Università degli Studi Roma Tre
Dipartimento di Ingegneria
Computer Networks Research Group

# kathara lab

## rip

| | |
|---|---|
| **Version** | 1.0 |
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| **E-mail** | contact@kathara.org |
| **Web** | http://www.kathara.org/ |
| **Description** | experiences with the ripv2 distance vector routing protocol – kathara version of the rip lab of netkit (vers. 2.4) |

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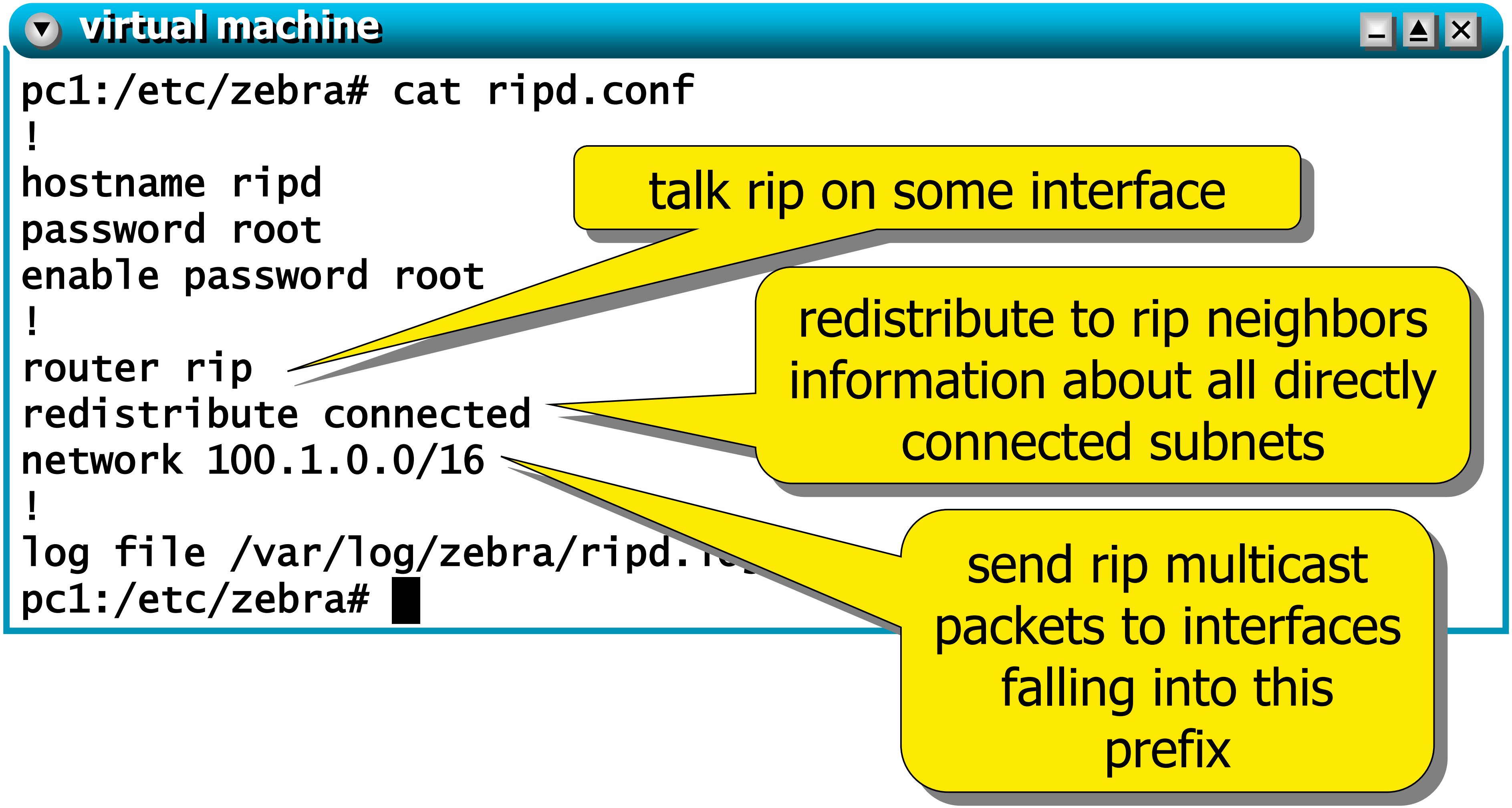
# routing protocols

- routing protocols are used to automatically update the routing tables
- they fall into two main cathegories:
  - link-state routing protocols
    - approach: send the minimum information to everyone
    - each router reconstructs the whole network graph and computes a shortest path tree to all destinations
    - examples: is-is, ospf
  - distance-vector routing protocols
    - approach: send all your information to a few
    - update your routing information based on what you hear
    - examples: rip, bgp
- in this lab we will see an example of RIPv2 protocol on quagga boxes

# sample ripd configuration file (`ripd.conf`)



```
pc1:/etc/zebra# cat ripd.conf
!
hostname ripd
password root
enable password root
!
router rip
redistribute connected
network 100.1.0.0/16
!
log file /var/log/zebra/ripd.log
pc1:/etc/zebra# █
```

talk rip on some interface

redistribute to rip neighbors information about all directly connected subnets

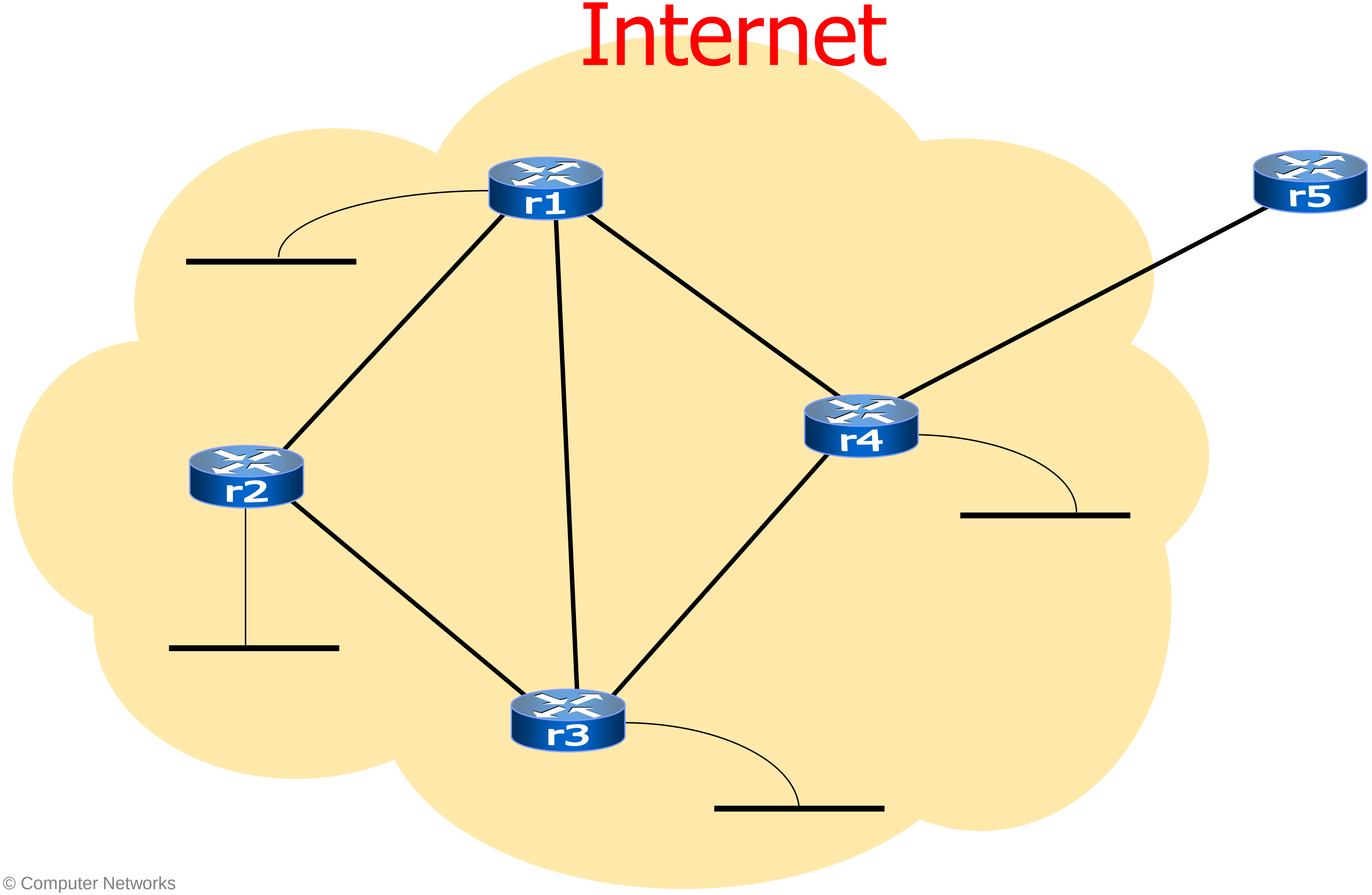
send rip multicast packets to interfaces falling into this prefix

# about `redistribute connected`

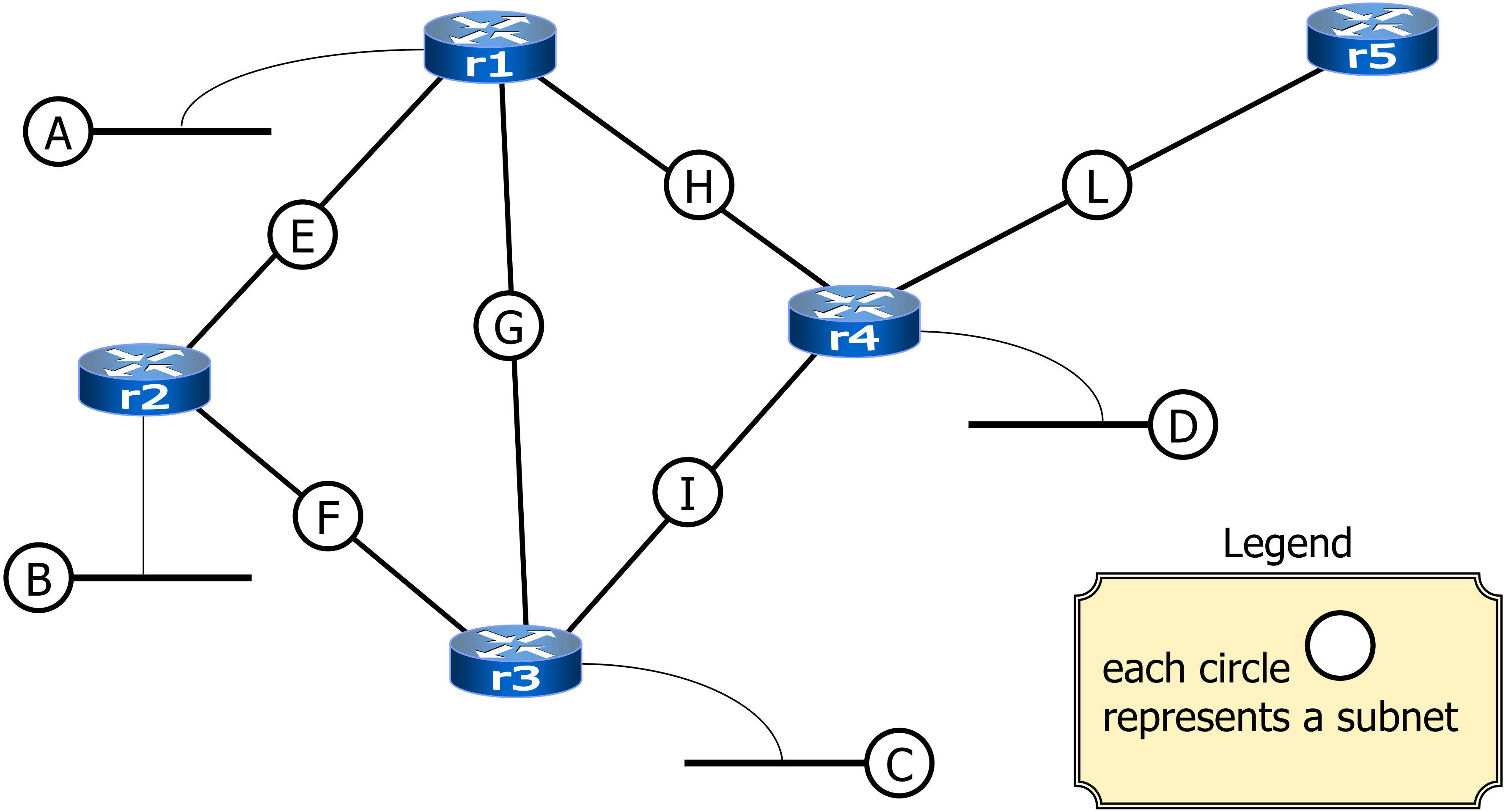
- by default (i.e., without further configuration) RIP already propagates information about directly connected subnets...
  ...attached to RIP-speaking interfaces only
- **`redistribute connected`** forces RIP to propagate information about *all* connected subnets

- 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

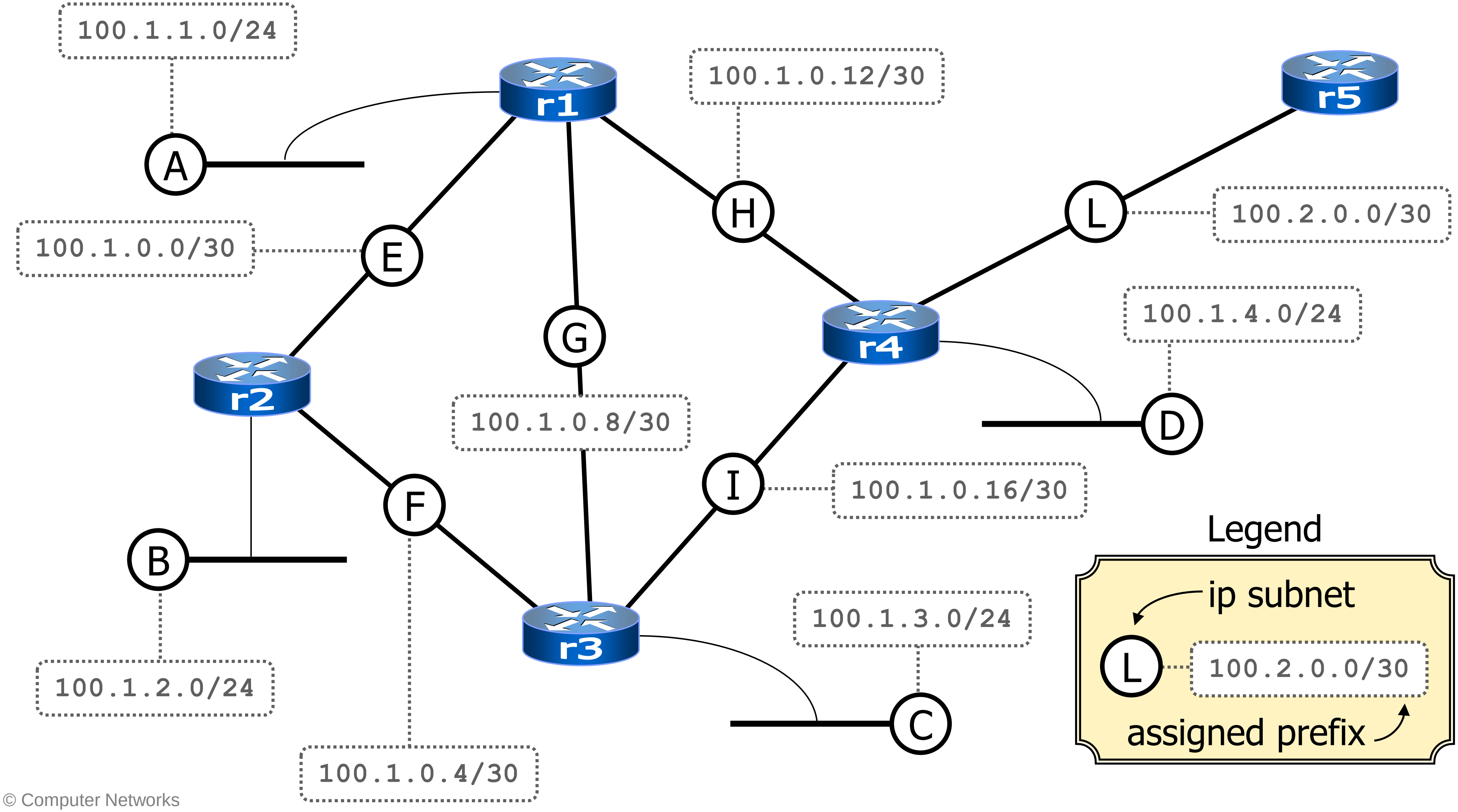
# a small network connected to the Internet



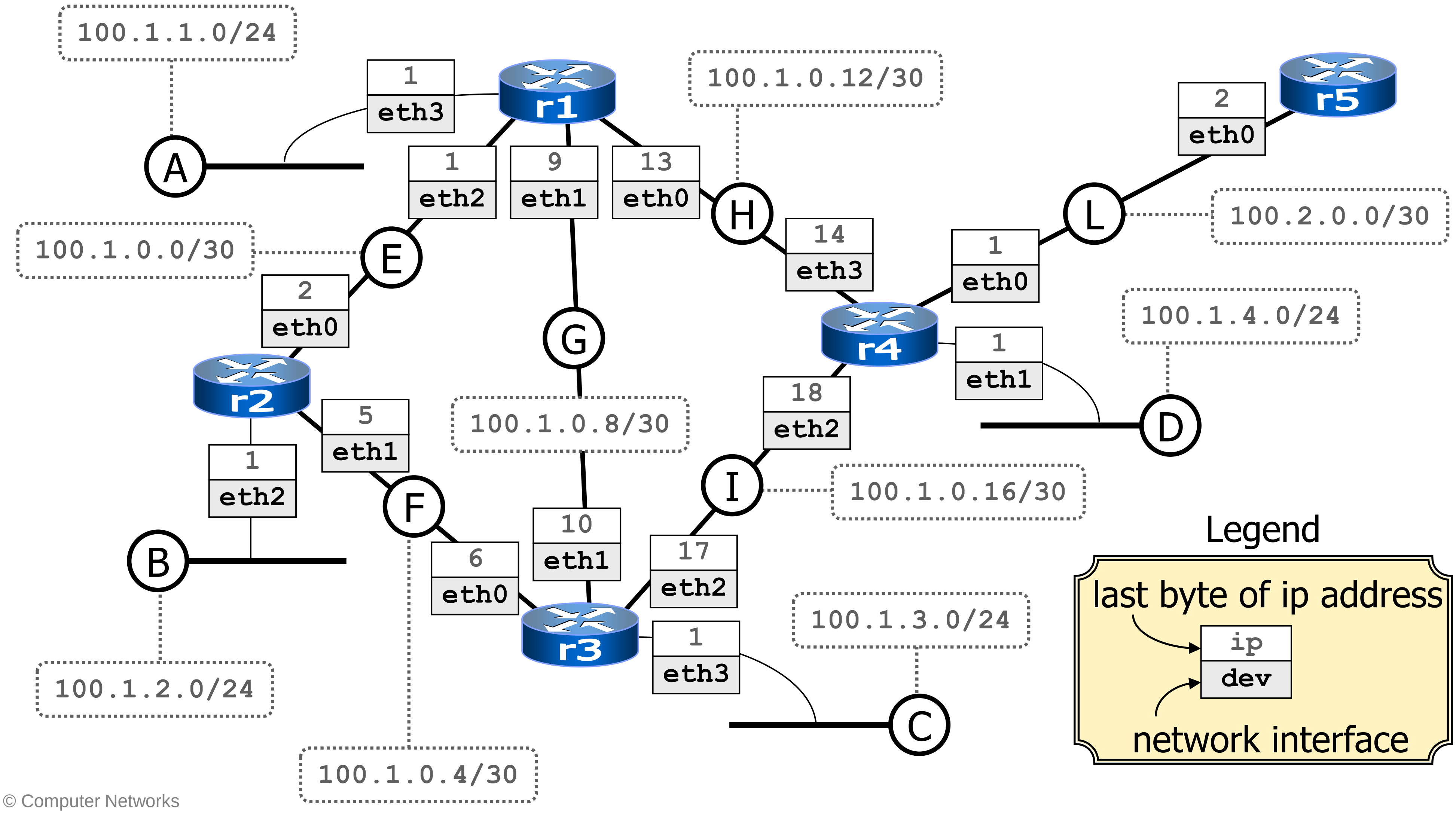
# the involved ip subnets



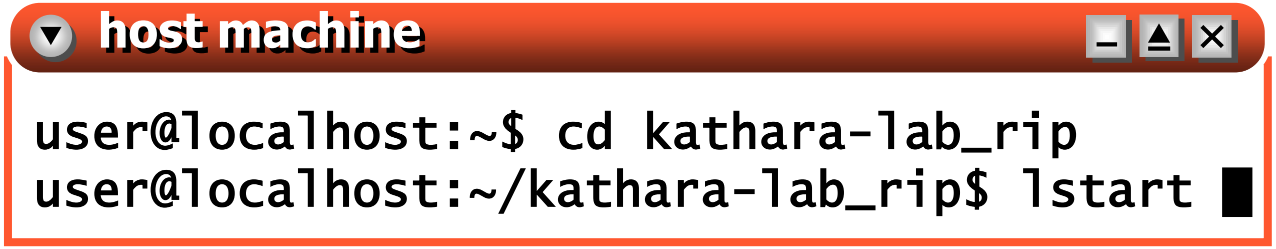
# assigning ip numbers to subnets



# assigning ip numbers to interfaces



# launching the lab script

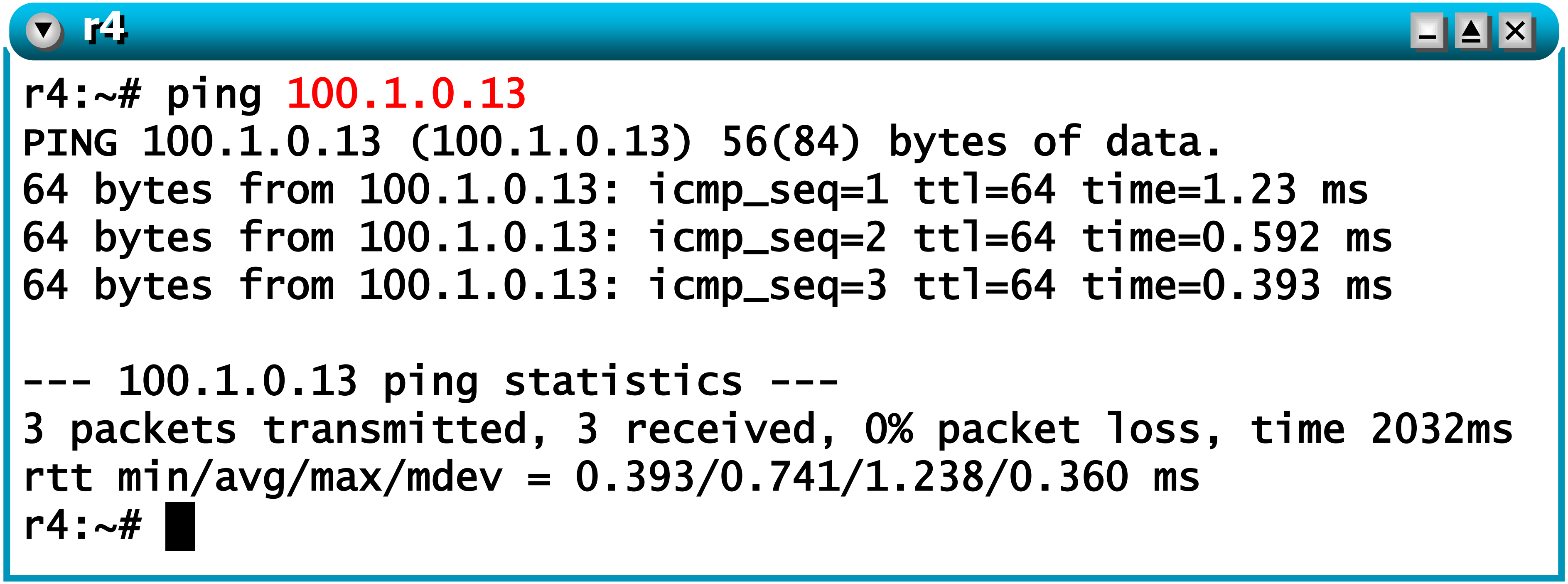


```
user@localhost:~$ cd kathara-lab_rip
user@localhost:~/kathara-lab_rip$ lstart
```

- the lab configuration is such that
  - five virtual hosts are created and connected to the right collision domains (virtual hubs)
  - for each virtual host
    - network interfaces are automatically configured
    - configuration files **`/etc/quagga/daemons`**, **`/etc/quagga/zebra.conf`**, and **`/etc/quagga/ripd.conf`** are updated
  - the zebra routing daemon is <u>not</u> automatically started

# checking connectivity

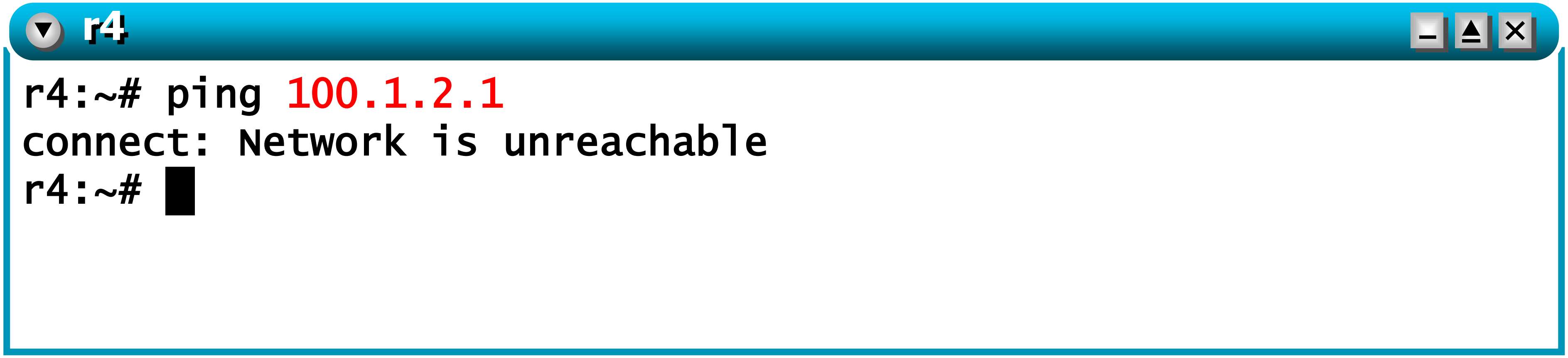
- towards a directly connected destination



```
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
r4:~#
```

# checking connectivity

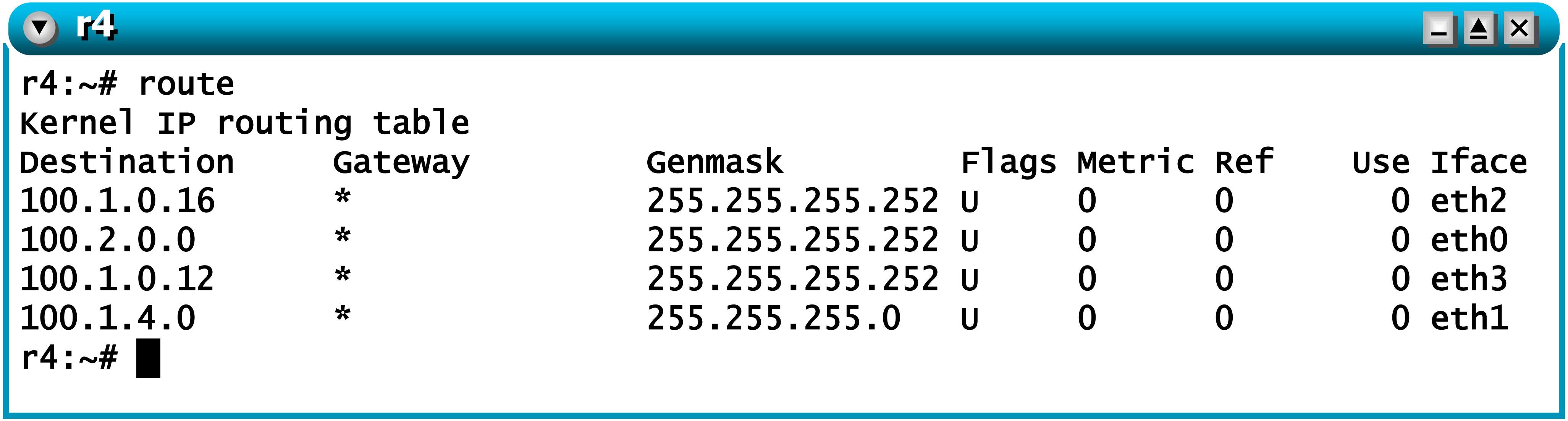
- towards a remote destination



```
r4:~# ping 100.1.2.1
connect: Network is unreachable
r4:~# █
```

- what's going on?

# examining the kernel routing table

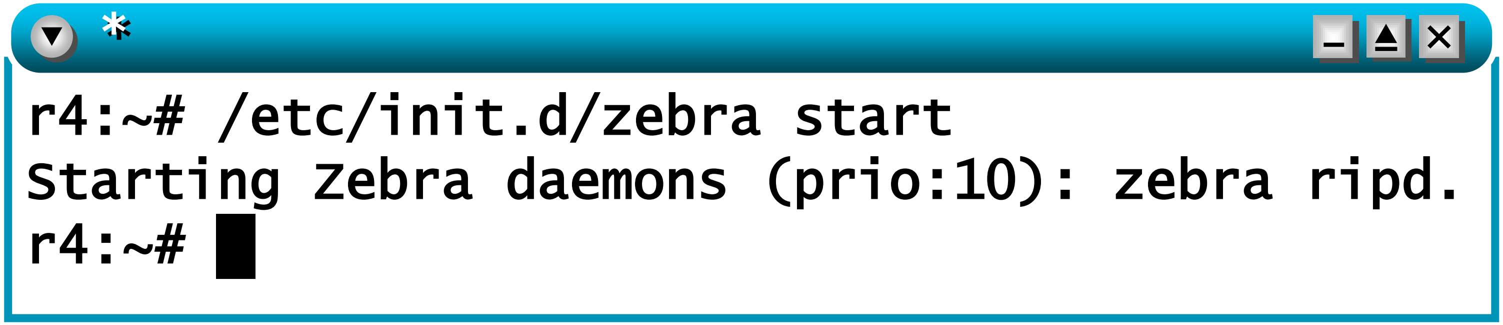


```
r4:~# route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
100.1.0.16      *               255.255.255.252 U     0      0        0 eth2
100.2.0.0       *               255.255.255.252 U     0      0        0 eth0
100.1.0.12      *               255.255.255.252 U     0      0        0 eth3
100.1.4.0       *               255.255.255.0   U     0      0        0 eth1
r4:~# █
```

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

# starting the routing daemons

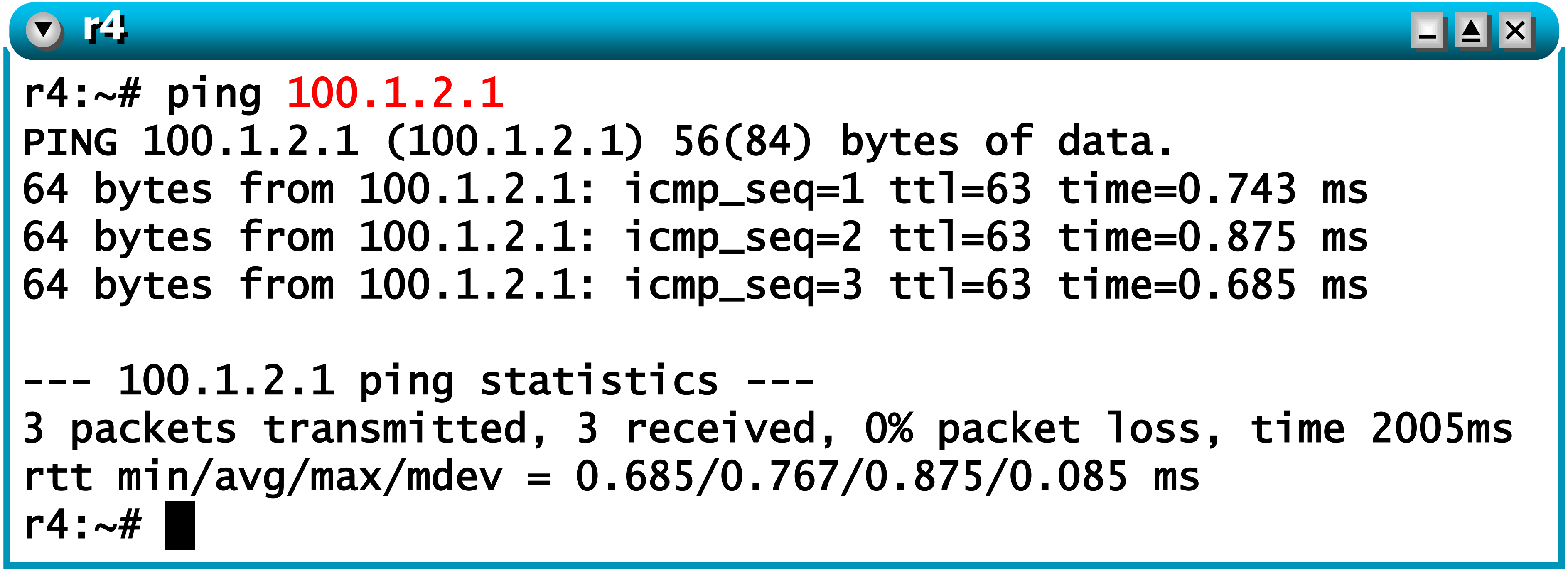
- on each router (but **`r5`**) issue the following command:



```
r4:~# /etc/init.d/zebra start
Starting Zebra daemons (prio:10): zebra ripd.
r4:~# █
```

# checking connectivity (again)

- towards a remote destination

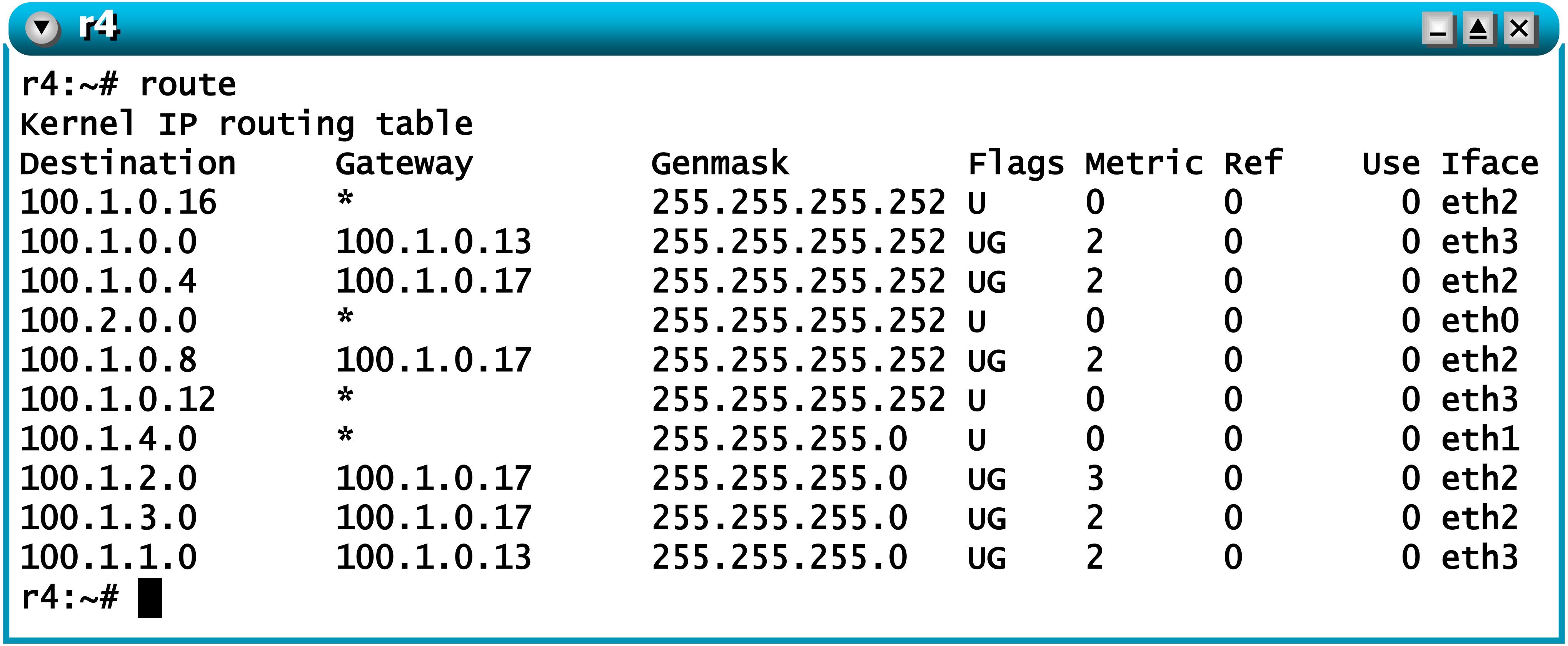


```
r4:~# ping 100.1.2.1
PING 100.1.2.1 (100.1.2.1) 56(84) bytes of data.
64 bytes from 100.1.2.1: icmp_seq=1 ttl=63 time=0.743 ms
64 bytes from 100.1.2.1: icmp_seq=2 ttl=63 time=0.875 ms
64 bytes from 100.1.2.1: icmp_seq=3 ttl=63 time=0.685 ms

--- 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
r4:~# █
```

- after a while, all remote destinations are reachable

# checking the routing table

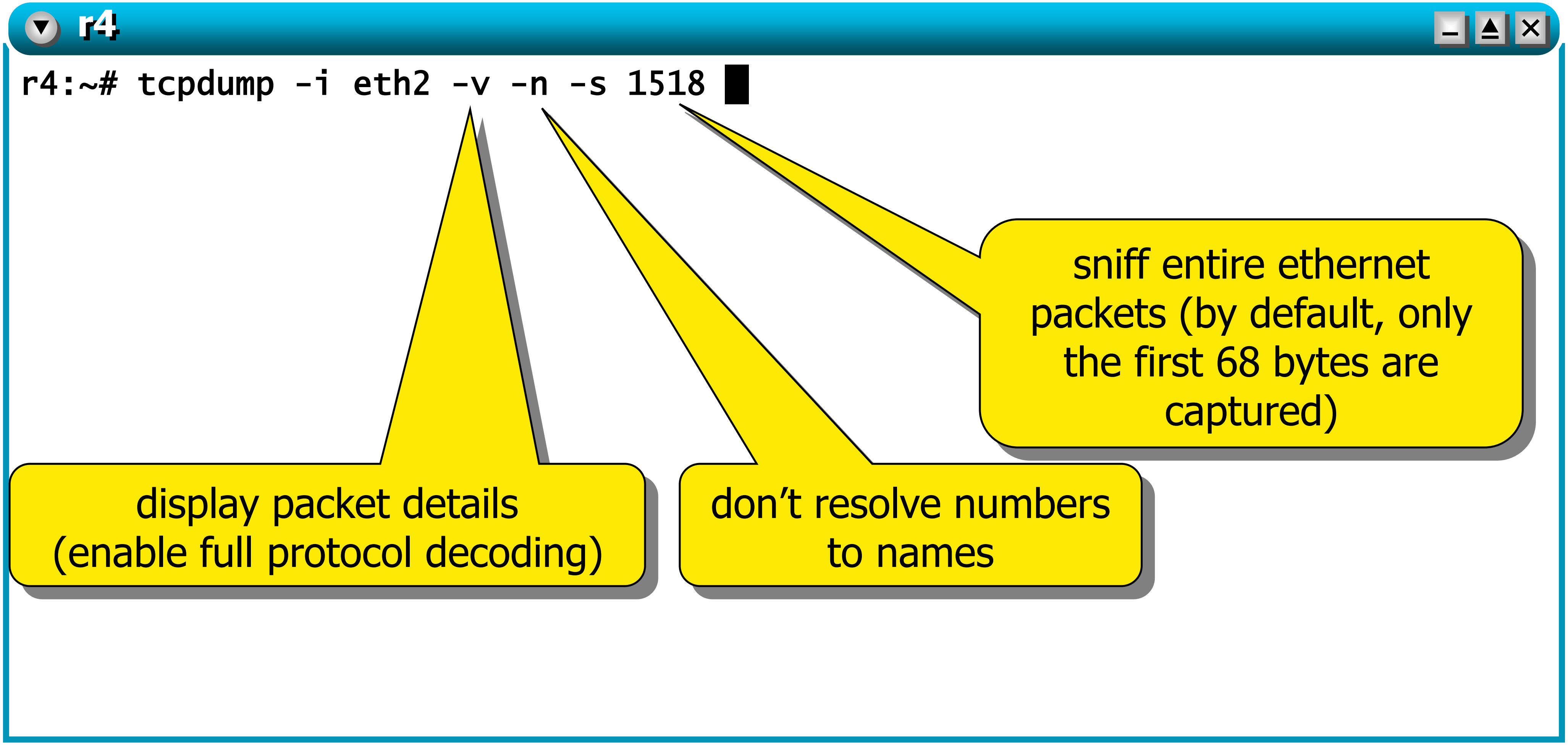
- the routing table is now updated



```
r4:~# route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
100.1.0.16      *               255.255.255.252 U     0      0        0 eth2
100.1.0.0       100.1.0.13      255.255.255.252 UG    2      0        0 eth3
100.1.0.4       100.1.0.17      255.255.255.252 UG    2      0        0 eth2
100.2.0.0       *               255.255.255.252 U     0      0        0 eth0
100.1.0.8       100.1.0.17      255.255.255.252 UG    2      0        0 eth2
100.1.0.12      *               255.255.255.252 U     0      0        0 eth3
100.1.4.0       *               255.255.255.0   U     0      0        0 eth1
100.1.2.0       100.1.0.17      255.255.255.0   UG    3      0        0 eth2
100.1.3.0       100.1.0.17      255.255.255.0   UG    2      0        0 eth2
100.1.1.0       100.1.0.13      255.255.255.0   UG    2      0        0 eth3
r4:~# █
```

# a look at ripv2 packets

- let’s sniff ripv2 packets



```
r4:~# tcpdump -i eth2 -v -n -s 1518
```

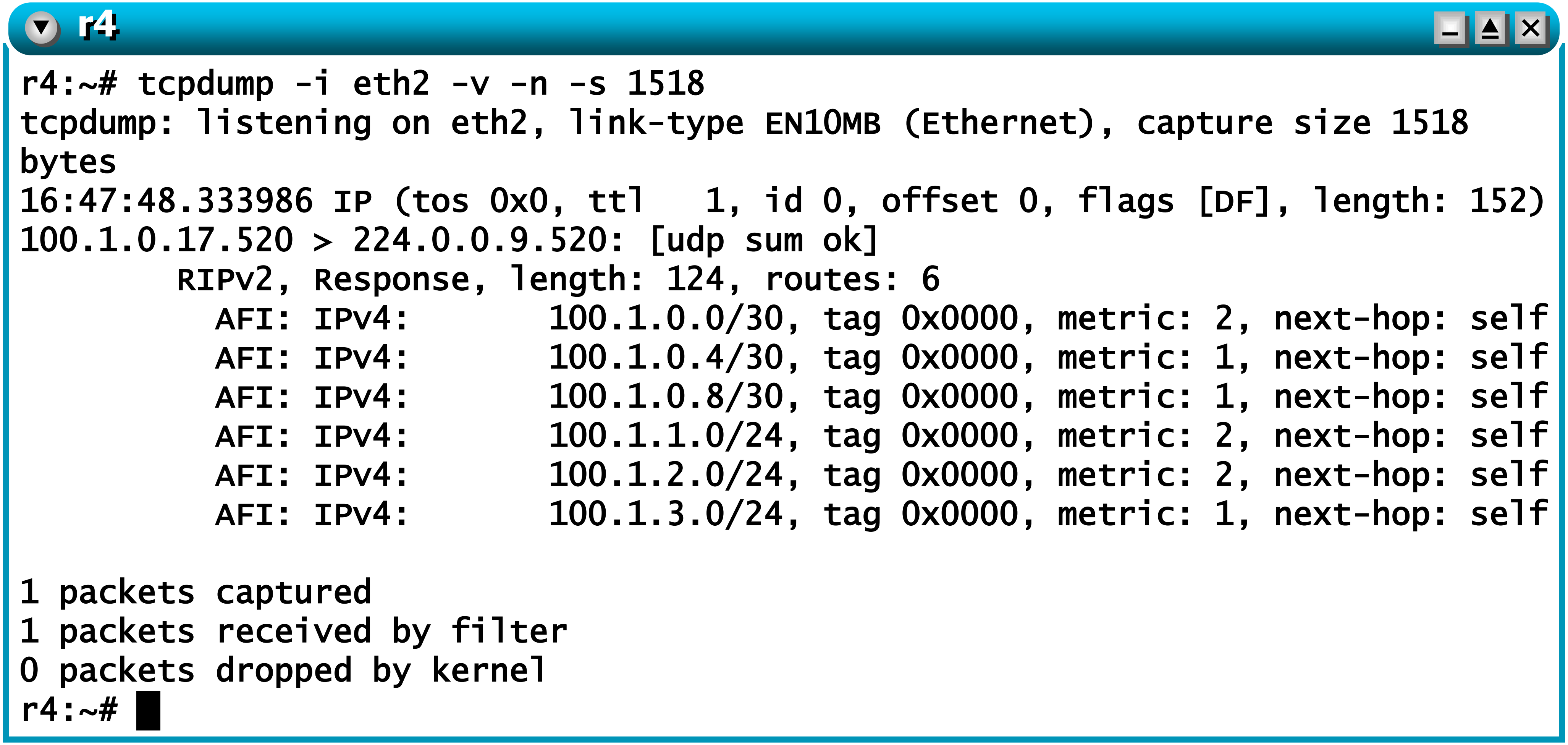
display packet details (enable full protocol decoding)

don’t resolve numbers to names

sniff entire ethernet packets (by default, only the first 68 bytes are captured)

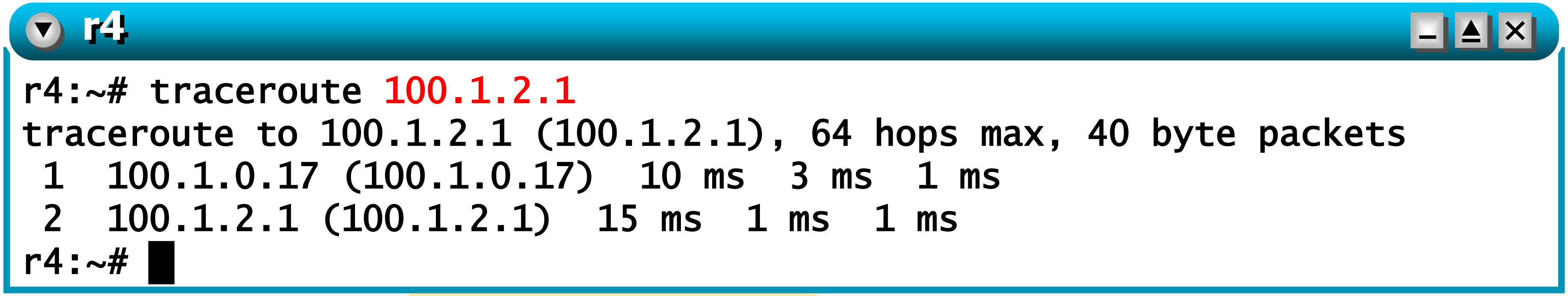
# a look at ripv2 packets

- let’s sniff ripv2 packets

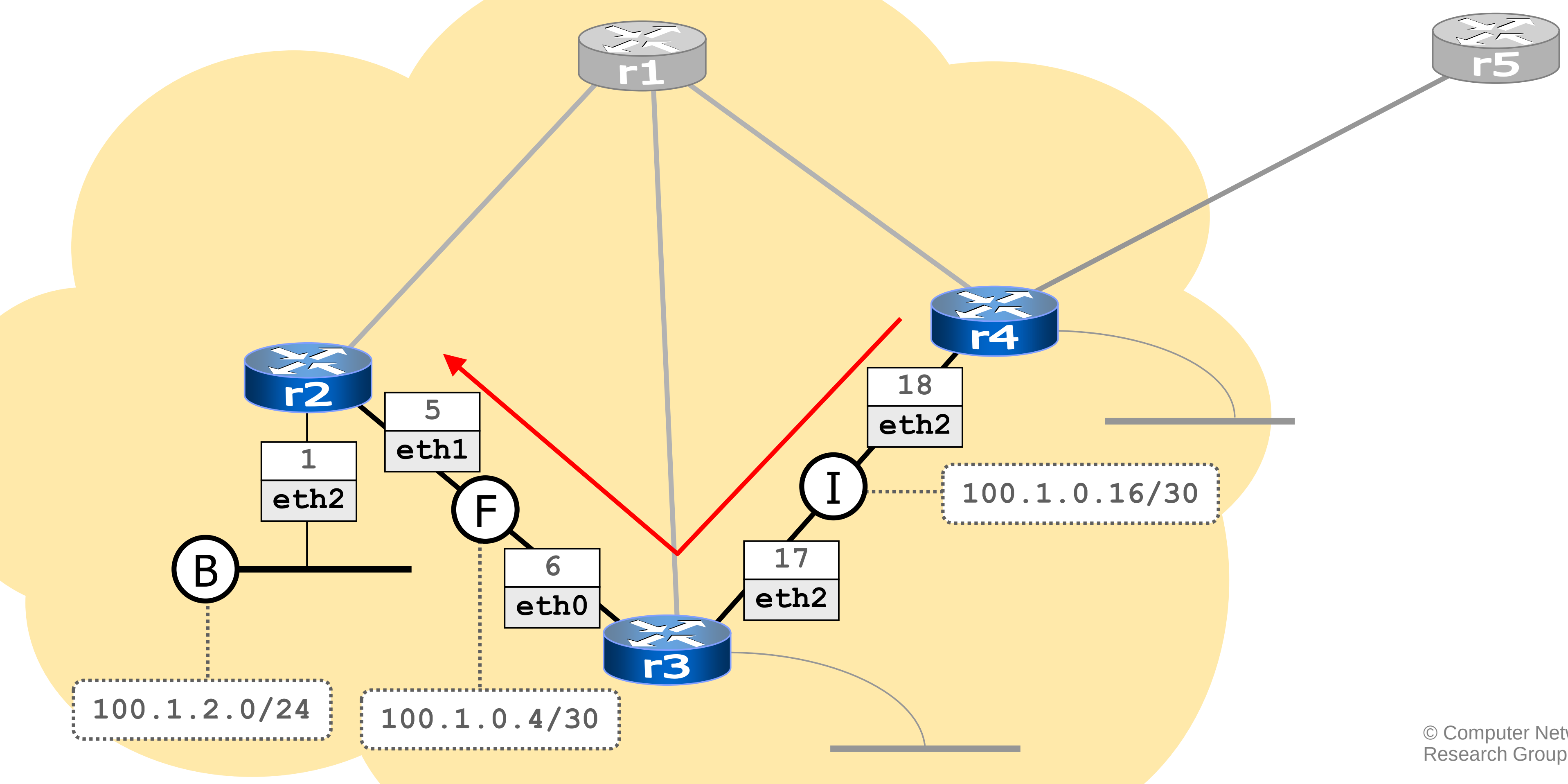


```
r4:~# tcpdump -i eth2 -v -n -s 1518
tcpdump: listening on eth2, link-type EN10MB (Ethernet), capture size 1518
bytes
16:47:48.333986 IP (tos 0x0, ttl   1, id 0, offset 0, flags [DF], length: 152)
100.1.0.17.520 > 224.0.0.9.520: [udp sum ok]
        RIPv2, Response, length: 124, routes: 6
          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

1 packets captured
1 packets received by filter
0 packets dropped by kernel
r4:~# █
```

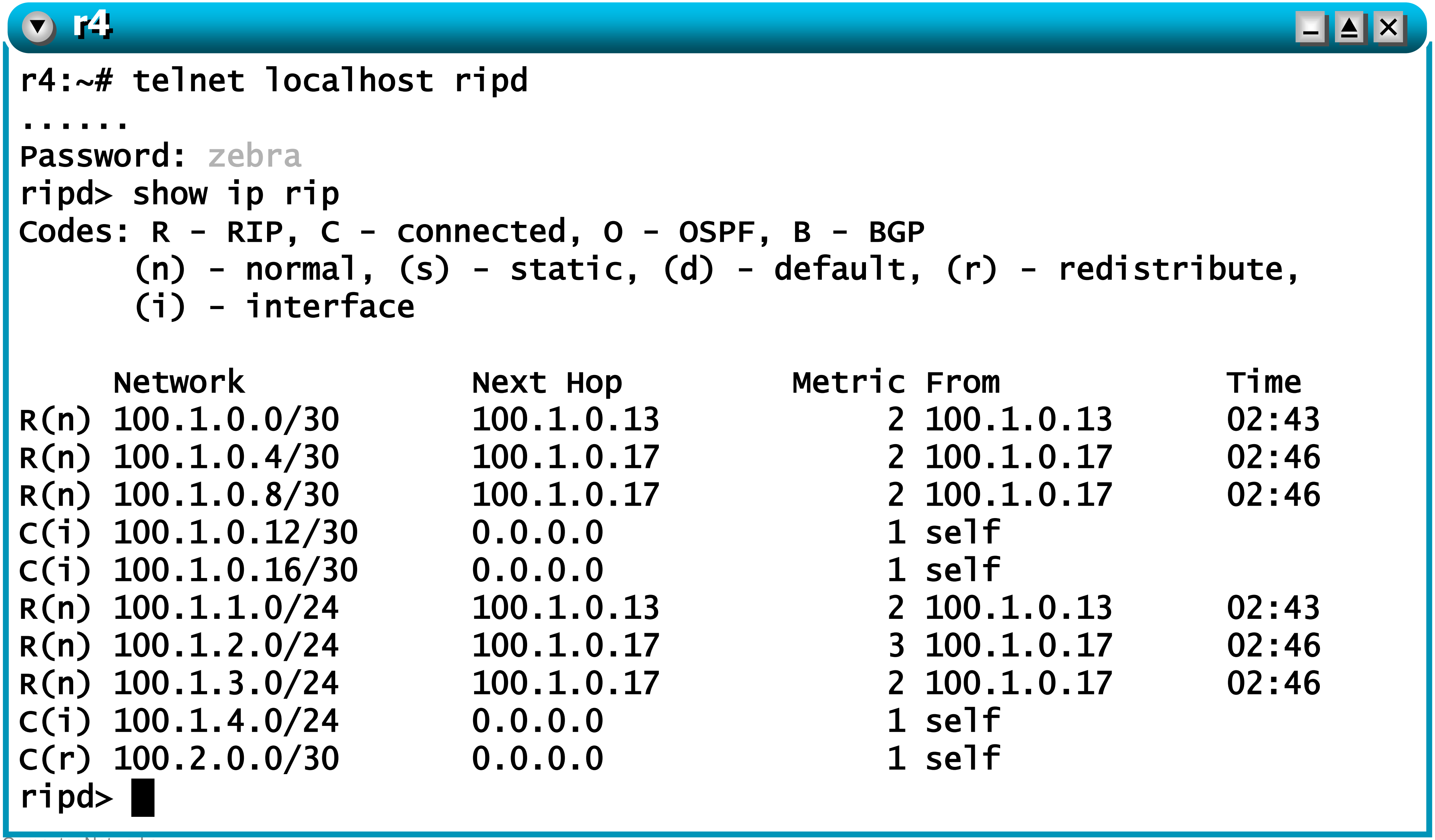
# a traceroute



```
r4:~# traceroute 100.1.2.1
traceroute to 100.1.2.1 (100.1.2.1), 64 hops max, 40 byte packets
 1  100.1.0.17 (100.1.0.17)  10 ms  3 ms  1 ms
 2  100.1.2.1 (100.1.2.1)  15 ms  1 ms  1 ms
r4:~# █
```



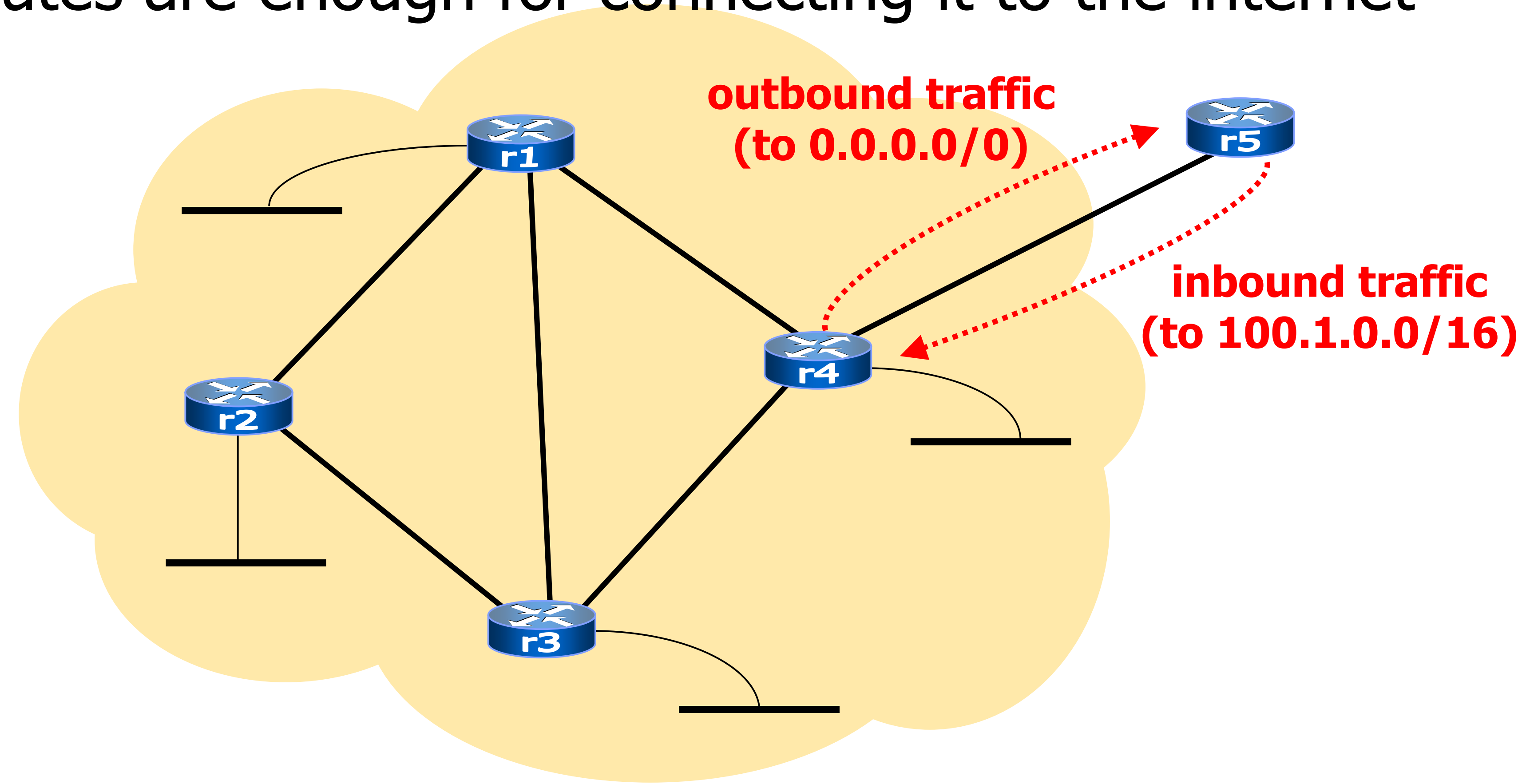
# inspecting the rip routing table



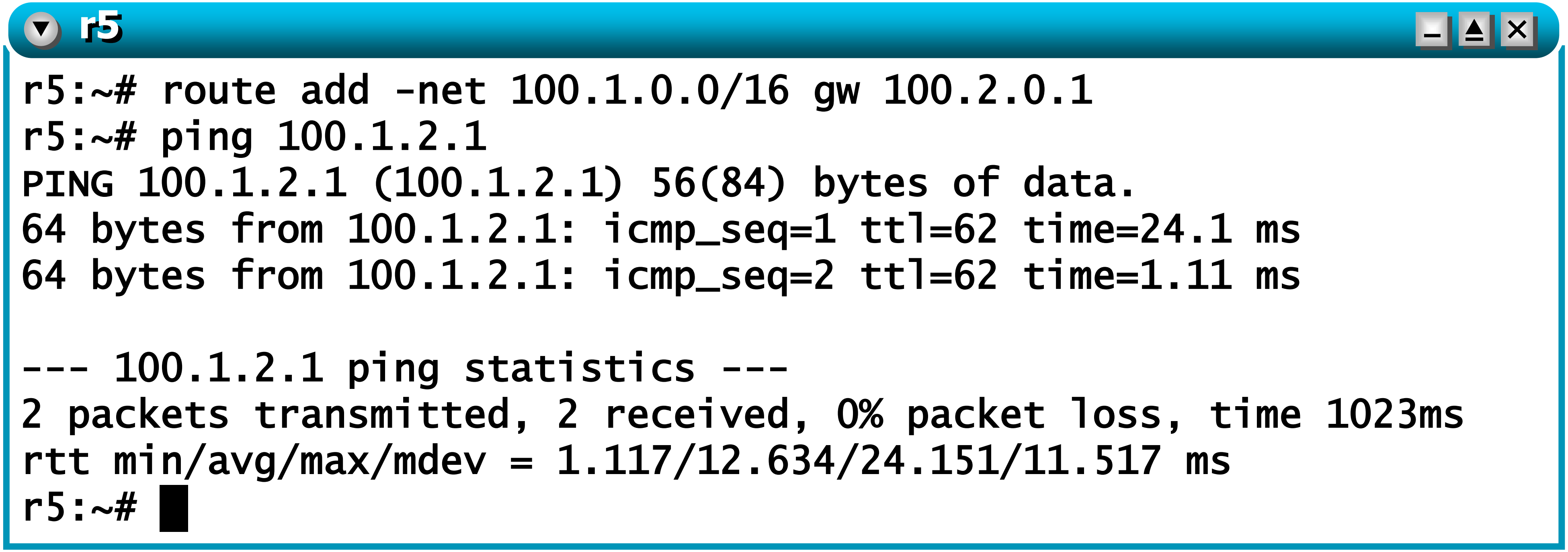
```
r4:~# telnet localhost ripd
......
Password: zebra
ripd> show ip rip
Codes: R - RIP, C - connected, O - OSPF, B - BGP
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network            Next Hop         Metric From            Time
R(n) 100.1.0.0/30       100.1.0.13            2 100.1.0.13      02:43
R(n) 100.1.0.4/30       100.1.0.17            2 100.1.0.17      02:46
R(n) 100.1.0.8/30       100.1.0.17            2 100.1.0.17      02:46
C(i) 100.1.0.12/30      0.0.0.0               1 self
C(i) 100.1.0.16/30      0.0.0.0               1 self
R(n) 100.1.1.0/24       100.1.0.13            2 100.1.0.13      02:43
R(n) 100.1.2.0/24       100.1.0.17            3 100.1.0.17      02:46
R(n) 100.1.3.0/24       100.1.0.17            2 100.1.0.17      02:46
C(i) 100.1.4.0/24       0.0.0.0               1 self
C(r) 100.2.0.0/30       0.0.0.0               1 self
ripd> █
```

# 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

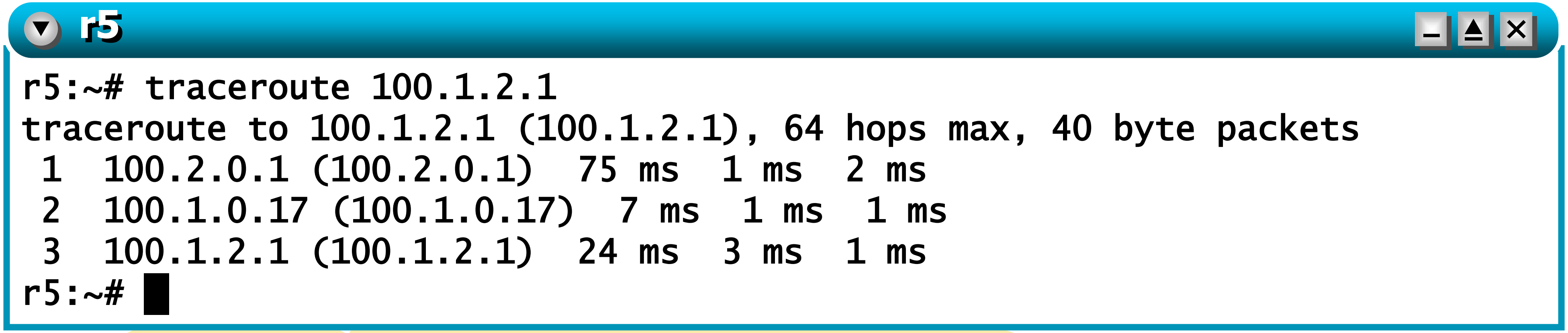


# adding a static route to `r5`

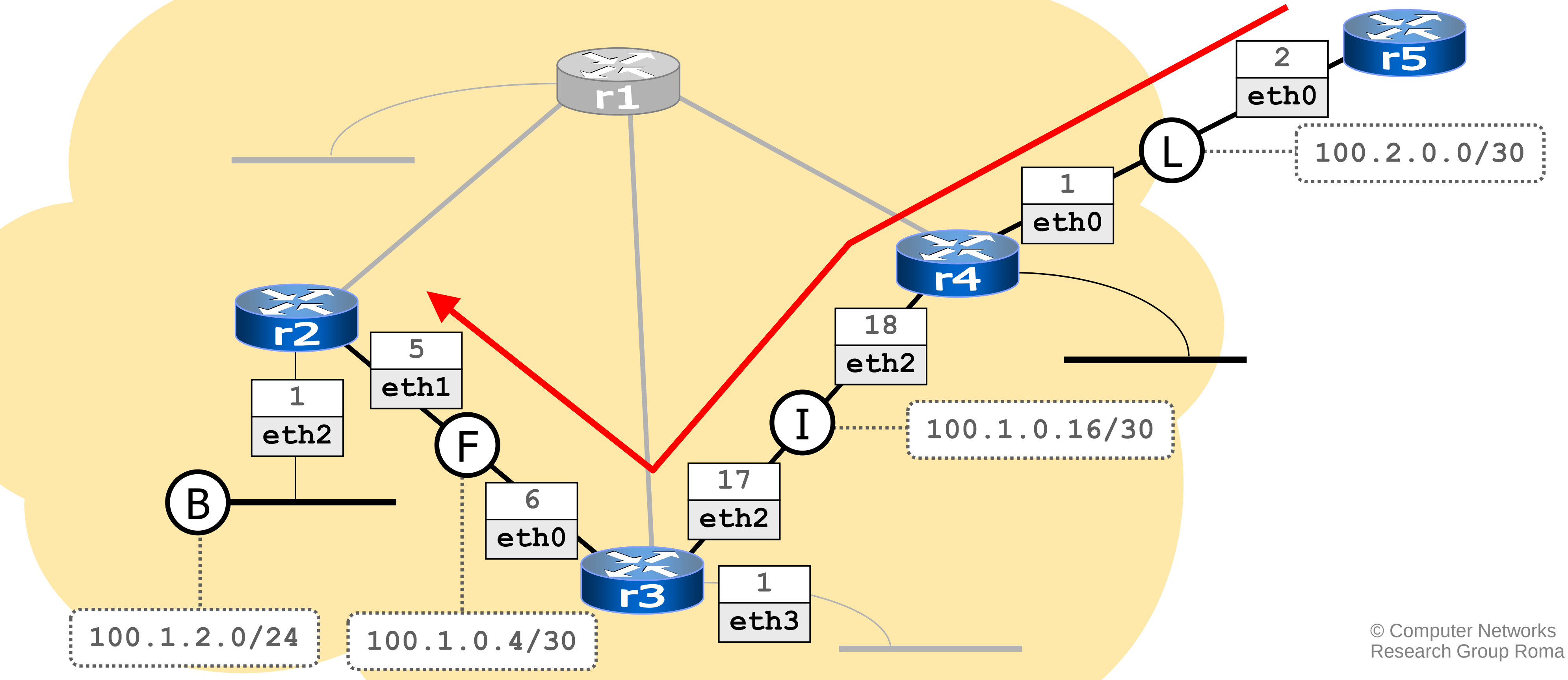


```
r5:~# route add -net 100.1.0.0/16 gw 100.2.0.1
r5:~# ping 100.1.2.1
PING 100.1.2.1 (100.1.2.1) 56(84) bytes of data.
64 bytes from 100.1.2.1: icmp_seq=1 ttl=62 time=24.1 ms
64 bytes from 100.1.2.1: icmp_seq=2 ttl=62 time=1.11 ms

--- 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
r5:~# █
```

# checking connectivity



```
r5:~# traceroute 100.1.2.1
traceroute to 100.1.2.1 (100.1.2.1), 64 hops max, 40 byte packets
 1  100.2.0.1 (100.2.0.1)  75 ms  1 ms  2 ms
 2  100.1.0.17 (100.1.0.17)  7 ms  1 ms  1 ms
 3  100.1.2.1 (100.1.2.1)  24 ms  3 ms  1 ms
r5:~# █
```



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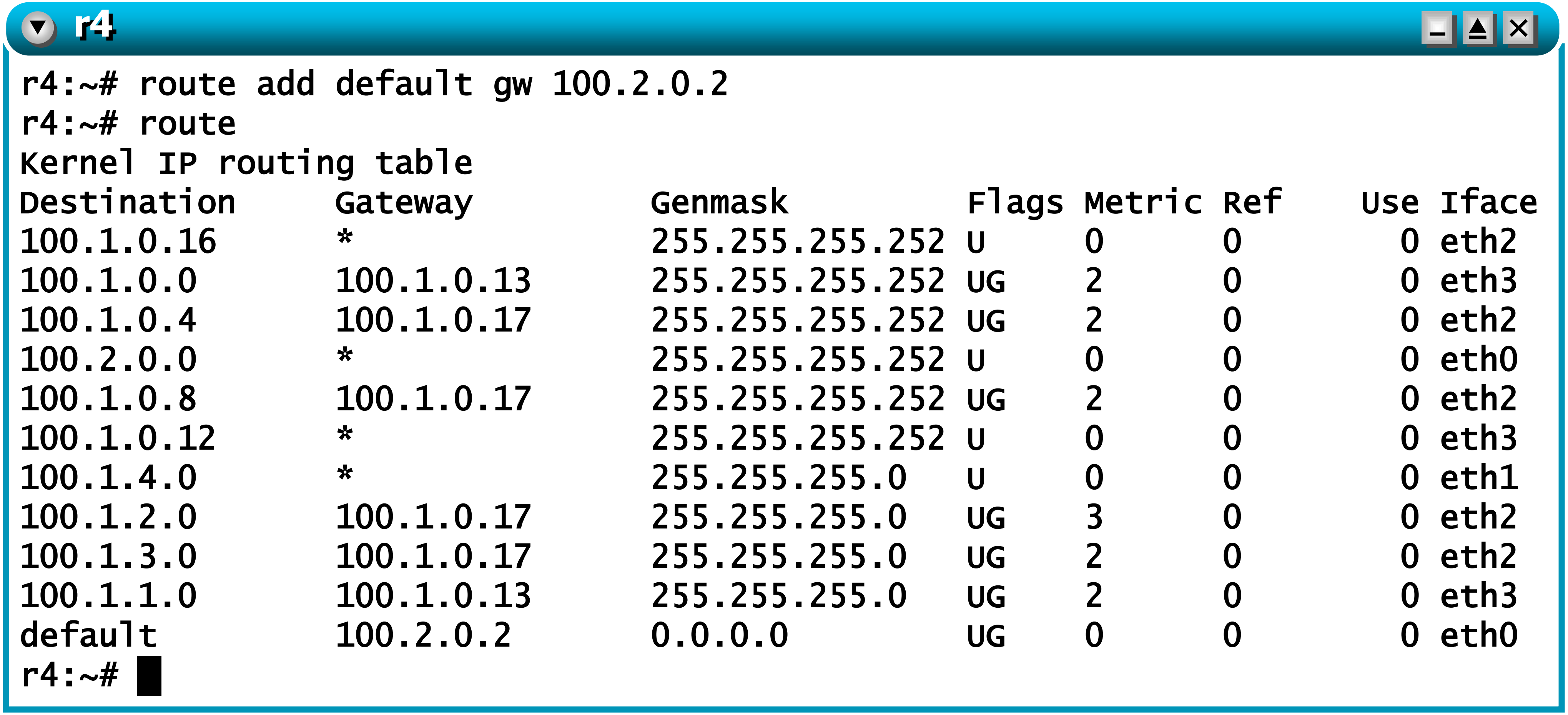
# configuring `r4`

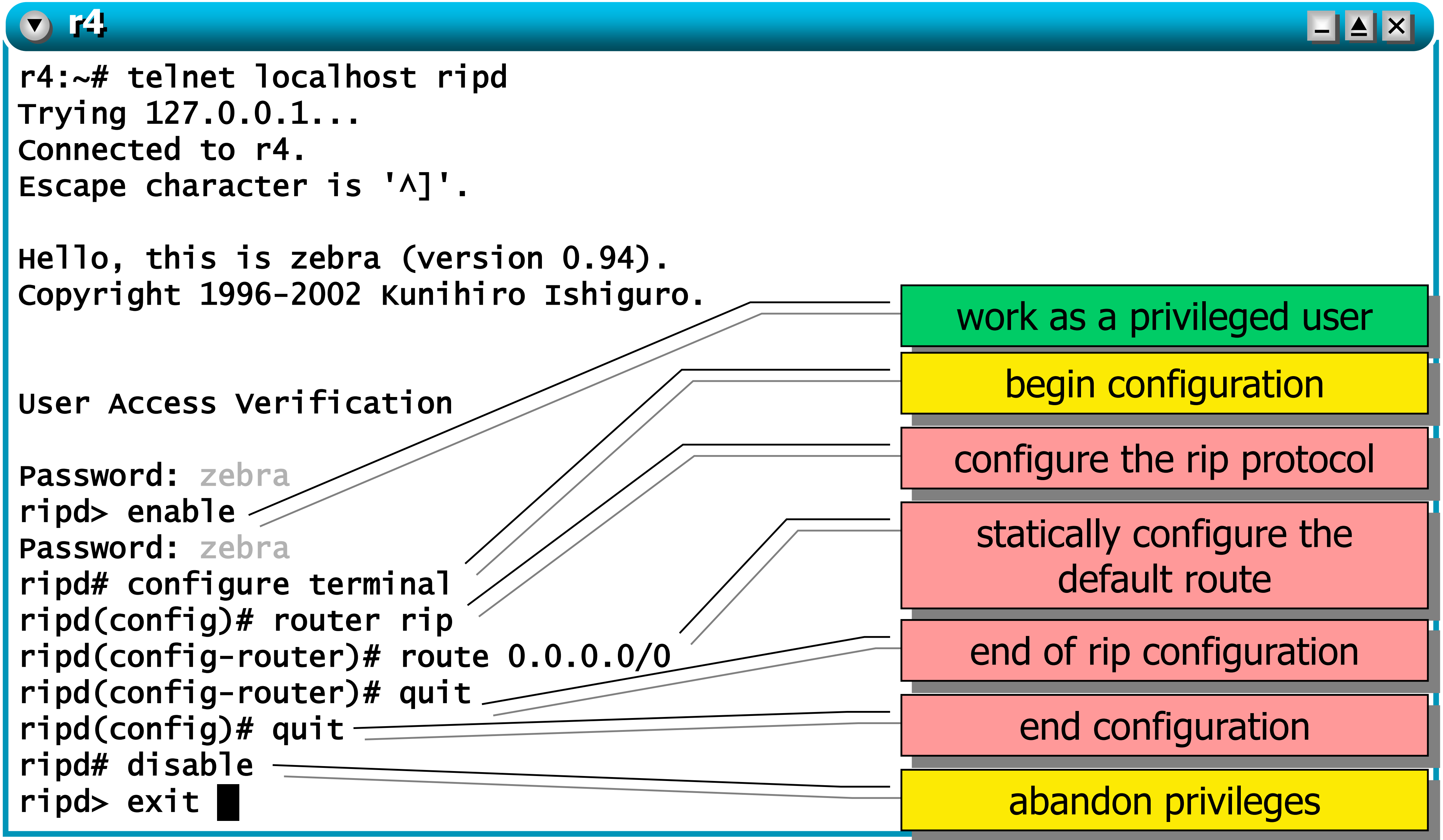
- step 1: configuring the default route



```
r4:~# route add default gw 100.2.0.2
r4:~# route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
100.1.0.16      *               255.255.255.252 U     0      0        0 eth2
100.1.0.0       100.1.0.13      255.255.255.252 UG    2      0        0 eth3
100.1.0.4       100.1.0.17      255.255.255.252 UG    2      0        0 eth2
100.2.0.0       *               255.255.255.252 U     0      0        0 eth0
100.1.0.8       100.1.0.17      255.255.255.252 UG    2      0        0 eth2
100.1.0.12      *               255.255.255.252 U     0      0        0 eth3
100.1.4.0       *               255.255.255.0   U     0      0        0 eth1
100.1.2.0       100.1.0.17      255.255.255.0   UG    3      0        0 eth2
100.1.3.0       100.1.0.17      255.255.255.0   UG    2      0        0 eth2
100.1.1.0       100.1.0.13      255.255.255.0   UG    2      0        0 eth3
default         100.2.0.2       0.0.0.0         UG    0      0        0 eth0
r4:~# █
```

# configuring r4

- step 2: propagating the default route into rip



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

Hello, this is zebra (version 0.94).
Copyright 1996-2002 Kunihiro Ishiguro.


User Access Verification

Password: zebra
ripd> enable
Password: zebra
ripd# configure terminal
ripd(config)# router rip
ripd(config-router)# route 0.0.0.0/0
ripd(config-router)# quit
ripd(config)# quit
ripd# disable
ripd> exit
```

work as a privileged user

begin configuration

configure the rip protocol

statically configure the default route

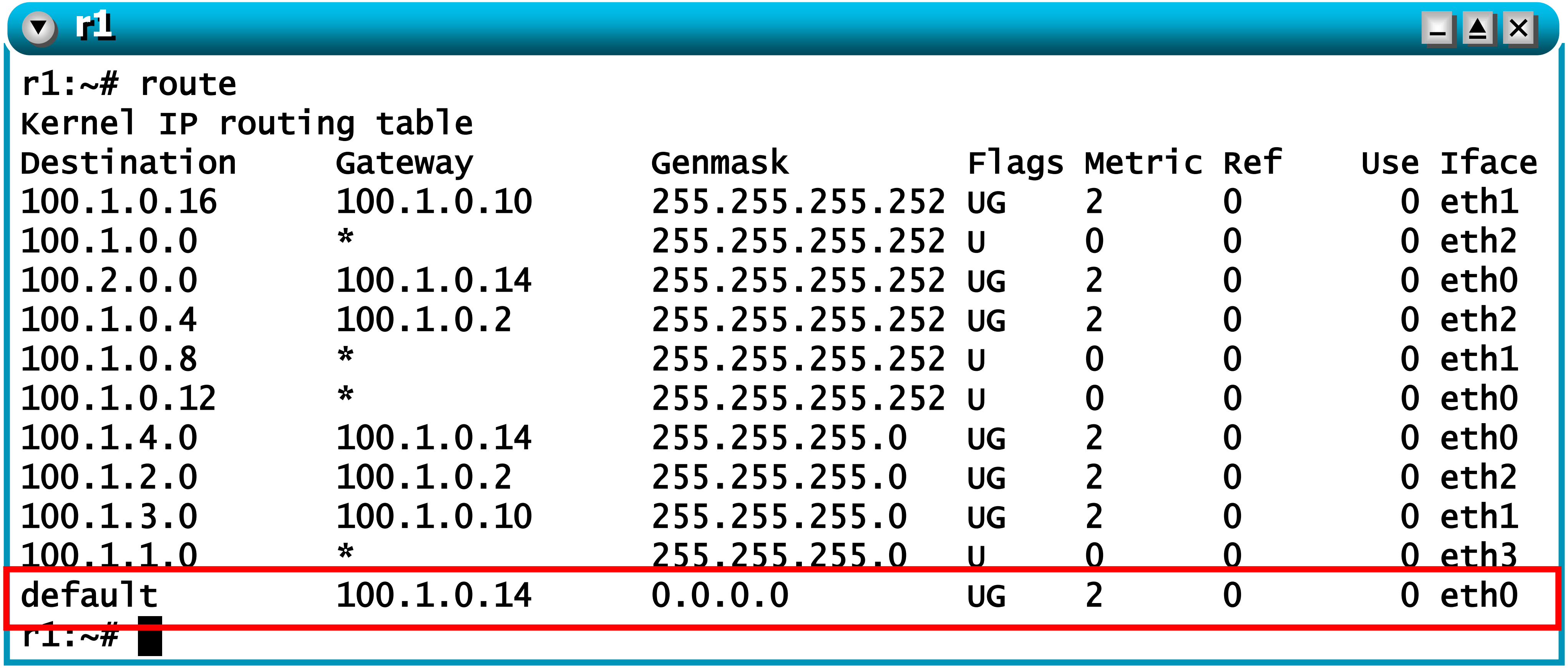
end of rip configuration

end configuration

abandon privileges

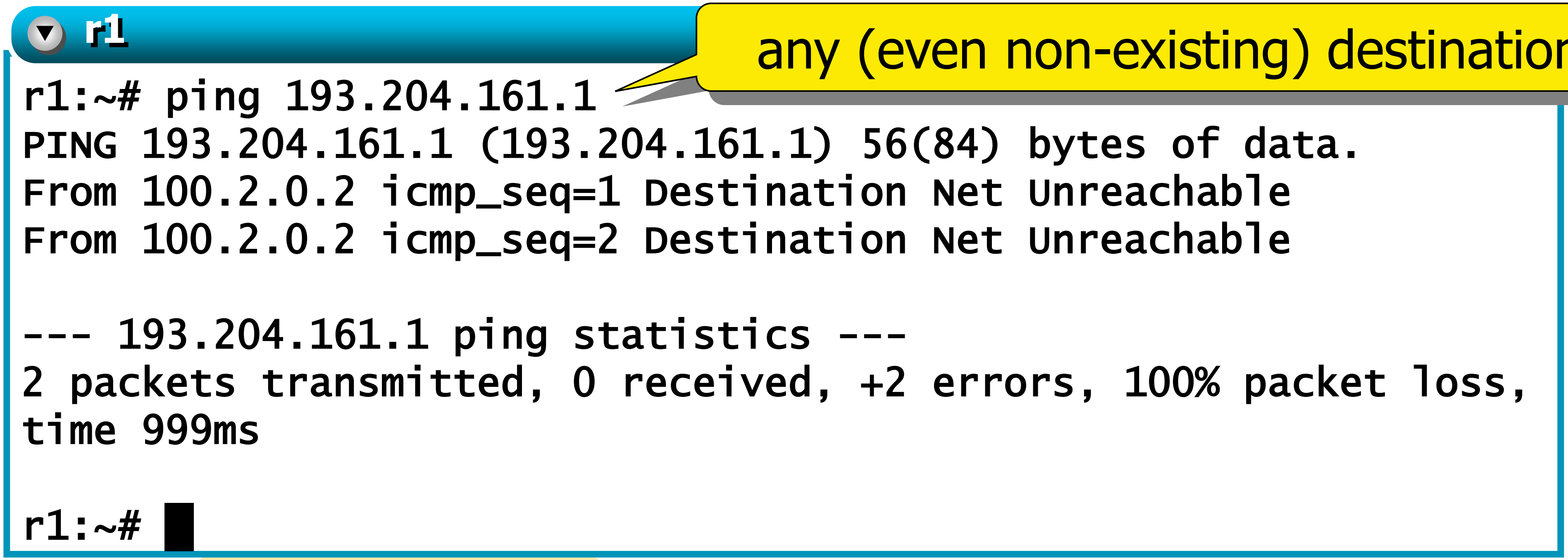
# the default route

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



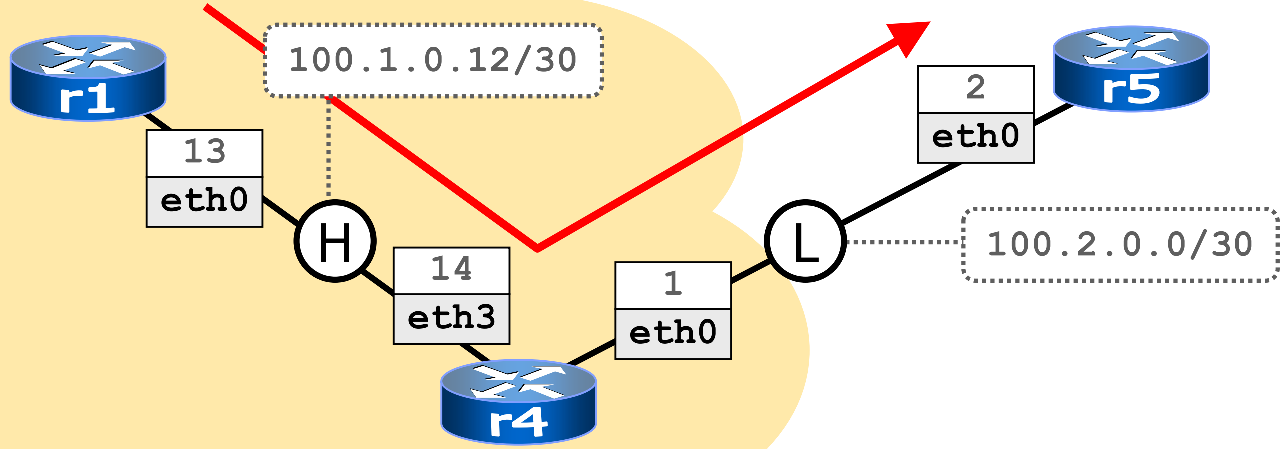
```
r1:~# route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
100.1.0.16      100.1.0.10      255.255.255.252 UG    2      0        0 eth1
100.1.0.0       *               255.255.255.252 U     0      0        0 eth2
100.2.0.0       100.1.0.14      255.255.255.252 UG    2      0        0 eth0
100.1.0.4       100.1.0.2       255.255.255.252 UG    2      0        0 eth2
100.1.0.8       *               255.255.255.252 U     0      0        0 eth1
100.1.0.12      *               255.255.255.252 U     0      0        0 eth0
100.1.4.0       100.1.0.14      255.255.255.0   UG    2      0        0 eth0
100.1.2.0       100.1.0.2       255.255.255.0   UG    2      0        0 eth2
100.1.3.0       100.1.0.10      255.255.255.0   UG    2      0        0 eth1
100.1.1.0       *               255.255.255.0   U     0      0        0 eth3
default         100.1.0.14      0.0.0.0         UG    2      0        0 eth0
r1:~#
```

# checking connectivity



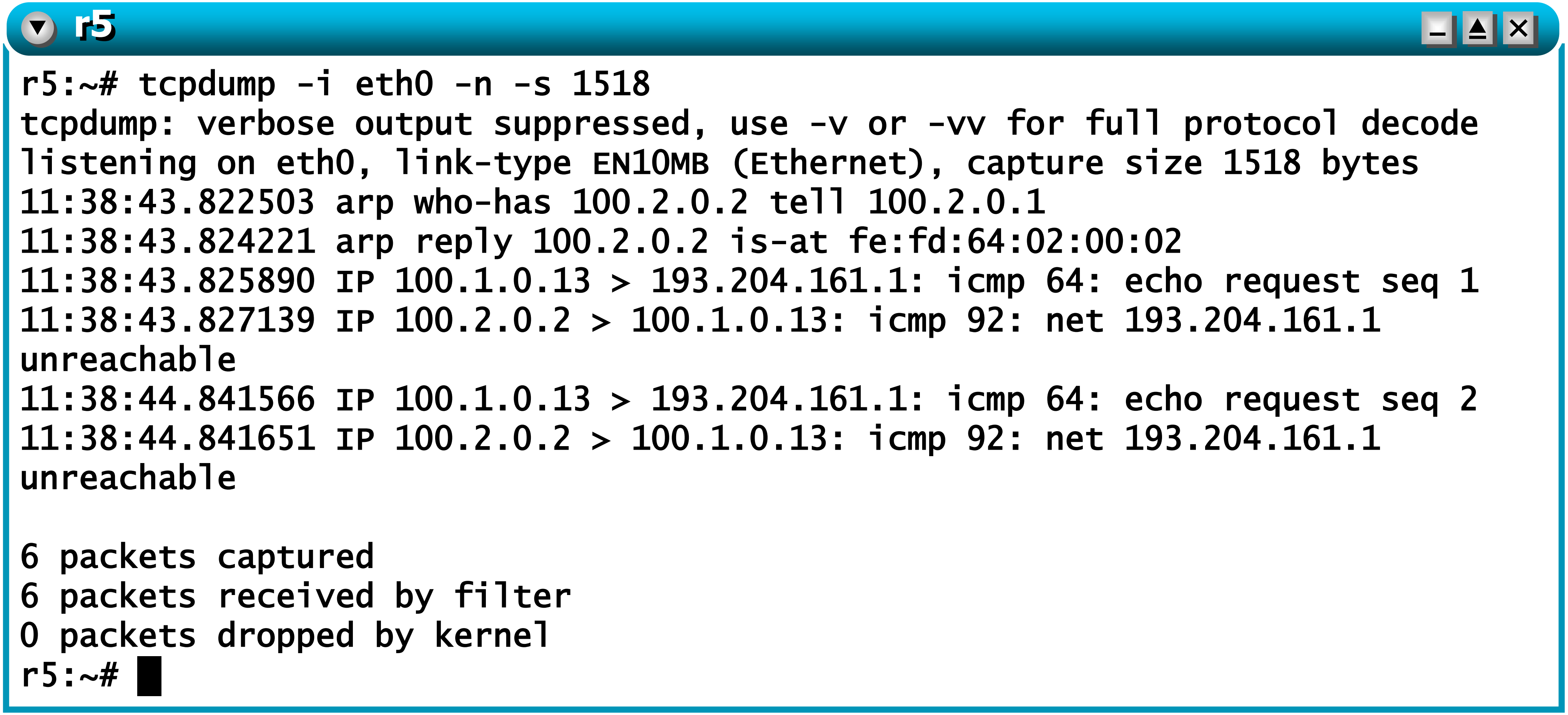
```
r1:~# ping 193.204.161.1
PING 193.204.161.1 (193.204.161.1) 56(84) bytes of data.
From 100.2.0.2 icmp_seq=1 Destination Net Unreachable
From 100.2.0.2 icmp_seq=2 Destination Net Unreachable

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

r1:~# 
```

any (even non-existing) destination



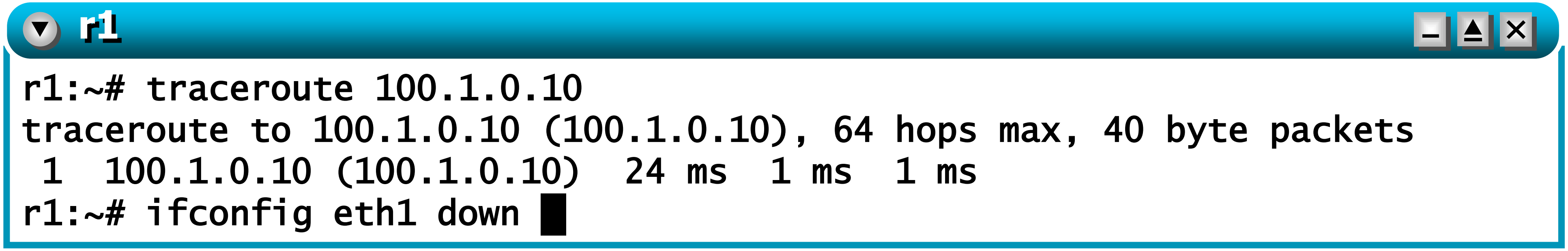
# checking connectivity

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

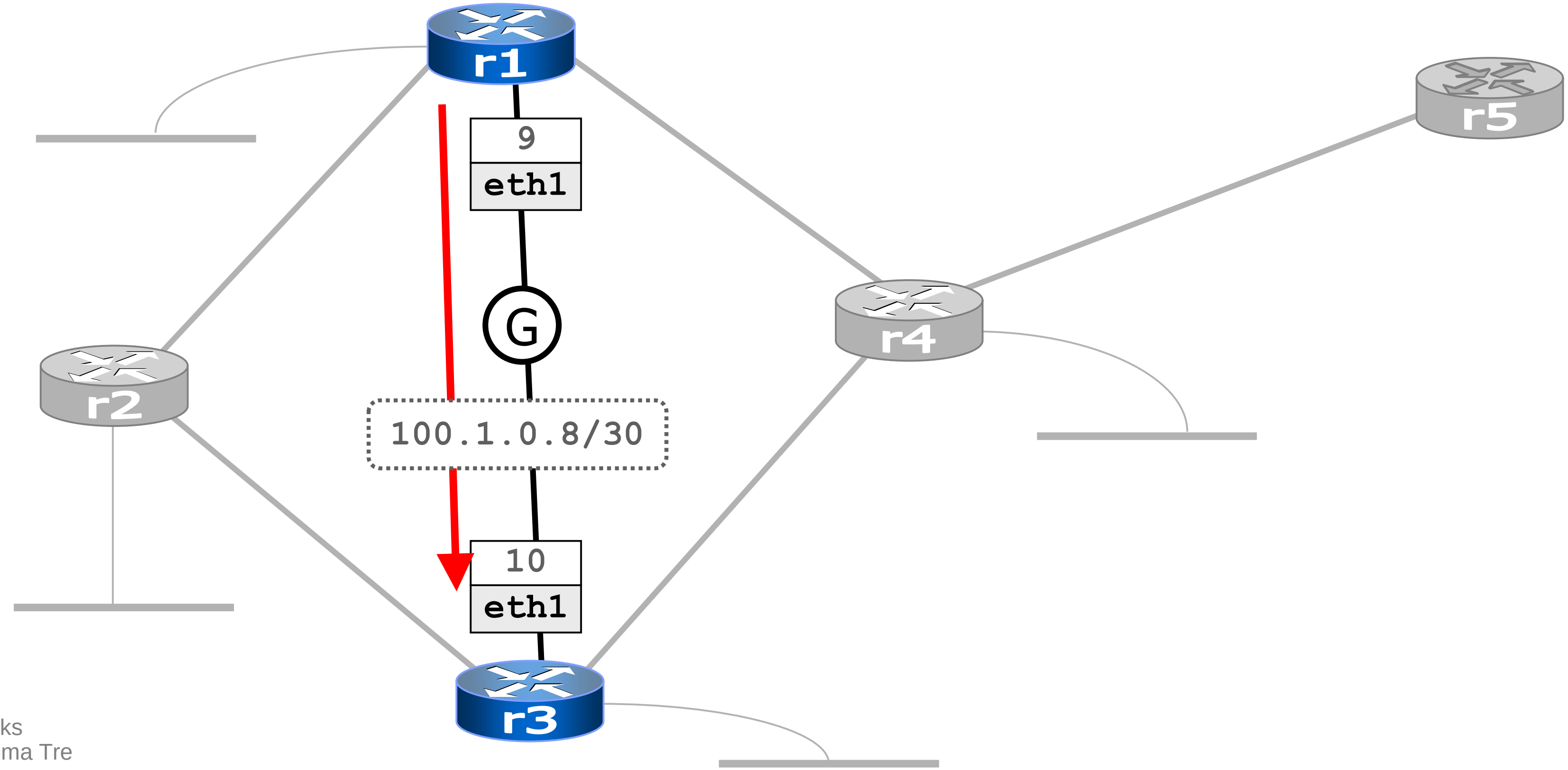


```
r5:~# tcpdump -i eth0 -n -s 1518
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth0, link-type EN10MB (Ethernet), capture size 1518 bytes
11:38:43.822503 arp who-has 100.2.0.2 tell 100.2.0.1
11:38:43.824221 arp reply 100.2.0.2 is-at fe:fd:64:02:00:02
11:38:43.825890 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
r5:~# █
```

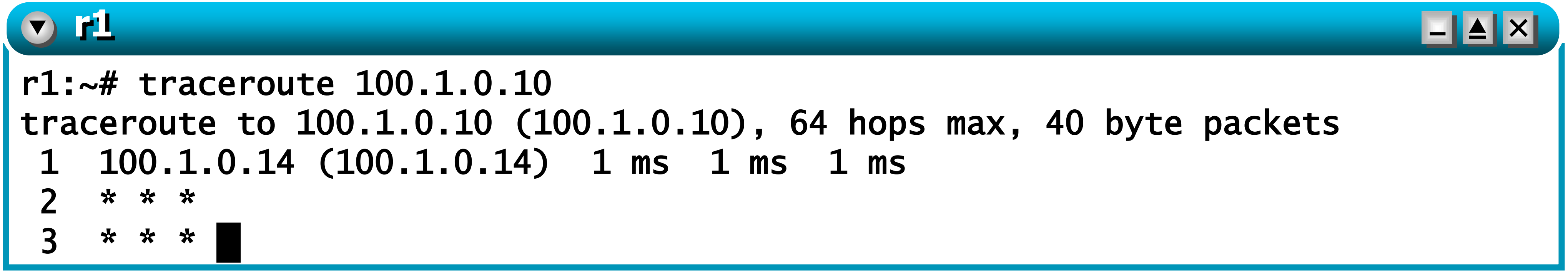
# shutting down an interface



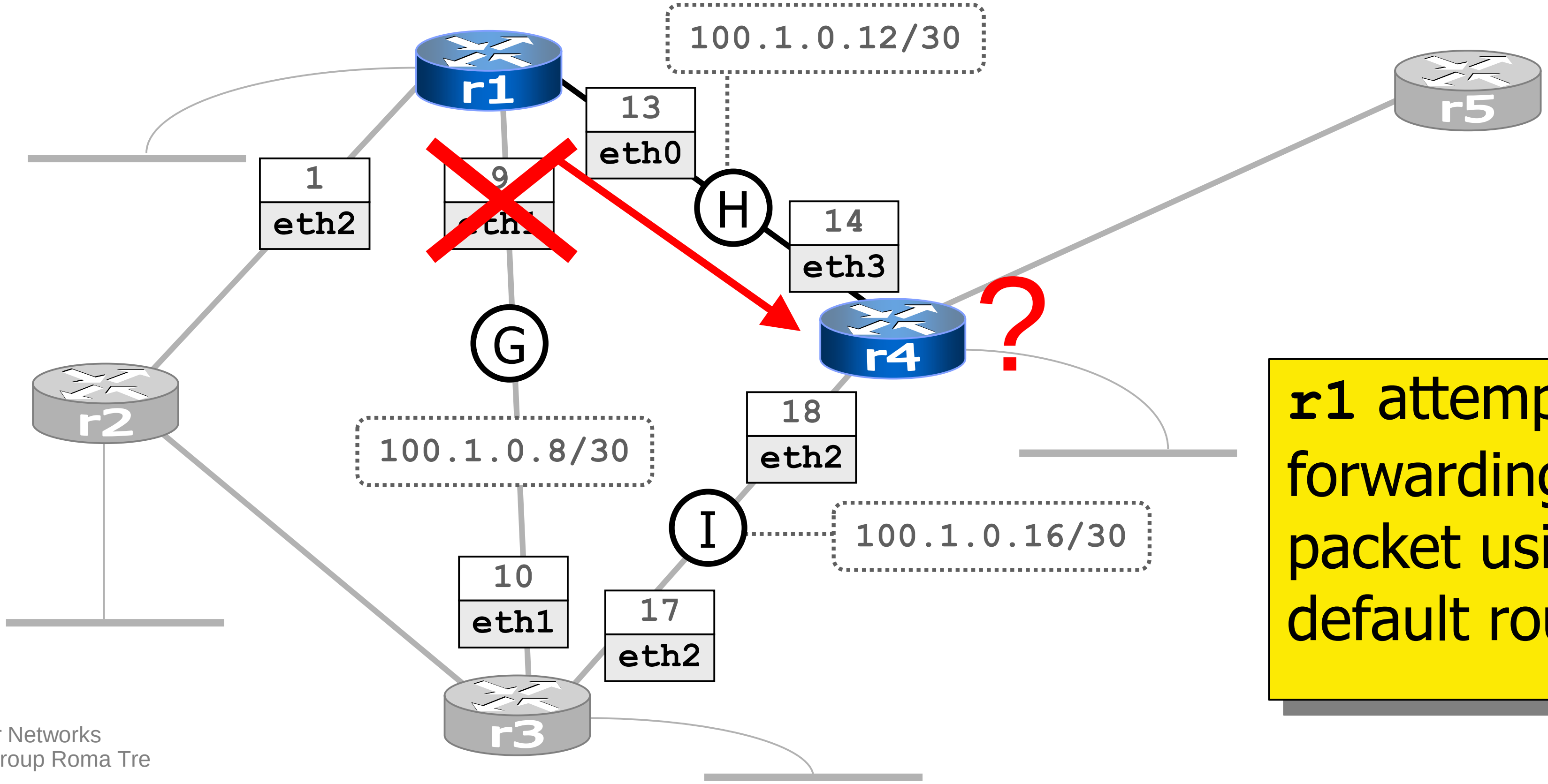
```
r1:~# traceroute 100.1.0.10
traceroute to 100.1.0.10 (100.1.0.10), 64 hops max, 40 byte packets
 1  100.1.0.10 (100.1.0.10)  24 ms  1 ms  1 ms
r1:~# ifconfig eth1 down █
```



# shutting down an interface

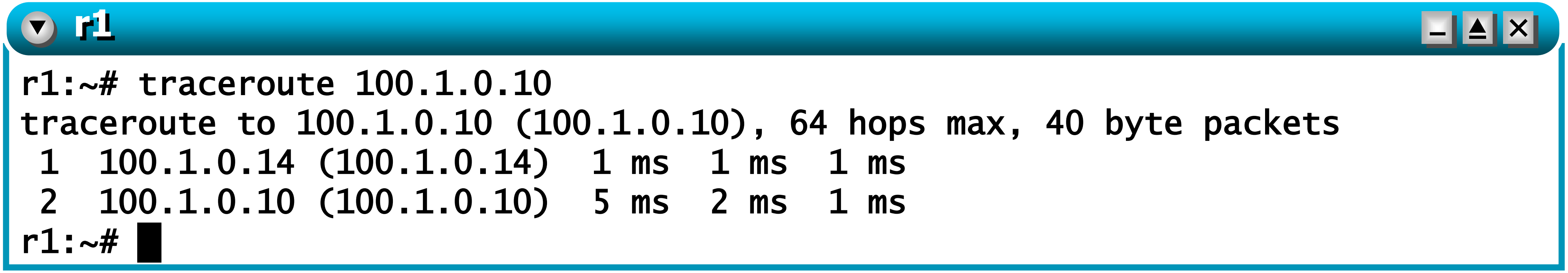


```
r1:~# traceroute 100.1.0.10
traceroute to 100.1.0.10 (100.1.0.10), 64 hops max, 40 byte packets
 1  100.1.0.14 (100.1.0.14)  1 ms  1 ms  1 ms
 2  * * *
 3  * * *
```

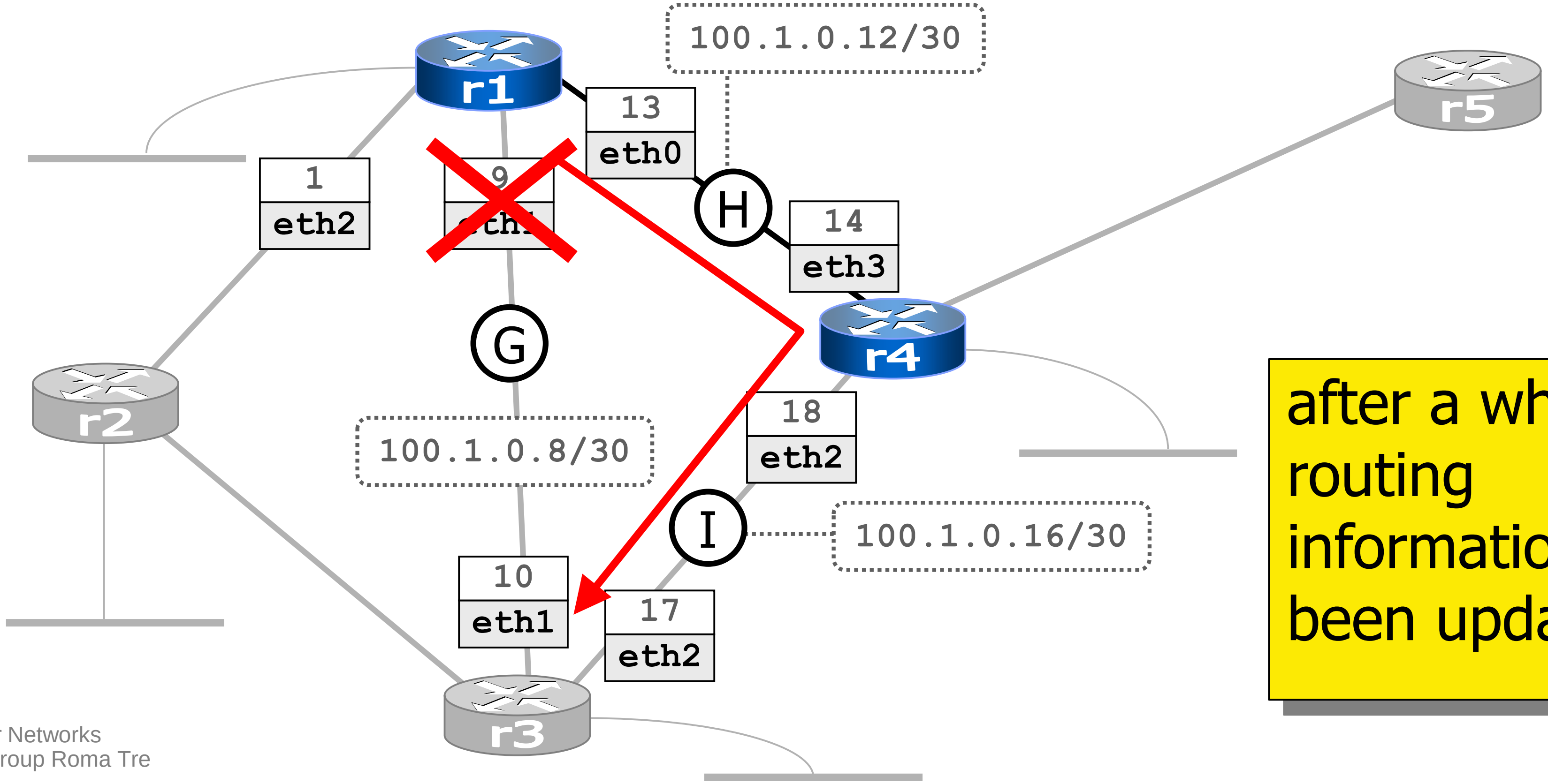


**r1** attempts forwarding the packet using the default route

# shutting down an interface



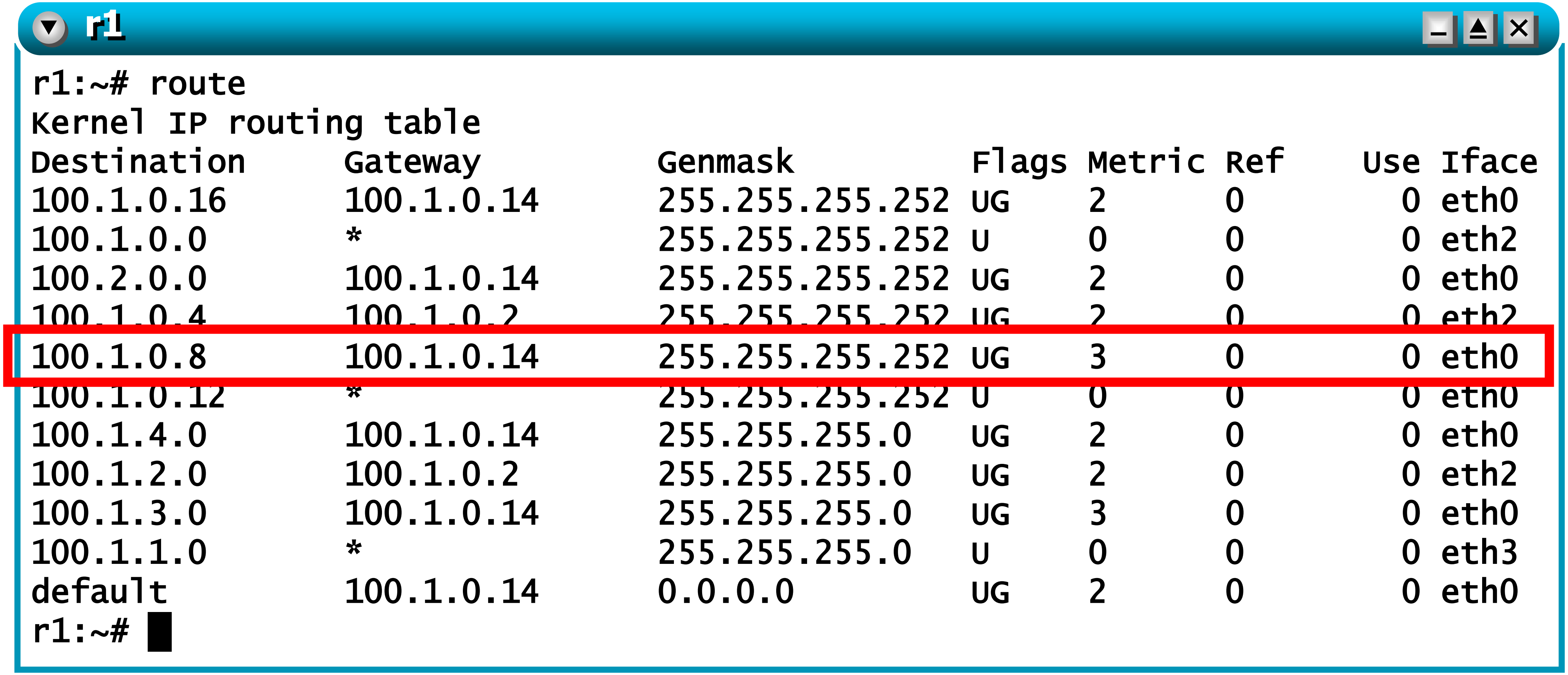
```
r1:~# traceroute 100.1.0.10
traceroute to 100.1.0.10 (100.1.0.10), 64 hops max, 40 byte packets
 1  100.1.0.14 (100.1.0.14)  1 ms  1 ms  1 ms
 2  100.1.0.10 (100.1.0.10)  5 ms  2 ms  1 ms
r1:~# 
```



after a while, routing information has been updated

# shutting down an interface

- **r1**'s routing table has been updated



```
r1:~# route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
100.1.0.16      100.1.0.14      255.255.255.252 UG    2      0        0 eth0
100.1.0.0       *               255.255.255.252 U     0      0        0 eth2
100.2.0.0       100.1.0.14      255.255.255.252 UG    2      0        0 eth0
100.1.0.4       100.1.0.2       255.255.255.252 UG    2      0        0 eth2
100.1.0.8       100.1.0.14      255.255.255.252 UG    3      0        0 eth0
100.1.0.12      *               255.255.255.252 U     0      0        0 eth0
100.1.4.0       100.1.0.14      255.255.255.0   UG    2      0        0 eth0
100.1.2.0       100.1.0.2       255.255.255.0   UG    2      0        0 eth2
100.1.3.0       100.1.0.14      255.255.255.0   UG    3      0        0 eth0
100.1.1.0       *               255.255.255.0   U     0      0        0 eth3
default         100.1.0.14      0.0.0.0         UG    2      0        0 eth0
r1:~# █
```