CS 3873: Net-Centric Computing

Assignment 1: Network Overview

Student Name: Mahmoud Moustafa Student Number: 3648276 Total: 12

**[Mandatory]** Declaration: “I warrant that this is my own work.”

Signed by Mahmoud Moustafa

[Optional] “I hereby give my permission for this work to be used (with my name and identifying information removed) for UNB Faculty of Computer Science program accreditation purposes.”

Signed by

1. (2 points) What are the five layers in the Internet protocol stack? Which layers does a router process?

   The internet protocol stack consists of five layers: the application, transport, network, link, and physical layers. A router processes the physical, link, and network layers.

---

---

2. (2 points) How long does it take a packet of length 2300 bytes to be sent over a link of distance 2500 km, propagation speed $2.5 \times 10^8$ m/s, and transmission rate 100 Mbps? Consider the total of the propagation delay dprop and the transmission delay dtrans. More generally, how long does it take a packet of length L to be sent over a link of distance d, propagation speed s, and transmission rate R bps?

   $d_{prop}$ = distance in meters / propagation speed in m/s
   $d_{prop} = 2.5 \times 10^6 / 2.5 \times 10^8 = 1/100s = 10ms$

   $d_{trans}$ = packet length in bits / transmission rate in bits
   $d_{trans} = 2300 \times 8 / 100 \times 10^6 = 23/125000\ s = 0.184ms$

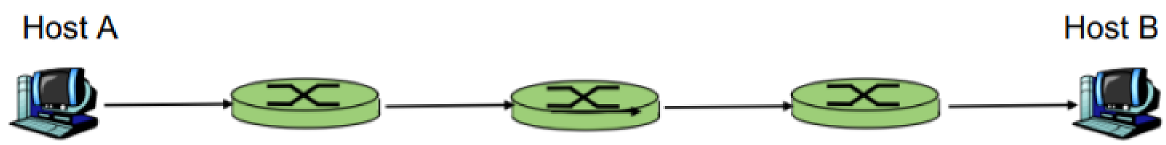
   end-to-end delay (in this case because we have only these 2 types of delays)= $d_{prop} + d_{trans} = 10.184ms$

---

---

3. (3 points) Suppose end system A wants to send a large file to end system B. The path from host A to Host B has three links of rates $R_1$=10 Mbps, $R_2$=25 Mbps, and $R_3$=20 Mbps.
   a. Assuming no further traffic in the network, what is the throughput for the file transfer?
   Due to the bottleneck link, the throughput is 10Mbps = 10000000bps
   b. Suppose the file is 200 MB. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?
   $(200 \times 10^6 \times 8) / (10 \times 10^6) = 160s$
   c. Repeat (a) and (b), but now with R2 reduced to 5 Mbps
   Throughtput = 5Mbps = 5000000bps
   $(200 \times 10^6 \times 8) / (5 \times 10^6) = 320s$

4. (4 points) Assume processing delay and propagation delay are very small and negligible. An end-to-end path in the following figure are only used by a pair of hosts A and B. Suppose the data rate of each link is R = 100 Mbps Suppose A is sending 100 packets to B over this path. Each packet contains 2000 bytes. Calculate the total end-to-end delay (de2e) for sending all the packets from Host A to Host B.



4) $d_{trans} = \frac{2000 \times 8 \times 100}{100 \times 10^6} = \frac{2}{125}\, s = 0.016 s$

$A \to R_1 \to R_2 \to R_3 \to B$ (4 links)

Therefore, $0.016 \times 4 = 0.064 s = 64 ms$

$d_{e2e} = d_{trans}$ [in this case because $d_{prop}$ & $d_{proc}$ are negligible]

$d_{e2e} = 64 ms$

$d_{e2e} = N \times (L/R)$

-2:
d(e2e) = (P-1) x dtrans + N x d(trans)
or
d(e2e) = P x L / R = P x d(trans)
Your final answer is incorrect
Check your steps

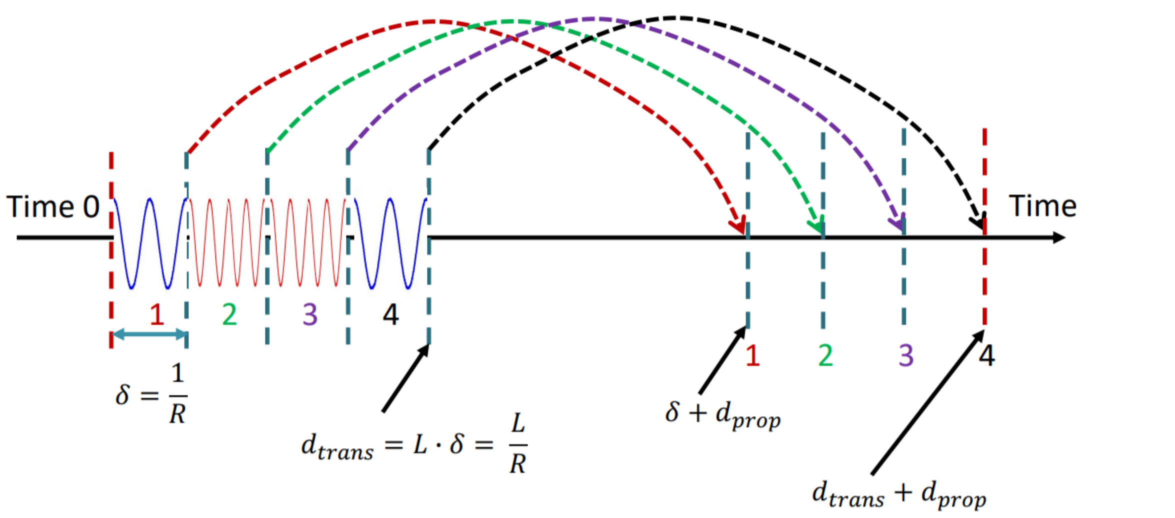
5. (4 points) Consider 2 hosts, A and B, connected by a single link of R bps. Suppose that the two hosts are separated by m meters, and the propagation speed along the link is s meters/sec. Host A is sending a number of packets sequentially to Host B. Each packet contains L bits. Consider only the transmission delay $d_{trans}$ and the propagation delay $d_{prop}$.

$d_{trans}$ = L * number of packets / R

$d_{prop}$ = m / s

a. Suppose host A begins to transmit the first packet at time t = 0. At time t = $d_{trans}$, where is the last bit of the packet: still at host A; over the link between A and B; or at host B?

If host A begins to transmit the first bit of the packet at t = 0, then at t = $d_{trans}$, the last bit of the packet should still be over the link between A and B. Based on the photo below taken from the lecture slides.




b. Suppose that $d_{prop}$ is greater than $d_{trans}$. At time t = $d_{trans}$, where is first bit of the first packet: still at host A; over the link between A and B; or at host B?

Since we are not considering nodal processing and queueing, the first bit would have left host A. Depending on the difference between $d_{prop}$ and $d_{trans}$, the first bit of the first packet would most likely be either at the end of the link or already arrived at host B. Meaning if the difference between them is huge then the first bit of the first packet would be over the link between A and B. But if the difference between them is small, then the first bit of the first packet should have arrived at host B.

c. Suppose s = 2.5 x $10^8$ m/s, m = 500 meters, L = 2 KB, and R = 10 Mbps. When will the first bit of the second packet arrive at Host B? (Hint: Host A only begins to send the second packet after the first packet has been transmitted onto the link.)

$L = 2 \times 10^3 \times 8 = 16000$ bits

m = 500 m

$R = 10 \times 10^6 = 10000000$ bits

$s = 2.5 \times 10^8$ m/s

$d_{trans}$ for 1 bit = 1/R = 1/10000000 = 0.0001ms

$d_{trans}$ for the entire packet = 16000 / 10000000 = 1.6ms

-1:
t = d(trans) + (1/R) + d(prop)
Your final answer is partially correct

$d_{prop} = 500/ (2.5 \times 10^8) = 0.002$ms

The entire first packet would arrive at $d_{trans} + d_{prop} = 1.602$ms

The first bit of the second packet would arrive at (arrival time of first packet + arrival time of the first bit): 1.602 + ($1/R + d_{prop}$): 1.602 + (0.0001+0.002) = 1.6041ms