4-1 results analysis for MIMO- OFDM

In order to achieve fair comparisons between OFDM scheme that is based on DWT and traditional OFDM scheme that is based on FFT same simulation parameters are used. The simulations were carried out for conventional OFDM with a 32 subcarriers using a BPSK, QPSK, 16QAM, 64QAM modulation technique using the Daubechies-4 (Daub-4) discrete wavelet bases were used to construct the discrete wavelet trees The results given in this section compare the proposed system OFDM using discrete wavelet transform (DWT) and traditional OFDM system using fast using Fourier transform (FFT) in term of BER and capacity case The proposed system gives a better improvements in BER and capacity over conventional OFDM [17].

The maximum data rate that can be attained over a given channel is determined by the capacity and bit error rate of that channel. That was investigated from channel capacity and bit error rate; the next table provides Simulation parameters for Multiple-Input and Multiple Output-OFDM (MIMO-OFDM) [16].

Table (4-1) simulation parameters

parameter	**value**
software	Labview
modulation technique	BPSK,QPSK,16QAM,64QAM
Number of antennas Tx/Rx	2×2,4×4
subcarrier	32
Channel	AWGN

4-2 Bit error rate

Bit error rate (BER) is the percentage of bits that have errors relative to the total number of bits received for given transmission system .The figures bellow show a relation between DWT and FFT in term of BER for different type of modulation techniques .In figure (4-1) compare between two system in term of BER when using BPSK it is can observed that when BER reaches to 1E-4 the signal to noise ratio (SNR) became 13 dB for OFDM-DWT (soled line) and 20dB OFDM-FFT (dashed line) respectively

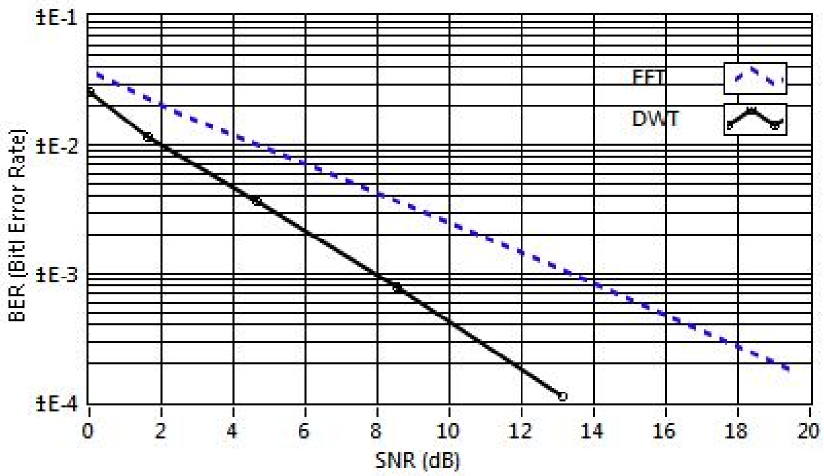

Figure (4-1) relation between BER and SNR for BPSK modulation

In figure (4-2) compared between two system in term of BER when using QPSK it is can observed that when BER reaches to 1E-3 the signal to noise ratio (SNR) became 7.8 dB for OFDM-DWT (soled line) and 12.2dB OFDM-FFT (dashed line) respectively

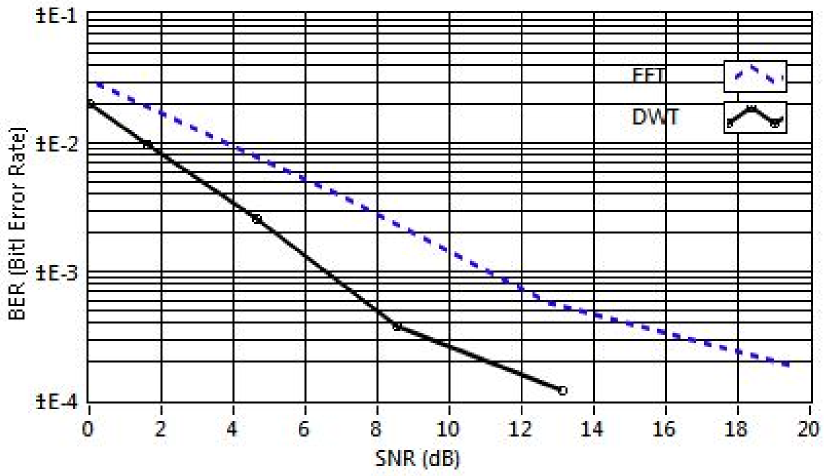

Figure (4-2) relation between BER and SNR for QPSK modulation

In figure (4-3) compared between two system in term of BER when using 16QAM it is can observed that when BER reaches to 1E-3 the signal to noise ratio (SNR) became 7.8 dB for OFDM-DWT (soled line) and 12.5dB OFDM-FFT (dashed line) respectively

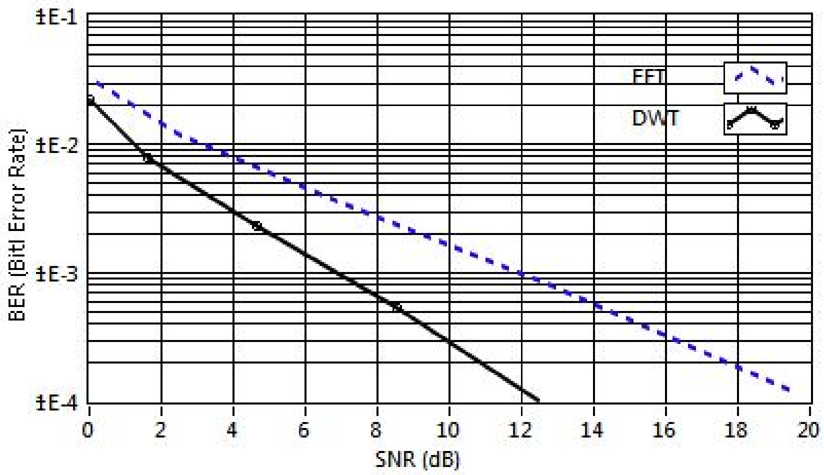

Figure (4-3) relation between BER and SNR for 16QAM modulation

In figure (4-4) compared between two system in term of BER when using 64 QAM it is observed that when BER reaches to 1E-3

The signal to noise ratio (SNR) became 7.8 dB for OFDM-DWT (soled line) and 12dB OFDM-FFT (dashed line) respectively

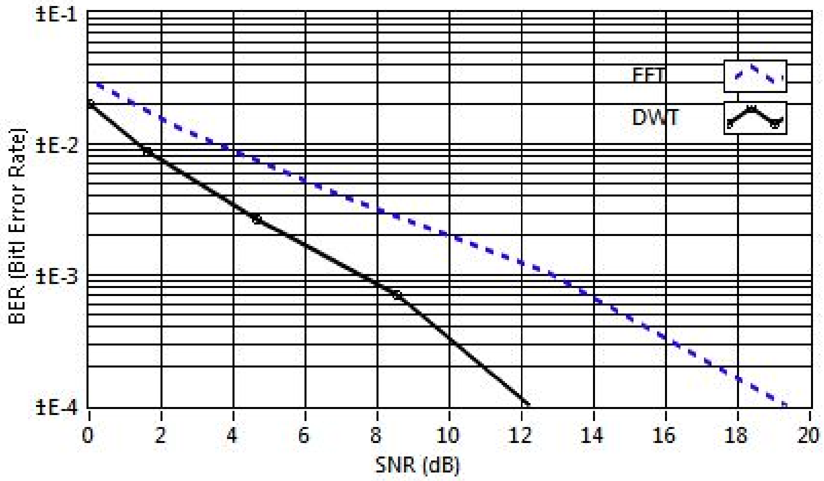

Figure (4-4) relation between BER and SNR for 64QAM modulation

From all above figures can see that the proposed scheme outperforms over traditional OFDM in term of BER for all modulation techniques

4-3 System capacity:

System capacity is formally defined as the maximum of the product of the number bits per time in limited bandwidth the figures bellow show a relation between two systems in term of capacity for different type of modulation techniques.

In figure (4-5) shows system capacity for two systems in relation to signal to noise ratio (SNR) when using a BPSK modulation soled line represent system capacity of OFDM-DWT and dashed line represent system capacity of OFDM-FFT

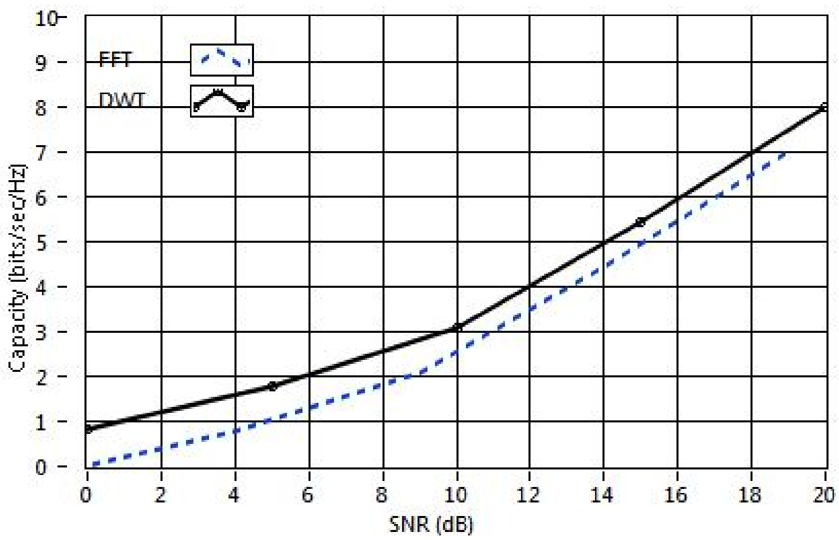

Figure (4-5) relation between capacity and SNR for BPSK modulation

In figure (4-6) shows system capacity for two systems in relation to signal to noise ratio (SNR) when using a QPSK modulation soled line represent system capacity of OFDM-DWT and dashed line represent system capacity of OFDM-FFT

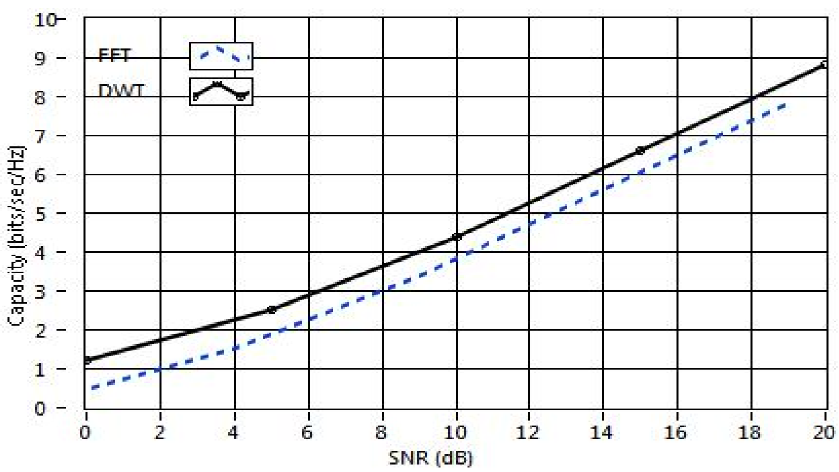

Figure (4-6) relation between capacity and SNR for QPSK modulation

In figure (4-7) shows system capacity for two systems in relation to signal to noise ratio (SNR) when using a 16 QAM modulation soled line represent system capacity of OFDM-DWT and dashed line represent system capacity of OFDM-FFT

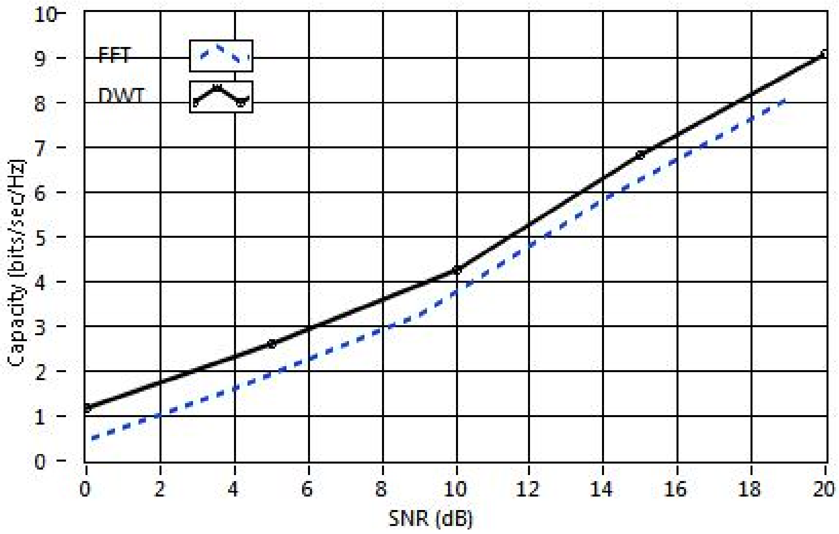

Figure (4-7) relation between capacity and SNR for 16QAM modulation

In figure (4-8) shows system capacity for two systems in relation to signal to noise ratio (SNR) when using a 64 QAM modulation soled line represent system capacity of OFDM-DWT and dashed line represent system capacity of OFDM-FFT

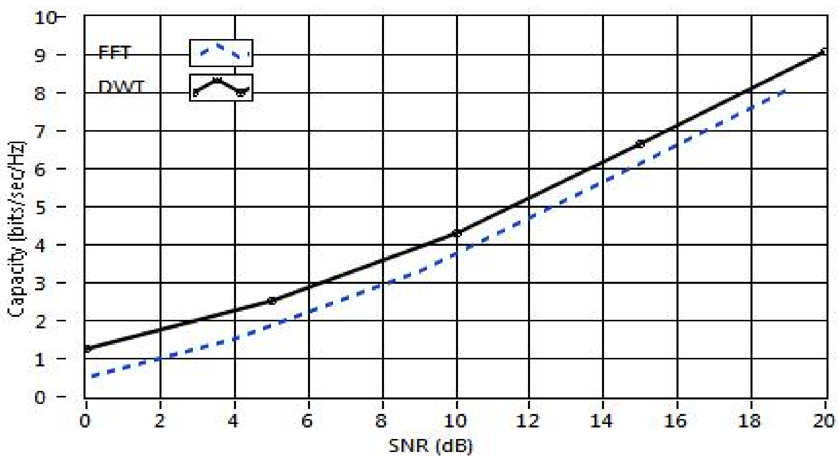

Figure (4-8) relation between capacity and SNR for 64QAM modulation

From all above figures found that the proposed OFDM system gives better results of capacity than traditional OFDM system.

4-4 Results of PAPR

From chapter two know peak power to average ratio (PAPR) and it is effects in MIMO-OFDM system and reduction solutions from simulation results found a proposed system have outperform performance compared to traditional system for different type of number of symbol (N) table (4-2) shows a relation between PAPR and crest factor in case of uses FFT and DWT for different type of numbers of samples (N)

Table (4-2) comparison between OFDM –FFT and OFDM -DWT

Samples (N)	OFDM -FFT		OFDM -DWT	
	PAPR(dB)	crest factor	PAPR(dB)	crest factor
32	14.5785	5.357	4.97	1.773
64	16.04	6.34	5.215	1.823
128	17.4	7.41	6.8	2.18
256	18.74	8.65	7.66	2.41
512	19.92	9.9	7.78	2.44
1024	20.93	11.132	8.127	2.548

4-5 Analysis of PAPR using CCDF

In the previous chapter we know a complementary cumulative distribution function to measure PAPR the next figures bellow show a relation between two systems for different number of sample. The next figures shows the performance of two MIMO-OFDM systems for different number of subcarriers N= 64,128, 512 and 1024.

From figure (4-9) it is observed that the values of PAPR for N= 64, became 17dB for OFDM-DWT (soled line) and 19dB OFDM-FFT (dashed line) respectively when CCDF reached to 1E-5.

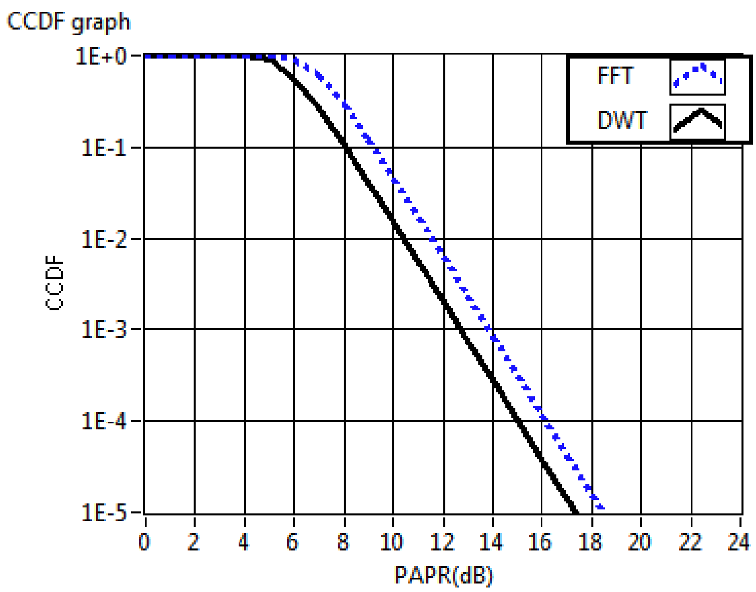

Figure (4-9) relation between CCDF curve and PAPR for N=64

From figure (4-10) it is observed that the values of PAPR for N= 128, became 18.2 dB for OFDM-DWT (soled line) and 19.5 dB OFDM-FFT (dashed line) respectively When CCDF reached to 1E-5.

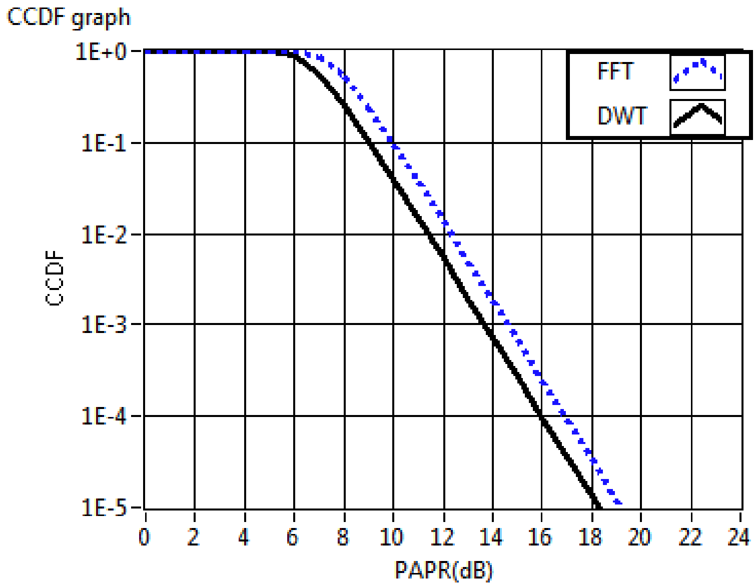

Figure (4-10) relation between CCDF curve and PAPR for N=128

From figure (4-11) it is observed that the values of PAPR for N= 512, became 20dB for OFDM-DWT (soled line) and 21dB OFDM-FFT (dashed line) respectively When CCDF reached to 1E-5.

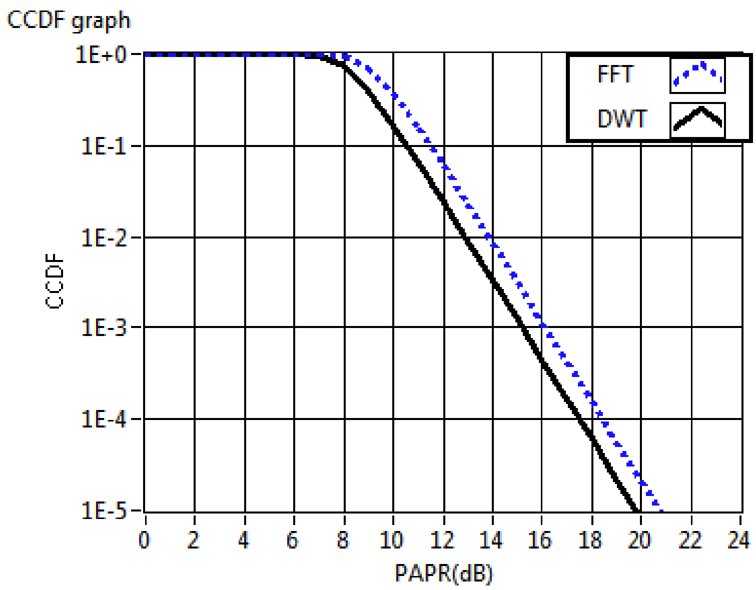

Figure (4-11) relation between CCDF curve and PAPR for N=512

From figure (4-12) it is observed that the values of PAPR for N= 1024, became 20.2dB for OFDM-DWT (soled line) and 22dB OFDM-FFT (dashed line) respectively When CCDF reached to 1E-5.

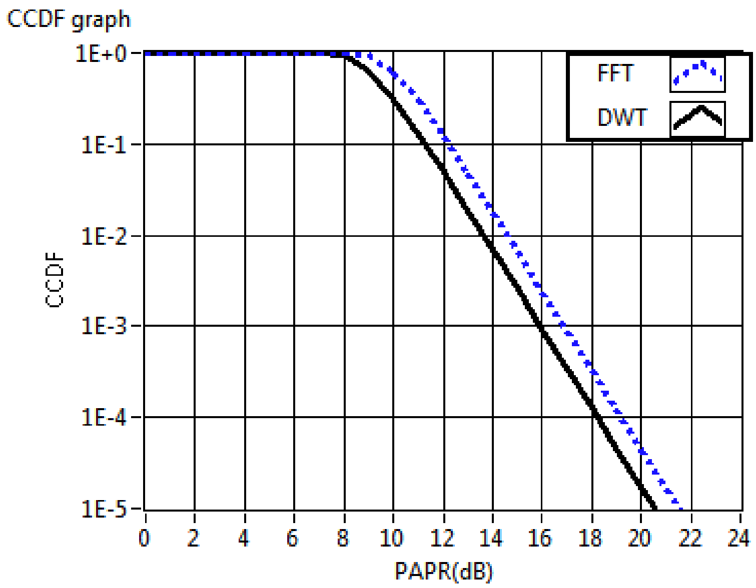

Figure (4-12) relation between CCDF curve and PAPR for N=1024

From all of figure above it is observed that the PAPR value increases significantly as number of carriers used in the MIMO-OFDM transmission increase as shown in Figures, Though the multi-carrier OFDM transmission provides high data rate, it results in high PAPR for higher subcarriers .From above figures we find OFDM-DWT based has a low PAPR compared to OFDM-FFT based