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# A COMPACT WIDE BAND PATCH ANTENNA FOR WLAN APPLICATION

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***Abstract*-In this paper, a design and analysis of compact probe fed slot antenna is presented. The proposed antenna has simple structure consisting Ω-shape on a rectangular patch, the overall dimension of the antenna come around 36mmX26mmX5.127mm and fed by 50Ω probe feed. The impedance matching and radiation characteristics of the designed structure are investigated by using MOM based IE3D™. The simulation results show that the antenna impedance bandwidth of the antenna reaches about 31 %( 4.25GHz-5.8GHz) with return loss better than -10 dB over the chosen frequency spectrum. The proposed antenna gain of 9dBi and 7dBi are achieved. Its radiation patterns are also studied.**

*Key Terms:-Probe-fed, Slot antenna, WLAN.*

## I. INTRODUCTION

Wideband Microstrip antennas are widely used in many wireless communication applications. Compact wideband Microstrip antenna with directional radiation for wireless communication systems are now of great interest owing to an increase in the data rate to meet this challenge in Microstrip patch antenna. The most serious limitation of the Microstrip antenna is narrow bandwidth, which is usually around few percent. Over the years many methods have been proposed to enhance impedance bandwidth of the Microstrip antenna, such as thick substrates [1], parasitic patch [2], E-slot patch [3], H-shaped patch [4], U-shaped slot patch [5, 6, 7, and 8], and shorting post [9, 10, 11, 12].

In this paper, Ω-shaped slot on a rectangular patch antenna is proposed for Wireless X-WAV (4.4-4.75 GHz), IEEE 802.11a (5.15-5.35, 5.725-5.8 GHz), Hiper LAN2 (5.45-5.725 GHz) communication bands. For ease of antenna fabrication, a thin microwave substrate has been selected.

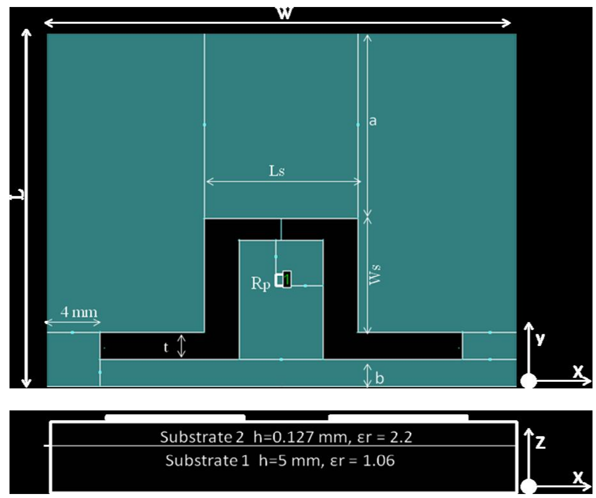


Fig.1 .Geometry of the proposed Probe-fed Rectangular slot Antenna.

## II ANTENNA GEOMETRY

The geometry of the Ω-shape patch a microwave substrate ($\varepsilon_r$=2.2, tan£=0.001) of thickness h=0.127mm placed on a form substrate ($\varepsilon_r$=1.06, tan£=0.0002) of thickness h=5mm is shown in fig.1. A rectangular patch of dimensions L x W separated from the ground plane using a foam substrate ($\varepsilon_r$). The Ω-shape is located in the center of the patch. The location of the Ω-slot on the patch can be specified by parameter 'a' and 'b'. The width and length of the arms of the slots are denoted by $W_s$ and $L_s$, while the Ω-slot thickness is indicated by the parameter't'. The rectangular patch is fed using 50Ω coaxial probe with inner diameter of 0.60mm. The proposed antenna produces wide bandwidth with Omni-directional radiation pattern. The wide bandwidth and wide impedance matching with reduced size of the antenna is achieved.

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TABLE 1

PAMAMETER VALUES OF ANTENNA

| Parameter | Description | Value |
|---|---|---|
| L | Length of the patch | 36 mm |
| W | Width of the patch | 26 mm |
| $L_S$ | Length of the slot | 11 mm |
| $W_S$ | Width of the slot | 9 mm |
| t | Thickness of the slot | 2 mm |
| $R_P$ | Probe Radius | 0.60 mm |
| a | Upper position of the slot | 13 mm |
| b | Lower position of the slot | 2 mm |

## III SIMULATED RESULTS AND ANALYSIS

In order to evaluate the performance of the proposed antenna, the antenna is simulated through the simulation tool IE3D$^{TM}$. the analysis of the antenna for different physical parameter values has been done by varying one of them and keeping others as constant. It is carried out here to study the flexibility in designing patch antenna.

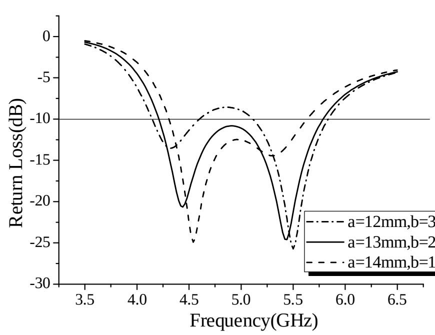



Fig.2. Simulated return loss curves for different a and b values

The two resonance frequencies of the Proposed Antenna occurs at $F_1$=4.56 GHz and $F_2$=5.5 GHz, thus the antenna is dual band (Fig. 2). By changing the location of the Ω-shape slot, i.e. a=12mm; b=3mm, the first resonant frequency increases from $F_1$=4.56 to 4.69 GHz and the second resonance frequency from $F_2$=5.5 to 5.4 GHz. As the Ω-shape slot is shifted on the patch, the bandwidth of the antenna decreases from 31 % to 29.3%. The best result for the -10dB bandwidth is obtain with a=13mm and b=2mm, where $F_1$=4.56 GHz and $F_2$=5.5GHz. The effect of various values of $W_s$ on the resonant frequency is investigated in Fig.3.

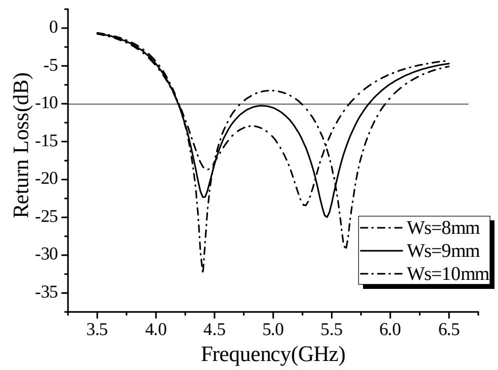



Fig.3. Simulated return loss curves for different $W_s$ values

It shows that decreasing value of $W_s$ from 9 mm to 8 mm, the frequency $F_1$ stays the same at $F_1$=4.56GHz and $F_2$ decreases from 5.5GHz to 5.3 GHz. Increasing the value of Ws from 9mm to 10mm, frequency $F_1$=4.56 GHz, and $F_2$ decrease from 5.5GHz to 5.4 GHz. According to fig.3 the antenna becomes dual band with decrease in Ws from 9mm to 8mm while the bandwidth is slightly decreased with the increase in Ws from 9mm to 10mm. Hence the best value of Ws is equal to 9mm.

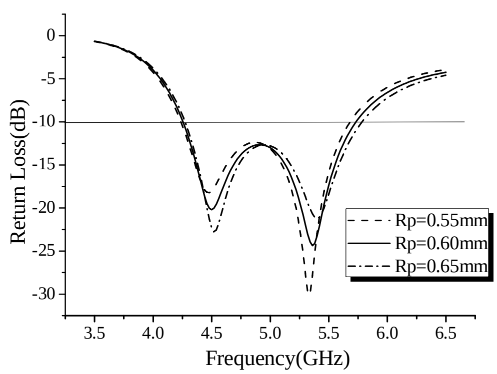



Fig.4. Simulated return loss curves for different $R_p$ values

In Fig. 4, it is observed that by changing the radius of the probe from 0.60mm to 0.65mm, $F_1$ and $F_2$ increase, while the -10dB bandwidth also increases. But considering the VSWR and input impedance, the $R_p$=0.60mm gives better result as compare to other two values. In Fig. 6, it is observed that by changing the value of $L_s$ from 10mm to 9mm, $F_1$ remains same and $F_2$ increases, while the -10dB bandwidth decreases. By changing $L_s$ from 12mm to 13mm, $F_1$ remains same and both $F_2$ and -10dB bandwidth decrease. Therefore $L_s$=12mm gives better results than other two values.

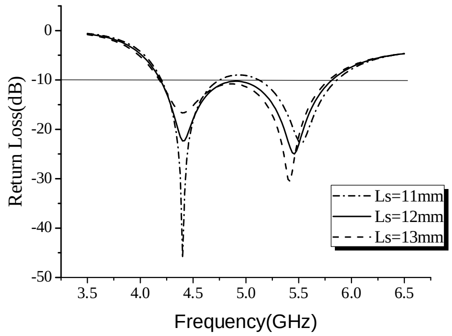



Fig.5. Simulated return loss curves for different $L_s$ values

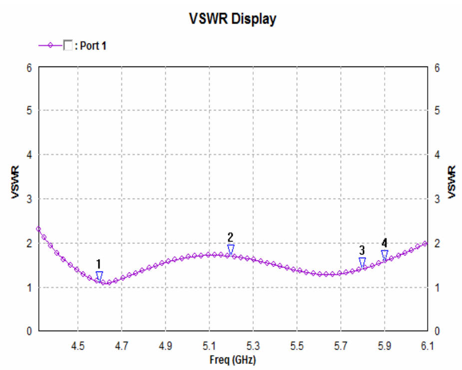



Fig. 6. Simulated VSWR curves

The simulated VSWR vs. Frequency curve of the antenna is shown in figure 6, which clearly indicates that the VSWR=0.6 & 2, at frequencies F1 and $F_2$ respectively.

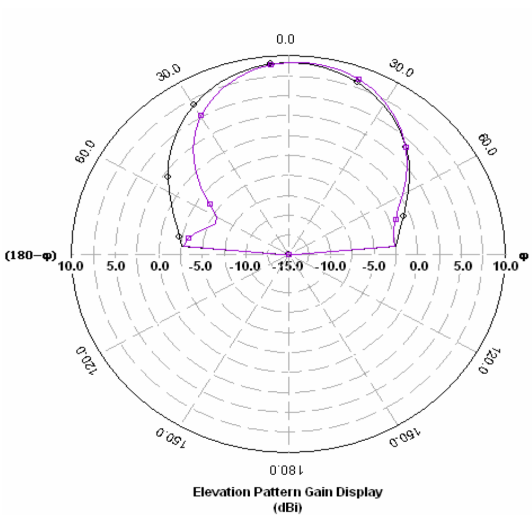
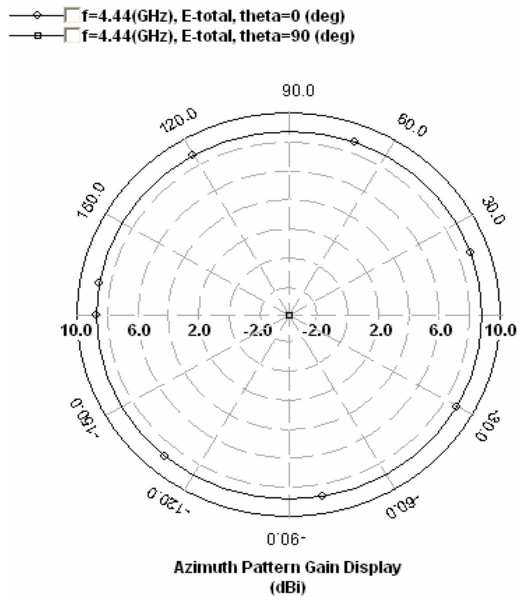



Fig.7 (a) E-plane Radiation pattern at frequency 4.4 GHz.




(b) H-plane Radiation pattern at frequency 5.5 GHz.

| Simulated Antenna Gain | | | |
|---|---|---|---|
| 4.6 GHz | 5.2 GHz | 5.8 GHz | 5.9 GHz |
| 9.055 dBi | 9.181 dBi | 7.818 dBi | 7.48 dBi |

Table 2: Gain of the proposed antenna at WLAN range

The radiation pattern of E & H planes are shown at 4.56GHz and 5.69GHz shown in Fig. 7 (a) & (b)

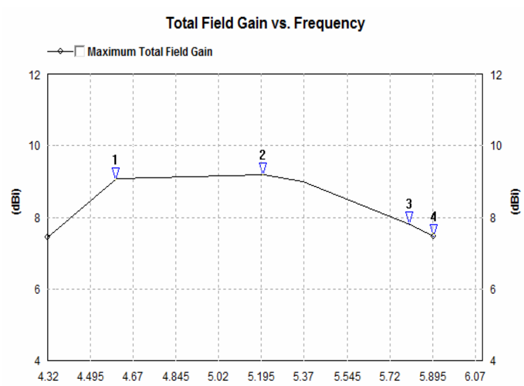



Fig.8. Peak inverse gain at frequency 4.6 GHz and 5.8 GHz.

Figure 8 shows simulated antenna gain. It indicates that 9dBi and 7dBi antenna gain at chosen frequency spectrum.

## IV CONCLUSION

A parametric study has been done for a patch antenna with Ω-slot. The simulation results shows that the proposed antenna can offer good performance for high speed Wireless LAN ranging from 4.25 GHz to 5.8 GHz. The proposed antenna achieved -10dB impedance bandwidth of about 31% (1.55GHz). Hence this type of antenna is suitable for WLANs application. The implementation and measurement of this antenna can be carried out in future.

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