

## COMP 361 Computer Communications Networks

### *Fall Semester 2002*

#### Final Examination

Date: December 16, Time 16:30pm : 19:30pm , venue Room 3007

Name: _____ Student ID: _____ Email: _____
--

#### **Instructions:**

1. This examination paper consists of 7 pages and 7 questions
2. Please write your name, student ID and Email on this page.
3. For each subsequent page, please write your student ID at the top of the page in the space provided.
4. Please answer all the questions within the space provided on the examination paper. You may use the back of the pages for your rough work.
5. Please read each question very carefully and answer the question clearly and to the point. Make sure that your answers are neatly written, readable and legible.
6. Show all the steps you use in deriving your answer, where ever appropriate.
7. For each of the questions assume that the concepts are known to the graders. Concentrate on answering to the point what is asked. Do not define or describe the concepts.

<b>Question</b>	<b>Points</b>	<b>Score</b>
1	10	
2	10	
3	15	
4	10	
5	20	
6	20	
7	15	
<b>TOTAL</b>	100	

1. Answer the following true/false questions by circling either T or F (10 points)

- |  |          |          |
|--|----------|----------|
| (a) ATM cell size is 64 bytes  | T        | <u>F</u> |
| (b) AAL5 uses only 44 bytes of the ATM cell's payload.   | T        | <u>F</u> |
| (c) Spanning tree algorithm is needed to prevent loops in extended LANs obtained by interconnected LANs with bridges.  | <u>T</u> | F        |
| (d) Domain Name Servers don't use caching to improve performance. They perform full name resolution each time they receive a name resolution request.  | T        | <u>F</u> |
| (e) In FDDI network when token is late, the station is forbidden to send both asynchronous and synchronous frames.   | T        | <u>F</u> |
| (f) Maximum segment size MSS at the TCP layer should be related to maximum data link frame size in order to avoid IP fragmentation.  | <u>T</u> | F        |
| (g) The Ethernet network uses CSMA/CD algorithm which is 1-persistent.   | <u>T</u> | F        |
| (h) When collision occurs in the CSMA/CD network, the time needed for the station to learn about the collision is limited by the round trip propagation delay of the cable plus the delay through repeater(s). | <u>T</u> | F        |
| (i) ICMP messages can not be lost by the network.  | T        | <u>F</u> |
| (j) The Link-state routing algorithm, requires small memory space when it is running in both small and large networks.   | T        | <u>F</u> |

2. Answer the following questions : (10 points)

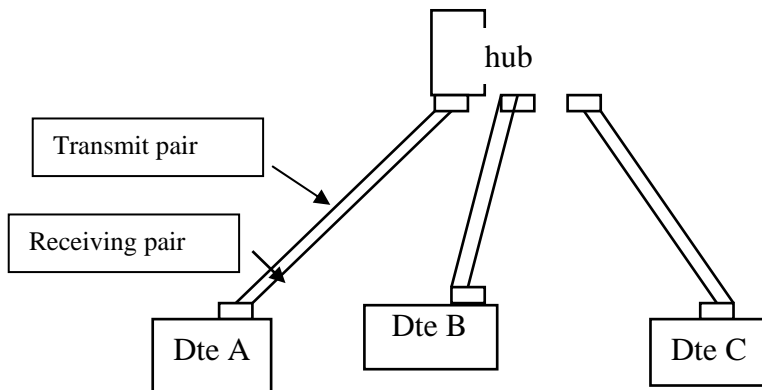
- a) What does a router do with *time to live* value in an IP header if the current hop is not the last routing hop? Does this affect any other field in the IP header? Which? (5 points)

Answer: If the destination does not match any of the local machine's addresses, IP decrements the *time to live* field in the IP datagram header, discarding the datagram if the count reaches zero, or computing a new *checksum* field and routing the datagram if the count remains positive.

- b) Is it possible to address a user's datagram to a router's IP address? Does it make sense to do so? (5 points)

Answer: Since every router has IP address associated with each its network interface it is possible to send the IP datagram to the router, but this however makes no sense since IP router is not running any application software which can use the data from this datagram.

3. In the following CSMA/CD 10 Base T network calculate the worst case time needed by the transmitting station A to learn about the collision caused by the transmission at the station C. Assume that length of each twisted pair is 50m and that one way propagation delay through hub is  $0.1\mu\text{s}$ . Also assume that signal propagation speed in the twisted pair is  $2 \times 10^8 \text{ m/s}$ . (15 points)



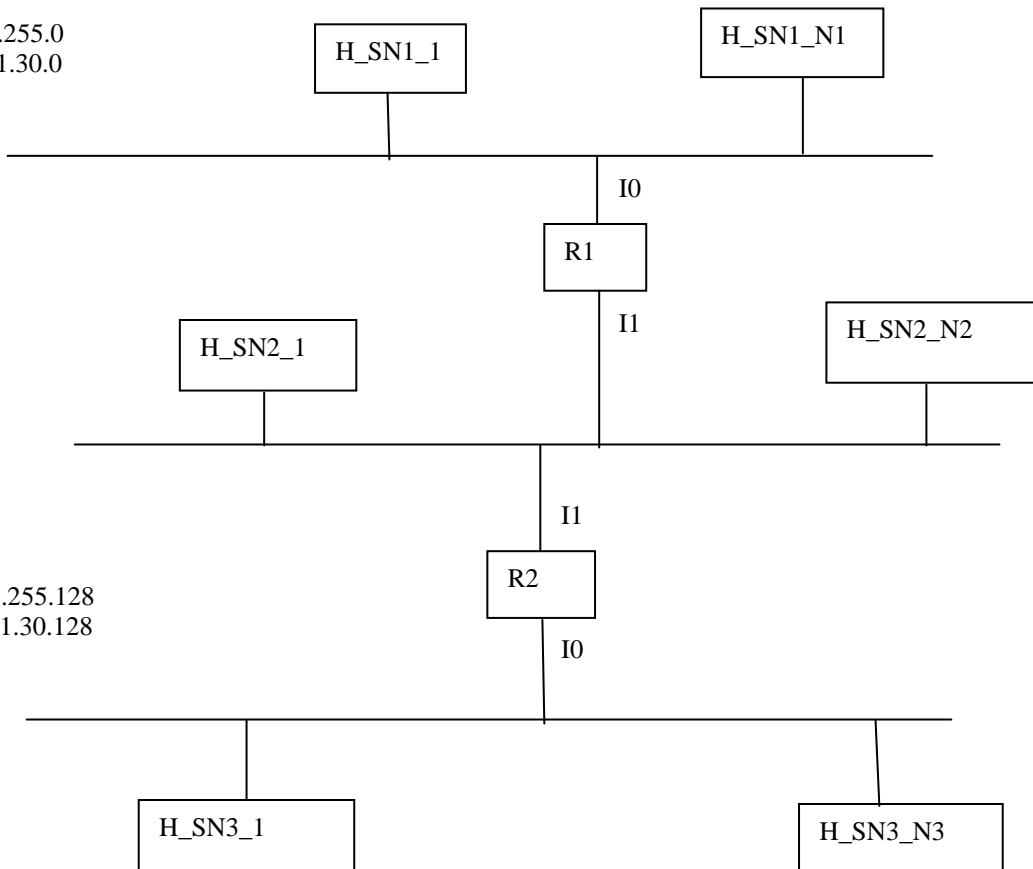
Answer: Worst case time to learn about the collision is  $4 \times 0.25 \mu\text{s} + 2 \times 0.1 \mu\text{s} = 1.2 \mu\text{s}$ .

4. Explain why having each entry in the ARP table timeout after 10-15 minutes is reasonable. Describe the problems that occur if the timeout value is too small or too large. (10 points)

Answer: Too short timeout value will cause frequent ARP broadcast queries. Too long timeout value may be dangerous since some network interfaces may fail and may be replaced while the cache keeps the old data link interface address. Wrong data link address will cause data transmission to the wrong address which will receive no acknowledgement, and will be repeated.

5. Problem for future network administrators: Each site is free to choose subnet masks for its networks. When making assignments, managers attempt to balance sizes of networks, numbers of physical networks, expected growth, and ease of maintenance. Assume that your colleague has tried to exploit most flexibility from the B class network and has given the following subnet number and mask assignment to the following three physical networks. Each subnet  $SN_i$  accommodates host numbers from the full address space allowed by the mask. (20 points)
- a) On which subnet(s) could be the host 147.91.30.195 ? (2 points)
  - b) On which subnet(s) could be the host 147.91.30.130 ? (2 points)
  - c) On which subnet(s) could be the host 147.91.30.50 ? (2 points)
  - d) Show the routing tables at R1 and R2 with entries related to this picture only. (6 points)
  - e) Will your colleague deserve the salary increase with this solution ? How would you describe the problem to your colleague? How would you suggest the proper solution to her/him ? Hint: use the same topology as shown in the figure below but change the address mask structure and limit the number of hosts on each subnet to 64? (8 points)

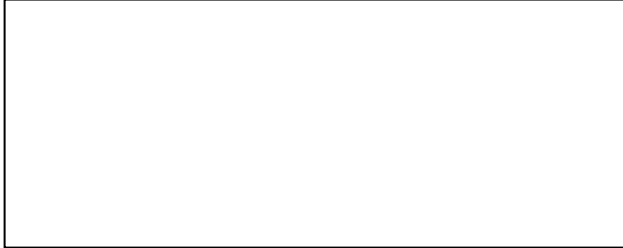
subnet mask 255.255.255.0  
subnet number 147.91.30.0  
SN1



subnet mask 255.255.255.128  
subnet number 147.91.30.128  
SN3

Answer:

- a) Host 147.91.30.195 can reside on all three networks.
- b) Host 147.91.30.130 can reside on subnets SN3 and SN1.
- c) Host 147.91.30.50 can reside on SN1 only.



Routing table at R2

Subnet number	Subnet mask	NextHop
147.91.30.0	255.255.255.0	R1
147.91.30.192	255.255.255.192	I1
147.91.30.128	255.255.255.128	I0

Difficulty arises because nonuniform masks give the most flexibility but make possible assignments that lead to ambiguous routes. For example logical AND operation between the destination address 147.91.30.195 and any of the three subnet masks SN1, SN2 and SN3 will give the appropriate subnet number SN1, SN2 and SN3.

This situation can be resolved by assigning one Subnet mask e.g 255.255.255.192 and network numbers 147.91.30.0, 147.91.30.64, 147.91.30.128, 147.91.30.192 where the number of hosts will be limited by 64 on each network.

6. Suppose that two Ethernet networks are interconnected through ATM network using interconnecting devices shown in the following Fig. a. The interconnecting device ID uses AAL5 in order to encapsulate Ethernet frames. The format of Ethernet frame is shown in Fig. b and format of Adaptation Layer 5 packet (protocol data unit = PDU) is given in Fig c. Assume that TCP application running on host H1 sends two characters CR (carriage return), LF (line feed) to the TCP application running on the host H2 (eg. by using PUSH operation). Calculate the number of ATM cells needed to transfer TCP segment carrying these two characters between H1 and H2. Assume that TCP header size is 20 bytes and IP header size is 20 bytes. Determine the length of padding in the Ethernet frame and the padding length in the AAL5 PDU. (20 points).

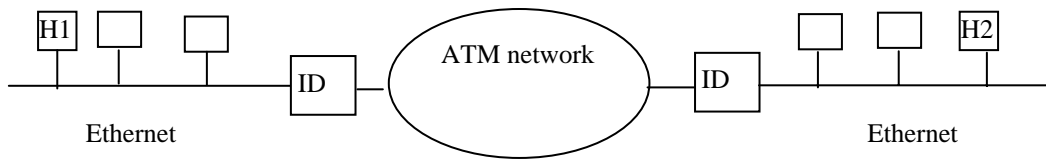


Fig a.

6 bytes    6bytes    2 bytes    46-1500bytes    4 bytes

Dest_addr	SRC_addr	Type	Body	CRC
-----------	----------	------	------	-----

Fig. b

< 64KB    0-47 bytes    2 bytes    2 bytes    4 bytes

DATA	PAD	reserved	Length	CRC-32
------	-----	----------	--------	--------

Fig c

Answer: Minimum size of Ethernet frame is 64 bytes and minimum Ethernet frame body size is 46 bytes. The length of the real payload of the Ethernet frame is 42 bytes. Therefore Ethernet data should be padded with 4 more bytes to fill the minimum body size of 46. Then the size of the DATA field of AAL5 PDU will be 64 bytes. This PDU must be divided into two ATM cell bodies. The length of AAL5 pad is  $96-64-8 = 24$ .

First cell

48 bytes of data
------------------

Second cell

16 bytes of data	24 bytes of PAD	reserved	Length	CRC-32
------------------	-----------------	----------	--------	--------

7. You are hired to design a reliable byte-stream protocol that uses a sliding window (like TCP). This protocol has to run over a 100 Mbps network. The RTT of the network is 100 ms, and the maximum segment lifetime is 60 seconds. How many bits would you include in the AdvertisedWindow and SequenceNum fields in your protocol header? (15 points)

Answer: The Advertised window space should be large enough to allow to keep the pipe full; i.e. it should be  $W/100\text{Mbps} = 100\text{ms}$ .  $W = 1.25\text{MB}$ . Since this is a byte stream protocol advertised window size is expressed in bytes and 21 bit is enough ( $2^{21} = 2,097,152$ ).

The sequence number should not wrap around for the maximum segment lifetime 60sec. Therefore,  $SEQ = 60\text{sec} * 100\text{Mbps}/8 = 7.5 * 10^8 = 750\text{MB}$ . Therefore 30 bits is enough since  $2^{30} = 1073741824$ .