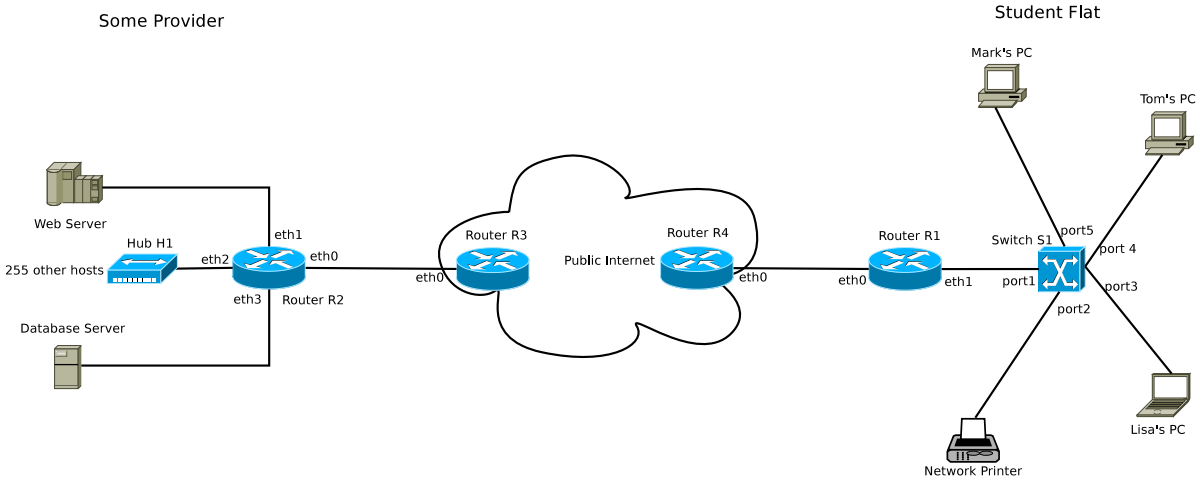
TECHNISCHE UNIVERSITÄT BERLIN
Fakultät IV – Elektrotechnik und Informatik
Fachgebiet Intelligente Netze
Prof. Anja Feldmann, Florin Ciucu, Stefan Schmid, Oliver Hohlfeld
Mustafa Al-Bado, Jan Böttger, Benjamin Frank, Juhoon Kim, Ingmar Poese

# 5th Assignment: Network Protocols and Architectures WS 10/11

**Question 1:** (15 + 10 + 10 + 5 + 10 = 50 points) *IP Address Assignment / Forwarding*

The figure below depicts the topology of a two networks ("Some Provider" and a "Student Flat") connected via the public Internet. The networks consist of four routers (`R1`, `R2`, `R3` and `R4`), a switch `S1`, a hub `H1` and several hosts. Interfaces of the routers are labelled by $eth_i$ and ports of the switch by $port_i$. Assume that *none* of the routers is a NAT gateway! You can also ignore any communication inside the public internet, i.e., between router `R3` and `R4`.




(a) Consider the topology[1] above and assign IPv4 addresses by choosing the smallest possible subnets. Provide the subnet mask in CIDR notation for each subnet. Hint: You do not have to assign individual IP addresses for the "255 other hosts" in the network of "some provider", but consider this value in the choice of your subnet.

Also assign MAC addresses of 8 bit length, i.e., two characters in HEX notation (e.g., AB). You do not have to assign MAC addresses to the "255 other hosts".

(b) Make a time travel and assume that CIDR is not available. How would your previous IP address assignment change? Comment on the number of unused IP addresses in each subnet.

(c) Show the forwarding table of router `R2`. Explain how the forwarding table at router `R2` will be used to forward a packet from Lisa's PC to the web server by explaining the algorithm that is used for switching decisions on this concrete example.

(d) Which parts of the Ethernet, IP and TCP header will be rewritten when a packet is forwarded by router `R1`?

(e) What are the IP and MAC address fields of a response sent by the web server to Mark's computer? Consider the response traversing all drawn links ([web server → `R2`], [`R2` → `R3`], [`R4` → `R1`], [`R1` → `S1`], [`S1` → Mark's PC]) and enter your result in a Table as Tab. 1.

[1] The figure of the topology provided can be downloaded from `http://www.net.t-labs.tu-berlin.de/teaching/ws1011/NPA_lecture/uebung/u05-topology.zip` in various formats and used for annotation.

| Paket Number | Source IP | Source MAC | Destination IP | Destination MAC |
|---|---|---|---|---|
| 1. [web server → R2] | ... | ... | ... | ... |

Table 1: Part (e)

**Question 2:** $(10 + 10 = 20$ points) *Network Address Translation*

Assume for this question that the administrator of the "Student Flat" enabled Network Address Translation (NAT) on router `R1`.

(a) As in the previous question, Lisa's computer wants to establish an HTTP connection to the web server using 8080 as its source and 80 as destination port. Show the NAT table of `R1`. Which IP addresses and which ports are used by the IP packets

- within the private network (student flat)
- outside the private network

on the way from and to the web server? How does the NAT gateway recognize the host to which an incoming packet should be forwarded?

(b) Now Toms computer wants to establish a HTTP connection to the webserver in parallel. Like Lisas computer, 8080 is used as a source port and 80 as destination port. Is there a difference in this scenario compared to (a)? Show the NAT table of `R1`.

**Question 3:** $(5 + 5 + 15 + 5 = 30$ points) *ARP*

(a) Find out what the terms "switch", "hub", "collision domain" and "broadcast domain" mean and explain each in one sentence.

(b) Given is the network in the first question. Draw all collision domains and all broadcast domains (visually discriminable).

(c) Describe all ARP queries and replies generated by an request of Lisas PC to the web server in a table similar to Tab. 2. Assume that *all* caches are empty and the IP of the web server is known by Lisas computer, so that DNS is *not* needed. Also assume that the routing is configured and works correctly.

| Source device | Dest. device | Request/Reply | src MAC | src IP | dst MAC | dst IP |
|---|---|---|---|---|---|---|
| ... | ... | ... | ... | ... | ... | ... |

Table 2: ARP

(d) How does the receiver distinguish between an ARP and IP packet contained in a frame?

**Due Date: Thursday, December, 2nd 2010 only until 13:55 h s. t.**

- **As PDF files (no MS Office or OpenOffice files):** Uploaded via ISIS (`https://www.isis.tu-berlin.de/course/view.php?id=3584`)
- **On paper:** Postbox in the Telefunkenhochhaus (basement, behind the doorman right)
- Put your name, StudentID number (Matrikelnummer) **and** the name of your tutor on your solution.