ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

Comparative Analysis of BER, SER, PAPR &PSD in OFDM using Wavelet Based OFDM System

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ABSTRACT: The analysis of BER, PSD, SER and PAPR performance of OFDM system using wavelets based OFDM system. We implement the parameter by using 16 QAM, 64 QAM, 256 QAM by using wavelet based OFDM system. We do study of wavelet based OFDM to find out the performance parameter using different types of wavelet. In WOFDM parallel transmission takes place, so it increases the spectrum efficiency than the traditional OFDM. The analysis of BER & SER profile is obtained by using energy per bit to noise, PAPR can be obtained by using z function, then Power spectral density is obtained by using frequency function. The performance of parameter shows that there is not much difference for all types of wavelet.

KEYWORDS: Bit Error Rate, Peak to Average Power Ratio, Power Spectral Density, Symbol Error Rate, Orthogonal Frequency Division Multiplexing, Wavelets.

I.INTRODUCTION

Orthogonal frequency division multiplexing system is a parallel transmission system, so it can be used in much broadband communication. Wavelet based OFDM system has high data rate. In normal OFDM used DFT & IDFT but in wavelet based OFDM used DWT & IDWT because it is a fast transform. WOFDM produce spectral efficiency which is better than traditional FDM system. In this paper we perform the parameter like as Power spectral density, Symbol error rate, Peak to average power ratio & Bit error rate for 16 QAM, 64 QAM, 256 QAM. So analysis of BER & SER profile is obtained by using energy per bit to noise, PAPR can be obtained by using z function, then Power spectral density is obtained by using frequency function. The performance of parameter shows that there is not much difference for all types of wavelet.

In wavelet data can be divide into different frequency component i.e. no of subcarrier can be used, so wavelet can be performed mathematical function. It is better than traditional OFDM SYSTEM. At the same CCDF function level considered as z also increasing as the order of wavelet can be increased. Number of wavelet can be chosen from wavelet families from this Haar wavelet is the simple one and it gives better performance than the other wavelet. Orthogonal frequency division multiplexing has multipath and multicarrier system and modulation technique, so multipath can be produced between transmitter and receiver. In multichannel and multicarrier technique available spectrum is divided into narrow bandwidth. Available bandwidth is divided into non overlapping frequency subchannel. Separate symbol stream can be produced when each sub channel is modulated. Interchange Interference can be reduced when avoid of the overlapping of subcarriers. Subcarriers are mathematically orthogonal to each other.

Wavelet transform

There are two types:

1. Discrete wavelet transform
2. Continuouswavelet transform

In wavelets transform wavelet coefficient can be used. This are mathematically function that data can be divided into different frequency component i.e. no of subcarrier can be used. For wavelet analysis wavelet prototype

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function can be used. It has time and frequency localization function, frequency analysis can be obtained with low and high frequency version.

II.SYSTEM MODEL AND ASSUMPTIONS

1. **Wavelet based OFDM:**

Number of wavelets family can be used. It save the bandwidth, wavelet obtained the translation and contraction properties. In many communication system we used the wavelet based OFDM than the other typical OFDM.

2. **System Model:**

In transmitter & receiver section consists of following contains:

- Random Data generator
- Encoder/decoder
- QAM mapping
- DWT & IDWT
- Channel model

Data can be generated and encoded .It can be mapped with 16, 64, 256 QAM.DWT&IDWT arethe fastest transform & it perform the linear operation. After that de mapping and demodulation can be performed, and thenthe reconstruction of signal or data can be obtained.

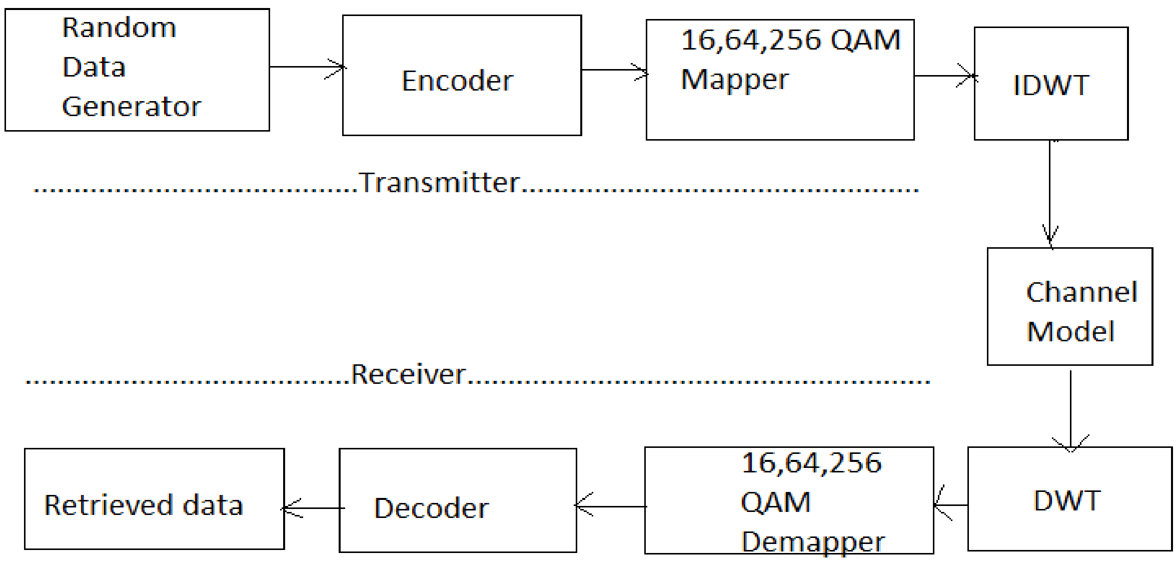

Fig.1Block Diagram of Wavelet Based OFDM

III. EFFICIENT COMMUNICATION

In this OFDM is multicarrier system.Signal representing each bit can be used the available Spectrum. In multicarrier system available Spectrum is divided into bandwidth narrow band.OFDM is a multicarrier modulation technique which has reduce the effect of inter symbol interference (ISI) at the receiver side.OFDM is a parallel transmission scheme.Most broadband systems are used the multipath transmission technique. With the used of OFDM there is a simple way of dealing with DSP algorithm.Orthogonal frequency division multiplexing system is a multipath, multicarrier modulation technique. Multipath means multiple paths between transmitter and receiver. At the receiver side signal can be obtained by the sum of transmitted signal.

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IV.SECURITY

We implement the parameter like as Bit error rate, Symbol error rate, Power spectral density, Peak to average power ratio by using different wavelet families for 16 QAM, 64 QAM, 256QAM. We use wavelet family Haar, Symlet, Coiflet, Daubechies, Discrete Mayer wavelet for the performance parameter. Haar wavelet given the better result than the other wavelet.High PAPR i.e. peak signal power is greater than average signal power. Peak-to-Average ratio describes the envelope fluctuation.

PAPR causes-

- Intermodulation
- Out of band radiation
- Reduce efficiency

V. RESULT AND DISCUSSION

1. Analysis parameter

Table No.1.The analysis parameter for BER, SER, PSD & PAPR are as below:

Parameter	value
Modulation type	16QAM,64QAM,256 QAM
No.of subcarrier	128
DWT point	128
Channel model	AWGN

Reduction of Bit error rate, Symbol error rate, Peak to average power ratio &Power spectral density can be performed in wavelet based OFDM analysis using 16, 64, 256 QAM.

Bit Error Rate:

- BER analysis for 16 QAM& 64 QAM

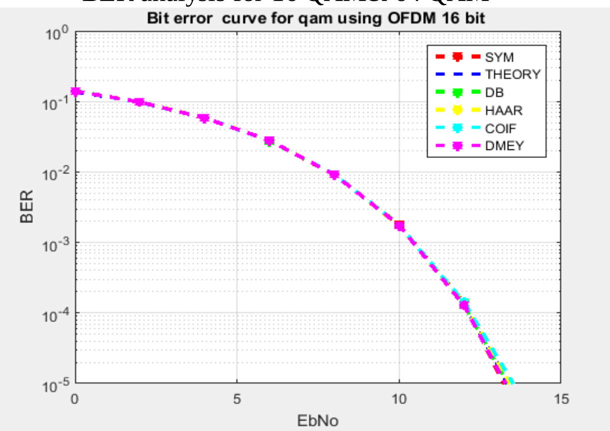

Fig. 2 BER for 16 QAM

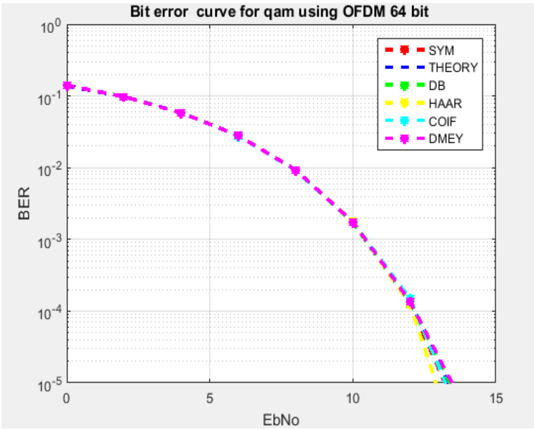

Fig. 3 BER for 64 QAM

- **BER for 16 QAM**: The conventional OFDM has use the 13.3 dB power at 10^{-5}.remaining wavelet obtained the power is sym(13.3dB),DB(13.2dB),Haar(13.4dB),coif(13.4dB), dmey(13.5dB).
- **BER for 64 QAM**: The conventional OFDM has use the 13.4 dB power at 10^{-5}.remaining wavelet obtainedsym(13.2dB),DB(13.2dB),Haar(13.4dB),coif(13.2dB), dmey(13.2dB).

- BER analysis for 256 QAM:

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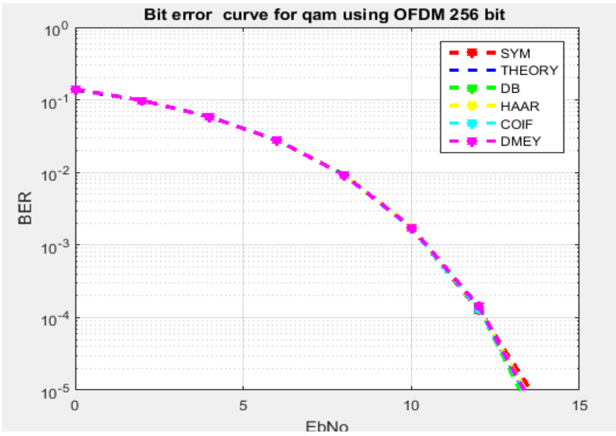


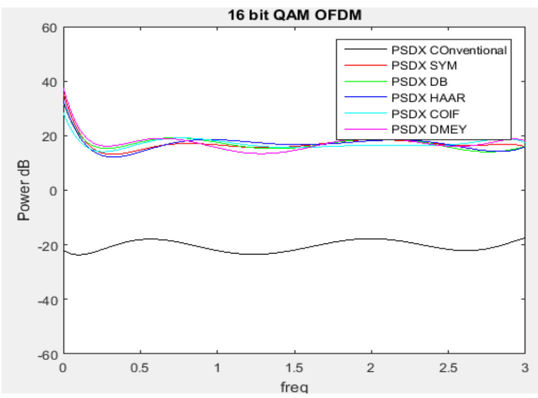
Fig. 4 BER for 256 QAM

- **BER for 256 QAM**: The conventional OFDM has use the 13.8 dB power at 10^{-5}.remaining waveletsym(14dB),DB(13.8dB),Haar(13.7dB),coif(14dB, dmey(14dB).

We found that WOFDM has better performance than the conventional OFDM.

Power Spectral Density:

- PSD for 16 QAM & 64 QAM



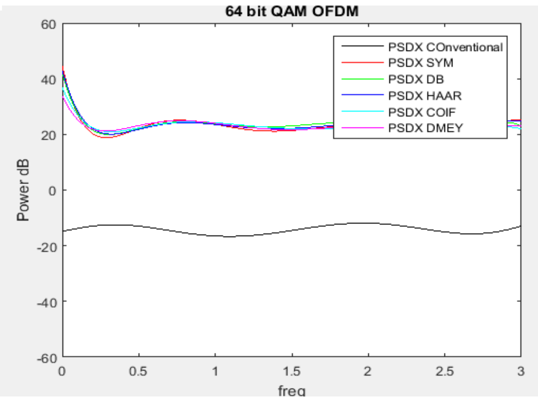


Fig .5PSD for 16 QAM Fig. 6 PSD for 256 QAM

At 0 frequency level, power is high after that spectrum remain constant.

- **PSD for 16 QAM**: At 0 frequency level, power of conventional OFDM is -20 dB. Remaining wavelet obtained the power is sym(33dB),DB(37dB),Haar(35dB),coif(37.5dB),dmay(38dB).
- **PSD for 64 QAM**: At 0 frequency level, power of conventional OFDM is -15 dB. Remaining wavelet obtained the power is sym(37dB),DB(40dB),Haar(38dB),coif(43dB),dmay(39dB).

- PSD for 256 QAM

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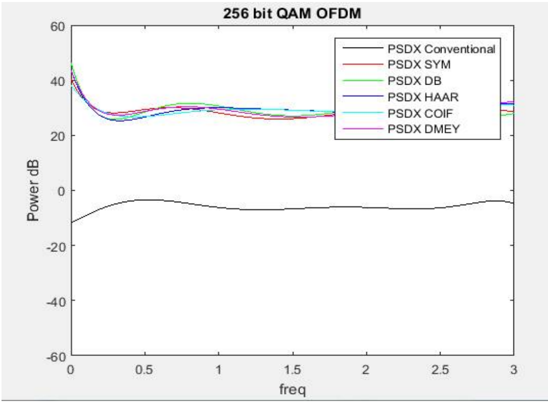

Fig. 7 PSD for 256 QAM

- **PSD for 256 QAM:** At 0 frequency level, power of conventional OFDM is -6 dB. Remaining wavelet obtained the power is sym(41dB),DB(40dB),Haar(39dB),coif(44dB),dmay(42dB).

We analyse that power spectral density performance is much better in 256 QAM.

Symbol Error Rate:

- SER for 16 QAM & 64 QAM

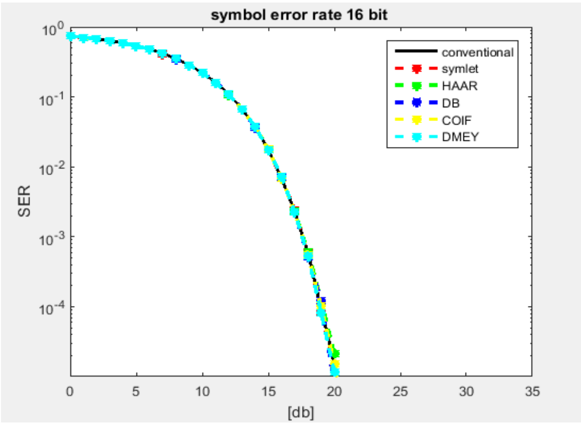

Fig. 8 SER for 16 QAM

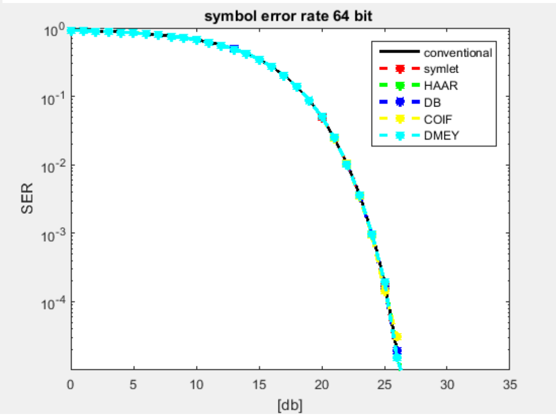

Fig. 9 SER for 64 QAM

- **SER for 16 QAM :**
  SER is closer to the 0.75 that is nearer to the 1. The conventional OFDM has power 20.2 dB. Another wavelet obtained the power as DB(19.9dB), Haar(20dB), symlet(20.2dB), coif(20.2dB), dmay(20.1dB).
- **SER for 64 QAM:**
  SER is closer to the 0.9 that is nearer to the 1.The conventional OFDM has power 26.1 dB. Another wavelet obtained the power DB(26.1dB), Haar(26.3dB), symlet(26dB), coif(26dB), dmay(26.3dB).

- SER for 256 QAM

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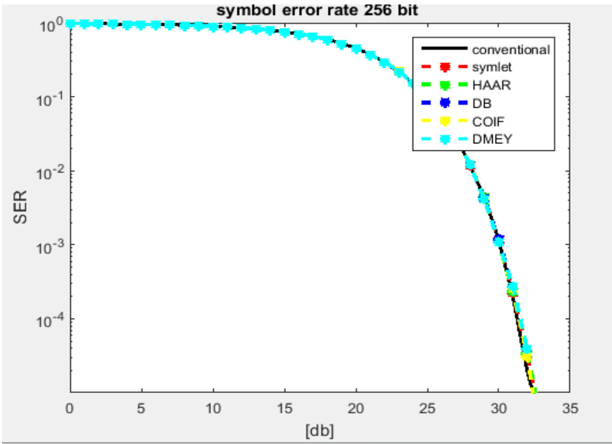

Fig. 10 SER for 256 QAM

- **SER for 256 QAM:**
  SER is closer to the 1.The conventional OFDM has power 32.4dB. Another wavelet obtained the power as DB(32.5dB), Haar(32.6dB), symlet(32.6dB), coif(32.4dB), dmay(32dB).

Peak to Average Power Ratio (PAPR)

- of 16, 64, PAPR 256 QAM for Haar&Dabuchies wavelet :
-

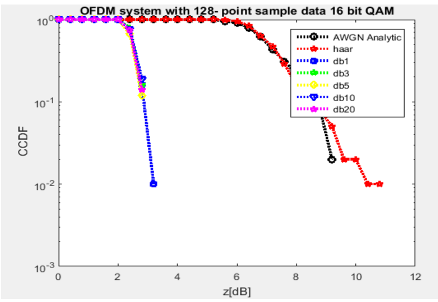

Fig. 11 PAPR for 16 QAM

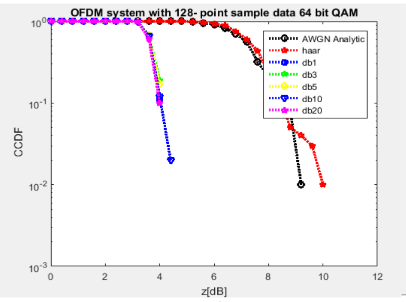

Fig. 12 PAPR for 64 QAM

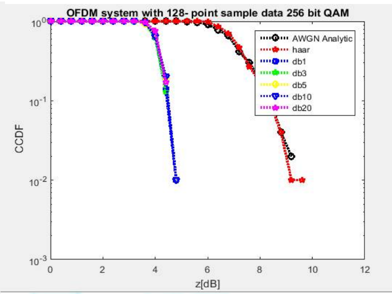

Fig. 13 PAPR for 256 QAM

At the CCDF of 10^{-1} HAAR has the highest power i.e. 8.4dB, 8.6dB, 9.6 dB respectively in 16, 64, 256 QAM.

- **PAPR for 16 QAM: For Haar&Daubechies wavelet**
  Theoretically obtained value is 8.4 dB. Remaining wavelets power as haar(8.4dB), dB1(2.8dB),dB3(2.8dB),dB5(2.8dB), dB10(3dB), dB20(2.8dB).
- **PAPR for 64 QAM: For Haar&Daubechies wavele**t
  Theoretically obtained value is 8.6 dB. Remaining wavelets power as haar(8.6dB), dB1(4dB),dB3(4.1dB),dB5(4.1dB), dB10(4.3dB), dB20(4dB).
- **PAPR for 256 QAM: For Haar&Daubechies wavelet**
  Theoretically obtained value is 9.2 dB. Remaining wavelets power as haar(9.6dB), dB1(4.45dB),dB3(4.4dB),dB5(4.45dB), dB10(4.45dB), dB20(4.45dB).

- PAPR of 16, 64, 256 QAM for Symlet Wavelet:

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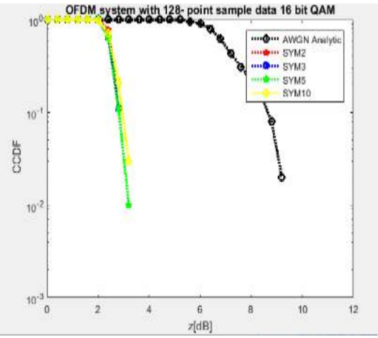

Fig. 14 PAPR for 16 QAM

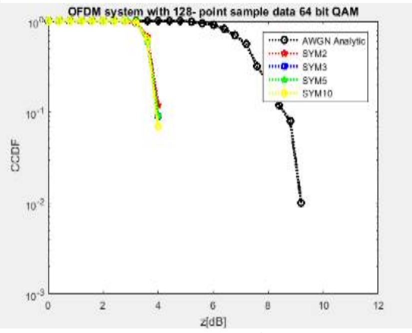

Fig. 15 PAPR for 64 QAM

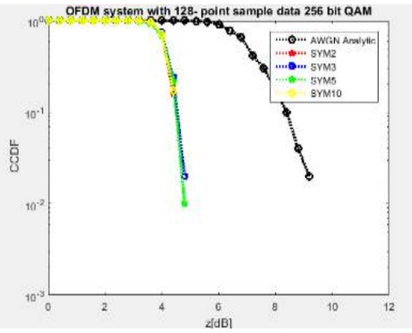

Fig. 16 PAPR for 256 QAM

- **PAPR for 16 QAM: For Symelet wavelet**
  Theoretically obtained value is 8.4 dB.Remaining wavelets power as sym2 (2.8dB), sym3 (2.8dB) sym5(3.2dB),sym10(3.2dB).
- **PAPR for 64 QAM: For Symlet wavelet**
  Theoretically obtained value is 8.6 dB. Remaining wavelets power as sym2 (4dB), sym3(4dB), sym5(4dB),sym10(4dB).
- **PAPR for 256 QAM: For Symlet wavelet**
  Theoretically obtained value is 9.2 dB. Remaining wavelets power assym2 (4.4dB),sym3(4.8dB), sym5(4.8dB),sym10(4.4dB).

- PAPR of 16,64,256 QAM for Coiflect&Dmayer wavelet:

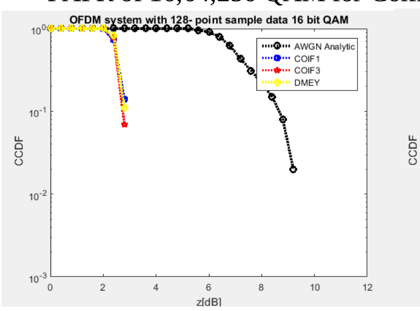

Fig. 17 PAPR for 16 QAM

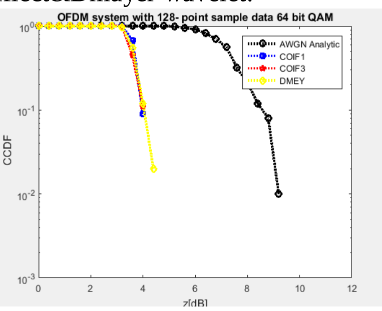

Fig. 18 PAPR for 64 QAM

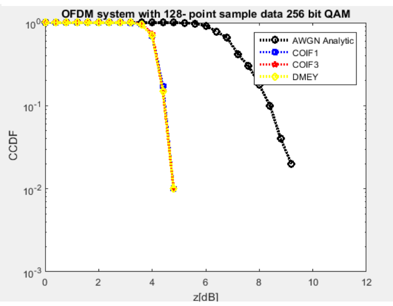

Fig. 19 PAPR for 256 QAM

- **PAPR for 16 QAM: For Coiflect, Dmayer wavelet**
  Theoretically obtained value is 8.4dB. Remaining wavelets power as coif1(2.8dB), coif3 (2.8dB), dmay(2.8dB).
- **PAPR for 64 QAM: For Coiflect , Dmayer wavelet**
  Theoretically obtained value is 8.6dB. Remaining wavelets power as coif1(4dB),coif3(4dB), dmay(4.4dB).
- **PAPR for 256 QAM: For Coiflect, Dmayer wavelet**
  Theoretically obtained value is 9.2dB. Remaining wavelets power as coif1(4.8dB),coif3(4.8dB), dmay(4.8dB).

VI.CONCLUSION

Wavelet based OFDM system performs the conventional OFDM system in term of BER,PSD, SER and PAPR performance specifically under AWGN channel. All the parameter can be implemented by using 16 QAM, 64 QAM, 256 QAM in wavelet based OFDM system. At the same level of CCDF function z increases then the order of wavelet can be increased for PAPR profile analysis.Thus from the performance PAPR & BER rate can be improved in wavelet based OFDM system than the traditional OFDM.For Symbol Error Rate profile, performance of system can be better in 64 & 256 QAM than the 16 QAM, which is also closer to the one. For PSD the performance of wavelet based

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(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 3, March 2016

OFDMsystem is much better than the conventional OFDM.Power level is increased than conventional OFDM, which is more in 64 & 256 QAM.

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