Assignment # 1
(CS-3001 Computer Networks – Fall-2024)

Due Date and Time: 15th September 2024 (11:59 PM) **Marks: 35**

<u>*Instructions:*</u>

- *Late assignment will not be accepted*
- *Only handwritten attempt will be graded, i.e., printed attempts will not be graded*
- *There will be no credit if the given requirements are changed*
- *Your solution will be evaluated in comparison with the best solution*
- *Whenever a calculation is involved, your solution should show complete steps and a final answer. There will be significant marks for the correct final answer (as far as assignments are concerned).*
- *You must write your roll number, name, and section (Computer Networks Course section) on your submitted attempt.*
- *Submit scan copy of your written assignment on GCR before deadline.*

For the problem below, consider your roll number.

Problem 1: [10 Marks]

Consider a packet of length L which begins at end system A and travels over three links to a destination end system. These three links are connected by two packet switches. Let di, si, and Ri denote the length, propagation speed, and the transmission rate of link i, for i = 1, 2, 3. The packet switch delays each packet by d proc. Assuming no queuing delays, in terms of di, si, Ri, (i = 1,2,3), and L, what is the total end-to-end delay for the packet? Suppose now the packet is 1,500 bytes, the propagation speed on all three links is 2.5 * 10^8 m/s, the transmission rates of all three links are 2 Mbps, the packet switch processing delay is 3 msec, the length of the first link is 5,000 km, the length of the second link is 4,000 km, and the length of the last link is 1,000 km. For these values, what is the end-to-end delay?

In the above problem, replace the packet size of 1500 with the packet size equal to

1200 + (your roll number modulus 25) bytes.

For example, if your roll number is 20i-0125, then the packet size is 1200 + (125 modulus 25) = 1200 bytes.

Problem 2: [10 Marks]

Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justify your answer:

[1] Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why?

[2] Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?

Problem 3: [8 Marks]

Consider a short, 30-meter link, over which a sender can transmit at a rate of 200 bits/sec in both directions. Suppose that packets containing data are 100,000 bits long, and packets containing only control (e.g., ACK or hand-shaking) are 300 bits long. Assume that N parallel connections each get 1/N of the link bandwidth. Now consider the HTTP protocol, and suppose that each downloaded object is 150 Kbits long, and that the initial downloaded object contains 10 referenced objects from the same sender. Would parallel downloads via parallel instances of non-persistent HTTP make sense in this case? Now consider persistent HTTP. Do you expect significant gains over the non-persistent case? Justify and explain your answer.

Problem 4: [7 Marks]

Suppose there is an institutional network connected to the Internet having average object size of 850,000 bits and that the average request rate from the institution's browsers to the origin servers is 12 requests per second. Also suppose that the amount of time it takes from when the router on the Internet side of the access link forwards an HTTP request until it receives the response is three seconds on average.
Model the total average response time as the sum of the average access delay (that is, the delay from Internet router to institution router) and the average Internet delay. For the average access delay, use $\Delta / (1 - \Delta)$, where Δ is the average time required to send an object over the access link and is the arrival rate of objects to the access link.

[1] Find the total average response time.
[2] Now suppose a cache is installed in the institutional LAN. Suppose the miss rate is 0.4. Find the total response time.

BEST OF LUCK!

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