Routerlab

Summer semester 2018

Worksheet 1
Group 08

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Pages: 14

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Question 1

Password changed.

Question 2

2a)

1) According to the information on LabFront, there are switches (Cisco 2960, Juniper EX2200, HP, TP-Link and others), routers (Cisco 829-FSP, Cisco 7206VXR, Juniper SRX240 and others), loadgens (Dell, Sun, Xen virtual loadgens), rack servers (Dell Poweregde) and other hardware (digi etherlite 32, Dual Opteron, HP ProLiant Gen 9, Gen8 servers, Sun Netra X4250 server, Dell Server, NEC OpenFlow, Quanta OpenFlow, GUDE switches etc.).

2) Our assigned routers are lev-rc1, lev-rc2, lev-rj1 and lev-rj2.
lev-rc1 has 10 interfaces and their names are Gi0, Gi1, Gi2, Gi3, Gi4, Gi5, Gi6, Gi7, Gi8, Gi9. lev-rc2 has 3 interfaces and their names are ge0/1, ge0/2, ge0/3. lev-rj1 and lev-rj2 each have 16 interfaces and their names are ge0/0/0, ge0/0/1, ge0/0/2, ge0/0/3, ge0/0/4, ge0/0/5, ge0/0/6, ge0/0/7, ge0/0/8, ge0/0/9, ge0/0/10, ge0/0/11, ge0/0/12, ge0/0/13, ge0/0/14, ge0/0/15. Apart from these network interfaces some of the devices also have console and power ports, which we do not list, because they are not network interfaces, but rather serve the purpose of being able to configure routers without having to rely on the network.
The interfaces used in the setup shown in Figure 1 on the assignment sheet are Gi8 and Gi9 on lev-rc1, as well as ge0/0/2 on lev-rj2.

3) In our cloud, which is Leverkusen Cloud, there are some links between the routers and switches. For example lev-rj2's interface ge0/0/2 is connected to lev-rc1 via Gi8 and lev-rj2's interface ge0/0/3 is connected to lev-sc1 via Gi1/0/14. lev-rc1's interface Gi9 is connected to lev-sc1 via Gi1/0/12. These links should be Gigabit links, as indicated by the interface names.
Other devices in the RouterLab have Serial, FastEthernet or TenGigabit or other types of data links.

2b)

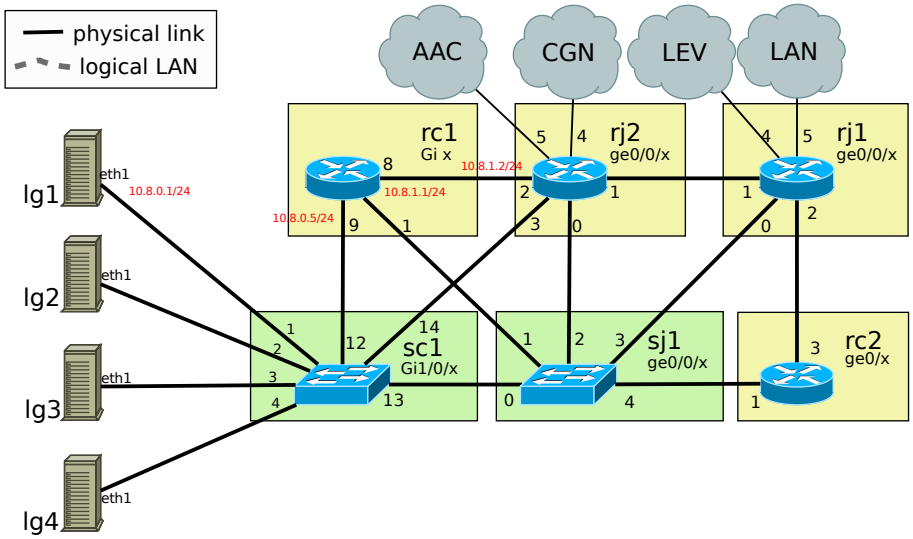
1) Choosing IPv6 prefixes from the allocated range:
fc00:470:525b:f800::/64
fc00:470:525b:f801::/64

Choosing IPv4 subnets from the allocated range:
10.8.0.0/24
10.8.1.0/24

2)
Interface eth1 on lev-lg1:
fc00:470:525b:f800::2/64
10.8.0.1/24

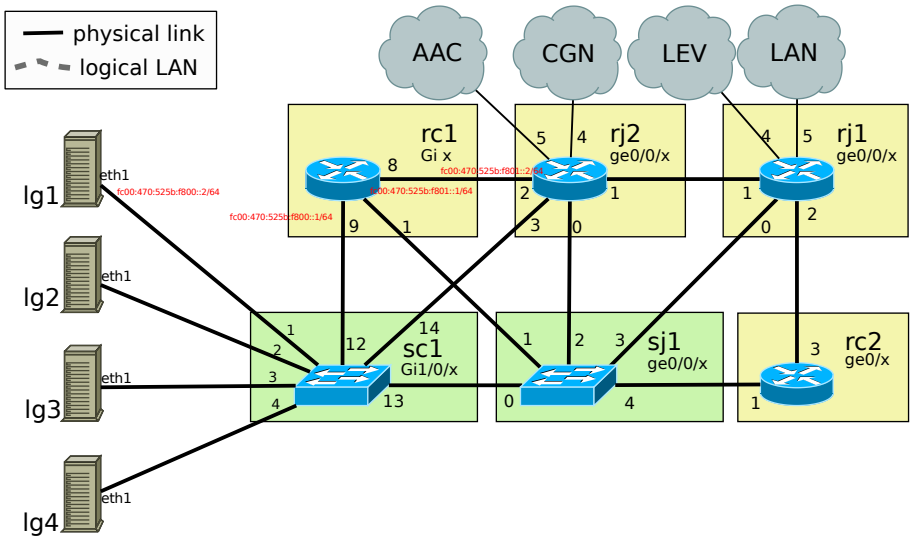
Interface Gi9 on lev-rc1:
fc00:470:525b:f800::1/64
10.8.0.5/24

We assigned the IP addresses within the prefix lengths given in the assignment (/24 and /64),



on sc1 all ports are GigabitEthernet0/x, the port numbers on the clouds refer to sc1 in the respective cloud

Figure 1: The IPv4 topology.



on sc1 all ports are GigabitEthernet0/x, the port numbers on the clouds refer to sc1 in the respective cloud

Figure 2: The IPv6 topology.

as indicated in the assignment. In practice, this would be a potentially wasteful allocation of address space. For the scope of this assignment, a /29 and a /30 subnet (or /125 and /126 prefixes) would be sufficient.

3)
Interface Gi8 on lev-rc1:
fc00:470:525b:f801::1/64
10.8.1.1/24

Interface ge0/0/2 on lev-rj2:
fc00:470:525b:f801::2/64
10.8.1.2/24

Question 3

3a)

Nothing to document.

3b)

1) There are 4 network interfaces on group08-lg-1.

```
root@group08-lg1:~# ip a s
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN
    group default
     link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
     inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
     inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast
    state UP group default qlen 1000
     link/ether 00:16:3e:af:08:10 brd ff:ff:ff:ff:ff:ff
     inet 172.16.0.208/20 brd 172.16.15.255 scope global eth0
        valid_lft forever preferred_lft forever
     inet6 fe80::216:3eff:feaf:810/64 scope link
        valid_lft forever preferred_lft forever
3: eth1: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN group
    default qlen 1000
     link/ether 00:16:3e:af:08:11 brd ff:ff:ff:ff:ff:ff
4: eth2: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN group
    default qlen 1000
     link/ether 00:16:3e:af:08:12 brd ff:ff:ff:ff:ff:ff
```

lo is the loopback interface which is currently active. eth0 is the currently active Ethernet interface. eth1 and eth2 are ethernet interfaces that are not currently used (status down, and no IP addresses assigned to them).

2) The network fe80::/10 is reserved for link-local addresses. These addresses can be self-assigned by a device. However they are not routable, so they can only be used for communication between devices in the same network.
Link-local addresses are not strictly needed if IP address allocation is managed by a DHCP server. But they allow for decentralized modes of address allocation and for easier communication between hosts on the same network.

3) We configured the interface eth1 using these commands:

```
root@group08-lg1:~# ip address add fc00:470:525b:f800::2/64 dev eth1
root@group08-lg1:~# ip address add 10.8.0.1/24 dev eth1
```

State of the interfaces after configuration:

```
root@group08-lg1:~# ip a s
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN
    group default
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast
    state UP group default qlen 1000
    link/ether 00:16:3e:af:08:10 brd ff:ff:ff:ff:ff:ff
    inet 172.16.0.208/20 brd 172.16.15.255 scope global eth0
       valid_lft forever preferred_lft forever
    inet6 fe80::216:3eff:feaf:810/64 scope link
       valid_lft forever preferred_lft forever
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast
    state UP group default qlen 1000
    link/ether 00:16:3e:af:08:11 brd ff:ff:ff:ff:ff:ff
    inet 10.8.0.1/24 scope global eth1
       valid_lft forever preferred_lft forever
    inet6 fc00:470:525b:f800:216:3eff:feaf:811/64 scope global
       mngtmpaddr dynamic
       valid_lft 2513881sec preferred_lft 526681sec
    inet6 fc00:470:525b:f800::2/64 scope global
       valid_lft forever preferred_lft forever
    inet6 fe80::216:3eff:feaf:811/64 scope link
       valid_lft forever preferred_lft forever
4: eth2: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN group
    default qlen 1000
    link/ether 00:16:3e:af:08:12 brd ff:ff:ff:ff:ff:ff
```

3c)

lev-rc1 runs version 15.2 of Cisco IOS, as shown by this output (some irrelevant parts removed):

```
lev-rc1>show version
Cisco IOS Software, C800 Software (C800-UNIVERSALK9-M), Version 15.2(4)
   M6, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2014 by Cisco Systems, Inc.
Compiled Wed 19-Mar-14 20:07 by prod_rel_team

ROM: System Bootstrap, Version 15.2(3r)XC, RELEASE SOFTWARE (fc1)

lev-rc1 uptime is 42 weeks, 6 days, 23 hours, 37 minutes
System returned to ROM by power-on
System image file is "flash:c800-universalk9-mz.SPA.152-4.M6.bin"
Last reload type: Normal Reload
Last reload reason: power-on

[...]
```

```
Cisco C892FSP-K9 (revision 1.0) with 488524K/35763K bytes of memory.
Processor board ID FCZ1917C10D
10 Gigabit Ethernet interfaces
1 Virtual Private Network (VPN) Module
DRAM configuration is 32 bits wide
255K bytes of non-volatile configuration memory.
250880K bytes of ATA System CompactFlash (Read/Write)

License Info:

License UDI:

-------------------------------------------------
Device#   PID                 SN
-------------------------------------------------
*0        C892FSP-K9          FCZ1917C10D


License Information for 'c800'
    License Level: advipservices    Type: Permanent
    Next reboot license Level: advipservices


Configuration register is 0x2102
```

3d)

lev-rj2 runs version 12.1 of JunOS, as shown by this output:

```
root@lev-rj2>show version
Hostname: lev-rj2
Model: srx240h2
JUNOS Software Release [12.1X44-D35.5]
```

(interfaces)

Question 4

4a)

We gathered information about current reservations and made our own reservation with the following commands (parts of the output removed for brevity):

```
group08@cheetah:~$ lab --show-reservations
[ OK ] Willkommen group08!
[ OK ] Authenticated via Magic Cookie
[ OK ] ------- Routerlab Active Reservations -------

|  id        start_time        |       end_time        |      login  /
   objects    |
+--------+-----------------------+-----------------------+-------------------------

| 12773 | 2016-05-23 11:52:26 | 2018-05-23 11:52:26 | infrastructure
          |
|       |                     |                     |    loadgen120
          |
```

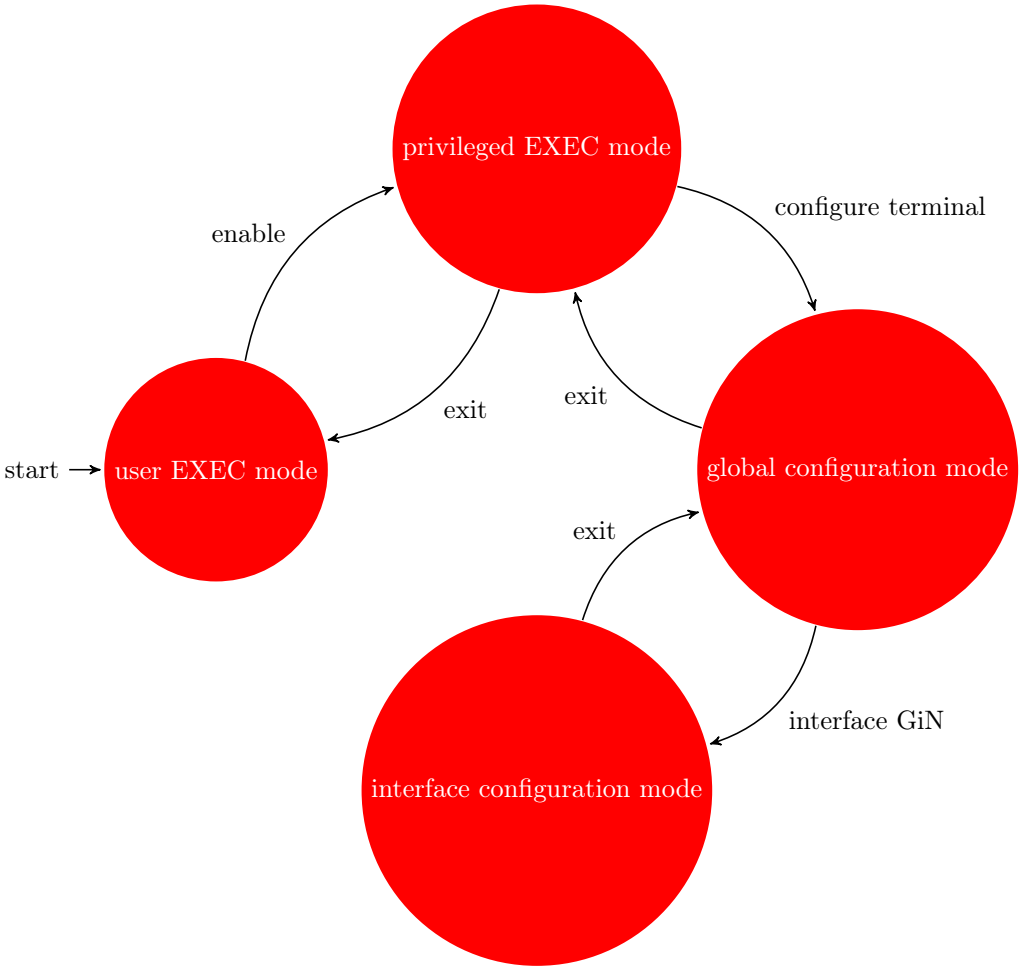


Figure 3: State Diagram for Cisco IOS Modes.

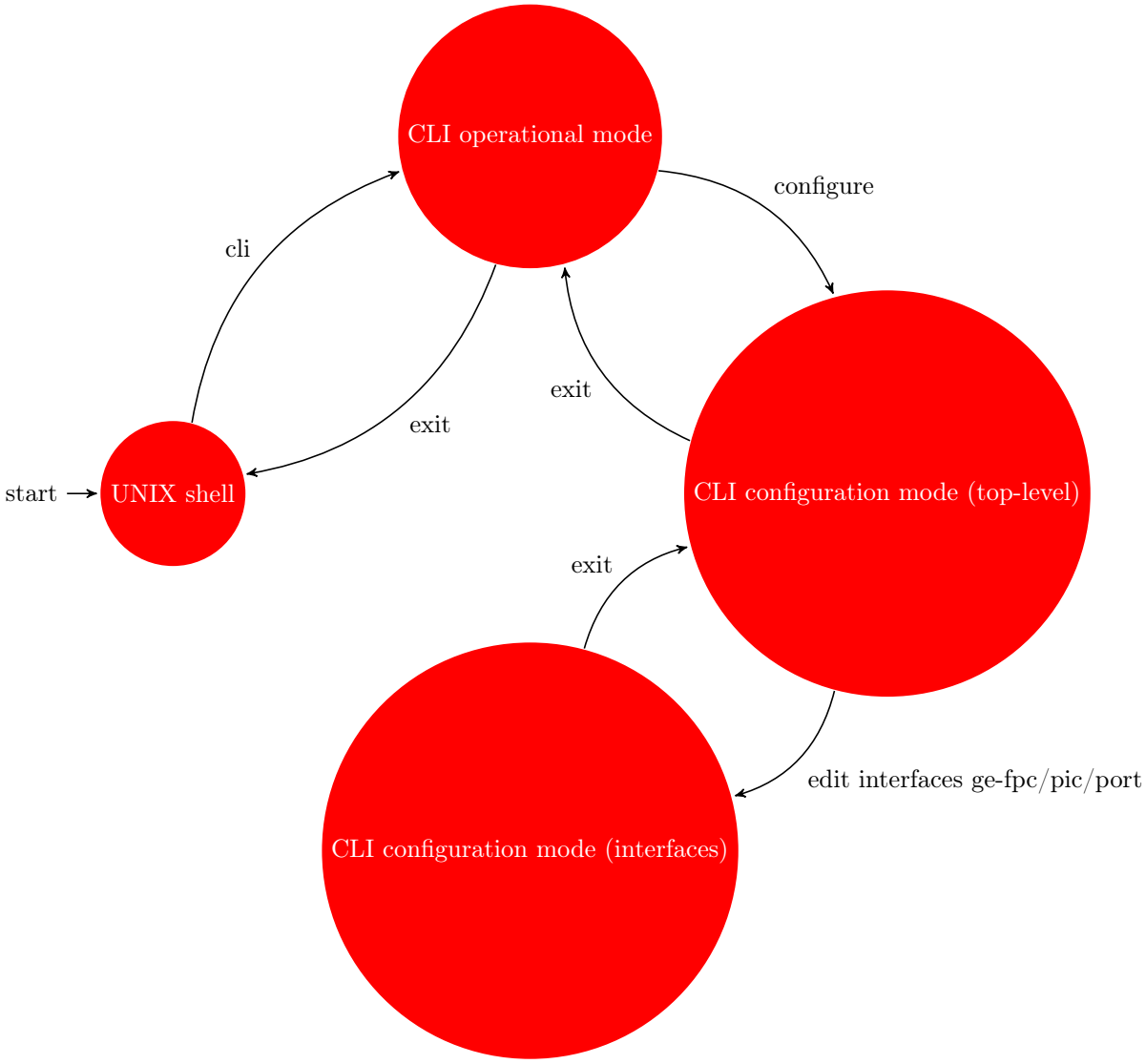


Figure 4: State Diagram for Junos OS Modes.

```
+-------+---------------------+---------------------+-------------------------
| 12792 | 2016-05-31 14:16:42 | 2018-05-31 14:19:18 | mrost
                  |
|       |                     |                     |    loadgen111
          |

[...]
+-------+---------------------+---------------------+-------------------------
| 15184 | 2018-04-30 16:00:00 | 2018-04-30 19:45:00 | group08
                  |
|       |                     |                     |    lev-rc1
              |
|       |                     |                     |    lev-rj2
              |
|       |                     |                     |    lev-sc1
              |
+-------+---------------------+---------------------+-------------------------
| 15183 | 2018-04-30 16:00:00 | 2018-04-30 19:45:00 | group06
                  |
|       |                     |                     |    cgn-rc1
              |
|       |                     |                     |    cgn-rj2
              |
|       |                     |                     |    cgn-sc1
              |
+-------+---------------------+---------------------+-------------------------
```

```
group08@cheetah:~$ lab --reserve now "today at 20:00" lev-rj1
[ OK ] Willkommen group08!
[ OK ] Authenticated via Magic Cookie
[ OK ] Grabbing device [lev-rj1]
[ OK ] Grabbed all possible devices
[ OK ] Reservation [15554] for [group08] has been added
```

4b)

See files "rc1_dump_4.txt" and "rj2_dump_4.txt".

4c)

On lev-rc1:

```
lev-rc1(config)#hostname test123
*Apr 30 14:41:36.987: %SYS-5-CONFIG_I: Configured from console by
    console
```

On lev-rj2:

```
root@lev-rj2# set system host-name kathrin

[edit]
root@lev-rj2# commit
```

```
commit complete

[edit]
root@kathrin#
```

4d)

Done - nothing to document here.

Question 5

5a)

```
lev-rc1>enable
Password:
lev-rc1#configure
Configuring from terminal, memory, or network [terminal]? terminal
Enter configuration commands, one per line.  End with CNTL/Z.
lev-rc1(config)#interface Gi8
lev-rc1(config-if)#ipv6 address fc00:470:525b:f801::1/64
lev-rc1(config-if)#no shutdown
lev-rc1(config-if)#exit
lev-rc1(config)#interface Gi9
lev-rc1(config-if)#ipv6 address fc00:470:525b:f800::1/64
lev-rc1(config-if)#no shutdown
lev-rc1(config-if)#exit
lev-rc1(config)#exit
lev-rc1#write memory
Building configuration...
[OK]
```

5b)

```
lev-rc1>enable
Password:
lev-rc1#configure
Configuring from terminal, memory, or network [terminal]? terminal
Enter configuration commands, one per line.  End with CNTL/Z.
lev-rc1(config)#interface Gi8
lev-rc1(config-if)#ip address 10.8.1.1 255.255.255.0
lev-rc1(config-if)#exit
lev-rc1(config)#interface Gi9
lev-rc1(config-if)#ip address 10.8.0.5 255.255.255.0
lev-rc1(config-if)#exit
lev-rc1(config)#exit
lev-rc1#write memory
Building configuration...
[OK]
```

5c)

```
root@lev-rj2# set interfaces ge0/0/2 unit 0 family inet6 address fc00
    :470:525b:f801::2/64

[edit]
root@lev-rj2# commit
```

```
commit complete
```

5d)

```
root@lev-rj2# set interfaces ge0/0/2 unit 0 family inet address
    10.8.1.2 255.255.255.0
[edit]
root@lev-rj2# set interfaces ge-0/0/2 enable
[edit]
root@lev-rj2# commit
commit complete
```

The usage of either using IPv4 or IPv6 can be enforced by assigning only the respective kind of IP addresses instead of using dual stack.

5e)

On Cisco: "no IP address" in interface configuration mode:

```
lev-rc1>enable
Password:
lev-rc1#configure
Configuring from terminal, memory, or network [terminal]? terminal
Enter configuration commands, one per line.  End with CNTL/Z.
lev-rc1(config)#interface Gi8
lev-rc1(config-if)#no IP address
lev-rc1(config-if)#exit
lev-rc1#write memory
Building configuration...
[OK]
```

On Junos OS an IP address can simply be deleted with a command analogue to adding it:

```
[edit interfaces ge0/0/2]
root@lev-rj2# delete unit 0 family inet address 10.8.1.2/24
root@lev-rj2# commit
commit complete
```

5f)

```
lev-sc1>enable
Password:
lev-sc1#configure
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line.  End with CNTL/Z.
lev-sc1(config)#interface Gi1/0/1
lev-sc1(config-if)#no shutdown
lev-sc1(config)#interface Gi1/0/12
lev-sc1(config-if)#no shutdown
```

5g)

1) We can use the *ping <IP4 or IP6 address>* command from JUNOS (UNIX shell or CLI operational mode), and IOS (privileged EXEC mode).

2) We can use the same *ping* command from group08-lg1 (standard Linux command line tool).

3) Some devices have ping disabled by default for security reasons.

After setting this up, pings work as intended:

```
root@group08-lg1:~# ping 10.8.0.5
PING 10.8.0.5 (10.8.0.5) 56(84) bytes of data.
64 bytes from 10.8.0.5: icmp_seq=1 ttl=255 time=1.56 ms
64 bytes from 10.8.0.5: icmp_seq=2 ttl=255 time=0.930 ms
64 bytes from 10.8.0.5: icmp_seq=3 ttl=255 time=0.737 ms
^C
--- 10.8.0.5 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 0.737/1.075/1.560/0.353 ms
root@group08-lg1:~# ping fc00:470:525b:f800::1
PING fc00:470:525b:f800::1(fc00:470:525b:f800::1) 56 data bytes
64 bytes from fc00:470:525b:f800::1: icmp_seq=1 ttl=64 time=0.709 ms
64 bytes from fc00:470:525b:f800::1: icmp_seq=2 ttl=64 time=0.864 ms
^C
--- fc00:470:525b:f800::1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 999ms
rtt min/avg/max/mdev = 0.709/0.786/0.864/0.082 ms

lev-rc1>ping 10.8.0.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.8.0.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
lev-rc1>ping fc00:470:525b:f800::2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FC00:470:525B:F800::2, timeout is 2
    seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms

lev-rc1>ping fc00:470:525b:f801::2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to FC00:470:525B:F801::2, timeout is 2
    seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/5/16 ms
lev-rc1>ping 10.8.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.8.1.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms

root@lev-rj2> ping fc00:470:525b:f800::2
PING6(56=40+8+8 bytes) fc00:470:525b:f801::2 --> fc00:470:525b:f800::2
16 bytes from fc00:470:525b:f800::2, icmp_seq=0 hlim=63 time=5.132 ms
16 bytes from fc00:470:525b:f800::2, icmp_seq=1 hlim=63 time=3.313 ms
16 bytes from fc00:470:525b:f800::2, icmp_seq=2 hlim=63 time=2.507 ms
^C
--- fc00:470:525b:f800::2 ping6 statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 2.507/3.651/5.132/1.098 ms
root@lev-rj2% ping 10.8.1.1
PING 10.8.1.1 (10.8.1.1): 56 data bytes
64 bytes from 10.8.1.1: icmp_seq=0 ttl=255 time=16.492 ms
64 bytes from 10.8.1.1: icmp_seq=1 ttl=255 time=1.822 ms
64 bytes from 10.8.1.1: icmp_seq=2 ttl=255 time=1.858 ms
^C
```

Question 6

6a)

lev-rj2 and group08-lg1 are in two different subnets (assigned in exercise 2). There is no routing between the two subnets yet, so the two hosts cannot communicate.

6b)

```
root@lev-rj2# set routing-options rib inet6.0 static route fc00:470:525
    b:f800::/64 next-hop fc00:470:525b:f801::1

[edit]
root@lev-rj2# set routing-options static route 10.8.1.0/24 next-hop
    10.8.1.1

[edit]
root@lev-rj2# commit
commit complete

root@lev-rj2#
```

6c)

```
lev-rc1>enable
Password:
lev-rc1#configure
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line.  End with CNTL/Z.
lev-rc1(config)#ipv6 unicast-routing
lev-rc1(config)#ip routing
lev-rc1(config)#exit
lev-rc1#write memory
Building configuration...
[OK]
lev-rc1#
```

6d)

Yes, the packets arrive on the appropriate interface.

6e)

Ping works in both directions, nothing to modify.

The traceroute program identifies the route that packets take to a remote host at a given moment. The program sends an (IP) packet with a TTL of 1 (hop) first to find out the first hop of the route. Then it sends out more packets, incrementing the TTL by 1 in every step, to find out the next hops on the route, until reaching the remote host.

```
root@lev-rj2> traceroute fc00:470:525b:f800::2
traceroute6 to fc00:470:525b:f800::2 (fc00:470:525b:f800::2) from fc00
    :470:525b:f801::2, 64 hops max, 12 byte packets
 1  fc00:470:525b:f801::1 (fc00:470:525b:f801::1)  2.696 ms  2.052 ms
     1.925 ms
 2  fc00:470:525b:f800::2 (fc00:470:525b:f800::2)  2.633 ms  2.555 ms
     2.396 ms
```

```
root@lev-rj2> traceroute 10.8.0.1
traceroute to 10.8.0.1 (10.8.0.1), 30 hops max, 40 byte packets
 1  10.8.1.1 (10.8.1.1)  2.335 ms  2.035 ms  1.755 ms
 2  10.8.0.1 (10.8.0.1)  2.561 ms  2.328 ms  2.241 ms

root@group08-lg1:~# traceroute -I fc00:470:525b:f801::2
traceroute to fc00:470:525b:f801::2 (fc00:470:525b:f801::2), 30 hops
   max, 80 byte packets
 1  fc00:470:525b:f800::1 (fc00:470:525b:f800::1)  0.872 ms  0.860 ms
    0.852 ms
 2  fc00:470:525b:f801::2 (fc00:470:525b:f801::2)  3.292 ms  3.296 ms
    3.290 ms

root@group08-lg1:~# traceroute -I 10.8.1.2
traceroute to 10.8.1.2 (10.8.1.2), 30 hops max, 60 byte packets
 1  10.8.0.5 (10.8.0.5)  0.794 ms  0.778 ms  0.787 ms
 2  10.8.1.2 (10.8.1.2)  2.253 ms  2.252 ms  2.241 ms
```

6f)

```
root@group08-lg1:~# ping 10.8.1.2
PING 10.8.1.2 (10.8.1.2) 56(84) bytes of data.
64 bytes from 10.8.1.2: icmp_seq=1 ttl=63 time=1.39 ms
64 bytes from 10.8.1.2: icmp_seq=2 ttl=63 time=1.31 ms
64 bytes from 10.8.1.2: icmp_seq=3 ttl=63 time=1.39 ms
64 bytes from 10.8.1.2: icmp_seq=4 ttl=63 time=1.28 ms
^C
--- 10.8.1.2 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3004ms
rtt min/avg/max/mdev = 1.287/1.347/1.397/0.065 ms

root@lev-rj2> ping 10.8.0.1
PING 10.8.0.1 (10.8.0.1): 56 data bytes
64 bytes from 10.8.0.1: icmp_seq=0 ttl=63 time=2.378 ms
64 bytes from 10.8.0.1: icmp_seq=1 ttl=63 time=2.426 ms
64 bytes from 10.8.0.1: icmp_seq=2 ttl=63 time=2.240 ms
64 bytes from 10.8.0.1: icmp_seq=3 ttl=63 time=2.353 ms
^C
--- 10.8.0.1 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max/stddev = 2.240/2.349/2.426/0.068 ms
```

The RTT from lev-rj2 to group08-lg1 is almost double of the RTT in the other direction. A possible reason for this is that the static route configured in lev-rj2 determines lev-rc1 as the intermediate hop for the packet, while in the opposite direction the route must be established when the packet is sent.

Question 7

```
group08@cheetah:~$ lab --end 15184
```

Files included in the assignment solution:

q04-config-rc1.txt, q04-config-rj2.txt, q05-config-rc1.txt, q05-config-rj2.txt, q05-config-sc1.txt, q06-config-rc1.txt, q06-config-rj2.txt, q06-config-sc1.txt