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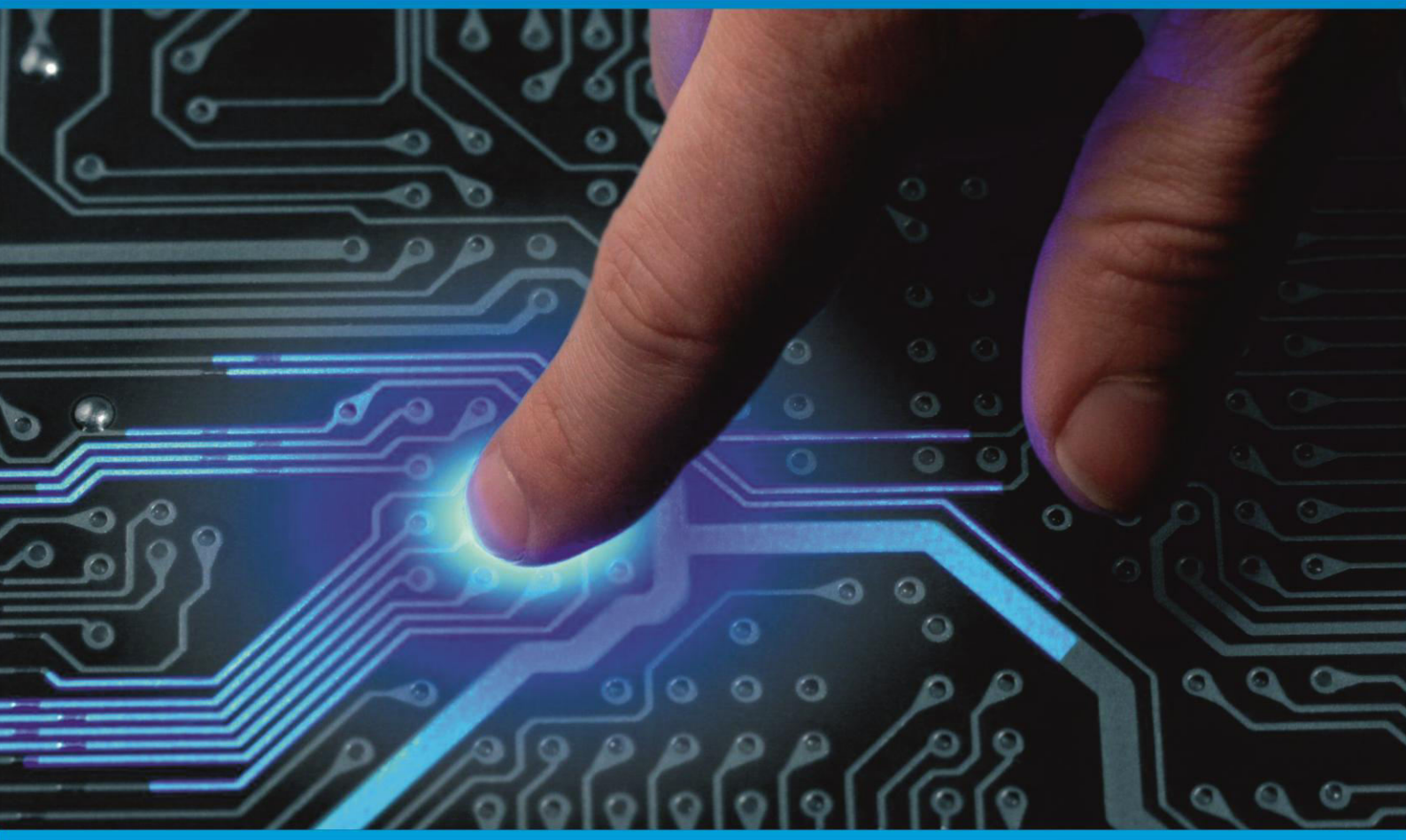

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Review of Microstrip Patch Antenna Array for 5G Communication Application

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ABSTRACT: The next generation mobile communication provides various advance application with high quality of services. The research is continuing going on 5G network communications applications. The antenna is key element of any communication devices. The expectation from 5G antenna is to meet the higher speed, low latency and large bandwidth. An antenna array is a set of multiple connected antennas which work together as a single antenna, to transmit or receive radio waves. Microstrip Patch Antenna (MPA) is array design is also very emerging research area for 5th generation communication application. This paper review and challenges of microstrip patch antenna array for future uses under 5G networks. CST microwave studio software is using to design and simulation of microstrip patch antenna array. Key parameters like bandwidth, resonant frequency, return loss, gain can be calculated through CST software.

KEYWORDS: Microstrip, Antenna, Array, CST, MPA, 5G.

I. INTRODUCTION

The interest for remote versatile correspondences administrations is developing at a touchy rate, with the expectation that correspondence to a cell phone anyplace on the globe consistently will be accessible sooner rather than later. The investigation of microstrip patch antennas has gained extraordinary ground as of late. Contrasted and customary antennas, microstrip patch antennas have more points of interest and better possibilities. They are lighter in weight, low volume, minimal effort, low profile, littler in measurement and simplicity of manufacture and congruity. Additionally, the microstrip patch antennas can give double and roundabout polarizations, double recurrence activity, recurrence dexterity, wide band-width, feedline adaptability, bar filtering omnidirectional designing.

In numerous remote correspondence frameworks it is important to structure antennas with order qualities (high gains) to fulfill the needs of long separation correspondence that may not be attainable by a solitary component antenna. The radiation from the single component is frequently wide in design with huge shaft edges. This isn't useful for point to point interchanges, which requires antennas that are increasingly mandate in nature for example Radar applications. Likewise, a solitary emanating component regularly creates radiation designs with unsuitable bandwidth, effectiveness, and gain parameters. All these and more make the use of a solitary component antenna not recommendable. In this manner, the execution of antennas in array design defeats these downsides.

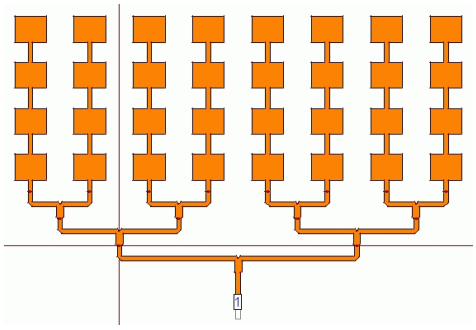

Figure 1: Antenna Array

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5G is the fifth era of cell versatile correspondences. It succeeds the 4G (LTE/WiMax), 3G (UMTS) and 2G(GSM) structures. 5G execution targets high data rate, lessened inaction, imperativeness saving, cost decline, higher system limit, and colossal contraption organize A fix antenna is made by scratching metal on one side of dielectric substrate where as in actuality side there is relentless metal layer of the substrate which outlines a ground plane [1].

Low-band 5G utilizations a comparative frequency reach to 4G cellphones, 600–850 MHz, giving download speeds somewhat higher than 4G: 30–250 megabits each second (Mbit/s).[5] Low-band cell towers have a reach and inclusion territory like 4G pinnacles. Mid-band 5G utilizations microwaves of 2.5–3.7 GHz, permitting paces of 100–900 Mbit/s, with every cell tower offering support as much as a few kilometers in span. A few districts are not executing low-band, making this the base assistance level. High-band 5G utilizations frequencies of 25–39 GHz, close to the lower part of the millimeter wave band, albeit higher frequencies might be utilized later on. It regularly accomplishes download speeds in the gigabit each second (Gbit/s) range, comparable to digital web. In any case, millimeter waves (mmWave or mmW) have a more restricted reach, requiring numerous little cells.

II. LITERATURE SURVEY

P. S. Naik et al.,[1] presents a 1×4 microstrip fix array antenna arrangement as applications at 5G C-band passage. Array utilizes a microstrip antenna module at 5G C-Band (3.4-3.8 GHz) with 2 vertical openings. The proposed configuration gives an absolute addition of 2.90 dB for single fix and 7.713 dB for 1×4 array structure. Return loss is viewed as - 15.6362 dB for a solitary fix and - 16.8991 dB for a 1×4 array is accomplished. Antenna acquire including return loss and radiation design is considered.

M. Nurrachman et al.,[2] shows the plan measurement is just 16mm × 14mm in measurement. Besides our frequency band was 28 GHz, with frequency focus 27.8 GHz (recreation) and 27.44 GHz (estimation), for bandwidth 5.68 GHz (reenactment) and 1.57 GHz (estimation), for S11 boundary - 32.89 dB (reproduction) and - 21.14 dB (estimation).

T. Velly et al.,[3] proposes a microstrip reflectarray antenna working at 28 GHz. The unit cell of the reflectarray comprises of a rectangular ring and a cross fix. The total reflectarray antenna of 13×13-unit cells with a feed horn was mimicked. The addition acquired by recreation was 22.81 dB. The antenna was manufactured and estimated.

U. Rafique et al.,[4] proposed antenna offers wideband attributes from 26.88 GHz to 61.17 GHz. Moreover, a four-component MIMO array has been intended for its conceivable use in 5G empowered specialized gadgets. It is exhibited that the proposed MIMO antenna array gives high seclusion between array components without upsetting the return loss of an individual component.

L. M. Ramadhan et al.,[5] The antenna is masterminded by rectangular fix as an array with 12 patches for the 3.5 GHz frequency and 96 patches for the 26 GHz frequency, so the quantity of patches on the antenna is 108 patches. The planned antenna will be utilized as an indoor transmitter antenna. The antenna utilizes a nearness coupled feed with connectors and dielectric constants 2.2. The planned antenna gets s-boundary consequence of not exactly - 10.8199 dB, an increase more noteworthy than 7.3 dB, and a shared coupling of not exactly - 32,6201 dB.

A. Yadav et al.,[6] presents a plan of 2 × 1 microstrip fix array antenna for 5G C-band passage applications. The array utilizes the component of rectangular microstrip antenna with U space on parasitic fix for 5G C-Band (3.4 - 3.8 GHz) application. A microstrip feed network is utilized to take care of the antenna array is additionally carried out in the plan. The antenna is two layered antenna array and low profile is a decent up-and-comer of antenna for 5G C band passageway applications.

B. T. Mohamed et al.,[7] this work shows, another 16-components, Corporate-arrangement Feed Rectangular Fix Antenna Array worked at 28GHz, for 5G portable remote applications have been planned and mimicked. The proposed array contains 16-components energized by one port, through a Y-Intersection power divider. The array has a wide bandwidth from 26.42 to 28.94GHz and a high increase of 17.1dB with a radiation effectiveness of 92%. The reproductions are based utilizing both HFSS (High-Frequency Design Test system) and CST Microwave Studio Programming.

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M. Tiwari et al.,[8] introduced for Super Wide Band/broadband correspondence in millimeter wave band. The antenna structure has been planned on a solitary substrate of FR-4 of thickness 1.6 mm. Two balanced microstrip fix antenna components situated vertical way to acknowledged better variety execution. The antenna components are comprised of a rectangular fix with microstrp feed line, working on the frequency of 28 GHz for Super wide band applications. To improve the separation between two symmetrical antenna components, one inclining opening line is cut on ground plan.

W. Chen et al.,[9] work presents a plan of 2×2 microstrip fix array antenna for 5G C-band passageway applications. The array utilizes the component of rectangular microstrip antenna with two vertical spaces for 5G C-Band (3.4 - 3.6GHz) application. A microstrip feed organization to take care of the antenna array are likewise carried out in the plan. The antenna array with low profile and basic design is a decent competitor of antenna for 5G C-band passageway applications.

D. N. Arizaca-Cusicuna et al.,[10] article presents the plan of 4x4 fix antenna array for 5G applications that gives a sensible bandwidth around 28 GHz. The fundamental component of this course of action is a rectangular fix antenna planned on the Rogers RT/Duroid 5880 substrate, which is mimicked and streamlined utilizing an industrially accessible electromagnetic reenactment programming.

R. K. Gupta et al.,[11] presents, a two port compact microstrip numerous info different yield (MIMO) antenna proposed and considered. Two fix is presented independent and with a typical DGS. It was the symmetric to Y-hub. C-opened rectangular fix antenna has six reverberation frequencies as beneath of - 15 dB return loss. Whose qualities were 3.3 GHz, 9.3 GHz, 12.7 GHz, 15.9 GHz and 21.3 GHz with most extreme addition 67.7 dBi at 3.3 GHz. This antenna show round polarization however Pivotal Proportion.

I. Gharbi et al.,[12] reason for the work is to explore the plan of rectangular fix antenna arrays took care of by miscrostrip and coaxial lines at 28 GHz for future 5G applications. Our goal is to plan a four component antenna array with a bandwidth higher than 1 GHz and a greatest radiation acquire. The exhibitions of the rectangular 4*1 and 2*2 fix antenna arrays planned on Rogers RT/Duroid 5880 substrate were enhanced and the recreation results uncover that the presentation of 4*1 antenna array took care of by microstrip line is superior to 2*2 antenna array took care of by coaxial link.

III. DESIGN STRATEGY

The literature review knows about various antenna design and results for advance application. The proposed antenna design concepts and application is finalising after the literature review. There is flow chart of case study where all the necessary steps mentioned to meet the desired strategy.

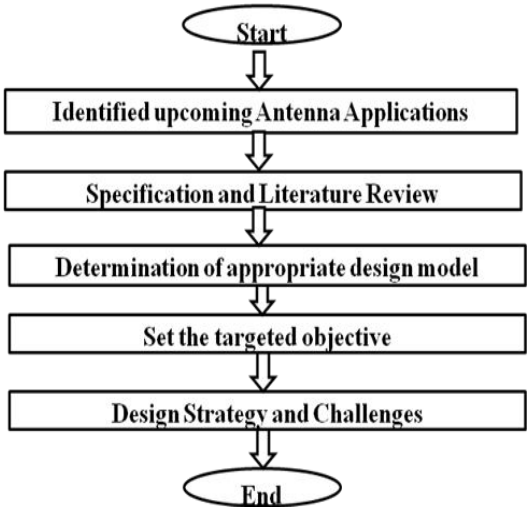

Figure 2: Flow Chart for case study

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Firstly, identified the advance or upcoming application like antenna design for 5G communication application, it is identified through previous papers studied. Then find the technical specification. Now find out the appropriate model or design for desired application and outcomes. The next step is to set the target objective of research work. At last focus on the various challenges which occur during research and make the design strategy.
After the selection antenna band and application of design, the next step is to calculate the radiating patch width and length using the standard formula.

IV. PARAMETERS

There are some important parameters which judge the results validity. Some of the followings-

Bandwidth- The bandwidth of an antenna refers to the range of frequencies over which the antenna can operate correctly. The antenna's bandwidth is the number of Hz for which the antenna will exhibit. The bandwidth can be calculated using the difference between upper frequency and lower frequency.

Return loss- return loss is that it is the loss of power in the signal returned / reflected by a discontinuity in a transmission line or optical fiber. This is normally expressed in decibels. In other words if all the power was transferred to the load, then there would be an infinite return loss. The good value of return loss is less than -10dB and it is also known as the S11 parameter.

Efficiency- Antenna Efficiency is the ratio of power radiated (Prad) by the antenna to the power supplied (Ps) to the antenna.

VSWR- VSWR stands for Voltage Standing Wave Ratio, and is also referred to as Standing Wave Ratio (SWR). VSWR is a function of the reflection coefficient, which describes the power reflected from the antenna. If the reflection coefficient is given by Γ, then the VSWR is defined by the following formula:

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|}$$

Resonant Frequency- A radio antenna is a form of tuned circuit consisting of inductance and capacitance, and as a result it has a resonant frequency. This is the frequency where the capacitive and inductive reactance cancels each other out.

Antenna Gain- Antenna gain and effective radiated power. The term antenna gain defines the degree to which an antenna concentrates radiated power in a given direction, or absorbs incident power from that direction, compared with a reference antenna.

V. CONCLUSION

The study on microstrip patch antenna and array antenna has been done in this paper. While laying out the antenna the things which we have to consider is substrate which we will use, empowering create, dielectric reliable of the substrate and its height and width. Therefore it is clear from literature review; antenna array is emerging design for advance communication due to its higher bandwidth and good gain. So it is believed that, this little size antenna will continue profiting for future years in 5G communication. The future work will be optimized the rectangular antenna array dimension, implementation and simulation done using the CST software.

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