Power Allocation for Wireless Networks to ReduceInter-Cell Interference

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Abstract

This paper describes about the optimized power allocation process for next generation OFDMA wireless network. In order to achieve optimal power allocation to the edge celland center cell users, the proposed scheme consistsof power allocation process with QAM modulationtechnique. This technique reduces the inter-cell interference (ICI) and the path loss of the radio resource by implementing the greedy power algorithm .This achieves a better throughput thanstate of the art techniques. The radio resources aredistributed to the edge cell users with a higher order form of QAM, thereby reducing the fading and shadowing effects of the signal. Hence this powerallocation process and QAM results in betterperformance to the edge cell and center cellutilizers with power retention of the radio resources.

Index Terms— OFDMA, QAM, resource allocation, inter-cell interference

I. INTRODUCTION

An approach known as optimal resource allocation is committed towards the issues that the terminals may agonize from appropriately high inter-cell interference and performance of multicellular OFDMA networks is very low. In OFDMA network optimal resource allocation is used and the low complexity graphic frame work isconstructed which minimizes the impact of ICI in the system. An insatiable algorithm was developedin a system in favor between cell-edge and cell-center users. To optimize this approach, it varies afine subcarrier condition.

Subcarrier assignment is a solution that provides resource allocation to a problem of individual allocation of power. In spite of using global optimization, here we concentrate on employing allocation of power to balance the cell edge user's performance that is key point in attaining high performance in all the networks. Moreover, centre-cell users achievement is taken into consideration for this problem. Therefore, optimization between cell-edge and cell-center users is achieved.

Here, we assess the achievement of the above discussed scheme to understand about a wireless cellular network. These methods are computed by considering various aspects in terms of distribution of users which is not even and different loads of traffic. Simulations are extended to understand thatthe discussed method provide better performance for cell-edge and cell-center users in comparison with that of methods that are already existing.

Below figure shows a mode of an OFDM channel that contains different modulated carriers that are placed closely. For example, a Voice modulation is given to a carrier, there may present the sidebands on both the sides. Receiver needs to receive a signal without distortion to demodulate the data. So, when these signals are transmitted weshould take care of the spacing between the signals which will be identified by the receiver and separate them by employing a filter. Also, guard band should present between them and it is not thesame in OFDMA. Here, sidebands are placed on one above the other another. But they will recive the signals withoou interference because of orthogonality of signals.

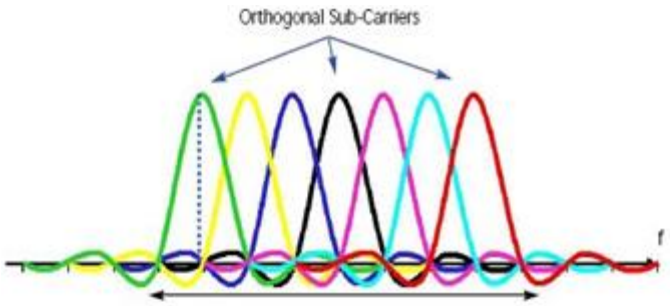

Fig 1: OFDM Channel model

The above figure has a set of demodulators, moving them to DC. The signal that is resulted is integrated to produce data from those carriers. Also, others signals are demodulated by the same. Here, we does not have contributions from interference.
OFDMA needs RF amplifiers in the final stage of the input side to control the signal peaks during the low average power that heads towards inefficiency. But in some systems they are less.

Also the OFDMA systems rely on error correction techniques to eliminate the disturbance that is introduced.

II. SYSTEM MODEL

Here, we consider a downlink network dependent on a multi-cell OFDMA. Below figure shows seven hexagonal cells outlined which is observed while BS placed at the centre is employed with antenna which is transmitting information in all the directions to provide service to the users.

OFDMA is the one in which the spectrum is classified into many sub carriers. Generally, a radio channel used to transmit information is referred to as traffic bearer.

Traffic bearer is a physical resource block in LTE that contains twelve sub carriers which areplaced sequentially in a single time slot. So, we aregoing to use PRB for a radio channel.

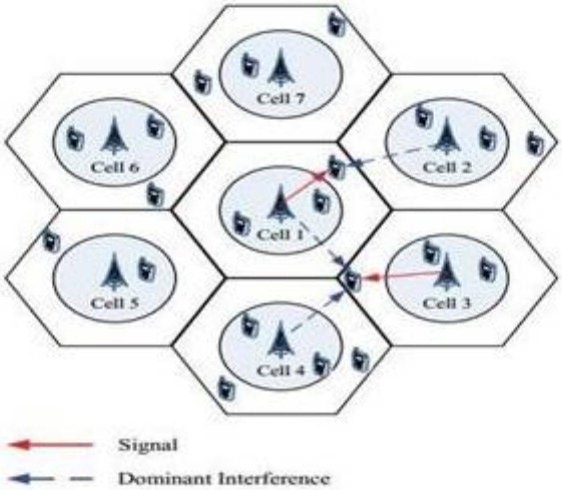

Fig 2: An Example of LTE Network with inter cell interference

Every cell has users which are divided as cell-center or cell-edge users based on their location and distance from BS. The location of theuser is known to the BS when they are transmittinginformation to the BS (UPLINK). Each transmission time interval in every BS takes a decision on the assignment of the PRB. Now, the duration is same as PRB's single time slot.

Power allocated to individual user is

Adjacent cell interference is referred to as inter-cell interference to each cell. In any cell-edgeuser there will be an interference dictated from the adjacent cell itself. Every cell-centers will have two interfering cells around them.

III. ISSUES IN POWER ALLOCATION AND ICI

The main aim is to improvise throughput ofeach and every cell centers by managing the throughput needed for cell-edge users. Therefore, balance between cell edge and cell-center users is approximated to be attained in the system. This user does not bother about ICI and generates good performance. But cell-edge users undergo more ICI and their improvement in the performance is due to only employing of optimization schemes.

Cell-edge users tolerate interference because of less distance to the BS's which are adjacent.

- Users are connected mutually in the same cell.
- The connection between the users is established as a pair with one of the supreme cells that are interfering.

IV. POWER ALLOCATION APPROACH

In the allocation of radio channel, allocation of power is identified independently in every cell. These are performed in a distributed way by BSs. Hence, here a distributed power allocation approach is employed based on cell-edge user's optimization of performance.

A. Overall Power Distribution

Transmission power of every cell is dividedin two pieces. Power distributed to cell edge users and cell center users. In Cell j, consider PEj represents the allocation power of cell edge users and PCj represents the allocation power of cell center users. The total power allocated is Pmax andit is given by the summation of PEj and PCj, Pmax
= PEj + PCj and it is approximated that Pmax is similar for each and every BSs.

independent on every PRB that is given to the endusers. Therefore, dynamic or fixed allocation of

$$P_{max} = P_E^j + P_C^j$$

power is done based on the methods used. Overall allocated power will not go beyond the BS maximum power.

$$P_E^j / P_C^j = \alpha \cdot |B_C^j| / |B_E^j|$$

Here, B_C^j represents PRB of cell-center and B_E^j represents PRB of cell-edge. Also, α ranges between 0 and 1 represents the factor identifying the higher weight.

Line of Sight Path Loss (the losses occurs in lineof sight with short and long range of signal transmission)

B. Power Allocation model for Cell-centerUsers

The main purpose of the cell- edge user's isto maximize its performance and vice- versa for cell-center users, even though their importance is more. Hence, we go for evaluating the allocation of power to cell-center users by distributing them uniformly to the PRBs employed in a particular cell.

C. Power allocation model for cell-edge users

Considering fixed allocation of PRB and allocation of power to the cell center users, problem here outcurves the allocation of power to the cell- edge users and classified into small problems.

V. STIMULATION RESULTS

A. STIMULATION OF PATH LOSS

The path losses can be categorized into three types 1.Free Space Path Loss (the datalosses occurs during the time of signal transmission and reception)

The equation for FSPL is

$$FSPL \quad =(4\pi d/\lambda)^2$$

$$=(4\pi df/c)$$

FSPL represents the path loss of free space.

d represents the distance from transmitter toreceiver.

λ represents wavelength of the signal.

f represents frequency of the signal.

2. Non Line of Sight Path Loss **(**The receiver is unable to get full strength of signal due to blocking of buldings ,trees,etc…,**)** fig 3 shows the comparison of three path losses.

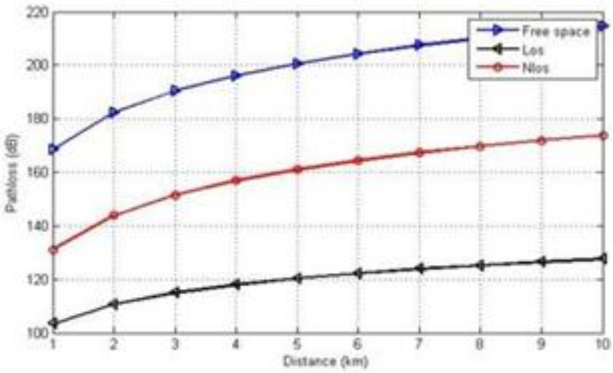

Fig 3: comparison of free space, Los, NLos

The TABLE I shows the transmission ofdata with particular frequency. Before the signal reaches the receiver end with a loss of data and thesignal loss is much less in line of sight and it is measured in decibel (db)

TABLE I
comparison of path losses

TYPES OF LOSSES	DISTANCE (KM)	FREQUENCY (hz)	LOSSES (db)
FSPL	2 5 10	900 900 900	183 200 215
LOS	2 5 10	2000 2000 2000	111 120 126
NLOS	2 5 10	2000 2000 2000	144 161 174

B. SIMULATION RESULTS FOR CELL USERS

TABLE II shows the stimulation parameter of cell edge users and cell centre users and modulation schemes

TABLE II SIMULATION PARAMETERS

Parameter	Value
FFT SIZE	
Cell centerCell edge	70
NO.OF.DATA	100
subcarriers	
Cell centerCell edge	114
power allocation α	114
(0<α<1)	
Cell centerCell edge	0.5
LOS path loss model	1.7
NLOS path loss model	103.4+24.2log10(d)dB,d in km131.1+42.8log10(d)dB,d in km
Channel model	Rayleigh multipath modelOFDMA
Modulation	BPSK,4,16,64QAM
Modulation schemes	

The proposed power allocation technique and 64 QAM modulation technique will produces better throughput by reducing the inter-cell interference and signal losses constantly
By this scheme of allocation and modulation methods, a better throughput can be achieved forboth edge cell and center cell users. The CDF (cumulative distribution function) of throughput comparison of different schemes is depicted in fig.4

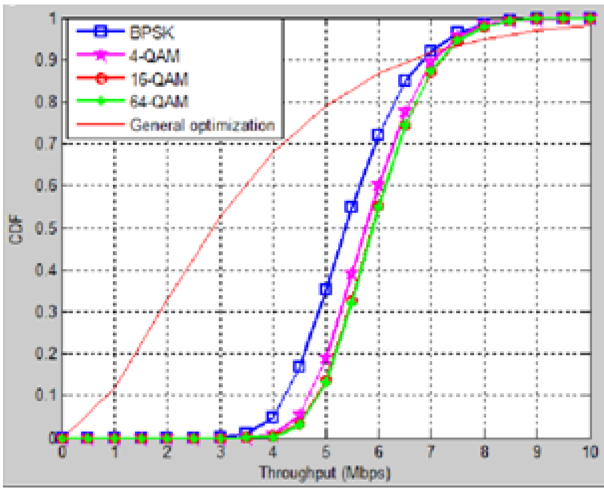

Fig 4: Cell-edge user performance

In this power allocation method, the edgecell users are served with data transmission throughput rate of 3.5 to 4.5 Mbps as shown in fig.4. The cell center user can also able to get 2.5 Mbps data transmission throughput rate as shown in fig.5. Compared to general optimization techniques, the proposed technique can provide an optimized power and coverage to the edge cellusers and greatly reduces the interference of the neighboring cells at the edge.

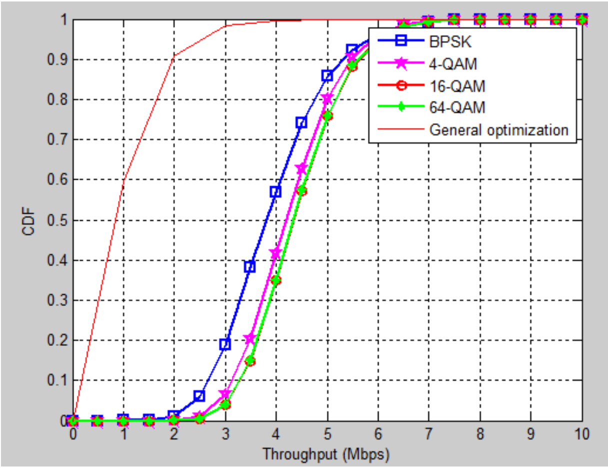

Fig 5: Cell-center users performance

As this proposed greedy algorithm employs the 64 QAM modulation, the ICI between the center cell users and the edge cell users gets reduced. The data transmission throughput rate of 2.5 mbps can be achieved for the center cell users, which is comparatively higher than that of transmission rate of 1.8 mbps of existing BPSK modulation.

VI. CONCLUSION

This power allocation and QAM modulation scheme for multicellular OFDMA technique, reduces the power conflicts between cell center andcell edge users within the cell served by a single BS. This scheme further provides a good performance by reducing the ICI and interference of neighboring cells

By this new approach a better throughput isachieved for both the edge cell and center cell users.

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