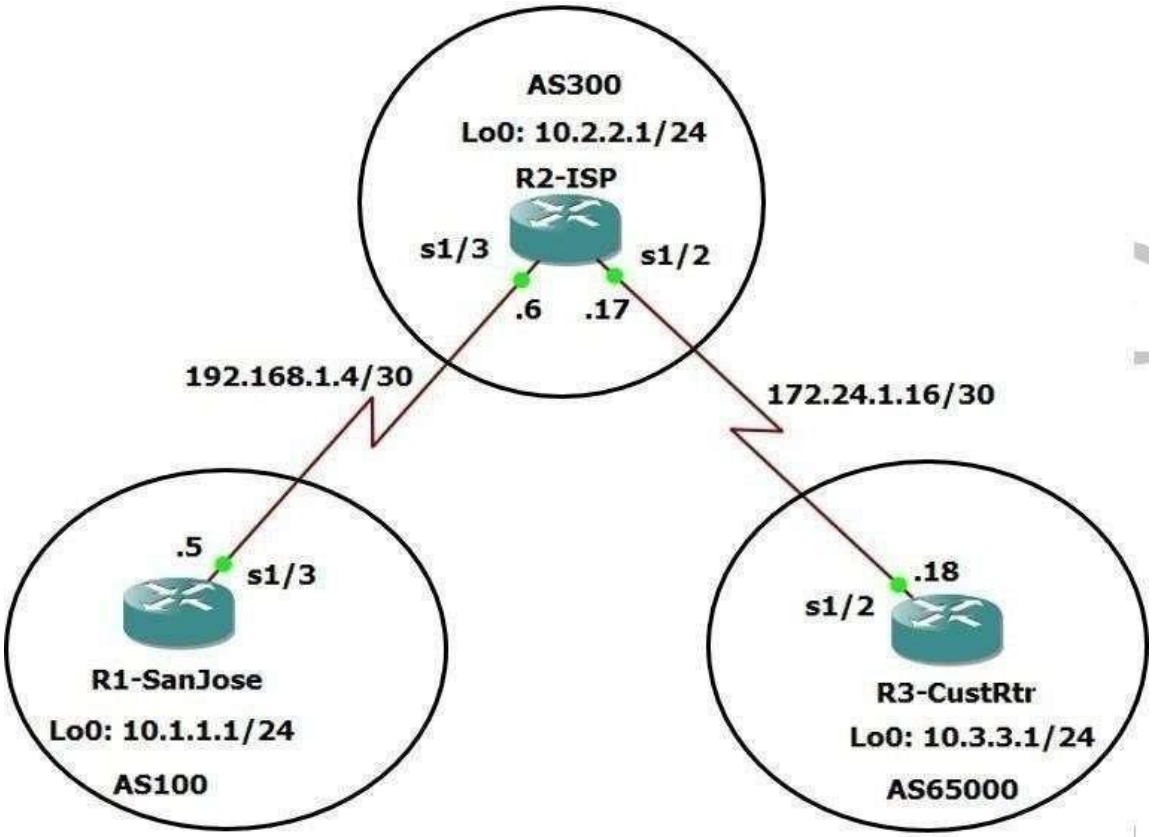
Practical No: 2

Aim: Using the AS_PATH Attribute (On GNS3).



Step 1: Configure hostname and interfaces on all routers.

Router 1-SanJose

```
R1#en
R1#conf t
R1(config)#hostname R1-SanJose
R1-SanJose(config)#int lo 0
R1-SanJose(config-if)#ip add 10.1.1.1 255.255.255.0
R1-SanJose(config-if)#no shut
R1-SanJose(config-if)#int se1/3
R1-SanJose(config-if)#ip add 192.168.1.5 255.255.255.252
R1-SanJose(config-if)#no shut
R1-SanJose(config-if)#exit
R1-SanJose(config)#exit
R1-SanJose#
```

Router 2-ISP

```
R2#en
R2#conf t
R2-ISP(config)#int lo 0
R2-ISP(config-if)#ip add 10.2.2.1 255.255.255.0
R2-ISP(config-if)#no shut
R2-ISP(config-if)#int se1/3
R2-ISP(config-if)#ip add 192.168.1.6 255.255.255.252
R2-ISP(config-if)#no shut
R2-ISP(config-if)#int se1/2
R2-ISP(config-if)#ip add 172.24.1.17 255.255.255.252
R2-ISP(config-if)#no shut
R2-ISP(config-if)#exit
R2-ISP(config)#exit
```

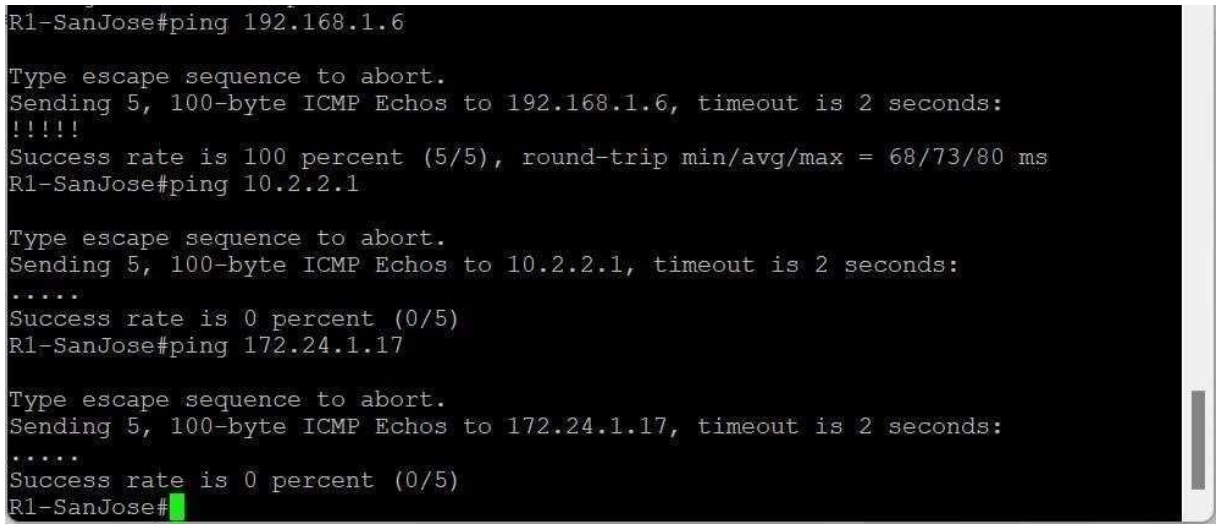
Router 3-CustRtr

```
R3#en
R3#conf t
R3(config)#hostname R3-CustRtr
R3-CustRtr(config)#int lo 0
R3-CustRtr(config-if)#ip add 10.3.3.1 255.255.255.0
R3-CustRtr(config-if)#no shut
R3-CustRtr(config-if)#int se1/2
R3-CustRtr(config-if)#ip add 172.24.1.18 255.255.255.252
R3-CustRtr(config-if)#no shut
R3-CustRtr(config-if)#exit
R3-CustRtr(config)#exit
```

Step 2: Check Connectivity

Use **ping** to test the connectivity between the directly connected routers.

SanJose will not be able to reach either Iso's loopback (10.2.2.1) or CustRtr's loopback (10.3.3.1), nor will it be reach either end of the link joining ISP to CustRtr (172.24.1.17) and (172.24.1.18).



Step 3: Configure BGP

R1-SanJose#conf t
R1-SanJose(config)#router bgp 100
R1-SanJose(config-router)#neighbor 192.168.1.6 remote-as 300
R1-SanJose(config-router)#network 10.1.1.0 mask 255.255.25.0
R1-SanJose(config-router)#^Z
R1-SanJose#

R2-ISP#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2-ISP(config)#router bgp 300
R2-ISP(config-router)#neighbor 192.168.1.5 remote-as 100
R2-ISP(config-router)#%BGP-5-ADJCHANGE: neighbor 192.168.1.5 Up
R2-ISP(config-router)#neighbor 172.24.1.18 remote-as 65000
R2-ISP(config-router)#network 10.2.2.0 mask 255.255.255.0
R2-ISP(config-router)#^Z
R2-ISP#

R3-CustRtr#conf t
R3-CustRtr(config)#router bgp 65000
R3-CustRtr(config-router)#neighbor 172.24.1.17 remote-as 300
R3-CustRtr(config-router)#%BGP-5-ADJCHANGE: neighbor 172.24.1.17 Up
R3-CustRtr(config-router)#network 10.3.3.0 mask 255.255.255.0
R3-CustRtr(config-router)#^Z
R3-CustRtr#

Step 4: Verify that these routers have establish the appropriate neighbor relationships by issuing the show ip bgp neighbors command on each router.

```
R2-ISP#sh ip bgp neighbors
BGP neighbor is 172.24.1.18,  remote AS 65000, external link
  BGP version 4, remote router ID 10.3.3.1
  BGP state = Established, up for 00:11:04
```

```
BGP neighbor is 192.168.1.5,  remote AS 100, external link
  BGP version 4, remote router ID 10.1.1.1
  BGP state = Established, up for 00:15:06
```

Step 5: remove the private AS

a. Display the SanJose routing table using the **show ip route** command. SanJose should have a route to both 10.2.2.0 and 10.3.3.0

b. Ping the 10.3.3.1 address from SanJose.

```
R1-SanJose#sh ip route
R1-SanJose#ping 10.3.3.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.3.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
R1-SanJose#

Gateway of last resort is not set

     10.0.0.0/24 is subnetted, 3 subnets
B       10.3.3.0 [20/0] via 192.168.1.6, 00:39:54
B       10.2.2.0 [20/0] via 192.168.1.6, 00:42:36
C       10.1.1.0 is directly connected, Loopback0
     192.168.1.0/30 is subnetted, 1 subnets
C       192.168.1.4 is directly connected, Serial1/3
R1-SanJose#
```

c. Ping again.

```
R1-SanJose#ping
Protocol [ip]:
Target IP address: 10.3.3.1
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 10.1.1.1
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 10.3.3.1, timeout is 2 seconds:
Packet sent with a source address of 10.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/63/88 ms
R1-SanJose#ping 10.3.3.1 source 10.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.3.1, timeout is 2 seconds:
Packet sent with a source address of 10.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/66/96 ms
R1-SanJose#
```

OR

```
R1-SanJose#ping 10.3.3.1 source 10.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.3.1, timeout is 2 seconds:
Packet sent with a source address of 10.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 40/66/96 ms
```

d. Check the **BGP** table from SanJose by using **show ip bgp** command. Note the AS path for the 10.3.3.0 network. The AS 65000 sould be listed in the path to 10.3.3.0

```
R1-SanJose#sh ip bgp
BGP table version is 4, local router ID is 10.1.1.1
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
*> 10.1.1.0/24      0.0.0.0                  0         32768 i
*> 10.2.2.0/24      192.168.1.6              0             0 300 i
*> 10.3.3.0/24      192.168.1.6                            0 300 65000 i
R1-SanJose#
```

e. Configure ISP to strip the private numbers from BGP routes exchanged with SanJose using the following commands.

R2-ISP#conf t
R2-ISP(config)#router bgp 300
R2-ISP(config-router)#neighbor 192.168.1.5 remove-private-as R2-ISP(config-router)#^Z

```
R2-ISP#clear ip bgp *
R2-ISP#
*Apr 28 20:55:26.451: %BGP-5-ADJCHANGE: neighbor 172.24.1.18 Down User reset
*Apr 28 20:55:26.455: %BGP-5-ADJCHANGE: neighbor 192.168.1.5 Down User reset
R2-ISP#
*Apr 28 20:55:28.511: %BGP-5-ADJCHANGE: neighbor 172.24.1.18 Up
*Apr 28 20:55:28.523: %BGP-5-ADJCHANGE: neighbor 192.168.1.5 Up
R2-ISP#
```

f. SanJose should be able to ping 10.3.3.1 using its loopback 0 interface as the source ofthe ping.

```
R1-SanJose#ping 10.3.3.1 source lo 0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.3.1, timeout is 2 seconds:
Packet sent with a source address of 10.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/59/88 ms
R1-SanJose#
```

g. Now check the BGP table on SanJose. The AS_PATH to the 10.3.3.0 network should bs AS 300. It no longer has the private As in the path.

```
R1-SanJose#ping 10.3.3.1 source lo 0

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.3.1, timeout is 2 seconds:
Packet sent with a source address of 10.1.1.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/59/88 ms
R1-SanJose#
```

Step 6: Use AS_PATH attribute to filter routes.

a. Configure a special kind of access list to match BGP with an AS_PATH attribute that both begins and ends with the number 100. Enter the following commands on ISP.

R2-ISP#conf t
R2-ISP(config)#ip as-path access-list 1 deny ^100$
R2-ISP(config)#ip as-path access-list 1 permit .*
R2- ISP(config)#

The first command uses the ^ character to indicate the the AS path must begin with the given number 100. The $ character indicates that the AS_PATH attribute must also end with 100. Essentially, this statement matches only paths that are sources from AS 100. Other paths, which might include AS 100 along the way, will not match this list.
In the second statement, the . (period) is a wildcard, and the * (asterisk) stand for a repetition Of the wildcard. Together, .* matches any value of the AS_PATH attribute, which in effect permits any update that has not been denied by the previous **access-list** statement.

b. Apply the cpnfigured access list using the **neighbor** command with the **filterlist** option.

R2-ISP#conf t
R2-ISP(config)#router bgp 300

R2-ISP(config-router)#neighbor 172.24.1.18 filter-list 1 out
R2-ISP(config-router)#^Z R2-ISP#
The out keyword specifies that the list is applied to routing information sent to this neighbor.

C. Use the **clear ip bgp *** command to reset the routing information. Wait several seconds and then check the routing table for ISP. The route to 10.1.1.0 should be in the routing table.

```
R2-ISP#clear ip bgp *
R2-ISP#
*Apr 28 21:12:51.315: %BGP-5-ADJCHANGE: neighbor 172.24.1.18 Down User reset
*Apr 28 21:12:51.315: %BGP-5-ADJCHANGE: neighbor 192.168.1.5 Down User reset
R2-ISP#
*Apr 28 21:12:52.599: %BGP-5-ADJCHANGE: neighbor 192.168.1.5 Up
*Apr 28 21:12:53.375: %BGP-5-ADJCHANGE: neighbor 172.24.1.18 Up
R2-ISP#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     172.24.0.0/30 is subnetted, 1 subnets
C       172.24.1.16 is directly connected, Serial1/2
     10.0.0.0/24 is subnetted, 2 subnets
B       10.3.3.0 [20/0] via 172.24.1.18, 00:00:17
C       10.2.2.0 is directly connected, Loopback0
     192.168.1.0/30 is subnetted, 1 subnets
C       192.168.1.4 is directly connected, Serial1/3
R2-ISP#
```

c. Check the routing table for CustRtr . It should not have a route to 10.1.1.0 in its routing table.

```
R3-CustRtr#sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     172.24.0.0/30 is subnetted, 1 subnets
C       172.24.1.16 is directly connected, Serial1/2
     10.0.0.0/24 is subnetted, 2 subnets
C       10.3.3.0 is directly connected, Loopback0
B       10.2.2.0 [20/0] via 172.24.1.17, 00:03:19
R3-CustRtr#
```

e. Return to ISP and verify that the filter is working as intended. Issue **the show ip bgp regexp ^100$** command.

```
R2-ISP#show ip bgp regexp ^100$
BGP table version is 4, local router ID is 10.2.2.1
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
*> 10.1.1.0/24      192.168.1.5              0             0 100 i
R2-ISP#
```

The output of this command shows all matches for the regular expression that were used in the access list. The path to 10.1.1.0 matches the access list and is filtered from updates to CustRtr.

Now all pings from ISP should be successful.

```
R2-ISP#ping 10.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/24/36 ms
R2-ISP#ping 10.2.2.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.2.2.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
R2-ISP#ping 10.3.3.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.3.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/28/32 ms
R2-ISP#ping 192.168.1.5
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/27/32 ms
R2-ISP#ping 192.168.1.6
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/56/64 ms
R2-ISP#ping 172.24.1.17
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.24.1.17, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 52/59/68 ms
R2-ISP#ping 172.24.1.18
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.24.1.18, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 24/28/32 ms
R2-ISP#
```

SanJose should not be able to ping the CustRtr loopback 10.3.3.1 or the WAN link 172.24.1.16/30.

```
R1-SanJose#ping 10.3.3.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.3.3.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
R1-SanJose#ping 172.24.1.16
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.24.1.16, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
R1-SanJose#
```

CustRtr should not be able to ping the Sanjose loopback 10.1.1.1 or the WAN link 192.168.1.4/30.