

Ans to the Question 01

The smallest element representing a bit of information is a data element. Digital signals are made up of signal elements. The data elements are what we need to send, while the signal elements are what we can send. Signal elements are carriers, whereas data elements are being carried.

Ans to the Question 02

As the system is using NRZ-I line encoding to transfer data with a 1 MHz bandwidth we can say the data rate will be $N \times 2$ or 2 Mbps.

Ans to the Question 03

Bipolar Schemes

In bipolar encoding (sometimes called multilevel binary), there are three voltage levels, positive, negative, and zero. The voltage level for one data element is at zero, while the voltage level for the other element alternates between positive and negative.

AMI and Pseudoternary: The following figure shows two variations of bipolar encoding: AMI and pseudo ternary.

A common bipolar encoding scheme is called bipolar alternate mark inversion (AMI). In alternate mark inversion, a neutral zero voltage represents binary 0. Binary 1s are represented by alternating positive and negative voltages.

A variation of AMI encoding is called Pseudoternary in which the 1 bit is encoded as a zero voltage and the 0 bit is encoded as alternating positive and negative voltages.

The bipolar scheme was developed as an alternative to NRZ. The bipolar scheme has the same signal rate as NRZ, but there is no DC component. The NRZ scheme has most of its energy concentrated near zero frequency, which makes it unsuitable for transmission over channels with poor performance around this frequency. The concentration of the energy in bipolar encoding is around frequency $N/2$.

Ans to the Question 04

The subsequent methods can be utilized for Analog to Digital Conversion:

1 - PULSE CODE MODULATION:

The most typical method to change an analog signal to digital data is named pulse code modulation (PCM). A PCM encoder has the subsequent three processes:

- Sampling
- Quantization
- Encoding

2 - DELTA MODULATION :

Since PCM is a very complicated method, other methods have been designed to relieve the complexity of PCM. The most spartan is delta Modulation. Delta Modulation finds the change from the earlier value.

3 - ADAPTIVE DELTA MODULATION:

By making the modulator's step size time-varying, the performance of a delta modulator can be significantly improved. When a message has a steep slope of modulating signal, the step size is larger, and when the slope is small, the step size is smaller. This adaptation is dependent upon the level of the input signal. It is called adaptive delta modulation (ADM).

Ans to the Question 04

In a scrambling technique, the number of bits is not increased and the information is synchronized. Using a technique like Bipolar AMI(Alternate Mark Inversion) results in synchronization issues due to the continuous sequence of zero's. Scrambling is one method for solving this issue.

A scrambling is designed to remove long strings of ones (1s) and zeroes (0s) from digital binary data. In physical layer transmitters, scramblers are used, while in receivers, descramblers are used. Because of the scrambling, the bit rate does not change, i.e. the input and output bits are the same size.

Coding blocks aid in the detection of errors and retransmission of signals. By replacing each m-bit data group with an n-bit data group, it is commonly referred to as mB/nB coding. As such, it adds extra bits (redundancy bits) that help in synchronizing the receiver and sender and also provide error detection.

It normally involves three steps: division, substitution, and combination. In the division step, a sequence of bits is divided into groups of m -bits. In the substitution step, we substitute an m -bit group for an n -bit group. Finally, the n -bit groups are combined together to form a stream that has more bits than the original bits.