NIET Journal of Engineering & Technology (NIETJET)
Volume 11, Issue 1, 2020 ISSN: 2229-5828 (Print)

Design and Analysis of Multiband MSP Antenna for Next Generation Wireless Network

Devendra Pratap[1], Md. Raza[1], V.K. pandey[1]

[1]Assistant Professor, Department of Electronics& Communication Engineering, Noida Institute of Engineering & Technology, Greater Noida
[2]Professor, Department of Electronics& Communication Engineering, Noida Institute of Engineering & Technology, Greater Noida

Abstract: *An antenna is a device that can send and receive signals for radio propagation. The development of fast and fixed portable communication systems requires a high level of transition to a wider area due to the increase in network users. This can be done using multiple bands. To strengthen the characteristics and performance of the antenna, microstrip antenna design techniques, various structures and shapes, analysis and feeding methods are applied. Therefore, to achieve multi-band operation in a limited space, the antenna is designed in an E-shape in combination of various shape slot to achieve multi-band operation. Simulation results show that the proposed antenna operates at two different frequencies, 3.57 GHz, and 5.73 GHz, and can be used in various wireless applications such as Wi-Fi and mobile Wi-MAX. All simulation results such as resonant frequency, return loss, radiation pattern and measurement results of the simulated antenna are presented in this paper. HFSS software has been used for simulation and analysis work.*

Keywords - Microstrip patch, Substrate, Radiation Pattern, VSWR, S11

1. INTRODUCTION

An Antenna can be used as a transducer that converts directed electromagnetic energy during a link to transmitted electromagnetic energy in free space. The antenna can likewise be considered an impedance transformer, coupling between an information or line impedance, and hence the impedance of free space. In the current scenario, wireless communication frameworks are quickly created because of expanding interest for portable devices which is to connect with various gadgets working at different frequencies [1-2]. Multiband antenna assumes a critical part in wireless communication frameworks as it can work in numerous recurrence groups for various remote applications like Global System for Mobile correspondence, Wireless Local Area Network, and portable Wi-MAX. The front view of the fabricated antenna and side view are shown using Fig.1 & Fig.2 respectively . The benefit of the multiband antenna is their capacity to coordinate different frequency bands in a single antenna which makes the plan and activity more complicated than single and double band antenna. From the research survey [3-6], the Fractal antenna clusters like Kotch exhibit, Sierpinski exhibit are likewise used to accomplish the multiband tasks. In any case, the Fractal antenna increment the plan intricacy. Microstrip fix radio wire is an appropriate gadget for remote correspondences which can be handily coordinated with microwave circuits in view of their low volume, meager profile, lightweight, and minimal expense, which can work at numerous frequencies. Thus, multiband Microstrip patch antenna is of extraordinary concern nowadays.

2. METHODOLOGY OF ANTENNA DESIGN

A microstrip patch antenna is a piece of appropriate equipment for wireless communication which can be effortlessly

Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.

coordinated with microwave circuits due to their low volume, flimsy profile, lightweight, and minimal expense, which can work at different frequencies. The proposed design is utilizing FR4 substrate with a thickness of 1.6mm. The dielectric steady of the FR4 substrate is 4.4. The components of the ground plane and the substrate are something very similar, for example (70×60 mm). The components of the slot are taken as (35×30 mm).

Fig1: Front View of Antenna Design Fabricated Antenna

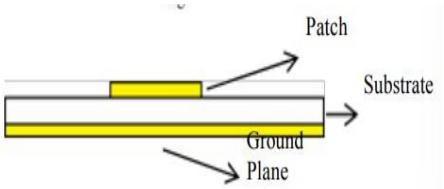

Fig.2: Side View of Antenna Design

It comprises of area of metallization a ground plane by a dainty dielectric substrate and took care of against the ground at a proper area. Electromagnetic energy is first directed or coupled to the district under the patch, which behaves like a resonant cavity with open circuits on the sides. A portion of the energy spills out of the pit and emanates into space, prompting an antenna . Various patch antennas on a similar substrate called microstrip antenna that can be utilized to make high addition cluster antenna and staged arrays[7]. It is framed utilizing a microstrip procedure by creating on a printed circuit board along these lines is otherwise called Microstrip radio wire or printed antenna. It is framed by manufacturing a rectangular metallic fix on a dielectric-covered ground plane. This can be said in basic terms that a dielectric material having a directing patch is upheld by a ground plane. The radio wire is planned and reenacted utilizing HFSS software. slots are made in the patch to acquire multiband qualities [8-9]. We have reproduced a antenna with a ground plane component of 70*60 , Patch aspect 35*30, aspect of feed 3*17.5. Microstrip line taking care of is utilized for the proposed radio wire as it is not difficult to manufacture. The length and width of the spaces decide the full frequencies of the radio wire [10-11]. By changing the extents of the length and width of the spaces multiband attributes might change. The upgraded boundaries of the spaces are picked for creation.

3. SIMULATION RESULTS

A significant role has been played by the dielectric constant of substrate material in the designing of MSP antenna. The dimensions of the antenna can be reduced by using a substrate with a high dielectric constant, but the performance of device is affected by using such subtract. Along these lines, there is a compromise among size and execution of patch antenna. If we are using patch antenna in wireless communication application, antenna size and weight should not be high. Consequently, the dimension of the dielectric substrate ought to be less. For better reception of signal, return loss should be less than -10 dB.

Bandwidth of an antenna is generally characterized either with the lower and upper limits of frequency band (fL and fu) or the percentage (%) bandwidth for a center frequency in antenna terminology. The transmission capacity of a antenna characterized as the recurrence range which the presentation of antenna fulfills determined norms of some antenna boundaries [12].All simulation is done at resonant frequency 3.57 GHz and 5.5 GHz as indicated in fig.3 to Fig 8.

Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.

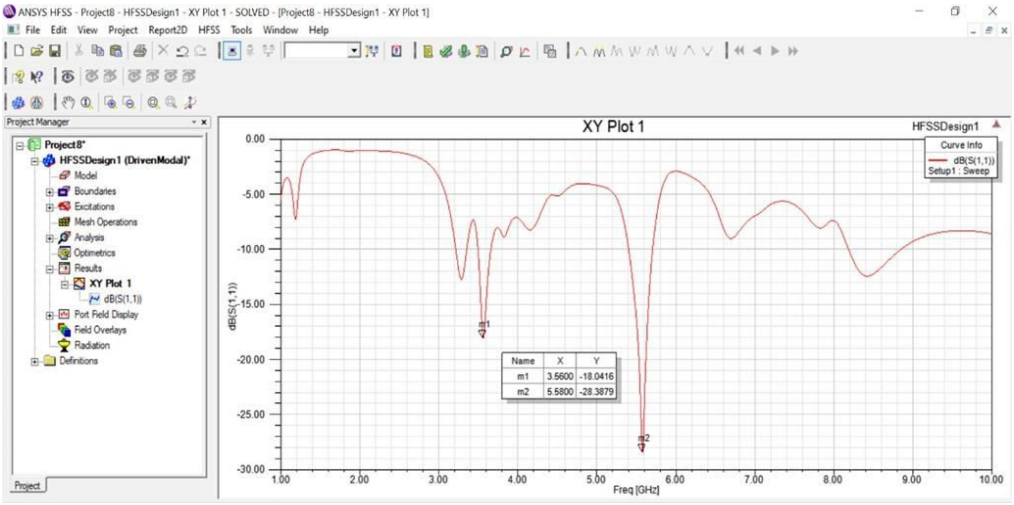

Fig. 3 S_{11} vs Frequency

After simulation, we observed that the antenna shows wideband attributes having operational frequency at 3.57 with a bandwidth of 2.2 GHz at return loss of - 18.04 dB. Full wave examination of the multiband Antenna setups was performed utilizing ANSYS HFSS with Finite Element Method. Broad reenactments were done involving the product to get ideal plan boundaries for the antenna [13]. The underlying components of the emanating part of the antenna were resolved to utilize the conditions created for the dielectric waveguide model (DWM) for a rectangular resonator in free space. The ideal components of the antenna are still up in the free space with trial advancement [14-15] by and large, to accomplish solid coupling, the multiband antenna should be created from high permittivity materials. The proposed antenna can cover GSM 900, DCS, PCS, UMTS, and ISM 2450 frequency band with limitation of VSWR ≤ 2 as displayed in fig.4. A reproduced consequence of this antenna shows wideband attributes having thunderous recurrence at 3.57 GHz worth of voltage standing wave proportion is 1.197.

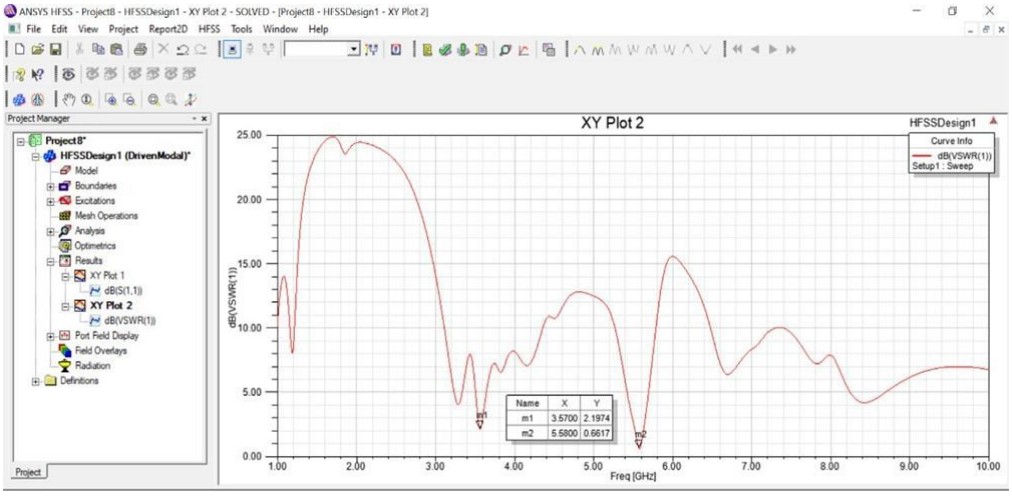

Fig. 4 VSWR vs Frequency

Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.

The term radiation design alludes to the directional (precise) reliance of the strength of the radio waves from the antenna or other source. Since a microstrip patch antenna emanates regularly to its fix surface [16]. The height design for φ=0° and φ=90° would be significant. Fig.5 and Fig.6 present the radiation design for the proposed patch radio wire.

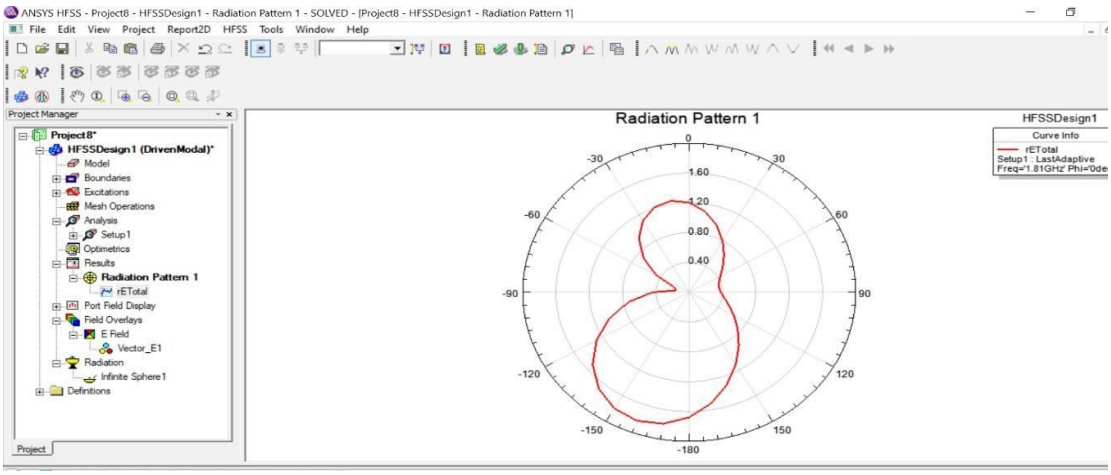

Fig.5: Radiation Pattern in the E Plane

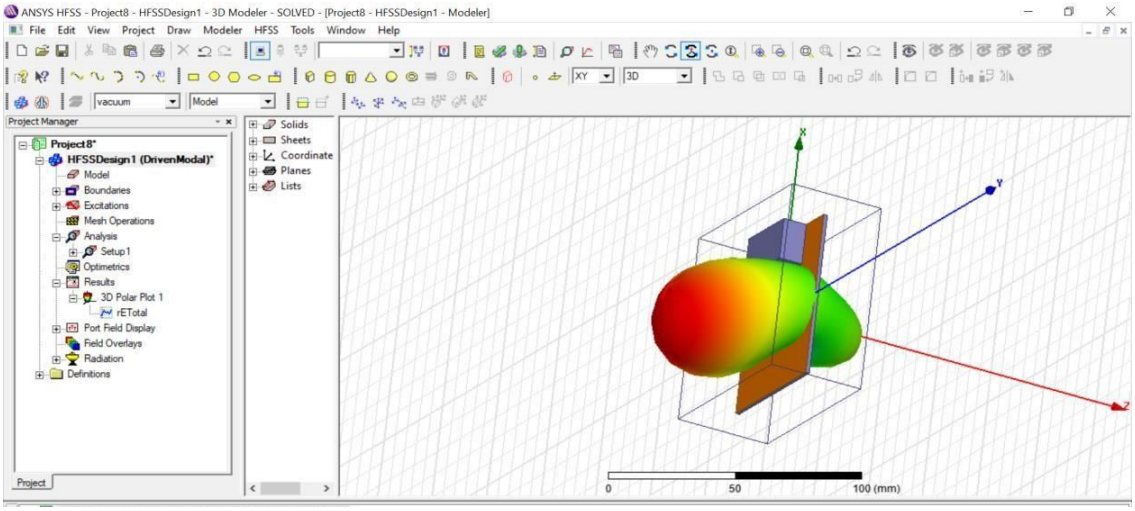

Fig.6: Radiation Field Pattern with Antenna Structure

Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.

E-field is an impact created by an electric charge that applies a power on charged objects in its area Electric fields themselves result straightforwardly from other electric charges or from changing attractive fields [17]. Fig.7 shows the electric field conveyance. The most extreme worth of the E-field got is 1.1 104 V/m.

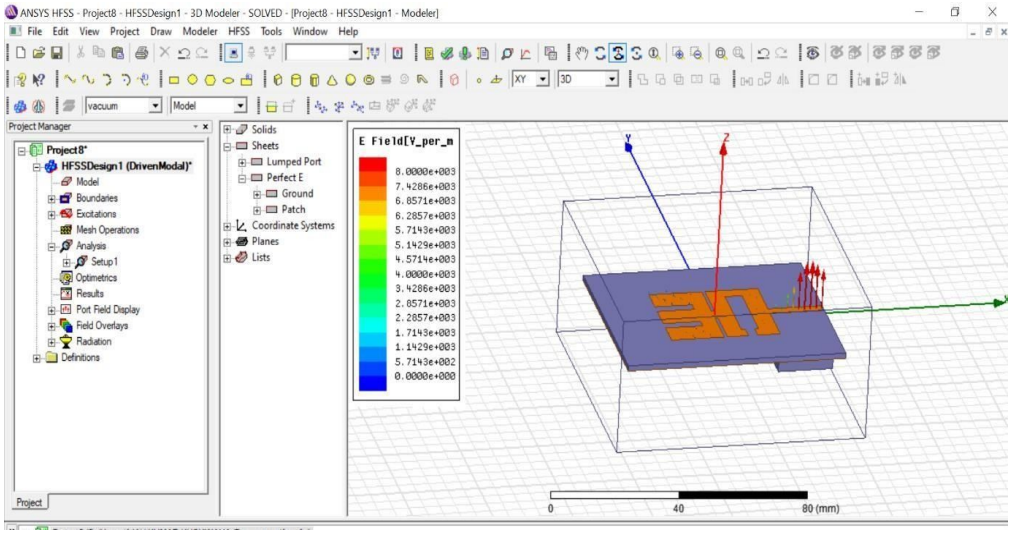

Fig. 7 E Field Lines of Antenna

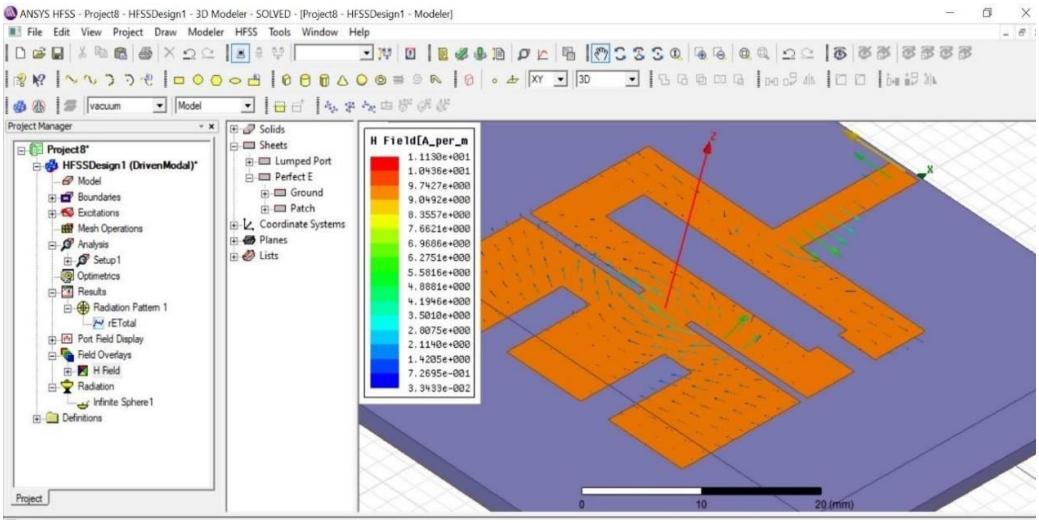

Fig.8: H Field Lines of Antenna

Table 2 presents the recurrence groups of the proposed radio wire. The reproduced transmission capacities antenna was 88% for the principal band, 18.45% for the second, and 33.25% for the third band. In all cases, the antenna offers adequate transmission capacity to cover all the European remote frameworks.

Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.

Table 2. Simulated results

S.NO	Resonance Frequency(GHz)	Return Loss (S11)(dB)	VSWR
1	3.57 GHz	-28.11dB	1.09
2	5.57 GHz	-18.11dB	1.29

4. CONCLUSION

So, we have designed and fabricated an MSP antenna that can be worked at two distinct frequencies using HFSS software. In this design, we are using two distinct frequencies 3.57 GHz and 5.57 GHz. This proposed antenna can be utilized for next-generation wireless network applications like Wi-MAX, and WLAN. Performance of Multiband is accomplished by advancing the length and width of the patch and by changing the length and width of the slot inside the designed antenna. Indeed, even the areas of the slots likewise influence the efficiency of the antenna. Every one of the frequencies got by planning this antenna return loss a lot lesser than the ideal worth, for example - 15dB and contrasted and created antenna estimated outcomes. For future work, different types of slots can be embedded to accomplish better impact and to reduce the antenna size. The increment in data transfer capacity of the proposed antenna can be expanded by using different methods like photonic band-hole structures and deserted ground structures.

REFERENCES

[1] C. A. Balanis, Antena Theory, Analysis & Design, 3rd Edition, Wiley;New York, 2005.
[2] Shobhit K. Patel, Y.P.Kosta, "E-shape Microstrip Patch Antenna Design for GPS Application.", International Conference on Current Trends in Technology, Nuicone – 2011.
[3] B.K. Ang and B.K. Chung, "A Wideband E-Shaped Microstrip Patch Antenna for5–6GHz Wireless Communications", Progress in Electromagnetics Research, PIER 75, 397–407, 2007.
[4] *Radouanekarli*, Hassan ammor, "A Simple and Original Design Of Multi-Band Microstrip Patch Antenna for Wireless Communication", International Journal of Microwaves Applications, Volume 2, No.2, March – April 2013.
[5] Han-CheolRyu, Hee Ran Ahn, Sang-Hwa Lee and Wee Sang Park, "Triple-Stacked Microstrip Patch Antenna for Multiband System", Electronics Letters 21sr November 2002 Vol. 38 No. 24.
[6] K. Jhamb L. Li K. Rambabu, "Novel-Integrated Patch Antennas with Multi-Band Characteristics", IET Microwaves and Antennas Propagation, 2011, Vol. 5, Iss.12, pp.1393–1398
[7] J. R. James, P.S. Hall. Handbook of microstrip antennas, I.E.E. Electromagnetic Waves Series 28 –Peter Peregrinus LTD, 1989.
[8] Best, S. R. Electrically Small Multiband Antennas, In: Multiband Integrated Antennas for 4G Terminals, D. A. Sanchez-Hernandez (ed.), 1-32, Artech House, ISBN 978-1-59693-331-6, Boston, USA. 2008.
[9] J.-S. Chen, Multi-frequency characteristics of annular-ring slot antennas, Microwave and Optical Technology Letters, Vol. 38, No . 6, pp. 506-511, Sep. 2003.
[10] Y.-T. Liu, S.-W. Su, C.-L. Tang, H.-T. Chen, K.-L. Wong, On-vehicle low-profile metal plate antenna for AMPS/GDM/DCS/PCS/UMTS multiband operations, Microwave and Optical Technology Letters, Vol. 41, No 2, pp. 144-146, Apr. 2004.

Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.

[11] Y.-S. Liu, J.-S. Sun, R.-H. Lu, Y.-J. Lee, New multiband printed meander antenna for wireless applications," Microwave and Optical Technology Letters, Vol. 47, No 6, pp. 539-543, Dec. 2005.
8. P. Eratuuli, P. Haapala, P. Vainikainen, Dual frequency wire antennas, Electronics Letters, Vol. 32, No . 12, pp. 1051-1052, Jun. 1996.
[12] P. Salonen, M. Keskilammi and M. Kivikoski, New slot configurations for dual-band planar inverted antenna, Microwave and Optical Technology Letters, Vol. 28 , N°5, pp. 293-298, March 2001.
[13] A. Serrano-Vaello and D. Sanchez-Hernandez, Printed antennas for dual-band GSM/DCS 1800 mobile handsets, Electronics Letters, Vol. 34, N° 2, pp.140-141, 22nd January 1998.
[14] H.F. Hammad, Y.M.M. Antar and A.P. Freundorfer, Dual band aperture coupled antenna using spur line, Electronics Letters, Vol. 33, N°25, pp. 2088-2090, 4th December 1997.
[15] D. Sanchez-Hernandez and I. Robertson, Triple band microstrip patch antenna using a spur-line filter and a perturbation segment technique, Electronics Letters, Vol. 29, N° 17, pp. 1565-1566, 19th August 1993.
[16] F. Yang, X. X. Zhang, X. Ye, and Y. Rahmat-Samii, Wide-band Eshaped patch antennas for wireless communications, IEEE Trans. Antennas Propag., Vol. 49, No 7, pp.1094–1100, Jul.2001.
[17] H.Pues, A.Van de capelle, Accurate transmission line model for the rectangular microstrip antenna, IEEE Microwave, Antennas and Propagation Proceedings, Vol.131, Pt.H, N°6, pp.334-340, December 1984.
[18] Govardhani Immadi, K. Swetha, M.Venkata Narayana,M.Sowmya, R.Ranjana, Design of microstrip patch antenna for WLAN applications using Back-to-Back connection of Two E-Shapes. Vol. 2, Issue 3, pp. 319-323, May-Jun 2012

Publisher: Noida Institute of Engineering & Technology,
19, Knowledge Park-II, Institutional Area, Greater Noida (UP), India.