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PERFORMANCE EVALUATION OF SC-FDMA SYSTEM WITH STBC CODES

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***Abstract*— The Long term evolution uses single carrier frequency division multiple access for uplink and orthogonal frequency division multiple access for downlink communication. SCFDMA is a recent technique which has advantage of low PAPR compared to OFDMA system so that the power amplifiers will be battery efficient. Coding over the space, time, and frequency domains provided by OFDM system will enable a much more reliable and robust communication over the harsh wireless environment. This article presents an overview to use various coding algorithms like STBC codes which improves efficiency or other multiple access technique like SC-FDMA method. Also the Bit Error Rate and PAPR values of the systems will be compared.**

Keywords—OFDM, SCFDMA, PAPR value, BER analysis, Fourier transform, CP (cyclic prefix), LTE uplink transmission

I. INTRODUCTION

The growing demand for services with high data rates and high spectral efficiency is the key to rapid technological evolution in the field of wireless communication. In the last two decades wireless communication has experienced a massive growth with a mission to provide new services with high data rates.

LTE uses Orthogonal Frequency Division Multiplexing (OFDM) as downlink access scheme and Single Carrier Frequency Division Multiple Access (SC-FDMA) as uplink access scheme. OFDM is a multicarrier transmission scheme that has become the technology of choice for next generation wireless and wire line digital communication systems because of its high speed data rates, high spectral efficiency, high quality service and robustness against narrowband interference and frequency selective fading. Depending on the transmission environment, multiple transmit and receive antennas may be used to increase diversity and improve BER performance or increase the transmitted data Depending on the transmission environment, multiple transmit and receive antennas may be used to increase diversity and improve BER performance or increase the transmitted data rate through spatial multiplexing, and/or reduce interference from the other users.But because of its drawback of producing high PAPR ratio that reduces power efficiency, will force to restrict its usage in wireless communication.

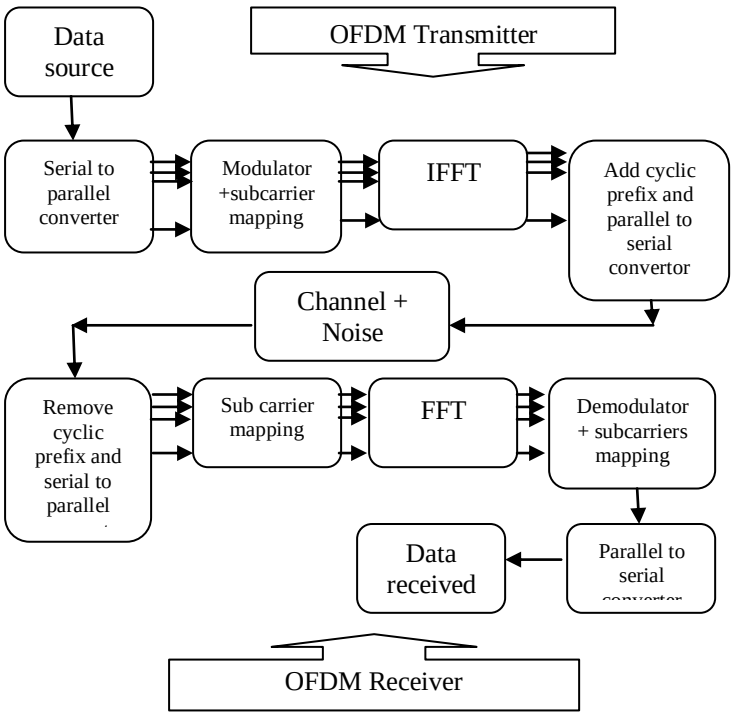

Figure 1 shows the basic block diagram of OFDM

In the above figure OFDM basic working is shown where first data is kept and then transmitted to the next block for the conversion of sequence of modulated symbols into parallel frequency sub carriers. After this manipulation, IFFT converts

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complex data symbols into time domain and OFDM symbols. Output from the conversion stage adds cyclic prefix (CP) which is also known as guard band. CP should be longer than channel delay spread. Thus, the whole process generates an output which will send to the receiver.

At the receiver side the whole process will go in backward direction from removing cyclic prefix to conversion from parallel to serial and then resultant output is the data.

II. SCFDMA

SC-FDMA is a single-carrier frequency division multiple access scheme. It deals with the assignment of multiple users to a shared common resource.SC-FDMA can be interpreted as a linearly preceded OFDM scheme in the sense that it has an additional DFT processing step preceding the standard OFDM processing. It has drawn great attention as an attractive alternative to OFDM especially in the uplink communication where lower PAPR greatly benefits the mobile terminal in terms of transmit power efficiency in addition to power amplifies reduced cost. It has been adopted as the uplink multiple access in 3GPP Long Term Evolution (LTE) or Evolved UTRA (E-UTRA).

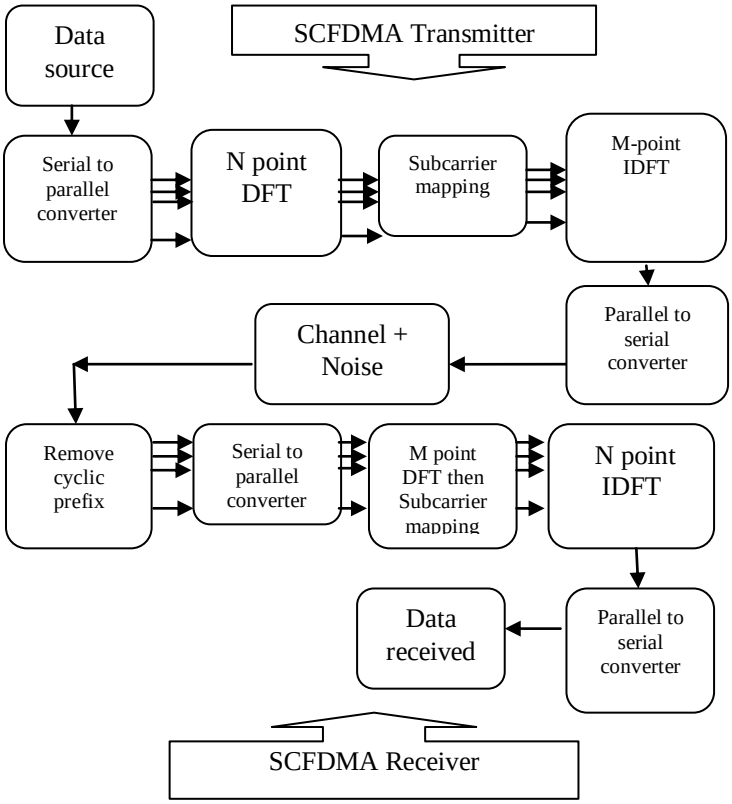

Figure 2 shows the basic block diagram of SCFDMA

After representation of SCFDMA, one thing has been noticed that both looked same yet it has a difference of N point DFT at the transmitter side and N point IDFT at the receiver side. DFT produces frequency domain symbols that will spread over a bandwidth [1].

On the other side, IDFT produce time domain channel symbols.

SCFDMA has some useful properties which make them popular:

- Provides less PAPR value
- Low sensitivity to carrier frequency offset
- It allows the use of low-cost power amplifiers
- Greater robustness against spectra nulls.

III. PROBLEM IN EXISTING APPROCHES

OFDM is the modulation technique used for both wired and wireless communication systems. It is consider as the best technique for high data rates in both wired and wireless communication systems ,but it has some limitation ,the major problem in using OFDM technique is high peak to average power ratio in signal, increase in Bit error rate (BER)and signal to noise ratio(SNR) of the signal . As in the previous techniques, DFT based OFDFM was used which does not provide better performance. OFDM system uses group of bits as 0's and 1's to generate sub carriers and then these bits will processed by IDFT to acquire time signal. Process looks easy and simple but it increases the power consumption of mobile devices. Regarding these problems in exiting system several modulation schemes has been under consideration .

IV. LITERATURE REVIEW

Anurag Pandey (3 July, 2014) "BER Performance of OFDM System in AWGN and Rayleigh Fading Channel" In this paper main focus is on the OFDM system used in wireless communication due to its enhancement in data rate and reduction in bandwidth. Simulation has been performed to show the results of signals over the faded channels and to obtain optimum Bit Error Rate. This paper focuses on the performance of the OFDM system on the basis of different modulation schemes and Rayleigh fading channels. [5]

Mukesh Kumar Mishra (December,2011) "Efficient BER Analysis of OFDM System over Nakagami -m Fading Channel": This paper presents Nakagami-m fading channels behaves on OFDM system and effected value of BER through the characteristics of function based approach of this fading channel. BER value is expressed in terms of confluent hyper geometric functions known as higher transcendental function. As a result, paper concludes that BER performance may degrade depending on the number of channel taps as well as on the increasing value of Nakagami-m fading parameters. [8]

Kumar Naresh (21 Feb, 2015) "BER Analysis in Wavelet Based SC-FDMA for LTE Uplink Transmission": This paper presents uplink and downlink communication with the help of single carrier frequency division multiple access and orthogonal frequency division multiple access. LTE i.e. Long term evolution adopted SCDFMA and used for uplink communication. SCFDMA is also known as Discrete Fourier Transform spread OFDM. This paper has proposed a new technique named as Wavelet based SCFDMA to analyze Bit error rate performance. Evaluation is performed on several wavelets under different modulation schemes with AWGN channel. Thus results shows that by using wavelet transform BER is reduced and performance is better as compared to existing approach used in SCFDMA. [21]

Rahul Ohlan et al (March 2016), "REVIEW PAPER ON OPERATIONAL ASSAY OF LTE SYSTEM IN STINT OF OFDMA & SC-FDMA"

This paper presents a recent trend in the field of LTE systems which are based on the OFDM with cyclic prefix and SCFDMA.OFDM basically used for downlink communication whereas SCFDMA is used for uplink communication. SCFDMA is better as compared to OFDM in terms of lower PAPR value. This paper presents some historical techniques that had been used and also discussed survey results. [25]

Prittu Ann Thomas et al (March 2014), "SC-FDMA -AN EFFICIENT TECHNIQUE FOR PAPR REDUCTION IN UPLINK COMMUNICATION SYSTEMS -A SURVEY"

This paper presents several modulation schemes that result lower PAPR value. OFDM provides high data rate due to which it has been used for modulation purposes though OFDM provides multi path delay spread tolerance as well as robust. Apart from this OFDM also consist of variation in signal amplitude that generates high PAPR. This effect reduces the efficiency of the devices in a network. Thus, SCFDMA becomes a first choice for modulation for uplink communication. [26]

V. CONCLUSION AND FUTURESCOPE

The overview results that OFDM has been used for its performance to get high performance system as well as high data rates. Apart from various disadvantages in OFDM but still it is used for communication between transmitter and receiver as if the signal is not orthogonal then there can be likely chances of crosstalk in a signal. Thus, another approach known as SCFDMA which is similar to OFDM but used for less sensitivity against distortion over and above great robustness.

In future more work can be done in the field of modulation of signals to produce less crosstalk signals, less distortion, less complex and robust enough against narrow band co-channel interference and spectra nulls.

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