TECHNISCHE UNIVERSITÄT BERLIN
Fakultät IV – Elektrotechnik und Informatik
Fachgebiet Intelligente Netze
Julius Schulz-Zander
Susanna Schwarzmann, Marcin Bosk

7th Assignment: Network Protocols and Architectures, WS 20/21

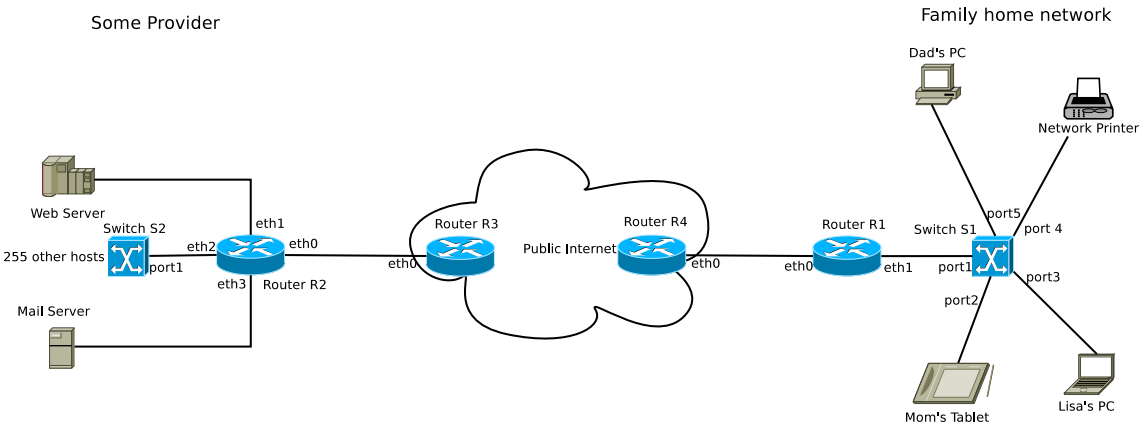

Figure 1: Structure of the company network

Question 1: (12 + 13 = 25 points) *Subnets*

Figure 1 shows two sites, "Some Provider" and "Family home network", which can reach each other via the public Internet. The topology comprises four routers (`R1`, `R2`, `R3` and `R4`), two switches `S1` and `S2`, and several hosts, e.g., Lisa's PC or Web Server. Each of the hosts only has one physical network interface. Interfaces of the routers are labeled eth_i and ports of the switch are labeled $port_i$. For the purpose of this exercise, you can ignore any communication and devices inside the public Internet, i. e., between routers `R3` and `R4`.

(a) In the topology, **draw a circle around each sub-network (subnet)**, i.e., mark which devices, interfaces, and links belong to the same subnet. Assume that the switches are Layer-2, so they do not speak IP and they do not have IP addresses.

Hint: Remember that the boundary of the subnet is at the router, as routers connect different subnets with each other.

(b) Within each subnet, **how many interfaces** are there? **How many IP addresses are needed** for each subnet, if each interface only gets one IP address?

Hint: The number of interfaces and the number of IP addresses needed are **NOT** equal to each other.

Please turn!

Question 2: $(5 + 5 + 10 + 15 + 15 + 5 + 5 + 15 = 75$ points) *IP address ranges and NAT*

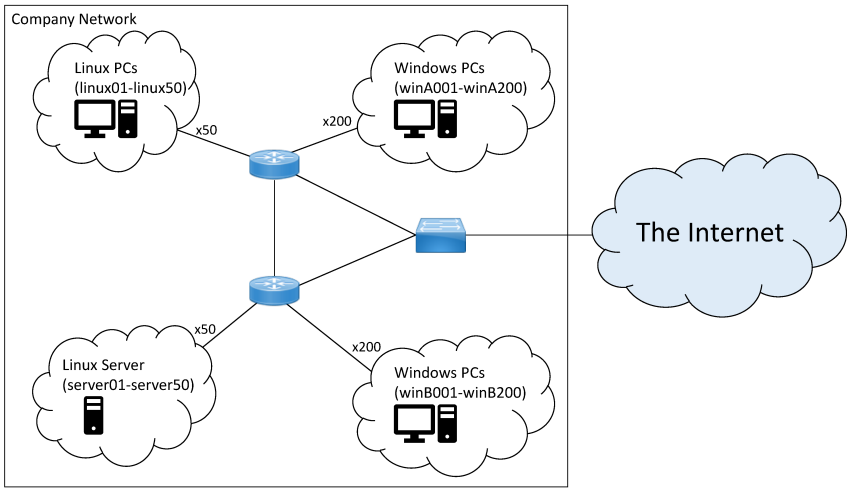

Figure 2: Structure of the company network

You are the admin of a company which plans to setup an IP-based LAN. The structure of the company network is shown in Figure 2. You now have to decide which valid IP addresses should be assigned for the systems. The address space should reflect a division of the system in Linux PCs, Linux Server, and Windows PCs.

Note: The white clouds around hosts denote subnets within the company network.

(a) Which address class should be used for the company network, if a **classful** addressing scheme is to be used? **Justify your answer briefly.**

(b) Which of the following addresses provide enough IP addresses for all hosts in the network?

(i) 201.157.0.0
(ii) 42.0.0.0
(iii) 136.78.0.0
(iv) 195.240.155.0

Hint: Classful IP subnetting is used, and thus no CIDR notation is shown here.

(c) Choose one of the addresses from previous part that provides enough IP addresses for all hosts in your company network. Now your task is to determine address ranges for the hosts present in your network. Allocate an IP address range to each of the following host classes.

(i) Linux Server
(ii) Linux PCs
(iii) Windows PCs

You do not have to use the CIDR notation to denote the address ranges you allocated to your subnets in this part of the question!

Hint: Are Windows PCs in a single subnet?

Please turn!

(d) Now assume that due to some re-structuring, it is not possible anymore to use the public IP addresses you have assigned in the previous task. Instead, the whole company network shall be run with private IP addresses and be connected to the Internet via a single public IP using NAT.

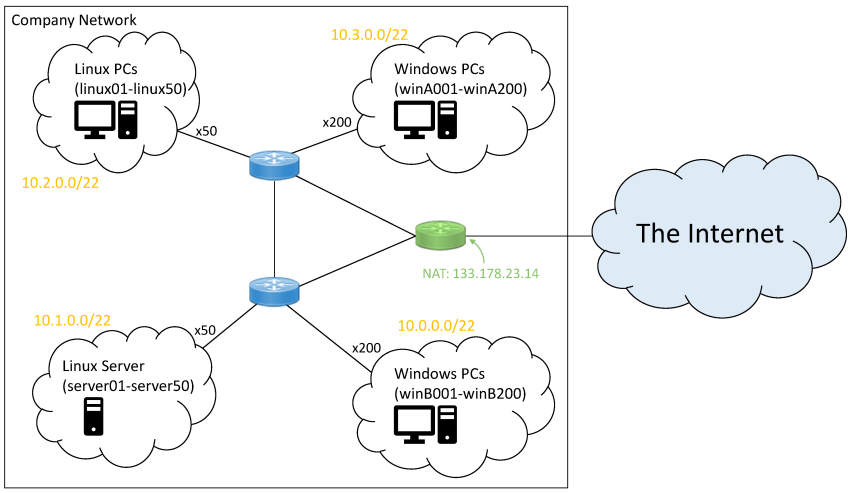

Figure 3: Structure of the company network with private IPs and NAT router

Figure 3 shows the company network with the newly introduced NAT router. Use the private address space 192.168.0.0/16 and assign, analogous to the previous task, address ranges for the different classes of hosts. **The ranges should be a good fit, i.e. as few addresses as possible should be wasted!** Please **use the CIDR notation** to show the address ranges you allocated!

Note: Subnet ranges written in orange in Figure 3 **DO NOT** represent the optimal solution asked for in this part of the question!!! They may be used for the following parts of the question in case you are unable to solve this part.

Hint 1: In this part you **need** to be efficient assigning address ranges!

Hint 2: Remember that there are IP addresses in a subnet that cannot be assigned to interfaces!

(e) Now, the three Windows PCs winA001, winA002, and winA003 simultaneously request via HTTP a document from a remote server with the IP 141.43.4.130. Furthermore, the Linux Server server01 is running a web server, which is accessed from an external host with IP address 141.43.4.132 via port 80.

Write down the NAT table for the above mentioned connections. Do not omit any relevant information, but also do not indicate any needless information. You can freely choose any ports within the valid port ranges.

(f) If an IP packet is sent from 141.43.4.130 to winA002, which information would the NAT router change and how?

(g) If an IP packet is sent from server01 to 141.43.4.132, which information would the NAT router change and how?

Please turn!

(h) Somebody is calling you now and tells you, that one of the employees is abusing the network for file sharing. As a proof for this, the following Ethernet frame is sent to you via e-Mail.

```
00 20 da db 23 e6 00 04 75 82 6a ed 08 00 45 00
00 34 0b d9 40 00 80 06 91 2f 0a 00 02 03 c1 63
90 55 f8 8a 00 50 6e fd 88 30 00 00 00 00 80 02
20 00 7b ff 00 00 02 04 05 b4 01 03 03 02 01 01
04 02
```

To investigate the issue, you want to find out who is contacting who and whether it is really file sharing.

First of all, determine which bytes of the Ethernet frame belong to the Ethernet header, IP header, and transport layer header. Determine which IP version and which transport layer protocol is used. Afterwards, determine the IP address and the port of both, source and destination, of the packet.

Which protocol is probably used, considering the ports you have detected? Is this information enough to finally decide whether it is file sharing? **Explain briefly.** As a last part of your investigation, use nslookup to find out which server belongs to the packets destination address.

With your background knowledge, now decide whether the employee needs to see the boss or not. **Explain briefly.**

Due Date: Wednesday, January 13th, 2021 11.59 pm (end of day)

- **As PDF files (no MS Office or OpenOffice files)**, uploaded via ISIS: `https://isis.tu-berlin.de/course/view.php?id=21979`
- Put the names and Student ID numbers (Matrikelnummer) of **all** your group members **and** the tutorial slot on your solution!