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Analysis of BER in SC-FDMA with STBC Codes

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ABSTRACT: Wireless communication is known as the future trends that are used to communicate between transmitter and receiver. Modulation has been done after generation of the signal in each multiple sub carriers to send it over the channel. In this paper, OFDM, SCFDMA and other modulation schemes are used and reviewed. Earlier OFDM method was used but it has various disadvantages like it is sensitive to Doppler shift and frequency synchronization problems [5]. It has high peak to average power ratio (PARP), requiring linear transmitter circuitry, which suffers from poor power efficiency. In OFDM method there is loss of efficiency caused by cyclic/guard interval. To overcome these limitations, it was advised to use various coding algorithms like STBC codes which improves efficiency or other multiple access technique like SC-FDMA method. Consequently, review has been done based on previous papers in literature survey.

KEYWORDS: OFDM, SCFDMA, PAPR value, BER analysis, Fourier transform, CP (cyclic prefix), LTE uplink transmission.

I. INTRODUCTION

Wireless communication is a field that grows rapidly due to which demand of radio systems with high data rate is increasing. Thus several carrier signals (TDFM, OFDM, FDMA, and SCFDMA) are used to transmit data with high data rate. Some of them are discussed in this paper.

OFDM is abbreviated as orthogonal frequency division multiplexing method use to encode the data on multiple carrier frequencies. It has been used for digital communication applications like audio broadcasting, DSL, wireless networks etc. OFDM follows frequency division multiplication which means that data travels in multi carrier modulation where sub-carrier signals carries data on parallel channels. From these sub carrier signals each signal is modulated with existing scheme of modulation known as QAM and PSK i.e. Quadrature amplitude modulation and Phase shift keying respectively[2]. But conventional modulation scheme generates low symbol rate in the same bandwidth. But due to its drawback of producing high PAPR ratio that reduces power efficiency, will force to restrict its usage in wireless communication.

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 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 [1].

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.

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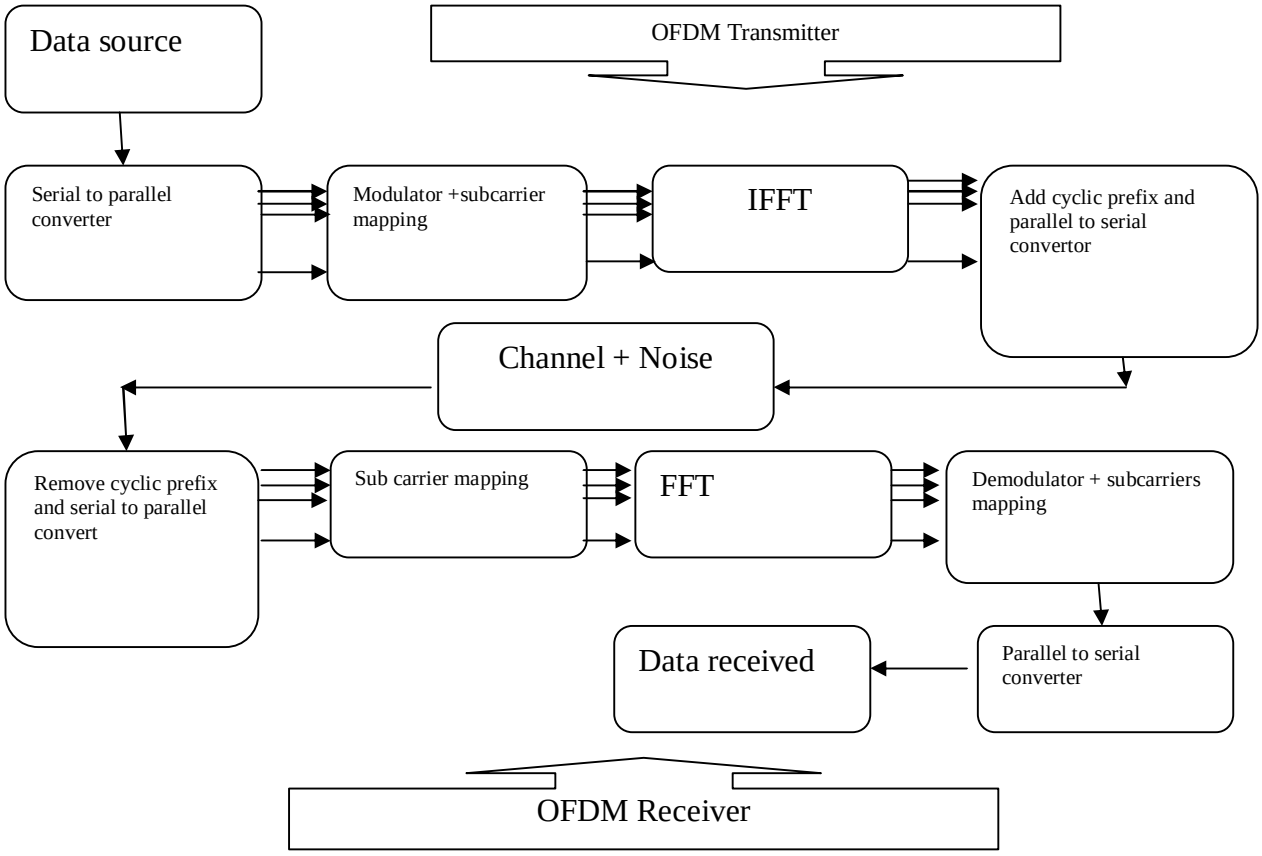

Figure. 1. Shows the basic block diagram of OFDM

II. **SCFDMA**

Thus SCFDMA has been used over the OFDM for its advantages. SCFDMA is known as single carrier frequency division multiple access schemes. It also follows same concept as in the multiple access schemes such as OFDM, TDMA and FDMA in which multiple users assigned with shared communication resource. SCFDMA have using OFDM scheme for transmission except DFT processing step which is an additional step in SCFDMA [1]. The reason behind using SCFDMA over OFDM because in the uplink communication, it produces low PAPR value which leads to better power efficiency and cost of the power amplifier is also reduced. As a result, SCFDMA has been used by uplink multiple access scheme in 3GPP LTE or E-UTRA. Performance of SCFDMA and OFDM is not much different but additional advantage of low PAPR makes SCFDMA famous for wireless communication because power efficiency of transmitter is important parameter. Though SCFDMA and OFDM working is same as sequence of bits are transmitted and mapped into complex symbols like BPSK, QPSK and M-QAM for individual user [20].

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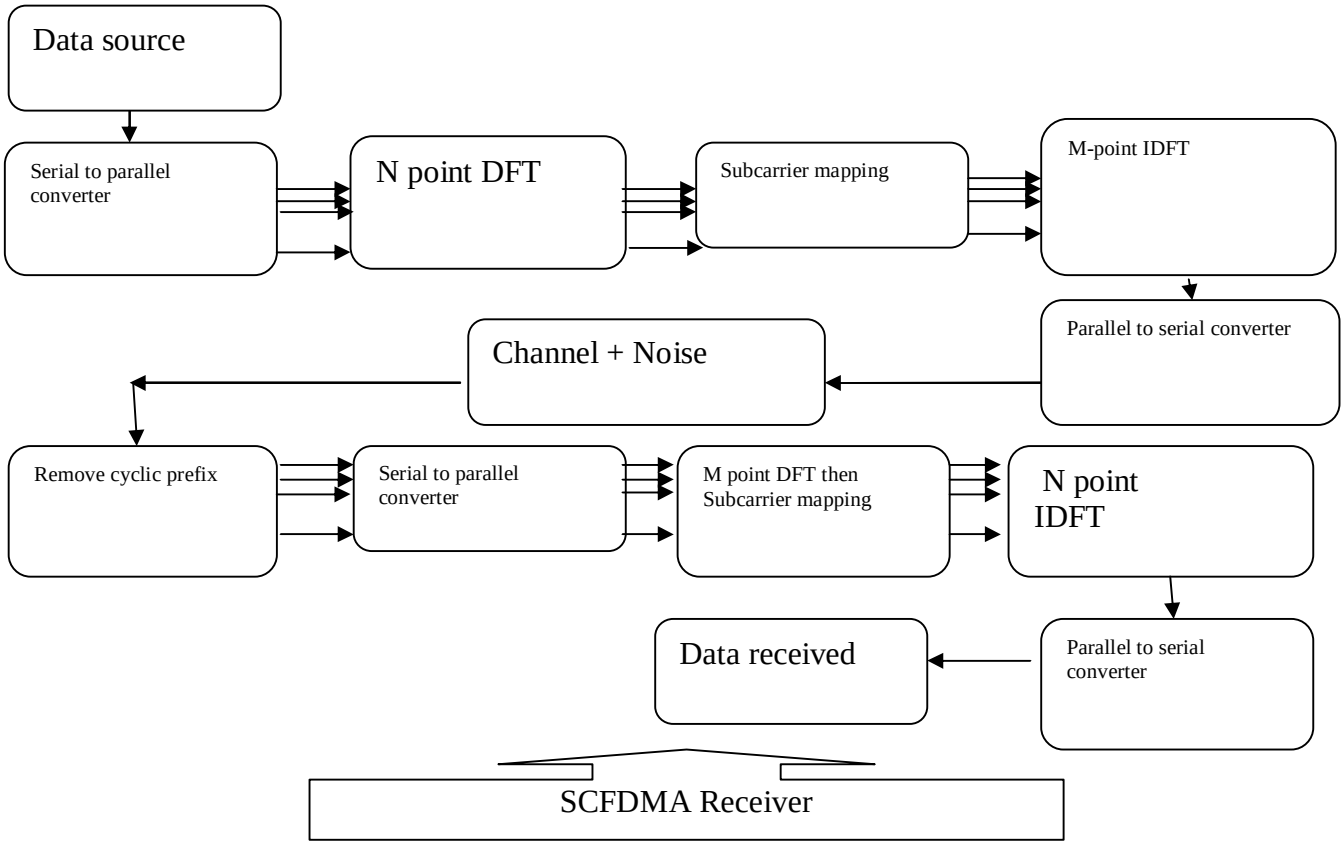

Figure 2. Shows the basic block diagram of SCFDMA

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 APPROACHES

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 [12]. 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

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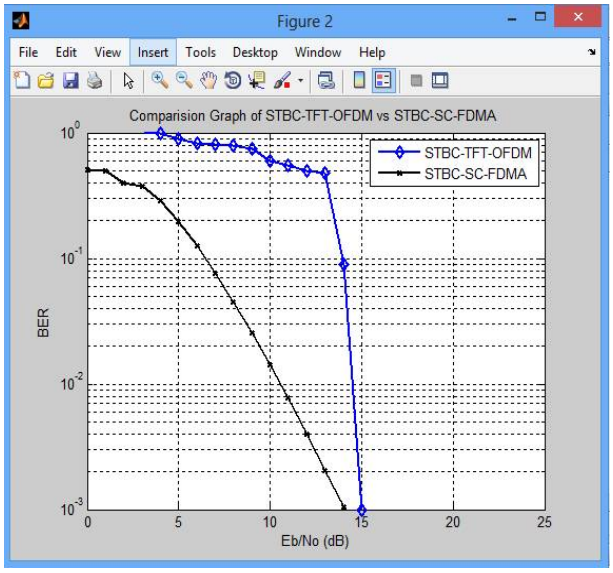
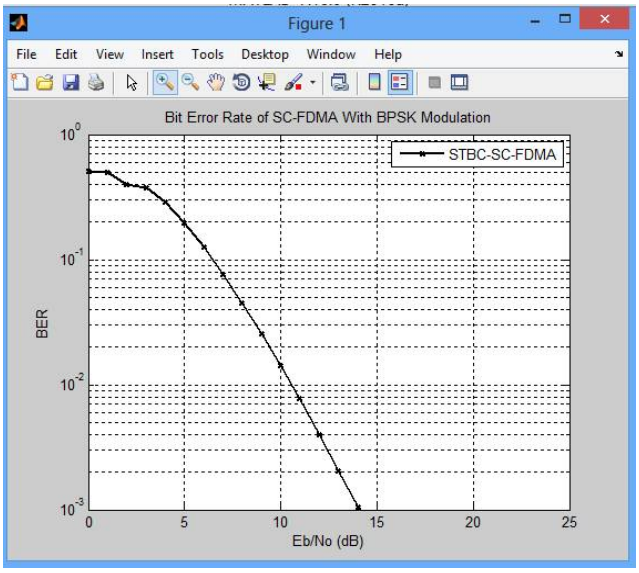
consumption of mobile devices. Regarding these problems in exiting system several modulation schemes has been under consideration [11].





IV. Conclusion and Future Work

This paper concludes that OFDM has been used for its performance to obtain high performance system as well as high data rates. Apart from various demerits in OFDM but still it is used for communication between transmitter and receiver as if the signal is not orthogonal then there can be 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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BIOGRAPHY

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