ISSN No. 0976-5697

Volume 3, No. 3, May-June 2012

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

GBA- An Efficient Method for Fixed Channel Allocation in Cellular Network

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Abstract- In our cellular network system the network is divided into multiple cells and each cell is having a limited frequency band allocated to it. There are a number of users who access this frequency band through channels. Since the frequency band is limited, it becomes a difficult task to assign a channel to a user when there are too many user and all the channels in the cell are busy. So the main objective of the mobile operators is to utilize the available frequency band as much as possible. This can be done by the frequency reuse. In this paper we are providing a method GBA (Grouping Based Allocation) to assign the channels to the users using the reservation criteria. Means users and the channels are divided into multiple groups. Division of the users is done by the average call duration of the mobile users and according to the users the channels are also classified. So channels in a group are reserved for a particular group of users. In this process we are considering four groups for a cell. The method is effective since it tries to reduce the blocking of calls.

***Keywords*:** Channel Allocation, Call Duration, Call Blocking

I. INTRODUCTION

The need of the cellular mobile service is increasing year by year at a very high rate in metropolitan areas. The challenge is to assign channel to each mobile user using the effective method of channel allocation, effective in the sense that it should cover maximum number of nodes in the network in the limited number of the channels available. So for mobile operators this is the main problem in the present time as the number of user are users are increasing.

Mobile operators are facing many difficulties for supporting a huge number of users or subscribers because of spectrum and equipments restrictions. Many researchers provided many techniques for the same but the problem is same till now because of the limited number of channels.

If there are the users higher than the capacity of a cell then the cell is called as the hotspot or simply hot cell. In such case when the new call arrives either it will be blocked or rejected or may be put for the waiting [1]. In such a case the call blocking or rejecting becomes a major issue because in such a case the performance of the mobile operators goes to decrease and the user gets the trouble in operating the service. It is necessary to fulfill the user requirements unless the mobile operators will have the huge loss. For this reason it is necessary to reuse the channel as much as possible because there are limited channels available to use so it is important to reuse them. In this paper we are proposing a method GBA to reduce the call blocking. We are using a reservation criteria means every cell has the channels reserved for the certain users. The idea behind this is that we are categorizing the users according the average call duration and according to this we are considering four groups of users. The time duration for each group will be defined by us. The groups are in ascending order means the group with minimum calls duration to the group with maximum call duration. The channels in the cell are also categorized according to this range. So channels are categorized into four parts. The idea behind the division is that sometimes the long duration calls gets the channels for a longer period of time, so sometimes the short duration calls get block because of these longer duration calls such as the emergency calls. In that case the other methods are the only solution as described previously but they all are having certain disadvantages so this method tries to overcome the disadvantages.

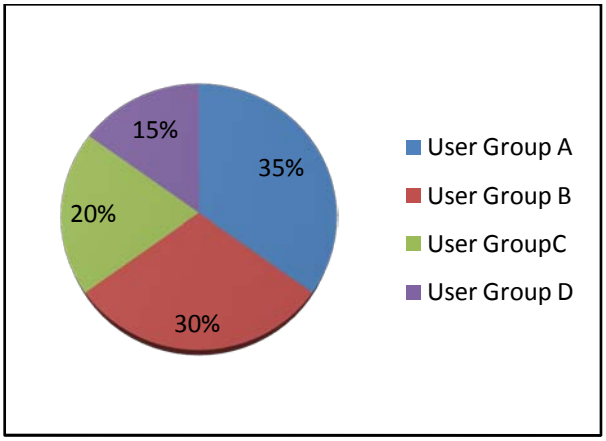

Figure.1 Distribution of Users in the Cell

Channels are also categorized according to users, means the categorized channel will be reserved for that particular user group.

II. PREVIOUS WORK

Much of research work has been done in the field of channel allocation to reduce the call blocking. Most of fix channel allocation work is based on channel borrowing and the call handoff. An LBSB [2] scheme was proposed which is used to deliver the fix number of channels (means the amount of the channels to migrate will be fix) from low density cell (low density cell is a cell in which there are users calls less than the channels available) to the high density cell (the cell in which the users calls are greater than

the available channels) using a centralized channel borrowing algorithm, Which is run by the MSC (Mobile Switching Center) periodically for a group of cells.

Although its performance is good in case of channel borrowing over the fixed channel allocation but the disadvantage is that it is heavily dependent on MSC since it is a centralized approach. Second is that the continuously information of the status of the cell in the network is an extra overhead and is the cause of delay.

A priority based scheme [3] was proposed to assign the channels in which the priorities are defined as the high priority and low priority for the calls and the channels are also categorized accordingly the channels are used accordingly means channel will be selected as the priority of the call, for allocation. The method is good but in case when there are no more channels remaining in the higher priority call and some channels are available in the low priority call then the high priority call has to degrade the priority in that case to have the channel from low priority calls channel group. By using this, the communication remain continue without breaking up the connection. The method is good but the problem is that there is no such a method to assign the high priority channels to a high priority call if all high priority channels in that cell are busy.

The motivation behind the all channel allocation method is to utilize as much as possible the frequency spectrum by reducing the call blocking probability in every cell. But very few methods are able to deal with the non uniformity of demand in different cells and this leads to imbalance in the performance. Another method named directed retry with channel sharing [4] is also proposed in which the neighboring cells overlap by which the transmitter can be hear by the user in the overlap region like their own cell. The only drawback is that channel sharing depends on the number of users in overlap region. A dynamic channel allocation strategy with a queue for elastic traffic [5] is also proposed in which there is a finite buffer which is used to store the non preempted call in by that they are trying to reduce the call blocking probability for the variable traffic. But in this method they are considering only data calls.

III. CLASSIFICATION OF CELL AND USERS

Normally in channel borrowing algorithms the classification of cell a cell is based on the degree of coldness 'D_c' accordingly it is classified as the high density cell and low density cell [6]. The degree of coldness is defined as:

$$D_c = C_A \mid C_O$$

Where C_A= number of channels available;

C_O=number of channels occupied or assigned;

If this degree of coldness is higher than some threshold value then the cell is classified as the cold cell or the low density cell and if it is lesser than some threshold value then it is classified as the hot cell means high density cell.

Users are classified into four groups based on their average call durations. The average call duration is calculated from the previous call history. These groups are as follows:

User group A: – Average call duration 150

User group B: – Average call duration 600

User group C: – Average call duration 1200

User group D: – Average call duration 2000

The channel classification is also based on these user groups.

IV. SYSTEM DESIGN

In this concept the fix number of channels is permanently allocated to each cell so first consider the one cell and its design or can say the architecture. We are considering these fixed channels only.

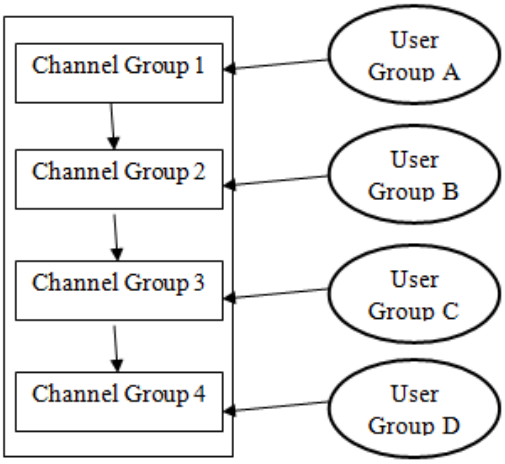

Figure.2 User and Channel Group Connectivity

V. PROPOSED APPROACH

The method proposed is based on the grouping of the users. In any cell there are many users and these users are classified into different groups. Groups are divided according to the call duration of the users. There will be four groups according to the duration of calls and these groups are in ascending order. Channels are reserved for the users according to the user group. If there is no channel available in the corresponding channel group for a particular user group then the free channel from the next channel group can be assigned to that user but if the channel is available in the previous channel group according to the sequence then that channel cannot be assigned to that user. Suppose the user groups are A, B, C and D and let the channels groups are 1, 2, 3 and 4 then if a user is in group A then he can use the channels of group 1 and if the channel is not available in that group then the user can be assigned a channel from the group 2 if available and if not then it will search for the next. But if user from the user group C wants a channel and all the channels in channel group 3 are occupied and if there are free channels available only in channel group 2 then that user cannot occupy that channel because it will then reserve that channel for the long time than that of the duration of that group so in that case the new calls in that group will begin to reject the calls. So in this case when there is no channel available for a long duration call in its corresponding group as well as in its next further higher group then it will search free channel in its nearest neighbor cells' groups.

The search will continue from the same group as in which that call is. For example if the user in group C doesn't have the channel in the channel group 3 and 4 of its cell then the channel will be searched in the neighboring cell, And the search will continue from the channel group 3 in the neighboring cell. It will not start search from the beginning

means from channel group 1. Further if any user in any group exceeds the call duration more than that of the allocated to the group then if channels are available in that group then it will continue the call in that channel only otherwise that user will shift to the next channel group. If channel is available in next group then it will simply occupy that channel otherwise the same process as described above will apply.

VI. FLOW OF PROCESS

The idea behind the process is described in the previous section this section is describing the working of the process using flow chart which describes the complete working of the process. After which a step by step process in the form of algorithm is described.

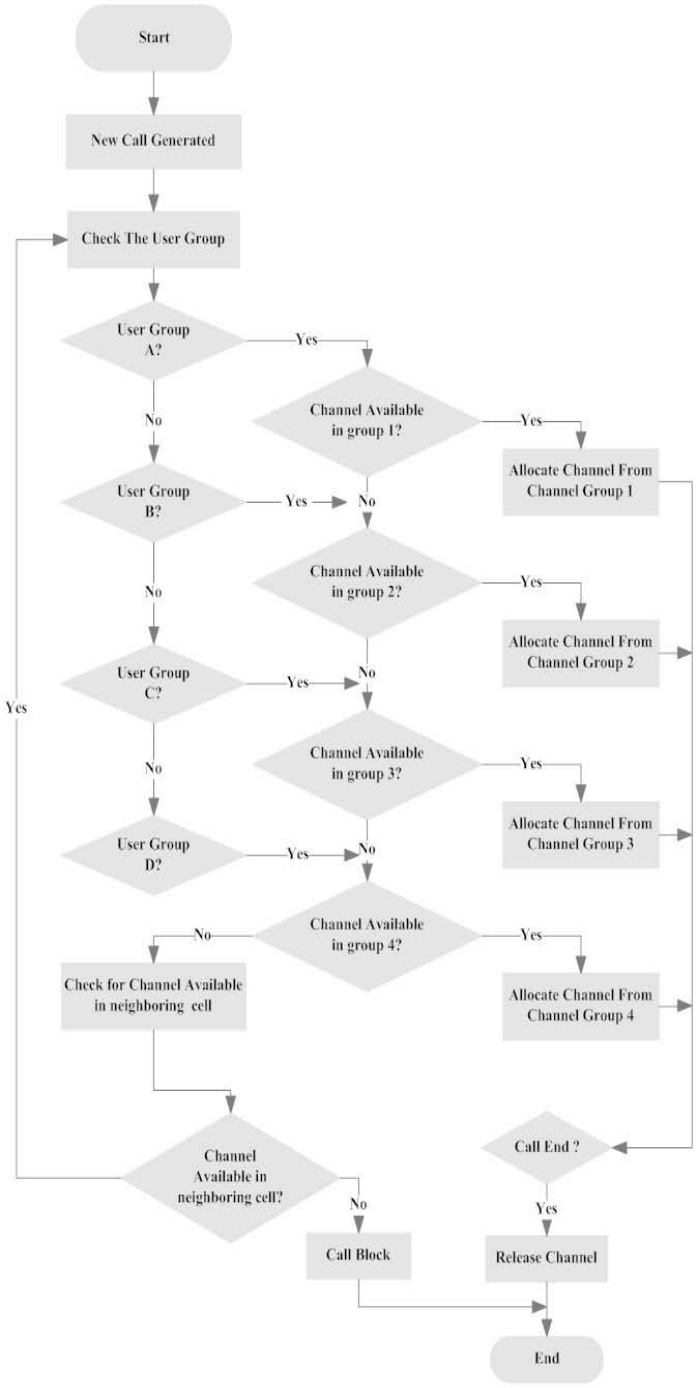

Figure.3 Flow Chart for the Method

a. First analyze the user to find the user group.
b. After finding the user group the corresponding channel group will provide the available channel in that group.
c. If the channel is available then that channel will assign to that call otherwise it will search the channel in the next upper channel group.
d. Repeat step 3 until no more upper channel group is remaining.
e. If channel is not assigned go to the neighbor cell of main cell.
f. Repeat steps 2 to 5 until channel is assigned to the call or no more neighbors remaining.
g. If no channel assigned then drop the call and wait for any channel to be free.

VII. PERFORMANCE ANALYSIS

Performance of the cellular networks is based on the two factors [7]:

a. GoS (Grade of Service)
b. QoS (Quality of Service)

Grade of service is measured by the probability of call blocking means how many calls get block in unit time duration. In our approach the call duration is longer and the average calls in unit time are also much but as we are considering the reservation based on grouping so the longer calls having different groups due to which the short duration calls are not get blocked. In other simple approaches if much of the longer duration calls are generated in unit time duration then much of the shorter duration calls are also get blocked because of the channel unavailability. But in our case this probability is reduced because we are having different channels for different user groups or different type of calls. By blocking some of the longer duration calls we are able to support the large number of short duration calls.

Second the Quality of Service is measured by certain parameters like voice quality, channel interference, call dropping and call blocking probability. As discussed the call blocking probability is very less in our approach and the channel interference is also very less because there is very less need to borrow a channel because only the long duration calls only need to borrow a channel in the case when those calls are not having the channels in their corresponding channel group. So the channel interference will be very less. Since call blocking probability is very less hence the call dropping probability is also very less. So these all factors are proving the Quality of Service of our method. This method is mainly useful in reducing the call blocking of emergency and the short duration business calls because we are blocking some of long duration calls to make channels available for short duration calls.

VIII. CONCLUSION

The method proposed in this paper is focusing on reducing the call blocking probability of the short duration calls like emergency calls or short business calls. We provided a method named Grouping Based Allocation (GBA) which dividing the users and channels into different groups and as a result the call blocking probability is reduced in this method. One more plus point in this approach is that, there is no need to install any other special equipment for the method.

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