

GRIGORIS ZINONOS

TASK 2

```
IMUNES: router10 (console) vty

Hello, this is Quagga (version 1.1.1).
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router10# show ip ospf route
===== OSPF network routing table =====
N   10.0.0.0/24      [50] area: 0.0.0.0
                        via 10.0.9.1, eth0
N   10.0.1.0/24      [40] area: 0.0.0.0
                        via 10.0.9.1, eth0
N   10.0.2.0/24      [40] area: 0.0.0.0
                        via 10.0.9.1, eth0
N   10.0.3.0/24      [40] area: 0.0.0.0
                        via 10.0.9.1, eth0
N   10.0.4.0/24      [30] area: 0.0.0.0
                        via 10.0.9.1, eth0
N   10.0.5.0/24      [40] area: 0.0.0.0
                        via 10.0.9.1, eth0
N   10.0.6.0/24      [40] area: 0.0.0.0
                        via 10.0.9.1, eth0
N   10.0.7.0/24      [30] area: 0.0.0.0
                        via 10.0.9.1, eth0
N   10.0.8.0/24      [20] area: 0.0.0.0
                        via 10.0.9.1, eth0
N   10.0.9.0/24      [10] area: 0.0.0.0
                        directly attached to eth0
N   10.0.10.0/24     [30] area: 0.0.0.0
--More--
```

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===== OSPF router routing table =====
R   10.0.1.2         [40] area: 0.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.3.2         [40] area: 0.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.4.2         [30] area: 0.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.6.1         [40] area: 0.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.9.1         [10] area: 0.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.10.1        [30] area: 0.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.10.2        [20] area: 0.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.11.1        [20] area: 0.0.0.0, ASBR
                        via 10.0.12.1, eth1
R   10.0.12.1        [10] area: 0.0.0.0, ASBR
                        via 10.0.12.1, eth1
R   10.0.13.1        [40] area: 0.0.0.0, ASBR
                        via 10.0.9.1, eth0
```

- Show ip ospf route
- Router 9
- 30
- Router5 was installed some time after router9. This happens because the routes need to be propagated from one router to the other, so router5 that is further from the local router takes longer time to be established than router 9 which is only one hop away from router 10. Used show ip route

```

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 10.0.9.1, eth0, 02:31:33
O>* 10.0.1.0/24 [110/40] via 10.0.9.1, eth0, 02:31:33
O>* 10.0.2.0/24 [110/40] via 10.0.9.1, eth0, 02:31:33
O>* 10.0.3.0/24 [110/40] via 10.0.9.1, eth0, 02:31:33
O>* 10.0.4.0/24 [110/30] via 10.0.9.1, eth0, 02:31:33
O>* 10.0.5.0/24 [110/40] via 10.0.9.1, eth0, 02:31:33
O>* 10.0.6.0/24 [110/40] via 10.0.9.1, eth0, 02:31:33
O>* 10.0.7.0/24 [110/30] via 10.0.9.1, eth0, 02:31:33
    *
O>* 10.0.8.0/24 [110/20] via 10.0.9.1, eth0, 02:31:41
O 10.0.9.0/24 [110/10] is directly connected, eth0, 02:32:27
C>* 10.0.9.0/24 is directly connected, eth0
O>* 10.0.10.0/24 [110/30] via 10.0.9.1, eth0, 02:31:33
O>* 10.0.11.0/24 [110/20] via 10.0.12.1, eth1, 02:31:47
O 10.0.12.0/24 [110/10] is directly connected, eth1, 02:32:27
C>* 10.0.12.0/24 is directly connected, eth1
O>* 10.0.13.0/24 [110/50] via 10.0.9.1, eth0, 02:31:33
O 10.0.14.0/24 [110/10] is directly connected, eth2, 02:32:26
C>* 10.0.14.0/24 is directly connected, eth2
--More--

```

TASK 3

a) traceroute 10.0.13.20

b) iperf -s 10.0.13.20
 Iperf -c 10.0.13.20

```
IMUNES: pc2 (console) bash
root@pc2:~# iperf -s 10.0.13.20
iperf: ignoring extra argument -- 10.0.13.20
-----
Server listening on TCP port 5001
TCP window size: 128 KByte (default)
-----
[ 4] local 10.0.13.20 port 5001 connected with 10.0.14.20 port 45124
[ ID] Interval      Transfer    Bandwidth
[ 4] 0.0-10.0 sec  21.0 GBytes 18.1 Gbits/sec
root@pc2:~#

IMUNES: pc1 (console) bash
root@pc1:~# iperf -c 10.0.13.20
-----
Client connecting to 10.0.13.20, TCP port 5001
TCP window size: 85.0 KByte (default)
-----
[ 3] local 10.0.14.20 port 45124 connected with 10.0.13.20 port 5001
[ ID] Interval      Transfer    Bandwidth
[ 3] 0.0-10.0 sec  21.0 GBytes 18.1 Gbits/sec
root@pc1:~#
```

c) As seen from the outcome of traceroute. Router 10, router 9, router 7, router 4, router 5.

d) The average RTT between pc1 and pc2 is 0.090 ms. (used PING)

```
root@pc1:~# ping 10.0.13.20
PING 10.0.13.20 (10.0.13.20) 56(84) bytes of data:
64 bytes from 10.0.13.20: icmp_seq=1 ttl=59 time=0.127 ms
64 bytes from 10.0.13.20: icmp_seq=2 ttl=59 time=0.089 ms
64 bytes from 10.0.13.20: icmp_seq=3 ttl=59 time=0.095 ms
64 bytes from 10.0.13.20: icmp_seq=4 ttl=59 time=0.088 ms
64 bytes from 10.0.13.20: icmp_seq=5 ttl=59 time=0.089 ms
64 bytes from 10.0.13.20: icmp_seq=6 ttl=59 time=0.092 ms
64 bytes from 10.0.13.20: icmp_seq=7 ttl=59 time=0.081 ms
64 bytes from 10.0.13.20: icmp_seq=8 ttl=59 time=0.088 ms
64 bytes from 10.0.13.20: icmp_seq=9 ttl=59 time=0.085 ms
64 bytes from 10.0.13.20: icmp_seq=10 ttl=59 time=0.091 ms
64 bytes from 10.0.13.20: icmp_seq=11 ttl=59 time=0.083 ms
64 bytes from 10.0.13.20: icmp_seq=12 ttl=59 time=0.088 ms
64 bytes from 10.0.13.20: icmp_seq=13 ttl=59 time=0.096 ms
64 bytes from 10.0.13.20: icmp_seq=14 ttl=59 time=0.096 ms
64 bytes from 10.0.13.20: icmp_seq=15 ttl=59 time=0.090 ms
64 bytes from 10.0.13.20: icmp_seq=16 ttl=59 time=0.085 ms
64 bytes from 10.0.13.20: icmp_seq=17 ttl=59 time=0.086 ms
64 bytes from 10.0.13.20: icmp_seq=18 ttl=59 time=0.089 ms
64 bytes from 10.0.13.20: icmp_seq=19 ttl=59 time=0.076 ms
64 bytes from 10.0.13.20: icmp_seq=20 ttl=59 time=0.088 ms
^C
--- 10.0.13.20 ping statistics ---
20 packets transmitted, 20 received, 0% packet loss, time 1943ms
rtt min/avg/max/mdev = 0.076/0.090/0.127/0.010 ms
root@pc1:~#
```

TASK 5

- a) The green area (ID 0.0.0.0) is the backbone of the topology as it is the logical link that connects the remaining areas.
- b) This time the path cost is bigger and the next hop is the same. The path cost increased as now the path needs to go through the green area which acts as the backbone area in order to reach router 4. The link between router 7 and router 4 can not be used as used in task 2 and therefore shorten the path cost because router 7 and router 4 belong to different areas.

```
===== OSPF router routing table =====
R   10.0.1.2      IA [40] area: 2.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.3.2      IA [40] area: 2.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.4.2      [30] area: 2.0.0.0, ABR, ASBR
                        via 10.0.9.1, eth0
R   10.0.6.1      IA [60] area: 2.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.9.1      [10] area: 2.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.10.1     IA [50] area: 2.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.10.2     [20] area: 2.0.0.0, ASBR
                        via 10.0.9.1, eth0
R   10.0.11.1     [20] area: 2.0.0.0, ASBR
                        via 10.0.12.1, eth1
R   10.0.12.1     [10] area: 2.0.0.0, ASBR
                        via 10.0.12.1, eth1
R   10.0.13.1     IA [60] area: 2.0.0.0, ASBR
                        via 10.0.9.1, eth0
===== OSPF external routing table =====
```

c)

```
root@router4:/# traceroute 10.0.10.2
traceroute to 10.0.10.2 (10.0.10.2), 30 hops max, 60 byte packets
 1 10.0.10.2 (10.0.10.2) 0.339 ms 0.284 ms 0.266 ms
root@router4:/#
```

i) 1

```
root@router7:/# traceroute 10.0.9.1
traceroute to 10.0.9.1 (10.0.9.1), 30 hops max, 60 byte packets
 1 10.0.9.1 (10.0.9.1) 0.350 ms 0.299 ms 0.283 ms
root@router7:/#
```

ii) 1

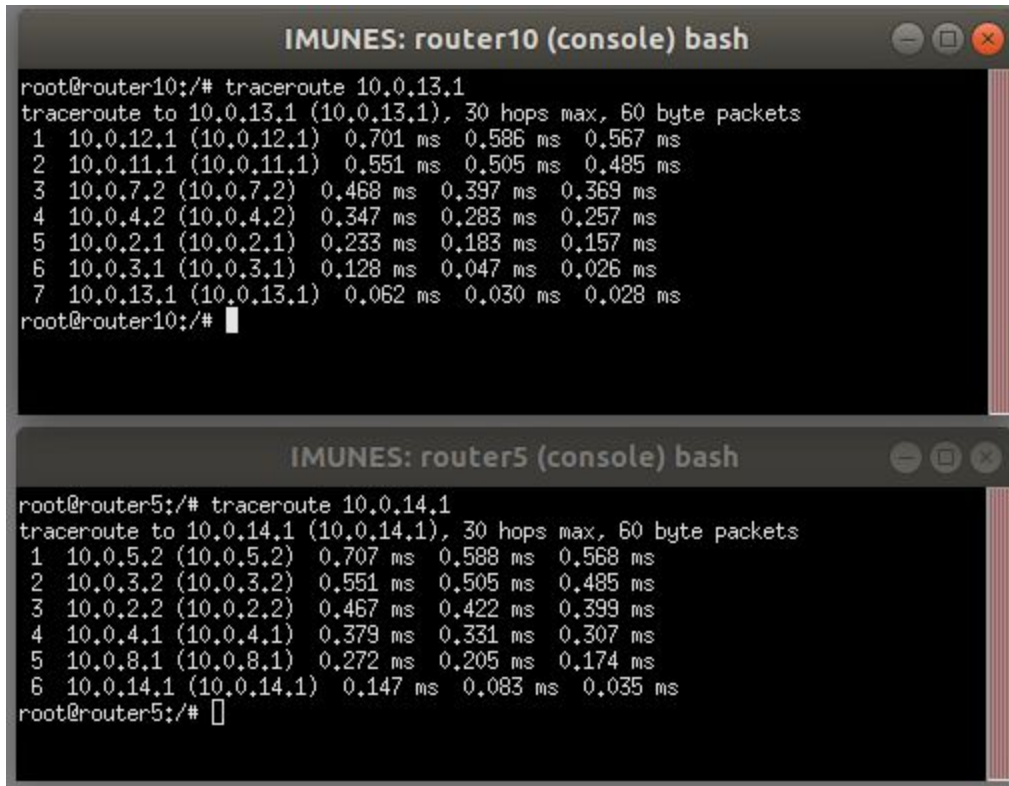
```
root@router4:/# traceroute 10.0.9.1
traceroute to 10.0.9.1 (10.0.9.1), 30 hops max, 60 byte packets
 1 10.0.3.2 (10.0.3.2) 0.441 ms 0.388 ms 0.372 ms
 2 10.0.2.2 (10.0.2.2) 0.359 ms 0.327 ms 0.308 ms
 3 10.0.4.1 (10.0.4.1) 0.292 ms 0.260 ms 0.240 ms
 4 10.0.9.1 (10.0.9.1) 0.220 ms 0.186 ms 0.162 ms
root@router4:/#
```

iii) 4

The third path is not the same as the concatenation of path i and path ii. Path i equals 1 as the link which connects router 4 and router 7 acts as a 'private network' or as a "hidden area" which only involves router 4 and router 7. The 2 connected interfaces of router 4 and 7 can exchange traffic directly because they belong to the same subnet and have the same MTU value despite the fact that they belong to different areas. Path ii equals 1 because the 2 routers belong to the same area and one is only one hop away from the other. When measuring path iii, the link between router 4 and router 7 can not be used as the 2 routers do not act as backbone routers to connect the blue area with the red area but only the 2 routers. Therefore the path needs to go through the green area which acts as a backbone area for the blue and red area.

TASK 6

b)



```

IMUNES: router10 (console) bash
root@router10:/# traceroute 10.0.13.1
traceroute to 10.0.13.1 (10.0.13.1), 30 hops max, 60 byte packets
 1 10.0.12.1 (10.0.12.1) 0.701 ms 0.586 ms 0.567 ms
 2 10.0.11.1 (10.0.11.1) 0.551 ms 0.505 ms 0.485 ms
 3 10.0.7.2 (10.0.7.2) 0.468 ms 0.397 ms 0.369 ms
 4 10.0.4.2 (10.0.4.2) 0.347 ms 0.283 ms 0.257 ms
 5 10.0.2.1 (10.0.2.1) 0.233 ms 0.183 ms 0.157 ms
 6 10.0.3.1 (10.0.3.1) 0.128 ms 0.047 ms 0.026 ms
 7 10.0.13.1 (10.0.13.1) 0.062 ms 0.030 ms 0.028 ms
root@router10:/#

IMUNES: router5 (console) bash
root@router5:/# traceroute 10.0.14.1
traceroute to 10.0.14.1 (10.0.14.1), 30 hops max, 60 byte packets
 1 10.0.5.2 (10.0.5.2) 0.707 ms 0.588 ms 0.568 ms
 2 10.0.3.2 (10.0.3.2) 0.551 ms 0.505 ms 0.485 ms
 3 10.0.2.2 (10.0.2.2) 0.467 ms 0.422 ms 0.399 ms
 4 10.0.4.1 (10.0.4.1) 0.379 ms 0.331 ms 0.307 ms
 5 10.0.8.1 (10.0.8.1) 0.272 ms 0.205 ms 0.174 ms
 6 10.0.14.1 (10.0.14.1) 0.147 ms 0.083 ms 0.035 ms
root@router5:/#

```

- i) router 10, router 11, router 8, router 7, router 3, router 2, router 4, router 5.
- ii) router 5, router 4, router 2, router 3, router 7, router 9, router 10.

The 2 paths are not symmetric and they do not traverse the same routers. When starting from router 10 the path goes through router 11 instead of router 9 which adds router 8 to the path because of the changes that I made for task 6a. Therefore the path is one hop longer than path ii.

TASK 7