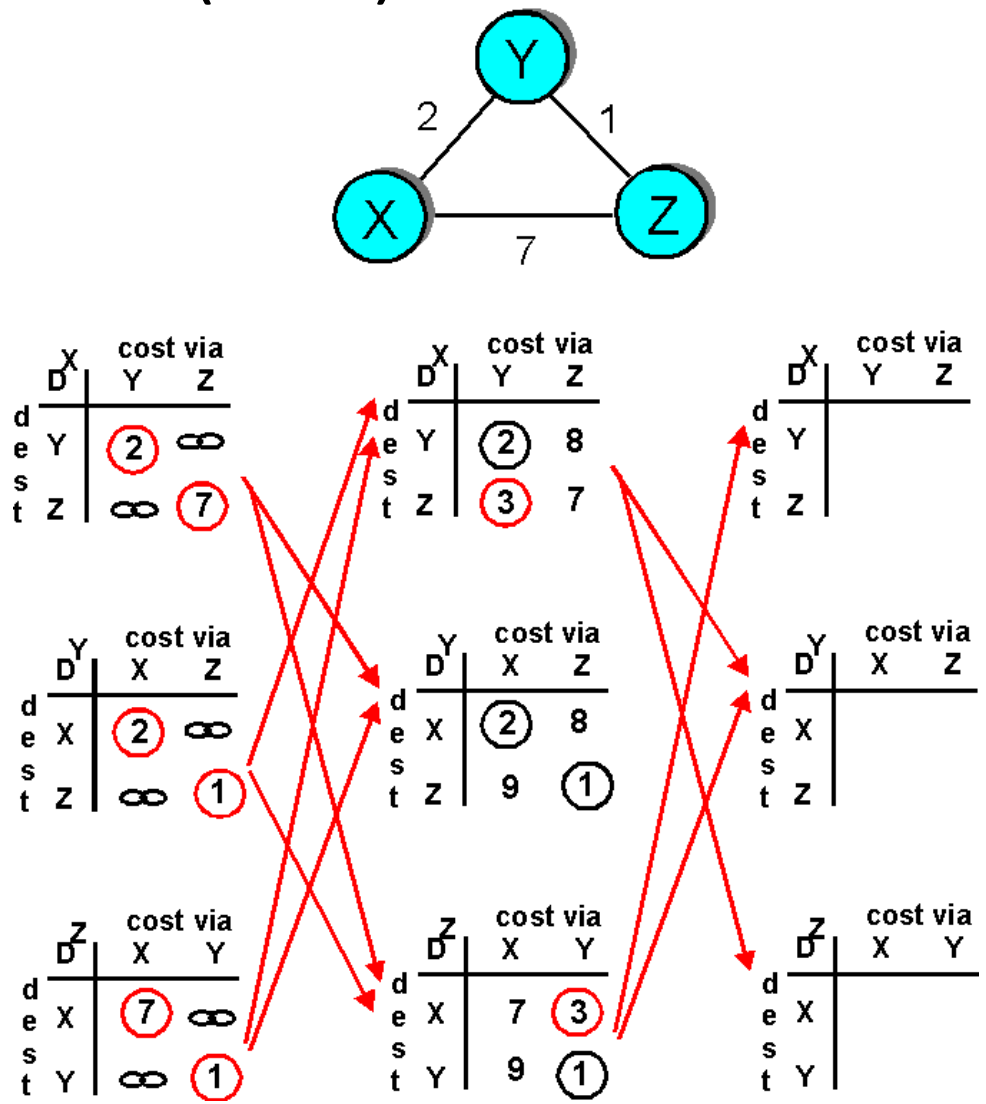
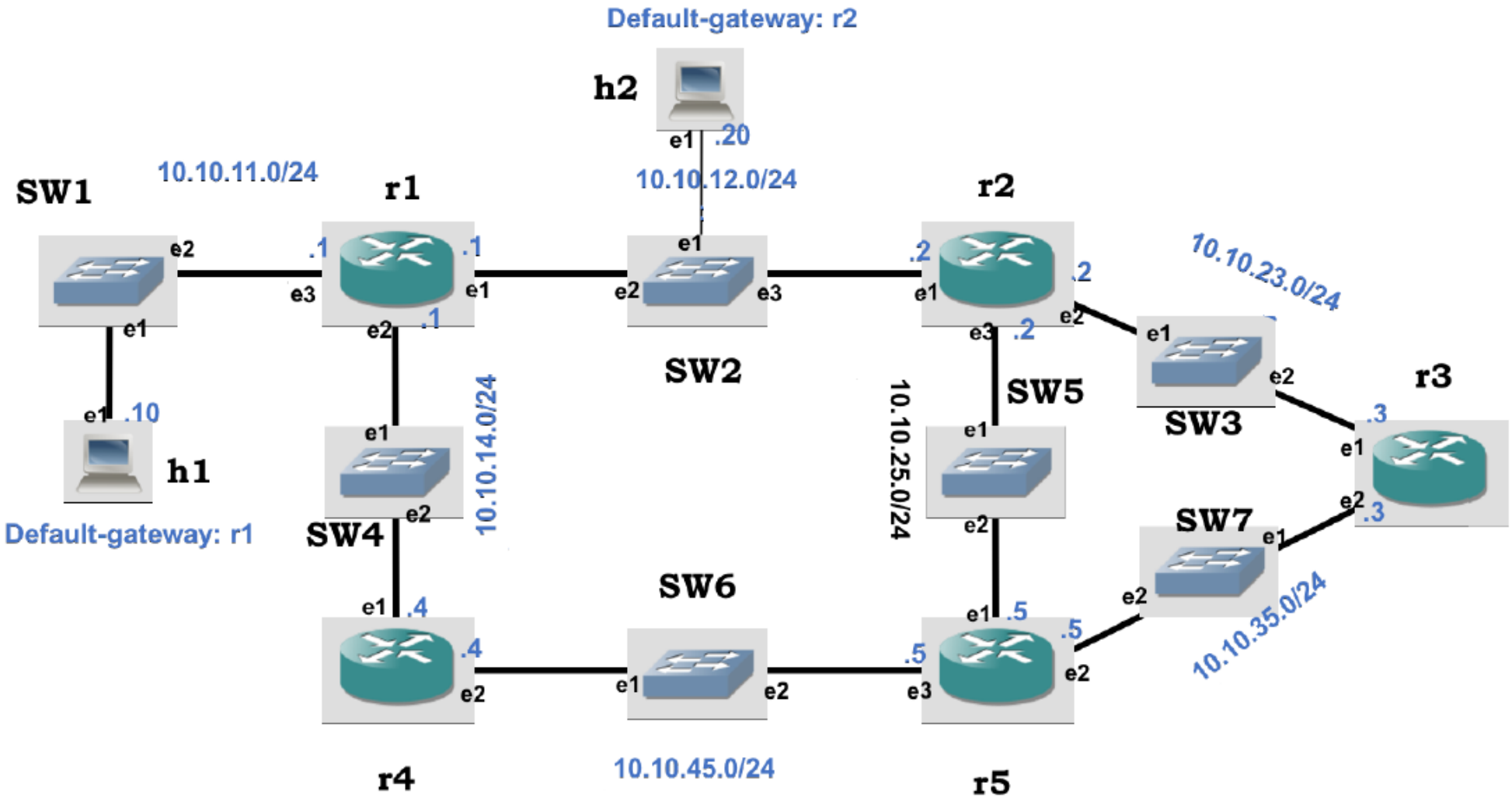
RIPv2

Routing Information Protocol (RIP)

- Distance-vector routing protocols:
  - typically run inside the network of an autonomous system (AS).
  - set up automatically network routes that ensure shortest path between two points in the network with respect to a predefined metric (such as number of hops).



Network topology



Settings for all routers

- daemons:

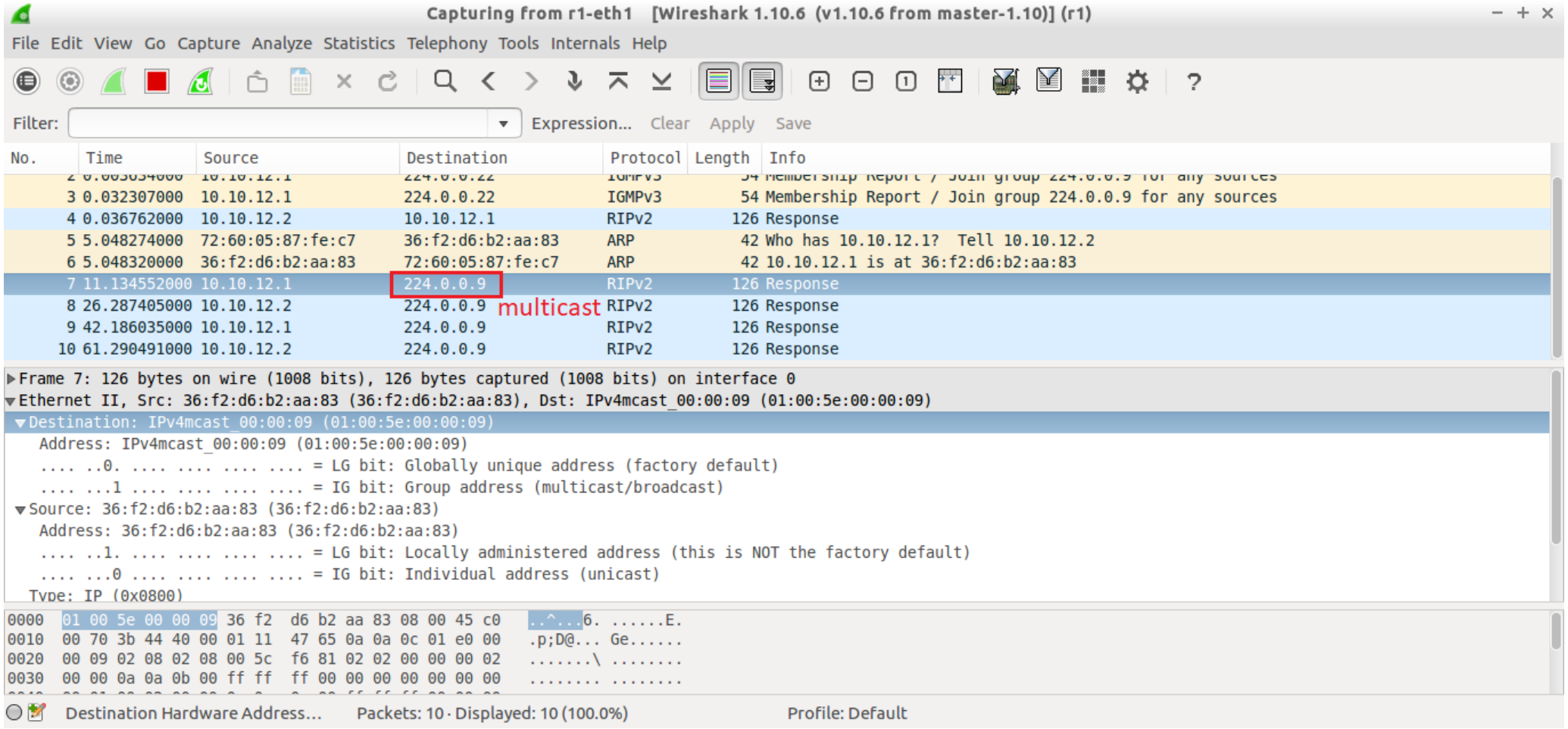
  zebra=yes
  bgpd=no
  ospfd=no
  ospf6d=no
  ripd=yes
  ripngd=no
  isisd=no

lab8.py

```
58  info('** Executing custom commands\n')
59  ###################################################
60  # Space to add any customize command before prompting command line
61
62  # We gather only the hosts created in the topology (no switches nor controller)
63  hosts = [ net.getNodeByName( h ) for h in topo.hosts() ]
64
65  info('** Starting the Quagga Service on Virtual Routers\n')
66
67  for r in ['r3', 'r4', 'r5', 'r1']:
68    net.getNodeByName(r).cmd( "echo 1 > /proc/sys/net/ipv4/ip_forward" )
69    net.getNodeByName(r).cmd("/etc/init.d/quagga start")
70
71  import time
72  time.sleep(10)
73  net.getNodeByName('r2').cmd( "echo 1 > /proc/sys/net/ipv4/ip_forward" )
74  net.getNodeByName('r2').cmd("/etc/init.d/quagga start")
75
76  info('** Enabling xterm for all hosts\n')
77  makeTerms( hosts, 'node' )
78
79  ###################################################
80    # Enable the mininext> prompt
81  info('** Running CLI\n')
82  CLI(net)
```

Capture r1-eth1 traffic

- root@r1:/# wireshark



configs/r1/logs/ripd.log

```
2022/06/22 13:04:39 RIP: ignore packet comes from myself
2022/06/22 13:04:39 RIP: ignore packet comes from myself
2022/06/22 13:04:39 RIP: RECV packet from 10.10.14.4 port 520 on r1-eth2
2022/06/22 13:04:39 RIP: RECV RESPONSE version 2 packet size 24
2022/06/22 13:04:39 RIP:   10.10.45.0/24 -> 0.0.0.0 family 2 tag 0 metric 1
2022/06/22 13:04:39 RIP: RECV packet from 10.10.14.4 port 520 on r1-eth2
2022/06/22 13:04:39 RIP: RECV RESPONSE version 2 packet size 24
2022/06/22 13:04:39 RIP:   10.10.45.0/24 -> 0.0.0.0 family 2 tag 0 metric 1
2022/06/22 13:04:40 RIP: RECV packet from 10.10.14.4 port 520 on r1-eth2
2022/06/22 13:04:40 RIP: RECV RESPONSE version 2 packet size 84
2022/06/22 13:04:40 RIP:   10.10.23.0/24 -> 0.0.0.0 family 2 tag 0 metric 3
2022/06/22 13:04:40 RIP:   10.10.25.0/24 -> 0.0.0.0 family 2 tag 0 metric 2
2022/06/22 13:04:40 RIP:   10.10.35.0/24 -> 0.0.0.0 family 2 tag 0 metric 2
2022/06/22 13:04:40 RIP:   10.10.45.0/24 -> 0.0.0.0 family 2 tag 0 metric 1
2022/06/22 13:04:40 RIP: update timer fire!
2022/06/22 13:04:40 RIP: SEND UPDATE to r1-eth1 ifindex 1718
2022/06/22 13:04:40 RIP: multicast announce on r1-eth1
2022/06/22 13:04:40 RIP: update routes on interface r1-eth1 ifindex 1718
2022/06/22 13:04:40 RIP: rip_send_packet 10.10.12.1 > 224.0.0.9 (r1-eth1)
2022/06/22 13:04:40 RIP: SEND to  224.0.0.9.520
2022/06/22 13:04:40 RIP: SEND RESPONSE version 2 packet size 124
2022/06/22 13:04:40 RIP:   10.10.11.0/24 -> 0.0.0.0 family 2 tag 0 metric 1
2022/06/22 13:04:40 RIP:   10.10.14.0/24 -> 0.0.0.0 family 2 tag 0 metric 1
2022/06/22 13:04:40 RIP:   10.10.23.0/24 -> 0.0.0.0 family 2 tag 0 metric 4
2022/06/22 13:04:40 RIP:   10.10.25.0/24 -> 0.0.0.0 family 2 tag 0 metric 3
```

configs/r1/logs/ripd.log

```
2022/06/22 13:04:49 RIP: update routes to neighbor 10.10.12.2
2022/06/22 13:04:49 RIP: rip_send_packet 10.10.12.1 > 10.10.12.2 (r1-eth1)
2022/06/22 13:04:49 RIP: SEND to  10.10.12.2.520
2022/06/22 13:04:49 RIP: SEND RESPONSE version 2 packet size 124
2022/06/22 13:04:49 RIP:   10.10.11.0/24 -> 0.0.0.0 family 2 tag 0 metric 1
2022/06/22 13:04:49 RIP:   10.10.14.0/24 -> 0.0.0.0 family 2 tag 0 metric 1
2022/06/22 13:04:49 RIP:   10.10.23.0/24 -> 0.0.0.0 family 2 tag 0 metric 4
2022/06/22 13:04:49 RIP:   10.10.25.0/24 -> 0.0.0.0 family 2 tag 0 metric 3
2022/06/22 13:04:49 RIP:   10.10.35.0/24 -> 0.0.0.0 family 2 tag 0 metric 3
2022/06/22 13:04:49 RIP:   10.10.45.0/24 -> 0.0.0.0 family 2 tag 0 metric 2
2022/06/22 13:04:50 RIP: RECV packet from 10.10.12.2 port 520 on r1-eth1
2022/06/22 13:04:50 RIP: RECV RESPONSE version 2 packet size 84
2022/06/22 13:04:50 RIP:   10.10.23.0/24 -> 0.0.0.0 family 2 tag 0 metric 1
2022/06/22 13:04:50 RIP:   10.10.25.0/24 -> 0.0.0.0 family 2 tag 0 metric 1
2022/06/22 13:04:50 RIP:   10.10.35.0/24 -> 0.0.0.0 family 2 tag 0 metric 2
2022/06/22 13:04:50 RIP:   10.10.45.0/24 -> 0.0.0.0 family 2 tag 0 metric 2
2022/06/22 13:04:50 RIP: triggered update!
2022/06/22 13:04:50 RIP: SEND UPDATE to r1-eth1 ifindex 1718
2022/06/22 13:04:50 RIP: multicast announce on r1-eth1
2022/06/22 13:04:50 RIP: update routes on interface r1-eth1 ifindex 1718
2022/06/22 13:04:50 RIP: rip_send_packet 10.10.12.1 > 224.0.0.9 (r1-eth1)
2022/06/22 13:04:50 RIP: SEND to  224.0.0.9.520
2022/06/22 13:04:50 RIP: SEND RESPONSE version 2 packet size 84
2022/06/22 13:04:50 RIP:   10.10.11.0/24 -> 0.0.0.0 family 2 tag 0 metric 1
2022/06/22 13:04:50 RIP:   10.10.14.0/24 -> 0.0.0.0 family 2 tag 0 metric 1
2022/06/22 13:04:50 RIP:   10.10.35.0/24 -> 0.0.0.0 family 2 tag 0 metric 3
2022/06/22 13:04:50 RIP:   10.10.45.0/24 -> 0.0.0.0 family 2 tag 0 metric 2
```

configs/r1/logs/zebra.log

```
2022/06/22 13:04:38 ZEBRA: Zebra 0.99.22.4 starting: vty@2601
2022/06/22 13:04:38 ZEBRA: zebra message received [ZEBRA_HELLO] 1
2022/06/22 13:04:38 ZEBRA: client 12 says hello and bids fair to announce only rip routes
2022/06/22 13:04:38 ZEBRA: zebra message received [ZEBRA_ROUTER_ID_ADD] 0
2022/06/22 13:04:38 ZEBRA: zebra message received [ZEBRA_INTERFACE_ADD] 0
2022/06/22 13:04:38 ZEBRA: zebra message received [ZEBRA_REDISTRIBUTE_ADD] 1
2022/06/22 13:04:39 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
2022/06/22 13:04:40 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
2022/06/22 13:04:40 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
2022/06/22 13:04:40 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
2022/06/22 13:04:50 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_DELETE] 19
2022/06/22 13:04:50 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
2022/06/22 13:04:50 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_DELETE] 19
2022/06/22 13:04:50 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
```

- Given that r1 has no better routes for these networks all of them will be accepted.

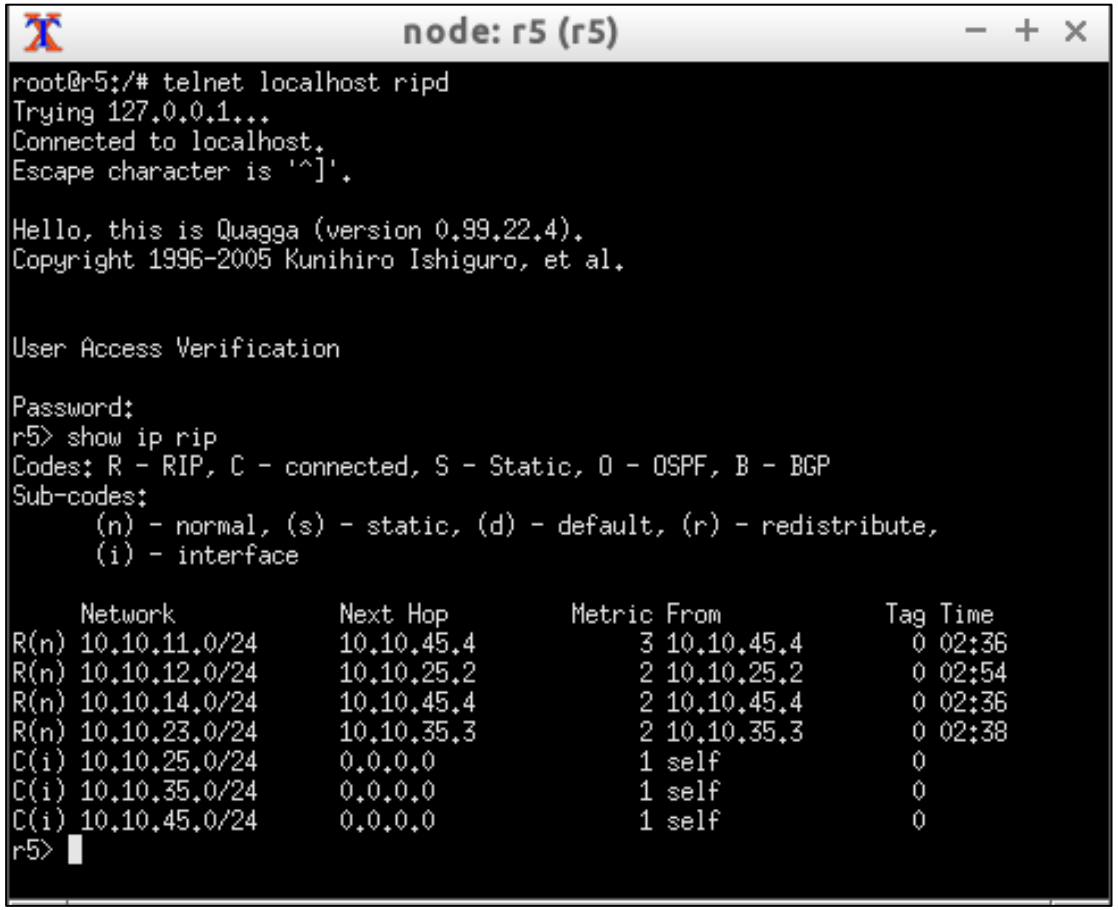
configs/r1/logs/zebra.log

```
2022/06/22 13:04:38 ZEBRA: Zebra 0.99.22.4 starting: vty@2601
2022/06/22 13:04:38 ZEBRA: zebra message received [ZEBRA_HELLO] 1
2022/06/22 13:04:38 ZEBRA: client 12 says hello and bids fair to announce only rip routes
2022/06/22 13:04:38 ZEBRA: zebra message received [ZEBRA_ROUTER_ID_ADD] 0
2022/06/22 13:04:38 ZEBRA: zebra message received [ZEBRA_INTERFACE_ADD] 0
2022/06/22 13:04:38 ZEBRA: zebra message received [ZEBRA_REDISTRIBUTE_ADD] 1
2022/06/22 13:04:39 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
2022/06/22 13:04:40 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
2022/06/22 13:04:40 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
2022/06/22 13:04:40 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
2022/06/22 13:04:50 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_DELETE] 19
2022/06/22 13:04:50 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
2022/06/22 13:04:50 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_DELETE] 19
2022/06/22 13:04:50 ZEBRA: zebra message received [ZEBRA_IPV4_ROUTE_ADD] 19
```

- Given that r2 offers fewer hops to 10.10.23.0/24, the previous entry through r4 will be deleted and the new entry through r2 will be added.

Monitoring Commands

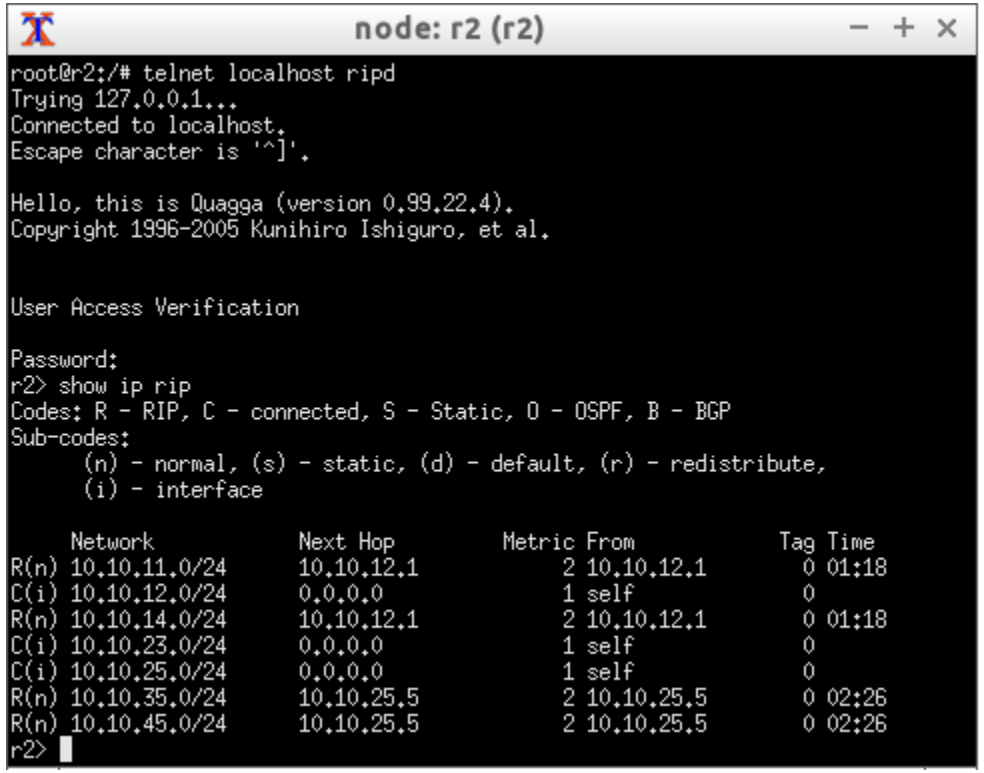
- RIP database
- Enter to Quagga configuration mode
- (password: quagga)



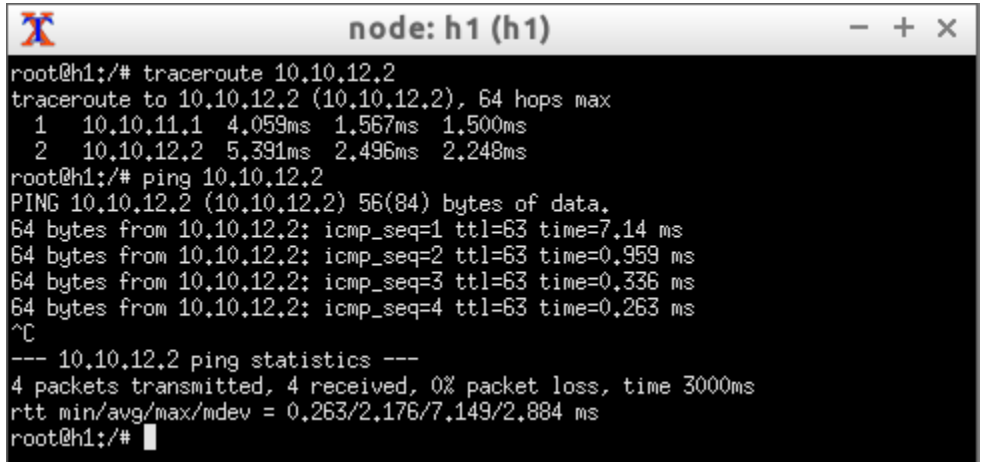
Understanding Neighbors in RIP

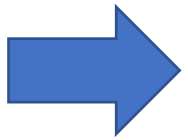
- The command network 10.10.11.0/24 would enable r1-eth3 interface for sending/receiving RIP database updates, which would be disregarded by h1 as it is not running RIP, h1 is only a host.
- From configs/r1/ripd.conf:
  - ! network 10.10.12.0/24
- Restart the Quagga service:
  - root@r1:/# /etc/init.d/quagga stop
  - root@r1:/# /etc/init.d/quagga start
- From Wireshark, we cannot see any

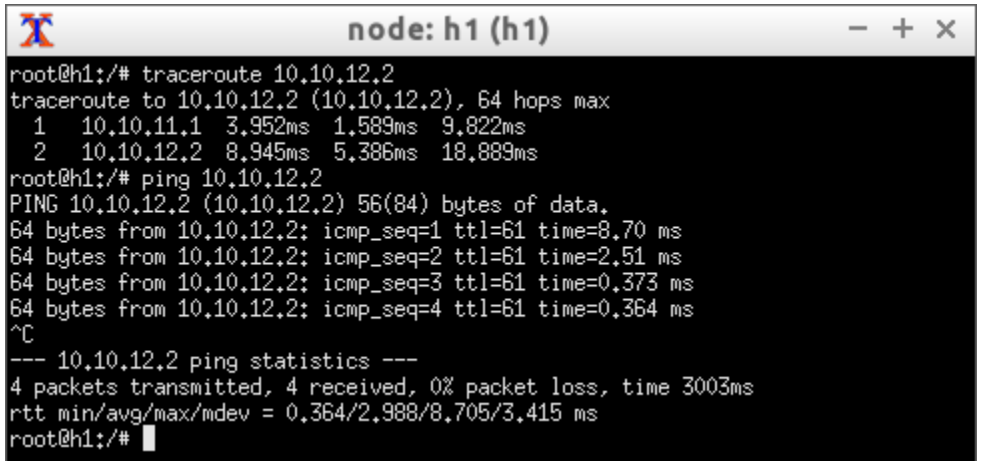
  RIPv2 packet coming from r1.

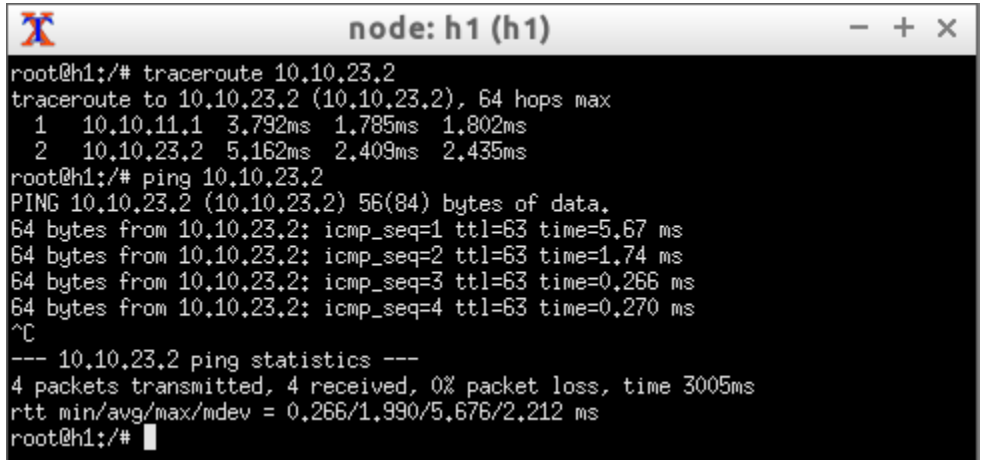


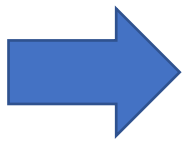
The difference

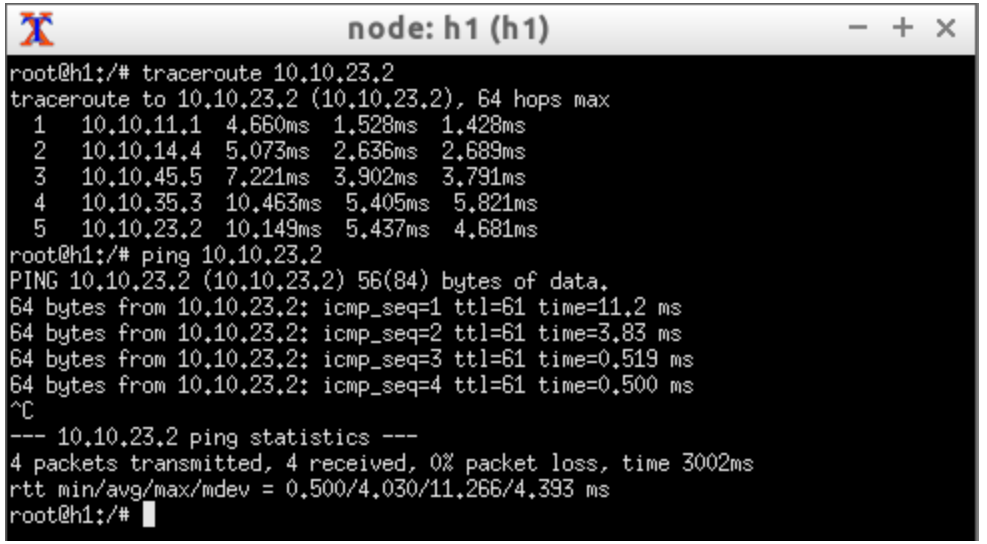






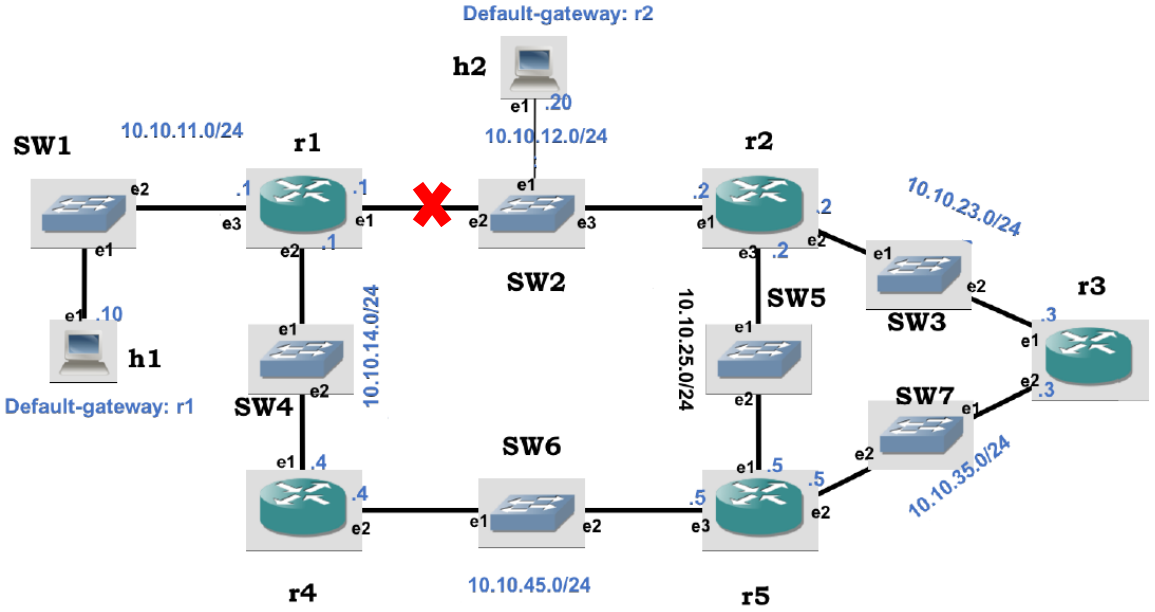






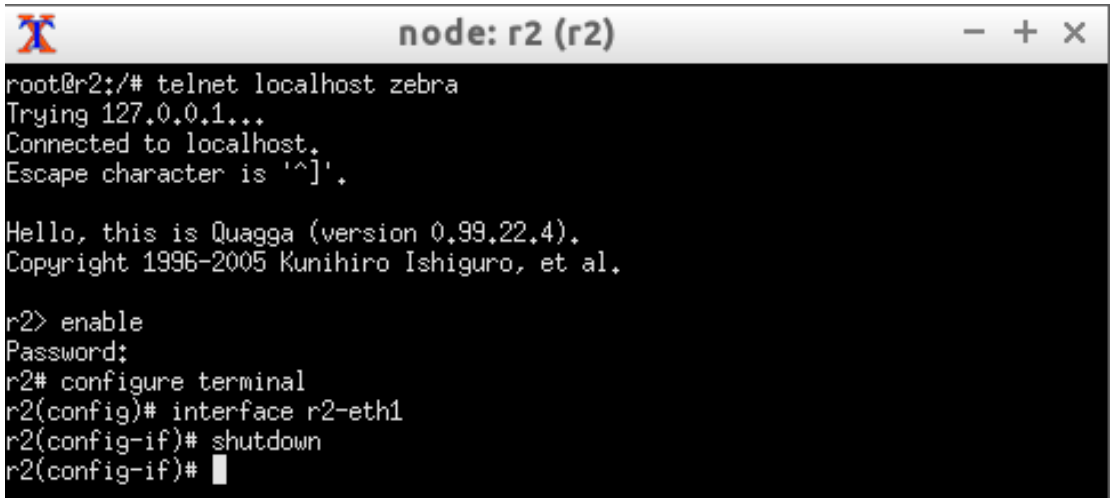
The difference

- RIP sees two different routers with a common prefix (10.10.12.0/24), and these two routers have no communication between each other. Therefore, r2 has to take the route announced by r5 as the only choice to go to any of r1's networks (other than 10.10.12.0/24, as r2 has it directly connected) and installs the networks to 10.10.11.0/24 and 10.10.14.0/24 through r5.



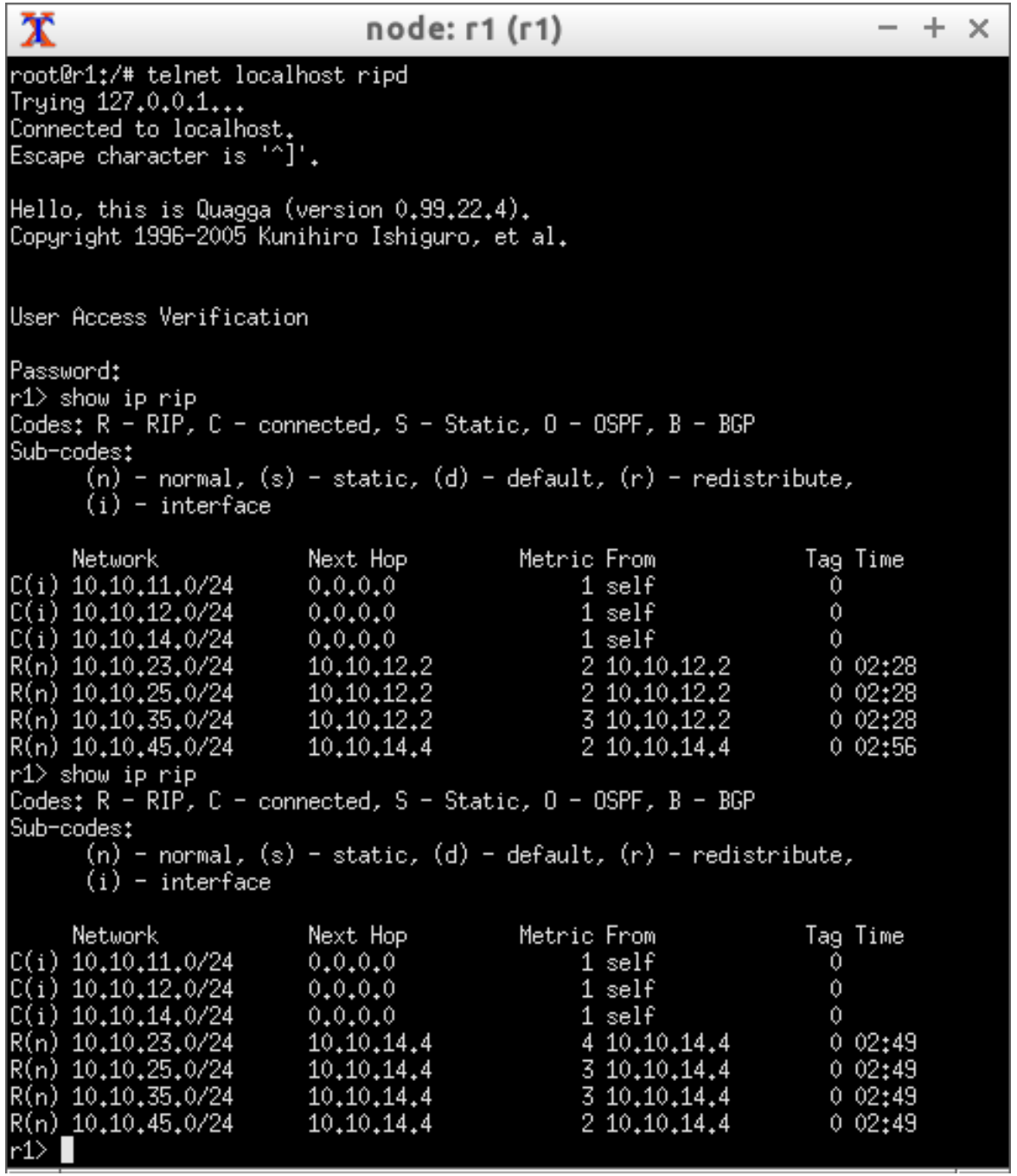
Broken Link

- $ sudo python lab8_v2.py
- Restart the Quagga service in r1, r2 and r4 respectively:
  - # /etc/init.d/quagga stop
  - # /etc/init.d/quagga start
- Shutdown the r2-eth1 interface on r2:



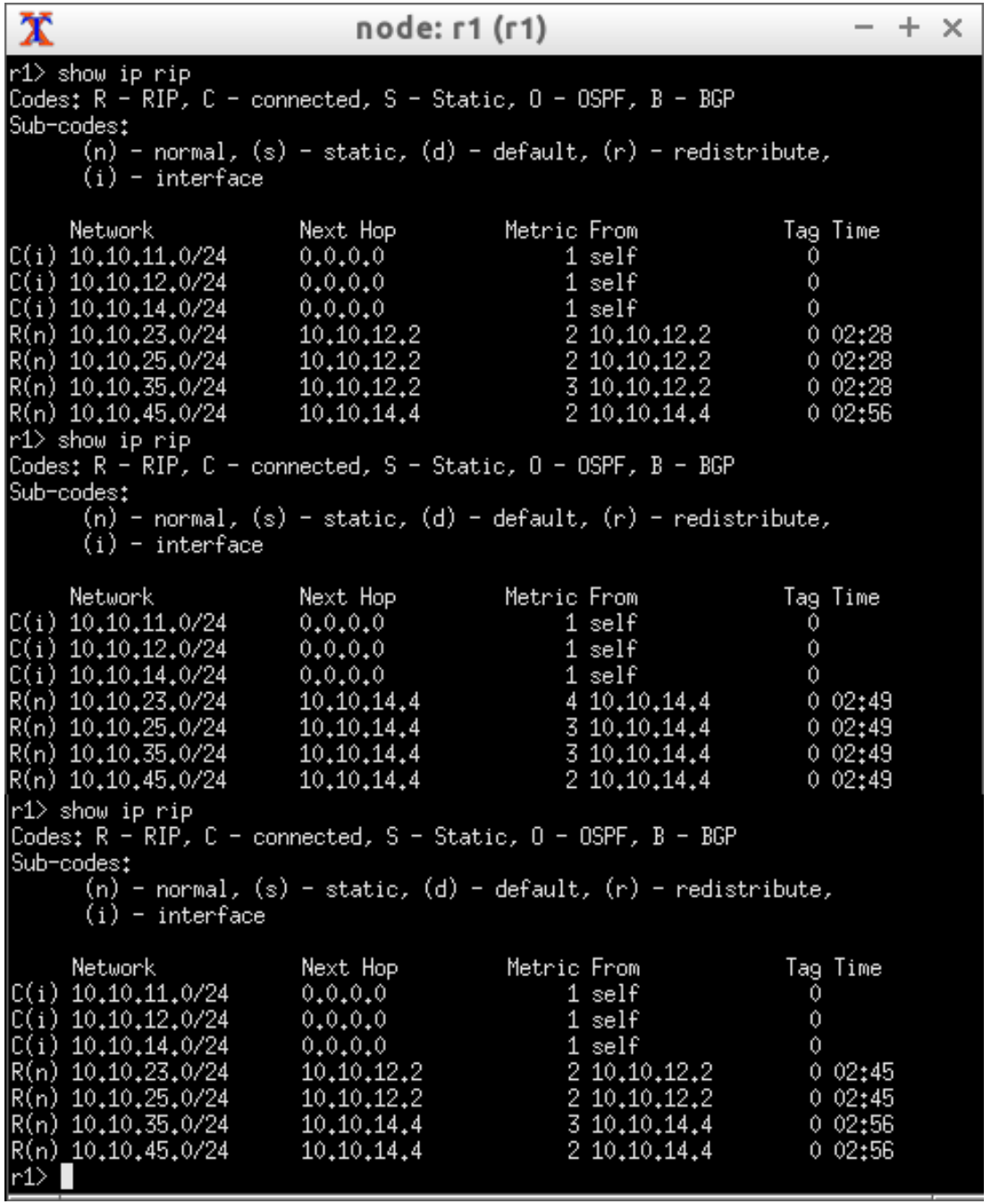
Broken Link

- After the expiration of the Invalid timer of 180s, the routes via r2 will be removed from the routing table of r1 and replaced with the routes via r4. This will happen after the reception of the first hello packet from r4 following the expiration of Invalid timer.



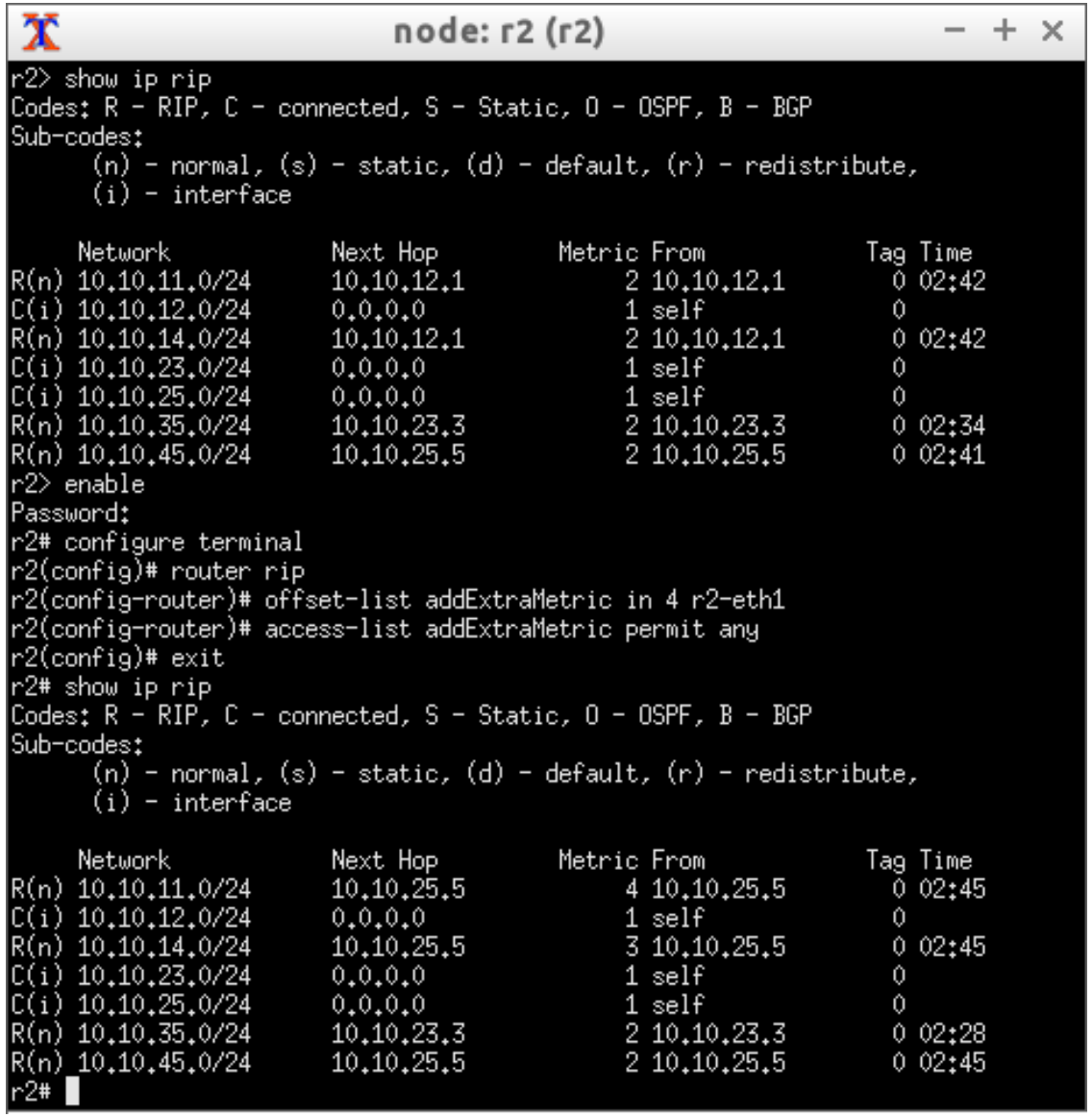
Broken Link

- After bringing up the r2-eth1 interface on r2 again, the routing table of r1 will take some time to converge. Its content will not be the same as in the beginning. The equal cost routes via r4 will be kept (only better routes are chosen).



Modified Link Metric

- From r2, we can directly inject an offset in r2's computation of the cost.
- In this case, r2 will receive the updates from r1, and it will add the desired offset in order to calculate the shortest-path tree.



Process Crash

node: r2 (r2)

```
root@r2:/# pidof ripd
43
root@r2:/# kill 43
root@r2:/#
```

node: r5 (r5)

```
root@r5:/# pidof ripd
43
root@r5:/# kill 43
root@r5:/#
```

node: r1 (r1)

```
root@r1:/# telnet localhost ripd
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.22.4).
Copyright 1996-2005 Kunihiro Ishiguro, et al.


User Access Verification

Password:
r1> show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network         Next Hop         Metric From            Tag Time
C(i) 10.10.11.0/24   0.0.0.0               1 self              0
C(i) 10.10.12.0/24   0.0.0.0               1 self              0
C(i) 10.10.14.0/24   0.0.0.0               1 self              0
R(n) 10.10.23.0/24   10.10.12.2            2 10.10.12.2        0 02:38
R(n) 10.10.25.0/24   10.10.12.2            2 10.10.12.2        0 02:38
R(n) 10.10.35.0/24   10.10.12.2            3 10.10.12.2        0 02:38
R(n) 10.10.45.0/24   10.10.14.4            2 10.10.14.4        0 02:38
r1> show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network         Next Hop         Metric From            Tag Time
C(i) 10.10.11.0/24   0.0.0.0               1 self              0
C(i) 10.10.12.0/24   0.0.0.0               1 self              0
C(i) 10.10.14.0/24   0.0.0.0               1 self              0
R(n) 10.10.23.0/24   10.10.12.2           16 10.10.12.2        0 01:45
R(n) 10.10.25.0/24   10.10.12.2           16 10.10.12.2        0 01:45
R(n) 10.10.35.0/24   10.10.12.2           16 10.10.12.2        0 01:45
R(n) 10.10.45.0/24   10.10.14.4            2 10.10.14.4        0 02:40
r1>
```

node: r4 (r4)

```
root@r4:/# telnet localhost ripd
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.22.4).
Copyright 1996-2005 Kunihiro Ishiguro, et al.


User Access Verification

Password:
r4> show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network         Next Hop         Metric From            Tag Time
R(n) 10.10.11.0/24   10.10.14.1            2 10.10.14.1        0 02:46
R(n) 10.10.12.0/24   10.10.14.1            2 10.10.14.1        0 02:46
C(i) 10.10.14.0/24   0.0.0.0               1 self              0
R(n) 10.10.23.0/24   10.10.14.1            3 10.10.14.1        0 02:46
R(n) 10.10.25.0/24   10.10.45.5            2 10.10.45.5        0 02:46
R(n) 10.10.35.0/24   10.10.45.5            2 10.10.45.5        0 02:46
C(i) 10.10.45.0/24   0.0.0.0               1 self              0
r4> show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network         Next Hop         Metric From            Tag Time
R(n) 10.10.11.0/24   10.10.14.1            2 10.10.14.1        0 02:50
R(n) 10.10.12.0/24   10.10.14.1            2 10.10.14.1        0 02:50
C(i) 10.10.14.0/24   0.0.0.0               1 self              0
R(n) 10.10.23.0/24   10.10.14.1           16 10.10.14.1        0 01:19
R(n) 10.10.25.0/24   10.10.45.5           16 10.10.45.5        0 01:25
R(n) 10.10.35.0/24   10.10.45.5           16 10.10.45.5        0 01:25
C(i) 10.10.45.0/24   0.0.0.0               1 self              0
r4>
```