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Hybrid Channel Allocation in Wireless Mobile Network Using Hybrid Genetic Algorithm

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ABSTRACT: The frequency spectrum that is available to a wireless system is usually limited and hence the channels within the spectrum need to be reused. Channel reuse causes interference within the network and interference degrades the SNR of received Signal, which decreases the capacity of the system. In this paper, we have devised a method to allocate the frequency spectrum to users appearing in a mobile cellular network. The hybrid channel allocation strategy is applied to reduce the blocking of calls and increase the output efficiency of the system while maintaining desired quality constraints of interference and signal quality. It has been demonstrated through the results that the performance of the hybrid channel allocation is superior to other channel allocation strategies such as FCA and DCA. It is demonstrated that the SNR level close to 40 dB is achieved in all the simulation. This level of SNR provides superior quality of communication. In this we have easily allocate the channels according to the need of SNR and frequency reuse distance with the help of GA and at last we have seen that with the help of limited number of frequency channels we fulfill the need of all cells and also the blocking portability is reduced.

Keywords: Frequency spectrum, hybrid channel allocation, channels, blocking.

I. INTRODUCTION

This paper first reviews about the allocation of channels to incoming GSM mobile calls with Hybrid Channel Allocation(HCA) scheme using Hybrid Genetic Algorithm(HGA). HGA is a combination of Genetic Algorithm and Simulated Annealing and is a new method of distributing the channels to a cellular network since it utilizes the process of natural selection followed by local search method . This new scheme for channel allocation is developed and implemented as opposed to the log domain presented by Smith *et. al.* [1, 13]. The performance of these schemes is analyzed by comparing the blocking probability for different representative ratios involving different schemes of user distribution. According to [3], most of the existing channel allocation methods are based on the deterministic methods. These methods require a set of known input parameters and rules to predict the channel assignment results. However, the channel assignment becomes difficult to be solved by the deterministic methods due to its complexity and computational time issues. Technique of frequency reuse has been proposed to maximize the frequency spectrum capacity in cellular network. Frequency reuse concept comprises of using the same frequency channel simultaneously with other cells subject to the base transceiver station (BTS) distance. However this technique would lead to EMC interferences. Hence an efficient frequency reuse pattern is necessary to minimize the interferences. There are numbers of heuristics approaches being suggested to overcome the channel assignment problems based on fixed reuse distance concept such as neural networks (NNs) in [1], simulated annealing (SA) in [4], Tabu search (TS) in [5] and genetic algorithm (GA). The evolutionary algorithm (EA) approaches such as GA outperforms other methods such as NNs, SA and TS, in terms of the ability to explore information over search spaces [6]. This type of algorithm can be used to solve complicated optimization task, such as optimal-local, multi-constrained and NP-complete problems [7].

II. LITERATURE SURVEY

The GA originates from the principal of natural selection and survival of the fittest. The algorithm is capable to obtain solutions in highly-nonlinear problems, which are characterized by multimodal solution space [8]. GA can be defined as highly parallel mathematics algorithm by [9] which transforming the population, each with an associated fitness value, into a new generation using operations based on the theories of evolution. Several GA-based approaches have been used to solve the channel assignment problem. For instance, [10] defined an asexual crossover and a special mutation to solve the channel assignment problem. However such crossover will easily destroy the structure of current solution and thus, causing the algorithm difficult to converge. In addition, [11] represented the channel assignment solution as a string of channel numbers which are grouped in such a way that each cell has a specified number of channels rather than using binary string. The results satisfied the traffic requirement.

The evolution is then advanced with a partially matched crossover operator (PMX) and basic mutation. Helonde et. al. in [14] presented a new Hybrid Channel Allocation (HCA) scheme that allocate a channel to an incoming call from pool of available channel such as basic constraints are satisfied. The proposed scheme presents an efficient Integer Linear Program (ILP) formulation that helps to allocate channel to a new call. This formulation does not allow channel reassignment of existing calls. Simulation is performed on a standard ideal network model of 70 channels and 49 cells. Experiments are done using MATLAB 7.9.0 R2009.

Y.S. Chia in [13] Adaptive HCA using Simple Genetic Algorithm: A Genetic Algorithm based optimization in HCA scheme is proposed which is capable to adapt the population size to the number of eligible channels for a particular cell upon new call arrivals in order to achieve faster convergence speed. Besides, the proposed approach can handle both the reassignment of existing calls as well as the allocation of channel to a new call in an adaptive process to maximize the utility of the limited frequency spectrum. The simulation for both uniform and non uniform traffic distributions on a 49-cells network model is shown.

D K Singh in [22] A Dynamic Channel Assignment using Modified Genetic Algorithm- The objective of the Dynamic Channel Assignment problem considered here is to assign a required number of channels to each cell in a way to achieve both efficient frequency spectrum utilization and minimization of interference effects (by satisfying a number of channel reuse constraints). Dynamic Channel Assignment (DCA) assigns the channels to the cells dynamically according to traffic demand, and hence, can provide higher capacity (or lower call blocking probability), fidelity and quality of service than the fixed assignment schemes. Devising a DCA, that is practical, efficient, and which can generate high quality allocations, is challenging and is studied in this paper.

III. NEED OF HYBRID GENETIC

In this hybrid method we are combining the two techniques i.e. genetic and Simulated annealing. Simulated annealing is a local search algorithm. It is based on the analogy between the process of finding a possible best solution of a combinatorial optimization problem and the annealing process of a solid to its minimum energy state in statistical physics. The searching process starts with one initial random solution. A neighborhood of this solution is generated using any neighborhood move rule and then the cost between neighborhood solution and current solution can be found with Equation,

$$C_{diff} = C_i - C_{i\_1}$$

where C_{diff} represents change amount between costs of the two solutions. C_i and C_{i_1} represents neighborhood solution and current solution. The termination criterion (outer loop) is predetermined.

$$\exp(-Cdiff/T) > R$$

where T temperature is a positive control parameter. R is a random number between 0 and 1.

Unlike other search and optimization techniques, a genetic algorithm promises convergence but not optimality, not even that it will find local maxima. This implies that the choice of when to stop the genetic algorithm is not well-defined. We stop the genetic algorithm process when 50 generations have gone by with no better chromosome identified. Since there is no guarantee of optimality, successive runs of the GA will provide different chromosomes with varying fitness measures. This is one of the drawbacks of using a genetic algorithm for optimization - since there is no guarantee of optimality, there is always the chance that there is a better chromosome lurking somewhere in the search space.

Although there is no guarantee of optimality, we are assured of exponential convergence. If we run the GA several times, it will converge each time, possibly at different optimal chromosomes. The schemata which promise convergence are actually indicative of the regions in the search space where good chromosomes may be found. Typically, the GA is coupled with a local search mechanism to find the optimal chromosome in a region.

So, if we use a hybrid algorithm, the problem reduces to ensuring that we run the GA as many times as is needed to pick out all the good regions. If we know before hand the shape of the search space, we can estimate the number of regions we expect to find. We can then repeatedly run the GA until these regions have been found. In most practical problems, however, the shape of the search space is not known before hand. The systematic approach is then to repeat GA runs until the best chromosomes that are found start to repeat with some regularity.

GAs are not good at identifying the optimal value of a chromosome for a problem but do very well in identifying the regions where those optima lie. Therefore, we use a hybrid GA every m generations, we anneal the best m% of the population. This has the effect of moving the top chromosomes in that generation (which are the result of exponential convergence toward the best regions) to the local maximum in their region. combined the strengths of genetic algorithm (GA) and simulated Annealing (SA), to solve this problem. These two algorithms are both naturally motivated, general purpose optimization procedures of generating new points in the search space by applying perturbation operators to current points [6]. The difference is that genetic algorithm operates on the whole population and the search process may be trapped in local optima, while simulated annealing possesses the capability of jumping out of local optimization. By reasonably combining the respective advantages of the two paradigms, we develop a hybrid genetic algorithm simulated annealing. Hence, we can combine two algorithms, which is a relatively newer area of research. The GA is carried out as a main frame of this hybrid algorithm while SA is used as a local search strategy to help GA jump out of local optima.

IV. PROPOSED MODEL

Our aim is provide wireless service in terms of GSM mobile communication technique by providing reusable frequency channels to the available users in a particular area. We have assumed a hypothetical area which is divided into network of 64 hexagonal subareas called ‘cells’. We have 70 total frequency bands that needs to be allocated to the users appearing in these 64 cells. We have to therefore allot optimum channels to the area as per the user requirements. The scheme of channel assignment is hybrid channel allocation which is a combination of fixed channel allocation (FCA) and dynamic channel allocation (DCA). The radius of each cell is assumed 1 unit and therefore the frequency reuse distance is

$$D = R\sqrt{(3K)}$$

We have assumed R = 1 unit. If the frequency reuse factor or the cluster size is K = 3, D = 3 units .We have divided the total 70 channels into two subsets each of FCA and DCA. FCA set has 21 channels while DCA set has 49 channels corresponding to a representative ratio of 21:49.

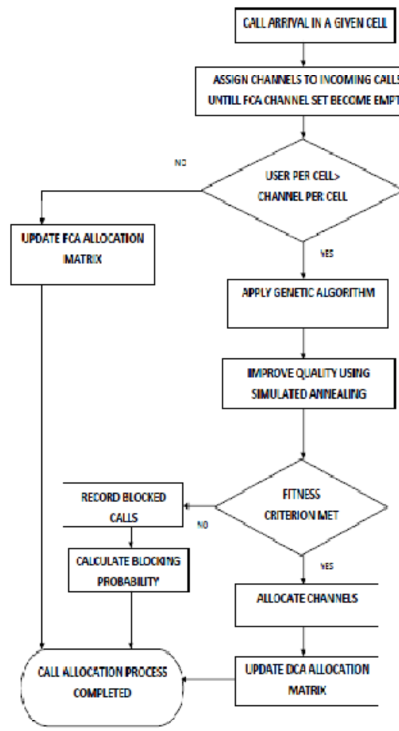

Fig. 1. Flow Chart of The HGA HCA.

V. SIMULATION RESULTS

The simulations are done by using MATLAB. The following assumptions are made in the simulation:
GSM 900 890 TO 915 MHZ & 935 TO 960 Mhz, Radius & Size Of Hexagonal Cell = 1,Total Cells = 64

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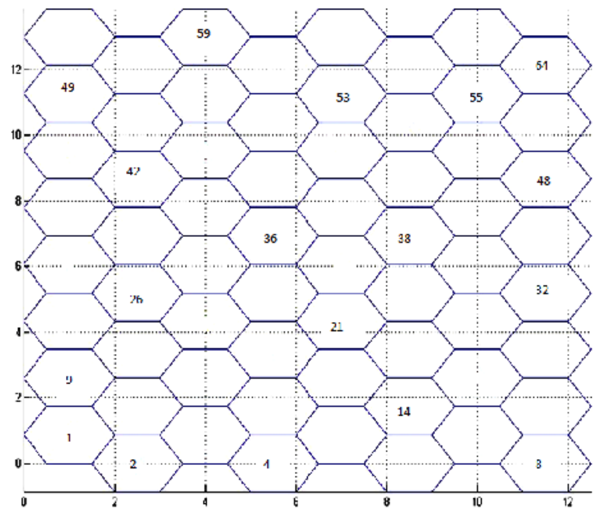

Fig. 2. Cell structure created using MATLAB with cell numbers of some cells specified.

Distance Between each cell is calculated and the matrix of distance between cells is formed. The distance vectors are calculated in the matlab and the result is displayed for distance between each of the 64 cells with the distance of other 64 cells A matrix of 64x64 is created to find the distance between the cells but for convenience we have shown only a 10x10 matrix for the distance. While evaluation of fitness function distance, we refer to the distance matrix as shown below.

Table 1 : Distance between Cells for first 10 cells.

	1	2	3	4	5	6	7	8	9	10
1	0	1.73	3	4.58	6	7.54	9	10.53	1.73	1.73
2	1.73	0	1.73	3	4.58	6	7.54	9	3	1.73
3	3	1.73	0	1.73	3	4.58	6	7.54	3.46	1.73
4	4.58	3	1.73	0	1.73	3	4.58	6	5.19	3.46
5	6	4.58	3	1.73	0	1.73	3	4.58	6.24	4.58
6	7.54	6	4.58	3	1.73	0	1.73	3	7.93	6.24
7	9	7.54	6	4.58	3	1.73	0	1.73	9.16	7.54
8	10.53	9	7.54	6	4.58	3	1.73	0	10.81	9.16
9	1.73	3	3.46	5.19	6.24	7.93	9.16	10.81	0	1.73
10	1.73	1.73	1.73	3.46	4.58	6.24	7.54	9.16	1.73	0

A) Scheme 1

Table 2: Demand vectors of users appearing in the cells.

Demand Vector	**Non Uniform Traffic Demand for 64cells**	**Total calls**
D1	1234123412341234123412341234-1234123412341234123412341234-1234123412341234	**160**
D2	2214431245115211134243221-2214431245115211134243221-2214431245115211	**157**
D3	4143443134411443314434 14-4143443134411443314434 14-4143443134411443	**192**
D4	5322314440441452514253 31-5322314440441452514253 31-5322314440441452	**192**
D5	1452215415425412425141 52-1452215415425412425141 52-1452215415425412	**194**
D6	6231123623161362612321 63-6231123623161362612321 63-6231123623161362	**194**
D7	5511151511555421612344 31-5511151511555421612344 31-5511151511555421	**198**
D8	4343425144445612352324 24-4343425144445612352324 24-4343425144445612	**218**
D9	1056435612466522232742 26-1056435612466522232742 26-1056435612466522	**230**

Table 3: Tabular representation of results compared with [21].

USERS	**NUMBER OF CALLS BLOCKED**			
Demand vector	**SIMPLE HCA**	**GRAPH THEORY HCA**	**GA HCA**	**HGA HCA**
D1	0	0	0	0
D2	0	0	0	0
D3	1	1	1	0
D4	3	3	2	0
D5	4	4	2	0
D6	8	6	0	0
D7	5	5	2	0
D8	9	10	9	2
D9	17	17	14	7

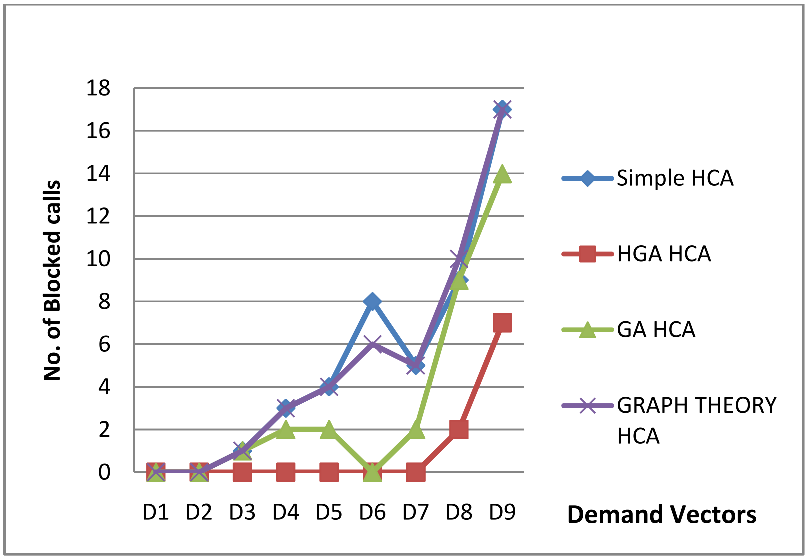

Fig. 3. The graph clearly shows superiority of HGA HCA over other schemes.

VI. CONCLUSION

This paper has been an investigation into the application of heuristic algorithms to solve complex optimization problems arising in wireless communication systems. Most of these problems are NP hard and involve numerous constraints, which are intractable to solution using. Hence this study has considered Hybrid Genetic Algorithm as an optimization approach to achieve the research objective to solve the realistic problem of channel allocation for GSM cellular networks.

The hybridization of Genetic Algorithm with Simulated Annealing gives improved performance in terms of SNR. Without hybridization, the number of mating cycles required for achieving this level of SNR are more. With hybridization, the convergence is achieved earlier in lesser number of mating cycles and the output SNR is better.

It is demonstrated that the SNR level close to 40 dB is achieved in all the simulation. This level of SNR provides superior quality of communication. In this we have easily allocate the channels according to the need of SNR and frequency reuse distance with the help of GA and at last we have seen that with the help of limited number of frequency channels we fulfill the need of all cells and also the blocking portability is reduced.

The blocking probability for very high traffic is exemplarily small as compared to the references. In other algorithms, the blocking rate is more than 75% for a certain value of users per cell but using HGA a blocking level of 50% is achieved which shows the superiority of our method over previous methods.

REFERENCES

[1]. Smith K.A, and Palaniswami M, “Static and dynamic channel assignment using neural networks,” *IEEE J. Select. Areas Commun*, Vol. **15**, pp. 238-249, 1997.

[2]. Vidyarthi G, Ngom A., and Stojmenovic I, “A hybrid channel assignment approach using an efficient evolutionary strategy in wireless mobile network,” *IEEE Trans. Veh. Techno*, Vol. **54**, pp. 1887–1895, 2005.

[3]. Sansalidis H.G, Stavroulakis P.P, and Rodriguez-Tellez J, “An efficient evolutionary algorithm for channel resource management in cellular mobile systems,” *IEEE Trans. Evol. Comput*, Vol. **2**, pp. 125- 137, 1998.

[4]. Chen J, Olafsson S, and Gu X, “Observation on using simulated annealing for dynamic channel allocation in 802.11 WLANs,” *Proc. VTC Spring*, pp. 1801-1805, 2008.

[5]. Lee C.Y, and Kang H.G, “Cell planning with capacity extension in mobile communications: a tabu search approach,” *IEEE Trans. Veh. Technol*., Vol. **49**, pp. 1678-1691, 2000.

[6]. Lima M.A. C, Araujo A.F.R, and Cesar A.C., “Dynamic channel assignment in mobile communications based on genetic algorithms,” *13th IEEE International Symposium on Personal, Indoor and Mobile Radio Communication*, Vol. **5**, pp. 2204-2208, 2002.

[7]. Yoshino J, and Othomo I, “Study on efficient channel assignment method using the genetic algorithm for mobile communication systems,” *Journal Soft Computing – A Fusion of Foundation, Methodologies and Applications*, Vol. **9**, pp. 143-148, 2005.

[8]. San Jose-Reveuelta L.M, “A new adaptive genetic algorithm for fixed channel assignment,” *Journal Information Sciences*, Vol. **177**, pp. 2655-2678, 2007.

[9]. Ghosh S.C, Sinha B.P, and Das N, "Channel assignment using genetic algorithm based on geometric symmetry," *IEEE Trans. Veh. Techno.*, Vol. **52**, pp. 860-875, 2003.

[10]. Cuppini M, "A genetic algorithm for channel assignment problems," *European Trans. Telecom. Rel. Techn*., Vol. **5**, pp. 285-294, 1994.

[11]. Lai W.K, and Coghill G.C, "Channel assignment through evolutionary optimization," *European Trans. Telecom. Rel. Techn*., Vol. **45**, pp. 91-96, 1996.

[12]. Shinde S. R, Chowdhary Dr. G. V, Dhore M. L, "Hybrid Channel Allocation in Wireless Network using Evolutionary Strategy," *IEEE Conf. on Advance Computing*, Vol. **7**, pp. 72-77, Feb 2010.

[13]. Chia Y.S, Siew Z.W, Kiring A, Yang S.S, "Adaptive Hybrid Channel Assignment in Wireless Mobile Network via Genetic Algorithm",*IEEE International Conference on Hybrid Intelligent Systems* ,Vol. 11, pp. 511-516,2011.

[14]. Helonde, Wadhai V, Deshpande Vivek S, Ohal Hemlata S," Performance Analysis of Hybrid Channel Allocation Scheme for Mobile Cellular Network", *IEEE-International Conference on Recent Trends in Information Technology* ,pp. 245 – 250, 2011.

[15]. Sharma Abhijit, Bhattacharya Uma," A New Channel Reservation Scheme to Reduce Call Blocking in Cellular Networks", *IEEE International Conference on Selected Topics in Mobile and Wireless Networking (iCOST*), pp.42-47, 2011.

[16]. Sridevi A, Sumathi V," Improved Fault tolerant Model for Channel allocation in wireless Communication", *IEEE International Conference On Control, Automation, Communication And Energy Conservation*,pp.1-6, 2009.

[17]. Ehsan Heidari, Movaghar Ali," Intelligent Clustering in Wireless sensor Networks", *IEEE International Conference on Networks & Communications*, pp12-17, 2009.

[18]. Chantaraskul S, Moessner K," Implementation of a genetic algorithm-based decision making framework for opportunistic radio", *IET Commun.*, Vol. **4**, Iss. 5, pp. 495–506, 2010

[19]. Han Yanfeng, Jin Hua, Tang Wanbin, Li Shaoqian," Performance analysis of opportunistic spectrum sharing with unreliable spectrum sensing", *IEEE International Conference on Intelligent Computing and Intelligent Systems (ICIS),*Vol. **3**, pp.299-304, 2010.

[20]. Cai Hongxiang, Huang Lianfen, Gao Zhibin, Cui Xiaonan, "Dynamic Channel Allocation Based On Genetic Algorith In TD-SCDMA System", *IEEE Youth Conference on Information Computing and Telecommunications (YC-ICT*),pp. 423-426, 2010

[21].Ohatkar Sharada Narsingrao, Bormane Dattatraya S," An Approach for Interference Reduction in Cellular Network", *International Conference on Wireless and Optical Communications Networks (WOCN)*, Vol. **11**. pp.1-5, 2014.

[22]. Singh D K, Kumar Deepak, Srinivas K," A Dynamic Channel Assignment in GSM Telecommunication Network Using Modified Genetic Algorithm", *6th Euro American Conference on Telematics and Information Systems (EATIS)*,pp. 1-5, 2012 .