Sep.10th Homework (Computer Networking)

Zilong Wang 18281218 CS1804 wangzilong@bjtu.edu.cn

R11. Suppose there is exactly one packet switch between a sending host and a receiving host. The transmission rates between the sending host and the switch and between the switch and the receiving host are R1 and R2, respectively. Assuming that the switch uses store-and-forward packet switching, what is the total end-to-end delay to send a packet length L? (Ignore queuing, propagation delay, and processing delay.)

Ans: The end-to-end delay is L/R1+L/R2

R14. Suppose users share a 2 Mbps link. Also suppose each user transmits continuously at 1 Mbps when transmitting, but each user transmits only 20 percent of the time. (See the discussion of statistical multiplexing in Section 1.3.)

a. When circuit switching is used, how many users can be supported?

b. For the remainder of this problem, suppose packet switching is used. Why will there be essentially no queuing delay before the link if two or fewer users transmit at the same time? Why will there be a queuing delay if three users transmit at the same time?

c. Find the probability that a given user is transmitting.

d. Suppose now there are three users. Find the probability that at any given time, all three users are transmitting simultaneously. Find the fraction of time during which the queue grows.

Ans: a. 2

b. When three users are transmitting simultaneously, the maximum bandwidth will be 3Mbps which is more than 2 Mbps, so there will be delay if three users transmit at the same time.

c. P = 20% = 0.2

d. P = 1 – (1- 0.02) ^ 3 = 0.008

R15. Why is it said that packet switching employs statistical multiplexing? Contrast statistical multiplexing with the multiplexing that takes place in TDM.

Ans: In a packet-switched network, the packets from different sources flowing into a link do not follow any fixed pattern, or route. This is why packet switching is said to employ statistical multiplexing. In case of TDM circuit switching, each host gets the same slot in a revolving TDM frame: this is completely predictable.

R17. Consider sending a packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable?

Ans: The delay components are processing delays, transmission delays, propagation delays, and queuing delays. All of these delays are fixed, except for the queuing delays, which are variable.

R18. Suppose Host A wants to send a large file to Host B. The path from Host A to Host

B has three links, of rates R1 = 500 kbps, R2 = 2 Mbps, and R3 = 1 Mbps.
a. Assuming no other traffic in the network, what is the throughput for the file transfer?
b. Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?
c. Repeat (a) and (b), but now with R2 reduced to 100 kbps.
Ans: a. min{R1, R2, R3} = R1 = 500kbps
b. 32 million bits / 500 000 bps = 64 seconds
c. (a) 100kbps (b) 320 seconds

R20. How long does it take a packet of length 1,000 bytes to propagate over a link of distance 2,500 km, propagation speed 2.5 *10^8 m/s, and transmission rate 2 Mbps? More generally, how long does it take a packet of length L to propagate over a link of distance d, propagation speed s, and transmission rate R bps? Does this delay depend on packet length? Does this delay depend on transmission rate?
Ans: time: L/R + d/s = 4ms + 10ms = 14ms No No

R21. Suppose end system A wants to send a large file to end system B. At a very high level, describe how end system A creates packets from the file. When one of these packets arrives to a packet switch, what information in the packet does the switch use to determine the link onto which the packet is forwarded? Why is packet switching in the Internet analogous to driving from one city to another and asking directions along the way?
Ans: the destination address. Each packet maintain an address of the destination. Reaching packet, packet display outgoing link which road to take to forwarded.

P2. Consider an application that transmits data at a steady rate (for example, the sender generates an N-bit unit of data every k time units, where k is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justifying your answer:
a. Would a packet–switched network or a circuit-switched network be more appropriate for this application? Why?
b. Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?
Ans: a. A circuit-switched network would be well suited to the application described, because the application involves long sessions with predictable smooth bandwidth requirements. Since the transmission rate is known and not bursty, bandwidth can be reserved for each application session circuit with no significant waste. In addition, we need not worry greatly about the overhead costs of setting up and tearing down a circuit connection, which are amortized over the lengthy duration of a typical application session.

b. Given such generous link capacities, the network needs no congestion control mechanism. In the worst (most potentially congested) case, all the applications simultaneously transmit over one or more particular network links. However, since each link offers sufficient *bandwidth to handle the sum of all of the applications' data rates, no congestion (very little queuing) will occur.*

P3. Review the car-caravan analogy in Section 1.4. Assume a propagation speed of 100 km/hour.

a. Suppose the caravan travels 200 km, beginning in front of one tollbooth, passing through a second tollbooth, and finishing just after a third tollbooth. What is the end-to-end delay?

b. Repeat (a), now assuming that there are eight cars in the caravan instead of ten.

*Ans: a. Delay time = 200km / 100km/h = 2hrs Time for taken by 3 tollbooths to reach 10 cars= 2*3=6 minutes. So, end-to-end delay = 2hrs + 6min = 2hrs6minutes*

b. 2hrs4minutes48seconds

P5. 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.

a. Express the propagation delay, dprop, in terms of m and s.

b. Determine the transmission time of the packet, dtrans, in terms of L and R.

c. Ignoring processing and queuing delays, obtain an expression for the end-to- end delay.

d. Suppose Host A begins to transmit the packet at time t=0. At time t=dtrans, where is the last bit of the packet?

e. Suppose dprop is greater than dtrans. At time t=dtrans, where is the first bit of the packet?

f. Suppose dprop is less than dtrans. At time t=dtrans, where is the first bit of the packet?

g. Suppose s=2*109, L=1024 bits, and R=256 kbps. Find the distance m so that dprop equals dtrans.

Ans: a. dprop = m/s seconds

b. dtrans = L/R seconds

c. $d_{end\text{-}to\text{-}end}$*=(m/s+L/R) seconds*

d. The bit is just leaving Host A

e. The first bit is in the link and has not reached Host B

f. The first bit has reached Host B

*g. Want m = L/R * s = 8,000 km*

P6. Suppose users share a 1Mbps link. Also suppose each user requires 100kbps when transmitting, but each user transmits only 10 percent of the time. (See the discussion of statistical multiplexing in Section 1.3

a. When circuit switching is used, how many users can be supported?

b. For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting.

c. Suppose there are 40 users. Find the probability that at any given time, exactly n users

are transmitting simultaneously (Hint: Use the binomial distribution)
d. Find the probability that there are 11 or more users transmitting simultaneously.

Ans: a. 1Mbps/100kbps = 10 users

b. 0.1

c. C_{40}^n (0.2)^n(0.8)^{40-n}*

d. 1-\Sigma_0^{10} C_{40}^n (0.2)^n(0.8)^{40-n}*

P7. In this problem we consider sending real-time voice from Host A to Host B over a packet-switched network (VoIP). Host A converts analog voice to a digital 64kbps bit stream on the fly. Host A then groups the bits into 48-byte packets. There is one link between Host A and B; its transmission rate is 1Mbps and its propagation delay is 2msec. As soon as Host A gathers a packet, it sends it to Host B. As soon as Host B receives an entire packet, it converts the packet' s bits to an analog signal. How much time elapses from the time a bit is created (from the original analog signal at Host A) until the bit is decoded (as part of the analog signal at Host B)?

Ans: T=48B/64Kbps+48B/1Mbps+2ms=0.006+0.000384+0.002=8ms+0.384ms= 8.384ms

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P8. Consider the discussion in Section 1.3 of packet switching versus circuit switching in which an example is provided with a 1 Mbps link. Users are generating data at a rate of 100 kbps when busy, but are busy generating data only with probability p = 0.1. Suppose that the 1 Mbps link is replaced by a 1 Gbps link.
a. What is N, the maximum number of users that can be supported simultaneously under circuit switching?
b. Now consider packet switching and a user population of M users. Give a formula (in terms of p, M, N) for the probability that more than N users are sending data.

Ans: a.10000

b. $\sum_{n=N+1}^{M} C_n^M p^n (1-p)^{M-n}$

P9.

L/R+d1/s1+d2/s2

P10.

\frac{\sum_{i=0}^{N-1}\frac{iL}{R}}{N}=\frac{(N-1)L}{2R}

P11.

\frac{\sum_{i=0}^{N-1}\frac{iL}{R}}{N}=\frac{(N-1)L}{2R}

P12.

T=\frac{L}{R_1}+\frac{L}{R_2}+\frac{d_1}{s_1}+\frac{d_2}{s_2}+d_{proc}

T=8ms+8ms+20ms+1ms=37ms

P13.

a.令 x=L/R 'total delay=x/(1-I)=x/(1-ax) b,total delay=L/R+IL/R(1-I)=L/R(1-I)

P14.

a.Delay=

dproc-sorce +dproc1+dproc2+……dprocn-1+L(1/Rsorce+1/R1+1/R2+……1/Rn-1)+d0/s0+d1/s1+……dn-1/sn-1

b. Delay=

dproc-sorce +dproc1+dproc2+……dprocn-1+L(1/Rsorce+1/R1+1/R2+……1/Rn-1)+d0/s0+d1/s1+……dn-1/sn-1+dq-sorce+dq1+dq2+…dqn-1

P15.

7，不会改变

平均 5ms

No

可以看到 trace 的 IP 地址是一致的，但是速度会有微小变化。

P16.

Delay=3.5*1000B/1Mbps=28ms

Delay=(L-x)/R+nL/R

P17.

Min{Rs,Rc,R/M}

P18.

a.2.5*10^8/1Gbps=0.25 m

b.dprop=10000/2.5*10^5=0.04s

R*dprop=40000000 bits

c.min(R*dprop,packet size)=400000bits

P19.

s/R=10000km

R=25bps

P21.

dtrans=40000b/1Mbps=0.32s

dprop=0.04s

t=10*(dtrans+2*dprop)=4s

dtrans+dprop=3.2s+0.04s=3.24s

把一个文件打碎成文件包会花费更多的时间

P22.

*dprop=36k km/2.4*10^5 km/s=36/240s=0.15s*

*R*dprop=1500000 bits*

dprop=0.15s

x/R=60s　x=600000000 bits

P23.

*dprop=10000km/2.5*10^5km/s=0.04s*

*R*drop=40000bits*

40000bits

带宽所能容纳的二进制位数的最大值

*2.5*10^8/10^6=250m 是*

s/R

P24.

*T1=7.5*10^6 bits/1.5Mbps=5s*

*Total=3*T1=15s*

第一个包被全接受需要时间 3ms，在此之后每过 1ms 就有一个包被接受。

*所以 total=3ms+4999*1ms=5002ms=5.02s 因此以包分发的方式以流水线的形式可以大大节省传送时间，提高效率*

1500bits/1.5Mbps=1ms

T=2ms

容易产生错误，丢包，受网络影响较大

P25.

一共 F/S 个包。

*总时间 t=2*L/R+(F/S-1)*L/R=(F/S+1)(40+S)/R=(40F/S+40+F+S)/R*

S=\sqrt{20F}