DC ASSIGNMENT

Submitted by

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Roll no. 06

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Q1. In CRC, if the dataword is 5 bits and the codeword is 8 bits, how many 0 need to be added to the dataword to make the dividend? What is the size of the reminder? What is the size of the divisor?

Ans.

Dataword, k=5 bits

Codeword, n=8 bits

The number of zeroes to be added to the dataword to find the dividend = n-k = 8-5

=3 zeroes

The size of the reminder, r=n-k =3 bits

Size of divisor= r+1=4 bits

Q2. Can the value of a traditional checksum be all 0s (in binary)? Defend your answer.

Ans.

The value of a checksum can be all 0s. This happens because the value of the wrapped sum is all ones (taking the one's complement of the wrapped sum). However the value of the checksum cannot be all 1s, because then the wrapped sum should be all 0s. This means that the data unit is zero.

Q3. If we want to be able to detect two bit error, what should be minimum Hamming distance?

Ans.

To detect error the minimum Hamming distance should be:

$d_{min}=s+1$; where s is the number of bits in the data.

Therefore, $d_{min}=3$ bits

Q4. A category of error detecting (and correcting) called Hamming code is a code in which $d_{min}=3$.This code can detect upto two errors (or correct one single error). In this code, the values of n, k and r are related as: $n=2^r-1$ and k=n-r. Find the number of bits in the dataword and codeword if r is 3.

Ans.

Codeword, $n=2^3-1 =7$ bits

Dataword, k=7-3=4 bits

Q5. In a codeword we add two redundant bits to each 8 bit dataword. Find the number of

a. Valid codeword
b. Invalid codeword

Ans.

Dataword, k=8 bits

Codeword, n=k+r =8+2= 10bits

a. Number of valid codewords=2^k= 256 words

b. Number of invalid codewords= 2^n-2^k =2^{10}-2^8 =768 words

Q6. In CRC, which of the following generators (divisors) guarantees the detection of a single bit error?

a. 101

b. 100

c. 1

Ans.

Both a and b are able to detect are able to detect error of size 2 bits. c cannot detect any error.

Q7. What is the minimum number of bits in a PN sequence if we use FHSS with a channel bandwidth of B=8 Khz and B_{ss}=100 Khz?

Ans.

Bandwidth B= 8 KHz

Spread Bandwidth B_{ss}=100 KHz

The number of hops= 100/8=12.5

So we need $\log_2(12.5)$=3.64 bits = 4 bits

Q8. We need to use synchronous TDM and combine 40 digital sources, each of 100 Kbps. Each output slot carries 1 bit from each digital source, but one extra bit is added to each frame for synchronization. Answer the following questions:

a. What is the size of the output frame in bits?

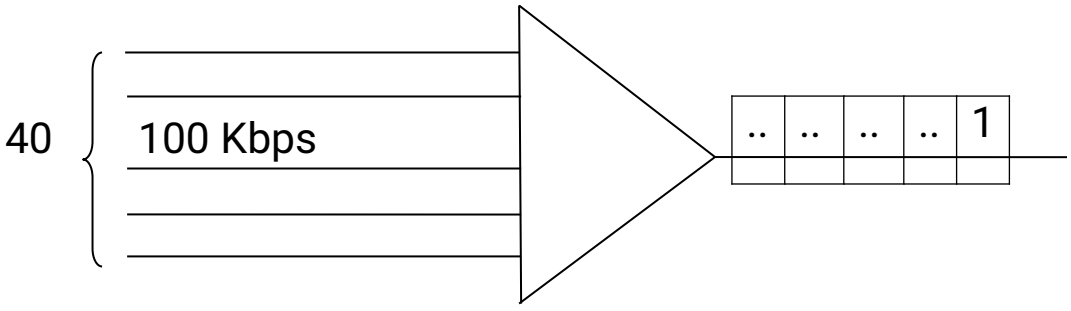
b. What is the output frame rate?

c. What is the duration of an output frame?

d. What is the output data rate?

e. What is the efficiency of the system (ratio of useful bits to the total number of bits)?

Ans.



a. Frame size=40+1=41 bits

b. Frame rate=1/(frame duration)= 10000 frames/sec

c. Frame duration=1/(frame rate)= 0.01 msec

d. Output data rate= frame rate* frame size=$100*10^3$ *41= 4.1 Mbps

e. Efficiency= 40/41*100=97.561%

Q9. Assume that a voice channel occupies a bandwidth of 4 Khz. We need to multiplex 12 voice channels with guard bands of 500Hz using FDM. Calculate the required bandwidth.

Ans.

Net bandwidth required= 4000*12+ 11*500 =53.5 Khz

Q10. Ten sources, six with a bit rate of 200 Kbps and four with a bit rate of 400 Kbps are to be combined using multilevel TDM with no synchronizing bits. Answer the following questions about the final stage of the multiplexing:

a. What is the size of a frame in bits?

b. What is the frame rate?

c. What is the duration of a frame?

d. What is the data rate?

Ans.

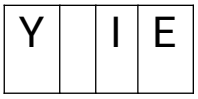
a. Each output frame carries 1 bit from each of the seven 400-kbps line frame size = 7*1 = 7 bits.

b. Frame rate = 400,000 frames/s.

c. Frame duration = 1 /(frame rate) = 1 /400,000 = 2.5 μs.

d. Output data rate = (400,000 frames/s) × (7 bits/frame) = 2.8 Mbps

Q 11. Show the contents of the five output frames for synchronous TDM multiplexer that combines four sources sending the following characters.



Note the characters are send in the order they are typed. The third source is silent.

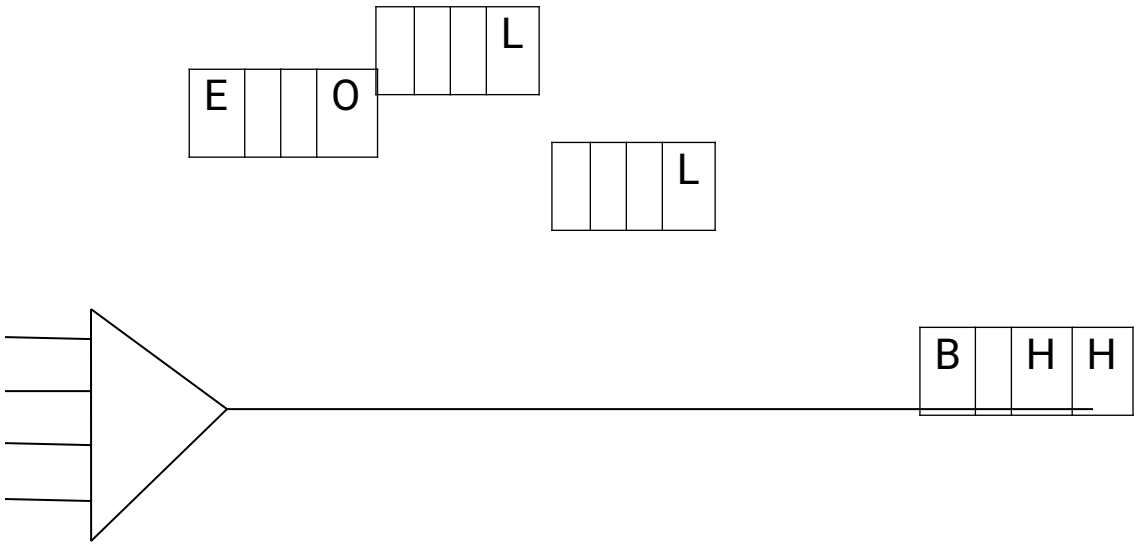
a. Source 1: HELLO

b. Source 2: HI

c. Source 3:

d. Source 4: BYE

Ans.



Each conversation gets an 8-bit time slot in each frame. There are 8,000 frames per second. So each conversation gets 64 Kbps.

Q12. Two channels, one with a bit rate of 190 Kbps and another with a bit rate of 180 Kbps, are to be multiplexed using pulse stuffing TDM with no synchronization bits. Answer the following questions:

a. What is the size of a frame in bits?

b. What is the frame rate?

c. What is the duration of the frame?

d. What is the data rate?

Ans.

a. The frame carries 1 bit from each source. Frame size =2 bits.

b. Frame rate = 190,000 frames/s.

c. Frame duration = 1 /190,000 = 5.3 μs.

d. Output data rate = (190,000 frames/s) × (2 bits/frame) = 380 kbps.