MOBILE COMPUTING AND HYBRID CHANNEL ALLOCATION

A Project Work Submitted in Partial Fulfillment

of the requirements for the Degree of

BACHELOR OF TECHNOLOGY

in

ELECTRONICS & COMMUNICATION ENGINEERING

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CERTIFICATE OF APPROVAL

This is to certify that the work embodied in this project entitled **MOBILE COMPUTING AND HYBRID CHANNEL ALLOCATION** submitted by Krishna Rabi Das, Abhijit Barua, Puspa Bhattarai, Utpal Borah, Dhajen Narzary, Hathorki Basumatary to the Department of Electronics & Communication Engineering, is carried out under our direct supervisions and guidance.

The project work has been prepared as per the regulations of Central Institute of Technology and I strongly recommend that this project work be accepted in partial fulfillment of the requirement for the degree of B.Tech.

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Certificate by the Board of Examiners

This is to certify that the project work entitled **MOBILE COMPUTING AND HYBRID CHANNEL ALLOCATION** submitted by Krishna Rabi Das, Abhijit Barua, Puspa Bhattarai, Utpal Borah, Dhajen Narzary, Hathorki Basumatary to the Department of Electronics & Communication Engineering of Central Institute of Technology, Kokrajhar has been examined and evaluated.

The project work has been prepared as per the regulations of Central Institute of Technology and qualifies to be accepted in partial fulfillment of the requirement for the degree of B. Tech.

Project Co-ordinator

Board of Examiners

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ABSTRACT

Present days mobile users are growing rapidly and the available frequency spectrum is limited, therefore the available spectrum must be utilized efficiently. In response to large no of channel assignment and allocation policies have been proposed and still under use.channel allocation has become an important subject of research and development in cellular network.in this research we are taking hybrid channel allocation as our base which is *one of the efficient channel allocation deployed in current cellular system.* Study says that one of the most occurring problem in efficient channel allocation is carrier to interference ratio. We can find the user traffic by realizing the factor like, call blocking probability, handoff, call holding probability etc.

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INTRODUCTION

Technological advance and rapid development of handheld wireless terminals have facilitated the rapid growth of wireless communications and mobile computing. Taking ergonomic and economic factors into account, and considering the new trend in the telecommunications industry to provide ubiquitous information access, the population of mobile users will continue to grow at a tremendous rate. Another important developing *phenomenon is the shift of many applications to multimedia platforms in order to present* information more effectively. The cellular principle divides the covered geographical area into a set of smaller service areas, called cells. Each cell has a base station and rapid information of mobile terminals (e.g., mobile phone). The base station is equipped with radio transmission and reception equipment. A group of base stations are connected to the mobile switching center (MSC). The MSC connects the cellular network to other wired or wireless networks. The base station is responsible for the communication between a mobile terminal and the rest of the information network.Now it has became an tough competition to satisfy the user providing maximum possible services as desired.so here we are trying to go for enhancing the undergoing system relying by overcoming on some major obstacles(interference) confronting the service.

MOTIVATION & OBJECTIVE

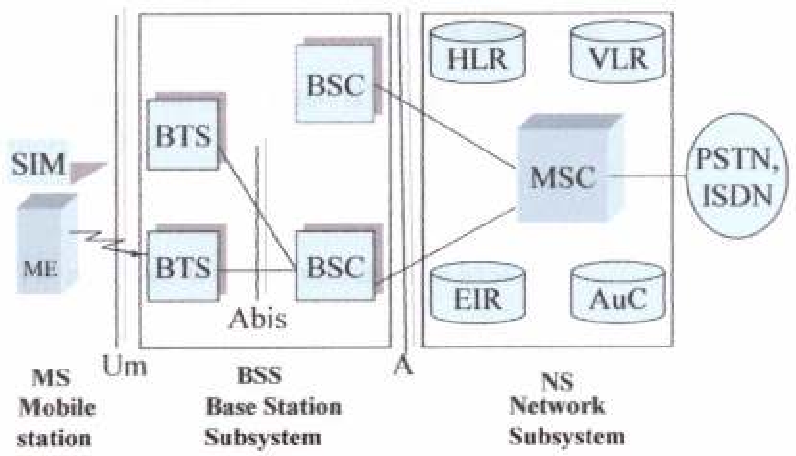
As the population is increasing in an tremendous rate it has became an competition for the communication companies to manage the heavy load within the limited bandwidth assigned to them. Although several channel allocation schemes have been provides by the engineers but it is not able to cope up with the current growth of the mobile users. Apart from the different techniques undergoing we are trying to develop an efficient scheme which will be little more efficient than the current undergoing schemes in the telecom sector. To solve this problem and to support maximum numbers of users the most accepted and intended technique is to reuse this limited number of channels up to its most possible extent without much distraction.

So our objective is to design such an channel allocation algorithm in which rather than focusing totally on different allocation schemes emphasing on hybrid channel allocation algorithm and back to back different interferences confronting us while allocating a channel to a users. The major intended interference confronting is the co channel interference leading to incompletion of the call. Thus call blocking probability and forced terminations are getting to play a major role in the system. to avoid co-channel interference total number of channels are divided into three groups and any cell can use the channel group provided that no one of its neighboring cell is holding the same group A finite number of channels is available in the cellular

GLOBAL SYSTEM FOR MOBILE COMMUNICATION(GSM)

- Digital cellular technology used for transmitting mobile voice and data services.
- GSM chose a combination of TDMA/FDMA as its access method. The FDMA part involves the division by frequency of the total 25 MHz bandwidth into 124 carrier frequencies of each 200 kHz bandwidth.
- Each channel is divided in time, using a TDMA scheme, into eight time slots. One time slot is used for transmission by the mobile and one for reception.
- Improved spectrum efficiency.
- International roaming.
- Low-cost mobile sets and base stations (BSs)
- High-quality speech
- Compatibility with Integrated Services Digital Network (ISDN) and other telephone company services.
- Supports for new services.

- General Architecture Of GSM



ARCHITECTURE OF GSM NETWORK

The GSM Network may be divided into four main Sub-Systems-

-Mobile Station (MS)

-Base Station Sub-System (BSS)

-Network and Switching Sub-system (NSS)

-Operation and Support Sub-System (OSS).

Mobile Station (MS): Two Blocks

- Mobile Equipment (ME)
- Subscribers Identity Module (SIM).

Mobile Equipment: It is the part of MS minus SIM. It has a Unique Identification No. IMEI (International Mobile Equipment Identity).

SIM – SIM (Subscriber Identity Module) is a smart card. It is used to access subscribed services. For its unique identification. SIM contains a No. IMSI (International Mobile Subscriber Identity). SIM also accommodates MSISDN (Mobile Subscriber ISDN Number).

Base Station Subsystem (BSS):

- BSS connects MS on one side and NSS on the other side.
- BSS can be divided into two units- BTS (Base Trans-Receiver Station) & BSC (Base Station Controller).
- BTS-

  -BTS provides Wireless resources to MSs.

  -BTS is usually placed in the Centre of a Cell.

  -BTS contains one or more TRXs (Trans-Receiver or Radio Units) to provide full duplex communication to MSs.

- BSC –

  -Each BSC controls a group of BTSs.

-BSC is the Radio Resource Manager.

-BSC is principally responsible for-

-Handovers within its area of coverage

-Frequency Hopping

-Exchange Functions

-Radio Resource Power level control.

NETWORK & SWITCHING SUB-SYSTEM (NSS):

- Its role is to manage communication between mobile users and other users.
- NSS consists of-

  -MSC (Mobile Switching Centre)

  -GMSC (Gateway Mobile Switching Centre)

  -HLR (Home Location Register)

  -VLR (Visitor Location Register)

  -AUC (Authentication Centre)

  -EIR (Equipment Identity Register).

MSC:

- MSC is the central component of NSS.
- MSC performs Switching and signaling functions.
- It interacts with PSTNs, other MSCs, HLR, VLR etc.
- Handling location registration through VLR.
- It controls inter-BSC and Intra-MSC handovers.
- It performs standard functions of a Digital Switch.

HLR:

- HLR contains most important Database of its MSs.
- It also stores current sub location & service entitlements.
- HLR contains IMSI, MSISDN Numbers of Subscribers.
- Subscription information of various services.
- Service Restrictions, if any.

VLR:

- VLR contains Sub parameters and Location information of Mobile Subs currently lying in its coverage area.
- When a new sub enters the coverage area of a VLR, it collects relevant information of the sub.
- VLR contains IMSI, TMSI, MSISDN, MSRN of a Sub.

AUC:

- AUC is a register used for security purposes.
- It provides parameters needed for authentication and encryption functions.
- It helps to verify user's identity.
- AUC is connected to the HLR.
- AUC is an assistant to HLR.

EIR:

- It is a register containing information about the Mobile Equipments.
- EIR is accessed during IMEI verification procedure.
- EIR contains IMEIs which may be in any of the three lists-

  -White or Valid Lists

  -Grey or Monitored Lists

  -Black or Prohibited Lists.

OPERATION & SUPPORT SUB-SYSTEM (OSS):

- OSS is connected with NSS and BSS to control and monitor the GSM System.
- OSS also controls the traffic load of BSS.
- OSS has only one sub-unit called OMC (Operation and Maintenance Centre).
- OMC may have further segregation as-

  - OMC-S for NSS part activity &

  - OMC-R for BSS (RSS) part activity.

CHANNEL ALLOCATION

- What is channel allocation?
- A given radio spectrum is to be divided into a set of disjointed channels that can be used simultaneously while minimizing interference in adjacent channel by allocating channels appropriately (especially for traffic channels).
- Channel allocation schemes can be divided in general into
  - Fixed Channel Allocation schemes (FCA schemes);
  - Dynamic Channel Allocation schemes (DCA schemes);
  - Hybrid Channel Allocation schemes (HCA schemes: combining both FCA and DCA techniques);

➢ Simple Borrowing (CB) Schemes

- In CB schemes, cell (acceptor cell) that can borrow free channels from its neighboring cell (*donor cell)* to accommodate new calls.
- Borrowing can be done from an adjacent cell which has largest number of free channels (*borrowing from the richest*)
- Select the first free channel found for borrowing using a search algorithm (*borrow first available scheme*)
- Return the borrowed channel when channel becomes free in the cell (*basic algorithm with reassignment*)
- To be available for borrowing, the channel must not interfere with existing calls, as shown in the next figure.

- Simple Borrowing (SB): A nominal channel set is assigned to a cell, as in the FCA case. After all nominal channels are used, an available channel from a neighboring cell is borrowed.

- Borrow from the Richest (SBR): Channels that are candidates for borrowing are available channels nominally assigned to one of the adjacent cells of the acceptor cell. If more than one adjacent cell has channels available for borrowing, a channel is borrowed from the cell with the greatest number of channels available for borrowing.

- Basic Algorithm (BA): This is an improved version of the SBR strategy which takes channel locking into account when selecting a candidate channel for borrowing. This scheme tried to minimize the future call blocking probability in the cell that is most affected by the channel borrowing.

- Basic Algorithm with Reassignment (BAR): This scheme provides for the transfer of a call from a borrowed channel to a nominal channel whenever a nominal channel becomes available.

- Borrow First Available (BFA): Instead of trying to optimize when borrowing, this algorithm selects the first candidate channel it finds.

➢ FIXED CHANNEL ALLOCATION (FCA):

- In FCA schemes, a set of channels is permanently allocated to each cell in the network.

- If the total number of available channels in the system S is divided into sets, the *minimum number of channel sets N required to serve the entire coverage area is related to the frequency reuse distance D as follows:*

$$N = D^2 / 3R^2$$

- Due to short term fluctuations in the traffic, FCA schemes are often not able to maintain high quality of service and capacity attainable with static traffic demands. One approach to address this problem is to borrow free channels from neighboring cells.

➢ DYNAMIC CHANNEL ALLOCATION (DCA):

- In DCA schemes, all channels are kept in a central pool and are assigned dynamically to new calls as they arrive in the system.

- After each call is completed, the channel is returned to the central pool. It is fairly straightforward to select the most appropriate channel for any call based simply on current allocation and current traffic, with the aim of minimizing the interference.
- DCA scheme can overcome the problem of FCA scheme. However, variations in DCA schemes center around the different cost functions used for selecting one of the candidate channels for assignment.

➢ Dynamic Channel Allocation (DCA) TYPES:

- DCA schemes can be centralized or distributed.
- The centralized DCA scheme involves a single controller selecting a channel for each cell;
- The distributed DCA scheme involves a number of controllers scattered across the network (MSCs).
- Centralized DCA schemes can theoretically provide the best performance. However, the enormous amount of computation and communication among BSs leads to excessive system latencies and renders centralized DCA schemes impractical. Nevertheless, centralized DCA schemes often provide a useful benchmark to compare practical decentralized DCA schemes.

➢ Functions of Centralized DCA:

- For a new call, a free channel from the central pool is selected that would maximize the number of members in its co-channel set.
- Minimize the mean square of distance between cells using the same channel.

➢ First Available Centralized DCA (FA): Among the DCA schemes the simplest one is the FA strategy. In F A, the first available channel within the reuse distance encountered during a channel search is assigned to the call.
The FA strategy minimizes the system computational time.

➢ Locally Optimized Dynamic Assignment (LODA): The channel selection is based on the future blocking probability in the vicinity of the cell where a call is initiated.

- Selection with Maximum Usage on the Reuse Ring (RING): A candidate channel is selected which is in use in the most cells in the co-channel set. If more than one channel has this maximum usage, an arbitrary selection among such channel is made to serve the call. If none is available, then the selection is made based on the FA scheme.

- Mean Square (MSQ): The MSQ scheme selects the available channel that minimizes the mean square of the distance among the cells using the same channel.

- 1-clique: This scheme uses a set of graphs, one for each channel, expressing the non co-channel interference structure over the whole service area for that channel.

- DISTRIBUTED DCA Schemes:

- It is based on one of the three parameters
  - Co-channel distance

    - co-channel cells in the neighborhood not using the channel

    - Sometimes adjacent channel interference taken in to account
  - Signal strength measurement

    - anticipated CIR above threshold
  - Signal to noise interference ratio

    - satisfy desired CIR ratio.

➢ HYBRID CHANNEL ALLOCATION (HCA):

- HCA schemes are the combination of both FCA and DCA techniques.
- In HCA schemes, the total number of channels available for service is divided into fixed and dynamic sets.
  - The fixed set contains a number of nominal channels that are assigned to cells as in the FCA schemes and, in all cases, are to be preferred for use in their respective cells.

In HCA, the total number of channels available for service is divided into fixed and dynamic sets. The fixed set contains a number of nominal channels that are assigned to cells as in the FCA schemes and, in all cases, are to be preferred for use in their respective cells. The second set of channels is shared by all users in the system to increase flexibility. When a call requires service from a cell and all of its nominal channels are busy, a channel from the dynamic set is assigned to the call. The channel assignment procedure from the dynamic set follows any of the DCA strategies described in the previous section. For example, in the studies presented in, the FA and RING strategies are used, respectively, for DCA,. Variations of the main HCA schemes include HCA with channel reordering and HCA schemes where calls that cannot find an available channel are queued instead of blocked. The call blocking probability for an HCA scheme is defined as the probability that a call arriving to a cell finds both the fixed and dynamic channels busy.

Performance evaluation results of different HCA schemes have been presented in. In , a study is done for an HCA scheme with Erlang-b service discipline for uniform size and shape cells where traffic is uniformly distributed over the whole system. The measure of interest is the probability of blocking as the load increases for different ratios of fixed to dynamic cells. As shown in, for a system with fixed to dynamic channel ratio, the HCA gives a better grade of service than FCA for load increases up to 50 percent. Beyond this load HCA has been found to perform better in all cases studied in. A similar pattern of behavior is obtained from the analysis in where the HCA scheme employed uses the FA DCA scheme and Erlang-c service discipline (calls that cannot find an available channel are queued instead of blocked). In addition, the HCA scheme with Erlang-c service discipline has lower probability of blocking than the HCA scheme with Erlang-b service discipline. This phenomenon is expected because in the former case calls are allowed to be queued until they can be served.

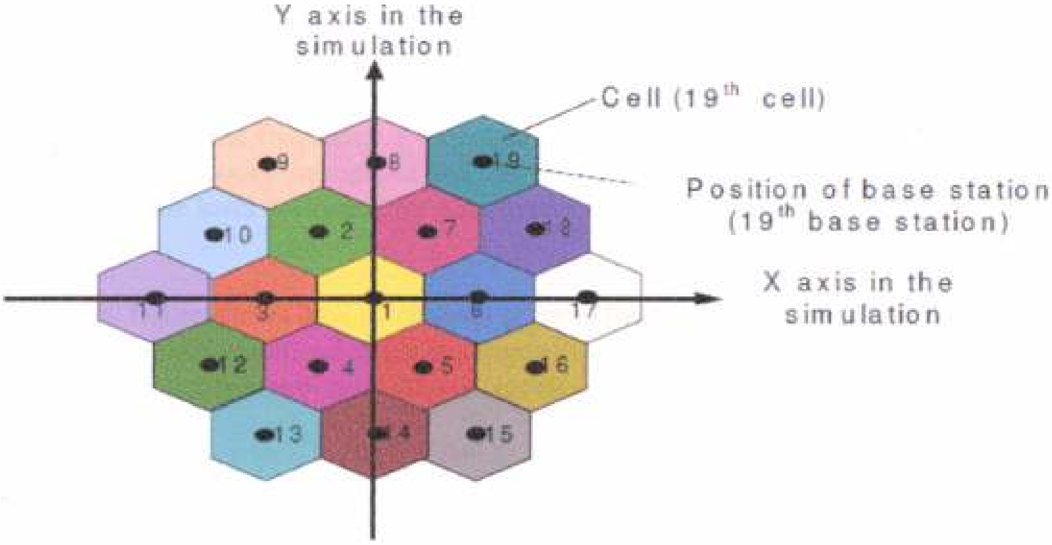
The ratio of fixed to dynamic channels is a significant parameter which defines the performance of the system. It would be interesting to find the optimum ratio in order to achieve better system performance. In general, the ratio of fixed to dynamic channels is a function of the traffic load and would vary over time according to offered load distribution estimations. HCA schemes have variants which add channel reordering, that is, switching channels assigned to some of the calls in progress to maintain a nearly optimum separation between coverage areas by simultaneously using the same channel in order to reduce inefficiency at high load. As in the hybrid borrowing strategy, channel reordering is done when nominal (fixed) channels become vacant. Namely, a nominal channel is assigned instead of the dynamic channel, which requires channel handoffs between occupied channels to realize an optimal allocation. This improves performance greatly by producing a significant increase in channel occupancy, but a huge amount of computing is required for channel rearrangement in a large system

Example: When a call requires service from a cell and all of its nominal channels are busy, a channel from the dynamic set is assigned to the call.

- Request for a channel from the dynamic set is initiated only when the cell has exhausted using all its channels from the fixed set.
- Optimal ratio: ratio of number of fixed and dynamic channels.
- 3:1 (fixed to dynamic), provides better service than fixed scheme for 50% traffic.
- Beyond 50% fixed scheme perform better.

For dynamic, with traffic load of 15% to 32%, better results are found with HCA.

<u>LAYOUT OF THE CELL USED IN OUR SYSTEM</u>



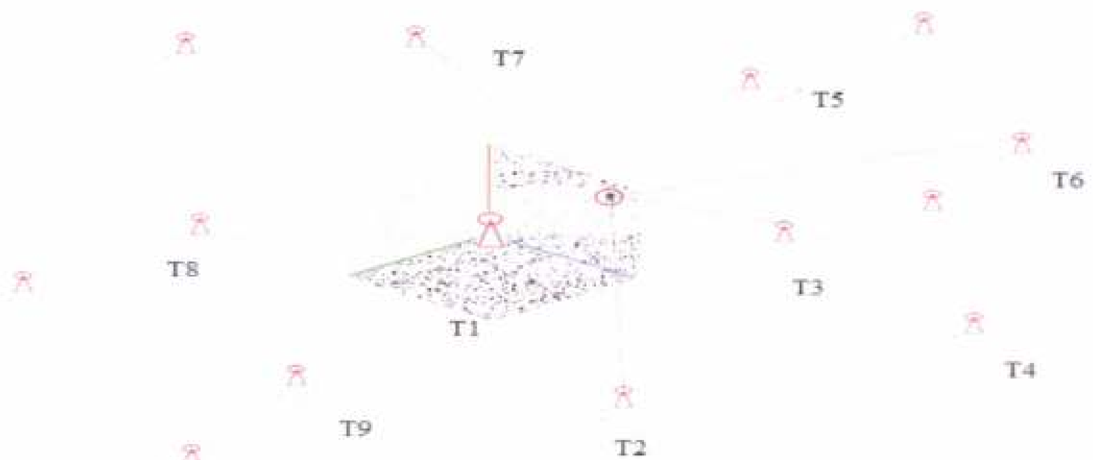
The above figure shows the cell layout used in our algorithm.Here we find three tiers with 6cells in the first tier and 12 cells in the second tier. Similarly if third tier will be used then the no. of cell will be 18.

CO- CHANNEL INTERFERENCE:

* Frequency reuse implies that in a given coverage area there are several cells that use the same carrier frequencies. These cells are called co-channel cells and the interference between signals from these cells is called co-channel interference.

* Co-channel interference occurs when two or more entities in the same geographic area transmit on the same frequency. Co-channel interference reduces signal to noise ratio; which, in turn, reduces throughput and can even interrupt communications when the SNR drops below the level necessary for a particular technology to operate effectively

The below figure shows how co channel occurs.Here T1,T2,T3,T4,T5,T6,T7,T8,T9 are co channel cells.R is using a channel assigned by T1 but the same channel is again used by all the other co channel cells,thus occurring a type of interference called as co channel intereferce.



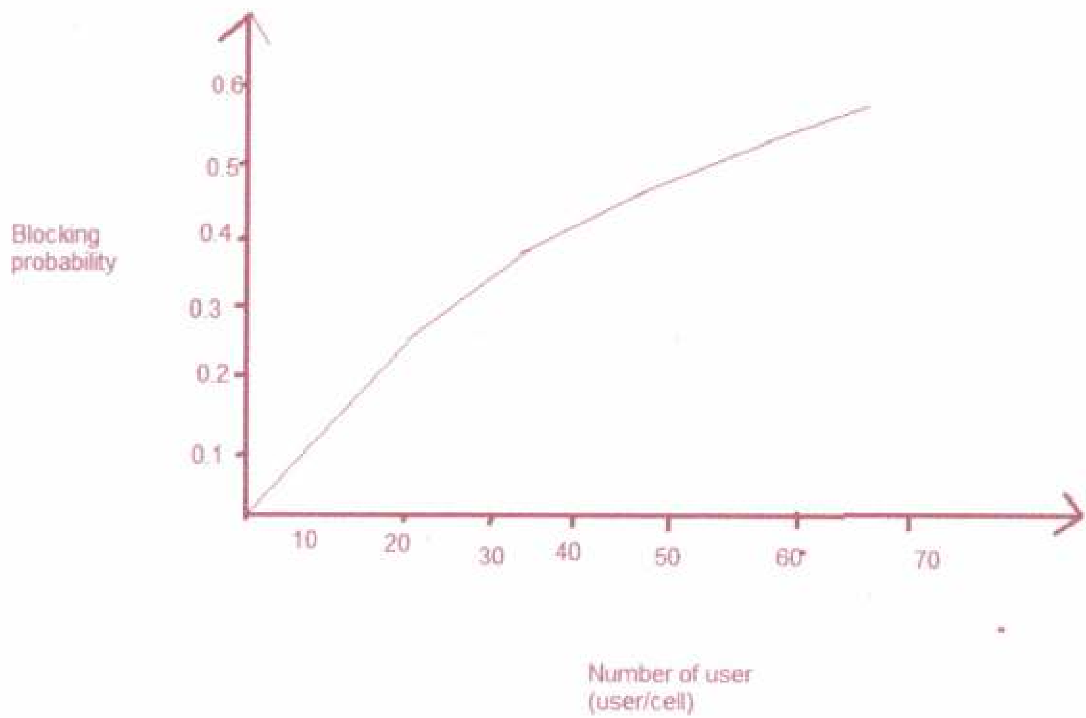
DIFFERENT PARAMETERS DETERMINING THE PERFORMANCE OF THE NETWORK ARE:

CALL BLOCKING PROBABILIY:

It is the ratio of number of calls which is blocked due to unavailability of channels in the system to the total no of calls initiated in the system'

Call blocking probability =no of blocked call/total no of call initiated.

Through blocking probability we can determined how traffic status in that particular cell within that specified time. Thus by looking into this criteria we can think of the no of channel to be allocated to that cell.



We can evaluate the results of our system on the consideration of blocking probability.

CALL HOLDING TIME:

Every initiated call has its own call holding time, and the initiated call is terminated after such a time. The holding time of each call is subject to exponential distribution with a mean value. In our system, we obtained the value of the holding time as the output function, which outputs a random value subject to exponential distribution with an average value of holding time

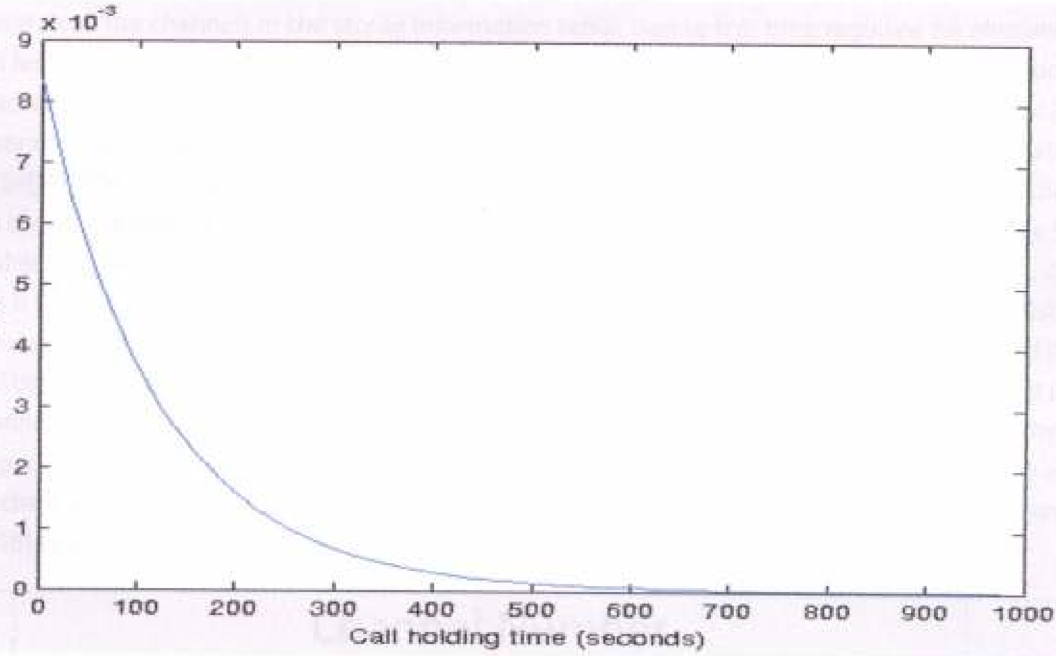


Fig: the above fig shows the call holding probability.Initially it is much higher but as the time passes away its probability also decreases.

BASIC CONCEPT ON ALLOCATION OF CHANNELS:

In this algorithm, co-channel interference is avoided by assigning the channel groups to base station provided that no neighbouring base stations acquire the same channel group. After acquiring the channel group, each base station acquires the channel. In order to acquire the channel each base station has to maintain the storage information table. Base station will access only the partition of the table. For example if base station 3 acquire group (Ga) then BS3 has to search the channel from group (Ga) , no need to search all the channels in the storag information table. Due to this time required for allocating a channel is less. The storage information table is a two dimensional table that contains the information about channel usage for itself and its neighbouring base station. The size of the table is determined by the number of channels in the cellular network and number of cells in the system. The size of the table is given by S=(N*M)Where, M = Number of channels in the cellular network. N = Number of cells in the system.In order to avoid interference, each group consists of channels having spacing. For example if total number of channels are 24 then group a (Ga) consist of channel number 1, 5, 7,11, 13, 17, 19, 22 and group b (Gb) consist of channel number 2, 4, 8, 10, 12, 15, 21, 24 similarly in group c (Gc) consist of channel number 3, 6, 9, 14, 16, 18, 20, 23. Now whenever base station 0 (BS0) wants a channel and if group b (Gb) is allocated then BS0 will directly search a channel from storage information table and pick a free channel and if a another call is coming in BS0 then it will take another free channel. Due to the channel spacing in one group the co-channel interference is avoided. For example, BS0 acquires Gb and allocated channel number is 4 and if another call is coming then it will pick next channel number from group b (Gb) that is channel number 8.

Base Station	Channel Number												
Numbe r	Ga				Gb				Gc				Number of Assignable Channels
	1	5	...	22	2	4	...	24	3	6	...	23	
BS3	1		...	1			...				...		3
BS0			...		1	1	...				...		2
BS1			...				...		1		...		1
BS2			...				...				...		0
BS4			...			1	...	1			...		3
BS5			...				...				...		0
BS6			...				...		1	1	...	1	6

Base Station	Channel Number												
Number	Ga				Gb				Gc				Number of Assignable Channels
	1	5	...	22	2	4	...	24	3	6	...	23	
BS3	1		...	1			...				...		3
C/I for BS3(dB)	23	21			24			25					
BS0			...		1	1	...				...		2
c/I for(dB) BS0					19	30							
BS1			...				...		1		...		1
c/I for BS1(dB)									27				
BS2			...				...				...		0
c/I for BS2(dB)													
BS4			...			1	...	1			...		3
c/I for BS4(dB)						29		28					
BS5			...				...				...		0
c/I for BS5(dB)													
BS6			...				...		1	1	...	1	6
C/I for BS6(dB)									30	30			

PROPOSED ALGORITHM USED

Algorithm for assigning a group from group user table:

*Base station receives request from MSC for the channel.

* Base station initializes its group user table.

*checks competition=0.

* selects a group from group user table.

* checks if other BS has the same request or not.

* checks if any other BS is currently using it or not.

If using then again select another channel from the group user table.

If not then

*look for the BS which has highest competition and assign the channel to it.

Algorithm of the work performed

```
generating the coordinates of center of celss situated

% nth tiers.

.

for i=1: no_of_tier

find x_coord and y_coord

end


% this part will define some points over each sector. and will store
the

% locations of individual user.

% for sector -I

while i<=user_no

   find the locations

. %for sector2

find the locations

%for sector3

find the locations

show the image.
```

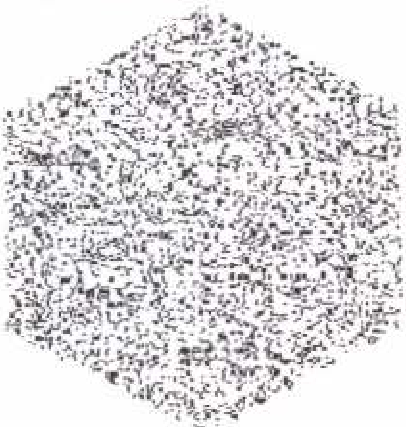
EXPERIMENTAL RESULT

After performing the designed algorithm we have obtained a hexagonal matrix which defines the location of a user. This user location depends on the location a particular user is initiating the call from a cell. Although it is difficult to locate the exact position but a definite area can be found as the cell is divided into three sectors.

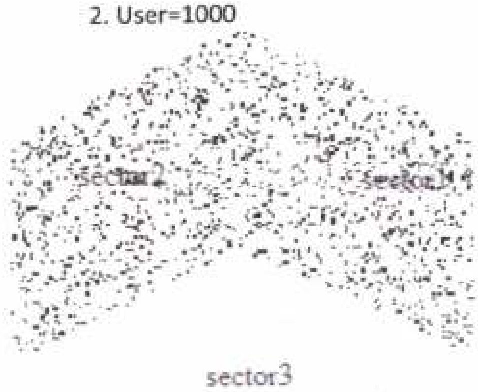
In the system, when, a user initiates a call, we generate a random integer whose value randomly fluctuates from 1 to user number and locates a user on a location in a cell. As a result, each user is scattered in a certain point in a cell with different probability at its initiation, and we can obtain non uniform user distribution over a cell.

The following hexagonal matrix is the outcome of our algorithm performing in matlab

1. User=2000

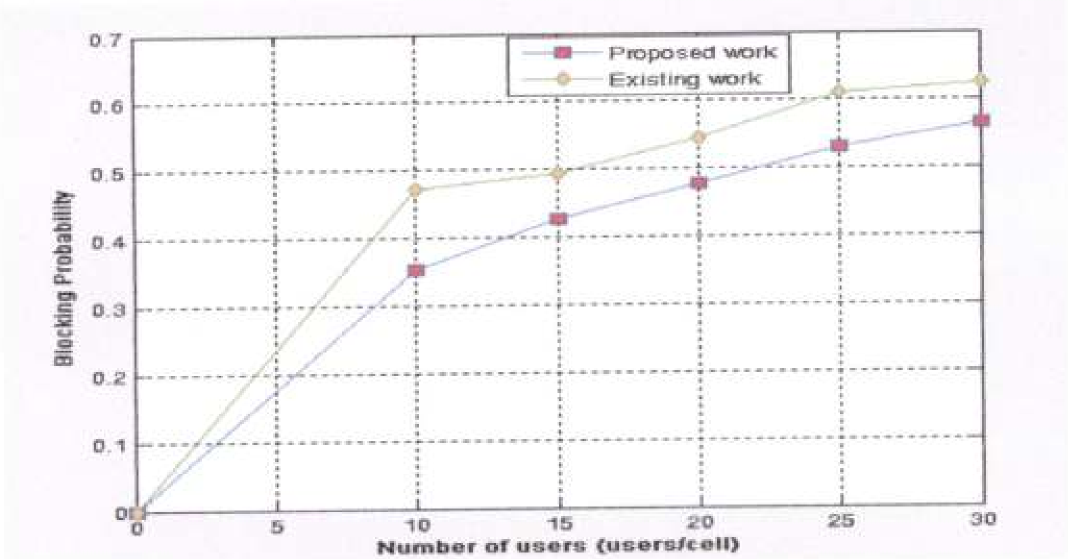


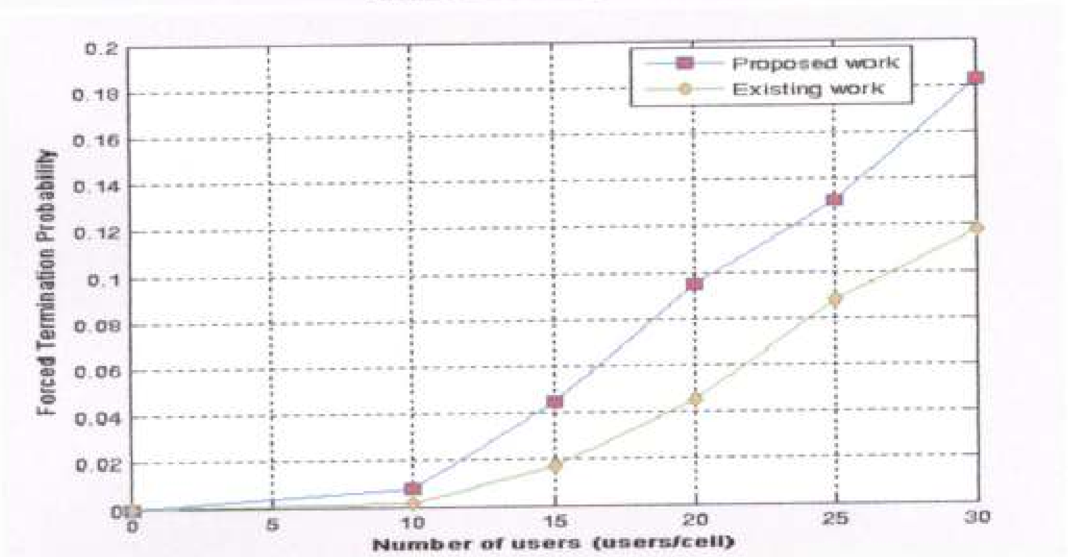
2. User=1000



FUTURE WORK

Our future considers the performance of call blocking probability of distributed hybrid channel allocation algorithm. In future work, the performance of the algorithm is measured with dropping probability with adaptive channels reserved for handoff calls without reducing the blocking probability. Following fig. roughly defines our future approach.





CONCLUSION

This paper proposed the distributed hybrid channel allocation algorithm which avoids co channel interference by executing this algorithm at each base station. To avoid co-channel interference the channels in the system are divided into the three groups and a base station can use the channel group only when no one of its neighboring base station is using that group. The result will indicates clearly the channel allocation algorithm exhibits better performance than the undergoing channel allocation algorithm. Again the blocking probability is depends on uniform and non uniform traffic. In uniform traffic distribution each cell has same channel demand and in non uniform traffic distribution each cell has different channel demand. So the blocking probability of non-uniform distribution is less as compared to uniform call distribution.

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