## الآية

## قال تعـــالى :

**" إنّمَا الْمُؤْمِنُونَ الّذِينَ إذَا ذُكِرَ اللّهُ وَجِلَتْ قُلُوبُهُمْ وَإذا تُلِيَتْ عَلَيْهِمْ آياتُهُ زَادَتْهُمْ إيمَانًا وَعَلَى رَبّهِمْ يَتَوَكّلُونَ "**

**سورةالانفالاية 2**

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# ABBREVIATIONS

| | |
|---|---|
| Advanced Mobile Phone System | AMPS |
| Authentication Centre | AC |
| Base Station | BS |
| Base Station Controllers | BSC |
| Base Station Subsystem | BSS |
| Base Transceiver Station | BTS |
| Binary Phase Shift Keying | BPSK |
| Bit energy | Eb/N0 |
| Bit ErrorRate | BER |
| Channel-dependent scheduling | CDS |
| Closed Loop Power Control | CLPC |
| Code Division Multiple Accesses | CDMA |
| Cubic Metric | CM |
| Cyclic prefix | CP |
| Direct sequence CDMA | DS-CDMA |
| Discrete Fourier transforms | DFT |
| Evolution-Data Optimized | EV-DO |
| Evolved Packet System | EPS |
| Federal Communications Commission | FCC |
| Frequency division duplex | FDD |
| Frequency division multiple access | FDMA |

| | |
|---|---|
| Frequency modulation | FM |
| Gateway GPRS | GGSN |
| General Packet Radio Services | GPRS |
| Generation Partnership Project | GPP |
| Global System for Mobile Communication | GSM |
| High Speed Packet Access | HSPA |
| Home Location Register | HLR |
| Home Subscriber Server | HSS |
| Intelligent services | IN |
| Inter-block interference | IBI |
| International Mobile Telephone | IMT |
| International Telecommunication Union | ITU |
| Internet protocol | IP |
| Inverse Discrete Fourier Transform | IDFT |
| Japanese Digital Cellular | JDC |
| Localized SCFDMA | LFDMA |
| Long Term Evolution | LTE |
| Mobile Switching Centre | MSC |
| Mobility management Entity | MME |
| Network Switching Subsystem | NSS |
| Nordic Mobile Telephones | NMT |
| Open loop power control | OLPC |

| | |
|---|---|
| Path loss | PL |
| Personal Communication Services | PCS |
| Personal Digital Cellular | PDC |
| Physical resource block | PRB |
| Physical Resource Blocks | PRBs |
| Physical Uplink Shared Channel | PUSCH |
| Policy and Charging Rules Function | PCRF |
| Power control | PC |
| Power Offset | Po |
| Power Spectral Density | PSD |
| Public Data Network | PDN |
| Quaternary PSK | QPSK |
| User equipment | UE |
| Total Access Communicatin Systems | TACS |
| Time-division duplex | TDD |
| Transmit Power Control | TPC |
| Universal Terrestrial Mobile System | UMTS |
| Uplink | UL |
| Time division multiple access | TDMA |
| Uplink-PTS | UPPTS |
| Resource Block | RB |
| Servicing GPRS | SGSN |
| Short Message Service Centre | SMSC |

| | |
|---|---|
| Signal to Noise Ratio | SNR |
| Signal-to interference and noise ratio | SINR |
| Signal-to-interference ratio | SIR |
| Sounding RS | SRS |
| System Architecture Evolution | SAE |
| Value Added Services | VAS |
| Radio Network Controller | RNC |
| Radio resource control | RRC |
| Reference Signals | RSs |
| Reference symbol received power | RSRP |
| Visitor Location Register | VLR |
| Voice over IP | VoIP |
| Voicemail Service | VMS |
| Wireless Fidelity | Wi-Fi |
| Wide band CDMA Mobile Switching Centre | WMSC |

# ABSTRACT

3GPP LTE represents a major advance in cellular technology.The role of uplink power control is to suppress interference. Power control refers to set output power levels of transmitters, base stations in the downlink and User Equipment (UE) in the uplink. In this thesis the performance of 3GPP Long Term Evolution (LTE) closed and open loop power control combined with fractional path loss compensation factor is evaluated by simulating the effects of open loop error, Transmit Control Protocol (TCP) command. The power by the UE must be controlled to reduce the power consumption. The uplink power control schemes; the open and the closed loop power control are investigated to reduce the power consumption. The effect of the parameters; the compensation factor, the pathloss and the Power Offset were tested in order to have an operating point .The closed loop power control with fractional path loss compensation factor is found to improve the system performance in terms of mean bit rate. The results showed that an increase in any of theseparametersincreases the transmission power.

# المستخلص

قدمت جمعية الGPP3 عدد من التقنيات المتطورة في مجال الاتصالات اللاسلكية,واحدث التقنيات التي قدمتها هي شبكة الLTE ذات الامكانيات الكبيرة في السرعات والسعة وعدد المستخدمين ومساحات التغطيةلكن بقية مشكلة الاحتفاظ بالطاقة لفترة زمنية طويلة هي المشكلة.عميلة الارسال من المستخدم الى المخدم واجهة هاجس الضعف في عمر بطارية الجهاز الطرفي او المستخدم.في هذا البحث تناولنا طريقتينلاطالة عمر البطارة لدى المستخدم هما تقنيتي الحلفة المفتوحة والحلقة المغلقة مع تغير معامل تعويض الطاقة ,وقمنا بدراسة مجموعة من المتغيرات ذات التأثير المباشر مع طافة الارسال مثل معامل تعويض الفقدومعامل فقدان المسار ومعامل التعديل في الطاقة نسبة الاشارة للتشويش, وقد وجدنا ان اي زيادة في هذه المعاملات ينتج عنها زيادة في طاقة الارسال والتي يجب حدها للحفاظ على عمر البطاربة.تم عمل المحاكاهعن طريق برنامج الMATLAP وتمت مناقشة النتائج مع تغير قيم المعاملات للحصول على أقل قيم لاستهلاك الطاقة في الأجهزة الطرفية.

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# CHAPTER ONE

# INTRODUCTION

## 1.1 Introduction**:**

Over the last few years, the requirements concerning services performance have become very tight. To be able to deliver the strict performance requirements requested by applications and services, new standards for innovative technologies are under development. For many operators in many countries, this year is going to be the starting point for launching Long Term Evolution(LTE ) networks

### 1.1.1 What is LTE:

It is a broad, still evolving standard under which 4G-type technologies are grouped. It operates on a different segment of the wireless spectrum.

LTE is the latest standard in the mobile network technology tree that previously realized the GSM/EDGE and UMTS/HSPA network technologies that now account for over 85% of all mobile subscribers. LTE will ensure 3GPP's competitive edge over other cellular technologies [1].

### 1.1.2 Objectives of LTE:

Increased downlink and uplink peak data rates while having a scalable bandwidthAnd improving the spectral efficiency throughall IP network and standard's based interface that can support a multitude of user types.

### 1.1.4 Some specific targets set for LTE:

Increased peak data rate: 100Mbps for DL with 20MHz (2 Rx Antenna at UE), 50Mbps for UL with 20MHz bandwidth andimproving spectral efficiency: 5bps/Hz for DL and 2.5bps/Hz for UL**,** improving cell edge performance (in terms of bit rate) and reduce latency.

### 1.1.5 LTE challenges:

The users expect to have best price while having transparent flat rate and full internet and multimedia, which leads to the operators challenge, reducing cost per bit and providing high data rate and low latency.

## 1.2 LTE performance requirements:

LTE was developed to improve the overall system performance, some of these performance required as follow.

### 1.2.1 Data Rate:

LTE has instantaneous downlink and uplink peak data rate ,in downlink 100Mbit/s in a 20MHz downlink spectrum (i.e. 5 bit/s/Hz), and in uplink peak data rate of 50Mbit/s in a 20MHz uplinkSpectrum (i.e. 2.5 bit/s/Hz)[2].

### 1.2.2 Cell range and capacity:

LTE provides 5 km optimal size for cell area and 30km sizes with reasonable performance up to 100 km cell sizes supported with acceptable performance.

And cell capacity up to 200 active users per cell(5 MHz) (i.e., 200 active data clients).

### 1.2.3 Mobility:

LTE system optimized for low mobility (0-15km/h) but supports high speed.

### 1.2.5 Latency:

LTE minimized latency in both user and control plane, user plane latency less than 5ms and control plane latency less than 50 ms.

Reducing latency can Improves the spectrum efficiency and broadcasting and allows for scalable bandwidth of 20, 15, 10, 5, 3 and 1.4MHz.co-existence with legacy standards.

## 1.3 Problem Statement:

- Battery power is a scarce resource for portable devices like mobile, notebooks, ultra-portables, gaming devices and video cameras which are all considered as UE. In the coming years these devices will operate over mobile broadband technology as LTE.
- In a multi user environment a number of user shares the same radio resources. A consequence of the limited availability of radio channels in the network is that the same channel has to be assigned to many users.
- Thus a signal intended for a certain user will reach other users and introduce interference to their connection, and degrade the quality. A user with very good quality may consider using a low power and still having acceptable quality. The advantage is that it will disturb other users less, and thereby their quality is improved.
- Single Carrier Frequency Division Multiple Access (SC-FDMA) has been chosen as the uplink multiple access technology in LTE. SC-FDMA has a low PAPR, which leads to lesser power consumption at the UE, which leads to maximize the battery life.

## 1.4 Proposed Solution:

Using MATLAB to implement an uplink channel (Transmitter and Receiver) using SC-FDMA.

Applying both open and close loop Power Control(PC) mechanisms and calculating performance results. Investigating the results while changing in performance parameter to get better results.

Setting output power levels is accomplished by PC mechanisms and is categorized into many and several groups:

(i) Open-loop power control.
(ii) Closed loop power control.
(iii) Combined open- and closed loop power control.

We will be using two mechanisms in this project which are open loop and closed loop PC.

## 1.5 Methodology:

The implementation and simulations are carried out using MATLAB.The intension is not to give a detailed performance analysis of the power control in LTE system but to exhibit general performance trends and tendencies under various conditions and scenario .The implementation and simulations are carried out using MATLAB and then two power control techniques are proposed with the aim of improving PC in LTE. Both open loop and closed loop power control schemes are PC techniques and are supported in LTE.LTE-based power control approach performs close to the optimal scheme provided that the associated parameters are properly set, so a comparison has been made between the open loop power control and the closed loop power control to evaluate which power control algorithm gives a the better result and optimum system performance. A simplified static simulation approach has been used which focuses on PC while neglecting the channel aware scheduling

and retransmissions. The approach consists primarily in taking a “snapshot” of the system where a configuration of users transmits with a certain psd, and proceeds to calculate the interference and signal distributions.

## 1.6 Research Outlines:

This thesis consists of five chapters described as follow:

**Chapter 2:** introduction to wireless communication and power control.

General introduction about the communication system that came before the LTE and the LTE itself plus the  power control mechanisms used in LTE uplink.

**Chapter 3:** presents the system design and analysis.

Analyses of the SC-FDMA channel which used in LTE uplink and the system design used in this thesis.

**Chapter 4:** simulation results and discussion.

Steps of the simulation used in this thesis and parameters used in it and the discussion of results taken from the simulation.

**Chapter 5:** conclusion and recommendations.

The conclusion of our work and some additional recommendation for future work.