

CptS/EE 455 Assignment #1

Instructor: Dingwen Tao

Due: 9/16/2021 at 11:59 pm

Deliverable: Complete the answers to the following questions and *submit to blackboard before the due date*. If you have any questions regarding the assignment, please contact TA Deep Inamdar (deep.inamdar@wsu.edu).

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)
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)
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 .
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 ?
5. What is the delay \times bandwidth product for a link of with the propagation time from Problem 1 and throughput from Problem 2?
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)
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.)
 $S \rightarrow R1 \rightarrow R2 \rightarrow D$
8. Now suppose a second source S2 sends to R1 over a separate link having the same speed as the $S \rightarrow R1$ 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?