

CS 6014 - HOMEWORK 1 QUESTION 1

$$\text{delay} = \underbrace{\text{delay}_{\text{prop}} + \text{delay}_{\text{trans}}}_{0} + \underbrace{\text{delay}_{\text{proc}} + \text{delay}_{\text{que}}}_{0 \text{ in shortest}}$$

500 bytes

$$\text{delay}_{\text{shortest}} = \text{delay}_{\text{prop}} + \text{delay}_{\text{trans}}$$

$$\Rightarrow \text{delay}_{\text{prop}} + \text{delay}_{\text{trans}} = 2.4 \text{ ms}$$

$$\Rightarrow \text{delay} - (\text{delay}_{\text{prop}} + \text{delay}_{\text{trans}}) = \text{delay}_{\text{que}}$$

$$\textcircled{1} 10 \text{ ms} - 2.4 \text{ ms} = 7.6 \text{ ms}$$

$$\textcircled{2} 2.8 \text{ ms} - 2.4 \text{ ms} = 0.4 \text{ ms}$$

$$\textcircled{3} 2.4 \text{ ms} - 2.4 \text{ ms} = 0 \text{ ms}$$

$$\textcircled{4} 4 - 2.4 \text{ ms} = 1.6 \text{ ms}$$

$$\textcircled{5} 5.5 - 2.4 \text{ ms} = 3.1 \text{ ms}$$

$$\text{average: } \frac{7.6 + 0.4 + 0 + 1.6 + 3.1}{5}$$

$$500 \text{ byte delay}_{\text{que}} \text{ avg} = 2.54 \text{ ms}$$

1000 bytes

$$\text{Shortest} = 2.8 \text{ ms}$$

$$\textcircled{1} 11.0 \text{ ms} - 2.8 \text{ ms} = 8.2 \text{ ms}$$

$$\textcircled{2} 10.0 \text{ ms} - 2.8 \text{ ms} = 7.2 \text{ ms}$$

$$\textcircled{3} 2.8 \text{ ms} - 2.8 \text{ ms} = 0 \text{ ms}$$

$$\textcircled{4} 3.0 \text{ ms} - 2.8 \text{ ms} = 0.2 \text{ ms}$$

$$\textcircled{5} 5.5 \text{ ms} - 2.8 \text{ ms} = 2.7 \text{ ms}$$

$$\frac{8.2 + 7.2 + 0 + 0.2 + 2.7}{5}$$

$$1000 \text{ byte delay}_{\text{que}} \text{ avg} = 3.66 \text{ ms}$$

estimate:

$$\textcircled{1} D_1 = D_{p1} + D_{t1} + D_{c1} + D_{q1} \rightarrow 500 \text{ byte} \rightarrow \text{let } D_1 = A_1 + B_1 + C_1 + Q_1$$

$$\textcircled{2} D_2 = D_{p2} + D_{t2} + D_{c2} + D_{q2} \rightarrow 1000 \text{ byte} \rightarrow \text{let } D_2 = A_2 + B_2 + C_2 + Q_2$$

* use D_1, D_2, Q_1, Q_2 avg.

$$A_1 = A_2, C_1 = C_2 = 0, B_1 = \frac{500}{R}, B_2 = \frac{1000}{R} \Rightarrow B_2 = 2B_1 = \frac{1000}{R}$$

$$\textcircled{3} D_1 = A_1 + B_1 + Q_1$$

$$\textcircled{4} D_2 = A_1 + 2B_1 + Q_2$$

$$\textcircled{5} D_2 - D_1 = B_1 + Q_2 - Q_1$$

$$B_1 = D_2 - D_1 - Q_2 + Q_1$$

$$\approx 6.46 - 4.94 - 3.66 + 2.54$$

$$B_1 = 0.4 \rightarrow \text{plug into } \textcircled{3}$$

$$A_1 = D_1 - B_1 - Q_1$$

$$A_1 = 2 \text{ ms}$$

$$B_1 = \frac{500}{R} \rightarrow R = \frac{500}{B_1} = 1250$$

$$\text{Delay propagation @ 600 bytes} = 2 \text{ ms}$$

$$B_3 = \frac{600}{R} = \frac{600}{1250}$$

$$B_3 = 0.48 \text{ ms}$$

$$\text{Delay transmission @ 600 bytes}$$