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# An Efficient Dynamic Channel Allocation Method for the Next Generation Mobile Networks

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**ABSTRACT**
Due to the mobility of the users in the mobile networks the traffic within it is heavily increasing. This mobility requires handoffs to increase a quality of connections between the base stations. To meet these requirements new handoff methods should be developed. The existing handoff methods are abstraction and lack dynamism to cope up with dynamic network traffic. This paper presents an efficient dynamic channel allocation method, which used to allocate the channels based on the observed network traffic in a particular time period. Main aim of this method is used to utilize the maximum available spectrum in the mobile networks by reducing the handoff dropping probability. The Simulation was carried out in the MATLAB; the simulation results proved that the proposed method utilizes the maximum spectrum with good Quality of Service.
***Keywords*** **:-** Channel Allocation, Mobile Networks, next generation networks.

## I. INTRODUCTION

Entire service area of the mobile network in divided into the channels. In general the mobile radio network spectrum is classified into two categories and that will be in the form of the channels. One category is for control channels and other is for the voice channels. In whole channels of the spectrum 95% will be for the voice channels and remaining 5% will be for the control channels. These channels are shared by the new calls and the handoff calls in the cell coverage area. Whenever the channel is busy the new call should be block or queued or rejected. The rejection probability is call rejected probability. Similarly handoff call rejected probability is called as the Handoff dropping probability. Handoff use different decision protocols like Network Controlled Handoff, Mobile Assisted Handoff and Mobile Controlled Handoff [1]. In Network Controlled the Mobile Switching Centre (MSC) is responsible for the overall handoff decision. In Mobile assisted Mobile Station (MS) is responsible for finding the Base Station (BS) whose signal strength is closest to it. In Mobile Controlled the MS got the full control in handoff decision [2].

### *A. Performance Metrics for Handoff*

The following are the performance metrics for handoff calls from one cell to another.

- Call Blocking Probability: The probability that a new call attempt is blocked.
- Handoff Blocking Probability: The probability that a Handoff call attempt is blocked.
- Handoff Probability: The probability that an ongoing call requires a handoff before the call terminates while communicating with a particular cell. This metric is translated into the average number of handoffs per cell.
- Call dropping Probability: The probability that a call terminates due to handoff failure. This metric can be derived directly from the handoff blocking probability and the handoff probability.
- Rate of Handoff: The number of handoff per unit time.
- Duration of Interruption: The length of time during handoff for which the mobile terminal communicates with neither BS.
- (G) Delay: The distance between the point at which handoff should occur and the point it occurs [3].

## II. RELATED WORK

Existing research works address the concept of Fixed Channel Allocation Scheme (FCA) where there are no separate channels allocated for handoffs [4]. The available channels are shared by both new originating calls and handoff calls in first come first serve basis. In this strategy, handoff request and new call request are dealt with equality. The cell doesn't consider the difference between Handoff request and new call request. It is intuitively clear that the termination of an ongoing call due to handoff failure is less desirable than blocking of new call. Quality of Service is not ensured as handoff blocking rate and new call blocking rate are equal.

Research paper [5] addressed the channel assignment strategies. Channel assignment strategies can be classified as fixed or dynamic. The choice of channel assignment strategy impacts the performance of the system. In a fixed channel assignment strategy, each cell is allocated a predetermined set of voice channels. Any call attempt within the cell can only be served by the unused channels in that particular cell. If all the cells in those cells are occupied, the call is blocked and the subscriber does not receive any service. In dynamic channel assignment strategy, voice channels are not allocated to different cells permanently. The channels are kept as a pool in MSC. When a channel request is made to BS, the serving BS requests channel from MSC. MSC then allocates a channel to the requested cell following an algorithm that takes into account, the likelihood of future blocking within the cell, the frequency of use of the candidate channel and reuse distance of the channel. Dynamic channel assignment strategy reduces call blocking but it increases the trunk capacity of the system [6]. It requires MSC to collect real time data on channel occupancy, traffic distribution and radio signal strength indications (RSSI) of all channels on a continuous basis. This increases the storage and computational load on the system but provides the advantage of increased channel utilization.

Research paper [7] investigates a case study on the quality of service of GSM networks in Nigeria using the call drop rate and the call handover success rate as the key performance indicators. They analyzed the scenario using the Erlang B probability formula, which highlights the service quality at any given moment on the number of channels available at that time. The parameters of the four main GSM services in Nigeria were analyzed with the help of data obtained from the Nigerian Communications Commission. The results showed that the operators are not performing well with regard to these metrics; therefore, ways to increase not just the performance of the metrics but also the performance of the whole network were suggested. They proposed a way for Cell splitting, sectoring and efficient resource management which was highlighted as the possible means of maximizing the networks' quality of service. This implementation would lead to soft handover in the network; thus, creating a more robust telecommunication system.

Research paper [8] focused the channel allocation on Non-priority and Priority schemes. In Non priority scheme all S channels are shared by both originating and handoff request calls. The BS handles both handoff request and originating call in the same way. Both kinds of requests are blocked, if no free channel is available. They have described the behavior of a cell as a (S + 1) states Markov process.

Channel borrowing strategy is analyzed in reference literature [9]. A cell is allowed to borrow channels from a neighboring cell if its channels are occupied. This strategy follows the combination of fixed and dynamic channel assignment. A channel set is nominally assigned to each cell according to Fixed Channel Assignment scheme. When all the channels in a cell are occupied, the cell borrows channels from adjacent cells to accommodate the incoming new/handoff calls, as long as the borrowed channels do not interfere with the channels used by existing call. The Mobile Switching Centre (MSC) supervises such borrowing procedures. It ensures that the borrowing of a channel does not disrupt the calls in progress.

Research paper [10] proposed a novel Orthogonal variable spreading factor (OVSF) to provide flexibility of rate variation in data calls and maximizes channel utilization. OVSF codes are used to support multimedia calls in CDMA wireless networks. The inefficient use of OVSF code tree reduces the system throughput. The ongoing call uses different codes at different times depending on the code tree status and instantaneous traffic load. For low traffic loads, the high rate codes can be utilized. For medium to high instantaneous load conditions, the vacant codes with capacity less than the call rate can be utilized. For same call reassignments, different codes are assigned in different times. The utilization of the code tree can reach close to 100%. Simulation results are given to verify the superiority of the proposed design.

Research paper [11] presents future personal communications networks (PCNs) supporting network-wide handoffs. They proposed a novel dynamic guard channel scheme which adapts the number of guard channels in each cell according to the current estimate of the handoff call arrival rate derived from the current number of ongoing calls in neighboring cells and the mobility pattern. New and handoff requests will compete for connection resources in both the mobile and backbone networks. Forced call terminations due to handoff call blocking are generally more objectionable than new call blocking. The proposed scheme is aimed to reduce the handoff dropping rate and is applicable to channel allocation over cellular mobile networks.

In Reference literature [12], the authors presented strategies for accommodating continuous service to mobile users by estimating resource requirements of potential handoff connections. A diverse mix of heterogeneous traffic with diverse resource requirements was considered. They investigated static and dynamic resource allocation schemes. The dynamic scheme probabilistically estimates the potential number of connections that will be handed off from neighboring cells, for each class of traffic. The performance of these strategies in terms of connection blocking probabilities for handoff and local new connection requests are evaluated. The performance is also compared to the scheme proposed by Yu and Leung. The results indicate that using dynamic estimation and allocation, the handoff dropping rate can be significantly reduced.

In Research paper [13], the authors developed a VHO decision algorithm that enables a wireless access network. It not only balances the overall load among all attachment points (e.g., base stations and access points) but also maximize the collective battery lifetime of mobile nodes (MNs). In addition, when ad hoc mode is applied to 3/4G wireless data networks, VANETs, and IEEE 802.11 WLANs for a more seamless integration of heterogeneous wireless networks, they proposed a route-selection method. This method forwards data packets to the most appropriate attachment point to maximize collective battery lifetime and maintain load balancing. Results based on a detailed performance evaluation study are also presented to demonstrate the efficacy of the proposed method.

Reference literature [14] gives a comprehensive study of Vertical Handover (VHO) algorithm. The authors discussed Received Signal Strength (RSS) based VHO algorithm. They analyzed an adaptive lifetime based VHO that handover between 3G networks and WLAN by combining the RSS with estimated lifetimes. Vertical Handover Decision Algorithm is necessary for the fourth generation wireless heterogeneous network for seamless communication anywhere and it is still a challenging area.

Reference literature [15] investigates the mobile router movement patterns in NEMO (Network Mobility) network environments and defines fast hierarchical NEMO handover scenarios based on classified movement patterns. Due to unexpected link breakdowns during the handover procedure, the NEMO handover requires additional latency and packet delivery costs depending on the situation that breaks occur. For the various handover failure cases, it is also essential to analyze these overhead costs to evaluate and compare the performance of a fast handover. Theoverheads associated with a NEMO fast handover include the latency, buffering cost and packet loss cost. These were formulated based on a timing diagram.

In Research papers [16] and [17], the authors proposed a new personal communications services (PCS) hand-off scheme. This scheme provides for hand-off to radio ports on which there is no free channel, - an existing connection. With sub-rating, an occupied full-rate channel is temporarily divided into two half-rate channels: one to serve the existing call and the other to serve the hand-off request. The blocking probabilities (combined forced terminations of existing call and blocking of new call attempts) of this new scheme compare favourably with the standard scheme (nonprioritizing) and prioritizing schemes. Analytical models and simulations investigating the impacts were presented. The results showed that even in the highest offered load in busy hour, it experiences less than half a second of sub-rated conversation on average and only about 3% of the calls experience more than 5.12% of sub-rated conversation. This scheme can increase capacity by 8-35% for systems with 1% call incompletion probability. By sub-rating existing calls on busy ports to create new sub-rate channels for hand-off access attempts, virtually all forced terminations are eliminated. The penalty has been shown to be a reduction of voice quality during the time that the links are sub-rated to accommodate the handoff call.

## III. PROPOSED SYSTEM

The proposed method is based on dynamic channel allocation strategy. It automatically searches the optimal number of Guard Channels to be reserved for handoff calls at each BS. For a Base Station BS, having total number of channels S, the Guard channel exclusively for handoff is chosen as SR. The rest of the available channels are used by the new originating calls in that cell and also by the handoff calls, which is SC. A new call request will be granted for admission if the total number of on-going calls (including handoff calls from other cells) is lesser than the number SC. A handoff call request will be granted for admission if the total number of on- going calls in the cell is lesser than the total capacity S.

The algorithm EDCA is illustrated as follows:

Data Structure is

The total number of available channels S Open Access Channels (new calls + Handoff calls) SC

Guard channels for handoff calls SR

Where, S = SC + SR, SC = S SR and SR is allocated dynamically

OC = number of on-going calls

NC = number of admitted new originating calls HC = number of admitted handoff calls

H=Total number of handoff call (admitted+rejected) Where, OC = NC + HC

Pd = Call dropping probability // used in FCA scheme Pf = Probability of Handoff failure

Pb = Call blocking probability t = time period

Th = Threshold for handoff call rejection probability

Algorithm: EDCA (t, S) // the algorithm takes time period and channels as input

{
SC =S- SR
For every handoff call request Do
{
If OC < S, then
{
HC = HC + 1 and grant admission OC = OC +1
}
Otherwise, Pf = Pf +1 and reject.
}
For every new call request Do
{
If OC < SC, then
{
Nc=Nc+1 and grant admission OC = OC +1
}
Otherwise, Pd = Pd +1 and reject.
}
If a call is completed or handoff to another cell
{
OC = OC 1
Check with MSC whether the ended call is handoff call or new originated call If handoff call then HC = HC-1
Else NC = NC-1
}
If a handoff call is dropped and Pf/H >= Au*Th then
{
SR = min { SR +1, Smax}
If Pf/H <= Ad*Th for N consecutive handoff calls, then
SR = max { SR 1, Smin}

}
NC and HC are reported to understand the successful handoff and new calls at a specified time period.
}//end of the algorithm: EDCA

The proposed algorithm increases the number of guard channels SR, when a handoff call is dropped under the condition Pf / H >= Au*Th. It decreases the number of guard channels after a number of consecutive handoff calls are dropped under the condition Pf/H <= Ad*Th. Au and Ad are usually chosen to be lesser than 1. By choosing Au < 1, the algorithm will most likely keep the handoff blocking rate below its given threshold. The algorithm increments the guard channel until it reaches the maximum number of channels in the BS. The guard channel increment process should be stopped if it reaches the maximum number of allowable channels in the network. Hence the equation SR = min {SR +1, Smax} is given to choose the maximum guard channel limit in the network. The guard channel decrement process has to be stopped if it reaches the minimum number of guard channels allotted in the network. Hence the equation, SR = max{SR 1, Smin} is given to stop the decrement of guard channels if the decrement process reaches the minimum allowable number of guard channels in the network.

The simulation studies are performed to compare the performance of the proposed algorithm with fixed channel allocation (FCA) and Static Guard Channel allocation policies. The results prove that the proposed algorithm guarantees the QoS. In the proposed method, the handoff failure rate is lesser than the chosen threshold. The new call dropping rate is also minimized.

## IV. RESULTS AND DISCUSSIONS

Figure 1 depicts the screen shot of Static Guard channel allocation scheme. In this scheme certain number of guard channels are permanently set aside for handoff calls. It is noted from the bottom pane that nodes 10, 6 and 4 are sending request to Base station 0 (BS_1) and bandwidth is allocated. This reveals that handoff is success for the nodes 10, 6 and 4.

Figure 2 depicts the screen shot of the proposed scheme Dynamic Channel Allocation. In this scheme, the guard channel numbers are adaptive and dynamic. The new call blocking rate and handoff blocking rate are reduced. It is noted from the trace pane that node 14 is allocated to Base station 0 (BS_1) and node 5 is allocated to Base station 2 (BS_3). This reveals that handoff is success for the nodes 5 and 14 in different base stations. The guard channel numbers are dynamically altered based on network traffic.

**Fig. 1 Screen Shot for Static Guard Channel Allocation Scheme**

**Fig. 2 Dynamic Channel Allocation Scheme**

Figure 3 shows the performance of the static guard channel allocation scheme i.e., fixed number of guard channels exclusively allocated for handoff. Here the handoff blocking rate is reduced but the new call blocking rate is highly increased due to allocation of more guard channels than actually required. In static guard channel allocation policy, if the chosen number of guard channels are lesser than required numbers then handoff blocking rate will increase which affects the throughput. Figure 4 shows the performance of the proposed scheme Efficient Dynamic Channel Allocation Algorithm (EDCA), which is a dynamic channel allocation method. In this method channel allocation is not static. They are allocated based on the network traffic. The number of guard channels gets dynamically adjusted. It is evident from the graph that both new originating calls and handoff calls utilizes the channel efficiently. The call blocking rate is low for both.

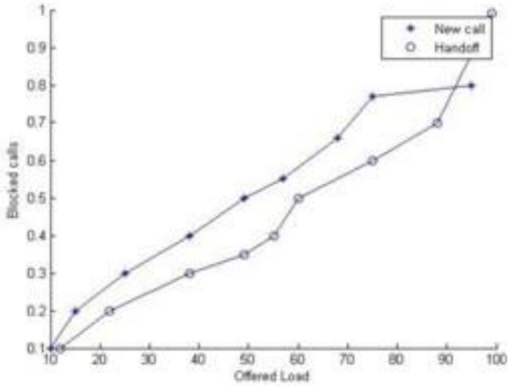


**Fig. 3: Static allocations of Guard Channels Exclusively for Handoffs**

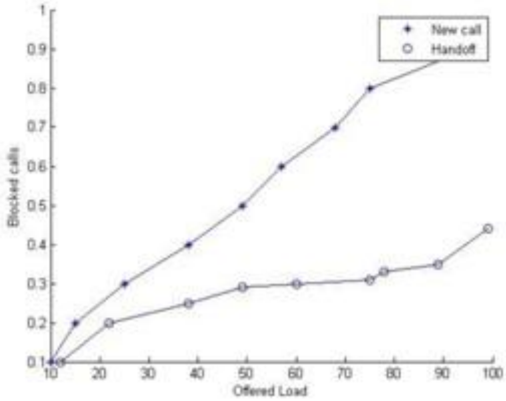


**Fig 4: Proposed scheme—Efficient Dynamic Channel Allocation Algorithm.**

## V. CONCLUSIONS

In this work, a significant contribution has been made in the area of call admission control with the hope of improving the Quality of Service. The simulation result shows that the proposed algorithm can adapt to the changes in traffic conditions. It achieves optimal performance in terms of guaranteeing handoff call blocking threshold and minimizing the new call blocking rate. This adaptive approach can automatically search the optimal number of guard channels to be reserved at a base station. Existing Guard channel allocation schemes lack dynamism to cope up with dynamic network traffic.

The proposed algorithm adjusts the number of guard channels dynamically according to the dropping rate of handoff calls for certain period of time. It either increases or decreases the number of guard channels allocated based on observed handoff rejection threshold. It is evident from the graph that the new strategy shows better resource utilization. The proposed scheme EDCA possesses high degree of spectrum utilization with good QoS.

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