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A COMPARATIVE STUDY OF NOISE IN LTE-A

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ABSTRACT

The focus of this research is in the area of analyzing the performance of the fourth generation (4G) mobile networks like the Long-term evolution systems (LTE and LTE Advanced), based on the parameters like signal to interference to noise ratio (SINR). The research method adopted in this work includes deigning of scenarios in the system level simulation tool MATLAB, developed by the MathWorks. These scenarios are simulated to study the effect of the inter site distances, operating frequencies, scheduling algorithms and antenna height and antenna spacing on the network performance parameters. Transmission line construction is one of the most complex engineering projects. Measuring the parameters of a transmission line is much more difficult than measuring any other public infrastructure. The present system used by utilities is time consuming and provides only information about the audible noise; but whatever method has been given so far, it does not give any information about the inaudible noise. The proposed method will enhance the public service provider involvement in the measurement process, and decrease the extra cost to measure the side effects of the project.

Keywords: GIS, JTCL, Inaudible Noise, LTE-A.

I. INTRODUCTION

Wireless communication services have experienced a dramatic growth, globally, over the past 2 decades. Starting from the analog services right up to the current digital cellular services, wireless communication services have far surpassed the fixed line telephony services with respect to its availability and number of subscribers. In India itself, as compared to the fixed line communication, the wireless communication penetration is about four times. Mobile subscribers worldwide have increased to around one billion users over a period of less than 20 years. With the introduction of an important technological component – Carrier Aggregation (CA) in 4G LTE-A systems, issues pertaining to operating frequencies and scheduling algorithms, have to be dealt with. The analysis carried out as a part of research work shows the effect of above-mentioned parameters on the throughput of a network. Also, an efficient scheduling algorithm ensures greater efficiency of a network. The findings from this research provides evidence that inter site distances determine the signal strength in the coverage area.

Mobile industry requires high data download speeds and reduced latency for various applications from VoIP to gaming to interactive use of data. Significant improvements in use of the available spectrum are also an essential requirement. The move from LTE to LTE Advanced was not a huge upgrade over LTE but instead it was more of an evolutionary step that provided improved speed and better network capacity [8].

II. LONG TERM EVOLUTION

LTE, introduced in release 8 standard, was adopted by ITU as international standard for wireless communications in the mobile network technology tree. The main objectives for LTE were increased downlink and uplink peak data rates, scalable bandwidth, improved spectral efficiency, increase in user capacity. These requirements were met with evolution of the OFDMA based LTE radio interface and a new all IP flat architecture with Evolved Packet Core (EPC). Together, Evolved Universal terrestrial radio access networks (EUTRAN) and EPC were formally called the Evolved Packet Systems (EPS). The three main driving forces behind evolution of mobile broadband which led to development and deployment of LTE were the growth in high bandwidth mobile applications like MMS, video sharing, IPTV etc., the extensive proliferation of smart mobile devices and the competition among service providers leading to flat revenues.

After the standardization of LTE and its deployment had been completed in most part of the world, 3GPP had turned its attention towards the next development that is truly 4G technology- international mobile telecommunication (IMT) advanced. The technology being developed to meet requirements of 4G had been termed as LTE-A. Release 9 introduced the 3.9 G referred to as pre-4G, but the system could not meet the ITU requirements of peak data rates, minimal data latency and reduced transmission errors. The successor, LTE-A which was introduced in Release 10 of 3GPP, aimed at both further improvement in the system capacity and improvement in the cell edge user experiences. Enhancements were provided by the collaboration of advanced network architecture with smart antenna technology. LTE-A uses packet switching techniques and the main new functionalities introduced in LTE-A are Carrier Aggregation (CA) and addition of low power nodes to the topology. Release 11 and beyond aimed for further enhancements of LTE-system functionality and specifications.

III. INDIAN POWER TRANSMISSION SYSTEM

The Indian Power Transmission System is the one of largest electrical interconnected systems all over the world. Transmission lines delivers and processes bulk electrical power on its way from generating stations to distribution, which completes the processing and delivers it to consumers. New Transmission Lines are required to meet the reliability needs of the system. India is the fifth biggest power generator in the world. As of March 31, 2008, it had a generation capacity of about 143 GW, with an annual output of over 700 billion units. Many of the electrical lines may be delayed or may not be constructed at all. The main reason for this is that it is very difficult, uncertain and expensive to route lines in India. Transmission Line Routing Measurement is a complex process which involves local, state and federal agencies. The permissible noise level of the line is first approved by the state, usually a state commission, and then it goes to federal agencies like the Department of Energy (DOE) and FERC for approval. Depending upon the line noise level, approval may be required from several federal and state agencies. This may create a high level of public opposition towards a line. Such legal litigation further delays the project. This result in an increase in the budget of the project and a stage may come at which the utility finds the project to be financially unfeasible. The proposed technique reduces the public resistance during the planning and design process and allows more people to participate in the complex infrastructure planning and design problems.

Transmission lines are the conductors that serve as a path for transmitting (sending) electrical waves (energy) through them. These basically forms a connection between transmitter and receiver in order to permit signal transmission.

Fig-1: Distribution via lines in Madhya Pradesh

IV. GIS FEATURES

GIS is a powerful tool for military trainers, environmentalists, and natural resource planners [6]. An information system that is designed to work with data referenced by spatial or geographic coordinates. In other words, a GIS is both a database system with specific capabilities for spatially-referenced data, as well as a set of operations for working (analysis) with the data. A system for capturing, storing, checking, integrating, manipulating, analyzing, and displaying data which are spatially referenced to the Earth [6].

Decibel: Since the unit decibel (dB) is usually utilized in engineering, a brief introduction and definition of terms is given here. The decibel is that the unit would not to express relative differences in signal power. it's expressed because the base-10 logarithm of the ratio of the powers of two signals:

$P\ [dB] = 10 \cdot \log(P/P_0)$ ……………… (1)

It is also common to express the signal amplitude in dB. Since power is proportional to the square of a signal's amplitude, the voltage in dB is expressed as follows:

$V\,[dB] = 20 \cdot \log(V/V_0)$ ……………… (2)

Power transmission lines have substations at the beginning, end and in between. Audible noise [4] effects of sub-stations depend on the extent of ground noise existing round the substation. Switching and protection equipment installed in sub-station produces noise within the sort of low frequency hum. This noise depends upon the operating mode of the equipment installed.

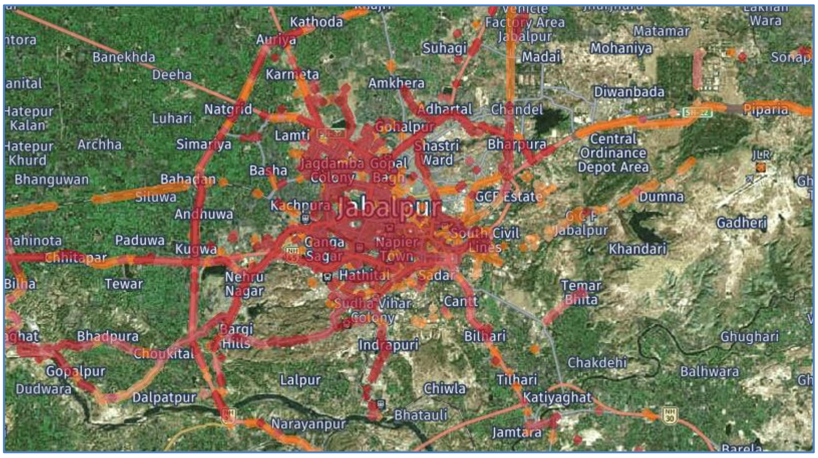

Fig-2: 4G Distribution in Jabalpur Zone [10]

Source: https://www.nperf.com/en/map/IN/1269633.Jabalpur/19111.Jio/signal/?ll=23.1558284289644&lg=79.9354934692383&zoom=12

This study deals with performance analysis of LTE systems in terms of essential network parameters such as weather conditions, distance, interference etc. Few of the issues have been analyzed in this work. As of February 2015, the number of mobile subscribers worldwide has passed the 3 billion mark and it keeps growing at a rate of 15 new subscribers per second. Mobile adoption is increasing in the developing regions of Asia-Pacific and the Middle East and Africa.

Engineering Features: Most all of us know that all wireless systems are interference limited. In Macro cellular design, great efforts are made to minimize interference, both internally generated and externally generated from various sources in order to maximize capacity. However, modern wireless systems including LTE and LTE-A (Advanced) are increasingly susceptible to interference due in part to the use of advanced modulation schemes. In the Macro environment most of the interference can be mitigated at the design stage but some is just a function of environmental and deployment factors. Careful cell site selection, location and design are increasingly important.

Electromagnetic Interference: Electromagnetic interference (EMI), also called radio-frequency interference (RFI) when in the radio frequency spectrum, is a disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction.

V. REVIEW OF LITERATURE

Most of the papers was a review paper giving a general idea about the requirements of the LTE-A technology. A vast pool of frequency bands from 450 MHz to 3.6 GHz is available for deployment of LTE and LTE-Advanced networks. Emerging technologies associated with conductors and transmission towers require a re-evaluation of models of audible noise generated by overhead line conductors. Measurements on which existing commercial models were developed were typically performed on a single, classical design of conductor around 50 years ago.

J. J. LaForest et al. [1] has presented a method for calculating the radio noise level of a transmission line where the Radio noise generation is produced by corona on station apparatus. During the past 15 years, much attention has been given to the determination of transmission line radio-noise (RI) levels resulting from conductor corona.

Excellent results have been obtained, using a theoretical approach based on RI power analysis and modal propagation arguments [1]. has intended to provide a summary of good engineering design practices, which will result in a tolerable radio noise level from the proposed line when placed in service. This guide applies to interference in the spectrum from 150 kHz to 5 MHz, which includes the radio broadcast portions of the spectrum [2]. Field measurements are suggested on nearby existing lines prior to the construction of a new line to establish existing noise and signal levels. For details of field measurements of radio noise, the reader is referred to proposed IEEE "Test Procedure for Measurement of Radio Noise from High-Voltage Transmission Lines".

K. Tanabe et al. [3] environmental problems, especially hum noise near transmission lines, have become a major concern and one of the greatest limiting factors in the design of transmission lines. Some reports have been published with regard to suppression of corona activity on conductor bundles. In this paper he uses 'Random Noise' instead of 'audible noise' because the level of random noise in the component frequency of over 500 Hz is almost equivalent to the level of audible noise.

Friederike Hammersen et al. [6] has measured the Mental Health. It covers anxiety, behavioral/emotional control, depression (each one item), and general positive affect. This study was among the first to examine the association between annoyance from environmental noise and mental health in adults using national data for Germany. Yingyi Liu et al. [9] said that the Audible noise has a serious negative impact on the lives and health of the residents around transmission lines. Therefore, it is very important to detect and study audible noise for the optimal design of transmission lines.

VI. DISCUSSIONS

The issue of interference management can be handled by carrying out precise parameterization, while planning and deploying the network. Care should be taken to ensure that there is maximum signal strength of the received signal and minimum interference from neighboring cell in the region of interest. Antenna height and antenna tilt are two of the few parameters considered for optimization of the network performance. Most Indian states have laws or rules, which are directly or indirectly related to transmission line construction. J. J. LaForest et al. [1] determined the value of the noise current on a spectral-density basis by using an RI meter with an RMS detector. Large transmission lines configurations with high voltage and current levels generate large values of electric and magnetic fields stresses which affect the human being and the nearby objects located at ground surfaces. This needs to be investigating the effects of electromagnetic fields near the transmission lines on human health [7].

VII. CONCLUSION

Noise is an environmental burden whose health impacts are the topic of various studies. Noise annoyance in itself is often considered an environmental health risk [5, 6]. Studies shows that lines have more outages in severe weather. Exposure to lighting strikes is far higher on a mountain top or ridge, which should be avoided as far as possible. The environment around a line, including wind, affects various electrical properties of the road. High velocity winds not only increase mechanical loading but also reduce the vertical and horizontal clearances. In regions where ice storms occur oscillations are produced near the elemental or at second or third harmonics, and this end in amplitudes. There are two measurement approaches: short-term and long-term. These methods are based on the survey and does not so effective. One of the major issues is related to the corona performance of the lines. The traditional approach to performance is based on information and techniques available. The traditional techniques are backward looking. That is, they focus on past performance rather than latest measured experiments. The concern about the limitations of existing performance measurement system has been felt in both theory circles and in most organizations. Performance measures focus more on cost and revenue data and less on the process. Most of the time it provides irrelevant or misleading information. Performance measures which contain bottom line results are too late to take up useful corrective action. Performance measures are without activity and process analysis which are essential to decide the value-added and non-value-added activity and process. Performance measures are based on tracking single dimensions of performance and they do not provide an integrated or holistic view of performance. Since performance is measured in specific areas only, managers tend to find themselves unable to assess whether they have implemented their strategies effectively. For bigger projects, especially startup operations, an additional dimension comes into play, and that's capital cost. Using usual equipment of cellular systems, the "Interference Detection Technique" is the best choice for a noisy environment. The reason is simple: in "Interference Detection Technique", the receiving and measuring units, and extra-costs for the installation of these equipment are not necessary.

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