CN PAST PAPER 2014 SOLUTION

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Short Questions

Q2

(i)

Bandwidth B = 4 kHz = 4 x 1000 Hz = 4000 Hz

Signal discrete levels M = 4

Data rate $D = 2 * B * M$ **----- (i)**

Putting these values in equation 1

$D = 2 * 4000 * 4$

D= $2 * 4000 * 2^2$

D=$2 * 4000 * 2$

$D = 16000\ bps$

(ii)

In a single channel contention based medium access control (MAC) protocols, whenever more than one station or node tries to access the medium at the same instant of time, it leads to packet collisions. If the collided stations tries to access the channel again, the packets will collide as the nodes are synchronized in time. So the nodes need to be displaced in time. To displace them temporally, a backoff algorithm is used (example binary exponential backoff (BEB)). For example, in BEB algorithm, whenever a node's transmission is involved in a collision with another node's transmission, both nodes will choose a random waiting time and wait for this amount of time before attempting again. If they are not successful in this attempt, they double their contention window and choose a random waiting time before transmitting again. This process will be repeated for certain number of attempts. If the nodes are not successful in their transmission after this limit, the packets will be dropped from their queue.

Examples are the retransmission of frames in carrier sense multiple access with collision avoidance (CSMA/CA) and carrier sense multiple access with collision detection (CSMA/CD) networks, where this algorithm is part of the channel access method used to send data on these networks. In Ethernet networks, the algorithm is commonly used to schedule retransmissions after collisions. The

retransmission is delayed by an amount of time derived from the slot time and the number of attempts to retransmit.

After *c* collisions, a random number of slot times between 0 and $2^c - 1$ is chosen. For the first collision, each sender will wait 0 or 1 slot times. After the second collision, the senders will wait anywhere from 0 to 3 slot times (inclusive). After the third collision, the senders will wait anywhere from 0 to 7 slot times (inclusive), and so forth. As the number of retransmission attempts increases, the number of possibilities for delay increases exponentially.

The 'truncated' simply means that after a certain number of increases, the exponentiation stops; i.e. the retransmission timeout reaches a ceiling, and thereafter does not increase any further. For example, if the ceiling is set at $i = 10$ (as it is in the IEEE 802.3 CSMA/CD standard), then the maximum delay is 1023 slot times.

Because these delays cause other stations that are sending to collide as well, there is a possibility that, on a busy network, hundreds of people may be caught in a single collision set. Because of this possibility, the process is aborted after 16 attempts at transmission.

Expected back-off

Given a uniform distribution of backoff times, the expected backoff time is the mean of the possibilities. That is, after c collisions, the number of backoff slots is in [0, 1, ..., N] where $N = 2^c - 1$ and the expected backoff time (in slots) is

$$\frac{1}{N+1}\sum_{i=0}^{N} i$$

Now, back-off time for fifth (c=5) collision, one could first calculate the maximum back-off time, N:

$$N = 2^c - 1$$

$$N = 2^5 - 1 = 32 - 1$$

$$N = 31$$

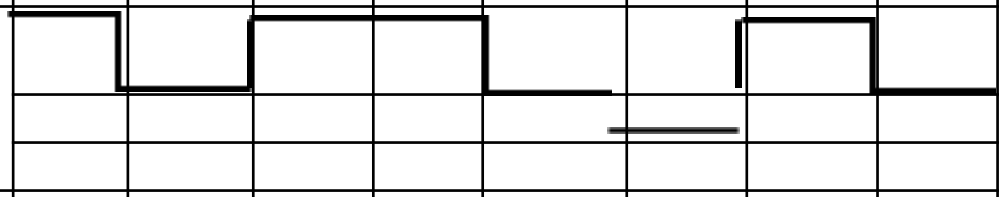
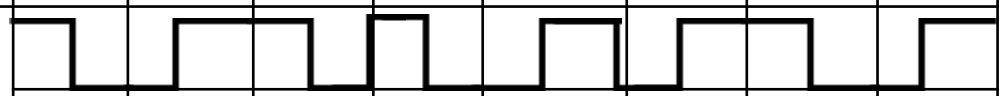
Then, calculate the mean of the back-off time possibilities:

$$E(c) = \frac{1}{N+1}\sum_{i=0}^{N} i$$

$$E(31) = \frac{1}{31+1}\sum_{i=0}^{31} i = \frac{1}{31}(0 + 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 + 11 + 1$$

$$E(31) = \frac{496}{32} = 15.1$$

(iii)

Bits	0	1	0	0	1	1	0	1
NRZ-L								
Manchester								

(iv)

Decision taken by bridge is depends on the port it arrives on (the source port) and the address to which it is destined (the destination address).

The decisions are given below:

1. If the port for the destination address is the same as the source port, discard the frame.
2. If the port for the destination address and the source port are different, forward on the destination port.
3. If the destination port is unknown, use the flooding and send the frame to all the ports except the source.

(v)

Issue	Datagram network	Virtual-circuit network
Quality-of-Service	Difficult	Easy because resources can be reserved in advance, when the connection is established.
Router Failure	Easy if router goes downs at the time only those users suffer whose packets were queued.	Difficult if router crashes and losses its memory, all the virtual circuits passing through it will have to be aborted

(vi)

Application	Reliability	Delay	Jitter	Bandwidth
File transfer	High	Low	Low	High
Video conferencing	Low	High	High	High

(vii)

Four metrics that can be observed in order to monitor the congestion in the network are:

i) Delay
ii) Packet loss rate
iii) Fairness
iv) Convergence rate
v) Throughput

(viii)

There is a hash table in a bridge which can list each possible destination and which output port it belongs on. When the bridges are first plugged in, all the hash table are empty. None of bridge know where any of the destination are, so they use flooding algorithm. Every incoming frame for an unknown destination is output on all the ports. As time goes on, the bridges learn where destination are. Once a destination is known, frames destined for it are put only on the proper port, they are not flooded. This algorithm is called backward learning, and from this way bridge buildup address lists.

(ix)

In networking, the amount of time it takes for a packet to travel from source to destination. Together, latency and bandwidth define the speed and capacity of a network.

Latency depends on the speed of the transmission medium (e.g., copper wire, optical fiber or radio waves) and the delays in the transmission by devices along the way (e.g., routers and modems). A low latency indicates a high network efficiency.

(x)

Asynchronous Transmission

Data-bits have specific pattern and they help receiver recognize the start and end data bits.For example, a 0 is prefixed on every data byte and one or more 1s are added at the end. Two continuous data-frames (bytes) may have a gap between them.

Synchronous Transmission

Timing in synchronous transmission has importance as there is no mechanism followed to recognize start and end data bits. There is no pattern or prefix/suffix method. Data bits are sent in burst mode without maintaining gap between bytes (8-bits). Single burst of data bits may contain a number of bytes. Therefore, timing becomes very important.

Long Questions

Q3

(a)

Please solve it by your self ☺

(b)

There are two propagation modes in Fiber Optics:

Multimode

This mode mostly use LED (light emitting diode) as a light source. LED produces unfocused light that enters core at many different places and many different angles. It is appropriate for short distances as it diffuses over distance. Therefore, in multimode the multiple beam of light from a light source follows different paths in the core. Travelling of beam in the cable depends on the structure of the core.

There are two type of multimode:

1-step-index multimode fiber

In this multimode fiber the core and the cladding have different densities. Further, the density of the core is constant from the center to the edges. The beam travels through the constant density in a straight direction. When sudden change in direction leads to distortion of the signal.

2-Graded-index multimode fiber

In graded index multimode fiber, the core has varying densities, the center of the core has the highest density and it gradually decreases towards the edge. When the beam travels through the fiber it touches the boundary of the core at different places and at different angles thus giving rise to the curve. Only the beam travelling through the center of the core travels unchanged. Hence multiple beams give rise to different curves or waveforms.

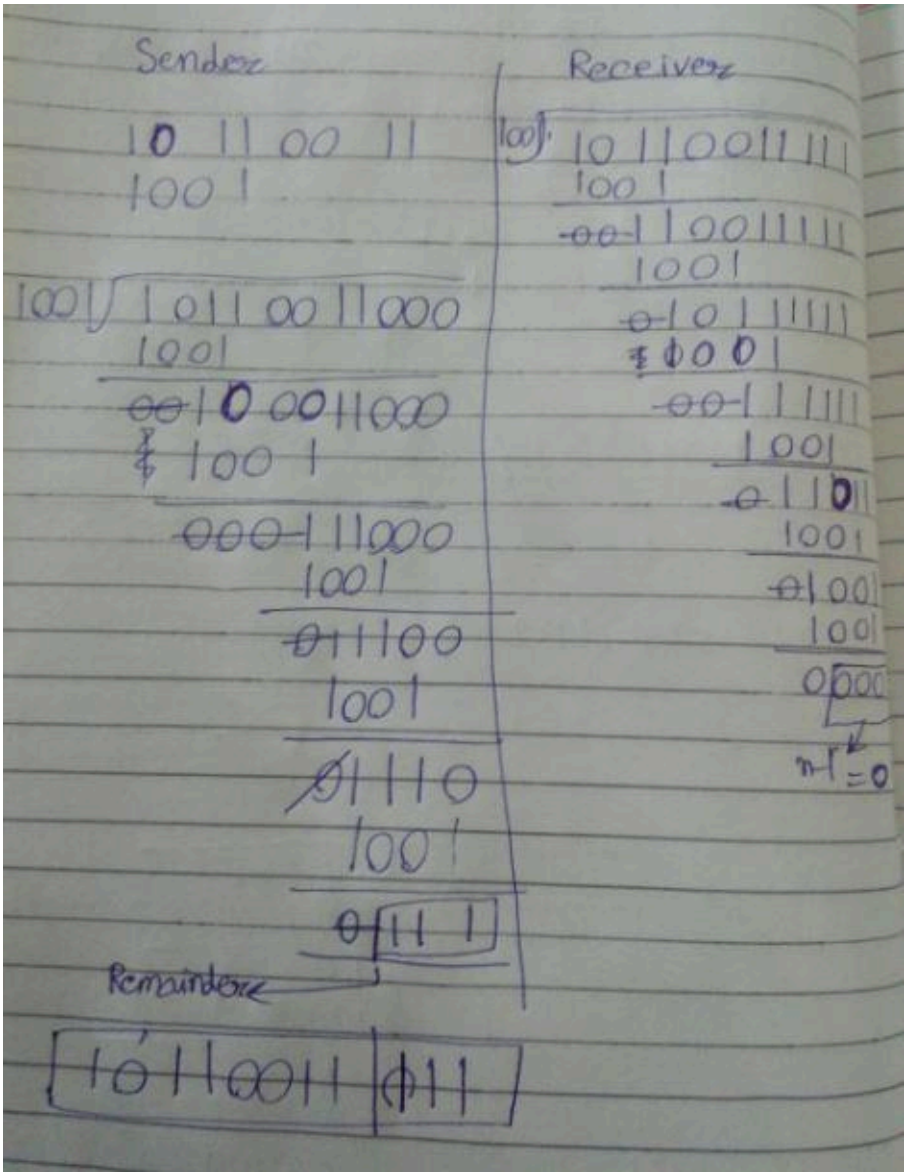
Single-mode

A single-mode fiber uses an ILD (Injection Laser Diode) as a light source. The laser produces a focused beam of light that enters the core at small range of angles which is almost close to the horizontal line. Further, the radius of core in single-mode fiber is less than that of multimode fibers. By reducing the radius of core, only a single angle or mode can pass through the core. Thus the beam of light propagates almost horizontally.

The advantage of this mode is that the distortion found in multimode cannot occur. Another advantage is that it can be used for longer distances. Applications such as telephone and cable TV.

(c)

Data unit = 10110011, divisor = 1001, remainder =111



Since at the receiver side the remainder is 0000 so its means that there is no error in the data unit and the data is successfully received by the receiver.

(d)

IP address: 157.110.88.0

Required subnets = 30

Host per subnet = 64

Subnets	1	2	4	8	16	32	64	128	
	128	64	32	16	8	4	2	1	hosts

It is a class ‘B’ address so it has 2 networks octet, 2 hosts octet. For sub-netting we use host bits. So what we do in these bits.

	128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1
170.110.	0	1	0	1	1	0	0	0	.	0	0	0	0	0	0	0	0

Subnets bits= 5

Subnets ≥ required subnets

32 ≥ 30

Hosts bits = 6

a) This address is “Class B” type.
b) There are 2 unusable subnets.
c) 255.255.95.192
d) 255.255.0.0
e) 157.110.94.48 □ because we start counting hosts from 157.110.94.1, the address 157.110.94.0 is subnet ID that cannot be used as a host.

(e)

To	A	I	F	C		New estimate delay from E	Line
A	0	24	20	21		8	A
B	12	36	31	28		20	B
C	25	18	19	0		6	C
D	40	27	8	24		20	D
E	8	10	12	6		0	-
F	23	20	0	40		12	F
G	18	31	6	31		18	G
H	17	20	17	19		25	H
I	21	0	14	22		10	I
J	9	11	7	10		16	J
K	24	22	22	24		30	K
L	29	33	9	9		15	L
	EA Delay Is 8	EI Delay Is 10	EF Delay Is 12	EC Delay Is 6		New routing table for E	