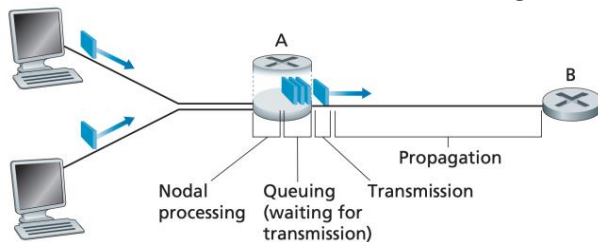


Week 2. Tutorial Problems

P6. This elementary problem begins to explore propagation delay and transmission delay, two central concepts in data networking. Consider two hosts, A and B, connected by a single link of rate R bps. Suppose that the two hosts are separated by m meters, and suppose the propagation speed along the link is s meters/sec. Host A is to send a packet of size L bits to Host B.

- Express the propagation delay, d_{prop} , in terms of m and s .
- Determine the transmission time of the packet, d_{trans} , in terms of L and R .
- Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.
- Suppose Host A begins to transmit the packet at time $t=0$. At time $t=d_{\text{trans}}$, where is the last bit of the packet?
- Suppose d_{prop} is greater than d_{trans} . At time $t=d_{\text{trans}}$, where is the first bit of the packet?
- Suppose d_{prop} is less than d_{trans} . At time $t=d_{\text{trans}}$, where is the first bit of the packet?
- Suppose $s=2.5 \cdot 10^8$, $L=1500$ bytes, and $R=10$ Mbps. Find the distance m so that d_{prop} equals d_{trans} .

P10. Consider the network illustrated in Figure 1.16.



Assume the two hosts on the left of the figure start transmitting packets of 1500 bytes at the same time towards Router B. Suppose the link rates between the hosts and Router A are 4-Mbps and the link rate between router A and router B is 4Mbps. One link has a 6-ms propagation delay and the other has a 2-ms propagation delay. Will queuing delay occur at Router A?

P11. Consider the scenario in Problem P10 again, but now assume the links between the hosts and Router A have different rates R_1 and R_2 in addition to different propagation delays d_1 and d_2 . Also assume the link rate between router A and router B is R . Assume the packet lengths for the two hosts are of L . For what values of the propagation delay will no queuing delay occur at Router A?