컴퓨터 네트워크 과제 1

과목명 컴퓨터네트워크

담당교수 정대인교수님

제출일 20210915

전공 컴퓨터전자시스템

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이름 이준용

한국외국어대학교

HANKUK UNIVERSITY OF FOREIGN STUDIES

P8.

Suppose users share a 3 Mbps link. Also suppose each user requires 150 kbps when transmitting, but each user transmits only 10 percent of the time. (See the discussion of packet switching versus circuit switching in Section 1.3.)

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

$$\frac{3Mbps}{150kbps} = \frac{3000kbps}{150kbps} = 20$$

b. For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting. 각각의 유저는 시간의 10%만 활성화되는것은 0.1의 확률 공간으로 변환된다.

$$P = 0.05 \times 0.1 = 0.005$$

c. Suppose there are 120 users. Find the probability that at any given time, exactly n users are transmitting simultaneously. (Hint: Use the binomial distribution.)

$$P(\text{동시에 } n\text{명의 유저들의 전송}) = 1 - \sum_{i=0}^{n} {}_{120}C_i \left(\tfrac{1}{10}\right)^i \left(\tfrac{9}{10}\right)^{120-i}$$

d. Find the probability that there are 21 or more users transmitting simultaneously.

$$21 \le n \le 120$$

$$P(\text{21명 이상의 유저들이 동시에 전송}) = \sum_{n=21}^{120} \left(1 - \sum_{i=0}^{n} {}_{120}C_i \left(\tfrac{1}{10}\right)^i \left(\tfrac{9}{10}\right)^{120-i}\right)$$

P13.

a. Suppose N packets arrive simultaneously to a link at which no packets are currently being transmitted or queued. Each packet is of length L and the link has transmission rate R. What is the average queuing delay for the N packets?

전체 대기열 지연은 하나의 패킷을 전송하는데 소모되는 시간에 패킷 수를 곱한 값이다.

$$t_{queue} = \frac{L}{R} \times N$$

b. Now suppose that N such packets arrive to the link every LN/R seconds. What is the average queuing delay of a packet? N개의 패킷은 $\frac{L}{R}\times R$ seconds 도착한다.

첫번째 패킷 전송은 $\frac{L}{R}$(sec), N번째 패킷은 $(N-1)\times\frac{L}{R}$이 걸린다.

그러므로 평균 지연 시간은

$$t_{avg} = \frac{L}{R} + \frac{L}{R}\times 2 + \frac{L}{R}\times 3 + \cdots + \frac{L}{R}(N-1) = \frac{\frac{1+N-1}{2}\times N\times\frac{L}{R}}{N} = \frac{L}{R}\times\frac{N}{2}$$

P14. Consider the queuing delay in a router buffer. Let I denote traffic intensity; that is I=La/R. Suppose that the queuing delay takes the from IL/R(1−I) for I<1.

a. Provide a formula for the total delay, that is, the queuing delay plus the transmission delay. total delay를 구하라. 거리를 d라고 할 때,

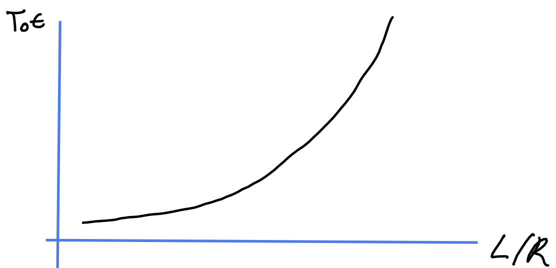
$$t_{tot} = t_{queue} + t_{trans} = \frac{IL}{R(1-I)} + \frac{d}{a}$$

$$\frac{L}{R}\frac{I}{1-I} + \frac{L}{R}$$

$$\frac{L}{R}\left(\frac{I}{1-I} + \frac{1-I}{1-I}\right)$$

$$\frac{L}{R}\left(\frac{1}{1-I}\right)$$

b. Plot the total delay as a function of L/R.



$$D^T(x) = \frac{x}{1-ax}$$

$$x = \frac{1}{R} \Rightarrow \frac{1}{a} \quad a \Rightarrow \frac{1}{x}$$

P15. Let a denote the rate of packets arriving at a link in packets/sec, and let μ denote the link's transmission rate in packets/sec. Based on the formula for the total delay (i.e., the queuing delay plus the transmission delay) derived in the previous problem, derive a formula for the total delay in terms of a and μ.

a는 패킷의 도착률이고, μ는 총시간을 나타내는 전송률이므로 전송속도 (서비스율)

위의 total delay (queuing delay + transmission delay) 공식에 입각하여

$$\mu = \frac{1}{\frac{L}{R}} = \frac{R}{L}$$

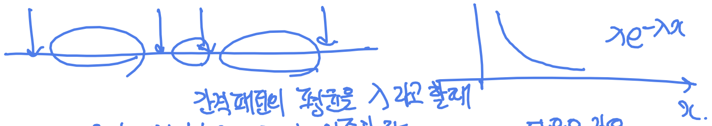
$$\frac{1}{도착률} + \frac{1}{전송률} \Rightarrow t_{tot} = \frac{1}{a} + \frac{1}{\mu}$$

$$D^T = \frac{x}{1-ax} \quad x = \frac{L}{R} = \frac{\frac{1}{\mu}}{1-\frac{a}{\mu}} = \frac{1}{\mu-a}$$

M/M/1 queue mark of property 과거와 상관없이 현재에만 의존한다.

도착 서비스

버스를 기다릴때



간격패턴의 평균을 λ라고 할때
다음의 도착시간도 λ에 의존한다.

다음은 같은 확률분포를 갖는다.

$$P(t,k) = \frac{(\lambda t)^k}{k!} e^{-\lambda t}$$ poisson distribution.

P16. Consider a router buffer preceding an outbound link. In this problem, you will use Little's formula, a famous formula from queuing theory.

Let N denote the average number of packets in the buffer plus the packet being transmitted.

Let a denote the rate of packets arriving at the link.

Let d denote the average total delay (i.e., the queuing delay plus the transmission delay) experienced by a packet.

Little's formula is N=a·d. Suppose that on average, the buffer contains 10 packets, and the average packet queuing delay is 10 msec. The link's transmission rate is 100 packets/sec. Using Little's formula, what is the average packet arrival rate, assuming there is no packet loss?

Little's formula $N = a \cdot d$, 여기서 a는 링크에 패킷 도착률이므로

$$a = \frac{N}{d}$$

d는 평균 전체 지연율 이므로 평균 queuing 지연 + 평균 transmission 지연 이므로

$$d = 10\,msec + \frac{10\ \cancel{packets}}{100\ \cancel{packets}/sec} = 10\,msec + 10\,sec = 10msec + 100msec$$

100 msec

$$d = 110\,msec$$

그러므로 정답은 $a = \frac{N}{d} = \frac{10}{110} = 90$ packets/sec