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Performance Enhancement of Multiple Cell Users in LTE

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***Abstract*: Few years back, telecommunication body 3GPP started a project called as LTE (Long Term Evolution) with the main goal of Providing a high data rate, low latency, and Packet optimized radio access technology, supporting flexible bandwidth deployment. Up to 50 times performance improvement and much better spectral efficiency to cellular networks makes LTE very important, but due to one frequency reuse factor there is a high interference between the cells. So, we have to use some techniques to enhance the performance, one of the technique used in this case is Coordinated Multipoint technique.**

***Keywords*: LTE, GSM, CoMP**

1. Introduction

LTE stands for Long Term Evolution and it was started as a project in 2004 by telecommunication body known as the Third Generation Partnership Project (3GPP). LTE evolved from an earlier 3GPP system known as the Universal Mobile Telecommunication System (UMTS), which in turn evolved from the Global System for Mobile Communications (GSM). The main goal of LTE is to Provide a high data rate, low latency, and Packet optimized radio access technology, supporting flexible bandwidth deployments.LTE is important because it will bring up to 50 times performance improvement and much better spectral efficiency to cellular networks.

LTE introduced to get higher data rates, 300Mbps Peak downlink and 75Mbps peak uplink. In a 20MHZ Carrier, data rates beyond 300Mbps can be achieved under very good signal conditions. LTE used both TDD and FDD. In FDD uplink and Downlink transmission used different frequency. While in TDD both uplink and downlink use the same carrier and separated time.

The system supports downlink peak data rates of 326 Mb/s with 4 × 4 MIMO (multiple input multiple output) within 20MHz bandwidth. Since uplink MIMO is not employed in the first release of the LTE standard, the uplink peak data rates are limited to 86 Mb/s within 20MHz bandwidth. In addition to peak data rate improvements, the LTE system provides two to times higher cell spectral efficiency relative to the Release 6 HSPA system. Similar improvements are observed in cell-edge throughput while maintaining same-site locations as deployed for HSPA. In terms of latency, the LTE radio-interface and network provides capabilities for less than 10 ms latency for the transmission of a packet from the network to the UE.

2. LTE frame structure

In LTE, users are assigned a certain number of subcarriers for predetermined period of time; these subcarriers are called physical Resource Blocks (PRBs). These Blocks have both time and frequency dimension.

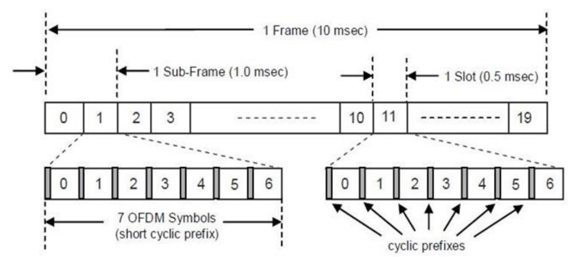

Fig. 1. LTE time domain frame structure

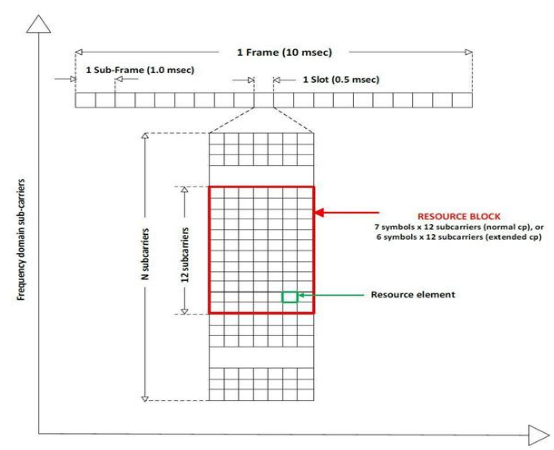

Fig. 2. LTE time-frequency resource grid

LTE frame is of 10 millisecond (msec) duration which is divided into 10 Subframes of 1msec duration. Each Subframe is further divided into two slots each has a length of 0.5msec. Each slot comprise either 6 or 7 OFDM symbols depending upon normal or extended cyclic prefix that is used.

A PRB is the smallest unit that Base Station can allocate to the user. Subcarrier Bandwidth and PRBs Bandwidths are 15 KHz and 180 KHz respectively for all system Bandwidths

A resource element is the smallest physical resource and it carries one subs subcarrier during one OFDM symbol. A group of Resource Element s are referred as physical Resource Blocks i.e. PRBs. A PRB has a seven OFDM symbols having duration of one time slot 0.5ms and 12 subcarriers having a Bandwidth of 180 KHz (15 KHz * 12 = 180 KHz), so each Resource Block in the case of normal cyclic prefix has of 84 Resource Element s (12 Subcarrier * 7 OFDM Symbols = 84 Resource Element s) whereas in the case of extended cyclic prefix.

Resource Block has 72 Resource Elements (12 Subcarrier * 6 OFDM Symbols = 72 Resource Element)

3. LTE network architecture

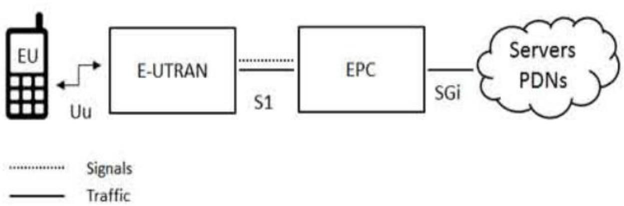

Fig. 3. LTE network architecture

The high-level network architecture of LTE is comprised of following components:

- (UE) The User Equipment.
- (E-UTRAN) The Evolved UMTS Terrestrial Radio Access Network.
- (EPC) The Evolved Packet Core.

The evolved packet core communicates with packet data networks in the outside world such as the internet, private corporate networks or the IP multimedia subsystem. The interfaces between the different parts of the system are denoted Uu, S1 and SGi as shown above.

4. Coordinate multipoint

Coordinated multipoint transmission and reception actually refers to a wide range of techniques that enable dynamic coordination or transmission and reception with multiple geographically separated eNBs. Its aim is to enhance the overall system performance, utilize the resources more effectively and improve the end user service quality.

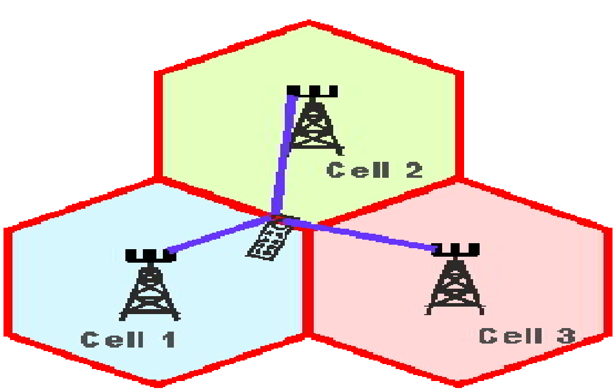

Fig. 4. Concept of LTE advanced CoMP

5. Simulation parameters and results

Table 1
Parameters

Parameters	Value
Antenna configuration	2x2, 3x3, 4x4
Cellular Layout	Hexagonal grid, 7 Cell Site
No of UE	48 per cell
System bandwidth [MHz]	20
Channel	Rayleigh fading channel
Signal mapping	QPSK
No. of subcarrier	1200
Subcarrierbandwidth [kHz]	15
Macro eNBTx power [dBm]	43
No. of RBs used by eNBs	100
Macro intersite distance [m]	500
Frequency [GHz]	2.14
UE noise density [dBm/Hz]	-174
MIMO decoding technique	ZF-SIC, ML
Pathloss Model	148.1+37.6log10(R)

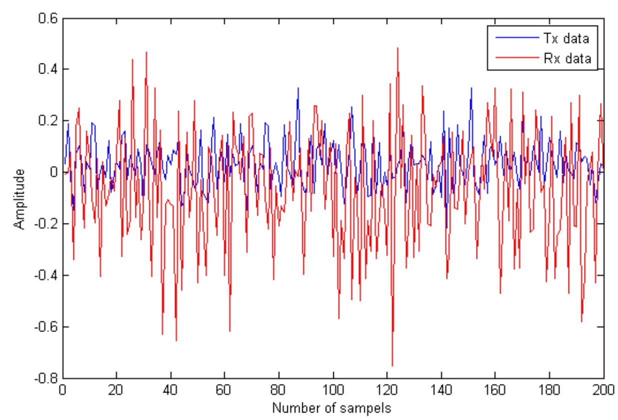

Fig. 5. Amplitude vs. No. of samples graph for transmitted and received signal

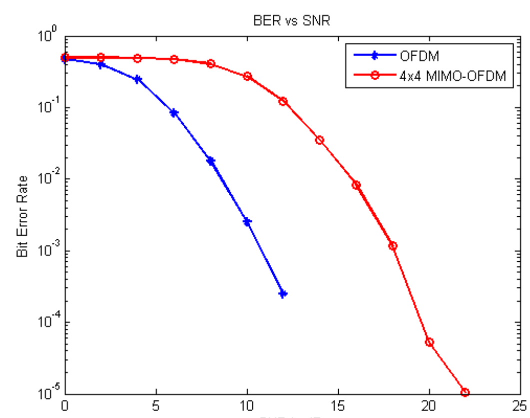

Fig. 6. BER Comparison for OFDM & MIMO-OFDM

6. Conclusion and future work

LTE have one of the Technique to improve System Capacity, data rate and decrease Bit Error Rate the technique is called CoMP. CoMP is the technique allow cooperative signal processing to jointly decode user's signals, for fast communication links between the nodes. By using receiver like

ZF-SIC (zero forcing with successive interference cancellation), we can further improves the result by minimizing interference.

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