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Performance Evolution of Downlink MIMO in LTE Technology



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Abstract:

LTE (Long Term Evolution) is the last step towards the 4th generation of radio technologies designed to increase the capacity and speed of cellular networks. At present, current generation of cellular technology dominated by 3G (third generation), L TE is marked as 4G. The third generation partnership project (3GPP) currently work for developing the 3rd generation mobile and telecommunication system with a future 4th generation system. This project mainly focuses on design of a LTE DL (downlink) inspired channel simulator using the AWGN and fading channel model, here OFDMA is used as a multiple access scheme. The performance of noise and interference in AWGN channel and fading channel at LTE DL is measured and compared to obtain less noisy channel. Both lower and higher order modulation schemes are used in LTE DL. The parameters used for comparison in AWGN channel and fading channel are BER (Bit Error Rate) and Eb/No (db).The proposed work is about to reduce the noise in AWGN channel and fading channel.

INTRODUCTION:

Long Term Evolution (L TE) enhances the susceptibility and speed of wireless data networks using various types of modulations (QPSK, 16QAM etc.). L TE redesigns and modifies the network architecture with substantially diluted transfer latent period. It depicts a wireless communication system which endorses downlink transmission using Orthogonal Frequency Division Multiple Access (OFD-MA) scheme up to 300 mbps of data transmission and 75 mbps throughput for uplink data transmission using Carrier Frequency Division Multiple Access (ScFDMA). OFDMA transmits data over a large number of subcarriers [1]. These signals are spaced in reciprocally perpendicular axis assembling at right angles to each another and their summation will be zero which removes mutual interference. SC-FDMA aggregates multipath interference abjuration and flexible subcarrier frequency assignment which provides only one carrier at a time instead of multiple carriers in transmission.

Frequency Division Duplex (FDD) and Time Division Duplex (TOO) are the two most common Frame Structure that are used in L TE where both transmitter and receiver operate on same frequency band and same time in FDD, but in TDD both transmitter and receiver works on same frequency at different time [2]. The purpose of this pa-per is to analysis the performance of OFDMA (Downlink transmission) in different types of L TE Frame structures with different modulation techniques. We analytically de-rive the OFDMA signals in FDD and TDD mode. The rest of this paper is organized as follows: Section 2 provide the brief idea about the OFDMA system model. Section 3 describes the L TE Frame Structure Types. Section 4 describes the 3GPP LTE System. In section 5,

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Simulation results are given and we finally conclude in Section 6.

OFDMA SYSTEM MODEL:

LTE (Long Term Evolution) uses OFDMA and SC-FD-MA at downstream and upstream for downlink and up-link transmission. The OFDMA system model is shown in Figure I. A brief description of the model is provided below. transmission. At first, S symbols/second data are transmitted to the transmitter and the data symbols are pass through a serial to parallel converter and the data rate on every X line is SIX symbols [3].The input data stream on each carrier is then mapped by using different types of modulation scheme such as QPSK, 16-QAM, 64QAM etc. Then Inverse fast Fourier Transform is used to find the corresponding Time wave form, which means that M symbols are sent to an Inverse Fast Fourier Trans-form that performs N-point IFFT operation. The output is N time sample [4]. The Guard interval is then introduced at the start of each sample which is known as addition of cyclic extension in the prefix. Then the length of the output sample is N+LP. The cyclically extended symbols are passed through a parallel to serial converter and then transmitted through a channel [5].

A channel model is then applied to the transmitted signal. The model allows for the signal to noise ratio, channel to be controlled. The signal to noise ratio is set by adding a known amount of white noise to the transmitted signal which is known as A WGN Additive white Gaussian noise [lO].

The Receiver basically does the reverse operation of the transmitter. The transmitted signals which pass through the channel are then converted by using Serial to parallel converter and cyclic extension is also removed. The signals pass through an N-point Fast Fourier Transform which converted time domain signal into frequency do-main. Then the signal is demapped and performs parallel to serial conversion using Parallel to serial convert block and the resultant signal is a M sample output [3].

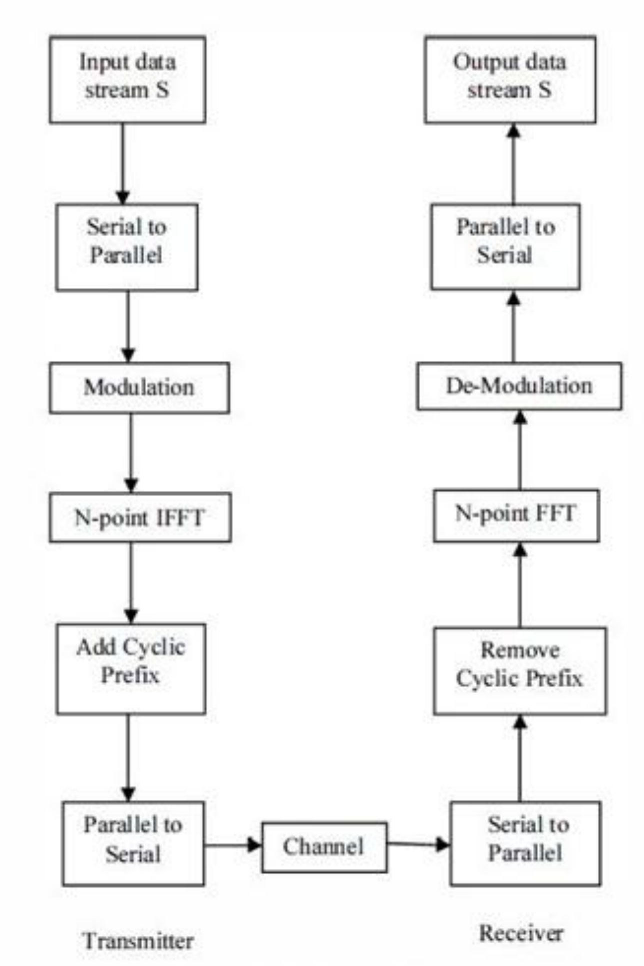

Figure 1: OFDMA System Model

LTE FRAME TYPE:

In L TE, Downlink and uplink transmission are organized into radio frame with Tf = 307200 *Ts=I 0 millisecond long where Ts = 1/ (30.72 x 106) s ;::;32.255 ns per clock period [8].Two types of Frame structure (i) Frame structure type 1 that endorses FDD duplexing scheme (LTE FDD) and (ii) Frame structure type 2 which supports TDD duplexing Scheme (LTE TDD) in LTE. In both LTE FDD and LTE TDD, the transmitted signal is organized into subframes of 1 millisecond (ms) duration and 10 subframes constitute a radio frame [6]. Each frame is 10 ms in duration. Each subframe is further divided into two slots, each of 0.5 ms duration. Each slot consists of either 6 or 7 ODFM symbols, depending on whether the normal or extended cyclic prefix is employed[7]. Dynamic

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scheduling of the uplink and downlink re-sources is used in both LTE FDD and LTE TDD.

A.LTEFDD:

In case of FDD operation, there are two carrier frequencies, one for uplink transmission (FUL) and one for downlink transmission (FDL). During each frame, there are consequently 10 uplink subframes and 10 downlink subframes and uplink and downlink transmission can oc-cur simultaneously within a frame[6].

B.LTE TDD:

In case of TDD operation, there is only one single car-rier frequency for uplink and downlink transmissions in the cell are always separated in time. As the same carrier frequency is used for uplink and downlink transmission, both the uplink and downlink transmission must switch from transmission to reception.

Thus, as a subframe is either an uplink subframe or a downlink subframe, the number of Subframes per radio frame in each direction is less than 10 [4]. Two switching point periodicities are supported by TDD-5ms and 10ms [9]. For the 5ms switching point periodicity, subframe 6 is likewise a special subframe identical to subframeI. For the 10ms switching point periodicity, subframe 6 is a regular downlink subframe [8]. L TE supports seven different uplink/downlink configurations.

In each frame, eight of the ten Subframes carry physical signals. Subframes 0 and 5 always carry downlink sig-nals. The other frames can carry either uplink or downlink physical channels. Subframes 1 and 6 carry synchroniza-tion signals.

IV. 3GPP LTE SYSTEM:

In 3GPP L TE system, downlink and uplink transmissions are organized into radio frames with 10 ms duration. Two radio frame structures are supported: Type 1, applicable to FDD L TE. Type 2, applicable to TDD L TE.

A.Frame Structure Type 1:

Each radio frame is long and consists of 20 slots of length, numbered from 0 to 19.A subframe is defined as two consecutive slots where subframe i consists of slots 2i and 2i+ l.For FDD, 10 subframes are available for downlink transmission and 10 subframes are available for uplink transmissions in each 10 ms interval. Uplink and down-link transmissions are separated in the frequency domain.

In halfduplex FDD operation, the UE cannot transmit and receive at the same time while there are no such restrictions in full-duplex FDD.

B.Frame Structure Type 2:

Frame structure type 2 is applicable toTDD. Each radio frame of length consists of two half-frames of length each. Each half-frame consists of eight slots of length and three special fields,DwPTS, GP, and UpPTS. All subframes are defined as two slots where subframe i consists of slots 2i and 2i+ 1. Subframes 0 and 5 and DwPTS are always reserved for downlink transmission.

A special subframe with the three fields DwPTS, OP and UpPTS. Both 5 ms and 10ms switch-point periodicity is supported. In case of 5 ms switch-point periodicity, UpPTS and subframes 2 and 7 are reserved for uplink transmission. In case of 10 ms switch-point periodicity, DwPTS exist in both half-frames while OP and UpPTS only exist in the first halfframeandDwPTS in the second half-frame has a length equal to . UpPTS and subframe 2 are reserved for uplink transmission and subframes 7 to 9 are reserved for downlink transmission.

v. SIMULATION DESION AND RESULTS:

In 30PP L TE design, BER performance with various sub-carrier modulation under A WON and fading channels are simulated using a bandwidth of 10MHZ in A WGN chan-nel and 3MHZ in fading channel. This design contains signal source, Noise, Receiver and BER performance. A QPSK and 16 QAM symbol

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constellation is considered. In this simulation BER vsEblNo is calculated using ADS simulation.

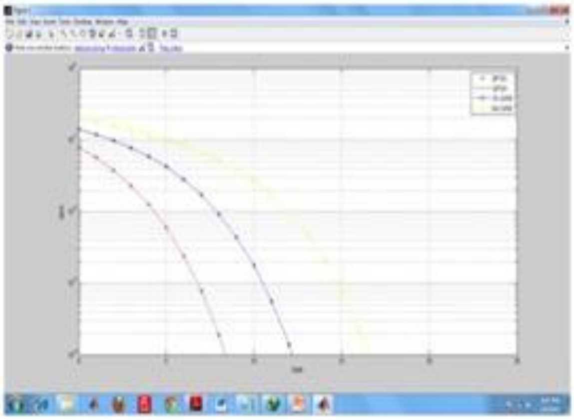

FIGURE1:BER WTH SNR

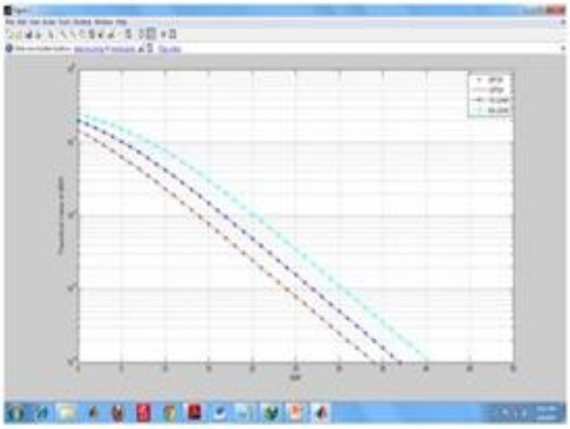

FIGURE2:BER WITH SNR (THEORITICAL VALUES)

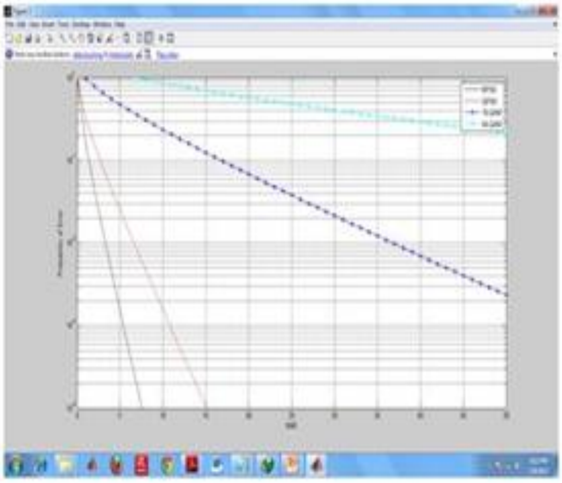

FIGURE3: PROBABILITY ERROR WITH BER

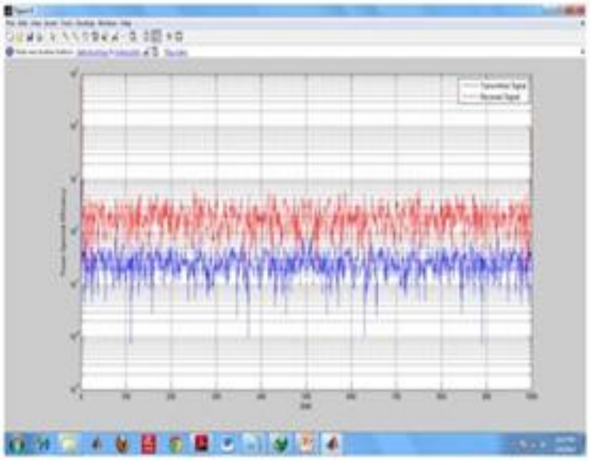

FIGURE4: POWER SPECTRAL EFFICIENCY OF TRANSMITTED SIGNAL AND RECEIVED SIG-NAL.

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