Introduction to Computer Networks

Homework #1: Due September 25 before classes, 2019

Submit a hardcopy in class.

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[1] (a) **(1 point)** List the delay components in the end-to-end delay of sending a packet from a source to a destination host over a packet-switched network over the same route.

(b) **(1 point)** Which of these delays are constant and which are variable over the same route for packets with the same length?

[2]. Suppose Host A wants to send a large packet to Host B over a datagram switching network. The path from Host A to Host B has three links, of rates R1 = 250 kbps, R2 = 2 Mbps, and R3 = 500 kbps. Assume the propagation delays on R1, R2, and R3 are 0.

(a) **(1 point)** Assuming no other traffic in the network, what is the throughput for the file transfer?

(b) **(1 point)** Assuming no other traffic in the network and suppose the packet size is 1000 bytes. Roughly, how long will it take to transfer the packet to Host B, assume the maximum allowed packet size over all links is 1500B?

[3]. Consider two hosts, A and B, connected by a single link of rate R bps. Suppose that the two hosts are separated by *m* meters, and suppose the propagation speed along the link is *s* meters/sec. Host A is to send a packet of size *L* bits to Host B. (d_{prop} = propagation delay, d_{trans} = transmission delay)

(a) **(1 point)** Express the propagation delay, d_{prop}, in terms of m and s.

(b) **(1 point)** Determine the transmission time of the packet, d_{trans}, in terms of L and R.

(c) **(1 point)** Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.

(d) **(1.5 points)** Suppose Host A begins to transmit the packet at time $t = 0$. At time $t = d_{trans}$, where is the last bit of the packet?

(e) **(1.5 points)** Suppose s = 250,000,000 meters/sec, L = 1000 bits, and R = 1 Mbps. Find the distance m so that $d_{prop} = d_{trans}$.

[4]. Which OSI layer is responsible for the following?

(a) **(1 point)** Determining the best path to route packets.

(b) **(1 point)** Providing process-to-process communications with reliable service.

(c) **(1 point)** Providing communications between adjacent nodes with reliable service.

[5]. **(2 points)** Suppose 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?

[6] **(2 points)** Suppose 100 users share a communication link with a bandwidth of 100Mbps, and each user transmits 20% of the time. When a user is active, she/he uses 5Mbps. What's the probability of congestion**.**