مجلة جامعة بني وليد للعلوم الإنسانية والتطبيقية

تصدر عن جامعة بني وليد – ليبيا

Website: https://jhas-bwu.com/index.php/bwjhas/index

العدد التاسع والعشرون، 2023

Visual Basic platform to evaluate Libyana Almadar performnace.

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تاريخ الاستلام: 17-06-2023 تاريخ القبول: 1-07-2023 تاريخ النشر: 07-09-2023

Abstract: Cellular system is widely used in most countries, where the main adopted scheme is frequency reuse, as the same bandwidth is utilized by each group of cells (cluster). The clusters are repeated among significant geographical area which leads to interference between the cells of the same frequency, furthermore, the cells of high population suffers from high probability of blocking PoB, where the user can not access the network, in addition to the number of users outside the coverage area.

The aim of this paper is to build Visual Basic application to measure the above mentioned parameters. Visual Basic platform has been successfully built and operated, where simulation experiment is performed on BaniWalid city. the application could be used in improving the performance of existing wireless networks such as Libyana and Almadar.

Keywords: Cellular System, Bandwidth, SIR, Probability of blocking, Coverage, Visual Basic.

Introduction

Cellular theory suggests dividing the geographical area into many groups of cells (clusters). [1] [2] [3]

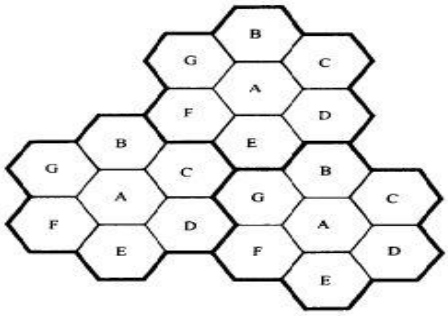


Figure 1: Cellular System Geographical Diagram

According to Frequency Reuse rule, each cluster is given the same frequency bandwidth, which is shared among three, four or seven cells, therefore interference occurs between co-channels, for example, between the cells in Figure1 with letter G, or any cells having the same letters, Co-cells, that results an interference at user's mobile . [1] [2] [3]

Signal-to- Interference Ratio, SIR, is the ratio of signal of cell where the user exits to remote co-cell [10] [11] [12]:

$$SIR = \frac{1}{\sum_{i=1}^{i_0} (\frac{d}{dk_i})^n} \text{.....(1)}$$

Where:

d is the distance from the mobile station to serving base station. dk is the distance from mobile station to interfering base stations.

i_0 is the number of co-channel interfering cells.

Path loss parameter defines the amount of loss that the signal encounters in its path from transmitter to receiver, its value from 2 to 3 [4] [5] [6].

Probability of Blocking P_n, the probability that the user finds the network busy, can be calculated by the following formula [9] [8] [7]:

$$A = \lambda.h \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

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

λ is the call arrival rate, number of calls per unit of time, h, is the average holding time (duration of the call), A is the traffic, n is the number of channels per cell (Capacity).

Number of users who are out of coverage is determined by calculating the customers who receives less than a lowest nominated threshold power (sensitivity). [1] [2] [3]

Visual Basic

Visual Basic is programming language for designing applications that run under Microsoft's Windows operating systems. The language is useful for both beginners and specialists, beginning programmers, who deal with the direct visual projects of building simple applications that include texts, lists and various menus; and specialist programmers, who aim to build sophisticated Windows-based projects with lowest possible cost. [13]

The purpose of the paper

The purpose of the paper is to build VB application in order to measure SIR in equation 1, POB in equation 3, and number of users out of coverage.

Proposed Application

Figure 2: Main Page

Figure2 shows the area where the application is tested, the picture illustrates a populated region in Bani Walid city, underneath the picture, group of command buttons, text boxes, where data are to be entered, labels, and menus that are explained as follows:

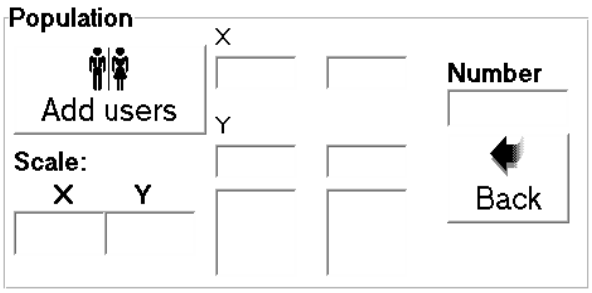


Figure3: Population Management.

Add Users button is used to distribute the users of the cellular network among dedicated area, this area is limited by X and Y coordinates and Scales. The distribution is performed randomly, required number of people is written in the text box which labelled by (Number). Two list menus present the location of each user; Back button is used to clear the population in the case of mistaken distribution.

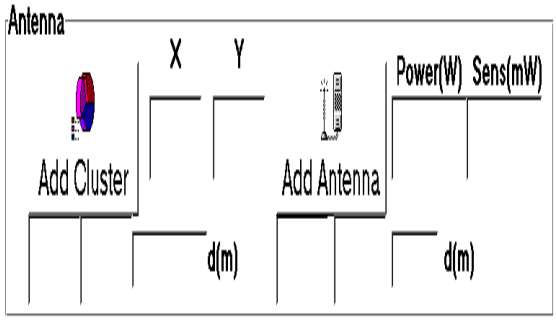


Figure4: Antenna Parameters.

Add cluster button starts the establishment of group of antennas (Cluster), which usually contains three, four or seven antennas. The frequency Bandwidth is divided equally among the antennas; therefore, each antenna has its own group of channels. Before pressing Add Cluster or Add antenna, X Y location of the antenna should be entered, as well as the transmitting power and Mobile sensitivity, these parameters determine the area of coverage.

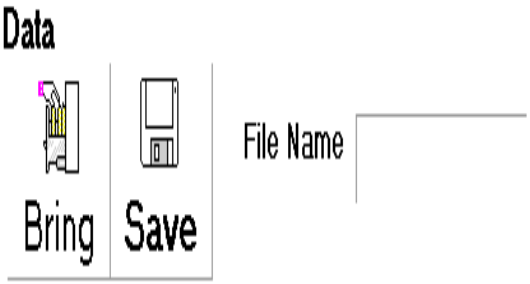


Figure5: DATA IMPORT/EXPORT.

Bring/Save Buttons are used to save and import data such as Antennas locations and number of users and their locations, after completing the distributions and antenna localization, the work can be saved and imported in another session.

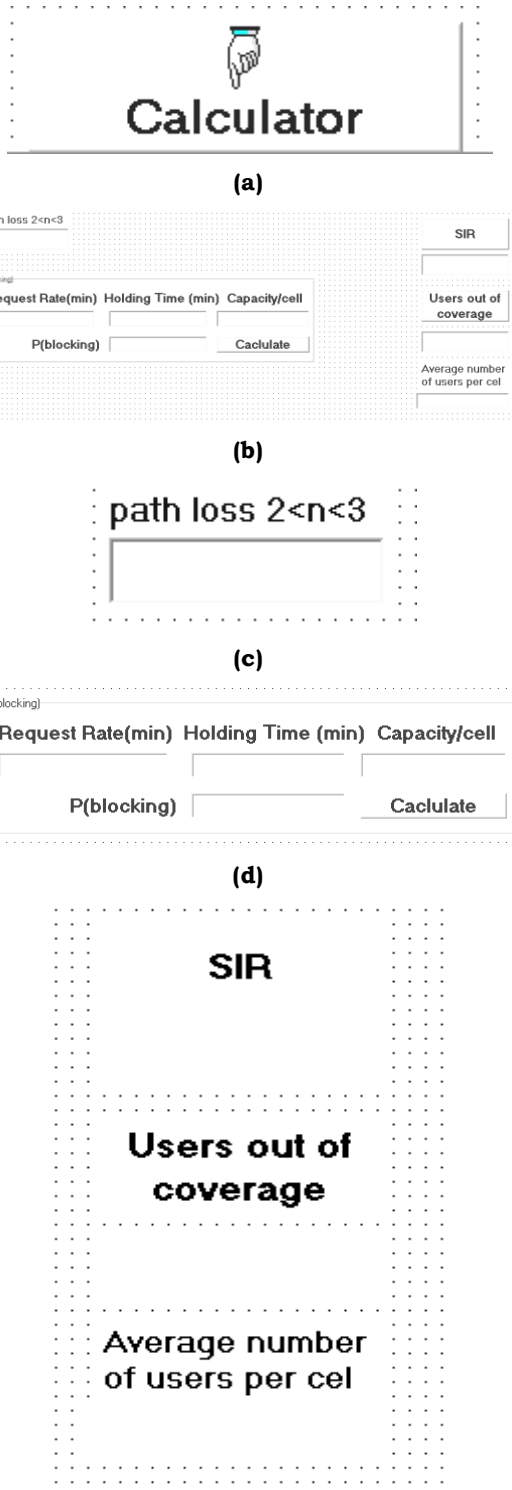


Figure6: (A) BUTTON TO SHOW RESULTS PAGE.(b) Results Page . (c) Path loss text box. (d) Traffic Management tools. (e) Users distribution Measurement.

Clicking Calculator button shows the results page, path loss text box (c) is used to type the value of the path loss parameter which is indicated in equation 1.

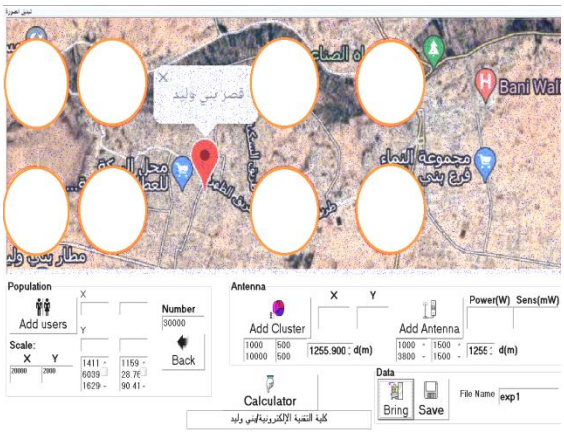
Request Rate is the number of calls per minute, Holding Time is the call period, and Capacity is the number of channels in each cell, these values are to be entered in the mentioned text boxes respectively before clicking Calculate button.

P(blocking) is the probability that the user finds the network busy, i.e all the channels are occupied, this command is used after filling the above boxes.

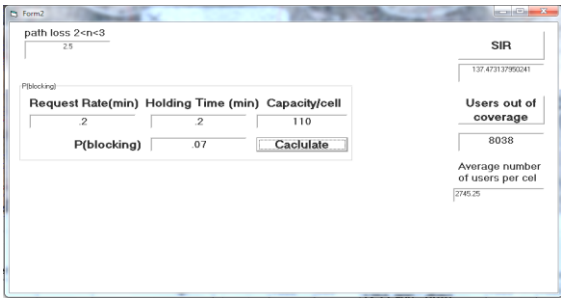
SIR button is pressed to determine the Signal to Interference Ratio, SIR, which is the ratio of the signal from nearest antenna to the signal from another antenna having the same frequency Band Width, co-cell.

Users out of coverage calculates the number of users that receive weak signal, lower than their mobiles' sensitivity.

Results



(a)



(b)

Figure7: (A) USER DISTRIBUTION RESULTS.(b) Traffic Results

Two clusters have been proposed, each cluster contains four antennas, the population is considered to be 30000 users distributed randomly among the area (20 Km x 2 Km), and Request Rate is assumed to be one call every five minute, with average duration of 12 seconds.

SIR is found to be about 137.4, and 8038 users are out of coverage, with 2745.25 users per cell.

Probability of Blocking is 7%, i.e. the user finds the network busy at seven calls out of hundred calls.

Conclusion

Robust Visual Basic application has been built in order to measure the performance of cellular systems; the application could be used as a tool to enhance the performance of existing wireless network such as Libyana and Almadar.

Many practical conclusions are accomplished from this study, the most major conclusion is that antenna location distribution plays primary role in changing the performance parameters, which means that the service can be improved by low cost action (moving the antenna location).
Transmit power has an obvious outcome on SIR, and the number of (out of coverage users). While number of channels and users per cell affect the probability of blocking.

The application has many options such as changing the picture and working with different areas, which gives appropriate flexibility and reliability in order to evaluate and improve various cellular networks. .

Abbreviations and Acronyms

CS: Cellular System, BW: Bandwidth, SIR: Signal to Noise Ratio, PoB: Probability of Blocking, VB: Visual Basic.

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