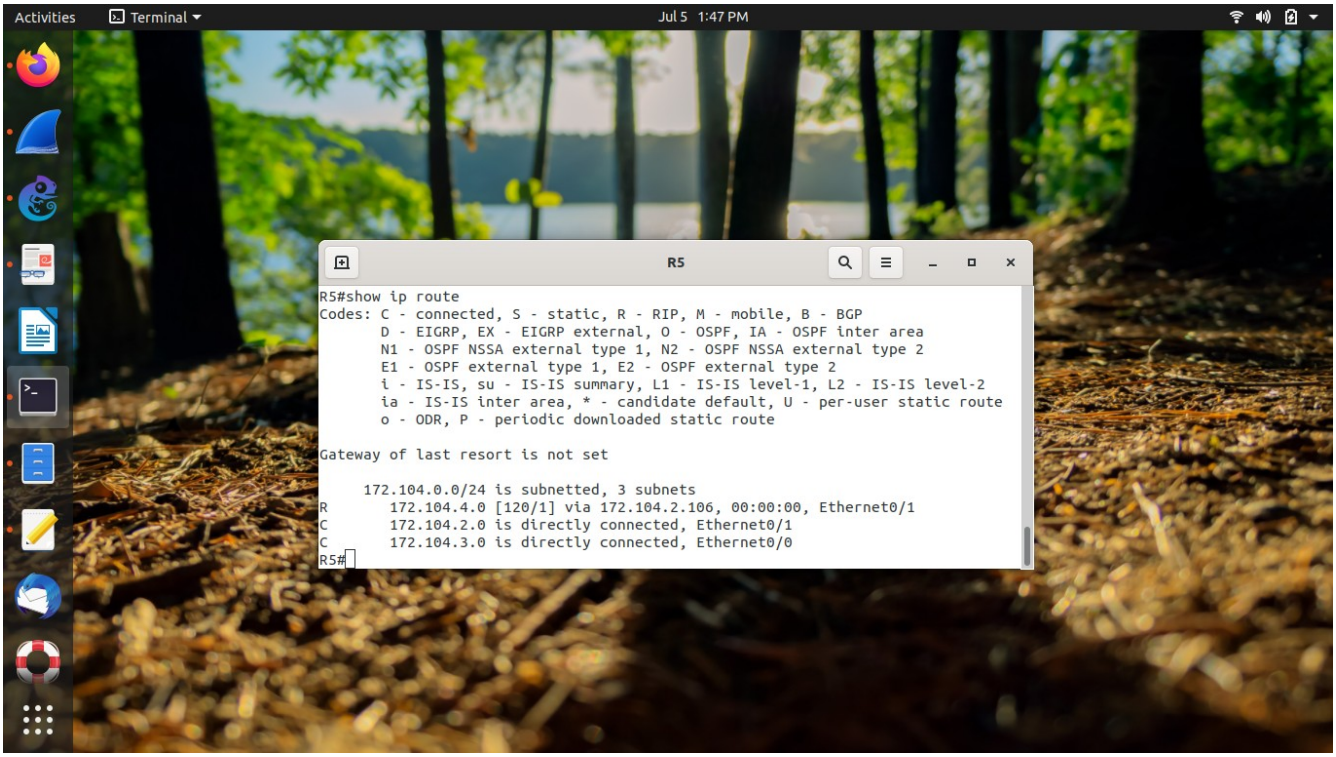
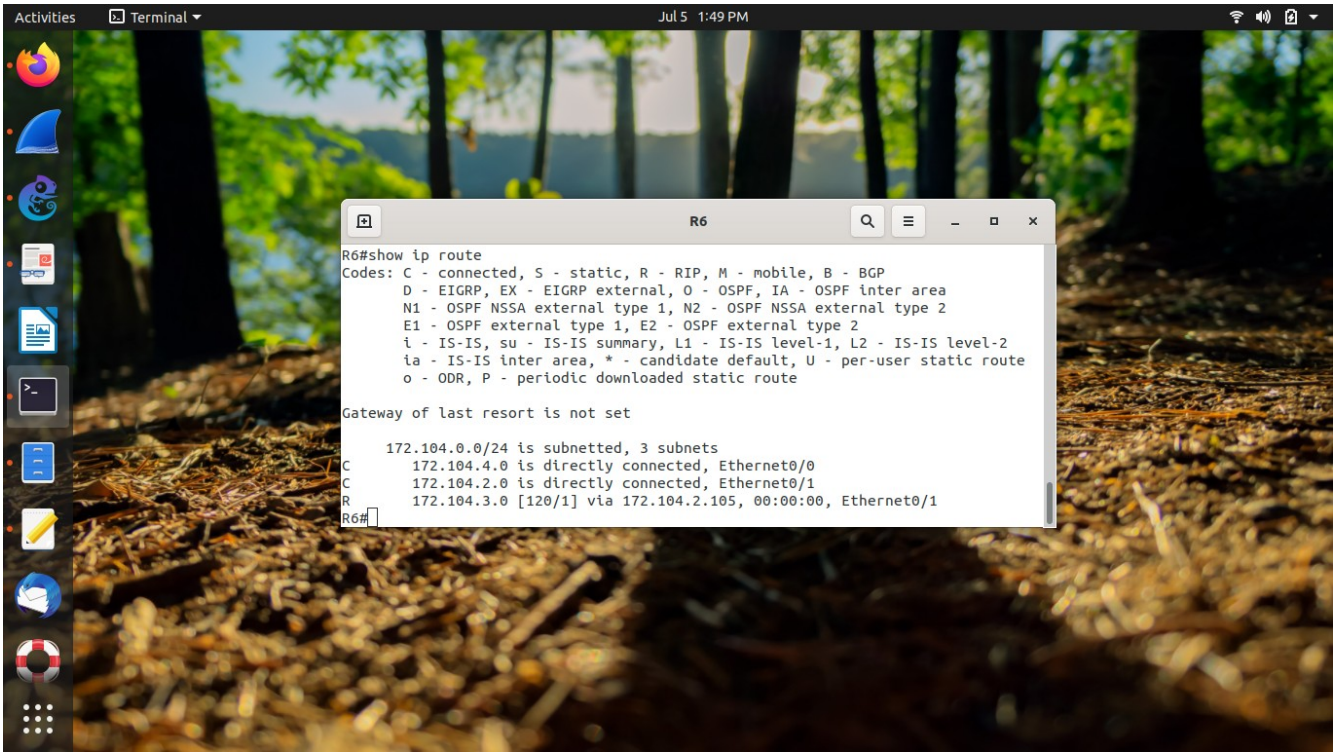
2b. show ip route :-

1) R5 :



172.104.1.0 network, which connects R1, R5 is disabled.
So, R5 is directly connected to PC5 and R6 via 172.104.3.105 and 172.104.2.0 respectively.
172.104.4.0, which is the network between R6 and PC6 is known via RIP packets.

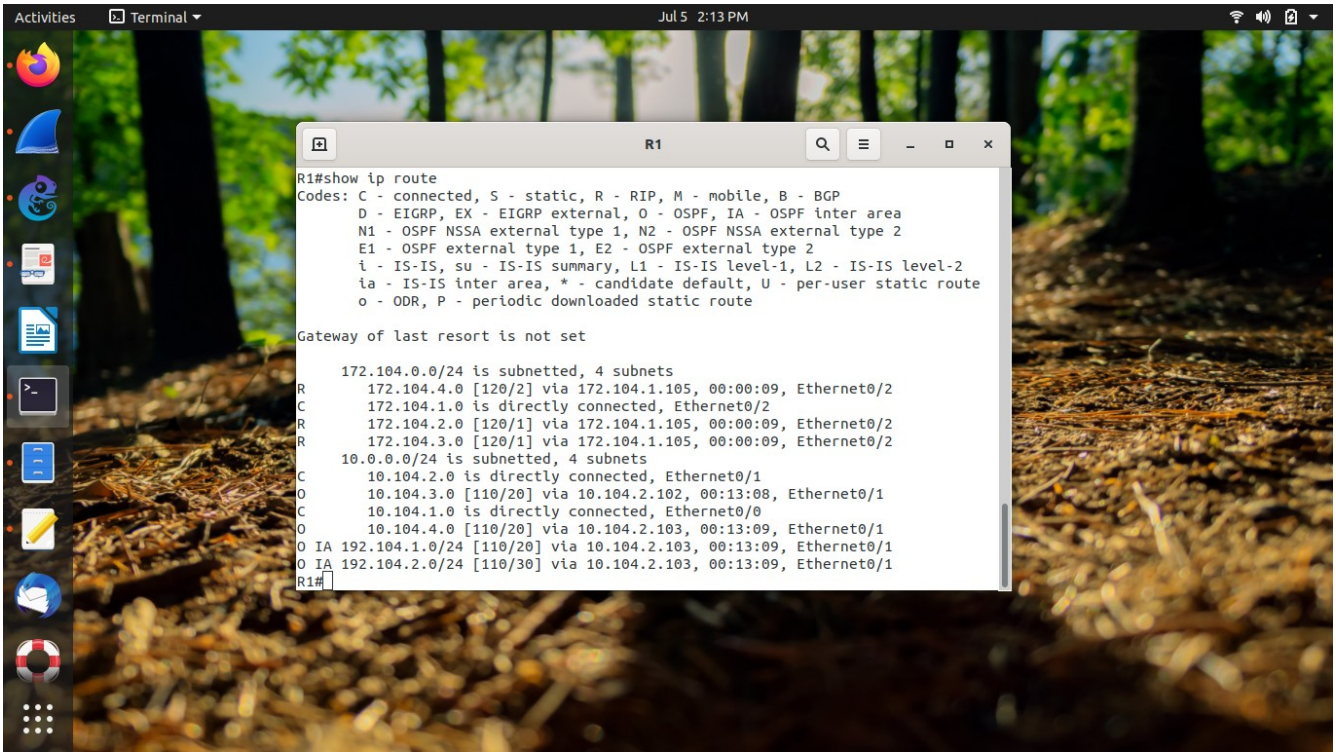
2) R6 :



172.104.1.0 network, which connects R1, R5 is disabled.
So, R6 is directly connected to PC6 and R5 via 172.104.4.106 and 172.104.2.0 respectively.
172.104.3.0, which is the network between R5 and PC5 is known via RIP packets.

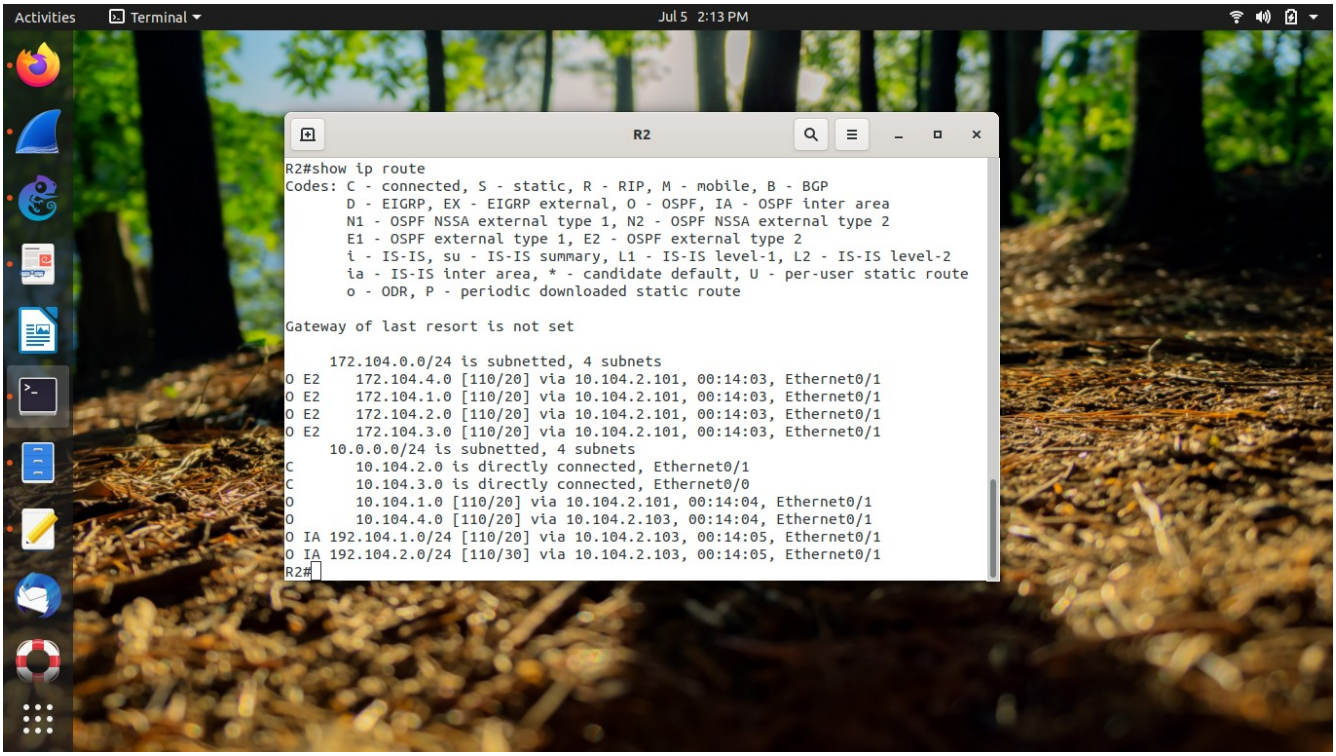
3 show ip route :-

1) R1 :



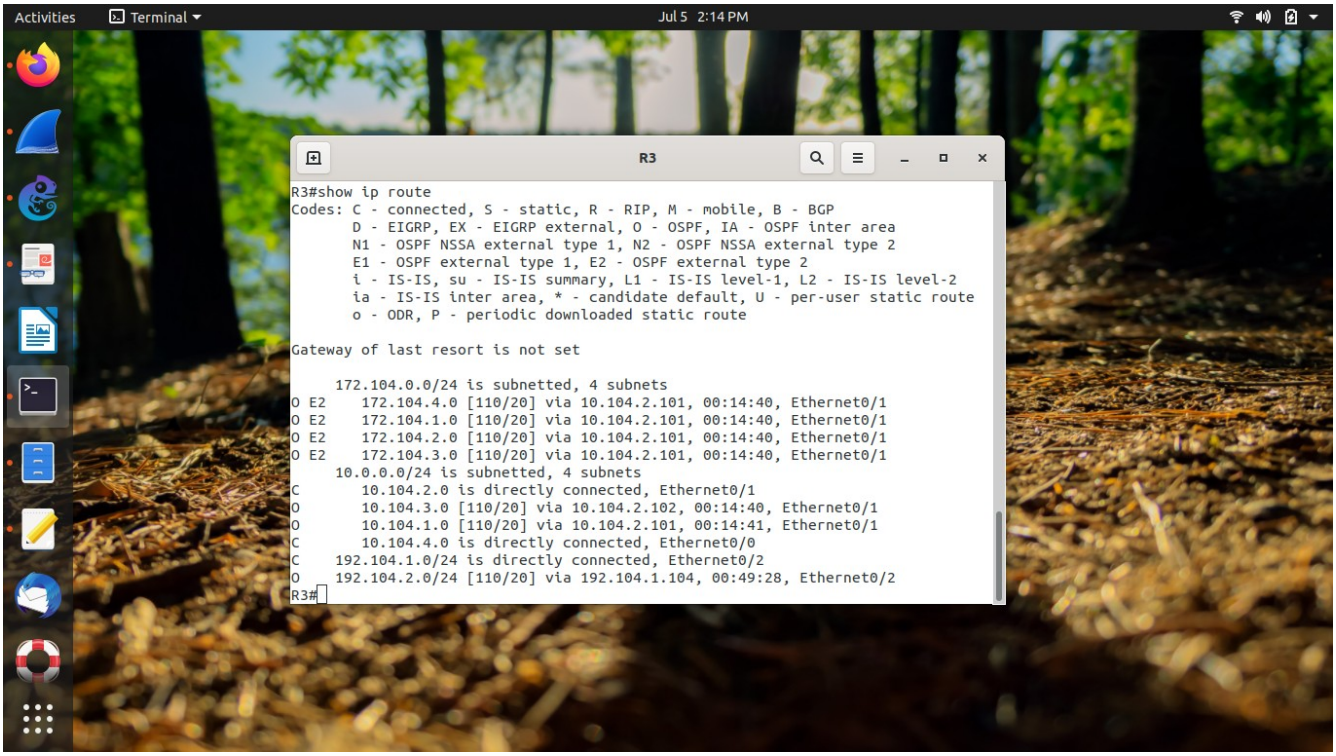
R1 is ASBR, that is, it is used to exchange routing information with other AS, which is 172.104.0.0/24 here.
R1 is directly connected to PC1, switch and R5 via 10.104.1.101, 10.104.2.101 and 172.104.1.101 respectively.
The info of subnets of 172.104.0.0, that is, 172.104.2.0, 172.104.3.0, 172.104.4.0 is brought to it by RIP packets via 172.104.1.105, which is R5's interface in R1-R5 link.
Info of the networks 10.104.4.0, 192.104.1.0, 192.104.2.0 is brought to it by 10.104.2.103 (on R3), and that of 10.104.3.0 is brought to it by 10.104.2.102 (on R2).

2) R2 :



R2 is directly connected to PC2 and switch via 10.104.3.102, 10.104.2.102 respectively.
The info of subnets of 172.104.0.0, that is, 172.104.1.0, 172.104.2.0, 172.104.3.0, 172.104.4.0 is brought to it by OSPF packets, which are of E2 type (or OSPF External type).
Info of the networks 10.104.4.0, 192.104.1.0, 192.104.2.0 is brought to it by 10.104.2.103 (on R3) which are packets of IA type, and that of 10.104.1.0 is brought to it by 10.104.2.101 (on R1).

3) R3 :

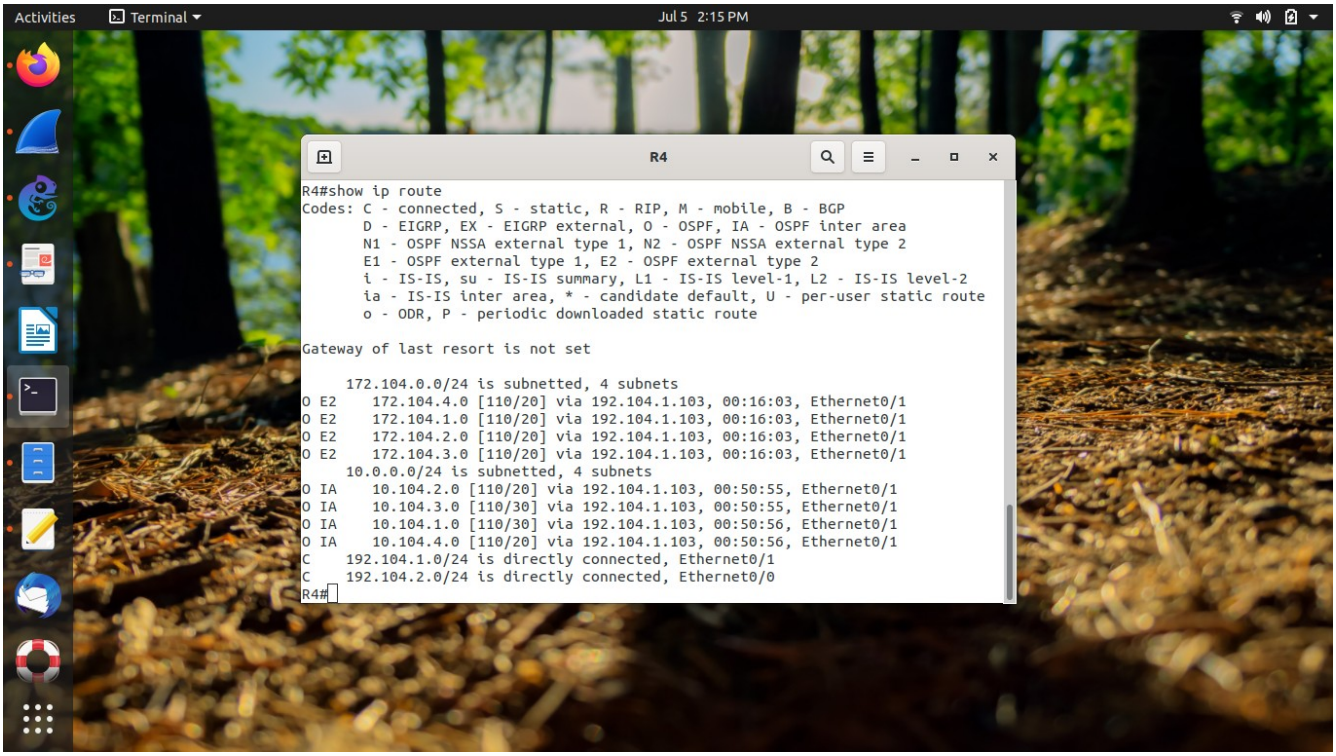


R3 is directly connected to PC3, switch, R4 via 10.104.4.103, 10.104.2.103, 192.104.1.103 respectively. All the subnets of 172.104.0.0/24 is known by the distribution of RIP packets by the ASBR R1, so, 172.104.0.0/24 networks get code of O(OSPF) and E2(External).

192.104.2.0 is known by OSPF packets again.
Note that as R3 is ABR, so, 192.104.1.0 and 192.104.2.0 are not coded as IA(Inter area).

All other 10.104.0.0/24 networks are known by OSPF.

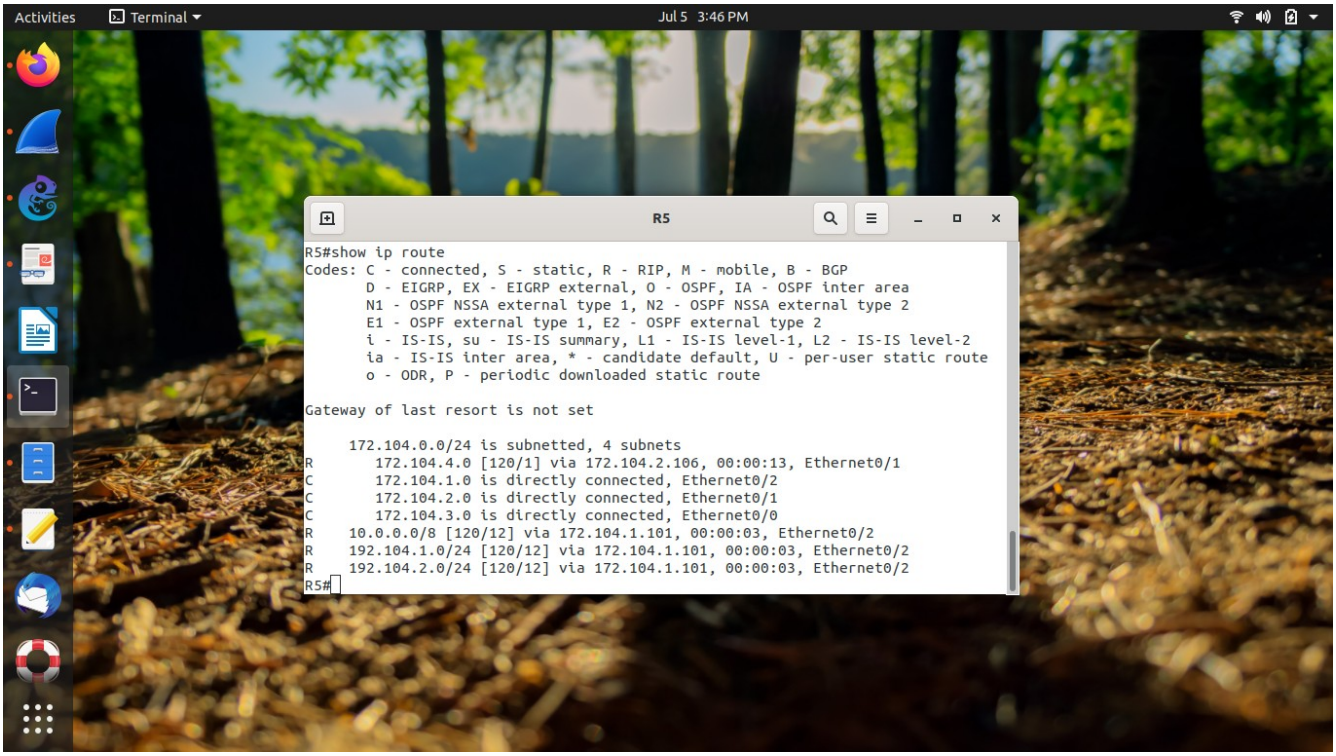
4) R4 :



R4 is directly connected to PC4, R3 via 192.104.2.104, 192.104.1.104 respectively. All the subnets of 172.104.0.0/24 is known by the distribution of RIP packets by the ASBR R1, so, 172.104.0.0/24 networks get code of O(OSPF) and E2(External). All these are known via 192.104.1.103(R3).

All the networks of subnet of 10.104.0.0/24 are in area 0, and so are known by O and IA, via 192.104.1.103.

5) R5 :

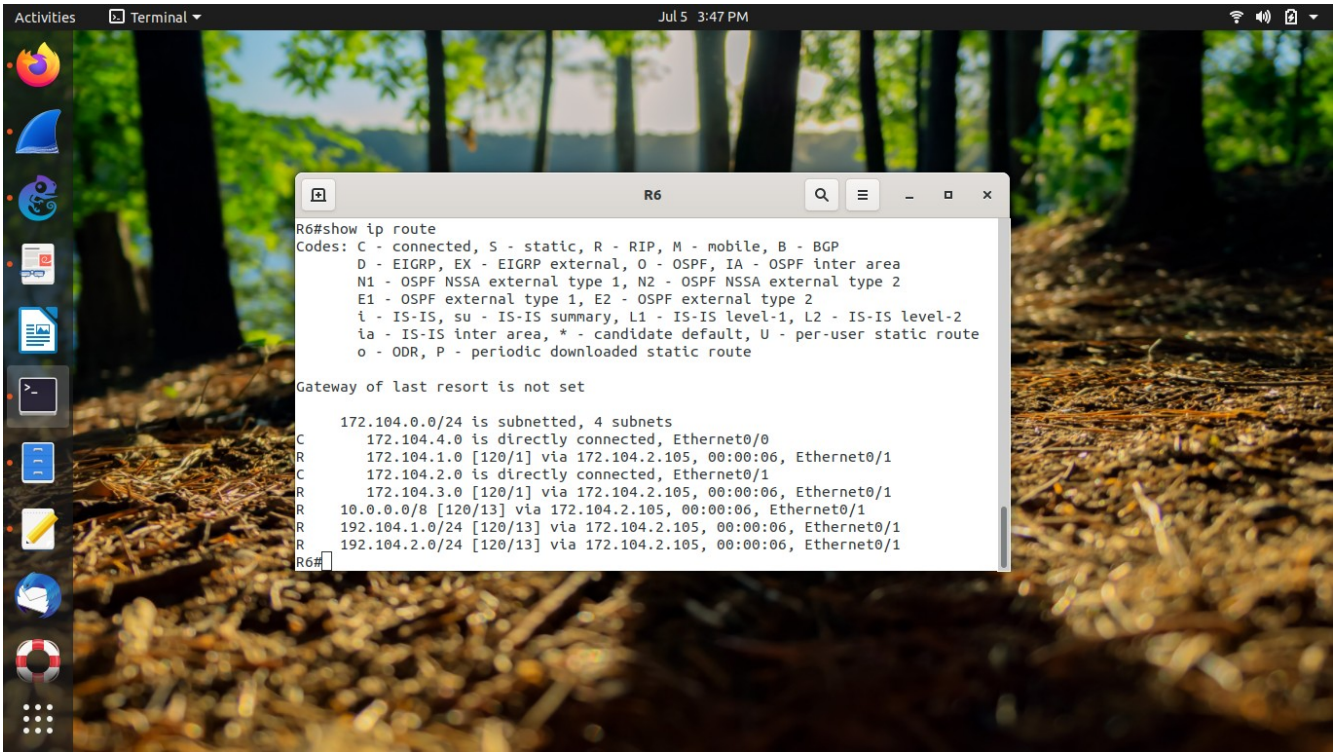


OSPF network info is exchanged in R1, which is ASBR, to make it appear as if other networks are being known RIP. Thus, 192.104.1.0, 192.104.2.0, all subnets of 10.0.0.0/8 are known by OSPF info in R1 but have code RIP, and are seen by R5 after 172.104.1.101 (R1's interface) gives it those.

R5 is directly connected to R1, PC5, R6 via 172.104.1.105, 172.104.3.105 and 172.104.2.105 respectively.

172.104.4.0 is known by RIP packets, given to it via R6 via 172.104.2.106.

6) R6 :



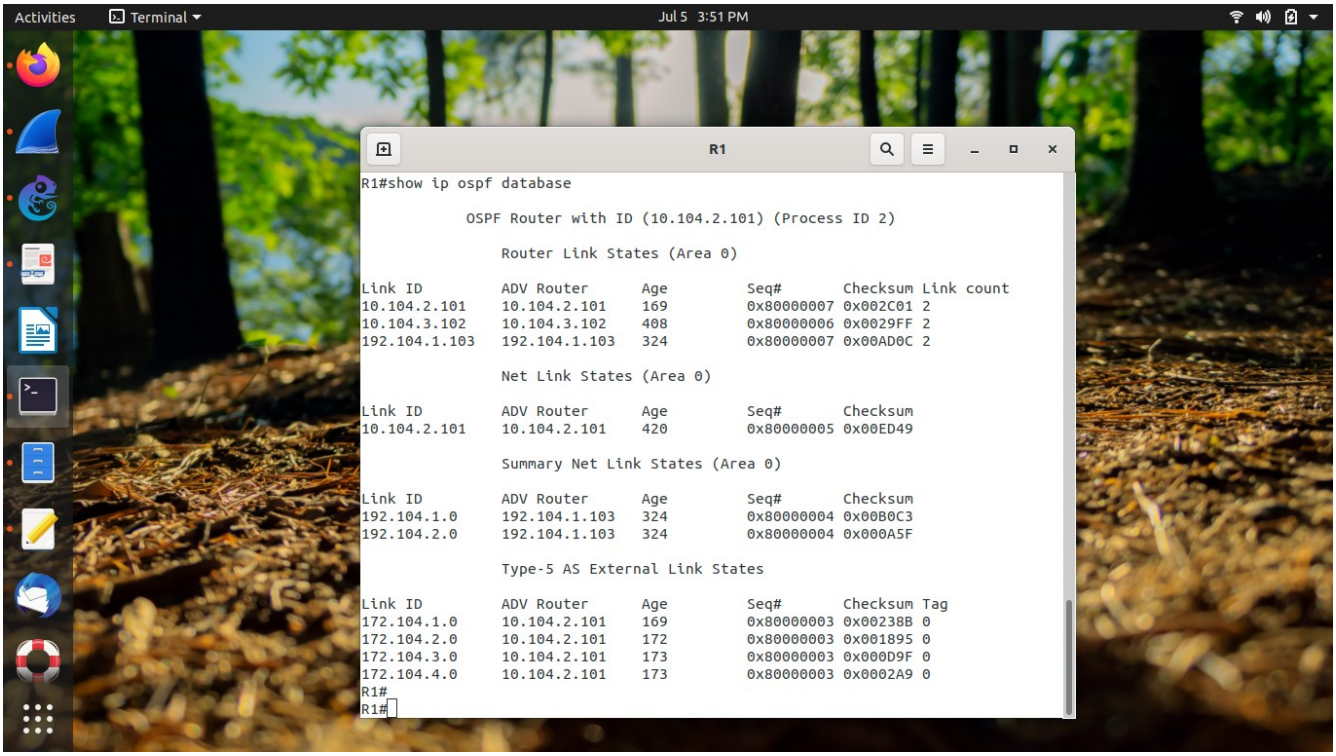
OSPF network info is exchanged in R1, which is ASBR, to make it appear as if other networks are being known RIP. Thus, 192.104.1.0, 192.104.2.0, all subnets of 10.0.0.0/8 are known by OSPF info in R1 but have code RIP, and are seen by R5 after 172.104.1.101 (R1's interface) gives it those.

R6 is directly connected to PC6, R5 via 172.104.4.106, 172.104.2.106 respectively.

172.104.3.0 is known by RIP packets, given to it via R5 via 172.104.2.105.

2c. show ip ospf database :-

1) R1 :



Router ID given to R1 is 10.104.2.101.

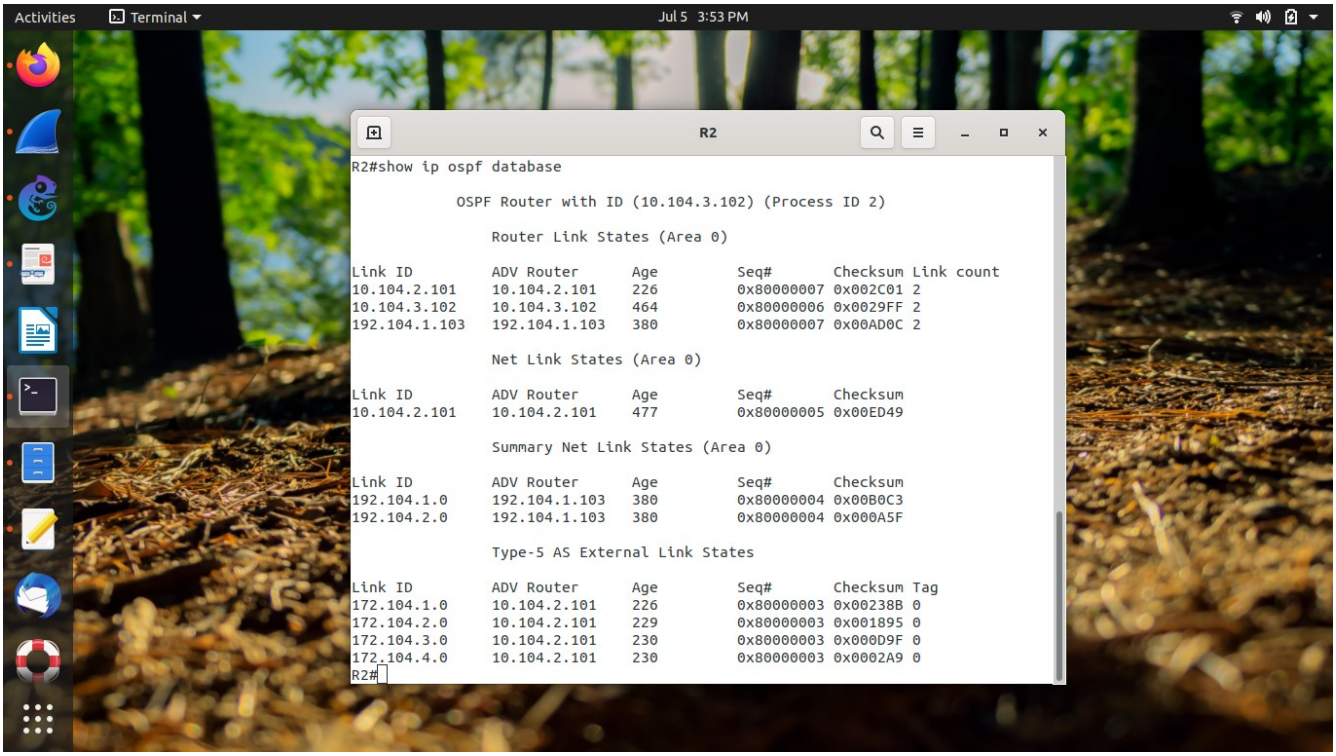
3 Router Link states are present in area 0, where R2 is present. These are 10.104.2.101(R1), 10.104.3.102(R2) and 192.104.1.103(R3). 2 links of 10.104.2.101 are 10.104.1.0, 10.104.2.0. 2 links of 10.104.3.102 are 10.104.2.0, 10.104.3.0. 2 links of 192.104.2.103 are 10.104.2.0, 10.104.4.0.

Network Link state exists. 10.104.2.101 is Link state id and Advertising router. So, R1 is DR.

Summary or Type-3 LSA exist. These give the 2 networks in other area, which have link IDs as 192.104.1.0 and 192.104.2.0. ADV router is 192.104.1.103 (R3).

External Link States or Type-5 LSA exists. It has all the networks in external network, in this case, which uses RIP. These are subnets of 172.104.0.0/24. All these have ADV router as 10.104.2.101(R1).

2) R2 :



Router ID given to R2 is 10.104.3.102.

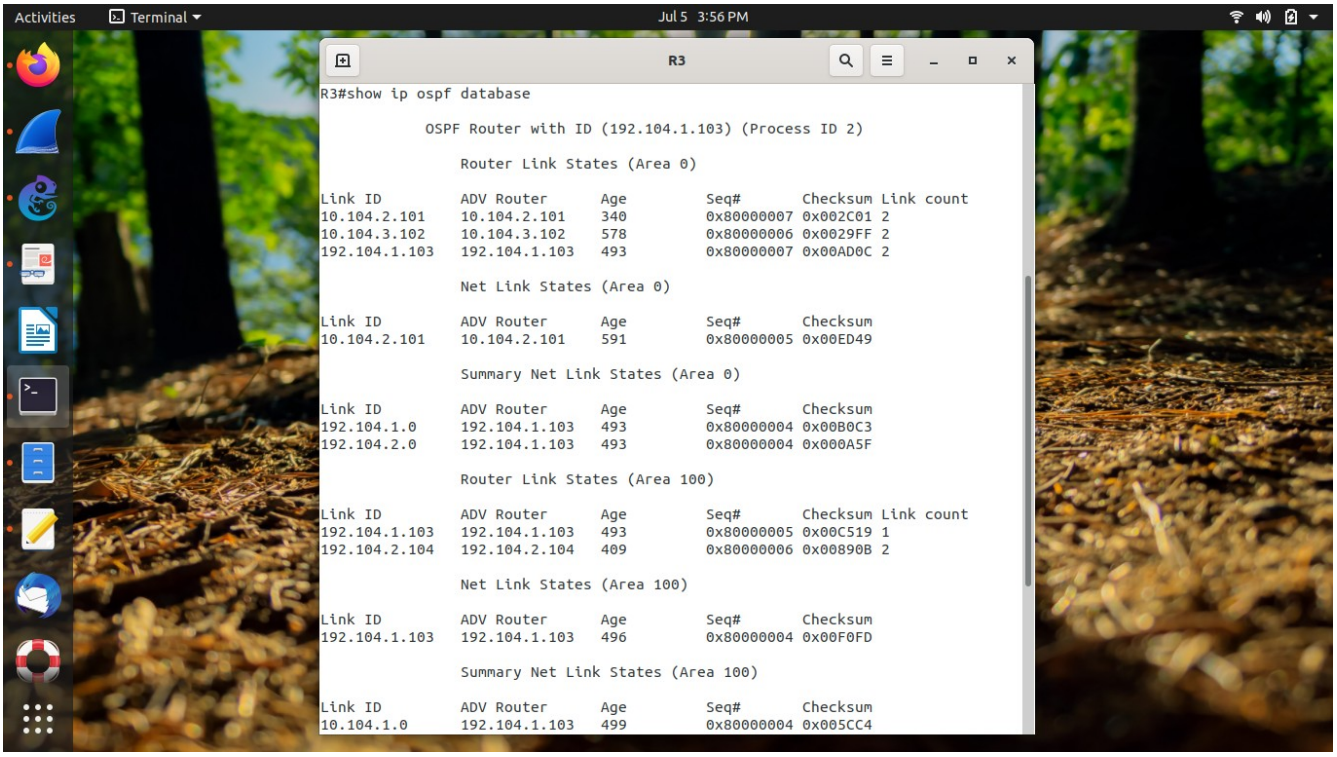
3 Router Link states are present in area 0, where R3 is present. These are 10.104.2.101(R1), 10.104.3.102(R2) and 192.104.1.103(R3). 2 links of 10.104.2.101 are 10.104.1.0, 10.104.2.0. 2 links of 10.104.3.102 are 10.104.2.0, 10.104.3.0. 2 links of 192.104.2.103 are 10.104.2.0, 10.104.4.0.

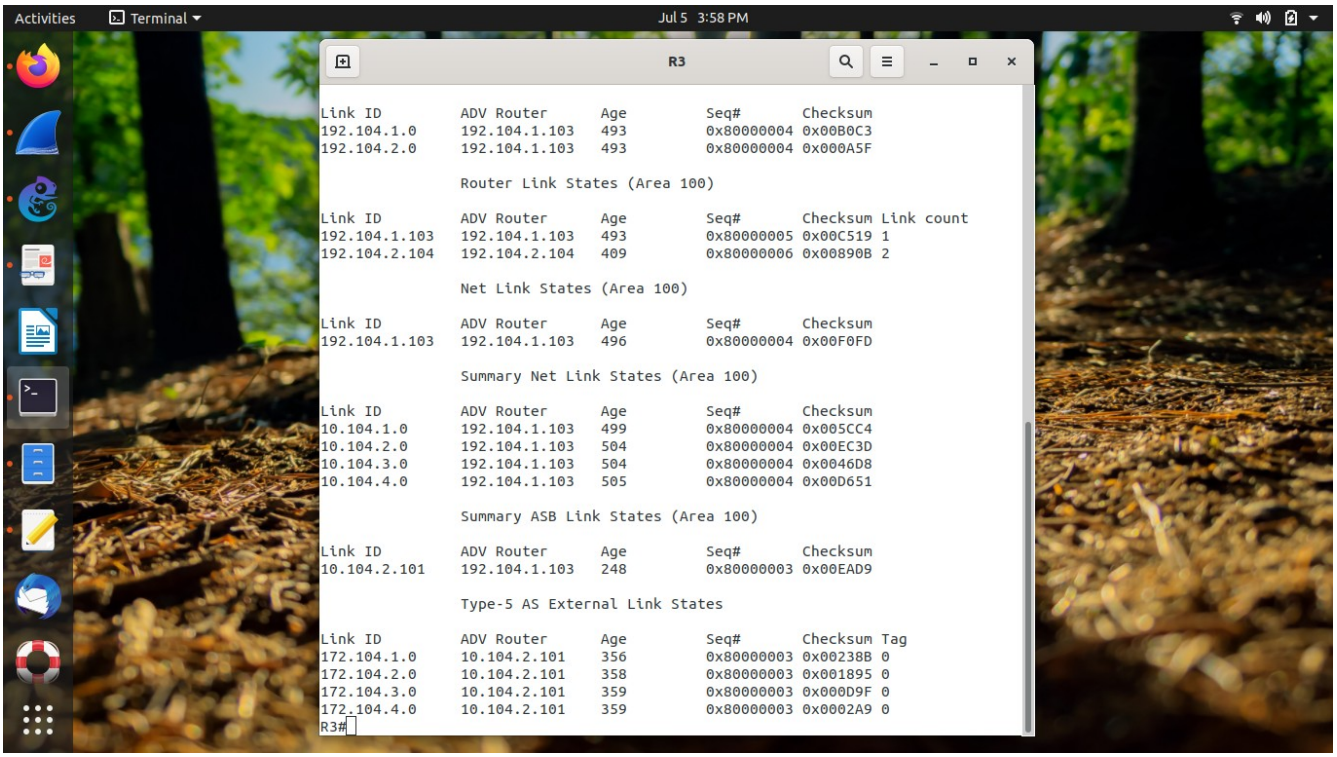
Network Link state exists. 10.104.2.101 is Link state id and Advertising router. So, R1 is DR.

Summary or Type-3 LSA exist. These give the 2 networks in other area, which have link IDs as 192.104.1.0 and 192.104.2.0. ADV router is 192.104.1.103 (R3).

External Link States or Type-5 LSA exists. It has all the networks in external network, in this case, which uses RIP. These are subnets of 172.104.0.0/24. All these have ADV router as 10.104.2.101(R1).

3) R3 :





R3 is ABR, between area 0 and area 100.
Router ID given to R3 is 192.104.1.103.

3 Router Link states are present in area 0, where R1 is present. These are 10.104.2.101(R1), 10.104.3.102(R2) and 192.104.1.103(R3). 2 links of 10.104.2.101 are 10.104.1.0, 10.104.2.0. 2 links of 10.104.3.102 are 10.104.2.0, 10.104.3.0. 2 links of 192.104.2.103 are 10.104.2.0, 10.104.4.0.

Network Link state exists. 10.104.2.101 is Link state id and Advertising router. So, R1 is DR.

Summary or Type-3 LSA exist. These give the 2 networks in other area, which have link IDs as 192.104.1.0 and 192.104.2.0. ADV router is 192.104.1.103 (R3).

External Link States or Type-5 LSA exists. It has all the networks in external network, in this case, which uses RIP. These are subnets of 172.104.0.0/24. All these have ADV router as 10.104.2.101(R1).

As R3 is ABR, states of area 100 are also mentioned.
2 Router Link states are present in area 100, where R4 is present. These are 192.104.1.103(R3), 192.104.2.104(R4). ADV router and Link state id are same for router LSA.

Network Link state exists. 192.104.1.103 is Link state id and Advertising router. So, R3 is DR.

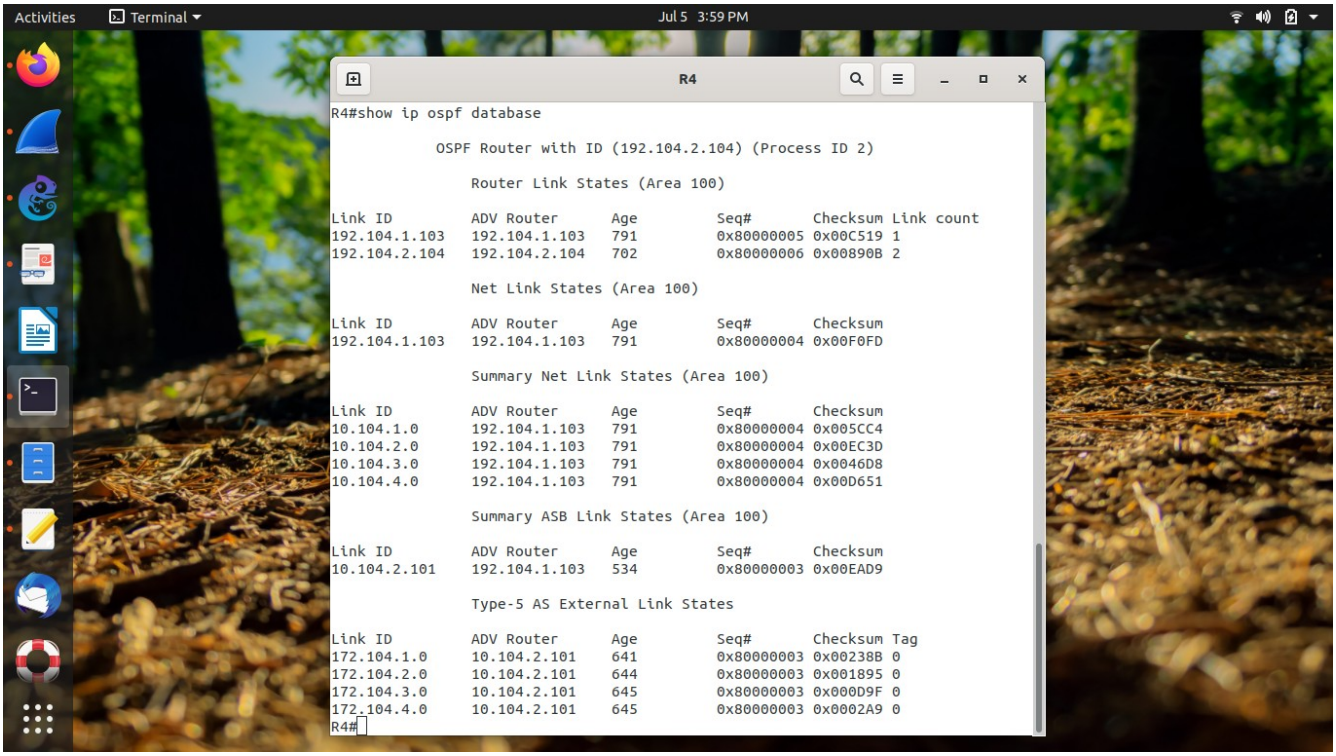
Summary or Type-3 LSA exist. These give the 4 networks in other area, which are subnets of 10.104.0.0/24.

Type-4 LSA or Summary ASB Link states exist. It has link id as 10.104.2.101 and ADV router as 192.104.1.103. The type 4 LSA is an LSA that instructs the rest of the OSPF domain how to get to the ASBR so that other routes in the OSPF domain can route to external prefixes redistributed into OSPF by the ASBR. If we have no way to reach the actual ASBR that redistributed the route, we obviously can't reach the external rout

External Link States or Type-5 LSA exists. It has all the networks in external network, in this case, which uses RIP. These are subnets of 172.104.0.0/24. All these have ADV router as 10.104.2.101(R1).

Thus, clearly, LSDB of R3 has combined LSDBs of area 0(R1) and area 100(R4), and so, all LSDBs are not equal in size.

4) R4:



2 Router Link states are present in area 100, where R4 is present. These are 192.104.1.103(R3), 192.104.2.104(R4). ADV router and Link state id are same for router LSA.

Network Link state exists. 192.104.1.103 is Link state id and Advertising router. So, R3 is DR.

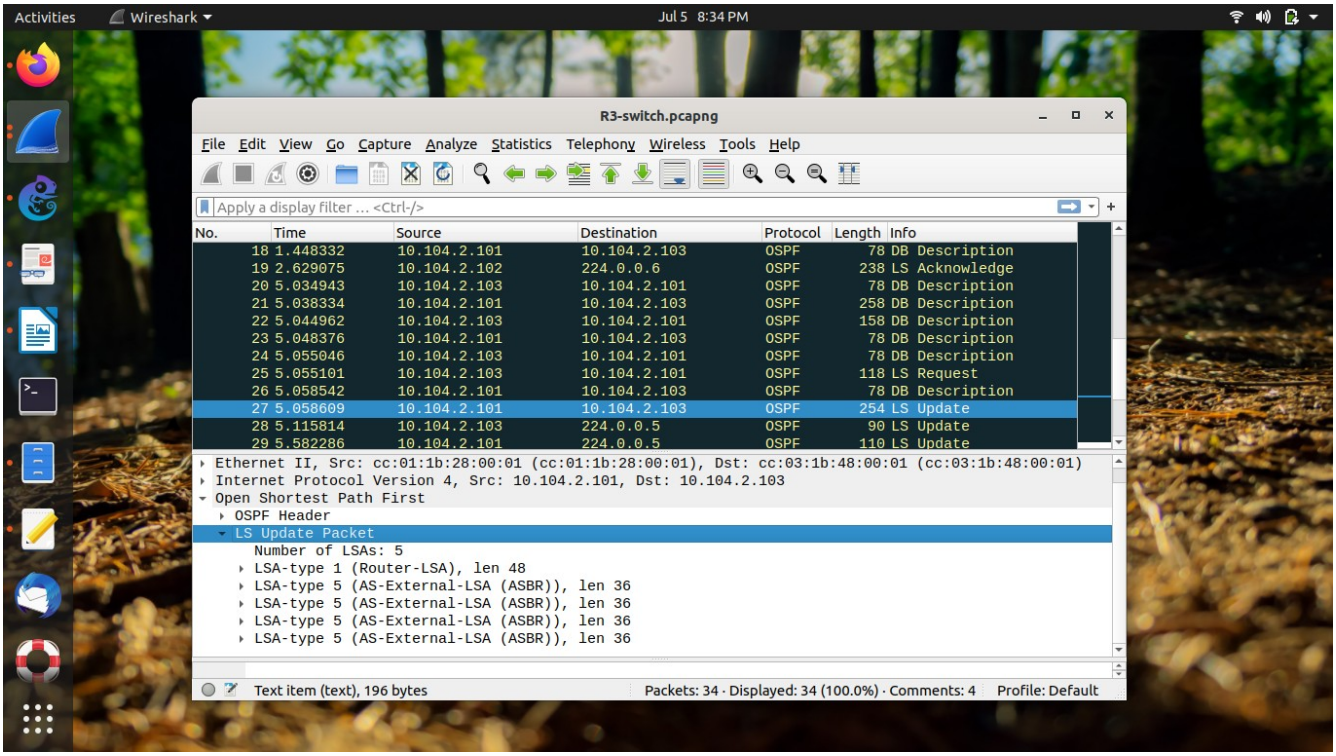
Summary or Type-3 LSA exist. These give the 4 networks in other area, which are subnets of 10.104.0.0/24.

Type-4 LSA or Summary ASB Link states exist. It has link id as 10.104.2.101 and ADV router as 192.104.1.103. The type 4 LSA is an LSA that instructs the rest of the OSPF domain how to get to the ASBR so that other routes in the OSPF domain can route to external prefixes redistributed into OSPF by the ASBR. If we have no way to reach the actual ASBR that redistributed the route, we obviously can't reach the external rout

External Link States or Type-5 LSA exists. It has all the networks in external network, in this case, which uses RIP. These are subnets of 172.104.0.0/24. All these have ADV router as 10.104.2.101(R1).

Wireshark Capture :

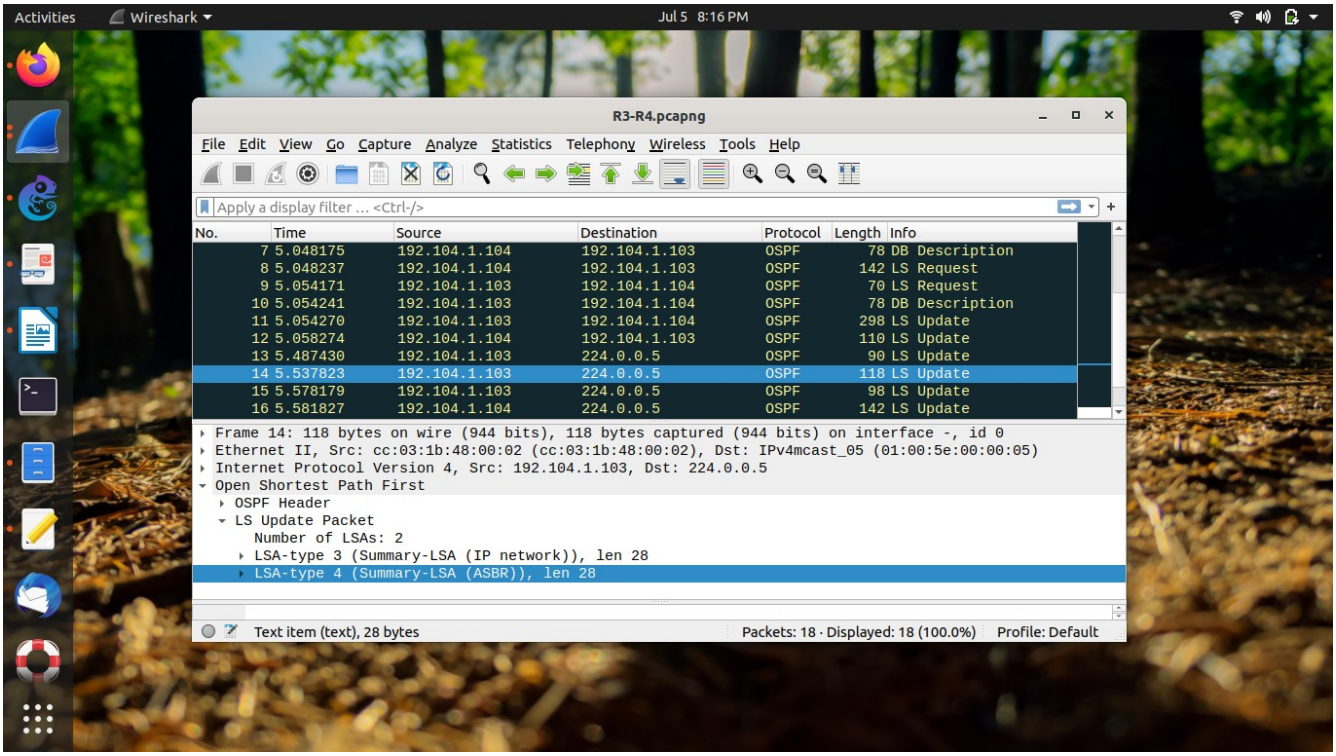
A) Between R3-switch :



In file R3-switch.pacpng-
packet number 21 (DB type) has this info and R3(10.104.2.103) is being informed by R1(10.104.2.101) about the external LSA. In packet 25, on seeing this DB, R3 is giving LSRequest to R1. In 27, R1 is sending an LSUpdate to R3, which has 1 Router LSA of R1, and other 4 External LSA, about the 4 172.104.0.0/24 subnets. In packet 32, R3 is acknowledging this update via LSAck to multicast (224.0.0.5).

The contents of the the 4 AS-External-LSA are- One with link state id as 172.104.1.0 and advertising router as 172.104.1.101, 2nd with link state id as 172.104.2.0 and advertising router as 172.104.1.101, 3rd with link state id as 172.104.3.0 and advertising router as 172.104.1.101, 4th with link state id as 172.104.4.0 and advertising router as 172.104.1.101.

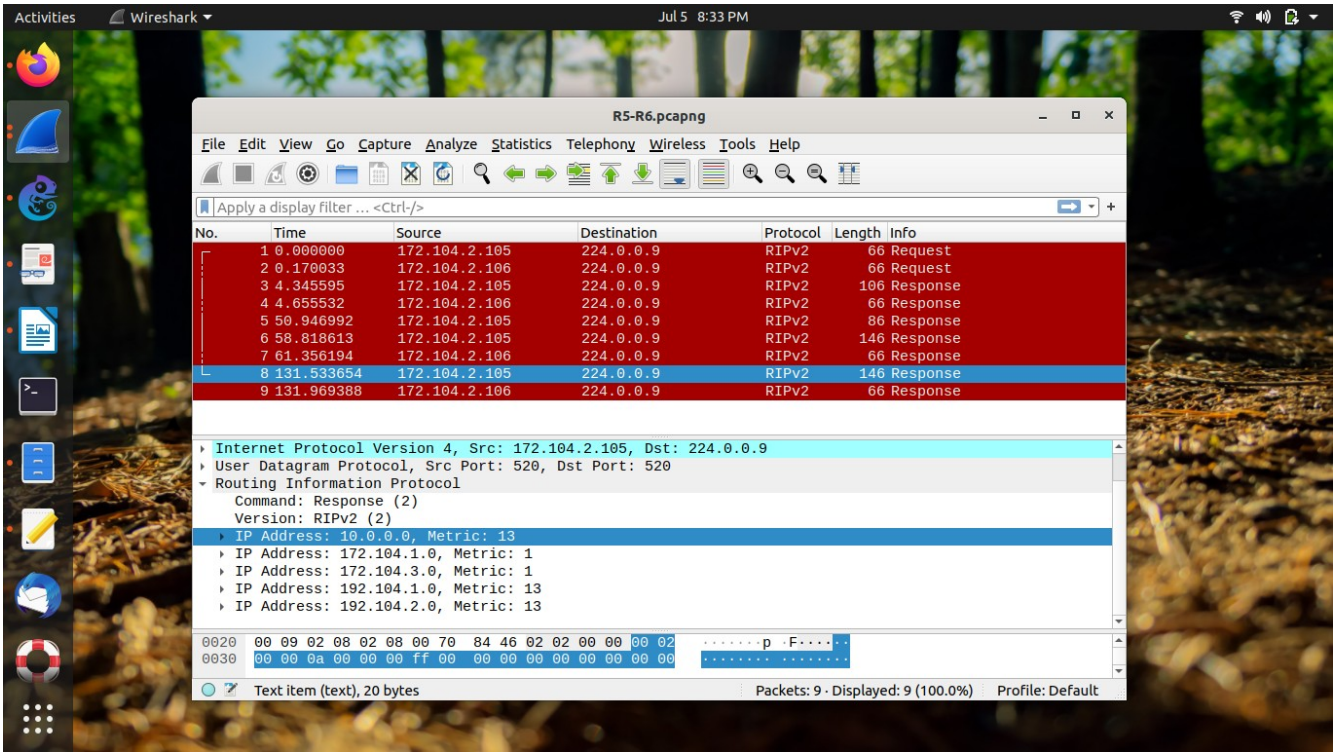
B) Between R3-R4:



In file R3-R4.pcapng-
In packet 14, R3 (192.104.1.103) gives out a multicast LSUpdate regarding LSA-type 4 (Summary LSA (ASBR)). It has link state id as 172.104.1.101, and advertising router as 192.104.1.103(R3). Thus, R3 is telling R4 and PC4 about the location of the ASBR R1, as the IP 172.104.1.101. Using this, they can reach 172.104.0.0/24.

In packet 8, R4 (192.104.1.104) is making LSRequest from R3 for 2 LSA-3, and the 4 LSA-5.
In packet 11, R3 gives LSUpdate to R4 regarding these LSAs. And at packet 14, R3 multicasts LSA-4.

C) Between R5-R6 :



In file R5-R6.pcapng-
In packet 3, R5(172.104.2.105) gives out a packet to 224.0.0.9(to all RIPv2 enabled packets in network), that has 172.104.1.0 network (between R1 and R5) and 172.104.3.0 (R5-PC5).

In packet 5, the networks 192.104.1.0 and 192.104.2.0 are put by R5 to 224.0.0.9

In packet 8, besides 172.104.1.0, 172.104.3.0, 192.104.1.0, 192.104.3.0; 10.0.0.0 networks are also there.

So, by packet 8, R6 knows about all the external networks from R5.