

Introduction

In digital communication, data transmitted over networks can be corrupted due to noise or interference. To make sure that the messages are received correctly, we should apply error-detection methods. In this project, we simulate the transmission of 8-byte binary messages from Bob to Alice over a noisy network and apply error-detecting code 'Parity Check' to ensure message integrity.

Types of Errors

Single-bit Error: it is when only one bit in a data unit is altered (flipped from $0 \rightarrow 1$ or $1 \rightarrow 0$).

It is most common in low-noise networks.

Multiple-bit Error: it is when two or more bits in a data unit are altered.

It happens due to bursts of interference.

Burst Error: it is when multiple consecutive bits in a data transmission are corrupted, leading to a sequence of incorrect values.

It is harder to detect and correct than isolated errors.

Error-Detection Methods

Parity Check

Adds an extra bit to make the total number of 1s either even or odd

Simple to implement; detects all single-bit errors.

Limitation: cannot reliably detect multiple-bit errors.

Checksum

Adds the sum of all bytes modulo a number as a check value.

Detects many errors, including some multiple-bit errors.

Limitation: not foolproof for complex errors as collisions may occur.

Cyclic Redundancy Check (CRC)

Uses polynomial division to generate a checksum.

Very reliable, widely used in network protocols.

Limitation: more complex to implement manually.

Hamming Code

Adds multiple parity bits to detect and correct single-bit errors.

Limitation: increases message size; more complex than simple parity

Chosen Error-Detection Method

I chose a parity byte (XOR of all 8 bytes) as the error-detecting code as it is simple to implement from scratch and detects all single-bit errors in the 8-byte message, but it can't correct errors and can't reliably detect multiple-bit errors.

Conclusion

The parity byte provides an effective demonstration of error detection. While it can't correct errors or detect multi-bit errors, it adds an error-detecting code to each message, allows the receiver to check for message integrity and simulates transmission errors and demonstrates detection clearly.