Efficient Multi Carrier Wireless Communication System using Smoothening Filter

Kainat Ansari[1], Prof. Abhinav Shukla[2]

[1]*M.Tech Scholar*, [2]*Research Guide*

Department of ECE, RKDF University, Bhopal

Abstract - The wireless era of communication is trending and the future is itself will be the wireless communication and expected it will be much more advanced. The modern wireless communication system are all equipped with the OFDM technology and almost exist everywhere. The high data rate is achieved in wireless technology is because of the OFDM and integration of other research being invented with hardware as well soft computing techniques. The hurdles to achieve optimum performance of the system are inter channel interference (ICI) and it is need to be reduced to develop efficient communication which must be easier to maintain and less noisy. This paper proposes a efficient way to optimize OFDM system and reduces the bit error rate (BER). The proposal utilizes raised cosine windowing with technique to reduce BER we have proposed the raised cosine windowing with 16-QAM modulation to achieve high data rate and less noise effect. The OFDM system is also designed with multi carrier with variable FFT size and this is visible in the simulation outcomes which show the increased performance better than previous system.

Keywords: Multi Career OFDM, Raised Cosine Window, 16-QAM, ICI, FFT & BER.

I. INTRODUCTION

One of the biggest challenges in wireless communication is to operate in a time- varying multipath fading environment under limited power constraints. The other challenge is the limited availability of the frequency spectrum. Future commercial and military wireless systems will be required to support higher data rates with reliable communication under spectrum limitations and multipath fading environments. Military communication systems must maintain reliable communication under the conditions of hostile jamming and other interference without increasing emitted power or requiring larger bandwidth.

In order to enhance the unwavering quality without expanding the discharged power, time, frequency or space diversity could be misused. In time diversity, the received signal is inspected at a higher rate, hence giving more than one example for each transmitted image. In frequency diversity, a similar data is sent over various carriers [1]. Both diversity procedures require larger bandwidth. To misuse space diversity, a similar data is transmitted or received through numerous antennas. Utilizing different antennas at the receiver and additionally the transmitter enhances the nature of a wireless communication connect without expanding the transmitted power or bandwidth [2]. In this way, the outline and usage of Multiple Input Multiple output (MIMO) communication frameworks is an attractive research area.

Orthogonal frequency division multiplexing (OFDM) is a generally utilized technique in wireless communication frameworks. Because of its adequacy in multipath channel conditions, OFDM has been embraced by a few wireless communication benchmarks, for example, the IEEE 802.11a neighborhood (LAN) standard and the IEEE 802.16a metropolitan region network (MAN) standard. The mix of OFDM and MIMO frameworks shows better solutions by adding greater diversity pick up to the regular OFDM frameworks utilizing a solitary antenna at both the receiver and the transmitter.

The fundamental parameters for future wireless communication frameworks are high transmission information rate, ghostly productivity and dependability. Not at all like Gaussian channels, wireless channels experience the ill effects of lessening due to multipath in the channel. Various duplicates of a solitary transmission touch base at the receiver at marginally unique circumstances. Without diversity strategies, extreme weakening makes it troublesome for the receiver to decide the transmitted signal. Diversity procedures give conceivably less lessened copies of the transmitted signal at the receiver.

Multiple-Input Multiple-Output (MIMO) antenna frameworks are the case of spatial diversity. This framework accomplishes high data rate without expanding the total transmission power or bandwidth [5]. It is likewise watched that the utilization of multiple antennas at both the transmitter and receiver gives critical increment in limit.

The communication process comprises of five fundamental components, in particular, source data, transmitter, channel, receiver and client data as appeared in Fig 1.1 underneath.

The information source: roduces a signal that carries the message. The message might be different sorts, either simple frame, for example, sound signal or digital form like bit stream from computer. The message signal from source is as a rule as baseband signal.

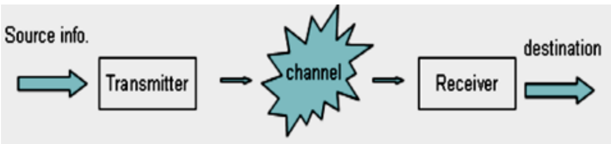

Figure 1.1 Basic elements of communication systems.

2. Transmitter: It works somehow on message signal and delivers a signal appropriate for transmission to getting point over the particular channel. The transmitted signal constantly substantially higher the most extreme frequency segment of the message signals.

3. Channel: It is a media used to transmit the signal from transmitting to reception end. During transmission commotion and diverse sort of meddling signals added to transmitting signal.

4. Receiver: It operates on receive signal and trying to reproduce original signal from it since the signal is corrupted version of transmitted signal.

5. User of information: It is a person or thing for which the message is intended.

The fading distortion in the channel causes ICI in the OFDM demodulator. The pattern of ICI varies from frame to frame for the demodulated data but remains invariant for all symbols within a demodulated data frame. Compensation for fading distortion in the time domain introduces the problem of noise enhancement. So frequency domain equalization process is approached for reduction of ICI by using suitable equalization techniques.

The major source of ICI is due to the frequency mismatch between the transmitter and receiver, and the Doppler shift. In mobile communication the channels are frequency selective fading in nature because of multipath components.

II. SYSTEM MODEL

OFDM signal has broadly spread power range. So if this Signal is transmitted in a band constrained channel, certain bit of the Signal range will be cut off, which will prompt inter carrier interference. Consider the range of transmitted signal.
To diminish the interference the spectrum of the signal wave shape should be more thought. This is accomplished by windowing the Signal. Fundamentally windowing is the way toward increasing a reasonable capacity to the transmitted Signal wave frame. A similar window is utilized as a part of the beneficiary side to get back the first Signal. The ICI will be dispensed with if the result of the window capacities fulfills the Nyquist minimal symmetry measure.
In the windowing method, an underlying motivation reaction is inferred by taking the Inverse Discrete Fourier Transform (IDFT) of the coveted recurrence reaction. At that point, the motivation reaction is refined by applying an information window to it.
The raised-cosine is a filter frequently utilized for Smoothening Filter in digital modulation due to its ability to optimize intersymbol interference (ISI). Its name stems from the fact that the non-zero portion of the frequency spectrum of its simplest form (β=1 is a cosine function, 'raised' up to sit above the f (horizontal) axis.
The raised-cosine channel is an execution of a low-pass Nyquist channel, i.e., one that has the property of minimal symmetry. This implies its range shows odd symmetry about $\frac{1}{2T}$, where T is the symbol-period of the communications system.
Its frequency-domain description is a piecewise function,

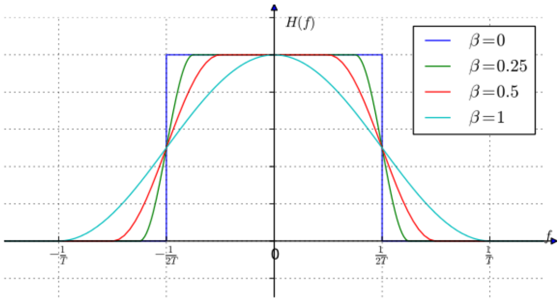

Figure 2.1 Raised-cosine filter

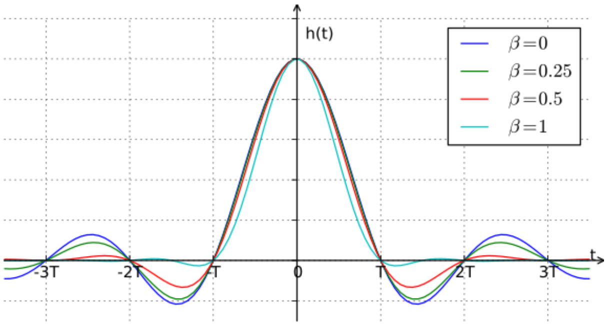

Figure 2.2 Impulse response of Smoothening Filter.
Raised cosine window is utilized as a part of increased with window work. Raised cosine work is characterized as takes after where beta is move off factor expands side lobe of OFDM range decreases. This decrease inside lobe level ICI control prompts the diminishment in ICI.

III. PROPOSED METHODOLOGY

Proposed work is based on the raised cosine windowing system to optimize performance of the OFDM system using with elimination of inter carrier interface ICI effect. Proposed system has segmented in three sections as illustrated in figure 3.1 transmitter, receiver and AWGN channel.

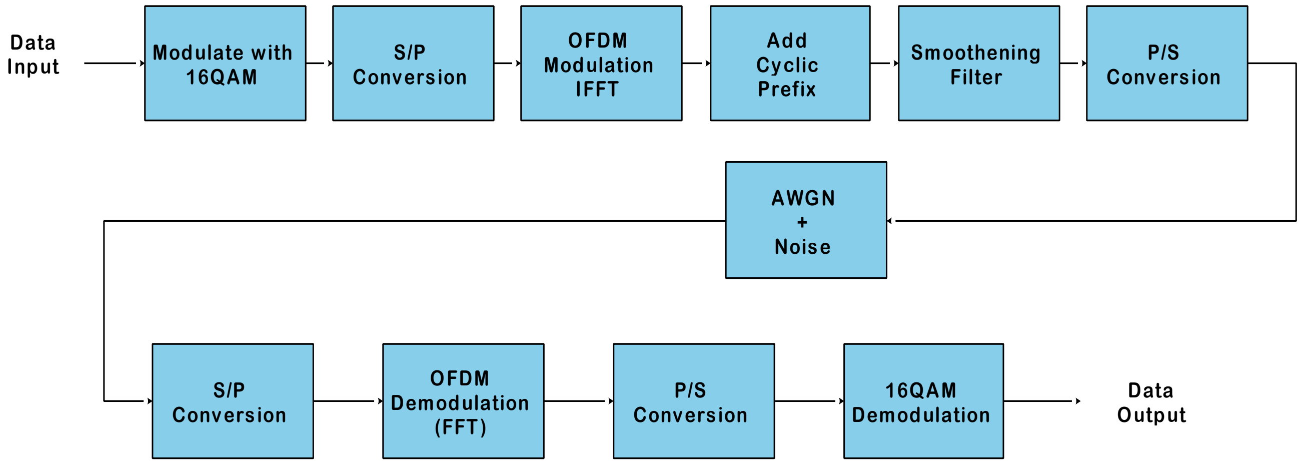

Figure 3.1 Block diagram of proposed system.

A. Transmitter

In transmitter section there is a 16 QAM modulator which modulate first the input signal similar to any other OFDM system there is a serial to parallel convert which covert the modulated signal in parallel then again it pass through the IFFT modulation a cyclic prefix added to the IFFT modulated signal that the receiver can easily determine the start bit and end bit of symbol. Then Smoothening Filter is applied to the signal which is ready to transmit.

B. Channel

There is an adaptive white Gaussian noise channel between transmitter and receiver. Due to fundamental properly of channel some noises are added in signal.

C. Receiver

Receiver is the destination. at this terminal signals are received and convert received signal parallel from serial. Demodulate OFDM signal with FFT. Parallel to serial conversion. Apply 16 QAM demodulation on received parallel to serial converted data.

Figure 3.2 has given flow chart of proposed work there are following steps of execution given below.

Step 1. Create Simulation Environment.

Step 2. FFT ($2^{11}/2^{12}/2^{13}$)

Step 3. SNR (0 to 10)

Step 4. Generate data to be transmitted over network.

Step 5. Modulate with 16-QAM

Step 6. Serial to Parallel Conversion

Step 7. OFDM Modulation(IFFT)

Step 8. Adding Cyclic Prefix

Step 9. Apply Smoothening Filter

Step 10. Prepare OFDM symbols per carrier.

Step 11. Parallel to Serial Conversion.

Step 12. Transmit signal through AWGN channel and Add noise.

Step 13. OFDM Symbol conversion

Step 14. OFDM Demodulation FFT

Step 15. Parallel to Serial Conversion.

Step 16. Demodulate with 16 QAM.

Step 17. Calculate Bit error Rate

Step 18. Calculate and Display results

IV. SIMULATION OUTCOMES

The simulation of previously explained wireless communication system is performed here. The simulation is performed by considering different parameters in mind and it also helps to analyze system better. The simulation results of proposed methodology are compared with the existing results of reference paper. Simulation graph shows the characteristics of bit error rate for different signal to noise ratio (SNR). The parameters varied to simulate the system are different number of symbols and carriers. The characteristics are compared among different FFT sizes of 1024, 4096 and 16384 with previous results.

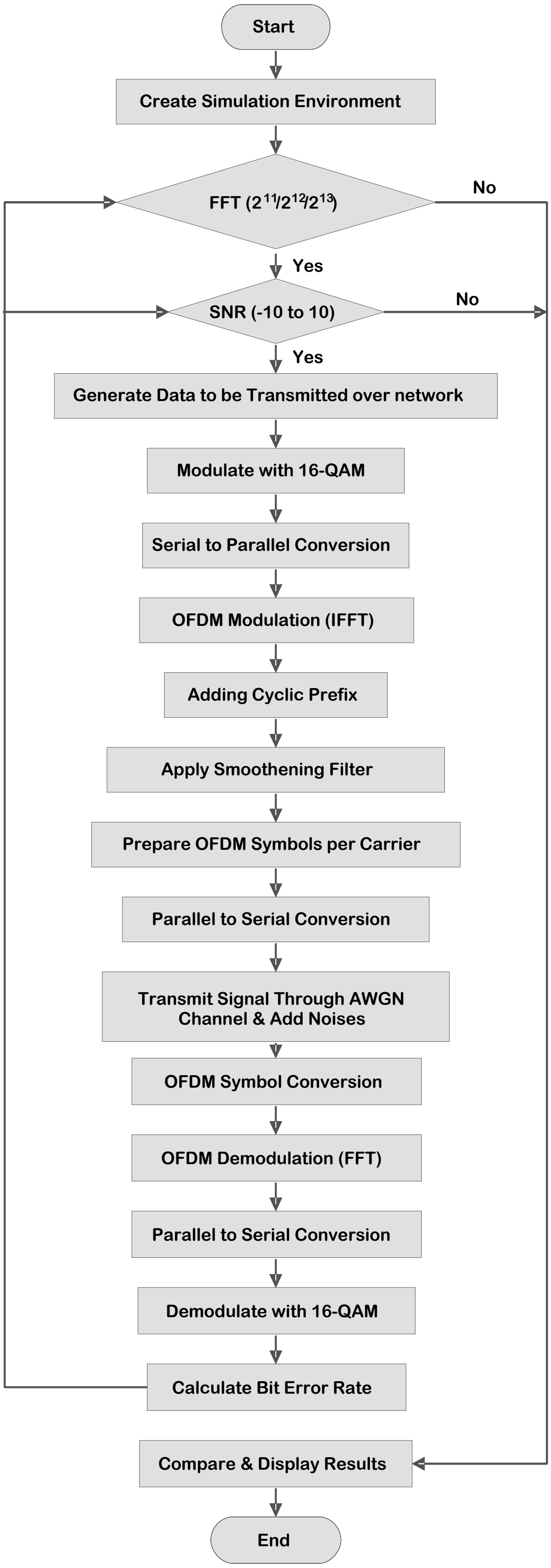

Figure 3.2 Flow chart of Proposed System

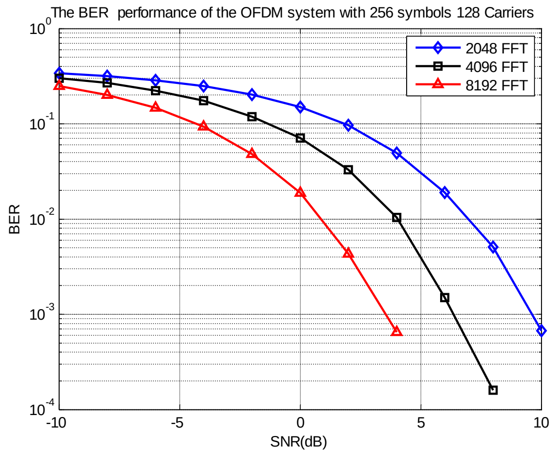

Fig. 4.1 Performance of Proposed System using 128 Carriers and 256 Symbols with Different FFT Sizes

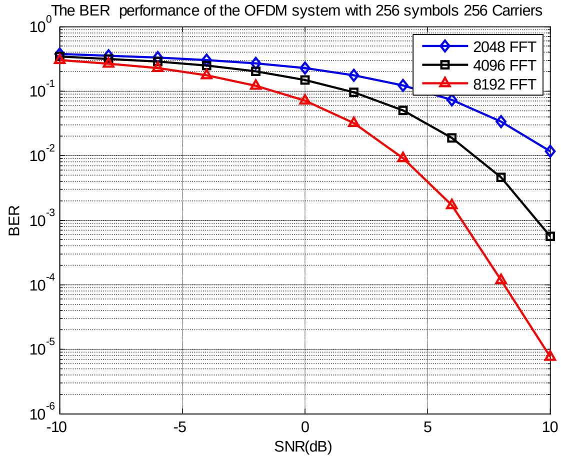

Fig. 4.1 Performance of Proposed System using 256 Carriers and 256 Symbols with Different FFT Sizes

V. CONCLUSION AND FUTURE SCOPE

The proposed system has signal smoothening filter utilized in the system and the simulation results comparison concludes that the proposed methodology performs better with system and produces lesser error and consumes lesser power than the previous works. The methodology has also utilizing 16-QAM modulation which is great for higher data rate and larger capacity of the system. In future the system can be equipped with the better hybrid detection as well as filtering technique to reduce error rate and improve system stability and reliability.

The proposed signal smoothening filter method for ICI cancellation Exploits the orthogonality of the ICI coefficient network and it can wipe out the ICI experienced OFDM frameworks totally and give huge BER change which practically coordinates the BER execution of OFDM framework without ICI by any means.

For further research work concerned on self ICI cancellation technique for performance enhancement and Extended Kalman filter method can also be applied under different channel conditions such as Rayleigh fading channel, urban area channel, rural area channel etc.

REFERENCES

[1] Chang He, L. Zhang, J. Mao, Aijun Cao, P. Xiao and M. A. Imran, "Output SNR analysis and detection criteria for optimum DCT-based multicarrier system," 2016 International Symposium on Wireless Communication Systems (ISWCS), Poznan, 2016, pp. 59-64.

[2] A. Ijaz et al., "Enabling Massive IoT in 5G and Beyond Systems: PHY Radio Frame Design Considerations," in IEEE Access, vol. 4, no. , pp. 3322-3339, 2016.

[3] L. Zhang, A. Ijaz, P. Xiao, A. Quddus and R. Tafazolli, "Single-rate and multi-rate multi-service systems for next generation and beyond communications," 2016 IEEE 27th Annual International Symposium on Personal, Indoor, and Mobile Radio Communications (PIMRC), Valencia, 2016, pp. 1-6.).

[4] L. Wen, R. Razavi, M. A. Imran and P. Xiao, "Design of Joint Sparse Graph for OFDM System," in IEEE Transactions on Wireless Communications, vol. 14, no. 4, pp. 1823-1836, April 2015.

[5] X. Wang, T. Wild, F. Schaich and S. ten Brink, "Pilot-Aided Channel Estimation for Universal Filtered Multi-Carrier," 2015 IEEE 82nd Vehicular Technology Conference (VTC2015-Fall), Boston, MA, 2015, pp. 1-5.

[6] R. Razavi, P. Xiao and R. Tafazolli, "Information Theoretic Analysis of OFDM/OQAM with Utilized Intrinsic Interference," in IEEE Signal Processing Letters, vol. 22, no. 5, pp. 618-622, M

[7] L. Zhang, P. Xiao, A. Zafar, A. Quddus, and R. Tafazolli, "FBMC system: An insight analysis on double dispersive channel impact", IEEE Transactions on Vehicular Technology, 2016.

[8] M. Rodrigues and I. Darwazeh, "Fast OFDM: A proposal for doubling the data rate of OFDM schemes", IEEE/IEE International Conference on Telecommunications, 2002.

[9] W.H Chen, C. Smith, and S. Fralick, "A fast computational algorithm for the discrete cosine transform", IEEE Transactions on Communications, vol. 25, no. 9, pp. 1004-1009, Sep 1977.

[10] Zhongde Wang, "Fast algorithms for the discrete W transform and for the discrete fourier transform", IEEE Transactions on Acoustics, Speech, and Signal Processing, vol. 32, no. 4, pp. 803-816, Aug 1984.

[11] P. Tan and N. C. Beaulieu, "A comparison of DCT-based OFDM and DFT-based OFDM in frequency offset and fading channels", IEEE Transactions on Communications, pp. 2113-2125, Nov 2006.

[12] N. Al-Dhahir, H. Minn, and S. Satish, "Optimum DCT-based multicarrier transceivers for frequency-selective channels", IEEE Transactions on Communications, vol. 54, no. 4, pp. 760-760, April 2006.

[13] X. Ouyang and J. Zhao, "Single-tap equalization for fast OFDM signals under generic linear channels", IEEE Communications Letters, vol. 18, no. 8, pp. 1319-1322, Aug 2014.

[14] V. Sanchez, P. Garcia, A. M. Peinado, J. C. Segura, and A. J. Rubio, "Diagonalizing properties of the discrete cosine transforms", IEEE Transactions on Signal Processing, pp. 2631-2641, Nov 1995.

[15] J. Zhao and A. Ellis, "Transmission of 4-ASK optical fast OFDM with chromatic dispersion compensation", IEEE Photonics Technology Letters, vol. 24, no. 1, pp. 34-36, Jan 2012.