Assignment Chapter-2

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1 Task

A noiseless 4-kHz channel is sampled every 1 msec. What is the maximum data rate? How does the maximum data rate change if the channel is noisy, with a signal-to-noise ratio of 30 dB?

1.1 Solution

1. Let us assume that binary data are transmitted via the connection. Due to Nyquist rule bit rate should be 2 times larger than available channel bandwidth. Thus:

$$C = 2H \times log_2(v) = 2 \times 4 \times 10^3 \times log_2 2 = 8Kbps \quad (1)$$

2. Due to the Shannon formula we got the following formula:

$$C = H \times log_2(1 + S/N) = 4 \times 10^3 \times log_2(1 + 10^{30/10}) \approx 39.87Kbps \quad (2)$$

Answers: 1)8 Kbps; 2)39.87 Kbps

2 Task

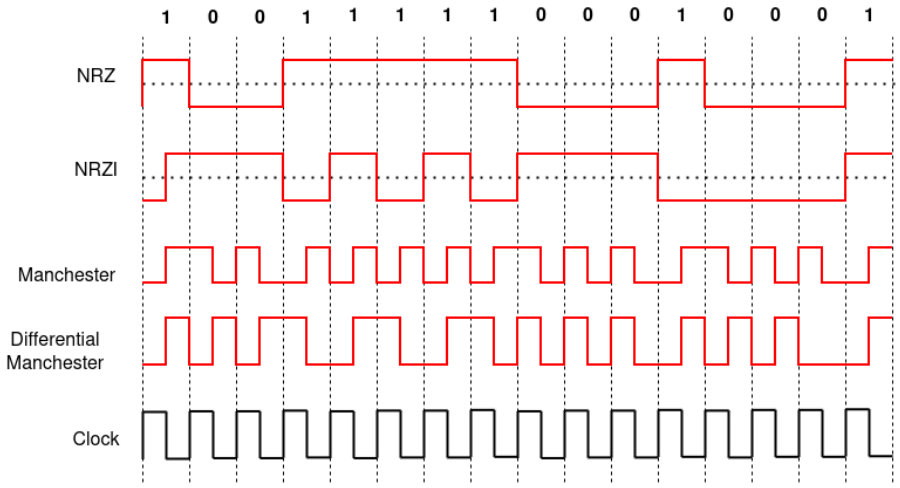

Figure 1: Solution

3 Task

What are the disadvantages of Manchester Encoding?

3.1 Answer

1. It requires much more bandwidth
2. Manchester encoding has a lower bit in comparison with others.So it takes more time to transmit data.
3. Because of frequent voltage transitions, on the long distances the signal loses its strength
4. At least we have one transition per bit time and maximum two transitions

At least one transition per bit time and possibly two
Bandwidth inefficient: 50%

4 D

A total of four stations perform code division multiple access CDMA communication. The chip sequences of the four stations are:
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)
Station X now receives such a chip sequence: (-1 +1 -3 +1 -1 -3 +1 +1). Which stations transmitted, and which bits did each one send?

4.1 Solution

In order to define which station take part in communication, we will compute the dot product of the result and each station chip sequence, and divide by its length.

$$\begin{pmatrix} -1 & -1 & -1 & 1 & 1 & -1 & 1 & 1 \\ -1 & -1 & 1 & -1 & 1 & 1 & 1 & -1 \\ -1 & 1 & -1 & 1 & 1 & 1 & -1 & -1 \\ -1 & 1 & -1 & -1 & -1 & -1 & 1 & -1 \end{pmatrix} \times \begin{pmatrix} -1 \\ +1 \\ -3 \\ +1 \\ -1 \\ -3 \\ +1 \\ +1 \end{pmatrix} = \begin{pmatrix} 1 \\ -1 \\ 0 \\ 1 \end{pmatrix}$$

Thus, only **A**, **B**, and **D** stations took part in data transition

Answer: A + $\overline{B}$ + D