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LTE Advanced: Next generation Wireless Broadband Technology - LTE uplink communication

Micky Maria Boban[1], Asha Panicker[2]

M.Tech Student, Electronics and Communication, Mangalam College of Engg., Ettumanoor, Kottayam, India[1]

Head of the Dept., Electronics and communication, Mangalam College of Engg., Ettumanoor, Kottayam, India[2]

Abstract: Long Term Evolution is both a standard for wireless data communication and an evolution of the GSM standards. To increase the speed and capacity of wireless data networks was the goal of LTE and it was achieved using signal processing techniques and modulations. The IP based network architecture with reduced latency compared to 3G systems is a major advantage. The release 8 was the primary technique and LTE Advanced is the modified version. In this paper an LTE-uplink model is developed and output from each block is obtained. Different modulation techniques are used in this LTE uplink for the transmission of symbols and for every SNR values the BER of BPSK modulation is observed to be closer to the theoretical value and hence BPSK modulation is better than QPSK modulation in both channels.

Keywords: System capacity, Uplink communication, DFT model, Modulation scheme.

I. INTRODUCTION

The wireless communication has been stimulated by an exposure in the growth of wide variety of high quality services in voice, video and data. This huge demand has made an influence on current and future wireless applications, Wireless Local Area Networks (WLAN), Wireless Fidelity (WiFi) and Third Generation Partnership Project(3GPP) Long Term Evolution(LTE). LTE uses Single Carrier –Frequency Division Multiple access (SC-FDMA) in uplink data transmission and Orthogonal Frequency Division Multiple Access (OFDMA) scheme for downlink data transmission. OFDMA can handle multipath fading and high bit rate transmission for mobile wireless channels.

SC-FDMA is advantageous than OFDM for its low Peak to Average Power Ratio (PAPR).Here we are going for an LTE Uplink model which is DFT-coded. We analyze the output obtained from the LTE uplink model and compare different transmission techniques on this LTE uplink.

II.EVOLUTION OF WIRELESS NETWORKS

First Generation(1G) network focused on landline telephony. It was circuit switched and supported analog voice transmission over air and it employed Frequency Division Multiple Access (FDMA) as its main technology. The Advanced Mobile Phone Systems(AMPS) in US and Total Access Communication Systems(TACS) in Europe were the outcome networks of 1G technology.

Second Generation (2G) network supported data transmission and it provided an enhancement in voice transmission too. But it supported digital transmission over circuit switching. Short Message Service (SMS) was introduced by 2G. Global System for Mobile(GSM), Interim Standard-95(IS-95) all are 2G technologies.

2.5G network consists of General Packet Radio Service (GPRS). In GPRS system, each mobile network assigned an IP address.

3G supports data rates of upto 2Mbps. It is the current generation of mobile standards. Wideband Code Division Multiple Access (WCDMA),UMTA, CDMA 2000(Code Division Multiple Access 2000),EDGE all are 3G techniques.

All 2G and 3G features are supported by Fourth Generation (4G) technology. It can facilitate high quality streaming video, high quality video conferencing and high quality voice over IP.LTE is a major outcome of 4G.

III. LONG TERM EVOLUTION

LTE is now on the market. Release 8 was its first version and was frozen in December 2008 and it is the basic technology. Packet switched optimized system, low complexity, higher data rates and Quality of Service (QoS) all are reasons behind development of LTE systems.

LTE Advanced is a major enhancement in LTE standard and it is a mobile communication standard. It was standardized by 3GPP in march 2011 as LTE Release 10. Carrier aggregation in LTE-A allows bandwidths of upto 100MHz [1].

Spectrum flexibility, Bandwidth scalability, Reduced network complexity, Carrier aggregation ,Data transmission and control signaling, Asymmetric transmission bandwidth, Layered OFDMA, Co- Ordinated Multipoint transmission/reception (COMP).Enhanced multi antenna transmission techniques, Extended coverage area, Support of layered bandwidth all are important features of LTE-Advanced.

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IV.LTE UPLINK AND DOWNLINK

In LTE systems OFDM is the downlink transmission technique and SC-FDMA is the uplink transmission technique. In both Time Division Duplex (TDD) and Frequency Division Duplex (FDD), the downlink subframe structure is common. Robust coding and powerful signal processing techniques are needed in order to overcome the Inter Symbol Interference (ISI) resulted by the requirement of high data rates [4]. The 3GPP LTE provides peak data rates of 75 Mb/s on the uplink an d300 Mb/s on the downlink and the use of OFDMA on downlink is a working assumption in LTE standard.

OFDMA, the downlink multiple access scheme is an OFDM based technique . A unique fraction of the system bandwidth is provided with each user by this scheme. OFDMA combines scalability multipath robustness and Multiple Input Multiple Output (MIMO) capability. OFDMA requires accurate frequency and phase synchronization since it is sensitive to frequency offset and phase noise[3]. Because of high transmit PAPR, OFDMA is not well suited to LTE uplink transmission.

SC-FDMA is used in LTE uplink transmission. It supports PAPR reduction and it increases mean transmit power and power amplifier efficiency, increases data rate, and reduces Bit Error Rate(BER)[5]. It is actually a modified form of OFDM and it offers similar throughput performance and complexity as that of OFDM. In DFT-coded systems time domain data symbols are transformed into frequency domain symbols. Low PAPR makes SC-FDMA suitable for uplink communication.

V.MODULATION SCHEMES

A. Binary Phase Shift Keying (BPSK)

BPSK is the simplest form of Phase shift keying. Two phases separated by 180° are used here. So it is named as 2-PSK also. We can't use it for high data rate communications. Because it is able to modulate only at 1bit/symbol rate[2]. It is the most robust modulation technique and functionally it is equivalent to 2-QAM modulation technique.

B. Quadrature Phase Shift Keying (QPSK)

The major attraction of QPSK is its symbol rate, so that two bits are modulated at once. Here four possible carrier phase shifts are used: 0, Π/2, Π, and 3Π/2. The phase of In-phase carrier is changed from 0° to 180°. Phase of Quadrature carrier is changed between 90° and 270°. QPSK performs by these phase shifts and the state of the carrier is termed as a symbol.

VI. SIMULATION AND PERFORMANCE ANALYSIS

LTE Uplink model is generated using MATLAB and the output from each block is analyzed. Different modulation schemes are compared in LTE uplink transmission.

A random bit stream is taken an input data.

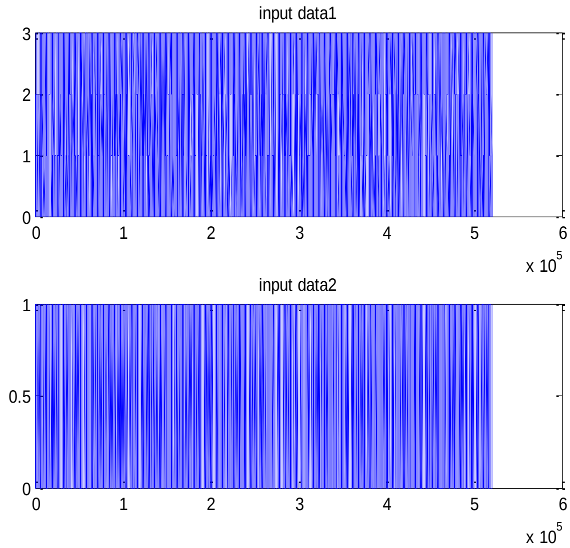

Fig.1: Input Data

Two input datas are separately taken BPSK and QPSK modulation to be applied in LTE uplink communication.

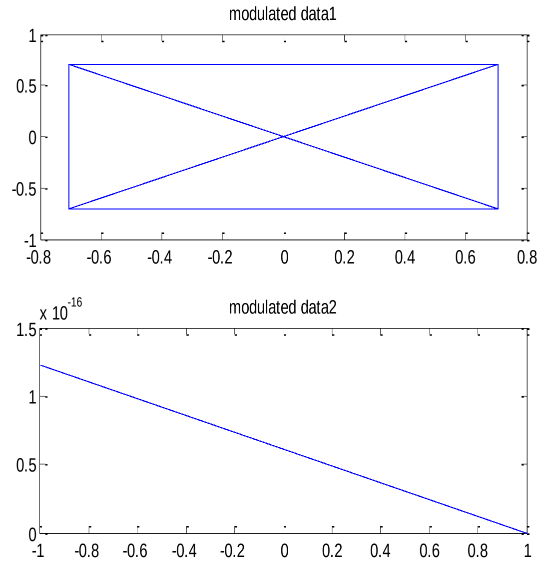

Fig .2: Modulated Data

The input data taken both QPSK modulated and BPSK modulated is given in this figure.

Pilot removed data which is parallel for both BPSK and QPSK modulated schemes is given in figure3 and figure 4 respectively.

Demodulated output from LTE uplink model for BPSK and QPSK scheme is given in figure 6.

A. Performance of LTE uplink systems

Different modulation schemes are studied first. BPSK and QPSK are studied separately and its performance on LTE uplink systems compared. Bit Error Rate is selected as a performance parameter.

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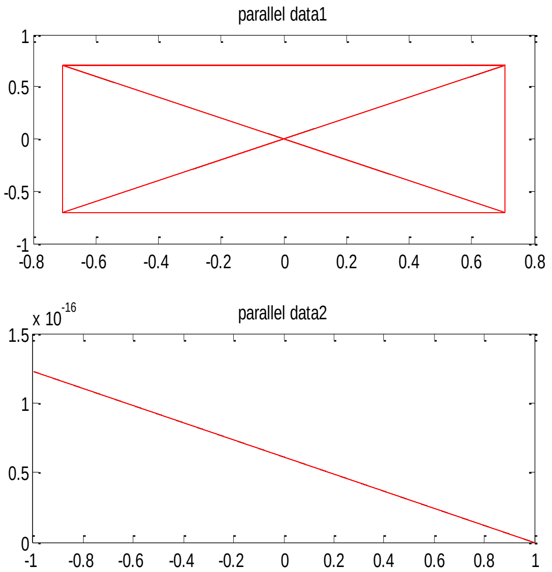

Fig.3: Parallel Data

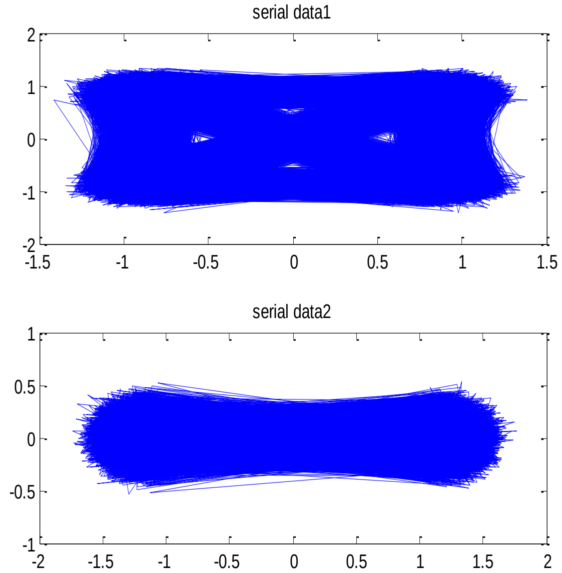

Fig.5: Serial Data

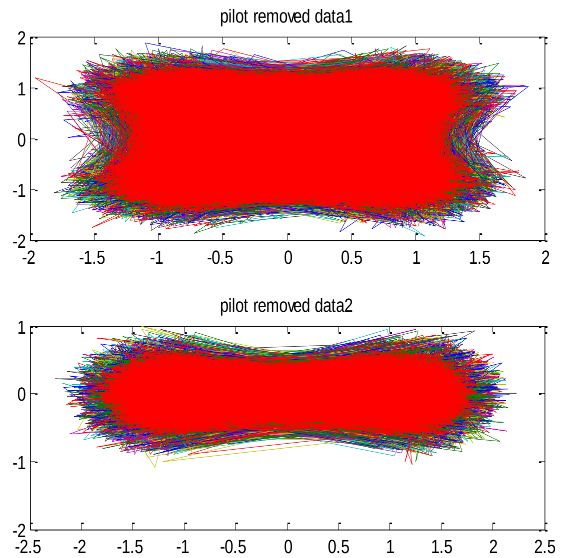

Fig.4: Pilot removed Data

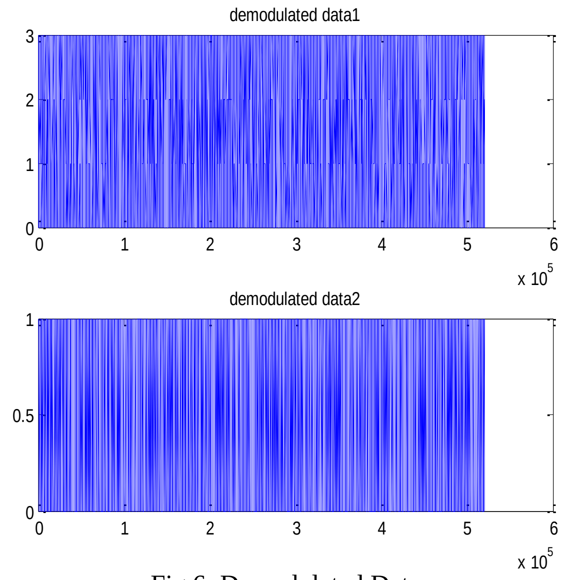

Fig.6: Demodulated Data

The following system parameters are considered for the simulation:

- Data mapping : BPSK & QPSK
- IFFT and FFT Size : 64-point
- Channel Used : AWGN
- No. Of data sub carrier : 52
- Data symbol duration (Td) : 64
- Cyclic prefix duration (Tcp) : 16

On the basis of Bit Error Rate BPSK is found to be more efficient.

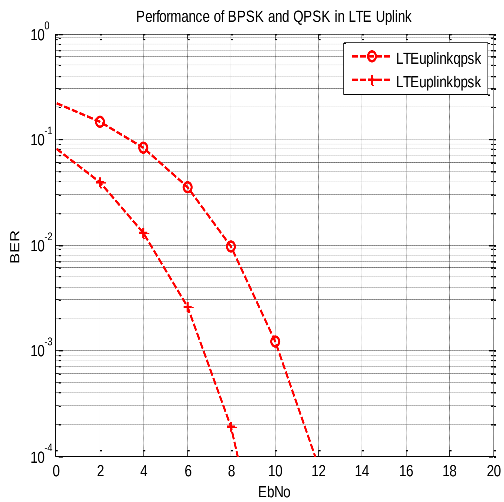

Fig 7:Performance of LTE uplink system

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VII.CONCLUSION

In this paper we overviewed the concepts and features of LTE-A. We can see that the performance achievable using some of these features is of great deal. Spectrum flexibility, Bandwidth scalability. Reduced network complexity, Carrier aggregation ,Data transmission and Control signaling, Asymmetric transmission bandwidth, Layered OFDMA, Coordinated multi-point transmission/reception, Enhanced multi-antenna transmission techniques, Extended coverage area, Support of larger bandwidth and Adaptiveness are viewed to be some of the important features of LTE-Advanced. Studied on LTE Uplink and its model. Generated LTE uplink model and analyzed the output from each block. Studied different modulation techniques. Compared the performance of various modulation techniques in LTE uplink. For every SNR values the BER of BPSK modulation is observed to be closer to the theoretical value and hence BPSK modulation is better than QPSK modulation in all channels.

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BIOGRAPHIES

Micky Maria Boban is currently pursuing *Masters of Technology in Communication Engineering* at Mangalam college of Engineering, Ettumanoor, Kottayam, Kerala, India.

Asha Panicker is working as *Head of the Dept. in Electronics and Communication Engineering* at Mangalam college of Engineering, Ettumanoor, Kottayam, Kerala, India.