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LTE Performance and Analysis using Atoll Simulation

[1]Mohammed Elhadi Abdelgalil, [2]Dr. Amin Babiker A/Nabi
Department of Telecommunications, Faculty of Engineering, Al-Neelain University

Abstract: *Long Term Evolution (LTE) is the last step to reach the complete the 4th generation of cellular networks. LTE intends to create a new technology for radio-access which will provide really high data rates, a low delay and a greater spectral efficiency. This paper represents some of the LTE parameters, including downlink average throughput and uplink average throughput, data rate, bandwidth, coverage, LTE operates in both paired and unpaired spectrum by supporting both Frequency-Division Duplex (FDD) and Time Division Duplex (TDD).[1]*
In this paper there will be a simulation of LTE planning, this simulation will include coverage by signal, overlapping zone, coverage by throughput in uplink and downlink and coverage by noise interference ratio in uplink and downlink.
Keywords: *LTE, evolved packet core (EPC), evolved-NodBs (eNBs)*

I. Introduction

The overall goal of Fourth Generation systems is to provide a converged network compatible with the Next Generation Network vision of convergence This kind of network integrates mobility management, security and QoS management mechanisms for both fixed and mobile broadband accesses, independent of the access technology. Though releasing 8 version of LTE does not strictly meet the ITU's definition of a 4G system. The wireless technology standard that serves as the basis for the Verizon Wireless fourth-generation (4G) wireless broadband network. Supported by the introduction of high speed packet access (HSPA), usage of mobile broadband services, LTE determines the goals of peak data rate for Downlink (DL) 100 Mbps and Uplink (UL) data rate for 50 Mbps increased cell edge user throughput, improved spectral efficiency and scalable bandwidth 1.4 MHz to 20 MHz. [2]

II. LTE Architecture

LTE architecture comprises Evolved Packet Cores (EPCs) and Evolved UMTS Terrestrial Radio Access Networks (E-UTRAN) EPCs communicate with each other and with E-UTRANs. EPC contains a Mobile Management Entity (MME) and a System Architecture Evolution Gateway (SGW) together with a Packet Data Network Gateway (PDN GW). E-UTRAN solely contains Evolved Universal Terrestrial Radio Access Network Base Stations (eNodeB or eNB) where the User Equipment (UE) communicates with eNB and eNBs communicate with each other and with the EPCs. There is one-to-one communication between UE and eNB but there is one-to-many communication among eNB, MME, and SGW.. The overall structure of LTE is shown in Figure 1 [3].

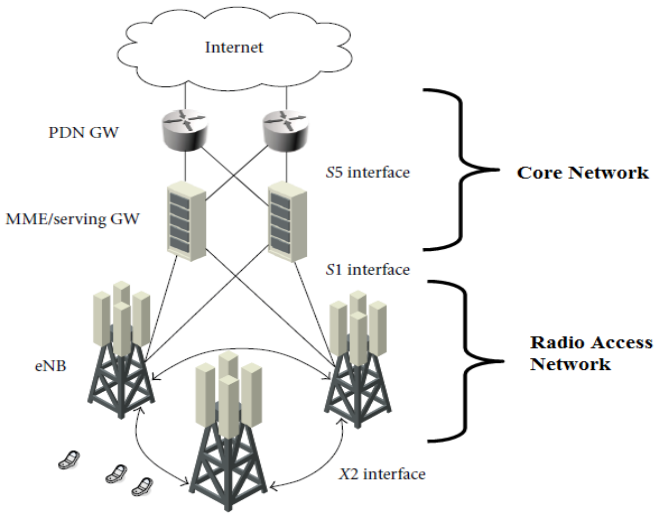

Figure 1: LTE Architecture[3]

There are different types of functions in a cellular network. Based on them, network can be split into two parts: a radio access network part and a core network part. Functions like modulation, header compression and handover belong to the access network, whereas other functions like charging or mobility management are part of the core network. In case of LTE, the radio access network is E-UTRAN and the core network EPC.

2.1 Radio Access Network

The radio access network of LTE is called E-UTRAN and one of its main features is that all services including real-time such as securing and optimizing radio interface delivery, , will be supported over shared packet channels. This approach will achieve increased spectral efficiency which will turn into higher system capacity with respect to current UMTS and HSPA. An important consequence of using packet access for all services is the better integration among all multimedia services and among wireless and fixed services. The main philosophy behind LTE is minimizing the number of nodes. Therefore the developers opted for single-node architecture. The new base station is more complicated than the Node B in WCDMA/HSPA radio access networks, and is consequently called eNB (Enhanced Node B).

2.2 Core Network

The new core network is a radical evolution of the one of third generation systems and it only covers the packet-switched domain. Therefore it has a new name: Evolved Packet Core. Following the same philosophy as for the E-UTRAN, the number of nodes is reduced. EPC divides user data flows into the control and data planes. A specific node is defined for each plane plus the generic gateway that connects the LTE network to the internet and other systems. The EPC comprises several functional entities such as the MME, SGW, PDN and PCRF.

a. The **MME** (Mobility Management Entity)**:** is responsible for the control plane functions related to subscriber and session management. In brief, the MME hosts the following functions:

- Performing intra-LTE handover.
- Paging – distribution of messages to eNBs.
- Handing security key management.
- Providing mobility in idle state.
- Controlling SAE (System Architecture Evolution).
- Handling mobility to other 3GPP or non-3GPP access networks

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b. The **SGW** (Serving Gateway)**:** is the anchor point of the packet data interface towards E-UTRAN. Moreover, it acts as the routing node towards other 3GPP technologies

c. The **PDN** Gateway (Packet Data Network)**:** is the termination point for sessions towards the external packet data network. It is also the router to the Internet.

d. The **PCRF** (Policy and Charging Rules Function)**:** controls the tariff making and the IP Multimedia Subsystem (IMS) configuration of each user.[4]

III. LTE Performance Requirements

LTE allow operators to achieve even greater peak throughputs in higher spectrum bandwidth, and to benefit from greater capacity at a reduced cost To achieve its goals, LTE must satisfy the following requirements

Data Rates

LTE should support a data rate up to 100 Mb/s within a 20 MHz downlink spectrum allocation and 50 Mb/s within a 20 MHz uplink.

Throughput

The downlink average throughput per MHz is about 3 to 4 times higher than in the release 6. The uplink average user throughput per MHz is about 2 to 3 times higher than in the release 6 High-Speed Packet Access (HSPA).

Bandwidth

LTE allows bandwidth ranging from 1.4 MHz up to 20 MHz, where the latter is used to achieve the highest LTE data rate. Furthermore, LTE operates in both paired and unpaired spectrum by supporting both Frequency-Division Duplex (FDD) and Time- Division Duplex (TDD).

Mobility

The mobility is optimized for low terminals speeds ranging from 0 to 15 km/h. The connection should be maintained for very high UEs speeds up to 350 km/h or even up to 500 km/h.

Coverage

The above targets should be met for 5 km cells and some slight degradation in throughput and spectrum efficiency for 30 km cells. 100 km cells and up can't meet the targets requirements.[4]

IV. LTE Simulation

In this paper there will be a simulation for LTE planning, this simulation will include coverage by throughput in uplink and downlink, coverage by signal level, coverage by signal to interference ratio in uplink and downlink and overlapping zone.

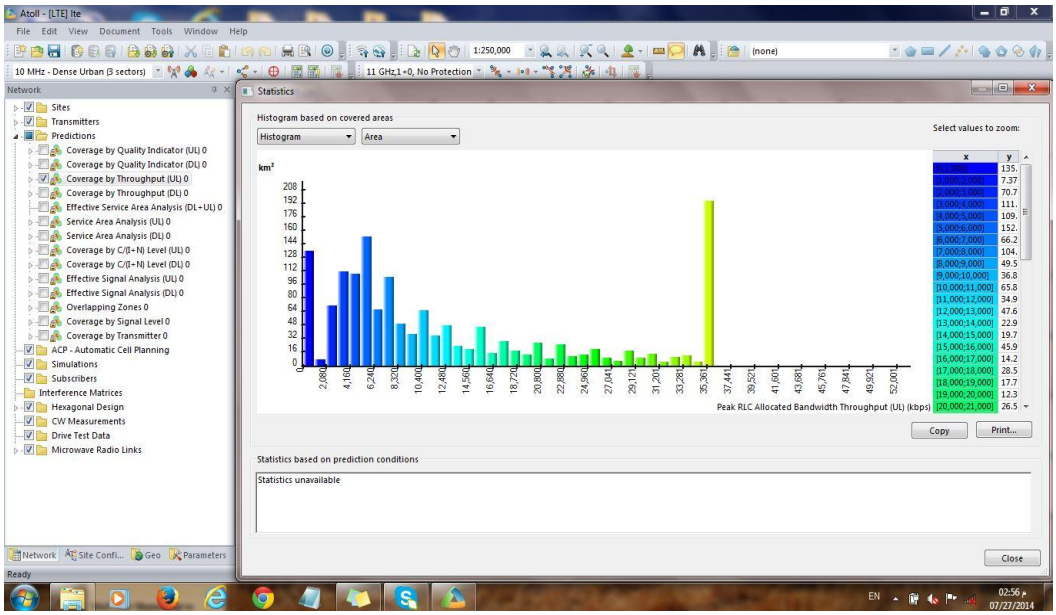

Figure 2: coverage by throughput in uplink

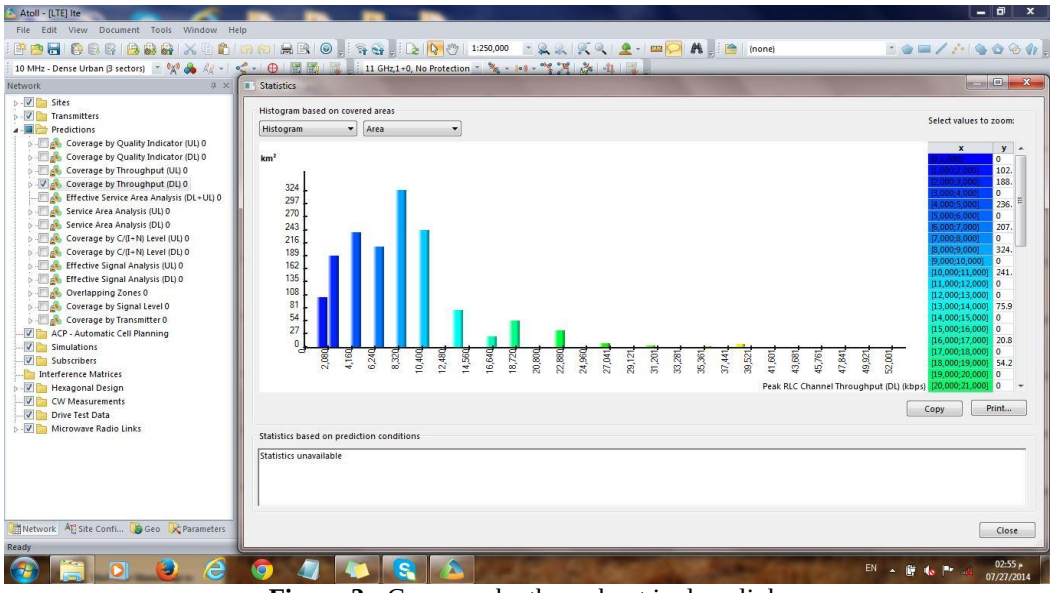

Figure 3: Coverage by throughput in downlink

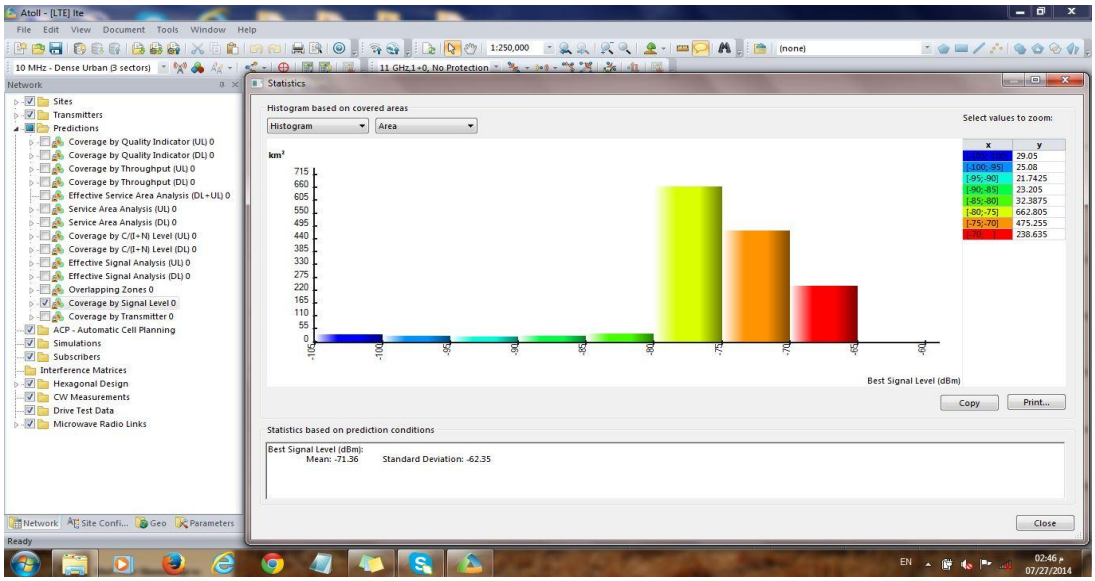

Figure 4: Coverage by signal level

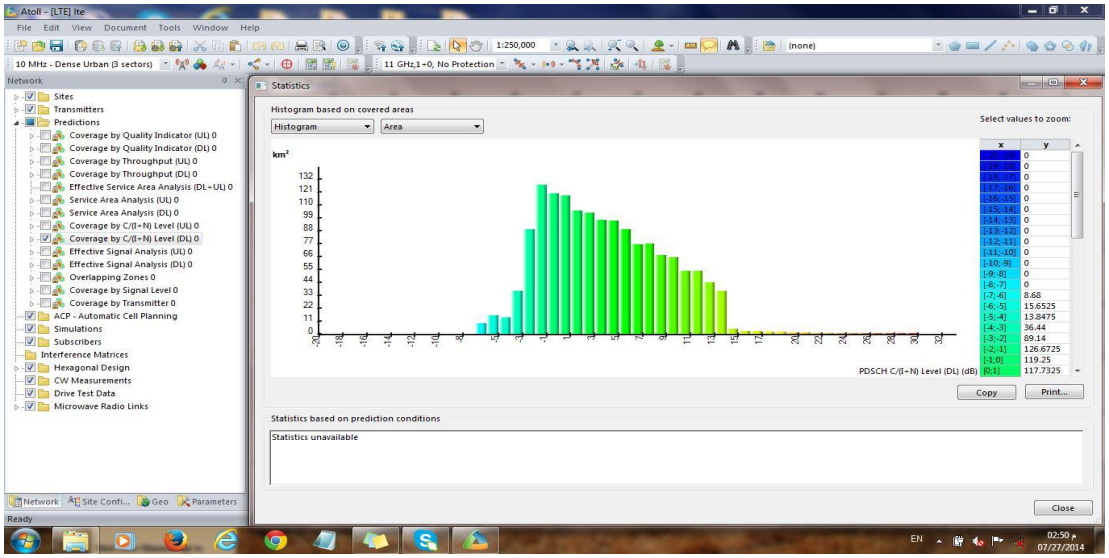

Figure5: coverage by signal to noise ratio downlink

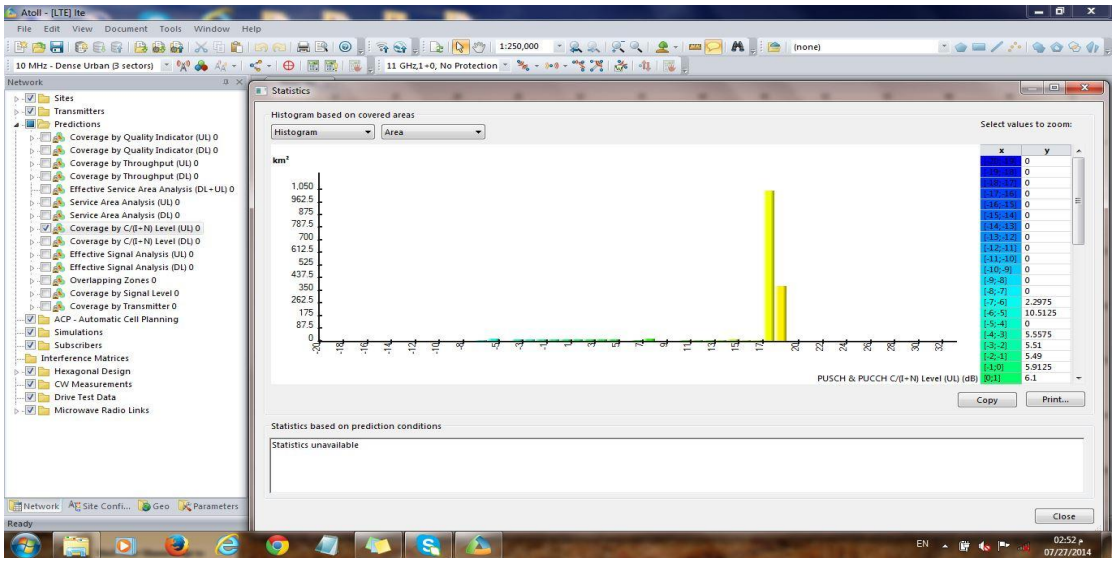

Figure6: coverage by signal to noise ratio uplink

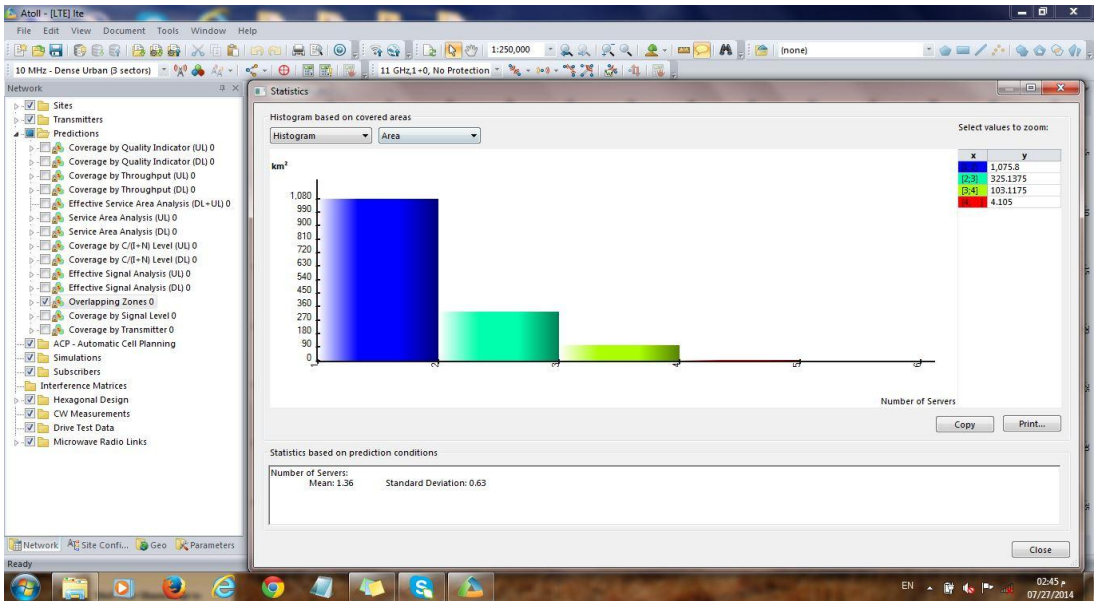

Figure7: overlapping zone

V. Conclusion

In this paper a tool simulator was used and many parameter were compared to get to know the LTE network performance with various method form different view and finally it was concluded that the network has many advantages over the previous networks form coverage by throughput in uplink and downlink, coverage by signal level, coverage by signal to interference ratio in uplink and downlink and overlapping zone in addition to The limited resources to transmit are an important fact to consider when the desire is to improve the speed of the transmissions. The different ways of sharing the available resources efficiently while trying not to interfere in high manner with the other transmissions is one of the problems of LTE.

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