**P10: Consider a packet of length L, which begins at end system A and travels over three links to a destination end system. These three links are connected by two packet switches. Let d\_i, s\_i, and R\_i denote the length, propagation speed, and transmission rate of link i, for i = 1,2,3. The packet switch delays each packet by d\_proc. Assuming no queuing delays, in terms of d\_i, s\_i, R\_i, (i = 1,2,3), and L, what is the total end-to-end delay for the packet? Suppose now the packet is 1,500 bytes, the propagation speed on all three links is 2.5\*10^8 m/s, the transmission rates of all three links are 2 Mbps, the packet switch processing delay is 3 msec, the length of the first link is 5,000 km, the length of the second link is 4,000 km, and the length of the last link is 1,000km. For these values, what is the end-to-end delay?**

Let’s break the transmission and propagation delays down.

d\_propN = dN/sN

d\_transN = LN/RN

This is the formula to find the end to end delay.

d\_end2end = (d\_prop1 + d\_trans1 + d\_proc1) + (d\_prop2+ d\_trans2 + d\_proc2) + (d\_prop3 + d\_trans3 + d\_proc3)

Let’s plug stuff in. Processing delays were not asked to be written differently.

= ((d1/s1) + (d\_proc1) + (L/R1)) + ((d2/s2) + (d\_proc2) + (L/R2)) + ((d3/s3) + (d\_proc3) + (L/R3))

Now, L = 1,500 bytes, s1/s2/s3 = 2.5\*10^8 m/s, R1/R2/R3 = 2Mbps, d\_proc = 3msec, d1 = 5,000km, d2 = 4,000km, d3 = 1,000km.  
Again, we’re using this formula:

d\_end2end = (d\_prop1 + d\_trans1 + d\_proc1) + (d\_prop2+ d\_trans2 + d\_proc2) + (d\_prop3 + d\_trans3 + d\_proc3)

d\_end2end = (5,000(1,000)m)/2.5\*10^8 + (1,500)bytes/2(1000000 bytes) per second + 3ms + (4,000(1,000)m)/2.5\*10^8 + (1,500)bytes/2(1000000 bytes) per second + 3ms + (1,000(1,000)m)/2.5\*10^8 + (1,500)bytes/2(1000000 bytes) per second + 3ms  
3ms = .003 seconds.  
Highly recommend a calculator here.

d\_end2end = .05125 seconds