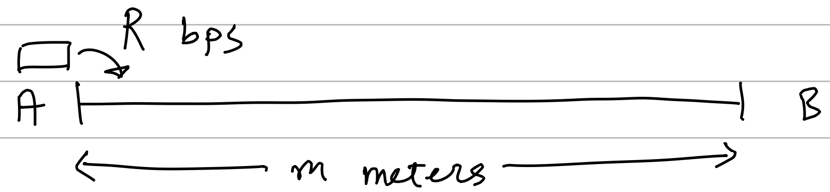
Theory Assignment 2

SWARNARUP
B21140

(1)



Propagation speed along Link s meters / sec.

L bits →

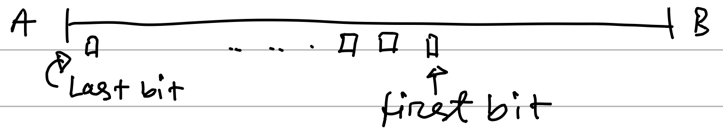
(a) Propagation delay $d_{prop} = m/s$ sec.

(b) Transmission time $d_{trans} = L/R$ sec.

(c) End to end delays $= m/s + L/R$ sec

(d) at $t = d_{trans}$ Last bit of the packet is at A starting to be on the Link for transmission.

(e) if $d_{prop} > d_{trans}$ at $t = d_{trans}$ the first bit of the packet is somewhere on the Link travelling from A to B but not yet reached B.



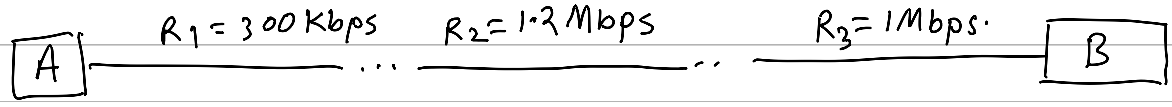
(f) if $d_{prop} < d_{trans}$, at $t = d_{trans}$ the first bit has already reached Host B.

(g) if $d_{prop} = d_{trans} \Rightarrow \frac{m}{s} = \frac{L}{R}$

distance $m = \frac{L}{R} \times s = \frac{100}{56 \times 1024} \times 3 \times 10^8$ meters

$= 523158$ meters

(2)



(a) throughput = min { transmission speeds }
= 300 Kbps

(b) file size $L = 4 \times 8 \times 10^6$ bits

Time taken to transfer file to B is

$$\frac{L}{\text{Throughput}} = \frac{4 \times 8 \times 10^6}{300 \times 1024} = 104 \text{ sec.}$$

(c) throughput = 250 Kbps

time taken to transfer file to Host B

$$= \frac{L}{\text{throughput}} = \frac{4 \times 8 \times 10^6}{250 \times 1024}$$

③

ⓐ probability of a given node succeeds for the first time:

$= p(\text{node didn't succeed in first 3 slot}) \times P(\text{success in 4th})$

$$= \prod_{i=1}^{3} \Big[\underbrace{(1-p)}_{\text{No attempt}} + \underbrace{p(1-(1-p)^3)}_{\text{attempt with collision}} \Big] \times p(1-p)^3$$

$$= \prod_{i=1}^{3} \left[1 - (1-p)^3 \right] \times p(1-p)^3$$

$$= \left(1-(1-p)^3\right)^3 p(1-p)^3$$

ⓑ $P(\text{some node success in slot 3}) = P(\text{exactly 1 node attemp in slot 3})$

$$= {}^4C_1\, p(1-p)^3$$
$$= 4\, p(1-p)^3$$

ⓒ $P(\text{first success in 6th slot})$

$$= \prod_{i=1}^{5} \left[P(\text{2 or more node attempt}) \right] \times P(\text{exactly 1 node attempt in 6th slo})$$

$$= \prod_{i=1}^{5} \left[1 - {}^4C_1\, p(1-p)^3 \right] \times {}^4C_1\, p(1-p)^3$$

$$= \left(1 - 4p(1-p)^3\right)^5 4p(1-p)^3$$

ⓓ $$\text{Efficiency} = \frac{\text{number of successful transmit time slot}}{\text{Total number of time slots}}$$

$$= P(\text{exactly 1 node attempts})$$

$$= {}^4C_1\, p(1-p)^3$$

$$= 4p(1-p)^3$$

(4)

Departure rate = P(successful Transmission) for SA

Let $Q_r(n,i)$ = prob. that i backlog node retransmit among n BL nodes.

$Q_a(m-n,i)$ = prob. that i un bl node transmit among $m-n$ unbL nodes.

(a) Departure rate when 2 BL node

= 1 bL node Retransmit × no Un BL Transmit
+
No BL node Retransmit × 1 UnBL Transmit

$= Q_r(2,1) \times Q_a(8,0) + Q_r(2,0) \times Q_a(8,1)$

P(no arrival at un BL nodes) $= e^{-\lambda} = e^{-0.512}$

$= (2 \times 0.15 \times (1-0.15)) \times (e^{-0.512})^8 + (1-0.15)^2 \times (8 \times (e^{-0.512})^7 (1-e^{-0.512}))$

$= 0.068$ pkts/sec.

(b) Drift $= (m-n)\, q_a - P_{success}$

$= (10-4)(1-e^{-0.512}) -$
$Q_a(6,1)\, Q_r(4,0) + Q_a(6,0)\, Q_r(4,1)$

$= 6 \times (1-e^{-0.512}) - (1-0.15)^4 \times (6 \times (e^{-0.512})^5 (1-e^{-0.512}))$
$- (4 \times 0.15 \times (1-0.15)^3) \times (e^{-0.512})^6$

$= 2.29$ number of nodes. per sec

c

(5)

P(successful Transmission) = p

P(retransmission) = q_r

t = 1 time slot of SA.

Time Delay = 0 × first time success

+

t × success in second time slot.

+

$2t$ × success in 3rd time slot.

⋮

$$= 0 \times P + t \times (1-P)\, q_r P + 2t \times (1-P)\left(q_r(1-P) + (1-q_r)\right) \times q_r P + 3t \times (1-P)\left(q_r(1-P) + (1-q_r)\right)^2 \times q_r P + \vdots$$

$$= t(1-P)q_r P \left[\sum_{i=1}^{\infty} i \times \left[q_r(1-P) + (1-q_r) \right]^{i-1} \right]$$

$$= t(1-P)q_r P \left[\frac{1}{1-[q_r(1-P)+(1-q_r)]} + \frac{q_r(1-P)+(1-q_r)}{\left(1-[q_r(1-P)+(1-q_r)]\right)^2} \right]$$

$$= t(1-P)q_r P \left[\frac{1}{P q_r} + \frac{1-Pq_r}{(Pq_r)^2} \right]$$

$$= t(1-P)\left[1 + \frac{1-Pq_r}{Pq_r} \right] = \frac{t(1-P)}{Pq_r}$$

time Detal $T = \frac{1-P}{Pq_r} \times$ one time slot

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$\{X_j\}$ iid $\quad p_X = p$

distribution of $S_N = p_{S_N} = P(S_N = i)$

$= P(X_1 + X_2 + \cdots X_N = i)$

$$P(X_1 + X_2 + \cdots X_N = i) = \sum_{n=0}^{\infty} P(N=n) \times P(X_1 + X_2 + \cdots X_n = i \mid N = n)$$

$$= \sum_{n=0}^{\infty} \frac{\lambda^n}{n!} e^{-\lambda} \times {}^nC_i \, p^i (1-p)^{n-i}$$

$$= \sum_{n=0}^{\infty} \lambda^n e^{-\lambda} \times \frac{1}{(n-i)!\, i!} \times p^i (1-p)^{n-i}$$

$$= \frac{e^{-\lambda} (\lambda p)^i}{i!} \sum_{n=0}^{\infty} \frac{(\lambda(1-p))^{n-i}}{(n-i)!}$$

$$= \frac{(\lambda p)^i}{i!} e^{-\lambda} \; e^{\lambda(1-p)}$$

$$= \frac{(\lambda p)^i}{i!} e^{-\lambda p}$$

$= \text{poisson}(\lambda p)$