SCC203 Coursework 2

Name: Laksan Thavarajah
Student Number: 38538598

Task 1

Create the topology shown in Figure 1. Each router should have the OSPFv2 protocol activated, and the RIP/RIPng protocols deactivated. Make sure the router names and interface names are the same as in Figure 1. Submit your IMUNES topology file with name: "task1_topology.imn".

Completed

Task 2

Execute the experiment and query the OSPF routing table of router10. Then answer the following questions and post screenshots of the results:

a) Which command did you use?

```
router10# show ip ospf route
```

b) What is the next hop to the IP of router 4?

It is Router 9(10.0.14.2) as it goes via router 9(10.0.14.2) to reach the interface id of router 4.

```
N    10.0.5.0/24           [30] area: 0.0.0.0
                           via 10.0.14.2, eth2
```

c) What is the cost of the path to the IP of router4?

It costs 30 as the path makes three individual hops through router 9, router 7 and then to the destination router 4.

```
[30]
```

d) Compare the path installation times for the path to the IP of router 5, and the path to the IP of router9. Which path was installed first in the routing table? Explain why.

```
Hello, this is Quagga (version 1.1.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.

router10# show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,
       > - selected route, * - FIB route

O>* 10.0.0.0/24 [110/50] via 10.0.14.2, eth2, 00:02:02
O>* 10.0.1.0/24 [110/40] via 10.0.14.2, eth2, 00:02:02
O>* 10.0.2.0/24 [110/40] via 10.0.14.2, eth2, 00:02:02
O>* 10.0.3.0/24 [110/40] via 10.0.14.2, eth2, 00:02:01
O>* 10.0.4.0/24 [110/30] via 10.0.14.2, eth2, 00:02:02
O>* 10.0.5.0/24 [110/30] via 10.0.14.2, eth2, 00:02:02
O>* 10.0.6.0/24 [110/20] via 10.0.14.2, eth2, 00:02:02
O>* 10.0.7.0/24 [110/30] via 10.0.9.2, eth0, 00:01:54
  *                       via 10.0.14.2, eth2, 00:01:54
O>* 10.0.8.0/24 [110/20] via 10.0.9.2, eth0, 00:01:54
O   10.0.9.0/24 [110/10] is directly connected, eth0, 00:02:52
C>* 10.0.9.0/24 is directly connected, eth0
O>* 10.0.10.0/24 [110/40] via 10.0.14.2, eth2, 00:02:01
O>* 10.0.11.0/24 [110/40] via 10.0.14.2, eth2, 00:02:01
O>* 10.0.12.0/24 [110/50] via 10.0.14.2, eth2, 00:02:01
O   10.0.13.0/24 [110/10] is directly connected, eth1, 00:02:51
C>* 10.0.13.0/24 is directly connected, eth1
O   10.0.14.0/24 [110/10] is directly connected, eth2, 00:02:08
C>* 10.0.14.0/24 is directly connected, eth2
C>* 127.0.0.0/8 is directly connected, lo
O>* 127.0.0.1/32 [110/0] is directly connected, lo, 00:02:52
router10#
```

The router 9 was installed first in the routing table because first it is directly linked to router 10 and costs 10 to traverse to it whereas traversing to router 5 would be cost 40. In the above table you can see that 10.0.14.0/24(router 9) was last updated at 00:02:01 whereas 10.0.0.10/24(router 5) was last updated 00:01:54 so router 5 got updated recently and would conclude router 9 is installed first.

Task 3

Measure the IP-level path, effective bandwidth and total latency from pc1 to pc2. Then answer the following questions:

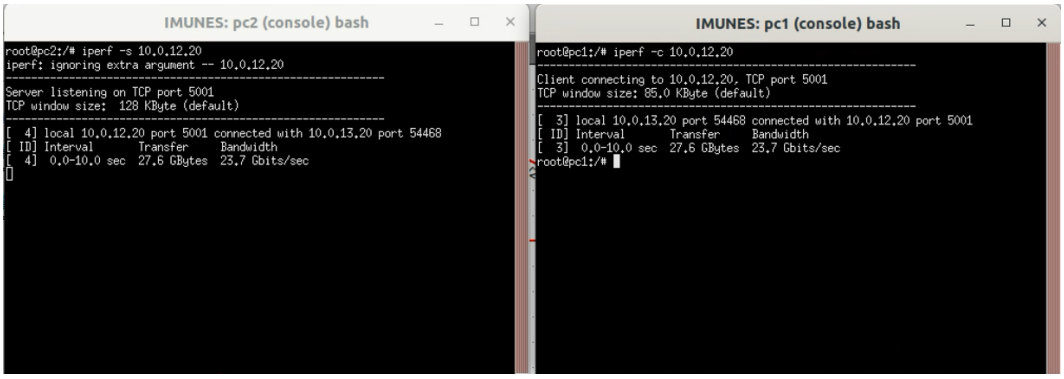
a. Which command did you use to measure the IP-level path? Post as screenshot of the result.

Traceroute was used to measure the IP-level path.

```
root@pc1:/# traceroute 10.0.12.20
traceroute to 10.0.12.20 (10.0.12.20), 30 hops max, 60 byte packets
 1  10.0.13.1 (10.0.13.1)  0.590 ms  0.519 ms  0.502 ms
 2  10.0.14.2 (10.0.14.2)  0.486 ms  0.438 ms  0.417 ms
 3  10.0.6.2 (10.0.6.2)  0.395 ms  0.351 ms  0.329 ms
 4  10.0.5.2 (10.0.5.2)  0.308 ms  0.264 ms  0.237 ms
 5  10.0.10.1 (10.0.10.1)  0.212 ms  0.157 ms  0.129 ms
 6  10.0.12.20 (10.0.12.20)  0.106 ms  0.051 ms  0.016 ms
root@pc1:/#
```

b. Which command did you use to measure the bandwidth? Post a screenshot of the result.

iperf -s for the host which is pc2 and iperf -c for client which is pc1.



The effective bandwidth would be 23.7 Gbits/sec.

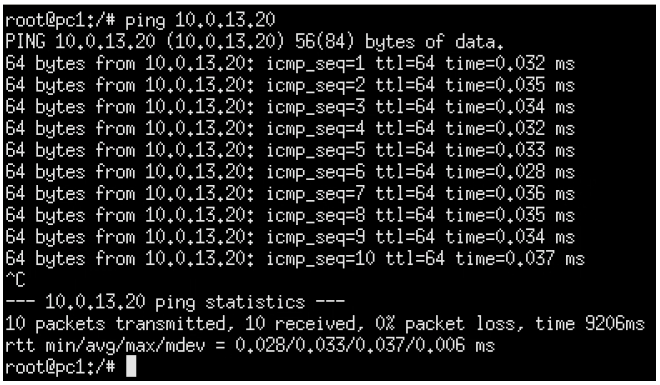
c. Write the sequence of routers for the path between pc1 and pc2 [5 marks]

Router 10 -> Router 9 -> Router 7 -> Router 4 -> Router 5

d. What is the RTT between pc1 and pc2?

The RTT is as below:

rtt min/avg/max/mdev = 0.028/0.033/0.037/0.006 ms



Task 4

Split the OSPF topology to three different areas as shown in Figure 2. The green area should have area ID 0.0.0.0, the blue area should have ID 1.0.0.0 and the red area should have ID 2.0.0.0. Make sure the router names and interface names are the same as in Figure 2. Submit your IMUNES topology file with name: “task4_topology.imn”.

Completed

Task 5

Answer the following questions about the topology you created in Task 4:

a) Which area is the backbone area of the topology?

Area 0.0.0.0 is the backbone as router 2 is connected to area 1.0.0.0 and router 3 being connected to area 2.0.0.0 which means they are linked through to each other using area 0.0.0.0.

b) Query again the OSPF routing table of router 10. Compare the next hop, and path cost with the values you found for Task 2.b and Task 2.c. Did any of the two values change and why? (You can also compare the IP-level paths to back your answer)

```
N IA 10.0.3.0/24            [50] area: 2.0.0.0
                            via 10.0.14.2, eth2
```

IP-Level Path Task 2

```
root@router10:/# traceroute 10.0.5.2
traceroute to 10.0.5.2 (10.0.5.2), 30 hops max, 60 byte packets
 1  10.0.14.2 (10.0.14.2)  0.043 ms  0.006 ms  0.004 ms
 2  10.0.6.2 (10.0.6.2)  0.023 ms  0.010 ms  0.012 ms
 3  10.0.5.2 (10.0.5.2)  0.025 ms  0.010 ms  0.010 ms
root@router10:/#
```

IP-Level Path Task 4

```
root@router10:/# traceroute 10.0.3.1
traceroute to 10.0.3.1 (10.0.3.1), 30 hops max, 60 byte packets
 1  10.0.14.2 (10.0.14.2)  0.536 ms  0.404 ms  0.385 ms
 2  10.0.6.2 (10.0.6.2)  0.369 ms  0.337 ms  0.321 ms
 3  10.0.4.2 (10.0.4.2)  0.307 ms  0.271 ms  0.252 ms
 4  10.0.2.2 (10.0.2.2)  0.235 ms  0.203 ms  0.183 ms
 5  10.0.3.1 (10.0.3.1)  0.162 ms  0.116 ms  0.090 ms
root@router10:/#
```

Yes, the value that changes would be the path costing from 30 to 50 due to the addition of a backbone area in which two routers are newly involved in traversal and increasing the total cost to 50. We can’t use the previous interface id of router 4 to traceroute as it doesn’t pass through the backbone area using that interface id, so another interface id of router 4 is used. However, the next hop does stay the same as in task 2 due to it being OSPF and so it would go through router 9(10.0.14.2) as it’s the route with a lower cost. This is further backed by

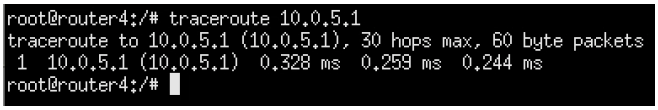
the screenshots above of the IP level path with the addition of backbone areas increasing the cost.

Measure the following IP-level paths:

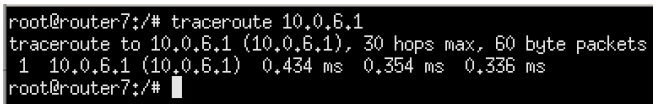
i. router4 to router7
ii. From router7 to router9
iii. From router4 to router9

Is path (iii) the same as the concatenation of path (i) and path (ii)? Explain your answer.

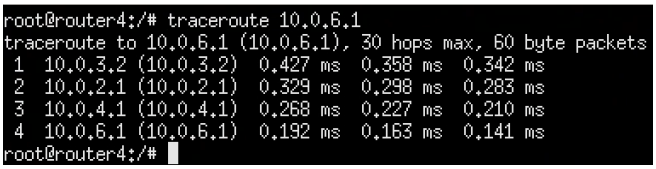
i. router4 to router7



ii. From router7 to router9



iii. From router4 to router9



It isn't the same as the concatenation of path (i) and path (ii) as those paths were a single hop due to them being directly connected to each other through a single link, whereas this isn't the case for router 4 to router 9 as they are not directly linked as were the paths in (i) and (ii) so it would mean that router 4 would have to pass via the backbone area and then get to router 9 instead.

Task 6

Answer the following questions. If you have not completed Task 4, you can answer these questions for the topology of Task 1.

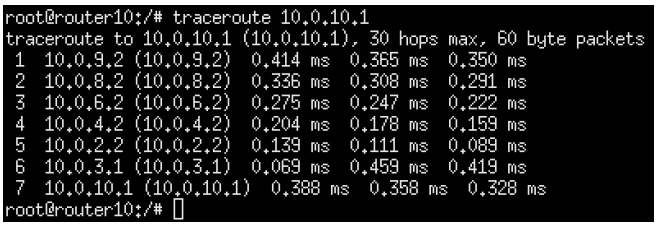
a) Change the configuration of router 10 so that it routes its traffic using router11 as its next hop. Save and submit the topology file with name “task6a_topology.imn”

Completed

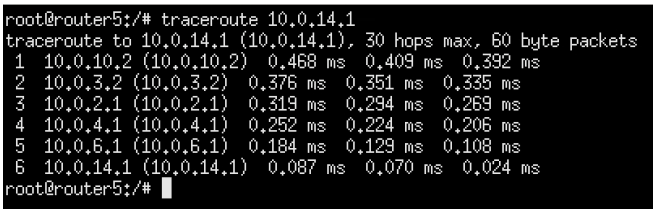
b) Find the sequence of router hops for the following two paths
   i. From router10 to router 5
   ii. From router5 to router10

Are these two paths symmetric? Specifically, do they traverse the same routers? Explain why.

i. From router10 to router 5



ii. From router5 to router10



They don’t traverse symmetrically as going from router 10 to 5 involves 1 extra hop due to task 6a in which we increased the cost of interface for router 9 so it won’t traverse through that way but through router 11 and it does as it is supposed to on the IP-level path. Whereas the IP-Level Path from router 5 to router 10 goes through router 9 to reach router 10. This is due to changing the cost of interface for router 9 in the config of router 10 whereas we didn’t do the same for router 7 in which it makes the decision of which route is cost efficient and so it will choose router 9.

c) Undo the configuration change you did for Task 6.a in router10. Can you change the configuration of router8 and router11 so that router10 still uses router11 as its next hop? Submit the topology file with name “task6c_topology.imn”

Completed

Task 7

Download the topology file from:

https://modules.lancaster.ac.uk/mod/resource/view.php?id=2065903

Some configuration errors in this topology prevent router3 from reaching router7. Fix these configuration errors and confirm that the two routers are reachable using the command of your choice. Submit the fixed topology file with name “task7_topology_fixed.imn”

Completed