Interference Diminish and Edge Rate Improving Technology in CoMP LTE HetNets

A. Rubija and R. Devi

Abstract--- CoMPtechnique is included in LTE HetNetsto diminish the interference and also to improve the high data rate. CoMP is also another edge rate improving technology that is an MU-MIMO in DL. Our solution is achieved by using CS/CB, JP.

Keywords--- Long Term Evolution (LTE), Multi User-Multi Input Multi Output (MU-MIMO), DownLink (DL), Co-ordinated Scheduling (CS), Co-ordinated Beamforming (CB), Joint Processing (JP).

I. INTRODUCTION

From the beginning to now all network users expecting the high data rate access at any time, at anywhere without break. According to their needs wireless network introduces various methods to full fill their needs. Initially the macro cell split the frequency and shared with pico cell [1].

When one users using the frequency in pico cell when the UE moves to the edge it will transfer to the nearby pico cell. It is done to achieve the performance without stopping the service. At that time it just transfer the nearby cell without calculating the free frequencies and signal strength this will leads to the interference if it is not having enough frequencies and very low signal strength. To clear this problem we are going to use CS/CB, JP in DL. By using this method we are going to decrease the occurrence of interference.

The rest of the paper is organised as follows: section 2 represents DL Transmission. In section 3 contains 3.1 and 3.2, 3.1 describes ABS and 3.2 describes CSB. Section 4Our contribution, 4.1 contains CS/CB and 4.2 contains JP. Finally section 5 contains the conclude part.

A. Rubija, MPhil(Computer Science), Vels University, Chennai. E-mail:Rubiannadurai.a@gmail.com
R. Devi, Assistant Professor, School of Computing Science, Vels University, Chennai.

II. DL TRANSMISSION

In LTE it had 7 transmission modes in Release-8. Next to this they had 8 transmission modes in Release-9. In LTE Release-10 they hosted a TM 9 transmission mode. It helps to decrease interference between base stations to achieve high user throughput, high performance. The new TM-9 enables the enhancement of network capabilities and performance with minimum addition of overhead. TM9 is designed to combine the advantages of high spectrum efficiency (using higher order MIMO) and cell-edge data rates, coverage and interference management (using beamforming). Flexible and dynamic switching between single-user MIMO (SU-MIMO) and an enhanced version of multi-user MIMO (MU-MIMO)[2] is also provided. A new Downlink Control Information (DCI) format - known as format 2C - is used for TM9 data scheduling. Two new reference signals are defined in TM9: Channel State Information Reference Signal (CSI-RS) and Demodulation Reference Signal (DMRS). The first is used from the UE to calculate and report the CSI[4] feedback (CQI/PMI/RI). TM-9 is particularly smart as it can detect when a mobile device is being used and send a different type of signal that is optimal for a mobile device (variable DM-RS – demodulation reference signals). This maximises the efficient use of the base station and guarantee's a decent data rate for users.

III. TECHNIQUES USED IN DL (ABS AND CSB)

Almost Blank Subframes

In order to supportpico downlink transmissions, the macro eNodeBs can mute all downlink transmissions to its

UEs in certain Subframes termed ABS. these Subframes are called “almost blank” because a macro can still transmit some broadcast signals over these Subframes. Since these broadcast signals only occupy a small fraction of the OFDMA[3] subcarriers, the overall interference a macro causes to a pico is much less during these ABS periods. Thus, the pico can transmit to its UEs at a much higher data rate during ABS periods. Note that a pico is also allowed to transmit to its UEs during non-ABS periods. This could provide good enough performance to UEs very close to the pico.

RELAXED-ABS

User primal update : update the primal variables z(t) by using UE’s update given by

$$R_u(t+1) = \frac{w_u}{\lambda_u(t)}$$

Macro primal updates:

$$N_m(t+1) = N_{sf\ \{(\beta_m(t) - \sum_{p:m\in I_p} \mu_{p,m}(t) > 0)}$$

Where tries are broken at random. Macro m then chooses $x_u(t+1)$, uε u_m as

$$x_u(t+1) = \begin{matrix} N_{sf}, for\ u = u_m^* \\ 0, for\ u \neq u_m^* \end{matrix}$$

Pico primal updates: in iteration (t+1), for each pico p, we maximizeH_p (p_t,{y_u}u ε U_p, A_p) by choosing

$$A_p(t+1) = N_{sf\ \{(\beta_p(t) - \sum_{m:m\in I_p} \mu_{p,m}(t) > 0)}$$

$$y_u^A(t+1) = \begin{matrix} N_{sf,} for\ u = u_p^*\ (ABS) \\ 0, for\ u \neq u_p^*(ABS) \end{matrix}$$

$$y_u^{nA}(t+1) = \begin{matrix} N_{sf,} for\ u = u_p^*\ (nABS) \\ 0, for\ u \neq u_p^*(nABS) \end{matrix}$$

Dual update: for each UE u, $\lambda_u(t)$ is updated as

$$\lambda_u(t) \leftarrow [\lambda_u(t-1) + \gamma\left(R_u(t) - r_u^{macro}\, x_u(t) - r_u^{pico,ABS} y_u^A(t - r_u^{pico}\, y_u^{nA}(t)\right)]^+$$

For each macro m, we update its dual price β_m as follows:

$$\beta_m(t-1) \leftarrow [\beta_m(t-1) + \gamma(\sum_{u\epsilon U_m} x_u\ \ t) - N_m(t))]^+$$

For each pico p, we update all dual variables βp, αp and μp,m for all m ε Ip as follows:

$$\mu_{p,m}(t) \leftarrow [\mu_{p,m}(t-1) + \gamma(A_p(t) + N_m(t) - N_{sf})]^+$$

$$\beta_p(t) \leftarrow [\beta_p(t-1) + \gamma(\sum_{u\varepsilon U_p} y_u^A\ \ t) - A_p(t))]^+$$

$$\alpha_p(t) \leftarrow [\alpha_p(t-1) + \gamma\left(\sum_{u\varepsilon U_p} (y_u^A(t) + y_u^{nA}(t \quad - N_{sf})\right]^+$$

The optimal values of the NLP are obtained by averaging overall iterations

$$\hat{Z}_T = \frac{1}{T}\sum_{t=1}^{T} Z_t$$

Cell Selection Bias

Typically in cellular networks, when a UE device (UE) has to select a suitable cell for association, it chooses the one with maximum received signal strength. However, if the same strategy is extended to HetNetdeployments with both macro-and picocells, this could lead to underutilization of the picoeNodeBs. This is because picostransmit at very low power, and thus, unless a UE is very close to the pico, signal strength from the macro is likely to be larger for the UE. To overcome this, LTE standards have proposed a concept called cell selection bias that works in the following manner. Suppose the cell selection bias of celli is α_i. Denote by P_i the reference-signal received power (in dBm) from cell iasmeasured by a UE.Here, a cell could be a pico cell or a macro cell. Then, the UE associates with cell K such that

$$K = \arg\max_i P_i + \propto_i$$

Thus, by assigning larger (smaller) bias to picos compared to macros, one can ensure that the picos are not underutilized (overutilized). The bias values are broadcast by the cells to assist UEs make the right association decision.

IV. OUR CONTRIBUTION

To decrease the interference we are going to apply our methods in CoMP in LTE HetNets. CS/CB, JP with MU-MIMO in DL these methods are implemented in interfaces with the UE to reduce the interference among transmission layers.

Fig.1. shows the signal transmission based on CS/CB and JP and also shows the type included.

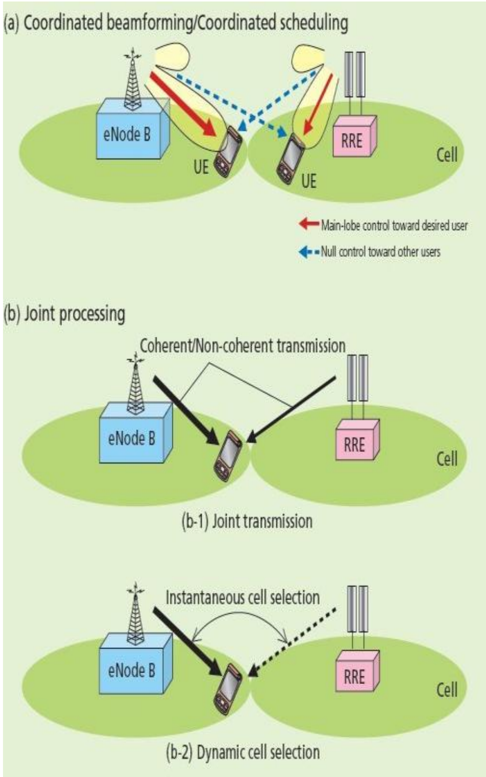

Fig. 1: CS/CB, JP

Co-ordinatedScheduling/Co-ordinated Beamforming

Scheduling and beamforming both used for scheduled transmit with reduced interference.

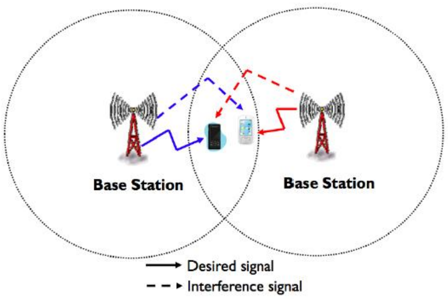

Fig. 2: Interference Signal

A CB[5] based on CSI sharing. It is designed for a system with two BSs and two MSs. Fig.2. describes how the precoders at both BSs should be choosen in order to avoid interference from Bs 1 to MS 2 and from BS2 to MS 1. To use it in a system with multiple BS and MS it was combined with scheduler as described below

Coordinated Beamforming scheduler: The concept of the scheduling algorithm is as follows:

9 dB range expansion for the PBSs is used. As a result there is only low interference from PBSs to macro MSs(MMSs) (because all MSs that receive a PBS with an acceptable power connect to it) but very high interference from MBSs to PMSs. Therefore the scheduling algorithm was designed in order to mitigate interference from MBSsto PMSs.

- One MBS cooperates with one PBS. The implementation of this cooperation is: Before assigning resources, the scheduler at the MBS triggers the scheduler for the PBS. The PBS scheduler can then decide if CBF should be applied and give corresponding constraints to the MBS scheduler.
- The scheduler at the PBS first calculates how many PBRseach MS should be assigned (round-robin fashion: each MS gets the same number of PRBs). For each PMSit is then analysed whether CBF is beneficial or not. For this purpose all possible combinations of two MSs, consisting of the PMS and one MMS each are formed. The CBF algorithm can be used for each combination to calculate precoders which mitigate the interference fromMBS to PMS and from PBS to MMS. The CBF algorithm does not suppress interference from other BSs than the cooperating one. Using the precoders, the SINR for PMS and MMS when using CBF can be estimated. This gives an indication about the estimated throughput. The same is done using the precoders for normal (not coordinated) beam

forming. By comparing the estimated through puts the decision on the usage of CBF is taken. The current implementation uses CBF if the sum through put of PMS and MMS is higher with than without CBF. If there are multiple groups with a gain when using CBF, the one with the highest sum throughput is chosen.

- When the PBS scheduler decided that CBF should be used for a group of PMS and MMS, the corresponding PRBs are reserved at PBS as well as MBS.

Joint Processing

JP used to co-ordinate many entities. It transmits or receives to or from UE's simultaneously[5]. It mainly focused to increase spectral efficiency. The transmission is coherent or non-coherent. It is classified in to two terms of co-operation i.e., JT-CoMP, DPS-CoMP

V. CONCLUSION

The implementation of MU-MIMO CoMP techniques and CS/CB and JP CoMP provides a great desirable throughput for cell edge user, optimal performance with reduced interference.

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