

## 9th Assignment: Network Protocols and Architectures, WS 20/21

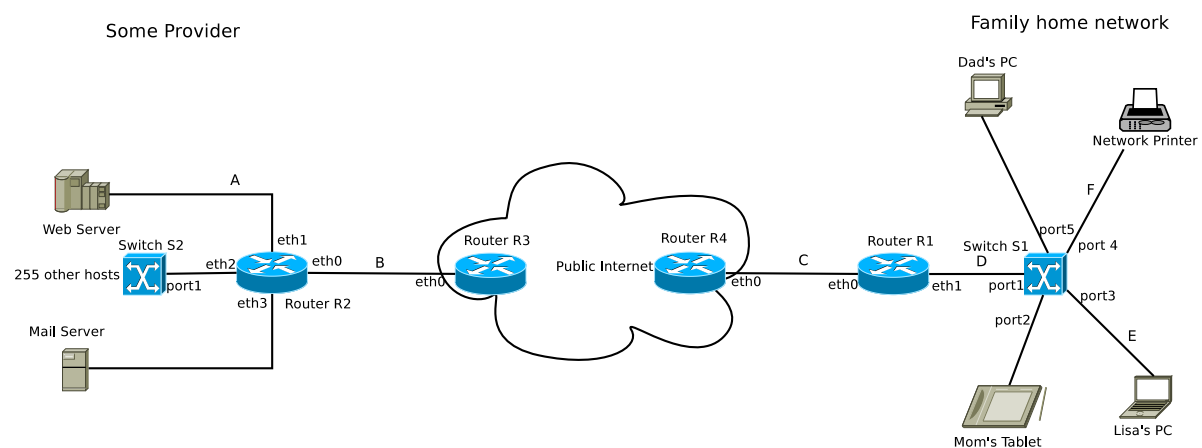


Figure 1: Network Topology

### Question 1: (10 + 10 + 10 + 15 + 15 = 60 points) *MAC Addressing and ARP*

The Figure 1 shows two sites, “Some Provider” and “Family home network”, which are connected via the public Internet. The topology comprises **four routers** (R1, R2, R3 and R4), **two switches** (no layer 3 switches but simple layer 2 devices) S1 and S2, and **several hosts**, e.g., Lisa’s PC or a Web Server. Interfaces of the routers are labeled  $eth_i$  and ports of the switch are labeled  $port_i$ . You can ignore any communication and devices inside the public Internet, i. e., between routers R3 and R4.

You can assume that the **router R1 employs NAT** and the following IP addresses are known in this topology:

- Lisa’s PC: 192.168.178.103
- Network printer: 192.168.178.101
- R1 eth1: 192.168.178.1
- R1 eth0: 231.95.3.4
- R2 eth1: 23.42.16.1
- R2 eth0: 35.147.214.31
- R3 eth0: 35.147.214.32
- R4 eth0: 231.95.3.5
- Web server: 23.42.16.2

You can download the topology from Figure 1 via ISIS from:  
<https://isis.tu-berlin.de/mod/resource/view.php?id=935044>  
 in various formats and use it for annotation.

**Please turn!**

LAN Segment	Source IP	Source MAC	Destination IP	Destination MAC
A	...	...	...	...

Table 1: Addressing

- In the topology from Figure 1, assign **MAC addresses to all layer 2 interfaces**<sup>1</sup>. For simplicity, it is sufficient to **provide the last 8 bits of the MAC address**, i.e., two characters in **HEX notation** (e.g., AB) as long as **they are unique**. You do not have to assign MAC addresses to the “255 other hosts”.
- In the topology, clearly **mark any broadcast and collision domain**. How do these domains change when **switch S2 is replaced by a hub**?
- Which **parts of the Ethernet, IP and TCP header** will be **modified** when a packet is **forwarded** by:
  - router **R1**
  - switch **S1**
- Lisa wants to **connect to the network printer via IPv4**. Assume that **all ARP caches in the network are empty**. What **ARP messages** are exchanged until **Lisa’s PC knows the network printer’s MAC address**? Enter the IP and MAC address fields of the messages into a table as in Table 1, **providing one row for each message seen on LAN segments E and F**.  
**Hint:** You need **one row for each ARP message on each of the two LAN segments**.
- Assume that Lisa’s PC has **sent a packet to the Web server**, and that the **Web server now sends back a packet, using IPv4**. What are the **IP and MAC address fields of a packet** sent by the web server to Lisa’s computer, **as observed on the different LAN segments**? Assume that **the ARP tables are not empty** anymore, and that **all necessary MAC addresses are known by the devices**. Consider the packet traversing **all LAN segments drawn** (A, B, C, D, E) and enter your result in a table as in Table 1, one row per LAN segment.

**Question 2:** (20 + 5 + 10 + 5 = 40 points) *Neighbor Discovery in IPv6*

We will now consider the **Neighbor Discovery in IPv6**. Use Wireshark to open the trace from: <https://isis.tu-berlin.de/mod/resource/view.php?id=935043> and answer the following questions.

- First, **explain all packets in the trace**, except for the packets belonging to the TCP connection, with **one or two short sentences each**.  
 Second, give a short summary about **the purpose of the TCP connections**.  
**Hint:** You can give names to the communicating devices.
- How many Neighbor Discoveries** are in the trace and **where** (or when) in the trace do they occur?
- Why are the packets in the trace sufficient to populate the IPv6 neighbor cache** of the hosts involved? Assume that the IPv6 neighbor cache was empty at the beginning of the trace.
- Comparing **Neighbor Discovery in IPv6** and **ARP in IPv4**, at **which layer(s) of the network stack** do they operate?  
**Hint:** You can probably take a quick look at some ARP packets on your local network just by opening Wireshark and starting a capture.

**Due Date: Wednesday, January, 27th 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!

<sup>1</sup>You can either **label them in the topology figure** or **provide a list**. Please make sure it is clear **which address belongs to which interface**.