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MAXIMUM EXPANSION WITH CONTIGUITY CONSTRAINT (MECC) SCHEDULING ALGORITHM IN UPLINK TRANSMISSION FOR LONG TERM EVOLUTION (LTE)

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ABSTRACT

Nowadays, uplink transmission is becoming more crucial and requires special attention due to the popularity of mobile usage for streaming live video and engaging with social networks. Single Carrier Frequency Division Multiple Access (SC-FDMA) is chosen because of the lower peak-to-average power ratio (PAPR) value in uplink transmission. A User Equipment can benefit from SC-FDMA in the uplink transmission in terms of increased transmission power efficiency along with increased data rates, which eventually translates to improved battery life on the UE. The contiguity constraint is one of the major constraints presents in uplink packet scheduling, where all resource blocks (RBs) allocated to a single user (UE) must be contiguous in the frequency-domain within each time slot to maintain its single carrier. However, the contiguity constraint reduces the spectral efficiency of the uplink transmission. This thesis proposed an uplink-scheduling algorithm namely the Maximum Expansion with Contiguity Constraints (MECC) algorithm, which aims to satisfy the contiguity constraint and improve the spectral efficiency, fairness, and throughput of the cell-edge users in the uplink transmission. The MECC algorithm is deployed in two stages. In the first stage, the RBs are allocated fairly among the UEs. The second stage allocates the RBs with the highest metric value and expands the allocation on both sides of the matrix, M with respect to the contiguity constraint. The performance of the MECC algorithm was conducted in three different environments with the speed of 0 km/h, 30 km/h, and 120 km/h, which resembles the static and vehicular movement of the UE using the LTE-SIM network simulator. The MECC scheduling algorithm is compared to other algorithms namely the Round Robin (RR), Channel-Dependent First Maximum Expansion (CD-FME), and Proportional Fairness First Maximum Expansion (PF-FME). The comparison has been made in terms of throughput, fairness index, delay, packet loss ratio (PLR), and spectral efficiency. Three types of traffic have been considered such as video and Voice over Internet Protocol (VoIP) flows, which are representing the real-time (RT) services while Best Effort (BE) flow represents the non-real-time (NRT). From here, it can be concluded that the MECC algorithm showed the most suitable among other algorithms by achieving an excellent result in terms of fairness, spectral efficiency, which is up to 91.57%, delivering the highest throughput, which is up to 90.04% and 43.41% for RT and NRT traffic respectively, achieving the lowest PLR, which is up to 10.04% improvement in the RT traffic and have a low delay that is within the acceptable range to provision the Quality of User Experience (QoE) for the RT traffic flow in a static and vehicular environment. Furthermore, the MECC algorithm achieved the highest cell-edge user's throughput among the others, which is up to 99.44% for all scenarios. Thus, the MECC algorithm is the most suitable scheduler in provisioning the QoS requirements for the RT and NRT traffics.

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CHAPTER ONE
INTRODUCTION

1.1 Introduction

In recent years, the fast growing demand for network services such as video streaming, voice over internet protocol (VoIP), and interactive gaming, requires high data rates and better throughput to provide a better quality of service (QoS) [1]. The introduction of Long Term Evolution (LTE) system under the consideration of Third Generation Partnership Project (3GPP) is the next focus of attention. LTE was designed in order to meet the increased data rate and application demands with reliable and trustworthy connections [2]. LTE is an evolutionary step beyond the Third Generation (3G) in mobile wireless communication and incorporates different technological innovations from various research domains such as digital signal processing, Internet Protocol, network architecture and security which have changed the scenario of mobile usage worldwide [3].

In 2012, uplink scheduling receives particular attention due to the increase of uploading activities such as video, photos and files sharing from the subscribers. According to the Ericsson Mobility Report [4], there have been no major changes in uplink traffic ratios for the past two years but the proliferation of mobile photo and video uploads to social networking sites will increase the uplink traffic volumes in the future due to the fact that users do not only focus on viewing existing content but actively contribute in creating content such as uploading posts, pictures, and videos [4]. Nowadays, subscribers mainly share or stream live videos and engage with social networks. In addition, as subscribers increasingly create their own content, a rise in uplink data traffic volume has occurred. For example, during the 2016 Rio event, the uplink data traffic share was as high as 33% of total traffic in and around the event arenas [5]. This is significantly higher than normal.