Design and Analysis of Microstrip Patch Antenna Array with DGS for LTE Application

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Abstract : In fastest developing innovation microstrip patch antennas are for all intents and purposes utilized in the field of development correspondence for their reduced size, ease, adaptability and productivity. Diverse shapes and sizes of patch antennas are accessible in the market. The paper exhibits a structure of 4X4 microstrip patch array antenna with finite and defected ground structure for 6GHz and investigation as far as full frequency, VSWR, Return loss and so on. The FR4 Epoxy substrate is utilized to structure the antenna with CST programming. Mimicked result accomplishes significant enhancement and can be utilized in 5G correspondence application.

IndexTerms - **Antenna, pattern, 5G, CST, FR4, VSWR, Return loss.**

I. INTRODUCTION

This fourth generation of portable correspondence innovation norms (4G) is to fulfill individuals' needs. The pattern is advance toward to the new generation. The fifth generation portable systems (5G) are proposed and created. The speed of 5G will be multiple times quicker than that of 4G. The 5G is an appealing point for remote systems. The microstrip antenna has the benefits of minimal effort, space-sparing, and less demanding assembling. Nonetheless, the plan of single component of microstrip antenna can't meet the necessity of passageway applications. Thusly, an antenna exhibit with microstrip antennas is embraced in the plan.

Frequency run 1 (< 6 GHz)- The most extreme channel bandwidth characterized for FR1 is 100 MHz. Note that start with Discharge 10, LTE bolsters 100 MHz transporter collection (five x 20 MHz channels.) FR1 underpins a most extreme adjustment arrangement of 256-QAM while LTE has a greatest of 64-QAM, which means 5G accomplishes critical throughput upgrades in respect to LTE in the sub-6 GHz bands. Anyway LTE-Propelled as of now utilizes 256-QAM, taking out the upside of 5G in FR1.

Frequency run 2 (24– 86 GHz)- The most extreme channel bandwidth characterized for FR2 is 400 MHz, with two-divert total upheld in 3GPP Discharge 15. The most extreme phy rate possibly bolstered by this configuration is roughly 40 Gbit/s. In Europe, 24.25– 27.5 GHz is the proposed frequencies go. Favorable position inborn to patch antennas is the capacity to have polarization assorted variety. Patch antennas can without much of a stretch be intended to have vertical, even, right hand round (RHCP) or left hand roundabout (LHCP) polarizations, utilizing various feed focuses, or a solitary feedpoint with topsy-turvy patch structures. This one of a kind property permits patch antennas to be utilized in numerous sorts of correspondences connects that may have differed prerequisites.

II. LITERATURE OVERVIEW

Y. Li et al.,[1] An eight-component various info different yield (MIMO) antenna connected for 5G and sub-6GHz indoor remote passages is examined in this paper. The proposed antenna exhibit underpins 4 × 4 MIMO in the LTE bands 42/43/46 (3400-3600 MHz, 3600-3800 MHz, and 5150-5925 MHz). Four fork-like electric dipoles arranged at the edges of the system circuit board cover the LTE bands 42/43, while four transformed L-molded open spaces put along the edges bolster the LTE band 46. The proposed antenna cluster shows great impedance coordinating and detachment, with return losses more prominent than 10 dB and segregations bigger than 15 dB. The aggregate productivity of the antenna cluster is higher than 70% in the ideal operation bands. The envelope connection coefficient (ECC) and ergodic channel limit are determined to confirm the MIMO execution.

C. Kumar et al.,[2] Defected ground structure (DGS) incorporated microstrip array has been investigated and shown here out of the blue with the essential point of accomplishing improved polarization immaculateness. A formed DGS with variable setup has been imagined and intended for rectangular arrays. This releases new capability of DGS configuration by decreasing the scratched out region by half. A 2 × 2 DGS coordinated array has been structured and tentatively exhibited in X-band demonstrating 12 dB improvement in the confinement between the copol and cross-pol radiations.

D. Guha et al.,[[3] A formed defected ground structure (DGS) that is uneven in a particular transmitting plane of a microstrip element has been investigated with the end goal of tending to the cross-polarization (XP) issues. The deviated arrangement has been considered from an understanding of the natural asymmetry of the modular fields underneath a test sustained microstrip patch and has been tentatively exhibited as the most ideal structure contrasted with its forerunners regarding the decrease in XP fields, precise range of concealment around boresight, and the space involved by the deformities. Various introductions of the imperfections with reference to the patches of various viewpoint proportion esteems have been completely inspected. More than 28-dB segregation between co-pol and traverse 190° precise range, which is to be sure 140° more whenever contrasted and a regular ground plane. Its better attributes with deference than the prior structures have additionally been recorded.

C. Kumar et al.,[4] A symmetric just as nonproximal defected ground structure has been imagined for a square microstrip patch to accomplish high co-to cross-energized (XP) disengagement over the important radiation planes. This structure does not pursue the thumb standard of prior works where the deformity was conveyed either underneath or in closeness to the patch limit. The proposed arrangement, in this way, has all the earmarks of being perfect for some particular applications, for example, double enraptured or circularly energized patches with improved polarization immaculateness. An agent structure in C-band has been talked about, prompting the confirmation of idea. Exploratory confirmation affirms up to 8-10 dB improvement in XP level, especially in the H-plane.

K.A Mouli et al.,[5] This work exhibits an investigation and examination of Rectangular Patch antenna Arrays and Triangular Patch Antenna Arrays. A few Arrays to be specific 1×2, 2×1, 2×2, 4×1, 2×4, 4×2 of both Rectangular and Triangular shapes are investigated utilizing the HFSS Recreation Programming Device. The Antenna Parameters Addition, Directivity and Return Misfortune are broke down. The Antenna Arrays are examined at a thunderous frequency of 2.2GHz which are appropriate for ISM Band, WLAN and Aviation Applications.

Table 1: Summary of Literature Review

Author name	**Year of Publication**	**Frequency Range**	**Objective**
Y. Li	June 2018	3.4-5.9 GHz	Eight-element multiple-input multiple-output (MIMO) antenna
S. N. M. Zainarry	Nov 2017	3-4 GHz	Antennas exhibit wide bandwidth above 4 GHz with an average gain values more than 12.5 dBi.
J. Zeng	Sep 2016	2.6-GHz	Hybrid antenna array elements are symmetrically placed along the long edges
S. Kumar	Oct 2018	3.4-5.9 GHz	Proposed MIMO antenna is composed of three different antenna element types

III. PROPOSED ANTENNA VIEW

In figure 2, indicating top perspective of proposed Cluster microstrip patch antenna, one side of a dielectric substrate goes about as an emanating patch and opposite side of substrate goes about as ground plane. Top perspective of a rectangular patch antenna with coaxial feed has. Patch and ground plane together makes bordering fields and this field is in charge of making the radiation from the antenna.

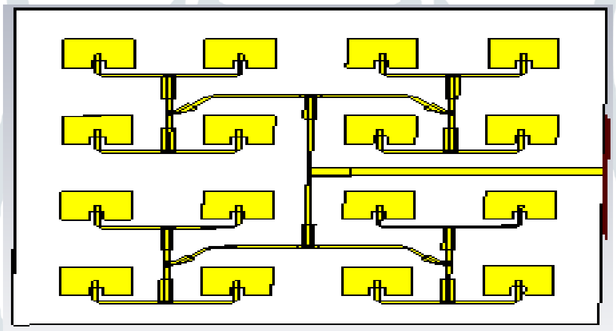

Figure 2: Top view of proposed Array microstrip antenna

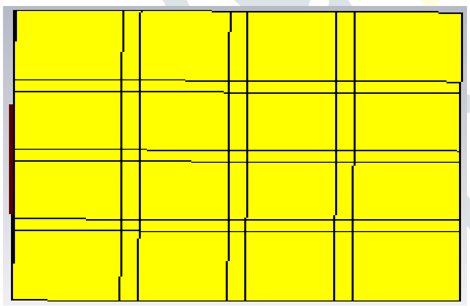

Figure 3: Finite ground structure

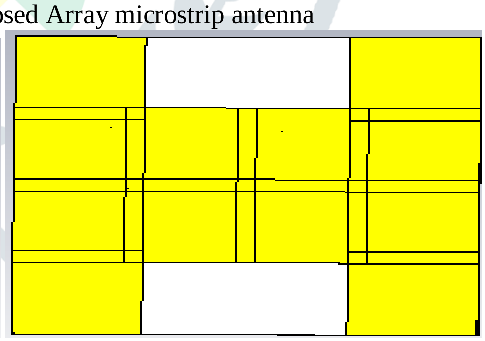

Figure 4: Defected ground structure

IV. SIMULATION AND RESULT

Proposed antenna design and simulated in CST microwave studio software.

Case-1: Finite ground structure

Table II Design parameters for proposed Antena

Frequency(f_r)	4-7 GHz
Dielectric constant(ε_r)	4.4 / FR4
Substrate Height(h)	1.6 mm
Line Impedance	50 Ω
Ground Plane	35 each mm^2
Tangent Loss	0.06

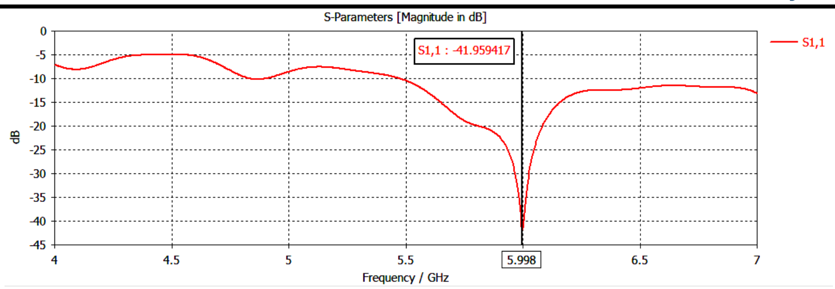

Figure 5: S parameter and Return loss

A. Bandwidth

The bandwidth of an antenna is characterized as "the scope of frequencies inside which the execution of the antenna, regarding some trademark, adjusts to a predefined standard." For broadband antennas, the bandwidth is generally communicated as the ratio of the upper-to-bring down frequencies of adequate operation.

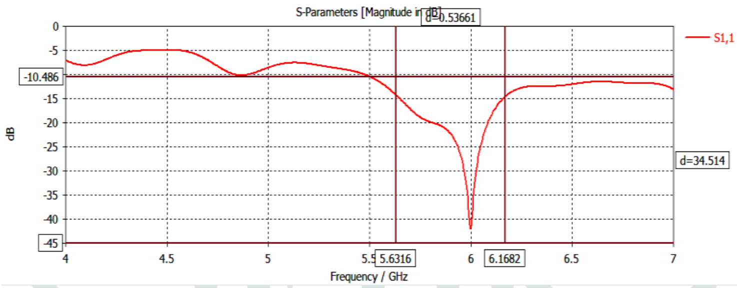

Figure 6: Bandwidth calculation

For broadband antennas, the bandwidth is communicated as a level of the frequency contrast (upper less lower) over the middle frequency of the bandwidth.

The bandwidth of proposed antenna is 536 MHz, (6.1682GHz-5.6316GHz).

B. Voltage Standing Wave Ratio (Vswr)

The most well-known case for estimating and looking at VSWR is when introducing and tuning transmitting antennas. At the point when a transmitter is associated with an antenna by a feed line, the impedance of the antenna and feed line must match precisely for most extreme vitality exchange from the feed line to the antenna to be conceivable.

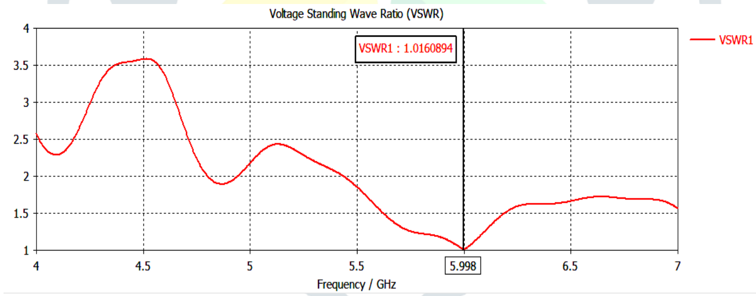

Figure 7: Voltage Standing Wave Ratios

Case-2: Defected ground structure

A. S11 or return loss

In figure 5.8, it is seen that, S11 parameter and return loss. They got estimation of S11 for 6.1229GHz is – 18.41 db and 6.598GHz is -17.39db. Here 6.1229GHz and 6.598GHz is resonant frequency, where antenna proficiency is higher.

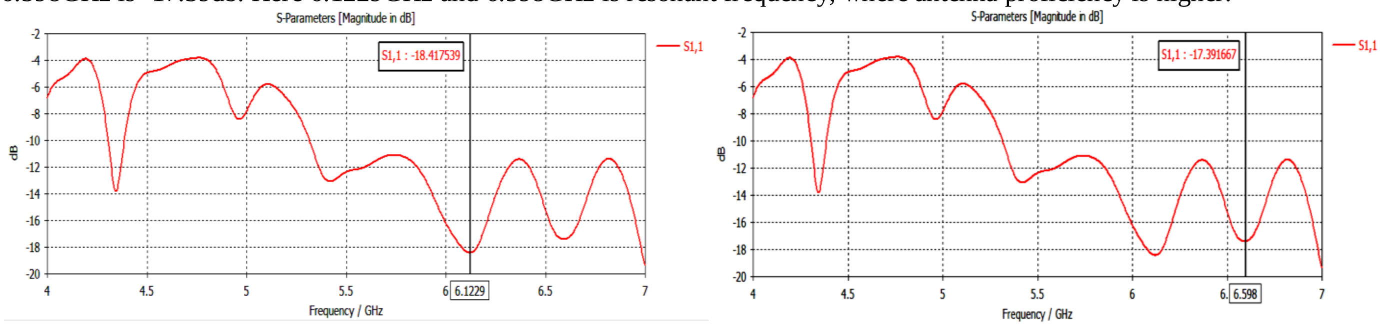

Figure 8: S parameter and Return loss

B. Bandwidth

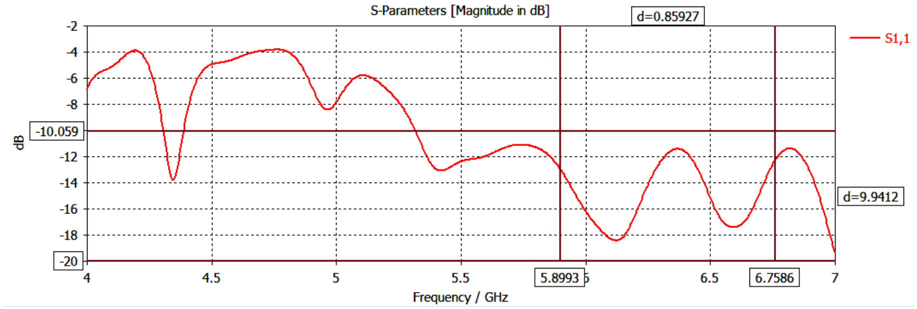

Figure 9: Bandwidth calculation

The transmission capacity of proposed antenna when DGS is 859MHz, (6.7586GHz-5.8993GHz) for all available bands.

C. VSWR

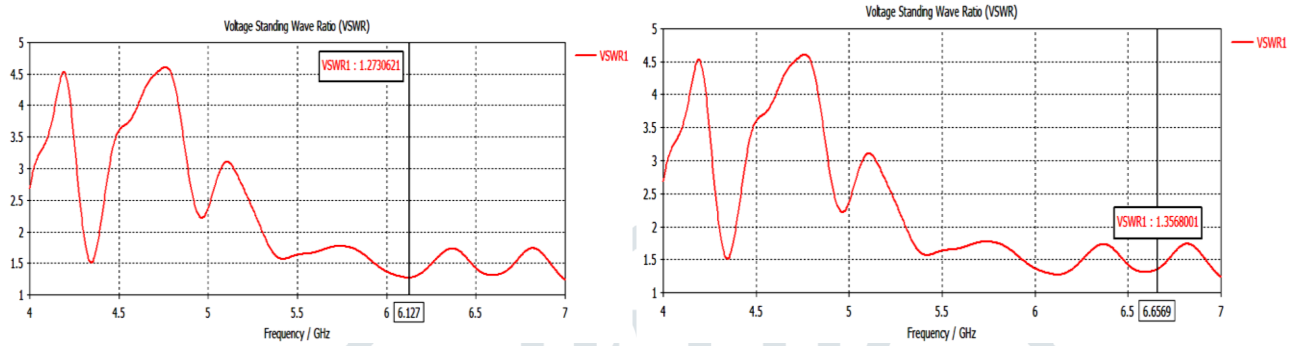

Figure 10: Voltage Standing Wave Ratios

VSWR must lie in the range of 1-2, which has been achieved for the frequencies 6.127GHz and 6.656GHz. The value for VSWR is 1.27 and 1.35 respectively.

Table III. Comparison of proposed design result with previous design result.

Sr No.	Parameter	Previous work	Proposed work (Finite Ground)	Proposed work (Defected Ground)
1	S11 or Return loss	-24db	-41.959db	-18.417db.
2	Band Width	500MHz	536 MHz	859 MHz
3	VSWR	1.2	1.016	1.273
4	Resonant Frequency	5.5GHz	5.998GHz	6.1229GHz

IV. CONCLUSION

A double band, rectangular microstrip patch antenna is planned and reproduced utilizing CST recreation programming. The reproduction results are exhibited and talked about. Structure of proposed antenna is straightforward and smaller in size of approx 35X35X1.6 〖mm〗^3. the minimal size of planned antenna makes it simple to be joined in little gadgets. Results demonstrate that the frequency bandwidth covers LTE band (4-7) GHz, at resonant frequencies 5.998GHz and 6.1229GHz GHz respectively for finite and defected ground structure and VSWR under 2, and S11 not exactly - 10 dB. In above clarified working band it demonstrates great impedance coordinating and bidirectional radiation designs. Therefore, it is seen that DGS gives better result than finite structure.

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