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DATA COM WK5

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1.

In a modern office environment, multiple computers, printers, and servers rely on Ethernet connections to share data efficiently. When a computer sends information across the network, the data must be converted into a form suitable for transmission over copper cables or fiber optics. This process begins with encoding, where digital bits (0s and 1s) are represented using specific voltage patterns or light pulses. For example, Manchester encoding ensures synchronization by assigning each bit a unique transition in the signal. Modulation techniques further adapt these signals to minimize errors and interference across physical media. In this scenario, an employee uploading a large file to a shared server sees the data broken into packets, encoded for transmission, and sent across the Ethernet cable. The receiving device decodes and reconstructs the original file seamlessly. Without effective encoding and modulation, data collisions, noise, and signal degradation would disrupt network reliability.

2.

Quadrature Amplitude Modulation (QAM) is a widely used modulation technique in digital communications. It combines two methods—amplitude modulation (AM) and phase modulation (PM)—to transmit data more efficiently. QAM works by varying both the amplitude and the phase of a carrier signal, creating unique "signal points" that represent groups of bits. For example, in 16-QAM, 16 distinct signal combinations can be used, allowing 4 bits to be transmitted per symbol. Higher-order QAM systems, such as 64-QAM or 256-QAM, can transmit even more bits per symbol, significantly increasing data rates. This makes QAM ideal for applications like broadband internet, Wi-Fi, cable television, and 4G/5G mobile networks. However, as QAM levels increase, signals become more sensitive to noise and interference, requiring a high signal-to-noise ratio (SNR) for accuracy. Overall, QAM plays a crucial role in balancing data speed and reliability, making it a cornerstone of modern digital communication systems

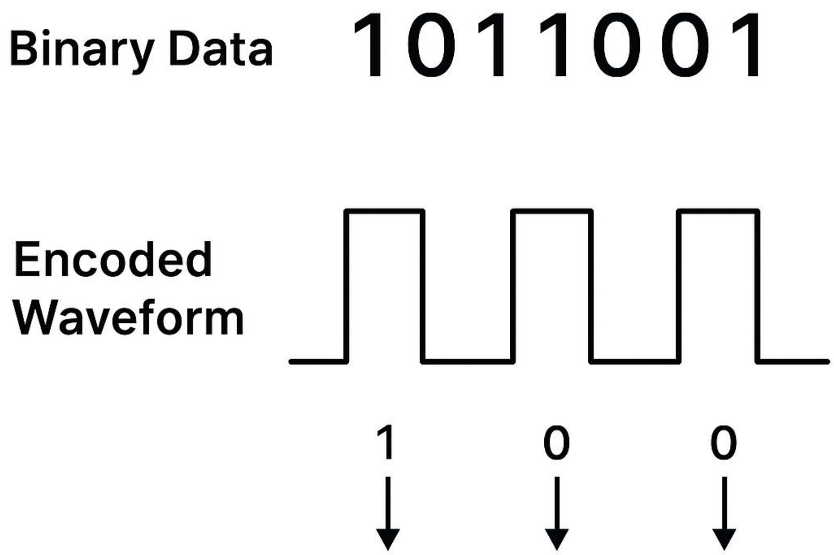
3.

Using the Falstad circuit simulator to explore Phase Shift Keying (PSK) provided a hands-on way to understand digital modulation. I built a simple setup where a carrier sine wave was generated and its phase was shifted depending on the input digital signal. For example, a

binary “0” might keep the wave in its original phase, while a binary “1” shifted it by 180 degrees. Watching the waveform on the virtual oscilloscope made it easier to connect theory with practice. The transitions in the phase clearly showed how information can be carried without changing amplitude or frequency. At first, aligning the input bitstream with the carrier signal required adjustment, but once synchronized, the results became very clear. This simulation reinforced how PSK is efficient for transmitting data while resisting noise. Overall, Falstad proved to be a useful tool for visualizing abstract communication concepts in a simple and interactive environment

4.

The encoding waveform diagram created in Draw.io illustrates how digital data is represented as electrical signals during transmission. In the design, a binary data stream such as “1011001” is shown at the top. Below it, the corresponding encoded waveform is drawn using Manchester encoding, where each bit is represented by a voltage transition. A binary “1” is shown as a high-to-low transition, while a binary “0” is represented as a low-to-high transition within one clock cycle. The waveform is aligned with a timing reference, showing how synchronization between sender and receiver is achieved. Arrows and labels highlight the mapping between bits and signal transitions. The purpose of this diagram is to visually demonstrate how abstract binary values are transformed into practical signals suitable for transmission over Ethernet cables or other media. By using Draw.io, the encoding process becomes clearer, helping students connect theory with visualization.


Binary Data
1011001
Encoded
Waveform
1
0
0