ISSN XXXX XXXX © 2018 IJESC

Research Article Volume 8 Issue No.3

Design and Analysis of Equitable Antenna for Cognitive Radio Applications

R. Yashwanth[1], B. Sakthi Narayanan[2], A. Sagaya Raj[3], M. Mohamed Jubail[4], K.Thirumalaivasan[5]
B.Tech Student[1, 2, 3, 4], HOD[5]
Department of Electronics and Communication Engineering
Achariya College of Engineering Technology, Puducherry, India

Abstract:
This paper presents, the antenna design for Cognitive radio applications. In the recent years of development in communication systems there is a need for the development of lightweight, compact and cost-effective antennas that are capable of maintaining high performance over a wide spectrum of frequencies. This technological trend has focused much effort into the design of a Micro strip patch antenna. This document deals with, Cognitive radio (CR) technology. It is a key which provides the capability to share the wireless channel with the licensed users in an opportunistic way. CR is predicted to be able to provide the high bandwidth to mobile users via heterogeneous wireless architectures and dynamic spectrum access techniques. The proposed Patch antenna is capable of switching between wide operating bands 2GHz – 8GHz. The antenna would be fabricated using FR4 substrate are capable of the antenna is simulated using IE3D.

Key words: Cognitive radio, patch antenna, IE3D.

I. INTRODUCTION

Antenna is a transducer that's converts radio frequency into alternating current. There are both receiver and transmitter antenna for sending radio transmissions. It plays an important role in the operation of all radio equipment. They are used in wireless local area networks, mobile telephony and satellite communication.

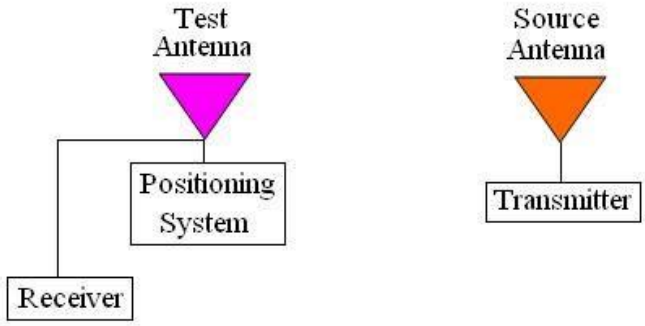


Figure.1. Antenna prototype

Microstrip Antenna was initially proposed by G.A. Deschamps in year 1953 but came in to existence in 1970's when Robert E. Munson and some of his fellow researchers developed it using a low loss substrate. Also known as Patch Antenna. These Antennas are mainly used at microwave frequency (above 1 GHz). A cognitive radio (CR) is a radio that can be programmed and configured dynamically to use the best wireless channels in its vicinity to avoid user interference and congestion. Such a radio automatically detects available channels in wireless spectrum, then accordingly changes its transmission or reception parameters to allow more concurrent wireless communications in a given spectrum band at one location.

II. ANTENNA GEOMETRY

I. Circular antenna

The geometrical configuration of the proposed Circular Antenna is shown in *Fig.2(a)*. The designed antenna is etched on a single layer of low cost FR4 dielectric substrate which is of 16 mm in diameter. The geometrical parameters are adjusted carefully and finally the antenna dimensions are obtained which is shown in the *Fig.2*. The substrate thickness t=1.6mm.

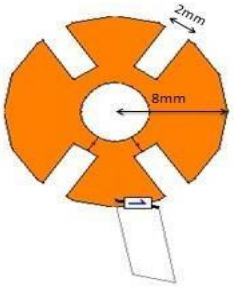


Figure.2. (a). Geometry of Circular antenna

A circular patch antenna or a radiating patch which has its geometry, where the feed line is attached, circular shape or an arc shape, makes the current to flow easily around the patch.

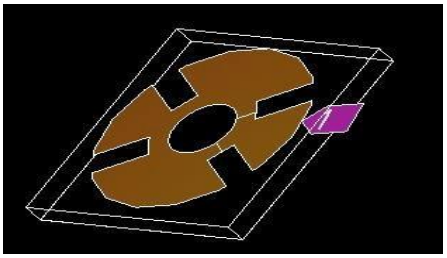


Figure.2. (b). 3D View of Circular antenna

2.Square antenna

A square antenna was created on FR4 substrate with Geometry of 40mm*40mm where the feed line is attached, arc shape, makes the current to flow easily around the patch. This makes the antenna to radiate with relatively larger bandwidth. Such antenna can be used for spectrum sensing in Cognitive Radio

A square patch, will not allow currents to flow easily around the patch. So it has narrow bandwidth. Such antenna can be used as a communicating antenna, with frequency reconfigurable geometry.

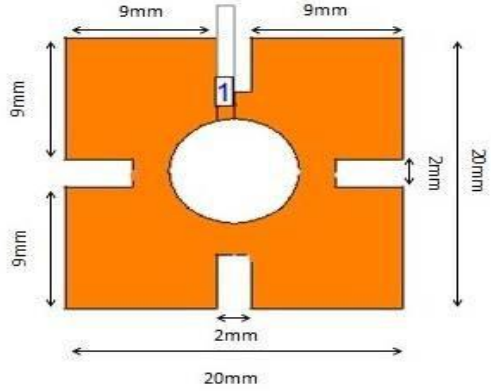


Figure.3.(a).Geometry of Square antenna

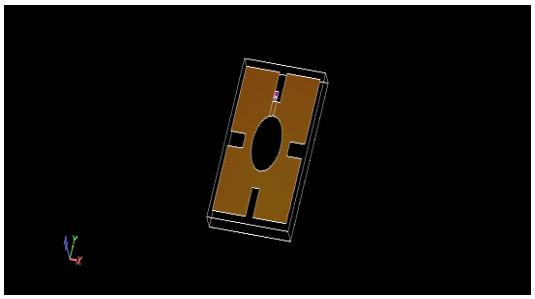


Figure.3. (b). 3D View of Square antenna

3.Equitable antenna

The equitable antenna was created on FR4 substrate with a thickness of 3.2mm the Length and width of the antenna is 40mm.Two inner slots are cuted in the dimension 18mm and 16mm respectively

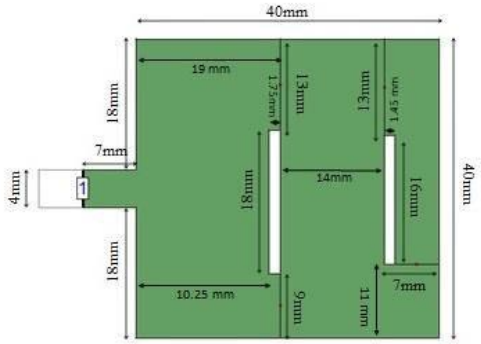


Figure.4. (a). Geometry of Equitable antenna

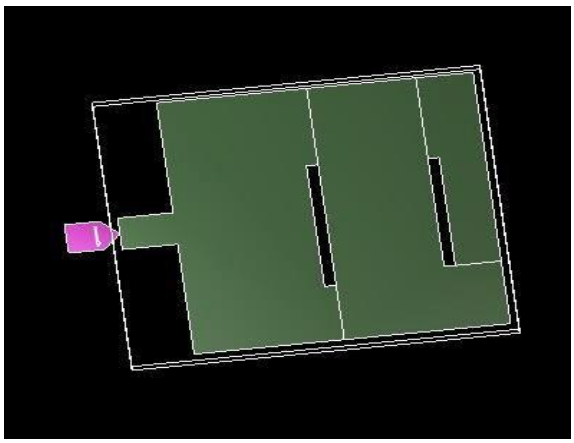
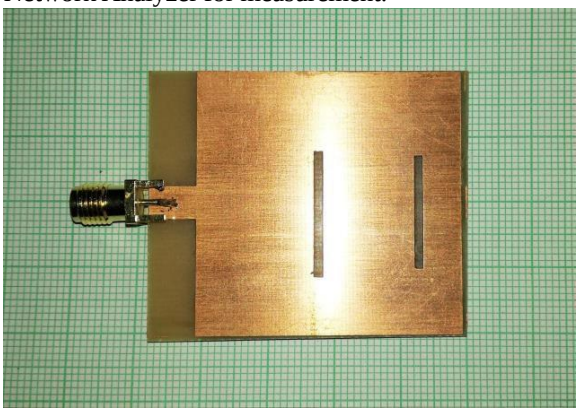


Figure.4. (b). 3D View of Equitable antenna

III. RESULT AND DISCUSSION

The snapshot of fabricated microstrip antenna is shown in *Fig.6. (a)* & (b) where a 50Ω transmission lines are extended to accommodate the SMA connectors to connect to the Scalar Network Analyzer for measurement.



(a)

(b)

Figure.5. A Snapshot of Fabricated Antenna :(a) Top View (b) Bottom View

The small discrepancy between them might be due to fabrication tolerance, loss tangent of the substrate and parasitic effect of the SMA connectors. The proposed antenna model is fabricated for real time operation using microstrip technology. Then the patch is made up of copper which mounted on the dielectric material FR-4 and its thickness is 1.6 mm. Snap shots of fabricated antenna is given in the above figure.

A. Return Loss

Return loss is the loss of signal power resulting from the reflection caused at a discontinuity in a transmission line or optical fiber. This discontinuity can be a mismatch with the terminating load or with a device inserted in the line. It is usually expressed as a ratio in decibels (dB).

$$RL(dB) = 10log\frac{P_i}{P_r}$$

Where, RL (dB) is the return loss in dB P_i is the incident power.

P_r is the reflected power.

B. Simulated Result of Antenna

Microstrip and coaxially fed patch antennas are commonly used in various types of smart antenna systems Return Loss is a parameter which indicates the amount of power that is lost to the load and does not return as a reflection.

1. Circular antenna

The return loss of the circular antenna is shown in the *fig 6* . It has a operating frequency of 8.3GHz which can be used for WiMAX applications

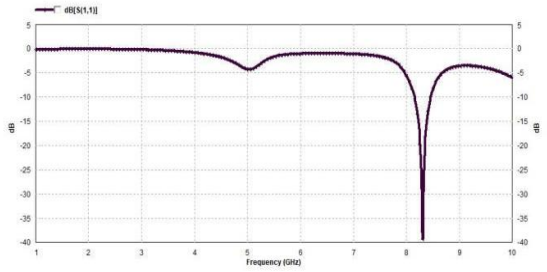


Figure.6. Return loss Graph for Circular antenna

2. Square antenna

The return loss of the square antenna is shown in the *fig 7*. It has an operating frequency of 5.3GHz, which is used for Super high frequency, commercial wireless LAN.

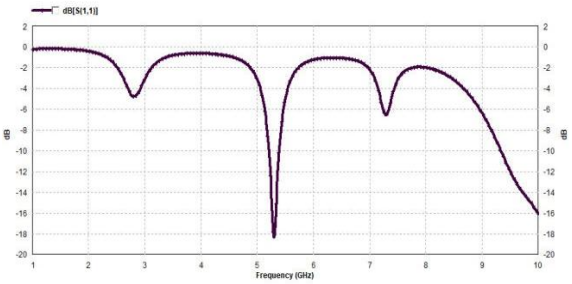


Figure.7. Return loss Graph for Square antenna

3. Equitable antenna

The return loss of equitable antenna is shown in the *fig 8*. It has an operating frequency of 2.7 GHz, which is used for microwave oven, mobile phone, Two-Way Radios and WLAN.

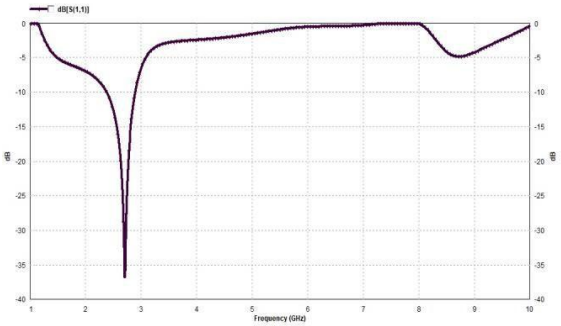


Figure.8. Return loss Graph for Equitable antenna

c. Radiation Pattern

An antenna radiation pattern is the characteristics that most affect system coverage and performance. The radiation pattern of antenna simply describes how an antenna focuses or directs the energy it radiates or receives. Antenna radiation pattern are typically presented in the form of a polar plot for a 360° angular pattern in one of two sweep planes and it is presented on a relative power dB scale.

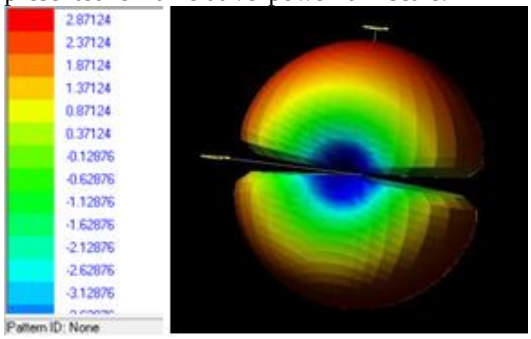


Figure.9. Radiation Pattern of Equitable Antenna

Table.1. Comparison And Performance Of Various Patch Antenna

Geometry Type	Circular	Square	Equitable
Return loss (dB)	-39	-16	-37
Gain(dBi)	-35.538	-36.436	2.871
Bandwidth (GHz)	0.4	0.2	0.4

IV. CONCLUSION

In this paper various micro strip antennas are studied for CRNs and presented. On comparison it is observed that, at the operating frequency between 2GHz to 8GHz the Equitable antenna attained best results with a gain of 2.871 dB, bandwidth of 0.4 GHz and operating frequency of about 2.7GHz, which can be used for WLAN application, mobile phone and Two-Way Radios.

V. REFERENCE

[1]. S. Pandit and G. Singh, "Spectrum Sharing in Cognitive Radio Networks: Medium Access Control Protocol Based Approach" Springer, Switzerland, 2017.

[2]. A. Kumar, P. Thakur, S. Pandit and G. Singh, "Fixed and Dynamic Threshold Selection Criteria in Energy Detection for Cognitive Radio Communication Systems" *10th IEEE Int. Conf. on Contemporary Computing (IC3)*, Noida, India, 2017.

[3]. S. Agarwal and S. De, "eDSA: Energy-efficient dynamic spectrum access protocols for cognitive radio networks", *IEEE Trans. Mobile Comput.*, Vol. 15, no.12,pp. 3057-3071, Dec. 2016.

[4]. *International Conference on Wireless Communications, Networking and Mobile Computing (WiCOM)*, Shanghai, China ,Sep. 2015,pp 1-6. A. Nafkha and B. Aziz, "Closed-form approximation for the performance of finite sample-based energy detection .

[5]. R.Umar, A.U.H. Sheikh, and M. Deriche, "Unveiling the hidden assumptions of energy detector based spectrum sensing for cognitive radios", *IEEE Communications Surveys and Tutorials*, vol. 16, no. 2, pp. 713-728, 2014.

[6]. Lise Safatly, Mario Bkassiny, Mohammed Al-Husseini, Ali El-Hajj, "Cognitive Radio Transceivers: RF, Spectrum Sensing, and Learning algorithms Review", Hindawi Publishing Corporation, International Journal of Antennas and Propagation, 2014.

[7]. A. Chaoub, E. Ibn-Elhaj and J. El-Abbadi, Multiple Description Coding based Distributed Communications over Cognitive Radio Networks", 20th International Conference on Telecommunication (ICT 2013), 2013.

[8]. P. S. Hall, P. Gardner and A. Faragone, "Antenna requirements for software defined and cognitive radios", IEEE proceedings, vol. 100, no. 7, pp. 2262-2270, July 2012.

[9]. M. Bkassiny, S. K. Jayaweera, Y. Li, and K. A. Avery,

"Optimal and low-complexity algorithms for dynamic spectrum access in centralized cognitive radio networks with fading channels, "in IEEE Vehicular Technology Conference (VTC-spring'11), Budapest, Hungary, May 2011.

[10]. Q. Jiang, V. C. M. Leung, M. T. Pourazad, H. Tang and H.-S. Xi, Energy-Efficient Adaptive Transmission of Scalable Video Streaming in Cognitive Radio Communications", IEEE System Journal, vol. 10, no. 2, pp. 761-772, 2016.

[11]. Sobron, P. Diniz, W. Martins, and M. Velez, "Energy detection technique for adaptive spectrum sensing", *IEEE Transactions on Communications*, vol. 63, no. 3, pp. 617- 627, March 2015

[12]. A. Margoosian, J. Abouei, and K. Plataniotis, "An accurate Kernelized energy detection in Gaussian and non-Gaussian/impulsive noises", *IEEE Trans. on Signal Processing*, vol. 63, no. 21, pp. 5621- 5636, Nov. 2015.

[13]. Yun Gao, Haotian Zhang, Yi Shen, Donglin Wang, "Threshold selection for energy detection in Cognitive Radio with a non-line-Ofsight environment", *Proc. 11th*