PERFORMANCE ANALYSIS OF CELLULAR SYSTEM USING DISTRIBUTED DYNAMIC CHANNEL ALLOCATION

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ABSTRACT

Modern cellular mobile communications systems are characterized by a high degree of capacity. Efficient management of the wireless channels by effective channel allocation algorithms is crucial for the performance of any cellular system. To provide a better channel usage performance, dynamic channel allocation schemes have been proposed. Among these schemes, distributed dynamic channel allocation approaches usually have better performance results. In this paper, we propose a distributed dynamic channel allocation (DDCA) algorithm for originating calls. This algorithm is executed at each base station and to allocate the channel to mobile station, base station communicates with each other. In DDCA, the total number of channels is divided into groups. Any cell in the cluster can acquire the channel group as long as no one of its adjacent cells is holding the same group. Due to this the cochannel interference is avoided. The result show blocking probability of distributed dynamic channel allocation is reduced by increase in number of channels. The proposed algorithm is based on a distributed dynamic channel allocation technique is to increase the throughput of the system for an increase in channels.

Index terms: Distributed dynamic channel allocation, blocking probability, throughput

I. INTRODUCTION

Wireless communication networks divide the geographical area they serve into smaller regions called cells[1].Each cell has a base station, also referred to as the mobile service station (MSS). The MSS’s are connected to each other by a fixed wire network. Several mobile hosts (MH’s) may be present in a cell. The MH’s, e.g., mobile telephones, can move from one cell to another. This architecture, first proposed in [2], is shown in Fig.1.
To establish a communication session a call, an MH has to send a request to the MSS of the cell in which it is present [3]. The call can be supported if a wireless channel can be allocated for communication between the mobile host and the mobile service station. If a particular wireless channel is used concurrently by more than one call originating in a cell, or in neighboring cells, the calls will interfere with each other. Such an interference is called co-channel interference. However, the same wireless channel can be used to support calls in geographically separated cells such that their signals do not interfere with each other. This is known as frequency reuse. The limited frequency spectrum allocated for cellular communication is divided into a finite number of wireless channels. An efficient channel allocation strategy should exploit the principle of frequency reuse to increase the availability of wireless channels to support calls.

II. SYSTEM MODEL

We assume a cellular communication system that divides the geographical region served by it into hexagonal cells, with a mobile service station in the center of each cell. The mobile service station of a cell is connected by a wire line link with the mobile service stations of neighboring cells that are within co-channel interference range.

A mobile service station can be in wireless communication with the mobile hosts in its cell. A mobile host can either be a cellular telephone or a mobile computer. Calls involving cellular telephones and data transfers involving mobile computers will collectively be referred to as communication sessions. All the cells, except those at the boundaries of the region, [4] have six neighbors, as shown in Fig. 2. The system has been assigned a frequency band that is divided into a finite number of wireless channels. These channels are independent of each other. So, adjacent channel interference can be neglected. However, a channel should not be concurrently used for more than one
communication session in the same cell or in neighboring cells. For example, if we assume a three-cell cluster system in Fig. 2, then if a channel is being used to support a communication session in cell 25, it should not be used to support another concurrent communication session in cells 17, 18, 24, 25, 26, 32, and 33. A mobile host can communicate with other units, mobile or static, only through the mobile service station of the cell in which it is present. A mobile host initiates the channel allocation protocol when it wants to establish a new communication session, or when it is informed by the mobile service station about the arrival of a communication request from some other unit. Thus, from the point of view of channel allocation, the two cases are similar. If the mobile service station determines that the connection request can be satisfied, it allocates a communication channel for the mobile host to communicate with the mobile service station for the duration of the session. From the mobile service station the signals can be forwarded along the fixed wire network, or along another wireless channel, depending on whether the other party involved in the communication session is a unit outside the cell or a mobile host in the same cell, respectively. After the session is over, the same channel can be used to support another session, either in the same cell or in neighboring cells.

Both the MSS’s and the communication links could fail. If an MSS in a cell fails, then all the calls supported by it fails at the same time. An MH could fail as well, the failure of an MH only affects its ongoing communication. All the channels available in the system are kept in an open pool and no channels are pre-allocated to any cell. When a cell \( C_i \) needs to allocate a channel to support a call, \( C_i \) first tries to select an unused channel allocated to it to support the call. If \( C_i \) has no unused channels to allocate when a new call request originates in the cell, then \( C_i \) has to borrow a channel from its neighbors to support the new originating call. To borrow a channel, \( C_i \) needs to send request messages to each of its neighbors asking for their channel usage information. In this case, we say that \( C_i \) is in search mode and it is called a borrower. When a cell grants a borrower’s request for a channel, we call this cell a lender. If \( C_i \) gets permission to use a channel from all neighbors to which the channel has been allocated, then it can allocate this channel to itself and use this channel to support the call. \( C_i \) keeps this channel even after the call using this channel terminates. For example, In Figure 3, suppose that cell \( C_i \) needs to borrow a channel, it sends request messages to all its neighboring cells \( C_1, C_2, C_3, C_4, C_5 \) and \( C_6 \). Suppose that \( C_i \) selects a channel \( r \) to borrow, where \( r \) has been allocated to \( C_2 \) and \( C_5 \) but not to any other neighbor\([4]\). If both \( C_2 \) and \( C_5 \) agree to lend channel \( r \) to \( C_i \), then \( C_i \) can use channel \( r \). \( C_i \) keeps the borrowed channel \( r \) after the call supported by channel \( r \) terminates in \( C_i \). By allowing a cell to keep a borrowed channel, a cell where a lot of calls have originated may have more channels allocated to it. Thus, channels can move from lightly loaded cells to heavily loaded cells, achieving good channel usage.

III RELATED WORK

In [5], the authors propose a distributed dynamic channel allocation algorithm under the 3-cell cluster model. In their approach, channels are not pre-allocated to cells. When a cell needs a channel to support a call, it picks an available channel which is allocated to it
to support the call. If no channels allocated to it are free, then it sends a request message to all its neighbors, asking for their channel usage information[6],[7]. Based on the channel usage information received from all its neighbors, it computes the set of channels that can be borrowed and picks one such channel to borrow[8],[9]. If all the neighbors to which the selected channel has been allocated grant its request, then it allocates the channel to itself and uses this channel to support the call. After a cell grants a neighbor's request for some channel \( k \), it marks this channel for transfer. A marked channel will neither be used by itself nor be lent to grant any other neighbor's request.

### IV. PROPOSED ALGORITHM

We consider multiple cells. There are set of channels denoted by spectrum. Each cell in the system maintains as the number of channel per cell\( (n) \), ID number of cell in the system\( (C_i) \), available channels allocated to \( C_i (A_i) \), channel selected by \( C_i (k) \), channels currently used by \( C_i (P_i) \), channels transferred to the neighbors \( T_i \), channels hold by \( C_i \) for neighboring\( (J_i) \).

![Fig 3: channel borrowing process in Cell C_i](image)

The Offered load ‘\( G \)’ is given by[10]

\[
G = \frac{sxn \times B 	imes area}{\beta} \quad (1)
\]

\[
b = \frac{G^m}{(n \times \sum_i \frac{d_i^2}{c_i})} \quad (2)
\]
Where \( G \) is offered traffic per cell, \( n \) is number of channels per cell, \( B \) is the bandwidth per channel (MHz), \( \beta \) is the number of users, \( b \) is the blocking probability

When \( C_i \) needs a channel to support the traffic load, \( C_i \) starts the algorithm as follows:

Step 1: If there is any allocated channel is not used then \( M_i = A_i - P_i - J_i \), if \( P_i \neq \Phi \) then set \( P_i = P_i + \{k\} \), where \( k \) is the selected channel.

Step 2: Otherwise, the channel in \( C_i \) is used. It sends a request to all its neighbors.

Step 3: After receiving reply messages from its neighbors, each reply contains \( P_i, J_i \), and \( T_i \). \( C_i \) compute the set of channels that can be borrow.

Let \( Q = P_i \cup J_i \cup P_j \cup J_j \), if \( F = n - Q \neq \Phi \), then a channel \( k \in F \). Set \( P_i = P_i + \{k\} \), and set \( A_i = A_i + \{k\} \) otherwise \( F \neq \Phi \), there is no free channel from the other cells can be transferred.

Step 4: Channel is not allotted to any other simultaneous request, the \( C_i \) sends a confirming request to its neighboring otherwise when the received message is refused the channel is not used by \( C_i \), set \( P_i = P_i - \{k\} \), and set \( A_i = A_i - \{k\} \) if there are no more free channels, stop the algorithm.

V. RESULTS

Considering various number of channels and area of the cell equal to 10 sq.m using different bandwidths the throughput is calculated for the number of users are 4096. The plots Fig(4), Fig(5), Fig(6) are drawn for blocking probability versus offered load by varying bandwidth of the channel. The performance of algorithm is tested also by obtaining the relation between throughput versus offered load Fig(7), Fig(8), Fig(9) for different bandwidths of the channel.

![Blocking probability Vs Offered load](image1)

Fig 4: Blocking probability Vs Offered load for \((n=8)\)

![Blocking probability Vs Offered load](image2)

Fig 5: Blocking probability Vs Offered load for \((n=16)\)
VI CONCLUSIONS
In this paper, we implemented distributed dynamic channel allocation technique to utilize the multiple channels available in cells. It is observed from the results that the blocking probability decreased with increase in bandwidth. When the offered load is increasing blocking probability also decreased. It has also been observed that throughput increased in increasing offered load as well bandwidth of the channel.

VII REFERENCES

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