Assignment #1 Question #2

CS 3171

Summer 2003

Problem Statement

Consider the frosting-and-conveyor-belt analogy for a sender, a single link, and a receiver, as introduced in class today. Suppose that the sender outputs 3 bits per second, and that the conveyor belt is 4 meters long and moves at 10 cm/sec. Suppose that packets are 40 bits long.

1. What is the propagation delay for this link?
2. What is the transmission delay?
3. How long will it take from the time the first bit of a packet is sent until the last bit arrives at the destination?
4. What is the physical length of a bit on the conveyor belt?
5. Add a 'router' and a second link identical to the first, so that there are two 4-meter conveyor belts in succession. Suppose that there is a processing delay of 8 seconds to begin retransmitting a packet at the router.

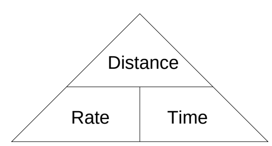
   Calculate how long it would take to transfer a message consisting of 15 packets across the two links.

Answers

rate of transmission is $3\,\mathrm{cm/sec}$

rate of propogation is $10\,\mathrm{cm/sec}$

length of each link is $4 \times 100\,\mathrm{cm/m} = 400\,\mathrm{cm}$



1. Propogation delay

$$\begin{aligned} \mathrm{d_{prop}} &= 4\,\mathrm{m} \times 100\,\mathrm{cm/m} \div 10\,\mathrm{cm/sec} \\ &= 40\,\mathrm{sec} \end{aligned}$$

2. Transmission delay

$$\begin{aligned} \mathrm{d_{trans}} &= 40\,\mathrm{bits/packet} \div 3\,\mathrm{bits/sec} \\ &= \frac{40}{3}\,\mathrm{sec/packet} \end{aligned}$$

3. Time for all bits to travel

$$\begin{aligned} \mathrm{d_{prop}} + \mathrm{d_{trans}} &= 40\,\mathrm{sec} + 40/3\,\mathrm{sec} \\ &= 160/3\,\mathrm{sec} \end{aligned}$$

4. Physical length of a bit

Bits are squeezed out (transmitted) onto a moving belt. The length is propogation speed divided by transmission rate.

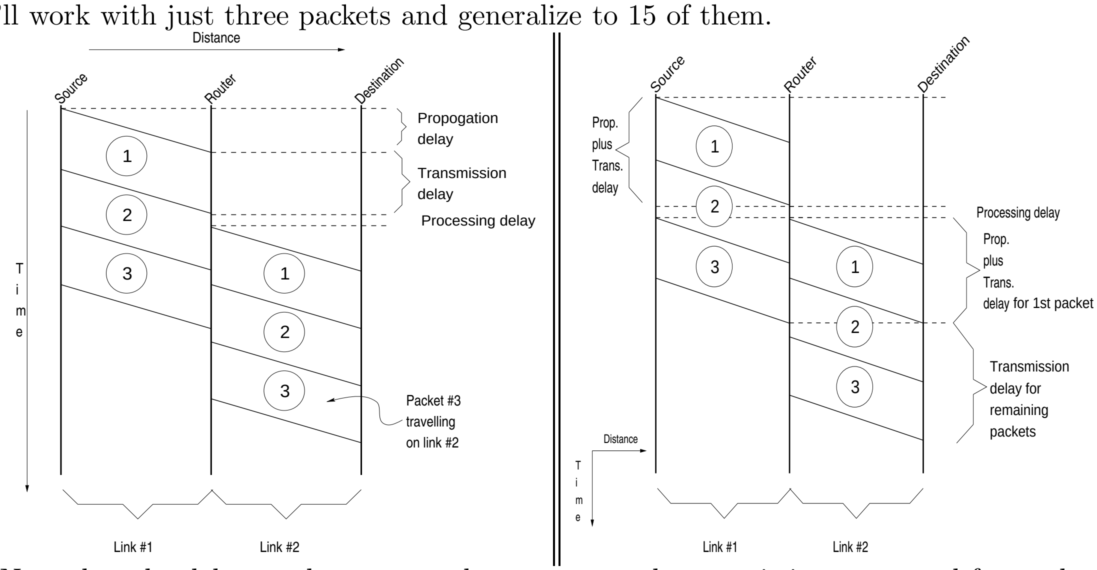
$$10\,\mathrm{cm/sec} \div 3\,\mathrm{bits/sec} \quad = \quad \frac{10}{3}\,\mathrm{cm/bit}$$

5. Two Belts Connected By A Router

The form of the solution is the same as for Problems 5(a) and 5(b) of Chapter 1.

Diagrams

We'll work with just three packets and generalize to 15 of them.



Note that the delay at the router only occurs once because it is a store-and-forward system.

First Packet

First, we need to compute the time required for the first packet: that is the time to travel from source to router, plus the time for delay at router, plus time to travel from router to destination.

$$160/3\,\mathrm{sec} + 8\,\mathrm{sec} + 160/3\,\mathrm{sec} \quad = \quad 344/3\,\mathrm{sec}$$

Subsequent Packets

Then, we need to compute the time required for the subsequent packets.

The other packets arrive every $\mathrm{d_{trans}}$.

So the total time is

$$\begin{aligned} 344/3\,\mathrm{sec} + 14 \times 40/3\,\mathrm{sec} \quad &= \quad 344/3 + 560/3\,\mathrm{sec} \\ &= \quad 904/3\,\mathrm{sec} \\ &= \quad 301\frac{1}{3}\,\mathrm{sec} \end{aligned}$$