Computer Networks Technologies and Services	**February 5ᵗʰ, 2018**
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) Given the following capture file with SIP messages, answer the following questions: (12 points)
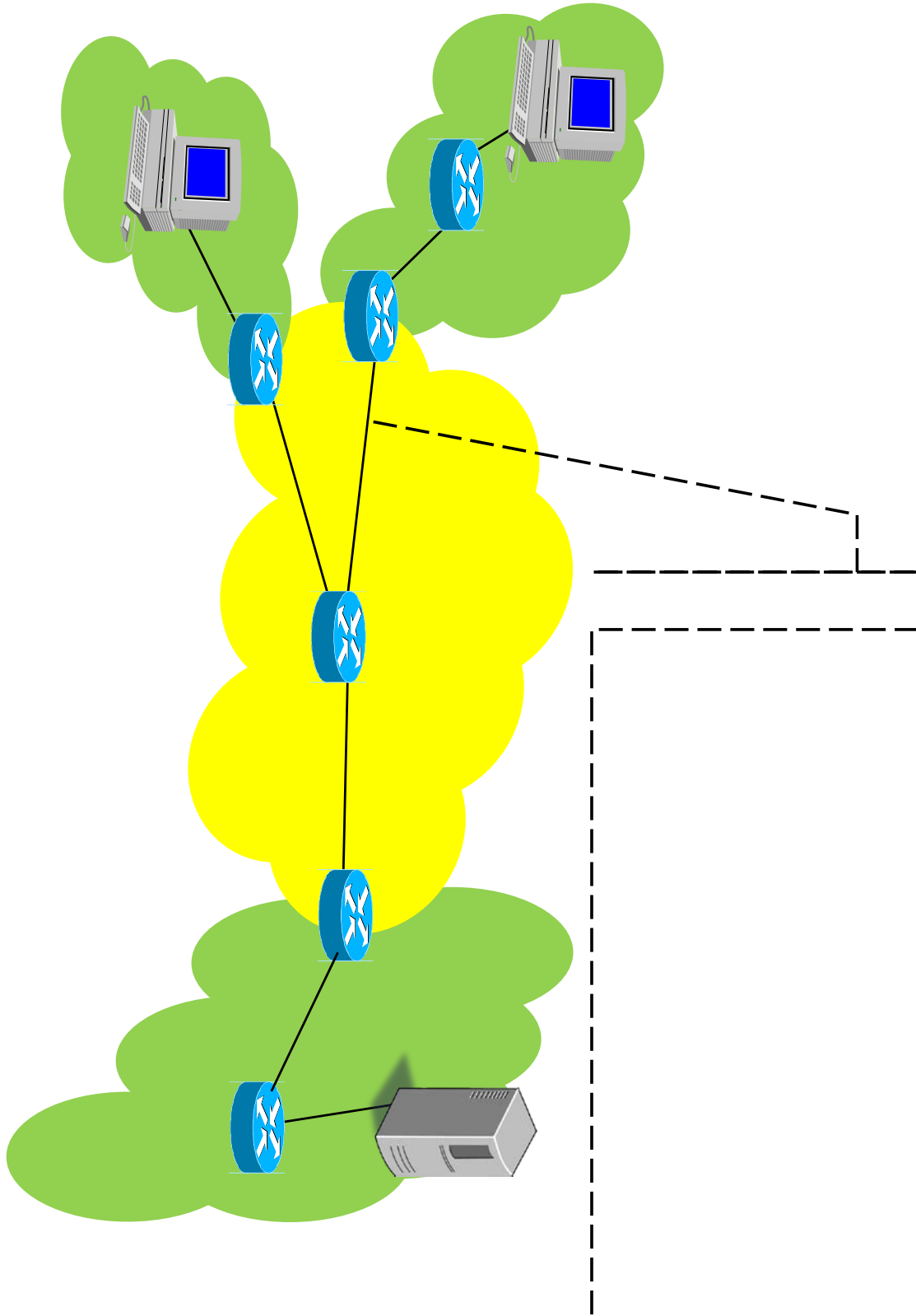   A. Indicate the IP address of at least one SIP proxy
   B. Indicate the IP address of the caller UA.
   C. Explain where in the network the capture was taken.
   D. Is record routing enabled? (Please motivate the answer)

Source IP	**Destination IP**	**Protocol**	**Description**
135.49.21.4	128.192.16.62	SIP/SDP	INVITE SIP:mario@polito.it
128.192.16.62	135.49.21.4	SIP	Status: 100 TRYING
128.192.16.62	135.49.21.4	SIP	Status: 180 RINGING
128.192.16.62	135.49.21.4	SIP/SDP	Status: 200 OK
135.49.21.4	128.192.16.62	SIP/SDP	ACK SIP:mario@130.192.18.23:7234
128.192.16.62	135.49.21.4	SIP	BYE SIP:lina@120.149.210.3:6734
135.49.21.4	128.192.16.62	SIP	Status: 200 OK

A.

B.

C.

D.

Question 2) Considering that the figure below represents a typical A+P deployment scenario, (18 points)

1. Assign an IP address to each interface of each host and network device (writing it directly on the figure, close to the interface itself).

2. Annotate (directly on the figure) the (name of the) role played by devices and/or functionality offered (beyond forwarding IP packets) and their parameters that are key for the solution to actually work.

3. Schematically describe (in the dashed box) a packet transiting on the link indicated in the figure, highlighting information carried by the various headers that is instrumental to the proper operation of the solution.

Question 3) With reference to the router pointed by the arrow in the following figure, list all the actions the router executes for setting up LSPs to carry traffic between hosts belonging to networks 135.3.0.0/16, 129.1.0.0/16 and 12.1.2.0/24. Please use the following notation to describe each action:

- 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. (12 points)

IP network

135.3.0.0/16

129.1.0.0/16

q

p

o

n

s

r

q

m

l

Label switch router

i

f

g

c

b

a

h

193.4.5.0/24

MPLS network

Label edge router

12.1.2.0/24

Question 4) List two different technologies that can be used for the wide area interconnection of IP routers (e.g., located 700 km away from each other) describing (*i*) their key features and (*ii*) relative advantages and disadvantages. (10 points)

Technology 1:

Key features:

Technology 2:

Key features:

Relative advantages and disadvantages (comparison of the two technologies):