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HW 1

CS 455

1. What is the propagation time over a link of length 5,000km if the propagation speed is 2*10^8 m/s? (the notation 10^8 means 10 to the 8th power)
   Speed = $2 * 10^8\ m/s = 2 * 10^5\ km/s$
   Propagation time = 5000km / $(2 * 10^5 km/s)$ = 0.025s

2. What is the transmission time for a packet of length 2000 MB on a link with data rate 10Mb/s? Note the conventions: B stands for byte (8 bits); b stands for bit (1 bit); M stands for decimal Mega (10_6)
   2000 MB = 16000 Mb
   Transmission time = 16000 Mb/(10Mb/s) = 1600s

3. Give a formula for the width w of a bit on a link in terms of the data rate R and the propagation speed s.
   W= s/R

4. Give a formula for how many bits of width w will be "in-flight" at the same time on a link of length d?
   D/w bits of width w will be "in-flight" at the same time on a link of length d.

5. What is the delay x bandwidth product for a link of with the propagation time from Problem 1 and throughput from Problem 2?
   Propagation time = 0.025s. Throughput is 10Mb/s.
   X = 2*propagation time * throughput = 0.05*10 = 0.5Mb

6. What is the total delay associated with sending a 2000 B packet on a 1,000km link with a propagation speed of 2*10^8 m/s and a transmission rate of 10Mb/s? (Ignore queueing and processing delays)
   Delay = $D_{transmission} + D_{propagation}$ = 2000*8 bits/(10000000b/s) + 1000Km/(2∗ $10^5\ km/s$) = 16000bits/(10000000b/s)+0.005s = 0.0016s+0.005s = 0.0066s

7. Now suppose instead of a single 1,000km link there are three 500km links connected by store-and-forward routers. Assuming the propagation speed and transmission rate are the same as before. What is the total delay for a 2000 B packet? The picture looks like this (S is the source, D is the destination and R1 and R2 are the two routers.)

   S → R1 → R2 → D
   Delay = 3*($D_{transmission} + D_{propagation)}$ = 3*(2000*8 bits/(10000000b/s) + 5Km/(2∗ $10^5\ km/s$)) = 3*(16000bits/(10000000b/s)+0.0025s) = 3*(0.0016s+0.0025s) = 3*(0.0041s) = 0.0123s

8. Now suppose a second source S2 sends to R1 over a separate link having the same speed as the S → R1 link. The packets from S2 are also destined for D. How will the delay change relative to question 7? Why? What assumption do you have to make to ensure that no packets are lost?

   There would be no affect unless two packets send at the same time. Since the propogation time is less than the transmission time, the later packet would not be affected by previous one.

   To make sure there are no packets loss, one assumption is two packets can't send at the same time. Sending the second packet needs to wait 0.0016 s after the first packet been sent.