Homework I

Chapter 1

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Question 1

What advantage does a circuit-switched network have over a packet-switched network?

电路交换的优点：通信时延小，有序传输，无排队冲突，适用范围广，实时性强，控制简单。可在段响应时间内保证定量的端到端带宽传输。

What advantages does TDM have over FDM in a circuit-switched network?

FDM(Frequency-Division Multiplexing, 频分复用) TDM(Time-Division Multiplexing, 时分复用),TDM 能高效地使用网络，冲突性较低，适用于数字信号和模拟信号，构造简单，容错率较低。FDM 只适用于模拟信号，需要硬件设置将信号转换为合适的频率。

Question 2

a

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

两个用户，每一个用户占用 1Mbps 的链接带宽

b

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?

每个用户传输需求为 1Mbps，总带宽为 2Mbps, 因此两人及以下不会产生队列延迟；若有 N 个用户，其不发生队列时延的理想总带宽为 (2N)Mbps>2Mbps, 因此会发生时延。

c

Find the probability that a given user is transmitting. ——0.2(20%)

d

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

$(0.2)^3 = 0.008 = 0.8\%$, 队列增长的时间比率也为 0.008(0.8%)

Question 3

a

Express the propagation delay, dprop in terms of m and s. ——$d_{drop} = m/s(s)$

b

Determine the transmission time of the packet, dtrans, in terms of L and R. ——$d_{tras} = L/R(s)$

c

Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.
$d_{eToe} = d_{drop} + d_{tras} = m/s + L/R(s)$

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?——刚刚离开 A

e

Suppose dprop is greater than dtrans. At time t = dtrans, where is the first bit of the packet?——在链路上，并且尚未达到主机 B

f

Suppose dprop is less than dtrans . At time t = dtrans, where is the first bit of the packet?——已经到达主机 B

g

Suppose $s = 2.5 \times 10^8$ m/s, L = 1500 bytes, and R = 10 Mbps. Find the distance m so that dprop equals dtrans.

$$d_{prop} = d_{tras} \tag{1}$$

$$m/s = L/R \tag{2}$$

$$m = Ls/R = 2.5 * 10^8 * 1500 * 8/10 * 10^6 bps = 3 * 10^5 m \tag{3}$$

Question 4

a

What is the packet inter-arrival time at the destination? That is, how much time elapses from when the last bit of the first packet arrives until the last bit of the second packet arrives?——L/R_s

b

Is it possible that the second packet queues at the input queue of the second link? Explain. Now suppose that the server sends the second packet T seconds after sending the first packet. How large must T be to ensure no queuing before the second link? Explain.

可能，第二个分组在第一个分组未完全输入到第二条链路前到达，P1 的时间为 $T_1 = L/R_s + L/R_s + d_{prop}$ 第二个分组到达路由器的时间为 $T_2 = 2L/R_s + d_{prop}$

使拥挤的情况不发生，即 $T_2 + T > T_1 \rightarrow L/R_s + T > L/R_c \rightarrow T > L/R_c - L/R_s$ $R1 := \Pi_{maker}, model(Product \bowtie PC)$