Computer Networks Technologies and Services	September 16th, 2016
First and last name	Student ID ....…....

NOTES

i. Nothing else than what is needed to write (pen, eraser), a piece of ID, and possibly water and food can be taken to the seat where you take your exam. Please leave any other item you might have (coat, bag, phone, calculator, and any other object) at the front or back of the classroom.

ii. The answers to each question must be written exclusively on the same page of the question, which is the only material that will be graded.

iii. Do not forget to write your name and student ID in each one of the marked spaces on the exam paper.

iv. In case you will use part of pages containing the questions as a scratch pad, please indicate it clearly and possibly cross out such parts before handing in the exam.

v. The score assigned to answers varies from zero to the maximum score reported at the end of the question. Please notice that the maximum scores of all questions do not necessarily sum up to 30.

vi. When answering questions, please feel free to use drawings whenever they can help expressing and clarifying the answer.

vii. Answers that are not understandable (for example because written badly or with bad handwriting) might be considered wrong.

viii. During the test, any communication with other classmates is prohibited and will cause the student to be sent away from the classroom

ix. The instructors and the assistants that are present during the test are there for the sole purpose of verifying proper progress of the exam. Their role is not giving any support to the interpretation of the text, neither helping the students to correctly formulate the answers. Please avoid any such request.
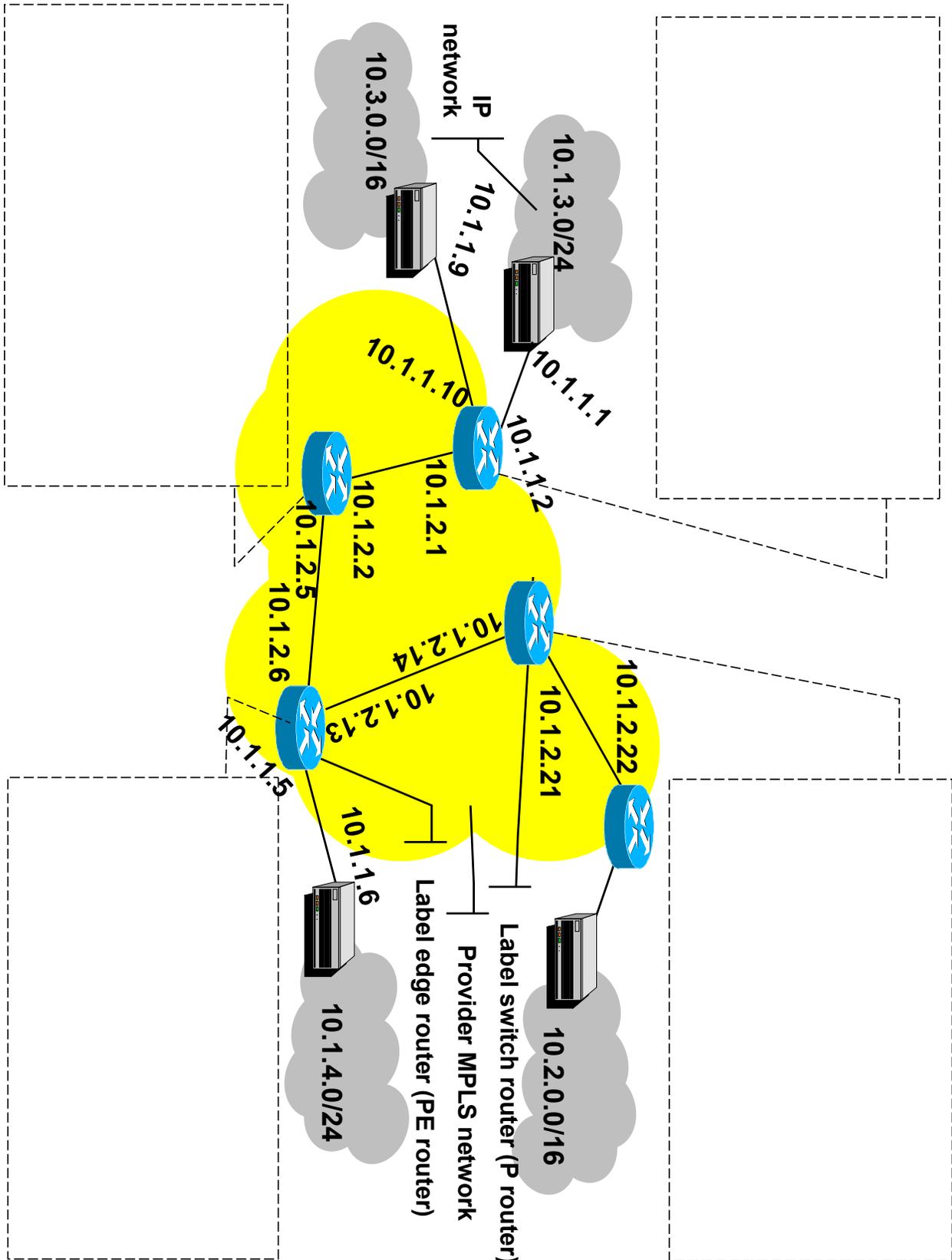
Question 1) A SIP user alice@iptel.org, already registered and connected to its own service provider, would like to make a phone call to another SIP user, bob@iptel.org. Assuming that the caller does not know yet the IP address of the callee, list all the messages sent and received by all the involved entities from the beginning of the call establishment procedure to the end of the call. Consider messages of all possible involved protocols. An answer based on a graphical representation is fine. (7 points)

Question 2) Write, directly in the table below, relevant information in packets exchanged on the network when the user of H1 sets up an FTP session to an FTP server running on H2. Use the "Upper layers" cell to specify information related to upper layer protocols encapsulated inside IP packets that are relevant in this scenario. Please list at most 7 packets; in case fewer are generated, it is not necessary to use all the rows in the table below. (6 points)
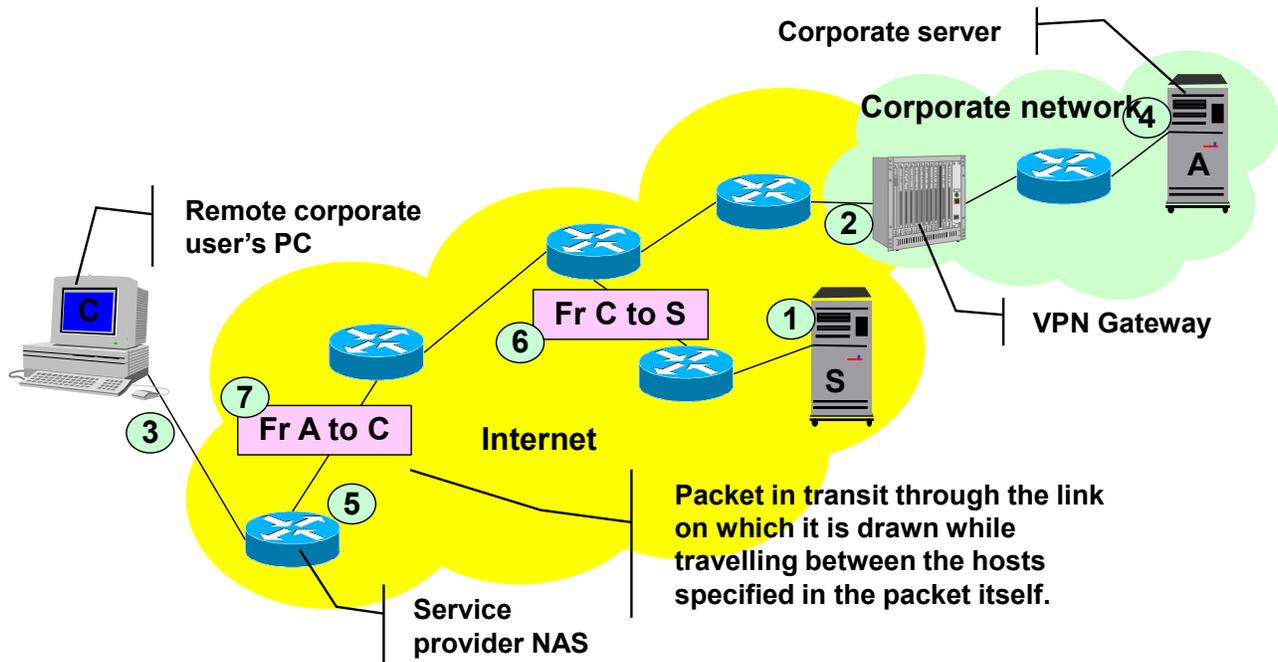
Internet

R1
2001:1:0:1::1/64
2001:1:0:2::1/64
MAC: 00-AA-BB-CC-DD-EE

H1
IPv6: 2001:1:0:1::2/64
DG: 2001:1:0:1::1
MAC 00:01:04:76:2A:5C

H2
IPv6: 2001:1:0:2::2/64
DG: 2001:1:0:2::1
MAC 00:01:04:78:8D:2B
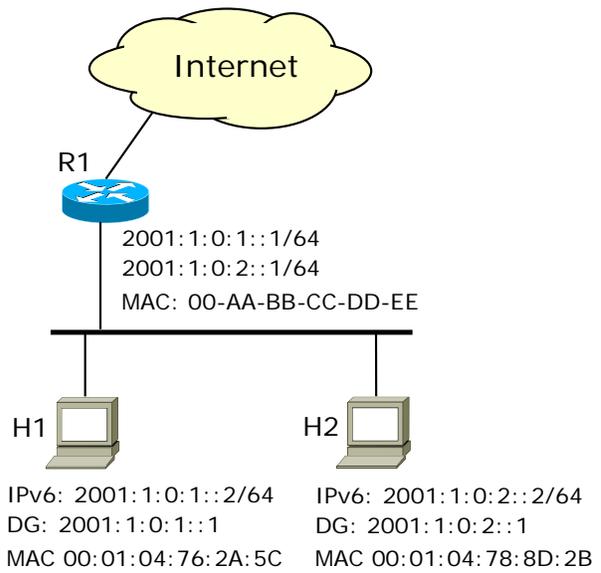
Pkt. 1	MAC src.	MAC dest.
	IP src.	IP dest.
	Upper layers	

Pkt. 2	MAC src.	MAC dest.
	IP src.	IP dest.
	Upper layers	

Pkt. 3	MAC src.	MAC dest.
	IP src.	IP dest.
	Upper layers	

Pkt. 4	MAC src.	MAC dest.
	IP src.	IP dest.
	Upper layers	

Pkt. 5	MAC src.	MAC dest.
	IP src.	IP dest.
	Upper layers	

Pkt. 6	MAC src	MAC dest.
	IP src.	IP dest.
	Upper layers	

Pkt. 7	MAC src.	MAC dest.
	IP src.	IP dest.
	Upper layers	

Question 2) With reference to the MPLS network depicted in the following figure, specify (directly in the dashed boxes) all of the information needed by the corresponding router to forward MPLS frames containing packets from hosts in network 10.1.4.0/24 to hosts in the networks 10.1.3.0/24 and 10.2.0.0/16. The IP addresses near the MPLS router interfaces should be interpreted as the IP addresses of the interface. (6 points)

IP network

10.3.0.0/16

10.1.3.0/24

10.1.1.9

10.1.1.10

10.1.1.1

10.1.1.2

10.1.2.1

10.1.2.2

10.1.2.5

10.1.2.14

10.1.2.6

10.1.2.13

10.1.2.22

10.1.2.21

10.1.1.5

10.1.1.6

10.2.0.0/16

10.1.4.0/24

Label edge router (PE router)

Provider MPLS network

Label switch router (P router)

Question 4) Given the customer provisioned access VPN scenario with centralized Internet access depicted in the following figure, indicate (directly in the table below) the IP addresses assigned to the interfaces and included in the packets marked with a number. Interface addresses can be chosen freely as long as they are compatible with the operating principles of IP and the common deployment practices of this specific access VPN solution. As far as packets are concerned, please explicitly provide both source and destination IP addresses and, in case multiple IP headers be deployed (tunneling), explicitly list the IP address pair (source and destination) within each of the headers, clearly specifying the header (i.e., internal or external) they belong to. As far as interfaces are concerned, please list all IP addresses assigned to them if the specific VPN deployment scenario requires them to have more than one address. (7 points)

Corporate server

Corporate network

Remote corporate user's PC

Fr C to S

Fr A to C

Internet

VPN Gateway

Packet in transit through the link on which it is drawn while travelling between the hosts specified in the packet itself.

Service provider NAS

1)	2)
3)	4)
5)	
6)	
7)	