TECHNISCHE UNIVERSITÄT BERLIN
Fakultät IV – Elektrotechnik und Informatik
Fachgebiet Intelligente Netze
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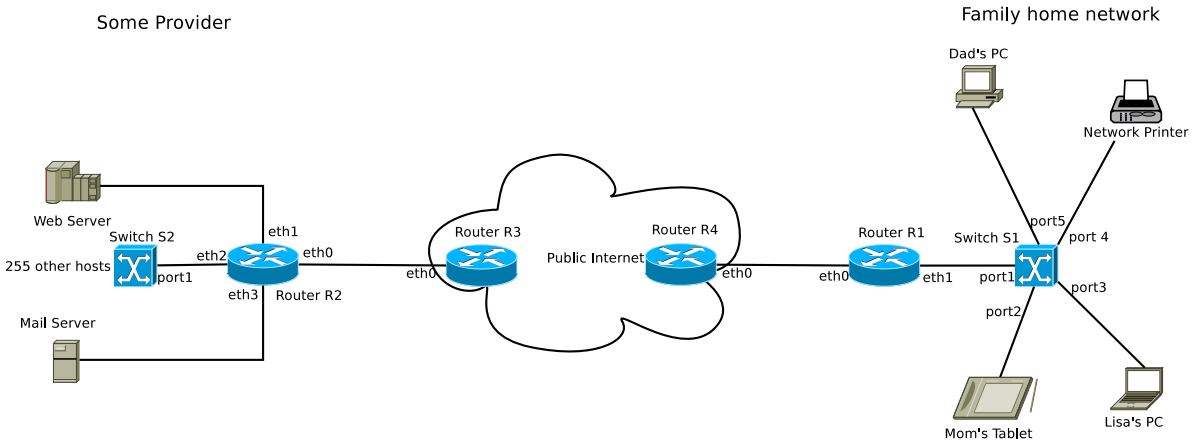
3th Assignment: Network Protocols and Architectures, WS 14/15

Question 1: $(15 + 10 + 10 = 35$ points) *IP Address Assignment*

The figure below depicts the topology of a two networks ("Some Provider" and a "Family home network") connected via the public Internet. The networks consist of four routers (`R1`, `R2`, `R3` and `R4`), two switches `S1` and `S2`, and several hosts. Interfaces of the routers are labelled eth_i and ports of the switch are labelled $port_i$. 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 prefix length 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.

(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) Now also assign IPv6 addresses to the topology above. What is the recommended IPv6 prefix length for these networks and why? Do you need global unicast addresses for the links between R1-R4 and R2-R3? Explain why or what alternatives exist. (Hint: If you don't know, do a quick Internet search for that).

Please turn!

[1] The figure of the topology provided can be downloaded via ISIS from `https://www.isis.tu-berlin.de/file.php/7028/Tutorials/u06-topology.zip` in various formats and used for annotation.

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

Assume for this question that the administrator of the "Family home network" 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 49170 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 ("Family home network")
- 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 Lisa's ex-boyfriend Tom wants to establish a HTTP connection to the webserver in parallel, using Dad's PC. Like Lisa's computer, 49170 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: $(10 + 5 + 10 = 25$ points) *Internet Protocol—Basics*

(a) Why are private address spaces (10/8, 172.16/12, 192.168/16, FC00::/7) needed, which are not routed in the Internet?

(b) What is the purpose of IPv6 Link Local Addresses (FE80::/10)? How does their use differ from addresses in the private address space (FC00::/7)?

(c) Explain the difference between routing and forwarding. What is a router, a host, an interface? Do routers have IP addresses? If yes, how many?

Question 4: $(10 + 5 + 5 = 20$ points) *Internet Protocol— Longest Prefix Match*

(a) Given a simplified forwarding table. Give the correct interface for packets with the following destination ip addresses:

- 185.55.141.176
- 185.55.141.182
- 184.55.141.246
- 185.55.144.13

Prefix/Mask	Interface
185.55.141.176/29	eth0
185.55.144.0/20	eth1
184.55.141.180/30	eth2
185.55.160.0/19	eth3
185.55.141.0/24	eth4
0.0.0.0/0	eth5

(b) What is the 32-bit binary representation of the IP address 212.134.14.93 in network byte-order? Mark the network number portion and host number portion assuming a subnet mask of /28.

(c) Consider a LAN (local area network) to which ten host interfaces and three router interfaces are attached. Suppose the LAN uses /24 addresses. Which of the first 32 bits will be at least identical in the IP addresses for the 13 interfaces?

Due Date: Wednesday, November, 12th 2014 only until 14:00 h s. t.

- **As PDF files (no MS Office or OpenOffice files):** Uploaded via ISIS (`https://www.isis.tu-berlin.de/2.0/course/view.php?id=2560`)
- Put your name, StudentID number (Matrikelnummer) **and** the name of your tutor on your solution.