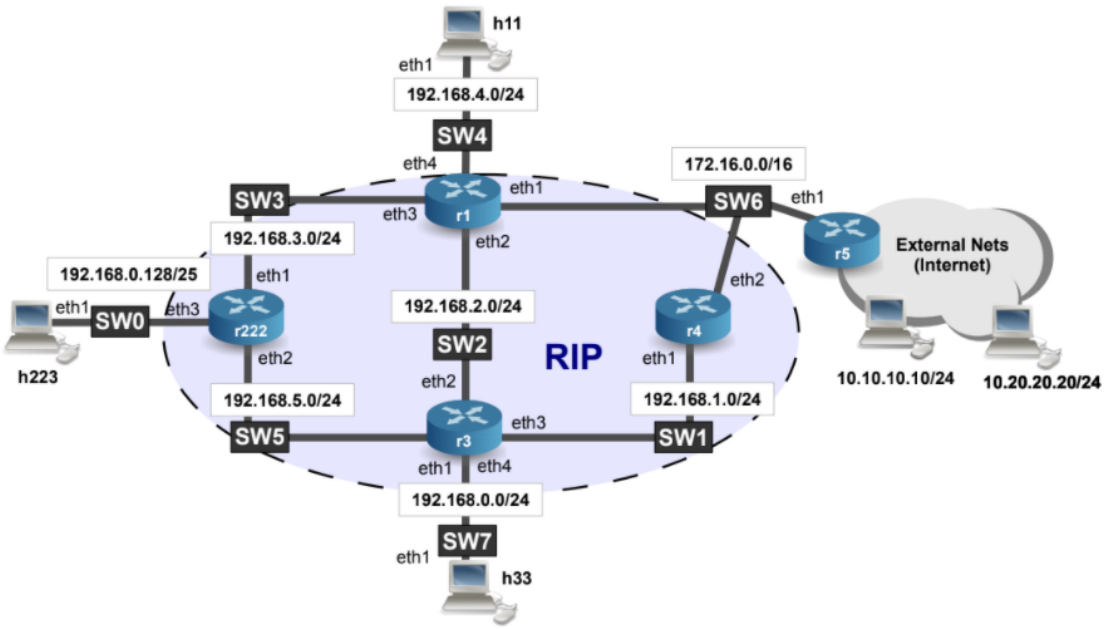


Exercise 1

The goal of this practice is to study RIP version 1 (RIPv1). Remember that RIPv1 is “classful“. The networking scheme for the exercise is shown in Figure 2.13. Interfaces are initially configured with an IP address whose IP HostID is set to the number on the name of each machine. For example, the network interface eth1 of r222 is set to 192.168.3.222. Also, SimNetX interfaces are configured in the physical host, where X is the number of the switch. The hosts have a default route to their corresponding routers. Start the simulation by executing the following command:

```
host:~# simctl rip start
```

After the scenario has been started, you have to load the initial configuration. Execute the initial label with the following command:

```
phyhost$ simctl rip exec initial
```

In this exercise, we will only use the hosts (h11, h223 and h33) and the routers r1, r222 and r3.

1. Execute a ping from router r3 to 192.168.2.1, 192.168.3.1 and 192.168.4.11. Discuss the results.

   `R3:~# ping -c1 192.168.2.1`→OK

   `R3:~# ping -c1 192.168.3.1`→Network is unreachable.

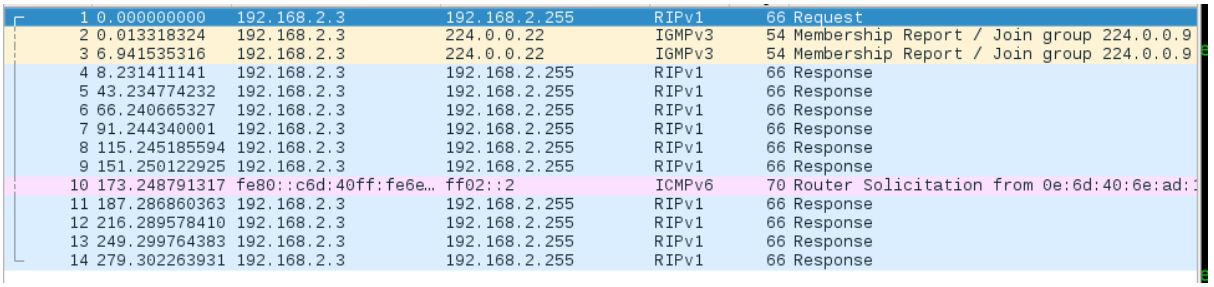
   `R3:~# ping -c1 192.168.4.11`→ Network is unreachable.

2. Start a capture on SimNet2. In r3, open the Quagga command tool and add the networks 192.168.1.0/24 and 192.168.2.0/24 to RIP:

   ```
   root@r3:~# vtysh
   r3# configure  terminal
   r3(config)# router rip
   r3(config-router)# version 1
   r3(config-router)# network 192.168.1.0/24
   r3(config-router)# network 192.168.2.0/24
   ```

   Explain the RIP response messages that you observe in SimNet2. In your explanation include the MAC addresses (L2), IP addresses (L3), ports (L4) and the RIP information.

   SImNet2:



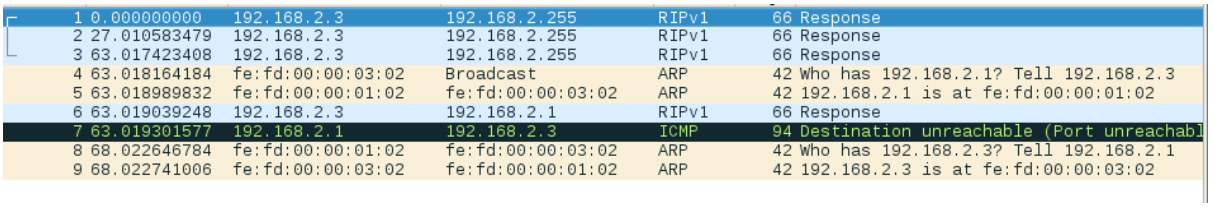
1	0.000000000	192.168.2.3	192.168.2.255	RIPv1	66 Request
2	0.013318324	192.168.2.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
3	6.941535316	192.168.2.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
4	8.231411141	192.168.2.3	192.168.2.255	RIPv1	66 Response
5	43.234774232	192.168.2.3	192.168.2.255	RIPv1	66 Response
6	66.240665327	192.168.2.3	192.168.2.255	RIPv1	66 Response
7	91.244340001	192.168.2.3	192.168.2.255	RIPv1	66 Response
8	115.245185594	192.168.2.3	192.168.2.255	RIPv1	66 Response
9	151.250122925	192.168.2.3	192.168.2.255	RIPv1	66 Response
10	173.248791317	fe80::c6d:40ff:fe6e…	ff02::2	ICMPv6	70 Router Solicitation from 0e:6d:40:6e:ad:1
11	187.286860363	192.168.2.3	192.168.2.255	RIPv1	66 Response
12	216.289578410	192.168.2.3	192.168.2.255	RIPv1	66 Response
13	249.299764383	192.168.2.3	192.168.2.255	RIPv1	66 Response
14	279.302263931	192.168.2.3	192.168.2.255	RIPv1	66 Response

RIPv1 Length:66B
@MACs: fe:fd:00:00:03:02 ; @MACd: ff:ff:ff:ff:ff:ff
@IPs: 192.168.2.3 (r3 eth2) ; @IPd: 168.168.2.255 (broadcast)
SPort: router (520) ; DPort: router (520) → port “well known” de RIP
IP Address: 192.168.1.0, Metric: 1

3. Capture on SimNet2 and type the following RIP command in r3:

```
r3(config-router)# neighbor 192.168.2.1
```

Describe what the command does and explain why you receive an error message (ICMP) from 192.168.2.1.
SImNet2:



1	0.000000000	192.168.2.3	192.168.2.255	RIPv1	66 Response
2	27.010583479	192.168.2.3	192.168.2.255	RIPv1	66 Response
3	63.017423408	192.168.2.3	192.168.2.255	RIPv1	66 Response
4	63.018164184	fe:fd:00:00:03:02	Broadcast	ARP	42 Who has 192.168.2.1? Tell 192.168.2.3
5	63.018989832	fe:fd:00:00:01:02	fe:fd:00:00:03:02	ARP	42 192.168.2.1 is at fe:fd:00:00:01:02
6	63.019039248	192.168.2.3	192.168.2.1	RIPv1	66 Response
7	63.019301577	192.168.2.1	192.168.2.3	ICMP	94 Destination unreachable (Port unreachabl
8	68.022646784	fe:fd:00:00:01:02	fe:fd:00:00:03:02	ARP	42 Who has 192.168.2.3? Tell 192.168.2.1
9	68.022741006	fe:fd:00:00:03:02	fe:fd:00:00:01:02	ARP	42 192.168.2.3 is at fe:fd:00:00:03:02

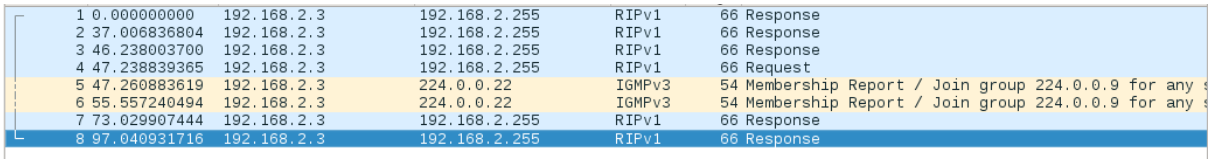
Es preten restablir a r1 com a veí però r1 no té actiu el daemon (Quagga)
To finish this exercise disable the neighbor with:

```
r3(config-router)# no neighbor 192.168.2.1
```

4. Capture in SimNet2 and then, in r3, set eth3 down:

```
root@r3:~# ifconfig eth3 down
```

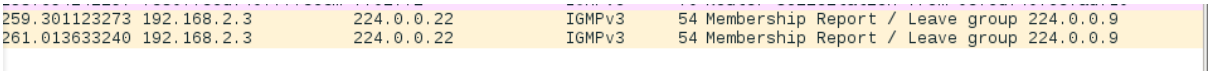
5. In r3, set eth3 up. Describe and explain the RIP response messages that you capture on SimNet2 at least during 30 seconds.
La mètrica es 16. Si esperem 30 segons (temps del següent update), la mètrica torna a ser 1.
6. In r3, remove the network 192.168.1.0/24 from RIP. Describe the RIP response messages that you observe in SimNet2. Wait at least for 2 minutes to end the capture.
`r3(config-router)# no network 192.168.1.0/24 → eliminar xarxa`



1	0.000000000	192.168.2.3	192.168.2.255	RIPv1	66 Response
2	37.006836804	192.168.2.3	192.168.2.255	RIPv1	66 Response
3	46.238003700	192.168.2.3	192.168.2.255	RIPv1	66 Response
4	47.238839365	192.168.2.3	192.168.2.255	RIPv1	66 Request
5	47.260883619	192.168.2.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9 for any s
6	55.557240494	192.168.2.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9 for any s
7	73.029907444	192.168.2.3	192.168.2.255	RIPv1	66 Response
8	97.040931716	192.168.2.3	192.168.2.255	RIPv1	66 Response

IP Adress: 192.168.1.0 , Metric: 16 (infinit) podem veure dos missatges IGMP Membership Report / Join group 224.0.0.9 for any sources

Finally, in r3, remove also the network 192.168.2.0/24 from RIP.



259.301123273	192.168.2.3	224.0.0.22	IGMPv3	54 Membership Report / Leave group 224.0.0.9
261.013633240	192.168.2.3	224.0.0.22	IGMPv3	54 Membership Report / Leave group 224.0.0.9

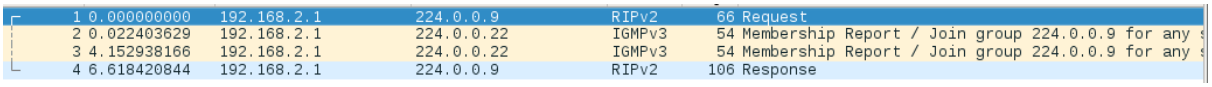
`r3(config-router)# no network 192.168.2.0/24`

Podem veure dos missatges IGMP Membership Report / Leave group 224.0.0.9

7. (INITIAL) Capture in all the networks to which r1 is connected and, in this router, type the following RIP command:

```
r1(config-router)# network 192.168.0.0/16
```

In which networks do yo see a RIP response packet? Why?
Describe the RIP messages including L2 MAC addresses, L3 IP addresses, L4 ports and the RIP information.
`r1(config-router)# network 192.168.0.0/16`
SimNet2,3,4:



1	0.000000000	192.168.2.1	224.0.0.9	RIPv2	66 Request
2	0.022403629	192.168.2.1	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9 for any
3	4.152938166	192.168.2.1	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9 for any
4	6.618420844	192.168.2.1	224.0.0.9	RIPv2	106 Response

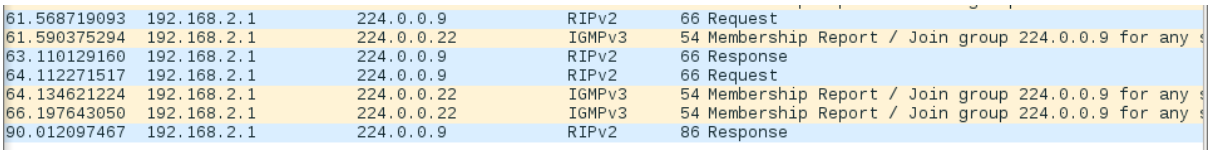
Es poden veure paquets RIP Response en SN2,3,4 però no a SN6. Això és perq nmes s'ha configurat la xarxa 192.168.0.0/16 i totes les seves subxarxes i, SN6 no pertany a aquest grup.
Si analitzem els paquets RIP Response podem veure que van tots dirigits a la seva @broadcast 192.168.X.255 a través del port 520 (UDP) i ens informa que per arribar a les altres dues xarxes hi ha mètrica 1.

8. Do you think that it makes sense to send RIP response messages through the 192.168.4.0/24 network? For example, it makes sense to send RIP response messages to h11?
No té sentit enviar RIP Responses a la SN4, ja que allí no hi ha cap router que necessiti ser notificat, només hi ha un host (h11), per tant, es sobrecarrega innecessària de la xarxa.

9. Capture on SimNet2 and type the following command in r1:

```
r1(config-router)# no network 192.168.0.0/16
```

Wait for a few seconds, do yo see any RIP message? why?
Then, in r1, in less than 2 minutes, activate RIP for the networks 192.168.2.0/24 and 192.168.3.0/24.
Explain the RIP messages captured on SimNet2.
No veiem cap missatge RIP perquè no hi ha cap xarxa RIP configurada, per tant, no hi ha cap router que pugui enviar RIP Responses.
`r1(config-router)# network 192.168.2.0/24`
`r1(config-router)# network 192.168.3.0/24`



61.568719093	192.168.2.1	224.0.0.9	RIPv2	66 Request	
61.590375294	192.168.2.1	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9 for any	
63.110129160	192.168.2.1	224.0.0.9	RIPv2	66 Response	
64.112271517	192.168.2.1	224.0.0.9	RIPv2	66 Request	
64.134621224	192.168.2.1	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9 for any	
66.197643050	192.168.2.1	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9 for any	
90.012097467	192.168.2.1	224.0.0.9	RIPv2	86 Response	

Podem veure dos RIP Request de quan s'ha configurat les dues xarxes, i els RIP Response automàtics, i si deixem passar el temps els RIP Responses d'update.
Si analitzem aquests paquets, podem veure que els RIP Requests mostren un missatge "Address not specified: Metric 16" ja que no té cap veí conegut. El primer Request mostra la xarxa 192.168.3.0 amb mètrica 16. Llavors, activem la segona xarxa i el segon Request ja ens mostra la xarxa anterior amb mètrica 1 però la xarxa 192.168.4.0 amb mètrica 16. A pesar d'això, el següent Response ja només mostra la primera opció ja que ha actuat el Garbage Collector.

10. Capture on SimNet2 and SimNet3. In r3, start RIPv1 for the network 192.168.5.0/24.
Do you observe RIP messages on SimNet2 from r3? why?

`r3(config-router)# network 192.168.5.0/24`

A la SN2 no observem cap missatge RIP de R3 ja que només hem configurat la seva eth1 que pertany a la SN5.

Now, in r3, start RIPv1 for the network 192.168.2.0/24.
For the captured traffic, explain the networks that you observe in the RIP response messages. In addition, explain if triggered updates, split horizon and poison reverse are activated in r1 and how can you know this.

`r3(config-router)# network 192.168.2.0/24`

`SimNet2:`

3	61.229422354	192.168.2.3	192.168.2.255	RIPv1	66 Request
4	61.229845817	192.168.2.1	192.168.2.3	RIPv1	66 Response
5	61.253604566	192.168.2.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
6	62.016942964	192.168.2.1	224.0.0.9	RIPv2	66 Response
7	66.244882742	fe:fd:00:00:01:02	fe:fd:00:00:03:02	ARP	42 Who has 192.168.2.3? Tell 192.168.2.1
8	66.245192037	fe:fd:00:00:03:02	fe:fd:00:00:01:02	ARP	42 192.168.2.3 is at fe:fd:00:00:03:02
9	67.317449314	192.168.2.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
10	88.019910426	192.168.2.1	224.0.0.9	RIPv2	66 Response
11	89.831141348	192.168.2.3	192.168.2.255	RIPv1	66 Response

Mirant SN2 veiem els RIP response de R1 (192.168.2.1) i R3 (192.168.2.3). Els dos ens indiquen que les xarxes 192.168.3.0 i 192.168.5.0 estan a un salt respectivament.

Si observem SN3, els respons captats informen que 192.168.2.0 està a un salt i la 192.168.5.0 a dos (Desde el r1→ 192.168.3.1).

Si observem els diferents algoritmes de RIP, veiem que el Triggered updates està activat, ja que quan s'ha connectat SN5 s'ha enviat un Response fora de temps notificant aquest canvi a tothom. El Split horizon també està activat, però el poison reverse no ho està.

11. (INITIAL, RIPv1-a) For your information, currently RIPv1 has been activated as follows:

```
r1.v1.eth2.192.168.2.0/24.active
r1.v1.eth3.192.168.3.0/24.active
-----------------------------------
r3.v1.eth1.192.168.5.0/24.active
r3.v1.eth2.192.168.2.0/24.active
```

To set this configuration you can use the labels of simctl initial and then ripv1-a.

`terminal:~$ simctl rip exec initial ; simctl rip exec ripv1-a`

Amb ripv1-a s'activa les eth2/3 de R1 i les eth1/2 de R3.
Try a ping from r3 to 192.168.3.1.
Does it work? why?

`r3:~# ping -c1 192.168.3.1`→ OK

R3 i R1 tenen les interficies necessàries pel ping ben conf.
Try a ping from r3 to 192.168.4.11.
Does it work? why?

`r3:~# ping -c1 192.168.4.11` → Network is unreachable.

R1 no té la eth4 a RIP i la xarxa 192.168.4.0 tampoc esta configurada.

Explain the RIB and FIB of the router r3.

- The RIB entries for RIP can be shown entering in Quagga and typing:

```
router# show ip rip
```

```
r3# 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) 192.168.2.0/24     0.0.0.0               1 self              0
R(n) 192.168.3.0/24     192.168.2.1           2 192.168.2.1       0 02:47
C(i) 192.168.5.0/24     0.0.0.0               1 self              0
```

Veiem que R3 esta directament connectat a les xarxes 2.0 i 5.0 i a la xarxa 3.0 mitjançant RIP amb mètrica 2 i gateway 192.168.2.1

- The FIB/RIB entries for all the protocols can be shown in Quagga with the command:

```
router# show ip route
```

```
r3# show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
       I - ISIS, B - BGP, > - selected route, * - FIB route

C>* 127.0.0.0/8 is directly connected, lo
C>* 192.168.0.0/24 is directly connected, eth4
C>* 192.168.1.0/24 is directly connected, eth3
C>* 192.168.2.0/24 is directly connected, eth2
R>* 192.168.3.0/24 [120/2] via 192.168.2.1, eth2, 00:08:21
C>* 192.168.5.0/24 is directly connected, eth1
```

Veiem que R3 esta directament connectat a les interfícies lo, eth4, eth2, eth3, eth1 i les seves respectives xarxes i connectat per RIP a la xarxa 192.168.3.0/24

- You can also see the FIB on a linux command-line typing:

```
root@r3:~# route -n
```

```
root@r3:~# route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
192.168.0.0     0.0.0.0         255.255.255.0   U     0      0        0 eth4
192.168.1.0     0.0.0.0         255.255.255.0   U     0      0        0 eth3
192.168.2.0     0.0.0.0         255.255.255.0   U     0      0        0 eth2
192.168.3.0     192.168.2.1     255.255.255.0   UG    2      0        0 eth2
192.168.5.0     0.0.0.0         255.255.255.0   U     0      0        0 eth1
```

Veiem només la informació relativa a @IP i gw, no podem veure mètriques.

12. Capture on SimNet4 and set the interface eth4 in r1 as passive. Then, add the network 192.168.4.0/24 to RIP and try again a ping from r3 to 192.168.4.11.
    Does it work now? why?
    Do you see RIP messages on SimNet4? Why?
    Explain the RIB and FIB of the router r3.
    `r1(config-router)# passive-interface eth4`
    `r1(config-router)# network 192.168.4.0/24`
    `r3:~# ping -c1 192.168.4.11` → OK
    Ara la xarxa 192.168.4.0/24 està inclosa a RIP i la eth4 també, a més l'hem establert com a passiva per a que no enviï missatges innecessaris de Response a h11.

    Si mirem la RIB/FIB observem que esta connectat directament a les seves interfícies, a més té les xarxes 3.0 i 4.0 a mètrica 2 a través del gateway 192.168.2.1

13. Capture on SimNet3 and SimNet5.
    In r3, add 192.168.5.0/24 to RIP and also add 192.168.0.0/24 to RIP but as passive.
    In r222, add 192.168.3.0/24 and 192.168.5.0/24 to RIP.
    For your information, currently RIPv1 has been activated as follows (label ripv1-b):

```
r1.v1.eth2.192.168.2.0/24.active
r1.v1.eth3.192.168.3.0/24.active
r1.v1.eth4.192.168.4.0/24.pasive
------------------------------------
r222.v1.eth1.192.168.3.0/24.active
r222.v1.eth2.192.168.5.0/24.active
------------------------------------
r3.v1.eth1.192.168.5.0/24.active
r3.v1.eth2.192.168.2.0/24.active
r3.v1.eth3.192.168.1.0/24.active
r3.v1.eth4.192.168.0.0/24.pasive
```

Explain the RIP messages sent by r222 and its RIP RIB.

SimNet3:

1	0.000000000	192.168.3.1	192.168.3.255	RIPv1	86 Response
2	23.009077708	192.168.3.1	192.168.3.255	RIPv1	86 Response
3	53.359917209	192.168.3.1	192.168.3.255	RIPv1	66 Response
4	57.013053186	192.168.3.1	192.168.3.255	RIPv1	106 Response
5	63.718618011	192.168.3.1	192.168.3.255	RIPv1	66 Response
6	86.022294038	192.168.3.1	192.168.3.255	RIPv1	106 Response
7	112.776318231	192.168.3.1	192.168.3.255	RIPv1	66 Response
8	116.036185582	192.168.3.1	192.168.3.255	RIPv1	106 Response
9	149.054613007	192.168.3.1	192.168.3.255	RIPv1	106 Response
10	179.061819250	192.168.3.1	192.168.3.255	RIPv1	106 Response
11	199.029578734	192.168.3.222	224.0.0.9	RIPv2	66 Request
12	199.050307794	192.168.3.222	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
13	201.190900282	192.168.3.222	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
14	202.179643646	192.168.3.222	224.0.0.9	RIPv2	66 Response
15	203.186595525	192.168.3.222	224.0.0.9	RIPv2	66 Request
16	203.215716331	192.168.3.222	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
17	203.914269081	192.168.3.222	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
18	203.941761046	192.168.3.222	224.0.0.9	RIPv2	66 Response
19	209.065039134	192.168.3.1	192.168.3.255	RIPv1	106 Response
20	211.958613400	192.168.3.1	192.168.3.255	RIPv1	66 Response
21	212.963577881	192.168.3.1	192.168.3.255	RIPv1	66 Request
22	212.963764921	fe:fd:00:00:02:01	Broadcast	ARP	42 Who has 192.168.3.1? Tell 192.168.3.222
23	212.963886884	fe:fd:00:00:01:03	fe:fd:00:00:02:01	ARP	42 192.168.3.1 is at fe:fd:00:00:01:03
24	212.963931850	192.168.3.222	192.168.3.1	RIPv1	66 Response
25	212.985937821	192.168.3.1	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
26	219.600538963	192.168.3.1	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
27	219.728088058	192.168.3.222	224.0.0.9	RIPv2	66 Response
28	232.950693665	192.168.3.222	224.0.0.9	RIPv2	86 Response
29	239.067646455	192.168.3.1	192.168.3.255	RIPv1	126 Response

SImNet5:

1	0.000000000	192.168.5.3	192.168.5.255	RIPv1	86 Response
2	27.008683122	192.168.5.3	192.168.5.255	RIPv1	86 Response
3	32.686244478	192.168.5.3	192.168.5.255	RIPv1	66 Response
4	33.694474307	192.168.5.3	192.168.5.255	RIPv1	66 Request
5	33.706201306	192.168.5.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.
6	41.803633841	192.168.5.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.
7	43.044913405	192.168.5.3	192.168.5.255	RIPv1	66 Response
8	44.047866020	192.168.5.3	192.168.5.255	RIPv1	66 Request
9	44.069314964	192.168.5.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.
10	47.238690714	192.168.5.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.
11	58.018294815	192.168.5.3	192.168.5.255	RIPv1	106 Response
12	92.026025922	192.168.5.3	192.168.5.255	RIPv1	106 Response
13	92.102692406	192.168.5.3	192.168.5.255	RIPv1	66 Response
14	93.111771756	192.168.5.3	192.168.5.255	RIPv1	66 Request
15	93.126637171	192.168.5.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.
16	94.292943355	fe80::e8c8:f6ff:fe0…	ff02::2	ICMPv6	70 Router Solicitation from ea:c8:f6:05:20
17	96.990474801	192.168.5.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.
18	115.029779217	192.168.5.3	192.168.5.255	RIPv1	106 Response
19	139.037878931	192.168.5.3	192.168.5.255	RIPv1	106 Response
20	169.044705847	192.168.5.3	192.168.5.255	RIPv1	106 Response
21	182.513879669	192.168.5.222	224.0.0.9	RIPv2	66 Request
22	182.542526678	192.168.5.222	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.
23	183.268944564	192.168.5.222	224.0.0.9	RIPv2	66 Response
24	186.327878765	192.168.5.222	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.
25	188.392991750	192.168.5.222	224.0.0.9	RIPv2	86 Response
26	191.284544475	192.168.5.3	192.168.5.255	RIPv1	66 Response
27	193.394196901	192.168.5.222	224.0.0.9	RIPv2	66 Response
28	199.053297862	192.168.5.3	192.168.5.255	RIPv1	126 Response
29	212.277914755	192.168.5.222	224.0.0.9	RIPv2	106 Response
30	224.055464505	192.168.5.3	192.168.5.255	RIPv1	126 Response

A ping from r222 to 172.16.0.1 should work?

Amb ripv1-b s'activa les eth2/3 de R1, les eth1/2 de R222, les eth1/2/3 de R3 i les eth4 de R1 i R3 passivament.

Si observem els Responses i la RIB de r222, veiem que està connectat directament a les seves interfícies que pertanyen a les xarxes 3.0 i 5.0, a més està connectat

mitjançant RIP a les xarxes 0/1.0 a través de 192.168.5.3 i a les xarxes 2/4.0 a través de 192.168.3.1, tot amb mètrica 2.
r222:~# ping -c1 172.16.0.1 → No hauria de funcionar perquè la xarxa 172.16.0.1 no està configurada a RIP.

14. Another way of including routes to RIP is to use “redistribution”. Redistribute the connected networks of r1 and r222 using the following Quagga command:

```
router(config-router)# redistribute connected
```

Describe the entries (if any) of the networks 172.16.0.0/16 and 192.168.0.128/25 present on the RIB of r1 and r222. Observing the RIB of the different routers, explain if you notice any differences between the networks distributed with redistribution and the networks distributed with the network command.

```
r222# 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) 192.168.0.0/24  192.168.5.3           2 192.168.5.3       0 02:40
C(r) 192.168.0.128/25 0.0.0.0              1 self (connected:1)  0
R(n) 192.168.2.0/24  192.168.3.1           2 192.168.3.1       0 02:42
C(i) 192.168.3.0/24  0.0.0.0               1 self              0
R(n) 192.168.4.0/24  192.168.3.1           2 192.168.3.1       0 02:42
C(i) 192.168.5.0/24  0.0.0.0               1 self              0
```

Al redistribuir ha trobat les dos xarxes que els quedaven per configurar SN0 i SN6 i tots els router han sigut notificats, i ara saben a quan salts estan d’elles.

Quan redistribuïm, obtenim les rutes més òptimes, per això, per exemple, a r1 veiem la 172.16.0.1 connectada directament. L’únic problema es que no podem diferenciar les rutes apreses per RIP i les apreses per redistribució.

15. Try a ping from r222 to 172.16.0.1. Does it work this time? why? Why do you think that 192.168.0.128/25 has not been redistributed? To give you a clue, recall that 172.16 is a class B. Try changing the IP address of the eth1 of r1 to 172.16.0.1/24. Is this network redistributed now? why? When you finish this exercise, restore the IP address again on the eth1 of r1 to 172.16.0.1/16.
    r222:~# ping –c1 172.16.0.1 → OK
    Al redistribuir hem fet el camí. 192.168.0.128/25 no està redistribuïda perquè està encapsulada a una xarxa més gran a la qual ja se sap arribar.
16. Start a capture on SimNet4 and SimNet7. Try a ping from h223 to h11. Does it work? Discuss the result explaining the messages that you observe (including ICMP and ARP) on each SimNet interface. Describe the final configuration after this exercise as:
    `router.(v1/v2).interface.network.(active/passive/redistr/failed)`
    h223:~# ping –c1 192.168.4.11
    Sap enviar el ping i coneix el camí d’anada, però no el de tornada. Quan h11 envia el Reply, aquest arriba a R1, però després no sap quin camí ha de seguir.

Exercise 2

The goal of this exercise is to test more features of RIP including its version 2 (RIPv2). The networking
scheme for the exercise is the same as in the previous exercise (Figure 2.13).

1. Start a capture on SimNet2. We start with the configuration of the previous exercise but this time with RIP version 2 in r1, r222 and r3. You can do this using the configuration of the previous exercise and setting version 2 with Quagga or executing sequentially the labels initial and ripv2-a. After approximately 10 seconds, try a ping from h223 to h11.
    Does it work now? Why?

Explain the entries in the RIB of the router r3 and the RIP messages that you observe in SimNet2.

```
terminal:# simctl rip exec initial
terminal:# simctl rip exec ripv2-a
h223:~# ping -c1 192.168.4.11 → OK
```

El ping funciona perq al treballar amb la v2 (classless) funciona funciona amb màscares i ho té tot a la taula de rutes.

1	0.000000000	192.168.2.1	224.0.0.9	RIPv2	66 Request
2	0.023254101	192.168.2.1	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
3	0.096854426	192.168.2.1	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
4	0.973651350	192.168.2.1	224.0.0.9	RIPv2	106 Response
5	1.781116539	192.168.2.1	224.0.0.9	RIPv2	146 Response
6	2.780958814	192.168.2.3	224.0.0.9	RIPv2	66 Request
7	2.781419922	fe:fd:00:00:01:02	Broadcast	ARP	42 Who has 192.168.2.3? Tell 192.168.2.1
8	2.781480295	fe:fd:00:00:03:02	fe:fd:00:00:01:02	ARP	42 192.168.2.3 is at fe:fd:00:00:03:02
9	2.781532187	192.168.2.1	192.168.2.3	RIPv2	146 Response
10	2.781603505	192.168.2.3	224.0.0.9	RIPv2	106 Response
11	2.795493904	fe80::40fb:8ff:fe4a..	ff02::2	ICMPv6	70 Router Solicitation from 42:fb:08:4a:7b:
12	2.806480824	192.168.2.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
13	3.780054019	192.168.2.3	224.0.0.9	RIPv2	106 Response
14	3.785095794	192.168.2.3	224.0.0.9	RIPv2	86 Response
15	11.437780982	192.168.2.3	224.0.0.22	IGMPv3	54 Membership Report / Join group 224.0.0.9
16	34.789249862	192.168.2.3	224.0.0.9	RIPv2	86 Response
17	35.983784613	192.168.2.1	224.0.0.9	RIPv2	146 Response
18	36.783057902	192.168.2.3	224.0.0.9	RIPv2	146 Response

A la SN2, podem veure que tant R1 com R3 consideren la xarxa 0.128/25 com una ruta a part, amb mètrica diferent (2) a la xarxa més gran que l'engloba (0.0/24) (M=1).

2. Capture in SimNet2 and add all the interfaces of r4 to RIP with the Quagga network command.
   Then, using the command ip as explained in Chapter 3, set an IP address of the form 192.168.100.X/32 in each loopback interface of each RIP router (r1, r222, r3 and r4), where X is the number of router (192.168.100.1 for r1 and so on). Then, add these IP addresses to RIP and check that now you can access to any router from h11 using the loopback addresses.
   Describe the commands introduced in each router and the responses sent through SimNet2 by r1 in the steady state. Explain also the entries in the RIB of the routers r1 and r4.

```
r4(config-router)# version 2
r4(config-router)# network 192.168.1.0/24
r4(config-router)# network 172.16.0.0/24

r1:~# ip address add 192.168.100.1/32 dev lo → @IP a loopback
r222:~# ip address add 192.168.100.222/32 dev lo
r3:~# ip address add 192.168.100.3/32 dev lo
r4:~# ip address add 192.168.100.4/32 dev lo

r1(config-router)# network 192.168.0.1/32
r222(config-router)# network 192.168.0.222/32 → redistribuir @IP con
RIP
r3(config-router)# network 192.168.0.3/32
r4(config-router)# network 192.168.0.4/32
```

Si fem pings des de h11 fins a les direccions anteriors funcionen correctament.
Si observem les RIB de r1 i r4 observem que contenen totes les @lo com assolibles, però si mirem els missatges de Responses, cap dels dos inclou a l'altre a causa de l'Split horizon. Aquest no envia missatges d'anunci de la ruta perquè tu ja li has fet una connexió directa. Els anuncis es produeixen amb el triggered updated, és a dir, just al mateix moment quan es produeixen. És una bona opció utilitzar la interfície de loopback ja que es la única que no pot caure, i ens assegurem que mentre el router estigui actiu podrem accedir a ell.

3. For the rest of the exercise, we simulate a link has been broken.Capture in SimNet3 and set eth2 down in r3.
   After the link is down, describe the responses that you observe in SimNet3 during at least 5 mnutes. In addition, describe the entries in the RIB of the router r1.
   (INITIAL, RIPv2-a, RIPv2-b)
   `r3:~# ifconfig eth2 down` → per simular que el link s'ha trencat
   Si observem la RIB de R1, ha canviat tots els seus gateways i ara per anar a qualsevol xarxa ha de passar pel r222, modificant les pertinents rutes.
   Ara si es vol anar des de R3 a R1, s'ha de passar per R222, però a SN3 no veiem cap Response amb la informació per Split horizon perquè, de fet, aquesta ja és la seva ruta.
4. Try a ping from h11 to the loopback address of r3. Does it work? Which is the path that ICMP messages follow? Under the current network state (link eth2 of r3 is down), is this path optimal? Note. You can use the traceroute command.
   Now, try a ping from h11 to the loopback address of r4. Does it work? Which is the path that ICMP messages follow? Under the current network state, is this path optimal? Why? Can you change the RIP configuration of any router to make this path more efficient (i.e. use a shorter path)?
   h11:~# ping –c1 192.168.100.3 à El ping funciona i va per R222. Tenint en compte que l'eth2 de R3 no està operatiu, aquest és el camí més òptim.
   h11:~# traceroute 192.168.100.3 à Traceroute envia missatges UDP (Força errors), augmenta el TTL fins que arriba al destí.
   1 192.168.4.1 (192.168.4.1) 0.101 ms 0.048 ms 0.038 ms
   2 192.168.3.222 (192.168.3.222) 0.120 ms 0.080 ms 0.198 ms
   3 192.168.100.3 (192.168.100.3) 0.152 ms 0.120 ms 0.118 ms
   h11:~# ping -c1 192.168.100.4 à OK!
   h11:~# traceroute 192.168.100.4
   1 192.168.4.1 (192.168.4.1) 0.095 ms 0.045 ms 0.040 ms
   2 192.168.3.222 (192.168.3.222) 0.121 ms 0.084 ms 0.082 ms
   3 192.168.5.3 (192.168.5.3) 0.155 ms 0.120 ms 0.117 ms
   4 192.168.100.4 (192.168.100.4) 0.181 ms 0.156 ms 0.155 ms
   Aquest camí no és òptim ja que podria anar per la eth1 de r1, però com que no coneix la ruta directa pega tota la volta. Es podria afegir la xarxa 172.16.0.0/16 a RIP per poder optimitzar el camí.
   r4(config-router)# network 172.16.0.0/16
   r1(config-router)# network 172.16.0.0/16
5. In r1, start RIP for the network 172.16.0.0/16, configure a static route to the network 10.10.10.0/24 and redistribute static routes. Try a ping from h33 to 10.10.10.10 and describe the path. It is optimal? why? Discuss how the network 10.10.10.0/24 is announced by r1 through eth1 and eth3.
   r1(config-router)# network 172.16.0.0/16
   r1(config)# ip route 10.0.0.0/24 172.16.0.1 à static route (S)
   r1(config-router)# redistribute static à redistribució de rutes
   h33:~# ping –c1 10.10.10.10 à El Request és òptim, passa per R4, però el Reply segueix un camí que no ho és (r3àr222àr1àr5), en lloc de passar per R4.
6. initial,ripv2-a,ripv2-b,ripv2-c In this exercise, we deal with default routes and how they can be included in a RIP domain. In first place, explain in which RIP routers of our topology you can you originate a default route and why? Then, select one of these routers, create a default route and originate it for RIP.
   Capture in SimNet6 and describe the traffic captured when you send a ping from h33 and from h11 to the host in the Internet 10.20.20.20. Use three requests for each ping (option -c3). Discuss the path that the ICMP messages follow.

Can you improve the configuration with more routers originating the default route in RIP? If so, explain an test your configuration.
(INITIAL, RIPv2-a, RIPv2-b, RIPv2-c)
Podem establir rutes per defecte als router R1 i R4, que són els dos router que tenen sortida cap a l'exterior (Internet)
r1(config-router)# default-information originate à També podria ser a R4
h11/h33:~# ping –c3 10.20.20.20 à Destination net unreachable (enviat per R1)
Per millorar la configuració també podríem establir R4 com a ruta per defecte.