WEEK-END ASSIGNMENT-01

Computer Networking Workshop (CSE 4541)

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Course Outcome: CO_1 **Program Outcome:** PO_1 **Learning Level:** L_5

Workouts on network performance parameters

1. Consider a 100 Mbps link between an earth station (sender) and a satellite (receiver) at an altitude of 2100 km. The signal propagates at a speed of 3×10^8m/s. Determine the time taken (in milliseconds, rounded off to two decimal places) for the receiver to completely receive a packet of 1000 bytes transmitted by the sender.

2. Hosts A and B are each connected to a switch S via 10-Mbps links as in the below Figure-1. The propagation delay on each link is $20\mu s$. S is a store-and-forward device; it begins retransmitting a received packet $35\mu s$ after it has finished receiving it. Calculate the total time required to transmit $10,000$ bits from A to B.

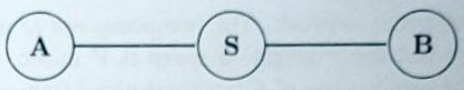

Figure 1: Two node interconnection through a switch

   (a) As a single packet.

   (b) As two 5,000-bit packets sent one right after the other.

3. Assume that an RTT (round trip time) is of 80 ms. An RTT $= 2 \times T_p$, where T_p is the propagation delay. Initially $2 \times$ RTT of "`handshake`" is required to setup the connection before data is sent. The file that would be transmitted is broken into packets of size 1 KB. So, calculate the total time required to transfer a 1.5 MB file in the following cases:

   (a) The bandwidth is 10 Mbps and data packets can be sent continuously.

   (b) The bandwidth is 10 Mbps, but after we finish sending each data packet, we must wait one RTT before sending the next data packet.

   Do a comparative analysis of total time in both the cases to conclude the better approach in sending the file over a network.

4. Consider a closed-loop network (e.g. a token ring network) with bandwidth 100 Mbps and propagation speed of 2×10^8 m/s. What would the circumference of the loop be to exactly contain one 250 byte packet? (**Hint: The bandwidth-delay product defines the number of bits that can fill a link.**)

5. Consider a source computer (S) transmitting a file of size 10^6 bits to a destination computer (D) over a network of two routers (R_1 and R_2) and three links(L_1, L_2,and L_3). L_1 connects S to R_1; L_2 connects R_1 to R_2; and L_3 connects R_2 to D. Let each link of length 100km. assume signals travel over each line at a speed of 10^8 meters per second. Assume that bandwidth of the network is 1 Mbps (i.e. the link bandwidth on each link is 1 Mbps). Let the file broken down into 1000 packets each of size 1000 bits. Find the total sum of transmission and propagation delays in transmitting the file from S to D.

6. An image is 1024×768 pixels with 3 bytes/pixel. Assume the image is uncompressed. How long does it take to transmit it over a 56-kbps modem channel? Over a 1-Mbps cable modem? Over a 10-Mbps Ethernet? Over 100-Mbps Ethernet?

7. A 100 km-long cable runs at the T1 data rate. The propagation speed in the cable is 2/3 the speed of light in vacuum. How many bits fit in the cable? (T1 data rate is 1.544 mbps and speed of light in vacuum 3×10^8 m/sec)

8. Suppose, we need to download a book. The book contains 80 pages, each page is an average 20 lines with 80 characters in each line, each character requires 8 bit. If we want to download the books in 30 sec, what will be the required bit rate.

9. If the data rate of a ring network is 20 Mbps, signal propagation speed is 200 m/s, then the number of bits that can be placed on the channel of 200 km is.

10. A system has an n-layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, an h-byte header is added. What fraction of the network bandwidth is filled with headers?

11. Let us consider a typical two nodes network. The two nodes are D meter distance apart. The date rate of the network is R bps and the propagation speed is V m/sec. Determine the efficiency and throughput of the network for a packet size of P bits transmitted from one node to other node in terms of transmission time and propagation time.

12. Consider a sender has **n** data packets, each of size **L** bits are transmitted to a receiver at a distance **D** meter away. The sender can send one packet at a time and wait for the acknowledgement called ACK packet from the receiver (the size of ACK is very very less than the data packet), then it can send the next packet. The process will continue till to the last frame. Find the efficiency and throughput of this mechanism assuming the working bandwidth of the network is **B** bps, and progation speed is **V** m/s.

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Q1)

Band width = 100 Mbps, distance = 2100km, propagation time is 3×10^8 m/s

Propagation time = $\frac{\text{Distance}}{\text{speed}} = \frac{2100 \times 10^3}{3 \times 10^8} = 0.007$ sec.

Transmission time = $\frac{1000 \times 8}{100 \times 10^6} = 8 \times 10^{-5}$ sec.

Total time taken = $0.007 + 8 \times 10^{-5} = 0.00708$ sec

Thus the total time taken 7.08 msec.

Q2)

a) Transmission delay from A to S = $\frac{10,000 \text{ bits}}{10 \text{ Mbps}} = 1$ ms.

Propagation delay: 2 x 20 ms = 40 ms.

Store & forward delay: = 1 ms. 35 ms

= 1.035 ms.

Total time: 1.035 + 40 ms + 1 ms.

= 2.075 ms. //

(b)

Time = 500 + 20 = 520 ms

At T = 555 ms packet 1 depart for B.

At T = 1075 ms packet 1 arrives B.

At T = 1000 ms packet 2 send to S.

At T = 1020 ms packet 2 reaches to S.

At T = 1575 ms packet 2 reaches B.

Total time = 1575 ms.

(3)

Number of packets in a 1.5 MB file is:

file size / packet size

$= \frac{1.5 \times 1000 \times 1024 \text{ bytes}}{1024 \text{ bytes/packet}} = 1500 \text{ packets}$

1 KB = 8000 bits.

Time taken to transmit one packet = 8000 bits / 10 Mbps = 0.8 ms

Total time to transmit ~~one~~ packet 1.5 MB files:

= 0.8 ms × 1,500 = 1200 ms. => 1.2 second.

(b)

Total time for one packets = 0.8 ms + 80 ms.

= 80.8 ms.

Thus, the total time required to transfer the entire 1.5 is:

total time = 80.8 ms × 1500

= 121 200 ms.

= 121.2 second.

4)

BW = 100 Mbps = 10^8

Propagation speed = 2×10^8 m/s.

Message size = 10^3 bits

BW × Delay = Message size

$$10^5 \times \frac{\pi}{2 \times 10^8} = 10^3$$

$$\pi = \frac{2 \times 10^8}{10^5}$$

circumference = 2×10^3.

5)

Propagation delay for L1 = $\frac{100 \text{ km}}{10^8 \text{ m/s}}$ = 1 ms.

Propagation delay for L2 = 1 ms

Propagation delay for L3 = 1 ms.

Transmission delay on each link = $\frac{1000 \text{ bits}}{1 \text{ Mbps}}$ = 1 ms.

Total Transmission delay = 1000 × 3 ms.

= 3000 ms = 3 second.

Total Propagation delay = 1 ms + 1 ms + 1 ms = 3 ms.

Total delay = 3 ms + 3000 ms = 3003 ms.

= 3.003 second.

6)

Image size = $1024 \times 768 \times 3 \times 8 = 18874368$ bits.

Time taken to transmit over 56 Kbps = $\frac{18874368}{56 \times 10^3} = 337.042$ sec

Time taken to transmit over 1 Mbps = $\frac{18874368}{1 \times 10^6} = 18.874368$ sec

Time taken to transmit over 10 Mbps = $\frac{18874368}{10^7} = 1.8874368$ sec

Time taken to transmit over 100 Mbps = 0.18874368 sec.

7) Speed = $2/3 \times C = 2 \times 10^8$ m/s.

Distance of cable = 10^5 m.

Time = $\frac{10^5}{2 \times 10^8} = 500$ μs.

Data rate = 1.544 Mbps.

For 500 μs $\longrightarrow$ $500 \times 1544000 \times 10^{-6} = 772$ bits.

8)

Book -> 80 pages.

avg. 20 lines with 80 character in each lines.

Total = $80 \times 20 \times 80 \times 80$

= 1024000.

Bit rate = $\frac{1024000}{30}$

= 34133.33 sec

(9)

Ring Network has circumference $C = 2 \times r$

Diameter of this is 200 km.

So, $C = 2 \times 3.14 \times 100000 = 628000$ m.

Time taken $= \frac{\left(\frac{1}{2} \times 628000\right) m}{200 \times 10^6 \text{ m/s}} = 1.57$ ms.

Bits = Bit rate x time taken

$= 20 \times 10^6$ bps $\times 1.57 \times 10^{-3} = 31,400$ bits.

(10)

Total n layers. For each layer header 'h' is added.

Message length = M.

Header length = nh.

$$\text{Fraction} = \frac{nh}{M + nh}$$

(11)

The efficiency can be calculated using as follows:

$$E = \frac{P}{(P + R \times D/V)}$$ and

the throughput can be calculated using

$$T = \frac{P}{P/R + D/V}$$

(12)

$$E = \left(L / (L + 2 * S) \right) * 7$$

Throughput $\Rightarrow$ $T = \left(L / L + 2 * S \right) * B / (2 * D/V + D/V)$

$$= \left(L / (L + 2 * S) \right) * \left(B + V / (S + D) \right)$$

where;

V = propagation

B = Bandwidth.