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IMPLEMENTATION OF SPECTRUM SENSING TECHNIQUE

¹Arun kumar, ²Pawan Sharma

¹P.G Scholar, Dept. of ECE, Mewar University

Email id: Sameer_33@sify.com

²Asst. Professor, Dept. of ECE, Mewar University

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Abstract

Cognitive Radio (CR) is considered as an intelligent technology, which improves the utilization of the radio spectrum. Cognitive Radio provides a solution to additional spectrum requirement problem for efficient spectrum utilization. In this work we have reviewed as well as described cognitive radio technology and its various aspects that can play a very important role in the field of wireless communication for improving the quality of service. To enhance the spectrum efficiency Cognitive Radio is integrated with different OFDM frameworks. Probability of detection (P_d) vs Probability of false alarm (P_{fa}), P_d vs Signal to Noise Ratio (SNR) and Bit Error Rate (BER) vs SNR for each OFDM framework is calculated and analyzed using Energy detection. The present work is thoroughly analyzed and implemented by using MATLAB.

Keywords: CR, OFDM, SNR, PFA

1. INTRODUCTION:

Wireless communication is the fastest growing sector of the communication industry. In this exact sense, it has captured the attention of everyone in the whole communications market. Analysis showed that cellular systems are constantly growing year round and presently there are about four billion mobile users all over the world. In fact, cellular mobiles have grown into an important business device and part of everyday life for common people [1]. Moreover, wireless communication has replaced many wired line networks in domestic as well as professional life.

Many types of equipment are remotely accessible and controlled with the help of wireless communication. Since radio frequency is the only spectrum which enables wireless communication between transmitter and receiver, and because of the increasing number of users within the radio frequency spectrum, it's not possible to add extra users. We have already adopted a lot of techniques to reduce the transmitting packet size [2]. In 3G, we adopted Time Division Multiplexing (TDM) and Frequency Division Multiplexing (FDM), but this brings congestion on when the number of users

is high. Code Division Multiple Access (CDMA) was the first multiple access technology adopted for 3G where the information was shared between multiple users using a single channel, and it also provided one of the most secure communications [3]. The consistent growth of wireless appliances (Wi-Fi) gives the clustered ISM (Industry, Scientific and Medical) bands. People are not able to utilize the spectrum properly due to the growth in ISM bands which leads to a demand for an additional spectrum for good QoS (Quality of Service). Multiple-carrier transmission is one of the most advanced techniques used in many recent applications; the concept behind this technique is to divide one carrier into a number of multiple-subcarriers [4]. The available bandwidth is subdivided into smaller bands with limited bandwidth, each subcarrier having a smaller bandwidth compared to the single carrier system. Each symbol is modulated with each carrier and transmitted through the antenna to the channel and received signal is demodulated by the demodulators. Implementing a bank of modulators and demodulators is challenging and practically it is not possible. IFFT (Infinite Fast Fourier Transform) and FFT (Fast Fourier Transform) can be used to reduce the complexity of the system as compared to traditional N-Modulator and N-Demodulator approaches. This allows for the fastest operation, as implemented on a DSP chip, in a modern communication system [5]. The main objective of the work is to design OFDM System with CP and, Pd vs SNR and Pd

vs Pfa and To incorporate cognitive radio with multi-carrier systems.

2. Proposed Methodology

The present work is implemented by using a MATLAB 2011b. The parameters considered in present work are briefly described below:

Energy detection is a popular method in CR for spectrum sensing and it identifies the presence of spectrum hole and optimizes the detection probability [6]. It compares the received signal energy with threshold value (λ) following the SNR to get two hypothesis - whether the signal is absent or present [7].

$$R(t) = \{n(t)\} : H_0$$

$$R(t) = \{h * U(t) + n(t)\} : H_1$$

3. Results and Discussion

The results are formulated by using a MATLAB-2010.

3.1. BER vs SNR

In both case the BER decreases with increase of SNR. For 0 to 3 dB, BER for OFDM with CP and OFDM without CP is approximately equal whereas with the increase of SNR, BER performance of OFDM with CP is much better than OFDM without CP. Simulation shows the primary system is much efficient and reliable with less ISI and less BER as compared to latter one as shown in fig.1 and Table.1.

Table.1 SNR vs BER

SNR (dB)	0	1	2	3	4	5	6	7	8	9	10	11	12
BER QAM-16 WITH CP	0.257 2	0.246 2	0.218 8	0.210 9	0.175 8	0.148 4	0.092 8	0.074 7	0.045 1	0.030 2	0.020 1	0.009 0	0.003 0
BER QAM-16 WITHOUT CP	0.293 0	0.281 3	0.261 5	0.261 7	0.238 3	0.214 8	0.191 4	0.180 7	0.136 7	0.105 5	0.066 4	0.023 4	0.003 9

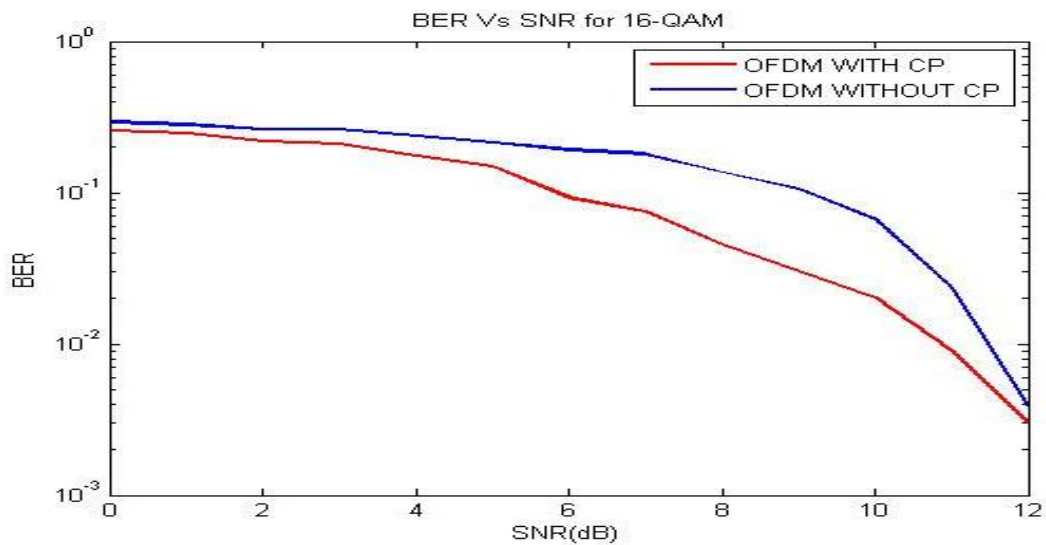


Fig.1. SNR vs BER

3.2. BER vs SNR with OFDM

The analysis of BER vs SNR for OFDM with filter at transmitter and receiver is shown in Fig. 2 and Table.2. In OFDM with filter at transmitter the BER decreases with increase of SNR. But OFDM with

filter at both transmitter and receiver side gives a constant BER for all SNR. So it proves OFDM with filter at transmitter is better as compared to OFDM with filter at both transmitter and receiver.

Table.2. SNR vs BER

SNR (dB)	0	1	2	3	4	5	6	7	8	9	10	11	12
BER with Filter	0.3086	0.3047	0.2930	0.2813	0.2773	0.2578	0.2308	0.2227	0.1953	0.1600	0.0825	0.0208	0.0039
BER.WITH FILTER @ Tx AND Rx	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534

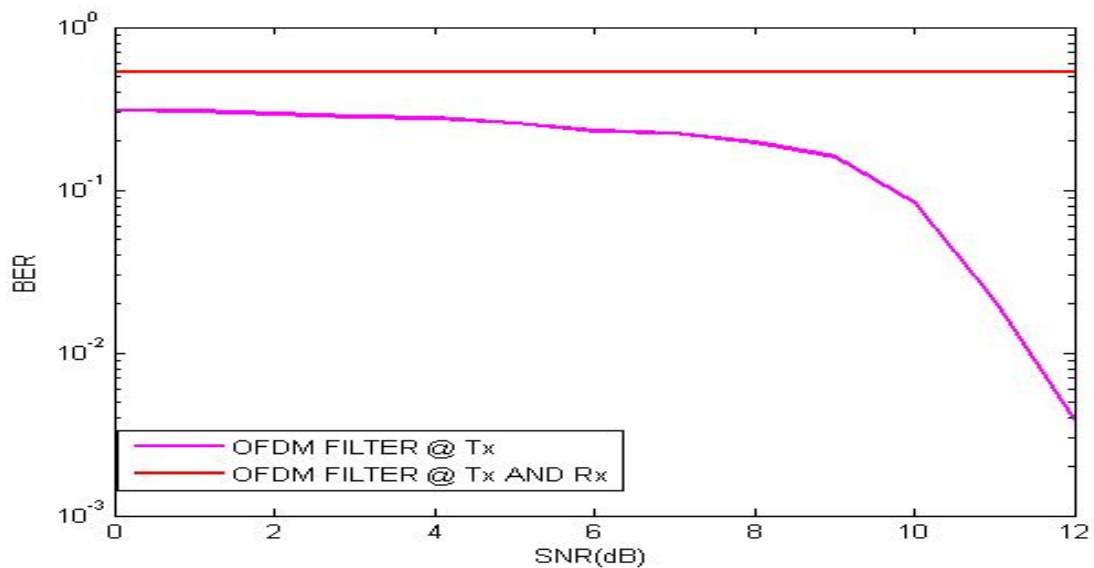


Fig.2. BER vs SNR

4. Conclusion:

In this work, we analysed performance of an OFDM system with and without Cyclic Prefix; filter at transmitter and filter at transmitter and receiver both. In this work, analysis of Energy detection integrated with OFDM, BER vs SNR and Pd vs SNR shows that the performance and efficiency

of OFDM with CP is better than that of OFDM without CP and OFDM with filter at transmitter as well as OFDM with filter at transmitter and receiver both.

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