Homework 2 (Packet Switching)

Just type your answers in the space provided. Submit your answers (a modified version of this file) as an attachment in the submission box.

Concepts

- Transmission Delay
- Propogation Delay
- Queueing & Processing Delay
- End-to-End Delay
- Bandwidth-Delay Product
- Packet Switching and Message Segmentation

Q1

1. How long does it take a packet of length L=1000 bytes to propagate over a link of distance d=2500 km, where propagation speed is $s=2.5 \times 10^8$ m/s, and transmission rate of R=2 Mbps?

Propagation delay =d/s

2500000/2.5*1000000000 =0.01s

10ms

Transmission delay= L/r

1000000/2000000=0.5

500

500+10=10.5ms

it take the packet 510ms

2. More generally, how long does it take a packet of length L to propagate over a link of distance d with propagation speed s, and transmission rate R bps?

Generally the overal end to end daley is affected by three factors. First the propagation delay and the transmission delay and then the third factor is the Queueing delay. The queueing delay is due to packet buffers in routers. That means if the packet gets to a router and there is congestion with other pakcets, then the router will transmit the packets in a first in first out manner. that means our packet has to wait for its turn as a result there is a delay which is the queueing delay. So our packet will take time thats equal to the sum of the propagation delay, transmission delay and the the sum of the queueing delay.

3. Does this delay depend on **packet length**?

the overal delay is affected by the packet length and this directly affects the transmission delay the biggeer the length the bigger the delay.
the Queueing delay if not affected by the packet length.

4. Does this delay depend on **transmission rate**?
   the transmission rate affect the transmission delay therefore affect the overal end to end delay. the bigger the rate the smaller the delay becomes
   the queueing delay how ever is not affected by these factors

Q2

Suppose two hosts **A** and **B**, are separated by d=20,000 km and are connected by a link R=1Gbps (10^9 bps). Assume that the propagation speed $s=2.5 \times 10^8$ m/s,

1. Calculate the **bandwidth-delay** product, i.e., $R \times$ propagation delay. What is the **unit**?

Propagation delay =d/s =8ms
1Gbps*0.08=0.08Gb =80 000 000 b
unit bits

2. Consider sending a file of L=800,000 bits from **A** to **B**. If the file is sent continuously as one large message, what is the **maximum** number of bits that will be in the link at any given time?

800,000 bits

3. What is the **width (in meters) of a bit** in the link? (If N is the number of bits in the wire with a distance of K meters, then K/N is meters per bit.)

4. Derive a general expression for the **width of a bit** in terms of the propagation speed s, the transmission rate R and the length of the link d.

Q3

In modern packet-switched networks, the source host segments long, application-layer messages (for example, an image or a music file) into smaller packets and sends the packets into the network. The receiver then reassembles the packets back into the original message. We refer to this process as **message segmentation**.

Assume we have a source **A** and a destination **B**, connected via three links and two switches **S1** and **S2**. **A** connects to **S1**, **S1** to **S2**, and **S2** to **B**.

We will consider two case where a message is sent from **A** to **B** with and without **message segmentation**. Consider a message that is $L=7.5 \times 10^6$ bits long that is to be sent from **A** to **B** in the following manner. And suppose each link $R=1.5 \times 10^6$ bps. For the time being, ignore propagation, queuing, and processing delays.

1. Consider sending the message from **A** to **B** without **message segmentation**. How long does it take to move the message from the host **A** to the first packet switch **S1**? Keeping in mind that each switch uses store-and-forward packet switching, what is the total time to move the message from **A** to **B** ?
   Time to send to packet switch1 is $7.5 * 10\mathbf{6}/1.5 * 10\mathbf{6} = 5$ s.
   total delay for three hops is 5 s × 3 hops = 15 s.

2. Now suppose that the message is **segmented** into 5,000 packets, with each packet being 1,500 bits long. How long does it take to move the first packet from **A** to the first switch **S1**?

L/r then 1500/1.5 ∗ 106 = 1 ms for first packet to get to packet switch1

3. When the first packet is being sent from the first switch **S1** to the second switch **S2**, the second packet is being sent from the **A** to the first switch **S1**. At what time will the second packet be fully received at the first switch **S1**?

It takes 2×1 ms = 2 ms for the first packet to get to switch 2
and this is the same time for the second packet to get to the first switch

4. How long does it take to move the file from **A** to **B** when **message segmentation** is used?

first packet take 3ms to reach the destination

total time = 3ms+ (4999×1ms)=5.002s