

Performance Analysis of Wavelet OFDM (WOFDM)

By

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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 give 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

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

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

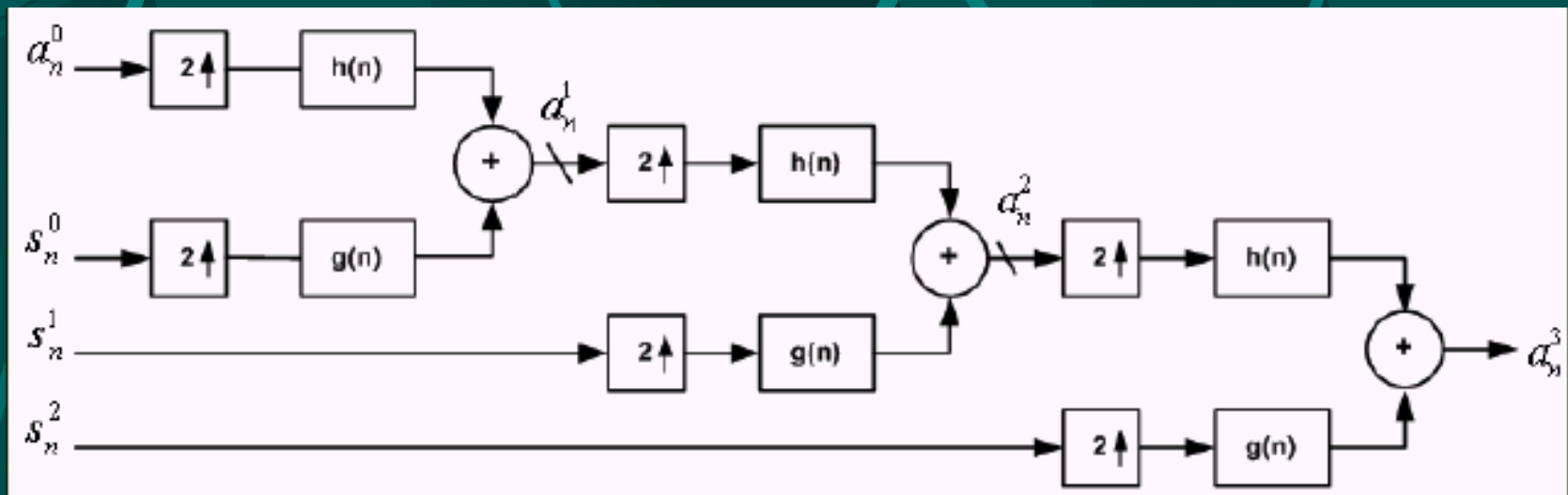
Scaling Function

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

Properties of Wavelet Transforms

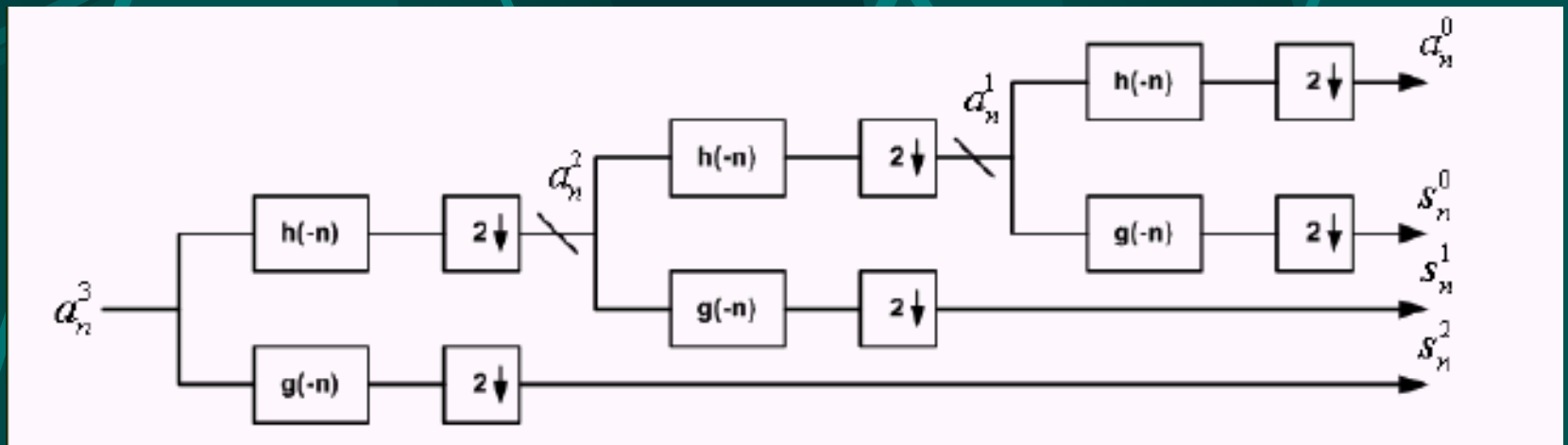
- Due to higher spectral containment property of wavelets, it is better to ameliorate the effects of narrowband interference
- Better Frequency and Time Localization
- Orthogonality

Filter Bank Implementation- Synthesis FB



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

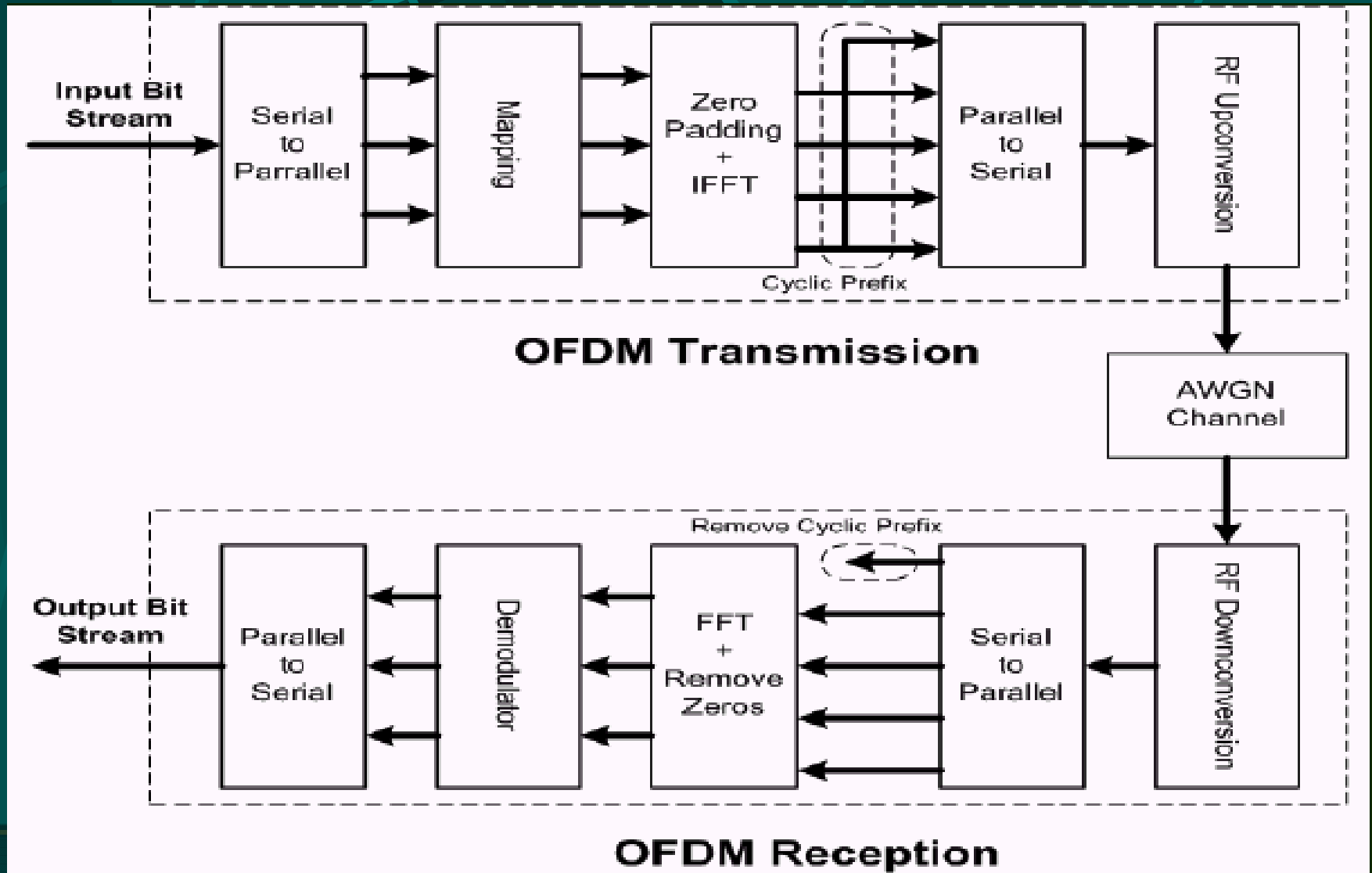
Filter Bank Implementation- Analysis FB



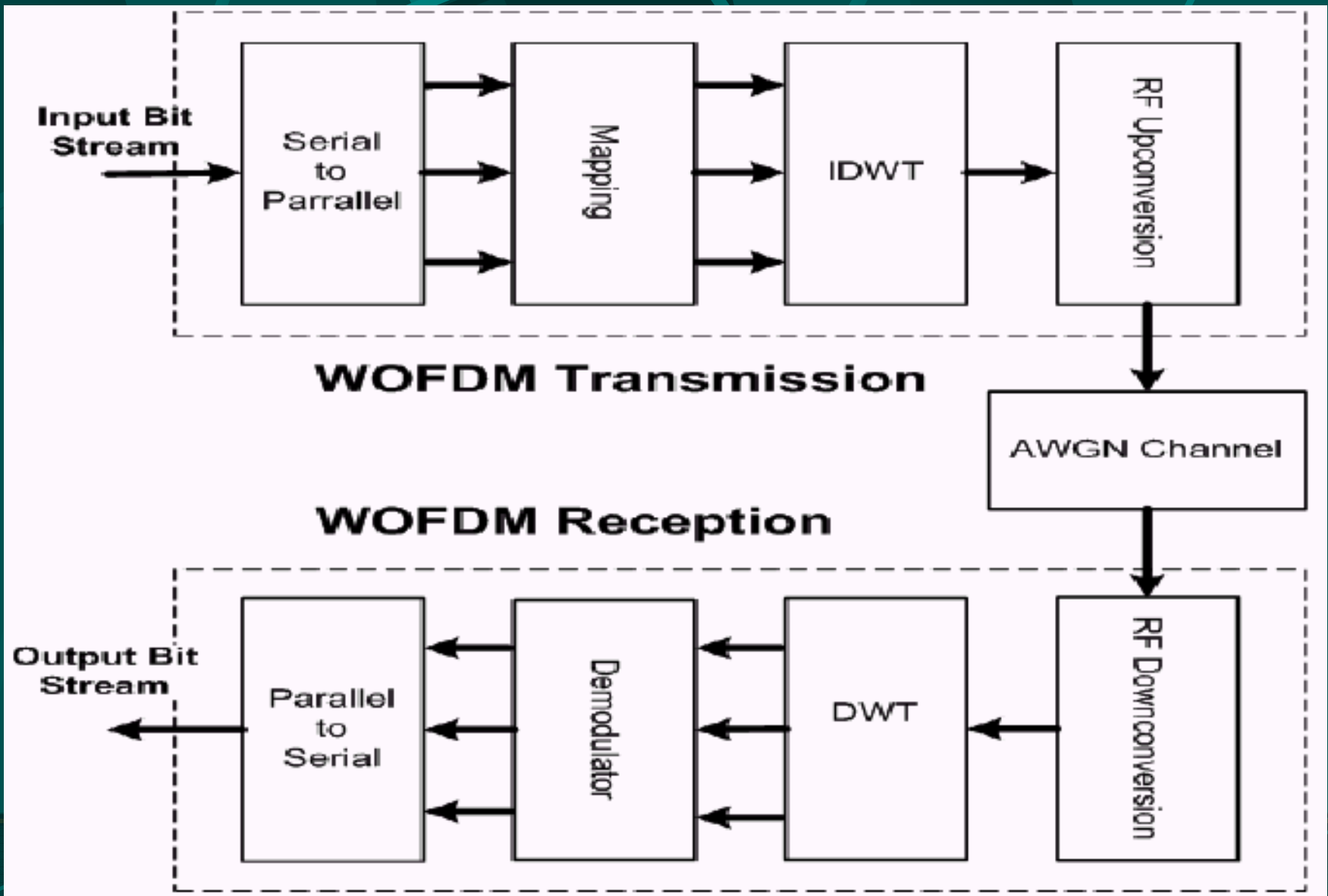
$$a_n^m = \sum_l h(l-2n) a_l^{m+1}$$

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

Classical OFDM

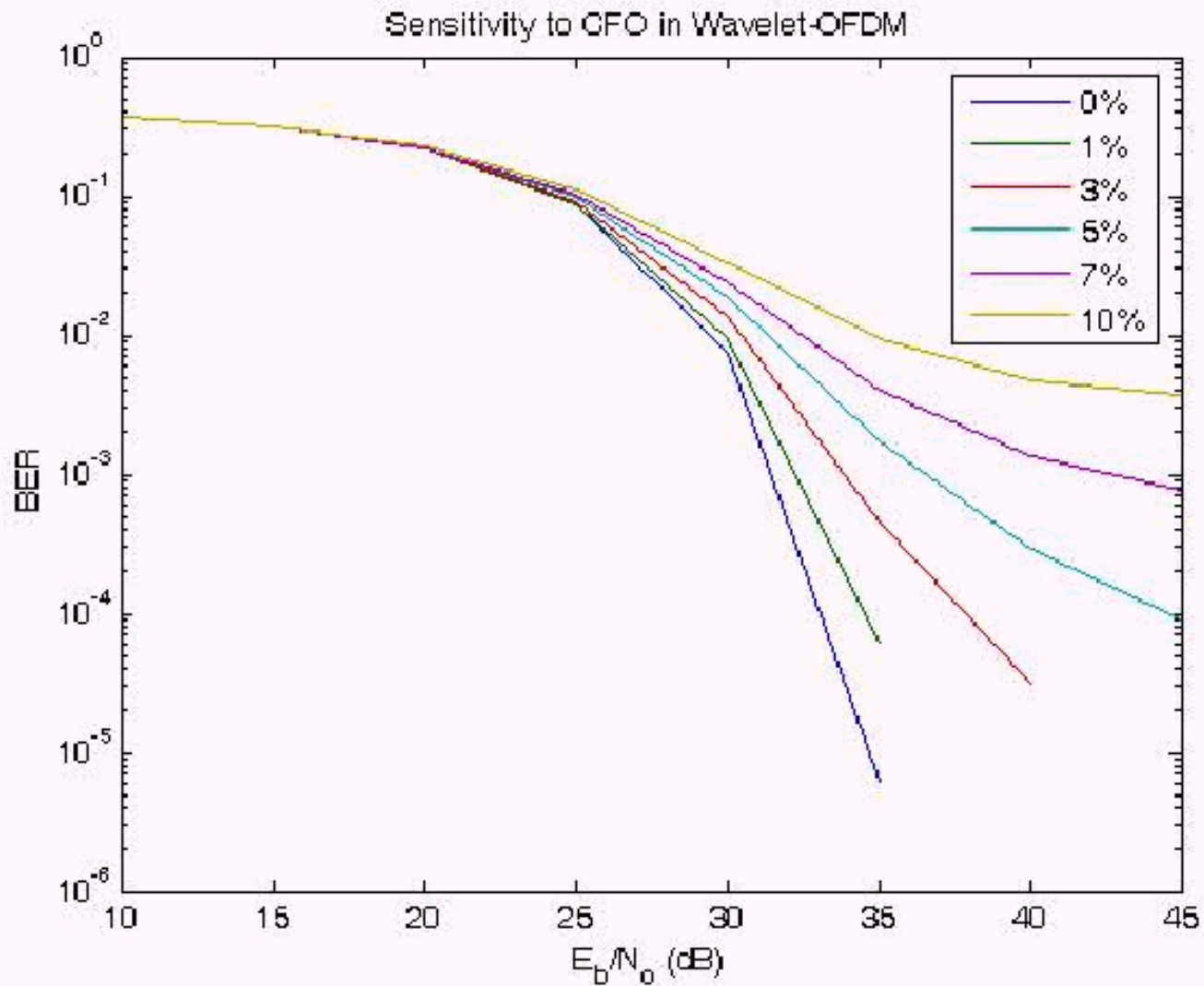


Wavelet OFDM

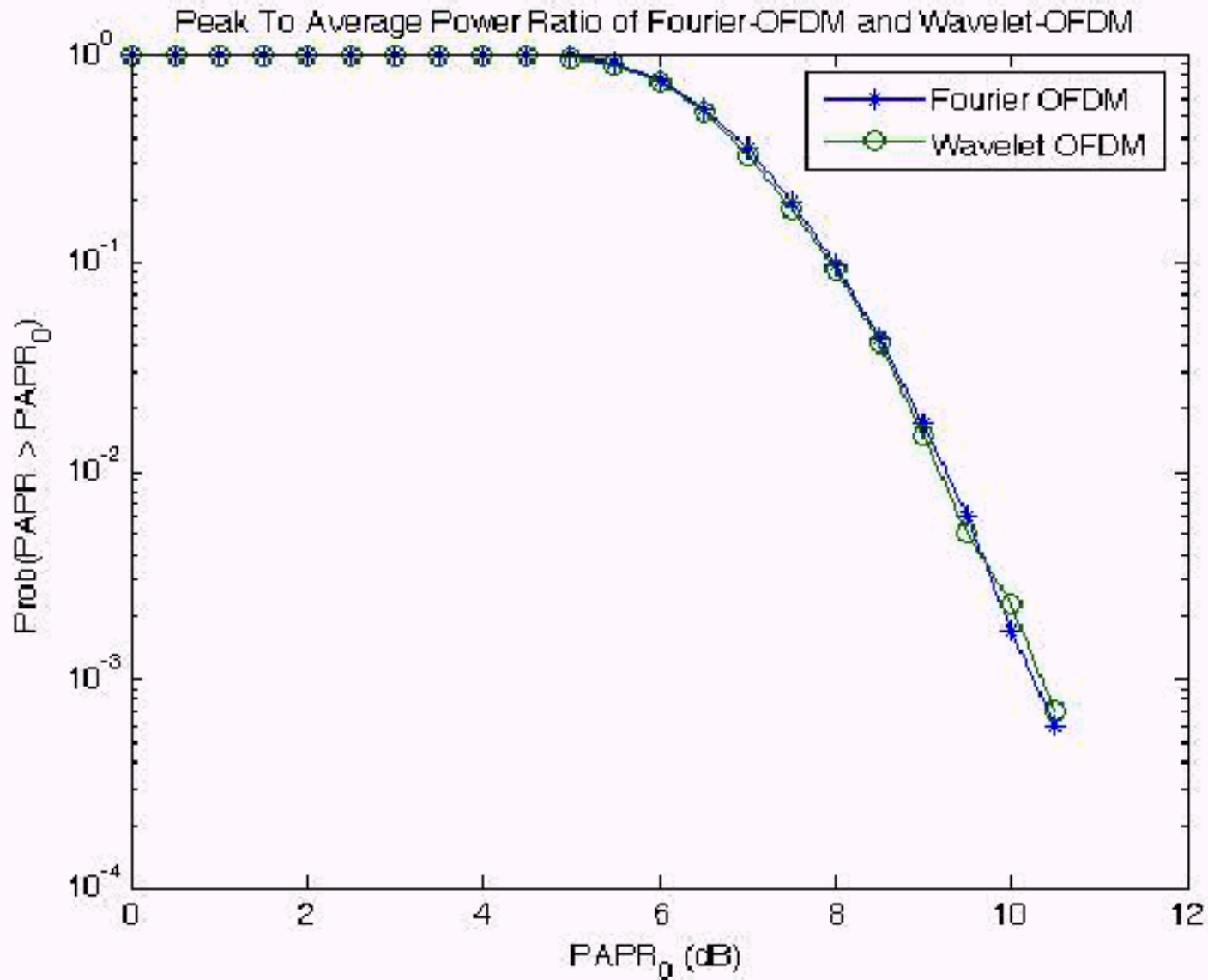


WOFDM Limitations

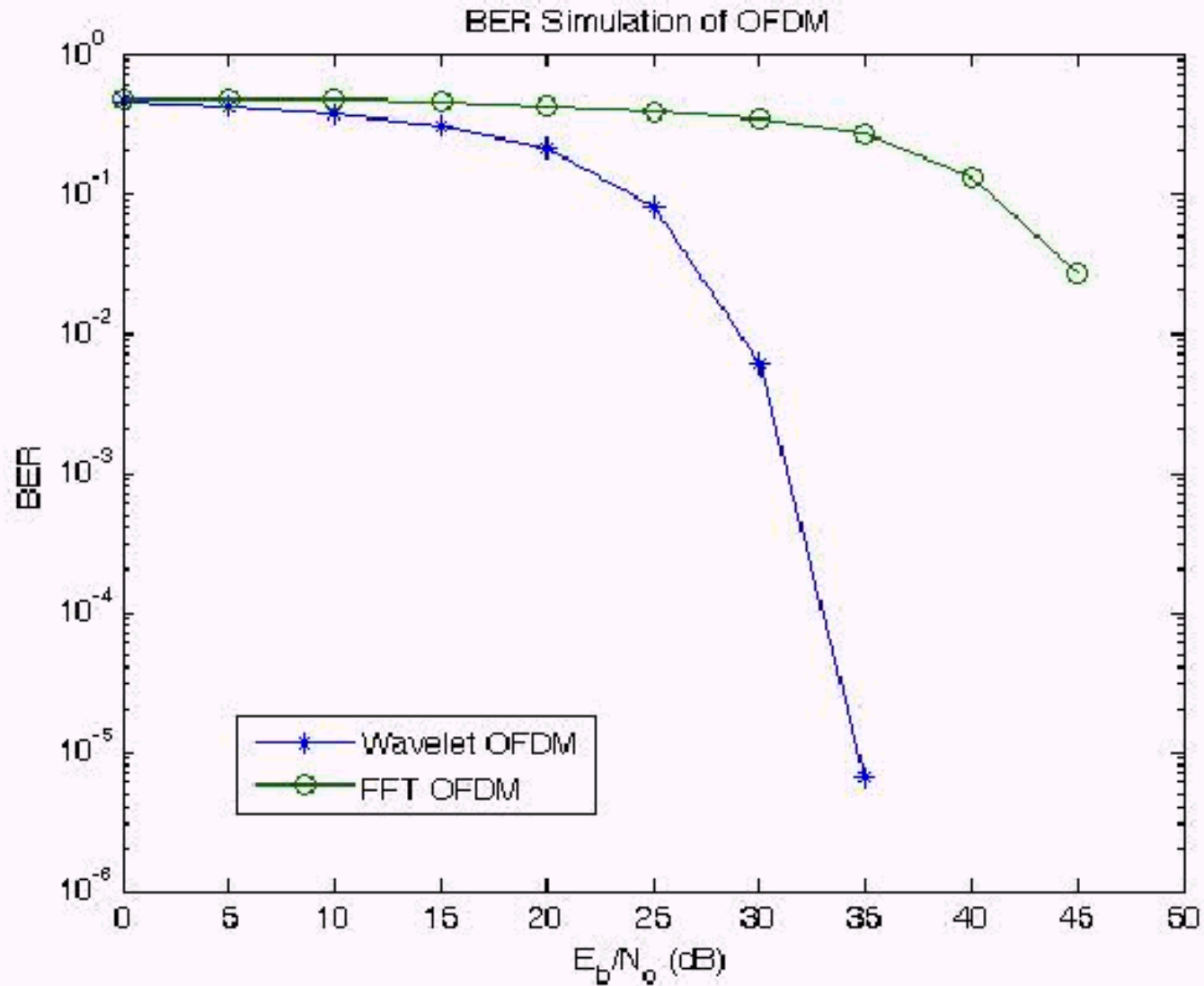
Sensitivity of CFO for WOEDM



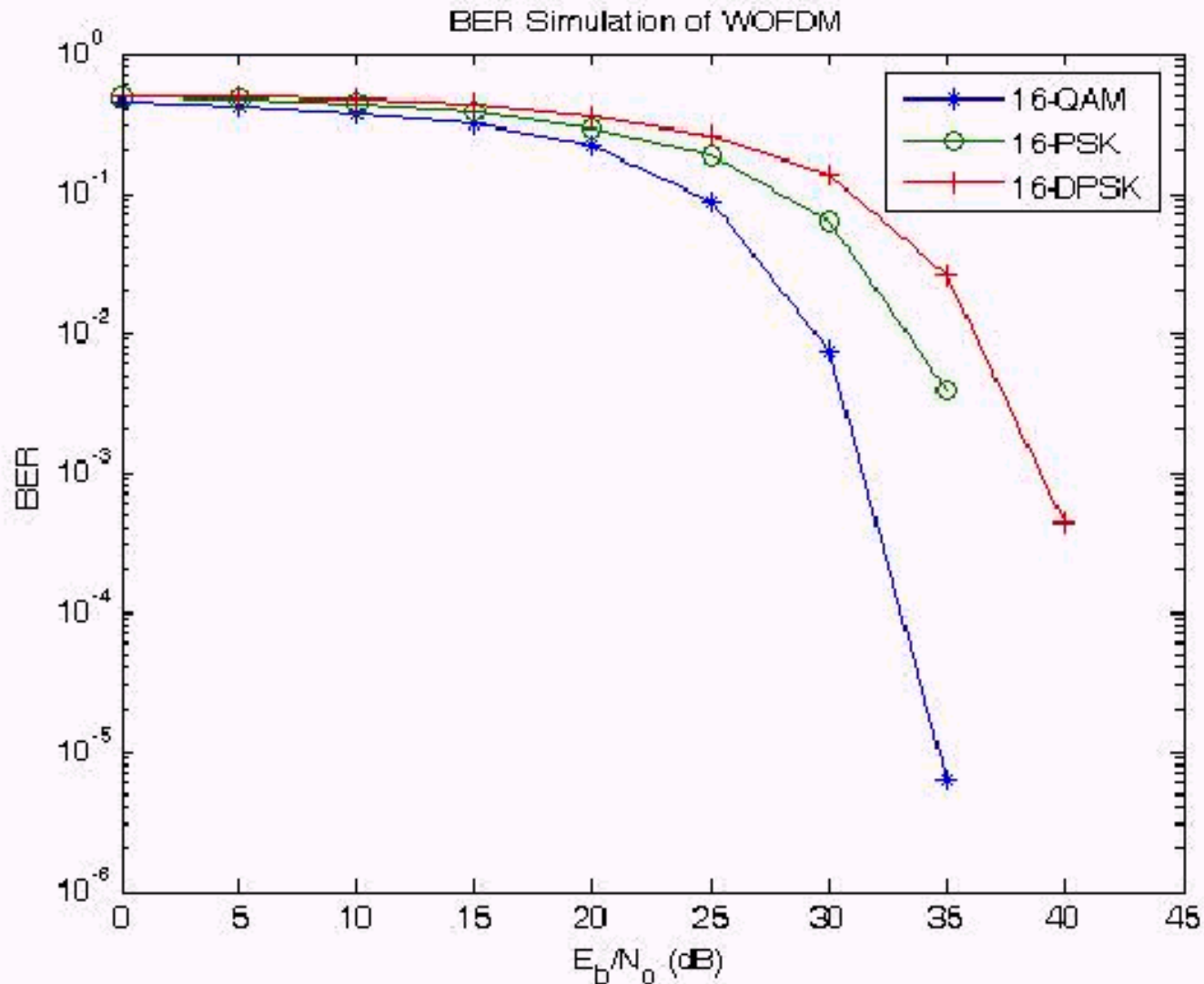
High PAPR for WOFDM and OFDM



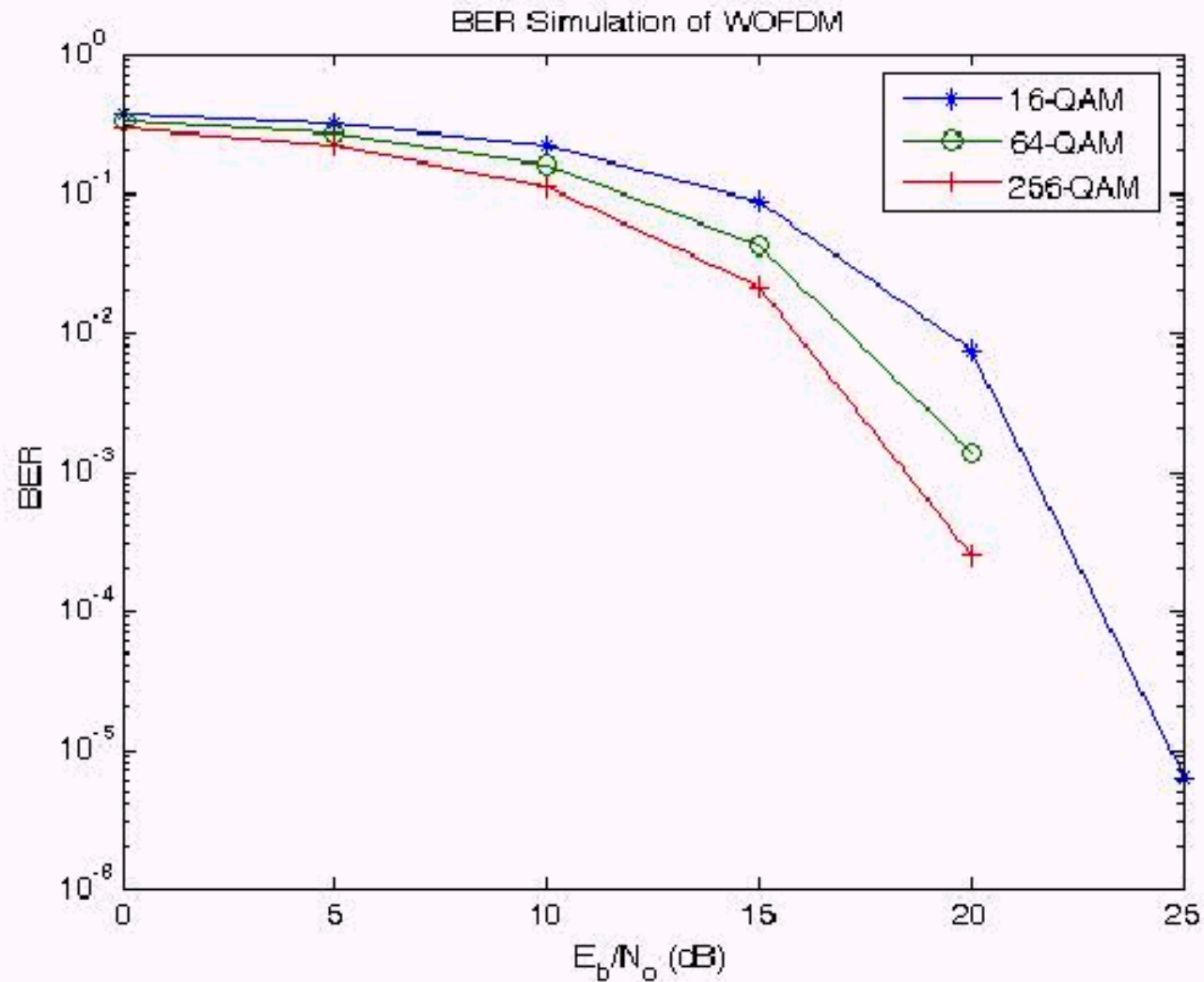
Performance Analysis



Performance Analysis [2]



Performance Analysis [3]



The background is a solid teal color with several overlapping geometric shapes and lines in a lighter shade of teal. These include long, thin lines that intersect to form various triangles and polygons. The lines are oriented in different directions, creating a dynamic, abstract pattern. The overall effect is modern and minimalist.

Thank You