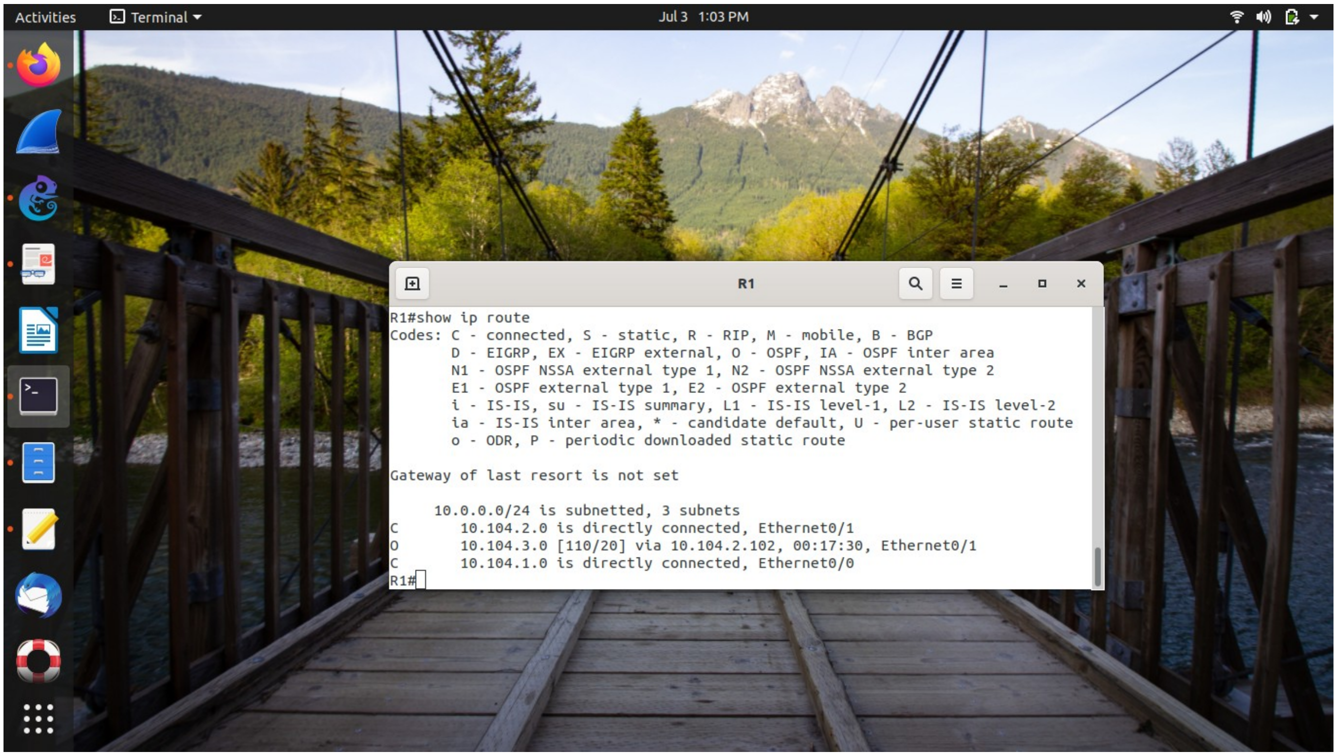
Show ip route :

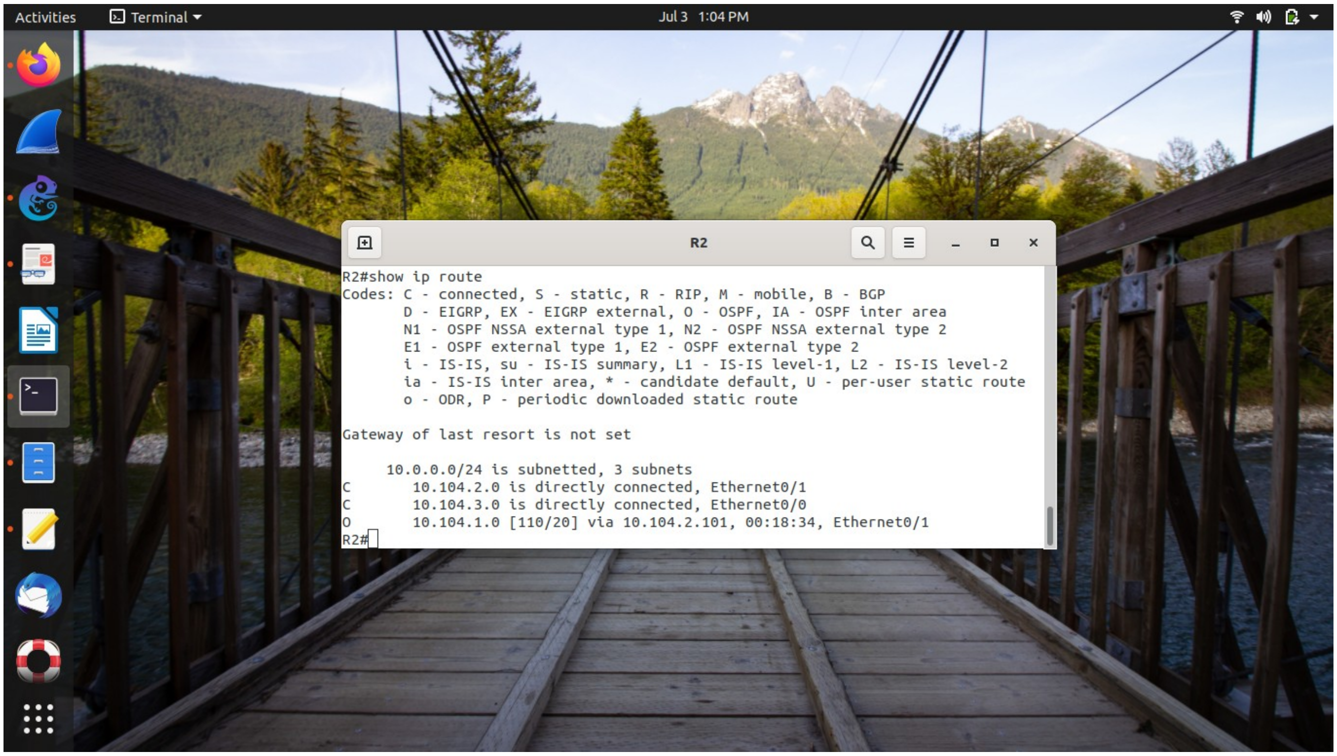
1) In R1 :



R1 is directly connected to PC1 and switch via 10.104.1.101 and 10.104.2.101. Switch connects devices of same network, so, R2, which is a part of network 2 is connected to R1 via 10.104.2.101.

10.104.3.0 network is reached from R1 via 10.104.2.102, which is the point via which R2 connects to network 2, and protocol used is OSPF.

2) In R2:

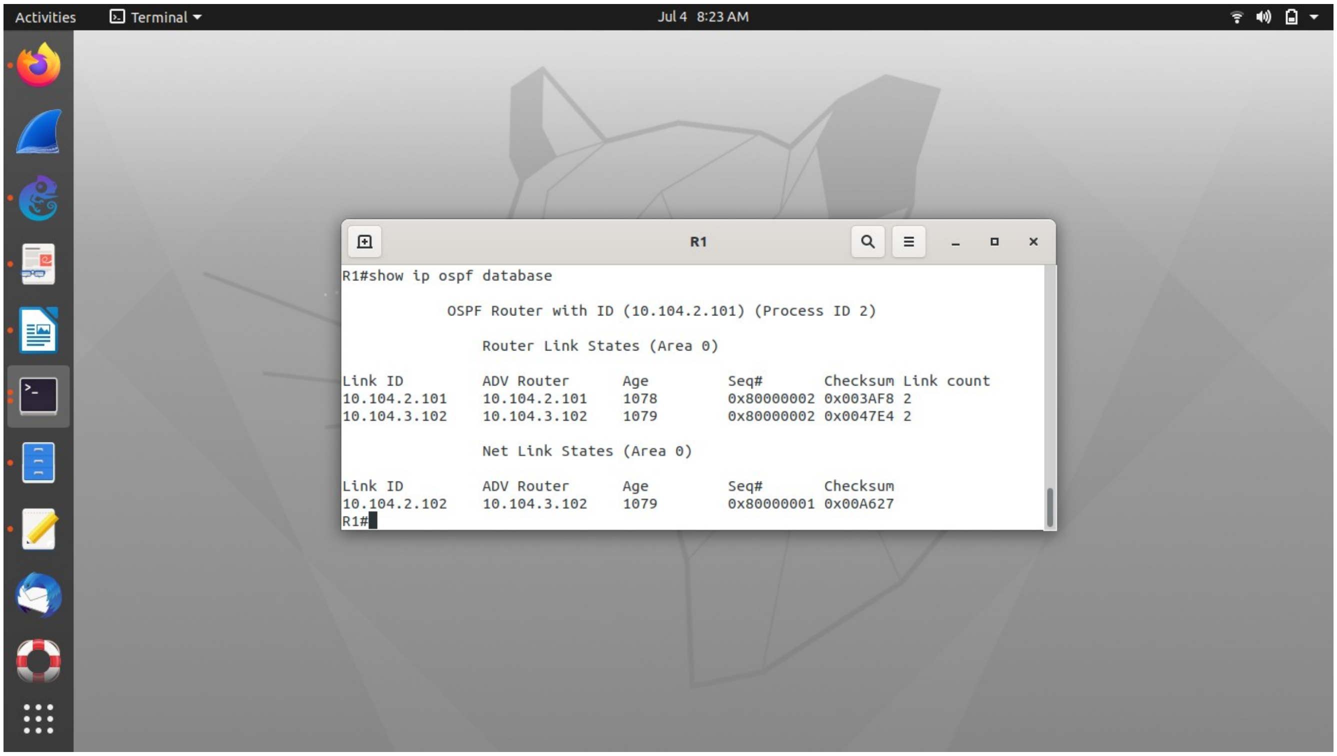


R2 is directly connected to PC2 and switch via 10.104.3.102 and 10.104.2.102. Switch connects devices of same network, so, R1, which is a part of network 2 is connected to R2 via 10.104.2.101.

10.104.1.0 network is reached from R2 via 10.104.2.101, which is the point via which R1 connects to network 2, and protocol used is OSPF.

Link State Database :-

1) R1:

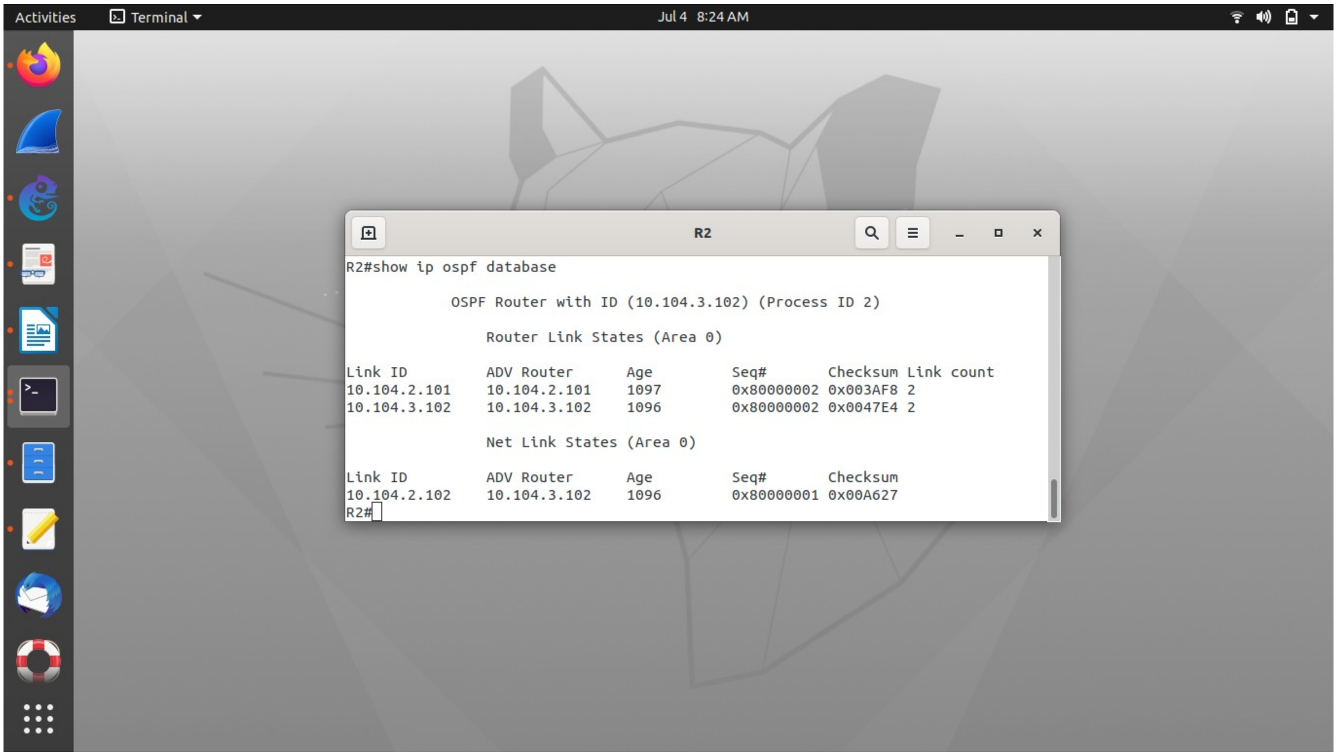


Router ID (RID) given to the router is 10.104.2.101, which is an IPv4 address on its interface.
2 types of LSA (Link State Advertisement) are there, namely, type 1 or Router LSA, and type 2 or Network LSA.

The 2 entries in Router LSA are 10.104.2.101 and 10.104.3.102, which are the router IDs of the 2 routers present. This shows that OSPF database is aware of all routers giving out Router LSA in its area. In type 1 LSA, link id of routers and advertising routers are same, because link id shows the IP of router that is forwarding an LSA, whereas advertising router shows ip of router that produced the LSA. As routers advertise themselves in type 1 LSA, so both are same.
Here, the 2 links connected to each router can be found by typing ‘show ip ospf database router self-originate’ in the router’s terminal. In R1, the 2 links are stub networks, with 1 connected to 10.104.1.0 and other to 10.104.2.0. ; and for R2, the 2 links are stub networks, with 1 connected to 10.104.2.0 and other to 10.104.3.0

Network LSA are flooded into area of network and the link-state ID of the type 2 LSA is the IP interface address of the DR (Designated router, in multi-access network), which in this case is 10.104.2.102. Note that advertising IP and link state IP are different here, though both came from same router R2.

2) R2 :



Router ID (RID) given to the router is 10.104.3.102, which is an IPv4 address on its interface.
2 types of LSA (Link State Advertisement) are there, namely, type 1 or Router LSA, and type 2 or Network LSA.

The 2 entries in Router LSA are 10.104.2.101 and 10.104.3.102, which are the router IDs of the 2 routers present. This shows that OSPF database is aware of all routers giving out Router LSA in its area. In type 1 LSA, link id of routers and advertising routers are same, because link id shows the IP of router that is forwarding an LSA, whereas advertising router shows ip of router that produced the LSA. As routers advertise themselves in type 1 LSA, so both are same.
Here, the 2 links connected to each router can be found by typing ‘show ip ospf database router self-originate’ in the router’s terminal. In R1, the 2 links are stub networks, with 1 connected to 10.104.1.0 and other to 10.104.2.0. ; and for R2, the 2 links are stub networks, with 1 connected to 10.104.2.0 and other to 10.104.3.0

Network LSA are flooded into area of network and the link-state ID of the type 2 LSA is the IP interface address of the DR (Designated router, in multi-access network), which in this case is 10.104.2.102. Note that advertising IP and link state IP are different here, though both came from same router R2.

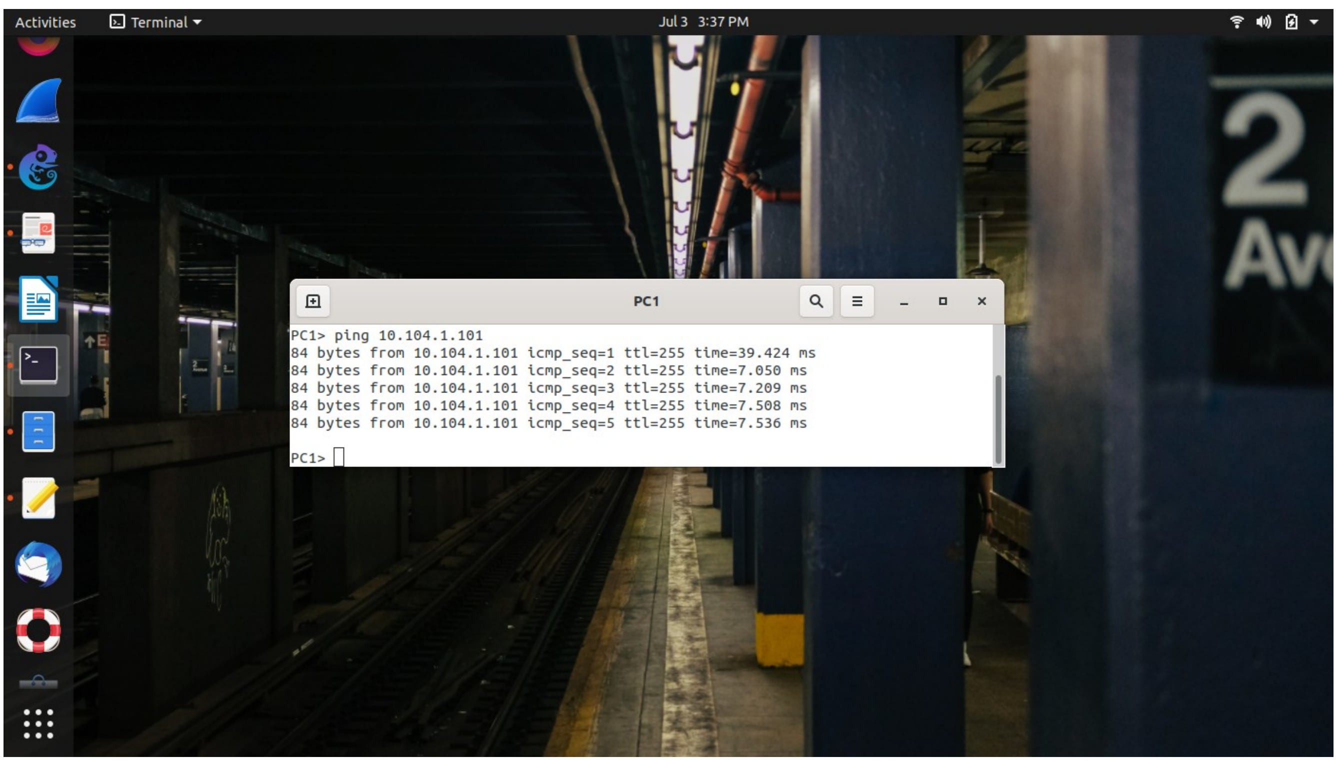
Note that sequence number of 10.104.2.101 are same in both R1 and R2; and that of 10.104.3.102 are also same in both R1 and R2.

If the LSA isn't already in the LSDB it will be added and a LSAck (acknowledgement) will be sent to the OSPF neighbor. The LSA will be flooded to all other OSPF neighbors and we have to run SPF to update our routing table.
If the LSA is already in the LSDB and the sequence number is the same then we will ignore the LSA.
If the LSA is already in the LSDB and the sequence number is different then we have to take action:

> If the sequence number is higher it means this information is newer and we have to add it to our LSDB.
>
> If the sequence number is lower it means our OSPF neighbor has an old LSA and we should help them. We will send a LSU (Link state update) including the newer LSA to our OSPF neighbor. The LSU is an envelope that can carry multiple LSAs in it

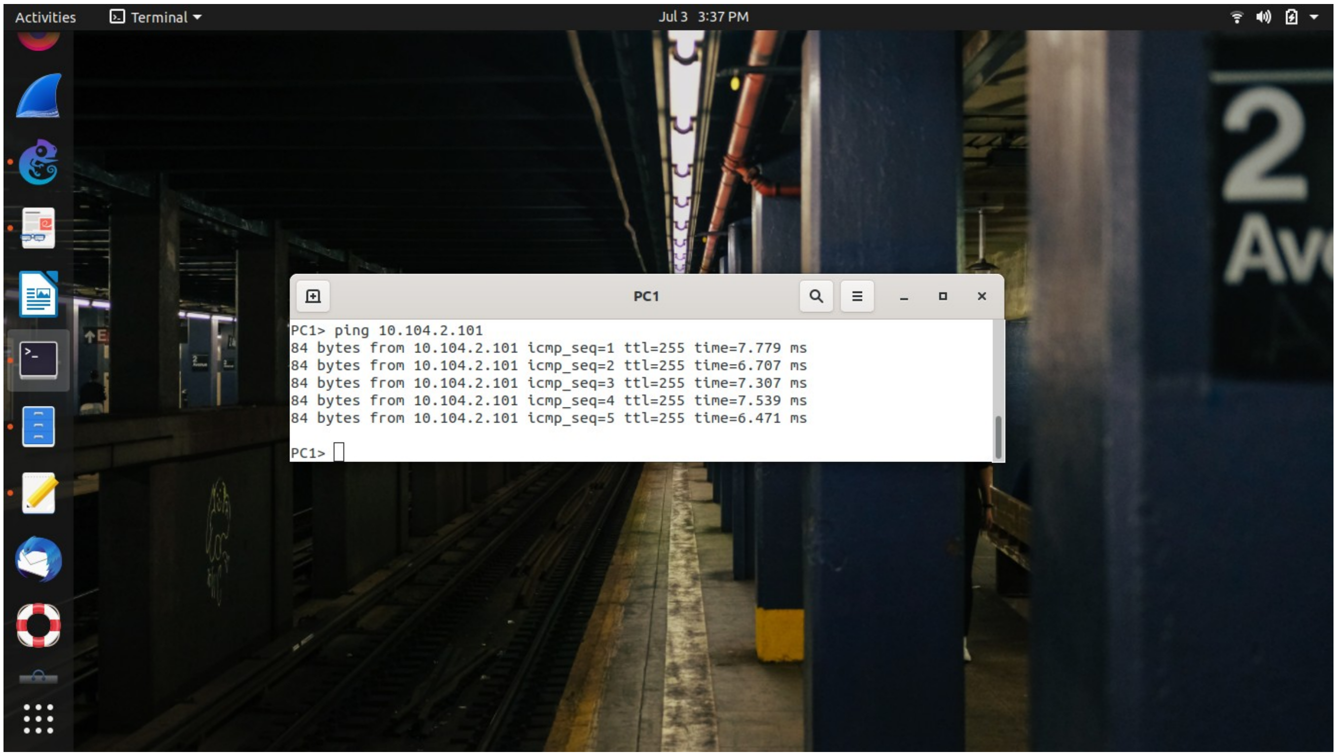
Ping from PC1 :-

1) To R1's 10.104.1.101 :



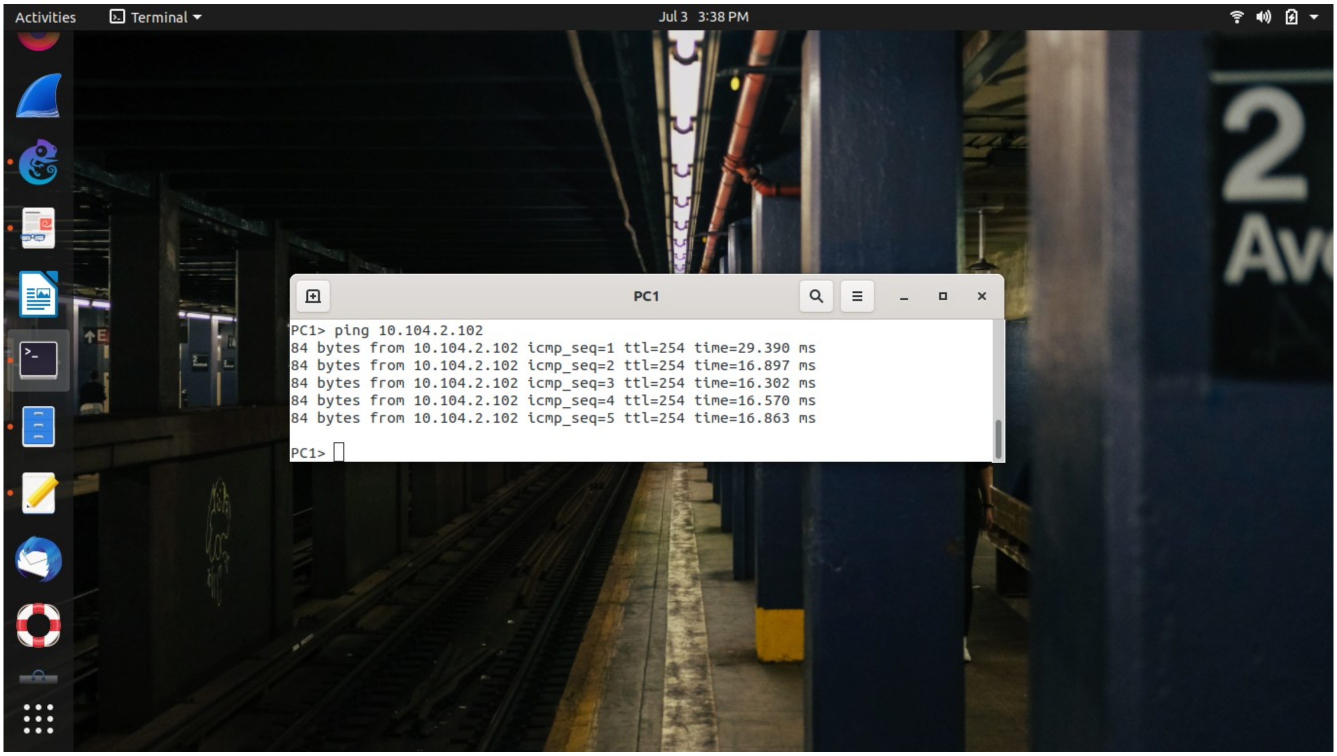
5 packets are sent to test ping. All of them, with sequence number shown in icmp_seq, return here. TTL is 255, showing 1 hop. Median time is 7.5 ms.

2) To R1’s 10.104.2.101 :



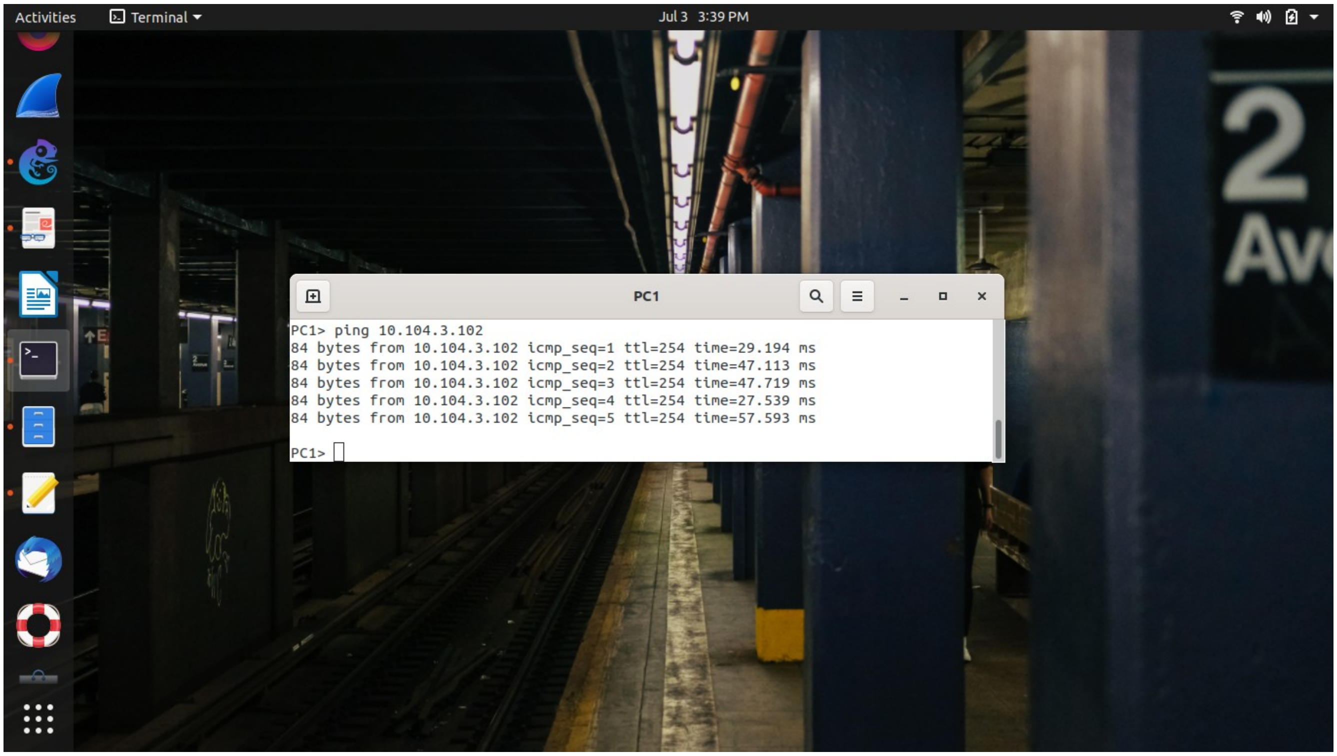
Packets are sent to test ping. All of them, with sequence number shown in icmp_seq, return here. TTL is 255, showing 1 hop. 84 byte ICMP packets are sent. Median time is 7.5 ms, which is the same as in previous case. This is because both 10.104.1.101 and 10.104.2.101 are on R1.

3) To R2’s 10.104.2.102 :



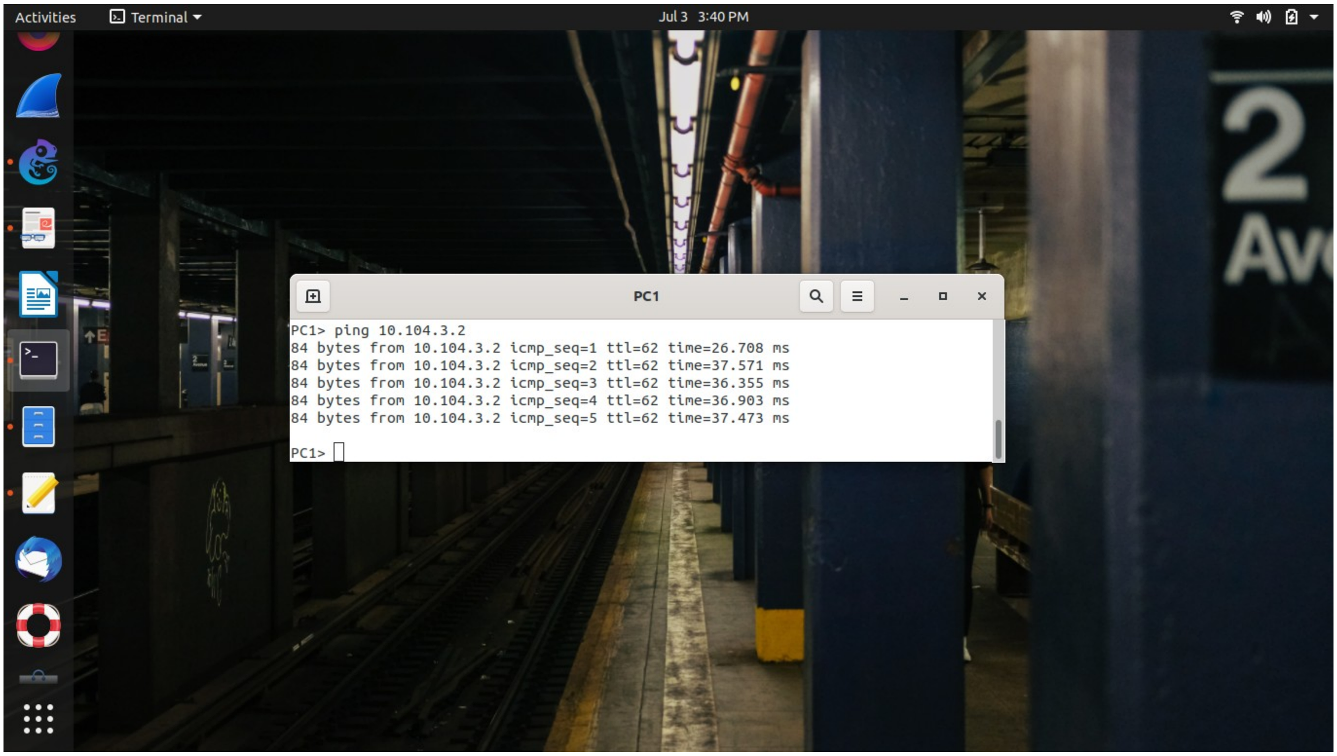
5 packets are sent to test ping. All of them, with sequence number shown in icmp_seq, return here. TTL is 254, showing 2 hops, 1 to reach R1 from PC1, and other to reach R2 from R1. Median time is 16.5 ms, which is almost double the time taken to reach R1 from PC1.
Note that the 1^{st} packet that reaches R2 takes a lot more time than others to return. So, we take median time than mean time.

4) To R2’s 10.104.3.102 :



5 packets are sent to test ping. All of them, with sequence number shown in icmp_seq, return here. TTL is 254, showing 2 hops, 1 to reach R1 from PC1, and other to reach R2 from R1.Time taken is considerably higher here.

5) To PC2’s 10.104.3.2 :



5 packets are sent to test ping. All of them, with sequence number shown in icmp_seq, return here. TTL is 62, showing that many hops were taken to reach PC2 in network 3. Median time is 36.3 ms.

Wireshark Capture from R1 to R2 :-

1) The first 2 packets are sent by 10.104.2.101 and 10.104.3.102 to let each other know that they are active neighbors. You can see that they have recognized each other as active neighbors from 3rd packet, in the “OSPF Hello Packet”. Note that in all these ‘Hello packets’, the DR and BDR have not being set yet.

2) Once adjacency is formed DB Description packets are sent . They describe the contents of the topological database. Based on this the receiver neighbor will decide what link information its missing and send a link state request for the FULL information about that missing link.
Init bit is set for the 1st DB packet sent from each router. After DB packet from 10.104.2.101, in the next Hello packet, a Dead interval of 40 ms and DR and BDR have been set to 10.104.2.102.
After DB packet from 10.104.2.102, in the next Hello packet, a Dead interval of 40 ms and BDR has been set to 10.104.2.101.
The next DB packet from 10.104.2.101 has ‘Master field’ reset while that from 10.104.3.102 has master field set. So, R2 is master, and R1 is slave.
‘More’ field is reset for the last DB packets.
Note that DB packets are sent by routers to each other, while Hello packets are multicast.

3) As 10.104.2.102 is master, it sends the 1st LS request for 10.104.2.101. 10.104.1.101 next sends LS Request for 10.104.3.102.
10.104.2.102 sends LS Update packet to the latter router's request, with number of LSA's=1, with number of links 2 and 2 stub network present- 10.104.2.0 and 10.104.3.0. Thus, R2 informs R1 about its networks.

10.104.2.101 sends LS Update packets, with number of links 2 and 2 stub network present- 10.104.2.0 and 10.104.1.0. Thus, R2 informs R1 about its networks. New LS Updates have new sequence nos.
After LS Update packets are received by R1, R1 sends 'LS Ack' packets to R2, and vice versa, to acknowledge the updates.
After this, both routers have information about each other's networks.

After this, 'Hello Packets' are sent every 10 seconds from 1 router to another, with DR, BDR, Active neighbour, network mask, etc information.