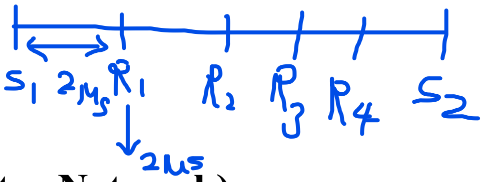
Q1. End to end signal propagation time = 2 x 4 + 2 x 5 = 18us
Min frame size = 2 x prop time = 2 x 18 = 36 us
At 20 Mbps, min frame size = 36 x 20 = 720bits

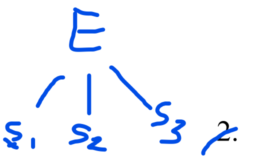


SC2008-CE3005-CZ3006 (Computer Network)

Part I: Tutorial – 3

1. The CSMA/CD specification for a medium is given below:
   (a) Maximum cable length per segment is 200 meters and the propagation delay is 1 µsec per 100 meters.
   (b) Maximum number of stations per segment is 20. only care about the stations furthest from each other
   (c) Maximum number of repeaters between any two segments (or say, between any two stations) of a LAN is 4. Delay through each repeater is 2 µsec.

   Determine the minimum frame size required for correct operation of the CSMA/CD protocol if the network is run at 20 Mbps.



P(collision) = P(all 0) + P(2 '1's, 1 '0') + P(all 1) = 0.5x0.5x 0.5 x 5 =0.625

3 times

2. Consider an Ethernet 10BASE-T single segment LAN where three stations are connected to an Ethernet hub, and the distance between each station and the Ethernet hub is the same. Assume that each of the three stations transmits a new frame at exactly the same time resulting in a collision, what is the probability that the next event on the channel is also a collision?
   (Hint: *if nothing happens on the first retrial time slot, it does not count as an event.*)

3. In a local area network using the CSMA/CD protocol, a modified Binary Exponential Backoff scheme is used if a collision is detected in the channel. Assume that two stations (A and B) are transmitting and their frames collide in one time slot. Each of them will retransmit its data frame over a window of size 2 slots. Station A retransmits in slot 0 with probability of p and station B retransmits in slot 0 with probability of q.

success when 1 '1', 1 '0'. 1/3 x 1/3 + 2/3 x 2/3 = 5/9

   (i) If $p = 1/3$ and $q = 2/3$, what is the probability that the first event in the channel will be a success?

~~q = 1-p~~
~~q^2 + p^2 = P(success)~~
~~= (1-p)^2 + p^2 = 1-2p+2p^2~~

   (ii) How would you maximize the probability that the first event in the channel will be a success, by choosing proper values for p and q?

P(success) = p(1-q) +(1-p)q. Minimize pq + (1-p)(1-q) is achieved when pq =0 and (1-p)(1-q) = 0. To maximise throughput, either p=0,q=1 or p=1,q=0

from table

64bytes = 64 * 8 = 512bits

4. Suppose that an 11-Mbps 802.11b WLAN is transmitting 64-byte frames back-to-back over a radio channel with a bit error rate of 10^{-7}. How many frames per second will be damaged on average? P(all bits survive) = (1-10^-7)^512 = 0.9999488. Number of frames/s = 11x10^6/512 = 21484. Number of dmg frames = (1-0.9999488) x 21484 = 1.0999808

~~error bits = 512 x 10^-7~~ 11x10^6

Qn 5 not tested prob

5. You are commissioned to design an experimental wireless network for SCE to support its 100 wireless devices. You have decided to adopt a multi-access reservation protocol (MARP) for frame transmission in the data link layer. Specifically, each transmission cycle consists of two phases: a reservation phase and a transmission phase. In the reservation phase, a chosen MAC protocol is used for transmission stations to reserve the channel; and in the transmission phase, the station that successfully reserves the channel transmits one frame. The data rate in

~~Length of data frame + reservation frame = 1010 bits. 1010 x throughput / 1 x 10^6 = 0.8. Throughput = 792.08 = 792 frames/s~~

S_r = 0.8
u = 1000/10^6
= 10^-3s
v= 10/10^6 = 10^-5s
Throughput S = u/((u-v)+v/S_r)
=10^-3/((10^-3-10^-5)+
10^-5/0.8) = 0.99975 = 99.75%

the wireless channel is 1 *Mbps*. The length of the data frame is 1000 *bits*, among which the reservation frame carries 10 information *bits*.

(i) If the MAC protocol used in the reservation phase has a utilization of 0.8, what will be the throughput of the MARP?

S_r is utilisation, u is data frame length in seconds=bits/bit rate, v is reservation frame length in seconds = bit/bit rate

(ii) Assume that the slotted Aloha protocol is used in the reservation phase. The utilization for the slotted Aloha protocol is Ge^{-G}, where $G = np$, n is the number of stations, and p is transmission probability. Calculate an optimal transmission probability to maximize the throughput of the MARP, and the corresponding maximum throughput?

Throughput of MARP maximised when S_r is higher. For slotted aloha, this means that the gradient of the curve is 0. Therefor differentiate.

$$\frac{d}{dG}(Ge^{-G}) = \frac{d}{dG}(G) \times e^{-G} + G \times \frac{d}{dG}(e^{-G})$$

$$= 1e^{-G} + Ge^{-G} \times \frac{d}{dG}(-G)$$

$$= -Ge^{-G} + e^{-G}$$

When $e^{-G} - Ge^{-G} = 0$, $e^{-G}(1-G) = 0$

$e^{-G} = 0$ or $1-G = 0$

undefined $\qquad G = 1 = np$

$\therefore p = \frac{1}{n}$ $\quad n = \frac{1}{100}$

~~$U = Ge^{-G} = 1e^{-1} = 0.3678$~~

~~$= 36.8\%$~~

$S_{r,max} = \frac{1}{e}$

$$S_{max} = \frac{u}{(u-v) + \frac{v}{S_{r,max}}} = \frac{10^{-3}}{(10^{-3} - 10^{-5}) + \frac{10^{-5}}{\frac{1}{e}}}$$

$= 98.31\%$