

# Computer Networks PYQs

(use timing diagram and flow diagram). Consider a wireless network, stations are 900 km apart. Assume that the network transmits 600-bit frames on a shared channel of 200 kbps.

- i) Find the possible values of back-off time for  $k=2$ .
- ii) What is the vulnerable time here for Pure ALOHA protocol?
- iii) What is the vulnerable time here for Slotted ALOHA protocol?
- iv) Find the throughput if the system generates 500 frames/sec using Pure ALOHA.
- v) Find the throughput if the system generates 500 frames/sec using Slotted ALOHA.

$$(2+3)+(3+2)+(1+1+1+2)=15$$

Ans.

$$Tfr = 600 \text{ b} / 200 \text{ kbps} = 600 / (200 * 1000) \text{ s} = 0.003 \text{ s}; Tp = 900 \text{ km} / 3 \times 10^8 \text{ m/s} = 0.003 \text{ s}$$

i) Possible values of back off time  $T_b$  for  $k = 2$  =

$$\{0, 1Tfr, 2Tfr, 3Tfr\} = \{0 \text{ s}, 0.003 \text{ s}, 0.006 \text{ s}, 0.009 \text{ s}\}$$

ii) For Pure ALOHA, vulnerable time =  $2 \times Tfr = 2 \times 0.003 \text{ s} = 0.006 \text{ s}$

iii) For Slotted ALOHA, vulnerable time =  $Tfr = 0.003 \text{ s} = 0.003 \text{ s}$

$$\begin{aligned} G &= \text{average number of frames generated by system in one frame transmission time} \\ &= 500 \text{ frames/s} \times Tfr = 500 \times 0.003 = 1.5 \end{aligned}$$

iv) Throughput for Pure ALOHA =  $G \times e^{-2G} = 0.0749 = 7.49\%$

v) Throughput for Slotted ALOHA =  $G \times e^{-G} = 0.3347 = 33.47\%$

B) Suppose  $S = \{S_1, S_2, S_3, \dots, S_n\}$  is a set of stations in a pure ALOHA network. Let the stations be separated in such a way that the distance between two stations  $S_{i \in \{1, 2, \dots, n\}}$  and  $S_{j \in \{1, 2, \dots, n\}}$  is  $i \times j$  meter, where  $i \neq j$ . If  $m$  is the number of unsuccessful attempts for a particular frame, then formulate the possible backoff time. You can assume that the propagation speed of the signal is  $k$  meter/second. In this environment every node will try to send their frames in every time slot with probability  $p$ . What will be the probability that only one node transmits in a particular time slot?

Ans.

$Tp$  = maximum propagation time between any two stations in a network

$$= n(n-1)/k \text{ sec} [\text{Max. distance will be when } i = n \text{ and } j = n-1]$$

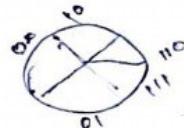
Possible backoff times  $T_b$  =  $\{0, Tp, 2Tp, \dots, (2^m - 1)Tp\}$

$$= \{0 \text{ sec}, n(n-1)/k \text{ sec}, 2n(n-1)/k \text{ sec}, \dots, (2^m - 1)n(n-1)/k \text{ sec}\}$$

Probability that only one node sends in a time slot =  ${}^n C_1 p^1 (1-p)^{n-1} = np(1-p)^{n-1}$

6. A) Assume that an ISP is granted a block of addresses starting from 190.100.0.0/16 for Jadavpur University. The ISP needs to distribute these addresses to five groups as follows:

i) The Faculty Council of Engineering and Technology has 128 units; each needs 256 addresses except the first and the last units. A total of 151 and 187 addresses are needed for the first and the last units respectively.



ii) The Faculty Council of Science has 64 units; The i-th unit (except the 64-th unit) uses  $(64 + i)$  addresses. The 64-th unit uses 128 addresses.

iii) The Faculty Council of Arts has 32 units; each needs 64 addresses. The i-th unit (except the 32-nd unit) uses  $(64 - i)$  addresses. The 32-nd unit uses 64 addresses.

iv) Interdisciplinary Schools and Centers have 128 units; each needs 64 addresses.

v) University Administrative Block has 8 units; each needs 32 addresses

..... and so many addresses are still

Ans.

### Assumptions

- The groups themselves do not reserve any IP address. All the addresses are reserved by the units only.
- When a unit requests X addresses, it includes its own network address and broadcast address in the calculation. So, the maximum number of hosts that unit network can accommodate is X - 2.

### Design

JU 190.100.0.0/16

---	Faculty Council of Engg and Technology	
---	Unit 1	190.100.0.0/24 to 190.100.0.255/24 (256, 105 unused)
---	Unit 2	190.100.1.0/24 to 190.100.1.255/24 (256)
.		
.		
---	Unit 127	190.100.126.0/24 to 190.100.126.255/24 (256)
---	Unit 128	190.100.127.0/24 to 190.100.127.255/24 (256, 69 unused)
---	Faculty Council of Science	
---	Unit 1	190.100.128.0/25 to 190.100.128.127/25 (128, 63 unused)
---	Unit 2	190.100.128.128/25 to 190.100.128.255/25 (128, 62 unused)
.		
.		
---	Unit 63	190.100.159.0/25 to 190.100.159.127/25 (128, 1 unused)

- |--- Unit 64      **190.100.159.128/25 to 190.100.159.255/25 (128)**
- Faculty Council of Arts
  - |--- Unit 1      **190.100.160.0/26 to 190.100.160.63/26 (64, 1 unused)**
  - |--- Unit 2      **190.100.160.64/26 to 190.100.160.127/26 (64, 2 unused)**
  - .
  - .
- |--- Unit 31      **190.100.167.128/26 to 190.100.167.191 (64, 33 unused)**
- |--- Unit 32      **190.100.167.192/26 to 190.100.167.255 (64)**
- Interdisciplinary Schools and Centers
  - |--- Unit 1      **190.100.168.0/26 to 190.100.168.63/26 (64)**
  - |--- Unit 2      **190.100.168.64/26 to 190.100.168.127/26 (64)**
  - .
  - .
- |--- Unit 127      **190.100.199.128/26 to 190.100.199.191/26 (64)**
- |--- Unit 128      **190.100.199.192/26 to 190.100.199.255/26 (64)**
- University Administrative Block
  - |--- Unit 1      **190.100.200.0/27 to 190.100.200.31/27 (32)**
  - |--- Unit 2      **190.100.200.32/27 to 190.100.200.62/27 (32)**
  - .
  - .
- |--- Unit 7      **190.100.200.192/27 to 190.100.200.223/27 (32)**
- |--- Unit 8      **190.100.200.224/27 to 190.100.200.255/27 (32)**

After assigning all the addresses, the addresses **190.100.201.0 to 190.100.255.255**, ie, **14080 addresses** are left.

3. Consider a network environment, where two computers C1 and C2 are on the same broadcast domain connected through 10Base-5. There are 4 repeaters inline between C1 and C2 each with a delay of 3  $\mu$ s. Suppose C1 and C2 transmit a frame of size Maximum Transfer Unit (MTU) of Ethernet at the same exact time and their frames collide. Now, C1 chooses K = 1 and C2 chooses K = 2 in the exponential backoff protocol. Assume that (i) electrical signals in a copper wire travel at approximately 2/3 the speed of light (ii) channel is CSMA/CD with backoff intervals that are multiples of 50  $\mu$ s (iii) the jam signal takes 10  $\mu$ s to transmit (iv) the minimum inter-frame gap for transmission is the time it takes to transmit 96 bits of data on the medium.
- i. Why has Ethernet imposed restrictions on both the minimum and maximum length of a frame?
  - ii. What are the different fields of IEEE 802.3 MAC frame (give a schematic representation of the frame)?
  - iii. What is the theoretical transmission time here?
  - iv. What is the size of the frame transmitted by C1 and C2?
  - v. What is the inter-frame gap here?
  - vi. What is the one-way propagation delay between C1 and C2 (assume the maximum length)?
  - vii. What should be the slot time here?
  - viii. What is the frame transmission time between C1 and C2?
  - ix. What is the minimum size of the frame here?
  - x. At what point in time is C1's frame delivered to C2?
- [Please give proper justification of your answer]  $2+2+1+1+1+2+1+1+1+3=15$

Ans.

- (i)
- Ethernet has imposed restrictions on the minimum length of the frame in order for the correct operation of CSMA/CD.
  - If a sender station sends 512 bytes of data and does not detect a collision, it can be sure that no other collision can occur.
  - The restrictions on maximum length were imposed to limit the size of the buffer because in the days of Ethernet memory was very expensive.

(iii)

$$T_{fr} = 1500 / 10 \times 10^6 = 1.5 \times 10^{-4} \text{ s}$$

(iv)

Size of frame transmitted by C1 and C2 = MTU of Ethernet = **1500 bytes**

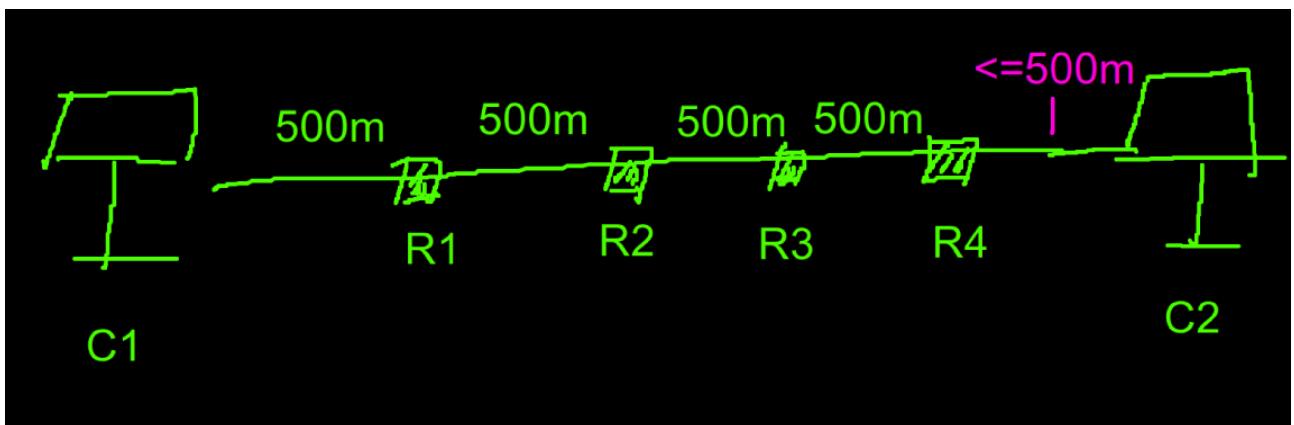
(v)

The interframe gap = time it takes to send 96 bits =  $96 / 10 \times 10^6 = 9.6 \times 10^{-6} \text{ s}$

(vi)

$$Tp = \text{Distance} / \text{Speed}$$

Since there are 4 repeaters, and repeaters in 10Base5 are placed if the distance exceeds 500 m, we can conclude that the distance between C1 and C2 can be no more than **2500 m**



Assuming maximum length,

$$Tp = 2500 / 2 \times 10^8 = 1.25 \times 10^{-5} \text{ s} = 12.5 \text{ microseconds}$$

How does CDMA differ from FDMA and TDMA? Explain the properties of orthogonal sequences which are suitable for CDMA. Show the Walsh table for  $W_{16}$ . Prove the second property and third property of orthogonal sequences for your CDMA example of  $W_{16}$ .

**Ans.**

W16=