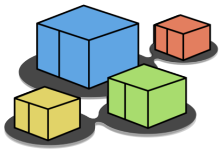
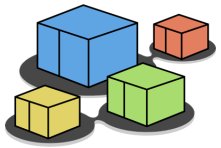


Kathará

kathara lab

rip with FRRouting

Version	1.1
Author(s)	G. Di Battista, M. Patrignani, M. Pizzonia, L. Ariemma, M. Scazzariello, T. Caiazzi
E-mail	contact@kathara.org
Web	http://www.kathara.org/
Description	experiences with the ripv2 distance vector routing protocol – derives from kathara rip lab ver. 1.2 which, in turns, derives from netkit rip lab ver. 2.4



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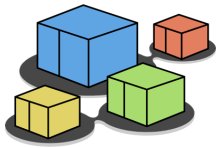
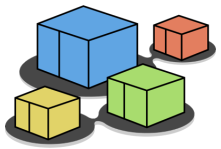


the RIP protocol

- RIP is a routing protocol
- RIPS is a distance-vector routing protocol
  - approach: send all your information to a few
  - update your routing information based on what you hear
- in this lab we will see an example of RIPv2 protocol on the FRRouting Suite

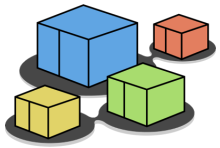


sample `frr.conf` configuration file

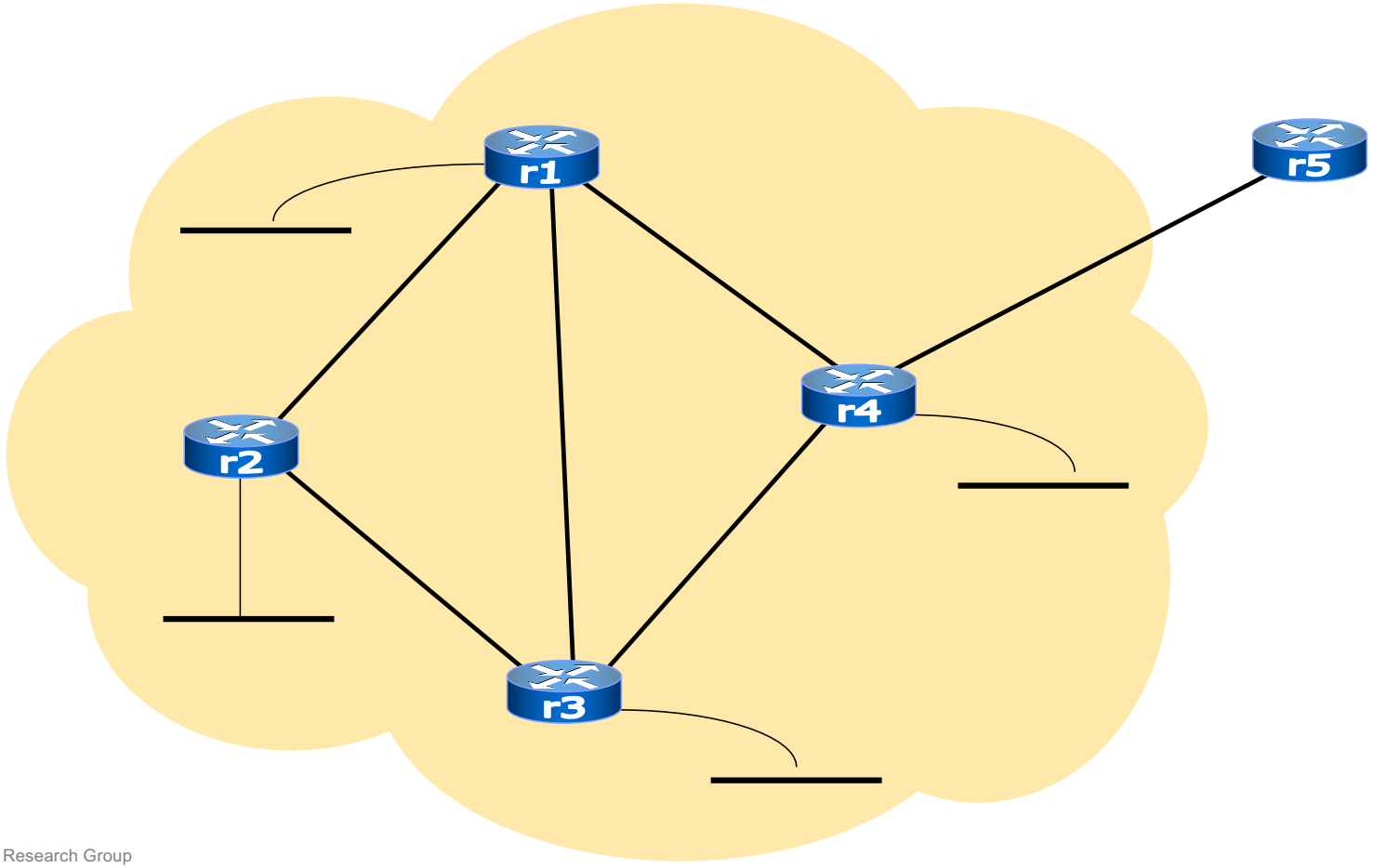
```
root@pc1:~$ cat /etc/frr/frr.conf
!
! FRRouting configuration file
!
!
!   RIP CONFIGURATION
!
router rip
network 100.1.0.0/16
!
log file /var/log/frr/frr.log
```

talk rip on some interface

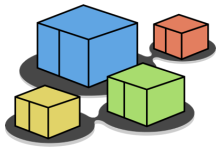
send rip multicast packets to interfaces falling into this prefix



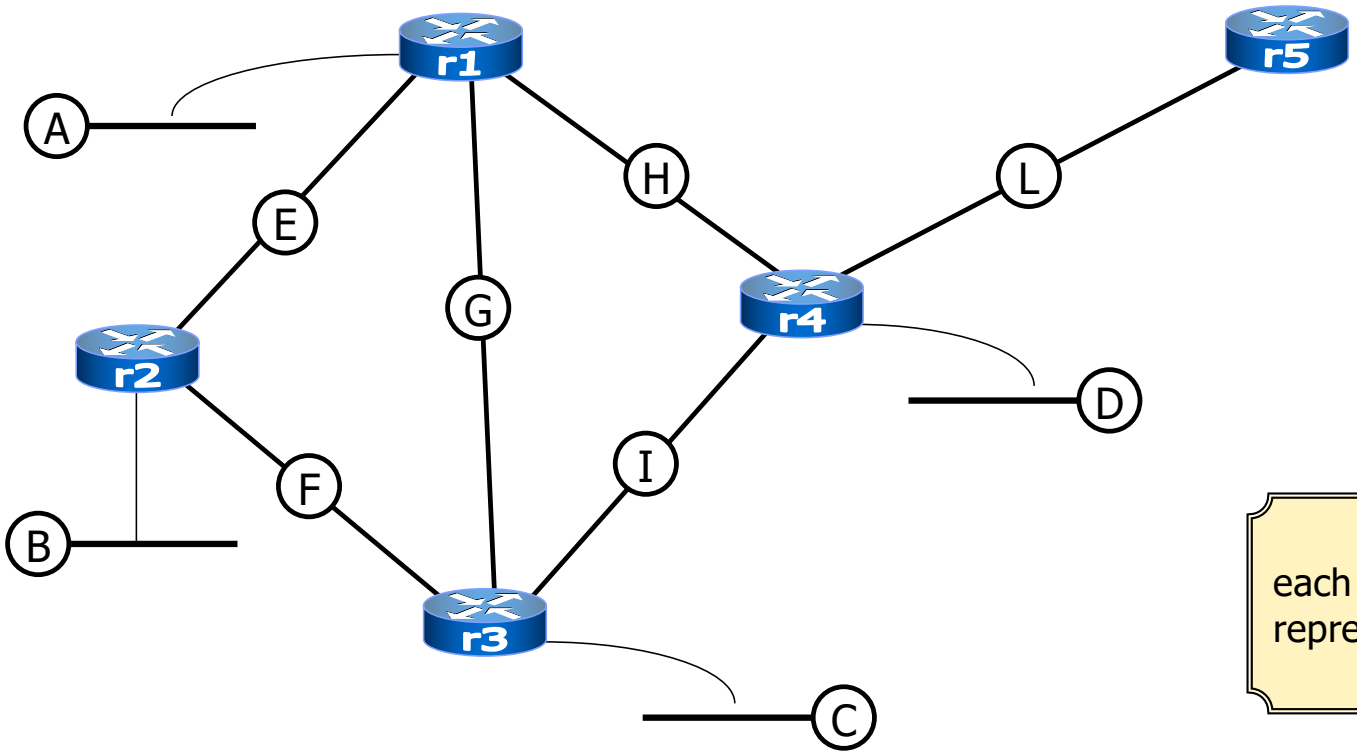
small network connected to Internet



last update: Oct 2023

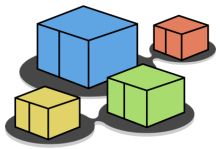


the involved ip subnets

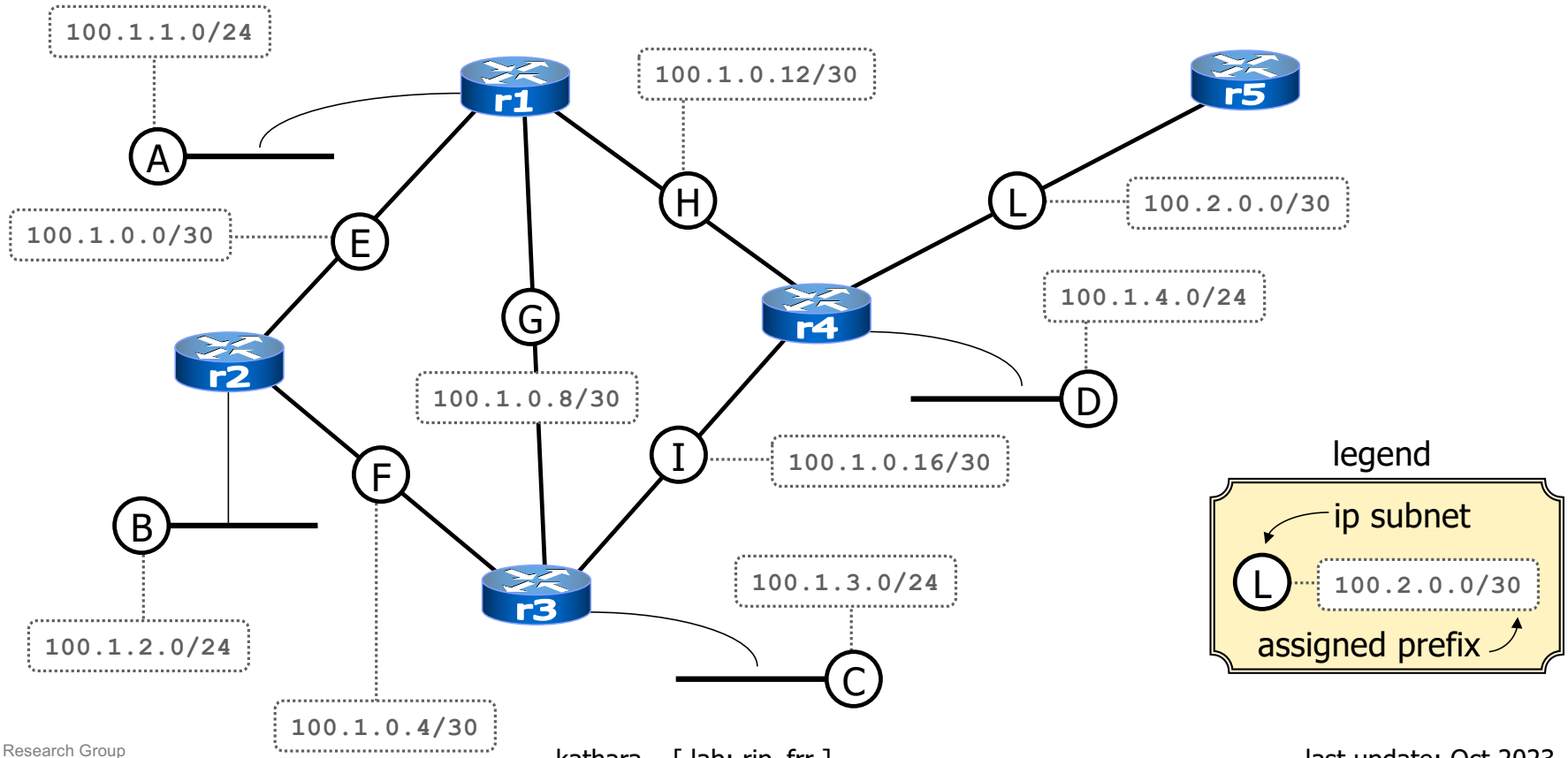


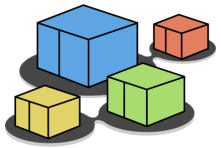
legend

each circle ○ represents a subnet

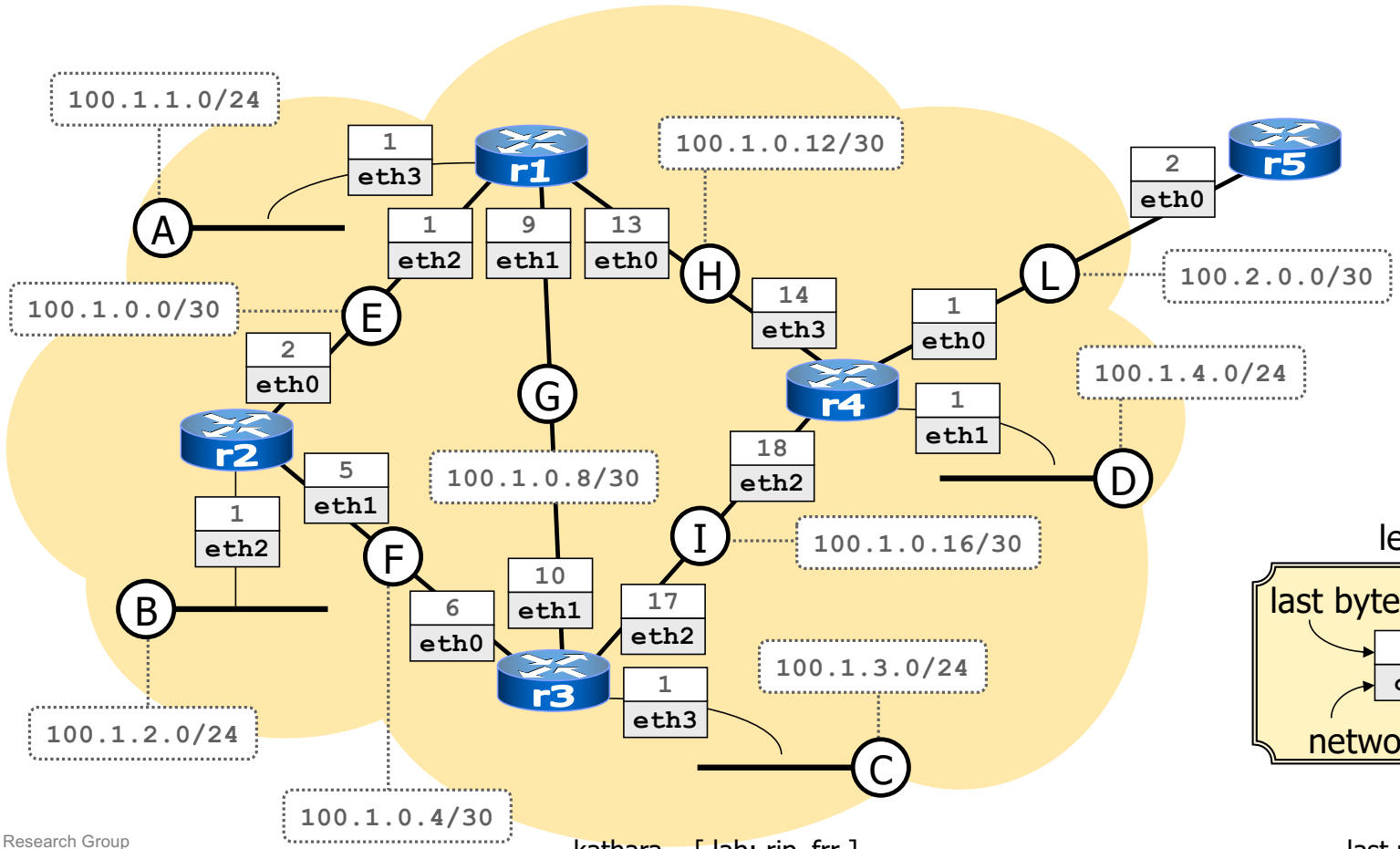


assigning ip numbers to subnets

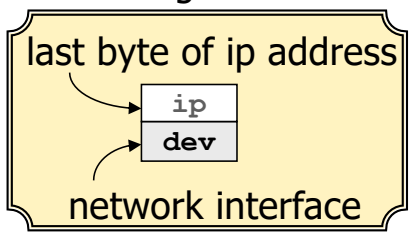


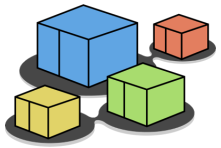


assigning ip numbers to interfaces



legend

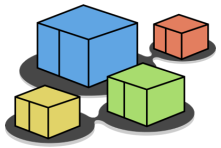




launching the lab

```
root@localhost:~$ cd kathara-lab_rip
root@localhost:~/kathara-lab_rip$ kathara lstart
```

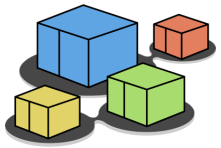
- the lab configuration is such that the frr routing daemon is not automatically started



checking connectivity

- towards a directly connected destination

```
root@r4:~$ ping 100.1.0.13
PING 100.1.0.13 (100.1.0.13) 56(84) bytes of data.
64 bytes from 100.1.0.13: icmp_seq=1 ttl=64 time=1.23 ms
64 bytes from 100.1.0.13: icmp_seq=2 ttl=64 time=0.592 ms
64 bytes from 100.1.0.13: icmp_seq=3 ttl=64 time=0.393 ms

--- 100.1.0.13 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2032ms
rtt min/avg/max/mdev = 0.393/0.741/1.238/0.360 ms
```

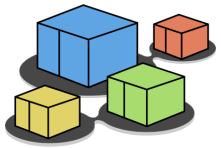


checking connectivity

- towards a remote destination

```
root@r4:~$ ping 100.1.2.1
connect: Network is unreachable
```

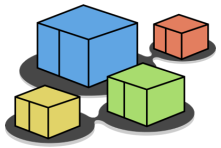
- what's going on?



examining the kernel routing table

```
root@r4:~$ ip route
100.1.0.12/30 dev eth3 proto kernel scope link src 100.1.0.14
100.1.0.16/30 dev eth2 proto kernel scope link src 100.1.0.18
100.1.4.0/24 dev eth1 proto kernel scope link src 100.1.4.1
100.2.0.0/30 dev eth0 proto kernel scope link src 100.2.0.1
```

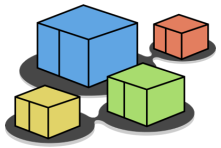
- since no routing daemon is currently running, only directly connected destinations are known to the router



starting the routing daemons

- on each router (but **`r5`**) issue the following command:

```
root@r4:~$ systemctl start frr
```

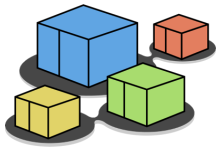


checking connectivity (again)

- towards a remote destination

```
root@r4:~$ ping 100.1.2.1
PING 100.1.2.1 (100.1.2.1) 56(84) bytes of data.
64 bytes from 100.1.2.1: icmp_seq=1 ttl=63 time=0.743 ms
64 bytes from 100.1.2.1: icmp_seq=2 ttl=63 time=0.875 ms
64 bytes from 100.1.2.1: icmp_seq=3 ttl=63 time=0.685 ms

--- 100.1.2.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2005ms
rtt min/avg/max/mdev = 0.685/0.767/0.875/0.085 ms
```

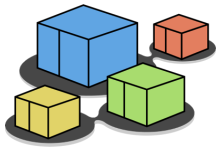
- after a while, all remote destinations are reachable



checking the routing table

- the routing table is now updated

```
root@r4:~$ ip route
100.1.0.0/30 nhid 12 via 100.1.0.13 dev eth3 proto rip metric 20
100.1.0.4/30 nhid 10 via 100.1.0.17 dev eth2 proto rip metric 20
100.1.0.8/30 nhid 10 via 100.1.0.17 dev eth2 proto rip metric 20
100.1.0.12/30 dev eth3 proto kernel scope link src 100.1.0.14
100.1.0.16/30 dev eth2 proto kernel scope link src 100.1.0.18
100.1.1.0/24 nhid 12 via 100.1.0.13 dev eth3 proto rip metric 20
100.1.2.0/24 nhid 12 via 100.1.0.13 dev eth3 proto rip metric 20
100.1.3.0/24 nhid 10 via 100.1.0.17 dev eth2 proto rip metric 20
100.1.4.0/24 dev eth1 proto kernel scope link src 100.1.4.1
100.2.0.0/30 dev eth0 proto kernel scope link src 100.2.0.1
```

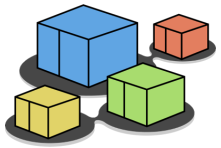


a look at ripv2 packets

- let's sniff ripv2 packets

```
root@r4:~$ tcpdump -tenni eth2 -v
```

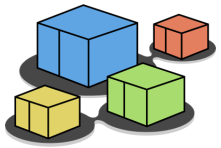
display packet details
(enable full protocol decoding)



a look at ripv2 packets

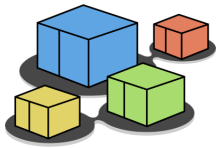
- let's sniff ripv2 packets

```
root@r4:~$ tcpdump -tenni eth2 -v
76:b9:c2:6b:d7:d8 > 01:00:5e:00:00:09, ethertype IPv4 (0x0800), length 166:
(tos 0xc0, ttl 1, id 62062, offset 0, flags [DF], proto UDP (17), length 152)
    100.1.0.17.520 > 224.0.0.9.520:
RIPv2, Response, length: 124, routes: 6 or less
  AFI IPv4,       100.1.0.0/30, tag 0x0000, metric: 2, next-hop: self
  AFI IPv4,       100.1.0.4/30, tag 0x0000, metric: 1, next-hop: self
  AFI IPv4,       100.1.0.8/30, tag 0x0000, metric: 1, next-hop: self
  AFI IPv4,       100.1.1.0/24, tag 0x0000, metric: 2, next-hop: self
  AFI IPv4,       100.1.2.0/24, tag 0x0000, metric: 2, next-hop: self
  AFI IPv4,       100.1.3.0/24, tag 0x0000, metric: 1, next-hop: self
```



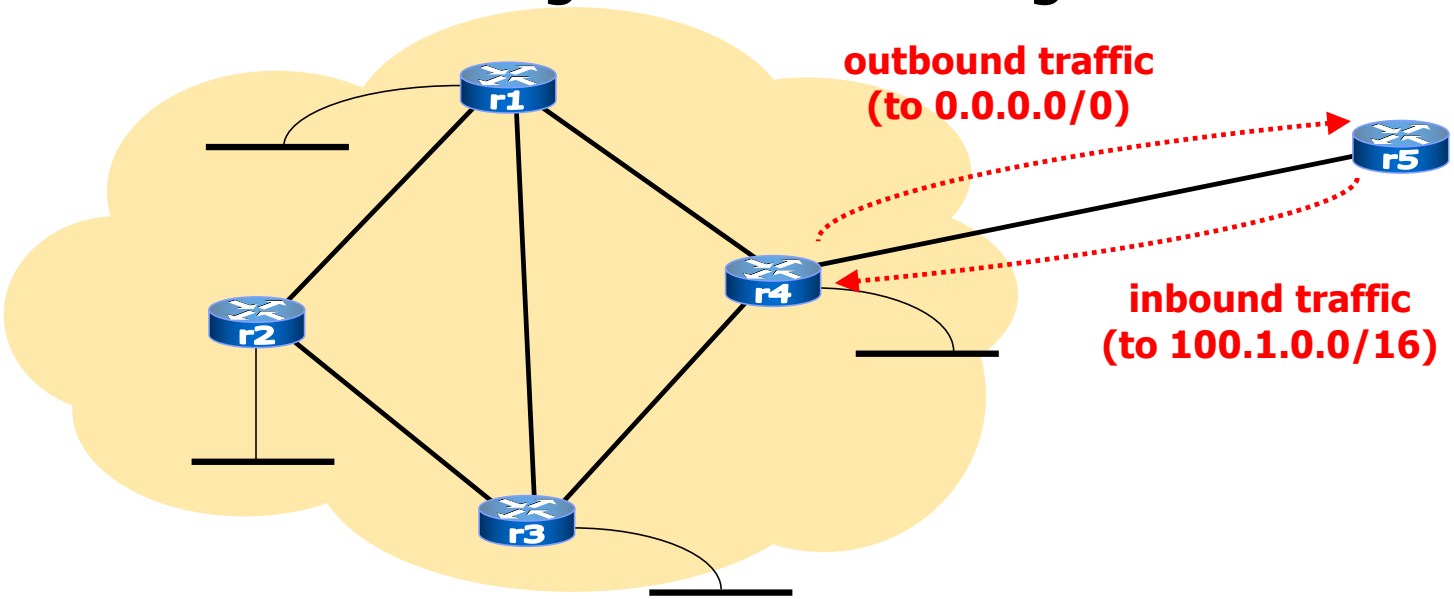
inspecting the rip routing table

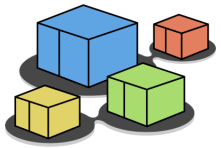
```
root@r4:~$ vtysh
r4# show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network            Next Hop         Metric From            Tag Time
R(n) 100.1.0.0/30       100.1.0.13            2 100.1.0.13        0 02:55
R(n) 100.1.0.4/30       100.1.0.17            2 100.1.0.17        0 02:27
R(n) 100.1.0.8/30       100.1.0.17            2 100.1.0.17        0 02:27
C(i) 100.1.0.12/30      0.0.0.0               1 self              0
C(i) 100.1.0.16/30      0.0.0.0               1 self              0
R(n) 100.1.1.0/24       100.1.0.13            2 100.1.0.13        0 02:55
R(n) 100.1.2.0/24       100.1.0.13            3 100.1.0.13        0 02:55
R(n) 100.1.3.0/24       100.1.0.17            2 100.1.0.17        0 02:27
C(r) 100.1.4.0/24       0.0.0.0               1 self              0
C(r) 100.2.0.0/30       0.0.0.0               1 self              0
```



static routing

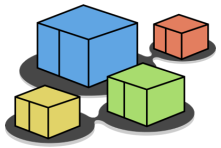
- our network is a stub network (i.e., it has just one connection to an external router, `r5`); hence, static routes are enough for connecting it to the internet





adding a static route to `r5`

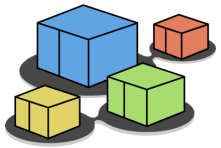
```
root@r5:~$ ip route add 100.1.0.0/16 via 100.2.0.1
root@r5:~$ ping 100.1.2.1
PING 100.1.2.1 (100.1.2.1) 56(84) bytes of data.
64 bytes from 100.1.2.1: icmp_seq=1 ttl=62 time=24.1 ms
64 bytes from 100.1.2.1: icmp_seq=2 ttl=62 time=1.11 ms

--- 100.1.2.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1023ms
rtt min/avg/max/mdev = 1.117/12.634/24.151/11.517 ms
```



configuring r4

- step 1: configuring the default route

```
root@r4:~$ ip route add default via 100.2.0.2
root@r4:~$ ip route
default via 100.2.0.2 dev eth0
100.1.0.0/30 nhid 12 via 100.1.0.13 dev eth3 proto rip metric 20
100.1.0.4/30 nhid 10 via 100.1.0.17 dev eth2 proto rip metric 20
100.1.0.8/30 nhid 10 via 100.1.0.17 dev eth2 proto rip metric 20
100.1.0.12/30 dev eth3 proto kernel scope link src 100.1.0.14
100.1.0.16/30 dev eth2 proto kernel scope link src 100.1.0.18
100.1.1.0/24 nhid 12 via 100.1.0.13 dev eth3 proto rip metric 20
100.1.2.0/24 nhid 12 via 100.1.0.13 dev eth3 proto rip metric 20
100.1.3.0/24 nhid 10 via 100.1.0.17 dev eth2 proto rip metric 20
100.1.4.0/24 dev eth1 proto kernel scope link src 100.1.4.1
100.2.0.0/30 dev eth0 proto kernel scope link src 100.2.0.1
```



configuring r4

- step 2: propagating the default route into rip

```
root@r4:~$ vtysh

Hello, this is FRRouting (version 8.0.1).
Copyright 1996-2005 Kunihiro Ishiguro,

r4# configure
r4(config)# router rip
r4(config-router)# route 0.0.0.0/0
r4(config-router)# quit
r4(config)# quit
r4# exit
```

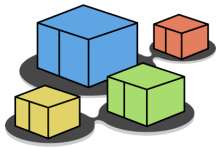
begin configuration

configure the rip protocol

statically configure the default route

end of rip configuration

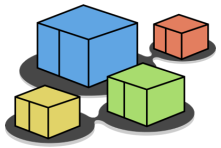
end configuration



the default route

- after a while, the default route has been injected (via rip) into the network

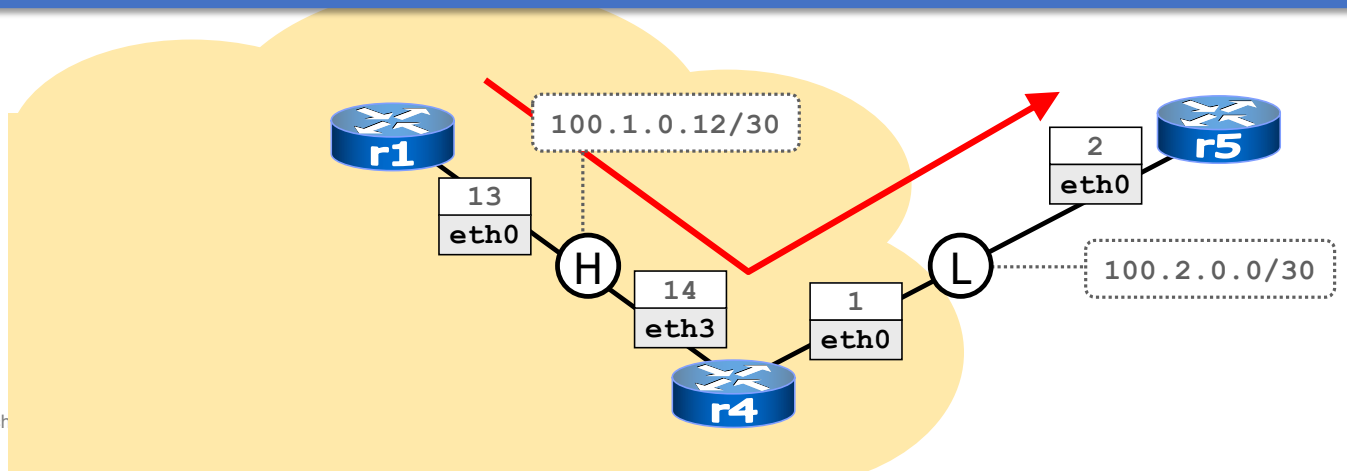
```
root@r1:~$ ip route
default nhid 12 via 100.1.0.14 dev eth0 proto rip metric 20
100.1.0.0/30 dev eth2 proto kernel scope link src 100.1.0.1
100.1.0.4/30 nhid 11 via 100.1.0.10 dev eth1 proto rip metric 20
100.1.0.8/30 dev eth1 proto kernel scope link src 100.1.0.9
100.1.0.12/30 dev eth0 proto kernel scope link src 100.1.0.13
100.1.0.16/30 nhid 12 via 100.1.0.14 dev eth0 proto rip metric 20
100.1.1.0/24 dev eth3 proto kernel scope link src 100.1.1.1
100.1.2.0/24 nhid 14 via 100.1.0.2 dev eth2 proto rip metric 20
100.1.3.0/24 nhid 11 via 100.1.0.10 dev eth1 proto rip metric 20
100.1.4.0/24 nhid 12 via 100.1.0.14 dev eth0 proto rip metric 20
100.2.0.0/30 nhid 12 via 100.1.0.14 dev eth0 proto rip metric 20
```

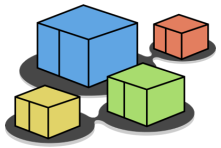


checking connectivity

any (even non-existing) destination

```
root@r1:~$ ping 193.204.161.1
PING 193.204.161.1 (193.204.161.1) 56(84) bytes of data.
From 100.2.0.2 icmp_seq=1 Destination Net Unreachable
From 100.2.0.2 icmp_seq=2 Destination Net Unreachable

--- 193.204.161.1 ping statistics ---
2 packets transmitted, 0 received, +2 errors, 100% packet loss,
time 999ms
```

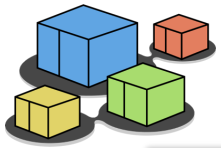




checking connectivity

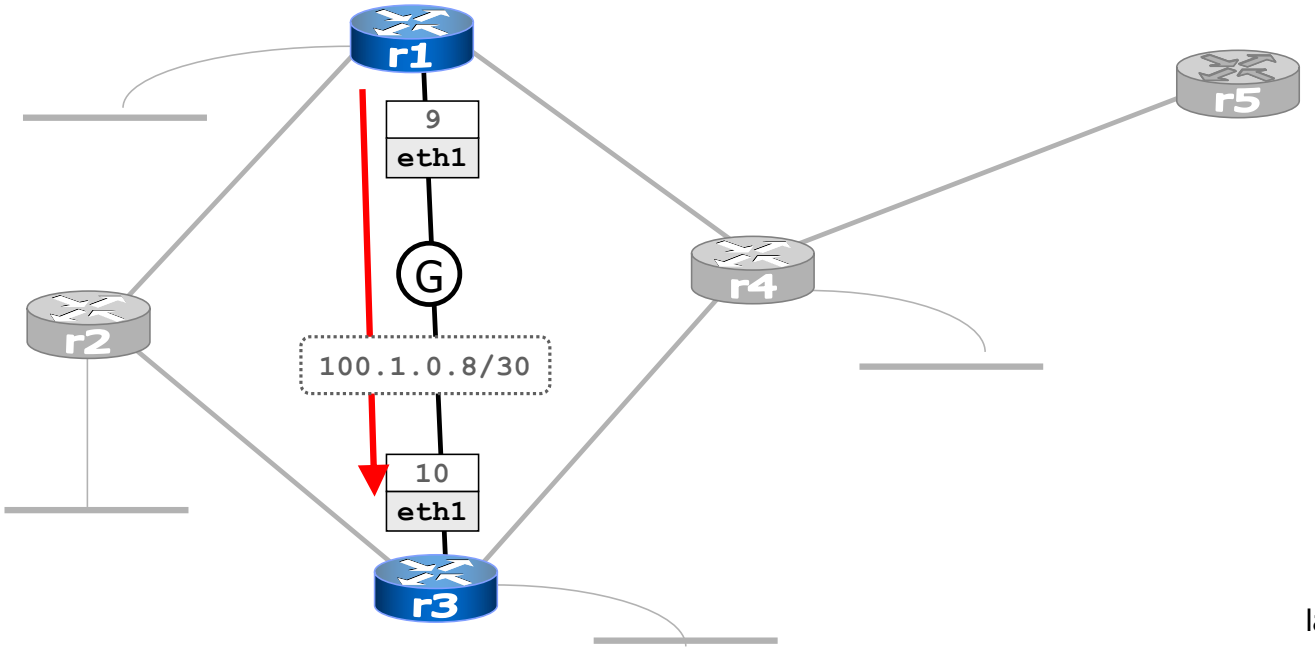
- **r5** is actually receiving echo request packets

```
root@r5:~$ tcpdump -tenni eth0
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth0, link-type EN10MB (Ethernet), capture size 1518 bytes
11:38:43.822503 arp who-has 100.2.0.2 tell 100.2.0.1
11:38:43.824221 arp reply 100.2.0.2 is-at fe:fd:64:02:00:02
11:38:43.825890 IP 100.1.0.13 > 193.204.161.1: icmp 64: echo request seq 1
11:38:43.827139 IP 100.2.0.2 > 100.1.0.13: icmp 92: net 193.204.161.1 unreachable
11:38:44.841566 IP 100.1.0.13 > 193.204.161.1: icmp 64: echo request seq 2
11:38:44.841651 IP 100.2.0.2 > 100.1.0.13: icmp 92: net 193.204.161.1 unreachable

6 packets captured
6 packets received by filter
0 packets dropped by kernel
```

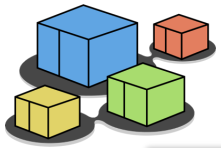


shutting down an interface

```
root@r1:~$ traceroute 100.1.0.10
traceroute to 100.1.0.10 (100.1.0.10), 64 hops max, 40 byte packets
 1  100.1.0.10 (100.1.0.10)  24 ms  1 ms  1 ms
root@r1:~$ ip link set eth1 down
```

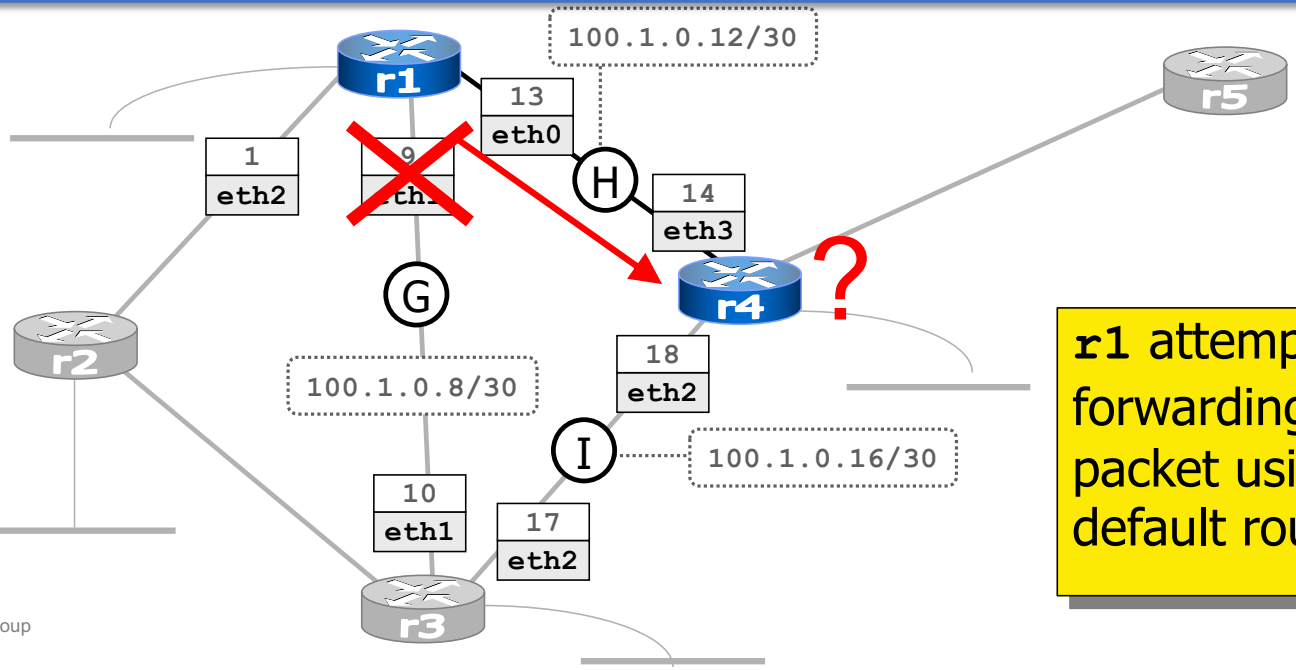


last update: Oct 2023



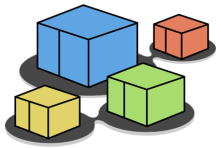
shutting down an interface

```
root@r1:~$ traceroute 100.1.0.10
traceroute to 100.1.0.10 (100.1.0.10), 64 hops max, 40 byte packets
 1  100.1.0.14 (100.1.0.10)  1 ms  1 ms  1 ms
 2  * * *
 3  * * *
```



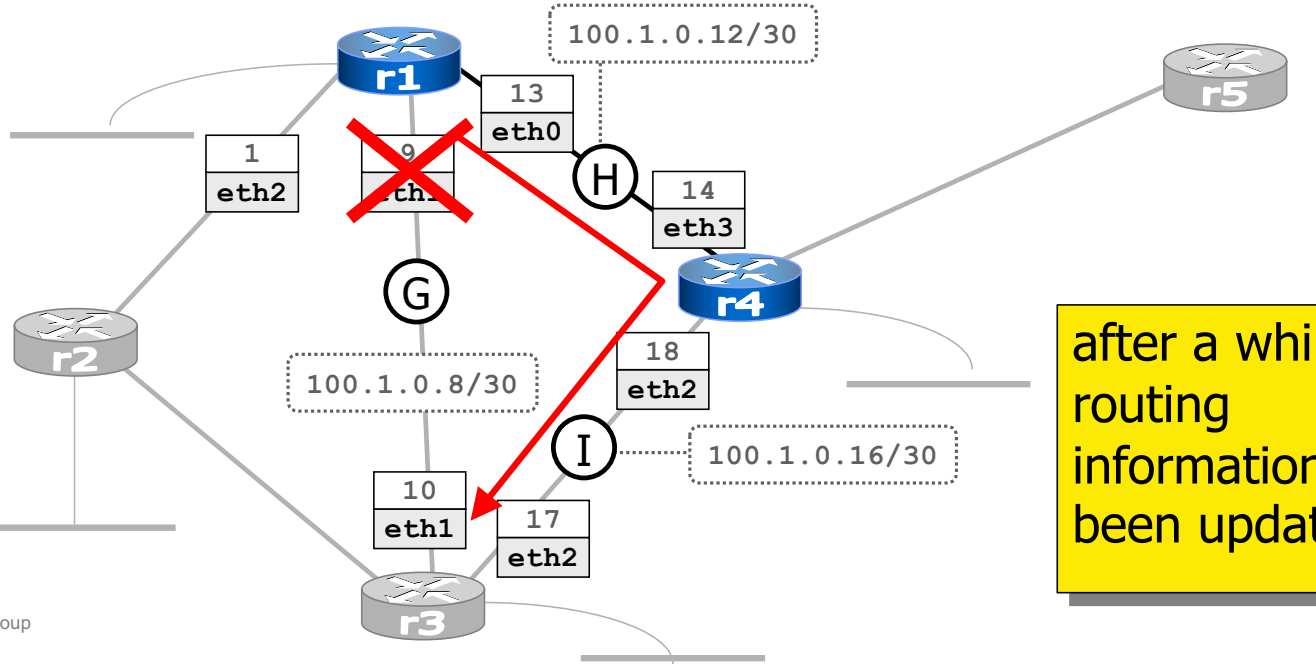
r1 attempts forwarding the packet using the default route

last update: Oct 2023



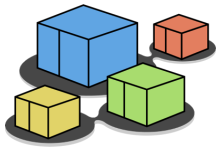
shutting down an interface

```
root@r1:~$ traceroute 100.1.0.10
traceroute to 100.1.0.10 (100.1.0.10), 64 hops max, 40 byte packets
 1  100.1.0.14 (100.1.0.14)  1 ms  1 ms  1 ms
 2  100.1.0.10 (100.1.0.10)  5 ms  2 ms  1 ms
```



after a while, routing information has been updated

last update: Oct 2023



about `redistribute connected`

- by default (i.e., without further configuration) RIP already propagates information about all directly connected subnets attached to RIP-speaking interfaces
- **`redistribute connected`** forces RIP to propagate information about all connected subnets
- the semantic of **`redistribute connected`** applies to all routing protocols
- the default behavior does not
  - some protocols (e.g., bgp) are lazier, and do not propagate anything unless explicitly told to do so