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netkit lab

zebra/quagga

Version	1.0
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Description	experiences with zebra/quagga configurations and command line interface

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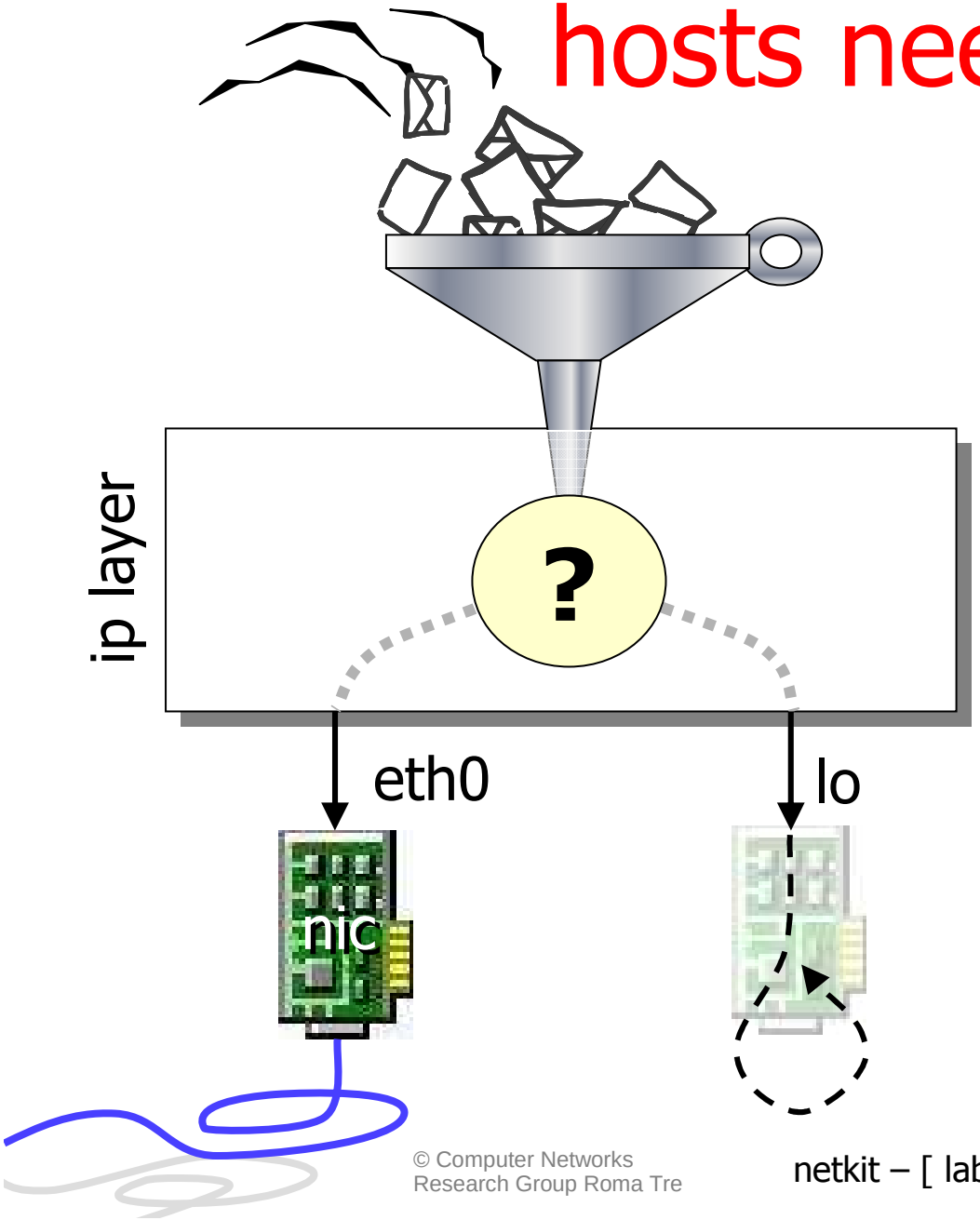
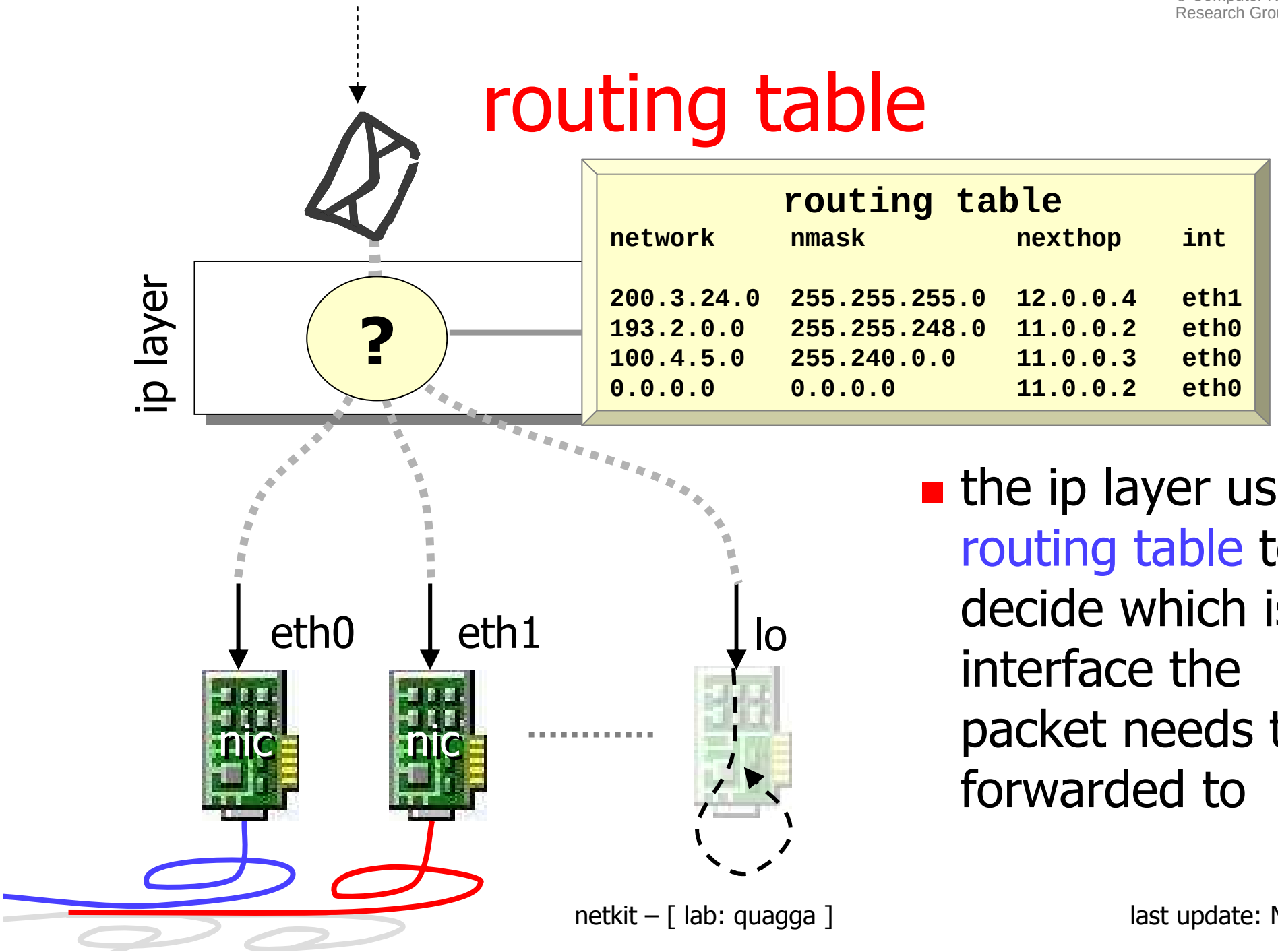
hosts need routing



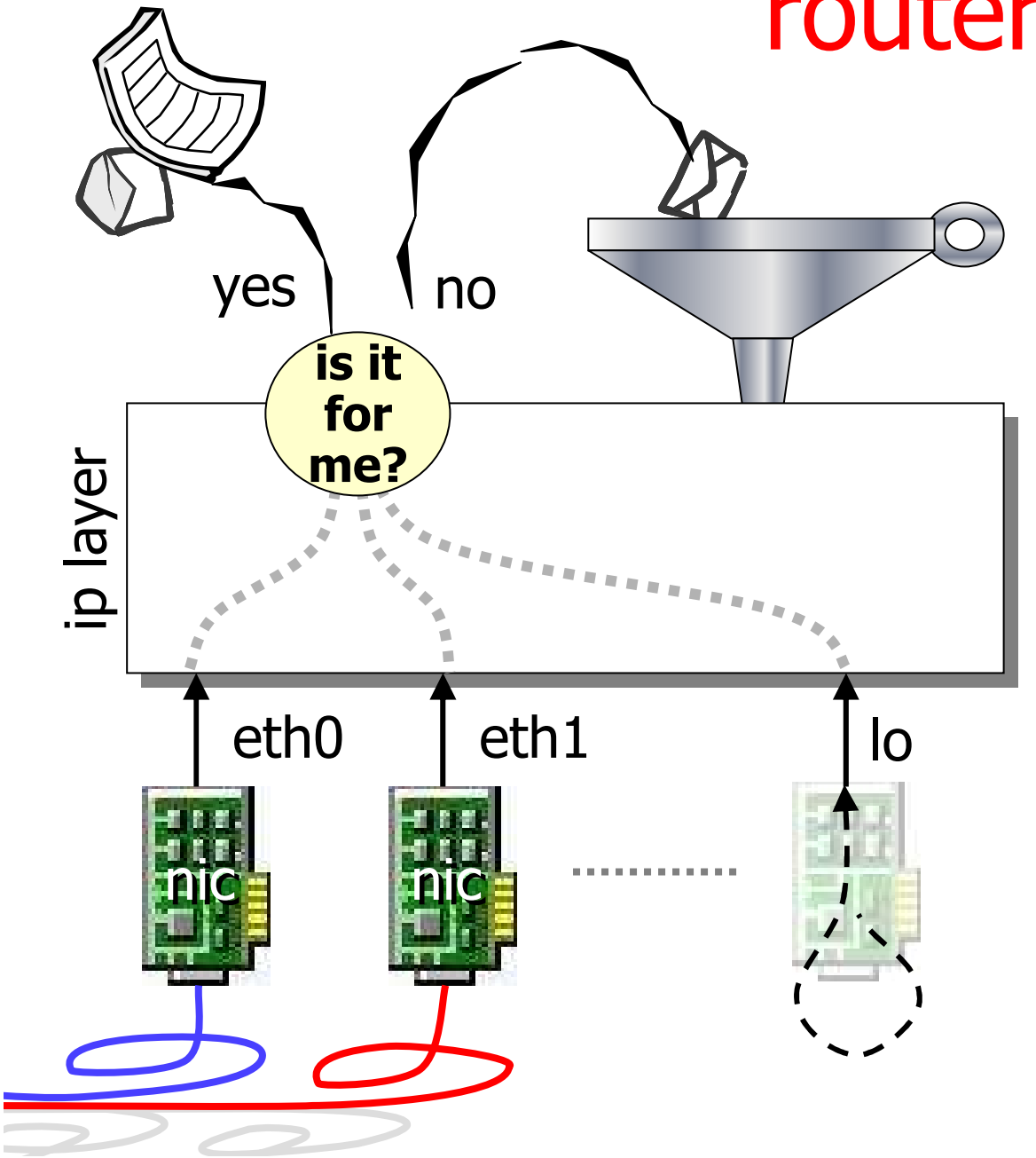
- each host with a network stack performs some elementary routing
- at the very least, the network stack may be used to access local services (e.g., Xorg)
- the host must decide when a packet needs to be sent to the network interface card (nic) and when it needs to be bounced to the loopback interface (lo)

routing table



- the ip layer uses a routing table to decide which is the interface the packet needs to be forwarded to

routers



- a router (also called gateway or intermediate-system)
  - has more than one network interface card
  - feeds incoming ip packets (that are not for the router itself) back in the routing process
    - this operation is called relaying or forwarding

routing protocols

- routing protocols are used to automatically update routing tables, relieving administrators from the need to do it manually
- routers (i.e., devices that run routing protocols) in netkit are virtual machines that run a specific piece of software that implements routing protocols

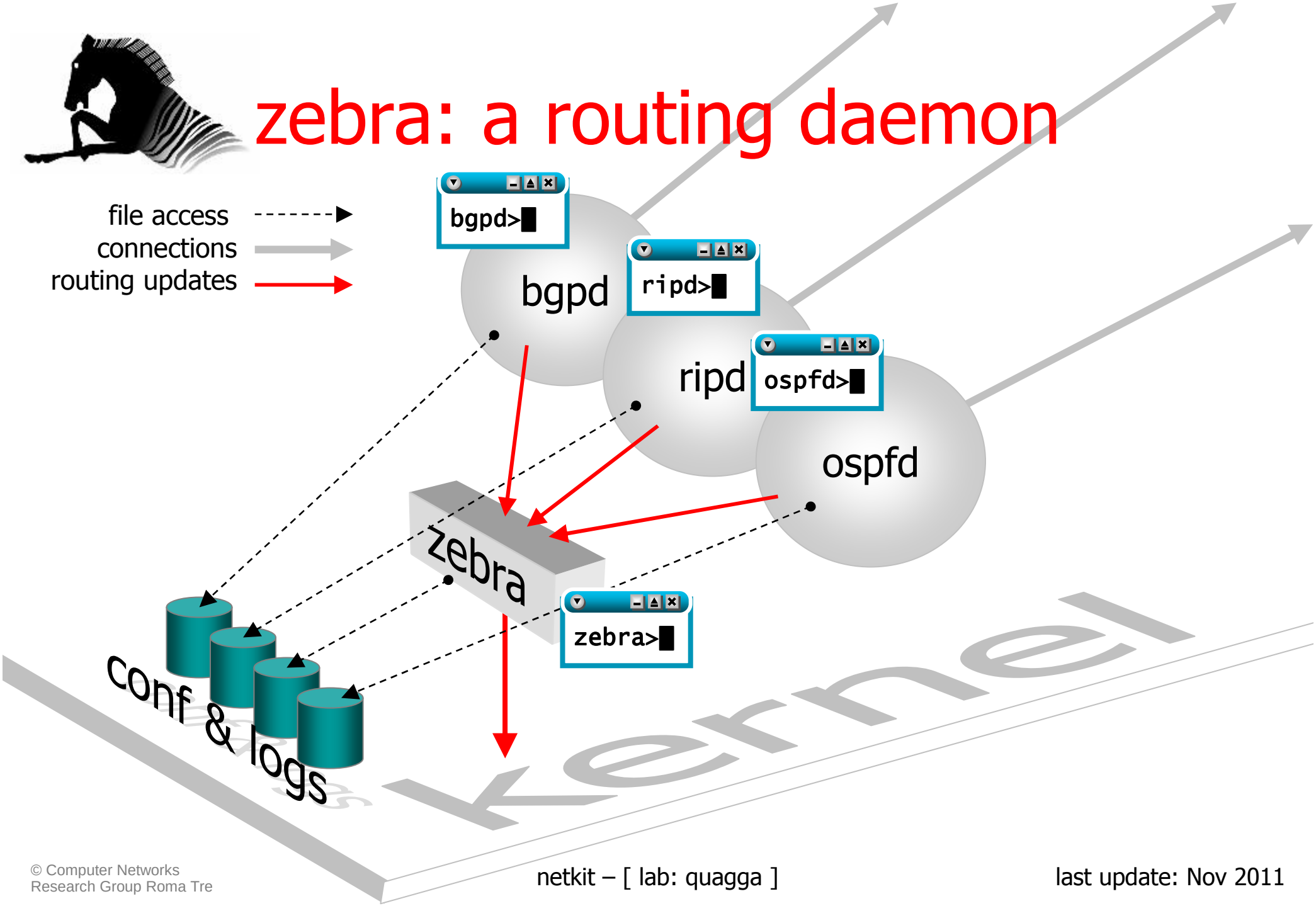
zebra/quagga

about zebra/quagga

Quagga Routing Software Suite,
GPL licensed IPv4/IPv6 routing software

- a software that implements several routing protocols
  - rip (v1 and v2)
  - ospf (v2 and v3)
  - is-is
  - bgp
- quagga: "a fork of GNU Zebra [that] aims to build a more involved community around Quagga than the current centralised model of GNU Zebra"
- zebra development stopped at release 0.95a
- quagga superseded zebra
  - in most cases, in netkit you can equivalently refer to "quagga" or "zebra"

zebra: a routing daemon



inspecting zebra configuration files

virtual machine

```
pc1:~# cd /etc/zebra/
pc1:/etc/zebra# ls
bgpd.conf           ospf6d.conf          ripd.conf           vtysh.conf
bgpd.conf.sample    ospf6d.conf.sample   ripd.conf.sample    vtysh.conf.sample
bgpd.conf.sample2   ospfd.conf           ripngd.conf         zebra.conf
daemons             ospfd.conf.sample    ripngd.conf.sample  zebra.conf.sample
pc1:/etc/zebra#
```

- when zebra is started, each daemon checks these files to read the starting configuration

sample **daemons** file

virtual machine

```
pc1:/etc/zebra# less daemons
# This file tells the zebra package
# which daemons to start.
# Entries are in the format: <daemon>=(yes|no|priority)
# where 'yes' is equivalent to infinitely low priority, and
# lower numbers mean higher priority. Read
# /usr/doc/zebra/README.Debian for details.
# Daemons are: bgpd zebra ospfd ospf6d ripd ripngd
zebra=yes
bgpd=no
ospfd=no
ospf6d=no
ripd=yes
ripngd=no
daemons (END)
```

the zebra main daemon will be started

the rip daemon will be started too

sample zebra configuration file (`zebra.conf`)

virtual machine

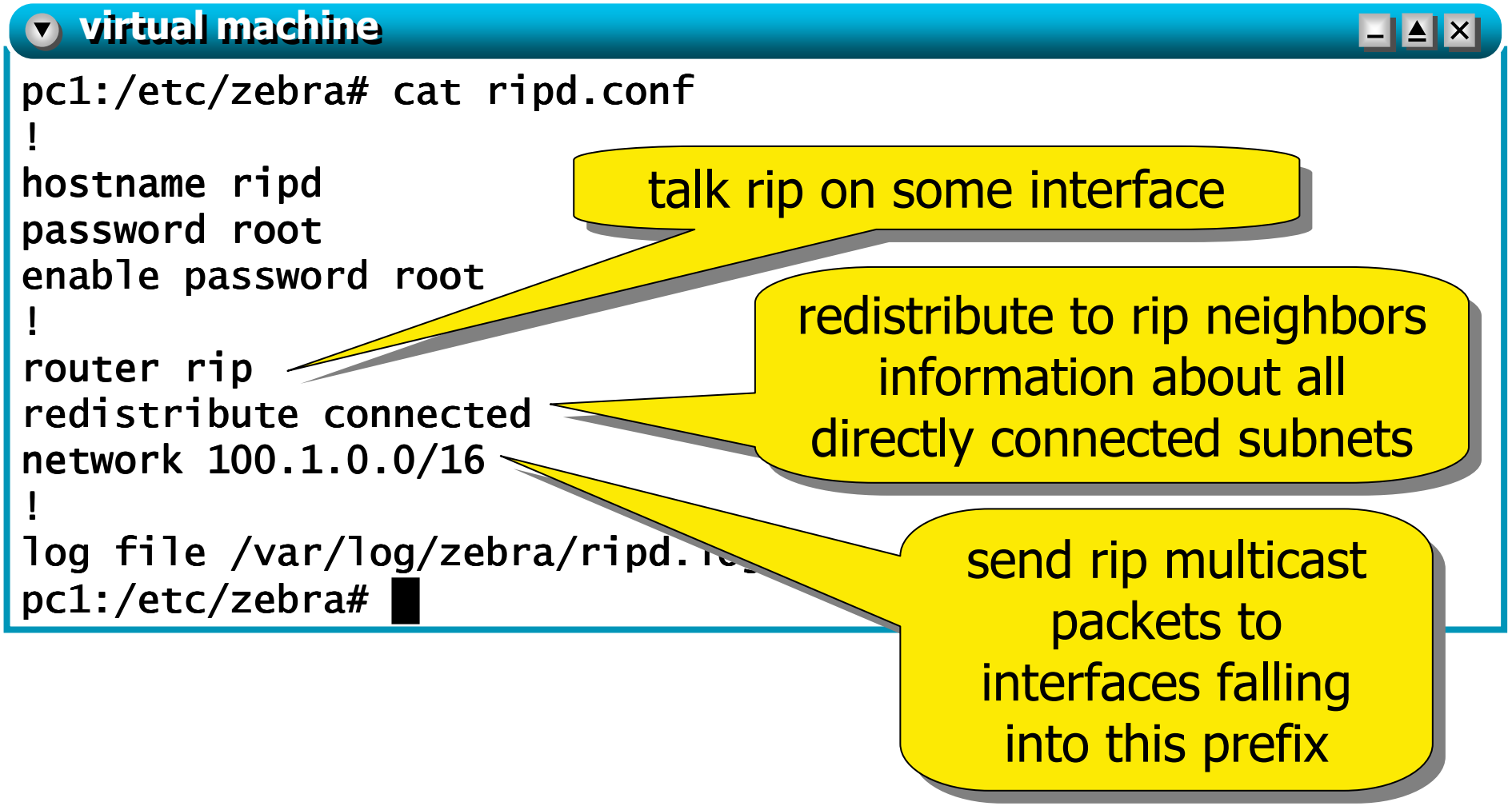
```
pc1:/etc/zebra# less zebra.conf
! -*- zebra -*-
!
! zebra sample configuration file
!
! $Id: zebra.conf.sample,v 1.14 1999/02/19 17:26:38 developer
Exp $
!
hostname Router
password zebra
enable password zebra
!
! interface lo
zebra.conf
```

the prompt of the zebra interface

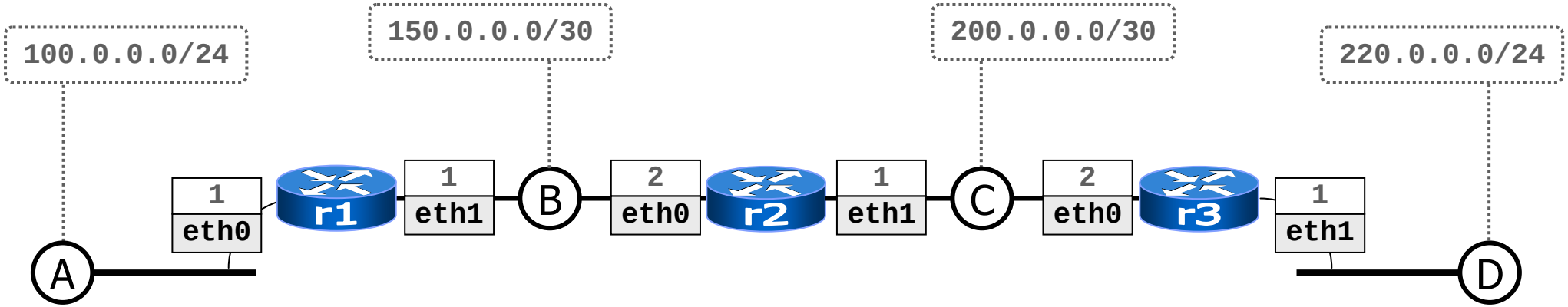
the password to connect to the daemon

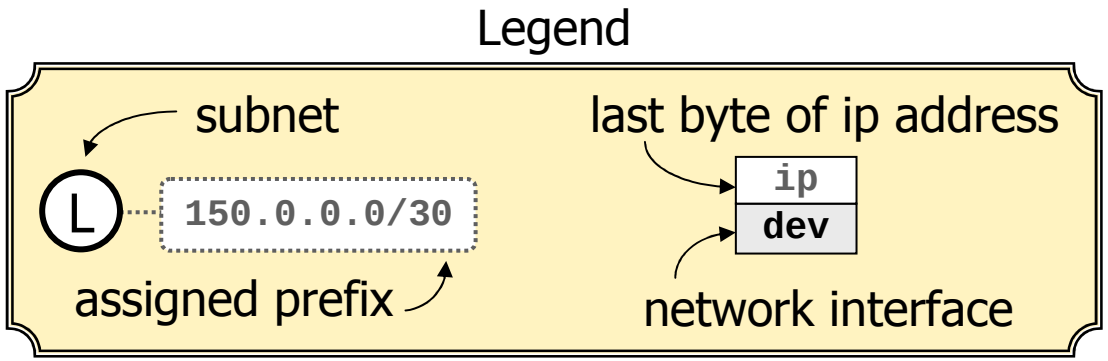
administrative password

sample ripd configuration file (`ripd.conf`)



a simple topology

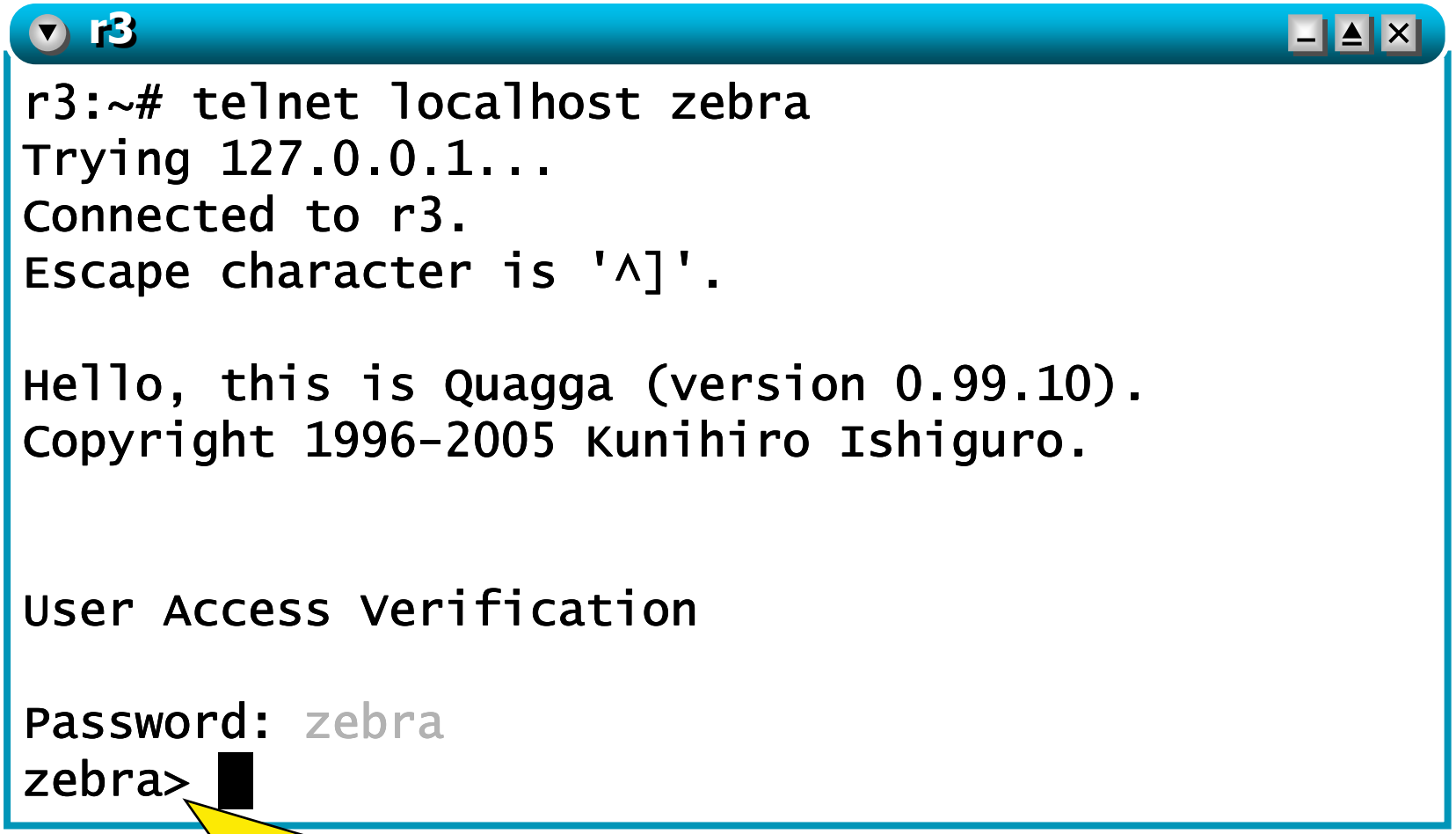




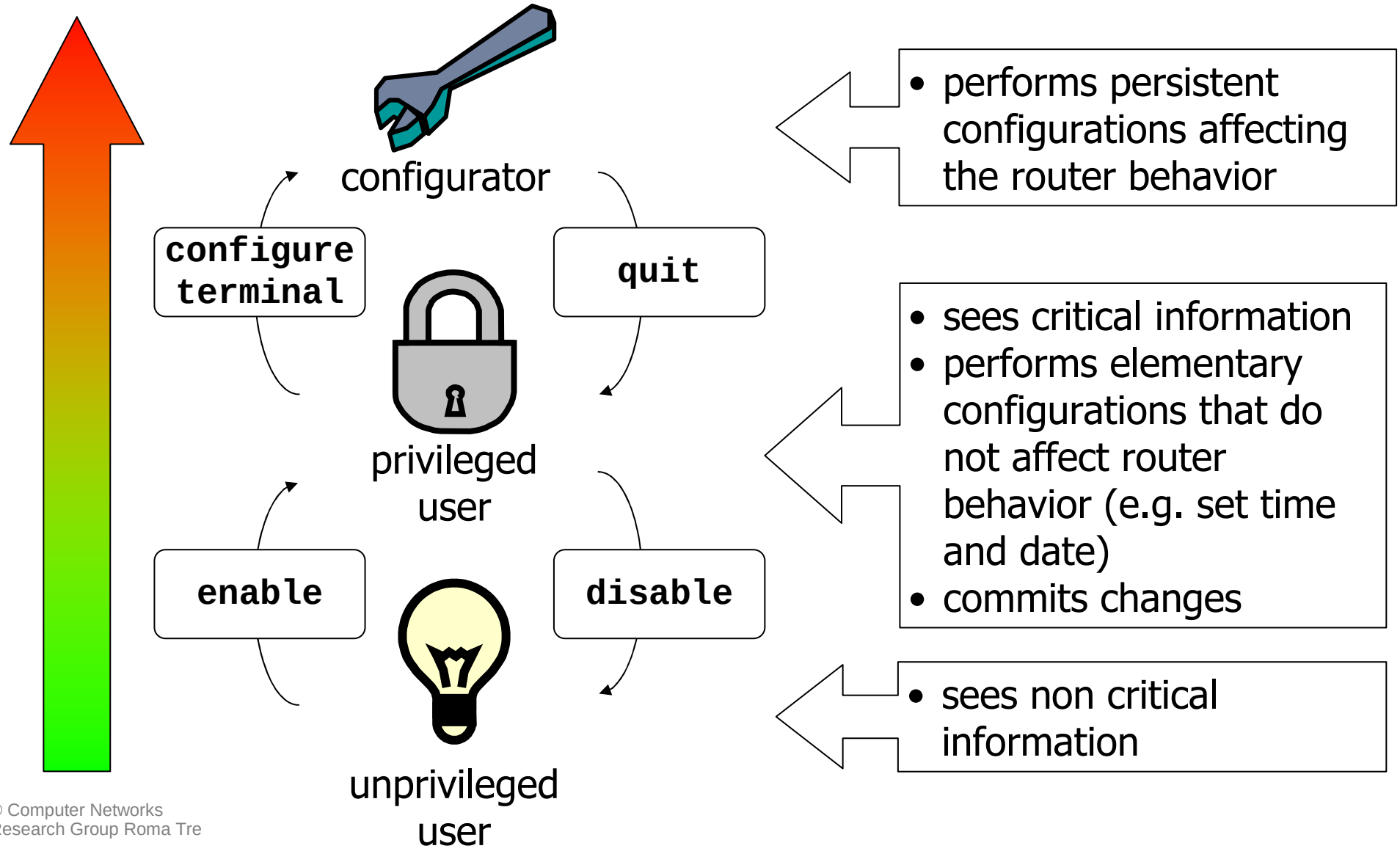
launching the lab script

- the lab configuration is such that
  - three virtual hosts are created and connected to the right collision domains (virtual hubs)
  - for each virtual host
    - network interfaces are automatically configured
    - quagga configuration files are updated
  - the zebra routing daemon is automatically started

connecting to the main zebra daemon

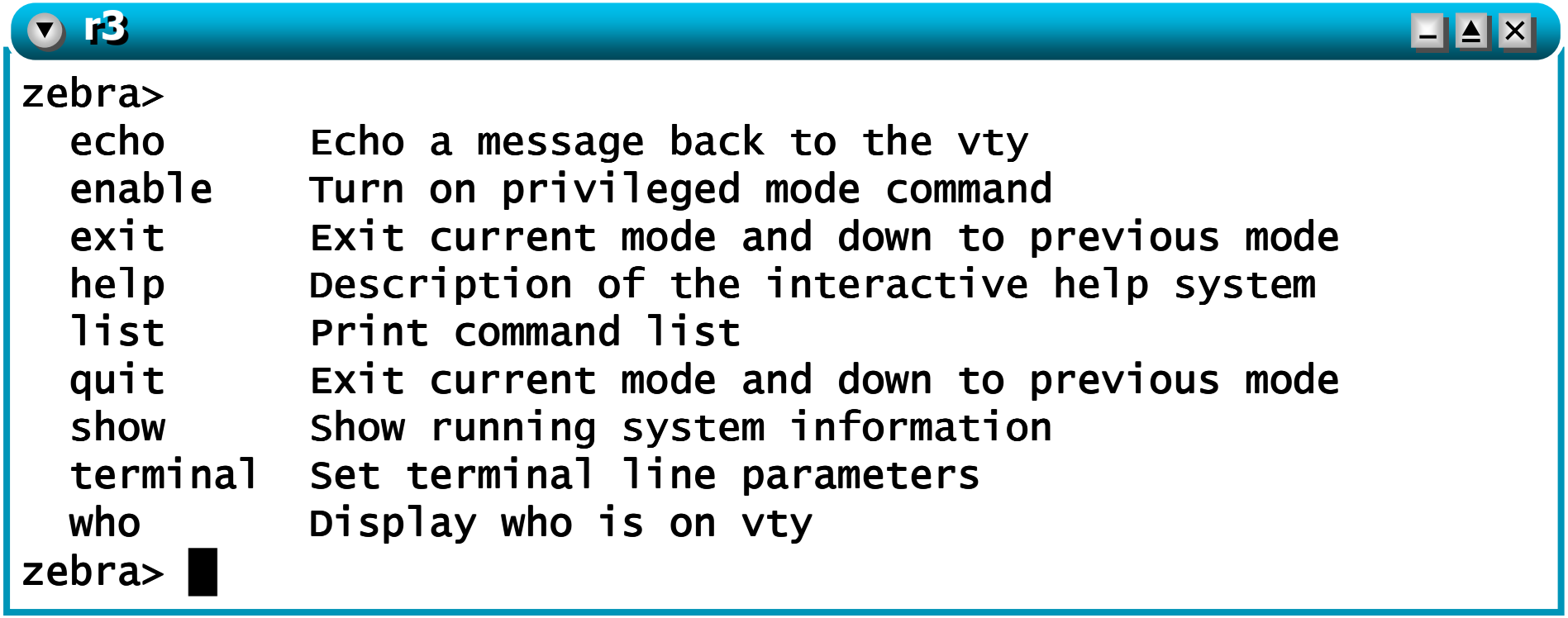


privileges on a router



available commands

- press '?' at the command prompt…



- …or…

available commands

- ...type 'list' (an excerpt of the output follows)

r3

```
zebra> list
  enable
  exit
  help
  list
  quit
  show interface [IFNAME]
  show ip forwarding
  show ip route
  show ipv6 forwarding
  show ipv6 route
  show memory
  show version
  terminal length <0-512>
  terminal no length
  who
zebra>
```

inspecting interfaces

r3

```
zebra> show interface eth0
Interface eth0 is up, line protocol detection is disabled
  index 3 metric 1 mtu 1500
  flags: <UP,BROADCAST,RUNNING,MULTICAST>
  HWaddr: ee:97:f2:ab:47:0c
  inet 200.0.0.2/30 broadcast 200.0.0.3
  inet6 fe80::ec97:f2ff:feab:470c/64
    15 input packets (0 multicast), 948 bytes, 0 dropped
    0 input errors, 0 length, 0 overrun, 0 CRC, 0 frame
    0 fifo, 0 missed
    9 output packets, 642 bytes, 0 dropped
    0 output errors, 0 aborted, 0 carrier, 0 fifo, 0 heartbeat
    0 window, 0 collisions
zebra>
```

- this roughly corresponds to using **`ifconfig`** at the shell prompt

inspecting the zebra routing table

r3

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

R>* 100.0.0.0/24 [120/3] via 200.0.0.1, eth0, 00:06:28
C>* 127.0.0.0/8 is directly connected, lo
R>* 150.0.0.0/30 [120/2] via 200.0.0.1, eth0, 00:06:28
C>* 200.0.0.0/30 is directly connected, eth0
C>* 220.0.0.0/24 is directly connected, eth1
zebra>
```

- FIB entries from this table (marked with a '>') are injected into the kernel routing table

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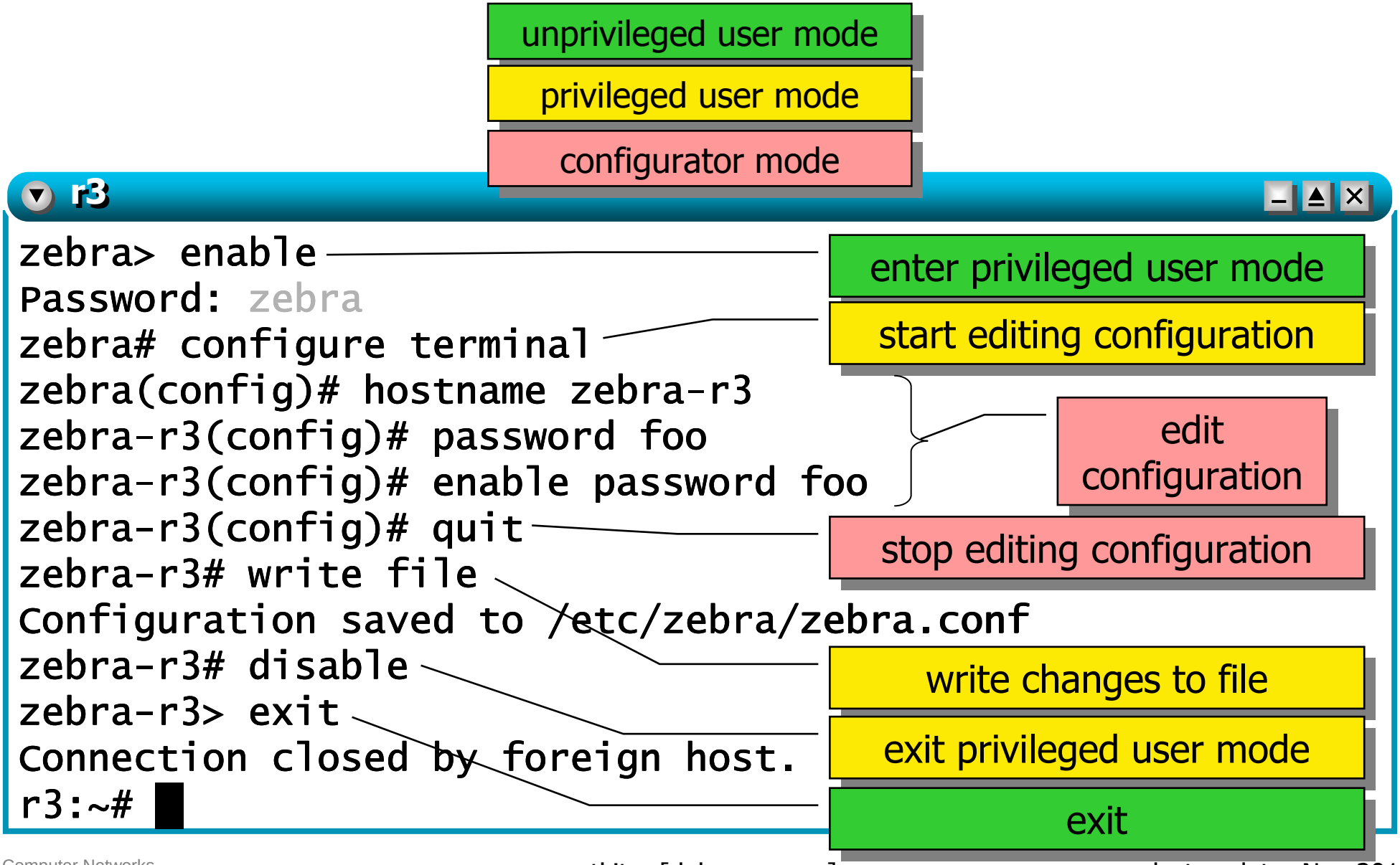
altering zebra configuration



inspecting the rip routing table

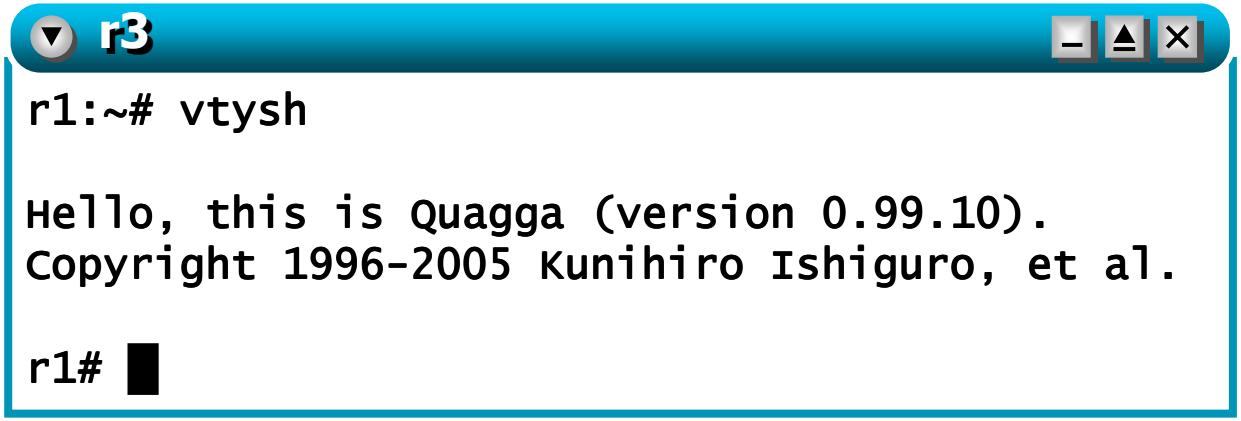
r3

```
r3:~# telnet localhost ripd
......
Password: zebra
ripd> 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) 100.0.0.0/24    200.0.0.1             3 200.0.0.1        0 02:43
R(n) 150.0.0.0/30    200.0.0.1             2 200.0.0.1        0 02:43
C(i) 200.0.0.0/30    0.0.0.0               1 self             0
C(i) 220.0.0.0/24    0.0.0.0               1 self             0
ripd>
```

a one-fits-all shell

- instead of having to connect to each single daemon, users can interact with quagga by using a built-in shell, called **`vtysh`**



- the user is not prompted for a password
- all the commands from the single routing daemons (including quagga itself) are available in this shell