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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), LTE 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 A WGN and fading channel model, here OFDMA is used as a multiple access scheme. The performance of noise and interference in AW GN channel and fading channel at L TE DL is measured and compared to obtain less noisy channel. Both lower and higher order modulation schemes are used in L TE DL. The parameters used for comparison in AW GN channel and fading channel are BER (Bit Error Rate) and Eb-No (db).The proposed work is about to reduce the noise in A WGN channel and fading channel.

Index Terms-Long Term Evolution (LTE), Frequency Division Duplex (FDD), Time Division Duplex (TDD) Orthogonal Frequency Division Multiple Access (OFDMA), Additive White Gaussian Noise (A WGN).

1. INTRODUCTION

Long Term Evolution (LTE) enhances the susceptibility and speed of wireless data networks using various types of modulations (QPSK, 16QAM etc.). LTE 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 (OFDMA) scheme up to 300 mbps of data transmission and 75 mbps throughput for uplink data transmission using Carrier Frequency Division Multiple Access (Sc-FDMA). 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 paper is to analysis the performance of OFDMA (Downlink transmission) in different types of L TE Frame structures with different modulation Techniques. We Analytically derive 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 LTE Frame Structure Types. Section 4 describes the 3GPP LTE System. In section 5, Simulation results are given and we finally conclude in Section 6.

2. OFDMA SYSTEM MODEL LTE

(Long Term Evolution) uses OFDMA and SC-FDMA at downstream and upstream for downlink and uplink transmission. The OFDMA system model is shown in Figure I. A brief description of the model is provided below. 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 Transform 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 domain. Then the signal is de-mapped and performs parallel to serial conversion using Parallel to serial convert block and the resultant signal is a M sample output [3].

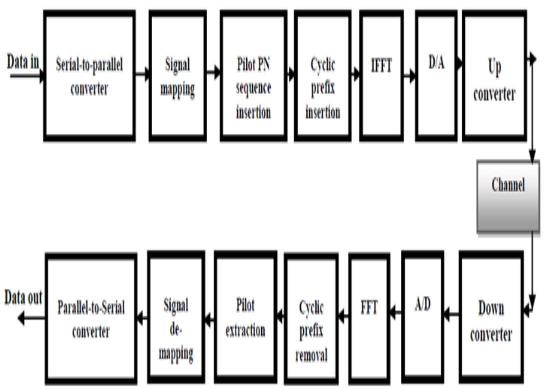


Figure I: OFDMA System Model

3. LTE FRAME TYPE

In LTE, 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 du-plexing scheme (LTE FDD) and (ii) Frame structure type 2 which supports TDD du-plexing Scheme (LTE TDD) in LTE. In both LTE FDD and LTE TDD, the transmitted signal is organized into sub-frames of 1 millisecond (ms) duration and 10 sub-frames constitute a radio frame [6]. Each frame is 10 ms in duration. Each sub-frame 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 scheduling of the uplink and downlink resources is used in both LTE FDD and LTE TDD.

A. LTE FDD

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 sub-frames and 10 downlink sub-frames and uplink and downlink transmission can occur simultaneously within a frame [6].

B. 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 sub-frames and 10 downlink sub-frames and uplink and downlink transmission can occur simultaneously within a frame [6].

B. LTE TDD

In case of TDD operation, there is only one single carrier 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 sub-frame is either an uplink sub-frame or a downlink sub-frame, the number of sub-frames 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, sub-frame 6 is likewise a special sub-frame identical to sub-frame I. For the 10ms switching point periodicity, sub-frame 6 is a regular downlink sub-frame [8]. L TE supports seven different uplink/downlink configurations. In each frame, eight of the ten sub-frames carry physical signals. Sub-frames 0 and 5 always carry downlink signals. The other frames can carry either uplink or downlink physical channels. Sub-frames 1 and 6 carry synchronization signals.

4. 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

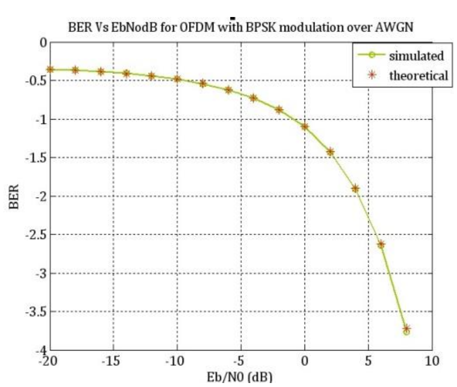
Each radio frame is long and consists of 20 slots of length, numbered from 0 to 19.A sub-frame is defined as two consecutive slots where sub-frame consists of slots 2i and 2i+1.For FDD, 10 sub-frames are available for downlink transmission and 10 sub-frames are available for uplink transmissions in each 10 ms interval. Uplink and downlink transmissions are separated in the frequency domain. In half-duplex 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 to TDD. 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, Down PTS, GP, and Up-PTS. All sub-frames are defined as two slots where sub-frame i consists of slots 2i and 2i+1. Sub-frames 0 and 5 and Down-PTS are always reserved for downlink transmission. A special sub-frame with the three fields Down-PTS, OP and Up-PTS. Both 5 ms and 10 ms switch-point periodicity is supported. In case of 5 ms switch-point periodicity, Up-PTS and sub-frames 2 and 7 are reserved for uplink transmission. In case of 10 ms switch-point periodicity, Down-PTS exist in both half-frames while OP and Up-PTS only exist in the first half-frame and Down-PTS in the second half-frame has a length equal to. Up-PTS and sub-frame 2 are reserved for uplink transmission and sub-frames 7 to 9 are reserved for downlink transmission.

V.SIMULATION DESION AND RESULTS

In 30PP L TE design, BER performance with various subcarrier modulation under A WON and fading channels are simulated using a bandwidth of 10MHZ in A WGN channel and 3MHZ in fading channel. This design contains signal source, Noise, Receiver and BER performance. A QPSK and 16 QAM symbol constellation is considered. In this simulation BER vs Eb No is calculated using ADS simulation.



BER for QPSK modulation in AWGN channel for OFDMA.

Table I: BER for QPSK modulation in A WGN for OFDMA.

Eb/No	BER
0.000	0.079
2.000	0.038
4.000	0.013
6.000	0.002
8.000	1.909E-4
10.000	3.872E-6
12.000	9.006E.9

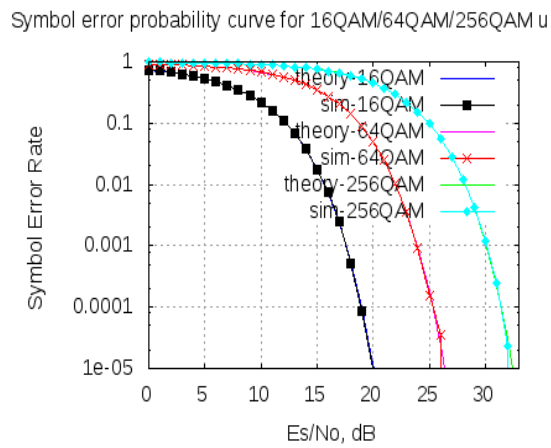
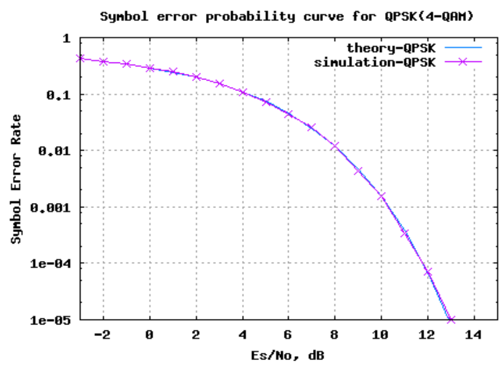


Fig:BER for 16 QAM Modulation in AWGN Channel for OFDMA.

Table 2· BER for 16QAM modulation in A WGN for OFDMA.

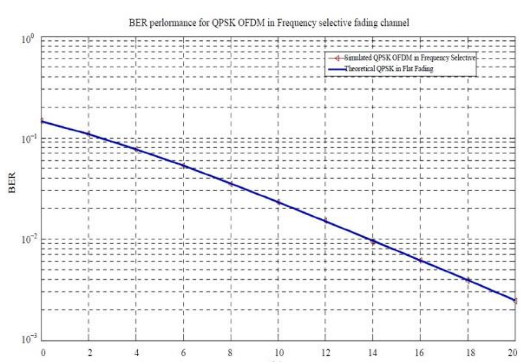
Eb/No	**BER**
5.000	0.190
6.000	0.166
7.000	0.141
8.000	0.112
9.000	0.057
10.000	0.029
11.000	0.001
12.000	6.012E-7



BER for QPSK Modulation in Fading channel for OFOMA.

Table 3: BER for QPSK modulation in FADING for OFDMA.

Eb/No	BER
10.000	0.068
11.000	0.068
12.000	0.044
13.000	0.028
14.000	0.016
15.000	0.009
16.000	0.004
17.000	0.002
18.000	0.001



BER for 16-QAM Modulation in Fading channel for OFDMA

Table 4: BER for 16QAM modulation in FADING for OFDMA

Eb/No	BER
10.000	0.041
11.000	0.026
12.000	0.016
13.000	0.009
14.000	0.005
15.000	0.002
16.000	0.001

BER for various modulation in AWGN channel for OFDMA

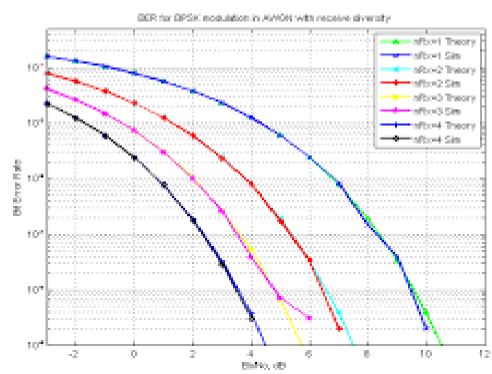


Table 5: BER for various modulation in AWGN channel for OFDMA

Eb/no	reference	Eb/no	QPSK
0.000	0.079	0.000	0.156
2.000	0.038	2.000	0.097
4.000	0.013	4.000	0.055
6.000	0.002	6.000	0.026
8.000	1.909E-4	8.000	0.007
10.000	3.872E-4	10.000	0.002
12.000	9.006E-9	12.000	2.967E-4

Table 6: BER for various modulation in A WGN channel for OFOMA

Eb/no	16QAM	Eb/no	64QAM
0.000	0.217	0.000	0.260
2.000	0.616	2.000	0.217
4.000	0.111	4.000	0.176
6.000	0.0710	6.000	0.139
8.000	0.043	8.000	0.098
10.000	0.020	10.000	0.062
12.000	0.007	12.000	0.035
14.000	0.002	14.000	0.018
16.000	3.548E-4	16.000	0.007

Table 7: BER = I E-I

Sub carrier modulation	Eb/No on A WGN channel
16 QAM	**8**
64 QAM	**8**

5. CONCLUSION

In this paper, we compare the various subcarrier modulation of 3G L TE downlink of OFDMA. In A WGN channel, QPSK error rate is less has compared to 16QAM and 64QAM. 16 QAM has lower error rate has compared to 64 QAM in A WGN channel. From the graph for BER vs Ebl No in A WG channel for higher order modulation schemes like 16QAM and 64QAM in terms of energy consumption remains the same as referred in table 6. From the graph, BER vs BblNo for A WGN channel performance as compared to fading channel. As an inference from the graph for BER vs EblNo higher order modulations performance nearly the same during downlink scenario as refered in table

5. REFERENCES

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