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Estimation Algorithm to Improve Cellular System Performance by Moving Base Stations locations

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Abstract— **Cellular system adopts the idea of frequency reuse, where the frequency bandwidth of each cell is repeated in non-adjacent cell, in order to use the available frequency band efficiently, however, the interference occurs even between the distant cells. The aim of the paper is to reduce the interference between these co-cells.**

The user receives the signal from its own cell, as well as the signal from the far cell which has the same frequency, the parameter Signal to Interference Ration, SIR, is the main factor to evaluate the performance of the cellular system.

In this paper, we propose algorithm to move the locations of base stations of the cells, in order to increase SIR value, decrease Probability of blocking, and number of users out of coverage.

Index Terms: **Cellular, Bandwidth, SIR, P of blocking, Coverage.**

I. INTRODUCTION

Cellular idea is based on dividing the area into number of clusters, each cluster contains number of cells. [1] [2] [3]

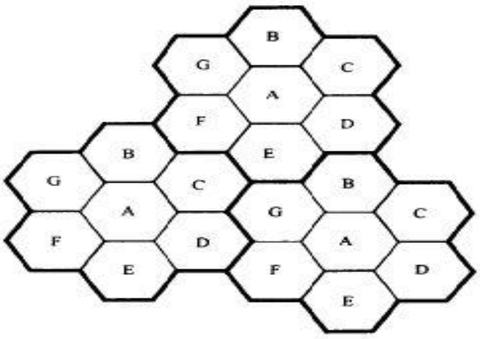

Figure 1. Geographic diagram of Cellular System [1] [2] [3]

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Frequency Reuse principle gives each cluster the same frequency bandwidth, which is divided into number of channels, this yields co-channels, i,e, there is a copy of each channel in each cluster., which leads to interference at user's device between the desired frequency of the local cell and the interferer frequency of the distant co-channel. [1] [2] [3] Signal-to- Interference Ratio is the factor that measures the interference situation of the network, and could be determined by the following equation [10] [11] [12]:

$$SIR = \frac{1}{\sum_{i=1}^{io}\left(\frac{d}{dk_i}\right)^n} \quad (1)$$

Where:

d is the distance from the mobile station to serving base station. dk is the distance from mobile station to interfering base stations.
i0 is the number of co-channel interfering cells.

SINR, Signal to Interference and noise Ratio is another considerable factor , where the noise is added to the denominator of equation 1. [4] [5] [6] another important factor, which is used to measure the performance of cellular system is Probability of Blocking, the probability that user finds the network busy, this factor is determined by the following two equations [9] [8] [7]:

$$A = ƛ.h \quad (2)$$

$$P_n = \frac{A^n/n!}{\sum_{m=1}^{n} A^m/m!} \quad (3)$$

ƛ is the call arrival rate, h, mean holding time (duration of the call), n is the number of channels.

The last factor is the number of users out of coverage, and determined by calculating the number of users who receives less than the minimum threshold power. [1] [2] [3] The purpose of the paper is to propose algorithm to increase SIR in equation 1, and to reduce POB in equation 3.

II. PROPOSED ALGORITHM

The proposed alternative solution is based on moving the existing base stations on a circular path in order to achieve improved parameters as follows:

- Starting with base station 1 which is illustrated in Figure 1, where the circular path is plotted in dashed line.
- Every predefined distance, the algorithm takes the measurements and chooses the reading, and then the station stops at the best location.
- The same procedures are applied on the other stations sequentially.

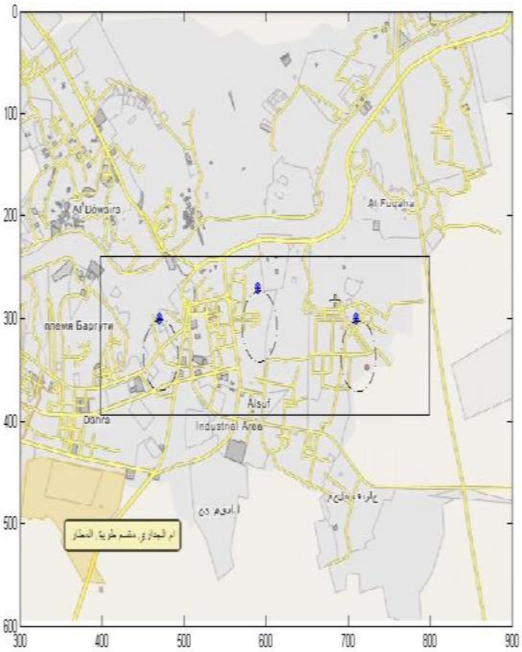

Figure 2. City Map and Antenna Movement

III. RESULTS

Table1 presents the adopted parameters in our experiment.

Table1. Experiment1 Values

Antenna power	50w
Receiver sensitivity	0.005w
Exponential path loss	2
d_o	20
Number of channels	100
bandwidth	50*10^3
Average traffic	0.0392
Request rate	1/4 to 5/12 calls/hour
Holding time	5 to 10 mun/call

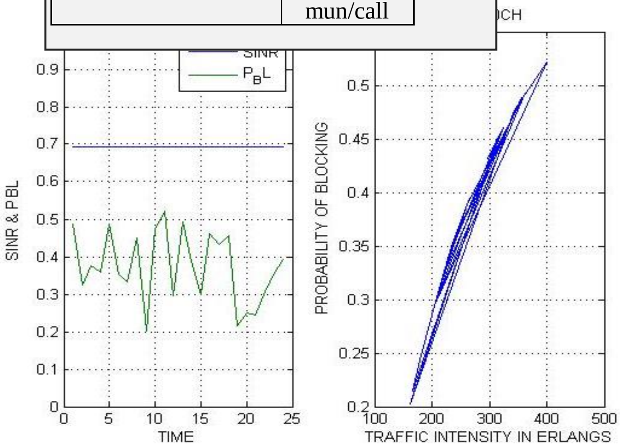

Figure 3. Sinr and pblocking vs time

Sir=6.94, = 8.42dB
Number of users out coverage =5834 =5.7%

Table 2. .Experiment 2 values

Antenna power	50w
Receiver sensitivity	0.005w
Exponential path loss	2
d_o	20
Number of channels	100
bandwidth	50*10^3
Average traffic	0.0392
Request rate	1/4 to 5/12 calls/hour
Holding time	5 to 10 mun/call

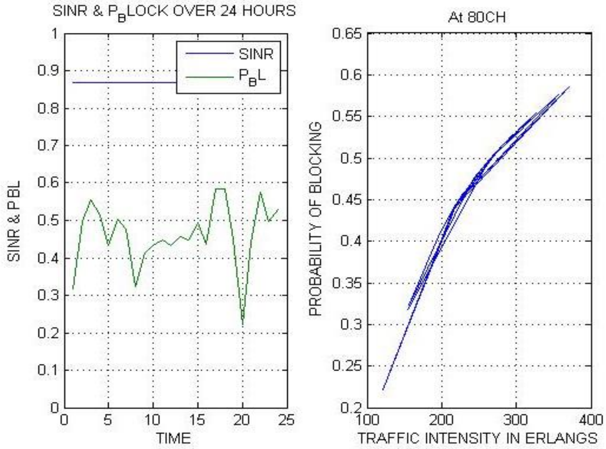

Figure 3: Sinr and pblocking vs time

Sir=6.94, = 8.42dB
Number of users out coverage =5834
=5.7%

According to Figure 2 and Figure 3, it could be noticed that SINR and POB can be enhanced by moving Base Station from their locations.

IV. CONCLUSION

Robust MATLAB codes have been built in order to measure the performance of cellular systems; in addition, a proposed algorithm is implemented to further improve the network's performance.

Many useful achievements are concluded from this study, the most significant conclusion is that Antenna location distribution plays notable role in changing the performance parameters.

Transmit power has a clear effect on SIR, SINR and the number of out of coverage users. While number of channels affects the probability of blocking. Also it can be noted that increasing the population density by about 20% increases the probability of blocking by about 10%.

Moving the antenna with the most population density has the major effect on the results. According to our distribution, moving the corner antennas has a bigger impact on the results than the middle ones. Generally this depends on the people distribution and antennas' locations.

Increasing the population about 100,000 costs 25 seconds for each step, which means for more than 10 million, the used software requires significant waiting time.

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REFERENCES

[1] Alexander Kukushkin "*Introduction to Mobile NetworkEngineering: GSM, 3G-WCDMA, LTE and the Road to 5G,"*
[2] Joseph Hoy, "*Forensic Radio Survey Techniques for Cell Site Analysis,*" John Wiley & Sons, Ltd, First Edition, © 2015.
[3] Asrar U. H. Sheikh, "*Wireless Communications: Theory and Techniques*," Springer, First Edition, © 2004.
[4] Jochen H. Schiller, "*Mobile Communications*," Second Edition, © 2003.
[5] Theodore S. Rappaport, "*Communications principles and practice-Prentice,*" Hall PTR, Second Edition, © 2002.
[6] By V. H. MAC DONALD(Manuscript received July 17, "*Advanced Mobile Phone Service: The Cellular Concep*," © 1978.
[7] KavehPahlavan&Prashant Krishnamurthy, "*Principles of Wireless Networks*," Hall PTR, First Edition, © 2002
[8] Michel DaoudYacoub, "WIRELESS TECHNOLOGY Protocols, Standards, and Technique," CRC Press, First Edition, © 2002.
[9] C. Y. Lee (Wiley (1993), "*Mobile communications design fundamentals,"* John Wiley & Sons, Ltd, Second Edition, © 1993..
[10] Mischa Schwartz, "*Mobile Wireless Communications*," Cambridge University Press, First Edition, © 2005.
[11] Ajay R Mishra, "*ADVANCEDCELLULAR NETWORK PLANNING AND OPTIMISATION*," John Wiley & Sons, Ltd, First Edition, © 2007.
[12] Simon Haykin, "*Communication system*," John Wiley & Sons, Ltd, Fourth Edition, © 2001

BIBLIOGRAPHY

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