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AN ANTENNA ARRAY OF MILLIMETER WAVE FREQUENCY FOR 5G APPLICATIONS

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Abstract— Nowadays there is a rapid increase in the usage of moblies for either voice calls or for the browsing or for watching HD videos online. There is a huge traffic in the usage of frequency[1] band of present technology that is 4G technology. So to overcome this problem so many scientists did research and came up with a solution that to upgrade to 5G technology.5G technology is very fast and has higher bandwidth with higher datarate which is used to over come the problems caused due to higher traffic in the network. One of the important device in the 5G technology is antenna. In this paper, we are going to present the design and Time domain Analysis[2] for Dipole Patch array antenna. The Antenna is made with Rogers substrate of Di-electric constant which has High Dielectric Strength ε=3.55 to operate at millimeter wave frequencies and is designed to have Compact size, and model. The antenna is taken care of by Co-planar Waveguide Transmission line and has a smaller absolute size.

Index Terms— Millimeter wave frequency, Rogers material, Dipole patch.

I. INTRODUCTION

A monopole Array antenna, class of radio antenna consisting of a straight rod-shaped conductor, often mounted perpendicularly over some type of conductive surface, called a ground plane[1]. Planar monopole antennas have been used in wireless communication systems for a long time due to their simple structures, feeding mechanisms, low fabrication costs. Wireless Communications are becoming as a part of day-to-day life of human beings. So, in order to achieve efficient and affordable wireless communication, compact and efficient radiators required[2]. Indeed, one of the efficient radiators is microstrip antenna (MA). Antenna of different dielectric material which acts as resonator or slots for radio waves generally in microwave and millimeter wave bands. Rectangular antenna has ubiquitous attention because of their advantages such as high radiation efficiency[3], low dissipation loss, small size, low cost etc.

The antennas are used for polarization diversity, to increase the channel capacity and to enhance the data rate. Over the decade the research is focusing[4] on bandwidth enhancement using Rectangular patch antenna. In case of dielectric resonator the entire geometry will radiate where as in microstrip patch antenna only the narrow radiation slots radiates. Wireless antenna is becoming more common in daily life applications due to their more Flexible nature. Applications of Antenna are many like wireless devices such as Laptops, Tablets, Smart Gadgets, Mobile phones and some others also in Bio-medical applications[5]. The Printed flexible antennas need has increased. The Micro strip antenna are simple comfortable and takes less manufacturing cost.

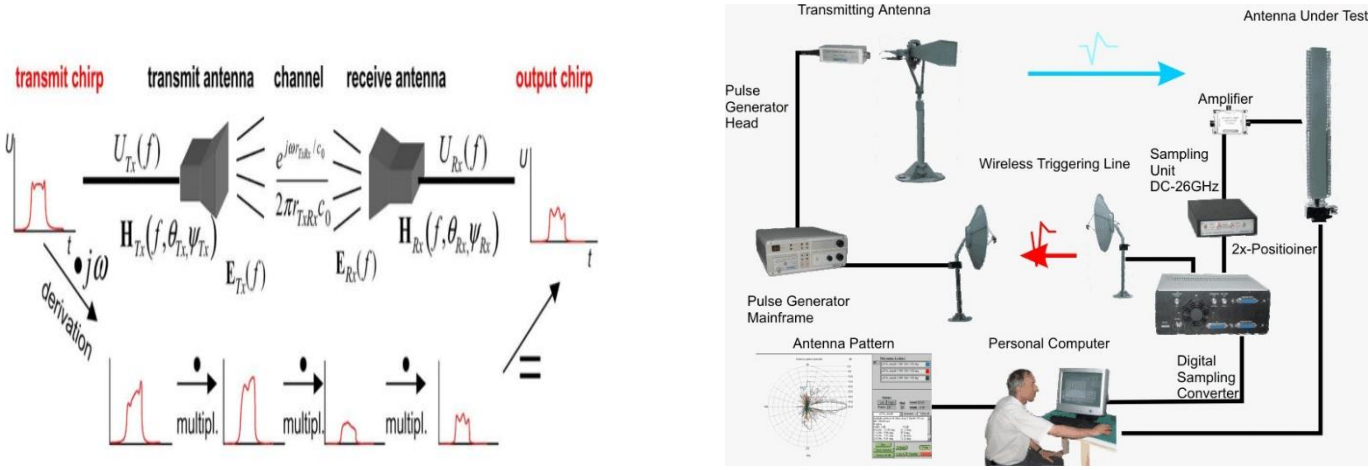

Fig: Block diagram of wireless transmission of Electromagnetic signals.

II. MOTIVATION

In the previous times to analyze an antenna process is done by hand or virtually but now in the recent times the new software which are now designed to make the process easy so that the use of antenna is used in many applications in our daily. As the wireless antenna is becoming[6] more common in daily life applications due to their more flexible nature applications of wireless antenna are many like wireless devices such as Laptops, tablets, Smart gadgets, Mobile phones and some others[7] the more we study the more interesting that we get in antenna applications.

III. METHODOLOGY

The method that has been adopted in this research work is briefly listed in the following steps
Step 1: Literature survey and a thorough review of the techniques which have been reported is observed.
Step 2: It is applied to achieve the miniaturization, multiband and gain features in antenna.
Step 3: The proposed antenna is designed in the HFSS tool.
Step 4: Different parameters is simulated and observed.
Step 5: Full wave simulation and analysis of proposed antenna.

IV. DESIGN CONSIDERATIONS

Resonant frequency, $f_r = \frac{1.8412}{2\pi Rp\sqrt{\epsilon_r}}$

Effective height, $a_e = Rp\left\{1 + \frac{2h}{\pi Rp\epsilon_r}\left[In\left(\frac{\pi Rp}{2h}\right) + 1.7726\right]\right\}^{\frac{1}{2}}$

The effective dielectric constant for narrow microstrip line is

$$\epsilon_{re} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2}\frac{\ln\left(\frac{\pi}{2}\right) + (1/\epsilon_r)\ln\left(\frac{4}{\pi}\right)}{\ln(8h/W)}$$

The characteristic impedance, Z_{0m} of microstrip line is given by

$$Z_{0m} = \frac{377}{2\pi\left\{(\epsilon_r + 1)/2\right\}^{1/2}}\left[\ln\left(\frac{8h}{W_f}\right) + \frac{1}{8}\left(\frac{W_f}{2h}\right)^2 - \frac{1}{2}\frac{\epsilon_r - 1}{\epsilon_r + 1}\left\{\ln\left(\frac{\pi}{2}\right) + (1/\epsilon_r)\ln\left(\frac{4}{\pi}\right)\right\}\right]$$

V. EXPERIMENT AND SIMULATION

Proposed Antenna

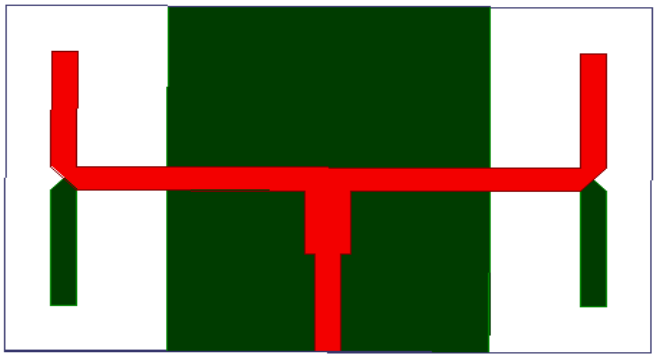

Fig: Proposed dipole patch.

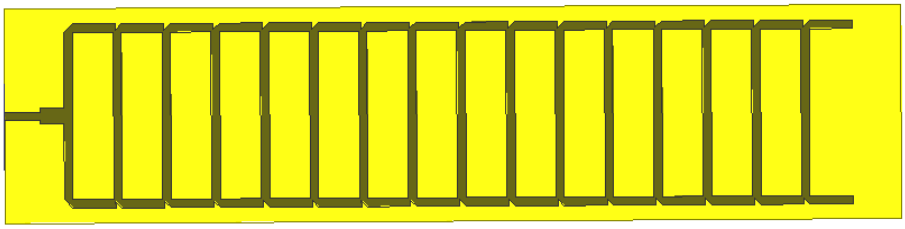

Fig: Proposed Dipole array patch.

Design of Dipole patch antenna:

A Dipole microstrip patch antenna designing is easier than other patch configuration as we only need one design parameter i.e. radius of the patch. The Dipole microstrip patch antenna is designed on a Rodgers substrate having a dielectric constant, εr = 3.55 and height of the substrate h which is generally 0.256mm. High Frequency Structure Simulator (HFSS) solves electromagnetic structures of high frequency applications using Finite Element Method (FEM). It is a powerful tool for antenna design and RF electronic circuit including transmission lines, filters and packaging. Faithful desired results can be obtained using parametric analysis and optimization.

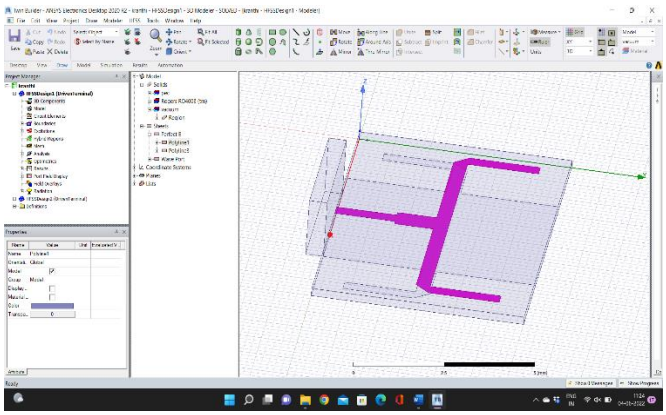

Fig: Designed Single dipole patch antenna

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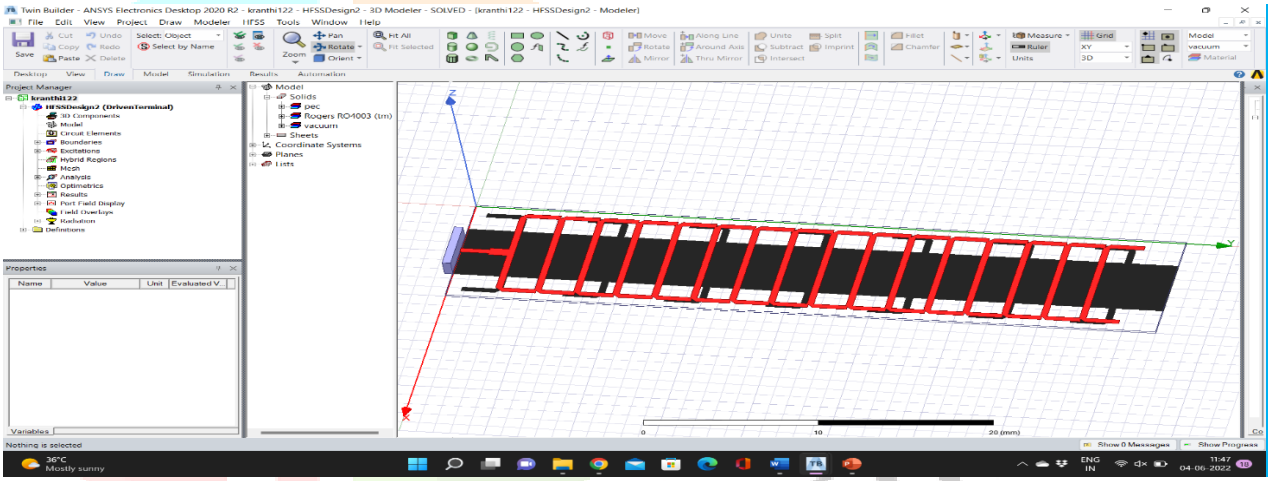

Fig: Designed array dipole patch antenna.

VI. SPECIFICATIONS

Table: Specifications of designed array antenna.

Particulars	Value or size
Operating frequency	22 and 33 GHz
Height of substrate	0.256mm
Length of substrate (L)	42mm
Width of substrate (W)	25mm
Length of ground (L_g)	12.5mm
Width of ground (W_g)	42mm
Radius of Dipole patch (R_p)	10.6mm
Width of the feed (W_f)	2.2mm

VII. RESULTS

Proposed antenna is designed using HFSS software tool and results has been extracted for the analysis. The below shown figures are the results that has been extracted in HFSS software for the designed antenna. The results are Scattering parameter, Voltage standing wave ratio, Impedance analysis, Radiation pattern analysis.

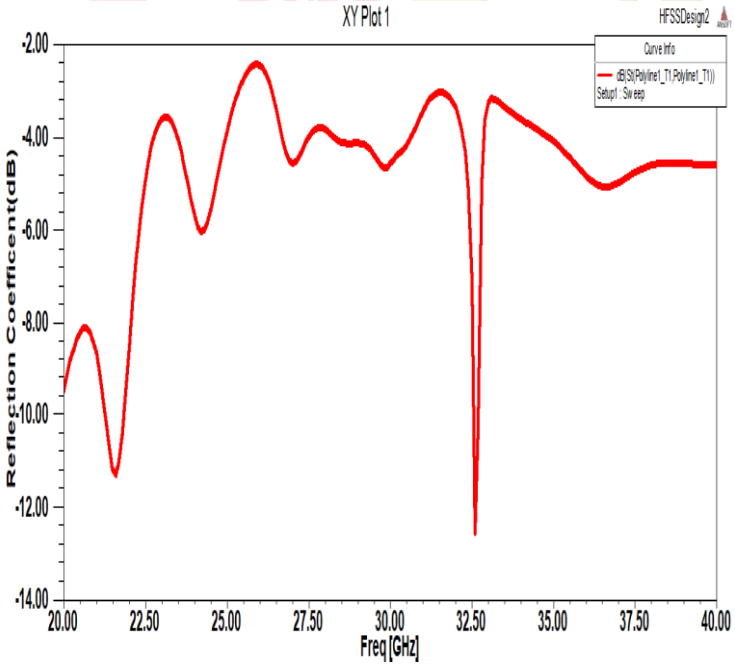

Fig: S parameter analysis

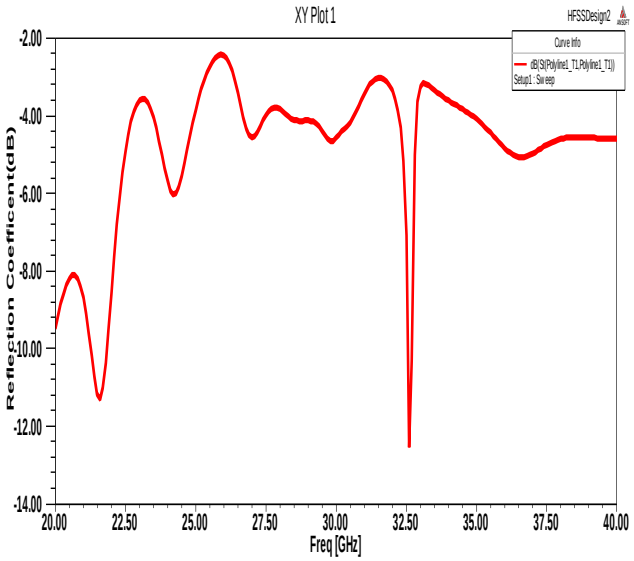

Fig: VSWR Analysis

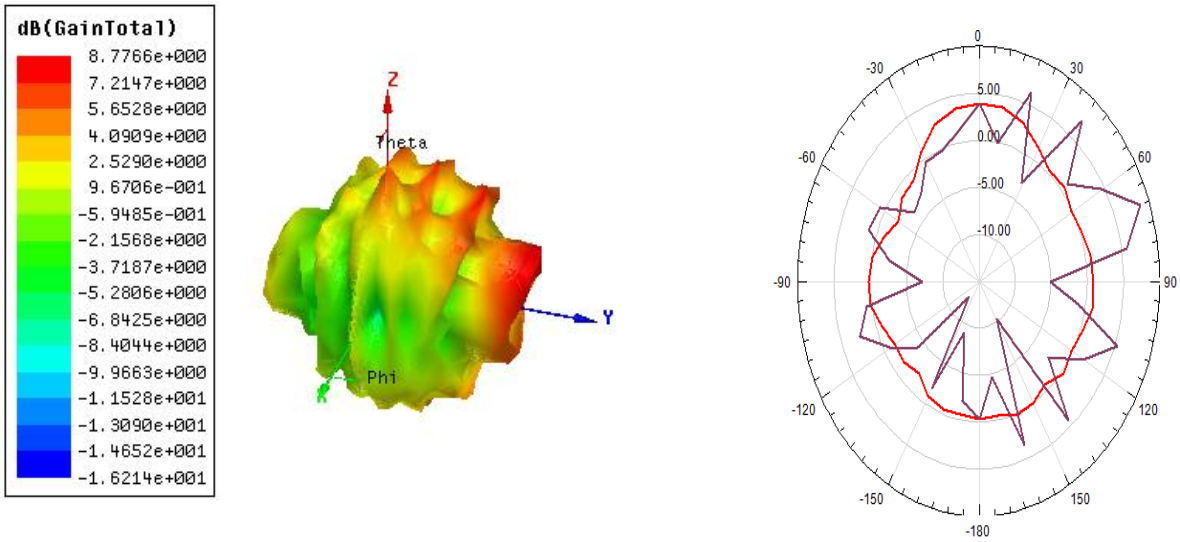

Fig: Impedence Analysis

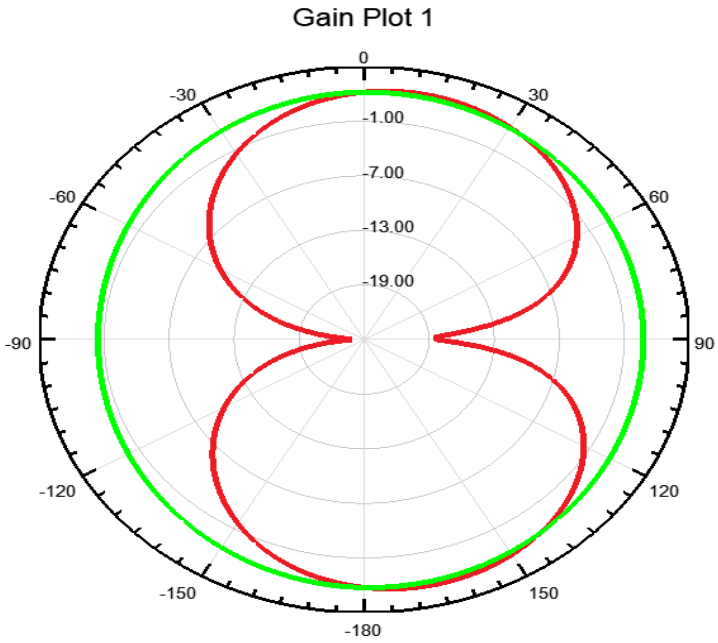

Fig: Radiation pattern

VIII. CONCLUSION

This work presents a typical Dipole Patch antenna fabricates using Rodgers substrate. Simulation and Measurement were conducted for both T-shaped and Dipole shaped scenarios. The measured 10 dB Reflection coefficient band width is 85% of the FCC's regulation. Anechoic chamber measurement of the far field characteristics showed the Dumbbell-shaped Radiation pattern at lower Linearity in Radiation Polarization is concluded in agreement with simulation results. Time Domain characteristics represents in impulsive response was estimated, the received pulses from different setup scenarios showed high correlation when compared to the input pulse with slight degradation in received pulses in case of T-shaped and Dipole shaped scenario. The purposed method shows clear scope to reduce theprobability of error in traffic violation control. However, this work can be improved further by usingmore advanced image processing techniques and adding new features.

IX. FUTURE SCOPE

Dipole strip patch antenna have a tremendous application potential. Even as of now, these antennas are designed and used in Personal Communication System, Mobile Satellite Communication, Direct Broadcast Satellite, Global Positioning System, Wireless Local Area Network, Intelligent Vehicle Highway System,[12] and also it is receiving attention for Microwave Therapy. These antennas are actively considered for application, such as satellite communication systems, where thin profile and light weight are important, consideration. The present model can be extended for micro strip patch Dipole antenna. For this development some additional models will have to be developed[15]. Many applications in communications and radar required dual frequency. The present work can be extended also for designing of dual frequency patch antenna.

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