# CHANNEL SHARING SCHEME FOR CELLULAR NETWORKS USING MDDCA PROTOCOL IN WLAN

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**Abstract**

*In cellular networks, it is vital to allocate communication channels efficiently because the bandwidth allocated for cellular communication is limited. When mobile hosts move from one cell to another cell, to provide uninterrupted service, the new cell should have enough channels to support the ongoing communication of the mobile hosts that moved into the cell. If channels are statically allocated, a cell may run out of channels when large number of mobile hosts moves to a cell, thus degrading the quality of service. To overcome this problem, dynamic channel allocation approaches have been proposed which allocate channels to cells on demand, thus increasing channel utilization and hence improving the quality of service. A distributed dynamic channel allocation algorithms gained a lot of attention due to their high reliability and scalability. The cell that wants to borrow a channel has to wait for replies from all its interference neighbors and hence, is not fault-tolerant. This work aims to propose a Distributed dynamic channel allocation algorithm to make use of the available channel efficiently. It can tolerate the failure of mobile nodes as well as static nodes and enhance the quality of service by making efficient reuse of channels. This paper proposes a channel allocation scheme with efficient bandwidth reservation, which initially reserves some channels for handoff calls, and later reserves the channels dynamically, based on the user mobility The results indicate that the proposed channel allocation scheme exhibits better performance by considering the above mentioned user mobility, type of cells, and maintaining of the queues for various traffic sources. In addition, it can be observed that our approach reduces the dropping probability by using reservation factor.*

## I. INTRODUCTION

The rapid growth of mobile users can be effectively handled by reusing the frequency channels in an efficient way. When the cells are

far apart so that the reuse distance and their signal strength do not interfere with the other, the same frequency channel can be used. The basic channel allocation schemes in cellular mobile system are fixed channel allocation scheme, dynamic channel allocation scheme. A fixed number of channels is allocated to each base station in the fixed channel allocation scheme. According to this scheme, a channel is allotted to a call if it is available in its corresponding cell, otherwise it is blocked. Borrowing schemes are used along with this scheme to improve the performance. In a borrowing scheme, the channel is borrowed from its neighboring cells when all the channels in its control are busy. However, there are relative advantages and disadvantages of this scheme in terms of total channel utilization and allocation complexity. In order to alleviate the above problems, Dynamic channel allocation scheme was developed. In this scheme, all the channels are kept in a central pool. No base station has control on the channels. When there is channel request from any base station, the mobile switching center chooses the channel that gives maximum efficiency, taking all the constraints into account. When the call is completed, the allocated channel may be reallocated to another MS in the same cell or returned to the central pool. There exist two types of dynamic channel allocation schemes. They are the distributed dynamic channel allocation (DDCA) scheme and the centralized dynamic channel allocation (CDCA) scheme. In DDCA, a channel is selected based on co-channel distance, signal strength and signal-to-noise interference ratio. A specific characterizing function is used to select one among candidate free channels in CDCA. Finally, the advantages of fixed and dynamic channel allocation schemes are considered in developing hybrid channel allocation scheme. In hybrid channel allocation scheme, some channels are fixed for each cell and some are kept in a central pool. In this paper, we introduce an algorithm which gives priority for real-time handoff calls. Our approach is to divide the service calls into four different types as real-time originating calls, real-time handoff calls, non-real-time originating calls and non-real-times handoff calls. The proposed method reserves some channels exclusively for real-time handoff calls, some channels are reserved for both real-time and non-real-time originating calls. There are common channels which may be acquired by any type of call. We maintain three different queues, real-time handoff calls, nonreal-time handoff calls and originating calls. One of the important factors to improve the quality of cellular service is to make handoffs almost invisible to the user and successful. Unsuccessful handoff requests are one of the main causes of forced call termination. Therefore, some network operators try to select a scheme which increases the blocking probability and reduces the dropping probability. The performance characteristics of any channel allocation scheme are blocking probability of originating calls, dropping probability of handoff calls, number of handoff requests, delay in channel assignment and total traffic. The drawback of the existing Dynamic Channel Allocation scheme is that the dropping probability is reduced by increasing the number of reserved channels, which increases the blocking probability. But a channel allocation scheme which maintains low blocking and dropping probability to achieve good quality-of-service with the help of reservation factor, which keeps track of the threshold values of the dropping probability and the blocking probability. Reservation factor "K" issued for modifying the number of reserved channels dynamically. The value of $K$ ranges from 0 to 0.5, when the maximum number of reserved channels should not exceed half the number of channels in the group. This value of $K$ when multiplied with the number of channels in the group gives how many channels to be reserved in a particular cell. Also, our scheme uses the reusability, which virtually maximizes the system capacity. In DDCA, group allocation is done only when there is a request for a channel in the cell. The reservation factor is used for reducing the dropping probability only. In MDDCA, groups are allocated initially only but not at the time of request for a channel. The reservation factor is based on both dropping and blocking probability in MDDCA .M-DDCA proposed a system with only originating calls and handoff calls. It does not maintain any queues for any type of calls. The proposed system in this paper deals with the traffic – real-time and non-real-time calls. Also this system maintains different queues for different calls. The rest of the paper is organized as follows. Section 2 describes the background work related to the DDCA Protocol. Section 3 describes MDDCA Section 4 discusses the results that have been obtained. Finally, the last section describes the conclusions .

## II. DISTRIBUTED DYNAMIC CHANNEL ALLOCATION(DDCA) PROTOCOL

In this Section, we present a brief overview on the literature related to channel allocation methods. Which deal with integrated services and also queuing systems, single traffic systems with and without queues. Apply algorithms, by giving priority to real-time handoff calls; queues are maintained only for handoff calls. As the blocking probability and the dropping probability are the two important metrics of quality-of-service, we consider both in order to improve the performance of the system. Distributed Dynamic Channel Allocation (DDCA) protocol for wireless and mobile networks scheme proposes the reservation of channels is modified dynamically when the dropping probability increases when compared to its threshold value. In DDCA, the total number of channels is divided into groups and these groups are mutually exclusive. The number of reserved channels is related to the traffic involved in the network. Reuse partitioning technique is used in the network-based dynamic channel assignment scheme .It has been carried out to increase the capacity of the cellular systems using the reusability concept. Because of reusability, same channels can be used in different places maintaining reuse distance between them. In this scheme, channels are open to all incoming calls and no channel allocation for each region is required. The channel can be given to any user, but co-channel interference must be avoided. This scheme aimed at minimizing the effect of assigned channels on the availability of them in order to use in the interfering cells and reduce their overall reuse distances. The system shows better performance when the traffic is distributed uniformly/non-uniformly and interference information provided.

The reservation factor is used to modify the number of reserved channels dynamically, based on the average dropping probability. The channels are divided into groups and are based on the mutual exclusion property. The cells are divided into three types: hot cells, medium cells and cold cells. The reservation of channels is also done by considering the type of cell, user's mobility and the location of the user. It is important to note that the performance of channel allocation methods depends on the type of traffic and its allocation priorities. The distributed dynamic channel allocation methods are proved to be best in utilizing bandwidth effectively.

## III. M-DISTRIBUTED DYNAMIC CHANNEL ALLOCATION WITH QUEUES (MDDCA WITH QUEUES)

In the proposed modified distributed dynamic channel allocation with queues using frequency reuse scheme, the total number of channels available in a cellular system is divided into three equal groups. The groups are taken as three as this is the minimum number which avoids co-channel interference with the frequency reusedistance between the cells and also can still meet the requirements of system performance. The distribution of groups among base stations is based on the existing three color theorem, i.e. no two neighboring base stations will have the same group of channels.

*System Model*

Let *C* channels in the cellular network be divided into three groups: Gp; Gq, and Gr . Let us reserve some Rp; Rq, and Rr channels for handoff calls from each group, respectively. These reserved channels should be used only for real-time and non-real time handoff calls. If required, the number of reserved channels can be dynamically varied based on the traffic at that instant. We maintain three different queues for real-time handoff calls, non-realtime handoff calls and real-time or non-real-time originating calls. where *N* is the total number of cells in the cellular network and g is the number of groups into which the total channels *C* are divided. The channels are divided into four parts: CO-channels exclusive for real-time and nonreal nonreal-time originating calls, Common Channels (CC) can be used by any type of call, Channels for real-time and non-real-time handoff calls (CRN), Channels exclusive for real-time handoff calls (CRR).In common channels, preference is given to real-time handoff calls.

These reserved channels SR can be increased based on the reservation factor K in order to reduce the dropping probability. Also, the number of reserved channels can be increased to some extent only, because if it exceeds some limit, then blocking probability increases drastically. Hence, the reservation factor, K, depends on both the dropping probability and blocking probability. Moreover, SO channels can be used only for originating (real-time and nonreal-time) calls. The remaining channels are common channels which can be used by either originating calls or handoff calls.We assume that the arrival processes for real-time and nonreal- time originating and handoff calls are Poisson. These call rates influence the probability of call acceptance and it is difficult to model an exact scenario. Thus, some assumptions are made as follows:

- All users move at a random speed and to a random direction.
- It is assumed that mobile stations have GPS devices equipped with them.
- All roads are straight.
- All users are uniformly distributed in a cellular network.
- Let the arrival rate of real-time originating calls be calculated. .
- Let the arrival rate of non-real-time originating calls be calculated.
- Let the arrival rate of real-time handoff calls be kHV .
- Let the arrival rate of non-real-time handoff calls be kHD.
- Let the call service rate for real-time calls be identified
- Let the call service rate for non-real-time calls be identified.
- Let the dwell time of mobile users in a cell be Tc_dwell.
- Let the size of queue QHV of real-time handoff calls be MV
- Let the size of queue QHD of non-real-time handoff calls be MD.

When a real-time handoff call is arrived, CRR is searched for a free channel. If available, the call is accepted; otherwise it searches in CRN, and then it searches in CC. Finally, if it gets a free channel from CRN or CC, the call is served if there is a free channel; else the reservation factor procedure is called. If reserved channels could be increased, the call is served; otherwise it is queued in QHV . If queue QHV if full, the call is blocked. When a non-real-time handoff call request comes, a channel is taken from CRN. If all the channels in CRN are busy, CC is checked. If free channel is available, it is allocated; otherwise the call is queued in QHD. Call is blocked when queue QHD is full.

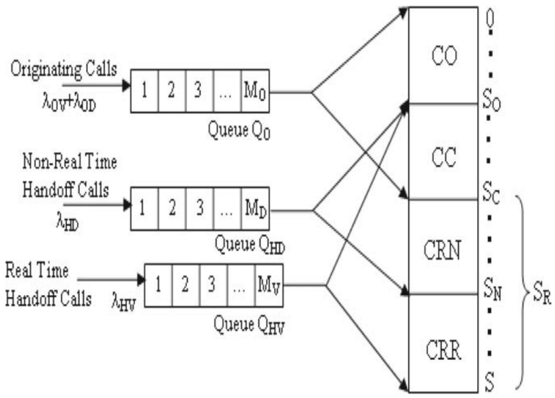


Fig. 1. System Model

When a real-time or non-real-time originating call arrives at a base station, the call is served with a channel from CO. If all channels in CO are busy, CC is searched for an available free channel. If channel exists, the call is served; otherwise the reservation factor procedure is called. If the reserved channels can be decreased and the channels for originating calls can be increased, then the call is served; otherwise it is queued in queue QO. An originating call is blocked when queue QO is full. When the call is released and the channel is freed, we check whether any real-time handoff call is waiting for a channel. If this is the case, then we allocate the channel to the real-time handoff call, otherwise we check for originating call, and at last check for non-real time handoff call. Because there is less priority for non-realtime handoff calls, there may be a high number of calls to be kept in waiting state. For this reason, we maintain the queue for nonreal-time handoff calls with large size when compared to the queue size of real-time handoff calls and originating calls. The calls in the queues are served based on the FIFO rule. A real-time handoff call in the queue is deleted when it is served or when it crosses the handoff area before getting a channel. But when the non-real-time handoff call in the queue crosses the handoff area,then it is transferred to the new base station. So, there will be no packet loss.

### 3.2. Performance Analysis

The state of the cell is defined by a three tuple of non-negative integers (*i*, *j*, *k*), where

**i:** number of real-time + number of non-real-time originating calls + the number of originating calls in queue QO

**j:** number of real-time handoff calls + number of real-time handoff calls in queue QHV

**k:** number of non-real-time handoff calls + number of non-realtime handoff calls in queue QHD.

### 3.3. Group Allocation to Base stations

According to this scheme, the base stations acquire the different groups based on the mutual exclusive paradigm. The competition value is set for each base station based on which group is allocated.Initially, the base station Bi initializes it group usage table with all the groups as 'not visited' and competition value to 0. Then Bi selects one group which is not visited from its group usage table. It will check whether any of its neighbors is using the same group.If so, it marks that group as 'visited' and selects another group which is not visited. The procedure repeats until it selects a group which is not being used by any of its neighbors. Then it will check if any neighbor requests for the same group and compares its competition value with others. If its competition value is high, group is allotted otherwise group is allotted to the other base station which requests the same group and increments the competition value.The process repeats till it acquires some group of channels. But, definitely, one or the other group will be allotted to every base station.

### 3.4.Channel allocation to mobile stations

When a real-time or non-real-time originating call arrives at a base station, it checks for the free channels in the group of channels which are reserved exclusively for originating calls, if there exists, channel is allotted to the requested mobile station. Otherwise, if there is a free channel in the common channels, the mobile station is served, otherwise, the call is queued in the QO, if queue is free. If queue QO is full, then the originating call arrived at the base station is blocked. The procedure for handling real-time and nonreal-time originating calls.When a real-time handoff call arrives at the base station, then it checks for the group of channels, which are reserved exclusively for them, if there is a free channel, the mobile station is served with the available channel. Otherwise, it checks in the common channels. If there is a free channel in the common channels, the mobile station is served. Otherwise, the call is queued in queue QHV, if the queue has a free space. Otherwise, the arrived real-time handoff call is dropped. When a non-real-time handoff call arrives at the base station, then it checks for the group of channels which are reserved exclusively for them, if there is a free channel, MS is served with the available channel, and otherwise, it checks in the common channels. If there is a free channel in the common channels, MS is served. Otherwise, the call is queued in queue QHD, if the queue has a free space; otherwise the arrived real-time handoff call is dropped.

### 3.5 Algorithm

```
If call arrived at BS is real time or non-real
time originating call then
If free channel exists in CO group of channels
then
Allocate channel from CO to MS.
Mark the allotted channel as "busy" in the
group usage
table.
Else
If free channel exists in CC group of channels
then
Allocate channel from CC
Mark the allotted channel as "busy" in the
group usage
table.
Else
Go to reservation factor procedure to modify
'K'
value to get some free channels
If free channels are obtained then
Allocate the channel from CC to MS
Mark the allotted channel as "busy" in the
group usage table.
else
If queue QO is not full then
```

Fig. 2: Algorithm for Reservation Procedure

When a real-time or non-real-time originating call arrives at a base station, it checks for the free channels in the group of channels which are reserved exclusively for originating calls, if there exists, channel is allotted to the requested mobile station. Otherwise, if there is a free channel in the common channels, the mobile station is served, otherwise, the call is queued in the QO, if queue is free. If queue QO is full, then the originating call arrived at the base station is blocked.

## IV. RESULTS AND DISCUSSION

### 4.1. Performance metrics

We consider two parameters: call blocking probability and call dropping probability of QoS to measure the performance of the proposed channel allocation algorithm. In Call blocking probability,when an originating call arrives at the base station, it checks for a free channel. If available, the call is served with the available channel. Otherwise, it is blocked. The probability that the originating call gets blocked is referred to as call blocking probability.Then the new base station first searches for a free channel in the reserved channels. If not available, it searches the remaining channels based on the limit of parameter k. If a free channel is available, it is allocated; otherwise the call gets disconnected i.e. the call is dropped. The probability with which the handoff calls are dropped is referred to as the call dropping probability.Our goal is to keep these probabilities as low as possible by effectively utilizing the available bandwidth.

### 4.2. Simulation parameters

The cellular network considered is assumed to have seven cells. The total number of channels is divided into three groups. As the total number of channels is assumed to be 30, the number of channels in each group will be 10, if the channels are distributed uniformly among the groups. If channels are distributed based on the type of the cell, hot cell holds 13 channels in a group, medium .

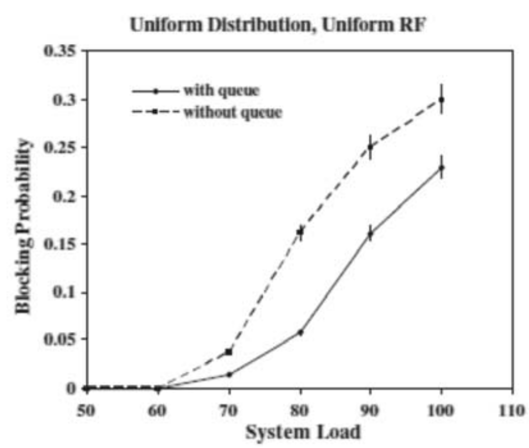


Fig. 3: System Load versus Blocking

Probability for different queue, Uniform Distribution

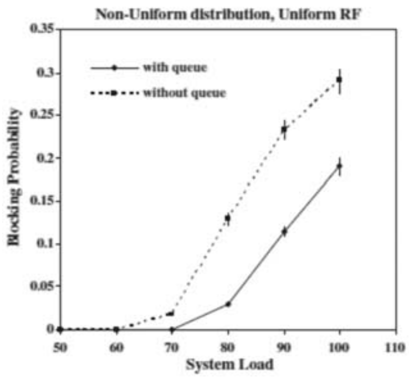


Fig. 4: System Load versus Blocking Probability for different queue,Non Uniform Distribution.

## V. CONCLUSIONS

As the growth of mobile users is increases at a high rate, and because of the limited frequency spectrum available, it is necessary to efficiently utilize the frequency spectrum available. This paper proposed a channel allocation algorithm with efficient bandwidth reservation based on user mobility and type of cells the user is entering. It has reserved the channels differently for different cells in the network, based upon the type of the cell.The types of the cells considered are hot cells, medium cells and cold cells. More number of handoff calls comes in hot cell, less number of handoff calls come in cold cell and the handoff calls are in average of above two for medium cells. This algorithm reserves more number of channels in hot cells and less number of channels in cold cells and an average of above two for medium cells by taking different K values for different cells. For hot cells,high K value is assigned. For cold cells low K value is assigned and for medium cells higher K value than cold cells but lower than hot cells is assigned. This K value dynamically changes based on the average call dropping probability of that cell. Also different queues are maintained for different types of calls. The results indicate clearly that the channel allocation scheme considering the user mobility and type of cells the user is entering, exhibits better performance by reducing the call dropping probability than the channel allocation scheme without considering them. Moreover,the results indicate better performance by reducing the call blocking probability when the channels are reserved unequally than reserved equally.

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