

# MINIATURIZED PATCH ANTENNA DESIGN WITH WIDE BAND CHARACTERISTICS FOR 5G COMMUNICATIONS

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Abstract: This research paper we have developed a new study concerning the miniaturization of micro strip patch antenna by using a wideband slotted star shaped antenna resonating at 42 GHz. The Antenna design plays main role in developing the faster communication technology like 5G. A miniature micro strip patch antenna has been developed, analysed and validated for WI-Max applications. The goal from this work was to improve the bandwidth, change in the dimensions of micro strip patch antenna. In this paper, a wideband slotted star shape antenna for 5G communication is presented. The antenna is developed over ROGERS RT5880tm substrate of 0.762mm height and dielectric permittivity of 2.2 with the dimension of 3mm width and 4.3mm length. A narrowband rectangular patch is changed to gain a wide bandwidth of 41.51GHz with the reference of -10dB return loss. In this thesis, a typical miniature slotted micro strip patch antenna technique has been introduced for the betterment of Gain, Directivity, Radiation pattern and Return Loss. This proposed antenna was design using High Frequency Structural Simulator (HFSS 17.0) software. These parametric studies would be a great interest in the designing of miniature micro strip antennas for wireless communications operating at 42GHz.

Keywords: Miniaturized antenna, wideband, 5G communications, HFSS 17.0.

## **1 INTRODUCTION**

5<sup>th</sup> Generation of communication (5G) has been proposed by the researcher as an answer of numerous issues. The 5G promises to give

high speed information rate and move to the expanse of people and developing advances like Internet of Things (IoT), Internet of Medical Things (IoMT) and Internet of Vehicles (IoV) [1]. Where Antenna is the most fundamental block of the wireless communication. As of late, the development of wireless systems prompts a great deal of innovations in the Micro strip antenna designs. Now day's wireless а communication systems has huge demand on various applications.[2] Micro strip Patch Antennas have a considerable amount of advantages over different antennas because of their less weight, low profile, less expense of creation and low volume.[3] Due to this striking highlight, when researchers are having noteworthy consideration towards miniature strip antennas.

Microstrip patch antenna can be utilized in extensive range of uses, for example, in wireless communication and biomedical diagnosis. [4] An antenna is Centre segment of communication in any of frequency assumes a significant part of 5G also; the small size high gain and wideband antenna is needed to communicate effectively. [5] There are many feeding techniques used for the Micro strip patch antennas. To keep the structure planar, a micro strip line in the plane of the patch can be etched to feed the antenna. [6] But again, it suffers from the drawbacks that the feed network interferes with the radiating properties of the antenna leading to undesired radiations. For the micro strip feed, [7] As there where an explosive increment in wireless data traffic, MMW communication has gotten one of the most charming strategies In the 5G mobile communications system. [8] the issues engaged with the plan of antenna array architecture for future 5G MMW antenna, in which the antenna components can be conveyed looking like a cross, or hexagon,

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notwithstanding the customary rectangle [9].

Despite of having numerous advantages, a drawback of microstrip main patch antennas is narrow bandwidth [10]. For real time applications, bandwidth enhancement is usually needed There are various methods for bandwidth enhancement such as using defected ground surface, increasing substrate thickness and slots on radiating patch [11]. For achieving the qualities of wide impedance [12] bandwidth monopole models are regularly utilized, for example, elliptical, pentagon, triangular, rectangular [12], square, hexagonal, annular ring and circular ring antennas. Different strategies had been utilized to the bandwidth improvement in Microstrip patch antenna viz. Multilayer patch, [13] Stacked antenna utilization at impedance match.

The profoundly paper contains a miniaturized antenna for wideband 5G Which communications. stables the estimation of gain and bandwidth. In this paper is partitioned into following area: segment II presents the theory and structure of antenna. Area III presents designing of the antenna. Area IV contains the outputs of the proposed antenna. Segment V contains the Conclusion While the conversation is deduced in last area joined by references.

# II STRUCTURE AND THEORY OF MICROSTRIP PATCH ANTENNA

For designing of substrate ROGERS RT5880tm is used due to easy fabrication and less cost. The width of patch is denoted by "W" and length of patch can be denoted by "L" and height of patch was denoted by "H". Since there dimensions in the patch are limited along with the width and length, where grounds of edges in the patch go through fringing. Since a portion of waves travel on the substrate and some on air, a viable dielectric constant Ereff is acquainted with represent fringing where the wave propagation on the line.

$$\mathcal{L}f\left(\frac{\varepsilon}{2}\right)^{\frac{1}{2}}, L = \frac{\varepsilon}{2f\sqrt{\varepsilon_{\varepsilon}}} - 2\Delta L$$



Fig. 1: Basic Geometry of Micro strip Patch Antenna III DESIGN OF STAR SHAPED MICROSTRIP PATCH ANTENNA

An antenna is planned on less cost Rogers RT/duroid 5880 tm substrate took care of 50ohm micro strip line. An antenna was executed in High frequency structure simulator Software (HFSS). Where proposed antenna resonates at 5 distinct bands, that are make possibility for ultra-wideband (UWB) and 5G systems.

The proposed antenna appeared in fig 2, utilizing the essential equations present in the rectangular patch antenna, because of their analysis, simplicity of fabrication and appealing radiation qualities, resonating at 42GHz is planned which is then adjusted by fluctuating their patch mould from three-sided to star shaped.

The total ground length size is degraded it increase the bandwidth of antenna. Finally, here triangular slot was introduced in this patch to remove this match, which results the star shape wideband antenna.

The star shaped antenna having the substrate ROGGERS RT5880tm. Having the copper tape of thickness 0.035mm, the relative permittivity is 2.2 and tangent loss is 0.0009 utilizing High frequency structural simulator (HFSS software). The antenna width is 3mm and length is 4.3mm and the substrate height 0.762mm.



Fig. 2: Proposed Antenna Design



Fig.3: (a) proposed antenna Return Loss and bandwidth



## Fig.3: (b) Proposed antenna gain



Fig.3: (c) Proposed antenna directivity



Fig.3: (d) Proposed antenna radiation pattern

#### **IV. RESULTS AND DISCUSSION**

The High Frequency Structural Simulation (HFSS software) can be utilized to analyze

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the proposed antenna results. Where return loss graph can be designed antenna at -10dB bandwidth is shown in figure 3(a) and the Return loss will get as m1 -35.43 and m2 is -29.07. The return loss is very less compared to previous papers. The bandwidth of the proposed antenna, the bandwidth is 41.51 GHZ. Hear the bandwidth is increased. The figure 3(b) shows Gain of proposed antenna, the gain is 3.49dB. The figure 3(c) shows Directivity of proposed antenna, the directivity is 3.46dB. The figure 3(d) show the proposed antenna Radiation pattern, the gain of the Radiation pattern exists at certain point that point is -1.5290.

In existing antenna having the bandwidth is 30GHz; the proposed antenna shows a wideband impedance bandwidth of 41.51GHz. The resonating frequency is 42GHz.

Table 1 show the correlation of present work with some most recent antennas for wideband applications, the proposed antenna shows wide bandwidth and miniaturized size is looked at [5] and [7] despite the fact that [8] and [1] have a more modest dimension than proposed antenna apparatus.

Table I: comparison	of Proposed	Antenna
with recent works		

	Dimension (mm)	Bandwidth
References		(GHz)
5	2×2×0.78	50.86-82.27
7	12×12×0.8	25.1-37.5
8	12.6×30×0.8	27.9-39.1
1	4×4×0.762	15-45
Proposed	3×4.3×0.762	57.48-16.01
Antenna		

#### **V. CONCLUSION**

Miniaturized slotted star shaped patch antenna for wideband 5G application is present. In this work, Developed a new study concerning reducing the size of micro strip patch antenna by utilizing the triangular star shaped antenna resonating at 42GHz. The main goal from this work is to improve the bandwidth and good value of gain and directivity. In the Paper, a miniature micro strip patch antenna having slotted star shaped design has been introduced for the betterment of Bandwidth, Gain and Directivity. Here in this paper we have used ROGGERS RT5880tm Substrate and Insert feed technique to improve the antenna performance. Verify the simulated results in HFSS software. Compared the most recent antennas for wideband applications, where proposed antenna shows better results compared to recent works and it is strong candidate for 5G communication.

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