Assignment 4:
Network topology and routing

1DV701 Computer Networks
- Introduction-

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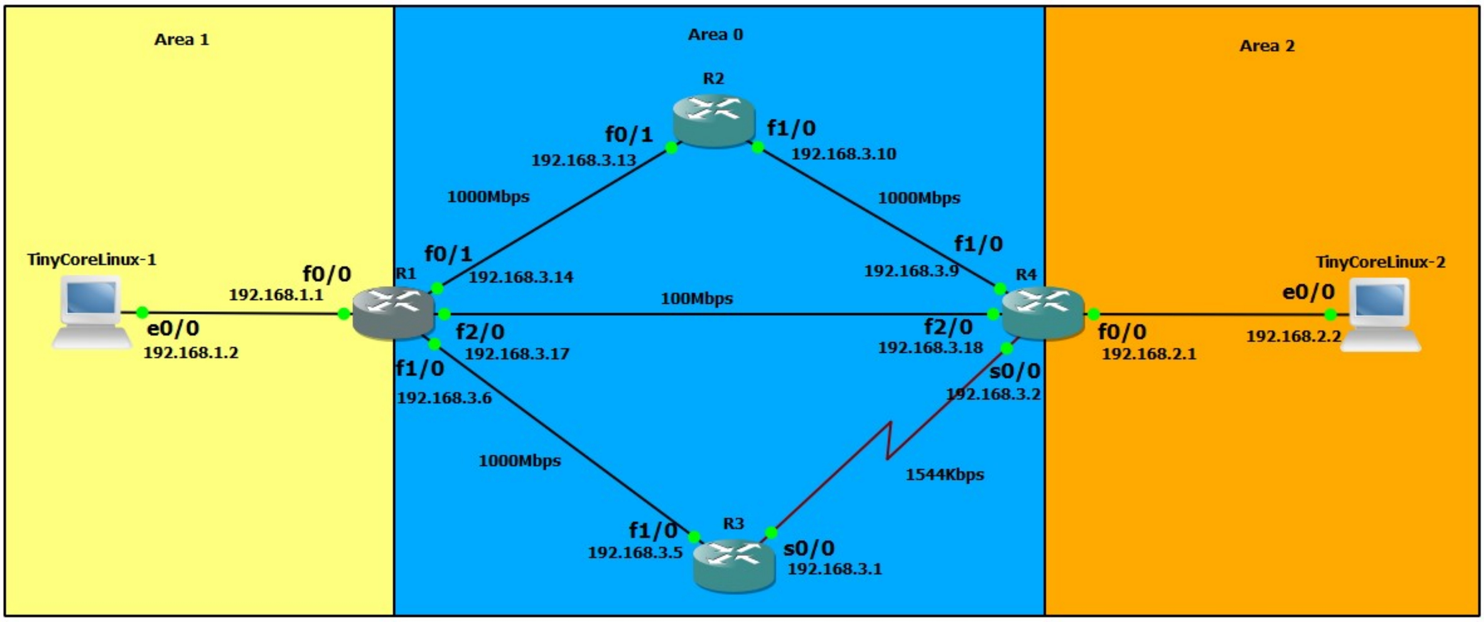
Introduction

In this assignment, I am using a network emulator called GNS3 to create a network topology. This report includes the test of different routing schemes with virtual Cisco routers.

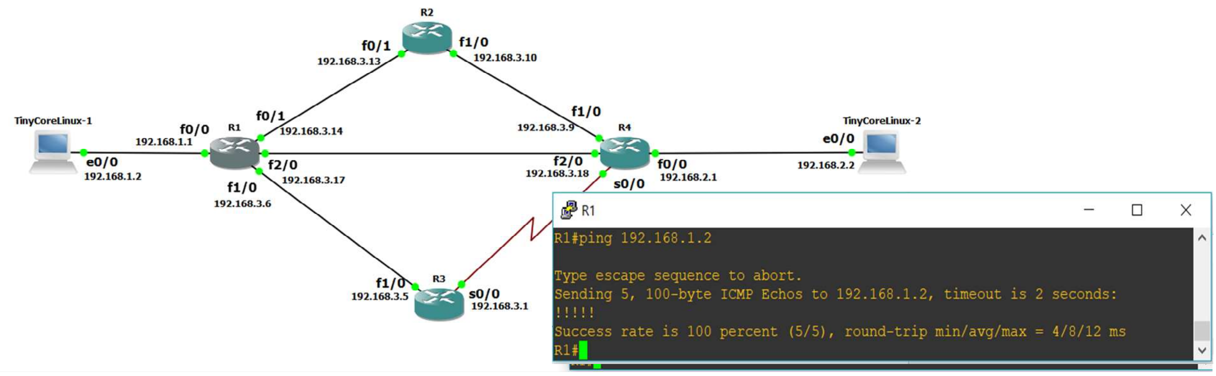
Problem 1

Configuring a network virtual environment and creating a required topology according to the guidelines. The set up includes two PCs TinyCoreLinux-1 and TinyCoreLinux-2 as well as 4 routers R1, R2, R3 and R4 (c3725). The c3725 has 2 Fast Ethernet interfaces on its motherboard, 3 sub-slots for WICs (a max of 6 serial ports) and 2 Network Module slots (a max of 32 Fast Ethernet ports / 8 serial ports). [1]

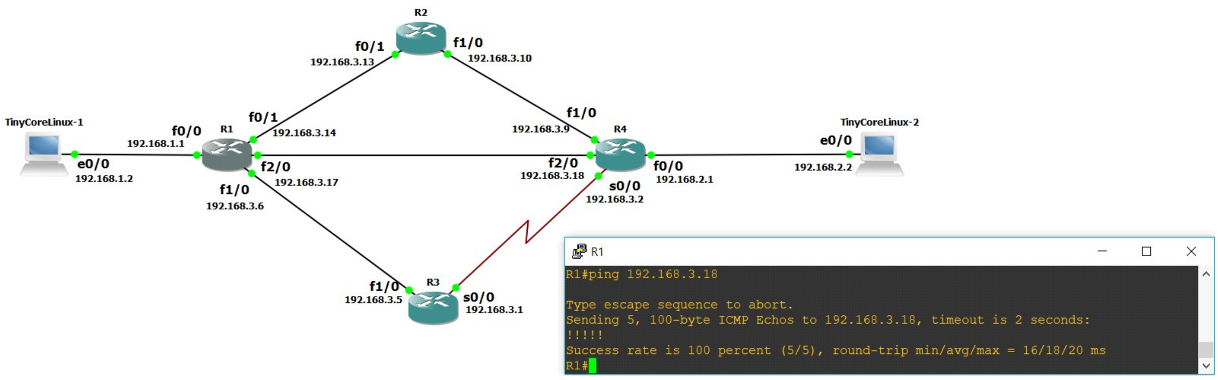
- A resulting screenshot from GNS3 with a completed topology that contains all IP addresses:



- Ping from R1 to C1:



- Ping from R1 to R4:



- An explanation of NM-1FE-TX and why this module is chosen among the available alternatives:

NM = network module
1FE = one fast Ethernet port
TX = 10/100 Base interface

For the router c3725 we have the option to choose between the NM-1FE-TX, NM-4T or NM-16ESW. The chosen network module (NM-1FE-TX) supports VLAN deployment and allows us to add, move and switch within the network easily. It is chosen because the NM-4T (4-port asynchronous (serial) module) is not supporting the async mode and the last option NM-16ESW is a switching module with 16 fast Ethernet ports (we don't need that many) and provides some basic switching functionality.

- An explanation of WIC-1T and why this module is chosen among the available alternatives:

WIC = WAN interface card
1T = 1-port serial

For the router c3725 we have the option to choose between the WIC-1T and WIC-2T. The chosen card is the WIC-1T, which is a 1-port serial WAN interface card. The other option is the WIC-2T, a 2-port Asynchronous serial ports with speeds of 600bps-115.2Kbps or in Synchronous mode - 8Mbps per port. Because of the speed, the other WIC was chosen.

- The practical difference between a /24 and a /30 subnet:
From the practical perspective the /30 subnet (Addresses: 4 | Hosts: 2) is more practical, because it does not waste any IP addresses compared to the /24 subnet (Addresses 256 | Hosts: 254), which wastes a lot.

Problem 2

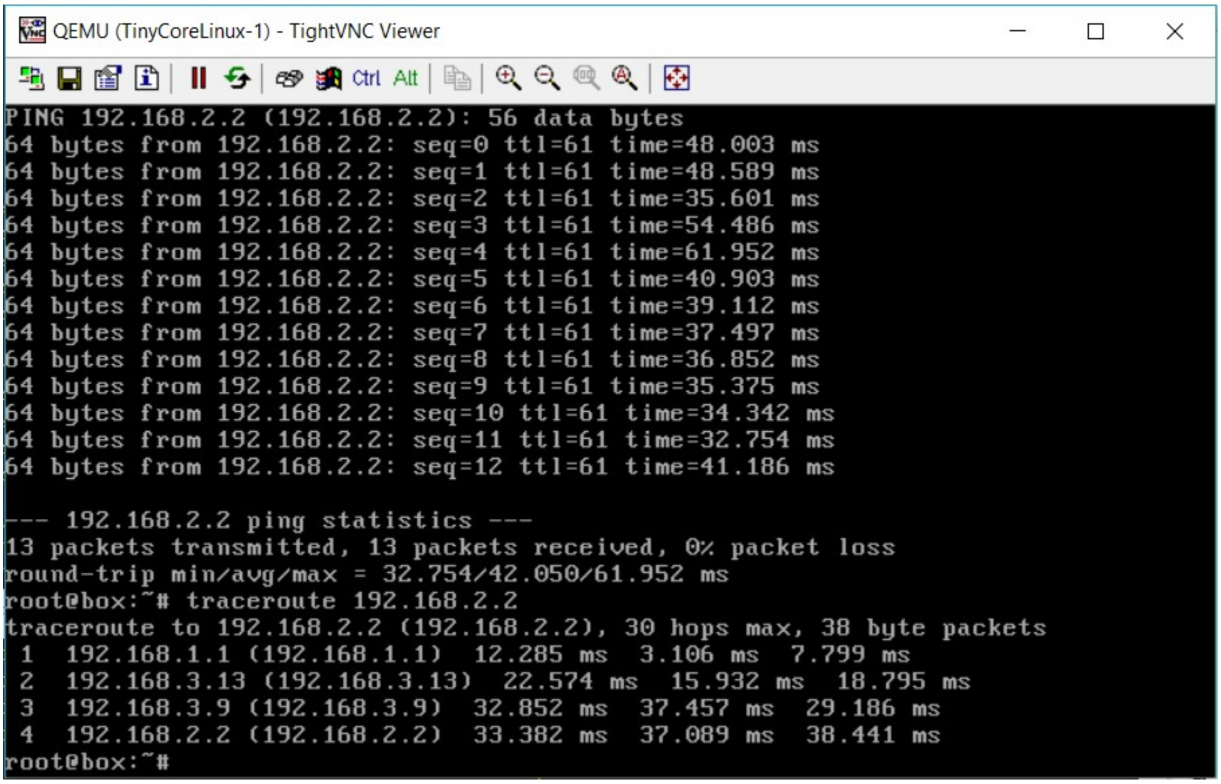
- The parameters of the ip route command:

Command: ip route [ip] [mask] [router_interface] [metric]

[ip] = IP address of the network to introduce the route to
[mask] = Subnet mask of the above [ip]
[router_interface] = The outgoing router interface f0/1, f1/0, f2/0, s0/0
[metric] = Priority of the route (lowest number = highest priority)

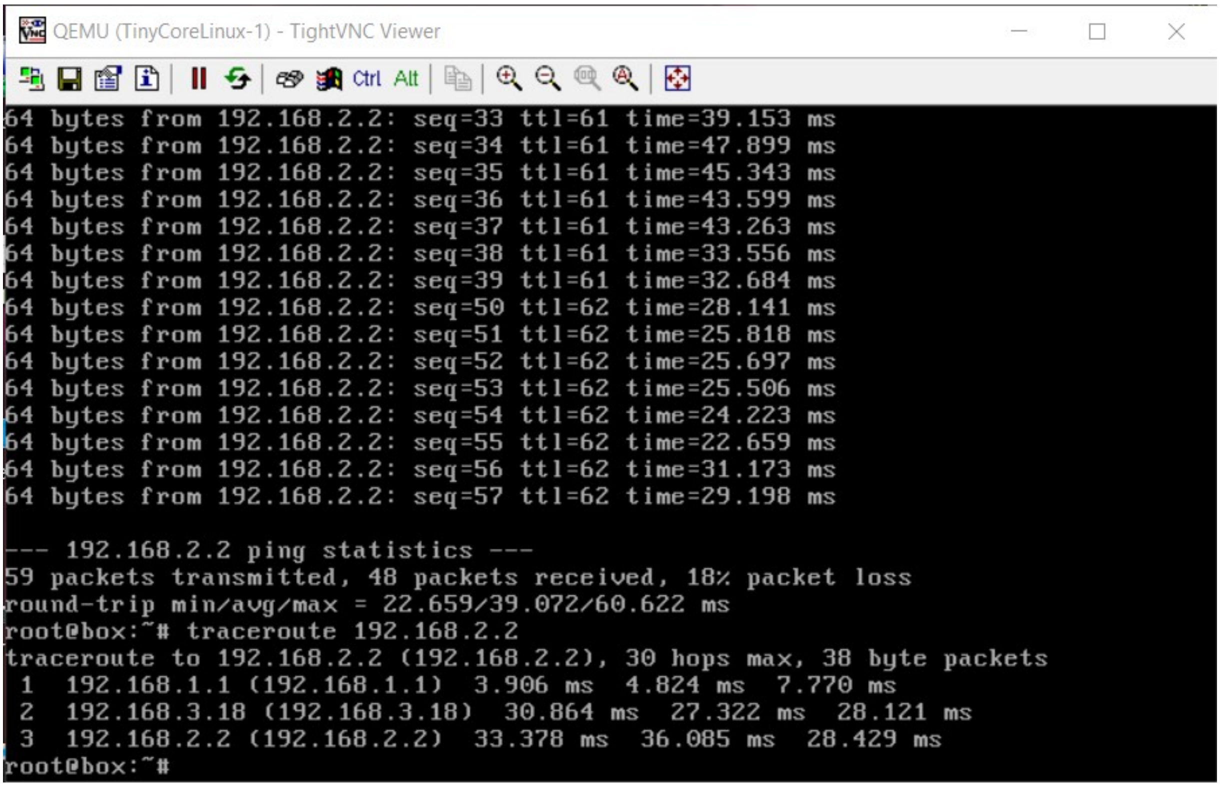
- Ping from C1 to C2:

I gave highest priority to the route C1 –> R1 –> R2 –> R4 –> C2, because it is the fastest route in my set up.



- Ping from C1 to C2 after the manual interrupt:

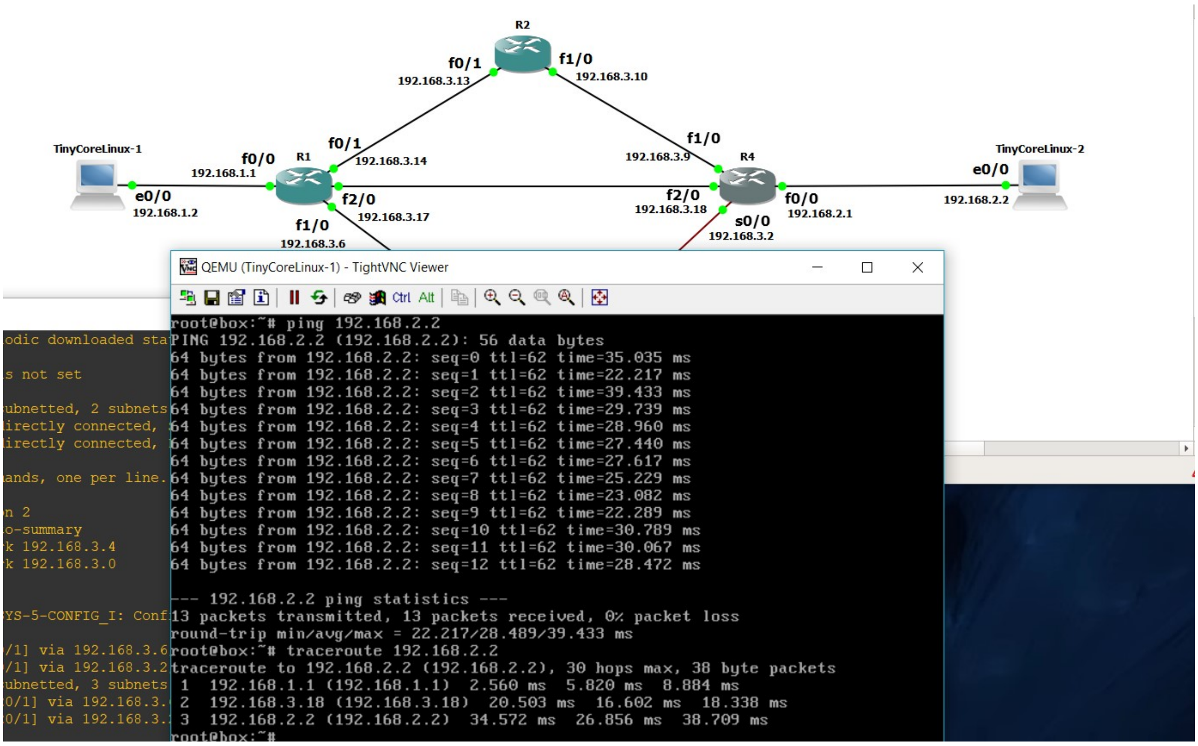
After shutting down both of the active router interfaces, the route was redirected via the path I gave priority number 2. C1 –> R1 –> R4 –> C2.



Problem 3

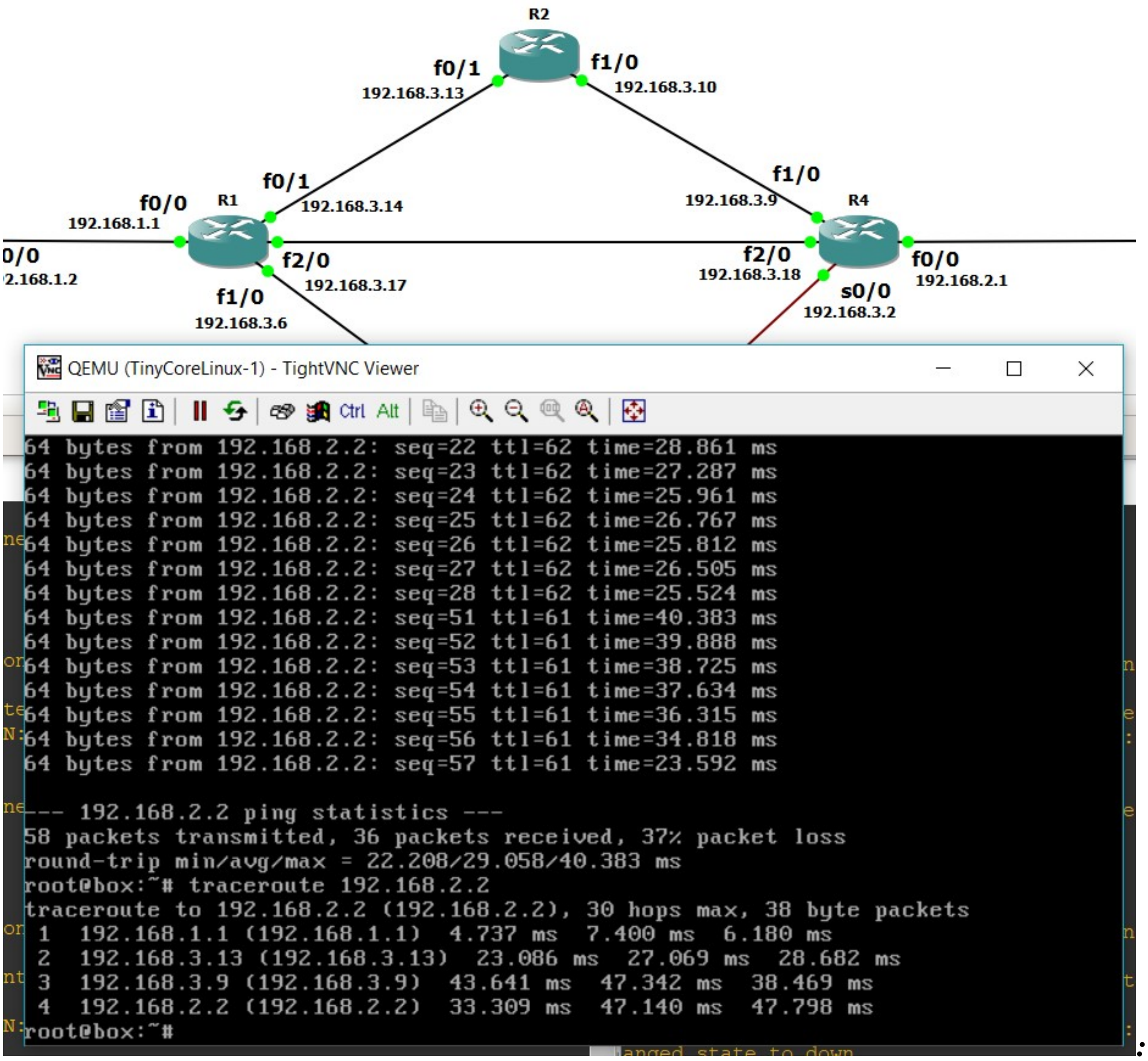
After returning to the basic router configuration the task is to configure a dynamic routing protocol RIPv2 in all routers. Using a *traceroute* command from C1 to C2 to see which routing path has been picked by RIPv2 as the most efficient. After executing the traceroute command we can see that the path C1 -> R1 -> R4 -> C2 was picked as the most efficient path, because RIPv2 is based on hop counting. This means that RIPv2 chooses the path, which has the smallest amount of routers on its path from C1 to C2. [2] The other two remaining paths both have an extra router when compared to this chosen path.

- Ping from C1 to C2 showing the chosen path:



- Ping from C1 to C2 showing the path after the manual interrupt

On the following picture we can see that 37% of the packets are lost before the new path starts to pass. As mentioned already, the RIPv2 algorithm is based on the hop count, so both of the alternative paths could have been chosen, but in my case the path C1 -> R1 -> R2 -> R4 -> C2 is chosen after the original path was interrupted manually.

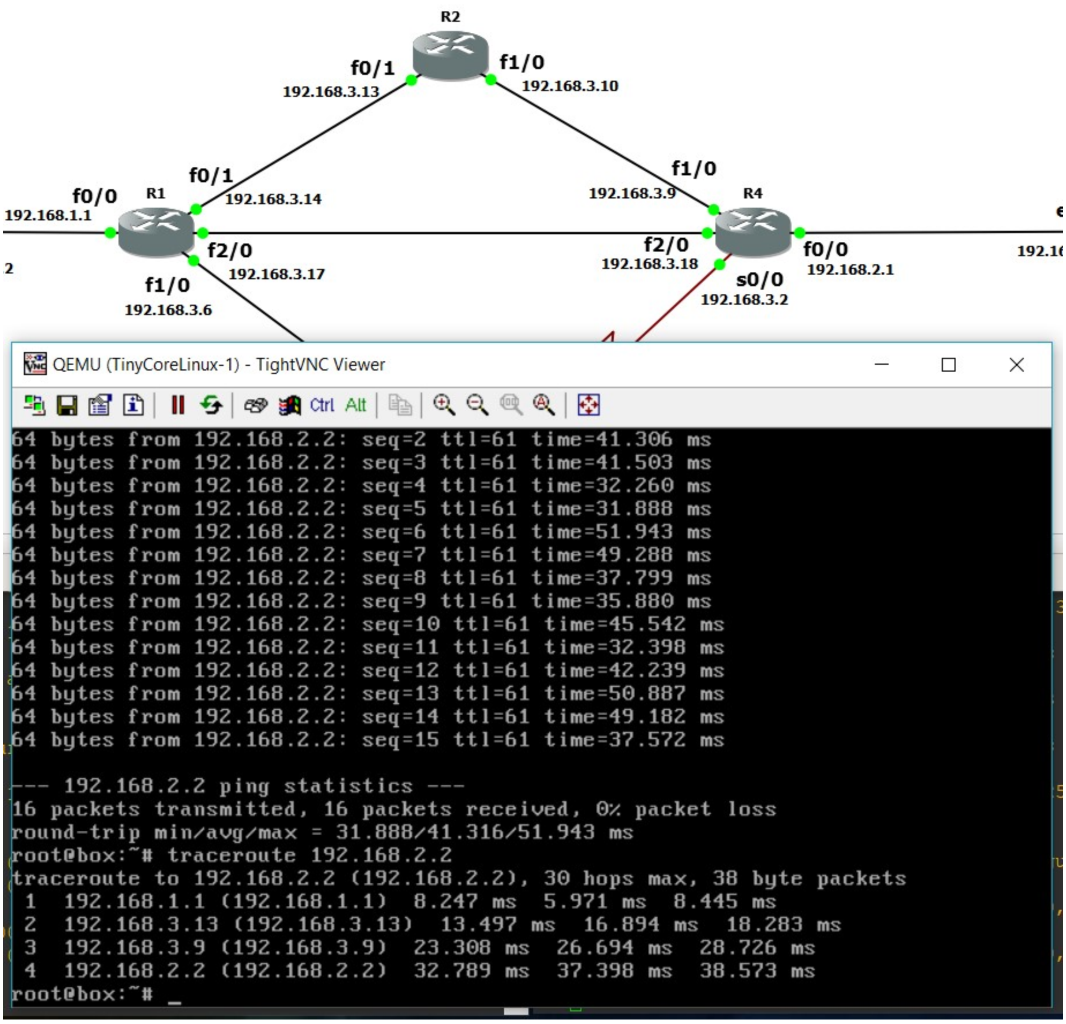


Problem 4

Returning to the basic router configuration and configuring a dynamic routing protocol OSPF. OSPF is based on link-state technology, which means that each router knows all the information (IP address, mask, type of network, etc.) about the neighboring routers. Together they form a link-state database. The cost (metric) of an interface in OSPF is basically the overhead needed to send packets via a certain interface. A higher bandwidth indicates a lower cost. [3]

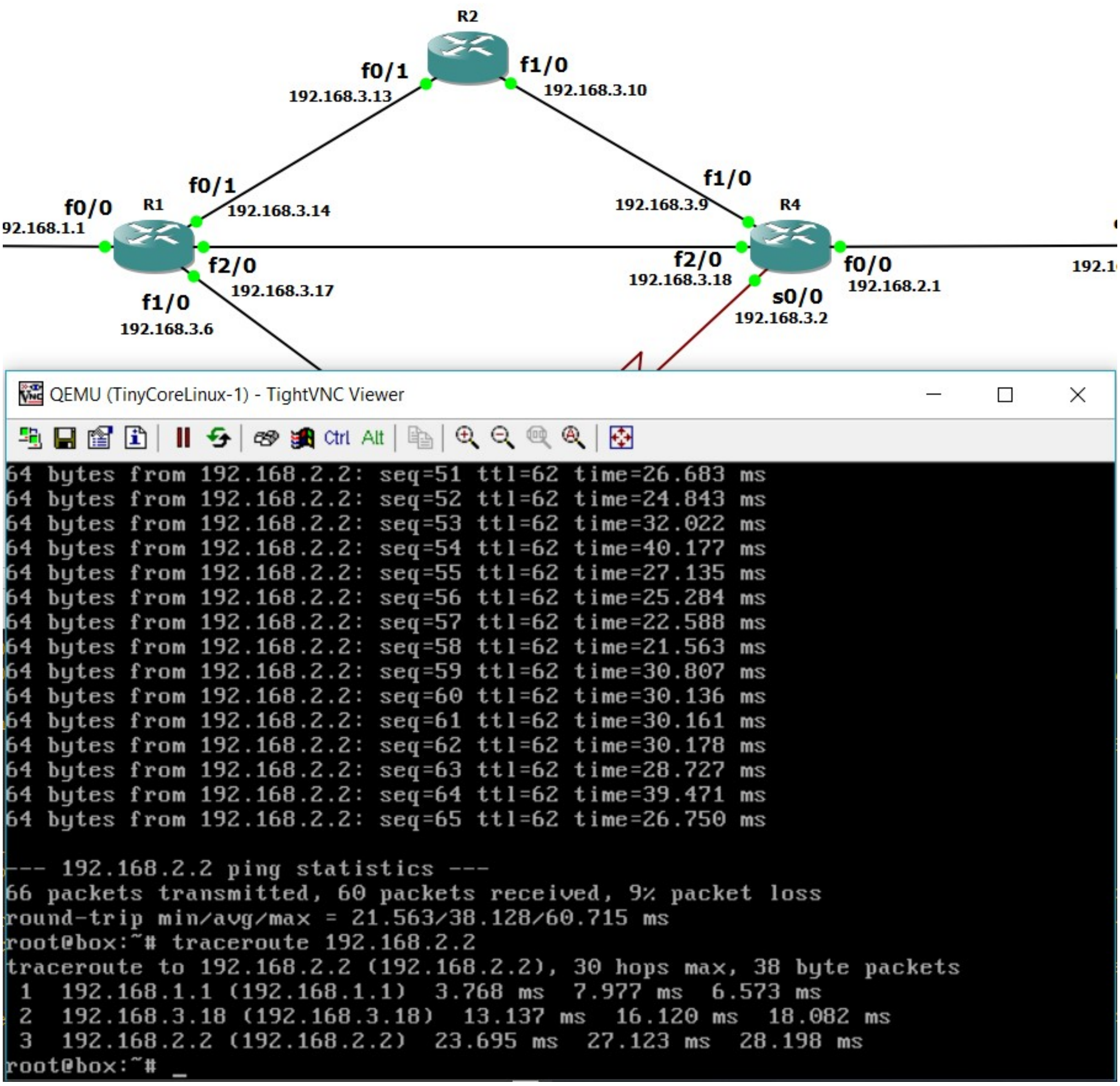
- Ping from C1 to C2 showing the most efficient path:

In the picture below, we can see that OSPF chose the path C1 -> R1 -> R2 -> R4 -> C2 as the most efficient path. (All metrics are visible in the screenshot from GNS3 with a completed topology at the beginning of this document)



- Ping from C1 to C2 showing the path after the manual interrupt:

In the picture below, we can see that OSPFs second choice is the path C1 -> R1 -> R4 -> C2. The second choice is the middle path, because the lower path via R3 would be too costly, since in my set up the bandwidth between R3 and R4 is 1544Kbps (which equals a cost of 64). A lower bandwidth indicates a higher cost.



Conclusion

Static: Has the parameters which are assigned at configuration. It is also based on priorities, which means that that path, which has the highest priority is taken first, even though it might be the slowest one. The configuration was easy and didn't take long. In case of failure, in my test the package loss was 18%, where the new path started to pass as soon as the connection was cut on both ends. Static routing is probably most efficient when used on smaller networks, when redundant link is not needed. Furthermore, static routing might be useful if the router cannot build a path to a specific destination.

RIPv2: Routing Information Protocol (RIP) uses hop count as the metric to measure the value of different routes. The hop count is the number of devices that are traversed in a path. So, in my example in Problem 3, RIPv2 chooses the path, which has the smallest amount of routers on its path from C1 to C2. The other two remaining paths both have an extra router when compared to the firstly chosen path. The configuration of the routers is easy and fast. In my example I had a 37% package loss, before an alternative path started to pass. RIP is suitable for smaller networks, since it has a limit of 15 hops (unreachable network has a metric of 16). [2]

OSPF: OSPF is based on link-state technology, which means that each router knows all the information (IP address, mask, type of network, etc.) about the neighboring routers. Together they form a link-state database. The cost (metric) of an interface in OSPF is basically the overhead needed to send packets via a certain interface. A higher bandwidth indicates a lower cost. The configuration is fast and easy. In my example, when interrupting the path, the package loss was 9%, so OSPF had the lowest package loss out of all three examples. Furthermore, OSPF is suitable for both smaller and larger networks. [3]

References

[1] https://docs.gns3.com

[2] https://www.cisco.com (https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/iproute_rip/configuration/15-mt/irr-15-mt-book/irr-cfg-info-prot.html)

[3] https://www.cisco.com (https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/iproute_ospf/configuration/xe-16/iro-xe-16-book/iro-cfg.html)