# Performance Analysis of Wavelet OFDM (WOFDM)

By
Asma Latif
Dr. N.D. Gohar

# Presentation Outline

- Brief Overview of Classical OFDM
- Wavelet Theory
- Wavelet implementation using FB
- Approach
- WOFDM
- Limitations
- Results

# Classical OFDM

- Orthogonality is achieved via IFFT and FFT
- Uses CP to combat channel impairments
- Reduces the BW Efficiency by factor $N/N+N_{CP}$
- No equalization or simple equalization needed at the receiver

# Shortcomings of Fourier Transforms

- Does not gives good information if the frequency components of the signal varies with time
- Transform is localized at $f_0$ iff x[n] is infinite
- A Solution:
  - **Short Time Fourier Transform**: Windowed Version of DFT
    - The Time Frequency Grid is uniform for all frequency and time
- Another Solution :Wavelet Transform
  - Both Frequency and Time Localization

# Wavelet Transform

$$s_n^m = \int_{-\infty}^{\infty} s(t) 2^{m/2} \psi(2^m t - n) dt$$

Wavelet Function

$$s(t) = \sum_{m=-\infty}^{\infty} \sum_{n=-\infty}^{\infty} s_n^m 2^{m/2} \psi(2^m t - n)$$

$$a_n^{m+1} = \int_{-\infty}^{\infty} s(t) \phi_n^{m+1}(t) dt$$

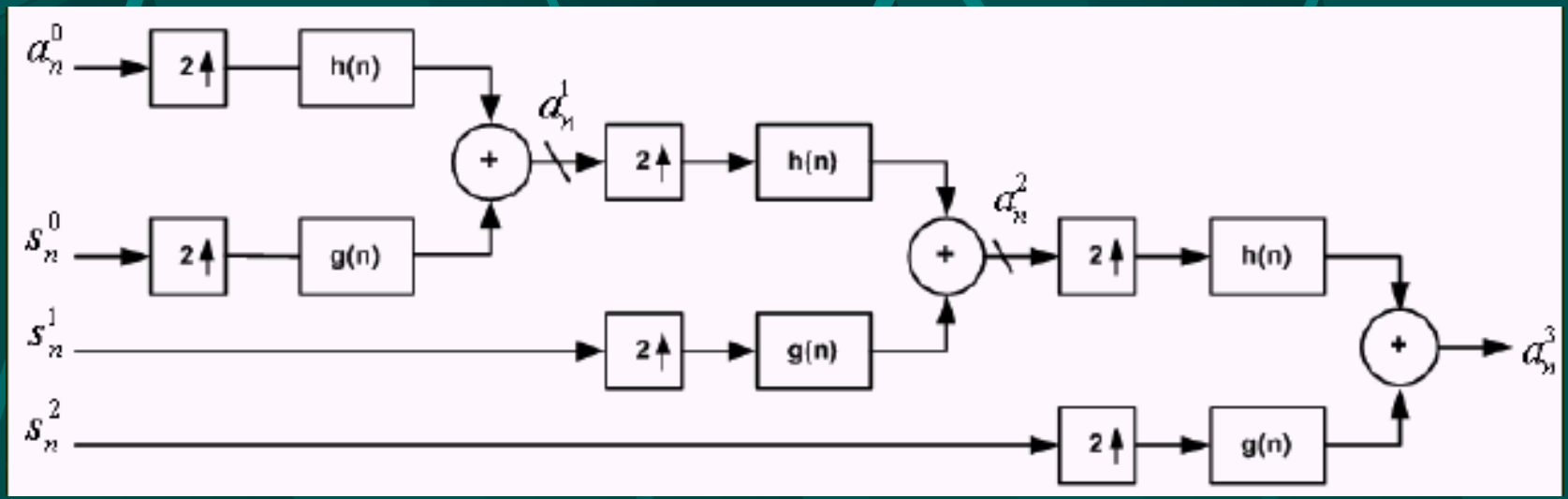
Scaling Function

$$A_{m+1} s(t) = \sum_n a_n^{m-1} \phi_n^{m+1}(t)$$

# Properties of Wavelet Transforms

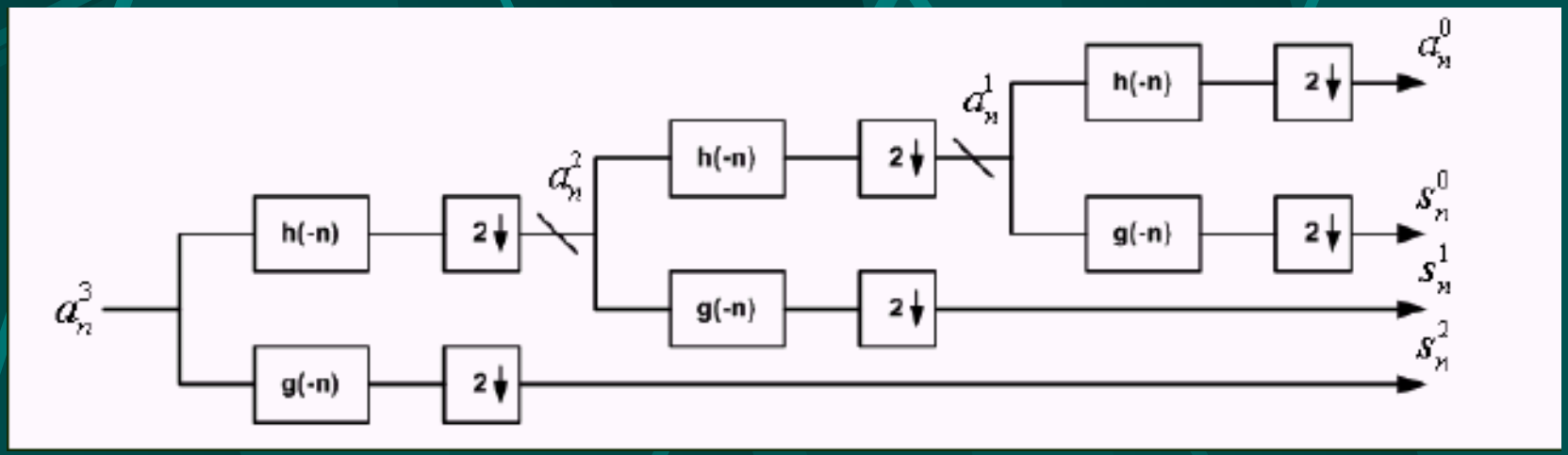
- Due to higher spectral containment property of wavelets, it is better to ameliorate the effects of narrowband interference
- Better Frequency and Time Localization
- Orthogonality

# Filter Bank Implementation- Synthesis FB



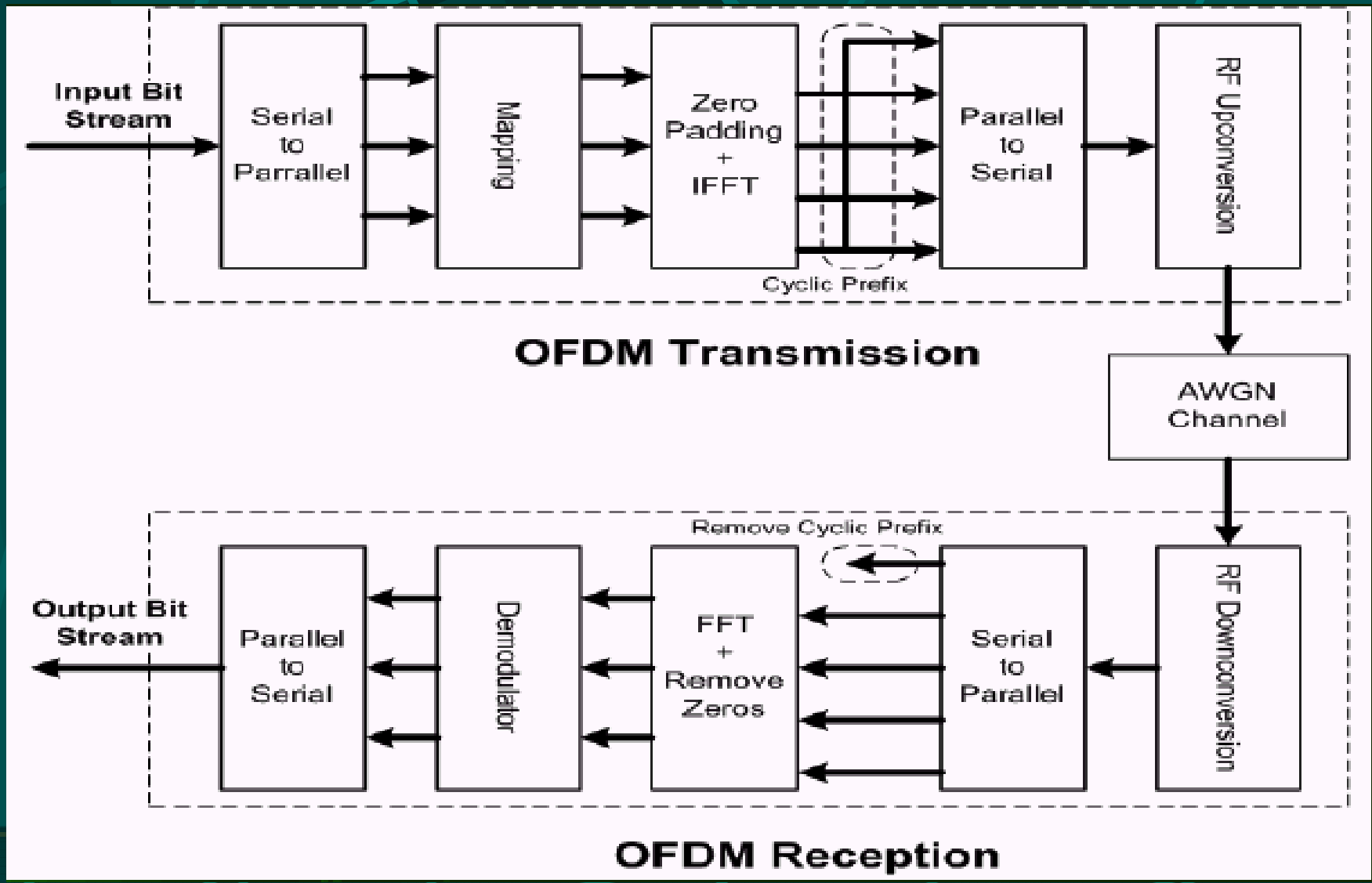

$$a_n^{m+1} = \sum_l h(2l-n)a_l^m + \sum_l g(2l-n)s_l^m$$

# Filter Bank Implementation- Analysis FB

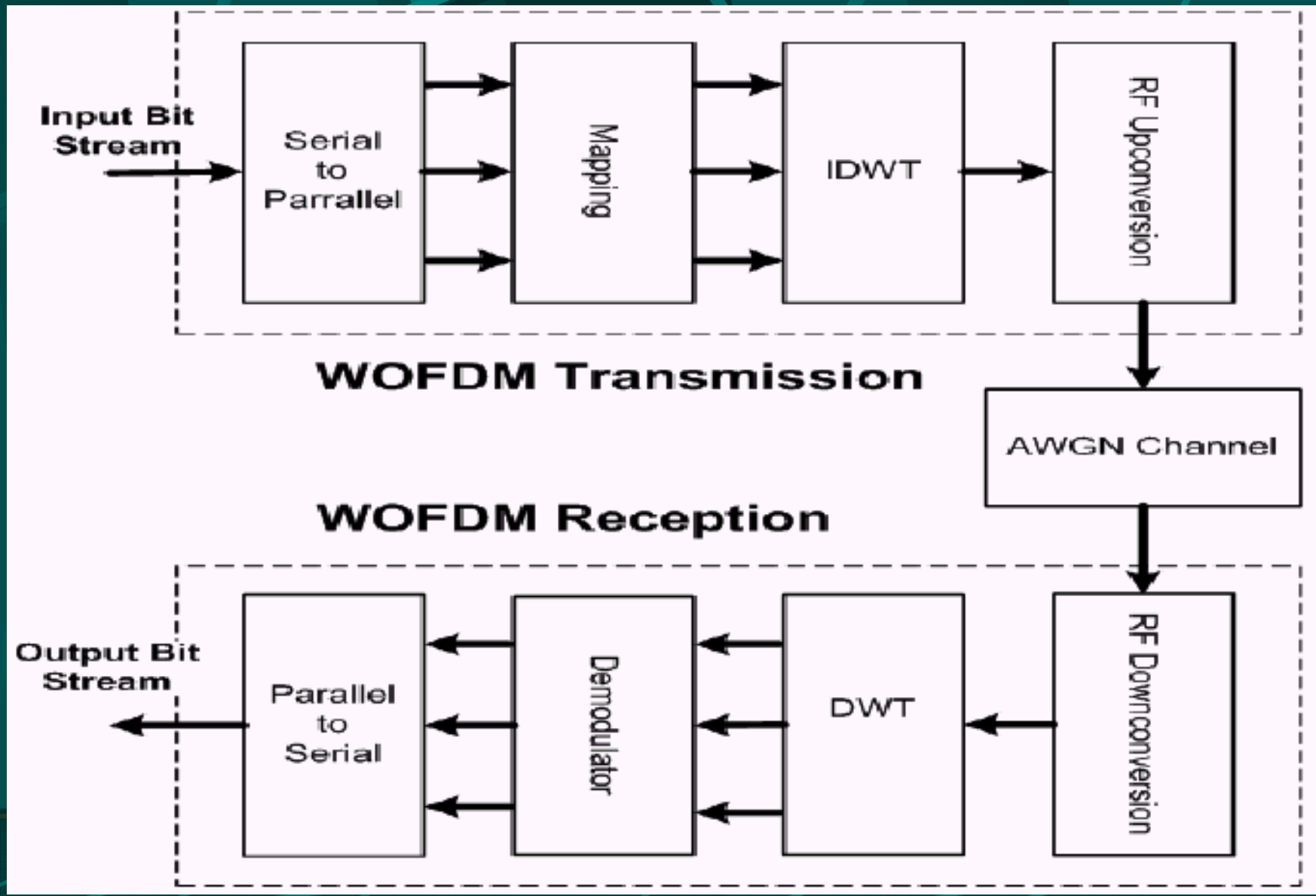



$$a_n^m = \sum_l h(l-2n)a_l^{m+1} \qquad s_n^m = \sum_l g(l-2n)a_l^{m+1}$$

# Classical OFDM

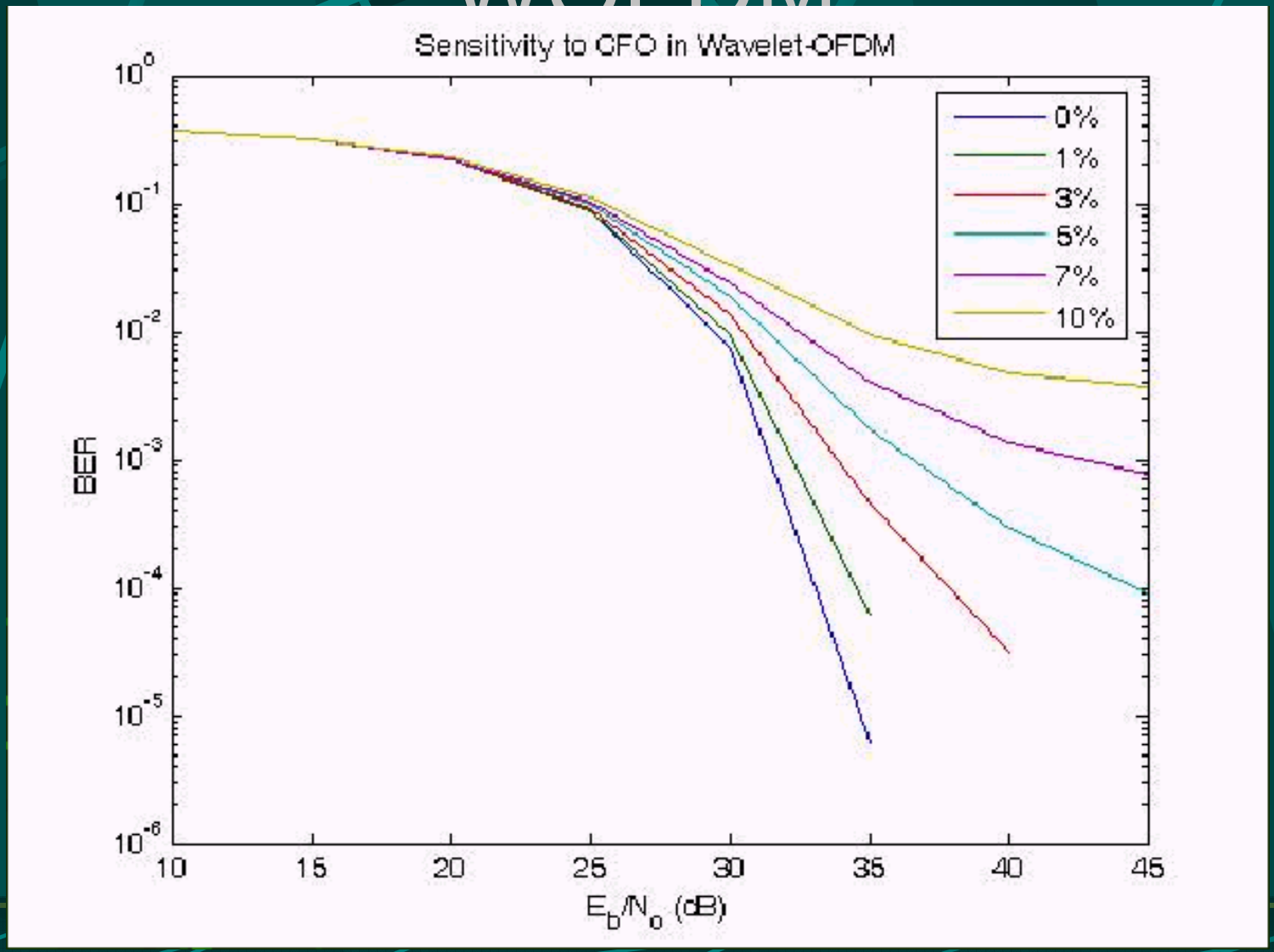


# Wavelet OFDM

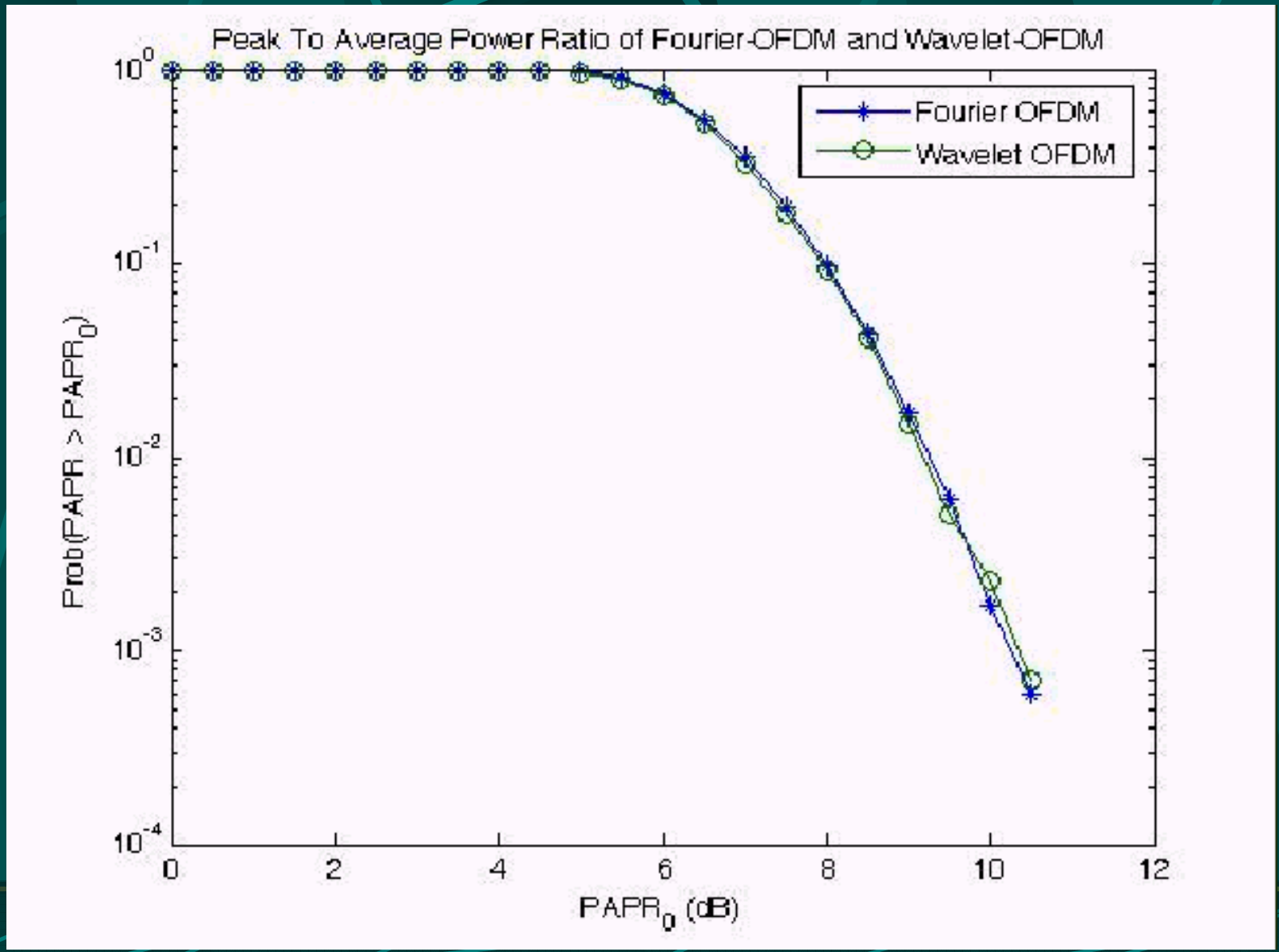


# WOFDM Limitations

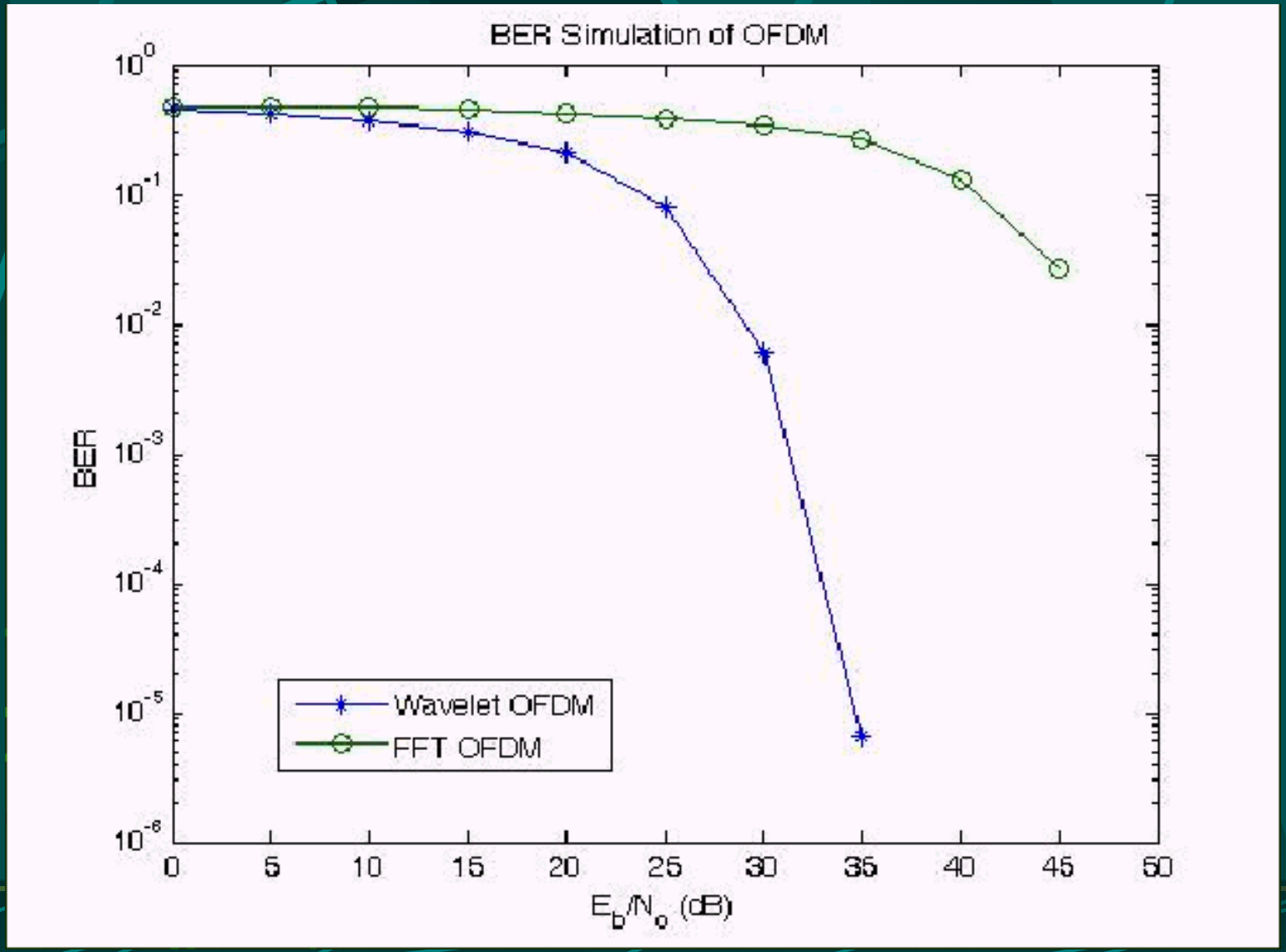
# Sensitivity of CFO for WOFDM



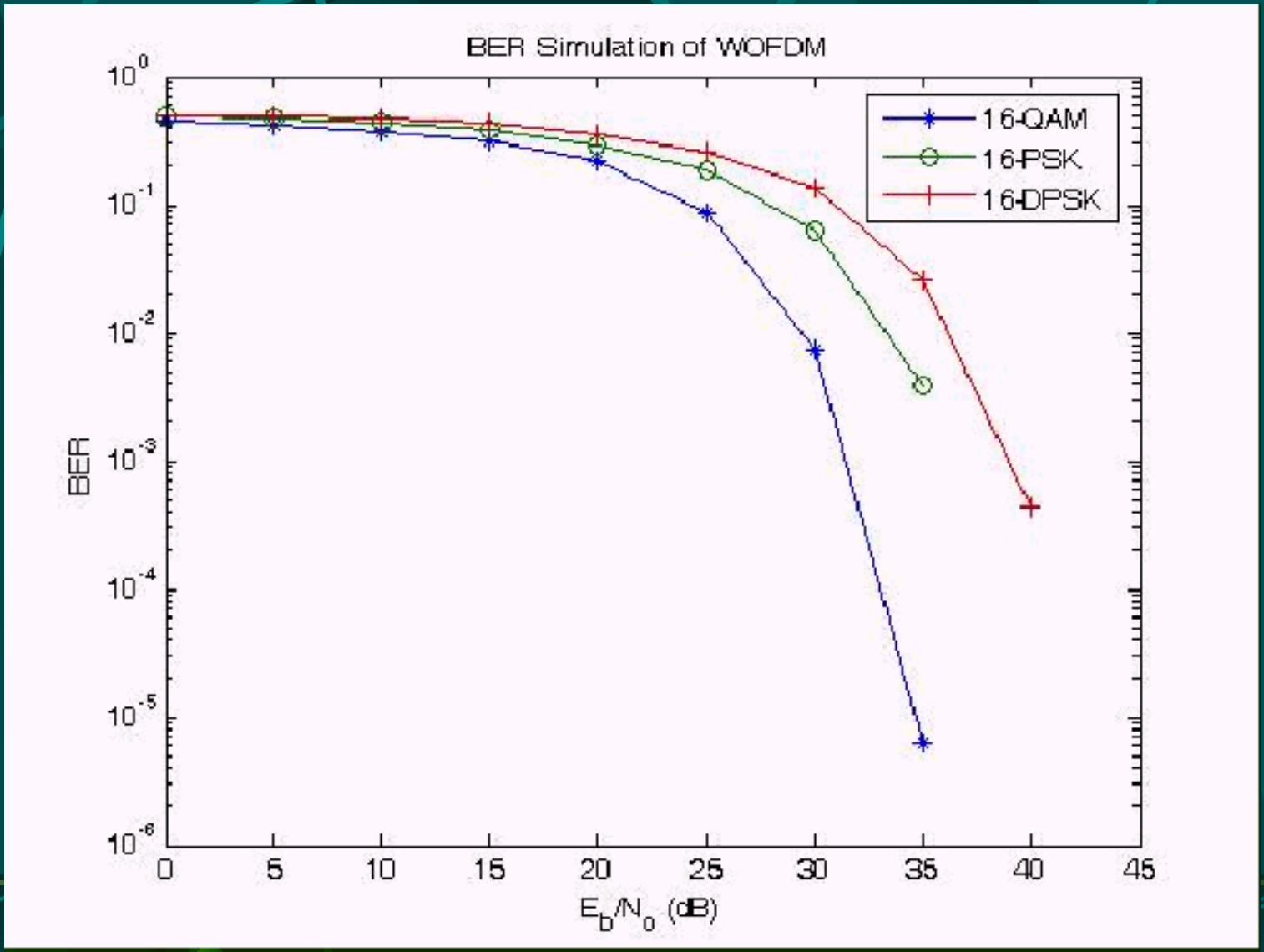
# High PAPR for WOFDM and OFDM



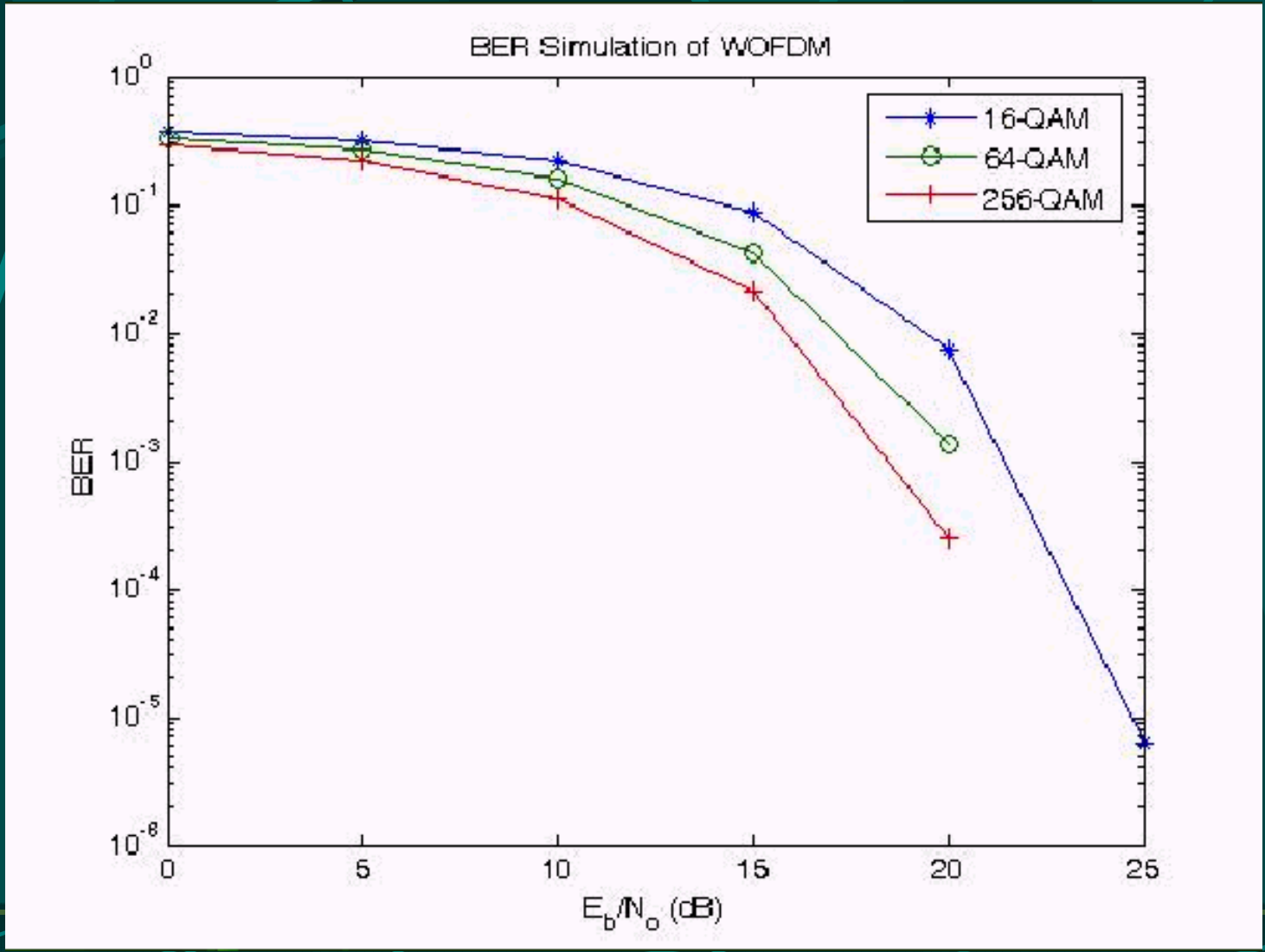
# Performance Analysis



# Performance Analysis [2]



# Performance Analysis [3]



# Thank You