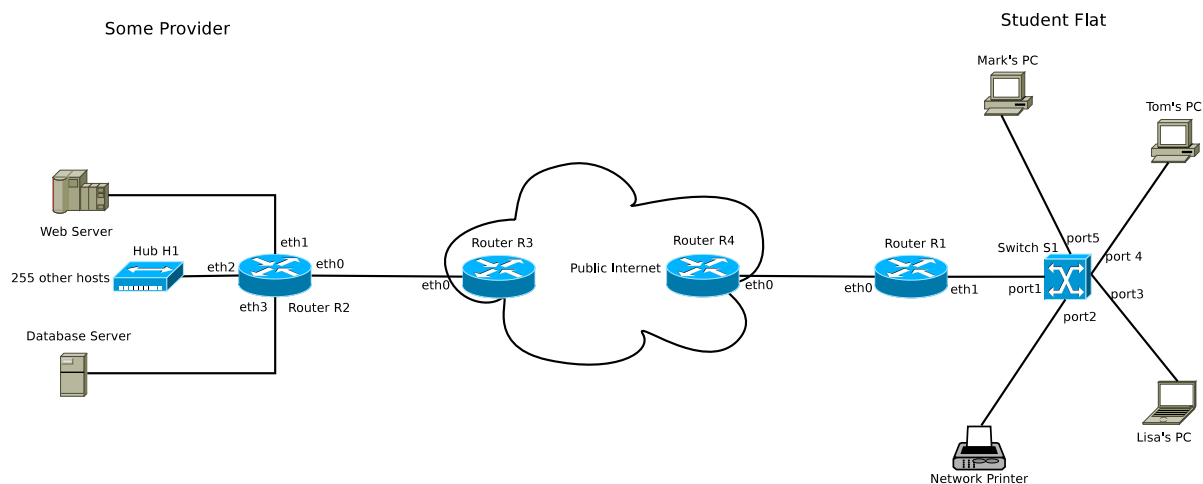


6th Assignment: Network Protocols and Architectures, WS 11/12

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.



- Consider the topology¹ 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”.
- 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.
- 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 forwarding decisions on this concrete example.
- Which parts of the Ethernet, IP and TCP header will be rewritten when a packet is forwarded by router R1?
- What are the IP and MAC address fields of a response sent by the web server to Lisa’s computer? Consider the response traversing all drawn links ([web server → R2], [R2 → R3], [R4 → R1], [R1 → S1], [S1 → Lisa’s PC]) and enter your result in a table as in Tab. 1.

¹The figure of the topology provided can be downloaded via ISIS from <https://www.isis.tu-berlin.de/mod/resource/view.php?id=219105> 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 Tom’s computer wants to establish a HTTP connection to the webserver in parallel. Like Lisa’s 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: (10 + 10 + 5 + 5 = 30 points) *Internet Protocol—Basics*

- (a) Why are private address spaces (10/8, 172.16/12, 192.168/16) needed, which are not routed in the Internet?
- (b) Explain the difference between routing and forwarding. What is a router, a host, an interface? Do routers have IP addresses? If yes, how many?
- (c) What is the 32-bit binary representation of the IP address 130.149.220.251 in network byte-order? Mark the network number portion and host number portion assuming a subnet mask of /27.
- (d) 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: Thursday, December, 8th 2011 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=5258>)
- **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.