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Homework 1

CST 311, Introduction to Computer Networks, Spring 2020

READ INSTRUCTIONS CAREFULLY BEFORE YOU START THE HOMEWORK.

This homework is due on Sunday, February 9, 2020.

Homework must be submitted electronically through iLearn on https://ilearn.csumb.edu by 11:55 pm on the due date. Late homework will not be accepted.

Homework must in pdf format only. Any other formats will not be accepted. You must submit a single file for the entire homework. The naming convention of the file should be HW1_yourlastname.pdf. **Put your name in the document as well.** Your homework submission should present the problems in the original order and be properly labeled.

This homework is worth 50 points. Each part of a question carries equal weight unless specified otherwise.

Name (2 points) : Adam Ayala

Introduction to Networking

This section contains problem solving questions.

1. (28 points) This elementary problem begins to explore propagation delay and transmission delay, two central concepts in data networking. 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. Express the propagation delay, d_{prop}, in terms of *m* and *s*.

      $d_{prop} = m / s$ sec

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

      $d_{trans} = L / R$ sec

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

      end-to-end delay = $d_{prop} + d_{trans} = m / s + L / R$ sec

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d. 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?

The last bit has just completed it's transmission process and is about to leave the host end point.

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

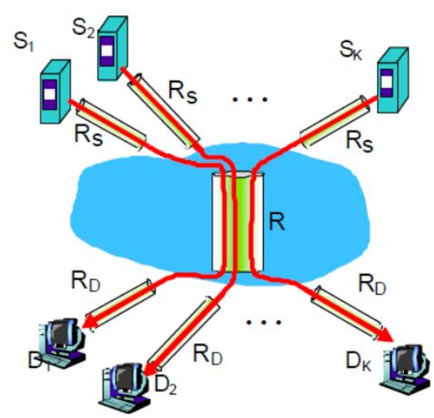
It is somewhere between the host endpoint and the receiver endpoint.

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

The first bit would already be at the receiver endpoint.

g. Suppose $s = 2.5 \times 10^8$, $L = 120$ bits, and $R = 56$ kbps. Find the distance m so that d_{prop} equals d_{trans}.

$d_{prop} = d_{trans}$; $m/s = L/R$; $m = (L \times s)/R$; $m = (120\text{b} \times 2.5 \times 10^8 \text{m/s})/(56 \times 10^3 \text{ b/s}) = 536\text{km}$



2. (20 points) Consider the network scenario in the figure below. K sources are connected to the Internet via links of capacity R_S, and within the network fairly share a common link of capacity R, to K destinations. Each destination is connected to the network by a link of capacity R_D. You can assume that there are no other links or source-destination pairs in the network. Suppose that source S_i has an infinitely large file it wants to send to destination D_i (i.e., each source sends to a different destination).

a. Suppose that $K=10$, $R_S = 100$ Mbps, $R_D= 54$ Mbps, and $R = 50$ Gbps. What is the throughput between each source-destination pair? Where are the bottleneck links?

$R_S = 100 \times 10^6$ $R_D = 54 \times 10^6$ $R = 50 \times 10^9 / 10 = 5 \times 10^9$

The bottleneck link is R_D at 54Mbps therefore it is the throughput.

b. Suppose now that *K=10*, $R_S = 100$ Mbps, $R_D = 1$ Mbps, and $R = 0.75$ Gbps. What are the throughputs between each source-destination pair? Where are the bottleneck links?

$R_S = 100 \times 10^6$ $R_D = 1 \times 10^6$ $R = 0.75 \times 10^9 / 10 = 0.075 \times 10^9 = 75 \times 10^6$

The bottleneck link is R_D at 1Mbps therefore it is the throughput.

c. In the scenario above, suppose we increase the capacity of the destination links to *100* Mbps. Will this increase the throughput between sources and destinations? Explain you answer.

Yes.
$R_S = 100 \times 10^6$ $R_D = 100 \times 10^6$ $R = 0.75 \times 10^9 / 10 = 0.075 \times 10^9 = 75 \times 10^6$

The bottleneck link is R at .75Gbps or 75Mbps per source therefore it is the throughput.

d. Now repeat a. above, but assume that the link connecting S_1 to the network has a capacity of *1* Mbps, and that all other values are unchanged.

$R_S = 1 \times 10^6$ $R_D = 54 \times 10^6$ $R = 50 \times 10^9 / 10 = 5 \times 10^9$

S1-D1 The bottleneck link is R_S at 1Mbps therefore it is the throughput.

Remaining links??

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