Resource Allocation Strategy for Comp Mu-MIMO 5G Network

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***Abstract*- Coordinated Multipoint (CoMP) in Long Term Evolution-Advanced (LTE-Advanced) improves the cell-edge data rates and the network spectral efficiency through base station coordination. In order to achieve high quality of service (QoS) in CoMPnetwork, resource allocation approach is one of the main challenges. The resource allocation strategies of cells in CoMP network affect each other's performance. Thus, the resource allocation approach should consider various diversities offered in multiuser wireless networks, particularly in frequency, spatial and time dimensions. The primary objective of this research is to develop resource allocation strategy for CoMP network that can provide high QoS. The resource allocation algorithm is developed through three phases, namely Low-Complexity Resource Allocation (LRA), Optimized ResourceAllocation (ORA) and Cross-Layer Design of ORA (CLD-ORA). The LRA algorithm is a three-step resource allocation scheme that consists of user selection module, subcarrier allocation module and power allocation module which are performed sequentially in a multi-antenna CoMP network. The proposed ORA algorithm enhances throughput in LRA while ensuring fairness. ORA is formulated based on Lagrangian method and optimized using Particle Swarm Optimization (PSO). The design of CLD ORA algorithm is an enhancement of the ORA algorithm with resource block (RB) scheduling scheme at medium access control (MAC) layer. Simulation study shows that the ORA algorithm improves the network sum-rate and fairness index up to 70% and 25%, respectively and reduces the average transmit power by 41% in relative to LRA algorithm. The CLD-ORA algorithm has further enhanced the LRA and ORA algorithms with network sum-rate improvement of 77% and 33%, respectively. The proposed resource allocation algorithm has been proven to provide a significant improved performance for CoMP LTE- Advanced network and can be extended to future 5G network.**

***Index Terms*- CLD ORA, CoMP network.**

I. INTRODUCTION

The Third Generation Partnership Project (3GPP) Long Term Evolution (LTE)-Advanced is envisaged as the fourth generation cellular standard, and is aligned with existing third generation deployments, e.g., Universal Mobile Telecommunications System (UMTS). The goals of LTE-Advanced are to improve the peak throughput by increasing the numbers of transmit and receive antennas. One of the key enabling technologies of LTE-Advanced is coordinated multipoint (CoMP) that targets to improve the cell-edge performance as well as overall network spectral efficiency through base stations (BSs) coordination.In this thesis, resource allocation algorithm for CoMP LTE-Advanced network that provides high QoS while is proposed. The proposed algorithm takes advantage of frequency, spatial and time diversities in the time-varying wireless channel to increase the CoMP network performance.

II. 5G NETWORK

5G network is very fast and reliable. The concept of hand held devices is going to be revolutionized with the advent of 5G. Now all the services and applications are going to be accessed by single IP as

telephony, gaming and many other multimedia applications. As it is not a new thing in market and there are millions of users all over the world who have experienced the wireless services wireless technology. It is not easy for them to shrink from using this new 5G network technology. There is only need to make it accessible so that a common man can easily afford the profitable packs offered by the companies so that 5G network could hold the authentic place. There is need to win the customer trust to build fair long term relation to make a reliable position in the telecommunication field. To complete with the preceding wireless technologies in the market 5G network has to tender something reliable something more pioneering. All the features like telephony, camera, mp3 player, are coming in new mobile phone models. 4G is providing all these utility in mobile phone. By seeing the features of 4G one can gets a rough idea about what 5G Networks could offer. There is messenger, photo gallery, and multimedia applications that are also going to be the part of 5G. There would be no difference between a PC and a mobile phone rather both would act vice versa.

III. SYSTEM DESCRIPTION

The main goal of the work is to develop resource allocation strategies for CoMP LTE-Advanced network that provides high QoS. The resource allocation approach should be able to take advantage of diversities offered in multiuser wireless networks, specifically in frequency, spatial and time domains. In order to achieve the main goal of the work, the specific objectives of the research include:

i) To develop low-complexity resource allocation algorithm that can achieve high throughput.
ii) To develop optimized resource allocation algorithm that can improve network throughput while ensuring fairness.
iii) To include cross-layer design (CLD) in the proposed optimized resource allocation algorithm to further enhance network performance.

The low-complexity resource allocation algorithm is assumed suboptimal since it gives reasonable network performance using simple algorithm. The resource allocation takes advantage of frequency, spatial and time diversities to benefit additional network improvement. The optimized resource allocation algorithm tries to achieve high network throughput while ensuring fair allocation among users. The CLD approach employs prioritize scheduling in the optimized resource allocation.

The proposed algorithm allocates system bandwidth and power among users in multi-antenna CoMP LTE-Advanced network. The work exploits diversities in different domains, specifically in frequency, spatial and time available at physical layer and MAC layer. Furthermore, cooperative communications such as CoMP efficiently take advantage of the broadcasting nature of wireless networks. The basic assumption is that BSs in CoMP network share useful information such as CSIs and data streams, form a virtual antenna array thus providing diversity that can significantly improve system performance.

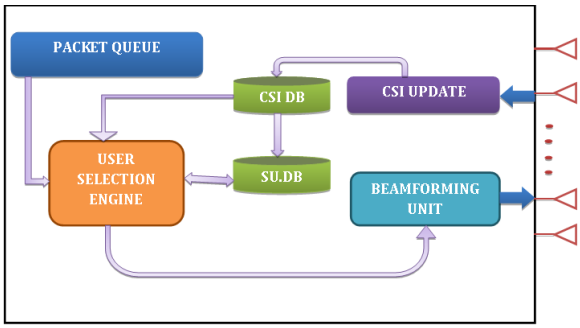

Fig 1: Block Diagram

To accomplish these LTE-Advanced requirements, several principle enabling technologies have been included in LTE-Advanced as presented in Figure. The enabling technologies are carrier aggregation, enhanced downlink spatial multiplexing, relay deployment, CoMP transmission and support for heterogeneous networks. Carrier aggregation allows several carriers to be aggregated either contiguously or non-contiguously to provide bandwidth extension. This provides a significant increase in the peak data rate, allows efficient interference management and supports heterogeneous deployment. Enhanced downlink spatial multiplexing extends the number of simultaneous data streams from four to eight. Relaying technique extends the network coverage area, hence improving the cell-edge performance. On the other hand, CoMP enhances the cell-edge data

rates as well as the overall network data rates through base station (BS) coordination. Heterogeneous networks comprise of a traditional macrocell-based network augmented with various types of low-power nodes that address the capacity and coverage challenges resulting from the growth of data services.

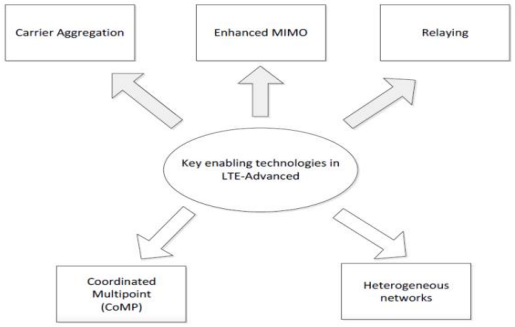

Fig2: The principle enabling technologies in LTE-Advanced

The capacity of a MIMO system employing transmit and receive antennas can be improved by the factor of min. Interestingly, it can be realized without using extra transmission power or bandwidth. MIMO systems have been actively studied and successfully implemented for the emerging broadband wireless access networks. Two types of downlink MIMO transmission techniques are supported; diversity techniques and spatial-multiplexing techniques. The diversity techniques intend to improve the transmission reliability by transmitting the same data stream from multiple antennas. Meanwhile, spatial multiplexing can be used to support multi-user MIMO, whereby multiple data stream are simultaneously transmitted to different users using the same time-frequency resource.

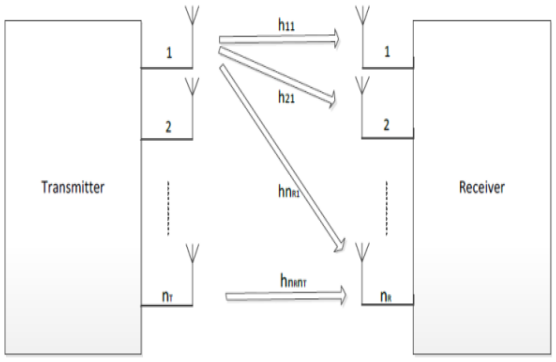

Fig 3: MIMO system

Given that hnRnT is the channel gain from transmit antenna to the receive antenna, the channel for the MIMO system, is written as:

$$H_{n_R \times n_T} = \begin{bmatrix} h_{11} & h_{12} & \cdots & h_{1n_T} \\ h_{21} & h_{22} & \cdots & h_{1n_T} \\ \vdots & \vdots & \cdots & \vdots \\ h_{n_R 1} & h_{n2} & \cdots & h_{n_R n_T} \end{bmatrix}$$

Among the key challenges encountered by wireless communication systems designers are fading and interference. Fading limits the coverage and reliability of any point-to-point wireless connection, meanwhile interference restricts the reusability of the resource. The conventional multi-user MIMO forms a MIMO interference channel. Its spatial degrees of freedom are defined by the number of transmit antennas at each BS. If several BSs form a cooperating cluster, the network can have additional spatial degrees of freedom. This concept known as cooperative MIMO, network MIMO, virtual MIMO or CoMP which offer substantial performance gain and becomes an attractive research topic in wireless communication.

Recently, CoMP technology has been proposed in 3GPP LTE-Advanced as a promising way to boost the system spectrum efficiency and the cell-edge performance. Downlink CoMP implies dynamic coordination among multiple geographically separated transmission points or base stations (BSs). The backhaul link allows the exchange of information which is used to coordinate the BS transmissions such that interference generated to neighboring cells is minimized. In other word, the backhaul link is used for radio resource management (RRM) purposes including ICIC. Two schemes are adopted in downlink CoMP transmission; joint processing (JP) and coordinated scheduling/ beamforming (CS/CB).

JP is classified into joint transmission (JT) and dynamic cell selection (DCS). In the CoMP (JT) transmission scheme, multiple BSs in the network cooperatively transmit signals to a user-end terminal (UE). The main idea of this class of transmission scheme is either to improve the received signal

quality or actively cancel the interference to other UEs, or both. Data intended for a UE is shared and jointly transmitted from all BSs in the CoMP network and the received signals at the UE will be coherently or non-coherently added up together.

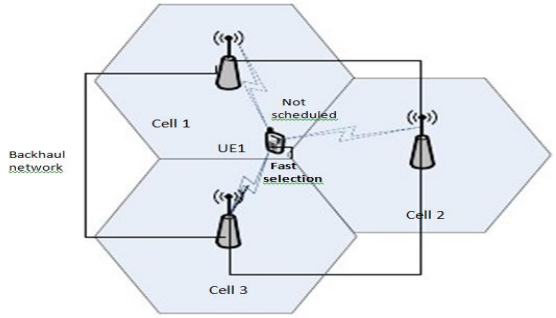

Fig 4: Downlink CoMP (DCS) transmission

In CoMP (CS/CB), data packet transmission for a UE is executed from one BS in the CoMP network. However, user scheduling/beamforming decisions are coordinated among the BSs involve in the network. Transmit beamforming weight for each UE reduces the undesirable interference to other UE. As a result, the celledge performance can be improved. A number of research studies have been conducted in this area.

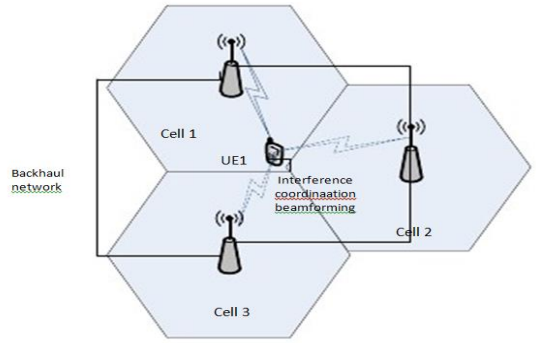

Fig 5: Downlink CoMP (CS/CB) transmission

IV. RESULTS

In this project we proposed two resource allocation approach such as Joint Processing (JP) and Cooperative Beamforming (CBF) and their performance with single user and multiple user, with various diversities are analyzed under following four situation.

1.BER for un-coded errors
2.BER for un-coded errors with no interference
3.BER for coded errors
4.BER for coded errors with no interference

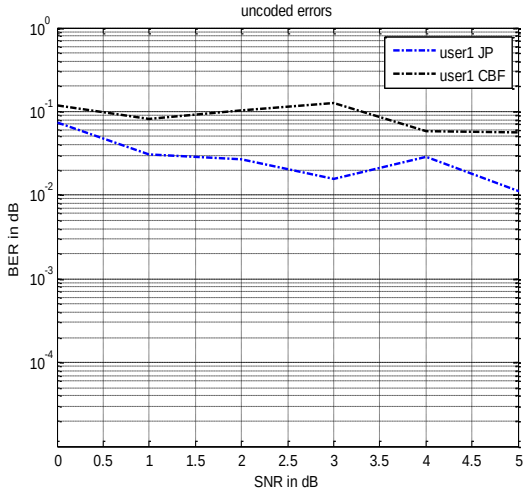

Fig 6: BER for un-coded errors

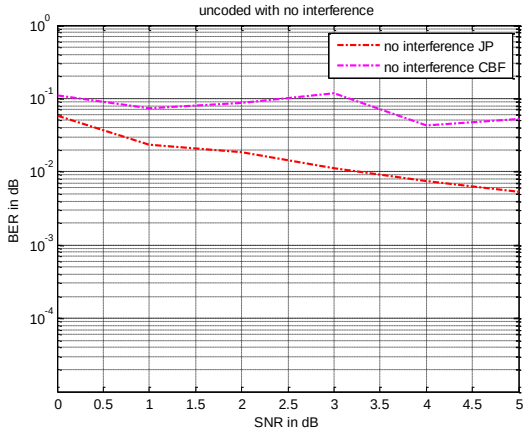

Fig 7: BER for un-coded errors with no interference

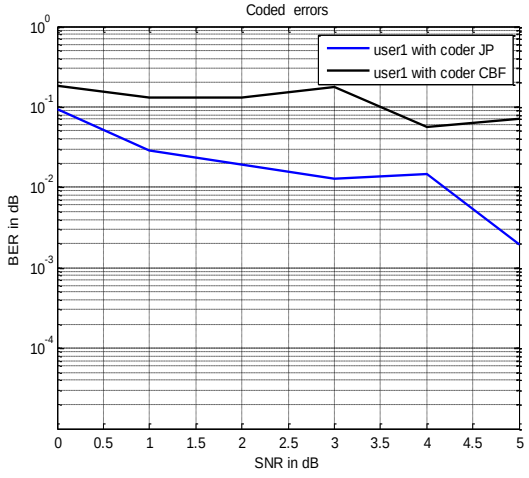

Fig 8: BER for Coded errors

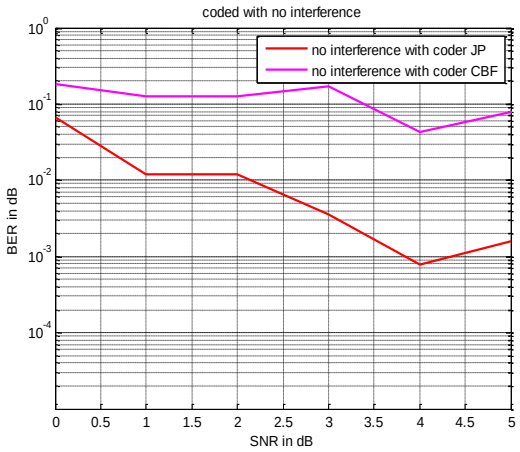

Fig 9: BER for coded errors with no interference

In this research work we developed two method (JP, CBF) resource allocation strategy for CoMP network that can provide high QoS. The JP algorithm with no interference has the improvement in BER of .001dB compared to CBF of 0.1 dB at the SNR is at 4 dB. The proposed resource allocation algorithm has been proven to provide a significant improved performance for CoMP LTE-Advanced network and can be extended to future 5G network.

V. CONSLUCTION

In wireless systems, interference is a major factor that limits the total network capacity. In this work, the allocation of system bandwidth and power among users in the network are coordinated such that the interference generated to other cells is minimized. This is also known as inter-cell interference coordination (ICIC), which is able to increase the overall network throughput.

The proposed optimized resource allocation that exploits CLD approach can also be adopted in multi-cellular network such as multi-tier mesh WiFi network. However, the mesh nodes (base stations) should be able to coordinate among themselves. The proposed algorithm is also applicable in highly dense populated cellular network as it is able to achieve high throughput performance while ensuring fairness. There is a scope of further improvement in terms of complexity/gain trade off , can be achieved by introducing dynamic CoMP clustering method , this also optimize load balancing, backhaul limitation, energy efficiency and spectral efficiency simultaneously, this could improve the future stages and the final outcome.

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