Report

Assignment 4
1DV701

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Contents

1 Problem 1

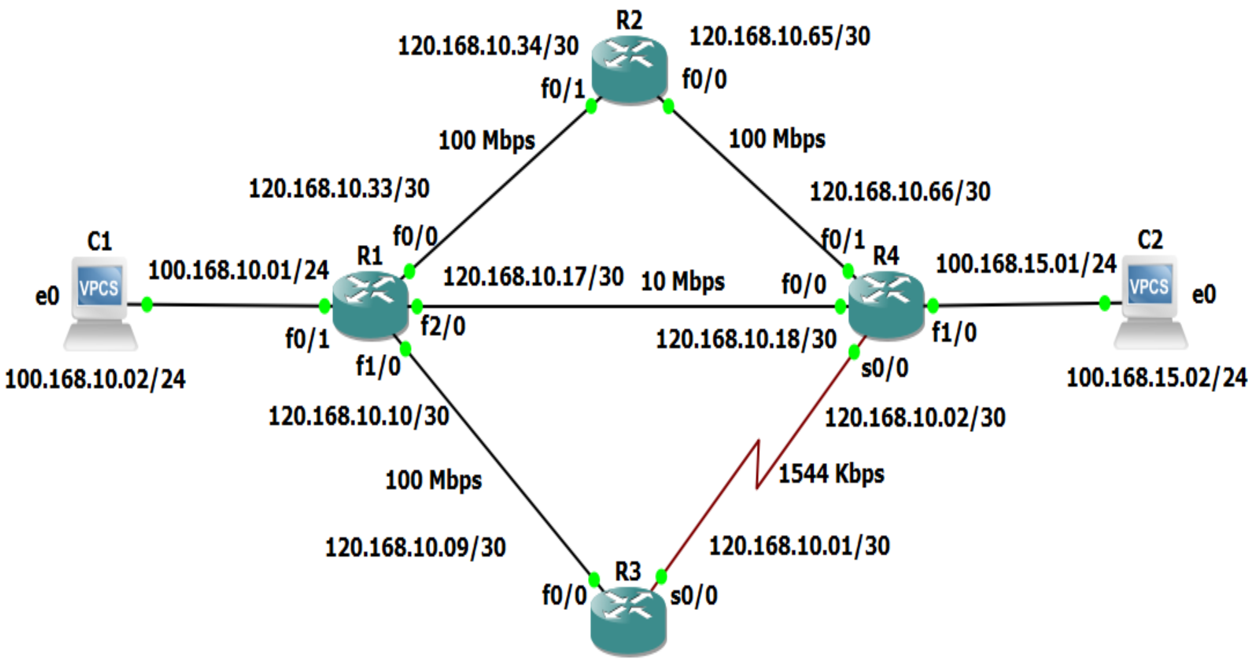


Figure 1: A completed Topology.

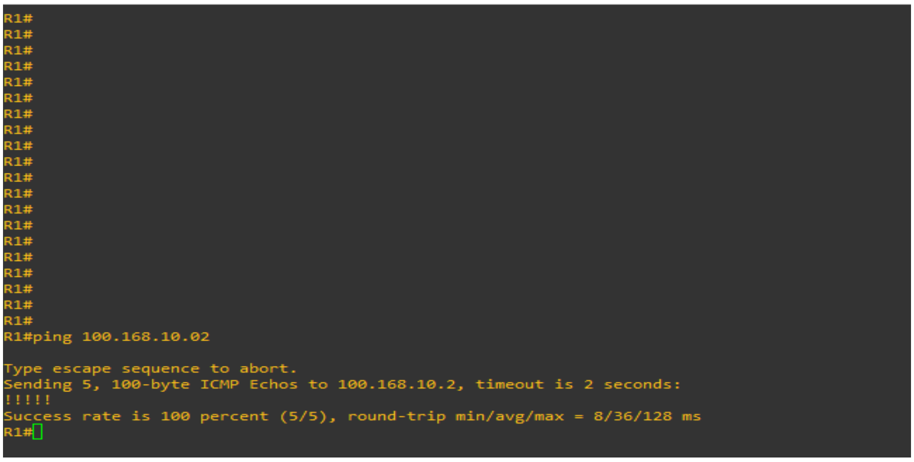


Figure 2: Ping: R1 to Computer 1

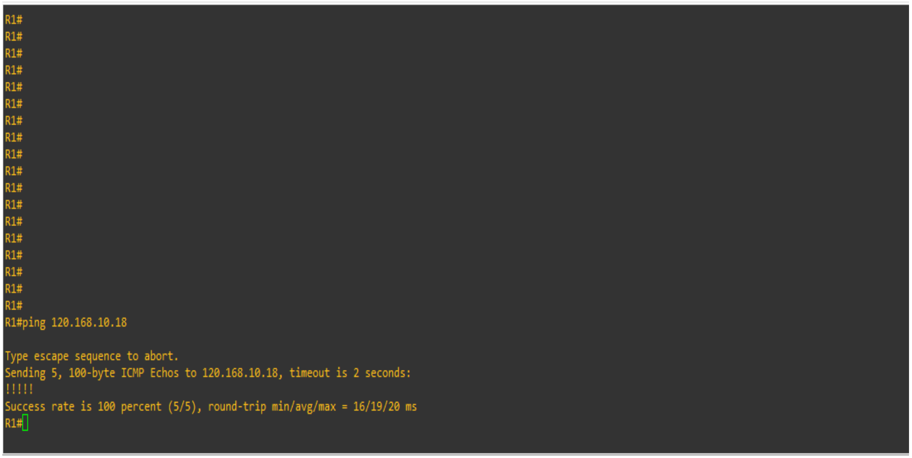


Figure 3: Ping: R1 to R4

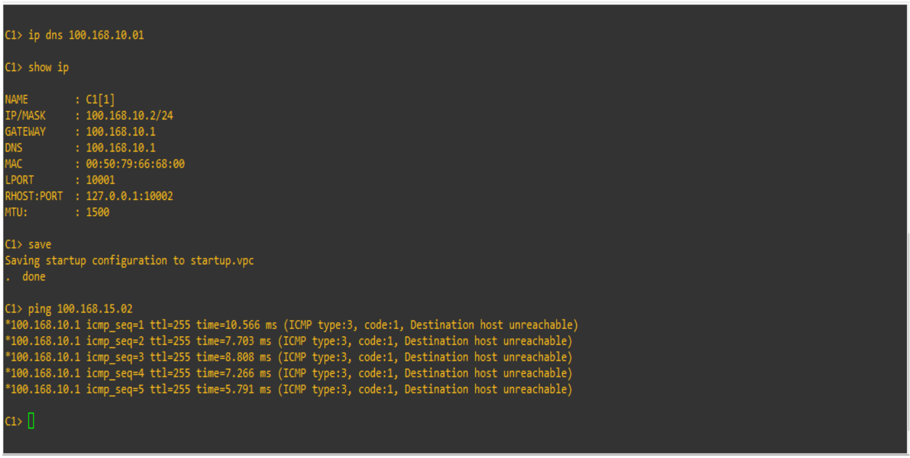


Figure 4: Ping: Computer 1 to Computer 2. Unreachable at this stage.

1.1 Discussion

To explain the reason behind why these modules, NM-1FE-TX and WIC-1T, are chosen, all the other modules (NM-4T and NM-16ESW) have to be defined as well. The explanations of the NM-1FE-TX, WIC-1T, NM-4T, and NM-16ESW abbreviations are as following:

- NM-1FE-TX: NM means Network Module and 1FE means One Fast Ethernet. The NM-1FE-TX offers one fast Ethernet with 10/100TX connection.
- WIC-1T: WIC means Wan Interface Card and it offers one serial connection.
- NM-4T: Network Module with four ports that provides only one mode; that is the synchronous mode.
- NM-16ESW: Network Module with 16 Fast Ethernet ports

The NM-16ESW contains 16 ports, and that number of ports is beyond the reasonable need for this context; therefore, it does not fit the purpose.

The NM-4T supports only synchronous mode and that implies this network module also does not fit the purpose of this context.

To illustrate further, Router 3 and Router 4 needed only one serial connection; therefore, the WIC-1T was the reasonable choice for the task.

When it comes to practical difference between a /24 and a /30 subnet, the differnce between 24/ subnet and 30/ subnet is the total amount of hosts. The 24/ subnet can have 255 hosts while the 30/ subnet can have fours hosts and two of the these hosts can be used to connect endpoints.

For the backbone, it was reasonable to use the 30 /subnet since the total need was ten addresses to connect the endpoints, and that implies there were five addresses with 30/ subnet that were used to connect one endpoint with another without leaving any unused addresses.

2 Problem 2

```
C1> ping 100.168.15.02
84 bytes from 100.168.15.2 icmp_seq=1 ttl=61 time=42.208 ms
84 bytes from 100.168.15.2 icmp_seq=2 ttl=61 time=64.096 ms
84 bytes from 100.168.15.2 icmp_seq=3 ttl=61 time=47.153 ms
84 bytes from 100.168.15.2 icmp_seq=4 ttl=61 time=55.788 ms
84 bytes from 100.168.15.2 icmp_seq=5 ttl=61 time=62.291 ms
```

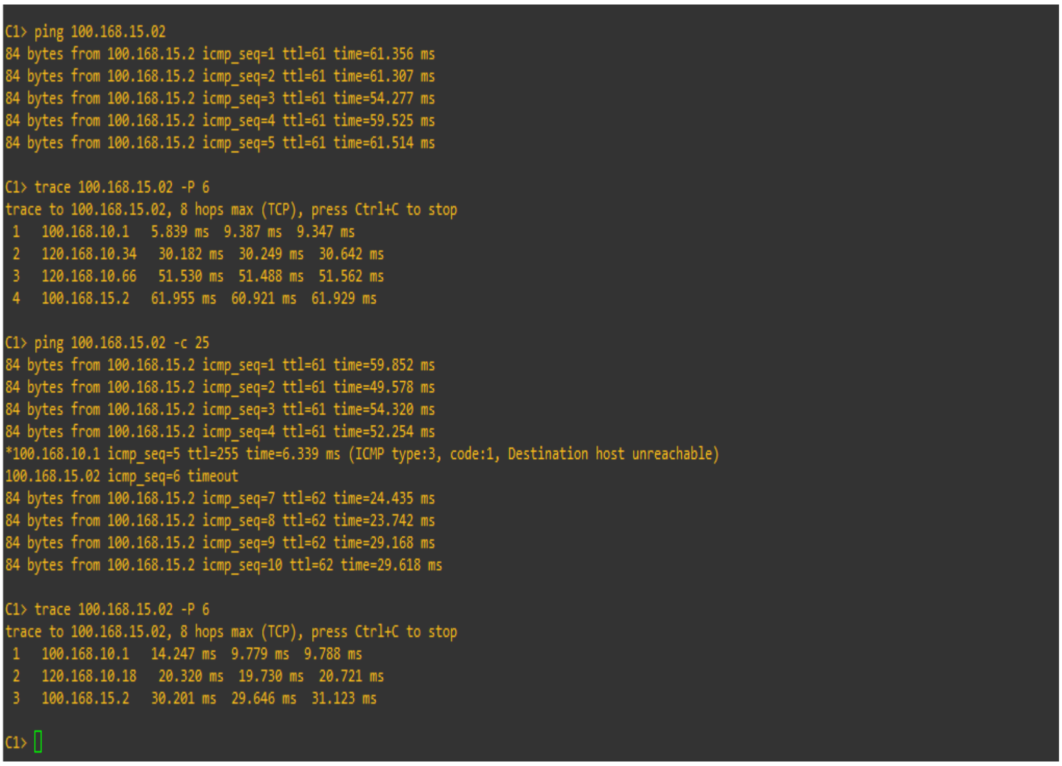
Figure 5: Ping: Computer 1 to Computer 2.

```
C1> trace 100.168.15.02 -P 6
trace to 100.168.15.02, 8 hops max (TCP), press Ctrl+C to stop
 1   100.168.10.1    5.182 ms  9.322 ms  10.174 ms
 2   120.168.10.34   31.173 ms  32.081 ms  32.390 ms
 3   120.168.10.66   41.663 ms  43.271 ms  42.263 ms
 4     *  *  *
 5   100.168.15.2    58.182 ms  9.423 ms  10.192 ms
```

Figure 6: Route: Computer 1 to Computer 2.

```
C1> ping 100.168.15.02 -c 25
84 bytes from 100.168.15.2 icmp_seq=1 ttl=61 time=66.073 ms
84 bytes from 100.168.15.2 icmp_seq=2 ttl=61 time=49.311 ms
84 bytes from 100.168.15.2 icmp_seq=3 ttl=61 time=57.215 ms
84 bytes from 100.168.15.2 icmp_seq=4 ttl=61 time=49.328 ms
*100.168.10.1 icmp_seq=5 ttl=255 time=52.129 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=6 ttl=255 time=9.241 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=7 ttl=255 time=2.283 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=8 ttl=255 time=10.464 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=9 ttl=255 time=4.050 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=10 ttl=255 time=4.766 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=11 ttl=255 time=7.577 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=12 ttl=255 time=7.673 ms (ICMP type:3, code:1, Destination host unreachable)
```

Figure 7: Ping Failing: After Shutting down the interfaces of the default route.



```
C1> ping 100.168.15.02
84 bytes from 100.168.15.2 icmp_seq=1 ttl=61 time=61.356 ms
84 bytes from 100.168.15.2 icmp_seq=2 ttl=61 time=61.307 ms
84 bytes from 100.168.15.2 icmp_seq=3 ttl=61 time=54.277 ms
84 bytes from 100.168.15.2 icmp_seq=4 ttl=61 time=59.525 ms
84 bytes from 100.168.15.2 icmp_seq=5 ttl=61 time=61.514 ms

C1> trace 100.168.15.02 -P 6
trace to 100.168.15.02, 8 hops max (TCP), press Ctrl+C to stop
 1   100.168.10.1    5.839 ms  9.387 ms  9.347 ms
 2   120.168.10.34   30.182 ms  30.249 ms  30.642 ms
 3   120.168.10.66   51.530 ms  51.488 ms  51.562 ms
 4   100.168.15.2   61.955 ms  60.921 ms  61.929 ms

C1> ping 100.168.15.02 -c 25
84 bytes from 100.168.15.2 icmp_seq=1 ttl=61 time=59.852 ms
84 bytes from 100.168.15.2 icmp_seq=2 ttl=61 time=49.578 ms
84 bytes from 100.168.15.2 icmp_seq=3 ttl=61 time=54.320 ms
84 bytes from 100.168.15.2 icmp_seq=4 ttl=61 time=52.254 ms
*100.168.10.1 icmp_seq=5 ttl=255 time=6.339 ms (ICMP type:3, code:1, Destination host unreachable)
100.168.15.02 icmp_seq=6 timeout
84 bytes from 100.168.15.2 icmp_seq=7 ttl=62 time=24.435 ms
84 bytes from 100.168.15.2 icmp_seq=8 ttl=62 time=23.742 ms
84 bytes from 100.168.15.2 icmp_seq=9 ttl=62 time=29.168 ms
84 bytes from 100.168.15.2 icmp_seq=10 ttl=62 time=29.618 ms

C1> trace 100.168.15.02 -P 6
trace to 100.168.15.02, 8 hops max (TCP), press Ctrl+C to stop
 1   100.168.10.1   14.247 ms  9.779 ms  9.788 ms
 2   120.168.10.18   20.320 ms  19.730 ms  20.721 ms
 3   100.168.15.2   30.201 ms  29.646 ms  31.123 ms

C1>
```

Figure 8: Choosing the alternative route: After Shutting down the interfaces of the default route.

2.1 Discussion

The following is the explanation of the parameters of the IP route command:

- IP: The IP address of the target destination, i.e. the final destination. For instance, in the case of forwarding a package from Computer 1 to Computer 2, than the target destination would be the IP address of Computer 2.
- Mask: The mask of the IP address of the target destination.
- Interface: The IP address of the next interface, that should be connected to the forwarding router, to accept the forwarded packet.
- Metric: The prioritization value. In this context, there are three available routes to the final destination. To configure a default route that has a higher priority than the others, the metric can be used to set the priorities of the routes. In this task, the metric value of the default route was set to 1, the metric value of the first alternative route was set to 2, and the metric value of the second alternative route was set to 3.

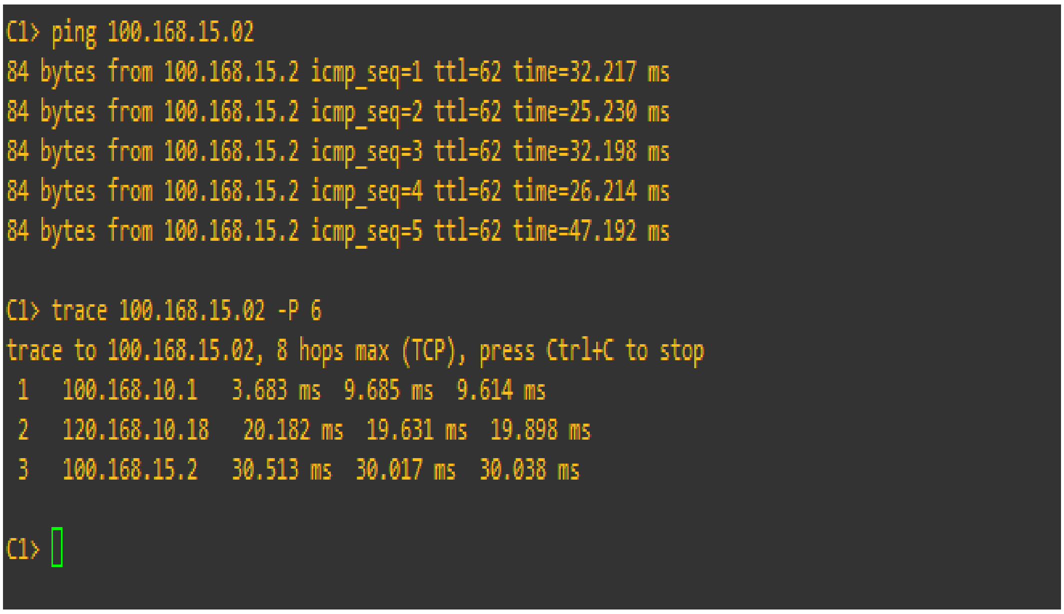
Figure 5 shows the ping test to check the connectivity between Computer 1 and Computer 2, and at this stage Computer 1 and Computer 2 can communicate and the ping test was successful.

When it comes to the default route, the default route was chosen after the metric of bandwidth rate in this context, see Figure 6. The route Computer 1, R1, R2, R4 to Computer 2, was chosen and the reason is that it has the highest bandwidth rate.

The route Computer 1, R1, R4 to Computer 2 has lowest number of hops but the bandwidth is quite low. The last route Computer 1, R1, R3, R4 and Computer 2 has three hops and the lowest bandwidth of all. That implies the route Computer 1, R1, R4 and Computer 2 became the first alternative route and the last route became the the second alternative route.

Figure 8 shows the ping test: Computer 1 communicating with Computer 2 when the default route was shut down and at that stage it could not reach the destination through the default route, therefore it took the designed first alternative route to communicate with Computer 2. It lost two package during the process of connecting through the first alternative route. Moreover, the latter mentioned Figure shows the routes before and after shutting down the default route and the lost packages.

3 Problem 3

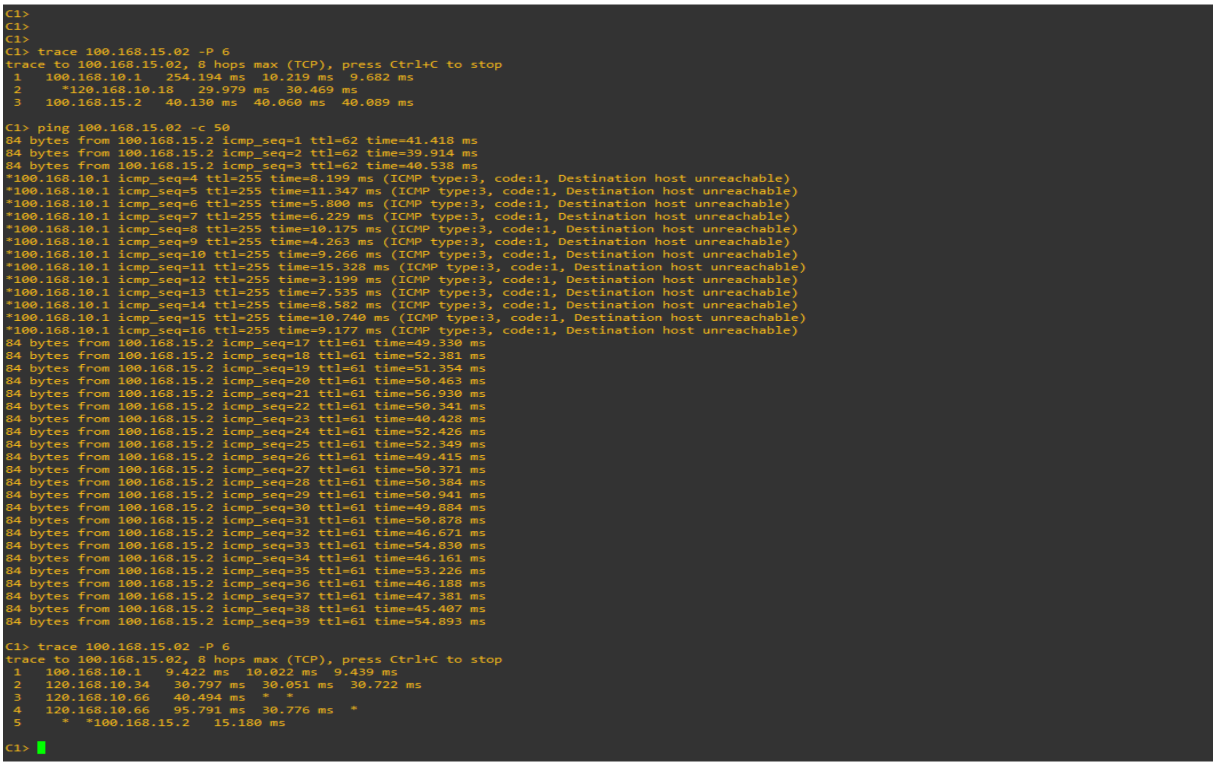


```
C1> ping 100.168.15.02
84 bytes from 100.168.15.2 icmp_seq=1 ttl=62 time=32.217 ms
84 bytes from 100.168.15.2 icmp_seq=2 ttl=62 time=25.230 ms
84 bytes from 100.168.15.2 icmp_seq=3 ttl=62 time=32.198 ms
84 bytes from 100.168.15.2 icmp_seq=4 ttl=62 time=26.214 ms
84 bytes from 100.168.15.2 icmp_seq=5 ttl=62 time=47.192 ms

C1> trace 100.168.15.02 -P 6
trace to 100.168.15.02, 8 hops max (TCP), press Ctrl+C to stop
 1   100.168.10.1   3.683 ms  9.685 ms  9.614 ms
 2   120.168.10.18   20.182 ms  19.631 ms  19.898 ms
 3   100.168.15.2   30.513 ms  30.017 ms  30.038 ms

C1>
```

Figure 9: RIPv2: the chosen default route by RIPv2.



```
C1>
C1>
C1>
C1> trace 100.168.15.02 -P 6
trace to 100.168.15.02, 8 hops max (TCP), press Ctrl+C to stop
 1   100.168.10.1   254.194 ms  10.219 ms  9.682 ms
 2     *120.168.10.18   29.979 ms  30.469 ms
 3   100.168.15.2   40.130 ms  40.060 ms  40.089 ms

C1> ping 100.168.15.02 -c 50
84 bytes from 100.168.15.2 icmp_seq=1 ttl=62 time=41.418 ms
84 bytes from 100.168.15.2 icmp_seq=2 ttl=62 time=39.914 ms
84 bytes from 100.168.15.2 icmp_seq=3 ttl=62 time=40.538 ms
*100.168.10.1 icmp_seq=4 ttl=255 time=8.199 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=5 ttl=255 time=11.347 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=6 ttl=255 time=5.800 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=7 ttl=255 time=6.229 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=8 ttl=255 time=10.175 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=9 ttl=255 time=4.263 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=10 ttl=255 time=9.266 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=11 ttl=255 time=15.328 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=12 ttl=255 time=3.199 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=13 ttl=255 time=7.535 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=14 ttl=255 time=8.582 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=15 ttl=255 time=10.740 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=16 ttl=255 time=9.177 ms (ICMP type:3, code:1, Destination host unreachable)
84 bytes from 100.168.15.2 icmp_seq=17 ttl=61 time=49.330 ms
84 bytes from 100.168.15.2 icmp_seq=18 ttl=61 time=52.381 ms
84 bytes from 100.168.15.2 icmp_seq=19 ttl=61 time=51.354 ms
84 bytes from 100.168.15.2 icmp_seq=20 ttl=61 time=50.463 ms
84 bytes from 100.168.15.2 icmp_seq=21 ttl=61 time=56.930 ms
84 bytes from 100.168.15.2 icmp_seq=22 ttl=61 time=50.341 ms
84 bytes from 100.168.15.2 icmp_seq=23 ttl=61 time=40.428 ms
84 bytes from 100.168.15.2 icmp_seq=24 ttl=61 time=52.426 ms
84 bytes from 100.168.15.2 icmp_seq=25 ttl=61 time=52.349 ms
84 bytes from 100.168.15.2 icmp_seq=26 ttl=61 time=49.415 ms
84 bytes from 100.168.15.2 icmp_seq=27 ttl=61 time=50.371 ms
84 bytes from 100.168.15.2 icmp_seq=28 ttl=61 time=50.384 ms
84 bytes from 100.168.15.2 icmp_seq=29 ttl=61 time=50.941 ms
84 bytes from 100.168.15.2 icmp_seq=30 ttl=61 time=49.884 ms
84 bytes from 100.168.15.2 icmp_seq=31 ttl=61 time=50.878 ms
84 bytes from 100.168.15.2 icmp_seq=32 ttl=61 time=46.671 ms
84 bytes from 100.168.15.2 icmp_seq=33 ttl=61 time=54.830 ms
84 bytes from 100.168.15.2 icmp_seq=34 ttl=61 time=46.161 ms
84 bytes from 100.168.15.2 icmp_seq=35 ttl=61 time=53.226 ms
84 bytes from 100.168.15.2 icmp_seq=36 ttl=61 time=46.188 ms
84 bytes from 100.168.15.2 icmp_seq=37 ttl=61 time=47.381 ms
84 bytes from 100.168.15.2 icmp_seq=38 ttl=61 time=45.407 ms
84 bytes from 100.168.15.2 icmp_seq=39 ttl=61 time=54.893 ms

C1> trace 100.168.15.02 -P 6
trace to 100.168.15.02, 8 hops max (TCP), press Ctrl+C to stop
 1   100.168.10.1   9.422 ms  10.022 ms  9.439 ms
 2   120.168.10.34   30.797 ms  30.051 ms  30.722 ms
 3   120.168.10.66   40.494 ms  *  *
 4   120.168.10.66   95.791 ms  30.776 ms  *
 5     *  *100.168.15.2   15.180 ms

C1>
```

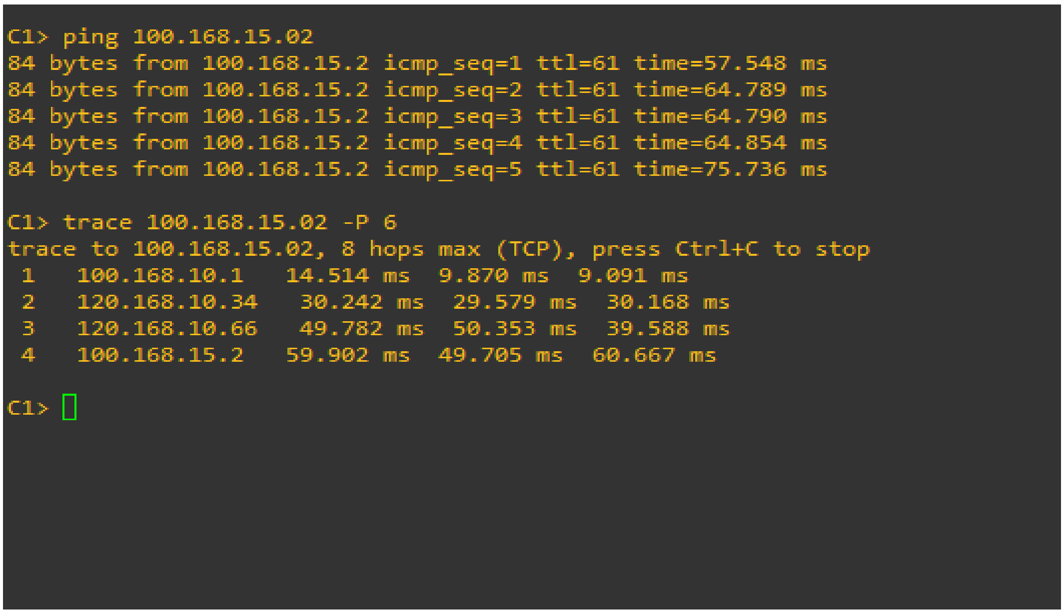
Figure 10: RIPv2: the alternative route after shutting down the default route.

3.1 Discussion

Figure 9 shows the most efficient route that RIPv2 has chosen. The route from Computer 1 to Computer 2, is Computer 1, R1, R4 and Computer 2 and that implies it took the shortest route given that this route has only two hops R1 and R4 but lower bandwidth than the other route that is Computer 1, R1, R2, R4 and Computer 2.

After shutting down the route RIPv2 has chosen initially as the default route, it decided an alternative router, see Figure 10, which is Computer 1, R1, R2, R4, and Computer 2, and that implies the remaining two routes have precisely the same amount of hops. It lost 13 packages before it went over the alternative route. However, the route Computer 1, R1, R2, R4, and Computer 2 is a better alternative given that is has a higher bandwidth than the other route.

4 Problem 4

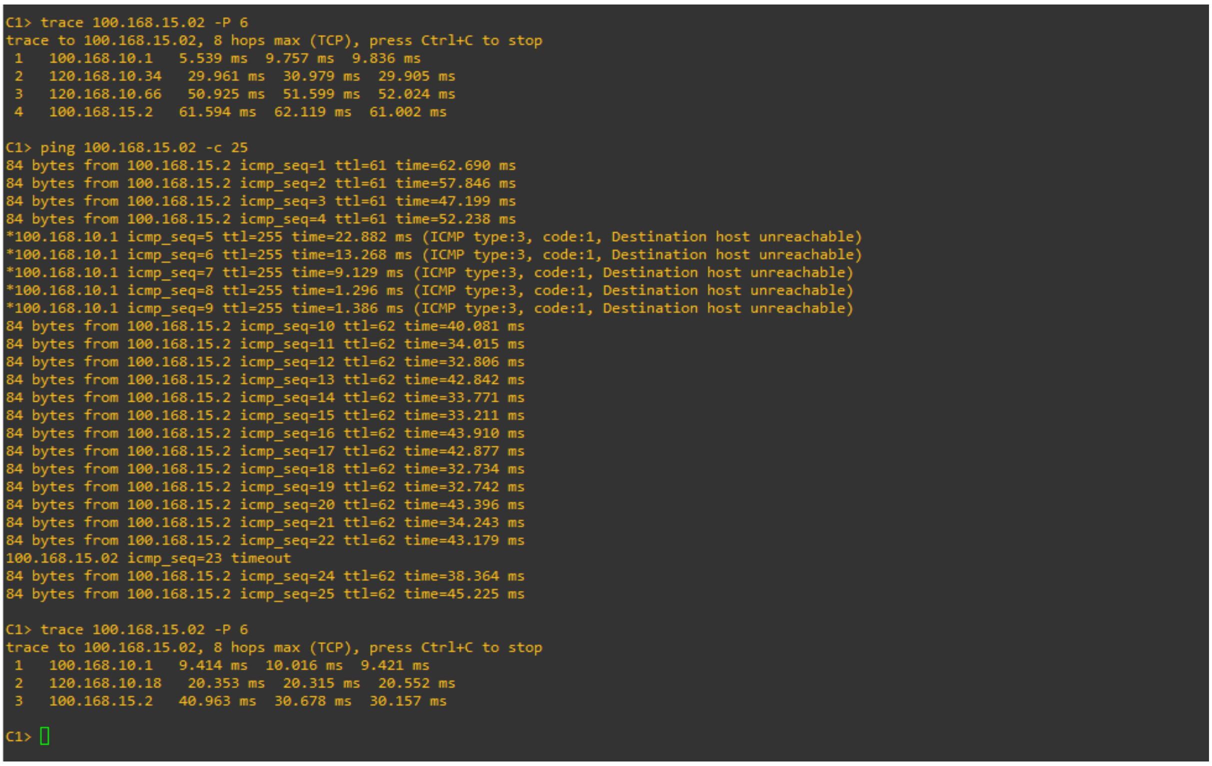


```
C1> ping 100.168.15.02
84 bytes from 100.168.15.2 icmp_seq=1 ttl=61 time=57.548 ms
84 bytes from 100.168.15.2 icmp_seq=2 ttl=61 time=64.789 ms
84 bytes from 100.168.15.2 icmp_seq=3 ttl=61 time=64.790 ms
84 bytes from 100.168.15.2 icmp_seq=4 ttl=61 time=64.854 ms
84 bytes from 100.168.15.2 icmp_seq=5 ttl=61 time=75.736 ms

C1> trace 100.168.15.02 -P 6
trace to 100.168.15.02, 8 hops max (TCP), press Ctrl+C to stop
 1   100.168.10.1   14.514 ms  9.870 ms  9.091 ms
 2   120.168.10.34   30.242 ms  29.579 ms  30.168 ms
 3   120.168.10.66   49.782 ms  50.353 ms  39.588 ms
 4   100.168.15.2   59.902 ms  49.705 ms  60.667 ms

C1>
```

Figure 11: OSPF 1: the chosen default route by OSPF 1.



```
C1> trace 100.168.15.02 -P 6
trace to 100.168.15.02, 8 hops max (TCP), press Ctrl+C to stop
 1   100.168.10.1   5.539 ms  9.757 ms  9.836 ms
 2   120.168.10.34   29.961 ms  30.979 ms  29.905 ms
 3   120.168.10.66   50.925 ms  51.599 ms  52.024 ms
 4   100.168.15.2   61.594 ms  62.119 ms  61.002 ms

C1> ping 100.168.15.02 -c 25
84 bytes from 100.168.15.2 icmp_seq=1 ttl=61 time=62.690 ms
84 bytes from 100.168.15.2 icmp_seq=2 ttl=61 time=57.846 ms
84 bytes from 100.168.15.2 icmp_seq=3 ttl=61 time=47.199 ms
84 bytes from 100.168.15.2 icmp_seq=4 ttl=61 time=52.238 ms
*100.168.10.1 icmp_seq=5 ttl=255 time=22.882 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=6 ttl=255 time=13.268 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=7 ttl=255 time=9.129 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=8 ttl=255 time=1.296 ms (ICMP type:3, code:1, Destination host unreachable)
*100.168.10.1 icmp_seq=9 ttl=255 time=1.386 ms (ICMP type:3, code:1, Destination host unreachable)
84 bytes from 100.168.15.2 icmp_seq=10 ttl=62 time=40.081 ms
84 bytes from 100.168.15.2 icmp_seq=11 ttl=62 time=34.015 ms
84 bytes from 100.168.15.2 icmp_seq=12 ttl=62 time=32.806 ms
84 bytes from 100.168.15.2 icmp_seq=13 ttl=62 time=42.842 ms
84 bytes from 100.168.15.2 icmp_seq=14 ttl=62 time=33.771 ms
84 bytes from 100.168.15.2 icmp_seq=15 ttl=62 time=33.211 ms
84 bytes from 100.168.15.2 icmp_seq=16 ttl=62 time=43.910 ms
84 bytes from 100.168.15.2 icmp_seq=17 ttl=62 time=42.877 ms
84 bytes from 100.168.15.2 icmp_seq=18 ttl=62 time=32.734 ms
84 bytes from 100.168.15.2 icmp_seq=19 ttl=62 time=32.742 ms
84 bytes from 100.168.15.2 icmp_seq=20 ttl=62 time=43.396 ms
84 bytes from 100.168.15.2 icmp_seq=21 ttl=62 time=34.243 ms
84 bytes from 100.168.15.2 icmp_seq=22 ttl=62 time=43.179 ms
100.168.15.02 icmp_seq=23 timeout
84 bytes from 100.168.15.2 icmp_seq=24 ttl=62 time=38.364 ms
84 bytes from 100.168.15.2 icmp_seq=25 ttl=62 time=45.225 ms

C1> trace 100.168.15.02 -P 6
trace to 100.168.15.02, 8 hops max (TCP), press Ctrl+C to stop
 1   100.168.10.1   9.414 ms  10.016 ms  9.421 ms
 2   120.168.10.18   20.353 ms  20.315 ms  20.552 ms
 3   100.168.15.2   40.963 ms  30.678 ms  30.157 ms

C1>
```

Figure 12: OSPF 1: the alternative route after shutting down the default route.

4.1 Discussion

Figure 11 shows the most efficient route that OSPF 1 has chosen. The route from Computer 1 to Computer 2 is Computer 1, R1, R2, R4, and Computer 2, and that implies it took the highest bandwidth rate available given that this route has the highest bandwidth rate of all. It chose this route as default since it chooses its routes based on the cost calculation.

After shutting down the route OSPF 1 has chosen initially as the default route, it decided an alternative router, see Figure 12, which is Computer 1, R1, R4, and Computer 2, and that implies this route has the next highest bandwidth rate.

5 Problem 5

This section explains the difference between the three routing methods Static, RIPv2 and OSPF.

5.1 Discussion

When it comes to static routing, the Network Administrator configures the routes manually, and that implies this method will not work for large networks since it is time-consuming, and it can require extensive effort. All of the latter means that this method will be costly for large networks if the static method should be applied. It can be applied for a SOHO network since this type of network is manageable and does not require unreasonable amount of effort. In this assignment, when the static routing was used, only two packages were lost, and in reality, the number can differ and provide a different presentation. Still, in this context, it was the lowest of all methods in terms of package loss.

As for the RIPv2 method, this method applies the distance-vector protocols, and that implies that it chooses its routes based on the distance metric. For instance, in this assignment, when the RIPv2 was adopted to solve problem 3, the method chose the route Computer 1, R1, R4, and Computer 2 as the default route from Computer 1 to Computer 2 and that is because this route has the shortest distance between the two endpoints which is two hops. In terms of configuration, this method does not require as much effort as the static method. This method can be used in networks that do not have more than 15 hops as this method can support 15 hops as the maximum amount of hops, and that means this method cannot be applied in networks that are expandable or in large networks. By comparing the results of Problem 3 and Problem 4 would lead to the conclusion that this method has a higher amount of package loss than OSPF and Static.

Lastly, the OSPF method applies the link-state routing, and that means that each router in the network notifies all the other routers about its adjacent routers; in that way, the routers can use this information to compute its routes. The latter concept can explain why the rate of package loss of this method is lower than the rate of RIPv2. Routers in this method notify one another regularly. In such a way, when a router goes down, the adjacent router will inform the others to learn about that router, and that will facilitate the process of finding different routes in a short time when a router goes down.

In terms of configuration, this method requires almost the same effort as the RIPv2, and it requires less effort than the Static method. This method uses the cost calculation as its metric to find the best routes to the target destinations. For instance, in Problem 4, it can be seen that it chose the route that has the highest bandwidth route as its default route from Computer 1 to Computer 2 and that because higher bandwidth will lead to lower costs in terms of sending and receiving data from one endpoint to another. Moreover, this method can be applied to small and large networks alike, as it can efficiently manage both capacities.