Review Paper on Different Dual Band Printed Slot Antenna for 5G Wireless Communication

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ABSTRACT

With advancement in communication technology over the past decade, there is an increasing demand for miniaturization, cost effective, multiband and wideband antennas. Dual band printed slot antenna designs can support in meeting these requirements. Various techniques, different shapes and geometries have been introduced for size reduction of dual band printed slot antennas. This paper is on various techniques for designing dual band printed slot antenna exhibits details of different geometries developed to get multiband behavior of printed slot antenna. In this paper geometry of the antenna and variousparameters such as return loss plot, gain plot, radiation pattern plot and VSWR plot are discussed. In this paper the review on various techniques of compactness by geometry on different shapes of printed slot antenna for 5G next generation wireless (NGW) mobile application are presented.

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1. INTRODUCTION

The fourth generation wireless communication systems have been deployed or are soon to be deployed in many countries. However, with an explosion of wireless mobile devices and services, there are still some challenges that cannot be accommodated even by 4G, such as the spectrum crisis and high-energy consumption [1]. Wireless system designers have been facing the continuously increasing demand for high data rates and mobility required by new wireless applications. To address the above challenges the research on fifth generation wireless systems (5G) that are expected to be deployed beyond 2020 [1]. To meet the requirements of 5G to enable higher capacity, higher rate, more connectivity, higher reliability, lower latency, larger versatility and applicationdomain specific topologies, new concepts and design approaches are in great need. Future fifth generation wireless communication networks (5G) will most likely use millimeter-wave frequencies. Some work done by the authors on designing 5G antennas/arrays have been recently released [2-4].

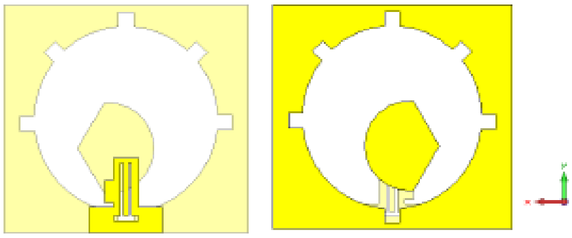
Future 5G wireless communication networks will most likely use millimeter-wave frequencies. In this paper, the design of a dual-band printed slot Antenna which utilizing a band rejection element for the 5G Wireless applications is reviewd and comparison of dual-band printed slot antenna for the Future 5G mobile communication networks is optimized.

2. GEOMETRIES OF PRINTED SLOT ANTENNAS

In this paper, we compared different antenna geometries, all are printed Slot antennas. First, we analyzed all these geometries and then we discuss about their results.

2.1. Dual Frequency Printed Slot Antenna 1

The overall dimension of patch 1 is simulated on a W x L = 8 x7.5mm^{2,} Substrate RogersRT5880 of 0.127 mm thickness, dielectric constant ∈ r = 2.2 and loss tangent tan δ = 0.0009 [5]. Shown in Figure 1. The optimized parameters of dual-band 5g antenna on dual frequency printed slot antenna 1 shown in Table 1.



(a) (b)

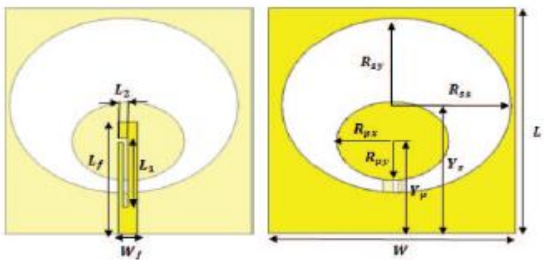
Figure 1. Geometrical Configuration of Dual-band 5G Antenna, (a)Top View, and (b) Bottom View

Table 1. The Optimized Parameters of Dual-Band 5G Antenna (mm)

W	L	W_f	L_f	R_p	R_s	W_1	L_1	W_{stub}	L_{stub}	W_s	L_s
8	7.5	2.42	0.8	1.5	3	1.58	1.66	0.85	0.29	0.5	0.28

2.2. Dual Frequency Printed Slot Antenna 2

Figure 2 shows the geometry of basic design of broadband printed elliptical slot antenna. The prototype antenna is constructed on a 5 x 5 mm2 (L x W) Rogers RT5880 of 0.127 mm thickness, dielectric constant Ɛr= 2.2 and loss tangent tan δ = 0.0009 [6]. The optimized parameters of dual-band 5g antenna on dual frequency printed slot antenna 2 shown in Table 2.



(a) (b)

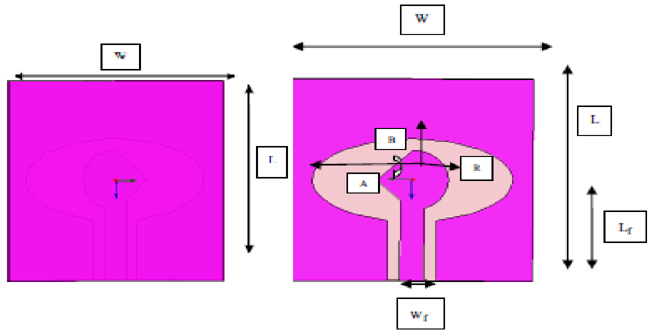
Figure 2. Geometrical Configuration of Dual-band 5G Antenna, (a)Top View, and (b) Bottom View

Table 2. The Optimized Parameters of Dual-Band 5G Antenna (mm)

W	L	W_f	L_f	L_1	L_2	R_{px}	R_{py}	R_{sx}	R_{sy}	Y_s	Y_p
5	5	0.39	2.53	1.5	0.095	1.12	0.87	2.32	1.95	2.83	2.03

2.3. Dual Frequency Printed Slot Antenna 3

Figure 3 shows the geometry of dual band printed slot antenna design is of 10 x 10 mm2and is built on a 0.762 mm-thick Neltec NH9320 substrate having the dielectric constant Ɛr = 3.2 with loss tangent tanδ=0.0024. An offset sectorial disk radiating patch of radius =1.5 mm is placed inside an elliptical shaped slot A= 4.150 mm, B=2.075 mm etched off the radiating plane. The center of the circular patch is on the same line of the substrate. The patch is excited using a 50-Ω microstrip line with width Wf =1mm and length, Lf = 4 mm [7]. The optimized parameters of dual-band 5g antenna on dual frequency printed slot antenna 3 shown in Table 3.



(a) (b)

Figure 3.Geometry and Dimensions of Dual Band Printed Slot Antenna (a) Top View; (b) Bottom View

Table 3.The Optimized Parameters of Dual-Band 5G Antenna (mm)

W	L	W_f	L_f	A	B	R
10	10	1	4	4.150	2.075	1.5

All the Simulation work is carried out using Ansoft HFSS and CST Microwave Studio simulation software.

3. RESULTS ANALYSIS AND DISCUSSION

In this paper we presented review work of three dual band printed slot antennas. Out of three Printed Slot antennas two antennas are on RogersRT5880 substrate of 0.127 mm thickness and one is on Neltec NH9320 substrate. The result analysis is done on the basis of Reflection coefficient graph, Bandwidth, Smith Chart and Gain vs Frequency curve of each antenna. We took each geometry one by one and analyzed it. The simulations of the proposed antenna are performed using HFSS [6] and Computer Simulation Technology (CST) Microwave Studio [6].

3.1. Result Analysis of Printed Slot 1

The proposed dual-band 5G antennas are illustrated in Figure 1. It is apparent that the proposed antenna can cover dual 5G bands of 28/38 GHz for |S11| less than -10 dB with single notch band of 30-34 GHz simulated with HFSS and CST Microwave Studio.

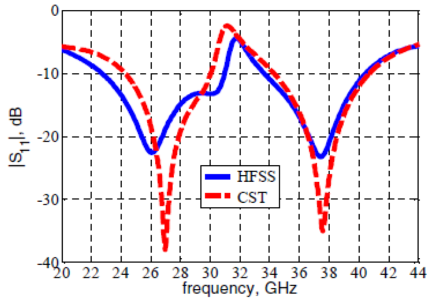


Figure 4. Reflection Coefficient |S11| versus Frequency of Proposed Dualband 5G Antenna

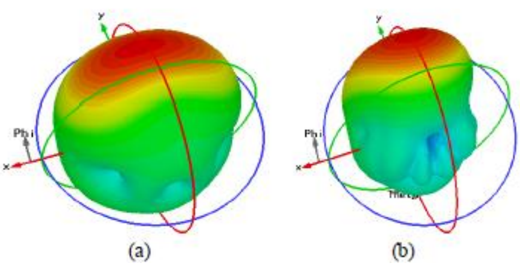


Figure 5. CST Simulated Radiation Patterns of Proposed Dual-band 5G Antenna at (a) 28 GHz, and (b) 38 GHz

Gain at both resonant frequencies is obtained from Gain curve which is shown in Figure 6. A stable gain with a value of 4.2 dBi in the first band at 28 GHz is observed and 6.9 dBi in the second band at 38 GHz.

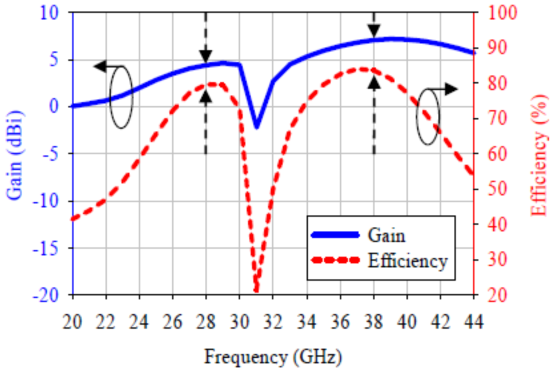


Figure 6. Maximum Realized Gain and Total Efficiency of Proposed Dualband 5G Antenna

3.2. Result Analysis of Printed Slot 2

The proposed dual-band 5G antennas are illustrated in Figure 2. It is clear that the proposed antenna can cover dual 5G bands of 28/38 GHz for S11 less than -10 dB with single notch band of 30-34 GHz simulated with HFSS and CST Microwave Studio.

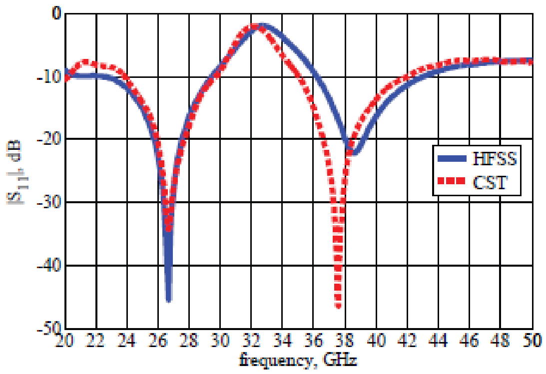


Figure 7. Simulated Reflection Coefficient |S11| versus Frequency of Proposed Dual-band 5G Antenna

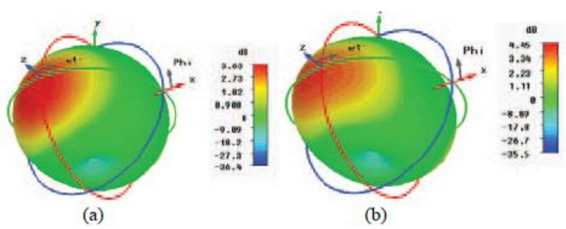


Figure 8. Simulated Radiation Patterns of Proposed Dual-Band 5G Antenna at Different Frequencies (a) 28 GHz, and (b) 38 GHz

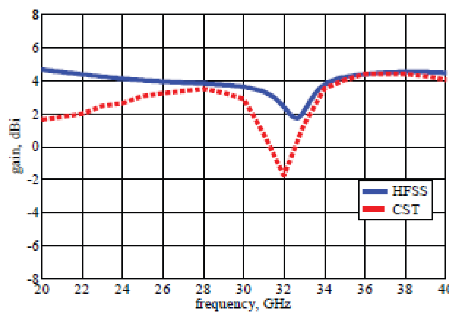


Figure 9. Simulated Maximum Realized Antenna Gain versus Frequency of Proposed Dual-Band 5G Antenna

It can be seen that the antenna gain is around 3.6 – 4.4 dBi over the operating band and the gain drops at notched frequency.

3.3 Result Analysis of Printed Slot 3

The simulated results of the return loss /reflection coefficients |S11| for the proposed dual band 5G antenna are shown in Figure 3. It shows that the proposed antenna has its -10 dB band width for mmwave frequencies and cover dual 5G bands of 32/42 GHz for |S11| with the centre frequency at 31.5 and 41.5 GHz with the bandwidth of 1.5 GHz.

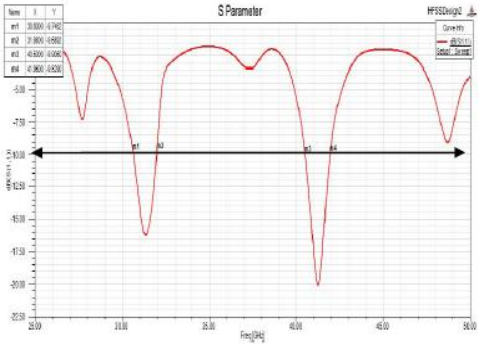


Figure 10. Reflection Coefficient |S11| versus Frequency of Proposed Dual Band 5G Antenna

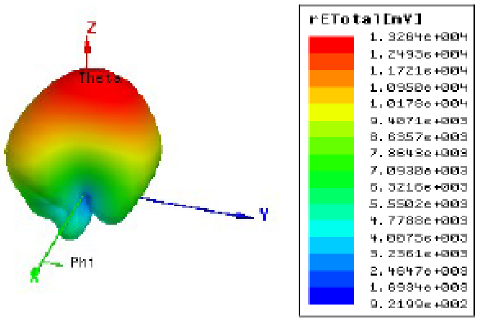


Figure 11. Simulated 3D Patteren

It shows that the proposed antenna has its -10 dB band width for mmwave frequencies and cover dual 5G bands of 32/42 GHz for |S11| with the centre frequency at 31.5 and 41.5 GHz with the bandwidth of 1.5 GHz each. The comparison of the antennas in figure shown in Table 4.

Table 4. Comparison of the Antennas in Figure

DPSA	Slot Size	Resonant Freq(GHz)	Bandwidth GHz	Current Distribution	Gain (dBi)	Performance	Application
Antenna 1	8 x7.5mm^2	28GHZ			4.2 dBi	Dual band	5G and NGW
		38GHz	-------	-------	6.9 dBi		
Antenna 2	5 x 5 mm^2	28GHz			3.6 dBi	Dual band	5G and NGW
		38GHz	--------	-------	4.4 dBi		
Antenna 3	10 x 10 mm^2	31.5GHz	1.5GHz			Dual band	5G and NGW
		41.5GHz	1.5GHz	------	-------		

4. CONCLUSION AND FUTURE SCOPE

In this paper, we examine three printed slot antennas. We start our work with reference slot 3, which have a frequency of 31.5 and 41.5 GHz with dual band performance.The dual-band antennas slot 1 have gain up to 7 dBi with sharp drop observed in the notched-frequency band near 31 GHz and slot 2 at 33 GHz. Printed Slot antenna 2 provides almost omni-directional patterns, relatively flat gain, and high radiation efficiency through the frequency band excluding the rejected band. Slot 3 design illustrated a direction beam which makes it as a good candidate as for 5G and other high frequency applications. Further aim is to build an array with this element to improve the directivity for the application in the frequency range. Considering antenna parameters graph, we conclude that dual band Printed Slot antenna 3 is more appropriate in comparison to remaining antennas.

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