MOBILITY ANALYSIS OF MODIFIED PROPORTIONAL FAIR (PF) SCHEDULER IN LTE/LTE-ADVANCE SYSTEM

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DEDICATION

I dedicated this work to my beloved mother

ABSTRACT

Long Term Evolution (LTE) is well known as a cellular network that can support very high data rates in diverse traffic conditions. One way of achieving it is through packet scheduling which is the key scheme of Radio Resource Management (RRM) for LTE traffic processing that is functioning to allocate sources for each frequency and time dimensions. In previous research, the new scheduling algorithm was built, namely the Modified-Proportional Fair (PF) scheduler that divides a single subframe into multiple time slots and allocates the resource block (RB) to the focused User Equipment (UE) in all time slots for each subframe based on the instantaneous Channel Quality Indicator (CQI) feedback received from UEs. Simulation results show that the Modified-PF scheduler provides the great overall performance in terms of throughput and spectral efficiency with comparable fairness as compared to Round Robin (RR) and PF schedulers. This project will determine the type of response by the scheduler towards different mobility condition by simulating the throughput and the spectral efficiency of at least 3 different UE with different velocity.

ABSTRAK

Evolusi Jangka Panjang (LTE) dikenali sebagai rangkaian selular yang boleh menyokong kadar data yang sangat tinggi dalam keadaan lalu lintas yang pelbagai. Satu cara untuk mencapainya adalah melalui penjadualan paket yang merupakan skim utama Pengurusan Sumber Radio (RRM) untuk pemprosesan lalu lintas LTE yang berfungsi untuk memperuntukkan sumber bagi setiap frekuensi dan dimensi masa. Dalam penyelidikan terdahulu, algoritma penjadualan baru dibina, iaitu penjadual Modified-Proportional Fair (PF) yang membahagi satu subframe tunggal ke dalam slot masa yang banyak dan memperuntukkan blok sumber (RB) ke Peralatan Pengguna terfokus (UE) dalam semua slot masa untuk setiap subframe berdasarkan maklum balas Saluran Kualiti Saluran segera (CQI) yang diterima daripada UE. Hasil simulasi menunjukkan bahawa penjadual Modified-PF menyediakan prestasi keseluruhan yang hebat dari segi kelebihan dan kecekapan spektrum dengan keadilan yang setanding berbanding dengan Round Robin (RR) dan penjadual PF. Projek ini akan menentukan jenis tindak balas oleh penjadual ke arah keadaan mobiliti yang berbeza dengan mensimulasikan daya tampung dan kecekapan spektrum sekurang-kurangnya 3 UE berbeza dengan halaju yang berbeza.

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LIST OF SYMBOLS AND ABBREVIATIONS

3G	:	Third Generation
3GPP	:	Third Generation Partnership Project
AP	:	Access Point
APP	:	Application Layer
AP-UE	:	Access Point-User Equipment
BS	:	Base Station
CoMP	:	Coordinated Multipoint System
CoMP-CS	:	CoMP-Coordinate Scheduling
CQI	:	Channel Quality Indicator
eCA	:	Enhanced Carrier Aggregation
FDD	:	Frequency-Division Duplex
FDMA	:	Frequency Division Multiple Access
FD-MIMO	:	Full Dimension-Multiple Input Multiple Output
FDS	:	Frequency Time Scheduling
IMT-Advanced	:	International Mobile Telecommunication-Advance
ITU	:	International Telecommunication-Advanced
LTE	:	Long Term Evolution
LTE-Advanced	:	Long Term Evolution-Advanced
MAC	:	Medium Access Control

Mbps	:	Mega bit per second
MBS	:	Multicast and Broadcast
MIMO	:	Multiple Input Multiple Output
MN	:	Mobile Network
Modified-PF	:	Modified Proportional Fair
MS	:	Mobile Station
OFDMA	:	Orthogonal Frequency Division Multiple Access
OFDM	:	Orthogonal Frequency Division Multiplexing
PC	:	Power Control
PF	:	Proportional Fair
PMIPv6	:	Proxy Mobile IPv6
QoE	:	Quality of Experience
QoS	:	Quality of Service
RB	:	Resource Block
RF	:	Radio Frequency
RR	:	Round Robin
RRA	:	Radio Resource Allocation
RRM	:	Radio Resource Management
RS	:	Relay Station
SINR	:	Signal to Interference and Noise Power Ratio
SNR	:	Signal to Noise Ratio
TDS	:	Time Domain Scheduling
TTI	:	Transmission Time Interval
UE	:	User Equipment
WiMAX	:	Worldwide Interoperability for Microwave Access

CHAPTER 1

INTRODUCTION

1.1 Research Background

Over the past few years, requests from wireless communications facilities have risen dramatically. The future introduces fresh difficulties to the performance of multiple cellular wireless access communications schemes in the form of demands on users for more complex or even resource-consuming multimedia service. Furthermore, the upcoming systems must ensure the quality of service (QoS) for all customers while allowing users to move around.

Orthogonal Frequency Division Multiple Access (OFDMA) that is a combination of Frequency Division Multiple Access (FDMA) and Orthogonal Frequency Division Multiplexing (OFDM) and a Modulation / multiple access technique, has been suggested by the International Telecommunication-Advanced (ITU) as the main

Physical (PHY) layer technology for the following era of International Mobile Telecommunication-Advance (IMT-Advanced) systems which are driven by increased demand for mobile broadband services with higher data rates and QoS. In the OFDMA, the base stations (BS) allow transmission of multiple users at the same time on completely diverse subcarriers throughout the same period.

One of the important elements of OFDMA is stated as Radio Resource Management (RRM) that is crucial in accomplishing the required performance for higher system loads by controlling key elements of each PHY and Medium Access control (MAC) layers[1]. This aspect is also essential for OFDMA broadband wireless networks where various consumers share limited spectral resources. This concept is well developed and in the recent versions of IEEE802.16 m and 3GPP version 15.

In fact, LTE-Advanced seems to be a backward compatible technology in the sense that it should be able to apply LTE-Advanced to the accessible LTE spectrum without influencing the LTE terminal[2]. In order to satisfy the IMT-Advanced requirements, LTE-Advanced should also regard many aspects as a backward compatibility technology such as capacity, low cost preparation and data rates, as well as the chance of maximum information prices of up to 1 Gb/s in downlink and 500 Mb/s in uplink.

The eNodeB has the medium access control layer (MAC) which contains the scheduler. The role of the scheduler is to allocate radio resources between UEs received by a specified cell and is a technique for the allocation of radio resources[3]. The methodology chosen by the planning algorithm affects the performance of every UE and the performance of the whole cell area. Therefore, the efficiency of different scheduling methods must be evaluated in most circumstances before any practical

deployment. In fact, the scheduling algorithm is the main part determining the overall performance.

In recent years, a new type of LTE packet scheduler named Modified-Proportional Fair (Modified-PF) has been researched. The Modified-PF scheduler splits a single subframe into various time slots and allocates the RBs to selected users to each slot depending on UEs CQI responses. It thus achieves a compromise between spectral efficiency and throughput and enables UE capabilities and cell performance to be improved.

1.2 Problem Statement

A research on modified-PF was conducted but the research does not evaluate the performance of the Modified-PF on mobility response of the UEs with fixed or random velocity in a cell of BS. Thus, this project is conducted to investigate the response of the Modified-PF towards mobile UEs.

1.3 Research Objective

1) To investigate the performance of modified-PF scheduling algorithm by taking into consideration UE's mobility
2) To compare the performance of modified-PF scheduler in LTE mobile environment with other existing schedulers.

1.4 Scope of Work

Modified-PF have been proposed in previous research, but the result is limited to several function such as single cell performance, tri-sector antenna and tri-sector plus femtocell. Eventually, there are no result on mobility environment because the research only involves static UE. This analysis is required to prove that the Modified-

PF is compatible with mobility environment. If the result showing positive feedback, the Modified-PF is compatible with the mobility environment.

1.5 Thesis Outline

This thesis focuses on evaluating the method of Modified-PF scheduling on the downlink function of LTE systems in the mobile surroundings This thesis is structured in five sections, explaining the primary study works in Chapters 3 to 4; study methodology, outcomes, and discussions. Chapter 1 offers the short background and apps of the development of IMT-Advanced. Chapter 1 also describes the objectives and range of work throughout the study works in an organized workflow.

Chapter 2 introduces the present LTE / LTE-Advanced design concept. The chapter summarizes the latest 3GPP release 13 in LTE / LTE-advanced. In addition, the section also briefly introduces in detail the RRM aspects to provide a definite overview of the development of a latest LTE / LTE-Advanced RRM method and provides some performance measures.

Chapter 3 presents methodology on the simulation process and implementing Proportional Fair, RR and Modified-PF scheduler. All type of simulation of LTE scenario will be discussed and all simulation parameter is presented. System Level Simulator of the Vienna University is used to simulate all scheduling scheme using MATLAB software.

Chapter 4 focuses on demonstrating the investigation on all Modified-PF scheduling algorithm on the different scenarios created. All three type of scenario is presented and discussed in this part. The performance of Modified-PF scheduler it the

compared with RR and PF scheduler. The comparison is also discussed and will be presented in this section.

The following section, Chapter 5, presents and summarizes this current study results and presents the benefits of the algorithm for Modified-PF scheduler. Lastly, the future work and suggestions for any further growth of studies in the LTE system will be stated at the end of this section.

CHAPTER 2

BACKGROUND STUDY

2.1 Current Developments in LTE-Advanced: Radio Resource Management Review

Release 13 of LTE has been launched at March 2016 by 3GPP which it complies to IMT-Advanced specification. Presently, LTE release 14,15 and 16 that are the improvement of Release 13 are being studied to give greater performance[4]. The ability of LTE is highly suggested by 3GPP because it can boost the capacity of user during transmission and receiving process[5]. RRM is one of important element in OFDMA where it is crucial in seeking the desired performance [6].

Release 13 includes three major categories of technology. The first category is the improvement of spectral efficiency and its representative technology is full dimension Multiple Input Multiple Output (FD-MIMO), which targets to boost spectral efficiency dramatically using huge antennas at the BS. Second category is the use of additional frequency resources and includes licensed assisted access (LAA) for the use of unlicensed spectrum while ensuring coexistence with current equipment and