COMSATS University Islamabad

Department of Computer Science

Mid-Term Examination BS(CS) FALL-2024

Instructors: Dr. Zulfiqar Ali, Dr. Mariam Akbar, Dr. Sheneela Naz, Miss Sara Ali, Miss Ayesha Hussain

Course Title: CSC340 Computer Networks **Maximum Marks:** 50

Dated: 04-11-2024 **Time Allowed:** 80 Min

Name: Abdul Moiz **Reg No.:** SP23-BCS-002.

---------- **CLO-1** ----------

(Summarize the fundamental concepts of computer networks)

Question No 1: (Marks 4+4+7=15)

Part A: In a network with a bandwidth of 20 Mbps and a round-trip time of 200 milliseconds, a 1 MB file is transmitted using TCP. If each acknowledgment requires 1 millisecond and the protocol's window size is 10 KB, what is the approximate throughput? [4] 0.4Mbps

Part B: A 3000-byte packet is sent from your office to a server. It is first sent over an 8 Mbps cable link. Once it has been received completely, it is then sent over a 200 Mbps ISP link. The propagation delay of the cable link is 1ms and the propagation delay of the ISP link is 20ms. How long does it take for the packet to reach the server? [4] 24ms

Part C:

1. Imagine you're sending a letter to a friend across the country. You could choose to: [4]

Option A: Write the letter, seal it in an envelope, and mail it. The envelope travels through the postal system, potentially passing through various sorting centres and delivery trucks before reaching its destination.

Option B: Establish a dedicated phone line between your house and your friend's house, and then talk directly through the line.

Which option is analogous to packet switching and which is analogous to circuit switching? Explain your reasoning, highlighting the key differences between the two network switching methods in terms of resource allocation, data transmission, and efficiency.

2. L = 1200 bytes = 9600 bits
Total data = 40 * 9600 = 384000 bits
Throughput = Total data in window / RTT
= 384000 / 0.2 = 19.2 Mbps.

2. An FTP application transmits data over a link with a bandwidth of 100 Mbps and a round-trip delay of 20 milliseconds. Assuming a packet size of 1,200 bytes and a window size of 40 packets, calculate the throughput. [3]

---CLO-2---

(Apply the concepts of computer networks to solve their related problems)

Question No 2: (Marks 5+5+5+5=20)

Part A:

1. $U_{sender} = \frac{L/R}{RTT + L/R}$ A communication link operates with a data rate of 2 Mbps and a one-way propagation delay of 15 msec. Using the stop-and-wait protocol and assuming acknowledgments have negligible delay, calculate the minimum frame size in bits needed to achieve 70% channel efficiency. [2]

$\Rightarrow 0.7 = \frac{L/2\times10^6}{3\times10^{-3} + L/2\times10^6}$

$\Rightarrow L = 1400$ bits

2. In a satellite communication system where the average source-to-destination distance is 22,000 kilometers with a one-way delay of 330 milliseconds, calculate the data rate needed for the round-trip delay to equal the transmission delay of a 1.5 KB packet? [2]

$T_{delay} = 1.5$ KB

3. Consider a real-time scenario where you're streaming high-definition video content over a long-distance network connection. The video content is transmitted at a rate of 10 Mbps, and it needs to travel over a network link that spans 2,000 kilometers with a propagation speed of 2 x 10^8 meters per second. [1]

$T = \frac{L}{R} = \frac{1.5\times10^3}{R}$

$\Rightarrow 2 * 330 = \frac{1.5\times10^3}{R}$

$\Rightarrow R = 18.69$ Kbps

a. Calculate the Time of Propagation

$T_{prop} = \frac{2000\times10^3}{2\times10^8 \, ms^{-1}} = 10 ms = 0.01 sec.$

b. Explain the Delay Dependencies

Part B: Suppose 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 = 500 kbps, R2 = 2 Mbps, and R3 = 1 Mbps.
a. Assuming no other traffic in the network, what is the throughput for the file transfer?
b. Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B? [5] 64 sec.

$\frac{4 \text{ million}}{500\times1024} = 64 sec$

Part C: Suppose that the two measured SampleRTT values are 106 ms and 120 ms. Compute the EstimatedRTT after each of these SampleRTT values is obtained, using a value of $\alpha = 0.125$ and assuming that the value of EstimatedRTT was 100 ms just before the first of these five samples were obtained. Compute also the DevRTT after each sample is obtained, assuming a value of $\beta = 0.25$ and assuming the value of DevRTT was 5 ms just before the first of these five samples was obtained. Last, compute the TCP TimeoutInterval after each of these samples is obtained. [5]

Part D: Assign IP addresses for your new MAN (Metropolitan Area Network), which consists of 8 different buildings, each building will have 255 workstations. Your administrator tells you to only use as much of the 172.10.0.0 network as you need. Your administrator will assign the IP addresses to the serial interfaces using a different network. You will need to determine the following four items for each of the eight buildings: [5]

(a) Subnet masks
(b) Network addresses
(c) Broadcast address for each subnet

(d) Valid host ranges on each subnet

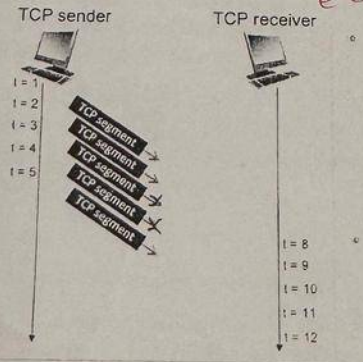
CLO-3

(Analyze various protocols, algorithms, and their functions in a network)

Question No 3: (Marks 6+9=15)

Part A: What will be the output if checksum algorithm is applied on given data: 1110011001100110 and 1101010101010101? [6]

Part B: Consider the figure below in which a TCP sender and receiver communicate over a connection in which the sender->receiver segments may be lost. The TCP sender sends an initial window of 5 segments. Suppose the initial value of the sender->receiver sequence number is 62 and the first 5 segments *each* contain 553 bytes. The delay between the sender and receiver is 7 time units, and so the first segment arrives at the receiver at t=8. As shown in the figure below, 2 of the 5 segment(s) are lost between the segment and receiver. [9]



i. Give the sequence numbers associated with each of the 5 segments sent by the sender. Format your answer as: a,b,c,... [5]

ii. Give the ACK numbers the receiver sends in response to each of the segments. If a segment never arrives use 'x' to denote it. and format your answer as: a,b,c,... [4]

Seq	ack
62	615
615	1168
~~X 1168~~	~~1221 1168~~
X 1221	~~1774~~ ~~1168~~
~~2274~~	1168