CHAPTER VI

MODIFIED PROPORTIONAL FAIR FOR LTE FEMTO CELLS WITH EICIC

This chapter is the first topic of research, which presents the effect of interference cancellation on heterogonous LTE network where femtocells are randomly deployed in a macro networks. We propose modified proportional fair scheduling algorithm based on almost blank subframe (ABS).

In order for a UE to connect, it needs to first acquire the eNB and achieve synchronization. In LTE this requires reliable decoding of the acquisition signals and the primary broadcast channel, which carries the master information block (MIB). A baseline LTE UE can typically reliably decode these channels only if its geometry is above -8dB, where geometry is defined as the ratio of average long-term signal and interference power. All UEs with geometry below this value will experience outage and will not receive any DL throughput

In section 6.1, we showed the SIR achieved by macro UE, where indoor and outdoor users are displayed separately for different minimum acquisition, where minimum acquisition is defined as the minimum required geometry for initial acquisition. In section 6.2, we compared carrier to interference ratio between indoor and outdoor users with and without interference cancellation (IC). In section 6.3, we described the proposed proportional fair (PF) scheduling and compared with traditional proportional fair.

6.1 POWER CONTROL IN FEMTOCELLS

The transmit power level of a femtocell base station affects its coverage range and the amount of interference it generates in the network. Although higher femtocells transmit power can provide wider coverage and better signal quality, it can, at the same time, cause tremendous interference to other surrounding users of the adjacent macrocell networks. Properly selecting the femtocell base station transmit power level can help manage the interference from the femtocells to the macro-users, while maintaining femtocells performance. One of the conventional practices is by applying transmitter power control technique. It is widely adopted as it can mitigate the femto-femto (co-tier) as well as femto-macro (cross-tier) interference and increase the network capacity [53].

Figure 6.1 shows the SIR achieved by macro UEs, where indoor and outdoor UEs are displayed separately for different minimum acquisition (-inf (theoretical),-8 dB, and -18 dB (using ICIC) [25], figure 6.1 shows for different minimum. acquisition indoor MUE will be affected but outdoor MUEs are the same, so power control algorithm may be a way to improve performance of indoor UEs.

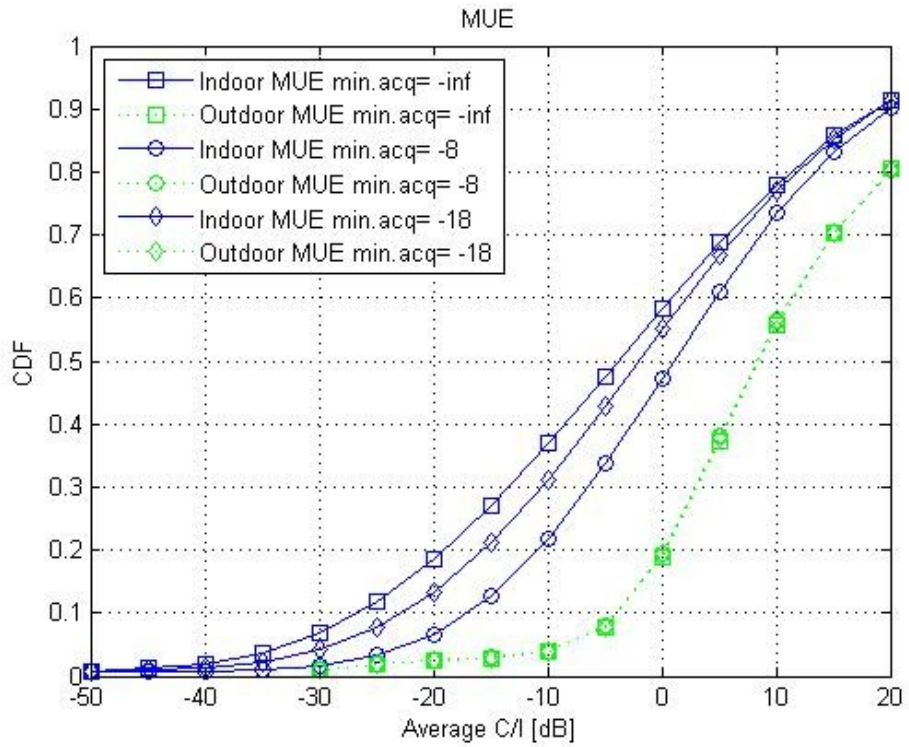

Figure 6.1.Average C/I for MUES

6.2 ALMOST BLANK SUBFRAME

Almost Blank subframes are part of Enhanced inter cell interference coordination (eICIC) framework [5] that the 3GPP members have proposed [19] as means to combat excessive co-channel cross-tier interference in heterogeneous network (HetNet) scenarios.

UE may be able to perform cell selection and acquisition, but it may still not be able to have any reliable data communication with the serving eNB if the geometry is very low due to interference on the data channels. One way to alleviate this issue is resource partitioning scheme for the data channel.

An exemplary resource partition scheme is the following: subframe resources are split among macro and femto cells to improve reliability of both the DL and UL data channels. In this particular example, which reflects the scenario considered in the subsequent throughput simulation results; macro nodes can use all subframes while HeNBs can use only half. This approach, which results in utilization of almost blank subframes (ABS), entails a throughput reduction for HeNBs due to the available resources being halved, but on the other hand allows macro UEs to penetrate deeply into femto coverage areas while still maintaining data communication with macro node, provided that the DL scheduler is aware of the subframes partitioning and the channel quality experienced by UEs on the different subframe types.

Figure 6.2 shows the effect of using Interference Cancellation (IC) on indoor and outdoor macro users. We conclude that average C/I of outdoor users doesn't change if interference cancellation exists or not.

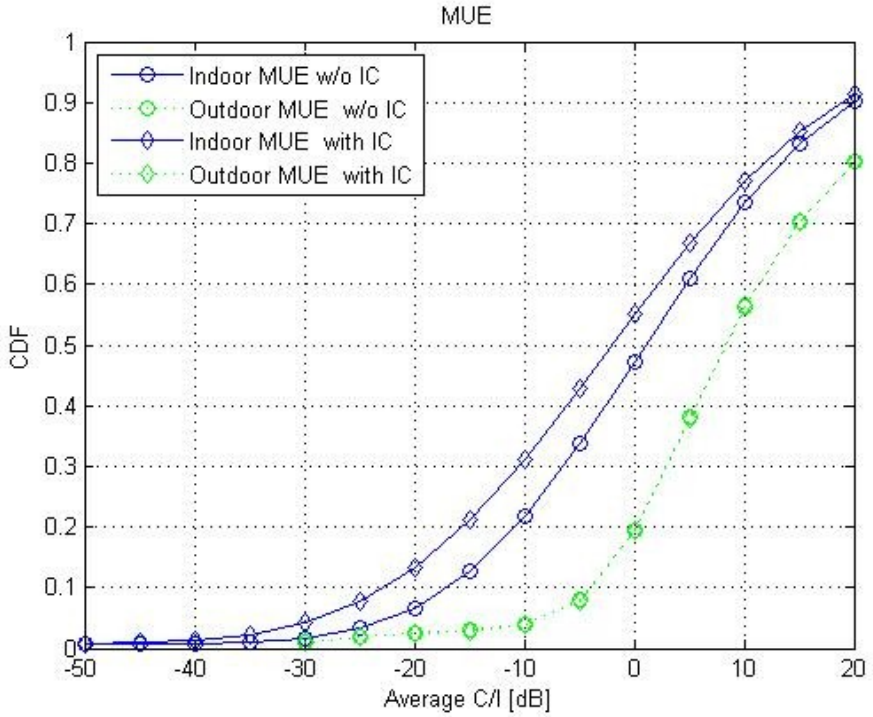

Figure 6.2 Average C/I of MUEs with IC

6.3 MODIFIED PROPORTIONAL FAIR WITH ABS

In our simulation, we divided UEs to three categories including:

- ✓ Indoor UEs: Users inside apartment.
- ✓ Far outdoor UEs: Users are far enough to be affected by HeNB interference.
- ✓ Near outdoor UEs: Near outdoor UEs are UEs which suffer high interference from HeNB due to near to building's wall.

Our proposed scheduling algorithm named Modified Proportional Fair (MPF) is concerning on near outdoor UEs which may have lower signal to interference ratio. The MPF aims to give users close to building more priority than users far from building which will be affected on two main parameters (user throughput and cell average throughput).We use the Almost Blank subframes to give priority to users suffering from HNB interference in half of subframes and

other users in other subframes. As described in previous chapter, in Almost blank subframe HNB is silent half of frame.

The modified scheduling algorithm proceeds as follows:

A) MUEs can be divided into three categories based on geographic locations of MUEs:

- Indoor MUEs
- Far outdoor MUEs
- Near outdoor MUES

B) In subframe which HNB are on, calculate SIR and give priority to far outdoor users depending on equation of PF.

C) In ABS subframe which HNB are silent, depending on previous SIR for indoor users and near outdoor users, we give priority to these users.

The goal of using MPF that allows users which have bad geometry to get throughput in better channel. Figure 6.3 shows the throughput performance of macro UEs in the considered scenario. It shows that the throughput of macro users when using modified proportional fair scheduling improves than using proportional fair scheduling.

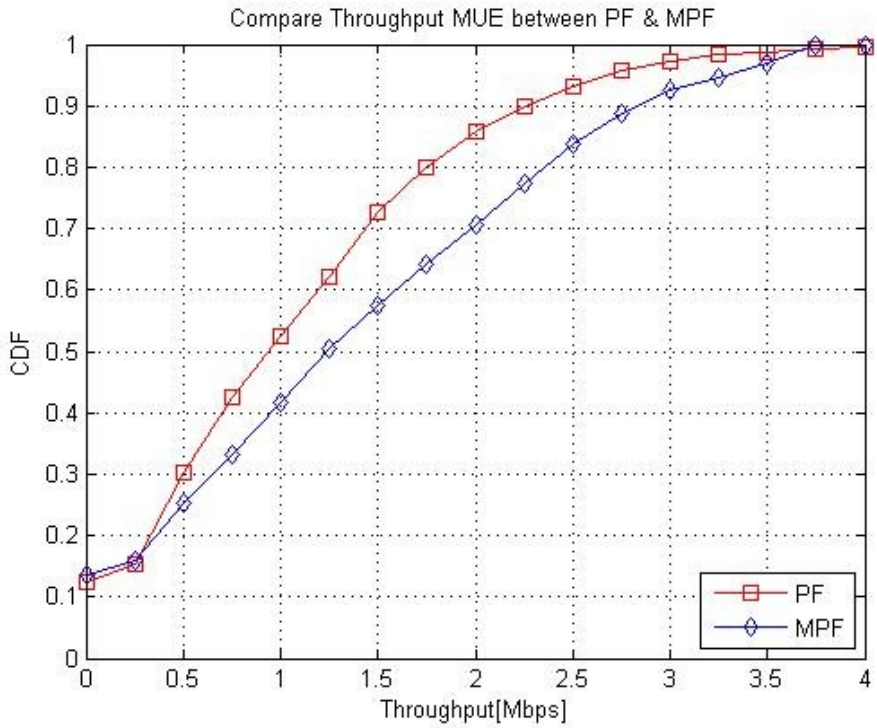

Figure 6.3 Comparison between PF & MPF

Figure 6.4 and 6.5 show the comparison the effect between MPF and PF on indoor and outdoor users.

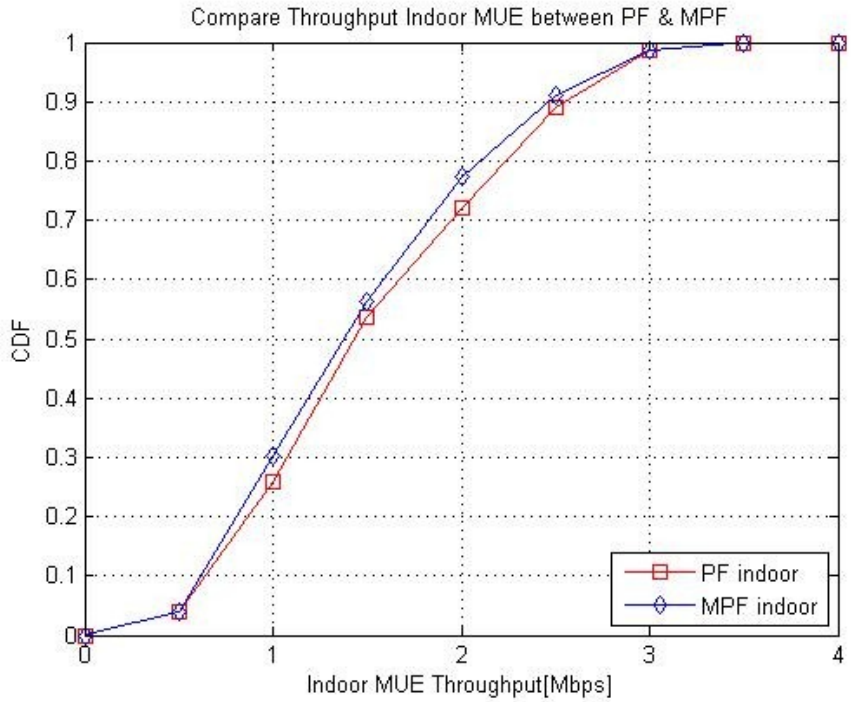

Figure 6.4 Comparison Indoor MUE throughput when using PF & MPF

It indicates that the throughput of indoor users doesn't change when using two scheduling algorithm because the modified proportional fair scheduling gives priority to near outdoor users or users near femto clusters, which suffer from interference.

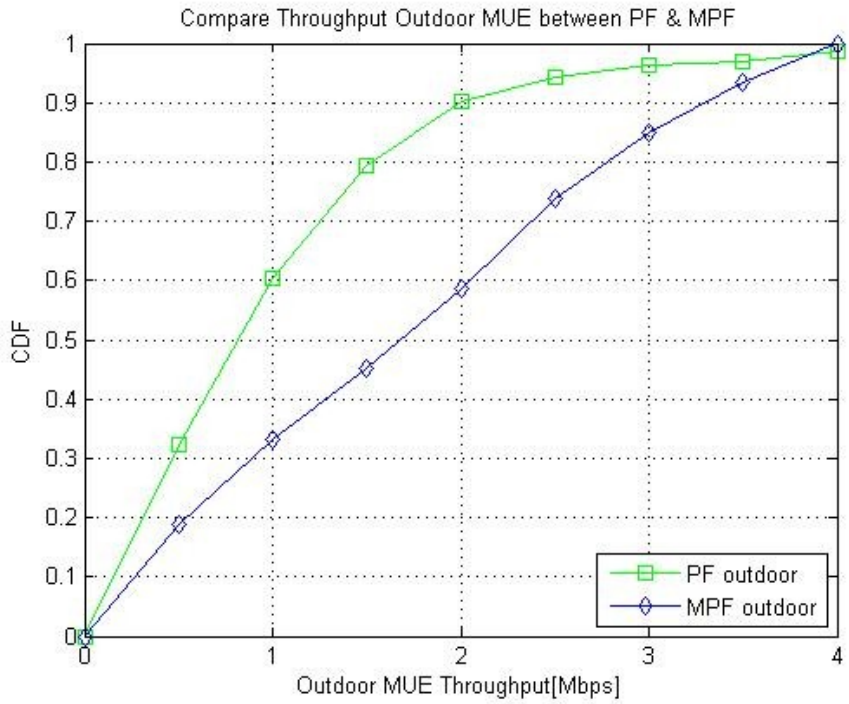

Figure 6.5 Comparison outdoor MUE throughput when using PF & MPF

It is observed that the performance improvement of user throughput when using MPF is in outdoor user while the throughput of indoor users doesn't change.