

Your name:

1. Suppose Fred wants to send a **1MB** file from one satellite to another. Both satellites are above Fred's home world, and are 1000 km apart. The speed of light in a vacuum is $3 * 10^8$ m/s. If he transmits at 64kb/s, approximately how long does it take to make the transfer?

- (a) 8s
- (b) 16s
- (c) 32s
- (d) 64s
- (e) 128s
- (f) 256s
- (g) 512s
- (h) 1024s
- (i) 2048s
- (j) none of those numbers is close

The formula for latency is latency = transmit time + propagation delay. So the answer is:

$$\begin{aligned} \text{transmit time} + \text{propagation delay} &= 1\text{MB}/(64\text{kb/s}) + 1000\text{km}/(3*10^8 \text{ m/s}) \\ &= 2^{20} * 2^3\text{b}/(2^6 * 2^{10}\text{b/s}) + 10^6\text{m}/(3*10^8\text{m/s}) \\ &= 2^7\text{s} + .33 * 10^{-2}\text{s} \end{aligned}$$

This is very nearly 2^7s , so the answer is (e)

2. Suppose Fred has a choice of making the satellites half as far apart or of doubling his transmission speed. Which makes the biggest difference in time needed to make the transfer?

- (a) moving the satellites closer together
- (b) doubling the transmission speed
- (c) neither—they both have the same impact on total time

If we chop the distance in half we save 1.67ms, but if we double the bandwidth, we save 32s, so the answer is (b). I think a number of people said (c) since there's nothing inherent in transmit time or propagation delay that makes one more important than the other. But in this problem transmit time was the larger share of total delay. In the 1Mb/s, 1Gb/s, 3Gb/s example in class, propagation delay was the larger share of the delay.