ASSIGNMENT
DATA COMMUNICATION

SUBMITTED BY:

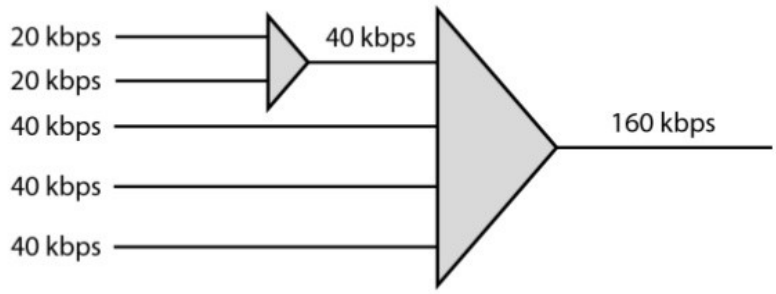
Muhsina Binth Abdulla C

S3-IT

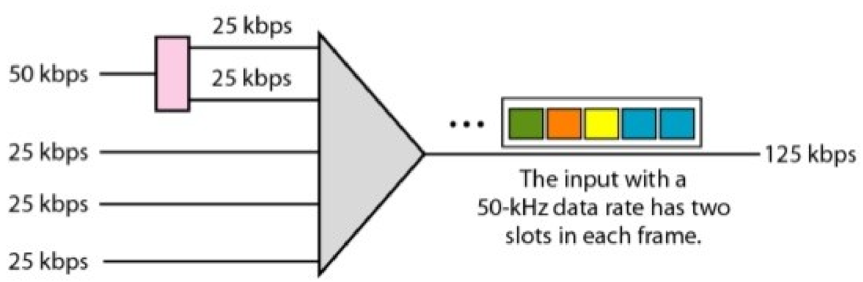
Group - 7

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

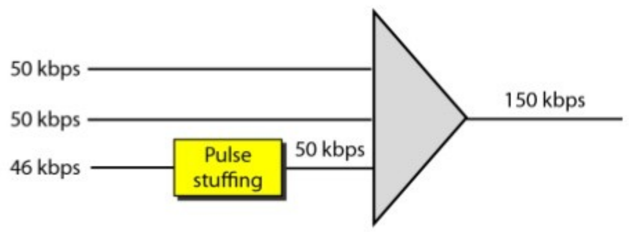
Multilevel multiplexing is a technique used when the data rate of an input line is a multiple of others.



Multiple-Slot: used when there is a GCD between the data rates.The higher bit rate channels are allocated more slots per frame, and the output frame rate is a multiple of each input link.



Pulse Stuffing : Used when there is no GCD between the links.The slowest The slowest speed link will be brought up to the speed of the other links by bit insertion, this is called pulse stuffing.



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 probability$=1-(1/2)^{r-1}$
$= 1-(1/2)^{6-1}$
$= 0.97$

c.$L=10$ ie $L>r+1$
therefor 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: Forward error correction (FEC) is a way of adding redundancy to messages so that the receiver can both detect and correct common errors.

When an invalid codeword is received, the receiver should choose the valid codeword with the minimum Hamming distance to the invalid codeword.

Data Block	Codeword
00	v1=00000
01	v2=00111
10	v3=11001
11	v4=11110

If we receive 00100, the Hamming distances are:

d(00100, v1) = 1
d(00100, v2) = 2
d(00100, v3) = 4
d(00100, v4) = 3

hence we should pick codeword v1. The receiver then decodes this codeword as the data block 00 and the data is correctly received.

This (5,2) code can always correct codewords received with one error.

Correctable Errors : For some positive integert , if a code satisfies:

$$d_{min} \geq 2t_c + 1$$

min tc then the code can correct up to tc bit errors in a received codeword. Equivalently, we can say the number of guaranteed correctable errors per codeword is

$t_c = [d_{min}-1]/2$

where [x] is the "floor" operator which always rounds down.

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