CS358 Computer Networks

Indian Institute of Technology, Patna
Mid Semester Assignment
February 23, 2022

Instructions:

Read the questions carefully and answer all of them. For the subjective questions, be very precise in your answers. For the problems show the steps clearly.

1. (a) Why is it said that packet switching employs statistical multiplexing? State why packet swicthing is advantageous over circuit switching for data networks. (2+2=4)

   (b) Consider an application that steadily transmits N-bit units of data at every k time units (k is small) for a very long duration of time. State with proper justification whether a packet switched or a circuit switched network would be suitable for such application. (3)

   (c) Suppose hosts A and B are connected through a router, where both the links (from A and B to router) are of length D meters and have bandwidth R bps. A is sending N packets, each of length L bits, every $\frac{2LN}{R}$ seconds. State the various forms of delay that the packets would encounter. Assuming negligible node processing delays at the hosts and routers, calculate the values of the other delays and the average packet delay encountered in the communication. Assume that the propagation speed of the media is C meters/s. $(2 + 6 = 8)$

2. (a) Consider an idealized model for the steady state dynamics of TCP, where in a period of time the connections window size varies from $\frac{W}{2RTT}$ to $\frac{W}{RTT}$ and only one packet is lost at the very end of the period. For this idealized model show that if a connection has loss rate L, then the average bandwidth is approximately given by $\frac{1.22MSS}{RTT\times\sqrt{L}}$. (4)

   (b) Considering segment sizes to be of 1500 bytes and RTT values of 100ms, to obtain an average throughput of 100Gbps, as per the idealized model what should be the window size W? What would be the allowable loss rate be in such a case? (3+2=5)

   (c) Why is TCP stated to be *RTT unfair*? Explain how does TCP CUBIC mitigates this problem. (3)

   (d) Suppose a TCP client is expecting a segment with sequence number 2001. Assuming all previous segments have been acknowledged by the client, state the reaction of the client after each of the following events that occurs in chronological order. (8)

      i. The client receives the next packet with sequence number 2001 and length 1000 bytes.
      ii. The client receives the subsequent packet with sequence number 3001 after 1000ms
      iii. After 1000ms it receives a packet with sequence number 6001 and length 1500 bytes

iv. After 200ms it receives the next packet with sequence number 5001 and length 1000 bytes

v. After 1000ms it receives the next packet with sequence number 4001 and length 1000 bytes