National Institute of Technology Calicut
Department of Computer Science and Engineering
MIDTERM EXAMINATION

Subject Code & Title : CS3006D: Computer Networks
Semester : VI
Max. Marks (Part-A): 12 (of total 30)

Degree : B.Tech.
Date : 26.02.2024
Duration (Part A and Part B) : 2 Hours

Instructions:

1. Note that questions are divided into Part A and Part B.
2. Ensure that you have given two booklets, each dedicated to one specific part. Answer questions from each part only in the corresponding booklet.
3. Ensure that your answers are precise and relevant.
4. There will be no additional sheets provided; manage your space effectively and maintain clear handwriting to accommodate all your answers within the given answer booklet.
5. Clarifications will not be provided during the exam. If necessary, make your assumptions, clearly state them, and provide your answers accordingly.

Part - A

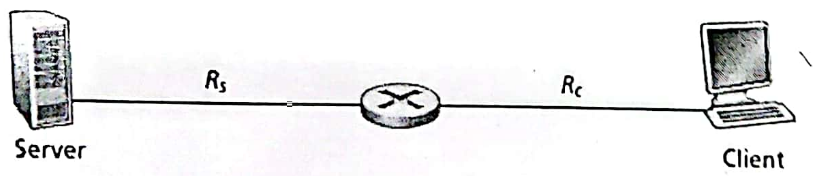
Answer all the Questions

1. Consider users share a 10 $Mbps$ link (i.e., link can transmit 10,000,000 bits per second) and each user requires 200 $Kbps$ while transmitting. Assume that each user transmits only 10% of the time. **[0.5M + 1M + 1M]**
   (a) If circuit switching is used, how many users can be supported?
   (b) If packet switching is used, find the probability that a given user is transmitting.
   (c) Suppose that there are 120 users. Find the probability that at any given time, exactly n users are transmitting simultaneously. (Hint: Use the binomial distribution.)

2. Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates $R1 = 500Kbps$, $R2 = 2Mbps$, and $R3 = 1Mbps$. **[0.5M+0.5M]**
   (a) Assuming no other traffic in the network, what is the throughput for the file transfer?
   (b) Suppose the file is 4 million bytes, roughly how long will it take to transfer the file to Host B?

3. Assume N packets arrive simultaneously to a link at which no packets are currently being transmitted or queued. Each packet is of length L and the link has transmission rate R. What is the average queuing delay for the N packets? **[1M]**

4. Consider the following figure. Assume that we know the bottleneck link along the path from the server to the client is the first link with rate R_s bits/sec. A pair of packets back to back from the server to the client, and there is no other traffic on this path. Each packet of size L bits, and both links have the same propagation delay d_{prop}. **[1M+2M]**



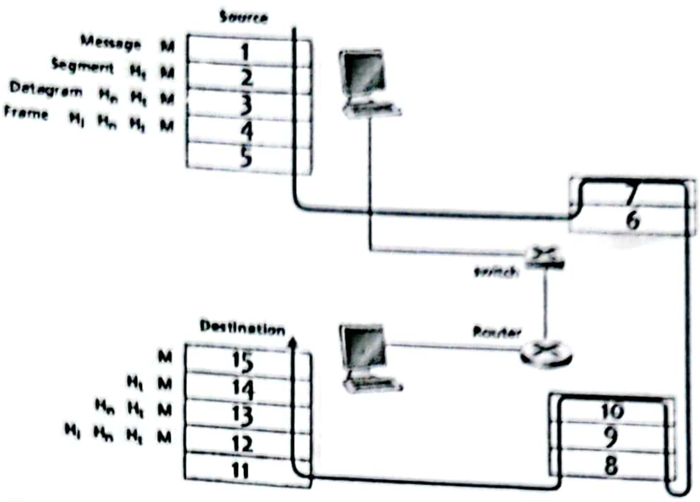
   (a) What is the packet inter-arrival time at the destination? That is, how much time elapses from when the last bit of the first packet arrives until the last bit of the second packet arrives?

(b) Now assume that the second link is the bottleneck link (i.e., $R_c < R_s$). Is it possible that the second packet queues at the input queue of the second link? Explain. Now consider that the server sends the second packet T seconds after sending the first packet. How large must T be to ensure no queuing before the second link? Explain

5. What do encapsulation and de-encapsulation mean? Why are they needed in a layering protocol stack? [1M]

6. Enumerate the different addresses used across the different layers of the TCP/IP model and their significance in data transmission within a network. [1M]

7. In the scenario below, imagine that you are sending an HTTP request to another machine somewhere on the network. [1M+0.5M+1M]



(a) Match the numbers in each box to their respective layers within the Internet protocol stack.

(b) What are the principal responsibilities associated with the layers represented by boxes 2, 3, and 4?

(c) How many times does the packet undergo processing at each layer as it passes through the switch, router, and destination devices? Justify your answer.

*******************ALL THE BEST**********************

Aeshiya

National Institute of Technology Calicut
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MIDTERM EXAMINATION

Subject Code & Title : CS3006D: Computer Networks
Semester : VI
Max. Marks (Part-B): 18 (Total of 30)

Degree : B.Tech.
Date : 26.02.2024
Duration (Part A and B) : 2 Hours

Instructions:

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Part-B

Answer all the Questions

1. Suppose Host A sends the data to Host B and they have agreed to follow Hamming code for error correction. In between A and B, there is an intermediary device (I) that always flips one bit randomly. Now, B receives 00011100101 that includes both the data and redundant bits. Compute both data and redundancy bits and their locations sent by the sender using Hamming Code technique. **[2 Marks]**

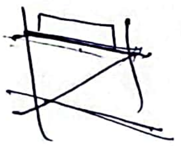
2. In HDLC, 61 stations are configured as unbalanced (also called a master-slave) that follows normal response mode (NRM). Suppose the primary station is ready to receive the data from the secondary station whose ID is 0000010. Give schematic representations for the primary station request and secondary station responses (both positive and negative). The flow (timeline) diagram should include actual bits in the frame. The data bits can be any random 10 bits that should be sent by 2 frames (each frame 5 bits). For frame check sequence, write as CRC. **[3 Marks]**

3. Assume that Host A sends an ACK frame to Host B. This frame is traveling through K (K>>5) intermediate routers, and each routers have two interfaces. How many times a data link layer is visited and IP addresses are modified in the frame throughout the transmission? Exclude the network and data link layer accesses in both Host A and B. **[2 Marks]**

4. Suppose you have to transfer/move 100 GB data from your system that is available in NITC campus to the system that resides in IIT Madras. You have two choices as follows: **[2 Marks]**
   (a) You have a dedicated noise free channel that connects your system to destination. The data transmission rate is 1 Megabytes per second. Neglect other latencies.
   (b) You can write/read your data into disks at the rate of 1 GB per second. You have reliable courier service from NITC to IIT Madras that can deliver your data in 8 hours.

   Which option is faster and by how much?

0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
101



A ACK → B

DR
P
B

5. Mr. ABC proposes a new sliding window protocol where a sender and receiver have an infinite size of sliding window. The sender can send 8 frames without receiving the acknowledgment from the receiver. One frame (1000 bits) takes 1 second to reach the receiver from the sender and vice versa in case of receiving an acknowledgement. However, the receiver sends an acknowledgement for every correct frame. Suppose if receiver receives the frame id (x) then it replies the acknowledgement as the same frame id (x). Also, the receiver buffers (infinite size) the out-of-order frames. However, if it receives the frames (same as sender window size) in order then the frames have to be delivered to the upper layer. It is worth noting that whenever the sender receives one ACK, one place is reserved for the upcoming (new) frame in the sender window. This new sliding window protocol is known by both the sender and receiver before first frame transmission. Retransmission for every frame happens only if the timer expires after 24 seconds. Assume that the data and ACK frame is dropped if the sequence number is even. The starting frame sequence number is 1. Justify your answer with a suitable flow (timeline) diagram.

(a) What is the size of the sender and receiver window size? [1 Mark]

(b) At 20 sec, how many frames are successfully received by the receiver? [1 Mark]

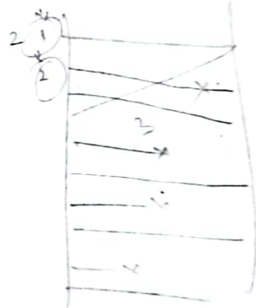
(c) At 24 sec, how many frames are sent by the sender. Also, what are the frames (id) present in the receiver window? [2 Marks]

(d) At 24 sec, what is the expected frame id from the receiver's side according to the proposed protocol? [1 Mark]

6. In Selective Repeat ARQ, let us assume that 50% frame (i.e. 2^{m-2}) is lost while the sender is transmitting the first instance (i.e. before first timeout) to the receiver. Suppose x is the frame sequence number, then time out of x is K+x . The Acknowledgement (NAK/ACK) for the frame x will be received in between the duration of x+1^{th} frame to x+2^{th} frame. The first timeout (i.e. K+x) is strictly greater than the ACK time (if the frame is received by the receiver) of the last frame in the sender window. The acknowledgement frame as well as the retransmission frame is always successful.

(a) What dropping policy will you propose to ensure that all the frames are transmitted in minimum/faster (best case) and maximum/slower (worst case) time? Analyse. [2 Marks]

(b) At what time (in terms of K and m) the receiver receives the first 2^{m-1} frames in-order for both best and worst case. Here, K>>m. Justify your answer with a suitable flow (timeline) diagram. [2 Marks]



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