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Modified Slot Antenna for GPS/S band/ C band /WLAN

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Abstract—A multiband slot antenna for GPS/S band/C band and WLAN is presented. The antenna consist of a main rectangular slot inside which there is a small rectangular slot of 3.6 mm dimension, an inverted T-shaped stub, two E-shaped stubs and two polygons to generate four frequency bands.The simulation tool used here is HFSS(High Frequency Structure Simulator).Through simulation radiation pattern of each case is plotted separately. From the simulation results, the antenna is expected to resonate from 1.57GHz-1.66GHz for GPS system, 4.06 GHz for applications in C band, 3.25 GHz for S band applications and 5.17GHz-5.93GHz for WLAN system.
Keywords— *GPS, WLAN, S band, C band, Slot antenna*

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I. INTRODUCTION

This era handle information through fingertips. A huge amount of data is flying around the world in fraction of a second. Due to the tremendous growth of most of the commonly integrated technology, it is possible to bring together multiple applications operating on different frequencies on a single wireless device. An antenna that cover more than one frequency band is termed as a multiband antenna. Slot antenna is preferred here because of its compact size, wide bandwidth and easy integration with other devices [2]. Different frequency bands are generated by etching slots on ground planes.

The antenna consist of a rectangular slot, inverted T-shaped stub[6], two E-shaped stubs, and two polygons to generate frequency bands at about 1.58 GHz, 3.25 GHz, 4.06 GHz, 5.18 GHz for GPS[3][7],S band[9], C band[8] and WLAN 802.11a[4][5] standard respectively[1].

In this, each frequency band is generated using only one antenna element [1]. Radiating portion of the antenna has a compact size. The proposed multiband antenna is designed and analysed using simulation tool HFSS. The analysis of structure presents reflection coefficient S11 Vs frequency, radiation pattern etc.

II. ANTENNA DESIGN

The multiband slot antenna shown in Fig. 1, which has a rectangular slot with a size L1 ×W1 = 48*18 mm^2 on one side of the substrate. This rectangular slot has an inverted T-shaped stub at the upper edge of the rectangular slot and two E-shaped stubs on the extreme left hand (LH) and extreme right-hand (RH) sides of the slot. The inverted T-shaped stub has the horizontal strip shaped on both sides . A T-shaped feed patch with microstrip fed on the other side of the substrate is used as a feed to the rectangular slot. The feed line has a width of Wf = 1.76 mm to achieve an impedance of 50Ω. The upper side of the T-shaped patch is extended on both end sides and then double-folded to achieve a required dedicated size. A step is used in the lower side of the T-shaped feed patch on both the LH and the RH sides as a measure to improve the impedance matching. The antenna can generate 4 frequency bands at about 1.58, 3.25, 4.06 and 5.81 GHz, for different applications. The rectangular slot and the inverted T-shaped stub together generate band 1 at about 1.58 GHz for the GPS system. The two E-shaped stubs operating as monopole radiators generate band 2 at about 3.25 GHz for the defense systems. The T-shaped feed patch and inverted T-shaped stub generate band 3 at about 4.06 GHz for the Commercial system applications. The T-shaped feed patch in the higher mode generates band 4 at about 5.81 GHz for the IEEE 802.11aWLAN system. The antenna also consist of two polygonal slots of 12 segments. The antenna is studied and designed on a substrate with a relative permittivity of εr = 4.4, a thickness of 1.59 mm, and a loss tangent of 0.02. The final dimensions of the multiband antennaare given in Table I.

Table 1- Dimensions of the antenna

L1	L2	L3	L4	L5	L6	L7	L8	L9
48	21.6	29	3.3	12	5.5	4	1.3	2
L10	L11	L12	L13	g1	g2	W1	W2	W3
2	4	11.5	3.6	2	0.4	18	1	0.5
W4	W5	Wf	Ws	hs	Ls			
3.6	15	1.76	44	0.8	56			

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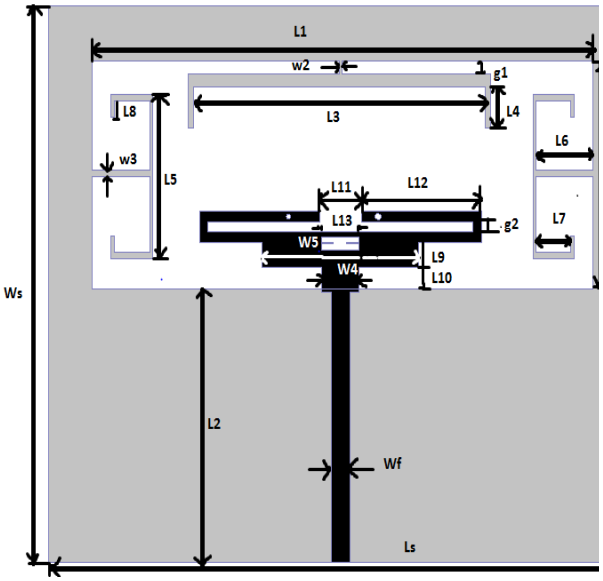

Fig.1 a) Bottom view of the antenna with completed structure showing parameters

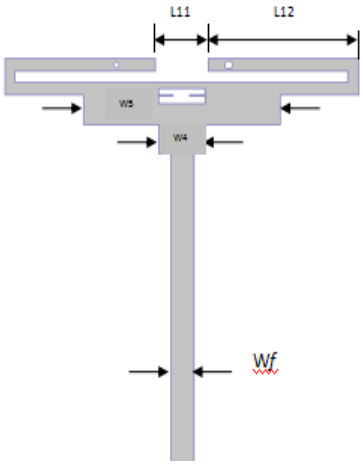

Fig.1 b)Front view of showing parameters of feed network

III.STUDIES OF ANTENNA

Different radiating elements have varying effects on the slot antenna. For this purpose, the antenna is studied under two conditions in HFSS. They are: 1) with T-shaped feed patch only.2) completed design. The radiation patterns of each resonating points is plotted and the outcomes are compared. The obtained results are illustrated in figure 2 below.

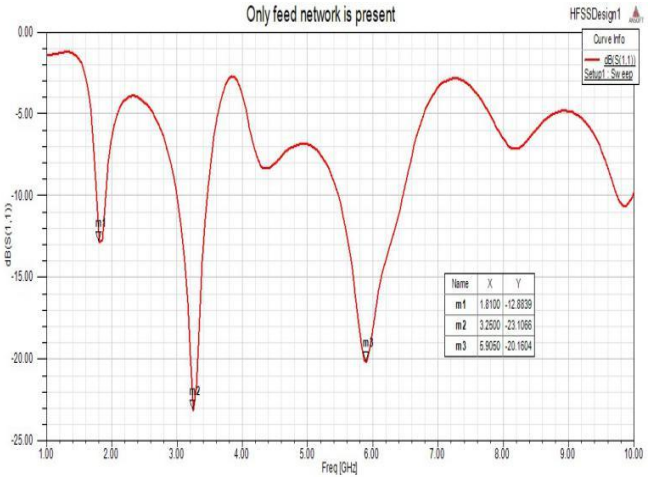

Fig.2.1. with T- shaped feed network only

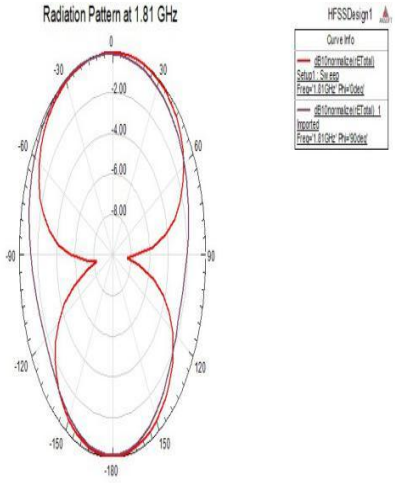

Fig 2.2 radiation pattern at 1.81GHz

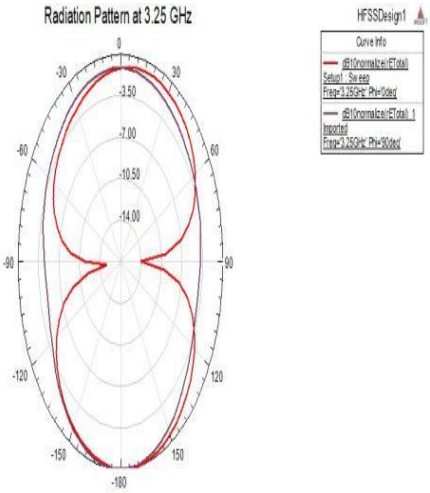

Fig.2.3 radiation pattern at 3.25GHz

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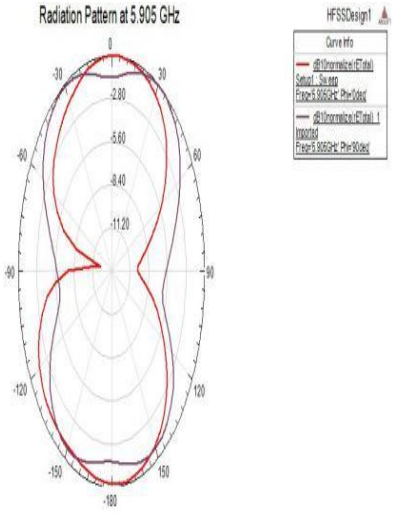

Fig2.4 radiation pattern at 5.905GHz

When the T-shaped patch was only used, mainly three resonating points were obtained below -10Db. It was observed to generate three frequency bands at about 1.81GHz,3.25 GHz and 5.905 GHz.

In the final model of the antenna all the slots were included in the structure which consist of T-shaped feed network, inverted T-shaped stubs, two E-shaped stubs were used along with two polygons of 12 segments, it could generate four frequency bands at 1.58 GHz, 3.25 GHz, 4.06 GHz, 5.18 GHz for GPS, S band,C band and WLAN 802.11a standard and respectively as shown in the graph between s11 and frequency.

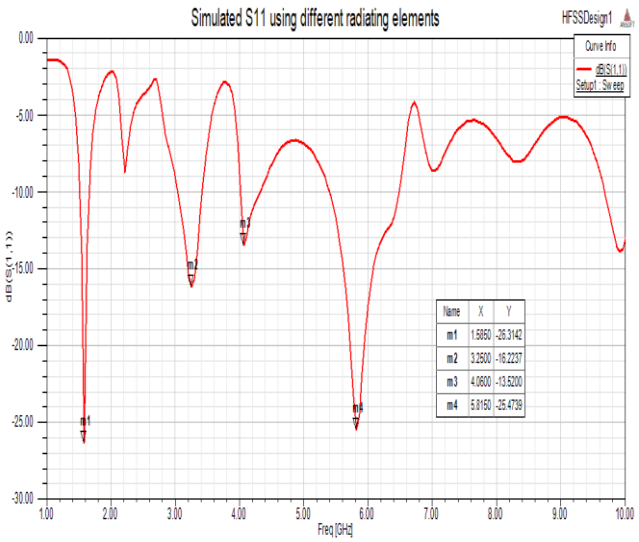

Fig.2.5.simulated s11 using all radiating elements along with two polygonal slots.

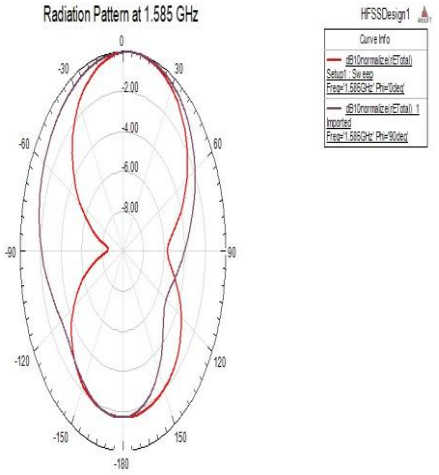

Fig 2.6 Radiation pattern at 1.585 GHz

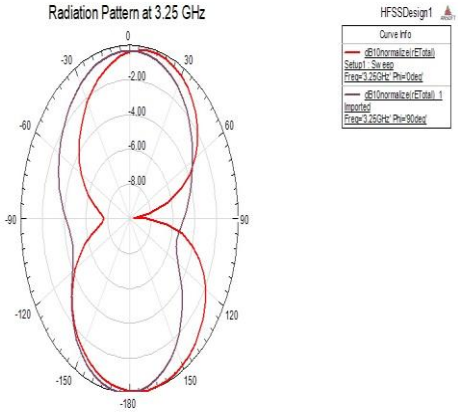

Fig 2.7 Radiation pattern at 3.25 GHz

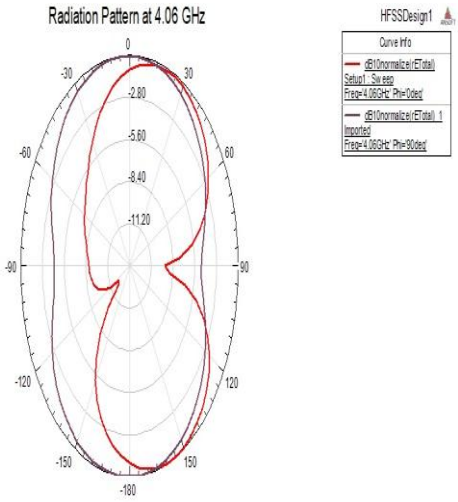

Fig 2.8 Radiation pattern at 4.06 GHz

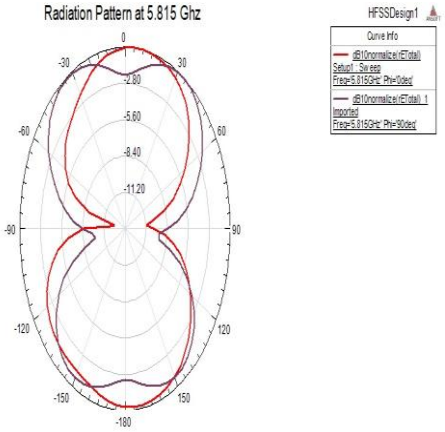

Fig 2.9 Radiation pattern at 5.815 GHz

IV. PARAMETRIC ANALYSIS

The multiband slot antenna mentioned above has many parameters such as L1, L3-L10, W1, W5 and g1 which has an influence on frequency bands generated. To find different applications, these parameters has to be altered. The process of generating different frequency bands by varying dimensions of different parameters of the antenna is termed as parametric analysis. Keeping the antenna size constant, parameters L12 and L3 are varied.

L3: Length of inverted T-shaped stub.

W5:Width of T-shaped patch

L12:Length of double folded stub in T-shaped feed patch

g1:Gap between inverted T-shaped stub and upper edge of slot

L6:Height of E-shaped stub.

L13: length of small rectangular slot at the centre

Two polygonal slots of 12 segments were also added

When L12 is varied from 23mm to 29 mm, a slight variation in frequency from 1.5GHz to 1.8GHz was observed, shown in figure 3.1. When length of inverted T-shaped stub was varied from 1mm to 3mm, as shown in figure 3.2.

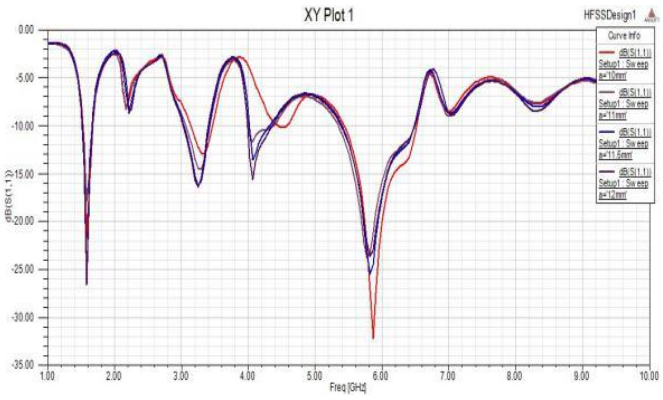

Fig.3.1 Simulated output when L12 is varied.

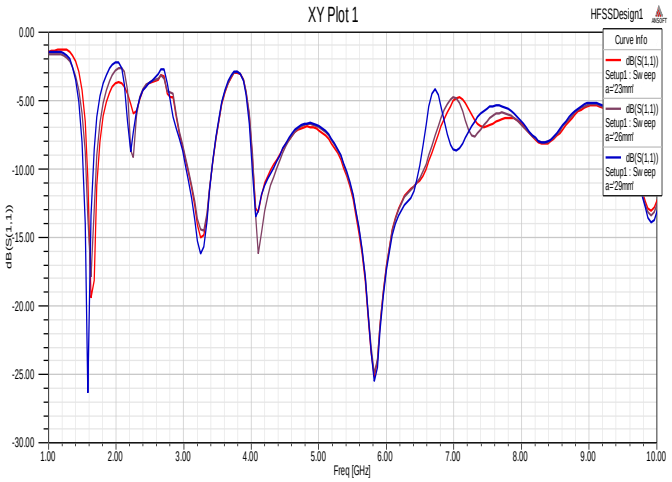

Fig.3.2 simulated output when L3 is varied.

V. APPLICATIONS

The designed multiband slot antenna capable of operating in (1.58GHz, 3.25GHz ,4.06GHz and 5.81GHz). These different frequencies have wide applications. Frequecy range 1.58GHz support L band which is mainly used in GPS(Global positioning system).Frequency range 3.25GHz support S band. These are used practically in weather radar, surface ship radars and some communication satellites. Since S band also contain 2.4- 2.483 GHz ISM band , these are used in cordless phones, wireless headphones, Wi-Fi, garage door openers, keyless vehicle locks, baby monitors as well as for medicaldiametry.

Frequency range 4.06 - 5.81 GHz support C band. C band has a key role in global telecommunication infrastructures. These are mainly used in communication satellites. Whenever a disaster strikes and terrestrial infrastructure is down, up-to-the-minute information is vital for those seeking rescue and to coordinate relief efforts. Therefore, satellite connectivity through C-band is key in getting communications services up and running. Since the designed multislot antenna is capable of generating different frequencies, so this single antenna can be used to serve multiple applications.

VI. CONCLUSION

The design of a four band slot antenna for GPS/S band/C Band/WLAN are presented here. The radiating portion of antenna consist of a T-shaped patch, inverted T-shaped stubs, two E-shaped stubs and two polygonal slots with 12 segments each. The simulation and analysis of structure were performed using the simulation software HFSS (High Frequency Structure Simulator).The performance of antenna was measured in terms of return loss S11, by plotting radiation pattern and efficiency was analyzed. From the final results, it can be seen that the antenna is capable of resonating at 1.58 GHz, 3.25 GHz, 4.06 GHz, 5.18 GHz for

GPS,S band, C band and WLAN 802.11a standard respectively.

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REFERENCES

[1] A Multiband Slot Antenna for GPS/WiMAX/WLAN Systems Y. F. Cao, S. W. Cheung, Senior Member, IEEE, and T. I. Yuk, Member, IEEE,IEEE Transactions On Antennas And Propagation, Vol. 63, No. 3, March 2016.

[2] A. P. Saghati, M. Azarmanesh, and R. Zaker, "A novel switchable single-and multifrequency triple-slot antenna for 2.4-GHz bluetooth, 3.5-GHz WiMax, and 5.8-GHz WLAN," IEEE Antennas Wireless Propag. Lett., vol. 9, pp. 534-537, 2010.

[3] Broadbeam Cross-Dipole Antenna for GPS Applications Yu-Xiang Sun, Kwok Wa Leung, and Kai Lu,IEEE Transactions On Antennas And Propagation, Vol. 65, No. 10, October 2017

[4] High-Gain Directional Antenna for WLAN Applications Marno van Rooyen, Johann W. Odendaal , Senior Member, IEEE, and Johan Joubert, Senior Member, IEEE, IEEE Antennas And Wireless Propagation Letters, Vol. 16, 2017.

[5] W. Hu, Y. Z. Yin, P. Fei, and X. Yang, "Compact triband square-slot antenna with symmetrical L-Strips for WLAN/WiMAXapplications,"IEEE Antennas Wireless Propag.Lett., vol. 10, pp. 462-465, 2011.

[6] Y. C. Lu and Y. C. Lin, "A mode-based design method for dual-band and self-diplexing antennas using double T-stubs loaded aperture," IEEE Trans. Antennas Propag., vol. 60, no. 12, pp. 5596-5603, Dec. 2012.

[7] B. R. Rao, W. Kunysz, and K. McDonald, Eds., GNSS/GPS Antennas. Norwood, MA, USA: Artech House, 2011.

[8] Rahul Tiwari, Archana Sharma, SeemaVerma, "Design and analysis of multiband rectangular microsrtip patch antenna for c band x band application", International journal of scientific and engineering research, vol. 6, no. 10, pp. 1387-1396, October 2015.

[9] César Domínguez, FerdinandoTiezzi, Jose Padilla, Rainer Wansch, Rafael Rummel , Alexander Popugaev,"Low-Cost S-Band Antennas for Mobile Satellite Systems", Antennas and Propagation (EUCAP), Proceedings of the 5th European Conference,2011.