Computer Networks Technologies and Services	**February 10th, 2014**
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 at the seat where you take your exam. Please leave any other non allowed item you might have (coat, bag, phone, calculator, and any other object) at the front or back of the classroom.
  ii. Only sheets of papers provided by who is administering the test can be used during the exam. The answers to all questions must be written exclusively on the exam paper, which is the only material that will be graded. Do not forget to write your name and student ID in each one of the marked spaces on the exam paper.
  iii. In case you will use whole pages or part of pages as a draft copy, please indicate it clearly and possibly cross out such parts before handing in the exam.
  iv. The score assigned to answers varies from zero to the maximum score reported at the end of the question.
  v.   When answering questions, please feel free to use drawings whenever they can help expressing and clarifying the answer.
  vi. Answers that are not understandable (for example because written badly or with bad handwriting) might be considered wrong.
  vii. During the test, any communication with other classmates is prohibited and will cause the student to be sent away from the classroom
  viii. 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.
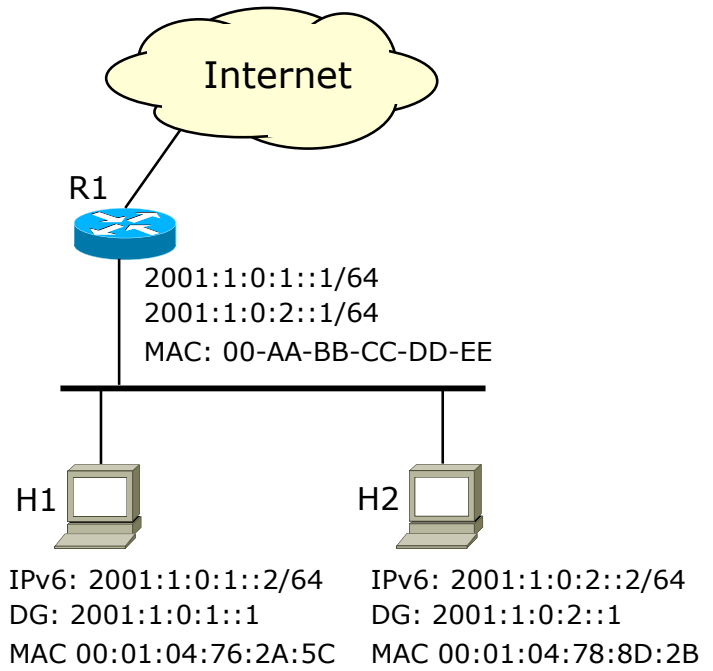
Question 1) The employees of a company can connect to their corporate network through a VPN software, which terminates all its traffic on a VPN gateway with address 15.2.1.3. Through that connection, employees have access to all the services available on the corporate network. The student should describe (briefly) a packet that transports a web page coming from Google (IP address 173.194.35.148), captured on the link that connects the employee (that uses the VPN service) to the Internet. Assume a centralized Internet access. The IP address of the client is 130.192.10.81, while the IP address assigned to the client within the VPN is 15.2.1.5. (6 points)

Question 2) Given the following capture file with SIP messages, answer the following questions: (7 points)

A. List the usernames, IP addresses and port numbers used by the caller and called UA.
B. What is the (SIP) role of the host with IP address `130.192.16.23`?
C. Is record routing enabled? (Please motivate the answer)

Source IP	Destination IP	Protocol	Description
130.192.16.23	130.192.16.62	SIP/SDP	INVITE SIP:mario@130.192.16.62:7234
130.192.16.62	130.192.16.23	SIP	Status: 180 RINGING
130.192.16.62	130.192.16.23	SIP/SDP	Status: 200 OK
130.192.16.23	130.192.16.62	SIP/SDP	ACK SIP:mario@130.192.16.62:7234
130.192.16.62	130.192.16.23	SIP	BYE SIP:lina@120.149.210.3:6734
130.192.16.23	130.192.16.62	SIP	Status: 200 OK

Question 3) Write, directly in the table below, relevant information in packets exchanged on the network when H1 sends an ICMP Echo Request message to 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 note that it is not necessary to use all the rows in the table below. (6 points)
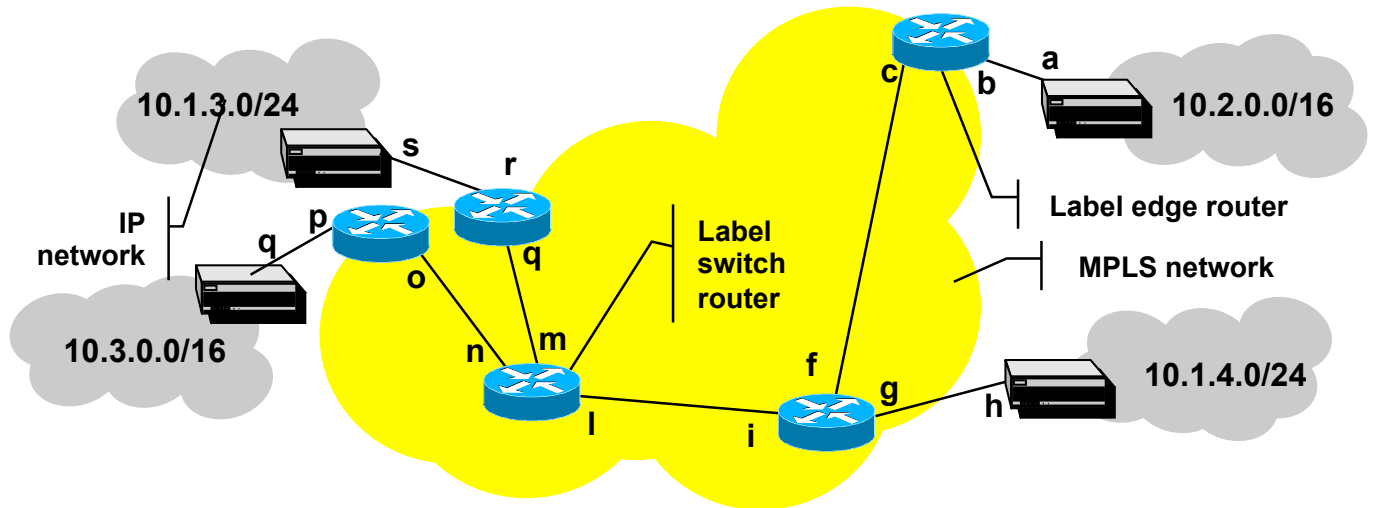
Internet

R1

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

H1

H2

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

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 4) Given the network in the following figure, specify the steps required for setting up an LSP to carry traffic from the label edge router at the top on the right hand side to destination 10.1.3.0/24. Specifically indicate each action executed either directly on the figure (close to the device taking such action or the link carrying the corresponding message) or in the blank space below (clearly showing the device executing each action or pair of devices exchanging each message), using the following notation:

- binding: `B, <FEC>, <label>`

- distribution: `D, <FEC>, <label>`

- mapping: `M, <input label or FEC>, <output label>, <next hop>`

where the first letter identifies an action and what follows are the corresponding parameters. Please consider the letter besides each interface in the figure as the IP address assigned to the interface itself. (9 points)

10.1.3.0/24

s

r

IP network

10.2.0.0/16

c b a

Label edge router

p

q

o

q

Label switch router

MPLS network

10.3.0.0/16

n m

l i

f

g

h

10.1.4.0/24