

Assignment 1

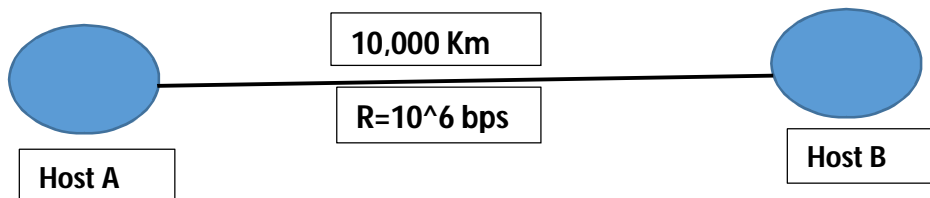
CS5110 – NA-1, Fall 2016

Solution

Suppose two hosts, A and B are separated by 40,000 kilometers and are connected by a direct link of $R = 1$ Mbps. Suppose the propagation speed over the link is 2×10^8 meters/sec. Consider sending a file of 4,000,000 bits from Host A to Host B.

a. Suppose the file is sent continuously as one big message. How long does it take to send the file, assuming it is sent continuously?

ANS:



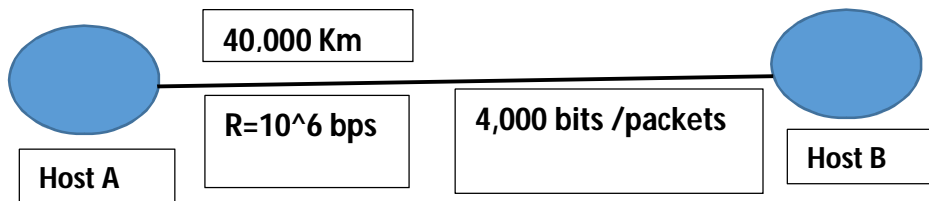
Propagation delay = $\text{Dist} / 2 \times 10^8 \text{ m/s} = 40,000,000 / 200,000,000$
 $= > 40/200 = 0.2 \text{ secs}$

Transmission delay = $L/R = 4,000,000 / 1,000,000 = 4 \text{ secs}$

Total Delay to send 4,000,000 bits file size continuously is $4 + 0.2 = \mathbf{4.20 \text{ sec}}$

b. Suppose now the file is broken up into 1000 packets with each packets containing 4,000 bits. Suppose that each packet is acknowledged by the receiver and the transmission time of an acknowledgement packet is negligible. Finally, assume that the sender cannot send a packet until the preceding one is acknowledged. How long does it take to send the file?

Solution:



Speed of propagation = $2 * 10^8$ m/s

Link (R) = 1,000,000bps

Length of packet = 4,000 bits

Number of packets = 1000

Propagation Delay (sender side) = $\text{Dist} / 2 * 10^8 \text{ m/s} =$
 $40,000,000 / 200,000,000 = > 40 / 200 = 0.2 \text{ secs}$

Propagation Delay (receiver side) = $\text{Dist} / 2 * 10^8 \text{ m/s} =$
 $40,000,000 / 200,000,000 = > 40 / 200 = 0.2 \text{ sec}$

Transmission Delay = $L/R = 4,000 / 1,000,000 = 0.004 \text{ secs}$

Total Delay per packet = $0.2 + 0.2 + 0.004 = 0.404 \text{ secs}$

Total Delay for all 1000 packets = $1000 * 0.404 = \mathbf{404 \text{ secs}}$ or
403.8 sec if you remove the last receiver propagation delay.

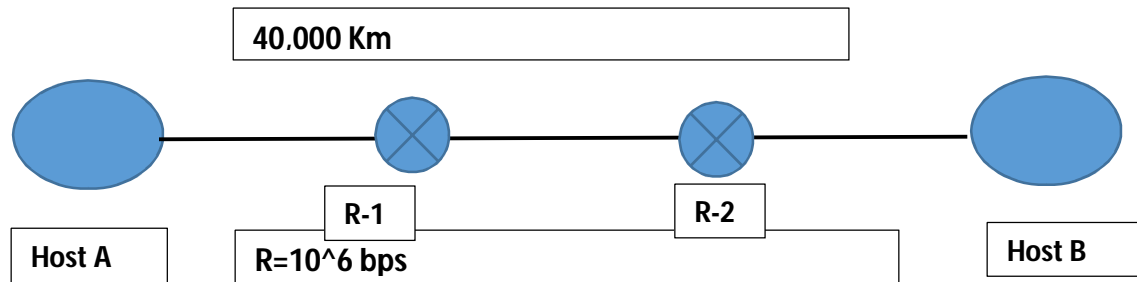
- c. Calculate the bandwidth-delay product, $R * t_{\text{prop}}$. What does it mean? (Provide an interpretation of the bandwidth-delay product.)

Solution:

Bandwidth-delay product = $R * t_{\text{prop}} = 10^6 * 0.2 = \mathbf{200,000 \text{ bits}}$

- d. If there are two routers between Host A and B (rather than a direct link), and all three links have 1 Mbps links, how long does it take to send the file? (use the assumptions in 1.b)

Solution:



Two Routers R-1 and R-2

There are three Links {A->R-1, R1->R-2, R2->B}

Therefore, total Transmission Delay would be $3 * L/R$

Total Time by each packet is propagation delay by sender +
Transmission delay + propagation delay by receiver

Propagation delay by sender = $D/S = \text{Dist} / 2 * 10^8 \text{ m/s} =$
 $40,000,000 / 200,000,000 = > 40/200 = 0.2 \text{ secs}$

Propagation delay by receiver = $D/S = \text{Dist} / 2 * 10^8 \text{ m/s} =$
 $40,000,000 / 200,000,000 = > 40/200 = 0.2 \text{ secs}$

Transmission Delay = $3 * L/R = 3(4,000 / 1,000,000) = 0.012 \text{ secs}$

Total delay per packets = $0.2 + 0.2 + 0.012 = 0.412 \text{ secs}$

Total time taken for 1000 packets from A to B is
 $= 1000 * 0.412 = 412 \text{ secs or } 411.8 \text{ secs if you remove the last receiver propagation delay.}$