A Current State of Art Review on Dual Band Dipole Antenna for LTE-A, UMTS Applications

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***Abstract*: In most of the applications of wireless communication in the recent era there is a demand for the antenna to fulfill various attributes such as compact size, increased gain, multiband profile needs. Hence in order to fulfill these attributes a single antenna with a single band of operation is in-sufficient. This leads to the design of a single antenna with multiband to satisfy the user profile toward various focused applications. This tends to the main challenge of design of the multiband antenna. Hence in order to meet those various application needs leads to the design and development of dual band dipole antenna with dual band frequencies ranging from 703MHz – 960MHz and 1710MHz – 2690MHz using CST Electromagnetic simulator for both lower and higher frequency applications which is most popularly used commercial simulator.**

***Index Terms*: Dual band, EM Tool, LTE-A, Wireless communication, Dipole Antenna.**

I.INTRODUCTION

Dipole antenna or doublet is most widely used simplest class of antenna that produces radiation pattern which is approximately equal to radiation pattern produced by elementary electric dipole. It commonly consists of two equal length conductors with feed line connected in between them. They are most frequently used resonant type of antenna that is if the feed point of such an antenna is shorted, it will resonate at a particular frequency.

Types of Dipole Antenna:

1. **Half wave dipole antenna:** As the name implies the length of such a type of dipole antenna is half the wavelength which is most widely used.
2. **Folded dipole:** As the name implies, folded dipole antenna is a form of dipole aerial or dipole antenna which is folded back on it still retaining the length between ends of a half wavelength.
3. **Short dipole antenna:** The dipole antenna with its length much less than that of a half wavelength whose response is less frequency dependent with current profile is approximated to a triangular distribution.
4. **Non-resonant dipole:** The dipole antenna that enables to operate over a much wider Bandwidth which is because it may be operated away from its resonant frequency and fed with a high impedance feeder.

II.RELATED WORK:

In the presented work by Xiangbin Miao et al, two designs of dual-mode beam-steerable antenna arrays using arc-shaped dipoles are proposed for indoor base-station applications. The optimal distribution of excitations, gain and front-back ratio are optimized by using maximum power transmission efficiency. The first design operates at 2.45 GHz and consists of a circular ring reflector and four arc-shaped dipoles, with the electrical length of one dipole arm being 1/4 wavelength. The omnidirectional gain of the first design is 1.5 dBi, and its peak gain and front-to-back ratio are 7.4 dBi and 15.5 dB respectively. The second design operates at 2.45 GHz, composed of two circular ring reflectors and eight arc-shaped dipoles distributed in two substrates, separated by a foam layer. Compared with the first design, it has a higher omnidirectional gain of 2.9 dBi and more uniform gain distribution, with a peak gain of 8.4 dBi and a front-to-back ratio of 12.5 dB [1].

In paper by Ahmed Z. Ashoor et al , an Energy harvesting surface (EHS) composed of cross dipoles with two feeding gaps was designed and analyzed for maximizing the radiation to ac harvesting efficiency at multiple polarizations of incident field. A 7 × 7 cross-dipole elements array was then fabricated and rectifying diodes were then placed at each cross-dipole element feeding gap to covert the collected ac power to dc power. Then these array elements are linked by inductors for dc channeling. This converted dc power of any incoming polarizations was then channeled to a load for measuring the radiation to dc conversion efficiency. Hence the presented EHS achieved a radiation to dc efficiency of 74% over all polarizations [2].

In the report work by Kwanhatai Pojang, the Log-periodic Dipole Array Antenna for WLAN, LTE, UWB Applications was fabricated on FR4 substrate with dielectric constant, 4.3 excited through a microstrip line feed by 50 ohm of impedance

matching. The variation of parameter of width and distance were used to improve the bandwidth frequency for WLAN, LTE and UWB. The measurement result shown that the VSWR coverage of the frequency range from 1.4 GHz to 12 GHz, average gain of 4.51 dBi and moreover the average efficiency of 75.32% [3].

In the reported work by Anwer S et al, a broadband triangular shaped dipole antenna of improved radiation characteristics with integrated balloon as a feed to the dipole involving elliptical slot and micro strip line which leads to high gain covering frequency range from 26.3 GHz-40 GHz of 5G bands which is suitable for wireless communication systems in millimeter range [4].

In a paper by Boon-Kok Tan et al, the bandwidth broadening is achieved by cascading two dipoles in series of different length that covers Ku-band 7 GHz of microwave, millimeter, and sub-millimeter wavelength applications. To achieve high front-to-back gain ratio of 18 dB two printed directors and a truncated ground planes are used. The feeder type used are micro strip line without any intermediate stage. The proposed design provides high efficient detector area application with simple design geometry [5].

A report by Gregorio Zamora-Mejıa et al, a tunable dual-band antenna covering 910MHz/2.4GHz which works for standards such as UHF-RFID, Bluetooth, GSM-840MHz, 3G-UMTS and Wi-Fi designed and simulated using Advanced Design System(ADS) Momentum is fabricated on FR4 printed circuit board. With specified gap between dipoles and tenability Power Harvesting and sensor network applications are presented, where the electric field strength of one carrier band is dominant over the other one or similar electric field strength that is present between two carriers [6].

In a paper by Debdeep Sarkar et al The proposed MIMO architecture with Complementary split ring resonator loaded dual band printed dipoles for 2.4 GHz WLAN and 1.8 GHz GSM bands excited with equal amplitude but different input-phase arrays by design of suitable power-divider and phase-delay lines which leads to diversity in the achieved radiation pattern in the same operating frequency range. Hence diversity in pattern can be achieved by simply switching the input from one antenna array to the other, instead of using RF switching diodes which is beneficial over use of diodes which increases the design cost and also cause adverse effects on efficiency and radiation patterns. The S-parameters and radiation patterns obtained from HFSS simulations and experiments are showed in measured ones [7].

In a paper by Zi Long Ma et al, the concept of Dual-polarized magneto-electric waveguide-based dipole antenna, two antenna designs with rectangular and triangular shaped E-dipoles are proposed. Which are differentially fed by 4 probes for former and a turnstile junction orthomode transducer feed for latter. The prototypes are fabricated and demonstrated using 3-D printing technique. Experimental results show that the rectangular shaped E-dipole design has a stable gain of 6 ± 1.5 dBi. Similarly the triangular shaped E-dipole design can achieve 5.15 ± 0.95 dBi gain over the operating frequencies. The antenna designed have good mechanical and electrical performance for high power capacity applications such as satellite and other wireless communication systems [8].

III.PROPOSED METHODOLOGY:

The proposed methodology is depicted in the flowchart of figure 1 .Accordingly the proposed type of multiband high frequency dipole antenna design for resonant frequency of 832MHz and 2200MHz covers various applications needed for emerging technology unlike a single band covering or satisfying a single application with large size and utilizing high output power. The design of this antenna and its development has compact size and high output power limits. However design of such a type of antenna is bit complicated but has more scope in emerging technology. Once the antenna design is chosen, the design parameters must be formulated, the orientation, shape and feeder of the antenna has to be designed. The CST Simulation software is used to analyze the design parameters. Following, build the design and test the antenna to compare simulated result with experimental results to evaluate whether the design goals were achieved.

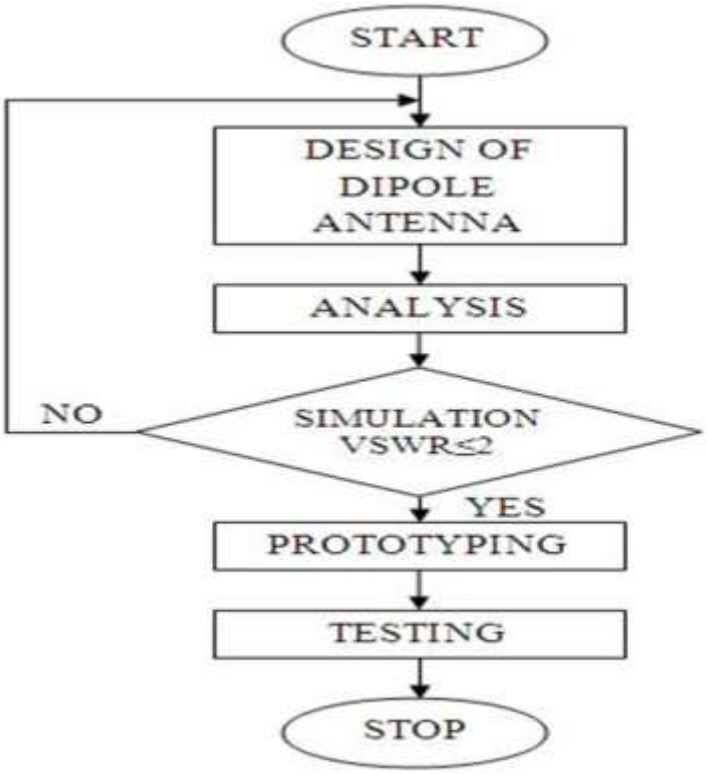

Figure 1: The Flowchart for depicting proposed methodology.

IV.TOOLS USED:

The tool to be used for design, simulation, development and testing are: CST software, which is a high-performance 3D EM analysis software package for designing, analyzing and optimizing electromagnetic(EM) components and systems. Electromagnetic field solvers for applications across the EM spectrum are contained within a single user interface in CST studio suite. The solvers can be coupled to perform hybrid simulations, giving engineers the flexibility to analyze whole systems made up of multiple components in an efficient and straightforward way. Co-design with Simulia products allows EM simulation to be integrated into design flow and drives the development process from the earliest stages. Common subjects of EM analysis include the performance, efficiency and installed performance of antenna and filters, Electromagnetic compatibility and interference, exposure of the human body to fields, electromechanical effects in motors and generators, and thermal effects in high-power devices.

CST studio suite is used in leading technology and engineering companies around the world and offers considerable product to market advantages, facilitating shorter development cycles and reduced costs. Simulation allows the use of virtual prototyping by industry leaders, which means that device performance.

V.CONCLUSION:

Hence the concept of this review paper is to design and develop dual band dipole antenna for LTE-A, and UMTS applications. The design of proposed antenna is carried out using CST tool and it will be tested and analyzed using network analyzer.

REFERENCES:

[1] Xiangbin Miao, Wan Wan, Zhu Duan, Wen Geyi, "Design of Dual-Mode Arc-Shaped Dipole Arrays for Indoor Base-Station Applications" IEEE Antennas and Wireless Propagation Letters, 2019.

[2] Ahmed Z. Ashoor and Omar M. Ramahi, "Polarization-Independent Cross-Dipole Energy Harvesting Surface" IEEE Transaction on theory and Techniques, VOL. 67, NO. 3, MARCH 2019.

[3] Kwanhatai Pojang, Paitoon Rakluea, "The Design of Log Periodic Dipole Array Antenna for WLAN/LTE/UWB Applications, International Symposium on Communications and Information Technologies (ISCIT), 2018.

[4] **Anwer S. Abd El Hameed, Adel Barakat, Adel B. Abdel-Rahman, Ahmed Allam, Ramesh K. Pokharel, and Kuniaki Yoshitomi,** "Broadband Printed-Dipole Antenna for Future 5G Applications and Wireless Communication",IEEE,2018.

[5] **Boon-Kok Tan, Stafford Withington, Ghassan Yassin,** "A Compact Microstrip fed Planar Dual-Dipole Antenna for Broadband Applications", IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS,2015.

[6] **Gregorio Zamora-Mejıa, Jaime Martınez-Castillo, Alejandro Dıaz-Sanchez, Jose M. Rocha-Perez,**"A 910MHz/2.4GHz Easily Tunable Dual-Band Antenna for Power Harvesting and Sensor Networking Applications" International Conference on Computing Systems and Telematics (ICCSAT), 2015.

[7] **Debdeep Sarkar ,Kushmanda Saurav, Kumar Vaibhav Srivastava,**"Dual band complementary split-ring resonator-loaded printed dipole antenna arrays for pattern diversity multiple-input-multiple-output applications" IET Microw. Antennas Propag, Vol. 10, Iss. 10, pp. 1113–1123,2016.

[8**] Zi Long Ma, Chi Hou Chan ,** "Waveguide-Based Differentially Fed Dual-Polarized Magnetoelectric Dipole Antennas", IEEE Transactions on Antennas and Propagation, August 2017.