# Network Technology and Programming Lab
# **Assignment** 3

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**Deadline: 05/05/2025 23:59**

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## Intro

The goal of this assignment is to familiarize yourselves with routing, subnetting and the CIDR notation. For the PC hosts, you can use any hosts available in the lab. Remember that you can access any network device as you did in the previous assignment. You don't have access to the host via SSH yet. By the end of this assignment you will have restored the connectivity. Keep the routers connected to the 24-port switch but expect to add/change connections. When you connect your computer to the switch the DHCP server will provide an IP on the 192.168.4.0/24 subnet to allow management of the routers. The hosts won't be getting an IP this way since that's part of the assignment.

You can set an IP using the *ip addr add* command. To revert the PC hosts in the initial configuration you can perform a reboot.

The username for the devices with full access is *hy435* and the password *hy435@csd*. For the R1, the EdgeSwitch 24 and the EdgeSwitch 8, a read only account with username *student* and password *hy435@csd* exists.

## Run Wireshark over SSH

To connect Wireshark to a host/router over SSH you can follow these steps:

1. Start Wireshark
2. Click on the cogwheel next to the entry "SSH remote capture"
3. On the Server tab, set the IP of the host/router you are interested in
4. On the Authentication tab, set the username and password for the device you are interested in
5. On the Capture tab, verify that the "Remote capture command selection" is set to "tcpdump" and "sudo" will be used to gain capture privilege on the remote machine. Note that the hosts are configured in a way that allows you to capture packets without root permissions. On the hosts, set the latter option to "none".
6. Save the configuration
7. Start the capture using "SSH remote capture"

On the lab hosts you can use Wireshark directly from the desktop as well, without having to worry about running it over SSH.

# 1. Set up the network

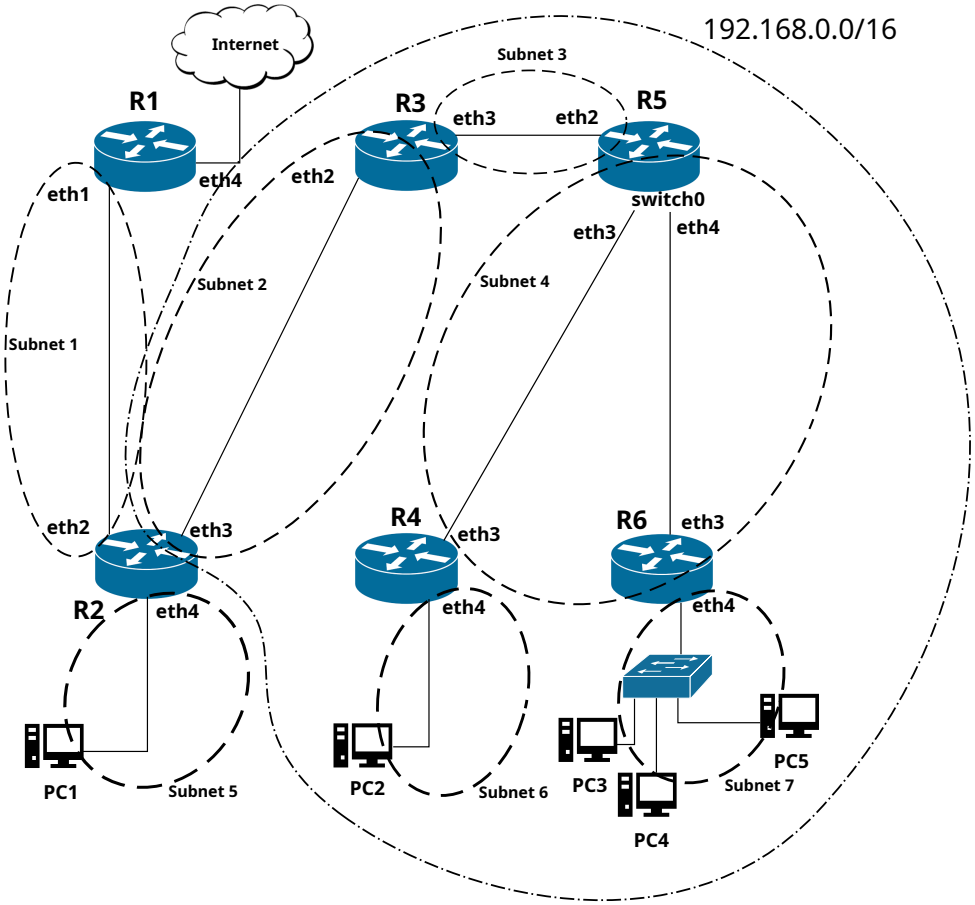


Figure 1: Assignment 3 Topology

Figure 1 depicts the topology that you will setup in this assignment. Take a good look at it and make sure you fully understand it. You will now build it step-by-step.

First, connect the devices as depicted using the cables found in the lab. Remember to reset all connections before leaving the lab.

Configure **Subnet 1** by setting the interfaces of R1 and R2 accordingly. Do not add any additional routing table entry yet. The details of **Subnet 1** are the following:

**Subnet 1:** 192.168.21.0/24
R1:eth1 = 192.168.21.4
R2:eth2 = 192.168.21.3

Configure the rest of the subnets in a similar manner:

**Subnet 2:** 192.168.21.0/30

R3:eth2 = 192.168.21.1
R2:eth3 = 192.168.21.2

**Subnet 3:** 192.168.20.0/30

R3:eth3 = 192.168.20.1
R5:eth2 = 192.168.20.2

**Subnet 4:** 192.168.0.0/22

This subnet requires a little extra effort to setup. To reduce the number of different network devices, the interfaces eth3 and eth4 of R5 belong to the same network. However, due to a limitation of the EdgeOS, it is not possible to route traffic to specific interfaces that belong to the same network. To overcome this issue, you can use the switch functionality that the ER-X router provides. The router provides a special interface called **switch0**. Assign to this interface the eth3 and eth4 interfaces. Then assign to the **switch0** an IP and use it a normal interface.

R5:switch0 = 192.168.0.3
R4:eth3 = 192.168.0.1
R6:eth3 = 192.168.0.2

**Subnet 5:** 147.52.20.144/28

R2:eth4 = 147.52.20.149
PC1 = 147.52.20.150

**Subnet 6:** 192.168.8.0/24

R4:eth4 = 192.168.8.1
PC2 = 192.168.8.2

**Subnet 7:** 192.168.9.0/24

This subnet is a little different. Instead of directly connecting the hosts to the router interface, they go through a switch. This allows them to communicate with each other without going through the router and also allows the router to connect to many hosts in the same subnet without having as many interfaces. Use the 8-port Ubiquity switch found in the lab.

R6:eth4 = 192.168.9.1
PC3 = 192.168.9.2
PC4 = 192.168.9.42
PC5 = 192.168.9.64

## 2. Configure the Routing Tables

Now that your network is in place, you will need to configure the routing tables of routers R2 to R6 so that connectivity between all 5 hosts (PC1, PC2, PC3, PC4, PC5) is accomplished. In addition, PC1 should be able to reach a host on the Internet, whereas PC2 and PC3 should be able to ping **eth4** of R1.

Note that in the R1 you have read-only access, but the routing tables are already configured. If you need additional routing rules on the R1, contact the TA.

### 2.1 Roadmap

The network topology that you have to build is quite complex. It is essential to build it in parts and ensure connectivity before moving on. The following roadmap will help you achieve your goal faster and more easily.

1. Configure the IP addresses and the subnets on the routers and hosts
2. Check if PC2 can reach R4. Apply proper routing tables on both host and R4
3. Check if PC3, PC4 and PC5 can reach each other.
4. Check if PC3, PC4 and PC5 can reach R6. Apply proper routing tables on all hosts and R6
5. Check if PC1 can reach R2. Apply proper routing tables on both host and R2
6. Apply routing so PC3, PC4 and PC5 can reach R5
7. Apply routing so PC2 can reach R5
8. Apply routing so PC1 can reach R3
9. Apply routing so R3 and R5 can communicate
10. Apply routing so R2 and R3 can communicate
11. Apply routing so PC2,3,4,5 can reach PC1
12. Apply routing so PC1 can reach the Internet
13. Apply routing so PC2,3,4,5 can reach **eth4** of R1

## 3. Routing across subnets

This exercise aims at helping familiarize yourselves with the way computers communicate over the network, across subnets. You will use our dear friend Wireshark, directly and over SSH. Give as much detail as you think is necessary (e.g. source/destination address, OSI layer, protocol). In this experiment we are only interested about the IPv4 communications. Remember, some packets may appear that are not useful for the communication (e.g. some running services, discovery protocols). It is your job to keep only what is useful.

1. Make sure that all hosts and routers are configured as described in the previous tasks.
2. Start Wireshark on PC1, PC3, PC5, R2-6.
3. Clear the ARP cache on the PCs.

4. Ping PC1 from PC5. Watch Wireshark on all devices and follow the flow of the packet. What are the packets exchanged? Who can see which packet, are there some that are visible on all hosts? Why? What are the IP and MAC addresses used for each packet? Explain in short how this communication works. Does it differ from the first assignment? Report your findings and include screenshots.

**Do not forget to backup your configuration and restore the default prior leaving the lab. You can use the description field for the static routes in the GUI interface in order to add a short description for your set up (TIP – DO USE THAT)**

## Report and submission

- Report in text form all the routing tables of the hosts and the R2-R6. To make sure your report is well-structured and readable, use appropriate software (Word isn't it).
- Report the traceroutes for the following cases:
  - PC3 →PC5
  - PC2 →PC3
  - PC3 →PC2
  - PC2 →PC1
  - PC3 →PC1
  - PC1 →8.8.8.8
  - PC2 →R1:eth4
  - PC3 →R1:eth4
- Can you ping 8.8.8.8 from PC2 or PC3? Report and explain briefly using screenshots with ip route command.
- Submit the configurations of the routers

## Oral Examination

All the students who have submitted their exercises are requested to attend the oral exam session, in order to present their solutions. A short quiz will also take place during that time. You will need to choose a timeslot for the oral exam using Doodle. More details will be sent to you via email.

**Attention**

- Each team will only be examined during the timeslot choosed.
- Both the timely submission and the oral exam session will contribute to the grading of the assignments.

**The submission deadline is 05/05/2025 23:59 via turnin:**
**turnin assignment3@hy435 <dir>**

**Have fun!**