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Computer Networks

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Assignment 2

Problem 4 (4 points)**:**
This problem will explore propagation delay and transmission delay. 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. ((a)-(f): 1/2 point, (g): 1 point)

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

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

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

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

(e) Suppose d_{prop} is greater than d_{trans}. At time $t = d_{\text{trans}}$, where is the first bit of the packet?

(f) Suppose d_{prop} is less than d_{trans}. At time $t = d_{\text{trans}}$, where is the first bit of the packet?

(g) Suppose $s = 2.5 \cdot 10^8$, $L = 100$ bits, and $R = 28$ Kbps. Find the distance m so that d_{prop} equals d_{trans}.

Problem 5 (2 points)**:**
In this problem we consider sending voice from host A to host B over a packet-switched network. Host A converts on-the-fly analog voice to a digital 64 Kbps bit stream. Host A then groups the bits into 48-byte packets. There is one link between host A and B. Its transmission rate is 1 Mbps and its propagation delay is 2 msec. As soon as host A gathers a packet, it sends it to host B. As soon as host B receives an entire packet, it converts the packet's bits back to an analog signal. How much time elapses from the time a bit is created (from the original analog signal at A) until a bit is decoded (as part of the analog signal at B)?

Problem 6 (2 points)**:**
Consider the queuing delay in a router buffer (preceding an outbound link). Suppose all packets are L bits, the transmission rate is R bps, and that N packets arrive to the buffer every LN/R seconds. Find the average queuing delay of a packet.

Problem 7 (2 points)**:**
Perform a *traceroute* between a source and destination on two different continents at three different hours of the day. (For example, from a computer here to weide.uni-paderborn.de). Find the average and standard deviation of the delays.