Practical No - 1

**Aim:** Configure IP SLA Tracking and Path Control Topology

**Step 1: Prepare the routers and configure the router hostname and interface addresses.**

**Router R1**

interface Loopback 0

ip address 192.168.1.1 255.255.255.0

interface Serial0/0/0

ip address 209.165.201.2 255.255.255.252

no shutdown

interface Serial0/0/1

ip address 209.165.202.130 255.255.255.252

no shutdown

**Router ISP1 (R2)**

interface Loopback0

ip address 209.165.200.254 255.255.255.255

interface Loopback1

ip address 209.165.201.30 255.255.255.255

interface Serial0/0/0

ip address 209.165.201.1 255.255.255.252

no shutdown

interface Serial0/0/1

ip address 209.165.200.225 255.255.255.252

no shutdown

**Router ISP2 (R3)**

interface Loopback0

ip address 209.165.200.254 255.255.255.255

interface Loopback1

ip address 209.165.202.158 255.255.255.255

interface Serial0/0/0

description ISP2 --> R1

ip address 209.165.202.129 255.255.255.252

no shutdown

interface Serial0/0/1

ip address 209.165.200.226 255.255.255.252

no shutdown

R1# show interfaces description

**Router R1**

ip route 0.0.0.0 0.0.0.0 209.165.201.1

**Router ISP1 (R2)**

router eigrp 1

network 209.165.200.224 0.0.0.3

network 209.165.201.0 0.0.0.31

no auto-summary

ip route 192.168.1.0 255.255.255.0 209.165.201.2

**Router ISP2 (R3)**

router eigrp 1

network 209.165.200.224 0.0.0.3

network 209.165.202.128 0.0.0.31

no auto-summary

ip route 192.168.1.0 255.255.255.0 209.165.202.130

**Step 2: Verify server reachability.**

R1(tcl)# foreach address {

+>(tcl)# 209.165.200.254

+>(tcl)# 209.165.201.30

+>(tcl)# 209.165.202.158

+>(tcl)# } { ping $address source 192.168.1.1 }

R1(tcl)# foreach address {

+>(tcl)# 209.165.200.254

+>(tcl)# 209.165.201.30

+>(tcl)# 209.165.202.158

+>(tcl)# } { trace $address source 192.168.1.1 }

**Step 3: Configure IP SLA probes.**

R1(config)# ip sla 11

R1(config-ip-sla)# icmp-echo 209.165.201.30

R1(config-ip-sla-echo)# frequency 10

R1(config-ip-sla-echo)# exit

R1(config)# ip sla schedule 11 life forever start-time now

R1(config)#exit

R1# show ip sla configuration 11

R1# show ip sla statistics

R1# show ip sla configuration 22

**Step 4: Configure tracking options.**

R1(config)# no ip route 0.0.0.0 0.0.0.0 209.165.201.1

R1(config)# ip route 0.0.0.0 0.0.0.0 209.165.201.1 5

R1(config)# exit

R1# show ip route

R1(config)# track 1 ip sla 11 reachability

R1(config-track)#delay dow 10 up 1

R1(config-track)#exit

R1# debug ip routing

R1(config)# ip route 0.0.0.0 0.0.0.0 209.165.201.1 2 track 1

R1(config)# ip route 0.0.0.0 0.0.0.0 209.165.201.1 2 track 1

R1# show ip route

ISP1(config)# interface loopback 1

ISP1(config-if)# shutdown

R1# show ip route

R1# show ip sla statistics

R1# trace 209.165.200.254 source 192.168.1.1

R1# show ip sla statistics

R1# show ip route

## Practical No - 2

**Aim: Using the AS_PATH Attribute**

**Router R1 (hostname Andheri)**

Andheri(config)# interface Loopback0

Andheri(config-if)# ip address 10.1.1.1 255.255.255.0

Andheri(config-if)# exit

Andheri(config)# interface Serial0/0/0

Andheri(config-if)# ip address 192.168.1.5 255.255.255.252

Andheri(config-if)# no shutdown

Andheri(config-if)# end

Andheri#

**Router R2 (hostname Bandra)**

Bandra(config)# interface Loopback0

Bandra(config-if)# ip address 10.2.2.1 255.255.255.0

Bandra(config-if)# interface Serial0/0/0

Bandra(config-if)# ip address 192.168.1.6 255.255.255.252

Bandra(config-if)# no shutdown

Bandra(config-if)# exit

Bandra(config)# interface Serial0/0/1

Bandra(config-if)# ip address 172.24.1.17 255.255.255.252

Bandra(config-if)# no shutdown

Bandra(config-if)# end

Bandra#

**Router R3 (hostname ChurchGate)**

Churchgate(config)# interface Loopback0

Churchgate(config-if)# ip address 10.3.3.1 255.255.255.0

Churchgate(config-if)# exit

Churchgate(config)# interface Serial0/0/1

Churchgate(config-if)# ip address 172.24.1.18 255.255.255.252

Churchgate(config-if)# no shutdown

Churchgate(config-if)# end

Churchgate#

Andheri(config)# router bgp 100

Andheri(config-router)# neighbor 192.168.1.6 remote-as 300

Andheri(config-router)# network 10.1.1.0 mask 255.255.255.0

Bandra(config)# router bgp 300

Bandra(config-router)# neighbor 192.168.1.5 remote-as 100

Bandra(config-router)# neighbor 172.24.1.18 remote-as 65000

Bandra(config-router)# network 10.2.2.0 mask 255.255.255.0

Churchgate(config)# router bgp 65000

Churchgate(config-router)# neighbor 172.24.1.17 remote-as 300

Churchgate(config-router)# network 10.3.3.0 mask 255.255.255.0

Bandra# show ip bgp neighbors

Andheri#show ip route

Andheri#ping 10.3.3.1 source 10.1.1.1 or ping 10.3.3.1 source Lo0

Andheri# show ip bgp

Bandra(config)# ip as-path access-list 1 deny ^100$

Bandra(config)# ip as-path access-list 1 permit .*

Bandra(config)# router bgp 300

Bandra (config-router)# neighbor 192.168.1.5 remove-private-as

Andheri# show ip route

Bandra# show ip bgp regexp ^100$

## Practical No – 3

Aim: Configuring IBGP and EBGP Sessions, Local Preference, and MED

**Router R1 (hostname ISP)**

ISP(config)# interface Loopback0

ISP(config-if)# ip address 192.168.100.1 255.255.255.0

ISP(config-if)# exit

ISP(config)# interface Serial0/0/0

ISP(config-if)# ip address 192.168.1.5 255.255.255.252

ISP(config-if)# no shutdown

ISP(config-if)# exit

ISP(config)# interface Serial0/0/1

ISP(config-if)# ip address 192.168.1.1 255.255.255.252

ISP(config-if)# no shutdown

ISP(config-if)# end

**Router R2 (hostname SanJose1)**

SanJose1(config)# interface Loopback0

SanJose1(config-if)# ip address 172.16.64.1 255.255.255.0

SanJose1(config-if)# exit

SanJose1(config)# interface Serial0/0/0

SanJose1(config-if)# ip address 192.168.1.6 255.255.255.252

SanJose1(config-if)# no shutdown

SanJose1(config-if)# exit

SanJose1(config)# interface Serial0/0/1

SanJose1(config-if)# ip address 172.16.1.1 255.255.255.0

SanJose1(config-if)# no shutdown

SanJose1(config-if)# end

**Router R3 (hostname SanJose2)**

SanJose2(config)# interface Loopback0

SanJose2(config-if)# ip address 172.16.32.1 255.255.255.0

SanJose2(config-if)# exit

SanJose2(config)# interface Serial0/0/0

SanJose2(config-if)# ip address 192.168.1.2 255.255.255.252

SanJose2(config-if)# no shutdown

SanJose2(config-if)# exit

SanJose2(config)# interface Serial0/0/1

SanJose2(config-if)# ip address 172.16.1.2 255.255.255.0

SanJose2(config-if)# no shutdown

SanJose2(config-if)# end

SanJose1(config)# router eigrp 1

SanJose1(config-router)# network 172.16.0.0

SanJose2(config)# router eigrp 1

SanJose2(config-router)# network 172.16.0.0

SanJose1(config)# router bgp 64512

SanJose1(config-router)# neighbor 172.16.32.1 remote-as 64512

SanJose1(config-router)# neighbor 172.16.32.1 update-source lo0

SanJose2(config)# router bgp 64512

SanJose2(config-router)# neighbor 172.16.64.1 remote-as 64512

SanJose2(config-router)# neighbor 172.16.64.1 update-source lo0

SanJose2# show ip bgp neighbors

ISP(config)# router bgp 200

ISP(config-router)# neighbor 192.168.1.6 remote-as 64512

```
ISP(config-router)# neighbor 192.168.1.2 remote-as 64512
ISP(config-router)# network 192.168.100.0

SanJose1(config)# ip route 172.16.0.0 255.255.0.0 null0
SanJose1(config)# router bgp 64512
SanJose1(config-router)# neighbor 192.168.1.5 remote-as 200
SanJose1(config-router)# network 172.16.0.0
SanJose1# show ip bgp neighbors

SanJose2(config)# ip route 172.16.0.0 255.255.0.0 null0
SanJose2(config)# router bgp 64512
SanJose2(config-router)# neighbor 192.168.1.1 remote-as 200
SanJose2(config-router)# network 172.16.0.0
SanJose2# show ip bgp summary

ISP# clear ip bgp *

ISP# ping 172.16.1.1

ISP# ping 172.16.32.1

ISP# ping 172.16.1.2

ISP# show ip bgp

ISP# ping 172.16.1.1 source 192.168.100.1

ISP# ping 172.16.32.1 source 192.168.100.1

ISP# ping 172.16.1.2 source 192.168.100.1

ISP(config)# router bgp 200
```

```
ISP(config-router)# network 192.168.1.0 mask 255.255.255.252
ISP(config-router)# network 192.168.1.4 mask 255.255.255.252
ISP# ping 172.16.64.1 source 192.168.100.1

ISP# show ip bgp

SanJose2# show ip route

ISP(config)# router bgp 200
ISP(config-router)# no network 192.168.1.0 mask 255.255.255.252
ISP(config-router)# no network 192.168.1.4 mask 255.255.255.252
ISP(config-router)# exit
ISP(config)# interface serial 0/0/1
ISP(config-if)# shutdown

SanJose2# show ip bgp

SanJose2# show ip route

SanJose1(config)# router bgp 64512
SanJose1(config-router)# neighbor 172.16.32.1 next-hop-self

SanJose2(config)# router bgp 64512
SanJose2(config-router)# neighbor 172.16.64.1 next-hop-self

SanJose1# clear ip bgp *

SanJose2# clear ip bgp *

SanJose2# show ip bgp

SanJose2# show ip route
```

```
ISP(config)# interface serial 0/0/1
ISP(config-if)# no shutdown

SanJose2# show ip route

SanJose1(config)# route-map PRIMARY_T1_IN permit 10
SanJose1(config-route-map)# set local-preference 150
SanJose1(config-route-map)# exit
SanJose1(config)# router bgp 64512
SanJose1(config-router)# neighbor 192.168.1.5 route-map PRIMARY_T1_IN in

SanJose2(config)# route-map SECONDARY_T1_IN permit 10
SanJose2(config-route-map)# set local-preference 125
SanJose1(config-route-map)# exit
SanJose2(config)# router bgp 64512
SanJose2(config-router)# neighbor 192.168.1.1 route-map SECONDARY_T1_IN in

SanJose1# clear ip bgp * soft

SanJose2# clear ip bgp * soft

SanJose1# show ip bgp

SanJose2# show ip bgp

ISP# show ip bgp

ISP# show ip route

SanJose1(config)#route-map PRIMARY_T1_MED_OUT permit 10
SanJose1(config-route-map)#set Metric 50
```

```
SanJose1(config-route-map)#exit
SanJose1(config)#router bgp 64512
SanJose1(config-router)#neighbor 192.168.1.5 route-map PRIMARY_T1_MED_OUT out

SanJose2(config)#route-map SECONDARY_T1_MED_OUT permit 10
SanJose2(config-route-map)#set Metric 75
SanJose2(config-route-map)#exit
SanJose2(config)#router bgp 64512
SanJose2(config-router)#neighbor 192.168.1.1 route-map SECONDARY_T1_MED_OUT out

SanJose1# clear ip bgp * soft

SanJose2# clear ip bgp * soft

SanJose1# show ip bgp

SanJose2# show ip bgp

ISP# show ip bgp

ISP(config)# router bgp 200
ISP(config-router)# neighbor 192.168.1.6 default-originate
ISP(config-router)# neighbor 192.168.1.2 default-originate
ISP(config-router)# exit
ISP(config)# interface loopback 10
ISP(config-if)# ip address 10.0.0.1 255.255.255.0

SanJose1# show ip route

SanJose2# show ip route

SanJose2# show ip bgp
```

SanJose2# traceroute 10.0.0.1

ISP(config)# interface serial 0/0/0

ISP(config-if)# shutdown

SanJose1# show ip route

SanJose2# show ip route

SanJose1# trace 10.0.0.1

## Practical No - 4

Aim: Secure the Management Plane

**Router R1**

interface Loopback 0

ip address 192.168.1.1 255.255.255.0

exit

interface Serial0/0/0

ip address 10.1.1.1 255.255.255.252

no shutdown

exit

end

**Router R2**

interface Serial0/0/0

ip address 10.1.1.2 255.255.255.252

no shutdown

exit

interface Serial0/0/1

ip address 10.2.2.1 255.255.255.252

no shutdown

exit

end

**Router R3**

interface Loopback0

ip address 192.168.3.1 255.255.255.0

exit

interface Serial0/0/1

ip address 10.2.2.2 255.255.255.252

no shutdown

exit

end

R1(config)# ip route 0.0.0.0 0.0.0.0 10.1.1.2

R3(config)# ip route 0.0.0.0 0.0.0.0 10.2.2.1

R2(config)# ip route 192.168.1.0 255.255.255.0 10.1.1.1

R2(config)# ip route 192.168.3.0 255.255.255.0 10.2.2.2

foreach address {

192.168.1.1

10.1.1.1

10.1.1.2

10.2.2.1

10.2.2.2

192.168.3.1

} { ping $address }

R1# tclsh

R1(tcl)#foreach address {

+>(tcl)#192.168.1.1

+>(tcl)#10.1.1.1

+>(tcl)#10.1.1.2

```
+>(tcl)#10.2.2.1
+>(tcl)#10.2.2.2
+>(tcl)#192.168.3.1
+>(tcl)#} { ping $address }

R1(config)# security passwords min-length 10
R1(config)# enable secret class12345
R1(config)# line console 0
R1(config-line)# password ciscoconpass
R1(config-line)# exec-timeout 5 0
R1(config-line)# login
R1(config-line)# logging synchronous
R1(config-line)# exit

R1(config)# line vty 0 4
R1(config-line)# password ciscovtypass
R1(config-line)# exec-timeout 5 0
R1(config-line)# login
R1(config-line)# exit

R1(config)# line aux 0
R1(config-line)# no exec
R1(config-line)# end

R1(config)# banner motd $Unauthorized access strictly prohibited!$
R1(config)# exit

R1(config)# username JR-ADMIN secret class12345
R1(config)# username ADMIN secret class54321

R1(config)# line console 0
R1(config-line)# login local
```

```
R1(config-line)# exit

R1(config)# line vty 0 4
R1(config-line)# login local
R1(config-line)# end

R1# telnet 10.2.2.2

[Username: ADMIN
Password: RADIUS-1-pa55w0rd]

R1(config)# radius server RADIUS-1
R1(config-radius-server)# address ipv4 192.168.1.101
R1(config-radius-server)# key RADIUS-1-pa55w0rd
R1(config-radius-server)# exit

R1(config)# aaa group server radius RADIUS-GROUP
R1(config-sg-radius)# server name RADIUS-1
R1(config-sg-radius)# server name RADIUS-2
R1(config-sg-radius)# exit

R1(config)# aaa authentication login default group RADIUS-GROUP local

R1(config)# aaa authentication login TELNET-LOGIN group RADIUS-GROUP local-case

R1(config)# line vty 0 4
R1(config-line)# login authentication TELNET-LOGIN
R1(config-line)# exit

R1# telnet 10.2.2.2

R1(config)# ip domain-name ccnasecurity.com
```

R1(config)# crypto key zeroize rsa

R1(config)# crypto key generate rsa general-keys modulus 1024

R1(config)# ip ssh version 2
R1(config)#

R1(config)# line vty 0 4
R1(config-line)# transport input ssh
R1(config-line)# end

R1# show ip ssh

R1# ssh -l ADMIN 10.2.2.2
R3#Device Configurations
**Router R1**

service password-encryption
hostname R1
security passwords min-length 10
enable secret 5 $1$t6eK$FZ.JdmMLj8QSgNkpChyZz.
aaa new-model
aaa group server radius RADIUS-GROUP
server name RADIUS-1
server name RADIUS-2
aaa authentication login default group RADIUS-GROUP local
aaa authentication login TELNET-LOGIN group RADIUS-GROUP local-case
ip domain name ccnasecurity.com
username JR-ADMIN secret 5 $1$0u0q$lwimCZIAuQtV4C1ezXL1S0
username ADMIN secret 5 $1$NSVD$/YjzB7Auyes1sAt4qMfpd.
ip ssh version 2

```
interface Loopback0
description R1 LAN
ip address 192.168.1.1 255.255.255.0
interface Serial0/0/0
description R1 --> R2
ip address 10.1.1.1 255.255.255.252
no fair-queue
ip route 0.0.0.0 0.0.0.0 10.1.1.2
radius server RADIUS-1
address ipv4 192.168.1.101 auth-port 1645 acct-port 1646
key 7 107C283D2C2221465D493A2A717D24653017
radius server RADIUS-2
address ipv4 192.168.1.102 auth-port 1645 acct-port 1646
key 7 03367A2F2F3A12011C44090442471C5C162E
banner motd ^CUnauthorized access strictly prohibited!^C

line con 0
exec-timeout 5 0
password 7 070C285F4D061A0A19020A1F17
logging synchronous
line aux 0
no exec
password 7 060506324F411F0D1C0713181F
login authentication TELNET-LOGIN
transport input ssh
end


Router R2
hostname R2
enable secret 5 $1$DJS7$xvJDW87zLs8pSJDFUlCPB1
interface Serial0/0/0
```

ip address 10.1.1.2 255.255.255.252

no fair-queue

interface Serial0/0/1

ip address 10.2.2.1 255.255.255.252

clock rate 128000

ip route 192.168.1.0 255.255.255.0 10.1.1.1

ip route 192.168.3.0 255.255.255.0 10.2.2.2

line con 0

exec-timeout 0 0

logging synchronous

line vty 0 4

password cisco

login

end

Router R3

service password-encryption

hostname R3

security passwords min-length 10

enable secret 5 $1$5OY4$4J6VFlvGNKjwQ8XtajgUk1

aaa new-model

aaa group server radius RADIUS-GROUP

server name RADIUS-1

server name RADIUS-2

aaa authentication login default group RADIUS-GROUP local

aaa authentication login TELNET-LOGIN group RADIUS-GROUP local-case

ip domain name ccnasecurity.com

username JR-ADMIN secret 5 $1$b4m1$RVmjL9S3gxKh1xr8qzNqr/

username ADMIN secret 5 $1$zGV7$pVgSEbinvXQ7f7uyxeKBj

ip ssh version 2

```
interface Loopback0
description R3 LAN
ip address 192.168.3.1 255.255.255.0

interface Serial0/0/1
description R3 --> R2
ip address 10.2.2.2 255.255.255.252

ip route 0.0.0.0 0.0.0.0 10.2.2.1

radius server RADIUS-1
address ipv4 192.168.1.101 auth-port 1645 acct-port 1646
key 7 01212720723E354270015E084C5000421908

radius server RADIUS-2
address ipv4 192.168.1.102 auth-port 1645 acct-port 1646
key 7 003632222D6E384B5D6C5C4F5C4C1247000F

banner motd ^CUnauthorized access strictly prohibited!^C

line con 0
exec-timeout 5 0
password 7 104D000A0618110402142B3837
logging synchronous

line aux 0
no exec

line vty 0 4
exec-timeout 5 0
password 7 070C285F4D060F110E020A1F17
```

login authentication TELNET-LOGIN

transport input ssh

end

## Practical No - 5

Aim : Configure and Verify Path Control Using PBR

**Router R1**

R1(config)#interface Lo1

R1(config-if)#ip address 192.168.1.1 255.255.255.0

R1(config-if)#interface Serial0/0/0

R1(config-if)#ip address 172.16.12.1 255.255.255.248

R1(config-if)#no shutdown

R1(config-if)#interface Serial0/0/1

R1(config-if)#ip address 172.16.13.1 255.255.255.248

R1(config-if)#no shutdown

R1(config-if)#End

**Router R2**

R2(config)#interface Lo2

R2(config-if)#ip address 192.168.2.1 255.255.255.0

R2(config-if)#interface Serial0/0/0

R2(config-if)#ip address 172.16.12.2 255.255.255.248

R2(config-if)#no shutdown

R2(config-if)#interface Serial0/0/1

R2(config-if)#ip address 172.16.23.2 255.255.255.248

R2(config-if)#no shutdown

R2(config-if)#End

**Router R3**

R3(config)#interface Lo3

R3(config-if)#ip address 192.168.3.1 255.255.255.0

R3(config-if)#interface Serial0/0/0

R3(config-if)#ip address 172.16.13.3 255.255.255.248

R3(config-if)#no shutdown

R3(config-if)#interface Serial0/0/1

R3(config-if)#ip address 172.16.23.3 255.255.255.248

R3(config-if)#no shutdown

R3(config-if)#interface Serial0/1/0

R3(config-if)#ip address 172.16.34.3 255.255.255.248

R3(config-if)#no shutdown

R3(config-if)#End

**Router R4**

R4(config)#interface Lo4

R4(config-if)#ip address 192.168.4.1 255.255.255.128

R4(config-if)#interface Lo5

R4(config-if)#ip address 192.168.4.129 255.255.255.128

R4(config-if)#interface Serial0/0/0

R4(config-if)#ip address 172.16.34.4 255.255.255.248

R4(config-if)#no shutdown

R4(config-if)#End

R3# show ip interface brief

R3# show protocols

R3# show interfaces description

**Router R1**

R1(config)#router eigrp 1

R1(config-router)#network 192.168.1.0

R1(config-router)#network 172.16.12.0 0.0.0.7

R1(config-router)#network 172.16.13.0 0.0.0.7

R1(config-router)#no auto-summary

**Router R2**

R2(config)#router eigrp 1

R2(config-router)#network 192.168.2.0

R2(config-router)#network 172.16.12.0 0.0.0.7

R2(config-router)#network 172.16.23.0 0.0.0.7

R2(config-router)#no auto-summary

**Router R3**

R3(config)#eigrp 1

R3(config-router)#network 192.168.3.0

R3(config-router)#network 172.16.13.0 0.0.0.7

R3(config-router)#network 172.16.23.0 0.0.0.7

R3(config-router)#network 172.16.34.0 0.0.0.7

R3(config-router)#no auto-summary

**Router R4**

R4(config)#router eigrp 1

R4(config-router)#network 192.168.4.0

R4(config-router)#network 172.16.34.0 0.0.0.7

R4(config-router)#no auto-summary

R1# show ip eigrp neighbors

R2# show ip eigrp neighbors

R3# show ip eigrp neighbors

R4# show ip eigrp neighbors

R1# tclsh

R1# show ip route

```
R4# traceroute 192.168.1.1 source 192.168.4.1

R4# traceroute 192.168.1.1 source 192.168.4.129

R3# show ip route

R3# show interfaces serial0/0/0

R3# show ip eigrp topology 192.168.1.0

R3(config)# ip access-list standard PBR-ACL
R3(config-std-nacl)# remark ACL matches R4 LAN B traffic
R3(config-std-nacl)# permit 192.168.4.128 0.0.0.127
R3(config-std-nacl)# exit

R3(config)#
R3(config)# route-map R3-to-R1 permit
R3(config-route-map)# description RM to forward LAN B traffic to R1
R3(config-route-map)# match ip address PBR-ACL
R3(config-route-map)# set ip next-hop 172.16.13.1
R3(config-route-map)# exit

R3(config)# interface s0/1/0
R3(config-if)# ip policy route-map R3-to-R1
R3(config-if)# end

R3# show route-map

R3# conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)# access-list 1 permit 192.168.4.0 0.0.0.255
R3(config)# exit
```

R3# debug ip policy ?

R4# traceroute 192.168.1.1 source 192.168.4.1

R4# traceroute 192.168.1.1 source 192.168.4.129

R3# show route-map

## Practical No - 07

Aim: Cisco MPLS Configuration