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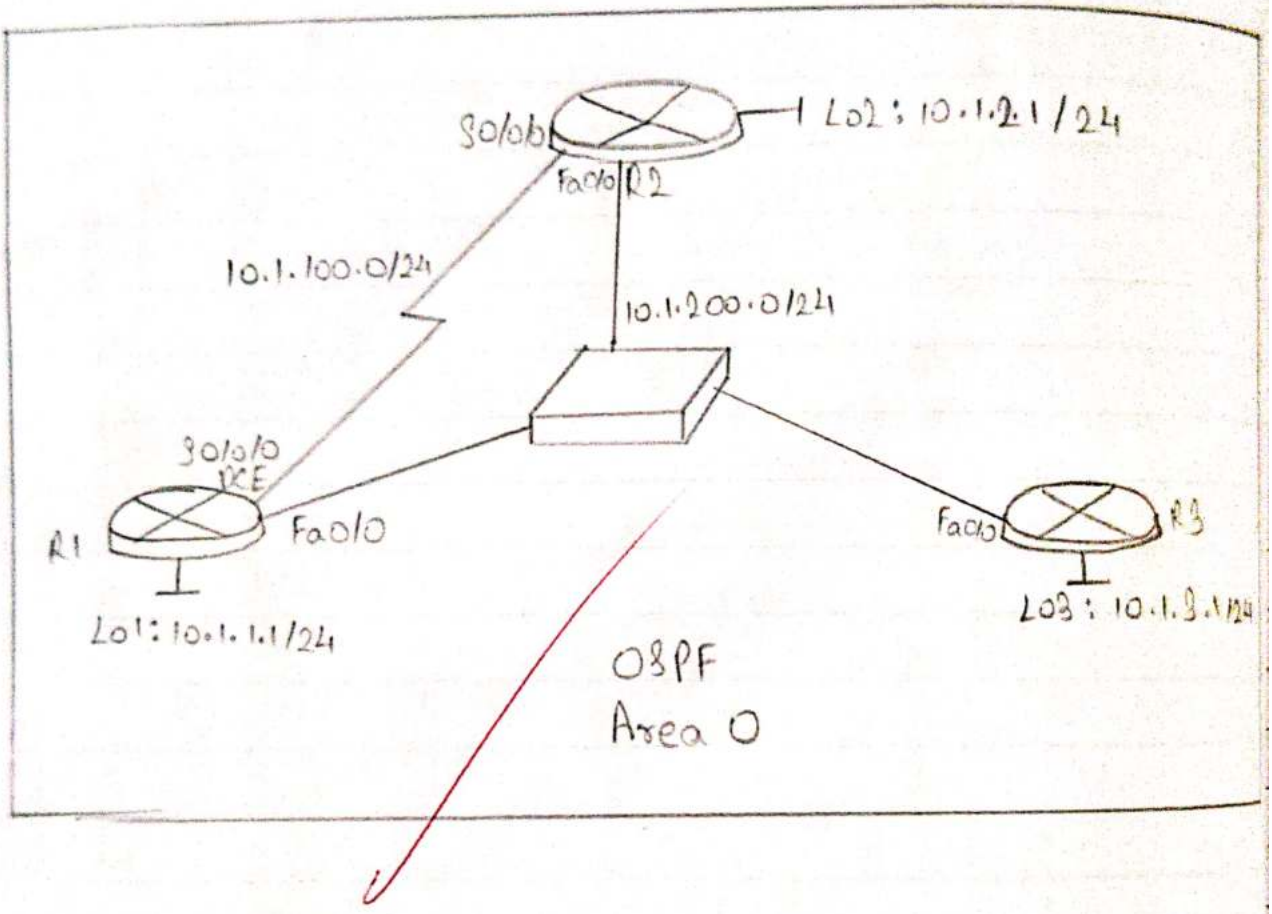
S0/0/0
Lo2 : 10.1.2.1/24
Fa0/0
R2
10.1.100.0/24
10.1.200.0/24
S0/0/0
DCE
R1
Fa0/0
Fa0/0
R3
Lo1 : 10.1.1.1/24
Lo3 : 10.1.3.1/24
OSPF
Area 0

Practical no. 1
Configuring OSPF-1

A] Single - Area OSPF link Costs and Interface Priorities

Step 1 - Configure addressing and loopbacks

a] Apply IP addresses to FastEthernet interface. Create Loopback 1, 2 and 3 and address them accordingly

```
R1(config)# interface loopback 1
R1(config-if)# description engineering department
R1(config-if)# ip address 10.1.1.1 255.255.255.0
R1(config-if)# interface FastEthernet 0/0
R1(config-if)# ip address 10.1.200.1 255.255.255.0
R1(config-if)# no shutdown

R2(config)# interface loopback 2
R2(config-if)# description marketing Department
R2(config-if)# ip address 10.1.2.1 255.255.255.0
R2(config-if)# interface FastEthernet 0/0
R2(config-if)# ip address 10.1.200.2 255.255.255.0
R2(config-if)# no shutdown

R3(config)# interface loopback 3
R3(config-if)# description accounting department
R3(config-if)# ip address 10.1.3.1 255.255.255.0
R3(config-if)# interface FastEthernet 0/0
```

```
R3(config-if)# ip address 10.1.200.3 255.255.255.0
R3(config-if)# no shutdown
```

b) Configure the serial interfaces on R1 and R3

```
R1(config)# interface Serial 0/0/0
R1(config-if)# ip address 10.1.100.1 255.255.255.0
R1(config-if)# clockrate 64000
R1(config-if)# bandwidth 64
R1(config-if)# no shutdown

R2(config)# interface Serial 0/0/0
R2(config)# ip address 10.1.100.2 255.255.255.0
R2(config-if)# bandwidth 64
R2(config-if)# no shutdown
```

Step 2 : Add Physical interfaces to OSPF

```
R1# conf t
R1(config)# router ospf 1
R1(config)# network 10.1.100.0 0.0.0.255 area 0
R1(config-router)# network 10.1.200.0 0.0.0.255 area 0
R1(config-router)# end
R1# debug ip ospf adj
OSPF adjacency events debugging is on.

R3(config)# router ospf 1
R3(config)# network 10.1.200.0 0.0.0.255 area 0
```

```
R1# show ip protocols
Router ID 10.1.1.1
Routing for Networks:
  10.1.100.0  0.0.0.255  area 0
  10.1.200.1  0.0.0.0    area 0
```

```
R1# show ip ospf
Routing Process "ospf 1" with ID 10.1.1.1
```

```
R1# show ip ospf neighbor
Neighbor ID   Pri   State      Dead Time   Address      Interface
10.1.2.1      1     FULL/BDR   00:36       10.1.200.2   FastEthernet 0/0
10.1.3.1      1     FULL/DR    00:35       10.1.200.3   FastEthernet 0/0
10.1.2.1      0     FULL/-     00:36       10.1.100.2   Serial 0/0/0
```

```
R1# show ip ospf interface brief
Interface   PID   Area   IP Address/Mask   Cost   State   Nbrs F/C
Fa 0/0      1     0      10.1.200.1/24     1      DROTH   2/2
Se 0/0/0    1     0      10.1.100.1/24     1      P2P     1/1
```

```
R1# show ip ospf interface FastEthernet 0/0
FastEthernet 0/0 is up, line protocol is up
Internet Address 10.1.200.1/24 Area 0
Process ID 1, Router ID 10.1.1.1, Network Type BROADCAST, Cost:1
```

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```
R1# show ip route
O   10.1.2.1/32 [110/2] via 10.1.200.2, 00:03 FastEthernet 0/0
O   10.1.3.1/32 [110/2] via 10.1.200.3, 00:03 FastEthernet 0/0
```

```
R1# show ip ospf interface Lo1
Process ID 1, Router ID 10.1.1.1, Network Type LOOPBACK, Cost:1
```

R2(config)# router ospf 1
R2(config-router)# network 10.1.100.0 0.0.0.255 area 0
R2(config-router)# network 10.1.200.0 0.0.0.255 area 0

Step 3: Use OSPF show commands

a] show ip protocols
b] show ip ospf
c] show ip ospf interface
d] show ip ospf interface brief
e] show ip ospf database

Step 4: Add loopback interfaces to OSPF

R1(config)# router ospf 1
R1(config-router)# network 10.1.1.0 0.0.0.255 area 0

R2(config)# router ospf 1
R2(config-router)# network 10.1.2.0 0.0.0.255 area 0

R3(config)# router ospf 1
R3(config-router)# network 10.1.3.0 0.0.0.255 area 0

Verify that these network have been added to the routing table using the show ip route command

```
R1(config)# interface loopback1
R1(config)# ip address network point-to-point
R1

R2(config)# interface loopback2
R2(config-if)# ip address network point-to-point

R3(config)# interface loopback 3
R3(config)# ip address network point-to-point
```

Step 5: Modify OSPF link costs

```
R1(config)# interface FastEthernet 0/0
R1(config-if)# ip ospf cost 50

R2(config)# interface FastEthernet 0/0
R2(config-if)# ip ospf cost 50

R3(config)# interface FastEthernet 0/0
R3(config-if)# ip ospf cost 50

R1(config)# router ospf 1
R1(config-router)# auto-cost reference-bandwidth 1000
```

```
R1# show ip ospf neighbor detail
 Neighbor 10.1.2.1 ,interface address 10.1.200.2
 Neighbor priority is 5
 DR is 10.1.200.1 BDR is 10.1.200.2
 Neighbor 10.1.3.1 , interface address 10.1.200.3
 Neighbor priority is 1
 DR is 10.1.200.1 BDR is 10.1.200.2
```

Step 6: Modify interface priorities to control the DR and BDR election

R1(config)# interface FastEthernet 0/0
R1(config-if)# ip ospf priority 10

R2 (config-if)# ip ospf priority 5

now write the command show ip ospf neighbor detail

Challege : Topology Change

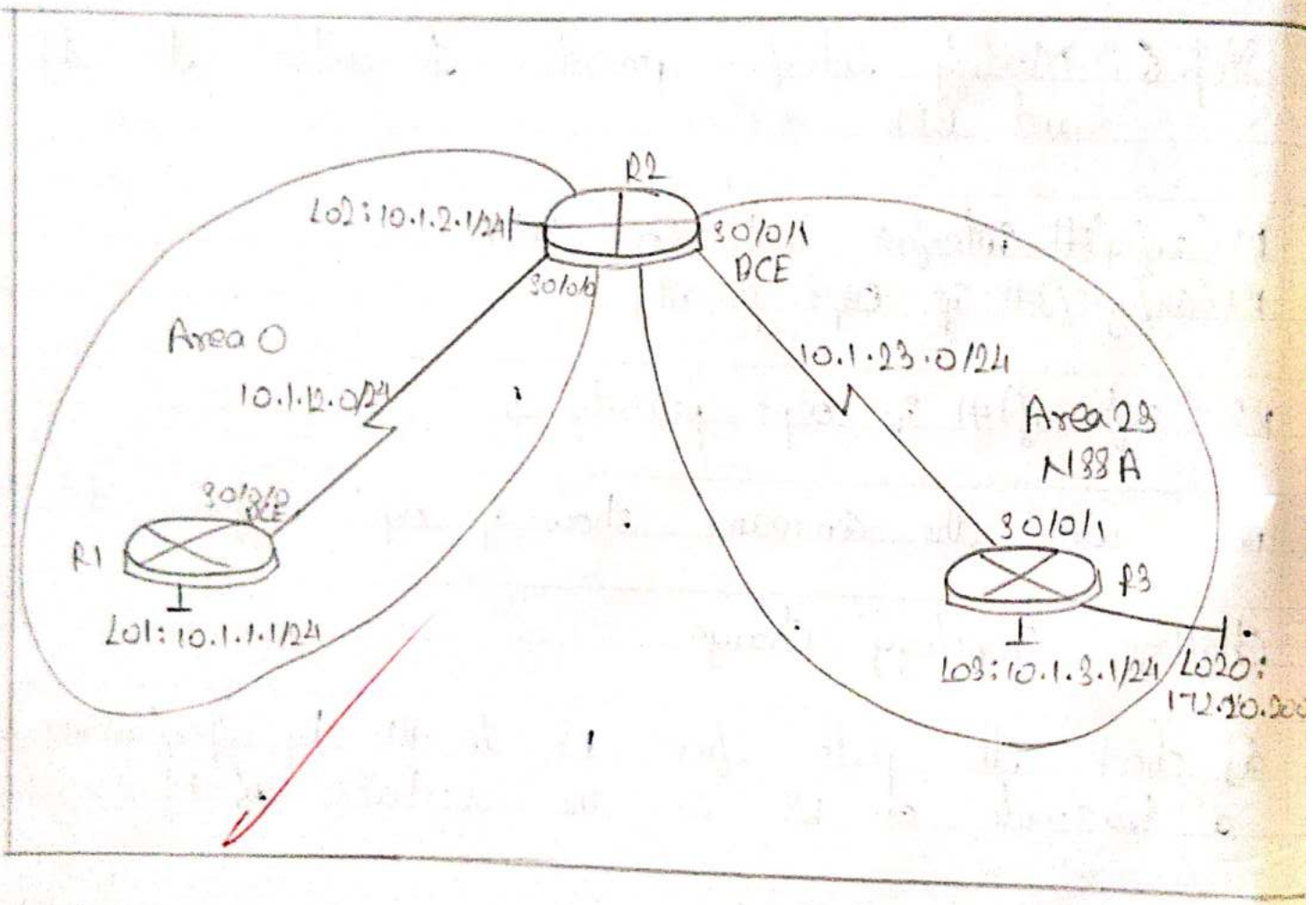
a] check the path from R3 to R1 by performing a traceroute on R3 to the loopback of R1

R3# traceroute 10.1.1.1
Tracing the route to 10.1.1.1
1. 10.1.200.1 0 msec 0 msec *

b] Initiate the ping from R3 to R1 loopback with high repeat number

R3# ping 10.1.1.1 repeat 10000

R1(config)# interface FastEthernet 0/0
R1(config-if)# shutdown


R2
Lo2: 10.1.2.1/24
3/0/1
DCE
3/0/0
Area 0
10.1.12.0/24
10.1.23.0/24
Area 23
NSSA
3/0/0
DCE
R1
3/0/1
R3
Lo1: 10.1.1.1/24
Lo3: 10.1.3.1/24
Lo20:

B) Multi-area OSPF with Stub Areas and Authentication

Step 1: Configure addressing and loopbacks

```
R1(config)# interface loopback 1
R1(config-if)# description Engineering Department
R1(config-if)# ip address 10.1.1.1 255.255.255.0
R1(config-if)# interface s 0/0/0
R1(config-if)# clockrate 64000
R1(config-if)# no shutdown

R2(config)# interface loopback 2
R2(config-if)# description Marketing department
R2(config-if)# ip address 10.1.2.1 255.255.255.0
R2(config-if)# interface s 0/0/0
R2(config-if)# ip address 10.1.12.2 255.255.255.0
R2(config-if)# no shutdown
R2(config-if)# interface s 0/0/1
R2(config-if)# ip address 10.1.23.2 255.255.255.0
R2(config-if)# clock rate 64000
R2(config-if)# no shutdown

R3(config)# interface loopback 3
R3(config)# description Accounting department
R3(config-if)# ip address 10.1.3.1 255.255.255.0
R3(config-if)# interface loopback 20
R3(config-if)# description Connection to Another AS
R3(config-if)# ip address 172.20.200.1 255.255.255.0
```

```
R3(config-if)# interface s0/0/1
R3(config-if)# ip address 10.1.23.3 255.255.255.0
R3(config-if)# no shutdown
```

Step 2: Add interfaces into OSPF

```
R1(config)# router ospf 1
R1(config)# network 10.1.12.0 0.0.0.255 area 0
R1(config-router)# network 10.1.1.0 0.0.0.255 area 0
R1(config-router)# interface loopback 1
R1(config-router)# ip ospf network point-to-point

R2(config)# router ospf 1
R2(config-router)# network 10.1.12.0 0.0.0.255 area 0
R2(config-router)# network 10.1.2.0 0.0.0.255 area 0
R2(config-router)# interface loopback 2
R2(config-if)# ip ospf network point-to-point
```

verify using command show ip route

```
R2(config)# router ospf 1
R2(config-router)# network 10.1.23.0 0.0.0.255 area 23

R3(config)# router ospf 1
R3(config-router)# network 10.1.23.0 0.0.0.255 area 23
R3(config-router)# network 10.1.3.0 0.0.0.255 area 23
R3(config-router)# interface loopback 3
R3(config-if)# ip ospf network point-to-point
```

```
R3# show ip route
O*IA  0.0.0.0/0 [110/65] via 10.1.23.2 ,00:56 , Serial 0/0/1
```

```
R2# show ip ospf
 Area 23
    It is a stub area
```

```
R3 # show ip ospf database
                Summary net Link states (Area 23)
Link ID      ADV Router     Age        Seq #        Check Sum
0.0.0.0      10.1.2.1       68         0x800002     0x0039F5
```

Step 3 : Configure a stub area

a] make area 23 the stub area using the area <area> stub command

R2 (config)# router ospf 1
R2 (config-router)# area 23 stub

R3 (config)# router ospf 1
R3 (config-router)# area 23 stub

b] Confirm it by using command show ip ospf command

c] Look at the output of the show ip ospf command

Step 4 : Configure a totally stubby area

a] Enter the stub no-summary command on R2 (the ABR) under the OSPF process

R2 (config)# router ospf 1
R2 (config-router)# area 23 stub no-summary

b] Look at the show ip ospf database output to see which routes are in area 23

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```
R2# show ip ospf
Area 23
  It is a NSSA area
```

```
R3# show ip route
O*IA 0.0.0.0/0 [110/65] via 10.1.23.2 ,00:20, Serial 0/0/1
```

```
R2# show ip ospf database
                Summary Net Link States (Area 23)
Link ID      ADV Router    Age    Seq#        CheckSum
0.0.0.0      10.1.2.1      34     0x8000001   0x00C265
                Type-7 AS External Link states (Area 23)
10.1.3.0     10.1.3.1      200    0x800001    0x0076FC
                Type-5 AS External Link states
10.1.3.0     10.1.2.1      199    0x8000001   0x00CA2F
```

Step 5: Configure a not-so-stubby area

a] change area 23 into an NSSA.

```
R2(config)# router ospf 1
R2(config-router)# no area 23 stub
R2(config-router)# area 23 nssa

R3(config)# router ospf 1
R3(config)# no area 23 stub
R3(config-router)# area 23 nssa
R3(config-router)# redistribute connected subnets
```

b] In the output of the show ip ospf command on R2, notice that area 23 is an NSSA and that R2 is performing the LSA type 7 to type 5 translation.

c] Issue the area 23 nssa no-summary command on R2

```
R2(config)# router ospf 1
R2(config-router)# area 23 nssa no-summary
```

d] check the routing table on R3. Notice that the inter-area routes have been replaced by a single default route

e] On R2, look at the show ip ospf database output to see the various LSA types

```
R2# show ip ospf interface s0/0/1
  Simple Password authentication enabled
```

```
R1# show ip ospf interface s0/0/0
  Message digest authentication enabled
                                youngest key id is 1
```

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Step 6: Configure OSPF interface authentication

a] Configure the link between R2 and R3 for plaintext authentication

```
R2(config)# interface s0/0/1
R2(config)# ip ospf authentication
R2(config-if)# ip ospf authentication-key cisco

R3(config)# interface s0/0/1
R3(config-if)# ip ospf authentication
R3(config-if)# ip ospf authentication-key cisco
```

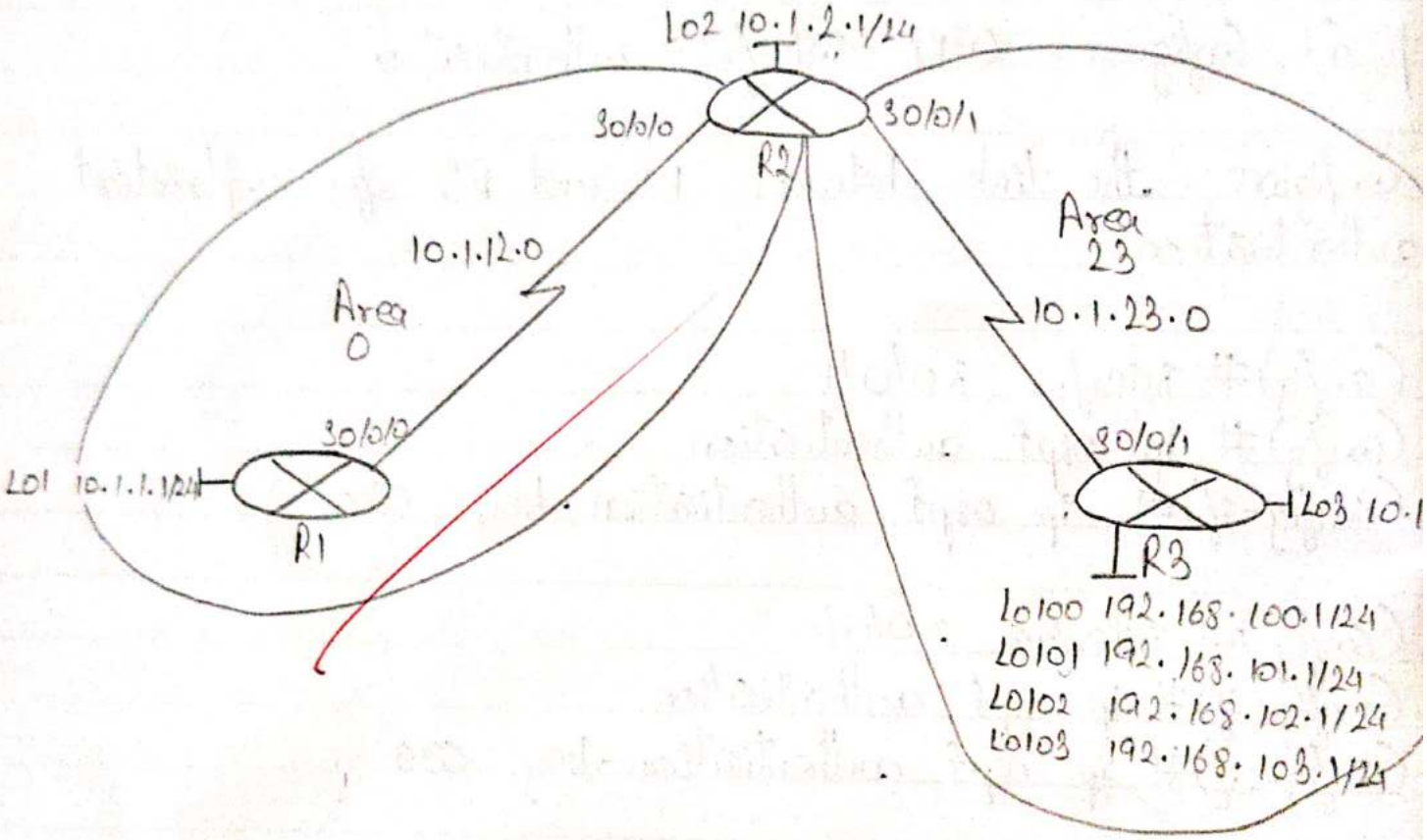
b] Verify the authentication using the show ip ospf interface

c] MD5 authentication between the R2 and R1

```
R1(config)# interface s0/0/0
R1(config-if)# ip ospf authentication message-digest
R1(config-if)# ip ospf message-digest-key 1 md5 cisco

R2(config)# interface s0/0/0
R2(config-if)# ip ospf authentication message-digest
R2(config-if)# ip ospf message-digest-key 1 md5 cisco
```

d] Verify the configuration using the show ip ospf interface command on R1


Lo2 10.1.2.1/24
30/0/0
30/0/1
R2
10.1.12.0
Area 0
Area 23
10.1.23.0
30/0/0
Lo1 10.1.1.1/24
R1
30/0/1
Lo3 10.1
R3
Lo100 192.168.100.1/24
Lo101 192.168.101.1/24
Lo102 192.168.102.1/24
Lo103 192.168.103.1/24

Practical no. 2
Configuring OSPF - II

A] OSPF Virtual Links and Area Summarization

Step 1: Configuring addressing and loopbacks

```
R1(Config)# interface loopback 1
R1(Config)# description Engineering Department
R1(Config-if)# ip address 10.1.1.1 255.255.255.0
R1(Config-if)# interface loopback 30
R1(Config-if)# ip address 172.30.30.1 255.255.255.252
R1(Config-if)# ip address 10.1.12.1 255.255.255.0
R1(Config-if)# clockrate 640000
R1(Config-if)# no shutdown

R2(Config)# interface loopback 2
R2(Config-if)# description Marketing department
R2(Config-if)# ip address 10.1.2.1 255.255.255.0
R2(Config-if)# ipterface s 0/0/0
R2(Config-if)# ip address 10.1.12.2 255.255.255.0
R2(Config-if)# no shutdown
R2(Config-if)# interface s 0/0/1
R2(Config-if)# ip address 10.1.23.2 255.255.255.0
R2(Config-if)# no shutdown
```

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```
R3 (config) # interface loopback 3
R3 (config-if) # description Accounting Department
R3 (config-if) # ip address 10.1.3.1 255.255.255.0
R3 (config-if)# interface loopback 100
R3 (config-if) #ip address 192.168.100.1 255.255.255.0
R3 (config-if)# interface loopback 101
R3 (config-if) # ip address 192.168.101.1 255.255.255.0
R3 (config-if) # interface loopback 102
R3 (config-if) # ip address 192.168.102.1 255.255.255.0
R3 (config-if)# interface loopback 103
R3 (config-if)# ip address 192.168.103.1 255.255.255.0
R3(config-if)# interface s0/0/1
R3 (config-if) # ip address 10.1.23.3 255.255.255.0
R3 (config-if)# no shutdown
```

Step 2 : Add interfaces into OSPF

```
R1(config)# router ospf 1
R1(config-router) # network 10.1.12.0 0.0.0.255 area 0
R1(config-router)# network 10.1.1.0 0.0.0.255 area 0
R1(config-router)# interface loopback 1
R1(config-if)# ip ospf network point-to-point

R2(config)# router ospf 1
R2(config-router)# network 10.1.12.0 0.0.0.255 area 0
R2(config-router)# network 10.1.2.0 0.0.0.255 area 0
R2(config-router)# interface loopback 2
R2(config-router)# ip ospf network point-to-point
```

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R2(config-router)# network 10.1.23.0 0.0.0.255 area 23

R3(config)# router ospf 1
R3(config-router)# network 10.1.23.0 0.0.0.255 area 23
R3(config-router)# network 10.1.23.0 0.0.0.255 area 23
R3(config-router)# interface loopback 3
R3(config-if)# ip ospf network point-to-point

Step 3: Create a virtual link

a] Add loopbacks 100 through 103 R3 to the OSPF process in area 100 using the network command. change the network type to advertise the correct subnet mask

R3(config)# router ospf 1
R3(config-router)# network 192.168.100.0 0.0.3.255 area 100
R3(config)# interface loopback 100
R3(config-if)# ip ospf network point-to-point
R3(config-if)# interface loopback 101
R3(config-if)# ip ospf network point-to-point
R3(config-if)# interface loopback 102
R3(config-if)# ip ospf network point-to-point
R3(config-if)# interface loopback 103
R3(config-if)# ip ospf network point-to-point

b] Create a virtual link using the area transit area virtual-link router-id OSPF configuration command on both R2 and R3

~~Show~~

```
R2# show ip route
O IA 192.168.102.0/24 [110/65] via 10.1.23.3 Serial 0/0/1
O IA 192.168.103.0/24 [110/65] via 10.1.23.3 Serial 0/0/1
O IA 192.168.100.0/24 [110/65] via 10.1.23.3 Serial 0/0/1
O IA 192.168.101.0/24 [110/65] via 10.1.23.3 Serial 0/0/1
```

```
R2# show ip neighbor
192.168.103.1   0   FULL/ -   -   10.1.23.3
```

```
R2# show ip ospf interface
OSPF_VL0 is up, line protocol is up
Router ID 10.1.2.1, Network Type Virtual_Link, Cost:64
```

```
R2# show ip route
O IA 192.168.100.0/22 [110/65] via 10.1.23.3, 0:00:01, Serial 0/
```

```
R2# show ip ospf database
Summary Net link states (Area 0)
192.168.100.0   192.168.103.1   1   (DNA) 0x800002   0x009A04
```

```
R3# show ip route
O   192.168.100.0/22 is a summary, 00:01:19, Null0
```

Bonus
Marks

R2 (config)# router ospf 1
R2 (config-router)# area 23 virtual-link 192.168.103.1

R3 (config) # router ospf 1
R3 (config-router)# area 23 virtual-link 10.1.2.1

c] Issue the show ip route and see the routes from area 100. You can verify the link with the show ip ospf neighbor and show ip ospf interface.

Step 4: Summarize an area

a] Configure R3 to summarize this area using the area area range network mask command

R3 (config) # router ospf 1
R3 (config-router)# area 100 range 192.168.100.0 255.255.255.0

b] You can see the summary route on R2 with the show ip route and show ip ospf database commands

c] Notice R3 that OSPF has generated a summary route pointing toward Null0

Step 5: Generate a default route into OSPF

```
R2# show ip route
O* E2  0.0.0.0/0 [110/1] via 10.1.12.1, 00:00:09, Serial 0/0/0
```

```
R3# show ip route
O*E2  0.0.0.0/0 [110/1] via 10.1.23.2 ,00:00:26, Serial 0/0/1
```

```
R3# ping 172.30.30.1
Sending 5, 100-byte ICMP Echos to 172.30.30.1,
timeout is 2 seconds: !!!!!
Success rate is 100 percent (5/5), round trip min/avg/max=
28/30/32 ms
```

a] Have R1 generate a default route

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

b] Verify that the default route appears R2 and R3 with the show ip route

c] You should be able to ping the interface connecting to the Internet from R2 or R3, despite never being advertised into OSPF

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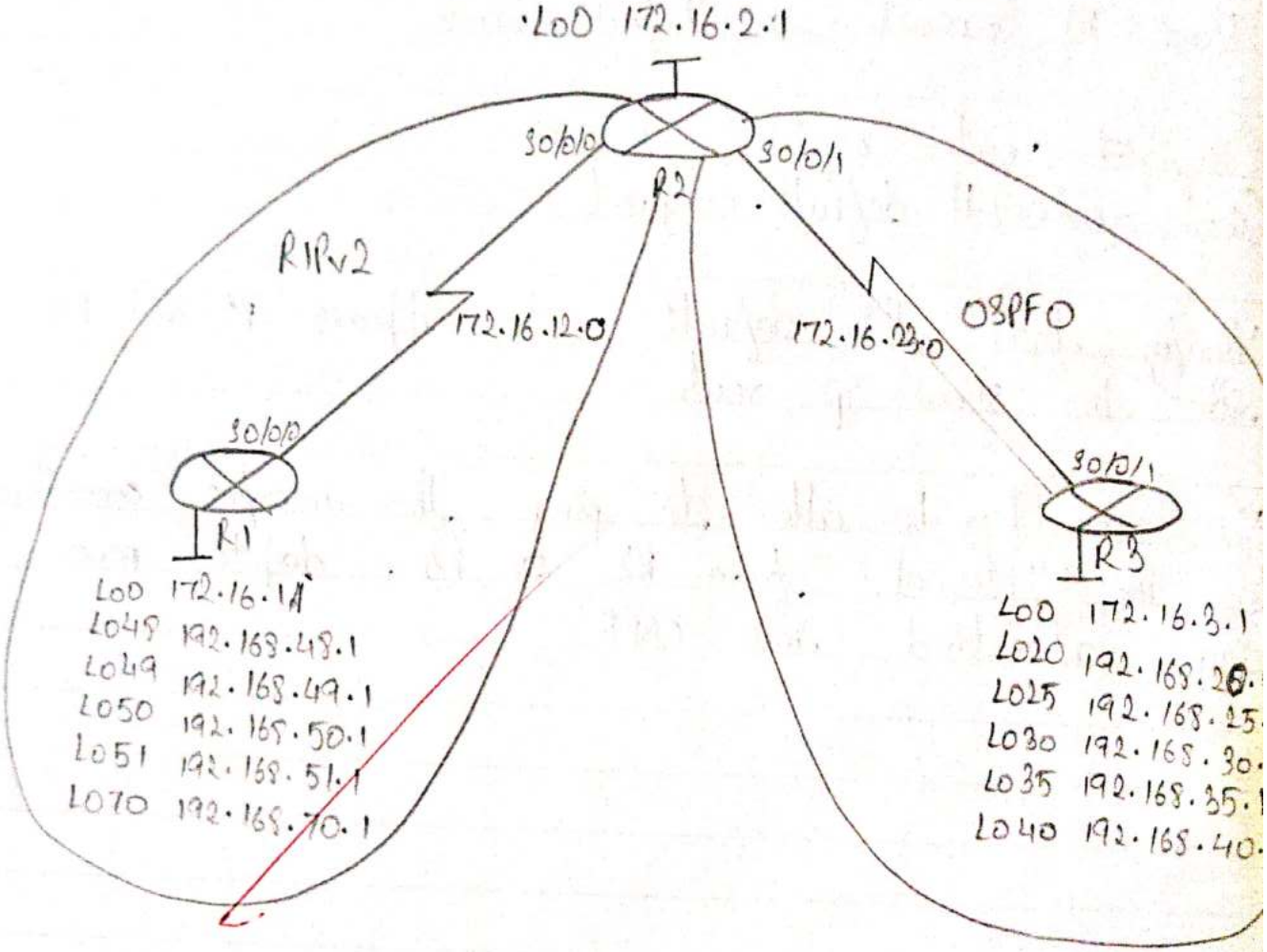
Lo0 172.16.2.1
S0/0/0
S0/0/1
R2
RIPv2
172.16.12.0
172.16.23.0
OSPFO
S0/0/0
R1
S0/0/1
R3
Lo0 172.16.1.1
Lo48 192.168.48.1
Lo49 192.168.49.1
Lo50 192.165.50.1
Lo51 192.168.51.1
Lo70 192.168.70.1
Lo0 172.16.3.1
Lo20 192.168.20.
Lo25 192.168.25.
Lo30 192.168.30.
Lo35 192.168.35.
Lo40 192.168.40.

Practical no. 3
Redistribution and Administrative Distances

A] Redistribution Between RIP and OSPF

Step 1: Configure loopbacks and assign addresses

a] Configure all loopback interfaces and DCE clockrate on the three routers

```
R1(config)# interface loopback 0
R1(config-if)# ip address 172.16.1.1 255.255.255.0
R1(config-if)# interface loopback 48
R1(config-if)# ip address 192.168.48.1 255.255.255.0
R1(config-if)# interface loopback 49
R1(config-if)# ip address 192.168.49.1 255.255.255.0
R1(config-if)# interface loopback 50
R1(config-if)# ip address 192.168.50.1 255.255.255.0
R1(config-if)# interface loopback 51
R1(config-if)# ip address 192.168.51.1 255.255.255.0
R1(config-if)# interface loopback 70
R1(config-if)# ip address 192.168.70.1 255.255.255.0
R1(config-if)# interface s0/0/0
R1(config-if)# clock rate 64000
R1(config-if)# bandwidth 64
R1(config-if)# no shutdown
```

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```
R2(config)# interface loopback 0
R2(config-if)# ip address 172.16.2.1 255.255.255.0
R2(config-if)# interface 3/0/0
R2(config-if)# ip address 172.16.12.2 255.255.255.0
R2(config-if)# bandwidth 64
R2(config-if)# no shutdown
R2(config-if)# interface 3/0/1
R2(config-if)# clockrate 64000
R2(config-if)# bandwidth 64
R2(config-if)# no shutdown

R3(config-if)# interface loopback 0
R3(config-if)# ip address 172.16.3.1 255.255.255.0
R3(config-if)# interface loopback 20
R3(config-if)# ip address 192.168.20.1 255.255.255.0
R3(config-if)# interface loopback 25
R3(config-if)# ip address 192.168.25.1 255.255.255.0
R3(config-if)# interface loopback 30
R3(config-if)# ip address 192.168.30.1 255.255.255.0
R3(config-if)# ip address 192.168.35.1 255.255.255.0
R3(config-if)# interface loopback 40
R3(config-if)# ip address 192.168.40.1 255.255.255.0
R3(config-if)# interface 3/0/1
R3(config-if)# ip address 172.16.23.3 255.255.255.0
R3(config-if)# bandwidth 64
R3(config-if)# no shutdown
```

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b] (optional) On each router, create an enable secret password

```
R1(config)# enable secret cisco
R1(config)# line con 0
R1(config)# logging synchronous
R1(config-line)# exec-timeout 0 0
R1(config-line)# line vty 0 4
R1(config-line)# password cisco
R1(config-line)# login
```

Step 2: Configure RIP v2

a] Apply the following commands to R1 and R2

```
R1(config)# router rip
R1(config-router)# version 2
R1(config-router)# no auto-summary
R1(config-router)# network 172.16.0.0
R1(config-router)# network 192.168.48.0
R1(config-router)# network 192.168.49.0
R1(config-router)# network 192.168.50.0
R1(config-router)# network 192.168.51.0
R1(config-router)# network 192.168.70.0
```

```
R2(config)# router rip
R2(config-router)# version 2
R2(config-router)# network 172.16.0.0
```

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```
R1# show ip rip database
172.16.2.0/24
172.16.23.0/24
```

```
R1# show ip route
S    192.168.48.0/22  is directly connected, Null0
```

```
R2# show ip route
R    192.168.48.0/22 [120/1] via 172.16.12.1 ; Serial 0/0/0
```

5] You can also verify which routes are coming from RIP advertisements with the show ip rip database command

Step 3: Configure passive interfaces in RIP

```
R2 (config)# router rip
R2 (config)# passive-interface s0/0/1

R1 (config)# router rip
R1 (config-router)# passive-interface loopback 0
R1 (config-router)# passive-interface loopback 48
R1 (config-router)# passive-interface loopback 49
R1 (config-router)# passive-interface loopback 50
R1 (config-router)# no passive-interface ~~loopback~~ s0/0/0
```

Step 4: Summarize a supernet with RIP

```
R1 (config)# interface s0/0/0
R1 (config)# ip summary-address rip 192.168.48.0 255.255.255.0
R1 (config)# ip route 192.168.48.0 255.255.252.0 null0
R1 (config)# router rip
R1 (config-router)# redistribute static
```

Verify that RIP supernet has been added to the routing table with the show ip route command

```
R3# show ip protocols
Passive Interface (s):
  FastEthernet 0/0
  Fast Ethernet 0/1
  Serial 0/0/0
  Serial 0/1/0
  Serial 0/1/1
  ~~Serial 0~~
```

```
R2# Show ip protocols
Redistributing rip , ospf 1
```

```
R1# ping 192.168.30.1
Sending 5, 100-byte ICMP echos to 192.168.30.1
Success rate is 0 percent (0/5)
```

```
R1# tracroute 192.168.30.1
1   172.16.12.2   12 msec   12 msec   16 msec
```

Step 6: Configure OSPF

```
R2 (config)# router ospf 1
R2 (config-router)# network 172.16.23.0 0.0.0.255 area 0

R3 (config)# router ospf 1
R3 (config-router)# network 172.16.0.0 0.0.0.255 area 0
R3 (config-router)# network 192.168.0.0 0.0.0.255 area 0
```

Step 7: Configure passive interfaces in OSPF

```
R3 (config)# router ospf 1
R3 (config-router)# passive-interface default
R3 (config-router)# no passive-interface s0/0/1
```

Verify using show ip protocols command

Step 8: Allow one-way redistribution

```
R2 (config)# router rip
R2 (config-router)# redistribute ospf 1 metric 4
```

Verify redistribution with the show ip protocols command
On R1 look, look at the routing table with show ip rip

Verify ping on loopback on R3 and also traceroute

```
R3# show ip route ospf
O*E2   0.0.0.0/0 [110/1] via 172.16.23.2, Serial 0/0/1
```

```
R3# show ip route ospf
O   E2   172.16.12.0 [110/20] via 172.16.23.2
O   E2   172.16.1.0  [110/20] via 172.16.23.2
O   E2   172.16.2.0  [110/20] via 172.16.23.2
```

R2 (config)# router ospf 1
R2 (config-router)# default-originate always

Verify that this route is present in the R3 routing table

Step 9: Redistribute between two routing protocols

R2 (config)# router ospf 1
R2 (config-router)# no default-information originate
R2 (config-router)# redistribute rip
R2 (config-router)# redistribute rip subnets

Verify on R3 with show ip route ospf command

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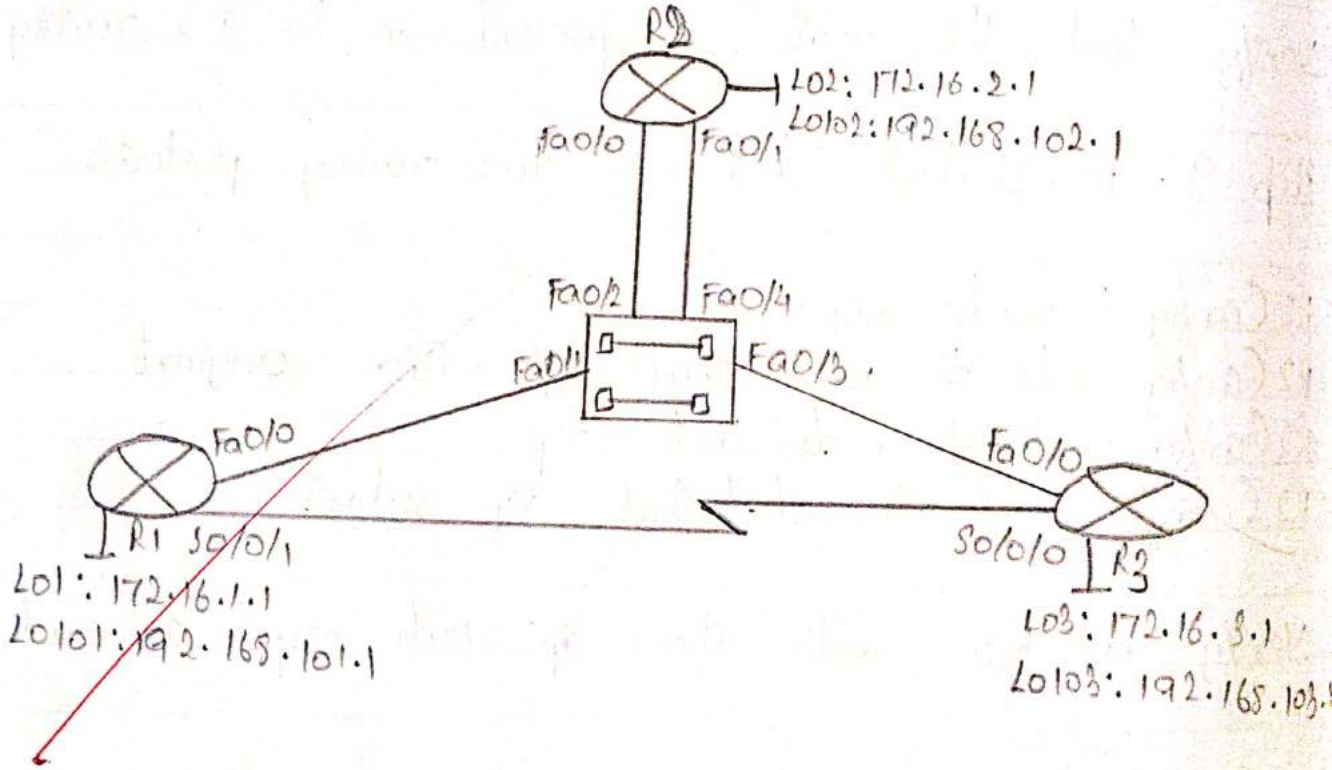
R2
Lo2: 172.16.2.1
Lo102: 192.168.102.1
Fa0/0
Fa0/1
Fa0/2
Fa0/4
Fa0/1
Fa0/3
Fa0/0
Fa0/0
R1
S0/0/1
Lo1: 172.16.1.1
Lo101: 192.165.101.1
S0/0/0
R3
Lo3: 172.16.3.1
Lo103: 192.165.103.1

B) Manipulating Administrative Distances

Step 1: Review default administrative distances

Step 2: Configure router loopbacks and addressing

```
R1# conf t
R1(config)# interface loopback 1
R1(config-if)# ip address 172.16.1.1 255.255.255.0
R1(config-if)# interface loopback 101
R1(config-if)# ip address 192.168.101.1 255.255.255.0
R1(config-if)# interface fastethernet 0/0
R1(config-if)# ip address 172.16.12.1 255.255.255.0
R1(config-if)# no shutdown
R1(config-if)# interface serial 0/0/1
R1(config-if)# bandwidth 64
R1(config-if)# ip address 172.16.13.1 255.255.255.0
R1(config-if)# no shutdown

R2(config-if)# interface loopback 2
R2(config-if)# ip address 192.168.102.1 255.255.255.0
R2(config-if)# interface loopback 102
R2(config-if)# ip address 192.168.102.1 255.255.255.0
R2(config-if)# interface fastethernet 0/0
R2(config-if)# ip address 172.16.12.2 255.255.255.0
R2(config-if)# no shutdown
R2(config-if)# interface fastethernet 0/1
R2(config-if)# ip address 172.16.23.2 255.255.255.0
```

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```
R2(config-if)# no shutdown

R3(config)# interface loopback 3
R3(config-if)# ip address 172.16.3.1 255.255.255.0
R3(config-if)# interface loopback 103
R3(config-if)# ip address 172.168.103.1 255.255.255.0
R3(config-if)# interface ~~loopback~~ fastethernet 0/0
R3(config-if)# ip address 172.16.23.3 255.255.255.0
R3(config-if)# no shutdown
R3(config-if)# interface s 0/0/0
R3(config-if)# bandwidth 64
R3(config-if)# ip address 172.16.13.3 255.255.255.0
R3(config-if)# clock rate 64000
R3(config-if)# no shutdown
```

Step 3: Configure VLANs

```
Switch(config)# vlan 12
Switch(config-vlan)# name R1-R2
Switch(config-vlan)# vlan 23
Switch(config-vlan)# name R2-R3
Switch(config-vlan)# exit
Switch(config)# interface fastethernet 0/1
Switch(config)# description to R1 Fa0/0
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 12
Switch(config-if)# interface fastethernet 0/2
Switch(config-if)# description to R2 Fa 0/0
```

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Switch(config-if)# switchport mode access
Switch(config-if)# switchport ~~mod~~ access vlan 12
Switch(config-if)# interface fastethernet 0/3
Switch(config-if)# description to R3 Fa0/0
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 23
Switch(config-if)# interface fastethernet 0/4
Switch(config-if)# description to R2 Fa0/1
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 23

Step 4: Configure RIP
a) Configure RIP v2 on three routers
R1(config)# router rip
R1(config)# version 2
R1(config-router)# no auto-summary
R1(config-router)# network 172.16.0.0
R1(config-router)# network 192.168.101.0
~~R1(config-router)#~~

R2(config)# router rip
R2(config-router)# version 2
R2(config-router)# no auto-summary
R2(config-router)# network 172.16.0.0
R2(config-router)# network 192.168.102.0

R3(config)# router rip
R3(config)# version 2

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```
R1# show ip route rip
R172.16.3.0 [120/1] via 172.16.13.3, 00:02:29, Serial 0/0/1

R2# show ip route rip
R172.16.3.0 [120/1] via 172.16.23.3, 00:02:18, FastEthernet 0/1

R3# show ip route rip
R172.16.1.0 [120/1] via 172.16.13.1, 00:02:47, Serial 0/0/0
```

R3(config-router)# no auto-summary
R3(config-router)# network 172.16.0.0
R3(config-router)# network 192.168.103.0

b] Verify the configuration using the show ip route rip command on each router

c] Verify that each routers is receiving RIP routes from other routers using the show ip protocols command

Step 5: Configuring OSPF

R1(config)# interface loopback 1
R1(config-if)# ip ospf network point-to-point
R1(config-if)# interface loopback 101
R1(config-if)# ip ospf network point-to-point
R1(config-if)# router ospf 1
R1(config-router)# network 172.16.0.0 0.0.255.255 area 0
R1(config-router)# network 192.168.101.0 0.0.255.255 area 0

R2(config)# interface loopback 2
R2(config-if)# ip ospf network point-to-point
R2(config-if)# interface loopback 102
R2(config-if)# ip ospf network point-to-point
R2(config-if)# router ospf 1
R2(config-router)# network 172.16.0.0 0.0.255.255 area 0
R2(config-router)# network 192.168.102.0 0.0.0.255 area 0

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R# show ip protocols
Distance: (default is 100)

```
R3(config)# interface loopback 3
R3(config-if)# ip ospf network point-to-point
R3(config-if)# interface loopback 103
R3(config-if)# ip ospf network point-to-point
R3(config-if)# router ospf 1
R3(config-router)# network 172.16.0.0 0.0.255.255 area 0
R3(config-router)# network 192.168.103.0 0.0.0.255 area 0
```

Step 6 : Modify the routing protocol distance

```
R1(config)# router rip
R1(config-router)# distance 100

R2(config)# router rip
R2(config-router)# distance 100

R3(config)# router rip
R3(config-router)# distance 100
```

You can verify the default distance for RIP using show ip protocols command

Step 7 : Modify distance between route source

```
R1(config)# router ospf 1
R1(config-router)# distance 85 192.168.100.0 0.0.3.255

R2(config)# router ospf 1
```

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```
R1# show ip protocols
Distance : (default is 110)
Address          wild mask        Distance      list
192.168.100.0    0.0.3.255          85
```

```
R1# show ip protocols
Adress           wild mask        Distance      list.
0.0.0.0          255.255.255.255    65          1

R2# show ip protocols
Address          wild mask        Distance      list
0.0.0.0          255.255.255.255    65          1

R3# show ip protocols
Address          wild mask        Distance      list
0.0.0.0          255.255.255.255    65          1
```

Bimal
17/02/25

R2 (config-router) # distance 85 192.168.100.0 0.0.3.255

R3 (config) # router ospf 1
R3 (config-router) # distance 85 192.168.100.0 0.0.3.255

Verify the change with the show ip protocols and show ip route command.

Step 8: Modify distance based on an access-list

R1 (config) # access-list 1 permit 172.16.0.0 0.0.255.255
R1 (config) # router rip
R1 (config-router) # distance 65 0.0.0.0 255.255.255.255 1

R2 (config) # access-list 1 permit 172.16.0.0 0.0.255.255
R2 (config) # router rip
R2 (config-router) # distance 65 0.0.0.0 255.255.255.255 1

R3 (config) # access-list 1 permit 172.16.0.0 0.0.255.255
R3 (config) # router rip
R3 (config-router) # distance 65 0.0.0.0 255.255.255.255 1

Verify the change with show ip protocols and show ip route

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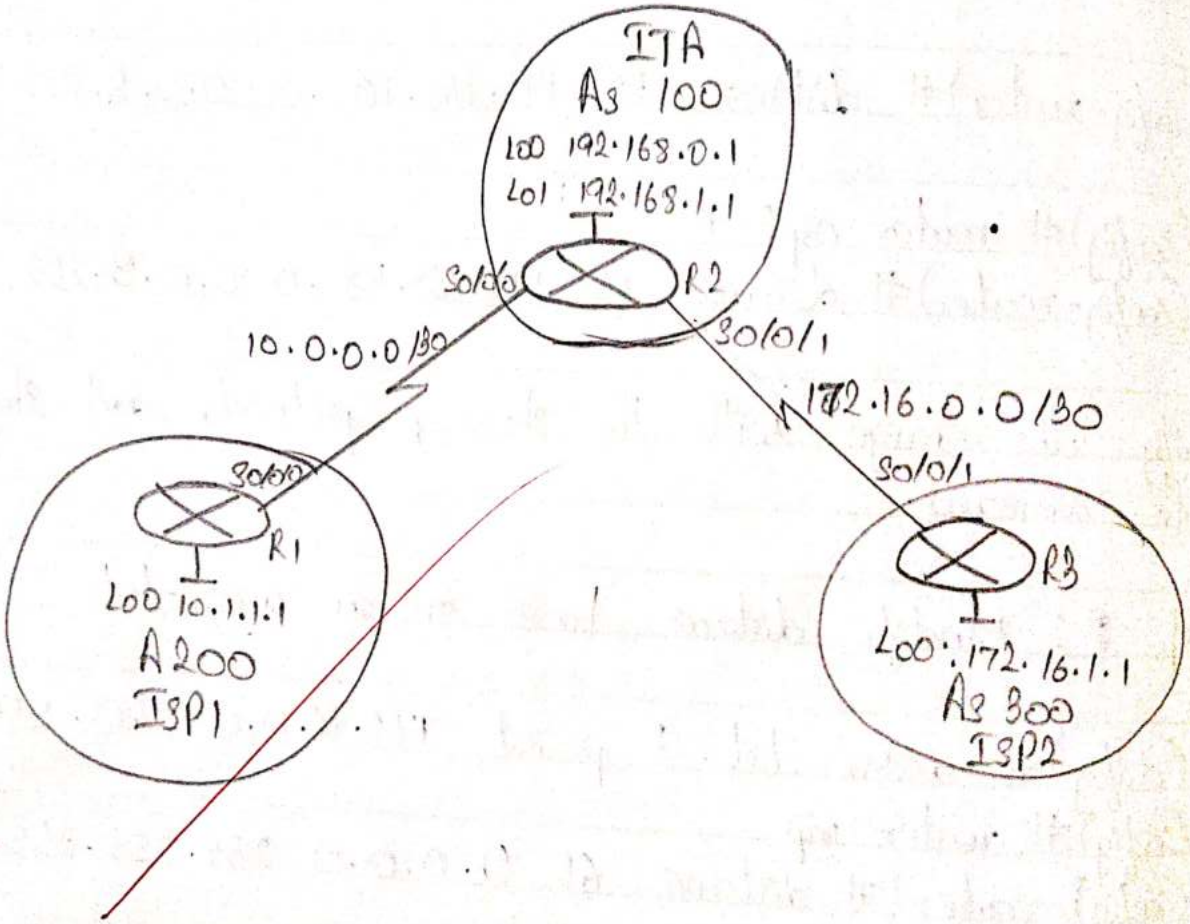
ITA
As 100
L00 192.168.0.1
L01 192.168.1.1
S0/0/0
R2
S0/0/1
10.0.0.0/30
172.16.0.0/30
S0/0/0
R1
L00 10.1.1.1
A200
ISP1
S0/0/1
R3
L00 172.16.1.1
As 300
ISP2

Practical no. 4
BGP

A] Configureiring BGP with default Routing

Step 1: Prepare the routers for the lab
Cable the network as shown in the topology

Step 2: Configure the hostname and interface addresses

```
R1 (config)# hostname ISP1
ISP1(config)# interface Lo0
ISP1 (config-if)# ip address 10.1.1.1 255.255.255.0
ISP1 (config-if)# interface Serial 0/0/0
ISP1(config-if)# ip address 10.0.0.1 255.255.255.252
ISP1 (config-if)# clock rate 128000
ISP1 (config-if)# no shutdown

R2(config)# hostname ITA
ITA(config)# interface Lo0
ITA(config-if)# ip address 192.168.0.1 255.255.255.0
ITA (config-if)# interface Lo1
ITA (config-if)# ip address 192.168.1.1 255.255.255.0
ITA (config-if)# interface s0/0/0
ITA (config-if)# ip address 10.0.0.2 255.255.255.252
ITA (config-if)# no shutdown
ITA (config-if)# interface s0/0/1
ITA (config-if)# ip address 172.16.0.2 255.255.255.252
```

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R3 (config)# hostname ISP2
ISP2 (config-if)# interface Lo0
ISP2 (config-if)# ip address 172.16.1.1 255.255.255.0
ISP2 (config-if)# interface S0/0/1
ISP2 (config-if)# ip address 172.16.0.1 255.255.255.0
ISP2 (config-if)# no shutdown

Step 3: Configure BGP on the ISP routers

ISP1 (config)# ~~bg~~ router bgp 200
ISP1 (config)# neighbor 10.0.0.2 remote-as 100
ISP1 (config-router)# network 10.1.1.0 mask 255.255.255.0

ISP2 (config)# router bgp 300
ISP2 (config-router)# neighbor 172.16.0.2 remote-as 100
ISP2 (config-router)# network 10.1.1.0 mask 255.255.255.0

Step 4: Configure BGP on ITA boundary router

ITA (config)# router bgp 100
ITA (config-router)# neighbor 10.0.0.1 remote-as 200
ITA (config-router)# neighbor 172.16.0.1 remote-as 300
ITA (config-router)# network 192.168.0.0
ITA (config-router)# network 192.168.1.0

Step 5: Configure router filters

a] On the ITA router, configure the following list
ITA (config)# access-list 1 permit 192.168.0.0 0.0.0.255

b] Apply this access list as a route filter using the distribute-list keyword with the BGP neighbor statement

ITA (config)# router bgp 100
ITA (config-router)# neighbor 10.0.0.1 distribute-list 1 out
ITA (config-router)# neighbor 172.16.0.1 distribute-list 1 out

c] Issue the clear ip bgp * command

ITA # clear ip bgp *

Step 6: Configure primary and backup routes using floating static routes

a] ITA (config)# ip route 0.0.0.0 0.0.0.0 10.0.0.1 210
ITA (config)# ip route 0.0.0.0 0.0.0.0 172.16.0.1 210

b] ISP1 (config)# interface loopback 100
ISP1 (config-if)# ip address 192.168.100.1 255.255.255.0

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c]
ITA # ping
protcol [ip]:
Target IP address : 192.168.100.1
Repeat count [5]:
Datagram size [100]:
Time out size [2]:
Extended commands [n]: y
Source address or interface : 192.168.1.1
Type of service [0]:
set DF bit in IP header ? [no]:
Validate reply data ? [no]:
Data Pattern [0xABCB]:
loose, Strict, Record, Timestamp, Verbose [none]:
Sweep range in sizes [n]:
Type escape sequence to abort
Sending 5, 100- byte ICMP Echos to 192.168.100.1
!!!!!
Success rate is 100 percent

Step 7: Configure primary backup routes using a default network and a static route
a] remove the floating static routes
ITA (config) # no ip route 0.0.0.0 0.0.0.0 10.0.0.1 210
ITA (config) # no ip route 0.0.0.0 0.0.0.0 172.16.0.1 210

```
ITA # show ip route
Gateway of last resort is no set
B 192.168.100.0/24 [20/0] via 10.0.0.1, 00:02:33
```

```
ITA# show ip route
Gateway of last resort is 10.0.0.1 to network
192.168.100.0
B* 192.168.100.0/24 [20/0] via 10.0.0.1
```

```
ITA# show ip route
Gateway of last resort is 172.16.0.1 to network
0.0.0.0
S* 0.0.0.0/0 [220/0] via 172.16.0.1
```

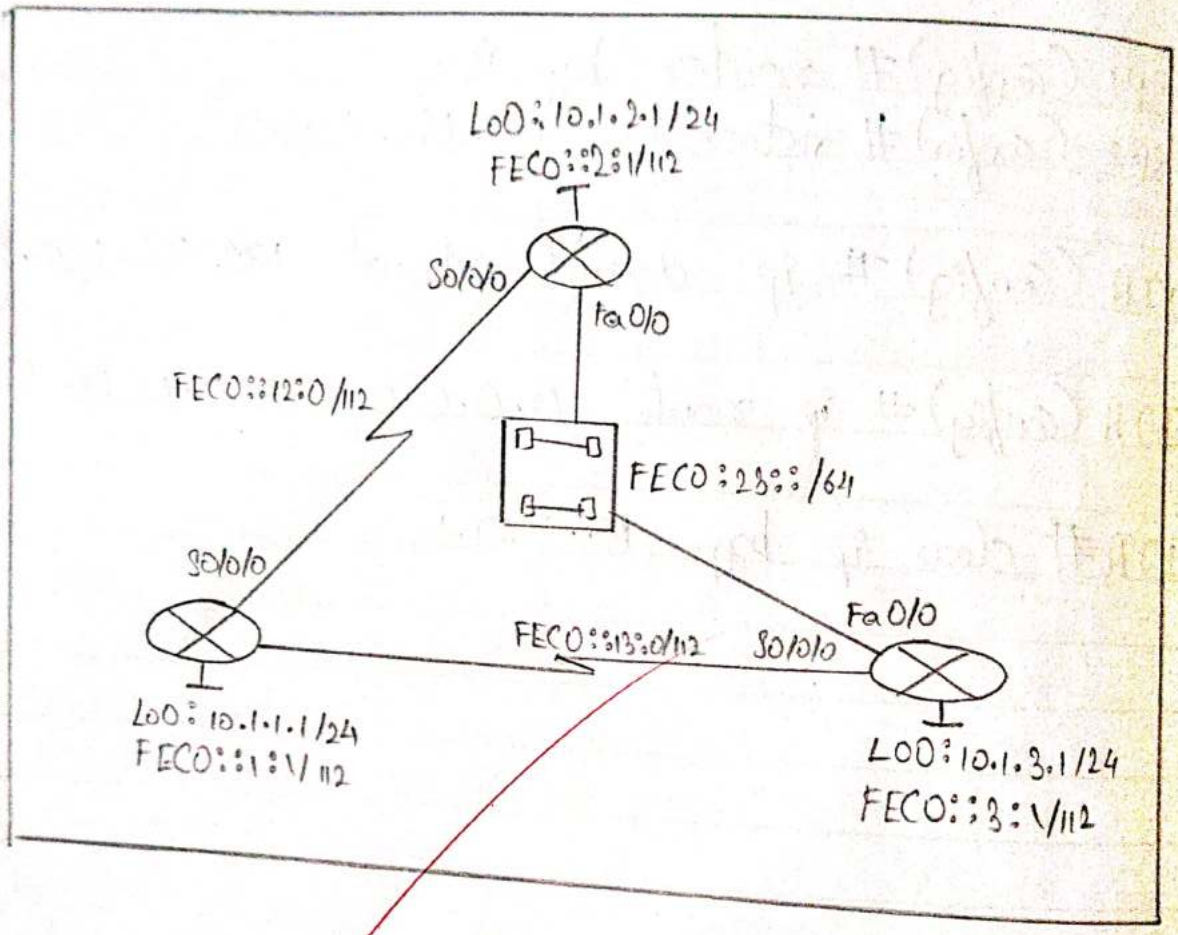
```
ITA # show ip route
B* 192.168.100.0/24 [20/0] via 10.0.0.1
```

b] ISP1 (config)# router bgp 200
ISP1 (config)# network 192.168.100.0

c] ITA (config)# ip default-network 192.168.100.0

d] ITA (config)# ip route 0.0.0.0 0.0.0.0 172.16.0.1 220

e] ITA# clear ip bgp 10.0.0.1


Lo0: 10.1.2.1/24
FEC0::2:1/112
S0/0/0
Fa0/0
FEC0::12:0/112
FEC0::23::/64
S0/0/0
Fa0/0
FEC0::13:0/112
S0/0/0
Lo0: 10.1.1.1/24
FEC0::1:1/112
Lo0: 10.1.3.1/24
FEC0::3:1/112

Practical no. 5
IPv6

A) Configuring OSPF for IPv6

Step 1 : Configuring the hostname and loopback interfaces

```
Router(config)# hostname R1
R1(config)# interface Lo0
R1(config-if)# ip address 10.1.2.1 255.255.255.0
R1(config-if)# ipv6 address FEC0::1:1/112

R2(config-if)# interface loopback0
R2(config-if)# ip address 10.1.2.1 255.255.255.0
R2(config-if)# ipv6 address FEC0::2:1/112

R3(config)# interface lo0
R3(config-if)# ip address 10.1.3.1 255.255.255.0
R3(config-if)# ipv6 address FEC0::3:1/112
```

Step 2: Configure static IPv6 addresses

```
R1(config)# interface s0/0/0
R1(config-if)# ipv6 address FEC0::12:1/112
R1(config-if)# clock rate 64000
R1(config-if)# bandwidth 64
R1(config-if)# no shutdown
```

R1# show ipv6 interface s0/0/0
Ipv6 is enabled, link-local address is FE80::219:6FF:FE23:4380

R2# show ipv6 interface s0/0/0
Ipv6 is enabled, link-local address is FE80::218:B9FF:FE92:2808

R1(config-if)# interface s0/0/1
R1(config-if)# ipv6 address FEC0::13:1/112
R1(config-if)# clock rate 64000
R1(config-if)# bandwidth 64
R1(config-if)# no shutdown

R2(config)# interface s0/0/1
~~R2(config-if)# ipv6 bandwidth 64~~
R2(config-if)# ipv6 address FEC0::12:2/112
R2(config-if)# bandwidth 64
R2(config-if)# no shutdown

R3(config)# interface s0/0/0
R3(config)# ipv6 address FEC0::13:3/112
R3(config)# bandwidth 64
R3(config)# no shutdown

Step 3: change the link-local address on an interface

R1(config)# interface s0/0/0
R1(config-if)# ipv6 address FE80::1 link-local

R2(config)# interface s0/0/0
R2(config-if)# ipv6 address FE80::2 link-local

Verify the link-local addresses with the show ipv6 interface command

```
R2# show ipv6 interface fastEthernet 0/0
Global unicast address (es):
  FEC0:23::218:B9FF:FE92:28D8, subnet is FEC0:23::/64 [EUI]

R2# show ipv6 interface brief
FEC0:23::218:B9FF:FE92:28D8
```

```
R3# ping FEC0::218:B9FF:FE92:28D8
Sending 5, 100 byte ICMP Echos
!!!!!
Success rate is 100 percent (5/5)
```

Step 4: Configure EUI-64 addresses

```
R2(config)# interface Fa 0/0
R2(config-if)# ipv6 address FEC0:23::/64 eui-64
R2(config-if)# no shutdown

R3(config)# interface Fa 0/0
R3(config-if)# ipv6 address FEC0:23::/64 eui-64
R3(config-if)# no shutdown
```

Step 5: Enable IPv6 routing and CEF

```
R1(config)# ipv6 unicast-routing
R1(config)# ipv6 cef

R2(config)# ipv6 unicast-routing
R2(config)# ipv6 cef
```

Step 6: Configuring OSPF v3

```
R1(config)# interface loopback 0
R1(config)# ipv6 ospf 1 area 0
R1(config)# interface s 0/0/0
R1(config-if)# ipv6 ospf 1 area 0
R1(config-if)# interface s0/0/1
R1(config-if)# ipv6 ospf 1 area 0
```

```
R1# show ipv6 ospf neighbor
Neighbor ID     Pri   State      Dead Time   Interface ID   Interface
10.1.3.1          1   FULL/-     00:39          6           Serial 0/0/1
10.1.2.1          1   FULL/-     00:40          6           Serial 0/0/0
```

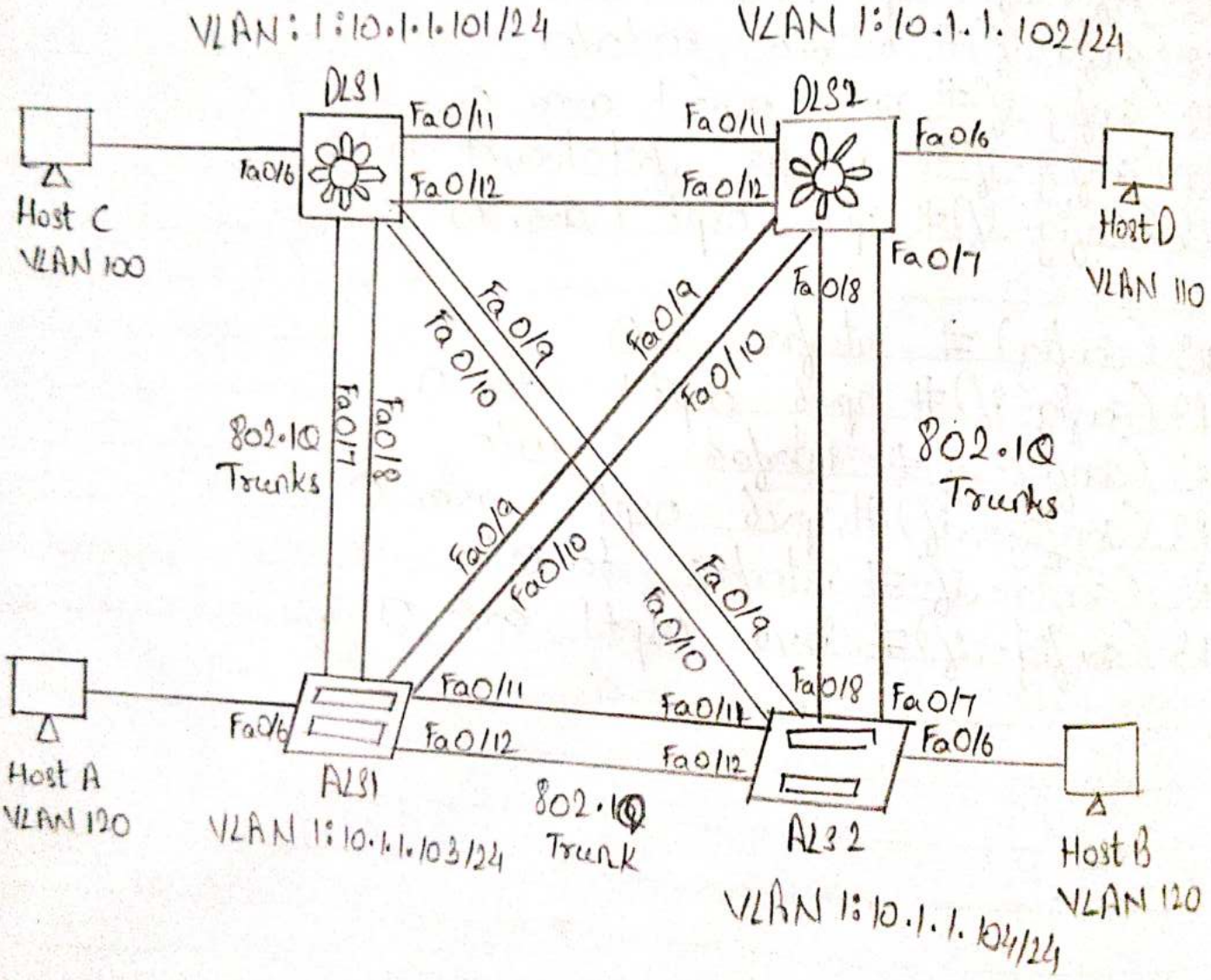
```
R2# show ipv6 ospf neighbor
Neighor ID      Pri   State      Dead Time   Interface ID   Interface
10.1.3.1          1   FULL/DR    00:39          4           FastEthernet 0/0
10.1.1.1          1   FULL/-     00:32          6           Serial 0/0/0
```

```
R3# show ipv6 ospf neighbor
Neighbor ID     Pri   State      Dead Time   Interface ID   Interface
10.1.2.1          1   FULL/BDR   00:39          4           FastEthernet 0/0
10.1.1.1          1   FULL/-     00:39          7           Serial 0/0/0
```

Bimal
17/02/25

```
R2(config)# interface lo0
R2(config-if)# ipv6 ospf 1 area 0
R2(config-if)# interface s0/0/0
R2(config-if)# ipv6 ospf 1 area 0
R2(config-if)# interface fastethernet 0/0
R2(config-if)# ipv6 ospf 1 area 0

R3(config)# interface lo0
R3(config-if)# ipv6 ospf 1 area 0
R3(config-if)# interface s0/0/0
R3(config-if)# ipv6 ospf 1 area 0
R3(config-if)# interface fa 0/0
R3(config-if)# ipv6 ospf 1 area 0
```

FOR EDUCATIONAL USE


VLAN: 1: 10.1.1.101/24
VLAN 1: 10.1.1.102/24
DLS1
DLS2
Fa0/11
Fa0/11
Fa0/6
Fa0/6
Fa0/12
Fa0/12
Host C
VLAN 100
Host D
VLAN 110
Fa0/7
Fa0/8
Fa0/9
Fa0/10
Fa0/9
Fa0/10
Fa0/9
Fa0/10
Fa0/7
Fa0/8
802.1Q
Trunks
802.1Q
Trunks
Fa0/9
Fa0/10
Fa0/10
Fa0/9
Fa0/11
Fa0/11
Fa0/8
Fa0/7
Fa0/6
Fa0/12
Fa0/12
Fa0/6
Host A
VLAN 120
ALS1
VLAN 1: 10.1.1.103/24
802.1Q
Trunk
ALS2
VLAN 1: 10.1.1.104/24
Host B
VLAN 120

Practical no. 6
VLANs and EtherChannel

Aim- Static VLANs, VLAN Trunking, and VTP domains and Modes

Step 1: Configure basic switch parameters

```
DLS1(config)# interface vlan 1
DLS1(config-if)# ip address 10.1.1.101 255.255.255.0
DLS1(config-if)# no shutdown
DLS1(config)# enable secret cisco
DLS1(config)# line vty 0 4
DLS1(config-line)# password cisco
DLS1(config-line)# login

DLS2(config)# interface vlan 1
DLS2(config)# ip address 10.1.1.102 255.255.255.0
DLS2(config)# no shutdown
DLS2(config)# enable secret cisco
DLS2(config)# line vty 0 4
DLS2(config-line)# password cisco
DLS2(config-line)# login

ALS1(config)# interface vlan 1
ALS1(config-if)# ip address 10.1.1.103 255.255.255.0
ALS1(config-if)# no shutdown
```

```
DLS1# 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,
                                Fa09, Fa0/10, Fa0/11, Fa 0/12,
                                Fa0/13, Fa0/14, Fa0/15, Fa0/16,
                                Fa0/17, Fa0/18, Fa0/19, Fa0/20,
                                Fa0/21, Fa0/22, Fa0/23, Fa 0/24
1002   fddi-default  act/unsup  Gi0/1, Gi0/2
1003   token-ring-default act/unsup
1004   fddinet-default act/unsup
1005   trnet-default act/unsup
```

```
DLS # show vtp status
                    VTP version                  Running VTP1 (VTP2 capable)
                    Configuration Revision       0
                    Maximum VLANs supported      1005
                    locally
                    Number of existing VLANs     5
                    VTP Operating Mode           Server
                    VTP Domain Name
                    VTP Pruning mode             Disabled
                    VTP V2 Mode                  Disabled
                    VTP Traps Generation         Disabled
                    MD5 Digest                   x57 0xCD 0x40 0x65 0x63
                                                 0x 59 0x47 0xBD
```

ALS2 (config)# interface vlan 1
ALS2 (config-if)# ip address 10.1.1.104 255.255.255.0
ALS2 (config-if)# no shutdown

Display the switch defalult VLAN information with the show vlan command

Use the show vtp status command on any switch.

Step 2: Configure VTP on the switches

Change the VTP domain name on DLS1 to SWLAB using the vtp domain command. If the VTP version defaults to 1 set it manually to version 2 using the vtp version command

DLS1(config)# vtp domain SWLAB
Changing domain name from NULL to SWLAB
DLS1 (config)# vtp version 2

ALS1 (config)# vtp mode server
Device mode already VTP server
ALS1 (config)# vtp mode client
setting device to VTP CLIENT mode

```
ALS1# show interfaces fastEthernet 0/7 switchport
Port Fa0/7
Switchport: Enabled
Administrative Trunking Encapsulation: dot1q
Terminal Trunking Encapsulation: dot1q
Mode VLAN: 1 (default)
Protected: false
```

```
DLS1# show interfaces trunk
Port     Mode    Encapsulation    Status      Native VLan
Fa0/7    on      802.1q           trunking    1
Fa0/8    on      802.1q           trunking    1
Fa0/9    on      802.1q           trunking    1
Fa0/10   on      102.1q           trunking    1
```

```
DLS2# show interfaces trunk
Port     Mode    Encapsulation    Status      Native vlan
Fa0/7    on      802.1q           trunking    1
Fa0/8    on      802.1q           trunking    1
Fa0/9    auto    n-802.1q         trunking    1
Fa0/10   auto    n-802.1q         trunking    1
```

Step 3: Configure trunking

DL31(config)# interface range fastEthernet 0/7-10
DL31(config-if-range)# switchport trunk encapsulation dot1q
DL31(config-if-range)# switchport mode trunk

AL31(config)# interface range fastEthernet 0/7-12
AL31(config-if-range)# switchport mode trunk

DL32(config)# interface range fastEthernet 0/7-8
AL32(config-if-range)# switchport trunk encapsulation dot1q
DL32(config-if-range)# switchport mode trunk

Step 4: Verify trunk configuration

Use the show interfaces fastEthernet 0/7 switchport command on AL32

Use show interfaces trunk command on DL31
Use show interfaces trunk command on DL32

Step 5: Configure access ports

AL31(config)# interface fastEthernet 0/6
AL31(config-if)# switchport mode ?

DL31(config)# interface fastEthernet 0/6
DL31(config)# switchport mode ?

```
AL3# show vtp status
      VTP version                                  Running VTP status
Configuration Revision                             1
Maximum VLANs supported                            255
locally
Number of existing VLANs                           5
VTP operating Mode                                 Client
VTP Domain Mode                                    SWLAB
VTP Pruning Mode                                   Disabled
VTP V2 Mode                                        Enabled
VTP Traps Connection                               Disabled
```

AL31 (config)# interface fastEthernet 0/6
AL31 (config-if)# switchport mode access

~~AL31#~~ Use the show interfaces command for fast Ethernet 0/6 to verify the configuration

Step 6: Verify VTP configuration

Before configuring the VLANs, verify the VTP configuration within the domain by using the show vtp status command

Step 7: Configure VLANs by assigning port membership

DL31 (config)# interface fastEthernet 0/6
DL31 (config-if-range)# switchport access vlan 100

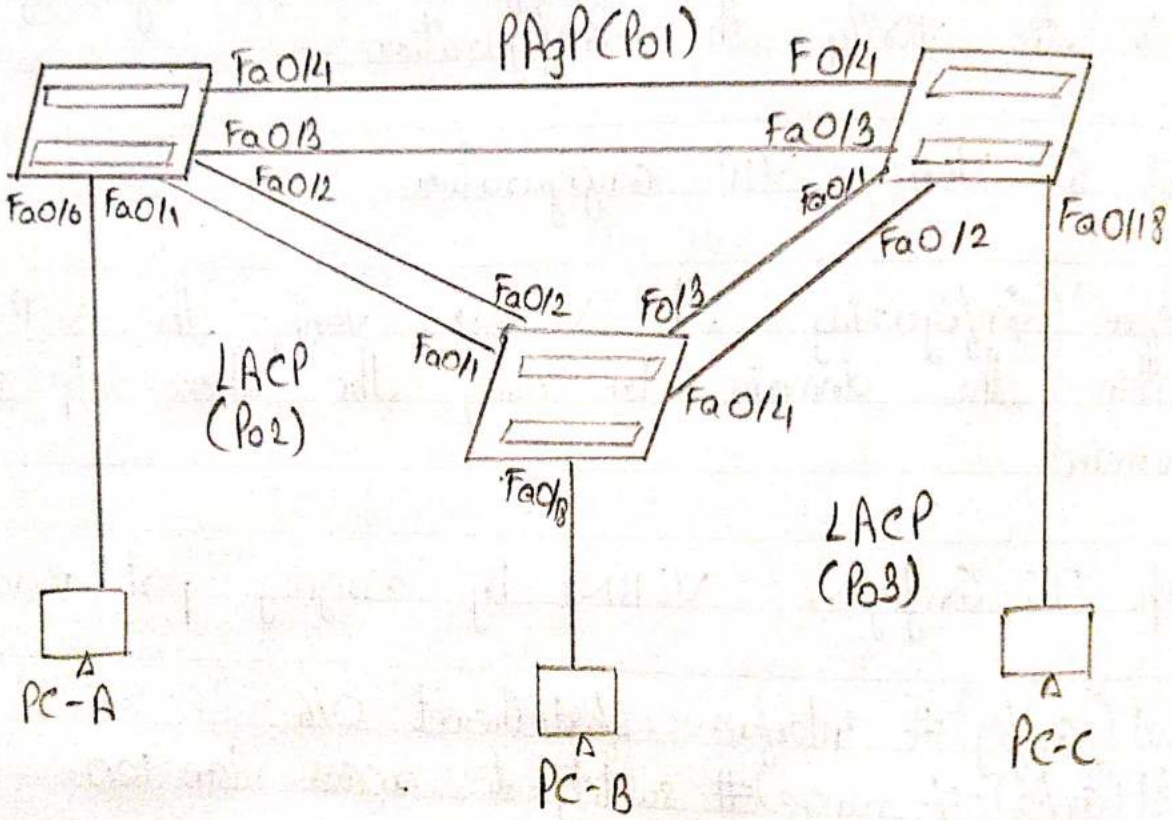
DL3 2 (config)# interface fastEthernet 0/6
DL3 2 (config)# switchport mode access vlan 110

Step 8: Configure VLANs in configuration mode

DL31 (config)# vlan 120

AL31 (config)# interface fastEthernet 0/6
AL31 (config-if)# switchport mode vlan 120
AL32 (config)# interface fastEthernet 0/6
AL32 (config)# switchport mode vlan 120

FOR EDUCATIONAL USE


PAgP (Po1)
Fa0/4
F0/4
Fa0/3
Fa0/3
Fa0/2
Fa0/1
Fa0/6
Fa0/1
Fa0/18
Fa0/2
Fa0/2
Fa0/3
Fa0/1
LACP
(Po2)
Fa0/4
Fa0/8
LACP
(Po3)
PC-A
PC-B
PC-C

Practical no. 6 B

Aim - Configuring EtherChannel

Addressing Table

Device	Interface	IP Address	Subnet Mask
S1	VLAN 99	192.168.99.11	255.255.255.0
S2	VLAN 99	192.168.99.12	255.255.255.0
S3	VLAN 99	192.168.99.13	255.255.255.0
PC-A	NIC	192.168.10.1	255.255.255.0
PC-B	NIC	192.168.10.2	255.255.255.0
PC-C	NIC	192.168.10.3	255.255.255.0

Part 1 : Configure PAgP

Step 1: Configure PAgP on S1 and S3

S1(config)# interface range f0/3-4
S1(config-if-range)# channel-group 1 mode desirable
Creating a Port-channel interface Port-channel 1
S1(config-if-range)# no shutdown

S3(config)# interface range f0/3-4
S3(config-if-range)# channel-group 1 mode auto
Creating a Port-channel interface Port-channel 1
S3(config-if-range)# no shutdown

```
S1# show run interface f0/3
Current configuration: 103 bytes
!
interface FastEthernet 0/3
channel-group 1 mode desirable
```

```
S1# show interfaces f0/3 switchport
Name: Fa 0/3
Switchport: Enabled
Administrative Mode: dynamic auto
Operational Mode: static access (member of bundle Po1)
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
```

```
S1# show etherchannel summary
Number of channel-groups in use: 1
Number of aggregators: 1

Group   Port-channel   Protocol   Ports
1       Po1(SU)        PAgP       Fa 0/3 (P)   Fa 0/4 (P)
```

Step 2: Examine the Configuration on the ports

~~S1# show run inte~~
use the show interfaces command on both S1 and S3

Step 3: Verify that the Ports have been aggregated

Step 4: Configure trunk ports

```
S1(config)# interface port-channel 1
S1(config-if)# switchport mode trunk
S1(config-if)# switchport mode trunk native vlan 99

S3(config)# interface port-channel 1
S3(config)# switchport mode trunk
S3(config)# switchport trunk native vlan 99
```

Part 2: Configure LACP

Step 1: Configure LACP between S1 and S2

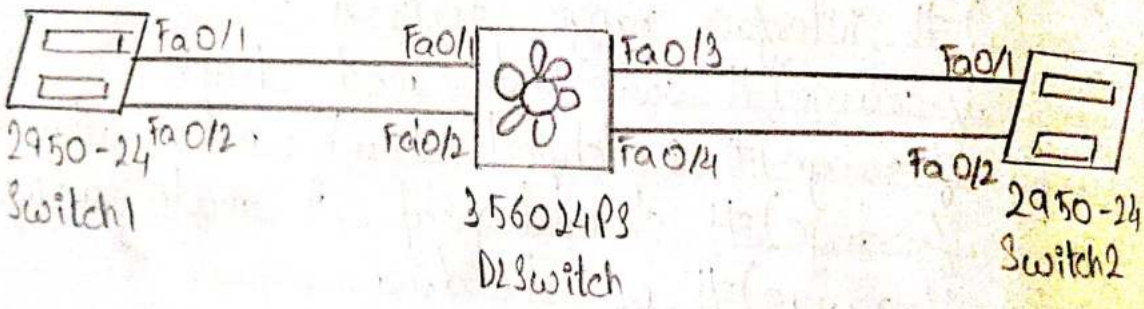
```
S1(config)# interface range f0/1-2
S1(config-if-range)# switchport mode trunk
S1(config-if-range)# switchport trunk native vlan 99
S1(config-if-range)# channel-group 2 mode active
S1(config-if-range)# no shutdown
```

```
S2(config)# interface range fo/1-2
S2(config-if-range)# switchport mode trunk
S2(config-if-range)# switchport trunk native vlan 99
S2(config-if-range)# channel-group 2 mode passive
S2(config-if-range)# no shutdown
```

Step 2: Configure LACP between S2 and S3

```
S2(config)# interface range fo/3-4
S2(config-if-range)# switchport mode trunk
S2(config-if-range)# switchport trunk native vlan 99
S2(config-if-range)# channel-group 3 mode active
S2(config-if-range)# no shutdown

S3(config)# interface range fo/1-2
S3(config-if-range)# switchport mode trunk
S3(config-if-range)# switchport trunk native vlan 99
S3(config-if-range)# channel-group 3 ~~active~~ mode passive
S3(config-if-range)# no shutdown
```

Step 3: Verify end-to-end connectivity


Fa0/1
Fa0/2
2950-24
Switch1
Fa0/1
Fa0/2
Fa0/3
Fa0/4
3560-24PS
D2Switch
Fa0/1
Fa0/2
2950-24
Switch2

Practical no. 7
Spanning Tree Protocol

A) Spanning Tree Protocol (STP) Default Behavior

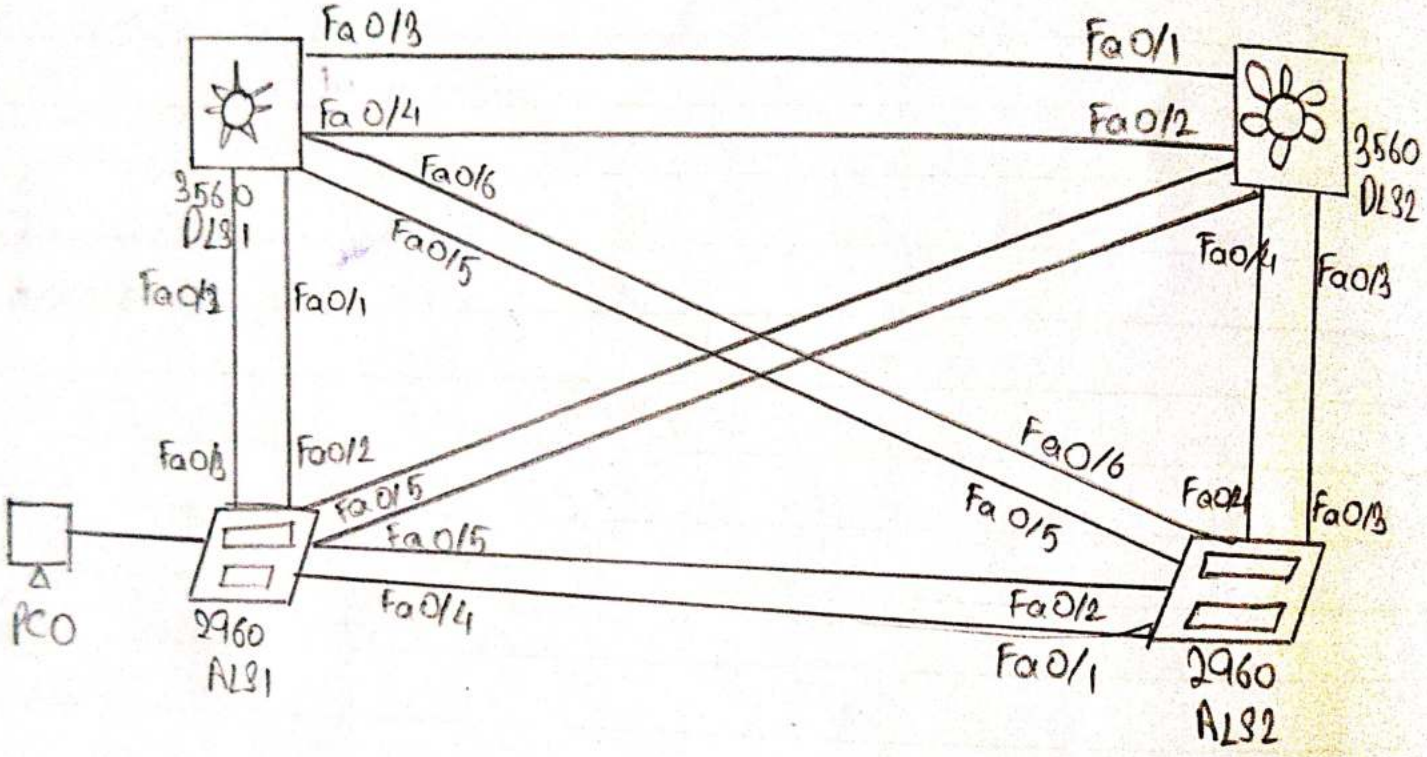
Step 1: Delete the vlan.dat database file, power cycle and erase the startup configuration on each switch before configuring the switches

Step 2: Issue the reload command. Cable and configure the switches with hostname, enable password and console security

Step 3: Use cross-over cables to make the connections since the switches are like devices. After the cables are connected and the switch detects the redundant links, spanning tree will be initiated.

Step 4: Verify STP with the show spanning-tree command on the DLSwitch

```
DLSwitch# show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.6413.DE15
             This bridge is the root
             Hello Time  2 sec  Max Age  20 sec
             Forward delay  15 sec
  Bridge ID  Priority    32769
             Address     0001.6413.DE15
             Hello Time  2 sec  Max Age  20 sec
             Forward delay  20 sec
             Aging time  20
Interface    Role  Sts  Cost  Prio.Nbr  Type
Fa 0/1       Desg  FWD  19    128.1     P2p
Fa 0/2       Desg  FWD  19    128.2     P2p
Fa 0/3       Desg  FWD  19    128.3     P2p
Fa 0/4       Desg  FWD  19    128.4     P2p
```


Fa0/3
Fa0/1
Fa0/4
Fa0/2
3560
DLS2
Fa0/6
3560
DLS1
Fa0/5
Fa0/4
Fa0/3
Fa0/3
Fa0/1
Fa0/6
Fa0/3
Fa0/2
Fa0/5
Fa0/5
Fa0/4
Fa0/3
Fa0/5
PC0
Fa0/4
Fa0/2
2960
ALS1
Fa0/1
2960
ALS2

B) Modifying Default Spanning Tree Behavior

Step 1: Configure Ports Fa 0/1 through Fa 0/6 on all switches to be trunk

```
DLS1# conf t
DLS1(config)# interface range f0/1-6
DLS1(config-if-range)# switchport range fastEthernet 0/1-6
DLS1(config-if-range)# switchport mode trunk
```

Step 2: Display default spanning tree information for all switches

Step 3: Configure a specific switches to be primary and secondary root

```
DLS2# debug spanning-tree events
```

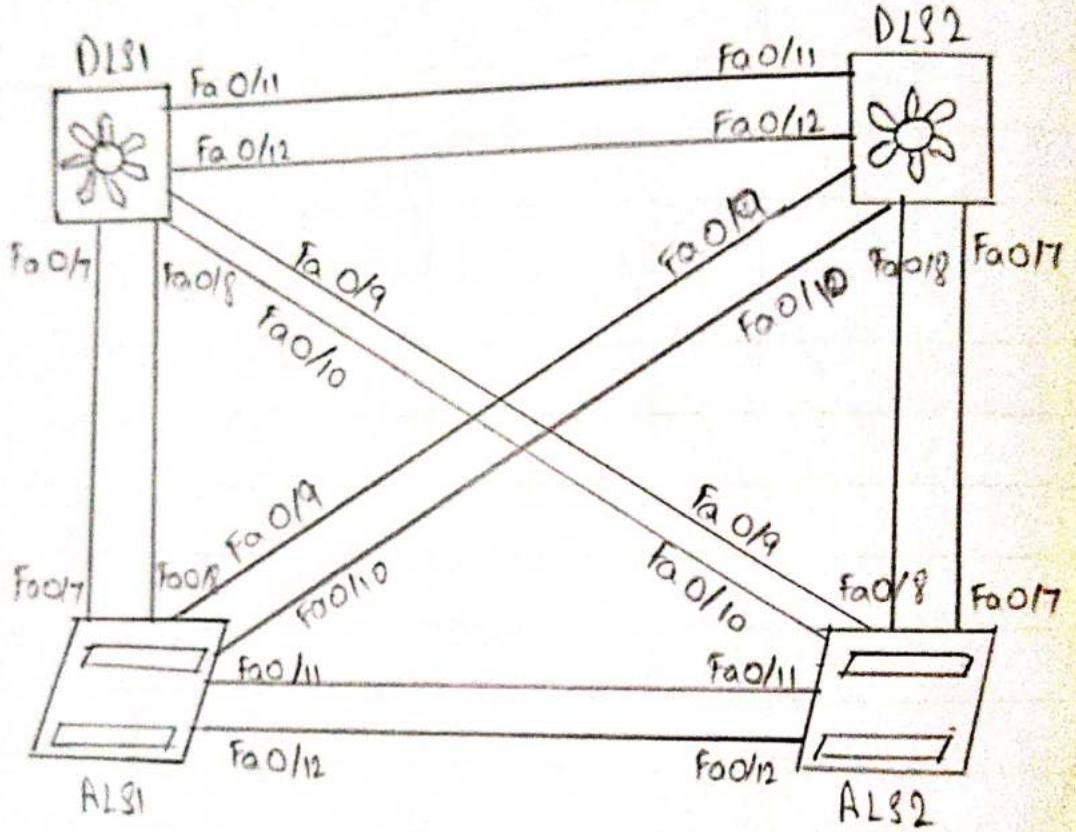
```
DLS1#(config)# spanning-tree vlan 1 root primary
```

```
ALS1(config)# spanning-tree vlan 1 root secondary
```

View the priority modification with the show-spanning-tree command

```
DLS1# show spanning-tree
VLAN 0001
 Spanning tree enabled protocol ieee
 Root ID    Priority  32769
 Bridge ID  Priority  32769

DLS2# show spanning-tree
VLAN 0001
 Spanning-tree enabled protocol ieee
 Root ID    Priority  32769
 Bridge ID  Priority  32769
```

```
DLS1# show spanning-tree
VLAN 0001
 Spanning tree enabled protocol ieee
 Root ID    Priority  24577
 Bridge ID  Priority  24577
```


DLS1
DLS2
ALS1
ALS2
Fa 0/11
Fa 0/12
Fa 0/11
Fa 0/12
Fa 0/7
Fa 0/8
Fa 0/9
Fa 0/10
Fa 0/9
Fa 0/10
Fa 0/8
Fa 0/7
Fa 0/9
Fa 0/10
Fa 0/9
Fa 0/10
Fa 0/7
Fa 0/8
Fa 0/8
Fa 0/7
Fa 0/11
Fa 0/11
Fa 0/12
Fa 0/12

Practical 8
VLAN and Spanning Tree

A) Per-VLAN Spanning Tree Behavior

Step 1: Configure ports Fa 0/7 through Fa 0/12 on all switches to be trunk

```
DLS1(config)# interface range fastEthernet 0/7-12
DLS1(config-if-range)# switchport trunk encapsulation dot1q
DLS1(config-if-range)# switchport mode trunk
```

Step 2: Configure VTP

```
DLS1(config)# vtp mode transparent
DLS1(config)# vtp domain CISCO
DLS1(config)# vlan 10, 20
DLS1(config)# end
```

Step 3: Assign a root switch for each VLAN

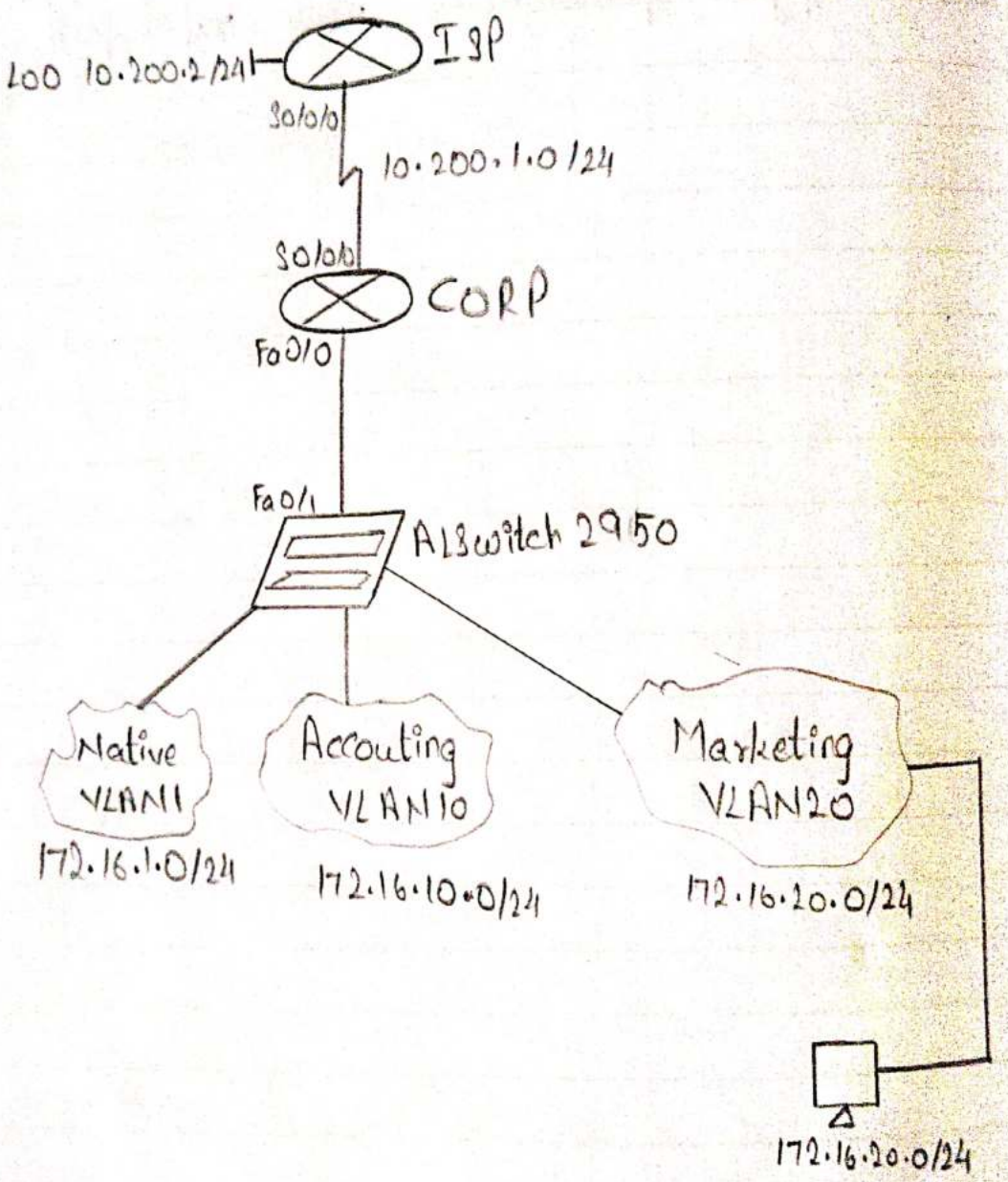
```
DLS1(config)# spanning-tree vlan 10 priority 4096

DLS2(config)# spanning-tree vlan 20 priority 4096
```

```
DLS1 # show spanning-tree
Spanning tree enabled protocol ieee
```

```
DLS1 # show spanning-tree
Spanning-tree enabled protocol rstp
```

Step 4: Configure RSTP

DLS1(config)# spanning-tree mode rapid-pvst


ISP
Lo0 10.200.2/24
S0/0/0
10.200.1.0/24
S0/0/0
CORP
Fa0/0
Fa0/1
A L3 switch 2950
Native VLAN1
172.16.1.0/24
Accouting VLAN10
172.16.10.0/24
Marketing VLAN20
172.16.20.0/24
172.16.20.0/24

Practical no. 9
Internal VLAN Routing

A] Inter-VLAN Routing with an External Router

VTP Domain	VTP Mode
CORP	Server

VLA 10	VLAN Name	VLAN Subnet	VLAN Gateway	Switch Ports
1	Native	172.16.1.0	172.16.1.1/24	Fa 0/1-4 13/-22
10	Accounting	172.16.10.0	172.16.10.1/24	Fa 0/5-8
20	Accounting	172.16.20.0	172.16.20.1/24	Fa 0/9-12
Trunk				802.1Q

Interface	IP Address	VLAN
Fa 0/0.1	172.16.1.1	1 Native
Fa 0/0.10	172.16.10.1	10
Fa 0/0.20	172.16.20.1	20
Serial 0/0	10.200.1.2	

Step 1: Configure ISP for communication with CORP router

```
ISP(config)# interface loopback 0
ISP(config-if)# ip address 10.200.2.1 255.255.255.0
ISP(config)# interface serial 0/0/0
ISP(config)# ip address 10.200.1.1 255.255.255.0
ISP(Config)# clockrate 56000
```

```
CORP(config)# interface Serial 0/0/0
CORP(config-if)# ip address 10.200.1.2 255.255.255.0
CORP(config-if)# no shutdown
CORP(config)# ip route 10.200.2.0 255.255.0 10.200.1.1
CORP(config)# exit
```

Step 2 : set the duplex mode to full to enable the interface

```
CORP(config)# interface fastEthernet 0/0
CORP(config-if)# full-duplex
CORP(config-if)# no shutdown

CORP(config)# interface fa 0/0.1
CORP(config-subif)# description Management VLAN 1
CORP(config-subif)# encapsulation dot1q 1 native
CORP(config-subif)# ip address 172.16.1.1 255.255.255.0

CORP(config)# interface fa 0/0.10
CORP(config)-subif)# description Accounting VLAN10
CORP(config-subif)# encapsulation dot1q 10
CORP(config-subif)# ip address 172.16.10.1 255.255.255.0

CORP(config)# interface fa 0/0.20
CORP(config-subif)# description Marketing VLAN 20
CORP(config-subif)# encapsulation dot1q 20
CORP(config-subif)# ip address 172.16.20.1 255.255.255.0
```

PC

C:\> ping 172.16.20.1

pinging 172.16.20.1

Reply from 172.16.20.1 : bytes = 32 , time = 18 ms TTL = 117

Reply from 172.16.20.1 : bytes = 32 , time = 18ms TTL = 117

Reply from 172.16.20.1 : bytes = 32 , time = 18ms TTL = 117

Reply from 172.16.20.1 : bytes = 32 , time = 18ms TTL = 117

Packet : sent = 4 , Received = 4 , lost = 0 (0% loss)

C:\> ping 10.200.1.1

Ping 10.200.1.1

Reply from 10.200.1.1 : bytes = 32 , time = 18ms TTL = 117

Reply from 10.200.1.1 : bytes = 32 , time = 18ms TTL = 117

Reply from 10.200.1.1 : bytes = 32 , time = 18ms TTL = 117

Reply from 10.200.1.1 : bytes = 32 , time = 18 ms TTL = 117

Packet : sent = 4, Received = 4, lost = 0 (0% loss)

Step 3: Configure the hostname, password and Telnet access for the switch

```
A2Switch (config)# interface VLAN 1
A2Switch (config-if)# ip address 172.16.1.2 255.255.255.0
A2Switch (config-if)# no shutdown
A2Switch (config-if)# exit
A2Switch (config)# ip default-gateway 172.16.1.1
```

Step 4: Configure the switch for trunking and assign VLANs. Set the interface connected to the router to trunk the router

```
A2Switch (config)# interface fa 0/1
A2Switch (config-if)# switchport mode trunk
```

```
A2Switch (config)# interface range fastEthernet 0/5-8
A2Switch (config-if)# switchport access vlan 10
A2Switch (config-if)# spanning-tree portfast
A2Switch (config-if)# interface range fastEthernet 0/9-12
A2Switch (config-if)# switchport access vlan 20
A2Switch (config-if)# spanning-tree portfast
```

Step 6: Verify