International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682
Vol.6, No.6, June 2017 DOI:10.15693/ijaist/2017.v6i11.500-504

Resource Allocation in an Efficient Manner for the Next Generation Wireless Cellular Systems

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Abstract: In mobile communications an efficient utilization of the channels is of great importance. In this project we describe the basic principles for obtaining the maximum utilization and study strategies for obtaining these limits. In general a high degree of sharing is efficient, but requires service protection mechanisms to guarantee the Quality of Service for all services. In this we address the multi cell interference on overall radio resource utilization and propose a new strategy for resource allocation in multi cell systems. Here we propose a concept of Load Matrix (LM) between the cells for allocation of radio resources. Simulation results verify that significant improvement in the resource utilization and to overall network performance.

Keywords:- Resource allocation, scheduling, interference management, QOS.

I. INTRODUCTION

With growing demand for wireless communications, advanced mobile cellular systems have evolved in many countries including in Europe, America, Korea, Japan and China. The maximization of revenue per bandwidth is one key factor for emerging systems given the limitation of radio resources available. On the other hand, customers demand more bandwidth and higher data transmission rates in order to support multimedia contents and real-time services. In order to satisfy this demand, efficient resource allocation and scheduling must be adopted to maintain the reasonable QOS and to increase the spectrum utilization. Wireless channel condition is affected by many factors such as fading, shadowing and interference which degrade the quality of the signal and cause delay. These factors will eventually affect the total capacity of the system. In addition, two forms of interference i.e. inter-cell interference that occurs between cells and intra-cell interference caused by own users can be distinguished. In order to achieve efficient resource utilization in all sorts of deployment scenarios and QoS requirements in the future wireless cellular systems, new resource allocation methods must be developed. In other words, resource allocation has to provide optimum or near optimum, for practical reasons, utilization of the available radio spectrum in the next generation of cellular wireless systems regardless of deployment scenarios and conditions. However, optimum point has to e found before considering the implementation practicality. Importance of resource scheduling was appreciated with the support of high data rate services in the evolution of UMTS Standard [Re199] to High Speed Downlink Packet Access (HSDPA) and Enhanced Uplink. Assessing the quality of resource allocation, one can distinguish two types of merits, One is overall throughput i.e. summation of cell capacity achieved in the system. The other is fairness amongst users in terms of offered transmission opportunities, where the location of user is likely to be distributed in a uniform manner over the whole network and the network controller needs to maintain the service level agreement. The trade-off between throughput and fairness is very important in a scheduling algorithm. One of the main objectives in resource allocation and scheduling is to comprise available resources and constraint elements in an efficient way. It is shown in that finding scheduling algorithms have different objectives. Their performance depends also on the deployed system and the environment characteristics. Some algorithms, for instance, aim for fairness in resources given to the user whereas others are more focused on generating higher throughput.

II. RELATED WORK

The modeling of a cellular communication system is usually divided into modeling of (a) traffic, (b) structure, and (c) strategy. In comparison with plain old telephone systems the problems become more complex as e.g. the number of channels available depends on the position of the subscribers, the subscribers are moving, and the intelligence available for decision-making is very high. If the subscribers are moving then the intelligence is required to decision making is very high. When two calls are overlapped there should be intelligence is to decide which channel is free and that should be allocated to the user. Based on the structure designing some effects may be reduced except interference. Now the main problem is exists in interference.

A. Round Robin*:*

It is a fair and simple algorithm, resources are allocated to users in a cyclic order offering fair resource sharing among them and it produces very low throughput. a) Fairness is increasing b) Throughput is decreasing

B. MaxC/I:

It is based on channel conditions by allocating the available resources to the user with the best channel quality in terms of signal to interference (SIR) ratio.
a) Fairness is decreasing b) Throughput is increasing

C. .Proportional Fair:

It increases the influences of previous transmission rates and allows trade-off between fairness and throughput.

D. Score-Based:

It analyses the user's traffic performance and allocates a transmission rate according to the scorer measured. RR, MaxC/I, PF and SB schedulers have their own difficulties one by one. To overcome these difficulties we propose Load Matrix concept.

III. PROPOSED METHOD

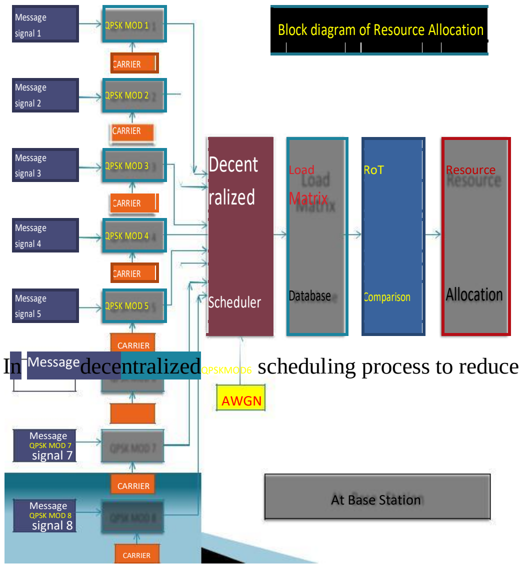
Load Matrix Scheduling: It is a scheduler for database of all active users and each user has load factor which facilitates joint management of interference within and between cells for allocation of radio resources i.e. interference Controller.

A. Centralized:

In this scheduling the scheduler is resides in RNC (Radio Network Controller)

B. Decentralized:

In this Scheduling the scheduler takes place at the base station. Advantage of centralized is interference knowledge is high at RNC, but it is having high network response is low. Advantage of decentralized It is having dynamic and fast response and fast varying environment. But interference knowledge is very low at base station.



In decentralized scheduling process to reduce Interference, we use several interference mitigation (reducing) techniques MUD (Multi User Detection), IC (Interference Cancellation), ABF (Antenna Beam Forming) and their Combinations. Although interference problem is still effective. Load Matrix scheduling is used in decentralized method and the Resources are allocated till pre defined RoT is reached at each base station. In this mainly three constraints are given below. Active user transmitting power should be in acceptable region. In this mainly three constraints are given below.

IV. LOAD MATRIX CONCEPT

One of the main challenges in resource allocation in a multicellular system is the control of intercell interference. In uplink scheduling, the basic problem is to assign appropriate transmission rate and time to all active users in such a way that result in maximum Radio resource utilization across the network whilst satisfying the QoS requirements of all the users. Amongst other constraints, another important factor in the resource allocation is the users transmit power. For a network of M users and N cells the constraints to be satisfied are Cnst1: For each active user i in the network, its transmit power Pi must be maintained in an acceptable region. P*i,max* is the maximum transmission power available to the user due to hardware limitation and/or any other restrictions. Cnst2: The total received power at base station should be kept below a certain threshold for all N base stations in the network (as a load control measure in a single-carrier Spread Spectrum system). We use Rise over Thermal noise (RoT) as defined in HSUPA [2] to represent the interference constraints. RoTj is the total in-band received power at the base station *j* (BS*j*) over thermal noise. Let *N* be the receiver noise power in a BS, *Pi* be the transmission power of user i and Gi,j be the channel gain from user *i* to BS *j*. For M active users in the network, RoTj can be written as

$$RoT_j = \left(N' + \sum_{i=1}^{M} PiGij \right) / N' \quad \ldots\ldots\ldots\ldots\ldots(1)$$

In this case Cnst2 can be formulated as

$$\left\{ RoT_j \leq RoT_{target} \quad j \in 1,\ldots, N \right\} \quad \ldots\ldots(2)$$

Where RoTtarget is assumed to be a fixed target value set by the network operator to maintain the uplink interference level.

Cnst3 : For each user, depending on its channel type (e.g. pedestrian, vehicular) and speed, each rate k has a minimum required SINR called SINRtarget,*k*. SINRtarget,*k* is the signal to noise plus interference ratio required at the serving base station j if rate k is being assigned to the user in order to achieve a given block/frame error rate. Rate $k \in \{1, \cdots, K\}$ is the highest rate acceptable (and therefore is the preferred rate) for user *i* with serving base station *j* if SINRtarget,*k* is the highest that can be achieved under both Cnst1 and Cnst2

$SINR_{i,j} \geq SINRtarget_{,k}$ $i \in \{1, \cdots, M\}$, $k \in \{1, \cdots, K\}$ (11) Load Matrix (LM) can be regarded as a database containing the load factors of all active users in the network. LM scheduling can be implemented in both centralized and decentralized strategies. In a decentralized LM scheduling, each base station should implement identical LM database. Here for simplicity, we only present the centralized LM scheduling where a central scheduler entity assigns radio resources to all the users in the network. Figure 2 illustrates an example of LM scheduling implementation based on the proposed system architecture for the 3rd Generation Long-Term Evolution (3G LTE) . We assume the averaged channel gain (over the scheduling period) from users to base stations is known to scheduler prior to rate assignment. In a network of *M* users and *N* cells, LM*i,j* is the load factor contributed by user i at BS j

$$LM_{ij} = \frac{P_i G_{ij}}{N' + \sum_{m=1}^{M} P_m G_{mj}} \quad \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

RoTtarget in all cells in the first round of rate assignment. This requires additional rounds (which we refer to it as iterations) of rate/power adjustments in order to minimize the difference between a cell RoT and its RoTtarget. In other words, at each scheduling instant, pi, k is iteratively adjusted and then by replacing RoTtarget with updated RoT from LM after each round of rate assignment. This check is an important step ensuring low probability of interference outage by keeping RoT below RoTtarget and at the same time increasing resource utilization with highest cell RoT possible (i.e. RoT close to RoTtarget). Obviously the number of iterations depends on the difference between RoT and RoTtarget at the end of each scheduling process. However, the simulation results presented in section V are with number of iteration and yet the difference between RoT and RoTtarget was found to be negligible.

SIMULATION RESULTS

To evaluate the performance of the LM concept, extensive system level simulations have been carried out using HSUPA [2]. The results are compared with the scheduler in [11] that is also used as a benchmark for comparison in [2]. It should be emphasized that the main objective in this paper is to highlight the impact of other cell interference existing in both centralized and decentralized scheduling algorithms. Another important objective is to show the performance of the scheduling algorithms compared with the upper-bound limit rather than comparison between different algorithms. Comparison with the upper-bound limit is a better indication of scheduling algorithm efficiency. Here the upper-bound limit on the interference outage performance is defined as a "step function" in CDF of RoT (as represented by target RoT in figures 4, 6 and 8). Interference outage performance directly affects all other performance measures like throughput and packet delay. The comparison with the benchmark algorithm is provided here as an example to show the effectiveness of the LM scheduling compared with a typical scheduling algorithm used in [2]. The system level simulator models 19 Omni-directional cell structure with 10 users per cell randomly and uniformly distributed. The resource allocation performance is carried out in terms of interference outage. Fig.4. CDF of RoT (intra-cell margin effect).

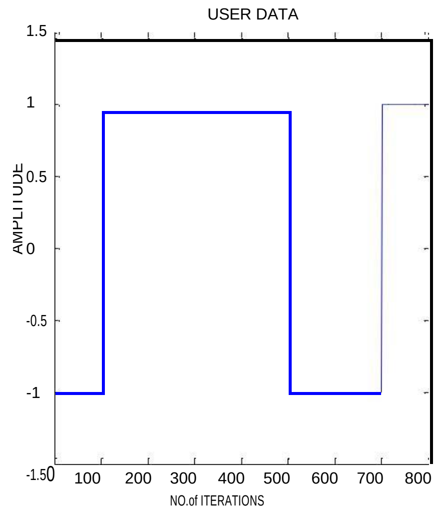


Fig.1.Binary input data

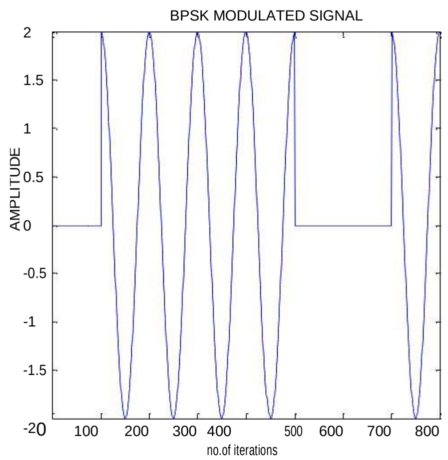


Fig.2.BPSK modulated signal

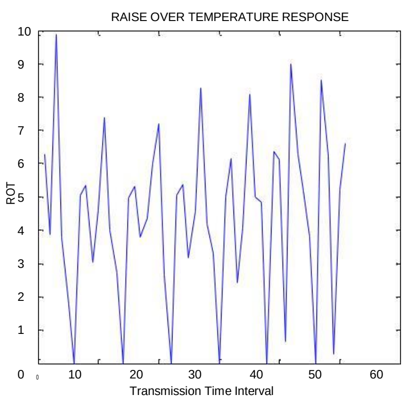


Fig.3.RoT fluctuation in multi-cell senario

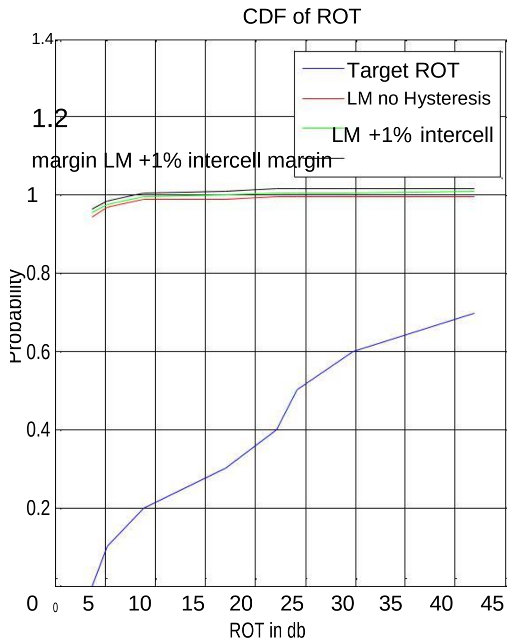


Fig.4.CDF of RoT (Best three combinations)

VI. Conclusion

The vulnerability of traditional resource allocation and scheduling schemes to intercell interference resulting in interference fluctuations is demonstrated in this project. Such interference results in the capacity wastage and excessive packet delay performance the load matrix concept address this problem specifically and provide an efficient resource allocation by jointly considering inter cell and intra cell interference before making decision on allocation Radio resources. Extensive simulation results for the LM demonstrate its capability through considerable performance improvements over the bench mark scheduling algorithm in terms of both average packet delay and cell throughput. By incorporating a new concept separate margins for intra cell and inter cell interferences into the LM, it was shown that better control over such interferences can provided resulting in high overall performances. As an example LM approach interference can always kept close to the specified target while average cell through put can be increased by ore than 30 % compared with a well known benchmark scheduling algorithm

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