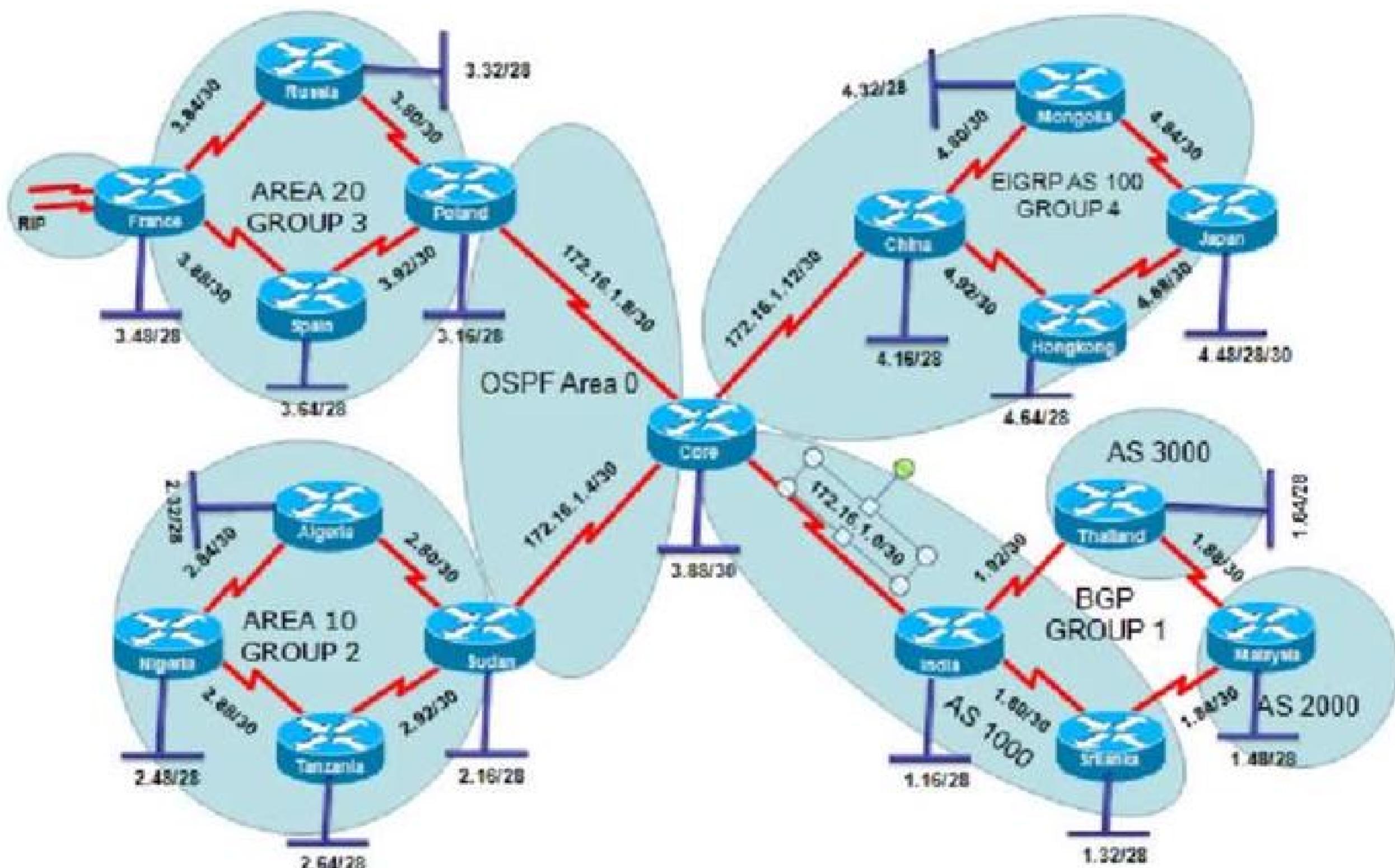
!The user session is torn down, and the AAA process is freed.

## Troubleshooting Scenario

### OBJECTIVE:

Troubleshoot the problems in every group.

### TOPOLOGY:



### TSHOOT TASKS: (Include loopback networks in Routing Protocol)

#### GROUP-1:

1. India should access loopback of Malaysia using one AS(Via Srilanka)
2. Srilanka should access loopback of Thailand using one AS(Via India)
3. All the routers should form neighborship using loopback address
4. Thailand should access 30.1.0.0 & 30.1.1.0 via 1.89 and 30.1.2.0 & 30.1.3.0 via 1.94

#### GROUP-2:

1. Area 10 should not receive External Networks and Summary Networks
2. Sudan and Tanzania should not become neighbours (using command)
3. Nigeria should ping to 30.4.1.1(JAPAN)
4. Configure Simple Password Authentication between Sudan and Algeria

**GROUP-3:**

1. Area 20 should not receive External Updates
2. Russia and Poland should not become neighbour (Do not remove WAN LINK network)
3. France should ping to 30.4.1.1 (Japan)
4. Configure MD5 Authentication between Poland and Core

**GROUP-4:**

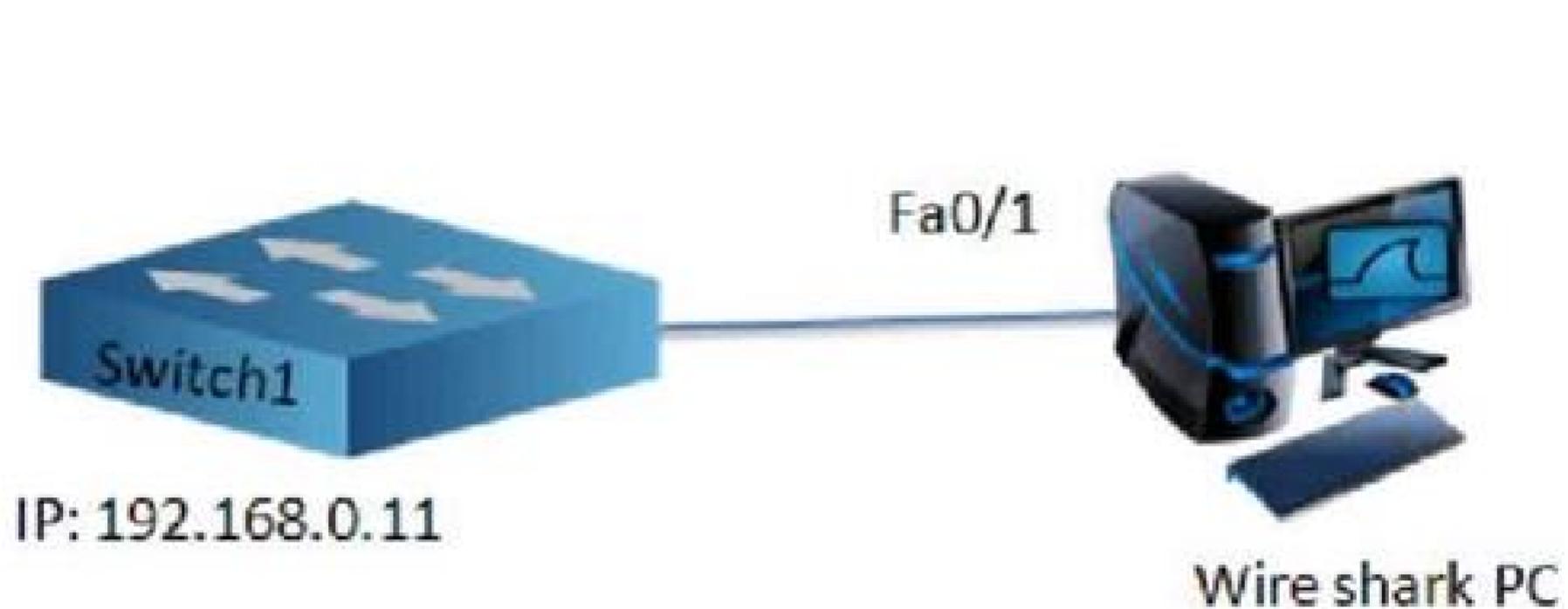
1. Form Neighbour relationship using Authentication (in all the routers)
2. Hongkong should not receive Update of Mongolia
3. Mongolia should ping to loopback of France
4. China shouldn't receive loopback of Sudan

## LAB: Analyzing Packets Using Wireshark

### OBJECTIVE:

Capture Telnet traffic to a switch using Wireshark

### TOPOLOGY:

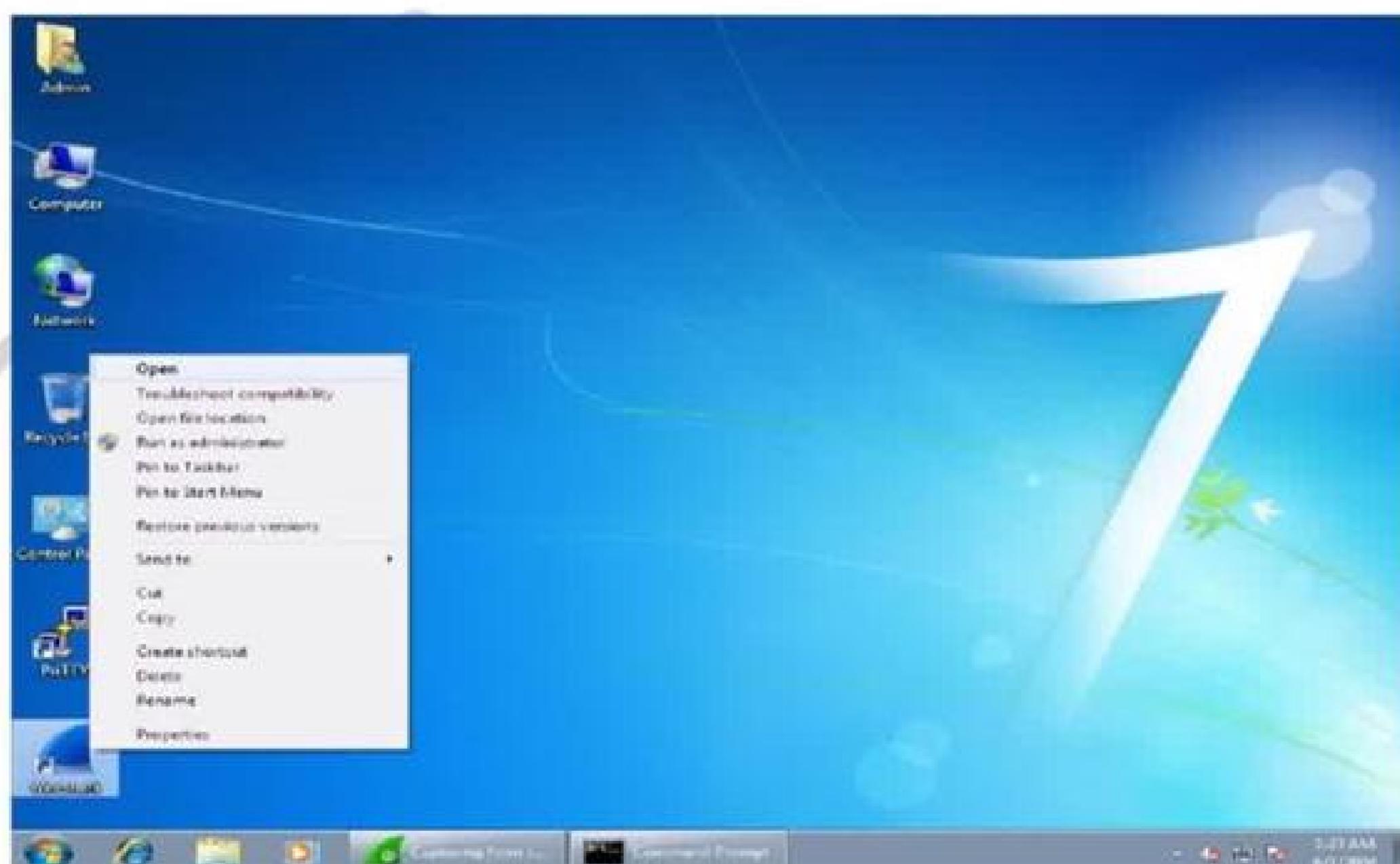


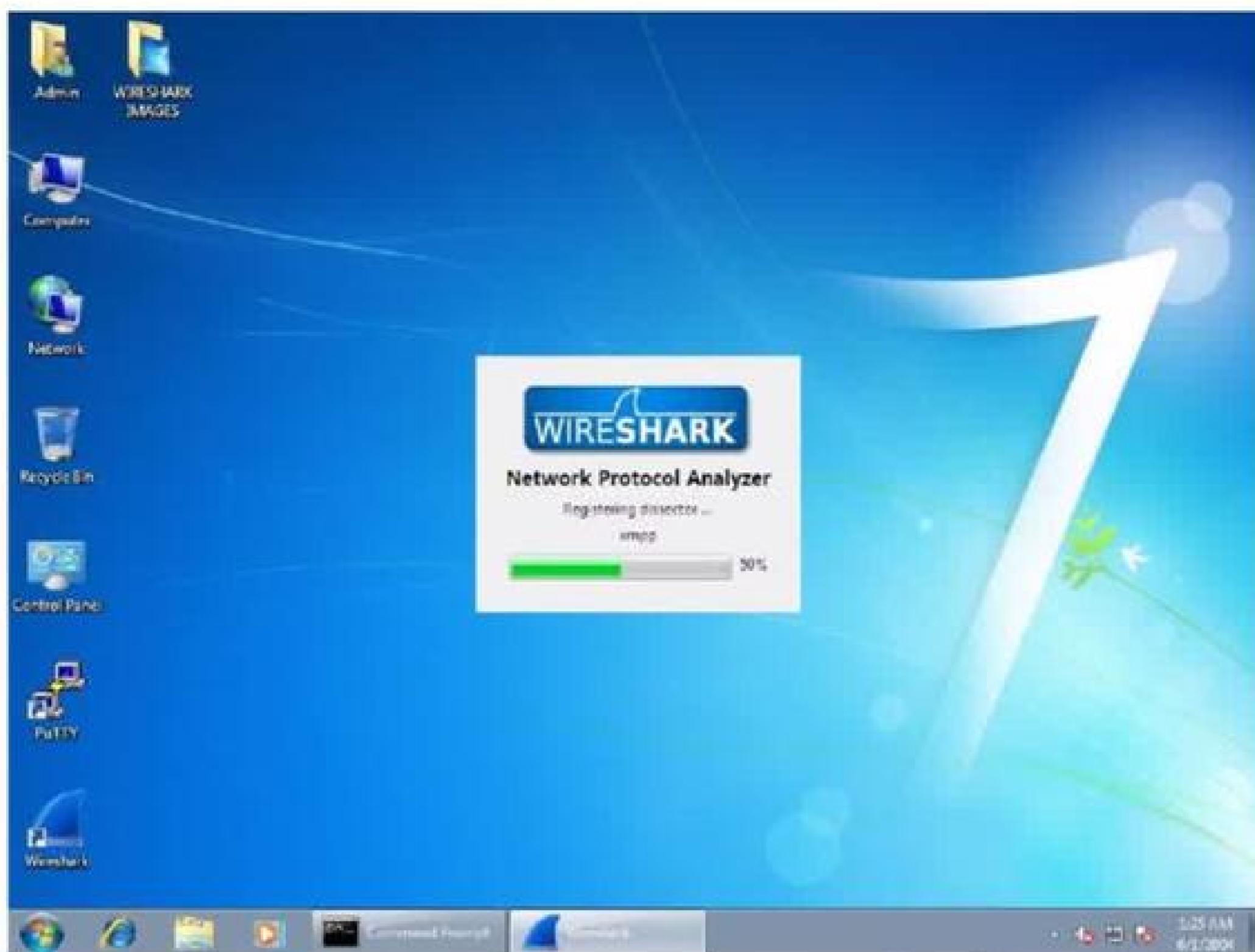
### TASK:

- 1) Capture Telnet Traffic to a switch using Wireshark

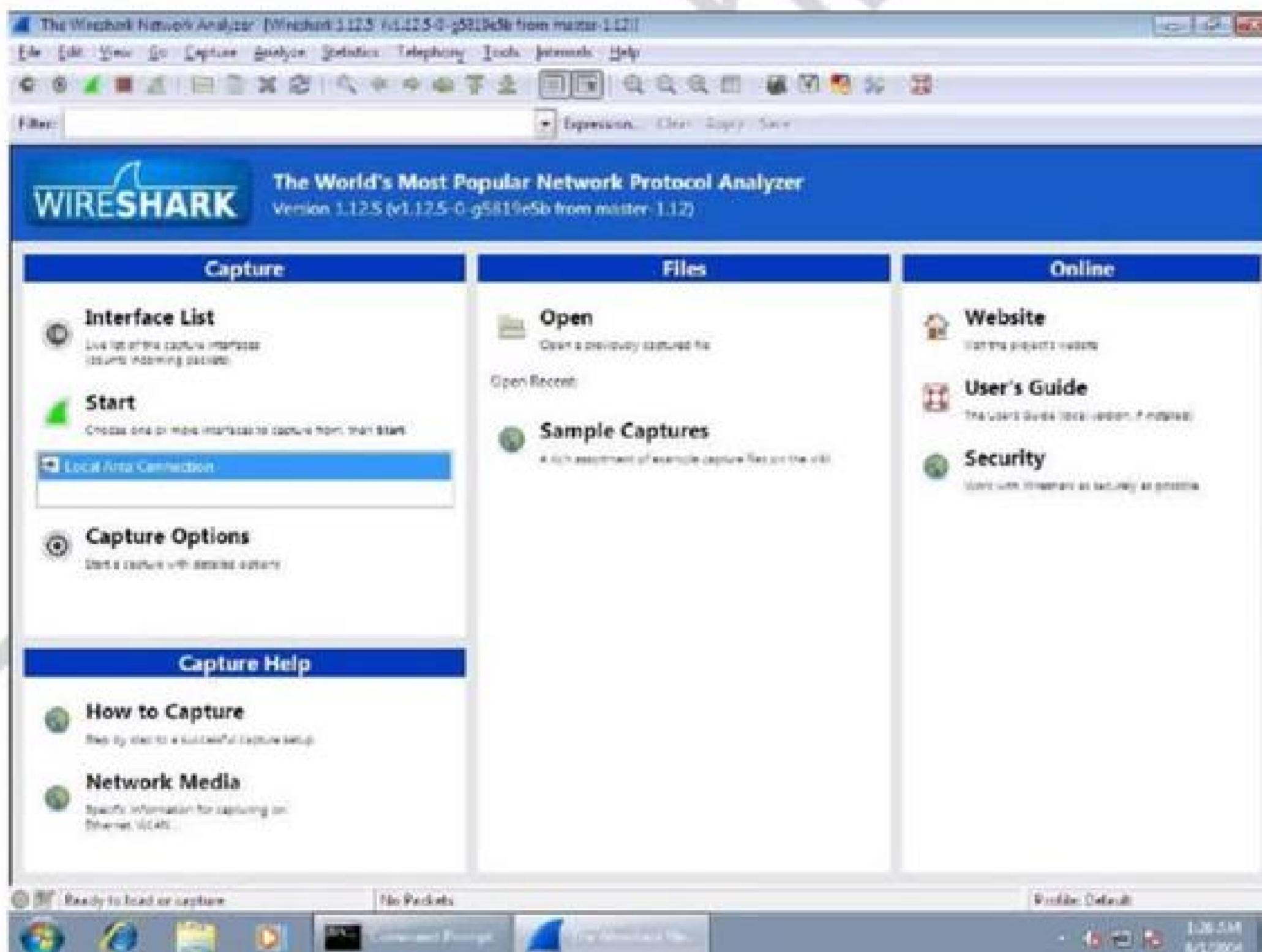
### STEPS:

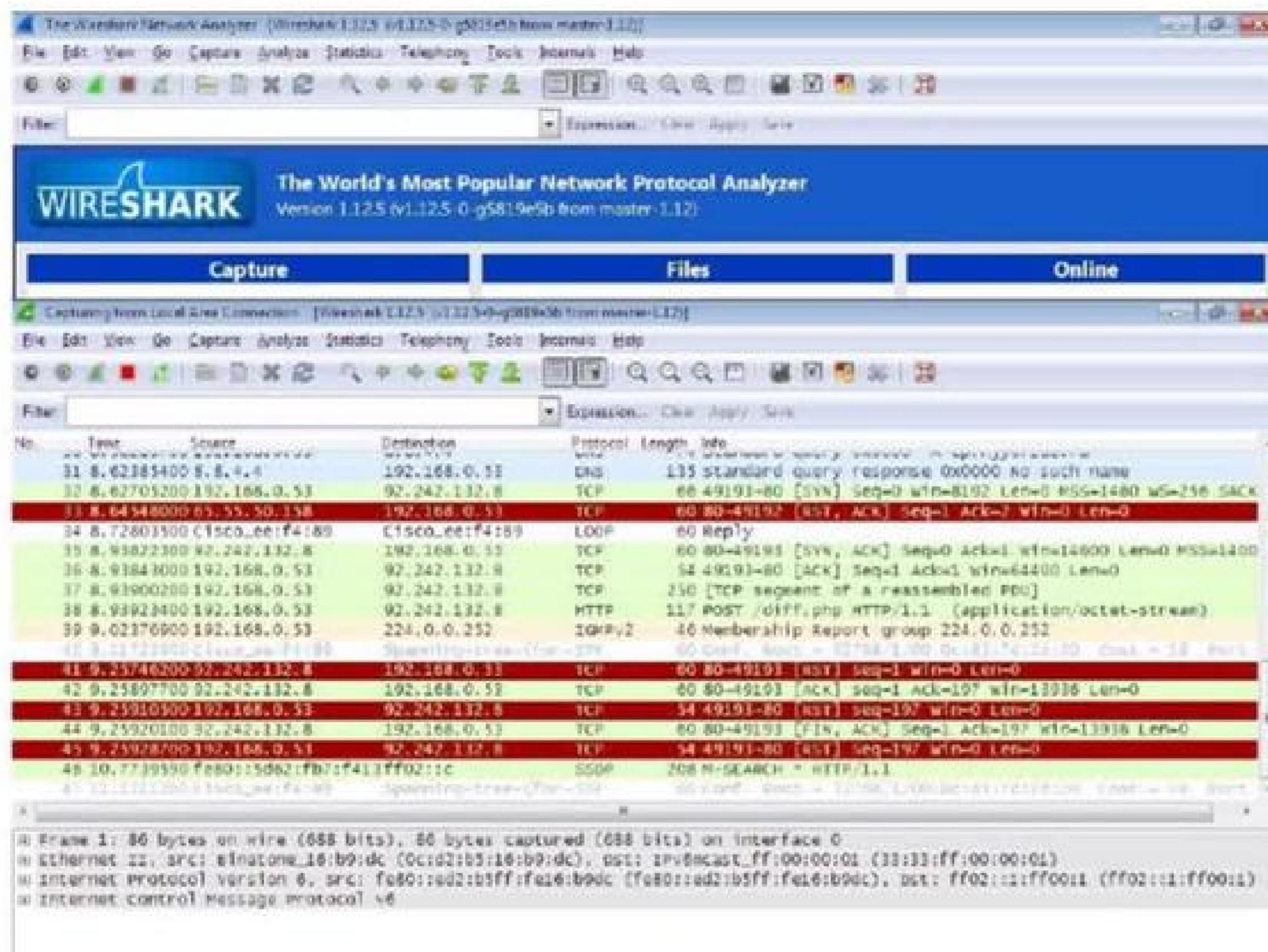
- 1) Open Wireshark in your pc.



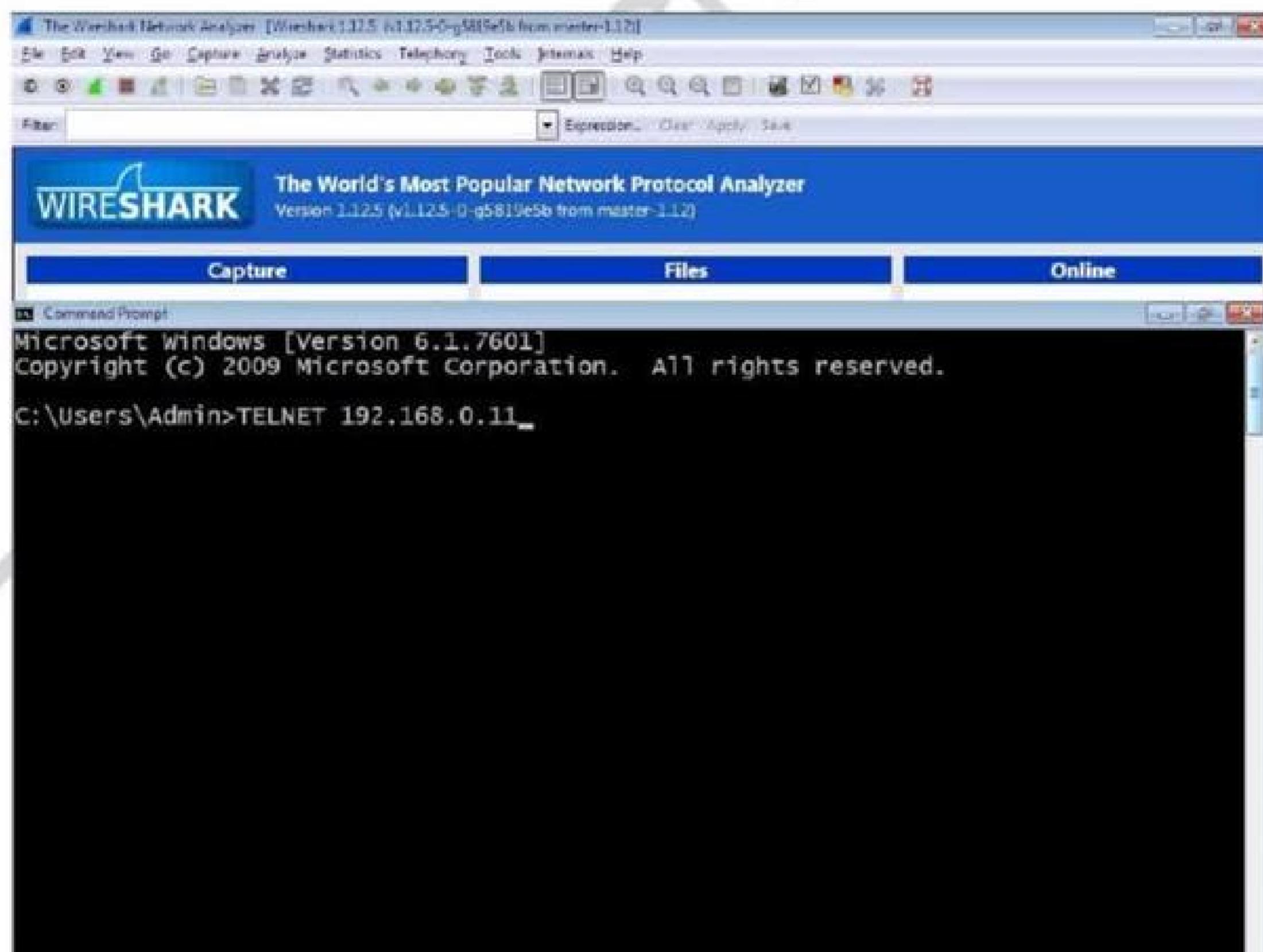


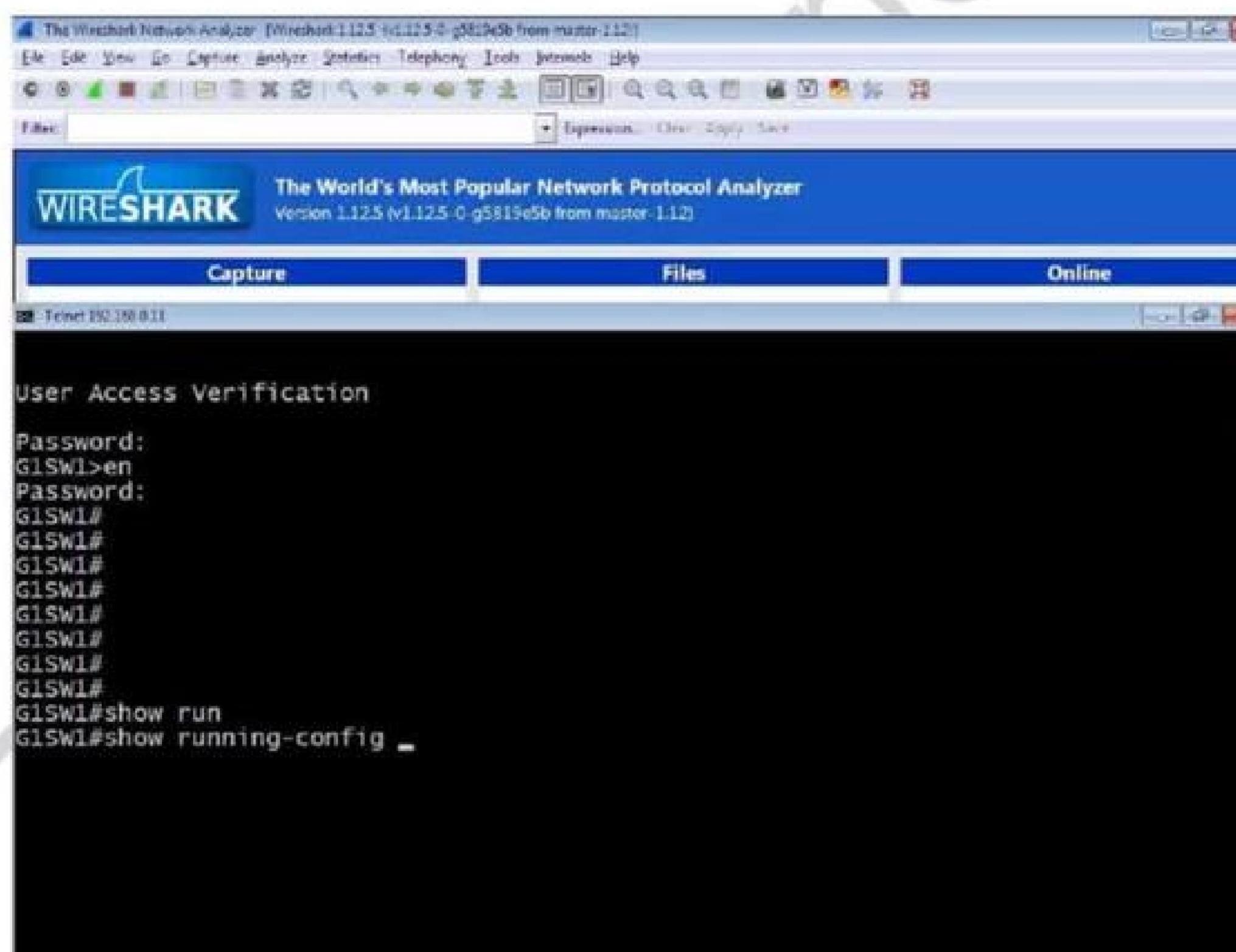
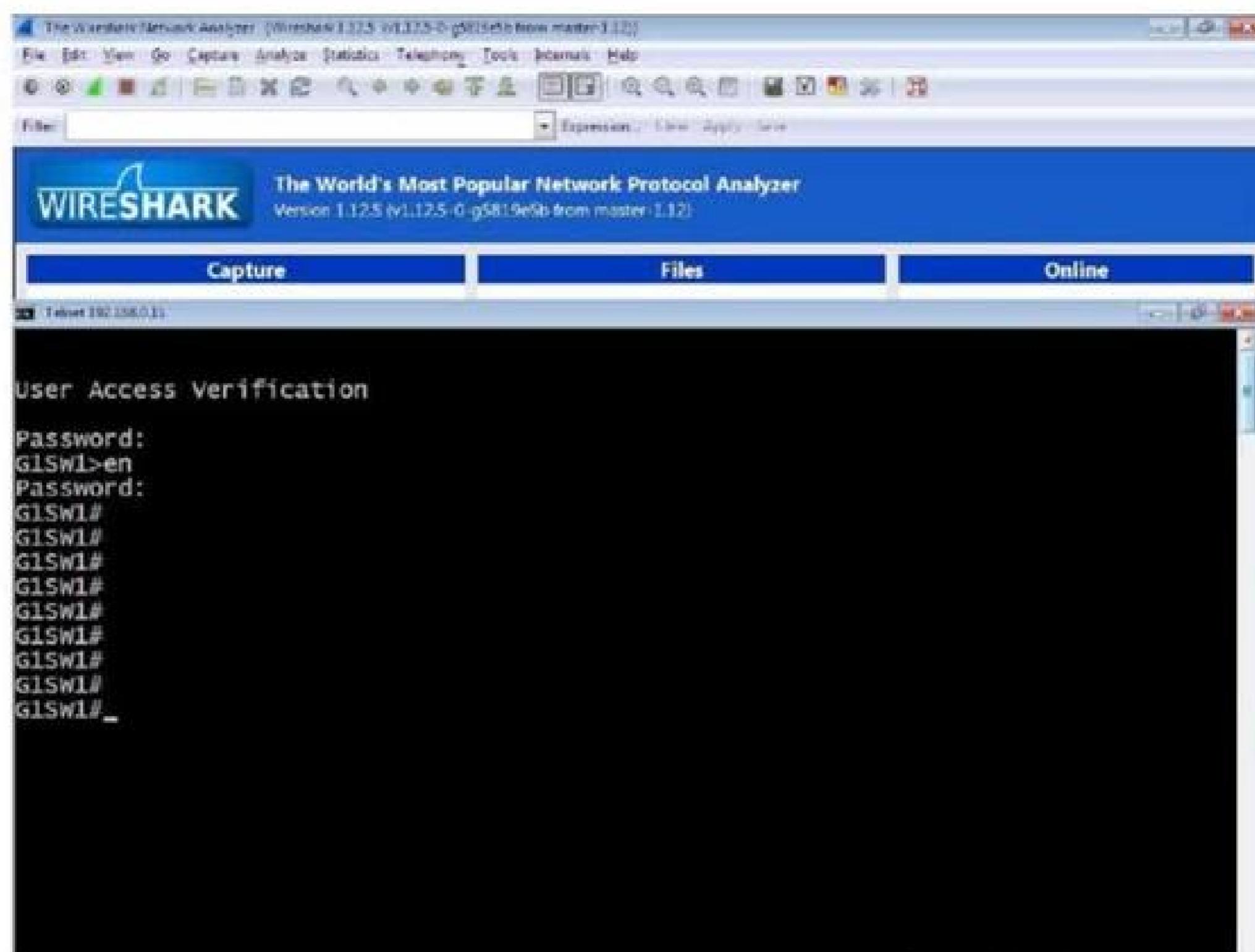
- 2) Select Local Area Connection and click on start to start capturing the packets

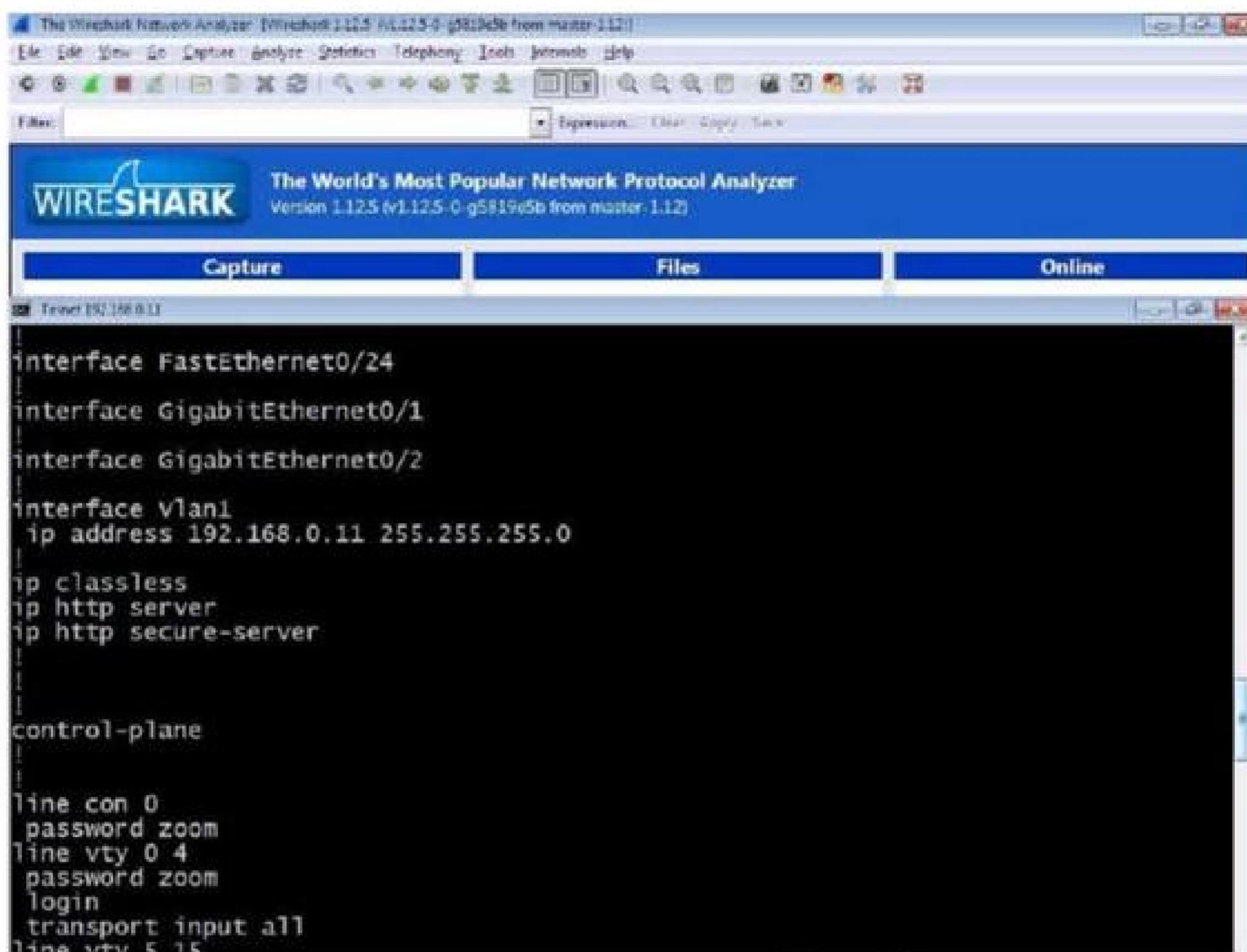




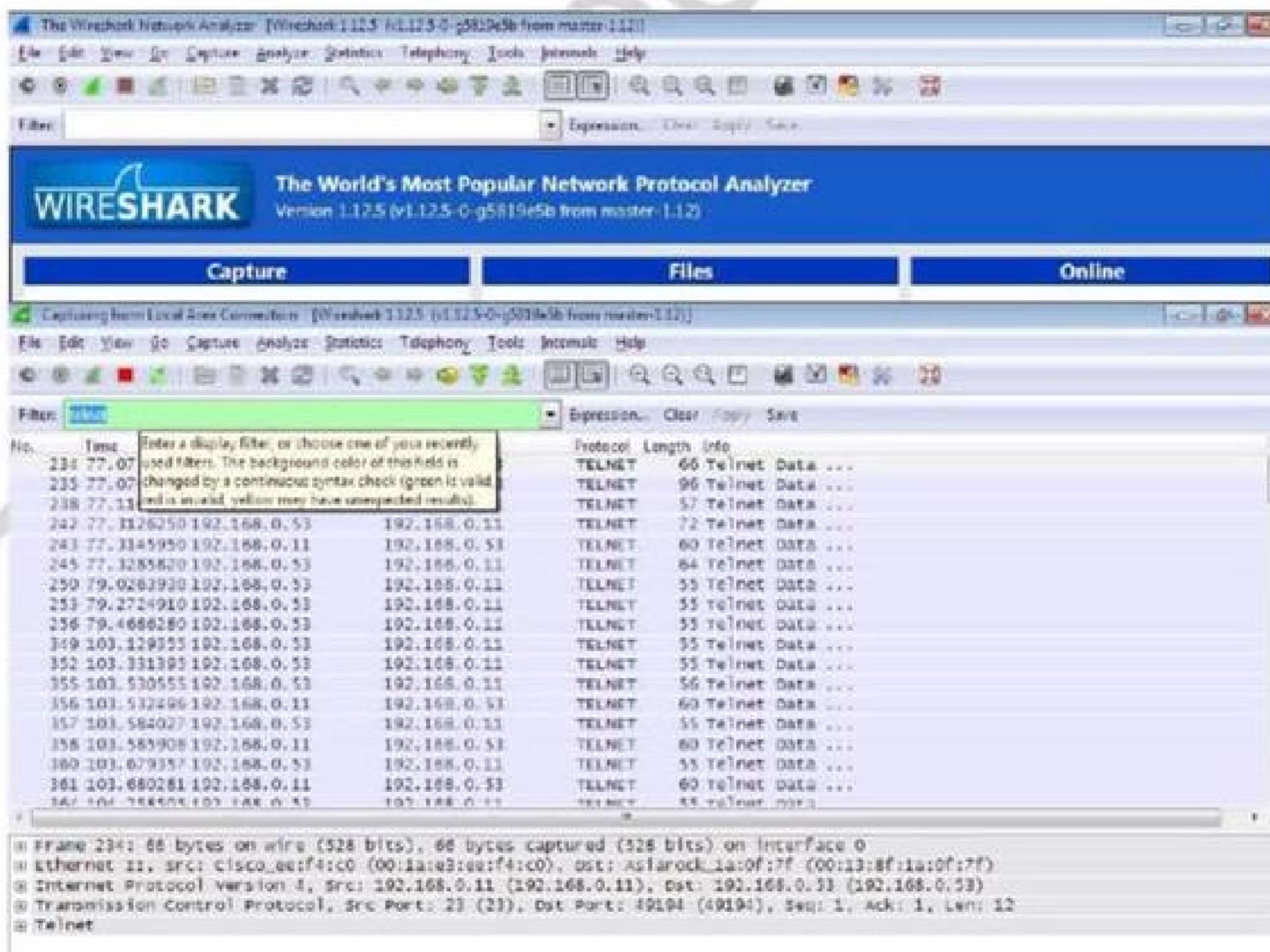
- 3) Open command prompt and telnet to switch and execute same commands on the switch.



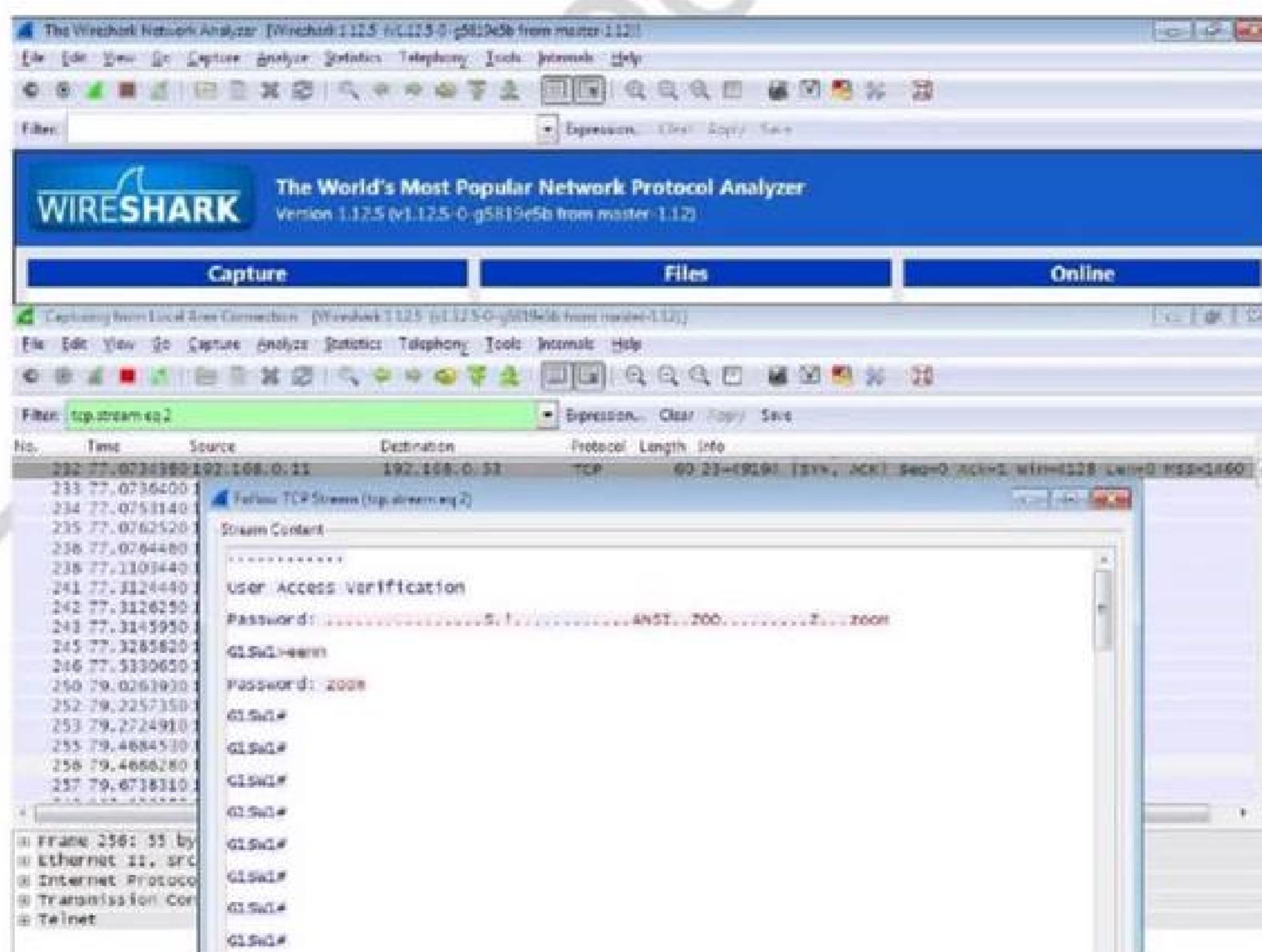
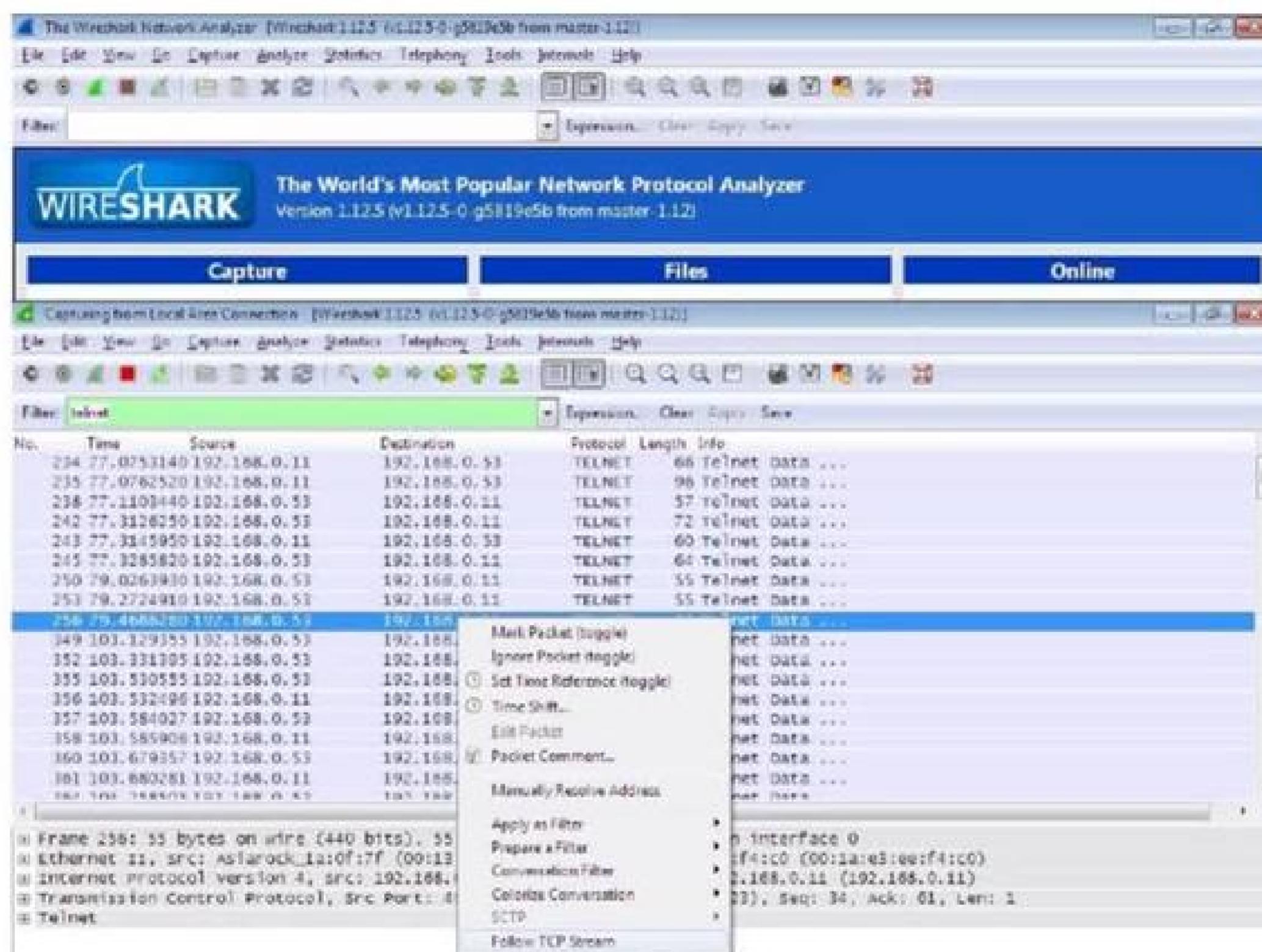




- 4) Now open Wireshark and type telnet in Filter to separate Telnet traffic.



- 5) Select any Telnet Packet and Click on Follow TCP stream to know the information of telnet traffic.



## LAB: Monitoring Network Devices Using PRTG

### OBJECTIVE:

Monitoring the performance of Network Devices using PRTG software.

### TOPOLOGY:

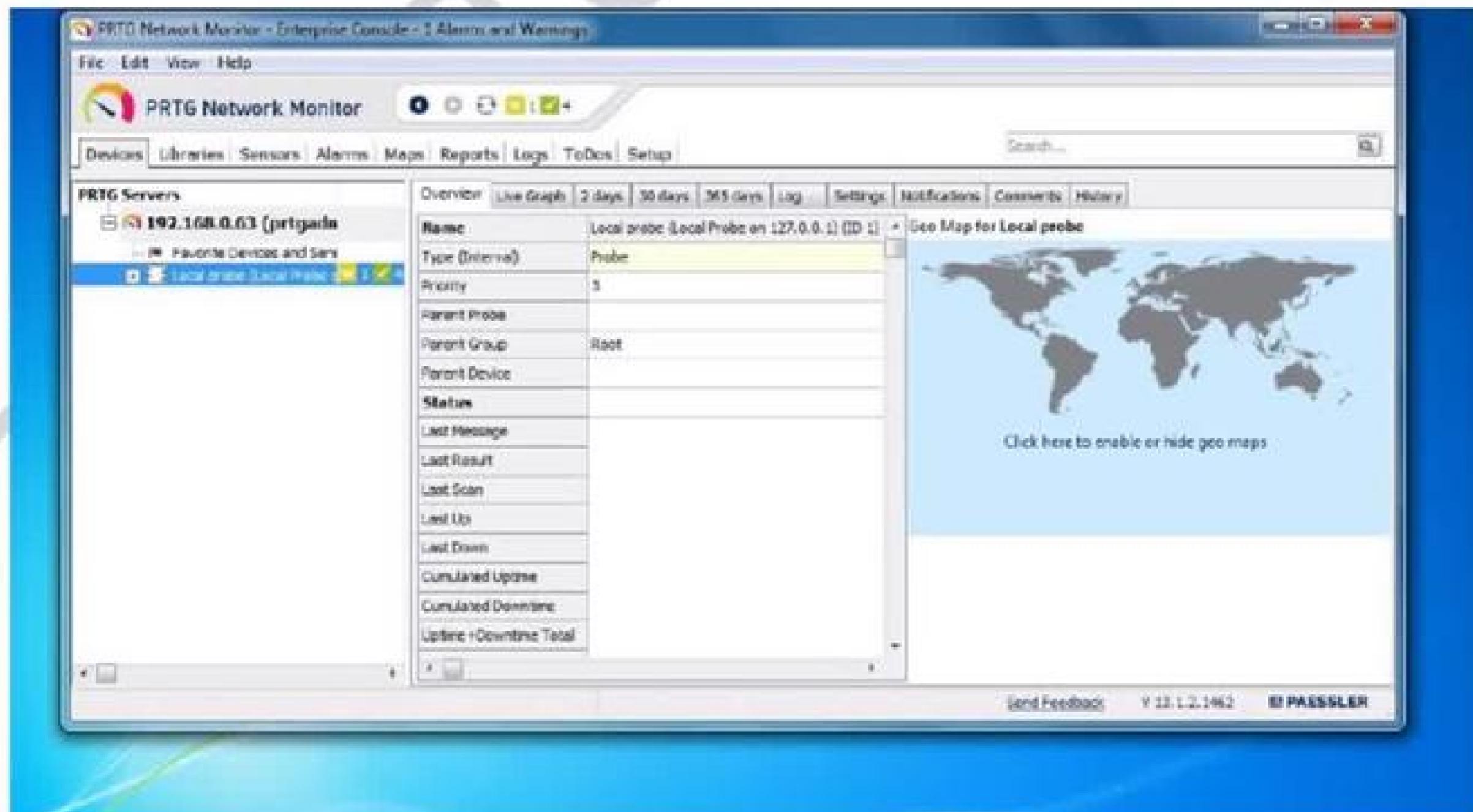
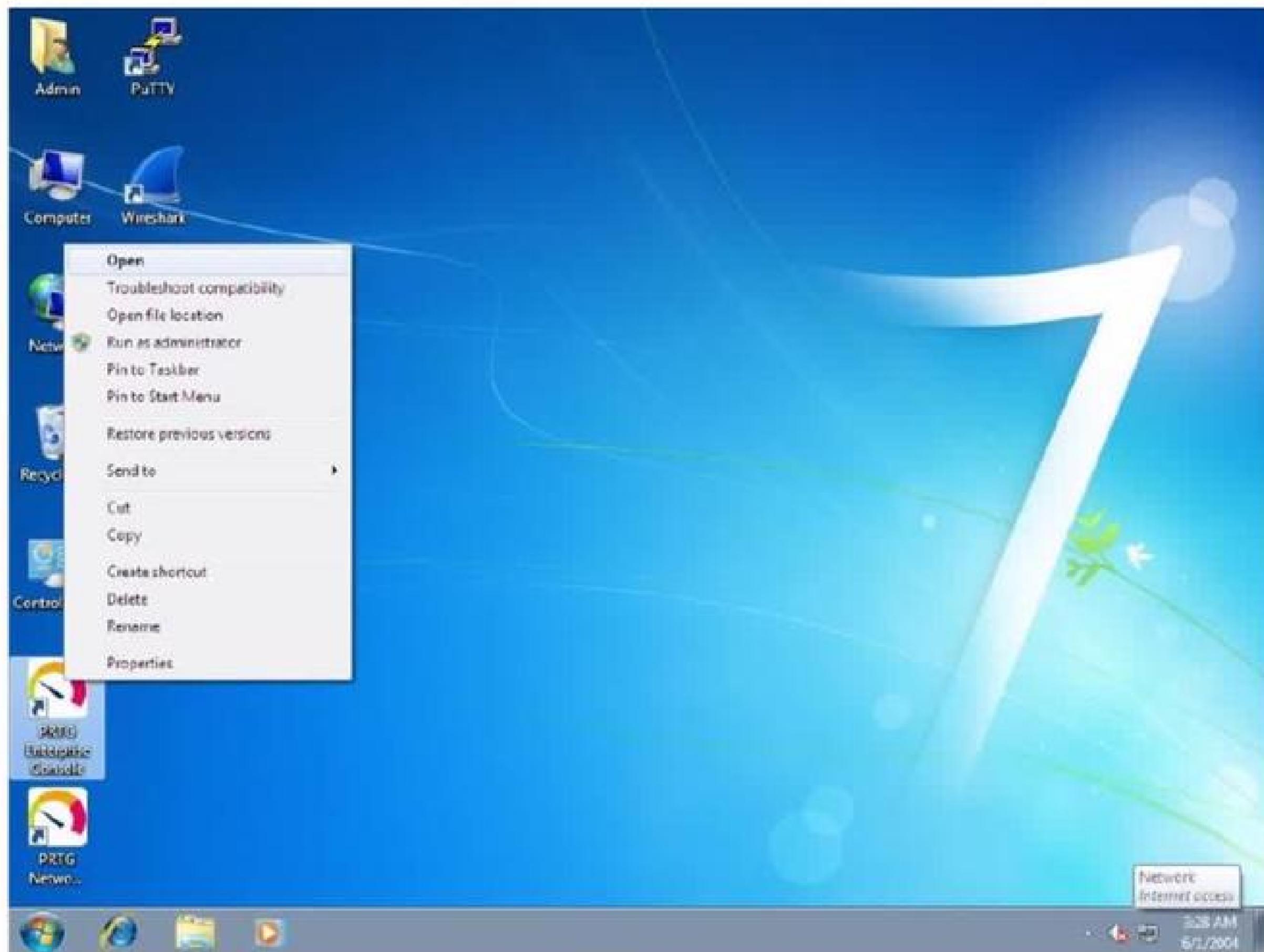


### TASK:

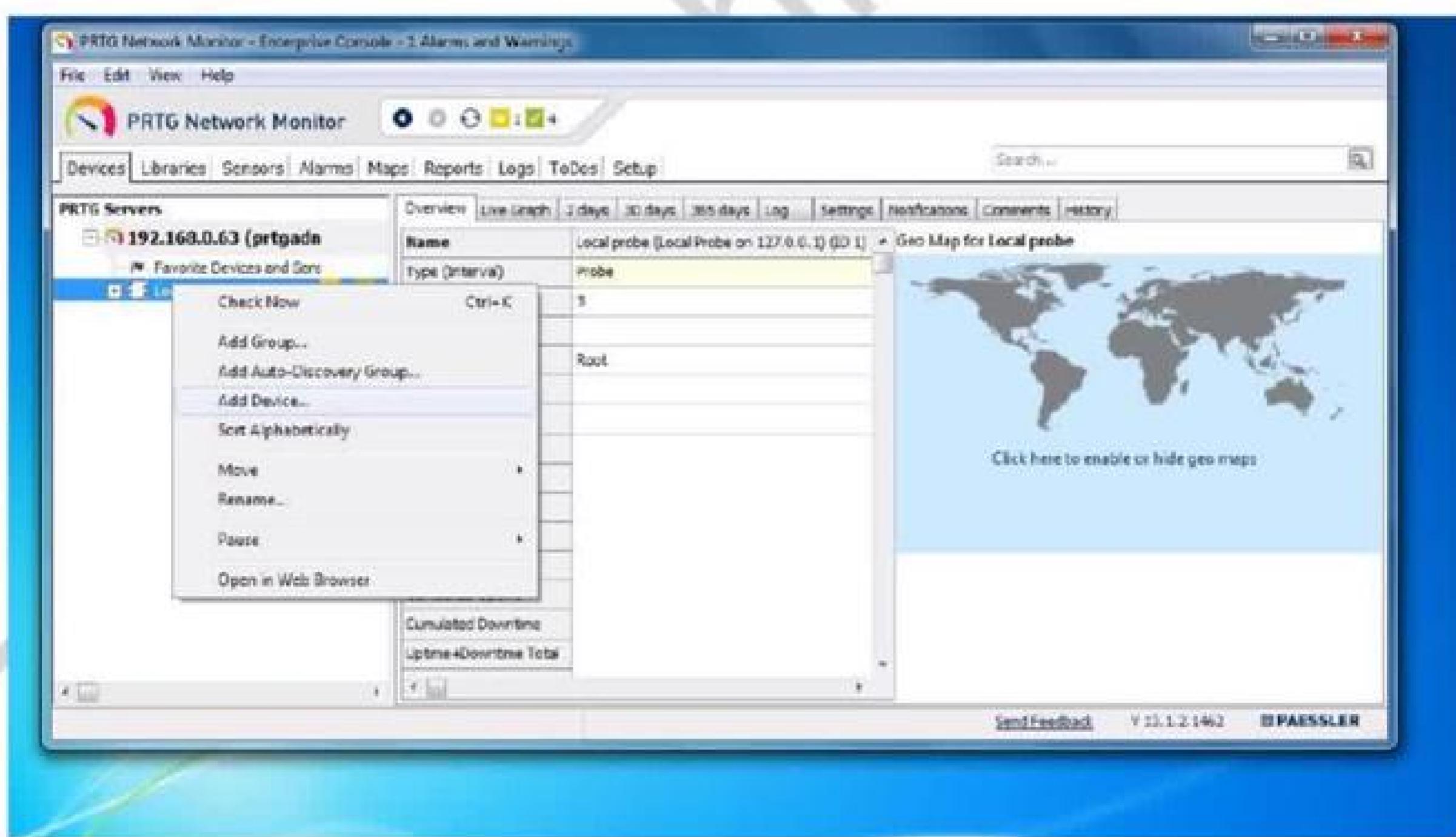
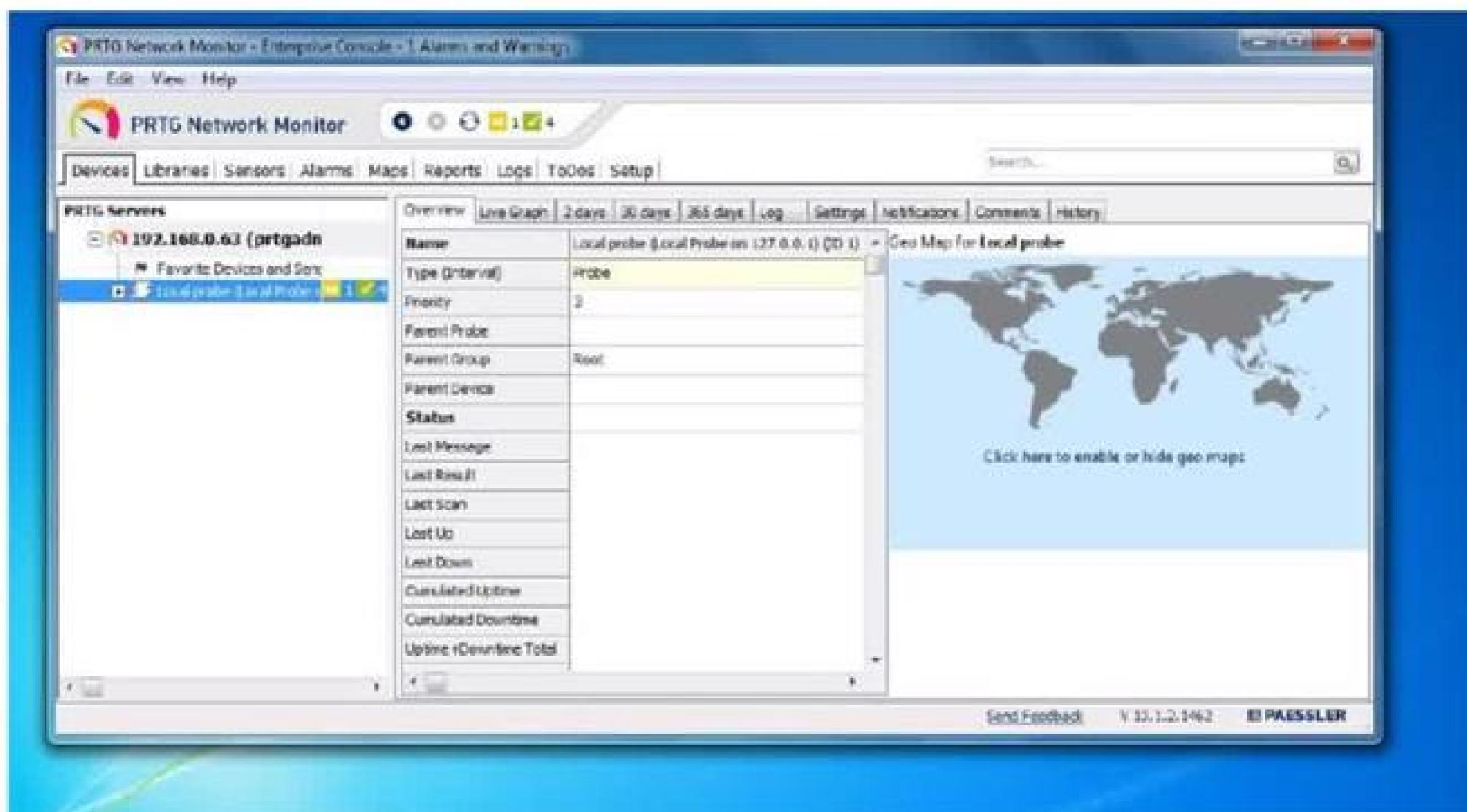
- 1) Monitoring the performance of Network Devices using PRTG software.

**STEPS:**

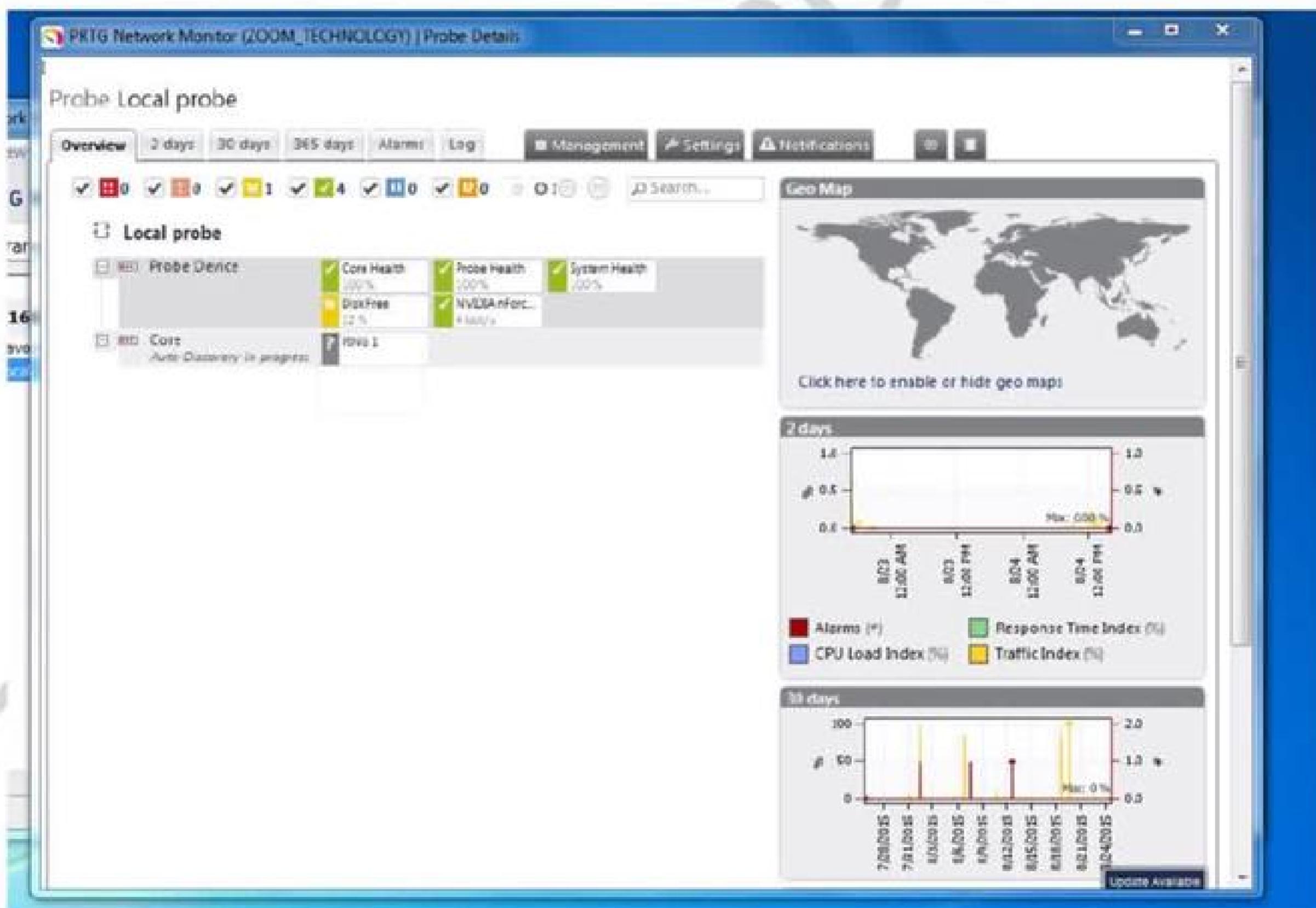
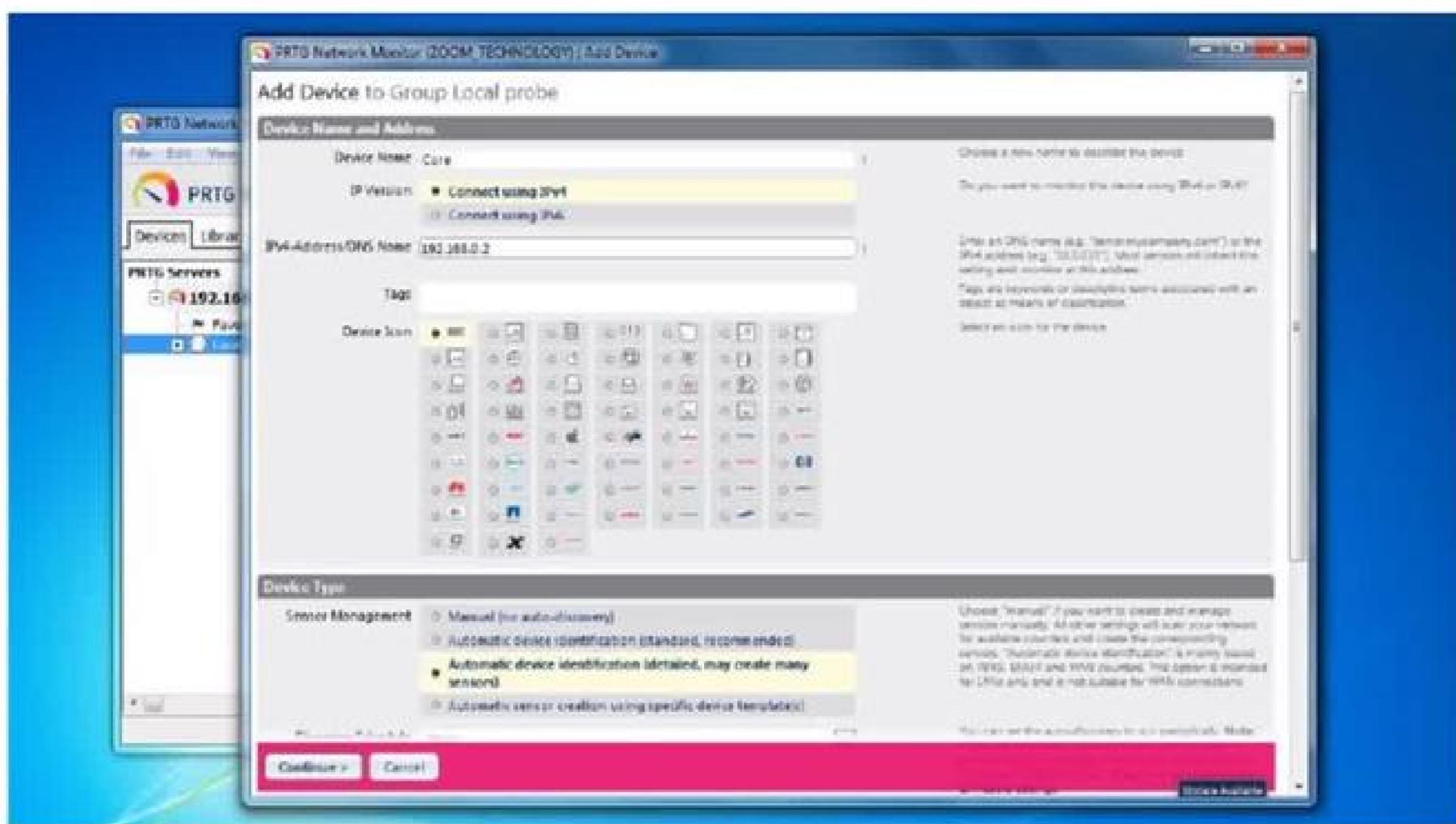
- 1) Open PRTG software in your snmp server pc.



- 2) Right Click on Local Probe and Click on Add device to add the network device that you want to monitor.



- 3) Give the details ( Hostname, IP address ) in the Add device tab and click on continue



The screenshot shows the PRTG Network Monitor interface. On the left, a tree view shows a root node '192.168.0.63 (prtprobe)' with children: 'Parent Device and Sensors' (selected), 'Local probe (Local Probe)', and 'Core'. Under 'Core', there are four sensors: 'Core Health' (Up), 'Probe Health' (Up), 'System Health' (Up), and 'Disk Free' (Warning). The main pane displays a table of log entries for the 'Core' sensor. The columns are: PRTG Server, Date/Time, Parent, Sensor, Status, and Message. The table contains 12 rows of log entries. The last entry is: 'Disconnected: Probe "Local probe" at 127.0.0.1:54321 has disconnected.'

PRTG Server	Date/Time	Parent	Sensor	Status	Message
192.168.0.63	8/24/2015 6:40:30 PM		local probe	OK	Deleted sensor: WICDCA nForce Networking Controller
192.168.0.63	8/24/2015 6:40:35 PM		None	OK	Deleted device: 192.168.0.11 [Core]
192.168.0.63	8/24/2015 6:40:35 PM		local probe	Editor	See history for details.
192.168.0.63	8/24/2015 6:40:35 PM		None	Info	Status sending fail: "shwvdu7@gmail.com" has NO records for the domain gmail.com
192.168.0.63	8/24/2015 6:40:37 PM		None	OK	Deleted device: 192.168.0.11 [Core]
192.168.0.63	8/24/2015 6:40:45 PM		None	New Child	New device: Core
192.168.0.63	8/24/2015 6:42:17 PM		None	Info	Status sending fail: "shwvdu7@gmail.com" has NO records for the domain gmail.com
192.168.0.63	8/24/2015 6:42:17 PM		None	New Child	New device: Core
192.168.0.63	8/24/2015 6:42:26 PM		None	OK	Deleted group: test group
192.168.0.63	8/24/2015 6:42:29 PM		None	OK	Deleted group: CDP Dep
192.168.0.63	8/24/2015 21:49:05 PM	Core	Probe Health	Up	100 %
192.168.0.63	8/24/2015 21:49:03 PM	Core	Disk Free	Warning	12 % (Free space C:\) is below the warning limit of 25 %
192.168.0.63	8/24/2015 21:49:01 PM	None		Connected	Probe "local probe" at 127.0.0.1:54321 has connected.
192.168.0.63	8/24/2015 21:49:02 PM	Core	Disk Free	Up	12 %
192.168.0.63	8/24/2015 21:49:22 PM	Core	Probe Health	Down	
192.168.0.63	8/24/2015 21:49:23 PM	None			Disconnected: Probe "Local probe" at 127.0.0.1:54321 has disconnected.

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(Pre requisite is CCNA R&S)  
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Batches: Morning: 7.30 or Evening: 6.00

**Fees: ₹ 7,500/-  
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