Optimization Down Tilt Angle for Traffic Data at Handset Base Station

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DOI: 10.23918/iec2020.02

Abstract— ***This paper study the effect of Traffic Signal Capacity measured in Dukan towers by using site master and TRX software program for measuring Traffic Erlang Capacity. A software program used to evaluating the real data in current cellular networks for traffic data in dukan city compared with the mechanical tilt angle and electrical tilt angle . the simulation results shows that the mechanical and electrical tilt angle respectively can accurately describing the variation of pattern in several mobile cell network in dukan region on real traffic data in cellular networks.***

In this paper a comparison made between traffic signal and electrical and mechanical tilt angle antenna at different sites in Dukan region. The idea of choosing random number of resources has been previously addressed in operations. Simulation results indicate that electrical and mechanical tilt angle depends on different environmental impact statements may lead to network results in terms of capacity and coverage performance. Choosing the suitable antenna down tilt angle is a very accurate issue in cellular network, since it affects the system performance, aiming to enhance the traffic signal strengths of serving cells, in addition to reduce in the interference levels with the cellular system.

Keywords— ***Electrical Tilt angle,* mechanical tilt angle, *traffic signal, Erlang capacity***

I. INTRODUCTION

Antennas are a essential component of communication systems. By definition, an antenna is a uniform device used for transforming an RF(radio frequency) signal, traveling on a conductor, into an electromagnetic wave in free space. Antennas property demonstration reciprocity, which means that an antenna will contain the same characteristics regardless if it is transmitting or receiving. A lot of antennas are resonant devices, by operating efficiently over arelatively narrow frequency band. An antenna must be tuned to the same frequency band of the radio system to which it is connected, otherwise the reception and the transmission will be impaired. When a signal is fed into an antenna, the antenna will emit radiation distributed in space in a certain way. A graphical representation of the relative distribution of the radiated power in space is called a radiation pattern. In most cases, carefully optimizing the down tilt angels produces enhanced signal strength levels at the targeted areas, thus reducing the interference levels from other covering cells. However, excessive down tilt angle may lead to dramatic coverage shortages, specifically at the edges of the main loop direction [1],[2].

In the simplest form, multiple antennas at the base stations may be used to form multiple beams to cover the whole cell site. 120^0 beam width (or six beams each with 60^0 beam width) can be used for this purpose. The coverage of each beam is then treated as a separate cell. Traditional base station installations of mobile communication make use of space diversify techniques, which require at least two antennas pointing in the same direction and separated by a distance of 10 to 20 wavelengths. Another wireless communication antenna configuration that used the array concept refers to adaptive antennas. These arrays are designed to achieve ثغرة narrow antenna beams in the azimuthally plane so as to obtain a good angular resolution to search/track the position of mobile terminals. When an adaptive array enables the location of each mobile, a set of beams is formed to cover. In base station applications, a set of directional antennas are needed for a 120^0 sectorial coverage[2]. The definition of Erlang (a unit of telecommunications traffic measurement) . In practical analyses which used for describing the total traffic volume of one hour [3].

Until recently, the satisfied method by downtilting an antenna was to mechanically near its position on the tower. But as clear by the yellow shading in Figure 1, the antenna represents an satisfy unit agreement of tilting along one plane only. As the front tilts down to lower the gain on the horizon, the back tilts up, changing the frontto-back ratio and increasing inter- . Utilization of antenna mechanical downtilt has been a tool for radio network planners to optimize networks. It has been observed to be an efficient method to reduce other-cell interference in the main-lobe direction [6].

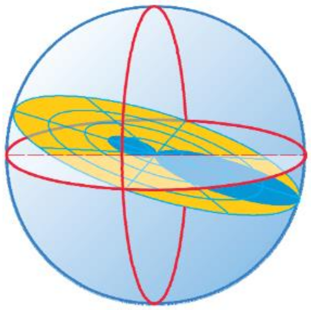

Fig.1 coverage mechanical downtilt

as shown from Figure 2 The electrical development downtilted antenna gives operators greater control with precision in shaping the radiation patterns of horizontal antenna . This help engineers to evaluate gain in a full 360 [9]. Electrical downtilt ANGLE is carred out by adjusting the antenna elements, and hence it slightly changes the antenna radiation characteristics when downtilt angle is changed[3].

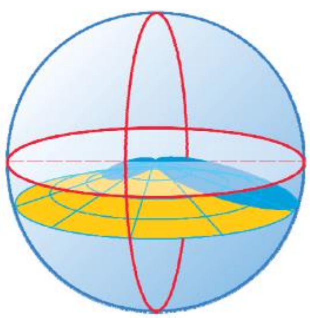

Fig.2 coverage of electrical downtilt

Radio frequency engineers continue to apply the same basic guidelines practically developed to help compensate for the limitations of mechanical downtilt antennas. By combining the electrical and mechanical methods can effect on almost needed applications, figure 3 shaws the Electrical vs. mechanical downtilt angle comparison [9].

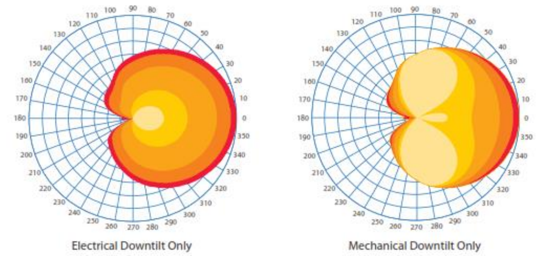

Fig.3 Electrical vs. mechanical downtilt angle comparison

Electrical down tilt is carried out by adjusting the antenna elements, and hence it slightly changes antenna radiation characteristics when down tilt angle is changed. There are commercially available antenna’s that can remotely change their down-tilt, azimuth and beam width [2].

II.RELATED WORK:

The related work are almost close to our paper study which are new published “2017 – 2019 “in the popular journals in the word : Elsevier journals, Hindawi Journals (“Advanced Transportation”, “ Advances in Civil Engineering”), and at the las t the IEEE Access journals.

In one of the Elsevier journals in 2018 the Longbiao Chen, Dingqi Yang, et al addressed in [4] many issues by proposing a deep-learning-based Cloud Radio Access Network (C-RAN) optimization framework. Firstly , they exploit a (MuLSTM) the shor title of Multivariate Long Short-Term Memory) model by learning the dependency, correlation and build a weighted graph by modelling the complementarity around the base station traffic patterns, by making an accurate traffic forecast for a future period of time, and propose a Distance-Constrained Complementarity-Aware algorithm by finding optimal base station clustering schemes with the objectives of optimizing capacity utility and cost deployment. They evaluate the performance of using data in two months from real-world mobile networks in two of regions in Italy. The Results showed that the [4]’s method effectively increases the average capacity, while reduced the overall deployment cost of the traditional Radio Access Network (RAN) architecture in the dataset , which correctly compared to the other methods.

In 2017 Shuo Wang, Xing Zhang, Jiaxin Zhang [5] they tried to build a accurate model to describe the traffic variation pattern for a single base station in real cellular networks. The first step: a sinusoid superposition model was proposed to describe traffic variation of multiple base stations based on real data in a current cellular network. It shows that the mean traffic volume of many base stations in an area changes periodically and has three important frequency components. In the next step: logging the normal distribution is verified for spatial modeling of real traffic data. The main traffic measurement at both spare ,busy time respectively were analyzed. in addition, the parameters of the model were presented in three main regions are the park and campus , Finally central business district. In 2017 Wang published two papers [6]and [7] where in [6] he study the development of most use self adaptive signal control systems " technical characteristics, current research status of self-adaptive control methods, and the signal control methods for heterogeneous traffic flow composed of connected vehicles and autonomous vehicles" so , the related achievements of the adaptive control system for the future traffic environment have extremely broad application prospects, while in [7] he study the single intersection, arterial lines,

and regional road network of a group of multiple intersections are taken in to account. Where the traffic signal optimization strategy based on reinforcement learning was suitable for complex traffic environments and the effects of which are better than the current optimization methods in the conditions of high flows in single intersections, arteries, and regional multi-intersection. In a word, the problem of insufficient traffic signal control capability is studied, and the hierarchical control algorithm based on reinforcement learning is applied to traffic signal control, so as to provide new ideas and methods for traffic signal control theory.

In 2019 Ziya Cakici ,Yetis Sazi Murat [8] developed a new traffic signal control model for the management of three-leg signalized intersections. Where in this study, a new signal timing and signal phasing optimization based control model is developed for the management of three-leg signalized intersections using the Differential Evolution algorithm. Use of the Differential Evolution algorithm for signal timing and signal phasing optimization is analyzed in this research. In 2019 from IEEE Access journals Taehoon Kim, Bang Chul Jung investigate in[2] thoroughly the grant-free multiple Access from the Markov chain (MAC) layer perspective. They provided an analytical framework based on a MAC to capture the performance of the grant-free multiple Access in terms of packet transmission success probability, from the simulations results , they validate an analytical framework and verify the necessity of adopting multi-packet reception (MPR) technique by supporting a number of IoT devices generating sporadic traffic. At the end of the literature work, in 2019 FenWang , Keshuang Tang et al [10] , they presented a group-based signal control optimization model for mixed traffic flows, which could account for both safety and delay. A numerical study was performed in [10] to demonstrate the applicability and effectiveness of the proposed model, by basing on the data collected at an intersection located in Shanghai. Where the simulation results showed that the proposed model could aid researchers and practitioners in the signal timing stage to reach the needed balance between safety and operational efficiency for the intersections with mixed traffic flows.

The essential idea is by taking into account the fact that each internal user, depend on its position in the cell, by channel fading and inter cell interference, experiences a random signal to interference plus noise ratio (SINR) on each subcarrier. Thus, each user requires a random number of subcarriers to satisfy its required data rate [6],[9].[3].Many of models of traffic existing by share their name with the Erlang unit formula function [7],[8].

Coverage area are as side lobes then back lobes. Increasing capacity means if we use one omni directional antenna with 1 Thrasceivers(TRX) needs 3Erlangs but if we use 1TRX for each sectorised part of the site(named by cell), it needs 3 Erlang then as we know by 3 sectors or cells we can cover 360 degrees, so each cell has 3Erlang then the total of the three sectors can take 9 Erlang.

III. SIMULATION RESULTS:

Choosing the antenna down tilt angle is a very critical issue in cellular network, since it effects on system performance, aiming to enhance the traffic signal strengths of serving cells, in addition to reducing the interference levels with the cellular system by having accurate result to make the signal strengths . For measuring the Erlang Traffic Capacity by choosing the dukan city sites. The dukan city map in Kurdistan Iraq region shown in Fig. 3.

By study the data measurements for the some the towers in dukan city. There are 22 sites studied in dukan region north of sulaymani city in Kurdistan Iraq are chooses . almost of dukan sites hold Katharine antenna types K742225 antenna, while some other holding different types from Katharine antenna, Actually I have a studied with two authors some of Katharine antenna types in [8].

just one site in dukan have different type antenna are TDJ-809015DME-65P. And the last other sites holding DX-824- 960-65-17.5i-M (Huawei antenna). I have a study with two authors on this type of antenna DXX-824-960/1710-2170-65/65-17I/17.5I-M/M-C in[9]**.** The last have almost same performance for DX-824- 960-65-17.5i-M (Huawei antenna). Fig. 4 shows a group of the dukan sites.

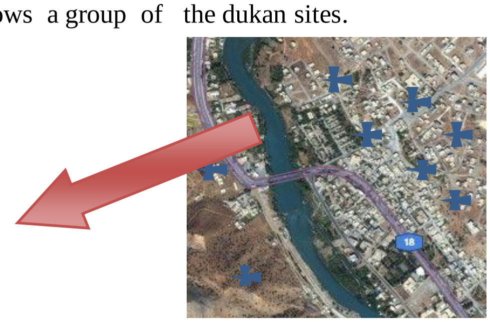

Fig.4 Dukan Region Map from Google Earth map.Some Of Dukan Sites

Instead of single Omni directional antenna use 3 sectored antennas Gains up to 18dBi Requirement is for 3TRXs as a minimum(each cell one TRX)

Improvement in both coverage and capacity. Increasing coverage means if we use omni antenna practically, it only propagates equally in all directions but sectorised directional antennas, has front lobe which has the strongest signal strength to serve the requested area to be covered and then less strongest coverage as side lobes then back lobes Increasing capacity means if we use one omni directional antenna with 1 Thrasceivers(TRX) needs 3Erlangs but if we use 1TRX for each sectorised part of the site(named by cell), it needs 3 Erlang then as we know by 3 sectors or cells we can cover 360 degrees, so each cell has 3Erlang

TABLE I. THE TRAFFIC MEASUREMENT WITH ELECTRICAL MECHANICAL DOWNTILT ANGLE MEASUREMENTS FOR ASIA CELL.

Traffic Data	**Downtilt(Degree)**	
	Electrical downtilt	**Mechanical downtilt**
3.266428571	3	6
12.04	5	5
6.42	0	3
15.13571429	0	0
8.638571429	0	0
17.81214286	0	0
6.787142857	0	0
9.167142857	0	0
14.38785714	0	5
4.916428571	6	4
2.575	8	3
21.71071429	0	2
33.61857143	0	4
19.635	0	4
19.87357143	2	1
33.71	0	7
38.83571429	3	0
8.070909091	3	0
8.456363636	5	0
0.580714286	2	0
2.397857143	7	0
10.82857143	4	0
7.054285714	0	2
22.56	3	3
4.624285714	0	4
14.465	2	4
25.53142857	2	5
7.667142857	4	5
11.365	4	0
18.69428571	4	5
9.528571429	4	4
3.237857143	4	3
6.934285714	4	1
6.599285714	0	1
3.751428571	0	0
12.48285714	4	0

From the Table I`. Showing the traffic measurement via "the electrical tilt angle"(E- tilt angle) and mechanical tilt angle (M- tilt angle) measurements for Asia cell base station in Dukan sites by using the MATTLAB Software Program. When the erlang trafiic value be 38.83571429 call/hour at its high measurement, while the value of E- tilt angle are 3^o (degree) and the value of M- tilt angle are 6^o (degree), while the least low measurement 0.580714286 call/hour at 2^o (degree) and the value of mechanical tilt angle are 6^o. From the above table it's clear that the Erlang Traffic measurement increased by increasing the E- tile angle and decreasing by decreasing the last, so as to for the value of mechanical tilt angle, but the last more than the electrical when the traffic increased. A comparison made between the traffic measurement with the electrical measurements , it only propagates equally in all directions but sectored directional antennas.by changing the E-tilt angle

Figure-5 shows two curves for the traffic measurements and the electrical tilt angle measurement. And how its effect on the performance antenna in cellular network.

Where in figure 5 and figure-6 respectively showing the two curves of the traffic measurements compared with the mechanical tilt angle measurements. And how its effect on the performance antenna in cellular network.

It's clear from the curves by comparing between them The results of the shows that the mechanical and electrical tilt angle respectively can accurately describing the variation of pattern in several mobile cell network in dukan region on real traffic data in cellular networks. Furthermore, the erlang traffic capacity are have good performance in the high traffic measurements.

Simulation results indicate that traffic and electrical down tilt angle measurements depends on the cellular environment while by comparing the traffic signal with the mechanical down tilt angle different environments may lead to different results on capacity and coverage performance. Increasing coverage means if we use omni antenna practically, it only propagates equally in all directions but sectorised directional antennas, has front lobe which has the strongest signal strength to serve the requested area to be covered and then make the transmitting signal less stronger thathe directional antenna or by other name sectors antenna.

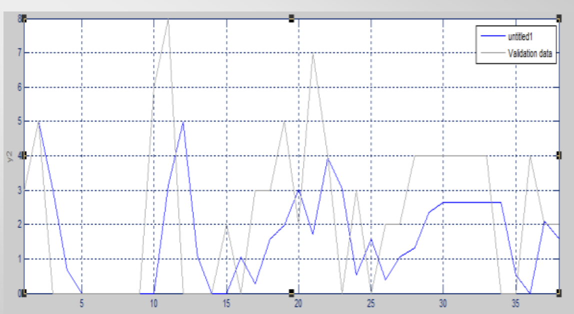

Fig.6 The Traffic Measurement In Dukan Sites

IV.CONCLUSION:

This paper evaluated and studied traffic signal capacity effects on performance of Dukan mobile phone base station. In this paper a comparison made between the traffic signal with electrical and mechanical down tilt angle at different sites in Dukan city. Simulation results indicate that traffic and electrical down tilt angle measurements depends on the cellular environment while by comparing the traffic signal with the mechanical down tilt angle different environments may lead to different results on capacity and coverage performance.

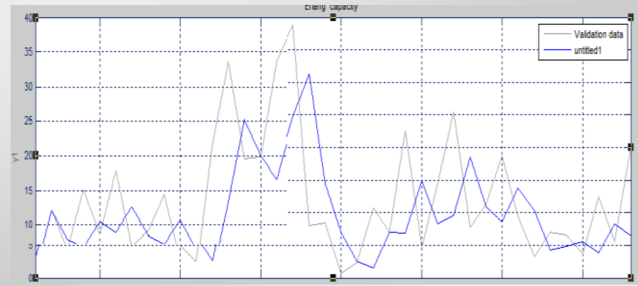

Fig.5 The Traffic Measurement via E-Tilt angle In Dukan Sites

A TRX software program used to evaluating the real data in current cellular networks for traffic data in dukan city compared with the mechanical tilt angle and electrical tilt angle . The simulation results shows that the mechanical and electrical tilt angle respectively can accurately describing the variation of pattern in several mobile cell network in dukan region on real traffic data in cellular networks.

System performance results in presence of both Erlang traffic signal capacity and electrical downtilt were simulated for different sites in Dukan city . According to the results, Erlang traffic signal capacity provides better performance in case of interference limited system, while performance difference is Insignificant for noise limited cases. The results emphasize the fact that the downtilting should be used, not only to maximize the network capacity, but also to reduce the interference frequency.

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