Semiconductor Optoelectronics
ISSN: 1001-5868

DESIGN OF 1 X 2 DUAL-BAND QUASI-YAGI ANTENNA

Hari Chandana B
Assistant professor, Department of ECE, Sree Vidyanikethan Engineering College
Tirupati, India, harichandana996@gmail.com

Neelima K
Assistant professor, Department of ECE, Mohan Babu University, Tirupati, India.
Neelumtech17@gmail.com

R. Sivaramakrishnan
Research Scholar Scsvmv University Enathur Kanchipuram, Sivaram6685@gmail.com
SCSVMV University

Abstract — Planar and array variations of a 1X2 dual-band Quasi-Yagi antenna will be studied. This antenna design had dual-band properties for different applications.
This can be employed, for instance, for applications like Wi-Fi, whereby frequency values are somewhere between 2.30GHz nor 2.48GHz, as well as for forthcoming wireless transmission applications like 5G, whose relative abundance are between 3.4GHz and 3.8GHz. It actually has a dipole geometry, loop geometry, because of this it shows two types of radiation features. Two input ports are required for the 1x2 element antenna array, and beneath the antenna structure, a practical antenna array using a ceramic insulator reflector is taken into consideration. The identical properties and gain properties of the Quasi-Yagi will be examined to upgrade, changing the antenna into a 1x2 array and the practical array with element as a reflector. This analysis was carried out using the Ansys HFSS programme..
Keywords— Wi-Fi Band, Dual-Band Antenna, 5G, Array Antenna, Quasi-Yagi Antenna

I. INTRODUCTION

As per advancement of Cloud Computing, which automatically increases the users count, due to this there will be a huge request for radiocommunication and mobile communication systems. So, the existing technologies must be used efficiently with full capacity as there is only limited band spectrums available for whole communication systems. Which proves that the home-grown webs and unauthorized bands in that range are gaining popularity [1-3]? The projected antenna design consists of dual-band characteristic features which applicable for 5G mobile communication systems, Wi-Fi applications [11][13][15][16][17]. Because of features like low cost, profile, easy manufacturing advantages the structure of antenna is said to be Quasi-Yagi type [12]. Having these adaptable and improvable features of projected antenna it operates good Enabled devices and power harvesting applications, in addition to mobile and radar implementation [4-8]. This script will familiarize the Quasi-Yagi design as an array configuration where the antenna array design has n number of inputs for MIMO [9][10][14] design and its virtual array changes. The aim is to increase the performance by decreasing the energy and material intake to produce a model for applications in easier way. By utilizing Ansys HFSS the study is executed.

II. DESIGN FOR ANTENNA

The antenna elements antenna has been tested using FR-4 (r = 4.4, tan = 0.02) as the dielectric material, with exact unit antenna design parameters of 1.6 mm for the platform and 17 m again for copper cladding. The architectural parameters of this evaluated and created antenna are shown in Fig. 1 and Table 1. This antenna's effective centre band frequencies are 2.3 GHz and 3.5 GHz, and its dipole's free space wavelength is 85 mm. The designed antenna is 111x19 mm2 in size, and the distance between each antenna is da=0.55 loops of wavelength. Using parametrical analysis, the length "d" among two antennas is found to be 35mm. All told, the lasso has a 0.208 loop length. The space between antenna and the reflector element is found out as λ/4 of $\lambda dipole$ and the simulation outcomes are showing below. Since there are two types radiating geometries, two types of radiation patterns are attained.

III. SIMULATION AND EXPERIMENTAL RESULTS

Far-field radiation parameter characteristics properties of antenna in anechoic chamber the corresponding antenna's radiation patterns are simulated and the results are displayed in fig.2. The gain, return loss and VSWR of Quasi-Yagi antenna was exposed in fig 3, fig4.

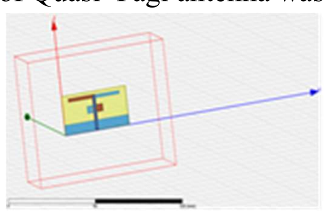

Fig1. Antenna Display (a) unit cell

TABLE 1. Proposal Constraints for Antenna

Parameter	Dimension (mm)	Paramater	Dimension (mm)
Lg	5	L_f	8.75
L_o	0.5	W_d	30
L_s	19	W_s	38
L_l	3.5	W_l	4
L_1	3.5	W_f	1.5

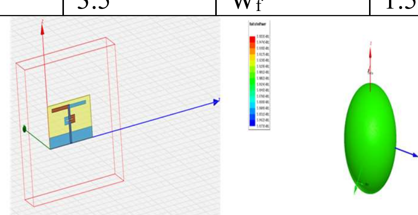

Fig 2. Quasi-Yagi Antenna and its radiation pattern

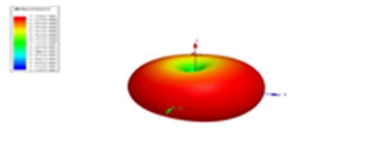

Fig 3. Quasi-Yagi Antenna Gain

In sidelong directions the gain is obtained was 2.928 Db at frequency of 2.45GHz as shown in top diagram. The corresponding values of VSWR & S(1,1) return loss is 2.128 &-8.880
The Radiation efficiency of Quasi-Yagi antenna is 8.891%. The highest directivity received in the design was 8.463 dB. The area of beam for designed antenna was 1.044 W/Sr. when an antenna is connected to the original data received TRP was 7.740W for 1W of supplied power at 3.5GHz.

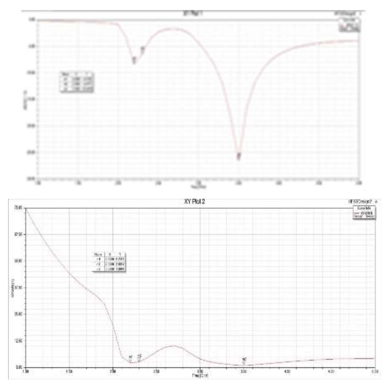

Fig 4: show the Quasi-Yagi antenna features of (a) s(1,1) (b)VSWR

To send and receive waves the antenna was later changed to array with 1*2 elements which further combined as a one design.

Design values of both antenna array and single antenna are equal. The parameters of antenna is taken as ($\varepsilon r = 4.4$, tan $\delta = 0.02$)h$substrate = 1.6mm$ and copper cladding of 17 ɱm, FR-4 as a dielectric material that has a radiation along sidelong i.e, high along the axis-z.

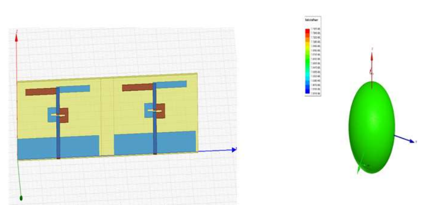

Fig 5: (a) Quasi-Yagi 1*2 antenna (b) RP

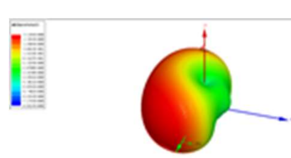

Fig 6: Quasi-Yagi 1*2 antenna gain

From the single antenna the highest gain obtained to 1*2 was found to be 3.13 dB which is the

7.17% increase in it. Highest directivity was found to be 3.748dB. VSWR follows the value of 2.8057. The corresponding efficiency, beam area was received as 88.9%, 5.34W/Sr. Reduced area of beam helps in forwarding of input signals by reducing the side lobe that decreases losses in the signal.

The TRP 5.985W. The efficiency is found to be 8.777%. The S(1,1) of obtained double band 1*2 antenna was -6.475 dB.

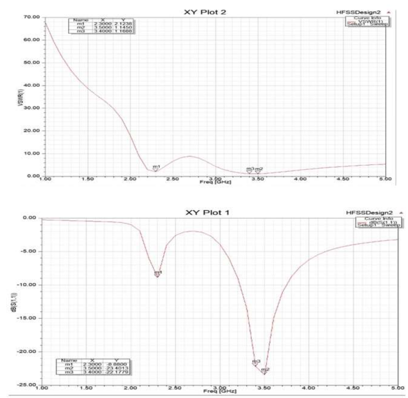

Fig 7: (a) S(1,1) (b)VSWR of 1*2 antenna.

Below table predicts that the gain of 1*2 is high that one antenna of 7.17 %. Also the efficiency was increased for 1*2 antenna from 101.95 % to 99.897% and from 71.85% to 66.22%

Table 2: Displays Quasi antenna and its array antenna comparisons

Paramater	Quasi-Yagi Antenna	Quasi-Yagi Array Antenna
Return loss(in dB)	-8.880 (2.3GHz) -23.4 (3.5GHz)	-6.475 (2.3GHz) -25.6 (3.5GHz)
VSWR	2.128	2.8057
Gain (in dB)	2.9281	3.1384
Directivity	0.84635	3.7480
Beam area	10.445	5.3548
Radiated power	0.77407	0.59853
Radiation efficiency	0.88914	0.87773
HPBW	110	90
FNBW	174	172
Bandwidth (MHz)	170	142

CONCLUSION

The combined adjustment in gain and directivity has been proposed by designing a 1X 2 Quasi-Yagi with a reflector, and its experimental and synthesized results are presented in this work. The correspondence among obtained data with generated data is strong. This array antenna's maximum gain is 3.13 dB, which is 7.17% higher than that of a single patch antenna.

References

[1] GSMA. 04(2016). 5G04 Spectrum. 04Public04 Policy Position04(July). 04Retrieved 04from https://www.gsma.com/spectrum/wp content/uploads/2016/06/GSMA-5G-Spectrum-PPP.pdf

[2] T. 04Jones & 04C. 04Dewing, 04Future04agenda: the world in 2020. 04Oxford: Infinite Ideas04Limited, 2011.

[3] "Spectrum for 4G and 5G," Qualcomm, 04 22-Jan-2018. [Online].Available: 04https://www.qualcomm.com/documents/spectrum-4g and-5g04.

[4] Sun04H., 04Guo, 04Y. X., 04He, M., 04&04Zhong, Z. (2013). A04dual-band04rectenna04using04broadband yagi antenna array 04ambient rf04power04harvesting. IEEE Antennas and Wireless04Propagation004Letters, 0412, 04918–921. https://doi.org/10.1109/LAWP.2013.2272873

[5] Cheong, 04P., Wu, K., 04Choi, 04W. 04W., &04Tam, K. 04W. 04 (2014). 04Yagi-uda04antenna04for04multiband radar04applications. 04IEEE04Antennas04and04Wireless Propagation04Letters, 0413, 041065–1068. https://doi.org/10.1109/LAWP.2014.232899104

[6] Lu, 04W. 04J., 04Zhang, 04W. 04H., 04Tong, 04K. 04F., &04 Zhu, 04H. B. 04 (2014). Planar04wideband04loop-dipole04composite04antenna. IEEE04Transactions04on04Antennas04and04Propagation, 62(4),2275–2279. https://doi.org/10.1109/TAP.2014.229982004

[7] Sarkar, 04D., 04&04Srivastava, 04K. 04V. 04 (2017). Compact0dual-band04dual04mode04microstripfed04dipole-loop04antennas04for04pattern04diversity arrays, Electronics04Letters, 0453(10), 639–640. https://doi.org/10.1049/el.2017.059304

[8] F. 04T. 04Celik04and04K. 04Karacuhha, 04"Dual – Band04Microtrip04Quasi04Yagi04Antenna04Design04for Free Band04and045G04Mobile Communication," 042018 XXIIIrd04International04Seminar/Workshop04on04Direct and04Inverse Problems04of Electromagnetic04and Acoustic Wave04Theory04 (DIPED), 04Tbilisi, 042018, 04pp. 189- 192.doi:10.1109/DIPED.2018.8543132 04

[9] Blanch, S., Romeu, J04., & Corbella, I. (2003). Exact representation04of04antenna04system diversity performance04from input parameter description. 04Electronics Letters, 0439(9), 04705. https://doi.org/10.1049/el:2003049504

[10] Ibrahim, 04A. 04A., 04Abdalla, 04M. A., 04& Volakis, J. L. (2017). 404elements04UWB04MIMO04antenna04for wireless04applications. 04201704IEEE04Antennas04and Propagation04Society04International04Symposium, Proceedings, 2017-January, 1651–1652.

[11] K. Neelima, 04G. Guru Prasad, 04"Characterization of inset04fed04rectangular04patch04for04multipl04 frequency operation", 04international004conference004on004power and embedded 04drive04control04 (ICPEDC 2017) by IEEE04and004SSN004College004of0040engineering, 04Chennai004March00416-18, 0042017.

[12] Mr sai04raja04Narendra, Ms04k04Sudha, Ms04HD Praveena, "Design and simulation of circular patch log periodic microstrip antenna array with reconfigurability using IE3D Software" International04journal04of04pure and04applied04mathematics, 04Vol04114, 04Issue 10, 04pp.301-308.

[13] Satyam, 04 K. Neelima, 04 P. V. Ramana04and04R. Nagendra. "Performance

Enhancement of Microstip Antenna at ISM Band using Slots," 202104International Conference04on04Emerging04Smart04Computing04and Informatics04 (ESCI), 042021, 04PP. 04797-04800, 04doi : 10.1109/ESCI50559.2021.9396898.
[14] R. Nagendra, S. Swarna latha, "Design and performance of four port MIMO antenna for IOT applications", ICT Express, 2021, ISSN 2405-9595,
https://doi.org/10.1016/j.icte.2021.05.008.
[15] Neelima04Koppala, G. 04Guru Prasad, H.D. 04Praveena, "Design of Multiband Microstrip Antenna using HFSS for Microwave Radio Relay, Wi-Fi, Satellite and Bluetooth Applications". National04Conference04on Wireless04Communication04Systems, 0427-2804jan042016, 04pp.11-16, ISBN No.: 978-93-85100-27-7.
[16] T. Ravi Kumar Naidu., Susila. M and TVS.Gowtham Prasad,. Developments And Challenges In The Design Of Active Integrated Antennas. Elementary Education Online, 20(1), pp.2383-2383, 2021
[17] TVS Gowtham Prasad, B. Rama Rao, D. Nataraj, and Srikanth Lammatha. Design of Multi Band Micro Strip Patch Antenna for S-Band and Ku Band Applications. Journal of Optoelectronics Laser, 41(6), pp.405-411, 2022.