QUALITY OF SERVICE PARAMETER CENTRIC RESOURCE ALLOCATION FOR LTE-ADVANCED

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Abstract

Efficient radio resource allocation algorithm is proposed in this paper. Proportional fair algorithm gives favorable performance compared to two classical algorithms max-C/I and RR. But PF algorithm does not consider QoS parameters while allocating resources to the users. Moreover with less transmission power utilization Fairness disappears in PF algorithm. A $PF_{QoS-Centric}$ is proposed in this paper. $PF_{QoS-Centric}$ gives better performance. In this proposed algorithm Data rate fairness and Allocation Fairness increase with increase in time jitter threshold values or increase in number of active users increases. Thus Data rate fairness and Allocation fairness is becoming more as compared to that of proportional algorithm. Here Throughput is also maintained during increase in fairness. QoS parameters like Data rate Fairness, Allocation Fairness Delay is most important for next generation of mobile communication. Propose Algorithm ($PF_{QoS-Centric}$) gives guarantee to satisfy the QoS parameters.

Keywords: Quality of Service (QoS), Packet scheduling, Proportional fair (PF), Radio resource allocation (RRA), Data rate Fairness, Allocation Fairness, Long term evolution-advanced (LTE-A).

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1. INTRODUCTION

The integration of wireless and internet communications and rapid development of next generation of mobile communications is expected to support the outburst of high-speed packet based application. These applications have large variety of QoS requirements. Radio resource Allocation faces challenges when come across such large variety of QoS requirements. This is because of Limited radio resources, rapidly changing wireless channel condition and ever increasing number of mobile users [1].

In this paper the QoS parameter is taken into consideration for the purpose of PF scheduling. This includes the required scheduling activity for a user to fulfill the QoS requirements. In this paper the scheduling for non-QoS users is also taken into consideration. Instead of selecting users based on the ratio of future data-rate to past achieved data-rate, here it is taken as the ratio of the minimum required data-rate to instantaneous throughput for that scheduling interval. For feasible load case it is satisfying the minimum required data-rate to the users demanding QoS services then providing access to users requiring non-QoS services, and for congested case it's maintaining the fairness to all users demanding QoS service with same relative degradation for all active users [2].

In this paper, it tries to maintain the QoS in terms of maximum tolerable latency. In this case the HoL delay is taken into consideration to take care of latency. And also buffer value is taken in to consideration, so that there should not be any loss of data for a user due to buffer overflow [3].

Mainly three techniques are used for resource allocation. These are Max-C/I, PF and RR. Examples of these three different scheduling behaviors for two users with different average channel quality are shown in fig 1(a), fig 1(b) and fig 1(c).
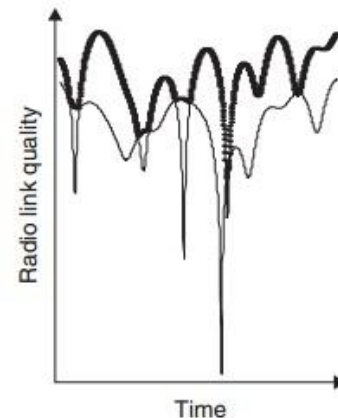

Fig -1(a): scheduling behaviors for two users with different average channel quality for max C/I. [5]

Allocating resources to the users with instantaneously best radio link conditions is known as MAX-C/I scheduling. The data-rate fairness disappears. Allocation of the resources among the existing active users in a manner, such that all the users will get access to equal amount of resources over certain duration of time The requirement of the user is not taken into consideration
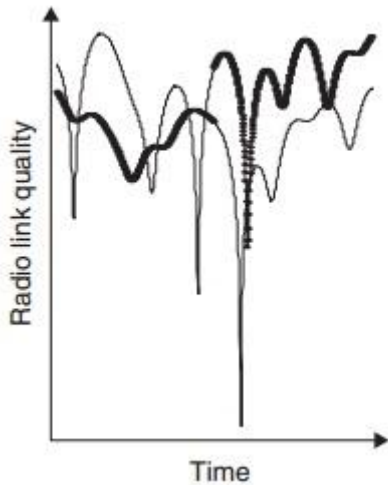
Fig -1(b): scheduling behaviors for two users with different average channel quality for RR. [5]
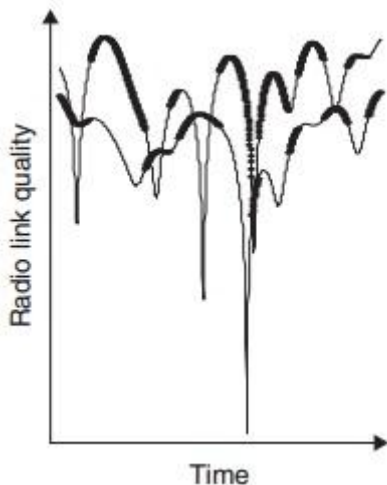

Fig -1(c): scheduling behaviors for two users with different average channel quality for PF. [5]

But among three Max-C/I and RR does not give optimum performances for throughput as well as QoS parameters. Moreover PF also gives poor performance compared to RR algorithms for Allocation Fairness.

In this paper problem formulation is to increase allocation fairness as well as data rate fairness and maintain other parameters. As the Fairness is one of the most important parameter among QOS parameters. Here we also study performance as the number of user increases.

The rest of paper is formed as follows. Section –II represents an idea about packet scheduler, section –III represents simulation algorithm and environment, section –IV represents simulation result and analysis, and section-V represents final conclusion.

2. PACKET SCHEDULING

In fig 2 a block diagram of packet scheduling is shown.

2.1 Scheduler

Here in the first stage the scheduler selects the schedulable users. The rest user will be inactive. This function is known as Schedulability check.
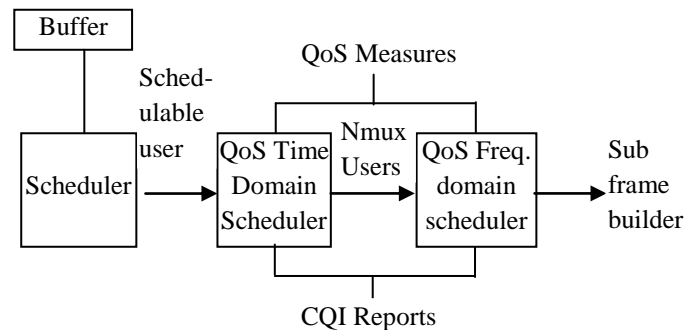

Fig -2: Block Diagram of Packet Scheduling. [3]

2.2 QoS Time Domain Scheduler

The time domain scheduler provides needed QoS, with regards of time jitter for packet delivery to the user. The users are splits into two classes according to delay is experienced by user. The users with time jitter value below the threshold time are grouped to in to class-1 and a prioritization is calculated according to formula given below.

$$Max_{LP} = \max\left(1, \frac{EBR(n)}{PR(n)}\right) \tag{1}$$

The users with jitter value more than threshold value are in class-2. Priority equation is

$$Max_{HP} = \max\left(Max_{LP}\right) + \max\left(1, \frac{EBR(n)}{PR(n)}\right) \tag{2}$$

Here, Max_{HP} is the priority metric of higher priority users (the users of class-2), Max_{LP} is the priority metric of lower priority users (the users in class-1). EBR(n) is the expected bit rate of user 'n' and PR(n) is the achieved past average bit rate over a certain time period.

2.3 QoS Frequency Domain Scheduler

In this algorithm selects users based on their priority value and assigns a resource so that user's throughput can be maximized. If sorted users do not have good channel condition then remaining users are taken into consideration. Thus it can be given chance to the users having higher EBR to access the PRBs to achieve throughput with higher priority and it can improve its throughput. It will help in maintaining the fairness, in terms of corresponding of required data-rate, among users.

3. SIMULATION ALGORITHM & ENVIORNMENT

Simulation algorithm and simulation environment are as follows.

PF$_{QoS-Centric}$ Algorithm

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1. Initialization: N=Number of users
2. If UE delay< Delay threshold
   Calculate Priority according to equation (1)
   Else
   Calculate Priority according to equation (2)
3. Sort all the users according to their priority value in decreasing order.
4. Select frist N_{mux} users according to the priority value who can be provided some data rate at particular time instance.
5. Select resource block of Maximum gain for particular user thus user throughput can be maximized and set allocation flag of that particular PRB to 1.
6. Repeat for N_{mux} users.
7. If some resource blocks are not allocated and sorted users do not have good channel condition then consider rest of the users for resource allocation.

The Simulation parameters are set according to the values specified by 3GPP-LTE [6]

Table -1: Simulation Environment

Parameter	Value
Carrier Frequency	2GHz
Delay Spread	0.001ms
LA per frame	1
Sub-frame duration	1ms
OFDM symbols per sub-frame	14
BW	5MHz
FFT size	512
MIMO	1X1
Target FER	0.1
Sub-frame duration	1ms
Inter Site Distance	1732mtrs
Number of active users	30 & 40
Mobility of the users	30kmph
Per user file size	2Mb
N_{mux}	10
Delay Threshold	5ms

4. SIMULATION RESULT AND ANALYSIS

In this paper, Outputs are compared for Classical PF and Proposed PF$_{QoS-Centric}$. Outputs also compared for Number of active users like 30 & 40. The other parameters consider for proposed algorithm are 5ms Delay, 1 X 1 MIMO, 1732mtrs Inter site distance, 2Mb Per user file size, 5MHz Band Width, 2 GHz Carrier Frequency, 14 OFDM symbols per sub-frame, 512 FFT size, 0.1, 1ms Sub frame duration, Target FER, 0.001ms Delay Spread, 30kmph Mobility of users, 10 N_{mux}.

Data Rate Fairness for Proposed algorithm is shown in fig-3. This new algorithm is still able to provide reciprocal data-rate fairness, among users, of about more than 80% with increase in time. This little fall in fairness is because of consideration of time jitter while scheduling. Though there is a drop in data rate fairness in case of new proposed scheme, this drop is not significant.
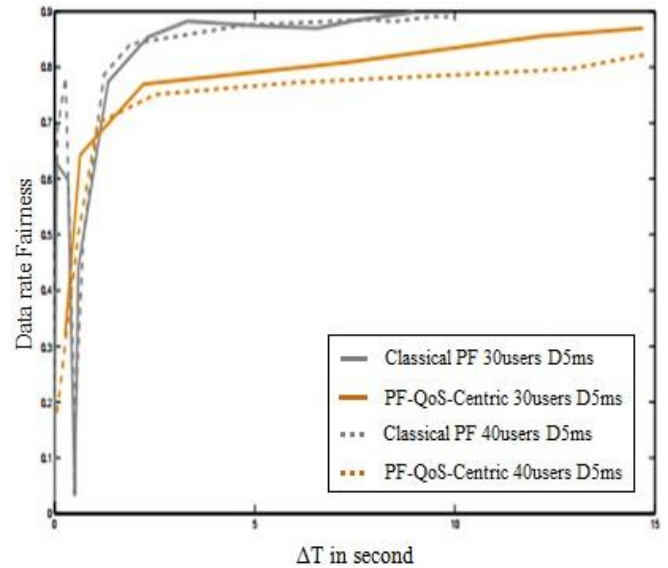

Fig -3: Data Rate Fairness

Allocation Fairness is shown in fig.4. The figure says that, in case of proportional fair, with increase in number of active users in the system the allocation fairness decreases. But in case of proposed scheme with increase in number of users in system the fairness in allocation is increasing. It is also clear from the figure that with increase in number of users in the system the allocation fairness is becoming more as compared that of proportional fair algorithm.
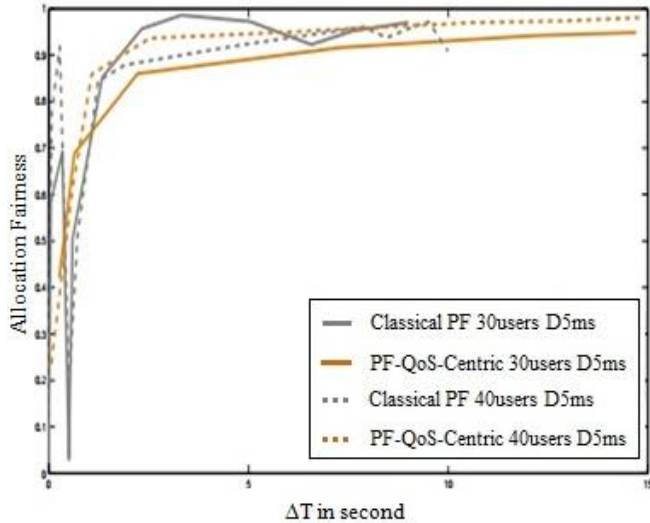
Fig -4: Allocation Fairness

5. CONCLUSIONS

Here we proposed such an algorithm which provides data rate allocation is more with increase in time. Proposed algorithm also gives better performance compared to proportional fair algorithm as increase in the number of users. Now a day QoS parameters are extremely important for next generation mobile communication. In this paper, QoS parameters are guaranteeing by the proposed algorithm (PFQoS-Centric)

REFERENCES

[1] Kausar, Y. Chen, K.K. Chai "QoS aware packet scheduling with adaptive resource allocation for OFDMA based LTE-advanced networks" in IET International Conference on Communication Technology and Application (ICCTA 2011),January 2011, pp. 207 – 212.

[2] Troels Emil Kolding, "QoS-Aware Proportional Fair Packet Scheduling with Required Activity Detection," in IEEE 4th Vehicular Technology Conference, 2006., Sept. 2006, pp. 1–5

[3] I. Z. K. P. E. M. G. Mongha, K. I. Pedersen, "QoS oriented time and frequency domain packet schedulers for the utran long term evolution," IEEE Vehicular Technology Conference, spring, 2008, 11-14 May 2008, pp. 2532 – 2536.

[4] Xiaoqiu Wang, Konishi S., Suzuki T," Multi-Layer Optimized Packet Scheduling for OFDMA-Based Cellular Systems" in IEEE Vehicular Technology Conference, 2009.April.2009,pp 1-5..

[5] J. S. P. B. Erik Dahlman, Stefan Parkval, 3G Evolution: HSPA and LTE for Mobile Broadband, 2nd ed. Academic Press, 2008, no. 2008931278.

[6] 3GPP-LTE,"LTE physical layer framework for the performance verification" Release 10, no.R1-070674, February 2007.

BIOGRAPHIES

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