2×2 Microstrip Patch Array Antenna for 5G C-band Access Point Application

[1]Priya Mishra, [2]Prof. Ankit Pandit

M.Tech Scholar, Department of Electronics and Communication, Rabindranath Tagore University, Bhopal, India[1]
Assistant Professor, Department of Electronics and Communication, Rabindranath Tagore University, Bhopal India[2]

ABSTRACT: Wireless communication application is not possible without using the antenna. Now a day's Microstrip patch antenna (MPA) is using broadly due to its major advantages then others. Most of the electronics device is using MPA. There are various shapes and pattern is proposed by antenna researchers. Microstrip patch antenna provides better performance in wireless communication applications. This paper proposed a 2×2 Microstrip Patch Array Antenna for 5G C-band Access Point Application. The CST microwave studio software is used to make a proposed antenna design and simulation. The resonant frequency of this antenna is 6.9 GHz. Overall bandwidth achieved by proposed antenna is 903 GHz. The large bandwidth is required for 5G communication applications.

KEYWORDS: Microstrip, Antenna, Array, 5G, Patch, Resonant Frequency, CST, C-band.

I. INTRODUCTION

It is widely used in portable wireless devices because of the ease of fabricating it on printed circuit boards. Multiple patch antennas on the same substrate called microstrip antennas can be used to make high gain array antennas, and phased arrays in which the beam can be electronically steered. With the advancement of remote correspondence advances, it has gotten progressively alluring for present day specialized gadgets to coordinate different correspondence guidelines, for example, 2G/3G/4G/5G. Hence, radio wires with broadband execution are popular for multi-standard inclusion. Microstrip antenna is generally utilized in remote correspondence frameworks. To accomplish broadband activity, different plans of microstrip reception apparatuses have been accounted for, for example, altering the state of the microstrip arms, improving taking care of strategies, stacking parasitic radiators, and utilizing magneto-electric reciprocal structures [1].

Moreover, radiation execution is additionally required for some remote correspondence applications, for example, indoor sign inclusion, remote passages, and small scale base stations. In view of the multi-mode PFDA, a straightforward and powerful structure to accomplish radiation execution is created by setting two of the proposed PFDAs consecutive. The subsequent reception apparatus displays great radiation designs in the even plane with level increase variety of under 1.27 dB. The introduced conservative broadband radio wire is a decent contender for indoor sign inclusion.

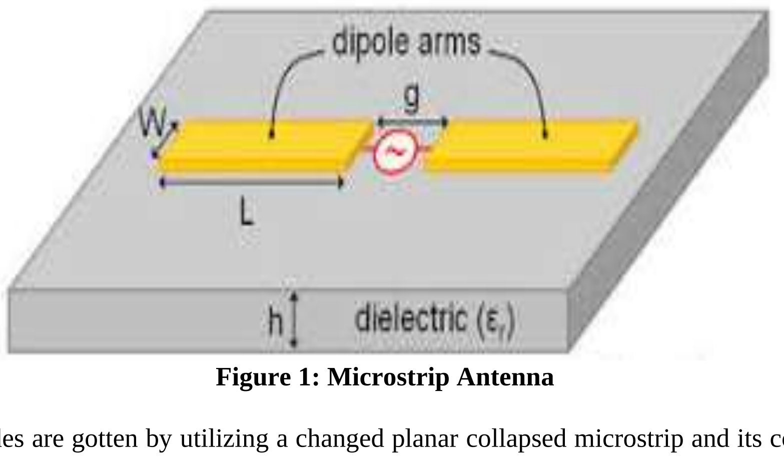
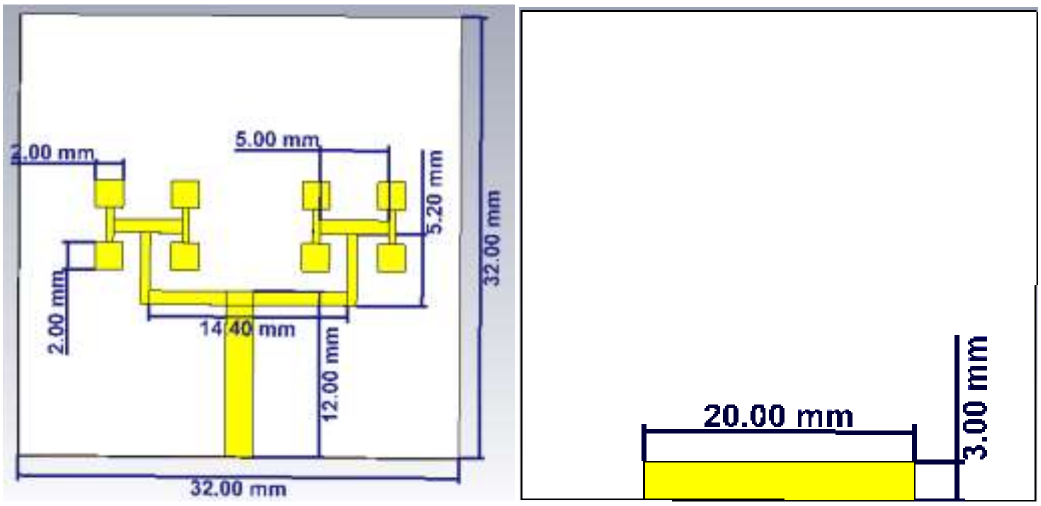


Figure 1: Microstrip Antenna

Three resounding modes are gotten by utilizing a changed planar collapsed microstrip and its coupled taking care of structure. Consolidating the shorting pins and parasitic patches, numerous resounding modes in the antenna are controlled, moved, and afterward joined to build the impedance data transmission. Utilizing this idea, a model of a multimode collapsed microstrip is planned, manufactured, and estimated [1]. Common coupling between two microstrip antenna with various measurements put at self-assertive equal positions is broke down utilizing synchronous indispensable conditions with definite parts and limited hole feeds[2]. A tale plan technique for a wideband double enraptured reception apparatus is introduced by utilizing shorted microstrips, incorporated baluns, and crossed feed lines. Reenactment and proportionate circuit investigation of the antenna are given. To approve the plan technique, a antenna model is planned, upgraded, manufactured, and estimated [3]. An epic ultra-wide-band firmly coupled microstrip reflects array radio wire is introduced in this work. This reflects array antenna comprises of a wideband feed and a wideband reflecting surface. The feed is a log-occasional microstrip cluster reception apparatus. The reflecting surface comprises of 26 × 11 unit cells. Every cell is made out of a firmly coupled microstrip and a defer line. The base separation between nearby cells is 8 mm, which is around 1/10 frequency at the most minimal working recurrence. By joining the benefits of reflect array reception apparatuses and those of firmly coupled exhibit radio wires, the proposed TCDR antenna accomplishes ultra wide transfer speed with decreased unpredictability and creation cost [4].

Microstrip radio wire is exceptionally well known in light of the fact that the data transmission of smaller scale strip microstrip antenna is high when contrasted with the miniaturized scale strip fix reception apparatus. Small scale strip microstrip reception apparatus will be the principle focal point of this work. A miniaturized scale strip microstrip is a usage of the customary microstrip radio wire on a dielectric chunk, which can be effortlessly created with existing PCB strategies. In contrast to regular small scale strip reception apparatus, that utilization one side of the chunk as the ground plane, the smaller scale strip microstrip essentially utilizes the dielectric section as the host material. This antenna is picked in light of the fact that it is straightforward but then has potential for future improvement. A conservative wideband double spellbound antenna with improved upper out-of-band concealment is introduced in this work. The proposed reception apparatus is a proportional arrangement of two electric microstrips and two attractive microstrips utilizing the crossed shunt circles. The fuse of the electric and attractive microstrips empowers the radio wire to accomplish wide impedance transmission capacity and a conservative radiator size. What's more, four parasitic strips are embedded close to the internal edge of the four circles to upgrade the antenna upper out-of-band concealment at 3.5 GHz with improved impedance data transfer capacity.

II. Proposed Antenna Design



(a) **(b)**

Figure 2: (a) Top view (b) Defected Ground Structure of proposed microstrip antenna array

Figure 2 is indicating proposed microstip antenna of plan. The top and ground layer is made by lossy copper material and substrate is made by FR4 material which having 4.4 dielectric steady worth.

III. Simulation and Result

The geometry of the proposed structure of microstrip for C-band applications is appeared in figure 2. The general size of the structure is 32mm × 32mm × 1.64mm (L × W × H) and imprinted on fire resistant 4 (FR4), with an overall permittivity of 4.4, and a loss digression of 0.024. Table 1 records the element of the proposed antenna. The antenna is taken care of by 50-Ω and 0.5W coaxial link or straightforward. The antenna utilizes the microstrip structure with one opening for C-Band applications.

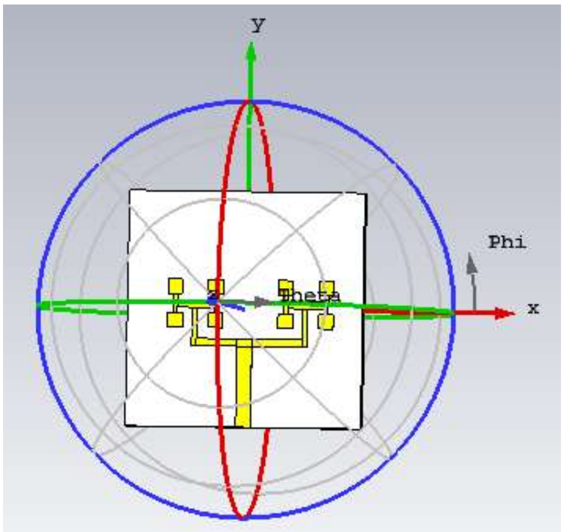


Figure 3: Simulation and fields of proposed antenna

CST microwave studio used to recreate the proposed plan. Figure 3 is demonstrating reenacted electric and attractive field in round organize framework.

Table 1: Design parameters for proposed Antenna

Sr No.	Parameter	Value
1	Lower Frequency(f_L)	4 GHz
2	Higher Frequency(f_H)	8 GHz
3	Dielectric constant(ε_r)	4.4 / FR4
4	Ground (LxW)	3 mm X 20 mm
5	Ground height	0.0.35mm
6	Substrate(LxW)	32mm X 32mm
7	Substrate Height(h)	1.57 mm
8	Line Impedance	50 Ω
9	Tangent Loss	0.06
10	Input watt	0.5W

Return loss

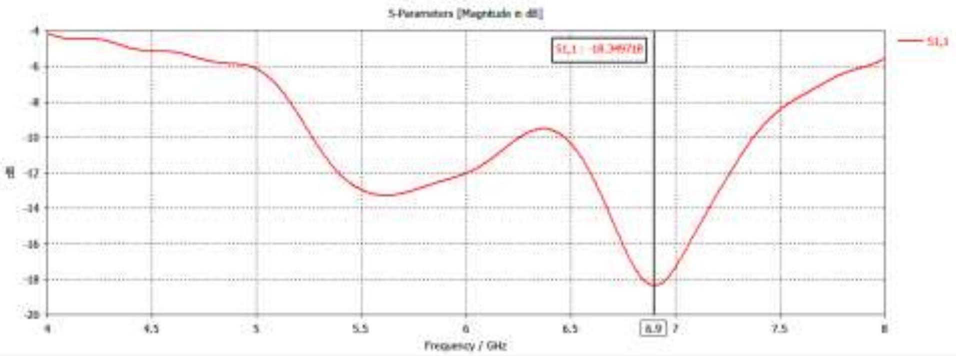


Figure 4: Return loss

Figure 4 presents return loss of proposed structure. It is obvious to see this chart, the return loss estimation of proposed antenna is – 18.34 dB with 6.9 GHz resonant frequency.

Bandwidth

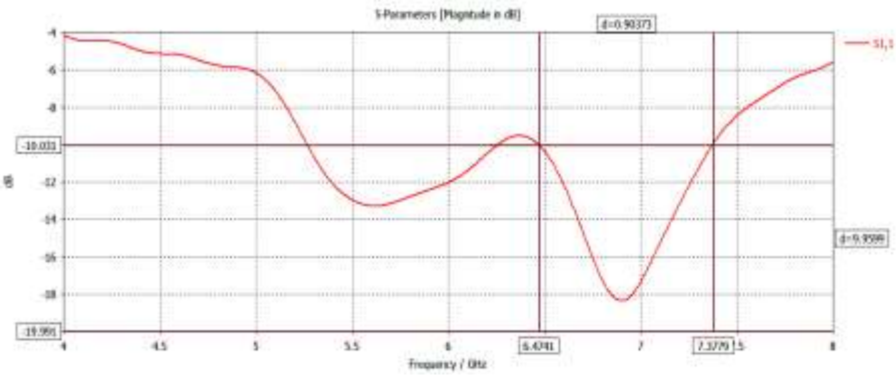


Figure 5: Bandwidth

For broadband antennas, the bandwidth is communicated as a level of the recurrence contrast (upper less lower) over the inside recurrence of the bandwidth. The bandwidth of proposed antenna is 903.73MHz, (7.3779GHz-6.4741GHz), for optimized band.

Voltage Standing Wave Ratio (VSWR)

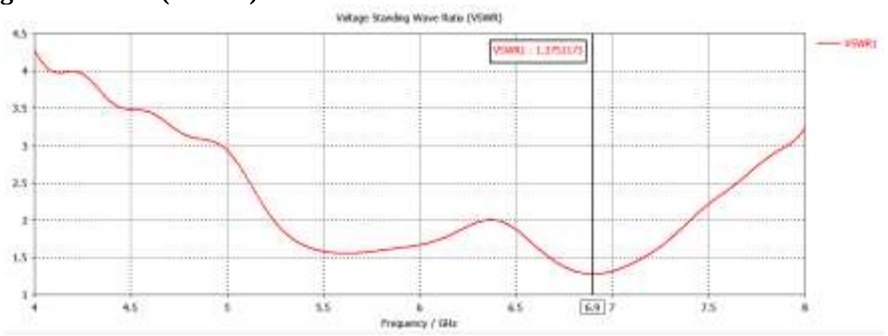


Figure 6: VSWR

Figure 6 shows VSWR esteem, it is voltage standing wave proportion, and is likewise alluded to as Standing Wave Proportion (SWR). VSWR is an element of the reflection coefficient, which portrays the force reflected from the antenna. The VSWR estimation of this antenna is 1.27.

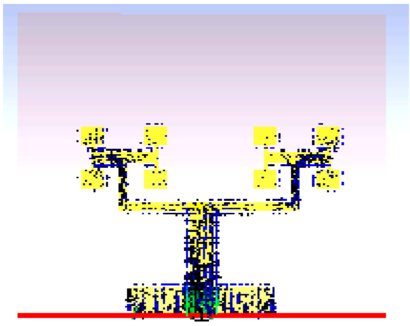
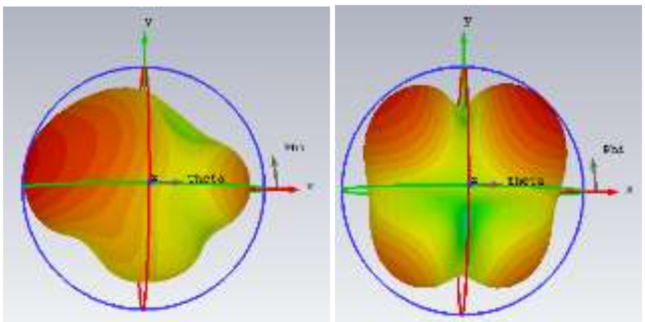


Figure 7: Current density

Figure 7 presents current thickness of proposed antenna. It is a real electric flow that is initiated by an applied electromagnetic field.



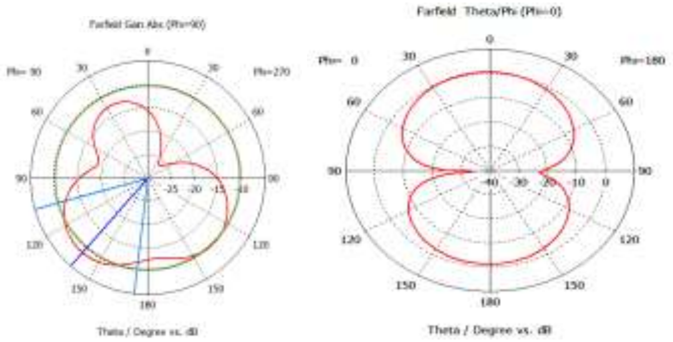


Figure 8: Radiation pattern

Figure 8 shows radiation pattern of proposed antenna at 6.9GHz band. It is a variety of the force transmitted by an antenna as an element of the heading ceaselessly from the antenna.

Table 2: Simulated Results of Proposed Antenna

Sr No.	Parameter	Value
1	Return loss or S11	-18.34 dB
2	Bandwidth	903.73 MHz
3	VSWR	1.27
4	Resonant Frequency	6.9 GHz

Table 2 shows about terms of every vital parameter like return loss, bandwidth, VSWR and resounding recurrence. It is clear by observing reenacted values from table 2, proposed antenna accomplish significant improved outcome.

IV. CONCLUSION

A microstrip antenna array is planned and recreated utilizing CST reenactment programming. The reproduction results are introduced and examined. Structure of proposed antenna is basic and reduced in size of 32 x 32 x1.6 mm^3. Reenacted results exhibit that the antenna bandwidth covers S band and C-band, at full recurrence 6.9 GHz for VSWR under 2, and S11 beneath - 10 dB. The bandwidth is huge accomplished better than micorstrip fix antenna structure. Micorstrio antenna array configuration is recently exploring theme among specialists. The general bandwidth is 903.73 MHz. Subsequently proposed antenna is reasonable and meets to current correspondence requests.

REFERENCES

[1] N. E. Russo, C. L. Zekios and S. V. Georgakopoulos, "Decoupling Modes in Multi-Band Microstrip Patch Antennas," in IEEE Open Journal of Antennas and Propagation, vol. 2, pp. 118-125, 2021, doi: 10.1109/OJAP.2020.3046458.

[2] A. Yadav, M. K. Saraswat, V. Palukuru and R. Gautam, "Antenna array for 5G C-band for mobile terminals," 2019 TEQIP III Sponsored International Conference on Microwave Integrated Circuits, Photonics and Wireless Networks (IMICPW), Tiruchirappalli, India, 2019, pp. 293-297, doi: 10.1109/IMICPW.2019.8933246.

[3] N. Ojaroudi Parchin, Y. I. A. Al-Yasir, H. Jahanbakhsh Basherlou, R. A. Abd-Alhameed and J. M. Noras, "Orthogonally dual-polarised MIMO antenna array with pattern diversity for use in 5G smartphones," in IET Microwaves, Antennas & Propagation, vol. 14, no. 6, pp. 457-467, 20 5 2020, doi: 10.1049/iet-map.2019.0328.

[4] B. Feng, Y. Tu, J. Chen, S. Yin and K. L. Chung, "Dual Linearly-Polarized Antenna Array With High Gain and High Isolation for 5G Millimeter-Wave Applications," in IEEE Access, vol. 8, pp. 82471-82480, 2020, doi: 10.1109/ACCESS.2020.2990494.

[5] S. Hussain, S. Qu, W. Zhou, P. Zhang and S. Yang, "Design and Fabrication of Wideband Dual-Polarized Array Array for 5G Wireless Systems," in IEEE Access, vol. 8, pp. 65155-65163, 2020, doi: 10.1109/ACCESS.2020.2984613.

[6] I. Serhsouh, M. Himdi, H. Lebbar and H. Vettikalladi, "Reconfigurable SIW Antenna for Fixed Frequency Beam Scanning and 5G Applications," in IEEE Access, vol. 8, pp. 60084-60089, 2020, doi: 10.1109/ACCESS.2020.2983001.

[7] J. R. Pérez et al., "Empirical Characterization of the Indoor Radio Channel for Array Antenna Systems in the 3 to 4 GHz Frequency Band," in IEEE Access, vol. 7, pp. 94725-94736, 2019, doi: 10.1109/ACCESS.2019.2928421.

[8] X. Shen, Y. Liu, L. Zhao, G. Huang, X. Shi and Q. Huang, "A Miniaturized Microstrip Antenna Array at 5G Millimeter-Wave Band," in IEEE Antennas and Wireless Propagation Letters, vol. 18, no. 8, pp. 1671-1675, Aug. 2019, doi: 10.1109/LAWP.2019.2927460.

[9] Y. Kim, H. Kim, I. Yoon and J. Oh, " 4 X 8 Patch Array-Fed FR4-Based Transmit Array Antennas for Affordable and Reliable 5G Beam Steering," in IEEE Access, vol. 7, pp. 88881-88893, 2019, doi: 10.1109/ACCESS.2019.2926379.

[10] H. T. Chattha, "4-Port 2-Element MIMO Antenna for 5G Portable Applications," in IEEE Access, vol. 7, pp. 96516-96520, 2019, doi: 10.1109/ACCESS.2019.2925351.

[11] A. Li, K. Luk and Y. Li, "A Dual Linearly Polarized End-Fire Antenna Array for the 5G Applications," in IEEE Access, vol. 6, pp. 78276-78285, 2018, doi: 10.1109/ACCESS.2018.2884946.

[12] R. Khan, A. A. Al-Hadi, P. J. Soh, M. R. Kamarudin, M. T. Ali and Owais, "User Influence on Mobile Terminal Antennas: A Review of Challenges and Potential Solution for 5G Antennas," in IEEE Access, vol. 6, pp. 77695-77715, 2018, doi: 10.1109/ACCESS.2018.2883788.

[13] A. Mukhopadhyay, “J. C. Bose’s Scientific Inventions Confirmed the Truth of Consciousness”, IJOHMN, vol. 4, no. 6, pp. 1-20, Dec. 2018. https://doi.org/10.24113/ijohmn.v4i6.72.

[14] S. H. R. Naqvi, P. H. Ho and S. Jabeen, "A Novel Distributed Antenna Access Architecture for 5G Indoor Service Provisioning," in IEEE Journal on Selected Areas in Communications, vol. 36, no. 11, pp. 2518-2527, Nov. 2018, doi: 10.1109/JSAC.2018.2874144.

[15] E. L. Bengtsson, F. Rusek, S. Malkowsky, F. Tufvesson, P. C. Karlsson and O. Edfors, "A Simulation Framework for Multiple-Antenna Terminals in 5G Massive MIMO Systems," in IEEE Access, vol. 5, pp. 26819-26831, 2017, doi: 10.1109/ACCESS.2017.2775210.