ID : A20447935

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Physical Layer Assignment # 1

1) a) $d_{prop} = \frac{m}{s}$

b) $d_{trans} = \frac{L}{R}$

c) $d_{total} = d_{prop} + d_{trans}$ [Ignoring processing & queuing delays]

$d_{total} = \left(\frac{mR + Ls}{Rs}\right)$

d) The bit just left Host A.

e) The bit is in the link & has not reached Host B.

f) The bit has reached Host B.

g) $d_{prop} = d_{trans}$

$\frac{m}{s} = \frac{L}{R}$

$m = \frac{Ls}{R}$

$= \frac{100 \times 2.5 \times 10^{8}}{28 \times 10^{3}}$

$= 892857.14\ m$ or $\boxed{892.9 Km}$

2) Data link layer : 30 bytes

Remaining 6 layer : 20 bytes / each & trailer of 4 bytes

Total number of header bytes = $30 + (20 \times 6) + 4$

$= 154$ bytes

Each message generated by the application is of length 500 bytes.

Total packet size = header size + message length

$= 154 + 500$

$= 654$ bytes.

The fraction of network bandwidth = $\frac{154}{654}$

$$\boxed{\eta = 0.235}$$

3) a) For BPSK,

$\therefore$ Bitrate $= 2 \times 3\text{KHz} \times \log_2 2 = 6000$ bps

Baud rate $= \dfrac{6000 \text{ bps}}{1 \text{ bit/symbol}}$

$\therefore$ Baud rate $=$ 6000 symbols/sec

For 64-QAM,

$\therefore$ Bitrate $= 2 \times 3\text{kHz} \times \log_2 64 = 36000$ bps

Baud rate $= \dfrac{36000 \text{ bps}}{6 \text{ bits/symbol}}$

$\therefore$ Baudrate $=$ 6000 symbols/sec

b) $30\text{dB} = 10 \log_{10} \text{SNR}$, SNR $= 1000$

$3\text{kHz} \times \log_2(1+1000) = 29902$ bps

c) If the signal to noise ratio is increased, the rate of data is improved. Increasing the bandwidth of the chanel also increases the data rate. For better throughput, the ratio of signal to noise ratio should be decreased.

4) a) Physical Layer

b) Network Layer is responsible for routing.

c) Presentation Layer

d) Session Layer

e) Network Layer

f) Physical Layer

g) Data Link Layer

h) Transport Layer

i) Application Layer

j) OSI model has 7 layers compared to the 4 layers of the TCP/IP model. Each layer has a specific purpose and then passes it to the next layer. TCP/IP is a modern implementation of a network model & is more reliable than OSI model.

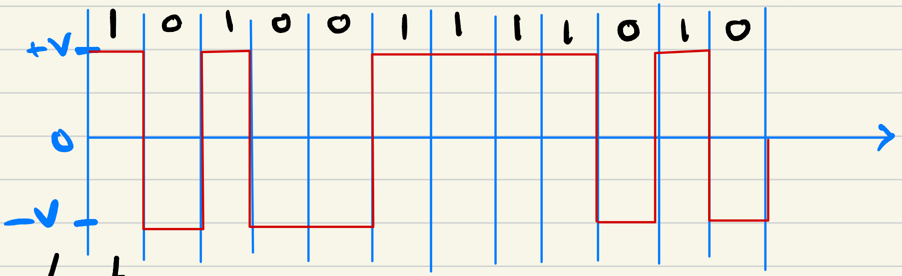
5) a) Non-Return to Zero (NRZ) is a binary code where 0 & 1 are represented by some voltage with 1 being positive voltage & 0 being negative voltage. Bits are streamed continously with the signal going straight to the voltage of the next bit after the previous one is transmitted instead of returning to 0 and then correcting the voltage.

b) Manchester code represents each bit of data using a transition from high to low or vis-versa. As 1 is represented by a transition from low to high & 0 is represented by a transition from high to low. Since each bit contains a transition & an equal amount of time from each other, the signal can be decoded without a clock signal.

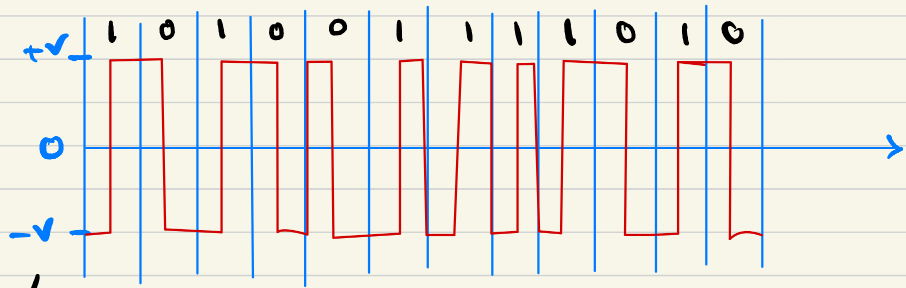
c) Bipolar encoding is a varient of return to zero code where there are 3 states, positive, negative voltages and zero. Either 0 or 1 is assigned to 0V & the other state alternates between positive & negative voltages.

Bit sequence for 1010 0111 1010

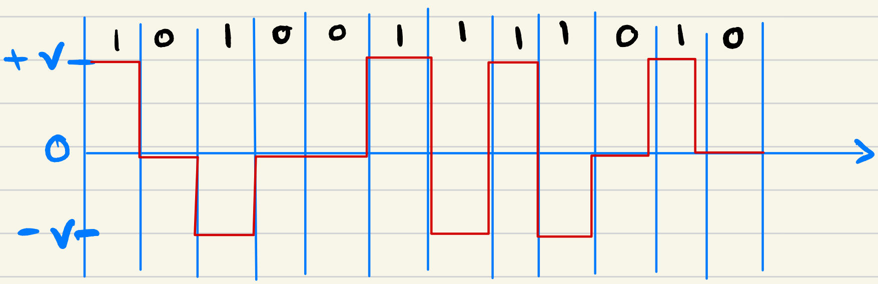
NRZ



Manchester



Bipolar



6) $S = (-1 +1 -3 +3 +1 -1 -1 +1)$

$A = (-1 -1 -1 +1 +1 -1 +1 +1)$

$B = (-1 -1 +1 -1 +1 +1 +1 -1)$

$C = (-1 +1 -1 +1 +1 +1 -1 -1)$

$D = (-1 +1 -1 -1 -1 -1 +1 -1)$

$S \times A = (+1 -1 +3 +3 +1 +1 -1 +1)$, Sum $= 8$

$S \times B = (+1 -1 -3 -3 +1 -1 -1 -1)$, Sum $= -8$

$S \times C = (+1 +1 +3 +3 +1 -1 +1 -1)$, Sum $= 8$

$S \times D = (+1 +1 +3 -3 -1 +1 -1 -1)$, Sum $= 0$

A transmitted 1.

B transmitted 0.

C transmitted 1.

D didn't transmit.

ID: A20447935 Data Link Layer

Name: Alan Palayil Assignment #2

1) The output after stuffing:

AB ESC ESC C ESC ESC ESC FLAG ESC FLAG D

2) The maximum overhead in byte-stuffing algorithm is 2n. (where n is the number of bytes in the payload).

3) The data after de-stuffing:

0110 0111 1101 1110 1111 11

4) $16 = m <= 2^r - 1 - r \therefore r = 5$. Check bits are needed at positions 1, 2, 4, 8, 16.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111	10000	10001	10010	10011	10100	10101
P1	P2	1	P3	1	0	1	P4	0	0	1	1	0	0	1	P5	1	0	1	0	1

P1 is the parity bit for all bits in positions with a 2^0 term (3, 5, 7, 9, 11, 13, 15, 17, 19 & 21)

P1 ⇒ (1110101111). P1 = 0.

P2 is the parity bit for all bits in positions with a 2^1 term (3, 6, 7, 10, 11, 14, 15, 18, 19)

P2 ⇒ (101010101). P2 = 1

P3 is the parity bit for all bits in positions with a 2^2 term (5, 6, 7, 12, 13, 14, 15, 20, 21)

P3 ⇒ (101100101). P3 = 1

P4 is the parity bit for all bits in positions with a 2^3 term (9, 10, 11, 12, 13, 14, 15)

P4 ⇒ (0011001). P4 = 1

P5 is the parity bit for all bits in positions with a 2^4 term (17, 18, 19, 20, 21)

P5 ⇒ (10101). P5 = 1

The bit pattern transmitted for the message is 011110110011001110101.

5) a) Bit stream is 10011101
Generated polynomial is 10101
Sender side binary division

```
10101 ) 100111010000 ( 1111
        10101
        -----
         11010
         10101
         -----
          1111
          10101
          -----
           10100
           10101
           -----
            1000  → CRC
```

In receiver side

```
10101 ) 100111011000 ( 111
        10101
        -----
         11010
         10101
         -----
          11111
          10101
          -----
           10101
           10101
           -----
           00000  → all are '0'.
```

So there is no error bits.

b) If the third bit is inverted from the left during transmission. Then the receiver side the bit stream will be like this 10[1]111011000 we can check if it has error. By following:

```
10101 ) 101111011000 ( 11
        10101
        -----
         10101
         10101
         -----
          1000  → It has to be '0' all but that is not occured.
```

∴ So, error can be checked, CRC method.

c) If the error message is a multiple of $G(x)$, then the error will not be detected. Examples are message will be all 0's, 10011100101, or 10010100100.

6) No. of frame = 8

∴ 0.6 % chance for attaining undamaged frames.

$p = (0.6)^8$

$= 0.0168$

The average trials of expected number of transmissions ahead successful reception $E = 1/p$

$E = \frac{1}{0.0168}$

$= 59.54 \simeq 60$ times.

7) 512 bytes × 8 bits/B = 4096 bits per frame

$\frac{4096}{128000}$ bps = 32 msec to send one frame.

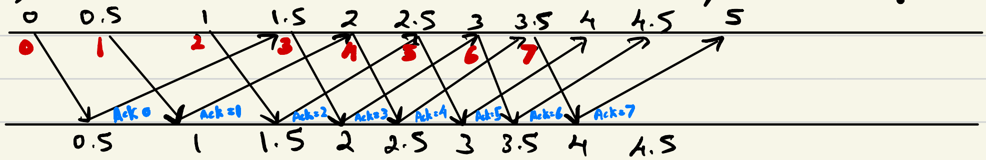
Round trip delay = 250 msec

∴ Window size 1 = $\frac{4096 \text{ bits}}{250 \text{ msec}} = 16.384 \times 10^3$ bps

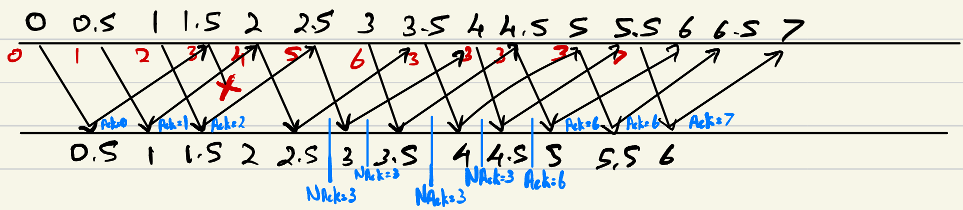
∴ Window size 7 = $16.384 \times 10^3 \times 7 = 114688$ bps

Window size 9 & greater: $16.384 \times 10^3 \times 9 = 147456$ bps but maximum capacity is 128 Kbps so for windows 15 & 127 it's 128 Kbps.

8) a) $N = 7$, time out $= 2$, $t_{prop} = 0.5$, $ACK_{trans} = 1$



b)



0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7
0 1 2 3 4 5 6 3 3 3 3 3
Ack=0 Ack=1 Ack=2 Ack=6 Ack=6 Ack=7
0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6
NAck=3 NAck=3 NAck=3 NAck=3 Ack=6