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Analysis of 6 GHz Rectangular Microstrip Patch Antenna Array for 5G Communication

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ABSTRACT: In today's modern scenario, Microstrip patch antennas are mostly preferred over other antennas to be fit in Mobile, Aircraft and Satellites due to very small sizes. Hence designing and development of superior & cost effective microstrip patch antenna is an active research area. A Microstrip line fed, line slot, double-band, rectangular microstrip patch antenna is designed which is most suited for telecommunication applications. Dissertation focuses on design and analysis of microstrip patch antenna array at 6GHz frequency range. CST software is used for designing and simulation. FR-4 with dielectric constant of 4.4 and thickness of 1.6 mm is used as a substrate in order to increase the bandwidth

Keywords: Antenna, radiation pattern, Electromagnetic, Microstrip, Patch

I. INTRODUCTION

5G is the fifth generation of cell mobile correspondences. It succeeds the 4G (LTE/WiMax), 3G (UMTS) and 2G(GSM) frameworks. 5G execution targets high information rate, diminished idleness, vitality sparing, cost decrease, higher framework limit, and enormous gadget network. The main period of 5G particulars in Discharge 15 will be finished by Walk 2019, to suit the early business organization. The second stage in Discharge 16 is expected finished by Walk 2020, for accommodation to the ITU as a competitor of IMT-2020 innovation Speed-5G guarantees better speeds in many conditions than the 4G organize. Qualcomm displayed a recreation at Mobile World Congress that predicts 490 Mbit/s middle velocities for 3.5 GHz 5G Enormous MIMO and 1.4 Gbit/s middle speed for 28 GHz mmWave. 5G NR speed in sub-6 GHz groups can be somewhat higher than the 4G with a comparative measure of range and antennas, however some 3GPP 5G systems will be slower than some progressed 4G systems, for example, T- Mobile's LTE/LAA arrange, which accomplishes 500+ Mbit/s in Manhattan. New use cases-Highlights of 5G arrange, including outrageous high transmission capacity, ultra low idleness, and high thickness associations, are relied upon to empower numerous new use cases that are difficult to be done by means of more established system measures.

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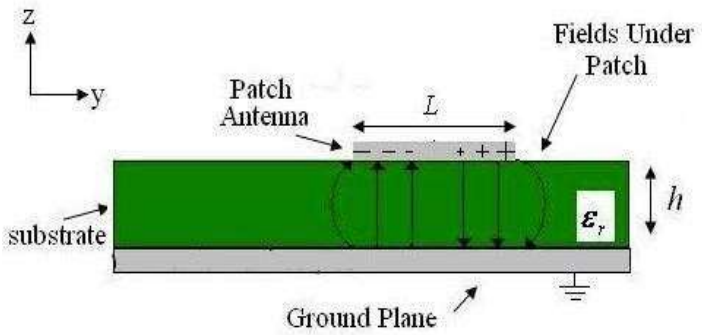
Models At first, the term was characterized by the Universal Media transmission Association's IMT- 2020 standard, which required a hypothetical pinnacle download limit of 20 gigabits, alongside different prerequisites for 5G systems. At that point, the industry guidelines assemble 3GPP have arranged the 5G NR (New Radio) standard together with LTE as their proposition for accommodation to the IMT-2020 standard ITU has partitioned 5G arrange administrations into three classifications: upgraded Mobile Broadband (eMBB) or handsets; Ultra-Dependable Low-Dormancy Interchanges (URLLC), which incorporates modern applications and independent vehicles; and Huge Machine Type Correspondences (MMTC) or sensors. Introductory 5G organizations will concentrate on eMBB and settled remote, which makes utilization of a considerable lot of indistinguishable abilities from eMBB. 5G will utilize range in the current LTE frequency extend (600 MHz to 6 GHz) and furthermore in millimeter wave(mmWave) groups (24– 86 GHz). 5G advancements need to fulfill ITU IMT-2020 prerequisites or potentially 3GPP, while IMT-2020 determines information rates of 20 Gbit/s, 5G speed in sub-6 GHz groups is like 4G



It is seen that upgrade in cutting edge innovation is quickly developing. In not very many years 3G interchanges change into 4G correspondence and as same speed 4G will change into 5G interchanges.So its need to configuration incorporates planning of a rectangular Microstrip patch antenna with improved data transmission and concentrate the impact of antenna measurements length (L), width (W) and substrate parameters, relative dielectric steady (ε_r) and substrate thickness on antenna transfer speed. The leading patch can be of any shape yet round and rectangular configurations are for the most part utilized. Different configurations are intricate to examine and require overwhelming numerical calculations. Thus we structured rectangular patch antenna. The plan is basic and the feed utilized is microstrip line. Antenna is critical component to accomplish this correspondence changes. There are quick research and development in the field of microstrip antenna, which can bolster for 5G correspondence or the other hand required huge

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accomplishment in every one of the parameters like data transfer capacity, antenna gain, directivity.

II. LITERATURE OVERVIEW

Y. Li, H. Zou, M. Wang, M. Peng [1] An eight-component various info different yield (MIMO) antenna connected for 5G and sub-6GHz indoor remote passages is contemplated in this paper. The proposed antenna cluster bolsters 4 × 4 MIMO in the LTE groups 42/43/46 (3400-3600 MHz, 3600- 3800 MHz, and 5150-5925 MHz). Four fork-like electric dipoles arranged at the edges of the framework circuit board cover the LTE groups 42/43, while four transformed L-formed open openings set along the edges bolster the LTE band 46. The proposed antenna cluster shows great impedance coordinating and disconnection, with return losses more noteworthy than 10 dB and detachments bigger than 15 dB. The aggregate proficiency of the antenna exhibit is higher than 70% in the ideal operation groups. The envelope relationship coefficient (ECC) and ergodic channel limit are determined to check the MIMO execution.

M. Li et al [3] A double enraptured half breed eight-antenna exhibit working in the 2.6-GHz band (2550-2650 MHz) for 5G correspondence multi-input multi-yield (MIMO) operation in the cell phone is displayed. The proposed mixture antenna cluster components are symmetrically put along the long edges of the cell phone, and they are made out of two diverse four-antenna exhibit types (C- formed coupled-nourished and L-molded monopole space) that show symmetrical polarization. Along these lines, coupling between the two antenna cluster types can be diminished, and the MIMO framework exhibitions are upgraded. A model of the proposed eight-antenna cluster is fabricated and estimated. A decent impedance coordinating (10 dB return loss or better), attractive cross- polarization separation (superior to 15 dB), and a worthy segregation (superior to anything 12.5 dB) are gotten. Envelope relationship coefficient and channel limit are additionally determined to assess the MIMO exhibitions of the proposed antenna cluster.

K. Laafif, M. Bouslama and A. Gharsallah [10] In this paper a reconfigurable radiation design antenna displayed to use for point-to-point correspondence base station frameworks. The strategy depends on a fabry perot cavity with two surfaces; a somewhat intelligent surface and an intermittent Frequency particular surfaces are joined to make an exchanging conduct of the antenna structure. The outcomes are approved for the 5.6GHz frequency that can be in for 5G remote correspondences to-point correspondence base station frameworks.

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Y. Li, H. Zou, M. Peng, M. Wang [13] In this paper, a 12-port 5G various info different yield (MIMO) antenna cluster for miniaturized scale remote passageways is examined. By coordinating four F-formed open space antennas and eight F-molded electric antennas, the proposed antenna exhibit underpins 4×4 MIMO in the LTE groups 42/43 (3.4-3.8 GHz), and 8×8 MIMO in the 4.9- GHz band/LTE band 46 (4.8-5.925 GHz). In the operation data transfer capacity, high aggregate proficiency (>70%) ., evident radiation decent variety trademark and low envelope relationship coefficient (ECC, <0.01) are acquired.

III. PROBLEM FORMULATION

From the above literature review we can conclude that the problem identified with the microstrip patch antenna for 5G communication-

- Narrow bandwidth and associated tolerance problems
- Lower gain (6 dB)
- Large ohmic loss in the feed structure of arrays
- Most microstrip antennas radiate into half-space
- Complex feeding design is required for high performance of the arrays
- Poor end-fire radiator, except tapered slot antenna
- Extraneous radiation from feed and junctions
- Lower power handling capability

IV. PROPOSED DESIGN

In figure 2, demonstrating 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.

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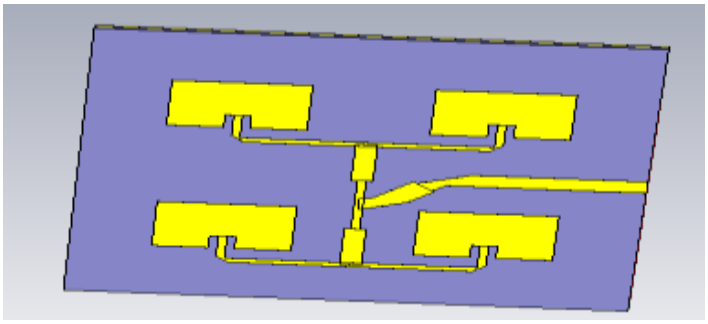

Figure-2 Top view of proposed Array microstrip patch antenna

V. SIMULATION RESULT

In order to realize multiband antenna, a wide assortment of antenna types, which utilizes distinctive multiband strategies, is utilized. The most generally utilized procedure for getting multiband antenna framework is the utilization of various resounding structures. The numerous thunderous structure technique is additionally regularly utilized ahead of time mobile correspondence frameworks to accomplish multiband mobile antennas.

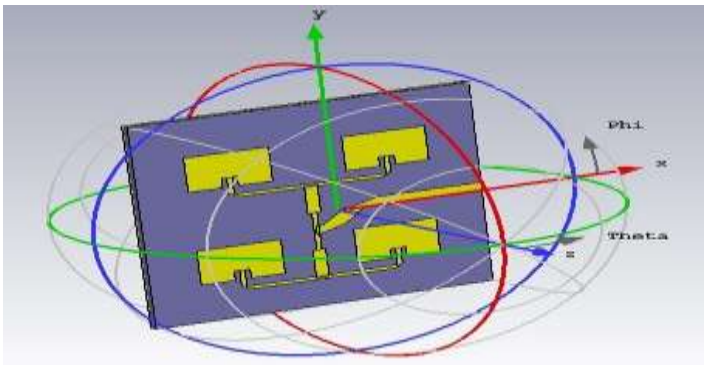

Figure 2.1 Simulation and fields of proposed antenna

Figure 2.1 indicating reenacted proposed antenna in CST microwave studio, it is a specific apparatus for the quick and exact 3D EM reproduction of high frequency issues. Alongside an expansive application extend

RESULTS

S11 PARAMETER AND RETURN LOSS

S11 speaks to how much power is reflected from the antenna, and subsequently is known as the reflection coefficient or return loss. On the off chance that S11=0 dB, all the power is reflected from the antenna and nothing is emanated. In figure it is seen that, S11 parameter accomplished more than significant dimension. Return loss is the distinction, in dB, among forward and reflected power estimated at some random point in a RF framework and, as SWR, does not fluctuate with the power level at which it is estimated. Figure 5.2, demonstrates the Return Loss (S11) parameters for the proposed antenna, which speaks to the multiband groups of frequency for which the antenna planned is streamlined i.e. frequencies going from 4 GHz to 7 GHz with S11 esteem past - 10 dB and the scope of frequencies according to the outcomes demonstrates that it has a decent transmission capacity whecontrasted with other microstrip antenna.

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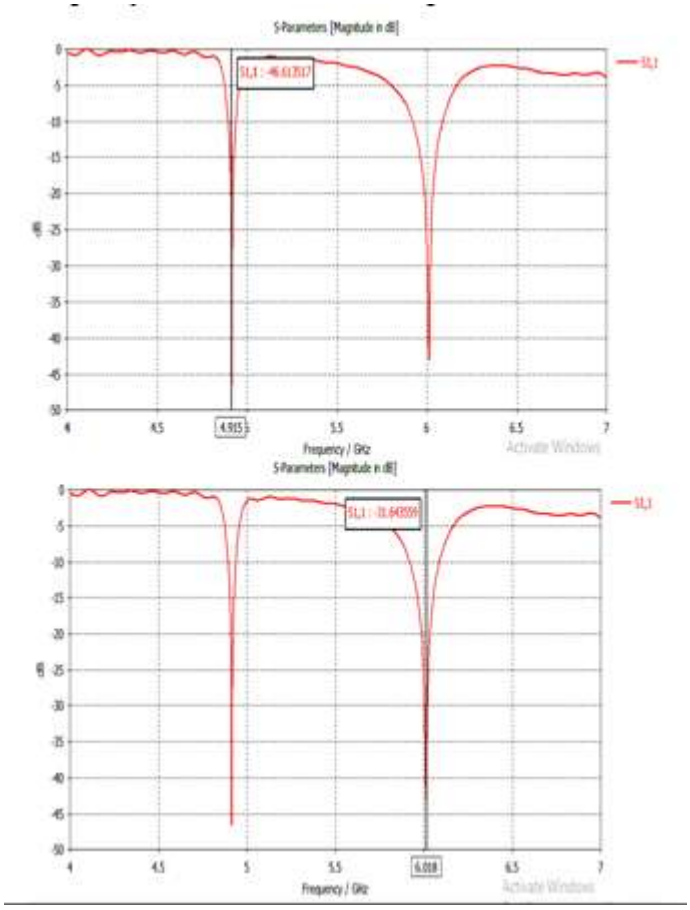

BANDWIDTH

The data transfer capacity of an antenna is characterized as "the scope of frequencies inside which the execution of the antenna, as for some trademark, fits in with a predetermined standard." For broadband antennas, the transmission capacity is generally communicated as the ratio of the upper-to-bring down frequencies of satisfactory operation

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 greatest vitality exchange from the feed line to the antenna to be conceivable. At the point when an antenna and feed line don't have coordinating impedances, a portion of the electrical vitality can't be exchanged from the feed line to the antenna. Vitality not exchanged to the antenna is reflected back towards the transmitter. It is the connection of these reflected waves with forward waves which causes standing wave designs

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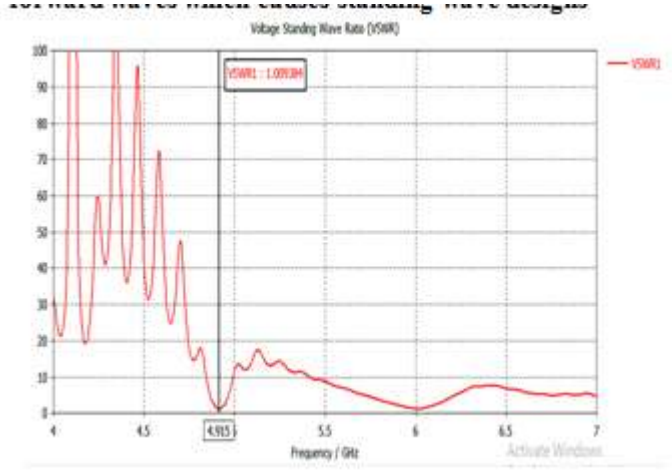
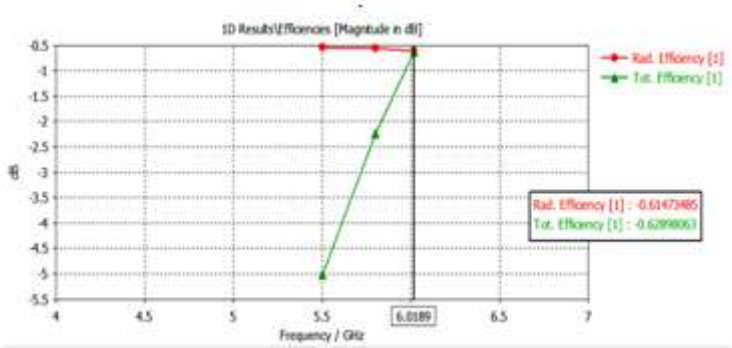


EFFICIENCY

The proficiency of an antenna is a ratio of the power conveyed to the antenna with respect to the power emanated from the antenna. A high effectiveness antenna has a large portion of the power present at the antenna's info emanated away. Being a ratio, antenna effectiveness is a number.



RADIATION PATTERN

The far-field pattern of an antenna might be resolved tentatively at an antenna territory, or on the other hand, the close field example might be discovered utilizing a close field scanner, and the radiation design concluded from it by computation.The far field radiation example might be spoken to graphically as a plot of one of various related factors, including; the field quality at a steady (expansive) span (a plentifulness example or field design), the power per unit strong point (control design) and the order gain. All the time, just the relative plentifulness is plotted, standardized either to the sufficiency on the antenna boresight, or to the aggregate emanated control. The plotted amount might be appeared on a direct scale, or in dB.

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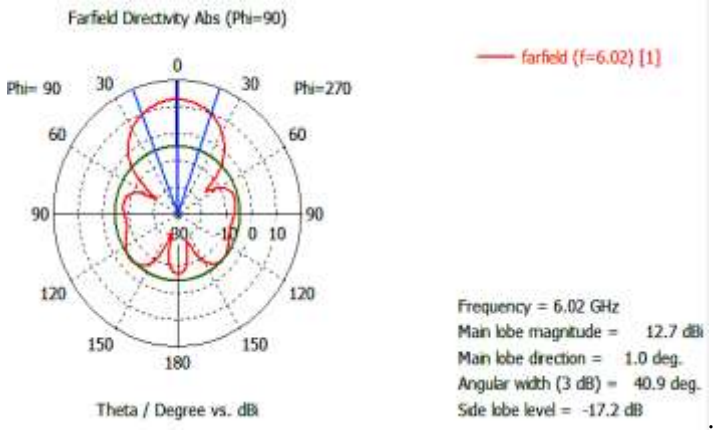

Sr. No.	Parameter	Value(Band-I)	Value(Band-II)
1	S11	< -10 db	< -10 db
2	Return Loss	-46.6 db	-31.64db
3	Band Width	45.7 MHz	172.77 MHz
4	VSWR	1.009	1.047
5	Total Efficiency	0.628	0.628
6	Resonant Frequency	4.915 GHz	6.018GHz

VI. CONCLUSION

In this paper, it is at first displayed the essential parameters of the antenna to be considered while planning an antenna and deciding the working frequency groups. In the last, the new kinds of proposed antenna (microstrip patch antenna, resounding structures), which are increasingly suitable for 5G correspondence applications, are introduced.A twofold band, rectangular microstrip patch antenna is planned and reproduced utilizing CST reproduction programming. The reenactment results are exhibited and talked about. Structure of proposed antenna is basic and smaller in size of approx 40×40 ×1.6. the minimized size of structured antenna makes it simple to be consolidated in little gadgets. Results demonstrate that the frequency data transfer capacity covers LTE band (4-7) GHz, at focus frequencies 4.91 GHz and 6.08 GHz separately for VSWR under 2, and S11 not exactly - 10 dB. In above clarified working band it indicates great impedance coordinating and bidirectional radiation designs. Different parametric consequences of antenna are accomplished and broke down by observing the streamlined aftereffect of various parameters. These parameters cover the S-parameter, VSWR, E-field and H- field gain and directivity. In this manner, proposed antenna is a decent candidate for remote correspondence applications in LTE band. The last outcomes fulfill every one of the parameters of a productive antenna.

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