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# Frequency Reconfigurable Antenna for Wi-Fi/Wi-Max Applications

Dr. D. Selvaraj[1] , Harsha T[2] , Tharun kv[3] , Maheedhar j[4] , Nikhli D[5]
[1]Professor, [2,3,4,5]UG Scholar, Department of Electronics and Communication Engineering
Panimalar Engineering College, Chennai, Tamil Nadu, India.

***Abstract***— **A novel, compact coplanar waveguide-fed flexible antenna is presented. The proposed design uses flexible FR-4(lossy) as a substrate with small size of 28 × 26.4 mm2. Two switches are integrated on the antenna surface to change the current distribution which consequently changes the resonance frequency under different conditions of switches, thereby making it a frequency reconfigurable antenna. The antenna design is simulated on CST Studio 2016.**
**The proposed antenna exhibits VSWR < 2 and appreciable radiation patterns with positive gain over desired frequency bands. Good agreement exists between simulated and measured results. On the basis of results, the proposed antenna is envisioned to be deployed for the following applications 4.3GHz, 5.4GHz, 13.4GHz, 5.6GHz.**

*Index Terms:* Multiband antenna; Reconfigurable antenna; Wi-Fi and WiMax application; Patch antenna, cst studio suite

## I. Introduction

An antenna is an electrical device which converts electric power into radio waves and vice versa. It is usually used with a radio transmitter or radio receiver. Antennas demonstrate reciprocity property which means it maintains same characteristics regardless transmitting or receiving. For better performance of antenna, a thick dielectric substrate having low dielectric constant is desirable for providing better efficiency, bandwidth and radiation. Now a days, antennas have undergone many changes, in accordance with their size and shape. There are many types of antennas depending upon their wide variety of applications. Antenna has the capability of sending or receiving the electromagnetic waves for the sake of communications where you cannot expect to lay down a wiring system.

A reconfigurable antenna is an antenna capable of modifying dynamically its frequency and radiation properties in a controlled and reversible manner.[2] In order to provide a dynamical response, reconfigurable antennas integrate an inner mechanism (such as RF switches, varactors, mechanical actuators or tunable materials) that enable the intentional redistribution of the RF currents over the antenna surface and produce reversible modifications over its properties. Reconfigurable antennas differ from smart antennas because the reconfiguration mechanism lies inside the antenna rather than in an external beamforming network. The reconfiguration capability of reconfigurable antennas is used to maximize the antenna performance in a changing scenario or to satisfy changing operating requirements.

Wireless applications are going to rule the communication systems of next generations, hence a lot of research and development is going on in the wireless communication systems, concentrating on multi bandwidth and multi-functional antenna systems. In this antenna a multiple band, say six bands are identified for primary use. Our motive is to reduce the size of the antenna

## II. Antenna Design

The proposed design is shown in Fig. 1. The proposed antenna uses Flexible FR-4(lossy) as a substrate. The dielectric constant of the substrate is 4.3 and loss tangent is 0.008 and with the thickness of 0.508 mm. The proposed antenna has a compact size of 28 mm × 26.4 mm. The antenna is fed by a 50 Ω microstrip line. The CPW feed line having the width of 1 mm is connected to the main radiator. The inner and outer radiator is connected to the main radiator via switch S1 and S2. First of all, CPW fed rectangular antenna which has a single band at 5.8 GHz is designed. The rectangle is introduced inside and outside the main radiator to acquire more resonance frequencies. The arc-shaped slots are introduced in appropriate locations in the inner and outer rectangle to obtain the desired band. The width of slot controls the current intensity and minimizes the return loss. The lumped element boundary condition is used to implement the switches in CST MWS. With the four states of switches four resonance modes at 4.3Ghz, 5.4Ghz, 13.4Ghz, 5.6Ghz are excited with good impedance matching.

The prototype of the proposed antenna is illustrated. Input reflection coefficient, VSWR, gain and radiation patterns are discussed in this section. It shows the simulated and measured reflection coefficient of the proposed antenna for different states of switches. The measured S11 response is in accordance with the simulated results. However, the slight shift between simulated and measured frequencies is due to fabrication inaccuracy, but it still covers the desired frequency bands. It has been observed that bandwidth for 4.3Ghz, 5.4Ghz, 13.4Ghz, 5.6Ghz band respectively.

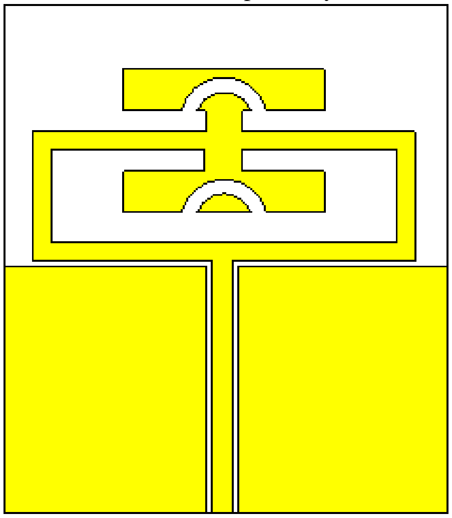

Figure 1: Both switches are in ON state (State 1)

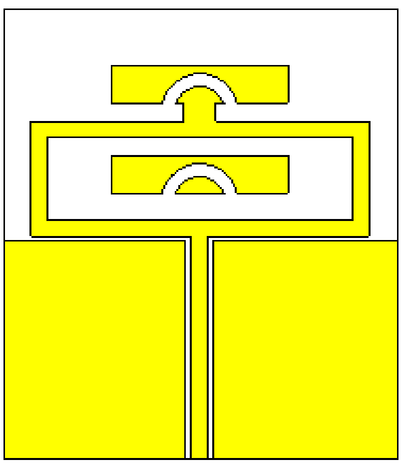

Figure 2: When switch S1 is ON and S2 is OFF(State2)

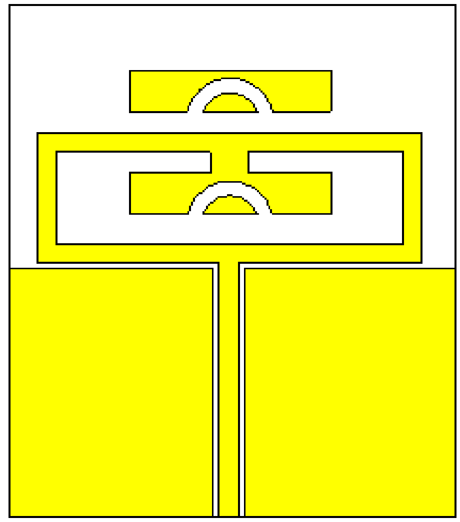

Figure 3: When switch S1 is OFF and S2 is ON(State3)

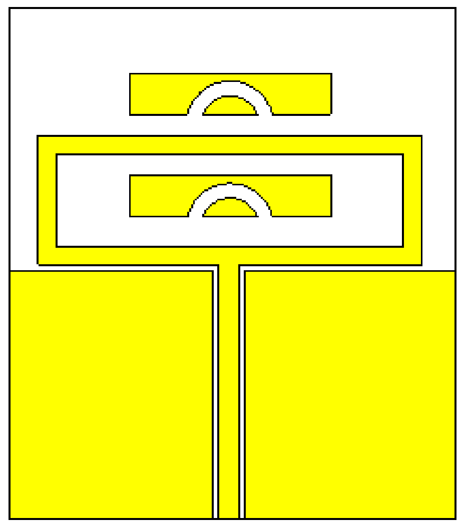

Figure 4: Both switches are in OFF state (State 4)

TABLE I. DESIGN PARAMETERS OF PROPOSED ANTENNA

| Parameter | Value | Parameter | Value |
|---|---|---|---|
| L | 28 | Lm | 7.1 |
| W | 26.4 | Lr | 2.8 |
| Lg | 13.642 | Wt | 5 |
| Wg | 12.45 | Wr | 11 |
| F | 1 | R1 | 1.4 |
| G | 0.258 | R2 | 2.4 |

TABLE II. SWITCHING STATES OF ANTENNA

## III. Analysis of Designed Antenna

Now in this section we will show the related output for E-field, H-field, Far-field, S-Parameters, gain of the proposed antenna (Figures 8 to 18).

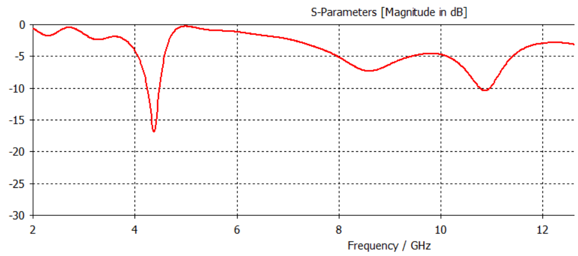


Figure 5: S-parameter for state 1

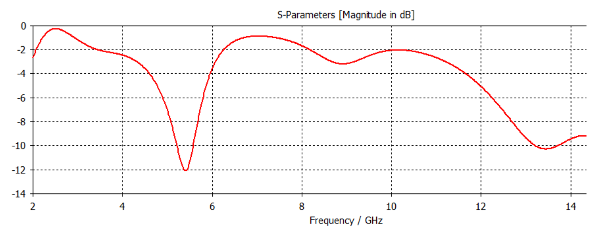


Figure 6: S-parameter for state 2

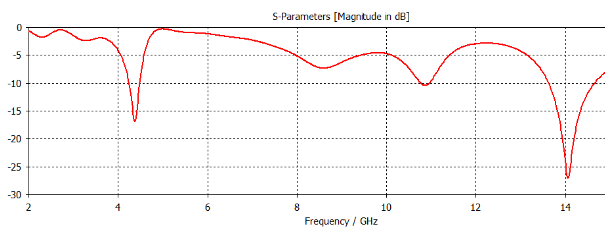


Figure 7: S-parameter for state 3

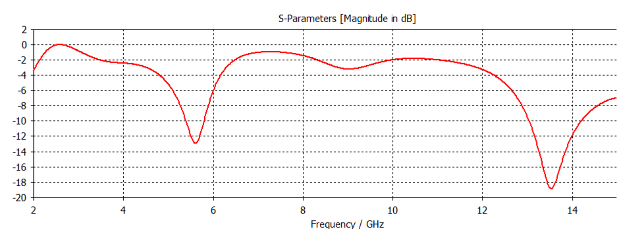


Figure 8: S-parameter for state 4

| States | S1 | S2 | Frequency(GHz) |
|---|---|---|---|
| State 1 | ON | ON | 4.3 |
| State 2 | ON | OFF | 5.4 |
| State 3 | OFF | ON | 4.3&14.0 |
| State 4 | OFF | OFF | 5.6 |

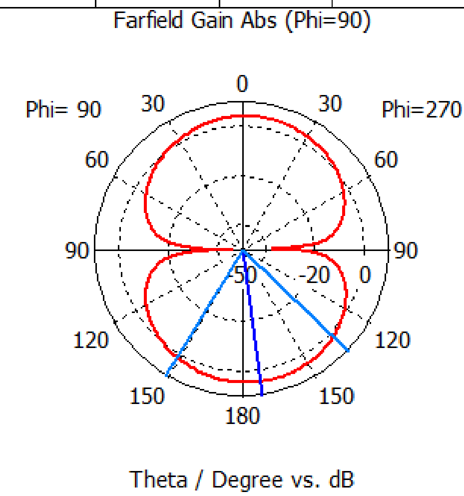


Figure 9:Farfield directivity plot for f=4.327

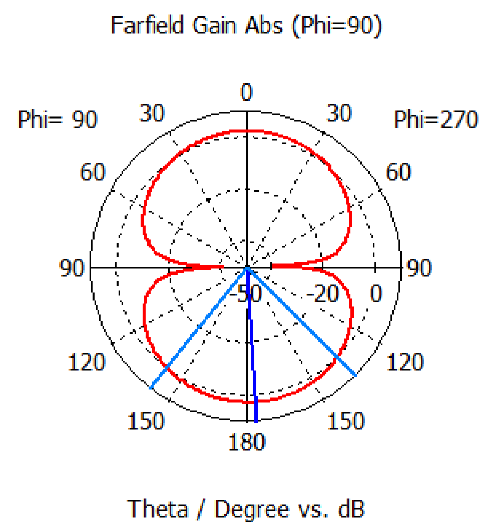


Figure 10:Farfield directivity plot for f=4.379

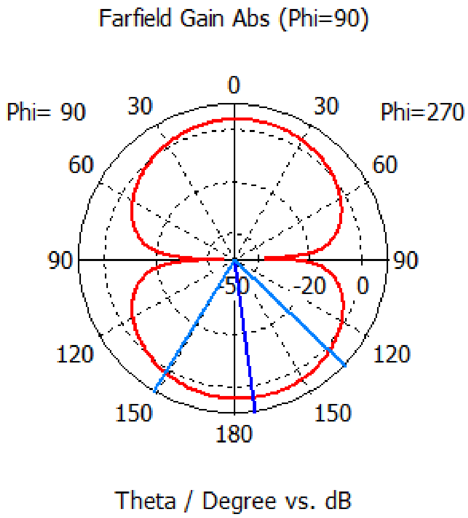


Figure 11:Farfield directivity plot for f= 5.601

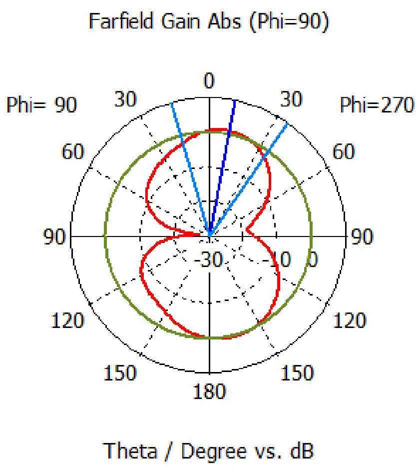


Figure 12:Farfield directivity plot for f= 14.064

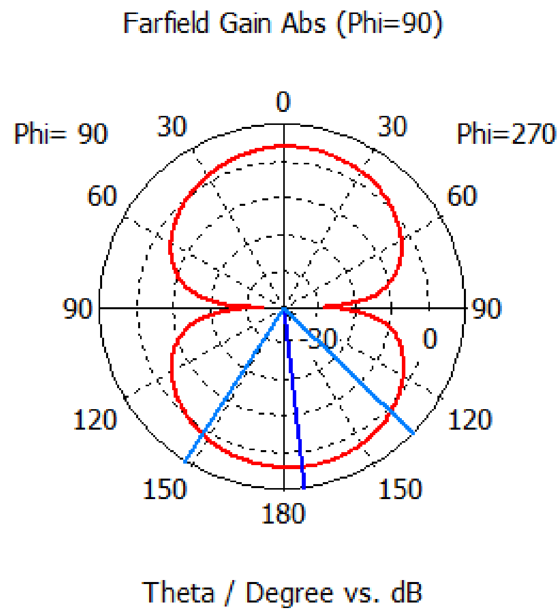


Figure 13:Farfield directivity plot for f=5.406

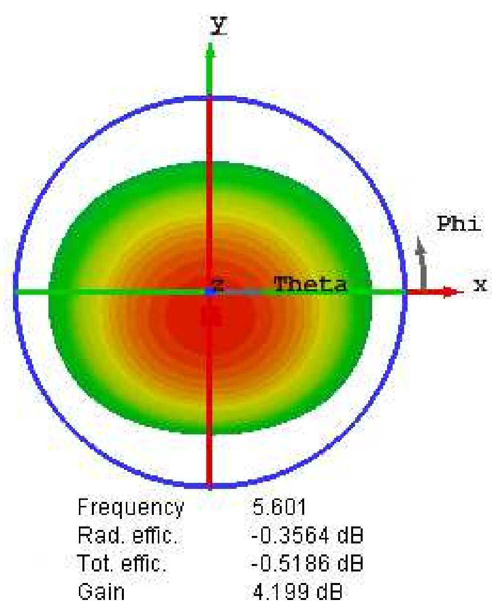


Figure 14:Radiation pattern for f=5.601

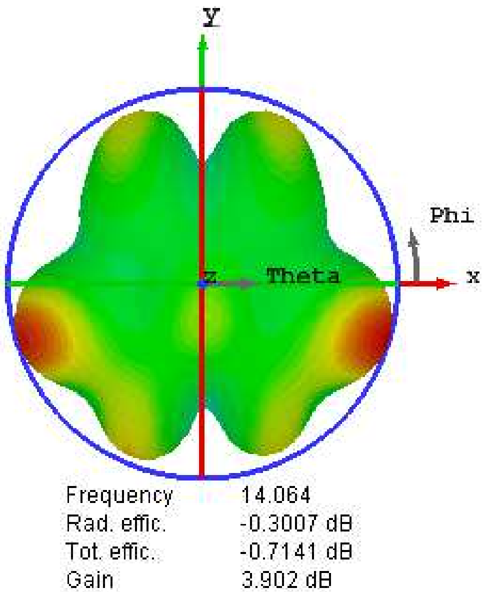


Figure 15:Radiation pattern for f=14.064

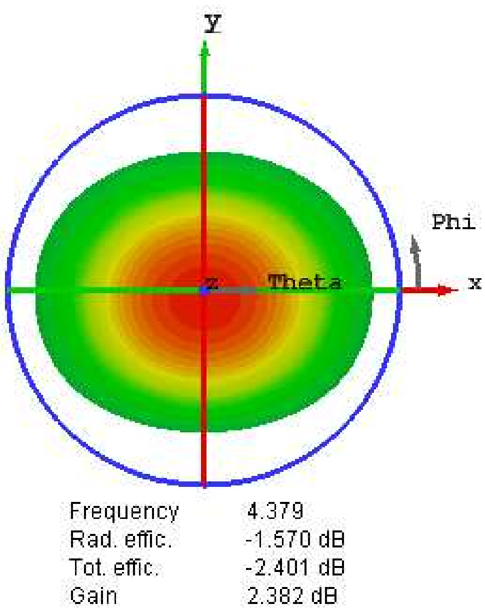


Figure 16:Radiation pattern for f=4.379

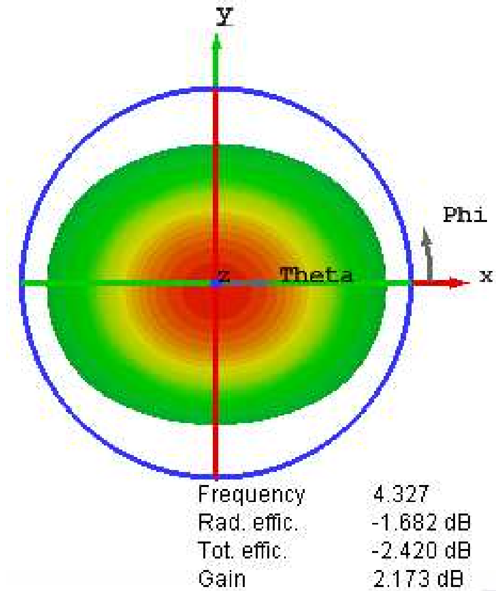


Figure 17:Radiation pattern for f=4.327

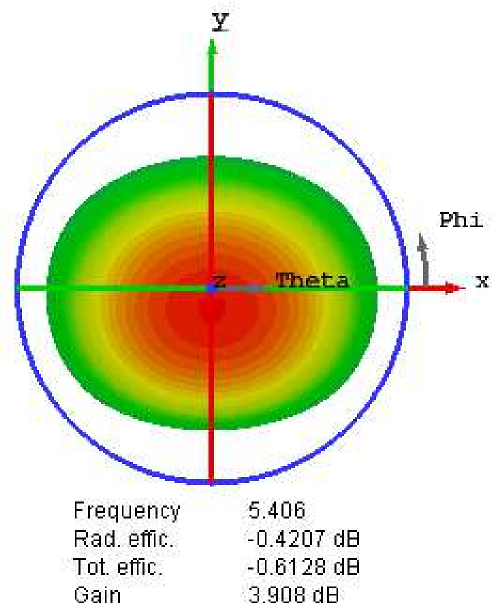


Figure 18:Radiation pattern for f=5.406

## IV. CONCLUSION

A Compact Flexible and Frequency Reconfigurable Antenna for Quintuple Applications Wi-Fi and WiMAX Application and was designed, fabricated and characterized. The same is simulated using a simulation tool named CST Studio suite. In this antenna the four frequency bands was achieved. WLAN applications the frequency band of 5.6/ 5.4

GHz and for WiMAX applications the frequency band of 4.3 / 14.06 GHz was achieved effectively with high efficiency. The performance properties of the proposed antenna are analysed for the optimized dimensions

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