



Praktikum RouterLab SS 2008 Work Sheet 1: Introduction to the RouterLab

The RouterLab is a small network testbed that contains switches, routers and Linux PCs. The goal of this work sheet is to get accustomed to its setup: Which devices do we have? How can devices be reserved and accessed? How to configure IP addresses and static routes on routers and Linux PCs? The learning curve in the beginning will be high. Therefore, you will have two weeks to complete this work sheet.

You are only allowed to access devices that have been assigned to you and that you have reserved beforehand in the reservation system. At the beginning of each work sheet, there will be a table that shows the assignment of devices (routers, switches, loadgens) to groups. If not stated otherwise, you are only (!) allowed to use a device if the following three conditions hold:

1. The device is assigned to you according to the table at the beginning of the current work sheet.
2. The current time is within the time slot that has been allocated to your group.
3. The device has been reserved in the reservation system (*labtool*). For the time slots, we assigned to each group at the beginning of the semester, this is done by us. If you need extra time, it is your responsibility to reserve the device.

Table 1: Assignment of devices to groups

Gruppe	Ham-Cloud	Muc-Cloud
Router	ham-rc1 , ham-rj1	muc-rc1, muc-rj1
Switches	ham-sc1	muc-sc1
IP range	10.1.0.0/16	10.2.0.0/16
Loadgens	loadgen104	loadgen102

Question 1: (5 Points) *Change your passwords*

You have obtained passwords for the *RouterLab* (*cheetah*, *labtool*) and for *Snakepit* (machines in room *Asterix*). Change your initial passwords immediately for the *RouterLab* as well as for *Snakepit*! To do this for the *RouterLab*, please check the following web site:
<https://routerlab.net.t-labs.tu-berlin.de>

Question 2: (15 Points) *RouterLab topology*

First, we need to get an overview of the topology of the RouterLab. For this purpose, please check the following sources:

- Wiki: <http://wiki.net.t-labs.tu-berlin.de/index.php/Portal:Routerlab>¹.
- Devices, links: <https://routerlab.net.t-labs.tu-berlin.de>

(a) Answer the following questions:

1. Which types of devices do exist in the RouterLab?

¹Access from outside is possible with login "wiki" and password "knowledge"

2. How many interfaces do your assigned routers (see Table 1) have and what are the interface names?
 3. What types of links exist in the RouterLab? Can you guess what are the bandwidths of the links?
- (b) The goal of this work sheet is to configure your devices such that packets can be sent from loadgen104 (Group B: loadgen102) to ham-rc1 (muc-rc1) and vice-versa. The rest of this work sheet will guide you through the necessary steps.

To start with, draw a topology map of the devices that you need to ensure IP connectivity between loadgen104/loadgen102 and ham-rc1/muc-rc1! Figure out which interfaces you need and assign IP addresses. You are not allowed to use other devices and IP addresses than those specified in Table 1. Your topology map should show the assignment of IP addresses as well as the interface names!

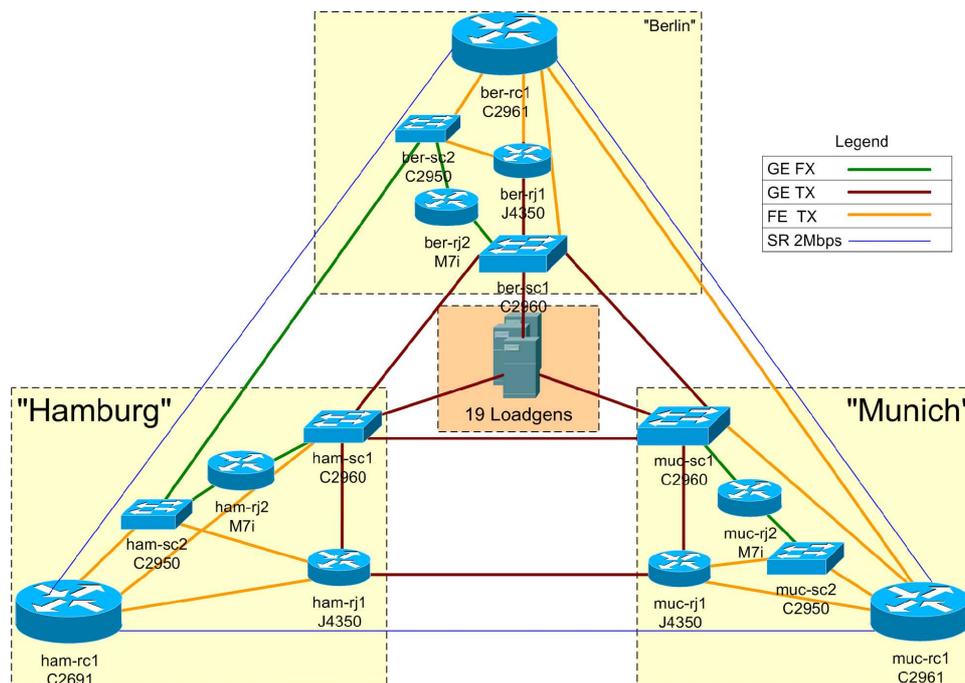


Figure 1: Setup of the RouterLab.

Question 3: (20 Points) Connecting to the devices

Now we will learn how to connect to the devices of the RouterLab. `cheetah` serves as a stepping stone for all devices. Therefore, you always have to log on to `cheetah` via `ssh` before you can connect to a device. From there all devices can be accessed via a console server while the `loadgens` are also reachable with `ssh`.

Our console servers provide a number of serial ports that are connected to the serial ports of the `loadgens`, routers and switches. The consoles of the connected devices can be accessed from `cheetah` by connecting to the console server with `Telnet`. The `labtool` alleviates the access to the devices, as it maps the name of a certain component (e.g., `ham-rc1`) to a the correct port of the console server. The following example shows how to connect to `ham-rc1` after logging on to `cheetah`:

```
lab -c ham-rc1
```

After pressing `Enter`, you are connected to the console of the appropriate device. In order to close the connection to a certain device, you have to press `Ctrl +]`. This will get you to the command mode of `Telnet` which you can exit with `q` or `quit`.

- (a) Log on as `root` to `loadgen104/loadgen102` using `ssh`! No password is required for this. Read the *manpage* of `ifconfig`, the tool that is used on Linux to configure IP addresses and interfaces!

1. How many physical interfaces are currently available on loadgen104/loadgen102? (Hint: Don't forget interfaces that are currently down!)
 2. Configure the IP address that you assigned to loadgen104/loadgen102 in Question 2b to the appropriate interface!
- (b) ham-rc1 (muc-rc1) runs as operating system Cisco IOS. In this course, we will mainly use the commandline interface to configure routers. Cisco IOS distinguishes between modes where you can only display the current configuration of the device and modes where you can actually change the configuration. Get accustomed with the modes that exist in Cisco IOS by reading Section "Cisco IOS CLI Command Modes Overview" in the Cisco reference manual provided on the RouterLab course web site!

Draw a state diagram where nodes reflect the CISCO IOS modes and edges the transitions from one mode into another! Consider only the following modes: *user EXEC mode*, *privileged EXEC mode*, *global configuration mode*, *interface configuration mode*.

A directed edge from mode *A* to mode *B* exists if there is a Cisco IOS command that allows you to directly switch from mode *A* to mode *B*. Label the directed edges with the required IOS commands. Label the nodes with the mode names and the signs that identify the node at the prompt!

Which Cisco IOS version is installed on ham-rc1 (muc-rc1)? (Hint: Use "?" in *privileged EXEC mode* to find the appropriate command. You can use *TAB* key for command completion.)

- (c) ham-rj1 (muc-rj1) uses as operating system JUNOS. To get accustomed with the modes on Juniper routers, read the following pages of the Juniper reference manual provided on the RouterLab course web site: p217, p222, p228, p238-p240

Draw a state diagram similar to the one for the Cisco router! Consider the following states: *UNIX shell*, *CLI operational mode*, *CLI configuration mode (top-level)*, *CLI configuration mode (interfaces)*

(Hint: When you first log on to a router, you will be in *CLI operational mode* in most of the cases. Use *quit* to switch from *CLI operational mode* to a UNIX shell. To go back type *cli*.)

Which JUNOS version is installed on ham-rj1 (muc-rj1)? (Hint: Use "?" in *CLI operational mode* to find the appropriate command)

The switches in the RouterLab use Cisco IOS as operating system, too. Therefore, the general handling of switches is similar to Cisco routers.

Question 4: (15 Points) Reserving devices and dumping configurations

The goal of this question is to get accustomed with the *labtool*, a program that allows to create reservations for devices and to dump and restore configurations of routers and switches.

- (a) Obtain information on the *labtool* by consulting the Wiki and by typing *lab -h* on *cheetah*. Find out which reservations are currently active! The device ham-rj2 (Group B: muc-rj2) has not been reserved yet for you. Reserve this device for all your timeslots until May 8th! Note that you are not allowed to actually log on to this device throughout this work sheet!
- (b) Configurations can be dumped either manually or via the *labtool*.

Manual Dump: It is done by accessing the router, displaying the complete configuration of the router, marking the configuration text in your terminal window and pasting it to your terminal window. To display the configuration on Cisco use *show running-config* in *privileged EXEC mode*, on Juniper use *show configuration* on the *CLI operational mode*. Manually dump the configuration of ham-rc1/muc-rc1 and ham-rj1/muc-rj1! Check that there is no extra information copied to the file.

Labtool Dump: Use the option *-d* of the *labtool* to dump the configuration of ham-rj1 (muc-rj1)! The output of the *labtool* will show you the version number of the generated dump.

- (c) Change the hostname of ham-rc1/muc-rc1 and ham-rj1/muc-rj1 to a random name, e.g., your first name! On Cisco use ? in *global configuration mode* to find the appropriate command. On Juniper use the *set system host-name* command in the *configuration mode*. Afterwards commit your changes (command *commit*)!!!!
- (d) Now we will restore the configuration that we dumped in Question 4b. For ham-rj1 use the manual dump, for ham-rc1 use the dump created with the *labtool*!

Reloading a manually generated dump: On Junipers use the command `load override terminal` in *CLI configuration mode*. Afterwards paste your configuration into your terminal window and then press `Ctrl + d`. Don't forget to commit your changes! (Note: On Cisco you don't need a special command. It's sufficient to just paste your configuration into the terminal window while being in *global configuration mode*.)

Reloading with the Labtool: Use `lab -l` to reload the configuration for the Cisco router! For this you will need the version number that `lab -d` provided in 4b. Open a connection to `ham-rc1 (muc-rc1)` before typing the `lab -l` command. What do you see?

Question 5: (15 Points) *IP address configuration on routers*

We will now configure the IP addresses that you assigned in your topology map of Question 2.

- (a) Find out how IP addresses are configured on Cisco routers by using "?" in the appropriate *interface configuration mode*. Assign IP addresses to `ham-rc1/muc-rc1` according to your topology map! Use the following command:

```
ip address <ip address> <netmask>
```

- (b) Assign IP addresses to `ham-rj1/muc-rj1` according to your topology map! IPv4 addresses can be configured on Juniper routers with the following command:

```
edit interfaces <if-name> unit 0 family inet address <ip address>
```

Don't forget to use the `commit` command afterwards!

- (c) Find out how to delete IP addresses for Cisco and Juniper routers!
- (d) Ensure that the following pairs of devices can mutually reach each other (use `ping!`):
- `loadgen104 (loadgen102)` and `ham-rj1 (muc-rj1)`
 - `ham-rj1 (muc-rj1)` and `ham-rc1 (muc-rc1)`

(Note: The `ping` command is available on Cisco and Juniper routers in *user EXEC mode / CLI configuration mode*.)

Question 6: (15 Points) *Static routes*

Recall that the goal of this work is to send packets from `loadgen104 (Group B: loadgen102)` to `ham-rc1 (muc-rc1)` and vice-versa.

- (a) Check if `ham-rc1 (muc-rc1)` can reach `loadgen104 (loadgen102)` using `ping!` Why does it not work?
- (b) Configure a static route on `ham-rc1 (muc-rc1)` to `loadgen104 (loadgen102)` via next-hop `ham-rj1 (muc-rj1)`.

Hint: Static routes on Cisco routers can be configured with the following command:

```
ip route <destination prefix> <destination mask> <next-hop>
```

- (c) Check if ICMP echo requests arrive at the appropriate interface of `loadgen104 (loadgen102)`. For this purpose use `tcpdump` on the appropriate interface of `loadgen104 (loadgen102)`. Do you see incoming packets? For more information on `tcpdump` we refer to the manpage. Why does `ping` from `ham-rc1 (muc-rc1)` to `loadgen104 (loadgen102)` not work yet?
- (d) Modify your setup such that `loadgen104 (Group B: loadgen102)` can reach `ham-rc1 (muc-rc1)` and vice-versa! (Hint: Check the manpage of the commands `route` and `ip`) To verify that everything is correctly configure, also do a `traceroute` from `loadgen104 (loadgen102)` to `ham-rc1 (muc-rc1)`!

Submission details: read the FAQ

http://www.net.t-libs.tu-berlin.de/teaching/ss08/RL_labcourse/faq.shtml

Submit the following:

- Topology map with used routers, switches, *loadgens* and assigned IP addresses
- All configuration inputs on routers, switches and loadgens (no trials, only the final ones!)
- The outputs of all commands such as `ping`, `tcpdump`, etc.
- The completed evaluation form (extra sheet)

Due Date: Friday, May 9th, 2008, 08:00 am