CONFIGURING THE BORDER GATEWAY PROTOCOL (BGP)

The last part of this lab provides some exposure to the inter domain Border Gateway Protocol (BGP), which determines paths between autonomous systems on the Internet. The exercises in this lab cover only the basics of BGP. Essentially, you learn how to set up an autonomous system and observe BGP traffic between autonomous systems. BGP uses a path vector algorithm, where routers exchange full path information of a route. An important feature of BGP is that it can define routing policies, which can be used by a network to specify which type of traffic it is willing to process. The current version of BGP, which is also used in the following exercise, is BGP version 4 (BGP-4)

The network configuration for this part is shown in Figure 5.3, and the IP configuration information is given in table 5.3. the network has three autonomous systems with AS numbers 100, 200 and 300. One PC, PC4, is used to capture the BGP packets transmitted between the ASs.

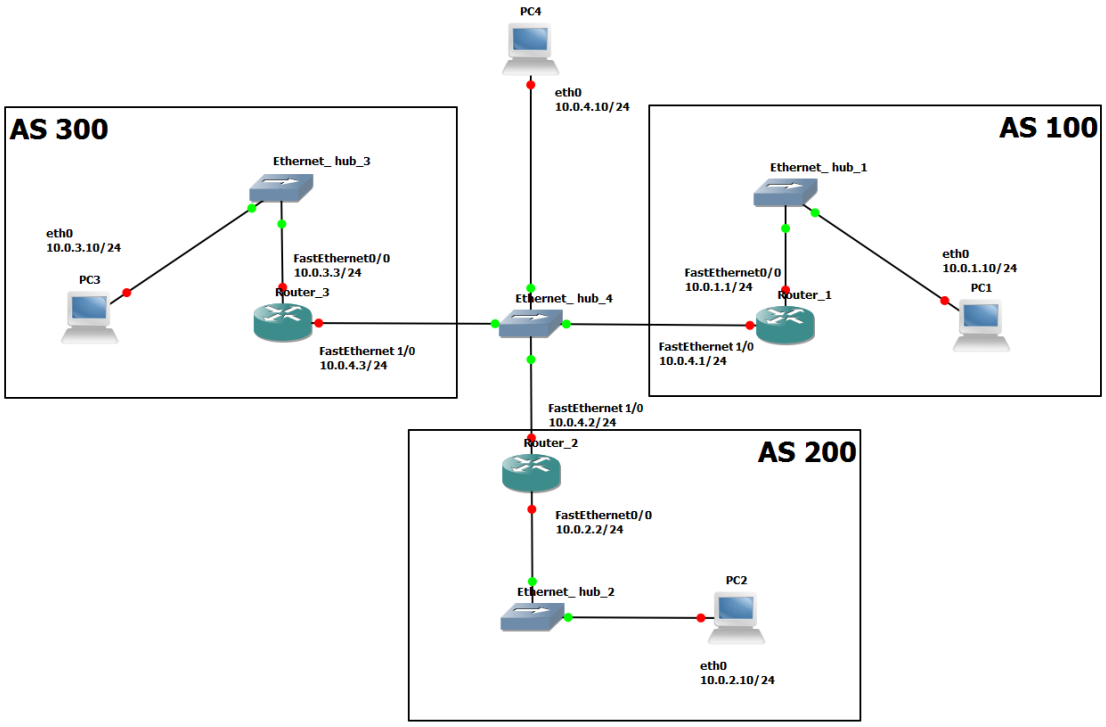

Figure 6.3 Network topology for Part 3.

PC	**Ethernet Interface eth0**	**Default Gateway**
PC1	10.0.1.10 / 24	10.0.1.1
PC2	10.0.2.10 / 24	10.0.2.2
PC3	10.0.3.10 / 24	10.0.3.3
PC4	10.0.4.10 / 24	
Cisco Routers	**Ethernet Interface FastEthernet 0/0**	**Ethernet Interface FastEthernet 0/1**

Router1	10.0.1.1 / 24	10.0.4.1 / 24
Router2	10.0.2.2 / 24	10.0.4.2 / 24
Router3	10.0.3.3 / 24	10.0.4.3 / 24

Table 6.3 IP addresses of the routers and PCs for Part 3.

Exercise 3(A). Basic BGP configuration.

In this exercise you will configure the Cisco routers as BGP routers and assign routers to autonomous systems. The configuration is completed when you can issue `ping` commands between any two PCs. Below we summarize the Cisco IOS commands that are used to enable BGP.

IOS MODE: GLOBAL CONFIGURATION

`router bgp ASnumber`

Enables the BGP routing protocol and sets the autonomous system number to ASnumber.

The command enters the router configuration mode with the following prompt:

Router1(config-router)#

`no router bgp ASnumber`

Disables the BGP routing process.

IOS MODE: PREVILEGED EXEC

`show ip bgp`

Displays the BGP routing table.

`show ip bgp neighbors`

Displays the neighbors, also called peers, of this BGP router.

`show ip bgp paths`

Displays the BGP path information in the local database.

`clear ip bgp *`

Deletes BGP routing information

IOS MODE: ROUTER CONFIGURATION

`network Netaddr`

`network Netaddr mask netmask`

Specifies a network address that will be advertised by the local BGP process. A network mask maybe added to denote the length of the network prefix.

`neighbor IPaddress remote-as ASnumber`

Adds a neighbor to the BGP neighbor table. IPaddress is the IP address and ASnumber is the AS number of the neighbor.

`timers bgp keepalive holdtime`

Sets the values of the keep alive and hold time timers of the BGP process. BGP routers exchange periodic messages to confirm that the connection between the routers is maintained. The interval between these messages is keep alive seconds (default: 60 seconds). The number of seconds that a BGP router waits for any BGP message before it decides that a connection is down is specified by the hold time (default: 180 seconds).

1. Setup the topology shown in Figure 6.3.

2. Disable all RIP or OSPF processes that are running on the Cisco routers. Use the following commands:

```
Router1# no router ospf 1
Router1# no router rip
```

3. Assign the IP addresses to Ethernet interface eth0 of each PC as indicated in Table 6.3

4. Add a default gateway to PC1, PC2, and PC3 as shown in Table 6.3.

```
PC1% route add default gw 10.0.1.1/24
PC2% route add default gw 10.0.2.2/24
PC3% route add default gw 10.0.3.3/24
```

5. Start Wireshark on PC4 and set a display filter to capture only BGP packets.

6. Configure the Cisco routers to run BGP with the autonomous system numbers shown in Figure 6.3. The routers must know the AS number of their neighbors. Following is the configuration for Router2. Router2 is in AS 200 and neighbors are AS 100 and AS 300.

```
Router2> enable
Router2# configure terminal
Router2(config)# no ip routing
Router2(config)# ip routing
Router2(config)# interface FastEthernet0/0
Router2(config-if)# no shutdown
Router2(config-if)# ip address 10.2.2 255.255.255.0
Router2(config-if)# interface FastEthernet1/0
Router2(config-if)# no shutdown
Router2(config-if)# ip address 10.0.4.2 255.255.255.0
Router2(config-if)# router bgp 200
```

```
Router2(config-router)# neighbor 10.0.4.1 remote-as 100
Router2(config-router)# neighbor 10.0.4.3 remote-as 300
Router2(config-router)# network 10.0.2.0 mask 255.255.255.0
Router2(config-router)# end
Router2# clear ip bgp *
```

7. On PC1, issue a `ping` command to PC3. The command succeeds when BGP has converged.

```
PC1% ping -c 5 PC3
```

8. Once the routing tables have converged, you should see all the other AS entries in the BGP routing table. On each Cisco router, save the output of the following commands (you will need this output to compare to results from Ex 3(B):

```
Router1# show ip route
Router1# show ip bgp
Router1# show ip bgp paths
```

9. Stop the Wireshark traffic capture on PC4 and save the BGP packets captured by Wireshark.

   - What is the IP address of the next-hop attribute for AS 100 on Router2?
   - What are the BGP peers in this topology?
   - Which BGP message(s) contain(s) the AS-PATH information? Use a BGP message in the Wireshark output to illustrate your answer.
   - Use the saved output to provide a brief explanation of how the routers find the proper path between the autonomous systems.

Exercise 3(B). BGP convergence

In this exercise you will disconnect one of the links between two BGP peers and observe how the BGP protocol reconfigures the paths.

1. On PC4 start Wireshark and set a display filter for BGP. Observe the flow of BGP packets between the autonomous systems.

2. On all routers, change the *keepalive timer* to 10 seconds and the *holdtime timer* to 30 seconds. This speeds up the convergence time by a factor of 6 as compared to the default values. The following are the commands for Router2:

```
Router2# configure terminal
Router2(config)# router bgp 200
Router2(config-router)# timers bgp 10 30
Router2(config-router)# end
Router2# clear ip bgp *
```

3. Shutdown the cable of interface FastEthernet1/0 on Router1.

```
Router1(config)# interface FastEthernet1/0
Router1(config-if)# shutdown
```

4. Wait until BGP converges, i.e., a `ping` from PC2 to PC3 is successful. Save the routing tables on Router2 and Router3.

    - What changes do you see?

5. Use the command `show ip BGP summary` on Router2 and Router3 to obtain the neighbor information.

    - Compare to previous result from Ex 3(A). What changes do you see?

6. Save the routing tables on Router2 and Router3.

    - What changes do you see from results in Ex 3(A)?

7. Stop the Wireshark traffic captured on PC4 and save the Wireshark BGP packets.

    - Which BGP messages indicate that there is a link problem? Use a BGP message to answer the question. (Hint: Look for the BGP update messages and check the "Withdrawn routes.")