Simulation of LTE Network Parameters

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Abstract - *LTE (Long Term Evolution) is a people to come standard by third Generation Partnership Project (3GPP) consortium. In this paper, the physical layer (PHY) of LTE handset is investigated in downlink transmissions. Reproductions of the physical layer of LTE handset are acquired with the utilization of LTE System Toolbox by Math works. Reproduction results are introduced to demonstrate the execution of LTE handsets in Physical Downlink Shared Channel (PDSCH). Estimations of throughput and Bit Error Rate (BER) are received for various simulation set ups.*

***Key Words*: LTE, PDSCH, 3GPP, Simulation, BER**

1. INTRODUCTION

LTE (Long Term Evolution) is the blend of both (radio and centre) system. Radio means radiation remote transmission of electromagnetic vitality through space. It convey the data, for example, sound by methodically (modulating) some property of the emanated waves. The radio hardware required in correspondence framework incorporates the transmitter and receiver. Core is backbone network gives ways to the trading of data between various sub systems. LTE gives high Spectral Efficiency, high information rate, short round trip time, frequency flexibility. LTE takes after the advances, for example, orthogonal frequency division multiplexing (OFDM), multiple inputs and multiple outputs (MIMO). LTE gives consistent administration and multimode gadgets for the clients subsequently its innovation developed over the different gadgets which have prompted enhanced information throughput, lower latencies and progressively adaptable designs.
LTE Radio Access Network (RAN) is contained the protocol entities: Packet Data Convergence Convention (PDCP), Radio Link Control (RLC), Medium Access Control (MAC) and The Physical layer (PHY) [1]. The PHY exchanges data to and from the MAC layer utilizing transport obstructs that pass on information for at most two sub frames [2]. This paper concentrates just on the physical layer. Simulations with the LTE System tool stash are completed in the Physical Downlink Shared Channel (PDSCH) The PHY handles coding and interpreting, modulation and demodulation, and antenna mapping. The LTE PHY is a profoundly effective methods for passing on both information and control data between an improved base station (eNodeB) and portable User Equipment (UE).

1.1 Overview of LTE

The system design contained 3 principle parts:

- User Equipment (UE)
- Evolved packet core(EPC)
- E-UTRAN(Evolved Universal Terrestrial Radio Access Network**)**

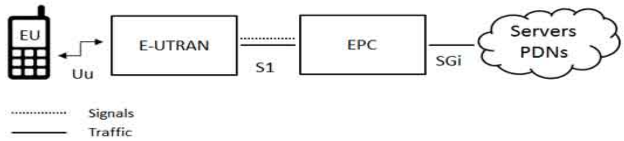

Fig -1 LTE Network Structure

User equipment: This is really mobile equipment (ME).

Evolved packet core: This conveys the packet information arrange in the outside world, for example, Internet, private corporate system or the IP mixed media sub framework.

The E-UTRAN (The access network)
The E-UTRAN handles the radio interchanges between the mobile and the evolved packet core and simply has one segment, the developed base stations, called eNodeB or eNB.

2. LTE DOWNLINK TRANSCEIVER

LTE downlink (from tower to gadget) transmission is in view of OFDMA. The LTE downlink physical resource can be spoken to by a frequency time resource grid [3]. Resource components are assembled into Resource Blocks (RBs) Furthermore, every RB comprises of 12 subcarriers with a dispersing of 15 kHz in the frequency domain and 7 successive OFDM images in the time domain. The quantity of accessible RBs in the frequency domain fluctuates relying upon the channel bandwidth [4], and it may change between 1.4 MHz and 20 MHz.

2.1 PDSCH Transceiver

The transmitter and collector structure of PDSCH is appeared in Fig-2. The transmitter in the physical layer begins with the assembled resource information which are as transport blocks. PDSCH is utilized to transmit the Downlink Shared Channel (DL-SCH). The DL-SCH is the transport channel utilized for transmitting downlink information Maybe a couple coded transport blocks(code word) can be transmitted all the while on the PDSCH relying upon the pre-coding plan utilized. The preparing ventures of transmitting downlink information in PDSCH are given beneath.

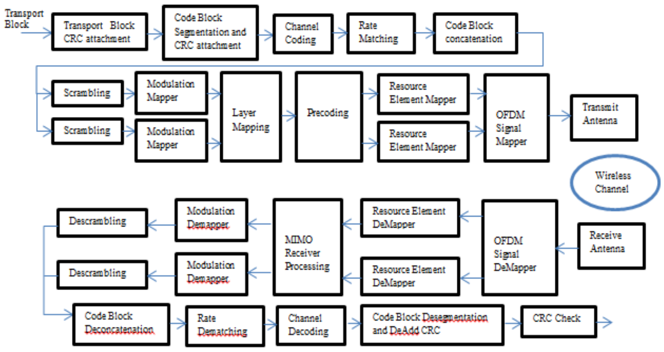

Fig-2 PDSCH Transmitter and Receiver structure

1) Transport block CRC attachment: A cyclic Redundancy check (CRC) is utilized for error recognition in transport blocks. The whole transport block is utilized to figure the CRC equality bits and these equality bits are then affixed to the finish of transport block.
2) Code block segmentation and CRC connection: In LTE, a base and most extreme code block size is determined so the block sizes are good with the block sizes bolstered by the turbo interleaver. Least code block size is 40 bits and most extreme code block size is 6144 bits. The info block is portioned when the information block is more noteworthy than the greatest code block estimate.
3) Channel coding: The channel coding plan for PDSCH embraces Turbo coding, which is a robust channel coding [2]. The coding rate of turbo encoder is 1/3[9].The code block experience turbo coding which is a type of forward error correction that enhances the channel limit by including excess data. The turbo encoder conspire utilizes a Parallel Concatenated Convolution Code (PCCC) with two recursive convolution coders and a contention free Quadratic Permutation Polynomial (QPP) interleaver.
4) Rate Matching: The fundamental assignment of the rate matching block is to make a yield bit stream to be transmitted with a coveted code rate. As the quantity of bits accessible for transmission relies on upon the accessible resources the rate coordinating calculation is equipped for creating. The three bit streams from the turbo encoder are interleaved trailed by bit accumulation to make a circular buffer. Bits are chosen furthermore, pruned from the buffer to make a yield bit stream with the desired code rate. The Hybrid Automatic Repeat request (HARQ) error correction plan is joined into the rate-matching algorithm of LTE.
5) Code Block Concatenation: In this stage, the rate coordinated code blocks are linked back together. This assignment is finished by successively linking the rate-matched blocks together to make the yield of the channel coding.

6) Scrambling: The code words are bit-wise increased with an orthogonal grouping and a UE-particular scrambling grouping to make the accompanying arrangement of images for each codeword.
7)Modulation: The mixed code words experience adjustment utilizing one of the PDSCH modulation plans QPSK, 16 QAM, 64 QAM, bringing about a block of modulation images.
8) Layer Mapping: modulation images are mapped to one, two, or four layers relying upon the quantity of transmit antenna utilized. There are predominantly two sorts of layer mapping, one for transmit diversity and the other for spatial multiplexing. On the off chance that transmits diversity is utilized, the info images are mapped to layers in view of the quantity of layers. In the instance of spatial multiplexing, the quantity of layers utilized is continuously less or equivalent to the quantity of antenna ports utilized for transmission of the physical channel.
9) Pre coding: Symbols on each layer will be pre-coded for transmissions on the receiving wire ports as indicated by various methods of transmission, which are spatial multiplexing, transmit diversity, and single antenna port transmission.
10) Mapping to Resource Elements: For each of the receiving wire ports utilized for transmission of the PDSCH, the block of complex esteemed images, are mapped in arrangement to resource components not involved by the other physical downlink channels with the exception of PDSCH, or synchronization and reference signals. The quantity of resource components mapped to is controlled by the quantity of resource blocks designated to the PDSCH. The images are mapped by expanding the subcarrier record and mapping every accessible RE inside assigned resource block for each OFDM image.
11) OFDM Modulation: Data stream are adjusted to much orthogonal sub-transporters in parallel. A bearer will diminish each code component rate of the sub-bearer, increment the code component images cycle, and enhance the arrangement of anti-interference ability. OFDM modulation is principally for Inverse Fast Fourier Transform (FFT).

2.2 Bit Error Rate (BER:

BER is the no. of bit blunder per unit time. It is the no. of bit mistake isolated by aggregate no. of exchanged bits amid a contemplated time interim. In communication framework, receiver side BER might be influenced by Tx channel noise, obstruction, contortion, bit synchronization and multipath fading. BER can be enhanced by picking a solid flag or high SNR esteems or by robust modulation or by line coding plan.

3. SIMULATION RESULTS AND ANALYSIS

In the advancement and institutionalization of LTE, also as the execution procedure of gadgets, simulations are fundamental for testing and examination. In this paper, the simulations are performed utilizing the Math works LTE Framework Toolbox. Throughput and Bit

Error Rate (BER) execution results are investigated for PDSCH handset.

3.1PDSCH Transmit Diversity Throughput Simulation

LTE System Toolbox capacities are utilized to demonstrate the PDSCH throughput of a transmit/receive chain. Channel noise is added to the obtained waveform which is then OFDM demodulated, bringing about a received resource grid framework for each received radio wire. Channel estimation is performed to decide the channel between each transmit/receive antenna. PDSCH information is then separated and decoded from this recouped resource framework. The PDSCH Transmit Diversity throughput simulation setup is appeared in Table-1. The simulation brings about Chart-1 demonstrate the throughput for 10 frames and Chart-2 for 20 frames. For 10 frames, the throughput is over 70% at the point when SNR is - 2.2dB or more. Additionally, the throughput is consistent when SNR is - 1.2dB or more. For 20 frames, the throughput is over 70% when SNR is - 1.2dB or more. At that point the throughput increments and turns out to be enduring when SNR is 3.4dB or more. Throughput percentage for 10 frames is shown in Chart-3.

Table -1: PDSCH simulation configuration

Codeword	Single
Transmission Scheme	Transmit diversity
Transmitter	4
Receiver	2
Multi antenna correlation	Medium
Propagation Channel	Extended Pedestrian A(EPA)
HARQ	8 HARQ retransmission scheme
Reference Measurement channel	R.12
Frames	10(Simulation I) 20(SIMULATION II)
SINR range	[-5.8, -4.6, -3.4, -2.2, -1.2, 0.2, 1.2, 2.2, 3.4, 4.6]

3.2 PDSCH Bit Error Rate (BER) Simulation

The LTE System Toolbox is utilized to make PDSCH BER bends under Additive White Gaussian Noise (AWGN) in a straightforward Graphical User Interface (GUI). Distinctive BER bends are plotted for SNR go values (- 10 to 10), transport block Size (1000, 1200), and modulation plans: QPSK, 16QAM, 64QAM. The BER bends in Chart-4 demonstrate that the BER bends drop quickly with expanding SNR for the coded modulation plans. It likewise demonstrates that when the transport block size increases the BER bends increments. Likewise, the BER bends increments with the coded modulation plans (QPSK, 16QAM, 64QAM) individually.

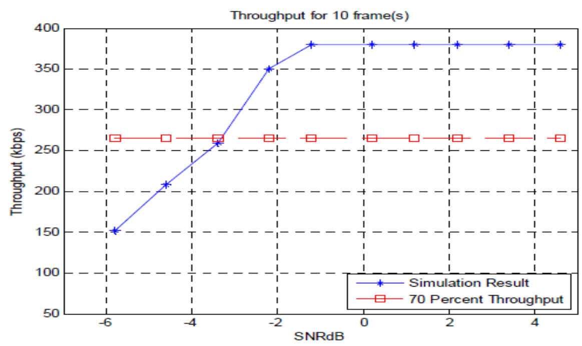

Chart -1: PDSCH Throughput against range of SNRs for 10 frames

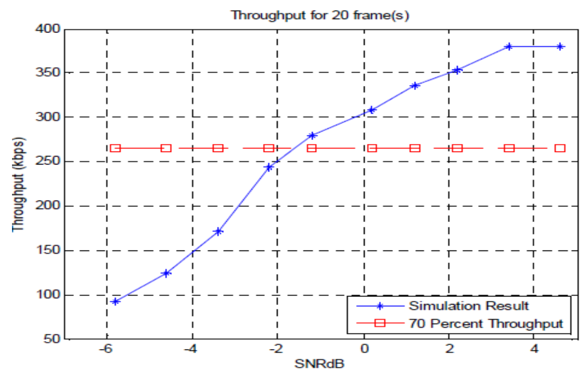

Chart -2: PDSCH Throughput against range of SNRs for 20 frames

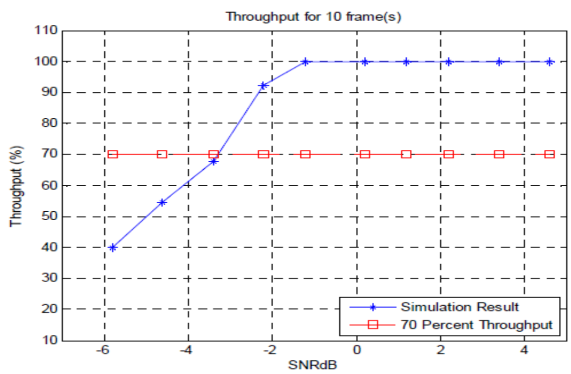

Chart -3: PDSCH Throughput Percentage for 10 frames

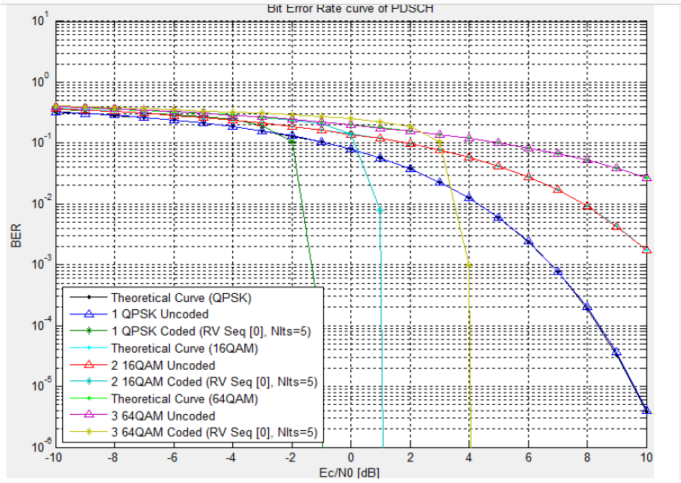

Chart -4: The BER curves for TB size of 1000

4. CONCLUSIONS

Thus, this has analyzed LTE handset in downlink (PDSCH) transmissions. The simulation comes from the LTE System Toolbox additionally broke down the execution of the LTE handset by the deliberate throughput and BER charts appeared previously. These outcomes indicate obviously the throughput and BER that can be normal for various SNR esteems. Additionally work can be done via completing different downlink end to end simulations, and demonstrating with the LTE System Tool Toolbox.

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