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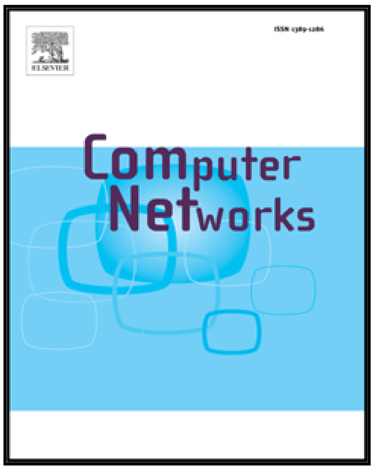

Dynamic Joint Processing: Achieving High Spectral Efficiency in Uplink 5G Cellular Networks

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Dynamic Joint Processing: Achieving High Spectral Efficiency in Uplink 5G Cellular Networks

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***Abstract*—Coordinated Multi-Point (CoMP) processing is a promising method to mitigate the intra-cluster interference and improve the average Signal-to-Interference-plus-Noise Ratio (SINR). Such method, however, cannot mitigate the inter-cluster interference and only changes the boundaries of interference from cell to cluster. On the other hand, since clusters in the traditional CoMP are static and all the spectrum is used in each cluster, we cannot avoid cluster-edge MSs. In this article, the problems of the current CoMP method are addressed and the reasons why clustering in CoMP should be studied jointly with spectrum allocation are discussed. Then, in the context of Cloud Radio Access Network (C-RAN), an innovative uplink solution—called Dynamic Joint Processing (DJP)—is proposed to mitigate both intra- *and* inter-cluster interference and to address the fluctuation in capacity demand. Two coexisting clustering approaches are presented based on the level of mobility of MSs: 1) in the *low-mobility* approach, *virtual clusters* are formed for each subband and their size is dynamically changed based on the position of the MSs; 2) in the *high-mobility* approach, a different set of subbands are assigned to different neighboring *hybrid cells* and the boundaries of frequency bands are dynamically optimized so to address the unanticipated change in capacity demand. Monte Carlo simulations confirm the validity of our statements and show the potential of our solution towards next-generation green communications.**

***Index Terms*—Cloud Radio Access Network; Interference Management; 5G; CoMP; Virtualization.**

I. Introduction

With the tremendous increase in demand for high data-rate wireless communications over the last few years, mobile operators have increased the number of Base Stations (BSs) and deployed smaller cells to enhance Spectral Efficiency (SE) and data rate. However, with smaller cells the interference problem becomes more challenging. Specially in the uplink, since the transmit antennas are omnidirectional, Mobile Stations (MSs) at the cell boundaries cause a large Inter-Cell Interference (ICI) to the neighboring cells. Hence, developing an advanced interference management techniques for the uplink is a crucial task in designing the next generation of cellular network.

The Coordinated Multi-Point (CoMP) transmission and reception technique is one of the major methods to mitigate the average interference and increase the SE [2]. In CoMP, a set of neighboring cells are divided into *static clusters*; within each cluster, a *fixed* set of BSs are connected to each other via the Back-haul Processing Unit (BPU) and exchange Channel State Information (CSI) as well as MS signals. Coordination of the BSs within a cluster can improve the overall Signal-to-Interference-plus-Noise Ratio (SINR). In the uplink, each BS receives a combination of MS signals from its own and from the other neighboring cells (see Fig. 1). By combining the CSI from different cells and sharing the received signals at the BPU, CoMP is thus able to cancel the intra-cluster interference.

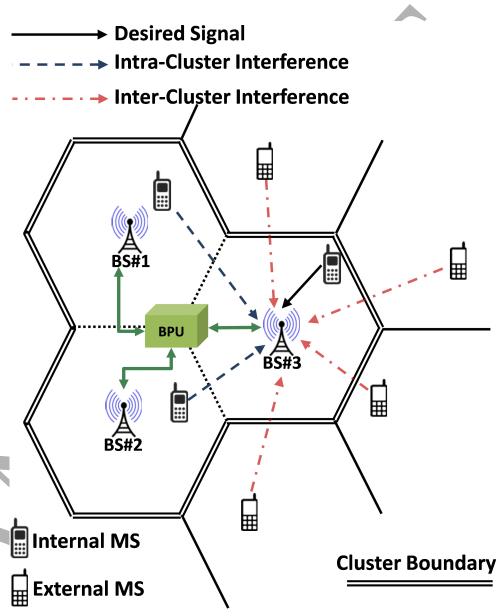

Fig. 1. Intra-cluster and inter-cluster interference in the uplink (we name the MS (BS) inside the cluster as *internal* MS (BS) and outside the cluster as *external* MS (BS)). In Coordinated MultiPoint (CoMP) processing BSs cooperate with each other and exchange data through Backhaul Processing Unit (BPU) in order to cancel the intra-cluster interference.

A. Our Vision

Although CoMP is able to reject the intra-cluster interference, it cannot mitigate the inter-cluster interference; hence, cluster-edge MSs can produce an intensive inter-cluster interference at the neighbouring BSs (see Fig. 1). In traditional CoMP, since only a fixed group of BSs are connected to each other and can exchange data, the cluster boundaries are set and cannot be changed. Consequently, CoMP cannot do any high data rate exchange among the clusters (as required to enable cooperative interference cancelation), and messages between clusters need to travel over costly backhaul links.

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