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Performance Enhancement of Dynamic Channel Allocation in Cellular Communication System

KEYWORDS Blocking probability, Forced termination probability, spectral efficiency, throughput

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ABSTRACT *The rapid evolution of cellular technology and the augmentative user demand for advanced mobile services leads the industry to develop more efficient network structures. The increasing number of cellular users and the demand for broadband mobile communications drives to the research of new methodologies for the design of cellular networks and services. In cellular mobile communication system the existing dynamic channel allocation scheme suffer from high blocking probability and forced termination probability. To mitigate this problem, in this paper we evaluated the performance of dynamic channel allocation scheme based on carrier-to-noise interference ratio, we have evaluated the system in terms of total system performance such as blocking probability, forced termination probability of the call, spectral efficiency and throughput of the system.*

I. INTRODUCTION

The entire service area of a radio environment is divided into several smaller areas called cells. Each cell has a base station located in its center. In order to make a call a mobile user has to establish a radio link to the base station of the corresponding cell. The radio link associated channel can interfere with the same channel activated in another cell if the cells are not sufficiently spaced apart [1]. The minimum separation distance between the cells that keeps the interference level under a given threshold is the reuse distance.Channel allocation is one of the fundamental solutions due to the fact that it determines how the available bandwidth will be managed [2]. However, channel assignment presents a challenge because co-located wireless networks are likely to be tuned to the same channels. Some strategy must be applied to select the assigned channel. In contrast to traditional call-by-call DCA schemes, where the channel assignment is based only on current channel usage conditions in the service area, in this work we considered an interference aware DCA algorithm, in which the channel assignment is adaptively carried out using context information on the previous as well as the present channel [3].

II. RELATED WORK

The available frequency spectrum is limited and the number of mobile users is increasing day by day, hence the channels must be reused as much as possible to increase the system capacity. Various channel assignment schemes namely fixed channel allocation (FCA) and dynamic channel allocation (DCA) schemes. In FCA [4],[5], [6] channels are allotted permanently to each cell based on predetermined estimated traffic where as in DCA [7], [8],[9] the channels are assigned on a call-by-call basis in a dynamic way and the entire set of channels is accessible to all the cells. DCA makes wireless networks more efficient, especially if the traffic load distribution is not known beforehand or varies with time. The advantage of dynamic channel assignment is the flexibility and the traffic or interference adaptability.

III PROBLEM FORMULATION

In the model, we first take input coordinates of the user's position and the base station to obtain the path loss value and then add shadowing attenuation value. After that we obtain the attenuation value of the desired signal and from this value we can obtain the carrier-to-noise ratio (C/N) of the signal received by the base station. After calculating the value of C/N, we search for an available channel that is not in use, and that satisfies the interference conditions of the carrier to- noise plus interference ratio C/ (N+I).The channel search is conducted in the repeated channel numbers of that cell, so that the provided number of channels is examined in its entirety. If another user is allocated to the same channel, we calculate the interference from that user. Simulation is made for 5, 15, 20, 25 and 30 user's per cell respectively. Each user has an average hold time of 120 seconds. For uniform traffic the average call arrival rate of 6 times per hour and 12times/hour in all cells. The simulation starts with the status initialization, then it enters into a parameter loop that corresponds to 5, 10, 15.20, 25 and 30 users per cell. A time loop starts in every parameter cycle. The time loop ends when the simulated time has reached 5000 seconds & is indexed with 10 seconds in every cycle. In each time cycle the existing calls are tested for the termination criterion. After that, new calls are randomly generated and the available channels are allocated in a fixed or dynamic manner respectively. A variable block number is indexed if the channel allocation fails. At the end, data obtained in simulation are written in the specified files and the program stops.

IV SYSTEM MODEL

We divided the total geographical area into 19 cells of cluster size 19 and 190 channels and each cell contains 10 channels. Two techniques are preferred in the system such as cell layout and cell wrapping. Discrete meshes for the allocation of traffic into hexagonal cell [10]. The mean arrival rate of each user is considered by the Poisson distribution, every initiated call has its own call holding time that is subjected to the exponential distribution mean value of holding time. Shadowing is assumed to be subject to log normal distribution. We discuss the system performance measures like blocking probability is defined as the statistical probability that a new call will fail to find suitable channels that satisfy the C/(N+I)Ratio condition is given in equation 1.

$$CNIR = \frac{AP_o D_o^{-\alpha_o} 10^{\frac{\xi_o}{10}}}{N + \sum_{i=1}^{s} AP_i D_i^{-\alpha} 10^{\frac{\xi_i}{10}}} \quad (1)$$

Here α is the path loss factor, A is a proportional coefficient, P_i is the transmitted power of user T_i ,D_i is the distance between user T_i and base station R_o .In addition, ξ_i is the distortion caused by shadowing between T_i and R_o, the value of which is expressed by decibel in equation 1.

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Blocking probability is the measure pertaining to new calls, a connected call can be interrupt before it finishes due to rapid degradation of the C/(N+I) ratio condition [11], most important characteristics for the performance of a cellular network is blocking probability given in equation 2. When a new call arrival occurs and the network cannot allocate a channel then we say that this call is blocked. The blocking probability $\mathbf{P}_{bl}$ is calculated from the ratio

$$P_{blocking} = \frac{\text{number of blocked calls}}{\text{number of calls}} \quad (2)$$

If the received power of each user is high enough, we can make the assumption that the interference from other users can be ignored. Thus, we can compare the simulated blocking probability with the theoretical which is given in equation 3

$$P_{blocking_{theoritical}} = \frac{\binom{n-1}{s}(vh)^s}{\sum_{i=0}^{s}\binom{n-1}{s}(vh)^i} \quad (3)$$

where **n** is the number of users, **s** is the number of channels, **v** is the average call arrival rate (for no connected user) and **h** is the average call holding time.

When a call is in progress and the required quality conditions are not met then this call is obligatory driven to termination. The forced termination $\mathbf{P}_{fr}$ is calculated from equation 4.

$$P_{fr} = \frac{\text{num of forced calls}}{\text{num of calls} - \text{num of blocked calls}} \quad (4)$$

Fig. 1 shows the cell layout of 19 hexagonal cells having information is stored in the 19×2 matrix. For example, base information (5,1) and base information (5,2) respectively reveal X and Y coordinate of the fifth base stations. In our system, regulated numbers of users are scattered in each of the 19 cells from which data are taken. Using the DCA algorithm, we should take cell with its neighbors having co-channel interference has a significant effect on the performance of the sample cell. For example, the 5th cell is subject to interference from the 1st, 4th, 14th, 15th, 16th, and 6th cells. Cells located farther away, such as the 2nd or 3rd ones, could interfere with the 5th cell. However, it is assumed that such interference is decreased enough by the distance that it can be ignored, and we take into account only the six immediate neighboring cells in the system. On the other hand in the case of the 9th cell, which is located on the boundary of the cell layout, it has only three neighboring cells, the 10th, 2nd, and 8th. Such a "boundary cell" has different performance than an "inner located cell," for example the 9th cell, which would show better performance than the 2nd cells, because fewer cells cause interference in the 9th cell. Consequently, taking user activity in the boundary cells as well as that in an inner cell into account does not adequately evaluate DCA performance [12]. Thus, to avoid such a problem, two solutions can be used. One is to take data only from inner cells such as the 1st, 2nd, 3rd, 4th, 5th, 6th, and 7th cells in Figure 1, and exclude boundary cells. These inner cells are all subject to interference from six neighboring cells and are expected to reveal effective performances of the DCA algorithm. The other solution is to use a cell wrapping technique.

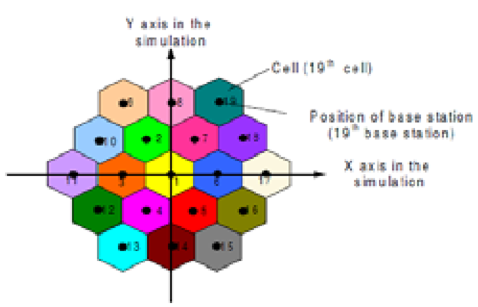

Figure1: Cell layout

Fig 2 shows a concept of this technique. In this technique, boundary cells are regarded as neighbors of the boundary cells located almost directly opposite the cell layout. In Fig 2, only the 19 shaded cells are cells that really exist, and the other cells are copies of the real cells having the same number. As a result, the 9th cell suffers from interference not only from the 10th, 2nd, 8th cells, but also copies of the 13th, 17th, and 14th cells in the neighboring positions. On this assumption, every cell in the cell layout can be regarded as being "Inner-located cell" having six neighbors. To realize cell wrapping, wrap information 19×19 matrixes reveals the relationship among the 19 cells, including cell wrapping. Thus, for example, wrap information (5, :) stores information for fifth cell about other cells, especially wrap information (5, 2) to wrap information (5, 7), which are the numbers of its six neighbors.

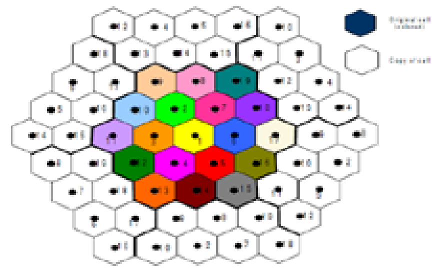

Figure 2: Cell-wrapping technique concept

V SYSTEM FLOWCHART

The flow chart of the system in Fig3 consists of three parts: the preparation part, several pieces of information needed for the system is introduced, such as the cell layout, before the main loop is started. The main loop of our system is activated by the while loop with preliminary finish time. Throughout the entire loop, the status of present users is checked and, if necessary, renewed in a short time interval. Several status indicators are successively stored in a matrix [14]. In every time period in the loop, each user causes several events, such as call initiation, channel searching, channel allocation, channel reallocation, and call termination based on the status matrix. In a time period, the following events are considered in turns: 1.Calls of connected users terminated if they finish in the period.2.Calls of still-connected users is examined. If a desirable interference condition is not satisfied, reallocation is attempted by searching for newchannels.3.With preliminary probability; users that are not connected start new calls and search for channels that satisfy the interference condition. 4. Returns to step1. Several types of numerical data are also measured in every period. Finally, in the output part, measured and accumulated data in the main loop are organized into output, in the form of output matrix.

Figure 3: Flow chart of the system

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VI. RESULTS AND DISCUSSION

We have already counted the essential numerical values such as call number, block number and force termination number, thereby calculating blocking probability P_{bl} and forced termination probability P_{fr} based on the equations (2), (3) and (4) respectively. From the results shown in fig 4 and fig 5 shows the blocking probability versus the number of users, are compared between theoretical and practical value of our proposed system and evaluated the performance of the forced termination probability theoretically and practically in the proposed system than the existing system as shown in fig6 and fig7.In our system, user distribution is considered to be uniform over one cell as well as over the entire cell layout. Such a condition is realized by cells distributed into a lot of small meshes. A mesh generator in our system, outputs the number of meshes in a cell and stores in a matrix which contains the position of each mesh. Fig 8 shows the result, where "Fineness" is a parameter for mesh fineness and is usually set to "Fineness=50" in our system. In this paper, using distributed dynamic channel allocation technique from Fig 9-10 and Fig 11-12 using ultra wideband technology increasing the number of users which increases the spectral efficiency and throughput.

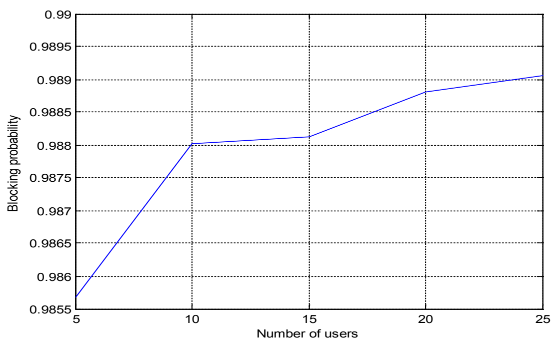

Figure 4: Number of users VsBlocking probabilty

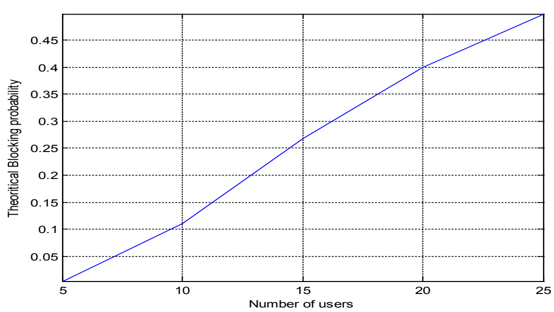

Figure5: Number of users Vs theoritical Blocking probabilty

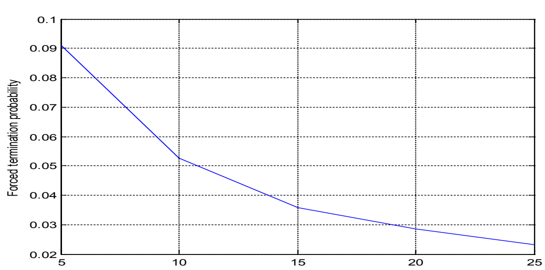

Figure 6: Number of users Vs Forced termination probabilty

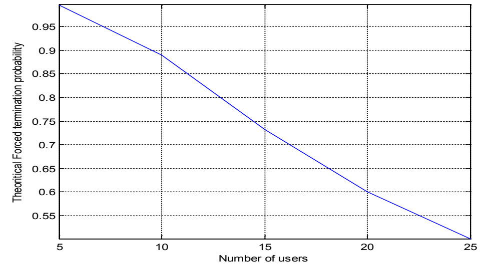

Figure 7: Number of users Vs theoritical forced termination probabilty

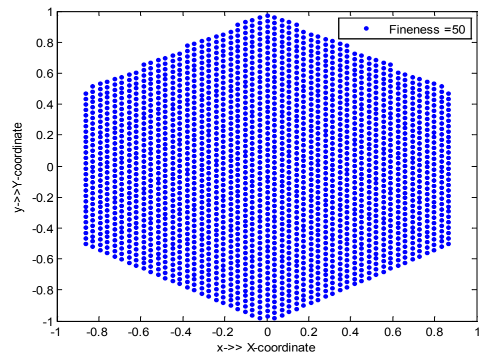

Figure 8: The schematic of the position of the cell mesh

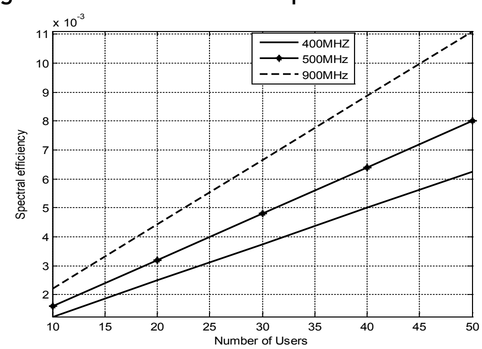

Figure 9: Number of users Vs Spectral efficiency

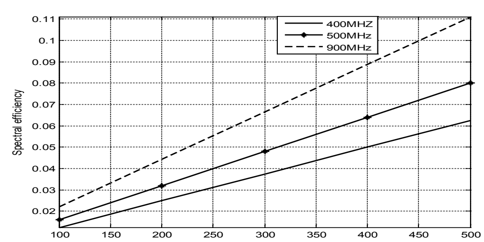

Figure10:Number of users Vs Spectral efficiency

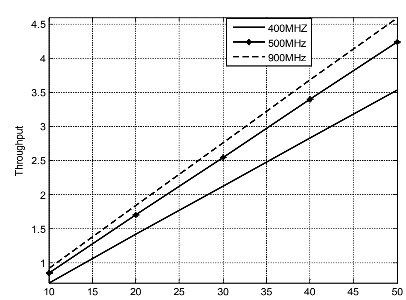

Figure 11: Number of users Vs Throughput

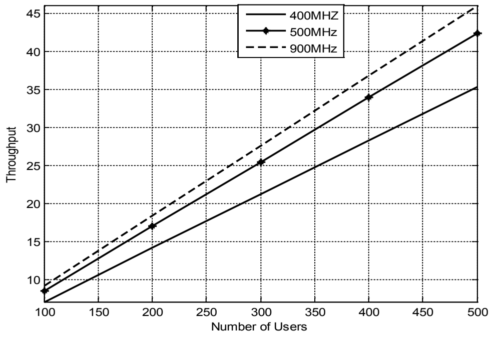

Figure 12: Number of users Vs Throughput

VII CONCLUSION

The wireless resource allocation has received a tremendous attention due to rapidly growing interest in wireless communications. In this paper we have provided an extensive survey of the resource allocation problem in wireless communications These emerging new areas will introduce a new set of constraints in channel allocation problems. We base our observation on an evaluation of total system performance considered by introducing a DCA simulation with various performance parameters. Dynamically changing the channels allocated to different cells enable the system to adapt to temporal and spatial distribution of channel demand. The proposed technique which is based on dynamic channel allocation will show remarkable achievement in terms of i) blocking probability ii) forced termination probability. We shall improve the technique in future that will outperform the existing technique both during peak hours and in congested part of the city, reducing the message complexity and channel acquisition delay. Dynamic channel allocation has received more attention because of high reliability and scalability. Most of the allocation techniques did not make full use of the available channels. The proposed channel allocation technique makes efficient reuse of channels using cell-layout and cell-wrapping. With the help of distributed dynamic channel allocation technique both spectral efficiency and throughput is playing an increasingly important role as future wireless communication systems will accommodate more and more users and high performance services.

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