Experiment No. -10

Experiment Title: Study of Differential Manchester Code in Data Communication

Objective: The primary objective of this experiment is to study the principles and performance characteristics of the Differential Manchester encoding scheme in data communication. Differential Manchester encoding is a technique used for binary data transmission, providing advantages such as synchronization and error detection. The experiment aims to understand the encoding and decoding processes, evaluate the efficiency of the scheme, and observe its behavior under different conditions.

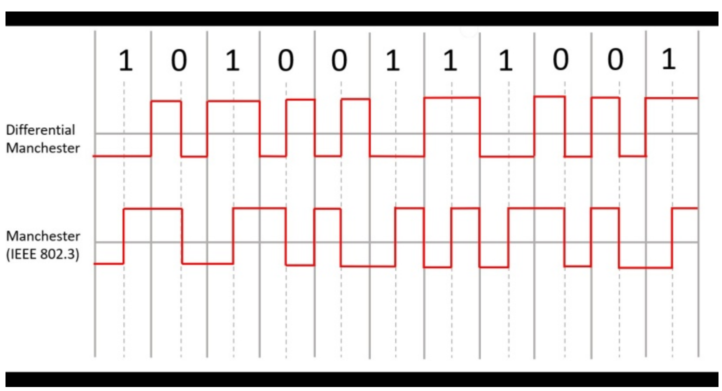
Equipment and Materials:

1. Computers or devices with network interfaces
2. Network simulation software (e.g., Cisco Packet Tracer, GNS3)
3. Ethernet cables
4. Data communication devices (such as PCs or laptops)
5. Oscilloscope or signal analyzer
6. Differential Manchester encoder/decoder (if available)
7. Signal generator (if available)

Differential Manchester encoding is a type of Manchester encoding, a digital signaling scheme used for data transmission. Unlike basic Manchester encoding, which uses both transitions (low to high or high to low) within each bit period, Differential Manchester encoding relies on transitions to represent the data.

In Differential Manchester encoding, the information is conveyed based on the presence or absence of transitions at the middle of each bit period. It ensures a clear distinction between 0s and 1s and provides self-clocking, making it easier for the receiver to synchronize with the incoming data.

Here's a detailed explanation of how Differential Manchester encoding works:



1. **Bit Representation:**
    - Each bit period is divided into two halves: the first half and the second half.
    - A transition at the middle of the bit period represents one type of bit (either 0 or 1), while the absence of a transition represents the other type.
2. **Transition Rules:**
    - For a "0" bit:
        - If the previous bit was a "0," a transition occurs in the middle of the bit period.
        - If the previous bit was a "1," there is no transition in the middle of the bit period.
    - For a "1" bit:
        - If the previous bit was a "0," there is no transition in the middle of the bit period.

    - If the previous bit was a "1," a transition occurs in the middle of the bit period.
3. **Waveform Examples:**
    - Consider the following scenarios:
        - If the previous bit is 0, and the current bit is 0, there is a transition in the middle.
        - If the previous bit is 0, and the current bit is 1, there is no transition in the middle.
        - If the previous bit is 1, and the current bit is 0, there is no transition in the middle.
        - If the previous bit is 1, and the current bit is 1, there is a transition in the middle.
    - This pattern ensures that each bit period has a transition, either from high to low or low to high, and the absence or presence of the transition indicates the value of the current bit.
4. **Advantages:**
    - **Self-Clocking:** The receiver can synchronize with the incoming data by detecting transitions, making clock recovery more straightforward.
    - **Reliable Data Transmission:** The clear distinction between 0s and 1s, combined with self-clocking, enhances the reliability of data transmission.
5. **Disadvantages:**
    - **Double the Bit Rate:** The bit rate of the signal is double the original data rate, as each bit is represented by two signal transitions.

In summary, Differential Manchester encoding is a differential encoding scheme that provides reliable data transmission by utilizing transitions in the middle of each bit period to represent information. Its self-clocking feature simplifies the synchronization process for the receiver.

Experimental Setup:

1. **Differential Manchester Encoding:**
    - Set up a simple network topology with at least two nodes capable of data communication.
    - Implement Differential Manchester encoding on the transmitting node.
    - Configure the encoding parameters such as bit rate, signal levels, and initial conditions.
2. **Frame Transmission:**
    - Generate binary data frames for transmission from the transmitting node.
    - Implement the encoding scheme to convert the binary data into Differential Manchester-encoded signals.
3. **Decoding Process:**
    - Implement Differential Manchester decoding on the receiving node.
    - Configure the decoding parameters to synchronize with the transmitted signal.
    - Record the decoded binary data at the receiving end.
4. **Signal Analysis:**
    - Use an oscilloscope or signal analyzer to visualize and analyze the Differential Manchester-encoded signals.
    - Observe the waveform and identify key features such as the transition points and signal structure.
5. **Performance Metrics:**
    - Measure the bit error rate (BER) by intentionally introducing noise or errors into the transmission.
    - Evaluate the synchronization capabilities of Differential Manchester encoding under varying conditions.
6. **Varying Conditions:**
    - Introduce variations in signal quality, such as changes in amplitude, phase, or noise levels.

- Evaluate the robustness of the Differential Manchester encoding scheme under these conditions.

Data Collection and Analysis:

1. Record the encoded and decoded signals for analysis.
2. Document the bit error rate and synchronization performance under different conditions.
3. Compare the observed performance with theoretical expectations for Differential Manchester encoding.

Conclusion: Summarize the findings of the experiment, highlighting the efficiency and characteristics of Differential Manchester encoding. Discuss its advantages, limitations, and applicability in practical data communication scenarios. Provide recommendations for using Differential Manchester encoding based on the experiment results and identify potential areas for further research or improvement.