JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

CIRCULARLY POLARIZED DUAL BAND MICRO STRIP PATCH ANTENNADESIGN AT 28 GHZ/38GHZ FOR 5G CELLULAR COMMUNICATION

K. ChandraSekhararao[1], Dr.A.Kavitha[2]

[1]Research Scholar, Department of ICE, Anna University, Chennai 600025, Tamilnadu, India.
[2]Professor, Department of Electronics & Communication Engineering, Vel Tech Multi Tech Dr.Rangarajan Dr.Sakunthala Engineering College, Chennai, Tamilnadu, India.
[1]kcr.429@gmail.com

Received: 14 Feb 2020 Revised and Accepted: 25 March 2020

ABSTRACT: One of the mobile phone engineering, technological innovations is usually rapid-developing currently due to the huge effect on cultural lifestyle. Appropriately, there exists an ought to research finally, the advancements in the antenna devices because they are viewed as primary products intended for cellular engineering, technological innovation. The present day antenna models make it possible for just one component to become utilized in various devices. The micro strip patch antennas happen to be effectively thought to be inside the improvement with the most recent communication systems in comparison towards the standard type as they definitely provide you with the benefit of becoming very low profile besides simple and easy or perhaps economical production methods. During the quite a few years, considerable studies have been performed over the antenna models. A circularly polarized patch antenna intended for upcoming fifth-generation cell phones can be provided with this paper. By means of twisting the edge of this antenna radiating patch by way of launching slot mechanism, the dimensions of the patch antenna is 51% smaller sized compared to a standard 0.5 wavelength patch, that allows this to hybrid within, inner mobile phones conveniently. Extensive beam width can be attained by means of encircling the patch which has a dielectric base as well as, assisting that antenna with a metal. Finally, the recommended antenna covers an extensive elevation angle as well as azimuth spectrum. Subsequently, this paper offers an extensive consideration with the previous as well as, succeeding study accomplishments in the Micro strip Patch Antennas (MPAs) by 28 GHz / 38 GHz intended for 5th generation (5G) application models. The different kinds of models viewed intended for comparability comprise of millimeter-wave, multi-band, broad banding approaches, small, lower profile, size-reduction, impedance band width, large gain or linear as well as circular polarization applications.

I. INTRODUCTION

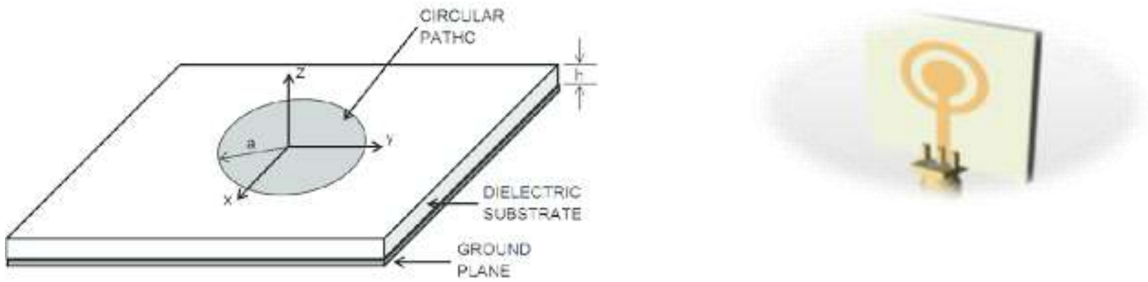
For 5G certainly patch of antennas will be needed generally for above 2.5GHz. 3.5GHz band is looking to be particularly important as it's likely to be globally harmonized for millimeter waves active antennas will be required as they will for sub 6GHz massive MIMO. I think even the definition of massive MIMO always is misunderstood basically a massive MIMO link means nothing more than 64 or more antenna elements on one side a link and much fewer antennas on the other side of like typically too so for a massive MIMO ray of 64 elements and millimeter waves specifically for dual band 28GHz to 38GHz the dimensions of the ray would be 2x2 inches but for three point 5 gigahertz your ray would be much larger typically 16x16 inches for the 64 elementary. Millimeter wave massive MIMO is different for fixed wireless access versus mobility for the fixed wireless access case obviously the target is stationary and your home think of the beam from the millimeter wave access point is a fire hose of data that jumps quickly from one home to another. Filling up the data buffer they're storing data for streaming of video and for browsing the web the beam jumps from home to home serving up each home state in the so basically you have dual band 28GHz to 38GHz per second fire hose of data jumping from home to home in milliseconds. In my view one of the biggest challenges operators when faced with 5G is adapting to the new massive MIMO antenna technology for many challenges here for example how do you measure the beam pattern of a massive MIMO intent, how do you radio plan, how do you assess one products performance against another, how do you drive test a massive MIMO moment, these are the main challengesthat operators will be facing. From an overall industry an antenna perspective,there are a couple of interesting things to do for sub 6GHz massive MIMO well the spectral efficiency gains outweigh the additional costs of the antenna the reduction in reliability and the cost of using up additional towers picks for millimeter wave they're going to be many challenges just the amount of densification

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

that's needed the number of base stations the issues with handset blockage in the dense radiation from the handset there's going to be a lot of issues but they are solvable.
The 5G network is likely to significantly improve communication capability simply by applying the large number of spectrum in the mm wave. Additionally it is supposed to find a way to allow as well as, assist extremely high data rates nearly one hundred times of 4G [1], [2].This may lead to innovative demanding network expectations and the antenna design intended for 5G communication to be able to satisfy the anticipated data rate as well as, efficiency. Because of the tremendous rise in cellular data during 5G, many domains including HD, AI, IoT, Block chain, Smart Cities & Smart grids will certainly become considerably improved. Like the cellular market attire toward making use of the mm wave bands, which will be prone to make use of the 28 to 73 GHz spectrum that may developed to be designed for future modern advances [3]. Depending on the expectations for 5G, antennas with light-weight, small size, inexpensive, simple installation, mechanically strong once attached to stiff area as well as , suitable for microwave IC are very essential [4]. In spite of their thin band width, Micro strip patch antenna is usually an ideal choice to fulfill almost all the above mentioned criteria. Throughout this study, a circularly polarized micro strip patch antenna will be suggested for fifth generation telecommunication also it was created to work at 28 GHz / 38 GHz frequency.

II. CIRCULAR MICROSTRIP PATCH ANTENNA DESIGN AT 28 GHz / 38 GHz FOR 5G APPLICATIONS

These antennas are becoming increasingly popular and useful because they're printed directly on the Circuit boards. Also the mobile phones in every hand these days so you could imagine the penetration of micro strip antennas and influence of these antennas in our daily life. Patch antennas are popular because they are low cost and they can be easily fabricated. And moreover the formation of error is in patch and denies is even more meaningful and it makes a lot of sense with directivity increasing manifolds fit with just a small amount of modification in the printed circuit board. In this section, the basic ideas about the circular patches antenna structure at 28 GHz / 38 GHz were discussed.



(a) (b)

Fig 1 a) Circular Patch Antenna b) Circular Patch Microstrip PCB Antenna 3D CAD model

The radius of the patch antenna can be determined by the equation (1) and (2) as shown below.

$$a = \frac{k}{\sqrt{\left[1 + \frac{2h}{\pi\epsilon_r k} \times \left\{\log_e\left(\frac{\pi k}{2h}\right) + 1.7726\right\}\right]}} \quad (1)$$

where,

$$k = \frac{8.794}{f_r\sqrt{\epsilon_r}} \quad (2)$$

fr - Resonant frequency

ε_r – relative permitivity

5G provides versatility on to milimeter-wave telecommunications because the future cellular network system endeavors to assist with considerably more customers. The growing of 5G is challenging antennas with abilities already not on the market. This produced several design and style difficulties to accomplish an acceptable tradeoff among technical problems and industrial difficulties. Various well known as well as , promising wireless networks function on larger frequency therefore it becomes required to have high speed antennas. A few investigators started to succeed to prevail over restrictions with the thin bandwidth recently. Parameters which includes techniques used, reflection percentage, gain, band width, materials utilized are used for evaluation.

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

III. COMPARATIVES ANALYSIS OF DIFFERENT FEED MECHANISM FOR 5G APPLICATIONS SYSTEM AT 28 GHZ / 38 GHz

Table 1. Comparitive analysis

S.No	MPA Configuration	Frequency fr	ε_r	Reference
1	Dual band printed slot	28/38	2.2	[7]
2	Dual polarized	28.5/38	2.2	[8]
3	Grid array	28	2.2	[9]
4	Mesh grid	28	4.2	[10]
5	Wide scanning	28	4.2	[11]
6	Millimeter wve	28	4.2	[12]
7	Antipodal tapered	28.5	2.2	[13]
8	Beam planar	28	2.2	[14]
9	Tapered slotted	28	2.2	[15]
10	Circular DD patch	28/38	NA	[16]
11	Microstrip	28	2.2	[17]
12	Dielecric patch	28/38	2.2	[18]
13	Electric dipole leaky	28	2.2	[19]
14	Planar	28	3.2	[20]
15	Ankh-key	28	2.2	[21]
16	Parasitic patch stacked	60	2.2	[22]
17	Patch antenna	28	2.9	[23]
18	Single band	59.93	2.2	[24]
19	Double F slot	38/58.10	11.9	[25]
20	Microstrip array	28	2.2	[26]
21	Dual band	28.25/38	2.2	[27]
22	Printed patch	28	2.2	[28]
23	16 element array	28.5	2.2	[29]

IV. ANTENNA CONFIGURATION

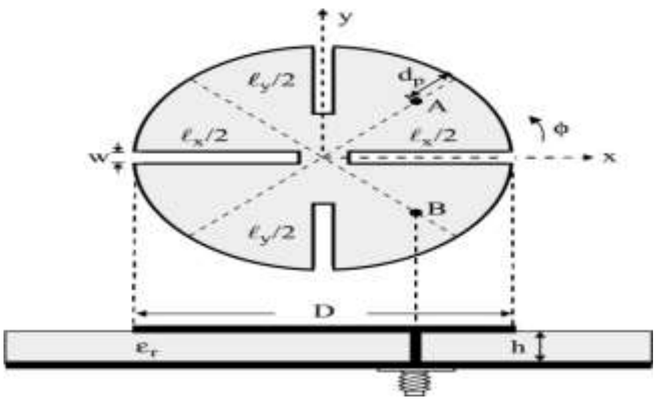


Fig 2:Geometry of a circularly-polarized dual band microstrip patch antenna

The above fig 2 represents the geometry of a circularly polarized microstrip patch antenna with 4 cutting edges. Where

l_x- length in the slot in x-direction
l_y- length in the slot in y-direction
d_p – Dual Polarized (Two probe feeds for the two feeding ports are located at distance dp)
ε_r- Dielectric Constant
φ- diameter of 45^o planes
w - Width of the slot
x – x axis
y – y axis
h - Hight
B -feed position at point A is for leftt-hand circular polarization operation

D – Distance
A - Feed position at point A is for right-hand circular polarization operation
B - Feed position at point B is for left-hand circular polarization operation

This way of cutting into equal pieces reduce the size of patch size in antenna and also it has a greater impact in gain, radiation and bandwidth as well. This kind of multilayered configuration is very much useful in wireless communication systems since because the desired performance can be achieved very easily. By varying the physical paramaters of the antenna, that can satify the requirement of various devices.
Positioned over a feed base certainly is the radiating component, a circular hat-shaped folded patch, of diameter 23 mm and thickness of 1.5 mm . With regard to change the structure, 4 slots will be loaded inside the hat-shaped patch. Measurements associated with the slots will be 3.1 mm, 2.78 mm and 1.1 mm and tend to be similar. A 90-degree differences is done around every single slot. The feeding framework can be created on the rectangle PCB by way of side length32 mm, thickness 1.6 mm, dielectric constant 2.66. At the top part in the PCB, a 0, 90, 180, and 270 degrees shifts are produced intended for 4 similar 0-shaped slots will be imprinted on the surface plane, with regards to center of the antenna. Finally, the grounded slot contains a thickness of 0.6 mm. The splitting up among every single opposite slot is usually 4 millimeter. A ring-shaped feeding microstrip can be attached to the underside line that has external diameter 16.8 mm as well as , width 0.66 mm can be imprinted. In -y direction towards the middle of the ring it is actually observed that the prolonged potion in the microstrip line can be displayed. This enables the antenna to become center-fed along with a connector. For impedance matching a bended potion with the microstrip line with the open end is carried out.
A dielectric substrate with side length 30 mm, thickness 4.5 mm, dielectric constant 2.65 is surrounded above the double-sided PCB. With a diameter of 24 mm a cylindrical cavity of the surrounded substrate is created. A metallic block with height of 20mm is attached below the PCB. At the center of the metallic block a cylindrical hole with diameter of 26 mm is formed similar to the surrounded dielectric substrate.

V. EXPERIMENTAL RESULTS AND DISCUSSION

Simulation of this proposed work is done by HFSS and Computer Simulation Technology (CST). The return loss of -9.2 dB is considered which will be around 10% and 90% will be the radiation reflection power of the antenna and it would be much better value for a mobile communcation network. The circularly polarized patch antenna resonates at the frequency of about 28GHz. For a better antenna the Voltage Standing Wave Ratio(VSWR) value should be between 1 and 2. This techinique achieved VSWR about 1.5376 which is shown in fig 3.

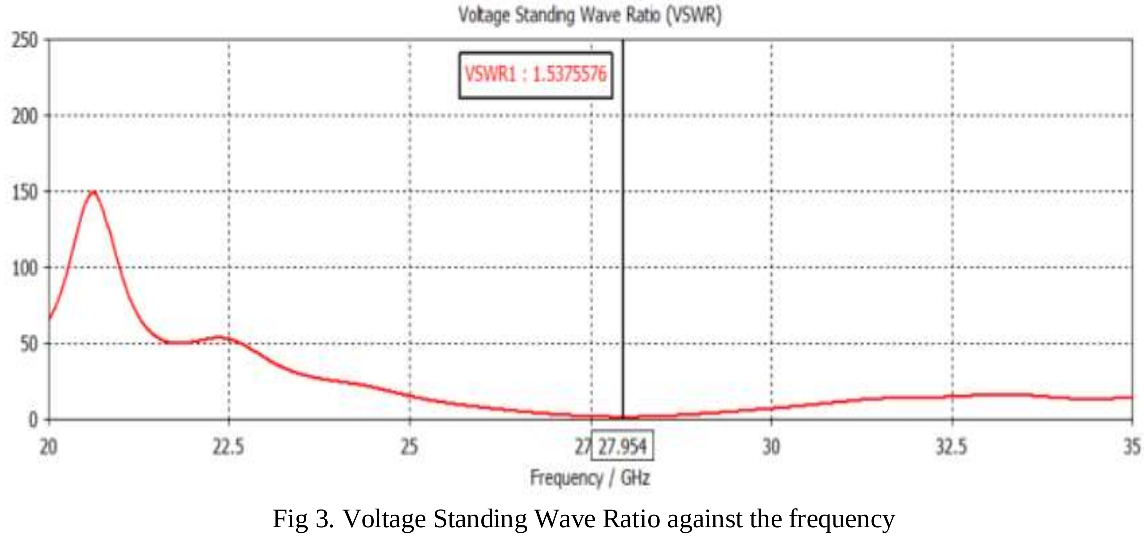


Fig 3. Voltage Standing Wave Ratio against the frequency
The antenna has achieved a gain of 7.93 with 1.6mm antenna circumference which will be a good for such a small sized circularly polarized antenna and it has achieved a side lobe level about -15.3dB and an angular width of 66.0 degree which is shown in fig 4.

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

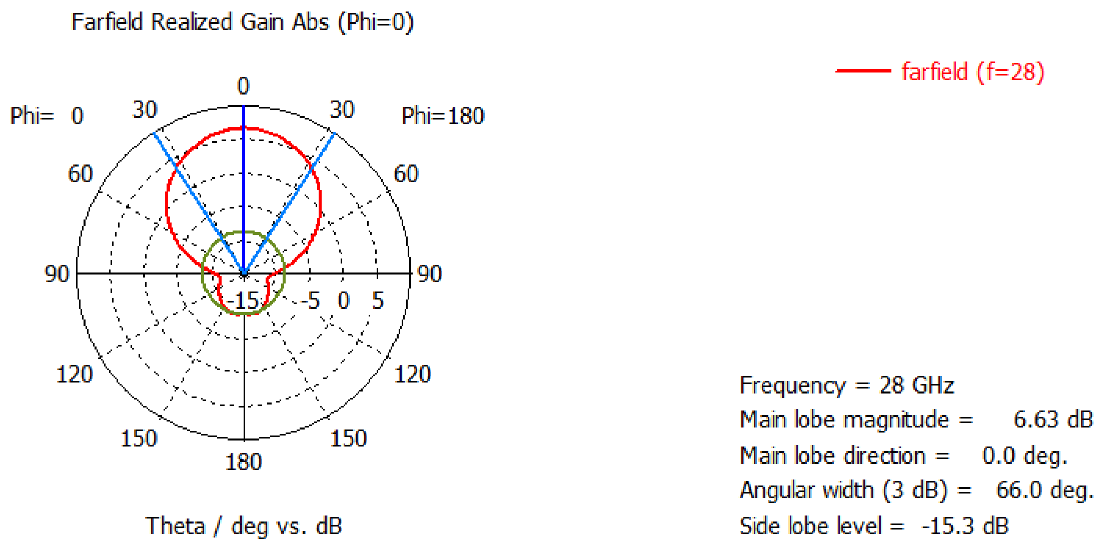


Fig 4. Gain of the antenna

In fig 5 the radiation pattern of the antenna is shown. The simulation results has achieved a directivity of 8.37 dBi and also 99% of radiation effeciency has been attained.

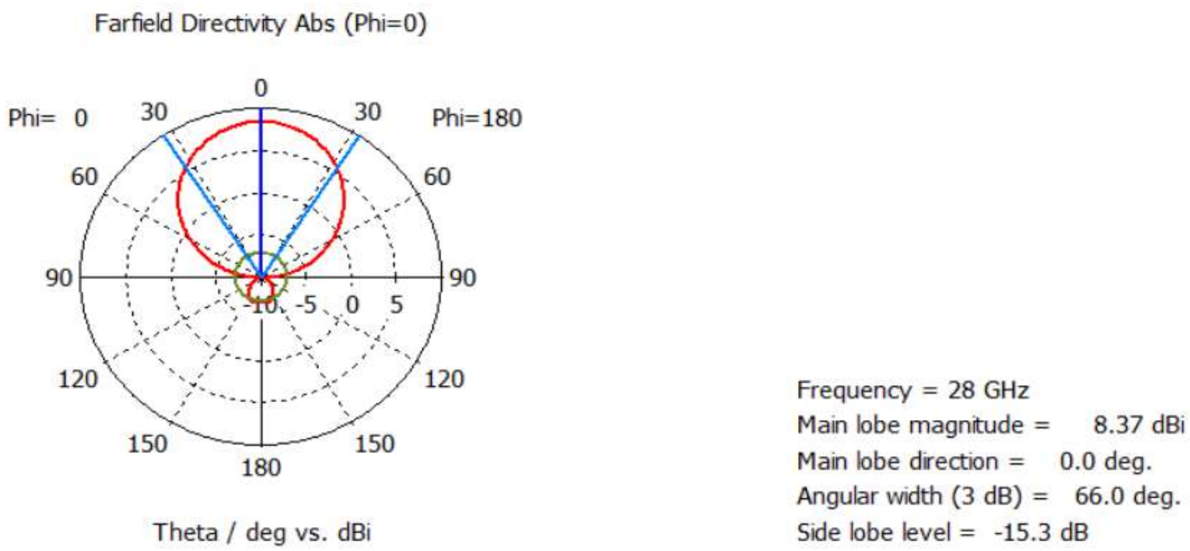


Fig 5. Radiation pattern of the antenna

Output parameters of circularly polarized microstrip patch antenna is given in table 2. Which shows the return loss, VSWR, gain, directivitiy, peak gain, radiated power, accepted power, incident power and radiation effieciency of circularly polarized microstrip patch antenna.

It can be obvious the fact that suggested antenna may encompass dual 5G bands of 28/38 GHz intended for reflection coefficient lower than -10 decibel with the one level band of 30-34 GHz. Finally, the simulated optimum gain from the suggested antenna is going to be revealed through Fig. 6 and 7. A well balanced gain having a value of 7.93 dBi inside the 1st band at 28 GHz can be noticed as well as , 6.9 dBi from the second band found at 38 GHz. A clear , crisp drop on the antenna gain could be seen in the notched-frequency band close to 31 GHz. Fig. 8 displays the simulated radiation patterns of suggested antenna at frequencies of 28, and 38 GHz. Simulated outcomes shows the fact that antenna can be described as omnidirectional models.

ISSN- 2394-5125 VOL 7, ISSUE 04, 2020

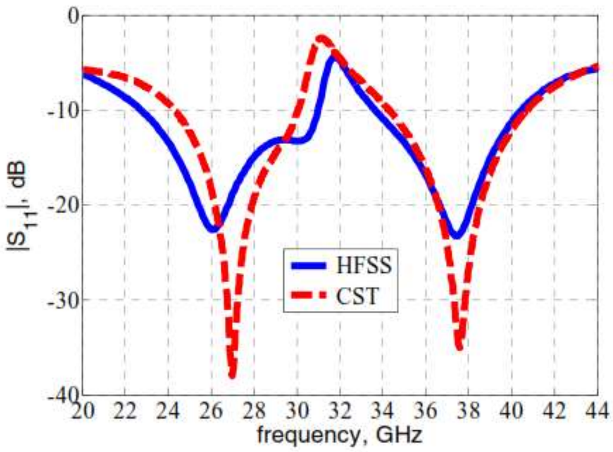


Fig 6.Reflection coefficient vs frequency of dualband microstrip antenna.

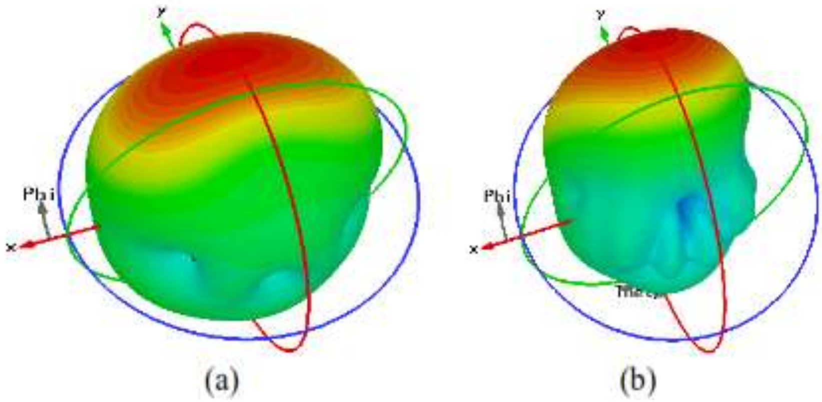


Fig 7.Computer Simulation Technology Simulated Radiation patterns microstripantenna at (a) 28 GHz (b) 38 GHz.

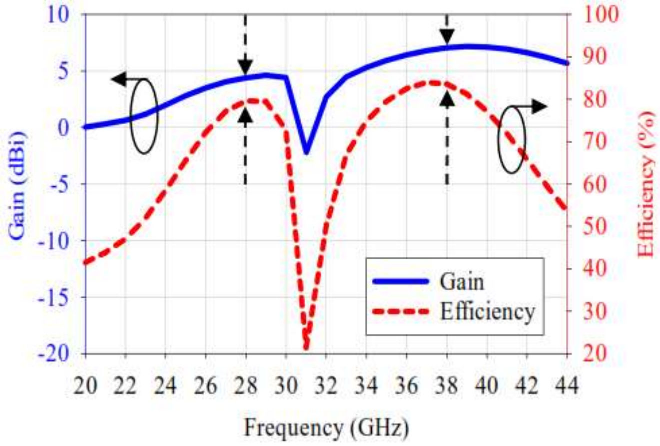


Fig 8. Maximum gain & efficiency of proposed microstrip antenna.

Table 2. Output parameters of simulated result

S.No	Parameter	1.6mm
1	Retrun loss	-9.2 GHz
2	VSWR	1.5376
3	Gain	7.93
4	Peak directivity	8.37
5	Peak gain	7.0
6	Radiated power	0.003
7	Accepted power	0.003

8	Incident power	0.004
9	Radiation efficiency	0.99

VI. CONCLUSION

A circulalry polarized microstrip patch antenna is proposed meant for 5G application because of the rise in needs of cellular as well as , portable units. The antenna works at a frequency of 27.954 GHz along with a -9.2 dB return loss. The suggested antenna has 99% radiation efficiency as well as 7.93dB gain. A bandwidth of 847 MHz could be attained with our result in comparison with earlier research which has 400 MHz in [5] also 582 MHz in [6]. Simulated Outcomes demonstrate the fact that suggested dual band antenna provides dual band results at 28 as well as , 38 Gigahertz designed for 5G model. The suggested dual band antennas possess gain approximately 7 decibel with distinct drop noticed close to 31 GHz. This suggested antenna is great choice intended for 5G cellular communication which inturn mandates large bandwidth. The dimensions of the antenna is incredibly small and therefore can be appropriate for systems in which the space may be a significant constrain.

VII. REFERENCES

[1] J. G. Andrews, et al., “What Will 5G Be?,”IEEE JSAC Special Issue on 5G Wireless CommunicationSystems, 2014.
[2] W. Roh, et al., “Millimeter-Wave Beamforming as an Enabling Technology for 5G Cellular Communications : Theoretical Feasibility and Prototype Results,” IEEE Communications Magazine, 106–113, 2014.
[3] S. Lokesh, S. Malathy, K. Murugan and, G. Sudhasadasivam (2010), “Adaptive Slot Allocation and Bandwidth Sharing for Prioritized Handoff Calls in Mobile Networks”, International Journal of Computer Science and Information Security, Vol.8 , 52-57.
[4] S. Sridevi and K. Mahendran, “Design of Millimeter Wave Microstrip Patch Antenna For MIMO Communication,” International Research Journal of Engineering and Technology, vol. 04, no. 10, pp. 1513– 1518, 2017.
[5] S. Johari, et al., “28 GHz Microstrip Patch Antennas for Future 5G,” Journal of Engineering and Science Research, vol. 2, no. 4, pp. 1–6, 2018.
[6] S. Mungur, et al., “Microstrip Patch Antenna at 28 GHz for 5G Applications,” Journal of Science Technology Engineering and Management Advanced Research & Innovation, vol. 1, no. 1, pp. 5–7, 2018.
[7] Kumar R, Lokesh S &Ramya Devi, M. (2018), “Identifying Camouflaging Adversary in MANET Using Cognitive Agents”, Wireless Personal Communication, https://doi.org/10.1007/s11277-018-5378-1.
[8] Jin-Kyoung Du, et al.”Dual-polarized Patch Array Antenna Package for 5G Communication Systems”, 11th European Conference on Antennas and Propagation, 2017.
[9] Chen, Z., et al. “FR4 PCB Grid Array Antenna for Millimeter-Wave 5G Mobile Communications”. IEEE MTT-S International Microwave Workshop Series, 2013
[10] Hong, W., et al.“Study and prototyping of practically large-scale mmWave antenna systems for 5G cellular devices”. IEEE Communications Magazine, 52(9), 63-69,2014.
[11] Hong, W., et al.“Design and analysis of a low- profile 28 GHz beam steering antenna solution for future 5G cellular applications”. In Microwave Symposium (IMS), IEEE MTT-S International (pp. 1-4).IEEE, 2014.
[12] Alreshaid, A., et al.“A compact millimeter-wave slot antenna array for 5G standards”. IEEE 4th Asia-Pacific Conference on Antennas and Propagation,2015
[13] Ashraf, M. A., et al. “Compact size enhanced gain switched beam conformal antipodal tapered slot antenna system for 5G MIMO wireless communication”. 2015 IEEE 11th International Conference on Wireless and Mobile Computing, Networking and Communications,2015.
[14] Lokesh, S. & Devi, M.R. “Speech recognition system using enhanced mel frequency cepstral coefficient with windowing and framing method” Cluster Comput (2017). https://doi.org/10.1007/s10586-017-1447-6
[15] Gampala, G., et al.“Design of millimeter wave antenna arrays for 5G cellular applications using FEKO”. 2016 IEEE/ACES International Conference on Wireless Information Technology and Systems and Applied Computational Electromagnetics .
[16] Jang, K., et al.“Handheldbeamforming antennas adoptable to 5G wireless connectivity”. 2015 International Workshop on Antenna Technology

[17] Chen, A., et al."Development of a Ka -band & wideband circularly polarized 64-element microstrip antenna array with double application of the sequential rotation feeding technique". IEEE antennas and wireless propagation letters, 10, 1270-1273, 2011.

[18] Osama m. haraz, et al., "Dense Dielectric Patch Array Antenna with Improved Radiation Characteristics Using EBG Ground Structure and Dielectric Superstrate for Future 5G Cellular Networks", The journal for rapid open access publishing, Vol. 2,909-913, 2014.

[19] Magneto electric Dipole Leaky-Wave Antenna for Millimeter Wave Application, IEEE Transaction on Antenna and Propagation, Vol. 65, No. 12,2017.

[20] SyedaFizzahJilani, et al., "Planar Millimeter-Wave Antenna on Low-Cost Flexible PET Substrate for 5G Applications", 10th European Conference on Antennas and Propagation, 2001.

[21] Noha M. Rashad, et al., "Pharaonic Ankh-Key Millimeter Wave Broadband Antenna Design and Fabrication for 5G Applications", IEEE Transaction on Antenna and Propagation, 2017.

[22] IskandarFitri, et al."A New Gridded Parasitic Patch Stacked Microstrip Antenna for Enhanced Wide Bandwidth in 60 GHz Band", IEEE Transaction on Antennas and Propagation, 2017

[23] Patrick Cabrol, et al., "60 GHz Patch Antenna Array on Low Cost Liquid-Crystal Polymer (LCP) Substrate", Systems, Applications and Technology Conference (LISAT), 2014.

[24] JyotiSaini, et al."Design a Single Band Microstrip Patch Antenna at 60 GHz Millimeter Wave for 5G Application", International Conference on Computer, Communications and Electronics (Comptelix), 2017

[25] Farhan Ahmad, et al."Design and Analysis of Millimeter Wave Double F Slot Patch Antenna for future 5G Wireless Communications", International Conference on Electrical and Computing Technologies and Applications , 2017.

[26] Cheng-Nan Hu, et al., "Design of a Mm-Wave Microstrip Antenna Array", Electromagnetics: Applications and Student Innovation Competition (iWEM), 2015.

[27] N. N. Daud, et al., "A Dual Band Antenna Design for Future Millimeter Wave Wireless Communication at24.25 GHz and 38 GHz", IEEE 13th International Colloquium on Signal Processing & its Applications (CSPA), 2017.

[28] G. F. Oktafiani, et al.,"Analysis of Printed Patch Antenna Array for 37 GHz Point-to-Point Wireless Links", The 22nd Asia-Pacific Conference on Communications, 2016.

[29] Beenish, et al."Design of a High Gain 16 Element Array of Microstrip Patch Antennas for Millimeter wave applications",2nd International Conference on Contemporary Computing and Informatics (ic3i),2016.

[30] Kumar, R., & Lokesh, S. (2015). "Fast and secure transmission of information among groups using a key management scheme". International Journal of Computer Science and Mobile Computing, 4(11), 40–47.