الآية

بسم الله الرحمن الرحيم

﴿ اللهُ نُورُ السَّمَاوَاتِ وَالْأَرْضِ ۚ مَثَلُ نُورِهِ كَمِشْكَاةٍ فِيهَا مِصْبَاحٌ ۖ الْمِصْبَاحُ فِي زُجَاجَةٍ ۖ الزُّجَاجَةُ كَأَنَّهَا كَوْكَبٌ دُرِّيٌّ يُوقَدُ مِن شَجَرَةٍ مُّبَارَكَةٍ زَيْتُونَةٍ لَّا شَرْقِيَّةٍ وَلَا غَرْبِيَّةٍ يَكَادُ زَيْتُهَا يُضِيءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ ۚ نُّورٌ عَلَىٰ نُورٍ ۗ يَهْدِي اللَّهُ لِنُورِهِ مَن يَشَاءُ ۚ وَيَضْرِبُ اللَّهُ الْأَمْثَالَ لِلنَّاسِ ۗ وَاللَّهُ بِكُلِّ شَيْءٍ عَلِيمٌ ﴾

صدق الله العظيم

سورة النور الايه 35

Dedication

Every challenging work need self efforts as well as guides of elders especially those who were very close to our heart,

My humble effort I dedicate to my sweet and lovely,

father & Mother ,

Whose affection ,love ,encouragement and prays of day and night make me able to get such success and honor ,

Along with all hard working and respected

Teacher.

Acknowledgment

For the ancestors who paved the path before me upon whose shoulder I stand also to my family and the many friends who supported me on journey, thank you.

I would like to express my supervisor

Assoc .Prof. De. Rashid Abdalhaleem Saied for his unweaving support, collegiality, and mentorship throughout this project.

I would like to extend my thank to those who offered collegial guidance and support this research DR. Mudather Fagiry and DR. Abu Algasim Mohammed Abd Alaal.

Abstract

The long term evolution (LTE) initiated to achieve high throughput environment, high network capacity and reduce the cost per bit.

The aim of the project is to realizing Quality of service requirement and optimizing system performance of LTE by using scheduling as a key for radio recourse management mechanism by investigated and study three of the downlink scheduling algorithms used in LTE system, Best-Channel Quality Indicator, Round Robin and proportional fair.

Optimized MATLAB simulator had been used to evaluate the throughput and delay of the three algorithms.

The result show that the best (CQI) is the best with respect to QoS due to the detection of best channel also the delay time and the throughput are discrete, in round robin algorithm it was found that each user will spend a time on the system according to arriving time, the delay is proportional to data size and the throughput is also discrete and in the proportional fair algorithm all users has the same throughput and delay time.

المستخلص

انشئ نظام التطور الطويل الأمد لتحقيق بيئة إنتاجية عالية مع عدد كبير من المستخدمين، وأيضا لتحقيق قدرة شبكة عالية وتقليل التكلفة لكل وحدة بيانات .

الهدف من هذا المشروع هو تحقيق الجودة وتحسين أداء نظام التطور طويل الامد باستخدام الجدولة كمفتاح لآلية إدارة الموارد الراديوبه بالتحقيق ودراسة ثلاثة من خوارزميات الجدولة للربط الهابط المستخدمة في نظام الجيل الرابع وهي خوارزمية أفضل مؤشر لجودة القناة ، خوارزمية جولة روبن وخوارزمية التناسب العادل.

استخدمنا برنامج المحاكاة مات لاب لتقييم الإنتاجية والتأخير في الخوارزميات الثلاثة. تمت دراسة ومقارنة النتائج وتوصلنا الي أن خوارزمية أفضل مؤشر لجودة القناة هى الأفضل فيما يتعلق بجودة الخدمة ويرجع ذلك إلى الكشف عن أفضل قناة بالاضافه الي ان زمن التأخير و الإنتاجية منفصلة ، في خوارزمية جولة روبن تبين أن كل مستخدم سوف ينفق كل وقت النظام وفقا لوقت وصوله وزمن التأخير نسبي مقارنه مع حجم البيانات و الإنتاجية أيضا منفصلة وفي خوارزمية التناسب العادل كافة المستخدمين لهم نفس الإنتاجية وزمن التأخير.

TABLE OF CONTENT

CONTENTS	Page
الأيه	I
DEDECATION	II
ACKNOWLEDGEMENT	III
ABSTRACT	IV
مستخلص	V
TABLE OF CONTENTS	VI - X
LIST OF TABLE	XI
LIST OF FIGURES	XII-XIII
LIST OF ABBREVIATIONS	XIV-XVI
CHAPTER ONE INTROUDCCTION	
1.1 PREFACE	2
1.2 PROBLEM STATEMENT	3
1.3 PROPOSED SOLUTION	3
1.4 OBJECTIVES	3
1.5 METHODOLOGY	4
1.6 THESIS OUTLINES	4

CHAPTER TWO LITERATURE REVIEW	
2.1 LTE OVERVIEW	6
2.1.1 FEATURE OF LTE	6
2.1.2 TECHNOLOGY OF LTE	6
2.2 LTE Advanced Overview	7
2.2.1 Feature Of LTE Advanced	8
2.2.2 System Architecture Evaluation	8
2.2.2.1 Evolved-Universal Terrestrial Radio Access Network (E-UTRAN)	9
2.2.2.2 Evolved Packet Core Network	9
2.2.3 LTE Advanced Technology	10
2.2.3.1 Orthogonal Frequency Division Multiplexing (OFDM)	10
2.2.3.2 Carrier Aggregation (CA)	11
2.2.3.3 Extended MIMO	12
2.2.3.4 Coordinated Multi-Point (COMP)	12
2.2.3.4 Heterogeneous Network (HETNET)	13
2.2.3.5 Relay Station	13
2.3 Radio Resource Management	14
2.3.1 Link Adaption	14
2.3.2 Hybrid ARQ	14

2.3.3 Packet Scheduler	15
2.4 Related Works	16
CHAPTER THREE **QOS AWARE RADIO RESOURCE MANEGMENT**	
3.1 Quality Of Service (QOS)	19
3.2 QOS Performance Measures	19
3.3 LTE Identifies The Following Major Quantitative parameters	19
3.3.1 Throughput	19
3.3.1.1 The Guaranteed Bit Rate (GRB)	19
3.3.1.2 The Maximum Bit Rate (MBR)	19
3.3.1.3 Aggregate Maximum Bit Rate	20
3.3.2 Delay	20
3.3.3 Packet Loss	20
3.3.4 Priority	20
3.3.5 Jitter	20
3.3.6 Wander	21
3.4 Scheduling Algorithms	21
3.4.1 Best Channel Quality Indicator	22
3.4.2 Round Robin	23
3.4.3 Proportional Fair	23

3.5 Performance Metrics Outage Probability	24
3.6 Throughput	25
3.7 Delay Time	26
CHAPTER FOUR **RESULT AND DISCUSSION**	
4.1 Simulation Parameters	28
4.2 Simulation Scenarios	28
4.2.1 Best CQI Scenarios	28
4.2.1.1 Simulation graphical representation of SNR VS BER	29
4.2.1.2 Simulation graphical representation of Throughput	31
4.2.1.3 Simulation graphical presentation of best channel quality indicator delay time	33
4.2.2 Scenario Round Robin	34
4.2.2.1 Simulation graphical presentation of Round Robin delay time	35
4.2.2.2 Simulation graphical presentation of throughput for Round Robin	37
4.2.3 Scenario Proportional Fair	37
4.2.3.1 Simulation graphical presentation of three user delay time	38

4.2.3.2 Throughput for proportional fair algorithm	39
4.2.3.3 Simulation graphical presentation of throughput in Proportional fair algorithm	40
4.3 Comparison Of Three Scheduling Algorithms	41
4.3.1 Delay Time Comparison	41
4.3.2 Throughput Comparison	42
4.3.3 Maximum Throughput For Three Algorithms	42
4.3.4 Maximum Delay For Three Algorithms	43
CHAPTER Five **CONCLUSION AND RECOMMEDATIONS**	
5.1 CONCLUSION	45
5.2 RECOMMEDATIONS	47
REFERENCES	48
APPENDICES	51

LIST OF TABLE

TABLE	Name	Page
4.1	Simulation parameter	29
4.2	SNR VS BER	30
4.3	Throughput Calculations	32
4.4	Delay Calculations	33
4.5	Users delay time	35
4.6	Throughput for round Robin Scenario	36
4.7	Delay time for three users	38
4.8	Throughput proportional fair	40

LIST OF FIGURES

FIGURE	Name	Page
2.1	OFDM Framing	8
2.2	LTE-Advanced Network Architecture	10
2.3	Subcarrier Spacing in OFDM	12
2.4	Carrier Aggregation	13
2.5	2 times 2 antenna configuration	13
2.6	The use of relay node to extend cell coverage	15
3.1	Best CQI flow chart	23
3.2	Round Robin flow chart	24
3.3	Proportional fair flow chart	25
4.1	LTE CQI SNR Vs BER	31
4.2	The throughput of the best CQI was detected that the increasing of SNR increases the throughput of the system	33
4.3	The delay time in CQI is discrete depend of user data size	34
4.4	The delay time of round robin depend on the arrive time of user and the delay is discrete	36
4.5	The throughput of round robin users	37
4.6	Delay time for three users proportional fair algorithm	39

4.7	Three user throughput in the proportional fair	41
4.8	Delay time comparison for three algorithms	42
4.9	Throughput comparison between three scheduling algorithm	43
4.10	Throughput percentage for three algorithm	43
4.11	Delay percentage for three algorithm	44

Abbreviations

3G	Third generation
AMBR	Aggregate Maximum Bit Rate
APN-AMBR	Access Point Name-AMBR
ARP	Allocation/Retention Priority.
AWGN	Additive White Gaussian Noise
BER	Bit Error Rate
BPSK	Binary phase shift keying
CA	Carrier Aggregation.
COMP	Coordinated Multi-Point
CQI	Channel Quality Indicator
DL	Down Link
DJ	Deterministic jitter
Enb	E node B
EPCN	Evolved Packet Core Network
E-UTRAN	Evolved-Universal Terrestrial Radio Access Network
FD	frequency domain
FDD	Frequency division duplex
FDPS	frequency domain packet scheduling
FIFO	First in first out

GBR	Guaranteed Bit Rate
HARQ	Hybrid Automatic Repeat Request
HETNET	Heterogeneous Network
HSS	Home subscriber server
IMT	International Mobile Telecommunications
LTE	Long Term Evolution
LA	Link Adaption
MBR	Maximum Bit Rate
MCS	modulation and coding schemes
MIMO	multiple input multiple output
MME	Mobility Management Entity
OFDM	Orthogonal Frequency Division Multiplexing
PDN	Packet Data Network.
PDN-GW or P-GW	Packet Data Network Gateway
PF	Proportional Fair.
PLR	Packet loss rate.
RB	Resource Blocks
PRBs	Physical Resource Blocks.
PS	Packet Scheduler
QCI	Quality channel Indicator

QOS	Quality of Service.
QPSK	Quad phase shift keying
RAN	Radio Access Network.
RB	Resource Blocks.
RJ	Random jitter.
RRM	Radio Resource Management.
SC-FDMA	Sub carrier –frequency division multiple access
SINR	Signal to interference-plus-noise ratio.
SNR	Signal to- Noise Ratio
SISO	Single input single output
S-GW	Serving Gateway.
TD	Time-Domain
TDD	Time Division Duplex
TDPS	Time-domain packet scheduling TDPS.
TTI	Transmission time interval.
UEAMBR.	User Equipment Aggregate Maximum Bit Rate
UEs	User Equipment's
UP	Up Link
VOIP	Voice over IP