

kathara lab

FRRouting

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

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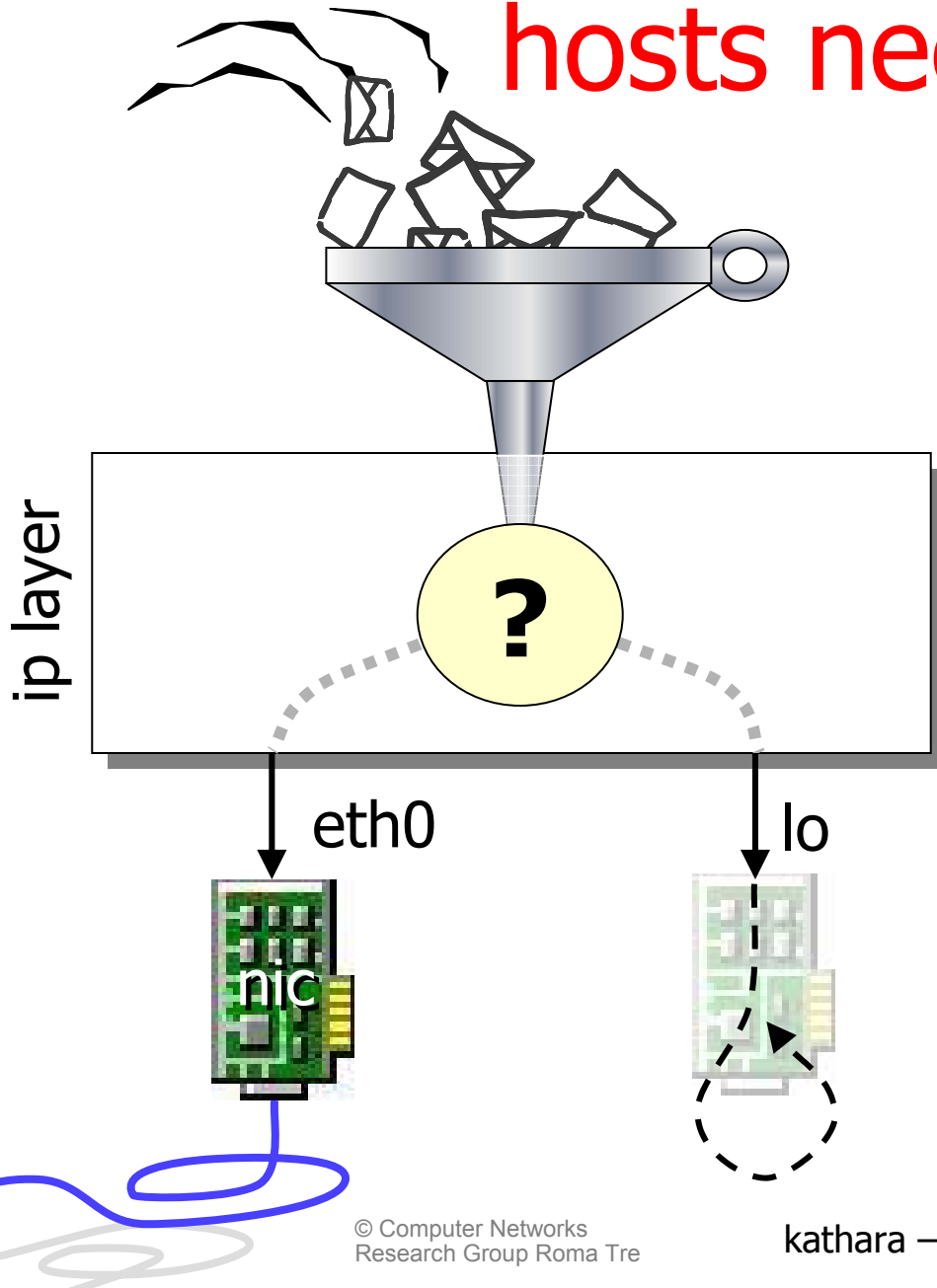
credits

- ver. 1.0 of this lab was realized starting from ver. 1.0 of “Quagga Introduction” (002-kathara-lab_quagga.pdf) of Kathará documentation
 - authored by G. Di Battista, M. Patrignani, M. Pizzonia, F. Ricci, M. Rimondini
- in turn, ver. 1.0 of “Quagga Introduction” was realized starting from the Netkit lab with the same name

preconditions

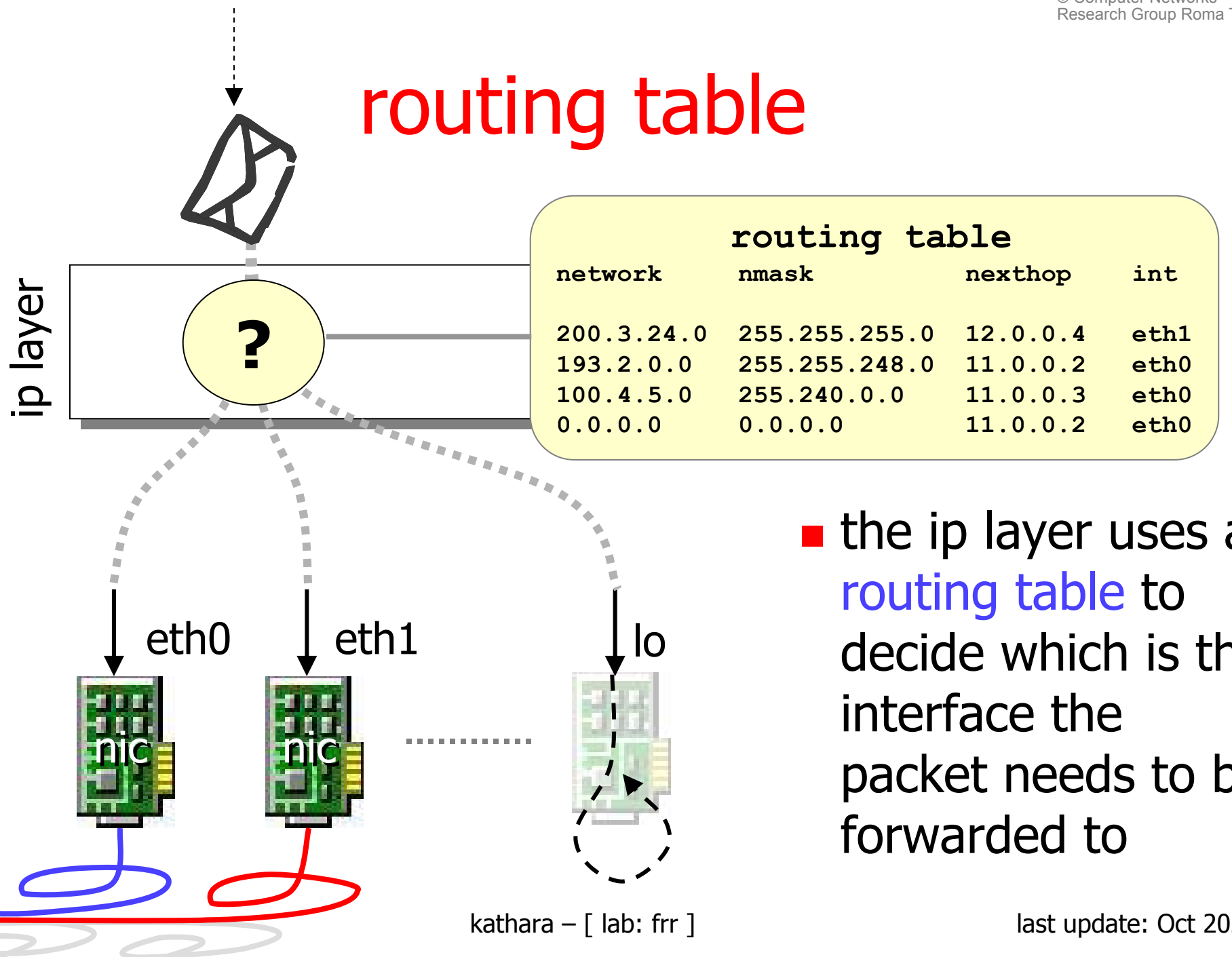
- for this lab we assume you have chosen “kathara/frr” as the default image of your Kathará installation
 - execute “kathara settings”
 - select “choose default image”
 - select “kathara/frr”
 - exit from the settings procedure

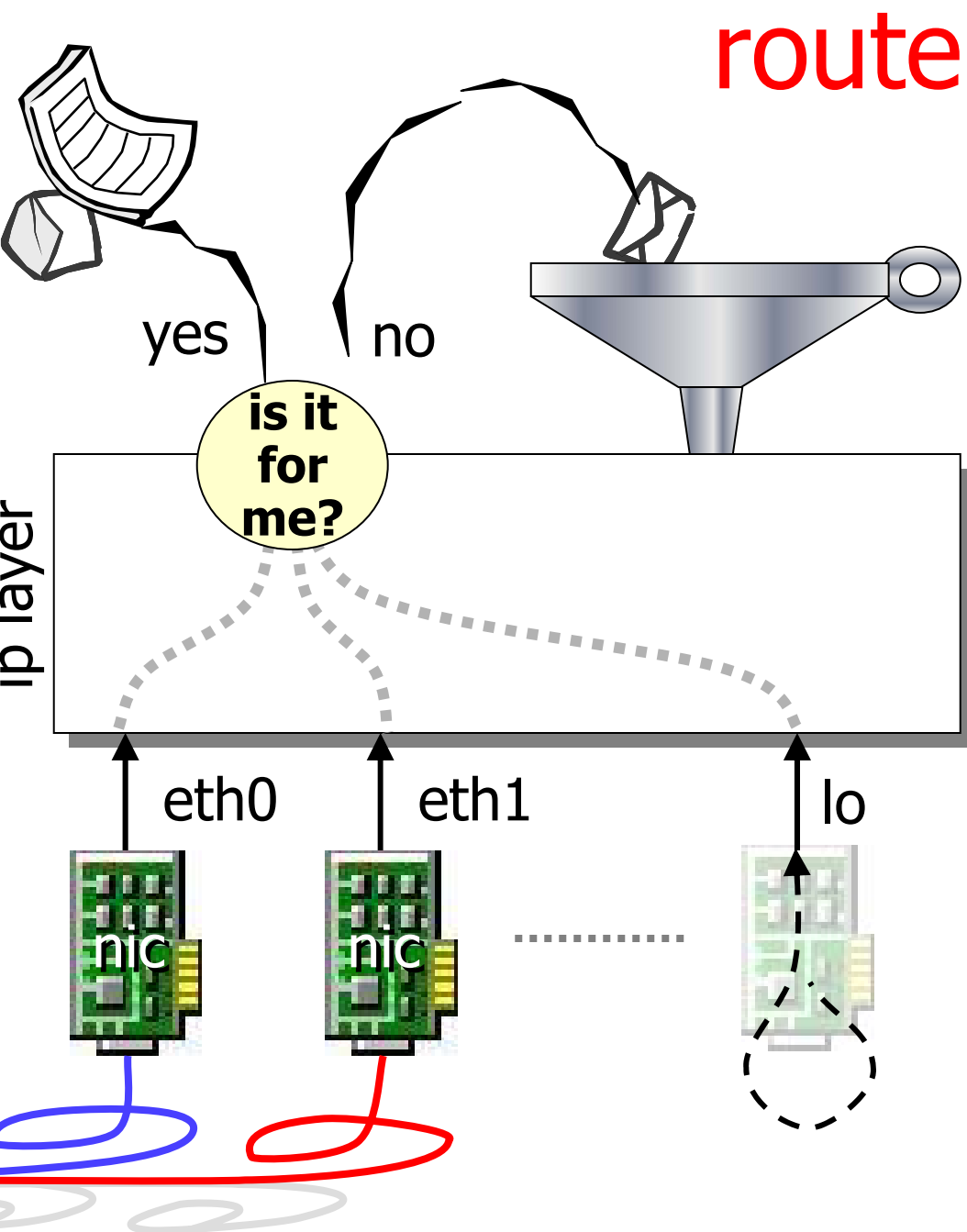
hosts need routing



- 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





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 Kathará are virtual machines that run a specific piece of software that implements routing protocols



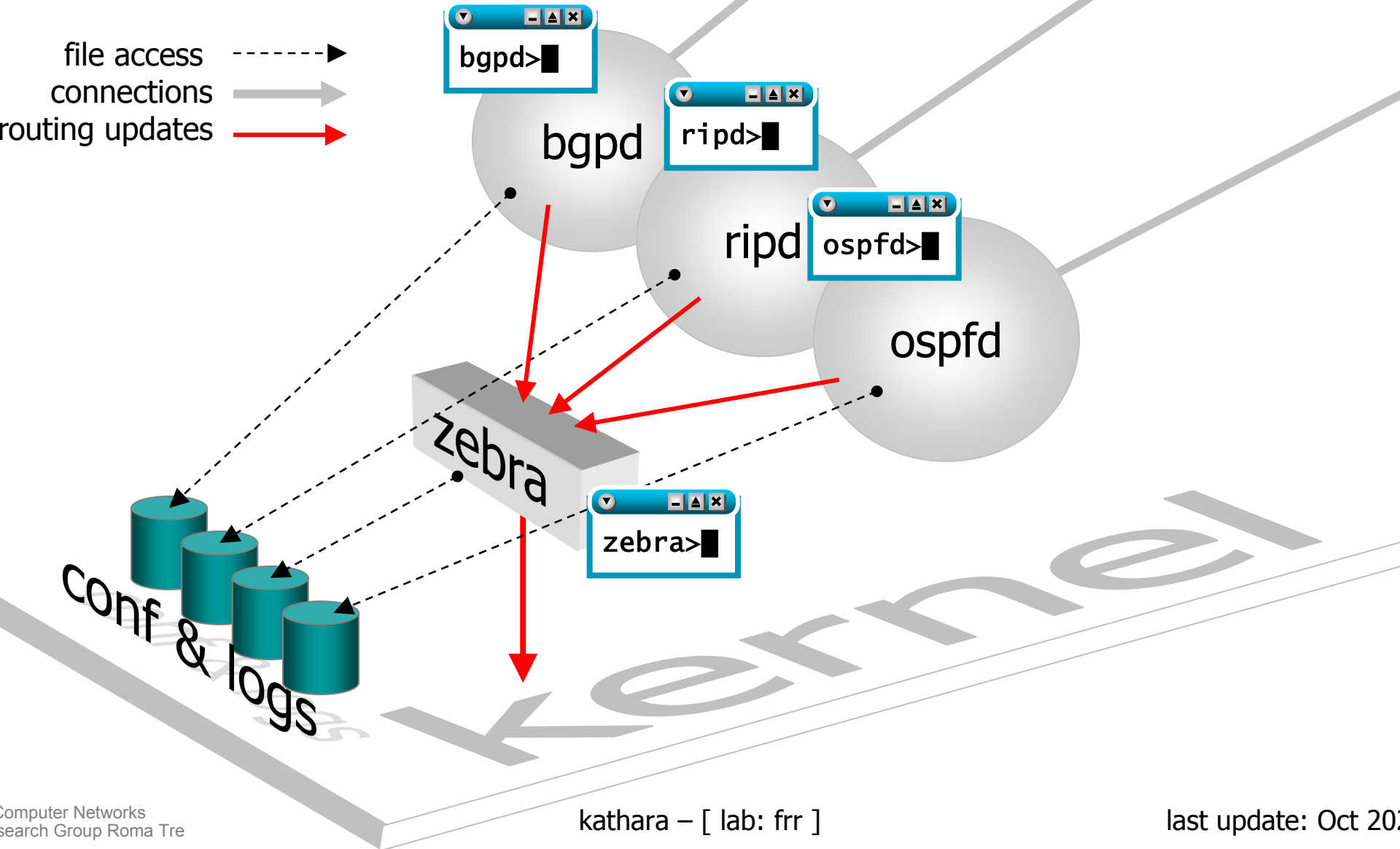
FRRouting

about frr

FRRouting: a free and open source Internet routing protocol suite for Linux and Unix platforms

- frr is a software that implements several routing protocols
 - rip (v1 and v2), ospf (v2 and v3), is-is
 - bgp
 - pim, ldp, bfd, babel, pbr, openfabric, vrrp, ...
- frr has its roots in the quagga project
 - quagga is no longer supported
 - first inaugural release frr 2.0, Mar 4, 2017 (github)
- in turn, quagga was a community project that originated from (and superseded) the zebra project
 - zebra development stopped at release 0.95a

frr is a routing daemon



inspecting frr configuration files

virtual machine

```
pc1:~# cd /etc/frr/  
pc1:/etc/frr# ls  
daemons      support_bundle_commands.conf    vtysh.conf  
pc1:/etc/frr# █
```

- when frr is started, the routing daemons check this directory to read the starting configuration

sample daemons configuration file

virtual machine

```
pc1:/etc/quagga# less daemons
# This file tells the frr package which daemons to start.
#
# Sample configurations for these daemons can be found in
# /usr/share/doc/frr/examples/.
#
# ...
#
zebra=yes
bgpd=no
ospfd=no
ospf6d=no
ripd=yes
ripngd=no
...
```

this may be missing since it is the default

the rip daemon will be also started

sample vtysh.conf configuration file

virtual machine

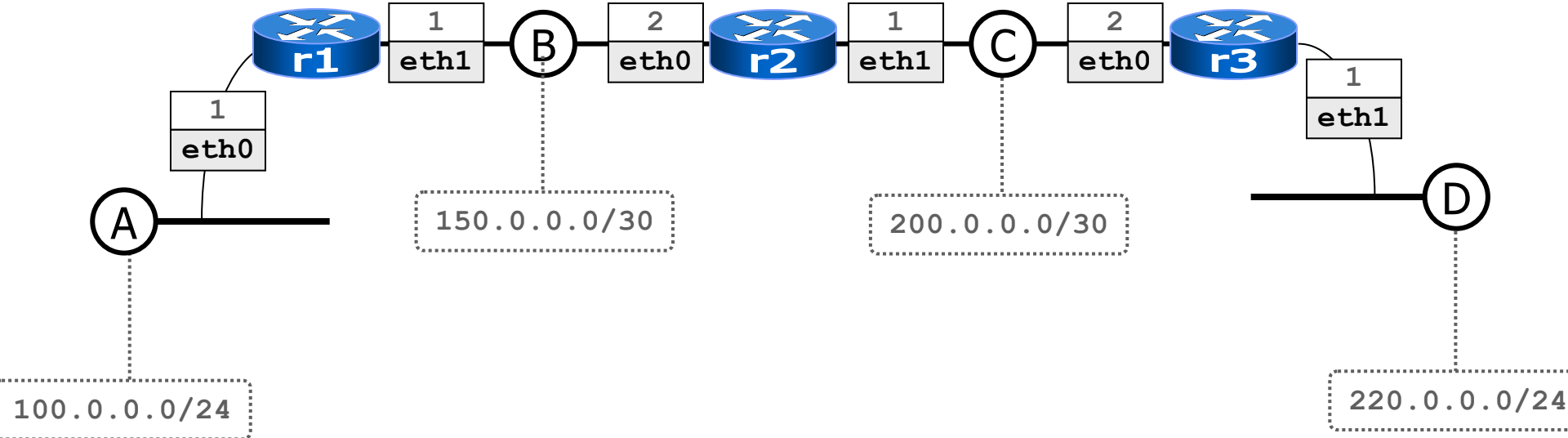
```
pc1:/etc/frr# cat vtysh.conf  
no service integrated-vtysh-config  
pc1:/etc/frr#
```

with this command each daemon will need its own configuration file

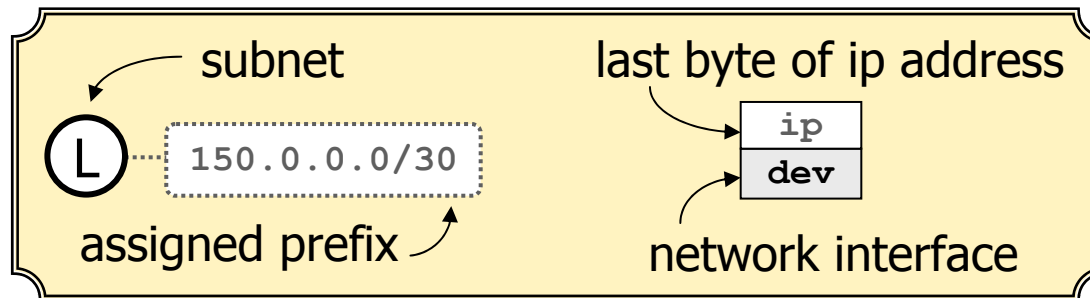
```
pc1:/etc/frr# cat vtysh.conf  
service integrated-vtysh-config  
pc1:/etc/frr#
```

a single configuration **frr.conf** file for all daemons (recommended)

a simple topology



legend



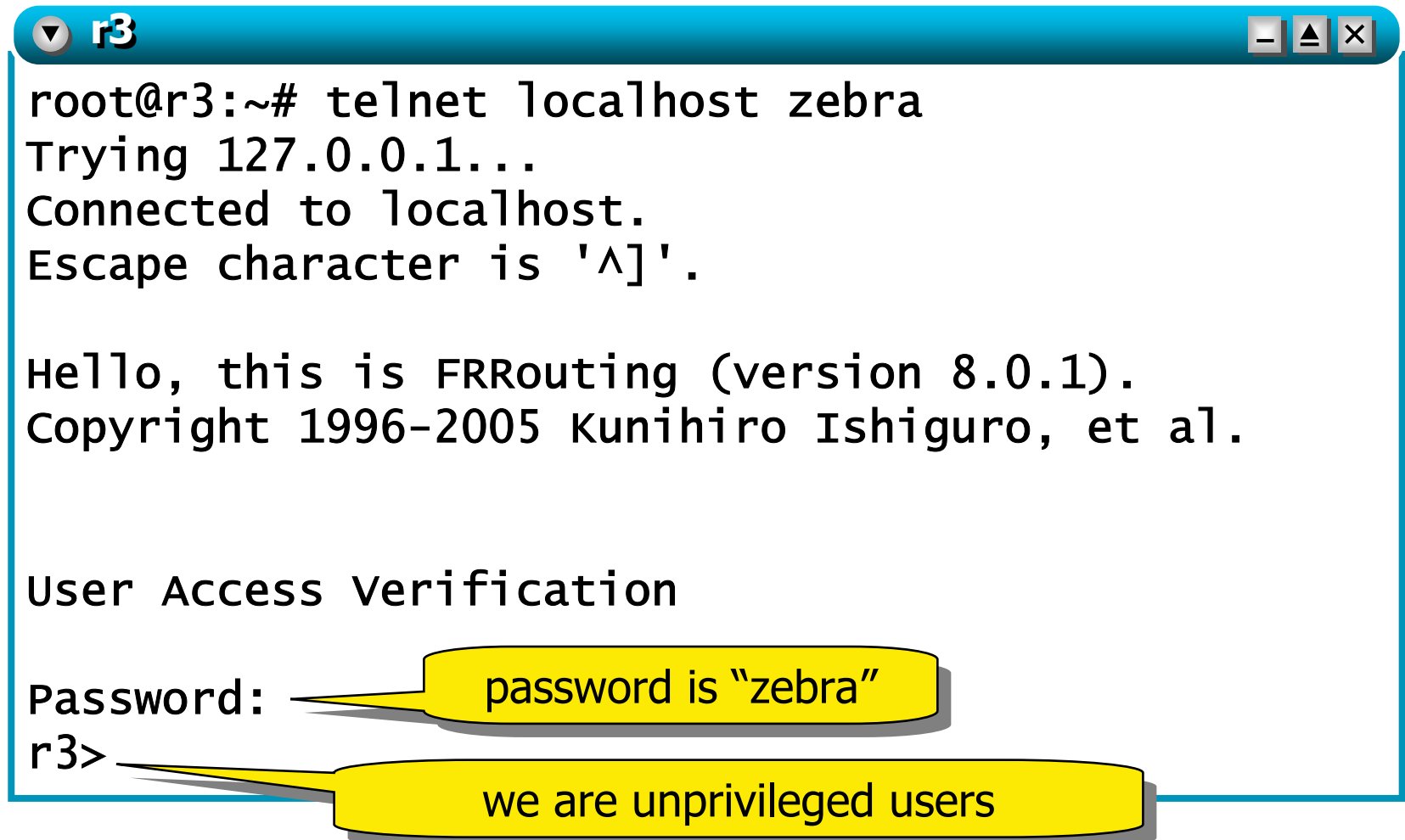
launching the lab script



```
host machine
user@localhost:~$ cd kathara-lab_frr
user@localhost:~/kathara-lab_frr$ kathara labstart
```

- 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
 - frr configuration files are updated
 - the frr routing daemon is automatically started

connecting to the main zebra daemon



A terminal window titled 'r3' with standard window controls. The terminal shows a telnet session to localhost zebra. The output includes the connection status, escape character, and a greeting from FRRouting. A 'User Access Verification' section follows, with a password prompt and a shell prompt. Two yellow callout boxes provide additional context: one for the password 'zebra' and another for the user type 'unprivileged users'.

```
root@r3:~# telnet localhost zebra
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

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

User Access Verification

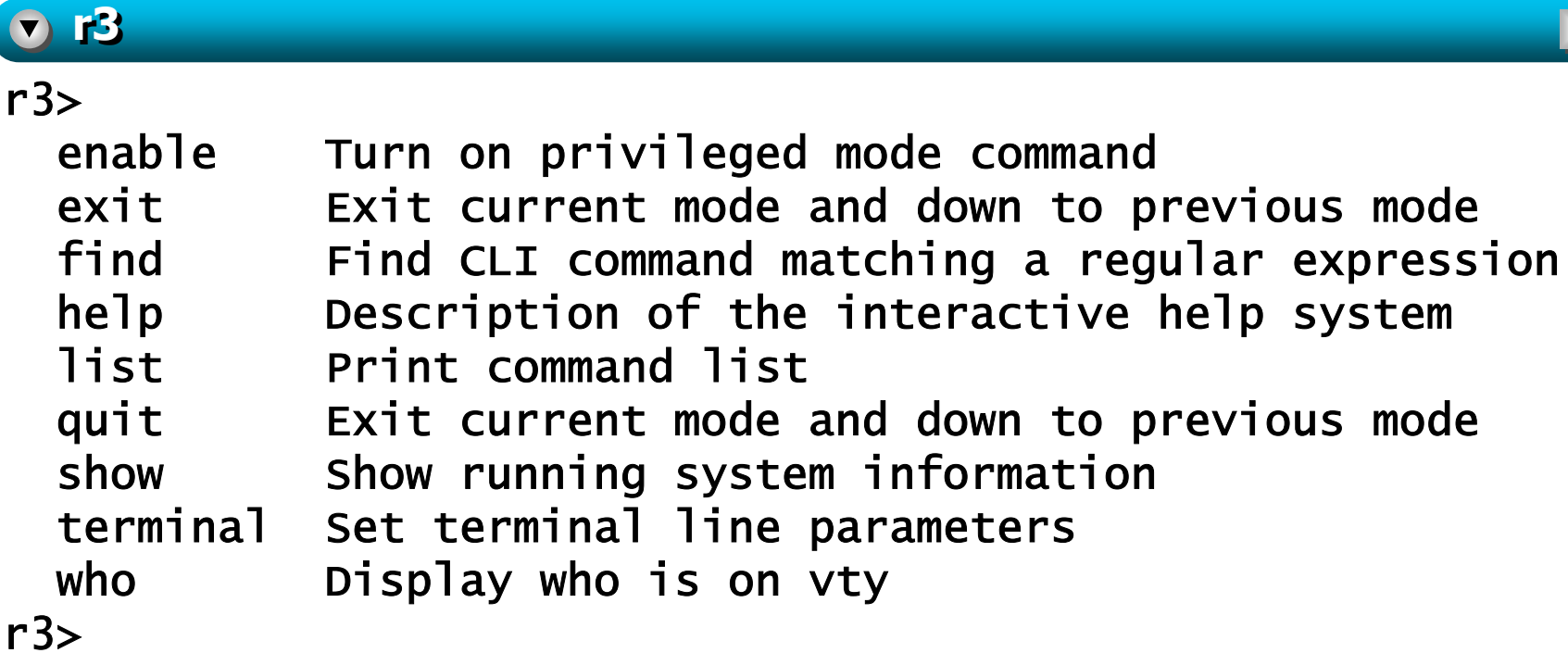
Password: 
r3>
```

password is "zebra"

we are unprivileged users

available commands of zebra daemon

- press '?' at the command prompt to have the list of all the available commands

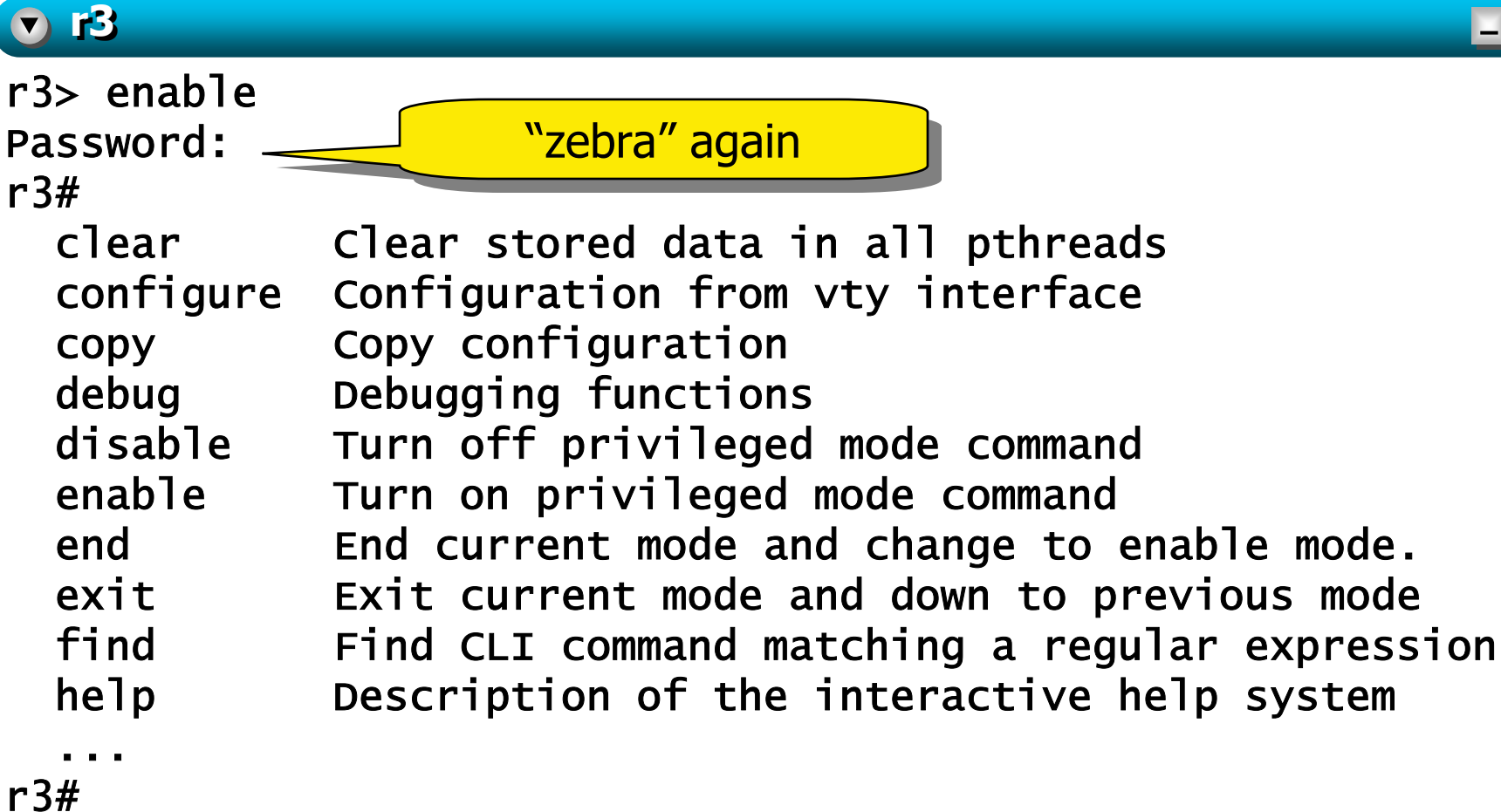


A terminal window titled 'r3' with standard window controls (minimize, maximize, close) in the top right corner. The terminal displays the output of the '?' command, listing available commands and their descriptions. The prompt 'r3>' is shown at the top and bottom of the output.

```
r3>
enable      Turn on privileged mode command
exit        Exit current mode and down to previous mode
find        Find CLI command matching a regular expression
help        Description of the interactive help system
list        Print command list
quit        Exit current mode and down to previous mode
show        Show running system information
terminal    Set terminal line parameters
who         Display who is on vty
r3>
```

available commands of zebra daemon

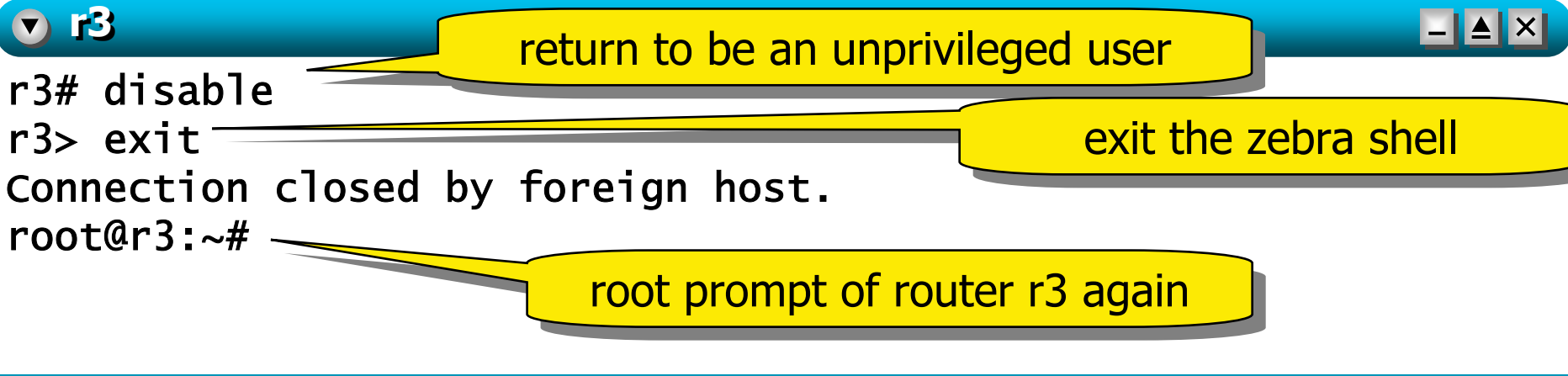
- type "enable" to become superuser, then '?'



```
r3> enable
Password:
r3#
clear          Clear stored data in all pthreads
configure      Configuration from vty interface
copy           Copy configuration
debug          Debugging functions
disable        Turn off privileged mode command
enable         Turn on privileged mode command
end            End current mode and change to enable mode.
exit           Exit current mode and down to previous mode
find           Find CLI command matching a regular expression
help          Description of the interactive help system
...
r3#
```

available commands of zebra daemon

- type "disable" to return an unprivileged user
- type "exit" to close the zebra shell



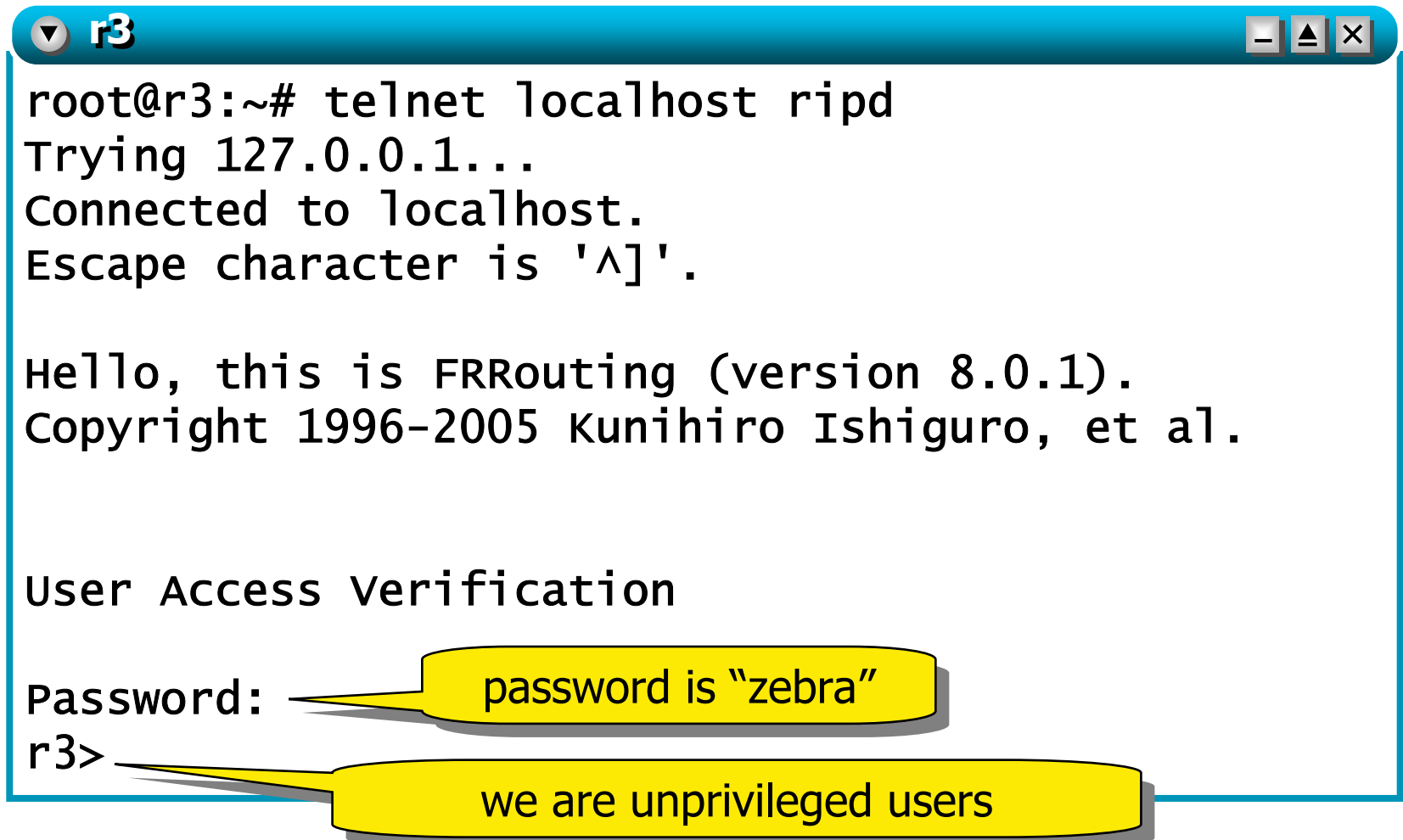
A terminal window titled 'r3' with standard window controls (minimize, maximize, close) in the top right corner. The terminal shows the following sequence of commands and output:

```
r3# disable
r3> exit
Connection closed by foreign host.
root@r3:~#
```

Three yellow callout boxes with pointers explain the actions:

- A box pointing to 'disable' contains the text: "return to be an unprivileged user".
- A box pointing to 'exit' contains the text: "exit the zebra shell".
- A box pointing to 'root@r3:~#' contains the text: "root prompt of router r3 again".

connecting to the ripd daemon



```
▼ r3
root@r3:~# telnet localhost ripd
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

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

User Access Verification

Password:
r3>
```

password is "zebra"

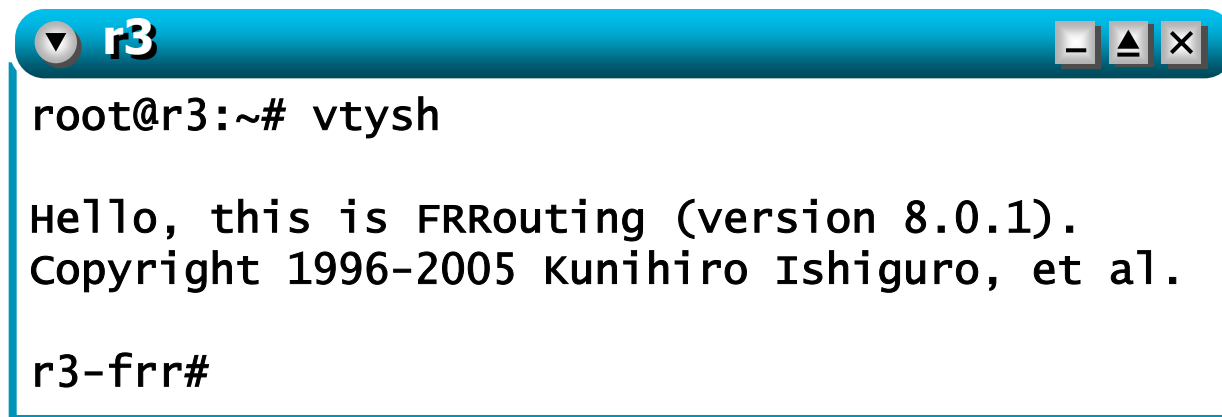
we are unprivileged users

connecting to all the routing daemons at once

- you should connect to
 - the zebra daemon for general configuration
 - the ripd daemon to configure the rip protocol
 - the ospfd daemon to configure the ospf protocol
 - ...
- alternatively, you could connect via the vtysh shell to configure all daemons from the same shell
 - this is the recommended practice

a one-fits-all shell

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

A terminal window titled 'r3' with standard window controls (minimize, maximize, close). The prompt is 'root@r3:~#'. The user has entered 'vttysh'. The output is 'Hello, this is FRRouting (version 8.0.1). Copyright 1996-2005 Kunihiro Ishiguro, et al.' followed by a new prompt 'r3-frr#'.

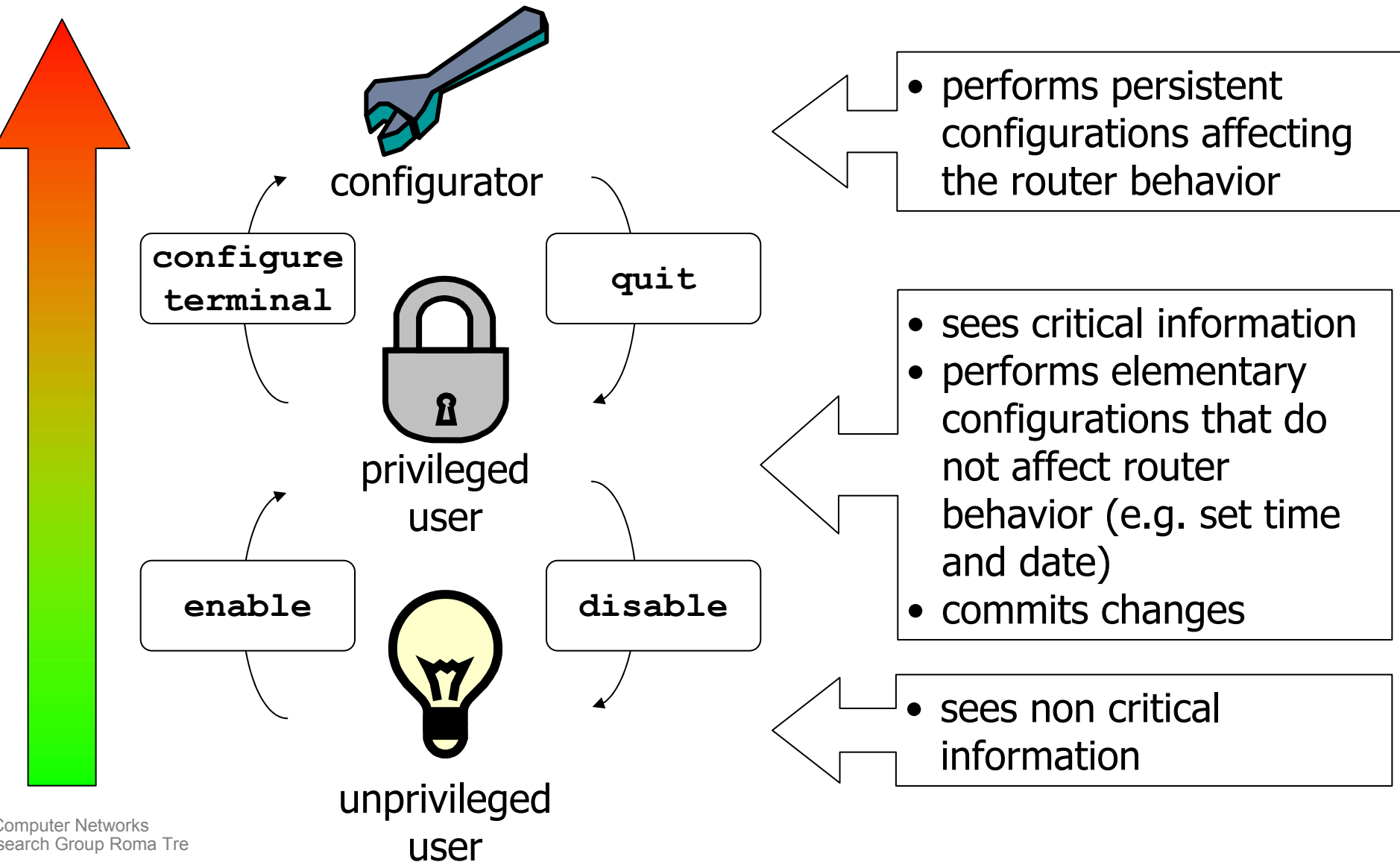
```
root@r3:~# vttysh

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

r3-frr#
```

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

privileges on a router



available `vttysh` commands

- press '?' at the command prompt...

▼ r3

```
r3-frr>
enable      Turn on privileged mode command
exit        Exit current mode and down to previous mode
mtrace      Multicast trace route to multicast source
no          Negate a command or set its defaults
ping        Send echo messages
quit        Exit current mode and down to previous mode
show        Show running system information
terminal    Set terminal line parameters
traceroute  Trace route to destination
r3-frr>
```


inspecting interfaces

▼ r3



```
r3-frr> show interface eth0
Interface eth0 is up, line protocol is up
  Link ups:          0      last: (never)
  Link downs:        0      last: (never)
  vrf: default
  index 398 metric 0 mtu 1500 speed 10000
  flags: <UP,BROADCAST,RUNNING,MULTICAST>
  Type: Ethernet
  Hwaddr: 56:1b:3b:d1:db:4a
  inet 200.0.0.2/30
  Interface Type VETH
  Interface Slave Type None
  protodown: off
  Parent ifindex: 397
r3-frr>
```

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

inspecting the frr routing table

```
▼ r3
r3-frr> show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, E - EIGRP, N - NHRP,
       T - Table, v - VNC, V - VNC-Direct, A - Babel, F - PBR,
       f - OpenFabric,
       > - selected route, * - FIB route, q - queued, r - rejected, b -
backup
       t - trapped, o - offload failure

R>* 100.0.0.0/24 [120/3] via 200.0.0.1, eth0, weight 1, 00:01:32
R>* 150.0.0.0/30 [120/2] via 200.0.0.1, eth0, weight 1, 00:01:32
C>* 200.0.0.0/30 is directly connected, eth0, 00:01:33
C>* 220.0.0.0/24 is directly connected, eth1, 00:01:33
r3-frr>
```

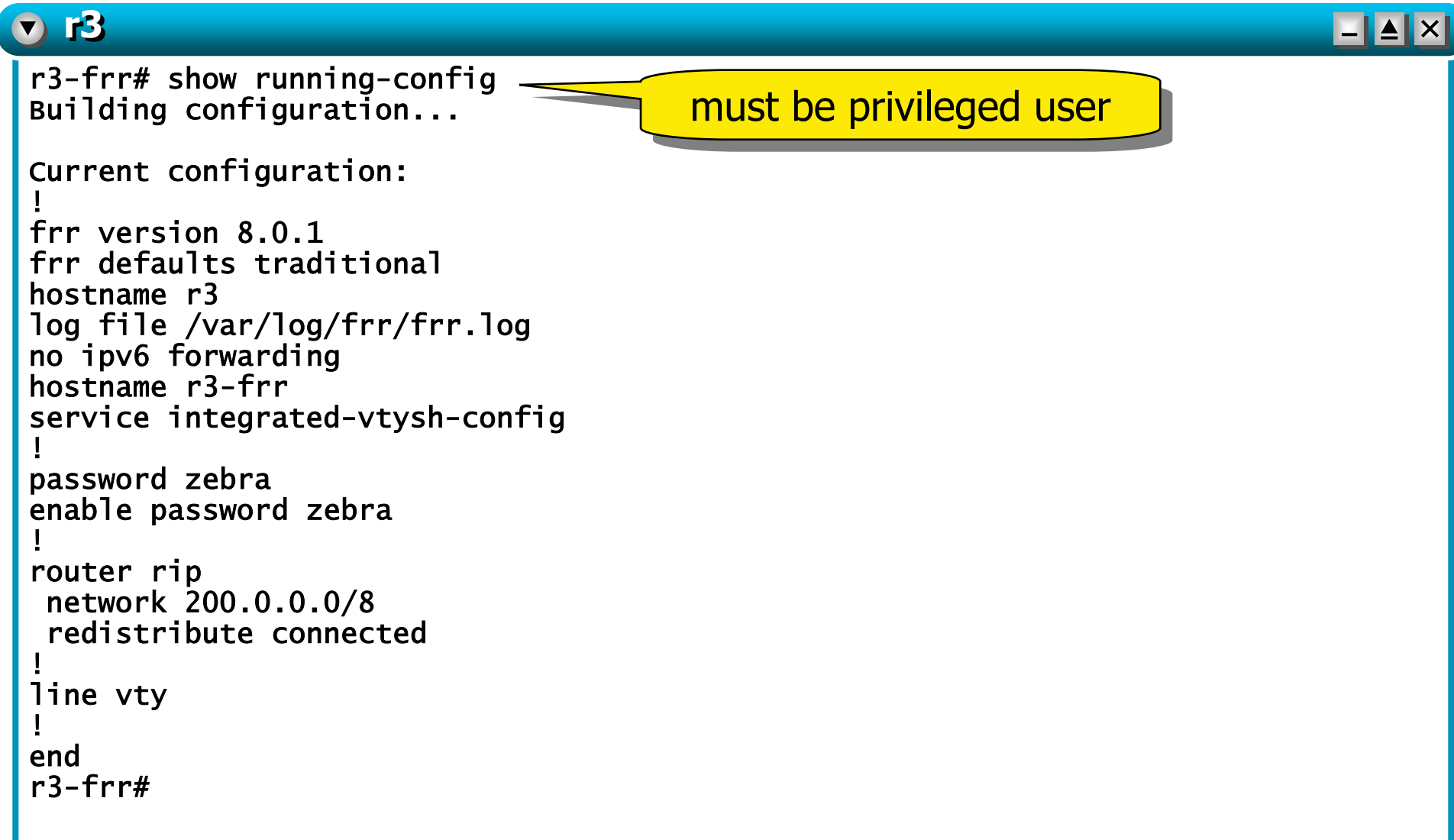
- FIB entries from this table (marked with a '>') are injected into the kernel routing table

inspecting the rip routing table

```
▼ r3
r3-frr> 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 02:54
R(n) 150.0.0.0/30            200.0.0.1                2 200.0.0.1                0 02:54
C(i) 200.0.0.0/30            0.0.0.0                  1 self                    0
C(r) 220.0.0.0/24            0.0.0.0                  1 self                    0
r3-frr> █
```

inspecting the current configuration



```
r3-frr# show running-config
Building configuration...

Current configuration:
!
frr version 8.0.1
frr defaults traditional
hostname r3
log file /var/log/frr/frr.log
no ipv6 forwarding
hostname r3-frr
service integrated-vtysh-config
!
password zebra
enable password zebra
!
router rip
  network 200.0.0.0/8
  redistribute connected
!
line vty
!
end
r3-frr#
```

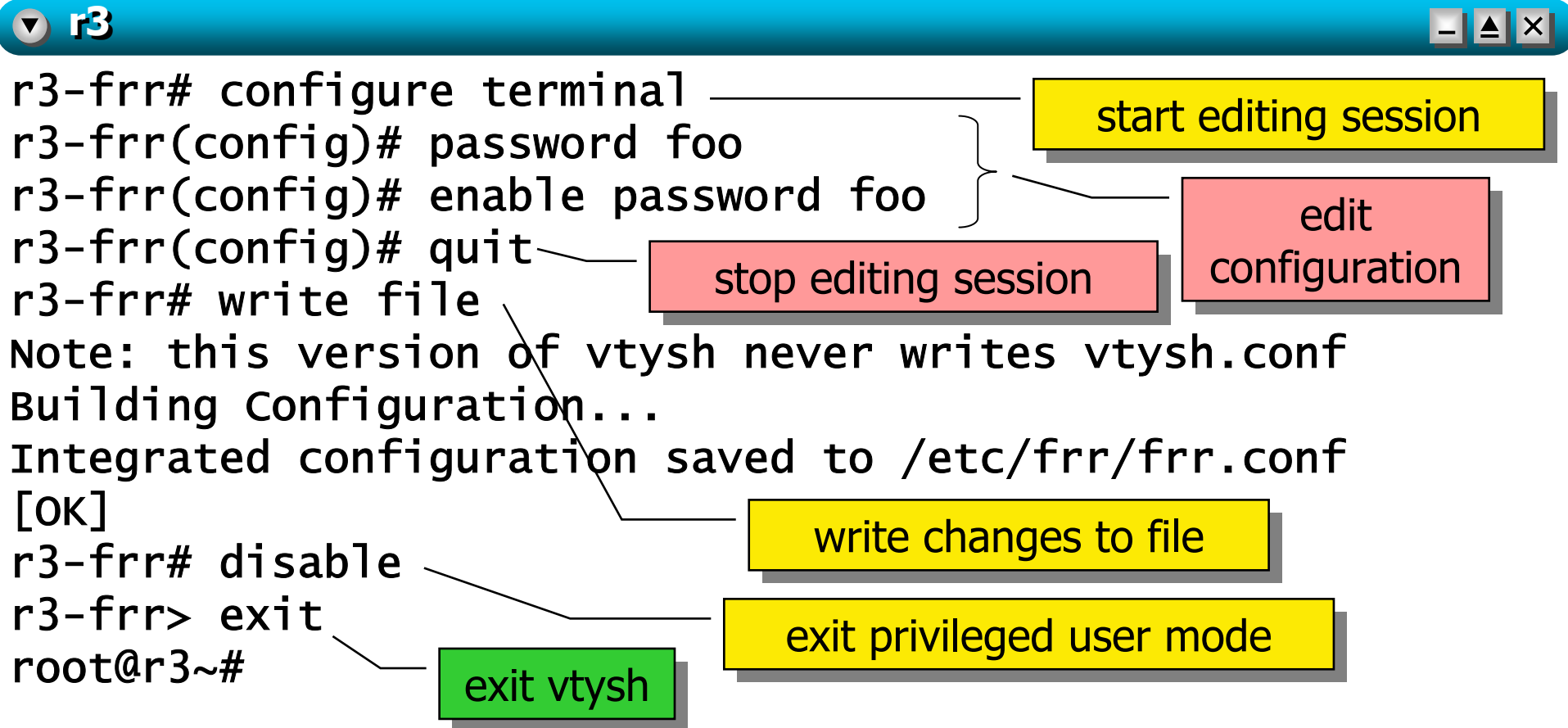
must be privileged user

changing the current configuration

unprivileged user mode

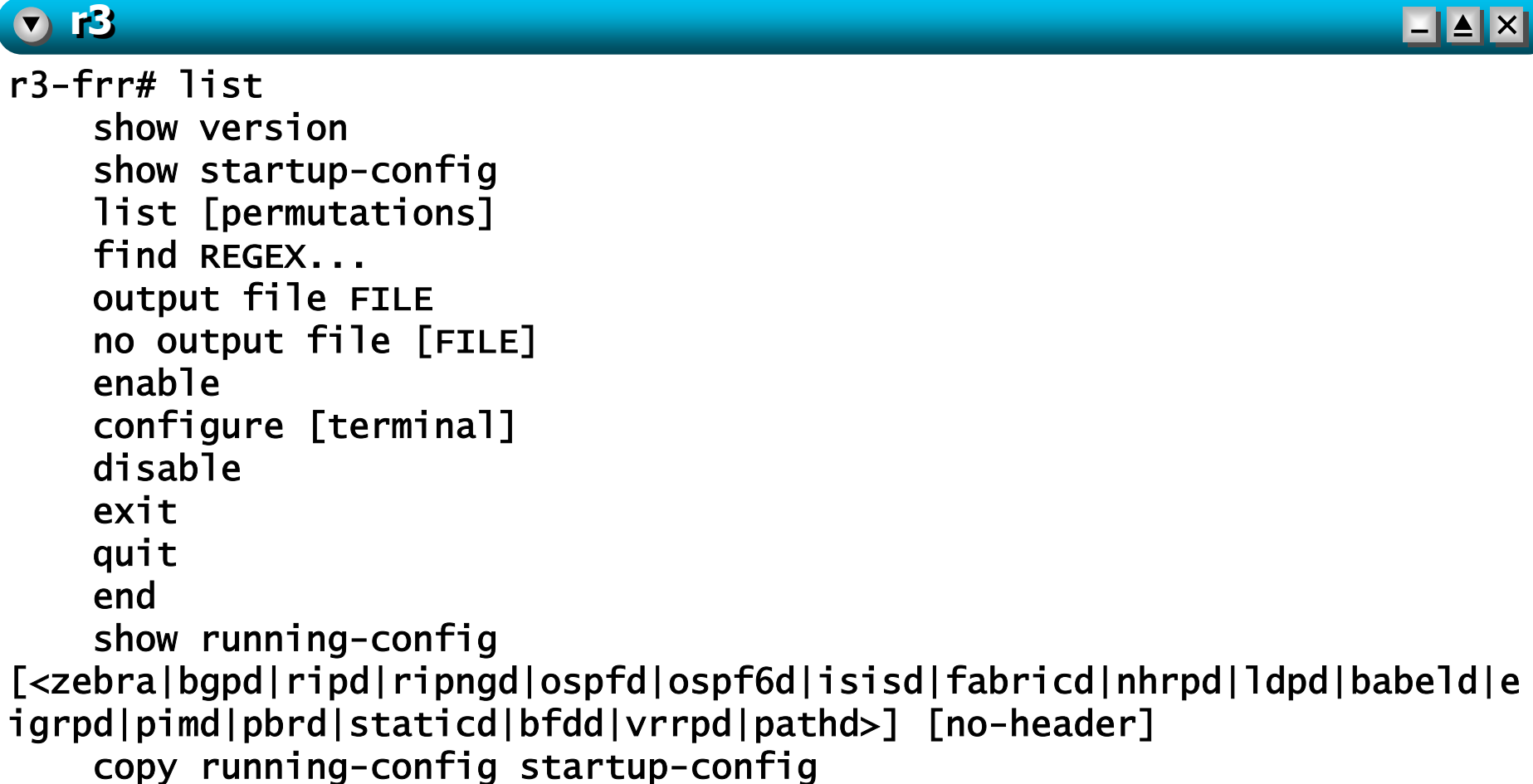
privileged user mode

configurator mode



all available commands

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



```
r3-frr# list
  show version
  show startup-config
  list [permutations]
  find REGEX...
  output file FILE
  no output file [FILE]
  enable
  configure [terminal]
  disable
  exit
  quit
  end
  show running-config
[<zebra|bgpd|ripd|ripngd|ospfd|ospf6d|isisd|fabricd|nhdpd|ldpd|babeld|e
igrpd|pimd|pbrd|staticd|bfd|vrrpd|pathd>] [no-header]
  copy running-config startup-config
```

some observations

- the frr configuration language is “operational” and not “declarative”
 - the configuration file is simply a list of configuration commands that would bring the router to its operative state
 - it is not an abstract description of how the router should behave according to the configurator
- the effect of the configuration commands changes when the default values for the router are changed
 - for example by a software upgrade
- you cannot remove a configuration command
 - if the command has a certain string (e.g., “ipv6 forwarding”) in order to remove it you should issue the same string preceded by “no” (e.g., “no ipv6 forwarding”)