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Effect of Cell Size on the Population, Average Call Time, Subscriber Number Per Call(SNPC) And Call Number Per Hour

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Abstract : *When we planning for cell mobile area, we should put in our consider the traffic and the coverage area by doing analysis using the TDMA – FDMA mobile cellular communication system. In this paper we collaborates with Ooredoo mobile company in Kuwait to see the effect of cell size on the population, average call time, subscriber number per call(SNPC) and call number per hour to get best size of the cell mobile.*
Keywords : *cell size, population, SNPC, average call time*

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I. Introduction

The rapid growth in demand for mobile communication has led. The engineers to dedicate their times on researches to provide the mobile subscriber the quality of service (QoS), also support wide range of service and improve the system capacity. The small cell system allow greater spectral reuse larger Capacity (11). However, small cell system induce an increasing number of hand off while overlying cell provide coverage and service for higher speed users(5), one of the most major challenges in the cellular system design is to allocate the mobile user (4). Here, will see an overview of different simulation of cell planning in order to provide adequate coverage by seeing the effect of cell size on the population (P), average call time (T), subscriber number per cell (SNPC) and call number per hour (n).

II. The Impact Of Changing The Cell Size

Cell size is changeable with many factor such as the power level Path loss , the population of the region and time average for each call all these will have a measure impact on the designing the cell size as we will study later on with the experiment on Matlab program. The cell size is different dependent on the region that will be implement on it such as urban need to have small radius cells with many cells to be capable to handle the capacity of area and the path loss cased from high traffic, but in the rural region the cell radius can be wider because of population of the area and the building are less.

III. Time Division Multiple Access (Tdma)

North American Digital Cellular (NADC) is called DAMPS and TDMA (11). TDMA is one of several technologies used in wireless communication, TDMA provides each call with time slots so that several calls can occupy one bandwidth. Each caller is assigned a specific time slot, in some cellular system, digital packets of information are sent during each time slot and reassembled by the receiving equipment into the original voice components. TDMA is the digital stander and has 30-kHz bandwidth, TDMA is able to use up to six channels in the same bandwidth (11).

IV. Code Division Multiple Access (Cdma)

CDMA is a digital air interface standard, it is 8 to 15 time the capacity of analog (11). Where the users are isolated by code they can share the same carrier frequency. CDMA is an interference limited system unlike TDMA, CDMA has a soft capacity limit. Precise power control of mobile is critical in maximizing the system's capacity and increasing battery life of the mobile, where this is the goal to keep each mobile at the minimum power level to ensure acceptable service quality.

V. Cell Coverage For Signal And Traffic

The received signals at the base stations and terminals of a wireless information network are complicated to describe (1), There are many of phenomena cause signal strength to vary with terminal position and at any location with time. The properties of the signal path that we consider here the distance between terminal and base station (BS), also the antenna high, base station transmitter power On average, the signal strength at a receiving antenna decreases with distance according to the path loss equation (Hata - Okumura) model (1). Where the most step for us to design a radio link that win required for us to determine the base station density in different coverage so it will be most i1llportant consideration in the radio coverage planning is the propagation model as we mention that the model will be (Hata- Okumura), because it does fit to all environment (1).

VI. Cell Radius

Cell radius is one of the important parameter that will have impact on path loss also the power level of the cell should be transmitted, the below equation is represented the cell radius (1).

A = nT /3600 (1)
SNPC = (1 - P x)/ A (2)
CN = P / (SNPC *ON) (3)
R= RA/ 2.6(CN) (4)

Where:
A: Erlang
T: average call time
SNPC: subscriber number per cell
Px: blocking probability
CN: cell number
P: population of the region
ON: number of the operator
RA: area of region
n: call number per hour

Capacity

Where the capacity (number of traffic channels per cell) (1):
C = 8 (PFN / N) – 2 (5)
PFN: possible frequency number
N: reuse factor

The Simulation Studies (Results)

The parameters taken from Ooredoo Mobile Phone Company as a new site is being install in a new area, the values are written below:
Cell radius (R) = 50 Km
Link frequency (f_c)= 900MHz
BS antenna height (h_b) = 35 meter
Average call time (T) = 60 min
Number of operator (ON) = 3
Blocking probability (P_x) = 0.02
In the simulation part for the cell radius will divide into four categories:
a - <u>cell radius versus population the parameters are:</u>
T= 60 sec, n =1, P_x = 0.02 Erlang, ON = 3, P = 0:10:30000,
RA = 150.
Where:
T = average call time
n = call number per hour
P_x = blocking probability
ON = the number of operator
P = population
RA = area of region

In this study the population is variable from 0 up to 30000, that will led radius to change according to change into the population the Figure (1) below illustrate the relationship between the cell radius Vs. population which is directly proportional any increase in the population win led to increase into the cell radius, the main idea is when the cell radius get larger, it could handle more subscribers.

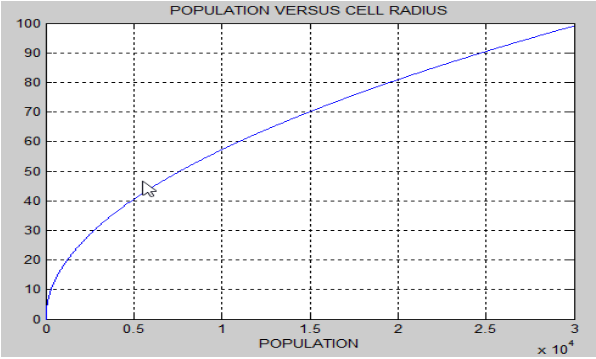

Figure (1) - Cell Radius (meter) Vs. Population

b - cell radius versus average call time parameters are:

T = 0.0001 :0.01 :60 sec, n =1 , Px = 0.02 Erlang, ON =: 3 , P = 30000, RA = 150.

Where:

T = average call time
n = call number per hour
P x = blocking probability
ON = the number of operator
P = population
RA = area of region

In this study the average call time (T) is variable from 0.0001 up to 60 see, that will led radius to change according to change into (T) the Figure (2) below illustrate the relationship between the cell radius V s. average call time (T) which is directly proportional any increase in the (T) win led to increase into the cell radius, the main idea is when the cell radius get larger, it could handle more calling time which is good to satisfied the user the call will not drop early.

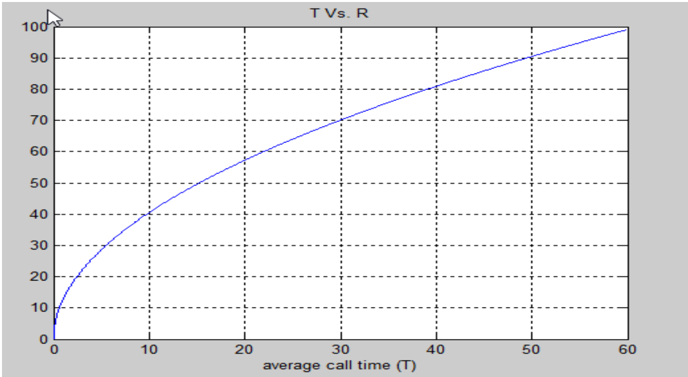

Figure (2) - Cell Radius (meter) Vs. Avg. Call Time (sec)

c- cell radius versus subscriber number per cell (SNPC) Parameters are:

T = 60 see n =3, PX = 0,02 Erlang ,ON = 3, P = 30000, RA = 150, SNPC = 0.001:0.1:39.2

Where:

SNPC = subscriber number per cell
T = average call time
n = call number per hour
Px = blocking probability
ON = the number of operator
P = population
RA = area of region

In this study used the equation (2) with above variable to get value of SNPC which was equal to 39.2 subscribers per cell (spc), let it to be variable from 0.001 up to 39.2 spc, that will led radius to change according to change into (SNPC) the Figure (3) below illustrate the relationship between the cell radius Vs. subscribe number per cell (SNPC) which is inversely proportional any increase in the (SNPCS) will led to decrease into the cell radius.

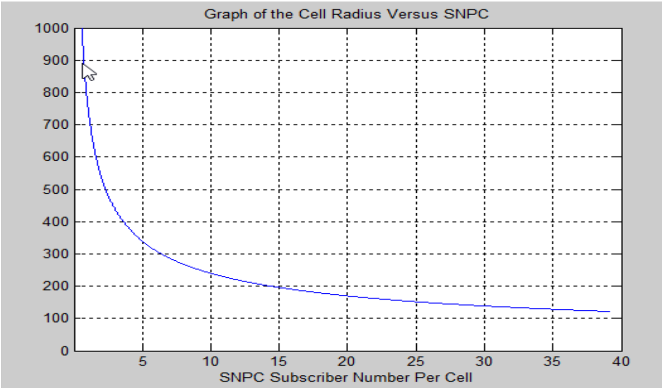

Figure (3) – Cell Radius (meter) Vs. SNPC

d- <u>cell radius versus call number per hour parameters are</u>:
T = 60 sec, n =0.0001: 0.01:3, Px = 0.02 Erlang, ON = 3 , P = 30000, RA = 150.
Where:
T = average call time
n = call number per hour
p x = blocking probability
ON = the number of operator
P = population
RA = area of region

In this study the call number per hour (n) is variable from 0.0001 up to 3, that will led radius to change according to change into (n) , in the Figure (4) below illustrate the relationship between the cell radius Vs. call number per hour (n) which is directly proportional any increase in the (n) win led to increase into the cell radius, the main idea is when the cell radius get larger, it could handle more calling number per hour which is good to satisfied the user which can make more call per hour.

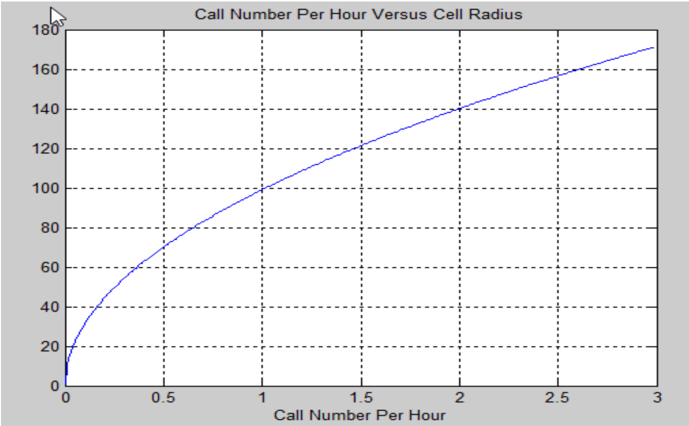

Figure (4)- Cell Radius Vs. Call Number Per Hour

VII. Conclision

The cell radius has been simulate with four parameters (population, average call time, SNPC, and call number per hour).

- For the population simulation we could notice that more the curve increase in the population axis that will led into increasing into cell radius figure (1) which that mean the cell radius should get larger if the population become ignore in the future.
- For the average call time, from the figure (2), any increase in the call time face it increasing in the cell radius, because the increasing in call time means the subscriber will be holding in that channel longer time

if it is not moving within that cell, so the chance for new subscriber to sing in the cell is weak because that the cell radius should be fit with the average time one subscriber could be reserve the channel.

- For SNPC here the cell radius will be fixed, so more we add subscriber in that cell which its fixed size, it will not be able to handle and hold, so it will appear drop calls waiting calls and busy line as if the cell getting smaller with more subscriber sign in that cell see figure (3).
- For call number per hour, as we know each cell has a number of caller per hour if that number increase that will not be able to handle so that will led to drop call and busy line, so if we want to increase the call number which to sign more subscribers cell radius should also increase as you see in figure (4)

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