Synchronization for OFDM System using 802.16 Standard

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Abstract— Orthogonal Frequency Division Multiplexing(OFDM) is one technique that has been proposed to offer substantially higher data rates than those currently available to the mobile user. As with any communications system effective, reliable and efficient techniques are required that will allow synchronization of remote terminal. Accurate frequency and timing synchronization of OFDM system is required in order to achieve good performance. The property that these systems rely on ortho-gonality of the subcarriers will be lost if synchronization is inaccurate. In this paper we focus on the frequency synchronization. This paper presents A Simu-link model based on 802.16 OFDM PHY baseband is built for simulation and performance evaluation.

Keywords *— OFDM, carrier frequency offset (CFO) , SNR, BER, WMAN, DVB, DAB.*

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I. INTRODUCTION

Orthogonal frequency division multiplexing (OFDM) is a digital multi-carrier modulation technique that has been come increasingly popular scheme in modern digital communication. It is the attractive technique for high speed wireless communication. It is robust against frequency selective fading in multipath channel . several wireless communication system adopt OFDM as a modulation technique such as wireless local area network (WLAN), wireless fidelity(Wi-Fi), 3rd generation partnership project long term evolution(3GPP LTE) & 4G LTE. It is also integrated in Digital Audio Broadcasting(DAB), Digital Video Broadcasting(DVB), DVB-T.

In OFDM, there are various domain of synchronizations such as timing synchronization, frequency synchronization and symbol synchronization. In this paper we examine the frequency synchronization. OFDM is very sensitive to carrier frequency offset(CFO) in the received signal due to Doppler shift or instability in local oscillator and results in a loss of subcarrier orthogonality. Hence it is required to reduce the frequency errors to small fraction of the subcarrier spacing. In this paper there are various techniques have been proposed for the frequency synchronization in OFDM.

II. LITERATURE REVIEW

The following literature review shows that different synchronization methods and algorithm. Moose [1] derived the maximum likelihood estimation (MLE) for carrier frequency offset (CFO) in frequency domain. The limit of acquisition for the CFO is +-1/2 of subscriber spacing. Schmidl and Cox [2] proposed frequency and timing synchronization algorithm by using repeated data symbol. Wei Zhong [3] proposed a novel integral frequency offset estimation which examined the phase changes of synchronization signals in frequency domain this method provides very low computational complexity. C.Geetha priya and A.M.Vasumathi [4] proposed accurate frequency synchronization method using Zadoff-chu sequence. Eric Bjornemo [5] proposed a Bayesian analysis in this way enables using fast frequency acquisition without pilots at low SNR. Ching-Liang Wang [6] proposed method of to make a modulatable orthogonal sequence partially geometric for Large CFO estimation. E.C. Kim [7] proposed enhanced the performance of frequency offset compensation by adding the ternary sequence to OFDM signals. Haling Minn [8] proposed frequency offset estimation approach using a maximum likelihood principle with sliding observation vector. Adegbenga B. Awoseyila [9] proposed a novel technique for 3GPP LTE specifications using one training with simple structure of two identical parts to achieve robust and full range time-frequency synchronization in OFDM system.

In this paper we synchronized data with additional cyclic prefix or preamble bit or guard bit. By adding these bits, we provide a perfect synchronization at receiver side. It also improves the performance of SNR, BER of the system.

III. OFDM SYSTEM MODEL

This model represents end to end baseband model of the physical layer of wireless metropolitan area network(WMAN) according to IEEE 802.16 standard. The transmitter consists of the incoming input Bernoulli binary stream are first generates a random data which applied to

FEC and modulator bank. Generally FEC is farward error correction encoding. In this encoding Reed Soloman coding is used. Modulator bank consists of different modulation techniques are used such as BPSK, QPSK and QAM. Using synthesis filter bank we use a single modulation technique is used. The input signal is now digital in nature, hence we use IFFT ,it is inverse fast Fourier transform which convert discrete samples into the continuous time domain signal. In this model, MISO OFDM channel is used. It is a multiple input and single output consist of one or more transmitter and single receiver. It has a maximum Doppler shift is 0.5 Hz. In that model, AWGN Channel is also used to improves the SNR of the system. In order to maintain SNR of 20 dB for OFDM carrier, offset is limited to 4%.

The Receiver section consists of OFDM Receiver which having space time diversity combiner consists of odd even preamble which added with continuous received signal and applied to the space time block coding. The extract data carriers are extracted the pilot bits in the received signal. The demodulator bank consists of different demodulating techniques such as BPSK, QPSK, QAM. At the output we resulting the different system performance. All the preamble based frequency offset estimation methods given in literature aims to accuracy and increase the range of frequency offset estimation. The importance of frequency offset estimation in various high speed broadband wireless applications.

IV. PROPOSED FREQUENCY OFFSET ESTIMATION AND CORRECTION

Frequency offset Caused by the asynchronous local oscillators at the transmitter and receiver and other is the Doppler shift. Later it shown that this offset results in a loss in SNR which independent of the sub-carrier index. At the front end of the receiver OFDM signals are subject to synchronization errors due to oscillator impairments and sample clock differences. The demodulation of the received radio signal to baseband, possibly via an intermediate frequency, involves oscillators whose frequencies may not be perfectly aligned with the transmitter frequencies. This results in a carrier frequency offset. The front end of an OFDM receiver where these errors can occur.

The most important effect of a frequency offset between transmitter and receiver is a loss of ortho-gonality between the subcarriers resulting in ICI. The characteristics of this ICI are similar to white Gaussian noise and lead to a degradation of the SNR. For both AWGN and fading channels, this degradation increases with the square of the number of subcarriers. This degradation as a function of the frequency offset normalized to the inter-carrier spacing.

Receiver carrier and transmitter carrier are generated from local oscillators. The oscillators are not phase synchronous, creating an arbitrary phase error .At the same time, deviations from the nominal oscillators values will create a carrier frequency offset (CFO) .A pure Doppler shift generates the same effects. The proposed a new technique for frequency synchronization using a filter banks. In OFDM, receiver carrier and transmitter carrier are generated from local oscillator.These local oscillator are not phase synchronous hence it creating the arbitrary phase error. Therefore deviations from local oscillators values will create carrier frequency offset (CFO).

$$\Delta f = fTc - fRc$$

fcR = Receiver carrier frequency

fcT = Carrier frequency of received signal

Δf = Carrier frequency offset, CFO

The proposed frequency synchronization technique. The frequency error estimation should be performed after the receiver filter bank. If frequency error estimation is done then at the same time frequency error correction should be performed in front of filter bank. Since, the carrier frequency is the derivative of carrier phase with respect to time. The OFDM system with frequency estimation after filter bank will produce error estimates at maximum rate of 1/T. In this frequency estimation, their having one filter-bank which carries filtered signal. And other is filtering feedback delay circuit which provides error frequency signal and this feedback frequency error signal is applied to frequency error correction through the feedback. If error will arises then it will correcting through feedback loop by using a filter bank.

Generally in this project we uses two types of filter banks such as analysis and synthesis filter bank at transmitter and receiver of the OFDM model. The above concept is also related to the filter bank concept. With the help of that concept, frequency is synchronize at both the transmitter and receiver side with improves the parameters such as SNR, BER. Generally 64 QAM is used for high data rates , so the following simulation shows that using 64QAM.

V. SIMULATION AND DISCUSSION

The simulation of synchronization for OFDM system using IEEE 802.16 standard is generally performed using Simu-link software. By using this software we analyses the results of Channel SNR , BER and Rate ID. In this simulation, we changes the different modulation and demodulation techniques. Band-width remains in between 1MHz- 28 MHz using802.16 standard.

In that model, if we use 64 QAM modulation and demodulation technique is used and bandwidth requirement is 5MHz then BER is 0.0001 and error is zero. So in this case SNR is 20.29dB. The simulation result as shown in figure 1, 2 and 3.

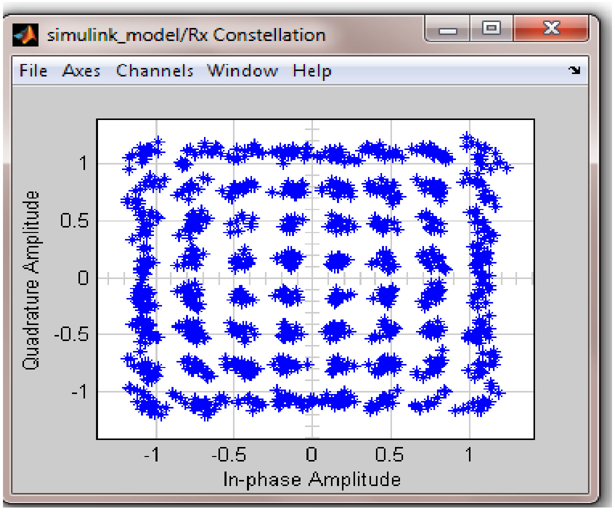

Fig1. Receiver Constellation of 64 QAM

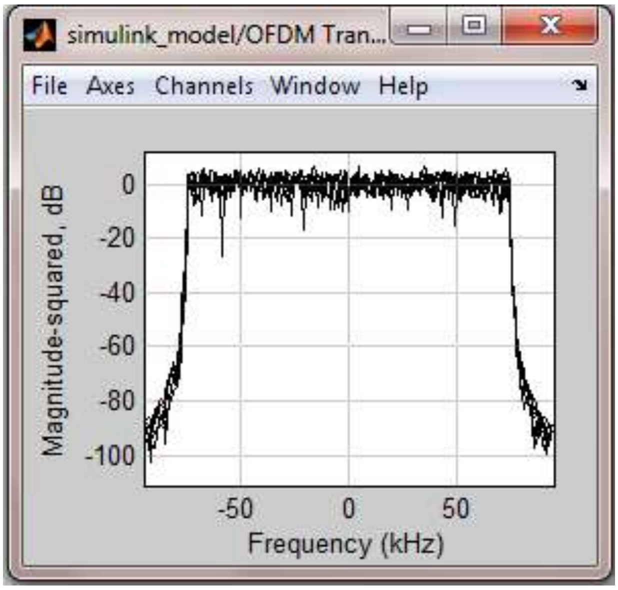

Figure 2. OFDM Transmitter1 Spectrum

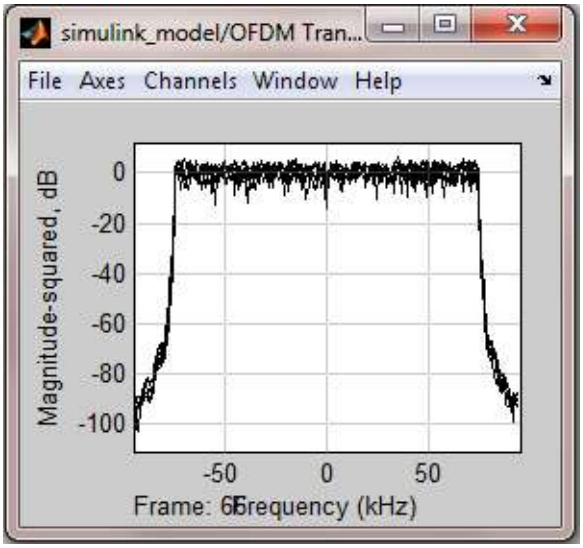

Figure 3. OFDM Transmitter 2 Spectrum

Figure1 shows that the how receiver is synchronized with the transmitter. Here in this constellation figure shows that quadrature amplitude of signal is in phase with the amplitude of carrier signal. Figure 2 and 3 shows that spectrum of transmitted signal which having less bandwidth required and improves the SNR up to 20.29 dB and BER is also zero. Hence efficiency of the system model is increases .

VI. CONCLUSION

There are different modulation and demodulation techniques were applied to that 802.16 OFDM Physical Link Model. Using that model we get different results using constellation figure, BER , SNR and synchronization is provided in terms of frequency. In OFDM system model, if bandwidth increases above the specific value then BER and number of errors are also increases due to noise ,so proper synchronization is not takes place. Proposed frequency synchronization estimation and correction having better performance as compare to other methods. For proper synchronization we use filter bank and adding a preamble bits or guard bits. This model uses an adaptive modulation and variable error correction is provided.

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