ASSIGNMENT
DATA COMMUNICATION

SUBMITTED BY:

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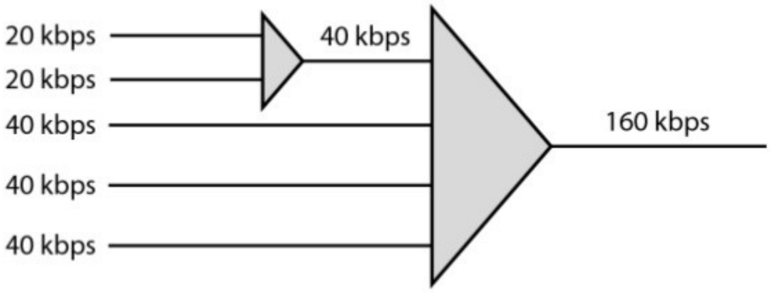
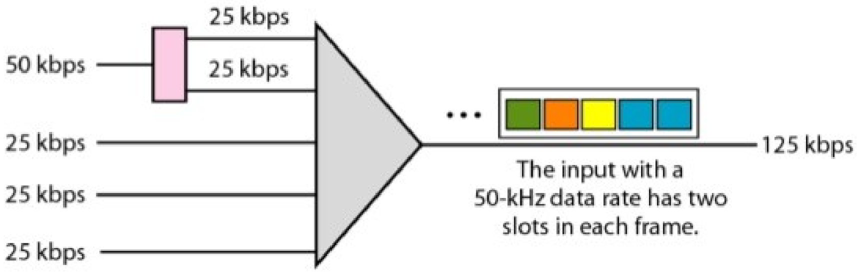
Group - 7

1. Distinguish between multilevel TDM,multiple-slot TDM,and pulse-stuffed TDM.

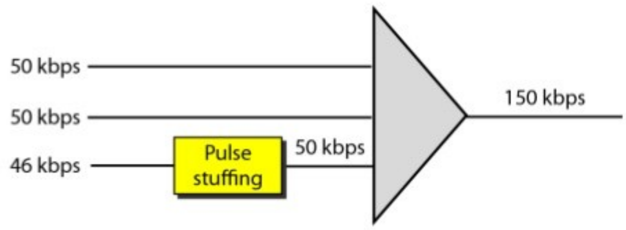
Multilevel multiplexing is a technique used when the data rate of an input line is a multiple of others.
For example, in Figure below, we have two inputs of 20 kbps and three inputs of 40 kbps. The first two input lines can be multiplexed together to provide a data rate equal to the last three. A second level of multiplexing can create an output of 160 kbps.



Multiple-Slot Allocation Sometimes it is more efficient to allot more than one slot in a frame to a single input line. For example, we might have an input line that has a data rate that is a multiple of another input. In Figure below, the input line with a SO-kbps data rate can be given two slots in the output. We insert a serial-to-parallel converter in the line to make two inputs out of one.



Pulse Stuffing : Sometimes the bit rates of sources are not multiple integers of each other. Therefore, neither of the above two techniques can be applied. One solution is to make the highest input data rate the dominant data rate and then add dummy bits to the input lines with lower rates. This will increase their rates. This technique is called pulse stuffing, bit padding, or bit stuffing. The idea is shown in Figure below. The input with a data rate of 46 is pulse-stuffed to increase the rate to 50 kbps. Now multiplexing can take place.



2.In CRC we have chosen the generator 1100101.what is the probability of detecting a burst error of length

a.5 b.7 c.10

ans: $g(x)=x^6+x^5+x^2+1$
$r=6$ (degree of g(x))

a.L=5 $L< r$
hence all burst errors will be detected.
Therfor probability=1

b.L=7 ie $L=r+1$
therefor $\text{probability}=1-(1/2)^{r-1}$
$= 1-(1/2)^{6-1}$
$= 0.97$

c.L=10 ie $L>r+1$
therefor $\text{probability}=1-(1/2)^r$
$=1-(1/2)^6$
$=0.98$

3.In CRC,which of the following generators(divisors) gaurantees the detection of an odd number of errors?
a.10111 b.101101 c.111

ans:NOTE : A generator that contains a factor of x+1 can detect all odd numbered errors

a. $g(x)=10111=x^4+x^2+x+1$

x+1 is a factor of g(x)

ie $x^4+x^2+x+1=(x+1)(x^3+x^2+1)$

hence g(x) can catch all odd-numbered errors

b. $g(x)=101101=x^5+x^3+x^2+1$

x+1 is a factor of g(x)

ie $x^5+x^3+x^2+1=(x+1)(x^4+x^3+x+1)$

hence g(x) can catch all odd-numbered errors

c. $g(x)=111=x^2+x+1$

x+1 is not a factor of g(x),hence odd numbered errors cannot be detected.

4.Assume we are sending data items of 16-bit length.if two data items are swapped during transmission,can the traditional checksum detect this error ? Explain.

Ans:No

In treditional checksum, the sum of datawords are calculated and is sent along with the data.In the reciever side the sum of recieved datawords are again calculated and is compared with the actual sum and errors are detected.if 2 bits are swapped during transmission,the sum will remain the same.Hence the error cannot be detected.

5. Assume we want to send a dataword of two bits using FEC based on the hamming distane.Show how the following list of datawords /codewords can automatically correct up to a one bit error in transmission.

00->00000   01->01011   10->10101   11->11110

ans: To detect t errors we need to have,

d_{min}=2t+1 where d_{min} is the minimum hamming distance

therefor to detect single bit error we need d_{min}=3

6.In a codeword we add two reduntant bits to each 8 bit data word.Find the number of

a.valid codewords b.invalid codewords

ans:number of bits of dataword, k=8
number of reduntant bits, r=2
number of bits of codeword n=k+r=10

a)Valid codewords $=2^8$
=256

b)Invalid codewords $=2^{10}-2^8$
=1024-256
=768

7.In CRC,which of the following generators(divisors) gaurantees the detection of a single bit error?

a.101 **b**.100 **c**.1

ans: a. $101=x^2+1$

for every i ,x^i is not divivisible by x^2+1,hence all single bit errors can be detected.

b. $100=x^2$

for i=2, x^i is divisible by g(x),hence single bit error in the first position (MSB position,i=2) cannot be detected.

c. $1=x^0$

for every value of i,x^i is divisible by g(x),hence no single bit error can be detected.

8.What is the hamming distance for each of the following codewords?

a.*d*(10000,00000) b.*d*(10101,10000)

c.*d*(00000,11111) d.*d*(00000,00000)

ans:NOTE: The Hamming distance between two words is the number of differences between corresponding bits.

a)1
b)2
c)5
d)0