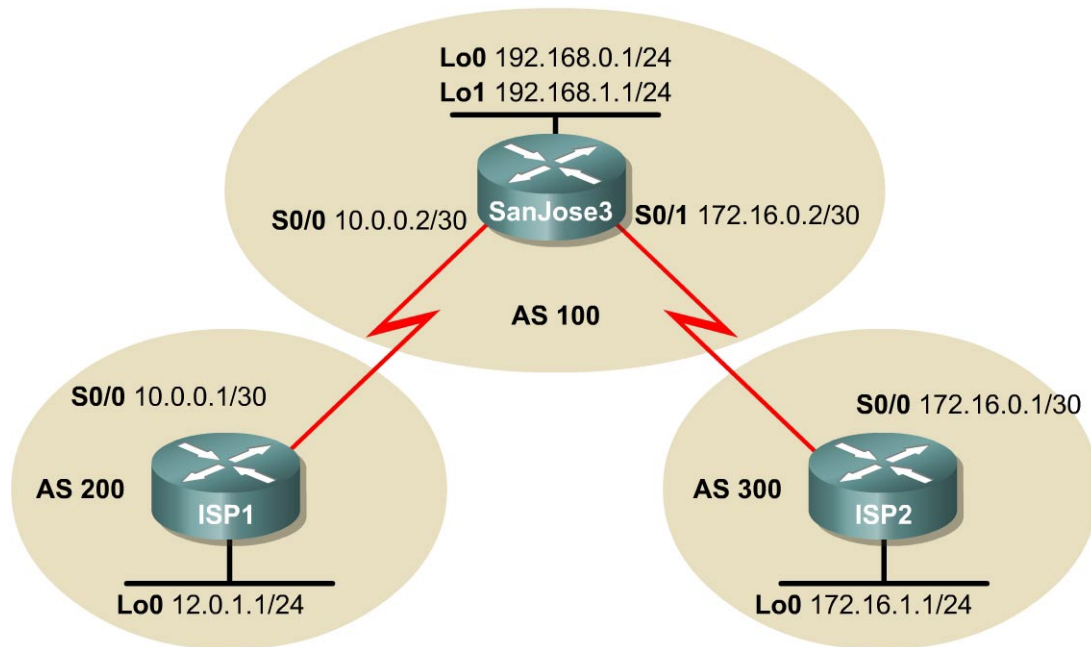


## Lab 9.11.1 Configuring BGP with Default Routing



### Objective

In this lab, the student will configure BGP to exchange routing information with two Internet Service Providers (ISPs).

### Scenario

The International Travel Agency relies extensively on the Internet for sales. The company has contracted with two ISPs for Internet connectivity with fault tolerance. The BGP that runs between the SanJose3 boundary router and the two ISP routers needs to be configured.

### Step 1

Build and configure the network according to the diagram, but do not configure a routing protocol. Configure a loopback interface with an IP address for each ISP router, as shown in the Figure. These loopbacks simulate real networks that can be reached through the ISP. Configure two loopback interfaces with the IP addresses for the SanJose3 router. These loopbacks simulate the connections between the core routers.

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

**Note:** The ISP1 router will not be able to reach the ISP2 router.

### Step 2

Configure the ISP routers. In this lab, configure the providers' equipment as well as the International Travel Agency's boundary router, SanJose3. On the ISP1 router, enter the following configuration:

```
ISP1(config)#router bgp 200
ISP1(config-router)#neighbor 10.0.0.2 remote-as 100
```

```
ISP1(config-router)#network 12.0.1.0 mask 255.255.255.0
```

On the router for ISP2, configure BGP as shown in the following:

```
ISP2(config)#router bgp 300
ISP2(config-router)#neighbor 172.16.0.2 remote-as 100
ISP2(config-router)#network 172.16.1.0 mask 255.255.255.0
```

With the ISP routers configured, now set up the International Travel Agency's boundary router, SanJose3.

### Step 3

Configure the SanJose3 router to run BGP with both providers. Use the following configuration:

```
SanJose3(config)#router bgp 100
SanJose3(config-router)#neighbor 10.0.0.1 remote-as 200
SanJose3(config-router)#neighbor 172.16.0.1 remote-as 300
SanJose3(config-router)#network 192.168.0.0
SanJose3(config-router)#network 192.168.1.0
```

This completes the BGP configuration. Check the routing table for SanJose3 with the `show ip route` command as follows:

```
SanJose3#show ip route

Gateway of last resort is not set

      172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/30 is directly connected, Serial0/1
B       172.16.1.0/24 [20/0] via 172.16.0.1, 00:00:03
      10.0.0.0/30 is subnetted, 1 subnets
C       10.0.0.0 is directly connected, Serial0/0
C       192.168.0.0/24 is directly connected, Loopback0
      12.0.0.0/24 is subnetted, 1 subnets
B       12.0.1.0 [20/0] via 10.0.0.1, 00:00:42
C       192.168.1.0/24 is directly connected, Loopback1
```

SanJose3 has routes to the loopback networks at each ISP router. Verify that SanJose3 has connectivity to these networks by pinging each loopback address from its console. These pings should be successful.

### Step 4

Use `show` commands to verify the operation of SanJose3. On SanJose3, issue the `show ip bgp` command as follows:

```
SanJose3#show ip bgp
BGP table version is 5, local router ID is 192.168.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop        Metric LocPrf Weight Path
*> 12.0.1.0/24      10.0.0.1          0             0 200 i
*> 172.16.1.0/24    172.16.0.1        0             0 300 i
*> 192.168.0.0      0.0.0.0           0           32768 i
*> 192.168.1.0      0.0.0.0           0           32768 i
```

1. What do the asterisks (\*) next to each route indicate?

2. What do the ">" symbols next to each route indicate?

---

3. What is the local router ID?

---

4. Which table version is displayed?

---

On the ISP1 router, issue the `shutdown` command on Loopback0. Return to SanJose3 and issue the `show ip bgp` command again.

5. Which table version is displayed?

---

The version number will vary, but the `shutdown` command should have caused a routing table update, so the version should be one higher than the last.

Bring the ISP1 router Loopback0 back up by issuing the `no shutdown` command.

On SanJose3, issue the `show ip bgp neighbors` command. The following is a partial sample output of the command:

```
BGP neighbor is 172.16.0.1, remote AS 300, external link
Index 2, Offset 0, Mask 0x4
BGP version 4, remote router ID 172.16.1.1
BGP state = Established, table version = 5, up for 00:02:24
Last read 00:00:24, hold time is 180
```

6. Based on the output of this command, what is the BGP state between this router and ISP2?

---

7. How long has this connection been up?

---

## Step 5

Check the routing table from ISP2 with the `show ip route` command. ISP2 should have a route that belongs to ISP1, 12.0.1.0.

SanJose3 may advertise a route belonging to ISP1. ISP2 then installs that route in its table. ISP2 might then attempt to route transit traffic through the International Travel Agency. Configure the SanJose3 router so that it advertises only International Travel Agency networks 192.168.0.0 and 192.168.1.0 to both providers. On the SanJose3 router, configure the following access list:

```
SanJose3(config)#access-list 1 permit 192.168.0.0 0.0.1.255
```

Then apply this access list as a route filter as follows, using the `distribute-list` keyword with the BGP `neighbor` statement:

```
SanJose3(config)#router bgp 100
SanJose3(config-router)#neighbor 10.0.0.1 distribute-list 1 out
SanJose3(config-router)#neighbor 172.16.0.1 distribute-list 1 out
```

After the route filter has been configured, check the routing table for ISP2 again. The route to 12.0.1.0, ISP1, should still be in the table.

Return to SanJose3 and issue the `clear ip bgp *` command. Wait until the routers reach the Established state, which might take several seconds.

After the routers reach the Established state, recheck the ISP2 routing table. The route to ISP1 should no longer be in the routing table.

The route to 172.16.1.0, ISP2, should not be in the routing table for ISP1.

## Step 6

Now that bidirectional communication has been established with each ISP by way of BGP, it is now time to declare the primary route and backup route. This can be done with floating static routes or within BGP.

To look at the floating static route method, issue the `show ip route` command as follows on SanJose3 router:

```
Gateway of last resort is not set

      172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/30 is directly connected, Serial0/1
B       172.16.1.0/24 [20/0] via 172.16.0.1, 00:07:37
      10.0.0.0/30 is subnetted, 1 subnets
C       10.0.0.0 is directly connected, Serial0/0
C       192.168.0.0/24 is directly connected, Loopback0
      12.0.0.0/24 is subnetted, 1 subnets
B       12.0.1.0 [20/0] via 10.0.0.1, 00:07:42
C       192.168.1.0/24 is directly connected, Loopback1
```

Notice that there is no Gateway of Last Resort defined. This is a huge problem since SanJose3 is the border router for the corporate network. Assume that ISP1 is the primary provider and ISP2 will act as the backup provider. Configure static routes to reflect this policy.

```
SanJose3(config)#ip route 0.0.0.0 0.0.0.0 10.0.0.1 210
SanJose3(config)#ip route 0.0.0.0 0.0.0.0 172.16.0.1 220
```

Now verify that a default route is defined. Issue the `show ip route` command as follows:

```
Gateway of last resort is 10.0.0.1 to network 0.0.0.0

      172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/30 is directly connected, Serial0/1
B       172.16.1.0/24 [20/0] via 172.16.0.1, 00:16:34
      10.0.0.0/30 is subnetted, 1 subnets
C       10.0.0.0 is directly connected, Serial0/0
C       192.168.0.0/24 is directly connected, Loopback0
      12.0.0.0/24 is subnetted, 1 subnets
B       12.0.1.0 [20/0] via 10.0.0.1, 00:16:39
C       192.168.1.0/24 is directly connected, Loopback1
S*    0.0.0.0/0 [210/0] via 10.0.0.1
```

Test this default route by first creating an unadvertised loopback on the router for ISP1 as follows:

```
ISP1#config t
ISP1(config)#int loopback 100
ISP1(config-if)#ip address 210.210.210.1 255.255.255.0
```

Issue the `clear ip bgp 10.0.0.1` command to re-establish a conversation with the 10.0.0.1 BGP speaker as follows:

```
SanJose3#clear ip bgp 10.0.0.1
```

Wait until the BGP conversation is re-established with the 10.0.0.1 host.

Issue the `show ip route` command to insure that the newly added 210.210.210.0 /24 network does not appear in the routing table.

```
SanJose3#show ip route

Gateway of last resort is 10.0.0.1 to network 0.0.0.0

    172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.16.0.0/30 is directly connected, Serial0/1
B       172.16.1.0/24 [20/0] via 172.16.0.1, 00:27:40
    10.0.0.0/30 is subnetted, 1 subnets
C       10.0.0.0 is directly connected, Serial0/0
C       192.168.0.0/24 is directly connected, Loopback0
    12.0.0.0/24 is subnetted, 1 subnets
B       12.0.1.0 [20/0] via 10.0.0.1, 00:27:45
C       192.168.1.0/24 is directly connected, Loopback1
S*    0.0.0.0/0 [210/0] via 10.0.0.1
```

Issue an extended `ping` to the 210.210.210.1 loopback interface originating from the 192.168.1.1, SanJose3, interface as follows:

```
SanJose3#ping
Protocol [ip]:
Target IP address: 210.210.210.1
Repeat count [5]:
Datagram size [100]:
Timeout in seconds [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 [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 210.210.210.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/32/36 ms
```

## Step 7

Another solution uses the `default-network` command instead of a 0.0.0.0/0 route.

Remove the floating static routes issued from the previous step as follows:

```
SanJose3(config)#no ip route 0.0.0.0 0.0.0.0 10.0.0.1 210
SanJose3(config)#no ip route 0.0.0.0 0.0.0.0 172.16.0.1 220
```

The network that was added in the last step, 210.210.210.0/24, should now be advertised on the ISP1 router for this portion of the lab exercise.

```
ISP1(config)#router bgp 200
ISP1(config-router)#network 210.210.210.0

ISP1# clear ip bgp 10.0.0.2
```

The SanJose3 router now needs to be configured with a **default-network** statement to re-establish a Gateway of Last Resort. Make sure that the classful network 210.210.210.0 /24 appears in the routing table and is followed with the **ip default-network** statement:

```
Gateway of last resort is not set

B    210.210.210.0/24 [20/0] via 10.0.0.1, 00:04:51
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C     172.16.0.0/30 is directly connected, Serial0/1
B     172.16.1.0/24 [20/0] via 172.16.0.1, 00:21:19
     10.0.0.0/30 is subnetted, 1 subnets
C     10.0.0.0 is directly connected, Serial0/0
C     192.168.0.0/24 is directly connected, Loopback0
     12.0.0.0/24 is subnetted, 1 subnets
B     12.0.1.0 [20/0] via 10.0.0.1, 00:04:51
C     192.168.1.0/24 is directly connected, Loopback1

SanJose3(config)#ip default-network 210.210.210.0
```

Wait a few seconds, and then re-examine the routing table on SanJose3 as follows:

```
Gateway of last resort is 10.0.0.1 to network 210.210.210.0

B*   210.210.210.0/24 [20/0] via 10.0.0.1, 00:04:28
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C     172.16.0.0/30 is directly connected, Serial0/1
B     172.16.1.0/24 [20/0] via 172.16.0.1, 00:20:56
     10.0.0.0/30 is subnetted, 1 subnets
C     10.0.0.0 is directly connected, Serial0/0
C     192.168.0.0/24 is directly connected, Loopback0
     12.0.0.0/24 is subnetted, 1 subnets
B     12.0.1.0 [20/0] via 10.0.0.1, 00:04:28
C     192.168.1.0/24 is directly connected, Loopback1
```

This will establish ISP1 as the only default route. This route can be manipulated with policy routing. Correct this by adding a backup route to the 172.16.0.1 host on ISP2 as follows:

```
SanJose3(config)#ip route 0.0.0.0 0.0.0.0 172.16.0.1 220
```

EBGP learned routes have an administrative distance of 20 and will be preferred to any routes with administrative distance greater than 20, such as the default route defined above with administrative distance 220. This will act as a backup if the 210.210.210.0 /24 network is unavailable. This network could be unavailable due to a fault, misconfiguration, or the short period after a **clear ip bgp 10.0.0.1** command is issued.

Verify that this newly added route establishes a consistent default route while the BGP conversation between SanJose3 and ISP1 re-establishes. Notice that the routing table includes two candidate default routes (\*) only one of which is used because of different administrative distances.

```
SanJose3#show ip route
Codes: C - connected, S - static, I - IGRP, 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,
E - EGP i - IS-IS, 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 10.0.0.1 to network 210.210.210.0

B*   210.210.210.0/24 [20/0] via 10.0.0.1, 00:19:17
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C     172.16.0.0/30 is directly connected, Serial0/1
B     172.16.1.0/24 [20/0] via 172.16.0.1, 00:35:45
     10.0.0.0/30 is subnetted, 1 subnets
C     10.0.0.0 is directly connected, Serial0/0
```

```

C    192.168.0.0/24 is directly connected, Loopback0
    12.0.0.0/24 is subnetted, 1 subnets
B    12.0.1.0 [20/0] via 10.0.0.1, 00:19:17
C    192.168.1.0/24 is directly connected, Loopback1
S*  0.0.0.0/0 [220/0] via 172.16.0.1

SanJose3#clear ip bgp 10.0.0.1
SanJose3#show ip route

Gateway of last resort is 172.16.0.1 to network 0.0.0.0

    172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C    172.16.0.0/30 is directly connected, Serial0/1
B    172.16.1.0/24 [20/0] via 172.16.0.1, 00:45:31
    10.0.0.0/30 is subnetted, 1 subnets
C    10.0.0.0 is directly connected, Serial0/0
C    192.168.0.0/24 is directly connected, Loopback0
C    192.168.1.0/24 is directly connected, Loopback1
S*  0.0.0.0/0 [220/0] via 172.16.0.1

SanJose3#show ip route
Gateway of last resort is 10.0.0.1 to network 210.210.210.0
B*  210.210.210.0/24 [20/0] via 10.0.0.1, 00:01:03
    172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
C    172.16.0.0/30 is directly connected, Serial0/1
B    172.16.1.0/24 [20/0] via 172.16.0.1, 00:46:42
    10.0.0.0/30 is subnetted, 1 subnets
C    10.0.0.0 is directly connected, Serial0/0
C    192.168.0.0/24 is directly connected, Loopback0
    12.0.0.0/24 is subnetted, 1 subnets
B    12.0.1.0 [20/0] via 10.0.0.1, 00:01:03
C    192.168.1.0/24 is directly connected, Loopback1
S*  0.0.0.0/0 [220/0] via 172.16.0.1

```

As expected, while the BGP conversation was down between SanJose3 and ISP1, the route to ISP2 was added as the Gateway of Last Resort. However, once BGP reestablished the conversation between SanJose3 and ISP1 the default route of 210.210.210.0 was again, set as the Gateway of Last Resort on SanJose3.