Project HY-335b
Phase 1

Group #44
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Question 1.1

Hosts IPs:

Hosts	IPs
GENE-L2	44.200.0.1/23
student_1	44.200.0.2/23
staff_1	44.200.0.3/23
student_2	44.200.0.4/23
staff_3	44.200.0.5/23
student_3	44.200.0.6/23
staff_3	44.200.0.7/23
ZURI-L2	44.200.0.8/23

GENE_router configuration:

```
GENE_router# show run
Building configuration...

Current configuration:
!
frr version 7.2.1
frr defaults traditional
hostname GENE_router
no ipv6 forwarding
!
interface GENE-L2
 ip address 44.200.0.1/23
!
line vty
!
end
GENE_router#
```

ZURI_router configuration:

```
ZURI_router# show run
Building configuration...

Current configuration:
!
frr version 7.2.1
frr defaults traditional
hostname ZURI_router
no ipv6 forwarding
!
interface ZURI-L2
 ip address 44.200.0.8/23
!
interface measurement_44
 ip address 44.0.199.1/24
!
router ospf
 network 44.0.199.0/24 area
!
line vty
!
end
ZURI_router#
```

student_1 configuration:

```
root@student_1:~# netstat -rn
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
0.0.0.0         44.200.0.1      0.0.0.0         UG        0 0          0 44-CERN
44.200.0.0      0.0.0.0         255.255.254.0   U         0 0          0 44-CERN
158.44.0.0      0.0.0.0         255.255.0.0     U         0 0          0 ssh
root@student_1:~# ifconfig
44-CERN: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 44.200.0.2  netmask 255.255.254.0  broadcast 0.0.0.0
        ether b2:9d:4f:58:7b:cd  txqueuelen 1000  (Ethernet)
        RX packets 1194402  bytes 62264878 (59.3 MiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 412  bytes 31786 (31.0 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 67  bytes 7250 (7.0 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 67  bytes 7250 (7.0 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

ssh: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 158.44.11.5  netmask 255.255.0.0  broadcast 0.0.0.0
        ether 1a:34:a1:79:0f:b4  txqueuelen 1000  (Ethernet)
        RX packets 9348  bytes 987060 (963.9 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 5088  bytes 584369 (570.6 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@student_1:~#
```

staff_1 configuration:

```
root@staff_1:~# netstat -rn
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
0.0.0.0         44.200.0.1      0.0.0.0         UG        0 0          0 44-CERN
44.200.0.0      0.0.0.0         255.255.254.0   U         0 0          0 44-CERN
158.44.0.0      0.0.0.0         255.255.0.0     U         0 0          0 ssh
root@staff_1:~# ifconfig
44-CERN: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 44.200.0.3  netmask 255.255.254.0  broadcast 0.0.0.0
        ether d6:da:dd:4c:4b:b6  txqueuelen 1000  (Ethernet)
        RX packets 1194988  bytes 62292469 (59.4 MiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 174  bytes 12718 (12.4 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 23  bytes 2576 (2.5 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 23  bytes 2576 (2.5 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

ssh: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 158.44.11.6  netmask 255.255.0.0  broadcast 0.0.0.0
        ether e2:6d:cf:fc:90:0b  txqueuelen 1000  (Ethernet)
        RX packets 5563  bytes 651398 (636.1 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1776  bytes 241570 (235.9 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@staff_1:~#
```

student_2 configuration:

```
root@student_2:~# netstat -rn
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
0.0.0.0         44.200.0.8      0.0.0.0         UG        0 0          0 44-ETHZ
44.200.0.0      0.0.0.0         255.255.254.0   U         0 0          0 44-ETHZ
158.44.0.0      0.0.0.0         255.255.0.0     U         0 0          0 ssh
root@student_2:~# ifconfig
44-ETHZ: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 44.200.0.4  netmask 255.255.254.0  broadcast 0.0.0.0
        ether e2:7f:33:71:17:41  txqueuelen 1000  (Ethernet)
        RX packets 1194586  bytes 62271876 (59.3 MiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 256  bytes 23402 (22.8 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 11  bytes 1064 (1.0 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 11  bytes 1064 (1.0 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

ssh: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 158.44.11.7  netmask 255.255.0.0  broadcast 0.0.0.0
        ether 66:80:1a:49:c4:3e  txqueuelen 1000  (Ethernet)
        RX packets 4484  bytes 539872 (527.2 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1037  bytes 135169 (132.0 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@student_2:~#
```

staff_2 configuration:

```
root@staff_2:~# netstat -rn
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
0.0.0.0         44.200.0.8      0.0.0.0         UG        0 0          0 44-ETHZ
44.200.0.0      0.0.0.0         255.255.254.0   U         0 0          0 44-ETHZ
158.44.0.0      0.0.0.0         255.255.0.0     U         0 0          0 ssh
root@staff_2:~# ifconfig
44-ETHZ: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 44.200.0.5  netmask 255.255.254.0  broadcast 0.0.0.0
        ether 2a:a4:27:3b:31:ce  txqueuelen 1000  (Ethernet)
        RX packets 1195071  bytes 62296720 (59.4 MiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 172  bytes 13922 (13.5 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 6  bytes 672 (672.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 6  bytes 672 (672.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

ssh: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 158.44.11.8  netmask 255.255.0.0  broadcast 0.0.0.0
        ether ee:6d:49:b3:c5:91  txqueuelen 1000  (Ethernet)
        RX packets 5006  bytes 587348 (573.5 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1341  bytes 166342 (162.4 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@staff_2:~#
```

student_3 configuration:

```
root@student_3:~# netstat -rn
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
0.0.0.0         44.200.0.1      0.0.0.0         UG        0 0          0 44-EPFL
44.200.0.0      0.0.0.0         255.255.254.0   U         0 0          0 44-EPFL
158.44.0.0      0.0.0.0         255.255.0.0     U         0 0          0 ssh
root@student_3:~# ifconfig
44-EPFL: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 44.200.0.6  netmask 255.255.254.0  broadcast 0.0.0.0
        ether 8e:31:f0:1d:d0:6c  txqueuelen 1000  (Ethernet)
        RX packets 1194368  bytes 62260166 (59.3 MiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 153  bytes 11802 (11.5 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 43  bytes 4424 (4.3 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 43  bytes 4424 (4.3 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

ssh: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 158.44.11.9  netmask 255.255.0.0  broadcast 0.0.0.0
        ether 06:09:94:7b:ea:79  txqueuelen 1000  (Ethernet)
        RX packets 5097  bytes 587546 (573.7 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1397  bytes 182521 (178.2 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@student_3:~#
```

staff_3 configuration:

```
root@staff_3:~# netstat -rn
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
0.0.0.0         44.200.0.1      0.0.0.0         UG        0 0          0 44-EPFL
44.200.0.0      0.0.0.0         255.255.254.0   U         0 0          0 44-EPFL
158.44.0.0      0.0.0.0         255.255.0.0     U         0 0          0 ssh
root@staff_3:~# ifconfig
44-EPFL: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 44.200.0.7  netmask 255.255.254.0  broadcast 0.0.0.0
        ether aa:ec:86:e2:93:4a  txqueuelen 1000  (Ethernet)
        RX packets 1195004  bytes 62291281 (59.4 MiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 55  bytes 3359 (3.2 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 31  bytes 3088 (3.0 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 31  bytes 3088 (3.0 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

ssh: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 158.44.11.10  netmask 255.255.0.0  broadcast 0.0.0.0
        ether 1a:29:db:b9:08:79  txqueuelen 1000  (Ethernet)
        RX packets 4812  bytes 563384 (550.1 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1155  bytes 142308 (138.9 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@staff_3:~#
```

ping from **student_1** to **GENErouter**:

```
root@student_1:~# ping 44.200.0.1
PING 44.200.0.1 (44.200.0.1) 56(84) bytes of data.
64 bytes from 44.200.0.1: icmp_seq=1 ttl=64 time=3.98 ms
64 bytes from 44.200.0.1: icmp_seq=2 ttl=64 time=2.20 ms
64 bytes from 44.200.0.1: icmp_seq=3 ttl=64 time=2.17 ms
64 bytes from 44.200.0.1: icmp_seq=4 ttl=64 time=2.19 ms
64 bytes from 44.200.0.1: icmp_seq=5 ttl=64 time=2.17 ms
64 bytes from 44.200.0.1: icmp_seq=6 ttl=64 time=2.19 ms
64 bytes from 44.200.0.1: icmp_seq=7 ttl=64 time=2.18 ms
^C
--- 44.200.0.1 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6011ms
rtt min/avg/max/mdev = 2.179/2.448/3.988/0.628 ms
root@student_1:~#
```

ping from **staff_3** to **ZURIrouter**:

```
root@staff_2:~# ping 44.200.0.8
PING 44.200.0.8 (44.200.0.8) 56(84) bytes of data.
64 bytes from 44.200.0.8: icmp_seq=1 ttl=64 time=9.24 ms
64 bytes from 44.200.0.8: icmp_seq=2 ttl=64 time=2.21 ms
64 bytes from 44.200.0.8: icmp_seq=3 ttl=64 time=2.21 ms
64 bytes from 44.200.0.8: icmp_seq=4 ttl=64 time=2.20 ms
64 bytes from 44.200.0.8: icmp_seq=5 ttl=64 time=2.20 ms
64 bytes from 44.200.0.8: icmp_seq=6 ttl=64 time=2.19 ms
64 bytes from 44.200.0.8: icmp_seq=7 ttl=64 time=2.22 ms
^C
--- 44.200.0.8 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6011ms
rtt min/avg/max/mdev = 2.198/3.215/9.244/2.461 ms
root@staff_2:~#
```

Question 1.2

Host IPs:

Hosts	IPs
student_1	44.200.2.2/23
staff_1	44.200.0.3/23
student_2	44.200.2.4/23
staff_2	44.200.0.5/23
student_3	44.200.2.6/23
staff_3	44.200.0.7/23
GENE-L2.10	44.200.0.8/23
GENE-L2.20	44.200.2.9/23
ZURI-L2.10	44.200.0.10/23
ZURI-L2.20	44.200.2.11/23

We changed the subnet used by the students from 44.200.0.0/23 to 44.200.2.0/23 because otherwise, packets that needed to be passed through the router would not pass through the router if staff and students were in the same subnet. We used 44.200.2.0 because we have a /23 mask and the block 44.200.1.0/23 is in the same subnet as 44.200.0.0/23.

traceroute from **EPFL_student** to **EPFL_staff**:

```
root@student_3:~# traceroute 44.200.0.7
traceroute to 44.200.0.7 (44.200.0.7), 30 hops max, 60 byte packets
 1  44.200.2.9 (44.200.2.9)  6.437 ms  6.066 ms  5.873 ms
 2  44.200.0.7 (44.200.0.7)  11.016 ms  10.971 ms  12.396 ms
root@student_3:~#
```

We notice that the packets first pass through the GENE-L2.20 interface and then make their way to the staff subnet. This behavior is expected as we set the gateway for the EPFL hosts to be GENE.

traceroute from **ETHZ_staff** to **EPFL_student**:

```
root@staff_2:~# traceroute 44.200.2.6
traceroute to 44.200.2.6 (44.200.2.6), 30 hops max, 60 byte packets
 1  44.200.0.10 (44.200.0.10)  3.894 ms  3.481 ms  3.389 ms
 2  44.200.2.6 (44.200.2.6)  11.978 ms  12.019 ms  12.106 ms
root@staff_2:~#
```

We notice that the packets first pass through the ZURI-L2.10 interface and then make their way to the student subnet. This behavior is expected as we set the gateway for the ETHZ hosts to be ZURI.

traceroute from **EPFL_student** to **ETHZ_staff**:

```
root@student_3:~# traceroute 44.200.0.5
traceroute to 44.200.0.5 (44.200.0.5), 30 hops max, 60 byte packets
 1  44.200.2.9 (44.200.2.9)  6.124 ms  6.032 ms  6.131 ms
 2  44.200.0.5 (44.200.0.5)  11.132 ms  11.045 ms  11.089 ms
root@student_3:~#
```

We notice that the packets first pass through the GENE-L2.20 interface and then make their way to the staff subnet. This behavior is expected as we set the gateway for the EPFL hosts to be GENE.

Question 1.3

traceroute from **PARI_host** to **ATLA_host**:

```
root@PARI_host:~# traceroute 44.107.0.1
traceroute to 44.107.0.1 (44.107.0.1), 30 hops max, 60 byte packets
 1  PARI-host.group44 (44.103.0.2)  0.407 ms  0.336 ms  0.320 ms
 2  NEWY-PARI.group44 (44.0.5.2)  2.362 ms  2.369 ms MIAM-PARI.group44 (44.0.6.2)  0.550 ms
 3  ATLA-NEWY.group44 (44.0.11.2)  2.633 ms ATLA-MIAM.group44 (44.0.13.1)  0.857 ms ATLA-NEWY.group44 (44.0.11.2)  2.593 ms
 4  host-ATLA.group44 (44.107.0.1)  0.836 ms  1.800 ms  1.954 ms
root@PARI_host:~#
```

Question 1.4

iperf3 from **LOND** to **BOST**:

```
root@LOND_host:~# iperf3 --client 44.106.0.1 --time 5
Connecting to host 44.106.0.1, port 5201
[  4] local 44.101.0.1 port 33276 connected to 44.106.0.1 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.01   sec  13.8 MBytes   115 Mbits/sec  683    202 KBytes
[  4]   1.01-2.01   sec  10.3 MBytes  86.1 Mbits/sec    0    238 KBytes
[  4]   2.01-3.00   sec  11.5 MBytes  97.8 Mbits/sec    0    273 KBytes
[  4]   3.00-4.00   sec  10.9 MBytes  91.7 Mbits/sec   11    226 KBytes
[  4]   4.00-5.00   sec  11.2 MBytes  94.4 Mbits/sec    0    257 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-5.00   sec  57.8 MBytes  97.0 Mbits/sec  694             sender
[  4]   0.00-5.00   sec  54.2 MBytes  90.8 Mbits/sec                  receiver

iperf Done.
```

iperf3 from **MIAM** to **PARI**:

```
root@MIAM_host:~# iperf3 --client 44.103.0.1 --time 5
Connecting to host 44.103.0.1, port 5201
[  4] local 44.108.0.1 port 48424 connected to 44.103.0.1 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  10.3 MBytes  86.2 Mbits/sec  898   21.2 KBytes
[  4]   1.00-2.00   sec  5.22 MBytes  43.8 Mbits/sec  319   32.5 KBytes
[  4]   2.00-3.00   sec  6.21 MBytes  52.1 Mbits/sec  382   17.0 KBytes
[  4]   3.00-4.00   sec  7.08 MBytes  59.4 Mbits/sec  580   8.48 KBytes
[  4]   4.00-5.00   sec  5.59 MBytes  46.9 Mbits/sec  327   12.7 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-5.00   sec  34.4 MBytes  57.7 Mbits/sec  2506             sender
[  4]   0.00-5.00   sec  30.5 MBytes  51.1 Mbits/sec                   receiver

iperf Done.
```

From the measurements we executed on the connection listed above we concluded that we are on the first configuration (44.0.7.0/24 has a bandwidth of 97.0 Mbps (>25 Mbps) and 44.0.6.0/24 has a bandwidth of 57.7 Mbps (>25 Mbps))

To make sure, we also tested the bandwidth from **NEWY** to **PARI**:

```
root@NEWY_host:~# iperf3 --client 44.103.0.1 --time 5
Connecting to host 44.103.0.1, port 5201
[  4] local 44.105.0.1 port 59082 connected to 44.103.0.1 port 5201
[ ID] Interval           Transfer     Bandwidth       Retr  Cwnd
[  4]   0.00-1.00   sec  2.41 MBytes  20.2 Mbits/sec  135   4.24 KBytes
[  4]   1.00-2.00   sec  1.37 MBytes  11.5 Mbits/sec  163   4.24 KBytes
[  4]   2.00-3.00   sec  1.12 MBytes  9.38 Mbits/sec  118   5.66 KBytes
[  4]   3.00-4.00   sec  1.18 MBytes  9.90 Mbits/sec  117   4.24 KBytes
[  4]   4.00-5.00   sec  1.12 MBytes  9.39 Mbits/sec  119   4.24 KBytes
- - - - - - - - - - - - - - - - - - - - - - - - -
[ ID] Interval           Transfer     Bandwidth       Retr
[  4]   0.00-5.00   sec  7.20 MBytes  12.1 Mbits/sec  652             sender
[  4]   0.00-5.00   sec  6.73 MBytes  11.3 Mbits/sec                  receiver

iperf Done.
```

As we see, the bandwidth is 12.1 Mbps (~10 Mbps)

Weights used:

The formula used to calculate the weights used is : 500/x (were x is one of the following bandwidth classes: 25, 10, 1)

Link	Weight
BOST-LOND	20 (=500/25)
NEWY-LOND	50 (=500/10)
NEWY-PARI	50 (=500/10)
MIAM-PARI	20 (=500/25)
MIAM-GENE	500 (=500/1)

To achieve the loadbalance on the two paths MIAM-NEWY and MIAM-ATLA-NEWY we changed the weight of ATLA-MIAM to 15 and ATLA-NEWY to 5 since we changed the weight of NEWY-MIAM to 20. The same was done on the two paths ZURI-LOND and ZURI-PARI-LOND (ZURI-PARI and PARI-LOND weight is 5). Doing that ensures that both paths (from ZURI to LOND and from NEWY to MIAM) have an equal weight of 10.

To achieve the loadbalance between ATLA and ZURI we also had to change the weight between NEWY-BOST to 5.

```
root@ATLA_host:~# traceroute 44.152.0.1
traceroute to 44.152.0.1 (44.152.0.1), 30 hops max, 60 byte packets
 1  ATLA-host.group44 (44.107.0.2)  0.498 ms  0.329 ms  0.321 ms
 2  MIAM-ATLA.group44 (44.0.13.2)  0.663 ms  0.610 ms  0.618 ms
 3  PARI-MIAM.group44 (44.0.6.1)  0.936 ms  0.913 ms  0.893 ms
 4  44.152.0.1 (44.152.0.1)  2.638 ms  2.618 ms  2.589 ms
root@ATLA_host:~#
```

The results of this traceroute are expected since the link between MIAM and PARI has the lowest weight due to it having the highest bandwidth.

Question 1.5

The weight between ATLA and NEWY is 5 . ATLA and MIAMI is also 5 but then it would have to go from MIAM to NEWY wich adds a cost of 10. So it is very logical that packets go directly from ATLA to NEWY and vice versa.

Here is a traceroute from **NEWY_host** to **ATLA_host** before the static routing:

```
root@NEWY_host:~# traceroute 44.107.0.1
traceroute to 44.107.0.1 (44.107.0.1), 30 hops max, 60 byte packets
 1  NEWY-host.group44 (44.105.0.2)  0.399 ms  0.316 ms  0.346 ms
 2  ATLA-NEWY.group44 (44.0.11.2)  0.639 ms  0.623 ms  0.566 ms
 3  host-ATLA.group44 (44.107.0.1)  0.590 ms  0.573 ms  0.712 ms
root@NEWY_host:~#
```

In order to redirect traffic from ATLA to MIAM we had to use a static route so that all packets destined to NEWY are sent to MIAM and then forwarded to NEWY via another static route. The second static route has to be used because the route MIAM-ATLA-NEWY and MIAM-NEWY is loadbalanced thus sending packets from MIAM back to ATLA when they have to get to NEWY has to be stopped.

The same was done the other way around by adding a static rout from NEWY to MIAM for all packets headed to ATLA. A static route from MIAM to ATLA does not have to be used since that route has the lowest weight anyway.

Here is a traceroute from **NEWY_host** to **ATLA_host** after the static routing:

```
root@NEWY_host:~# traceroute 44.107.0.1
traceroute to 44.107.0.1 (44.107.0.1), 30 hops max, 60 byte packets
 1  NEWY-host.group44 (44.105.0.2)  0.111 ms  0.014 ms  0.013 ms
 2  MIAM-NEWY.group44 (44.0.12.2)  0.130 ms  0.076 ms  0.060 ms
 3  ATLA-MIAM.group44 (44.0.13.1)  0.450 ms  0.415 ms  0.375 ms
 4  host-ATLA.group44 (44.107.0.1)  0.430 ms  0.392 ms  0.355 ms
root@NEWY_host:~#
```

And here is the *show ip route* command, executed on **MIAM_router**:

```
MIAM_router# show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, E - EIGRP, N - NHRP,
       T - Table, v - VNC, V - VNC-Direct, A - Babel, D - SHARP,
       F - PBR, f - OpenFabric,
       > - selected route, * - FIB route, q - queued route, r - rejected route

O>* 44.0.1.0/24 [110/25] via 44.0.6.1, port_PARI, 5d05h01m
O>* 44.0.2.0/24 [110/35] via 44.0.6.1, port_PARI, 5d05h01m
O>* 44.0.3.0/24 [110/30] via 44.0.6.1, port_PARI, 5d05h20m
O>* 44.0.4.0/24 [110/25] via 44.0.6.1, port_PARI, 5d05h00m
O>* 44.0.5.0/24 [110/70] via 44.0.6.1, port_PARI, 00:40:54
  *                      via 44.0.12.1, port_NEWY, 00:40:54
  *                      via 44.0.13.1, port_ATLA, 00:40:54
O   44.0.6.0/24 [110/20] is directly connected, port_PARI, 5d05h21m
C>* 44.0.6.0/24 is directly connected, port_PARI, 6d01h55m
O>* 44.0.7.0/24 [110/45] via 44.0.6.1, port_PARI, 00:40:54
  *                      via 44.0.12.1, port_NEWY, 00:40:54
  *                      via 44.0.13.1, port_ATLA, 00:40:54
O>* 44.0.8.0/24 [110/70] via 44.0.12.1, port_NEWY, 00:40:54
  *                      via 44.0.13.1, port_ATLA, 00:40:54
O   44.0.9.0/24 [110/500] is directly connected, port_GENE, 5d05h22m
C>* 44.0.9.0/24 is directly connected, port_GENE, 6d01h54m
O>* 44.0.10.0/24 [110/25] via 44.0.12.1, port_NEWY, 00:40:54
  *                       via 44.0.13.1, port_ATLA, 00:40:54
O>* 44.0.11.0/24 [110/20] via 44.0.13.1, port_ATLA, 00:40:54
O   44.0.12.0/24 [110/20] is directly connected, port_NEWY, 00:40:54
C>* 44.0.12.0/24 is directly connected, port_NEWY, 6d01h55m
O   44.0.13.0/24 [110/15] is directly connected, port_ATLA, 00:41:08
C>* 44.0.13.0/24 is directly connected, port_ATLA, 6d01h56m
O>* 44.0.198.0/24 [110/30] via 44.0.6.1, port_PARI, 5d05h20m
O>* 44.0.199.0/24 [110/35] via 44.0.6.1, port_PARI, 5d05h01m
O>* 44.101.0.0/24 [110/35] via 44.0.6.1, port_PARI, 5d05h00m
O>* 44.103.0.0/24 [110/30] via 44.0.6.1, port_PARI, 5d05h20m
O   44.105.0.0/24 [110/30] via 44.0.12.1, port_NEWY, 00:40:54
                           via 44.0.13.1, port_ATLA, 00:40:54
S>* 44.105.0.0/24 [1/0] via 44.0.12.1, port_NEWY, 5d00h27m
O>* 44.106.0.0/24 [110/35] via 44.0.12.1, port_NEWY, 00:40:54
  *                        via 44.0.13.1, port_ATLA, 00:40:54
O>* 44.107.0.0/24 [110/25] via 44.0.13.1, port_ATLA, 00:40:54
O   44.108.0.0/24 [110/10] is directly connected, host, 6d01h03m
C>* 44.108.0.0/24 is directly connected, host, 6d01h58m
O>* 44.151.0.1/32 [110/25] via 44.0.6.1, port_PARI, 5d05h00m
O>* 44.152.0.1/32 [110/25] via 44.0.6.1, port_PARI, 5d04h27m
O>* 44.153.0.1/32 [110/20] via 44.0.6.1, port_PARI, 5d05h20m
O>* 44.154.0.1/32 [110/30] via 44.0.6.1, port_PARI, 5d05h20m
O>* 44.155.0.1/32 [110/20] via 44.0.12.1, port_NEWY, 00:40:54
  *                        via 44.0.13.1, port_ATLA, 00:40:54
O>* 44.156.0.1/32 [110/25] via 44.0.12.1, port_NEWY, 00:40:54
  *                        via 44.0.13.1, port_ATLA, 00:40:54
O>* 44.157.0.1/32 [110/15] via 44.0.13.1, port_ATLA, 00:40:54
C>* 44.158.0.0/24 is directly connected, lo, 6d01h57m
O>* 44.158.0.1/32 [110/0] is directly connected, lo, 6d01h02m
O>* 44.200.0.0/23 [110/35] via 44.0.6.1, port_PARI, 3d21h14m
O>* 44.200.2.0/23 [110/35] via 44.0.6.1, port_PARI, 3d20h55m
C>* 158.44.0.0/16 is directly connected, ssh, 04w6d09h
O>* 198.0.0.0/24 [110/35] via 44.0.6.1, port_PARI, 5d05h00m
MIAM_router#
```