I2208

By
Daniel
Dalati

2023

LEBANESE UNIVERSITY
Faculty of Sciences
3 Section

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Course: I2208 **Year: 2018-2019**

Duration: 1 hour **Exam: Partial**

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Comprehension questions (22 points)

Q1. (16 points)

Complete the following table:

	Unique	Assigned by	Coded on how many bytes?
Address physical	Yes (2 points)	The manufacturer (3 points)	6 bytes (3 dots)
Address logic	Yes (2 points)	Local IT respondents (3 points)	4 bytes (3dots)

Q2. (6 points)

How can we recognize the end of the frame?
Depending on the code used (Ethernet II) (3 points)
Frame length (Standard 802.3) (3 points)

Exercise 1 (50 points): CSMA/CD

Part 1

CSMA is a solution for channel access.

has. Why do we say that CSMA resembles a “civilized conversation”? (3 points)

We listen, we wait for the end, and we continue

b. How does the network card of a station S detect a collision? (9 points)

Before sending its data, S checks that Data Input =0. (3 points)
S sends its data, therefore Data Bus = Data Output. (3 points)
S means the channel, if Data Input# Data Output, it means that another station is transmitting: collision!! (3 points)

vs. Why is CSMA/CD not enough to solve the network access problem? (4 points)

Because it only solves half the problem. When we see the collision.

d. What steps are being taken to complement the CSMA/CD solution to resolve the network access issue. (9 points)

Avoid discreet collisions at all costs: (3 points)
Avoid frames that are too short ÿ RTT (3 points)
Limit network length ÿ MTU (3 points)

Part 2

Consider a network of eight stations using the CSMA/CD method. Calculate the time during which a station risks not detecting the transmission of a frame and therefore not detecting a collision. We give: • Average distance between 2 stations: 15

m;

• Propagation speed: 200,000 km/s.

Solution :
Length of medium = 7x15 = 105 m. (5pts)
To detect a collision we need RTT. (2pts)
RTT = 2 x propagation time. (3pts)
Propagation time = length of the medium / propagation speed (5pts)
Propagation time = 105x 10-3 /200000 = 52.5 10-8 s (5pts)
The time during which a station risks not detecting the transmission of a frame and therefore not detecting a collision < 2 x 105 x 10-3 / 2 105 = 105 10-8 s=10.5 μs. (5pts)

Exercise 2: (28 points)

Consider two stations A and B connected via a switch by Ethernet links.
Each link introduces a propagation delay of 10 microseconds.
The switch is of the “store and retransmit” type, i.e. the switch
waits for the packet to be completely received by the input link before retransmitting it on the output link.

A wants to send 5000 bits to B. The transmission rate is 10 Mb/s.

Calculate the transfer delay (from the first bit sent by A to the last bit received by B) if the switch starts retransmitting immediately after it finishes receiving the packet (no additional storage delay). The transmission rate by the switch is also 10 Mb/s.

Note: Give the different deadlines to take into consideration and show the calculation carried out.
Solution
Transfer delay = Transmission delay + Propagation delay (AS) + retransmission delay by the switch + propagation delay (SB). (10 points)
No memorization delay by the switch because it retransmits immediately after reception.

– Dprop propagation delay: 10 µs
– Dtrans transmission delay: size/rate (5 points)
Dtrans = 5•103 /(10x106) = 500 µs (5 points)
– Total transfer delay: Dtot = 2 • Dtrans + 2 • Dprop = 1020 µs (8 points)

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Course: I2208 **Year: 2017-2018**

Duration: 1 hour **P + F: S2**

Dr.Rana Rahim

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Part P (Partial): (out of 100 points for ~45 minutes)

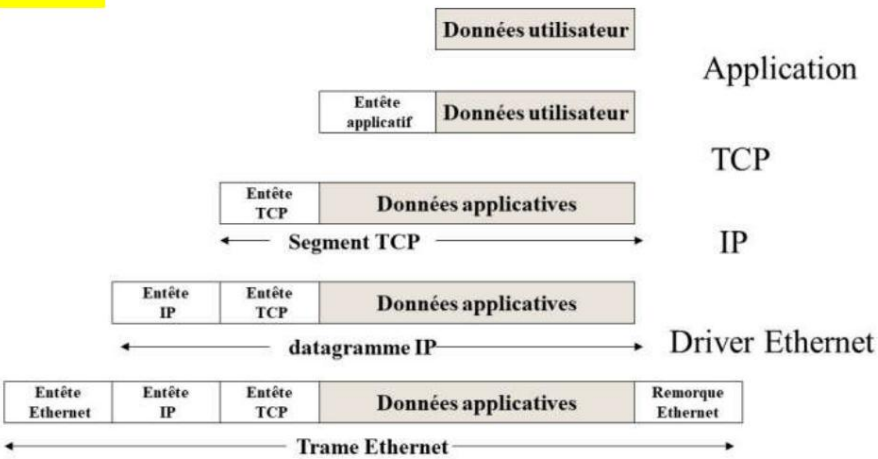
Exercise 1: Comprehension questions (55 points)

Q1. Answer true or false and correct if false (one line max). (25 points)

1. All communications on the Internet are governed by protocols. TRUE
2. The infrastructure of a local network is private and is managed locally by IT staff. TRUE
3. Advantage of a bus type network: if the cable is broken, the network does not break down. False: if the cable breaks, the entire network breaks down.
4. A mesh network is easy to troubleshoot and very reliable, and it does not cost a lot of cabling. False: A mesh network is easy to troubleshoot and very reliable, BUT expensive to wire.
5. Communication between layers: A layer N of a host communicates with its counterpart of the remote host. TRUE

Q2. Give a diagram showing the encapsulation mechanism defined by the TCP/IP model. Note the name of the message at each level. (21 points)

Solution

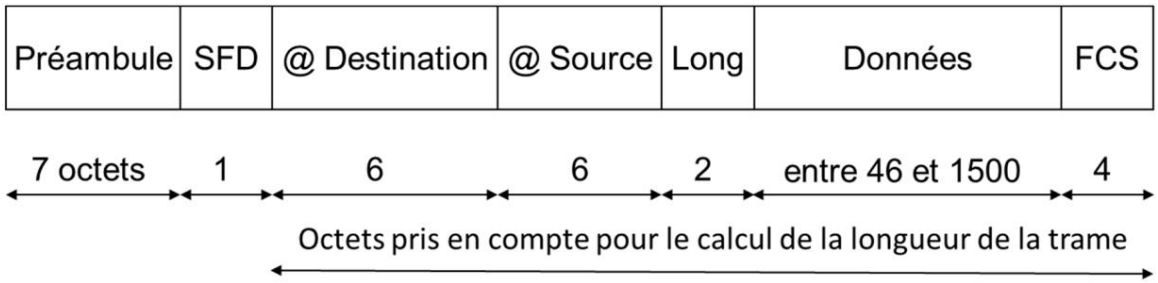


Q3. Intermediate equipment operates up to layer 3 of the OSI model. For each of these 3 layers, give an example of equipment that works there. (9 points)

Solution :
Layer 3: router
Layer 2: Switch
Layer 1: HUB

Exercise 2 (24 points)

Either the format of the 802.3 Ethernet frame



has. What is the minimum size of an 802.3 Ethernet frame? (6 points) b. What is the maximum size of an 802.3 Ethernet frame? (6 points) c. What does the Data field of a frame contain? (6 points) d. What is the transmission time of 592 bits on a 10 Mbps network? (6 points)

Solution

a. Min: (2*6) + 2 + 46 + 4 = 64 bytes b. Max: (2*6) + 2 + 1500 + 4 = 1518 bytes c. It contains the data coming from the upper layers according to the mechanism encapsulation defined by the OSI model. d. Transmission time = Number of bits / bit rate The transmission time of 592 bits at 10 Mbits/s corresponds to 59.2 ÿseconds.

Exercise 3 (21 points)

A transmitter E intends to transmit an image file of size 23 MB (megabytes). How long will its transmission take: 1. via the telephone link at a rate of 9600 bit/s? (7 points) t=file size/bitrates File size = 23MB=23*8 Mbits= 184Mbits.

T1 = 184*106 /9600=19167s; 2. by a link via a 56 Kbit/s Internet connection? (7 points)
T2 = 184*106 /56000=3285s; 3. via a wireless connection, with an upload speed of 300kbit/s? (7 points)
T3 = 184*106 /300000=613.33s;

Part F (Final): (out of 100 points for ~105 minutes)

Exercise 4 (14 points)

The CSMA/CD protocol specifies a minimum frame length of 64 bytes.

What is the maximum distance of a data path between two stations for a 100 Mbit/s network and a propagation speed of 100000 km/s?

Clearly give the different stages of reasoning.

Solution

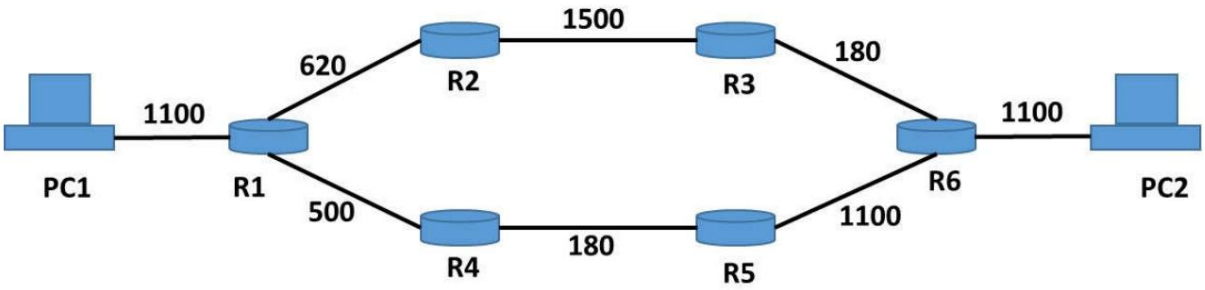
The minimum frame transmission time must correspond to the RTT (round trip time) (2 points)

Minimum frame transmission time = size/rate (2 points)
T trans= (64x8)/(100x106)s=512x10-8 s (2 points)
The propagation time is equal to half the RTT = Tprop = RTT/2 (2 points)
Tprop= 512x10-8 s /2 = 256 x10-8 s (2 points)
Maximum distance = Tprop x Vprop (2 points)
Maximum distance = 256 x10-8 sx 100000 103 m/s = 256 m (2 points)

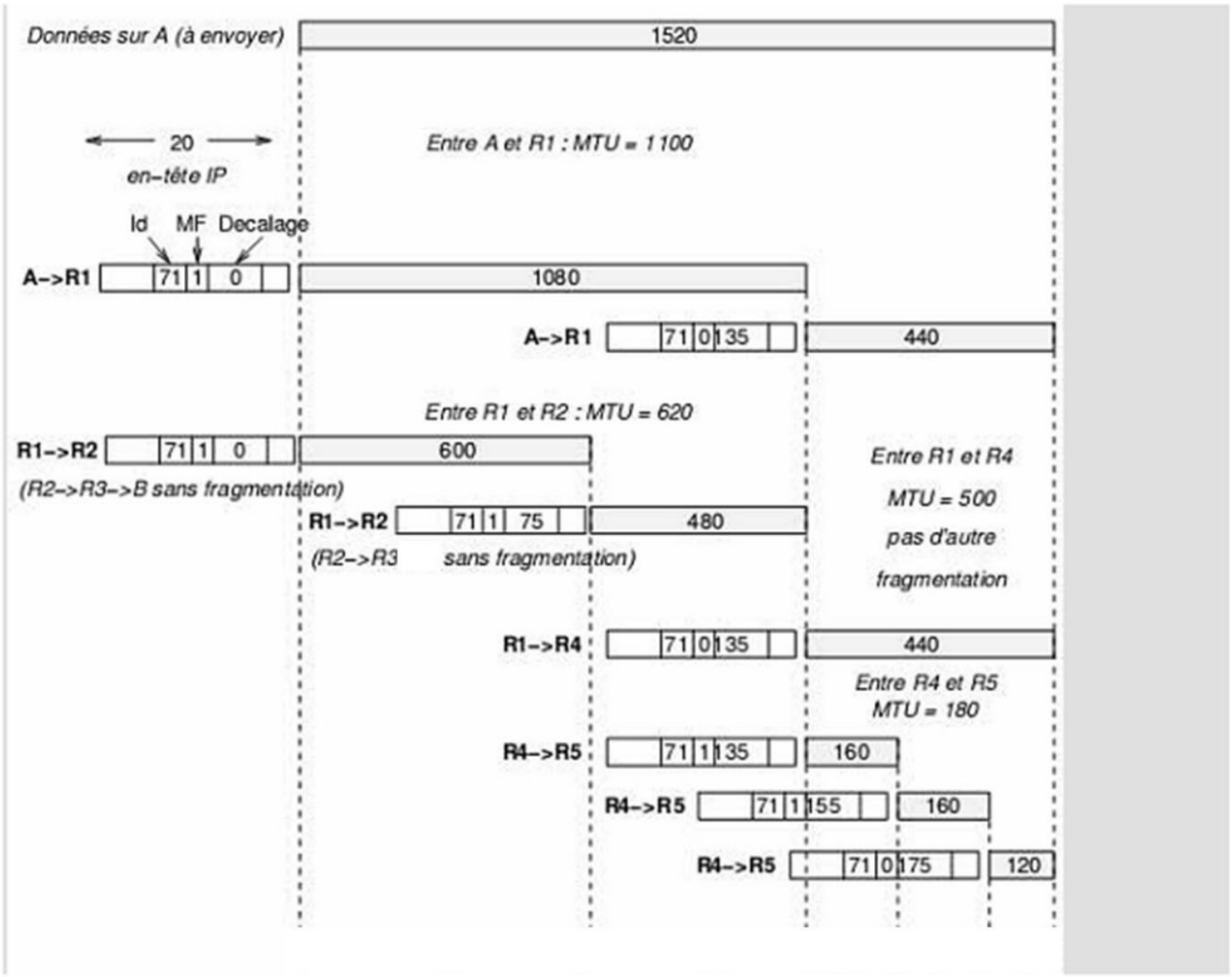
Exercise 5 (52 points)

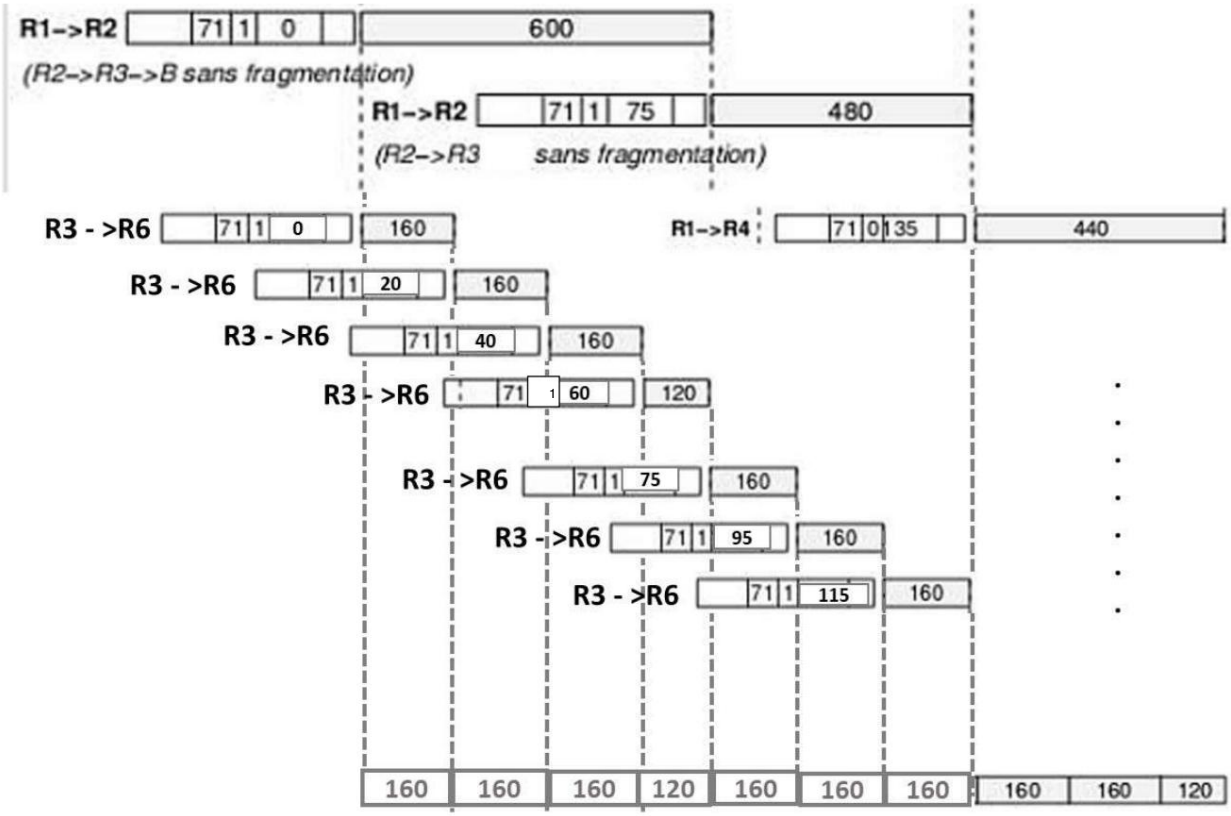
Consider a network made up of 6 IP routers (R1 … R6) and two stations PC1 and PC2 which must communicate. Each link between hosts (station or router) is labeled by its MTU (Maximum Transmission Unit).
It is assumed that PC1 must transmit 1520 bytes of data to PC2.
Describe the fragmentations carried out for the transmission of an IP packet sent by PC1 to PC2, assuming that router R1 alternately transmits the frames it receives to R2 then to R4.

Specify the field values (Identification, More FragmentFlag, Offset) for each packet fragment. We will assume that the initial value of the Package Identifier is 71.



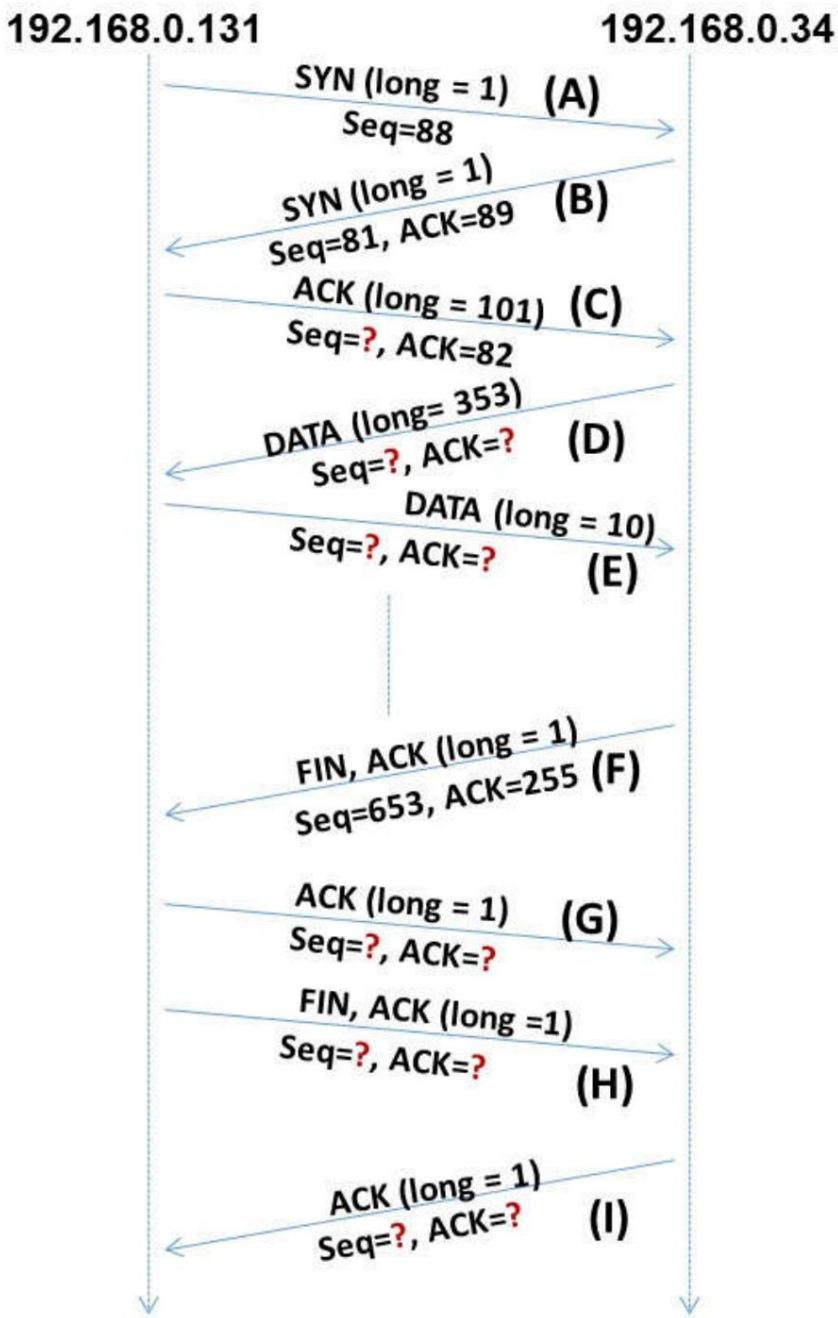
Solution



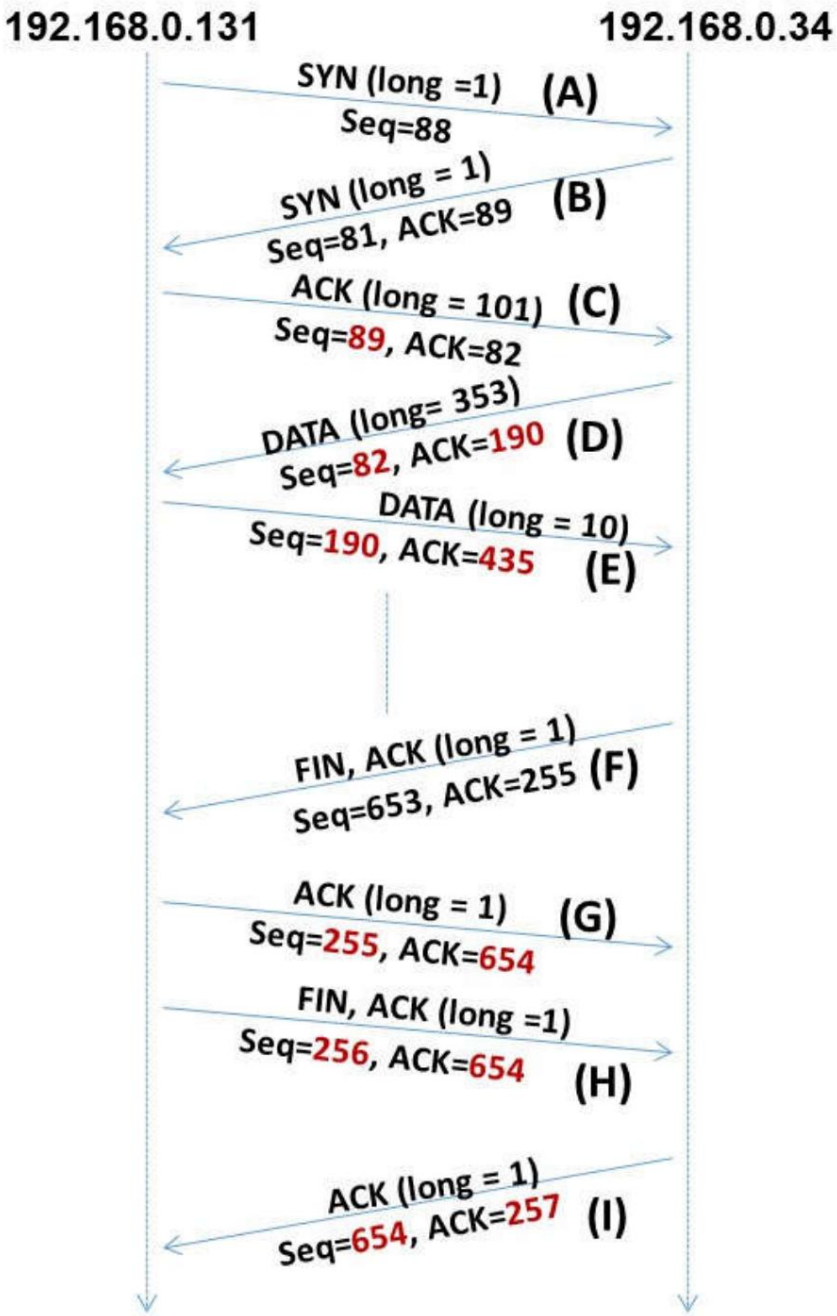


Exercise 6 (34 points)

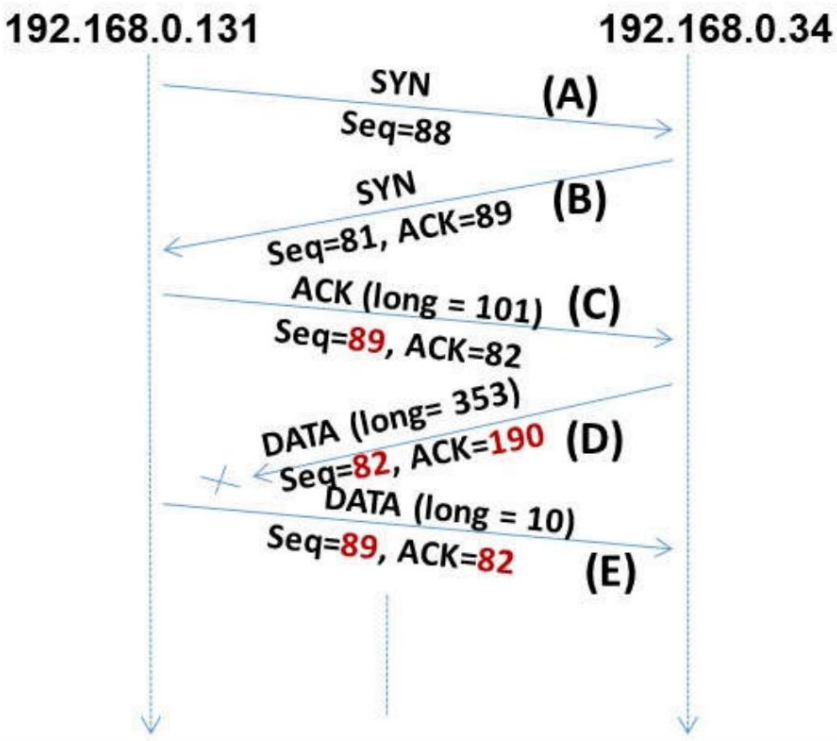
The following diagram represents the exchange of a few TCP segments during a connection from a client to an FTP server followed by a transfer and then closing the connection. The nature of each segment (SYN, ACK, FIN, DATA) is given as well as the sequence and acknowledgment numbers. Long designates the length in bytes.



1. Complete the missing values. (22 points)



2. What happens to message (E) if we consider that message (D) is lost? (4 points) justify the values obtained. (4 points)



If D is lost then the client believes that the server did not receive its message C and it retransmits.

3. After sending the message (F), could the server send DATA messages? (2 points) Why? (2 points)

No, he couldn't. Because the F message is a FIN message, i.e. it requests the closure of the connection on the server side.

Extracted from previous exams

Exercise 1

Consider a network **of eight stations** using the CSMA / CD method. Calculate the time during which a station **may not detect** the transmission of a frame and thus not detect a collision.
We give:

- Average distance between two stations: 15 m;
- Propagation speed: 200000 km / s.

RTT=2*t_{PROP}
t_{PROP}=DISTANCE/SPEED OF PROG=(7*15*10^{-3}Km)/ 200000 km / s=52.5*10^{-8}sec

RTT=2*52.5*10^{-8}sec=10.5 MICROSEC

Time to transmit
Transmission time<10.5 MICROSEC (collision will not be detected)

Exercise 2

Consider two stations A and B connected via a switch through Ethernet links. Each link introduces a propagation delay of 10 microseconds.
The switch is a "store and forward", ie the switch waits for the full receipt of the packet by the input link before forwarding it to the output link. Station A wants to send 5000 bits to B. The transmission bit rate (throughput) is 10 Mb/s.

Calculate the transfer time (since the first bit sent by A to the last bit received by B) if the switch begins retransmitting immediately after it has finished receiving the package (no additional storage delay). The transmission bit rate (throughput) of the switch is 10 Mb/s.
Note: Provide different delays for consideration and show the calculation performed.

A_____S_____B

Total transfer time from A to B= transmission time+ proptime (A-S)+Transmission time of S+ proptime (S-B)

transmission time at A: size/throughput=5000bits/10*10^6bit/sec=500microsec.
Total transfer time from A to B= 2*(500microsec)+2*10 microseconds.=1020microsec

3. Why CSMA/CD is similar to civilized conversation?

Before transmission:
Listen to the medium
Medium is available, no signal
Start transmitting

4. Compare MAC address and IP addresses

IP addresses: 32 bits =4 bytes, is unique , layer 3
MAC address:6 Bytes, allocated by manufacturer, is unique , layer 2

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Course: I2208

Year: 2016-2017

Duration: 2 hours

Final exam

Dr.Rana Rahim

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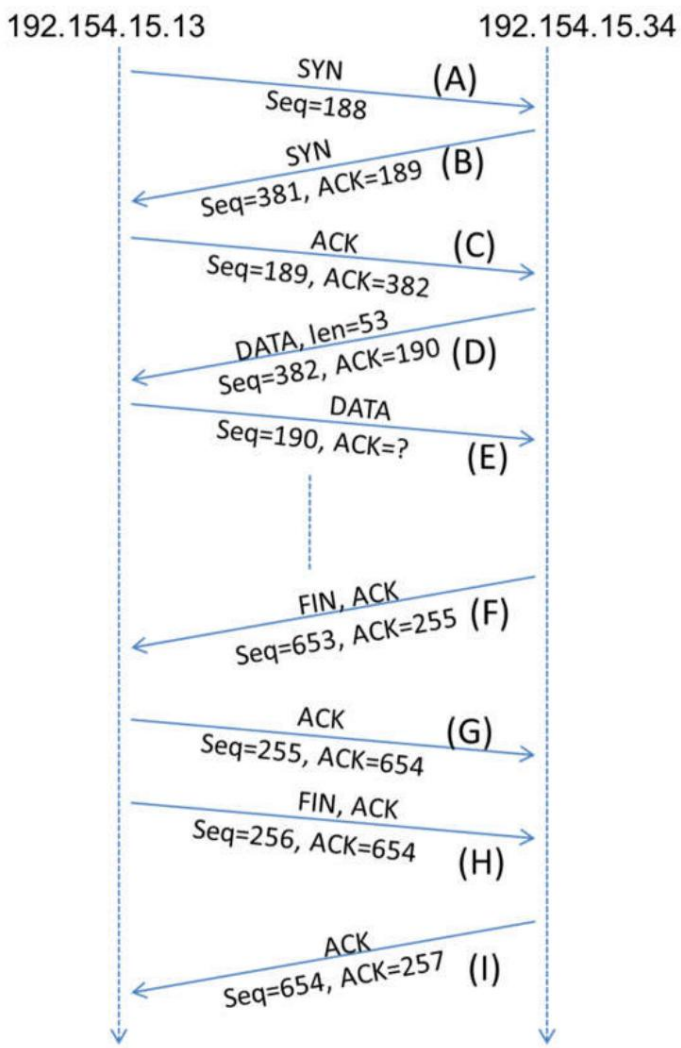
Exercise 1 (14 points)

The following diagram represents the exchange of a few TCP segments during a connection from a client to an FTP server followed by a transfer and then closing the connection. The nature of each segment (SYN, ACK, FIN, DATA) is given as well as the sequence and acknowledgment numbers.



has. What are the client and server IP addresses? (4 points)

Client: 192.154.15.13, server: 192.154.15.34

b. What port numbers are used? (4 points)

Server: 21 for FTP

Client: first available port number

vs. What are the segments corresponding to the connection phase? (2 points)

The first three segments A, B and C participate in the connection.

d. What is the Ack value of segment (E)? (2 points)

The acknowledgment in segment (E) is 382 + 53 bytes = 435 bytes.

e. What are the segments corresponding to the connection closing phase? (2 points)

The last 4 segments F, G, H and I participate in the connection.

Exercise 2 (24 points)

We consider an environment in which TCP operates on a link with a speed of 100 Mbits/s and a round-trip propagation time of 25 ms. What is the maximum link usage? Knowing that the receiver window announcements are encoded on 16 bits.

Write down the intermediate results of your calculation and calculate with units (bits, seconds, etc.).

Solution

Receiver window announcements are encoded at 16 bits. As a result, the maximum size of the sliding window is 65,535 bytes = 216-1. (5 points)

TCP can transmit the contents of a window by RTT, so the maximum achievable throughput is D = 65535 bytes/25 ms = 2.6 MB/s = 21 Mb/s. (10 points)

Maximum usage is therefore limited to U = 21 Mb/s/100 Mb/s = 0.21 = 21%. (9 points)

Exercise 3: (12 points)

Consider two machines A and B which communicate together.

1. What information does machine “A” need to reach the network in which machine “B” is located? (2 points) Name one important feature of this information. (2 points)

Knowing the IP address allows you to reach the network in which machine B is located. The IP address is unique in a given network.

2. What other information does machine “A” need to be able to communicate with a remote service on machine “B”? (2 points) Name one important feature of this information. (2 points)

You must know its port number, in addition to the IP address of the machine itself. The same port number must be used throughout the communication.

3. Name two Transport level protocols. Which one is best suited for question-and-answer type communications? (4 points)

TCP and UDP. UDP is best suited for question-and-answer type communications.

Exercise 4 (30 points): A company has the IP address 133.34.0.0. The administrator decides to segment the network into three subnetworks: one for administration, one for the research laboratory and the last for production.

has. How many bits are needed to create these subnets? specify the corresponding mask. (4 points)

b. How many machines can we put per network? (5 points)
vs. Choose three possible addresses for the three subnets created. (6 points)
d. Give the broadcast address of each subnet and the available address range to address the machines in each subnet. (15 points)

Note: addresses must be given in binary and decimal.

Solution

has. To address 3 subnetworks, it is necessary to have at least 2 bits. The binary value of the third byte of the mask is therefore 1100 0000, which is worth 192 in decimal. Therefore the mask is 255.255.192.0.

b. There are 16-2=14 bits left to address the hosts. We can therefore address 214 -2 = 16382 machines per subnetwork (4 points). The 2 values removed are for the broadcast address and the network address (1 point).

vs. The choice is made on the value of the two segmentation bits. For example, let's choose bits 00, 01 and 10. The three corresponding subnet addresses are: 133.34.0.0/18, 133.34.64.0/18 and 133.34.128.0/18.

We could also have chosen bits 11 which corresponds to the subnet with address 133.34.192.0 /18. (6 points)

d. The broadcast address is constructed by setting all the machine addressing bits to 1.
So the broadcast address on the 133.34.0.0/18 subnet is 133.34.63.255; on the subnet 133.34.64.0/18 the @broadcast is 133.34.127.255 and on 133.34.128.0/18 the @broadcast is 133.34.191.255. (2 points each)
The available address range is:

On the 133.34.0.0/18 network: 133.34.0.1 to 133.34.63.254 (3 points)

On the 133.34.64.0/18 network: 133.34.64.1 to 133.34.127.254 (3 points)

On the 133.34.128.0/18 network: 133.34.128.1 to 133.34.191.254 (3 points)

Exercise 5 (20 points)

Consider a network of MTUs of 148 bytes.

1. Calculate the maximum amount of data an IP packet can contain on this network. (2 points)
   148-20=128 *bytes*

Consider an IP packet of size 576 bytes that arrives at the network. Its ID field is 4345.

2. How many datagrams will this packet be fragmented into? and what is the size of each fragment? (8 points)
   576 – 20 (Header) = 556 data bytes

   556/128 = 4.34 or 4 fragments *containing* 128 *data bytes and one containing* 44 bytes *data.*

   4 fragments of size 148 bytes and one fragment of size 64 bytes.

3. Determine by explaining your method, what will be the value of the offset field of each of the fragments? (10 points)

   The first has no offset OFFSET FRAG1 = 0

   For the second: 128/8 OFFSET FRAG2 = 16

   For the third 2x128/8 OFFSET FRAG3 = 32

   For the fourth 3x128/8 OFFSET FRAG4 = 48

   For the fifth 4x128/8 OFFSET FRAG5 = 64

LEBANESE UNIVERSITY
of Science
Section 3

Faculty
Course:

I2208 Year: 2018-2019

Duration: 2h Final exam

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Exercise 1: (16 points)
Assume that instead of using 16 bits for the network part of an IP address, we used 22 bits.

1. How many subnets is it then possible to define? (5 points)

   22-16=6 bits
   2^6=64 possible subnets

2. Give the corresponding subnet mask. Justify your answer (3 points)
   22 bits: network+subnet→22 1's

11111111.11111111.11111100.00000000
255.255.252.0

3. What is the maximum number of computers that can connect to each subnet? Justify your answer (4 points)

32bits IP address – 22bits=10 bits to identify machines on the network.

maximum number of computers=2^{10}-2=1024-2=1022 machines

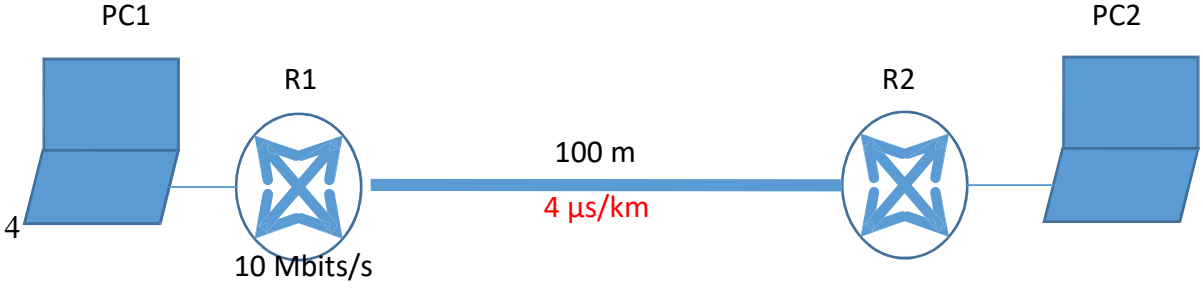
4. Numerical Example: Consider the 202.2.0.0/16 network address. Give the address of the 1st and 8th subnets. (4 points)

First network address: 11001010.00000010. 00000100.00000000 in decimal:202.2.4.0
8th network address: 11001010.00000010. 00100000.00000000 in decimal 202.2.32.0

Other method:
First network address: 11001010.00000010. 00000000.00000000. 202.2.0.0
8th network address: 11001010.00000010. 00011100.00000000 in decimal 202.2.28.0

Exercise 2: (20 points)
Consider a satellite link (RTT = 500 ms) with a transmission bit rate (throughput) of 1 Gbit/s.
What is the maximum achievable transmission bit rate for a maximum utilization of the link?
Note the intermediate results of your calculations and compute with units (bits, seconds, etc.).

Exercise 3: (25 points)
Consider the following diagram:



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The router R1 is connected to Ethernet 10 Mbits/s. R1 is linked to R2 by a coaxial cable of 100 m of length. The propagation speed of the medium is 4 microseconds/km. The treatment time in R1 is estimated at 1 microsecond per received packet. At time t = 0, R1 receives one packet of 1 Kbyte of size from PC1 to PC2.
We assume that the processing time in R2 is negligible and that once a package destinated for PC2 has arrived in R2, it is delivered to PC2 without delay.

At what moment the destination (PC2) receives the packet? Consider the following 2 cases:

1. Where R1 router queue is empty upon arrival of the data.

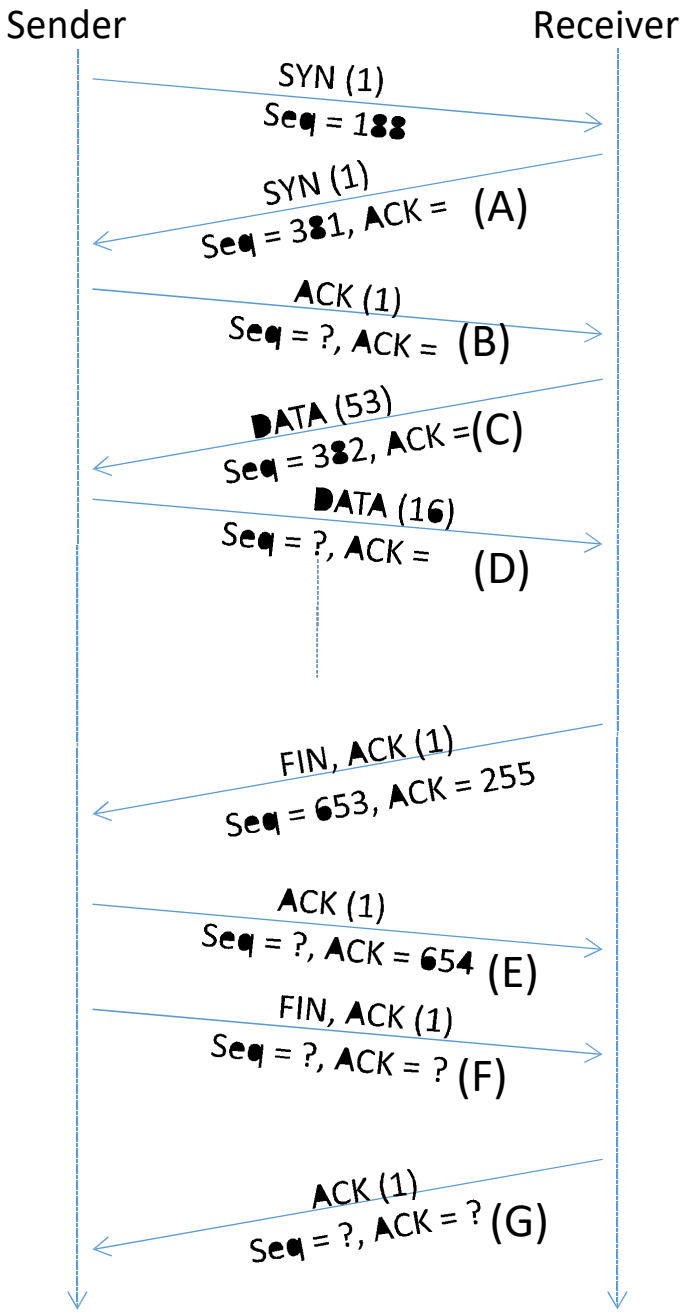
   Transmission time=1000*8/10=800microsec
   Prop time=($100*10^{-3}$km*4micro sec)/1km=0.4 microsec

   Destination will receive the packet at t=1+800+0.4=801.4 microsec

2. Case where 500-byte packet is already waiting for transmission in the queue.

$500*8/(10*10^{6})$bit/s=400 micro sec
Destination will receive the packet at t=400+1+801.4=1202.4micro

Exercise 4: (22 points)
The following figure presents a TCP exchange corresponding to an FTP transfer. The nature of each segment (SYN, ACK, END, DATA) is given, the number in brackets is the number of bytes transmitted in the segment. Sequence numbers and acknowledgment are given below. Complete the figure.



Exercise 5: (17 points)

An IP packet, having a size of 2000 bytes, leaves the network 1 where the MTU is 3520 bytes to enter the network 2 where the MTU is 1500 bytes.

a. Give the size of IP datagrams that run on the network 2 after fragmentation. Specify the size of the header and the data. (6 points)

b. Give the value of the fields More Fragment flag (MF) and fragment offset of each fragment. Clarify what these values mean. (8 points)

c. IP datagrams leave the network 2 to enter the network 3 where the MTU is 2500 bytes. What will happen? (Reassembly? Fragmentation? Modification of MF fields and Fragment Offset?)
Justify your answer. (3 points)

Lebanese University

Sciences of Faculty

3 Section

Race: I2208 **Year: 2019-2020**

Exam: Final Duration: 1:30 H

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Exercise 1 (18 points): Answer true or false and correct if false (one line at most). (3 points each)

1. A MAC address is made up of 4 bytes. False 6 bytes
2. In a network, the intermediate elements work on layers 1 to 4 of the OSI model. False 1 to 3
3. Each layer is associated with a single protocol. False 4.

CSMA reduces collisions by a lot; but does not eliminate them completely. True 5. The port address is the address of the service running on a host and used by the transport layer.

6.TCP provides: a connection-oriented service, unreliable transmission and in-sequence delivery.

Exercise 2 (35 points): Two stations S1 and S2 are connected to a switch SW via lines at 8 Mb/s. The propagation delay on each line is 25 microseconds.

The switch SW stores and processes the packet before retransmitting it over the line. It will retransmit on the line 30 microseconds after having finished receiving it.

1. List the different types of delay required to transfer a packet from S1 to S2. (6 points)

Transmission delay
Propagation delay
Processing delay (switch)

2. Calculate the total time required to transmit 8000 bits from S1 to S2 when
   has. A single 8000-bit packet is sent (15 points)
   b. Two 4000-bit packets are sent (14 points). The inter-frame time is neglected.

has. 8000 bits

Total time=transmission delay from S1+prop. Delay from S1 to SW+proceessing delay+transmission delay from SW+prop.delay from SW to S2.

transmission delay=8000bits/(8*106 bits/s)=1ms

Total time=2*1ms+2*25*10-3ms +30*10-3ms =2.08ms

b. Two 4000-bit packets are sent (14 points). The inter-frame time is neglected.

Total time=transmission delay from S1+prop. Delay from S1 to SW+proceessing delay+transmission delay from SW+prop.delay from SW to S2.

Transmission delay=4000/(8*106)=0.5ms

Total transmission time for the first= Total time= transmission delay from S1+prop. Delay from S1 to SW+proceesing delay+transmission delay from SW+prop.delay from SW to S2.=2*trans.delay+2*prop+processing =2*0.5+30*10-3 +2*25*10 -3 =1.08ms

The second packet will follow directly the first one It will start to be transmitted after transmission time 0.5ms

Total time=0.5+1.08=1.58ms

Exercise 3 (17 points): An IP packet containing 3700 bytes of data leaves network 1, whose MTU is worth 4000 bytes, to enter network 2 whose MTU is 1300 bytes.

has. Give the size of the IP datagrams which will circulate on network 2 after fragmentation. Specify the size of the header and the size of the data. (9 points) b. Give the value of the *More Fragment* and *Fragment offset* fields of each fragment.
Specify what these values mean. (8 points)

has. 3700bytes
Initial=3720 (20 bytes header)

The first IP datagram in network 2=1300bytes (1280 bytes data+20 bytes header)
3700-1280=2420bytes

The second IP datagram in network 2=1300bytes (1280 bytes data+20 bytes header)

3700-2*1280=1140
Third= 1140 bytes of data
1160bytes

b. More frag (MF field)=1 for the first and second: it indicates that other fragments will follow. It is 0 for the third.

Offset field:

First fragment, data should be inserted beginning at byte 0

Second 1280/8=160 (the offset value is specified in units of 8 bytes chunks) so in bits the offset is 160*8*8=160*64 bits

data should be inserted beginning at byte 1280

Third(1280+1280)/8=320(2*160)
Offset=2*160*8*8 bits, data should be inserted beginning at byte (1280+1280)

Exercise 4 (30 points): An organization receives the address block 125.238.0.0/8.
The administrator wants to create 512 subnets.

1. Find the required subnet mask. (10 points)
2. Give the number of addresses that can be used for machines in each subnet. (10 points)
3. Find the fist and last usable addresses in subnet 1. (10 points)

Lebanese Univeristy
Faculty of Sciences
Section 3

الجامعة اللبنانية
كلية العلوم
الفرع الثالث

Course : I2208 **Year : 2019-2020**

Duration : 1h:15 **Exam : Session 2**

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Exercise 1 (32 points):

A. What are the differences between:
   a. a repeater and a hub? (2 points)

hub has more interfaces than a repeater

   b. a hub and a switch (give 2 differences) ? (4 points)

hub is works at the physical layer, switch at the LL

(RELATED TO THE TD exercices)

B. At which layer of the OSI model does each of these devices operate: (6 points)
   a. a hub?
   b. an Ethernet switch?
   c. an IP router?

C. How does a recipient know that they have received the last fragment of a fragmented datagram? (4 points)

More fragment field bit, it is in the IP header, when kit is set to 0, it means this is the last fragment

D. MCQ (16 points, 2 points for each)

1. As a network administrator, what is the subnet mask that allows 510 hosts with the IP address 172.30.0.0?

a. 255.255.0.0 b. 255.255.248.0 c. 255.255.252.0 d. 255.255.254.0

explanation

2^9=512

255.255.254.0

.1111111**0**.00000000

2. A _____ normally connects LANs and WANs to the Internet and has a table that is used to make route decisions.

a. Repeater b. bridge c. router d. none of the above

3. Which of the following statements is **correct** about CSMA / CD?
   a. This is a media access method used in FDDI WANs.
   b. A device sends data without checking for media availability because all devices have equal access.
   c. Several devices can transmit successfully simultaneously.
   d. Only one device can transmit successfully at a time.

4. A host can be identified by _____ while a program running on the host can be identified by _____.
   a. A port number ; an IP address
   b. An IP address ; a port number
   c. An IP address ; a host address
   d. An IP address ; a well-known port

5. UDP is called the _____transport protocol.
   a. connectionless, reliable
   b. connection oriented, unreliable
   c. connectionless, unreliable
   d. none of these answers

6. What is the function of a Layer 2 switch?
   a. Transmits data based on logical addressing
   b. Duplicates the electrical signal from each frame to each port
   c. Learns the port assigned to a host by examining the destination MAC address
   d. Determines which interface is used for transmitting a frame according to the destination MAC address

7. LLC (Logical Link Control) is responsible for:
   a. Creation and closure of links
   b. Control of packet traffic
   c. Ording of packets
   d. All of the above

8. MAC (Media Access Contol) is responsible for
   a. Access management to physical media
   b. packet delimitation
   c. checking for errors on packets
   d. All of the above

Exercise 2 (40 points):

The administrator of the "GoBack" company decides to segment the 158.62.0.0/16 network into 5 subnets.

a. How many bits are needed to create these five subnets? (3 points) Specify the corresponding mask. (2 points)

3bits →11100000
Mask 255.255.224.0

b. Give five possible addresses for the five subnets created. (10 points)

11100000
The five subnets addresses are
001→158.62.32.0/19
010→158.62. 64.0/19 (01000000=64 base 10)
011→ 158.62. 96.0/19
100→158.62. 128.0/19
101→158.62. 160.0

c. How many machines can we put per network? why? (5 points)

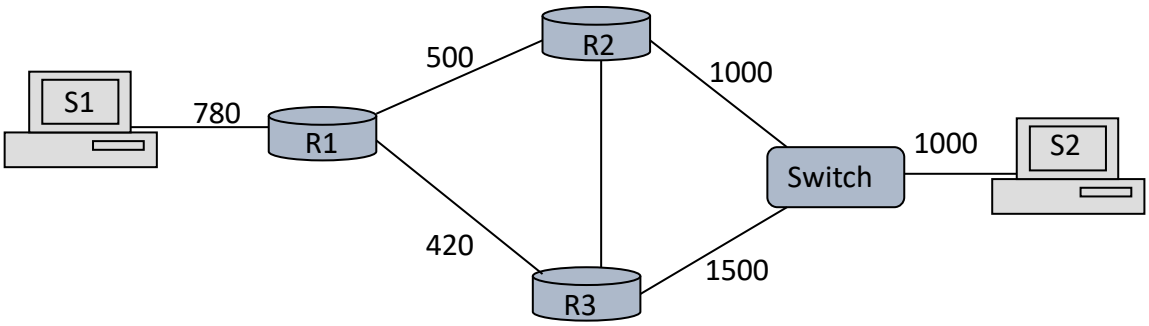
Initially we had 16 bits for hosts,
After subnetting 16-3=13 bits
2^{13}-2=8190 hosts / subnet

d. For each sub-network, give the broadcast address and all the addresses available to address its machines (first and last addresses). (20 points)

In binary, the range is 00100000.00000001 to 00111111.11111110

Subnetwork	Broadcast address	Range of available addresses
158.62.32.0/19	158.62.63.255/19	158.62.32.1 to 158.62.63.254
158.62. 64.0/19	158.62. 95.255/19 Last 2 bytes 01011111.11111111	158.62.64.1/19 to 158.62.95.254/19
?		
?		
?		

Exercise 3 (28 points):
Consider the network below made up of 3 IP routers (R1, R2, R3) and two stations S1 and S2 which must communicate.



Each link between hosts (station or router) is labeled by its MTU (Maximum Transmission Unit). The MTU defines the maximum size of an IP packet that can be carried in the frames of a particular physical network.
It is assumed that S1 must issue 1520 bytes of data to S2.
Describe the fragmentations carried out for the transmission of an IP packet sent by S1 to S2, assuming that router R1 alternately transmits the frames it receives to R2 then to R3. Specify for each packet fragment, the values of the fields (Identification, More Fragment Flag, Offset). Assume that the initial value of the Packet identifier is 71.

LEBANESE UNIVERSITY
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3 Section

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Course: I2208 **Year: 2020-2021**

Duration: 1 hour 30 minutes **Final exam**

All documents are prohibited

Exercise 1 (18 points): Answer true or false and correct if false (one line max).

1. A MAC address is made up of 4 bytes. False 6 bytes
2. In a network, intermediate elements work on layers 1 to 4 of the OSI model. False 1 to 3
3. CSMA significantly reduces collisions, but does not completely eliminate them. TRUE
4. Port address is the address of service running on a host and used by the transport layer. TRUE
5. TCP provides: connection-oriented service, unreliable transmission and delivery in sequence. False/reliable
6. Maximum utilization of a link will occur when TCP can transmit the contents of a window via RTT. TRUE

Exercise 2 (30 points)

1. An IP datagram can be split into several fragments.
   has. What information do we have to know that a packet is a fragment? (5 points)
   Thanks to the MF More fragment flag fragmentation bit which, when set to 1, means that the datagram is a fragment.
   b. How do we reconstruct a datagram on arrival? (5 points)
   We reconstruct the datagram on arrival by reassembling all the fragments in order, using the MF bit, the datagram displacement field (offset) and the message identifier.
   vs. Consider a network with an MTU of 148 bytes. Let an IP packet arrive at this network. This packet will be fragmented into 5 fragments of which 4 fragments are of size 148 bytes and one fragment is of size 64 bytes.
   i. What is the initial package size? (10 points)
   *4 fragments of size 148 bytes and one fragment of size 64 bytes. So 4 fragments containing 128 data bytes and one containing 44 data bytes. The amount of data in the initial packet = 4*128 + 44 = 556 data bytes. Hence the initial packet size = 556 + 20 = 576 bytes.*
   ii. Determine by explaining your method, what will be the value of the offset field of each of the fragments? (10 points)
   The first has no offset ÿ OFFSET FRAG1 = 0
   For the second: 128/8 ÿ OFFSET FRAG2 = 16
   For the third 2x128/8 ÿ OFFSET FRAG3 = 32
   For the fourth 3x128/8 ÿ OFFSET FRAG4 = 48
   For the fifth 4x128/8 ÿ OFFSET FRAG5 = 64

Exercise 3 (17 points)

You are recruited for an administrator position for the company “GoWork”. This company has the IP address 214.123.155.0. The manager has asked you to create 10 separate subnets for the company's 10 departments, based on this IP address.

1. What is the class of this network? (5 points)

214 = 128 + 64 + 16 + 4 + 2 = 11 [010110] ÿ class C

2. What subnet mask should you use? (5 points)

To have 10 different subnets, the network must use 4 additional bits to encode the subnets.

3 bit ÿ 8 subnets < 10

4 bit ÿ 16 subnets > 10

The original mask contained 24 bits (255.255.255.0). It should now contain 28 for each department hence the mask: 255.255.255.240 (240 = 128 + 64 + 32 + 16 = 11110000)

3. How many machine IP addresses can each subnet contain at most? (7 points)

Each subnetwork can contain a maximum of 14 (24 - 2) machines, in fact each subnetwork has 4 bits for the machine address. We must remove two addresses: @ network and @ broadcast.

Exercise 4 (17 points)

We consider a LAN network with a maximum distance of 2 km.

has. Calculate the propagation delay knowing that the propagation speed is 210,000 km/s. (5 points)

b. Calculate the transmission rate for which the transmission delay for 100 byte packets will be equal to the propagation delay calculated in question a? (12 points)

Solution

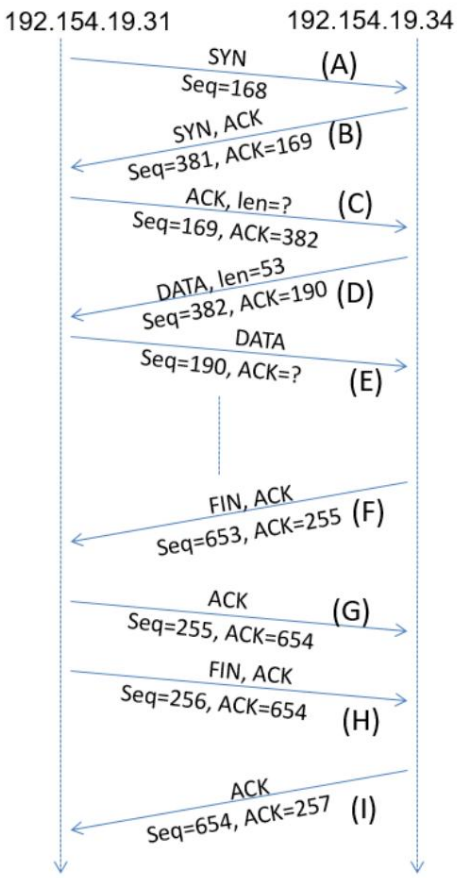
$$\text{Délai de propagation : } d_{prop} = \frac{2 \text{ km}}{210'000 \text{ km/s}} = 9.524 \cdot 10^{-6} \text{ s} = 9.524 \ \mu\text{s}$$

$$\text{Débit } x \text{ nécessaire pour transmettre 100 octets en } d_{prop} = 9.524 \cdot 10^{-6} \text{ s :}$$
$$9.524 \cdot 10^{-6} \text{ s} = \frac{100 \cdot 8 \text{ b}}{x} \Rightarrow x = \frac{800 \text{ b}}{9.524 \cdot 10^{-6} \text{ s}} = 84 \cdot 10^{6} \text{ b/s} = 84\text{Mb/s}$$

Exercise 5 (18 points)

The following diagram represents the exchange of a few TCP segments during a connection from a client to an FTP server followed by a transfer and then closing the connection. The nature of each segment (SYN, ACK, FIN, DATA) is given as well as the sequence numbers and of acquittal. Len indicates the length of data carried in the segment.

has. What are the client and server IP addresses? (4 points)



Client: 192.154.19.31, server: 192.154.19.34

b. What are the segments corresponding to the connection phase? (3 points)

The first three segments A, B and C participate in the connection.

vs. What is the value of "len" of segment (C)? (4 points)

The value of "len" of segment (C) is 190-169 bytes = 21 bytes.

d. What is the Ack value of segment (E)? (4 points)

The acknowledgment in segment (E) is 382 + 53 bytes = 435 bytes.

e. What are the segments corresponding to the connection closing phase? (3 points)

The last 4 segments F, G, H and I participate in the connection.

Course: I2208 **Year: 2020-2021**

Duration: 1 hour 30 minutes **Exam: Session 2**

Exercise 1: MCQ (10 points)

1. Which Layer 1 devices can be used to expand the area covered by a single LAN segment?
   has. Switch
   b. NIC
   vs. Hub
   d. Repeater
   e. RJ45 transceiver
2. Acknowledgments, sequencing, and flow control are features of which OSI layer?
   has. Layer 2
   b. Layer 3
   vs. Layer 4
   d. Layer 7
3. MAC address is also called ______.
   has. Physical address
   b. Logical address
   vs. Source address
   d. Destination address
4. Which of the following protocols is the connectionless protocol?
   has. UDP
   b. TCP
   vs. IP
   d. All the foregoing
5. Which network is suitable for a building?
   has. WAN
   b. LAN
   vs. MAN
   d. All the foregoing

Exercise 2: (20 points)

Q1. You must create 5 subnets of a Class C network, each with at least 16 hosts. What subnet mask would you use?

calsse C ==> Mask of the main network 255.255.255.0
to create subnets with at least 16 hosts (2^4) ==> the Mask Needs 24 bits for network plus 4 bits.
==> The mask is: 11111111.11111111.11111111.11110000 = 255.255.255.240
with the mask is the same for any given subnet

Q2. You have a network that needs 29 subnets while maximizing the number of host addresses available on each subnet. How many bits do you need to borrow from the host field to provide the correct subnet mask?

At least 5 bits, 2^5 = 32 (32 subnets available).

Q3. What is the network NET ID of a host with an IP address of 172.16.66.0/21?

Q4. Giving the class B IP address 172.16.0.0, the address 172.16.0.0/19 provides how many subnets and hosts?

172.16.0.0 is class B ==> the mask of this network is 255.255.0.0 (16 bits for the network part)
But the address 172.16.0.0/19 is 19 bits for the network part ==> the mask
becomes 11111111.11111111.11100000.00000000 (3 bits more) ==> the number of suitable subnetworks is 2^3 = 8.

Exercise 3: (24 points) Calculate the latency (total delay from first bit sent to last bit received) for the following:

A. The sender and receiver are separated by two 1-Gigabit/s links and a single switch. The packet size is 5000 bits and each link introduces a propagation delay of 10 microseconds. Suppose the switch starts forwarding immediately after receiving the last bit of the packet and the queues are empty. (12 points)

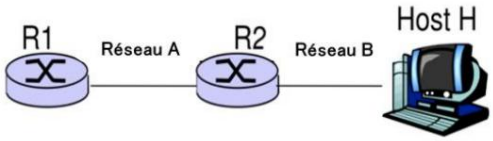
B. Same as (A) with three switches and four links. (12 points)

Exercise 4: (24 points) Consider the following scenario:

Assume an MTU of 1500 bytes for network A and 532 bytes for network B respectively.

Suppose that R1 receives an IP packet *[packet* P] directed to host H and containing a TCP segment of 2000 data bytes .

Assume 20 bytes for the IP header.



describe the M [More Fragment] bit and Offset field for the IP fragments of the *P packet* sent from R1 on network A and for packets sent from R2 on network B. (12 points)

The packet P goes to R1 then to the network A which has an MTU = 1500 Oct. < The packet containing the packet ==>
P will be fragmented into 2 fragments A1 and A2, the containing of A1 is 1500 Oct. (20 bytes for the header and 1480 Oct. for the Data), of More Fregment Flag MF = 1 char

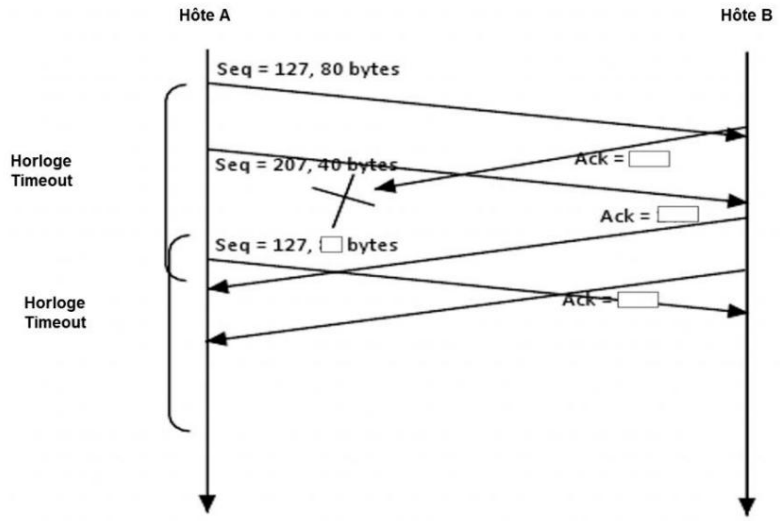
, there are fragment(s) following A1, and offset = 0, With A2 has containing 540 Oct. (20 bytes for the header and 520 Oct. for the Data), More Fregment Flag MF = 0 and offset = 1480/8 = 185.
Then P goes to R2 then to network B which has an MTU = 532 Oct. <containing A1 and A2 ==> A1 will be fragmented into 3 fragments A11 -> , A12 and A13.
A11 (532 Oct. , 20 header and 512 data) (MF = 1 and offset = 0).
-> A12 (532 Oct. , 20 header and 512 data) (MF = 1 and offset = 512/8 = 64).
-> A13 (476 Oct. , 20 header and 456 data) (MF = 0 and offset = 1024/8 = 128).

==> A2 will be fragmented into 2 fragments A21 and A22.
-> A21 (532 Oct. , 20 header and 512 data) (MF = 1 and offset = 0).
-> A22 (28 Oct. , 20 header and 8 data) (MF = 0 and offset = 512/8 = 64).

Exercise 5: (22 points)

Hosts A and B are communicating over a TCP connection and host B has already received all bytes up to byte 126 from A. Suppose that host A then sends two segments (S1 and S2) to host B back-to-back. S1 and S2 contain 80 and 40 bytes of data respectively. In S1, the sequence number is 127, the source port number is 302, and the destination port number is 80. Host B sends an acknowledgment every time it receives a segment from host A.

Complete the missing fields in the figure below by answering the following questions:



has. In the second segment sent from host A to B (S2), what are the sequence number, source port number, and destination port number?

b. If S1 arrives before S2, in the acknowledgment of the first arriving segment, what is the ACK number, the source port number and the destination port number?

vs. If S2 arrives before S1, in the ACK of the first arriving segment, what is the ACK number?

1: General Understanding (18pts)

A. What layer in the IP stack best corresponds to the phrase: 'moves datagrams from the source host to the destination host'

B. What layer in the IP stack best corresponds to the phrase: 'bits live on the wire'

C. What layer in the IP stack best corresponds to the phrase: 'handles the delivery of segments from the application layer, may be reliable or unreliable'

D. What layer in the IP stack best corresponds to the phrase: 'passes frames from one node to another across some medium'

E. What layer in the IP stack best corresponds to the phrase: 'handles messages from a variety of network applications'

F. Which network equipment is most appropriate to connect a multimedia server broadcasting video to 10 screens?

a) Switch b) H...b c) Router d) Modem

G. Which network equipment is most appropriate to connect 10 machines, 1 file server, 1 network printer?

a) Router b) Modem c) S...itch d) Firewall

H. Which network type is appropriate for a company composed of 10 floors in the same building?

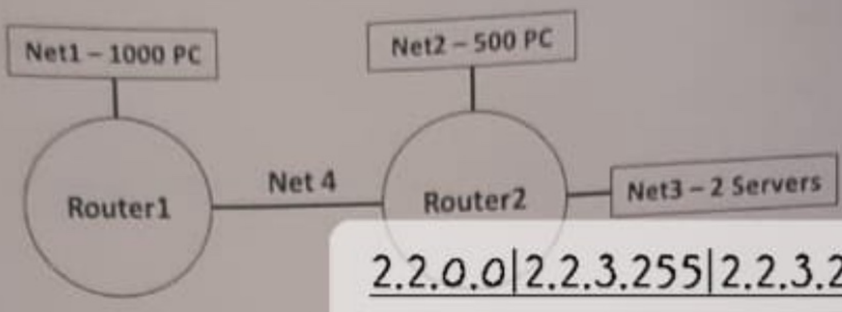
a) LAN b) MAN c) WAN

I. Which network equipment is/are required to set up an enterprise network, composed of 10 floors, all the floors share same IP subnet and connect to the internet from a single point.

a) Switch per floor and 1 central ro...r
b) 1 Router per floor
c) 1 modem per floor
d) 1 Hub per floor and 1 central router

Ex2: IP Addressing (20pts.)

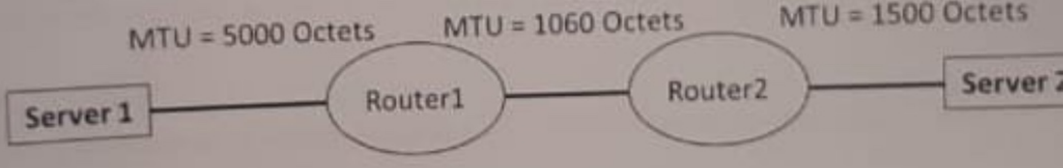
A. Using 2.2.0.0/22, propose addressing plan to the following network. Each Net. should have Number of required addresses, CIDR, network & broadcast addresses, and default gateway



Network	Nb of @ required	CIDR	Network @	Broadcast @	Default gateway
Net 1	1003	/22	2.2.0.0	2.2.3.255	2.2.3.254
Net 2	503	/23	2.2.4.0	2.2.5.255	2.2.5.254
Net 3	5	/29	2.2.6.0	2.2.6.7	2.2.6.6
Net 4	4	/30	2.2.6.8	2.2.6.11	2.2.6.10

Ex3: Fragmentation (21pts.)

A message of 4000 octets (header included) is to be transferred from Server 1 to Server 2. The MTU of each link is provided in the network diagram (see following figure)



A. Provide the fragmentation details for each network node. *(16pts.)*

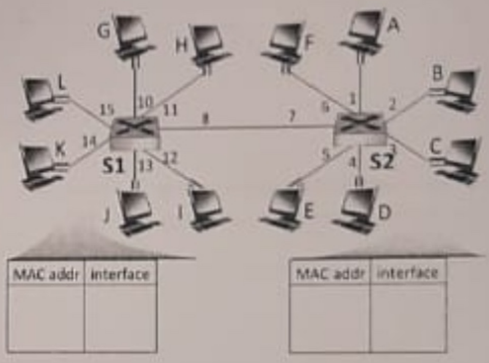
B. Can a router confuse two fragments that have the same following: source, destination, and fragment number? *(5pts.)*

Ex4: Switch (20pts.)

Given the following network,

Assume that the following transmissions occur (the transmissions in reply occur but are not shown in the list below):

t=1: C -> D
t=2: H -> C
t=3: J -> H
t=4: L -> E



Fill out the two switch tables.

S1 Switching table	
MAC address	Interface
D	C
H	H
J	J
L	J

S2 Switching table	
MAC address	Interface
C	C
H	D
J	H
L	L
E	E

Ex5: TCP (21pts.)

A. Given the following Wireshark TCP extraction. *(9pts.)*

```
f0 f6 00 50 23 e1  db 7a d8 ae 24 60 50 11
02 00 88 3a 00 00
```

Please provide:

1. The source port, destination port (in decimal)?
2. The control flags set to 1?

1.port:F0F6 dest:0050
2.control flag:5011

B. The following diagram represents a TCP communication between 2 machines.

1. Provide the IP addresses of the client and the server? *(3pts.)*

client:192.168.0.131
server:192.168.0.34

2. Which segments represent the connection set-up phase? *(3pts.)*

A-B-C

3. How many octets are transferred in the 4th segment? *(3pts.)*

435-382=53

4. Which segments represent the connection closure phase? *(3pts.)*

F-G-H-I