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Orthogonal Frequency Division Multiplexing (OFDM) Modulation and Demodulation Implementation

In this work, modulation and demodulation of the **Orthogonal Frequency Division Multiplexing (OFDM)** multi-carrier system was implemented, and **Bit Error Rate (BER)** performance was evaluated for different **Signal-to-Noise** ratios.

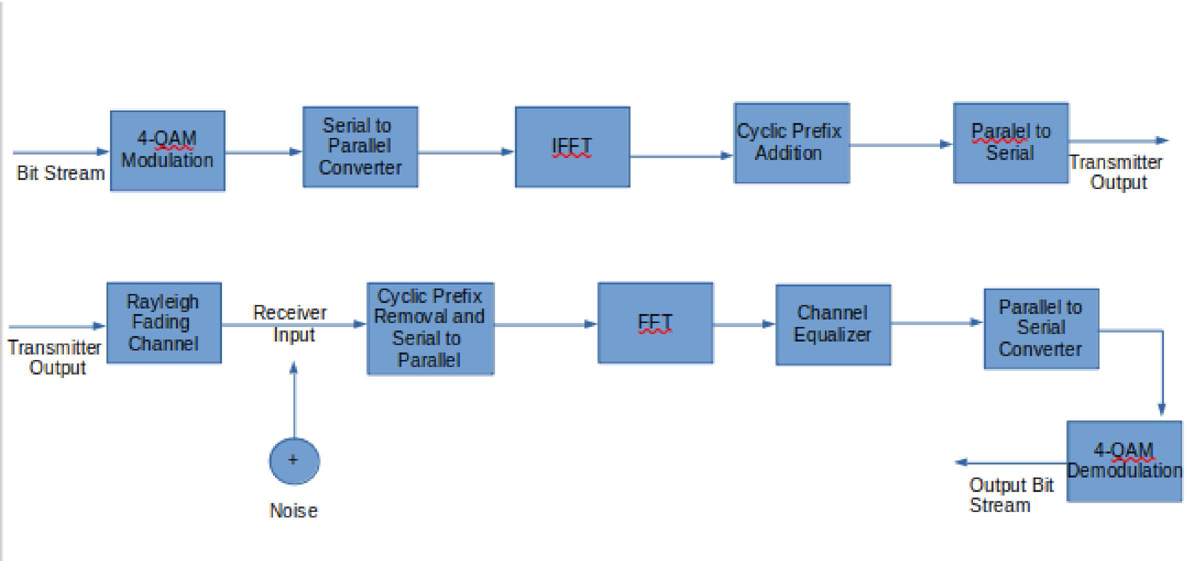

Figure 1. OFDM Modulation and Demodulation Block Diagram

System Design

The input bit stream is modulated by **4-QAM** modulation scheme where, **M = 4** and each **k = log$_2$M = 2** bits are mapped to 4 different complex signals, **q_m** = $\pm 1 + \pm j1$, m = 0,1,2,3. **OFDM** is employed by using **Fast Fourier Transform (FFT)** and **Inverse Fast Fourier Transform (IFFT) algorithm.** The sub-carrier number is **N**, so **N** parallel **QAM** modulated signals are sent at the same time through **N** sub-channels. The cyclic prefix is added to provide **guard-band** and degrade **Inter-symbol Interference (ISI).** In OFDM, all sub-channels can be treated as narrow-band so they all have linear phase. The received signal is,

$R_i = T_i * H_i + N_i$ where, **T_i** is the transmitted symbol, **H_i** is the each sub-channel in frequency and **N_i** is the noise component for each sub-channel in frequency domain.

Simulation Results

The simulation was carried out in **MATLAB** environment. The number of sub-carriers are **N = 256.** The cyclic prefix number is **64.** The three tap Rayleigh Fading Channel model was used. Power delay profile is given as, **[0.7071 0.4472 0.5477].** The number of **Monte Carlo** simulations were **1000** and each simulation, **512** bits were sent. **SNR** values were selected from **0** to **25** in increments of **5.**

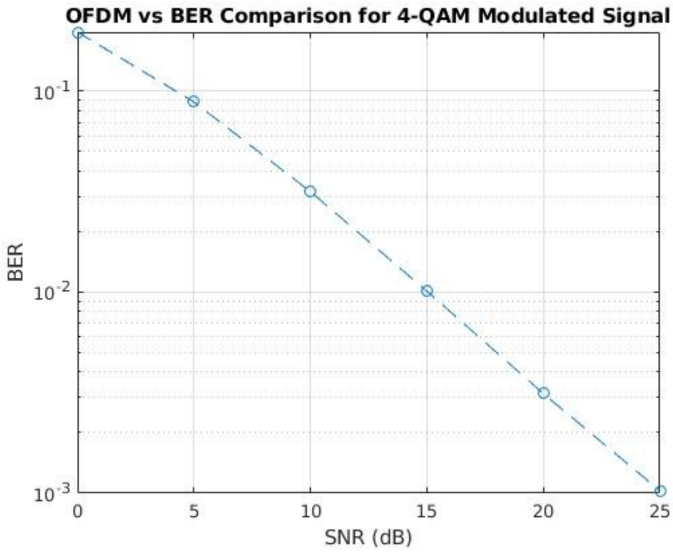

Figure 2. OFDM vs Bit Error Rate

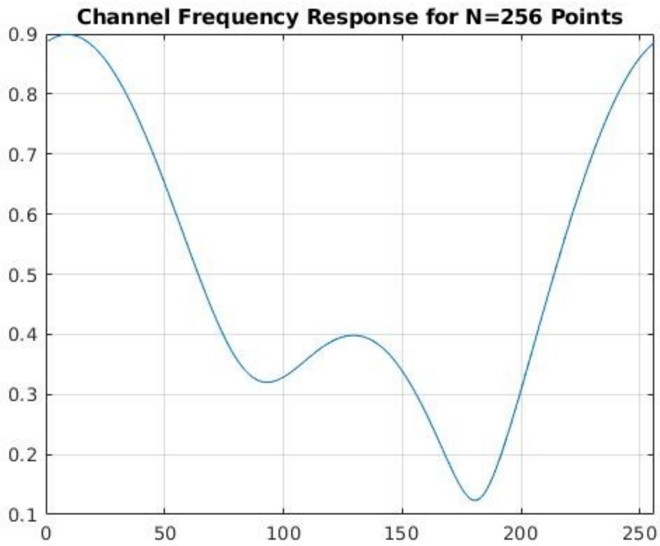

Figure 3. Rayleigh Fading Channel