Assigment 1

February 5, 2016

1

1. 2 Mbps / 200 Kbps = 10 users
2. $\binom{50}{5}0.01^5 0.99^{45}$
3. $1 - \binom{50}{n}\sum_{n=0}^{20} 0.01^n 0.99^{50-n}$

2

1. $R \times d_{drop} = 110^6(500010^3/2.710^8) = 1.8510^4 bits$
2. As $1.85\times10^4 bits < 50000$, then the maximum number of bits is :$1.85\times10^4 bits.$ or $d_{prop}/(d_{trans}(1bit))$: $1.85 * 10^-2/10^-6 = 1.85 * 10^4$
3. $\frac{linkLength}{[d_{prop}/d_{trans}(1bit)]} = 5 * 10^6/(1.85 * 10^4) = 270m$
4. $\frac{linkLength}{[d_{prop}/d_{trans}(1bit)]} = \frac{(m/1)}{[\frac{(m/s)}{1/R}]} = s/R$

3

- $P_0 = (1 - P)^N$
- $P_m = \binom{N}{m}p^m(1 - p)^{N-m}$
- $P_{tr} = \sum_{n=0}^{m} \binom{N}{n}p^n(1 - p)^{N-n}$
- $P_k = (1 - P_{tr})^{k-1}P_{tr}$
- Let random variable T represent the number of times that A has to send the file to get it accepted at B. We have, $E[T] = \sum_{k=1}^{\infty} kP_k = \sum_{k=1}^{\infty} k(1 - P_{tr})^{k-1}P_{tr} = \frac{1}{P_{tr}}$.

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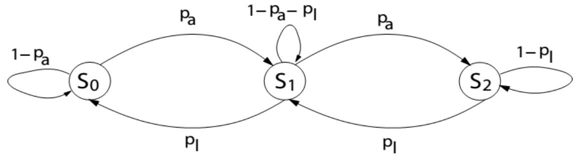
Figure 1: part 1



- We are in state S_0 at time $k = 1$, when there is no arrival in the first transition step, and it follows that: $P_0^{(1)} = 1 - P_a$
- We are in state S_1 at time $k = 1$, when there is an arrival in the first transition step, and it follows that: $P_1^{(1)} = P_a$
- We can not reach state S_2 from S_0 in 1 transition step, and it follows that: $P_2^{(1)} = 0$
- We have:

$$
\begin{aligned}
P_0^{(1)} &= (1 - P_a)P_0 + P_l P_1 \\
P_1^{(1)} &= P_a P_0 + (1 - P_a - P_l)P_1 + P_l P_2 \\
P_2^{(1)} &= P_a P_1 + (1 - P_l)P_2
\end{aligned}
$$

- We have to solve the system of equation:

$$
\begin{aligned}
P_0^{(1)} &= (1 - P_a)P_0 + P_l P_1 \\
P_1^{(1)} &= P_a P_0 + (1 - P_a - P_l)P_1 + P_l P_2 \\
P_2^{(1)} &= P_a P_1 + (1 - P_l)P_2
\end{aligned}
$$

  Under the condition that:

$$P_0 + P_l + P_2 = 1$$

  Using the equation

$$P_0 = (1 - P_a)P_0 + P_l P_1$$

  We obtain that:

$$P_1 = \frac{P_a}{P_l} P_0 = \rho P_0$$

  For $\rho = \frac{P_a}{P_l}$ Using this result in the equation

$$P_1 = P_a P_0 + (1 - P_a - P_l)P_1 + P_l P_2$$

  we obtain that

$$P_2 = \rho^2 P_0$$

  Finally, using the condition that

$$P_0 = (1 - P_a)P_0 + P_l P_1$$

  We get that

$$P_0 = \frac{1}{1 + \rho + \rho^2} = \frac{1 - \rho}{1 - \rho^3}$$

- Using results of (f), the steady state probabilities are:

$$
\begin{aligned}
P_0 &= \frac{1}{1 + \rho + \rho^2} = \frac{1 - \rho}{1 - \rho^3} \\
P_1 &= \rho \frac{1}{1 + \rho + \rho^2} = \frac{1 - \rho}{1 - \rho^3} \\
P_1 &= \rho^2 \frac{1}{1 + \rho + \rho^2} = \frac{1 - \rho}{1 - \rho^3}
\end{aligned}
$$

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- processing delay, transmission delay, propagation delay and queuing delay. All of these delays are fixed, except for the queuing delays, which are variable according to the pressure of the packets on link.

- (1)$64kbps/8 = 8kframe/s$

  (2)$192 \times 10^6/8 = 24 \times 10^6 frame/s$

  (3)$24 \times 10^{/}(8 \times 10^3) = 3000$

  (4) processing delay. Or time used to switch packages.