ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 10, October 2013

HFSS based Frequency Reconfigurable Antenna for Cognitive Environment

S.V.S.Jayasyam[1], M.Kishore Babu[2], E.Prasad[3]

Assistant Professor, Department of ECE, S V College of Engineering, Tirupati, A.P, India[1,2,3]

ABSTRACT: Antennas are essential and critical components of wireless communication, but sometimes their inability to adjust with new operating scenarios can limit system performance. Tuning antennas to configure dynamically or manually such that they can adapt to changing system requirements can eliminate those restrictions and offers additional functionality. A frequency reconfigurable E-shaped patch antenna has the operating frequency range from 1.6 GHz to 3.8 GHz. With ideal switch case the simulated results of the design is obtained.

I. INTRODUCTION

In recent year's wireless communication have experienced explosive growth, it must support the increasing demand for high rates due to rapidly increasing devices.[1] In this regard, antennas used for those devices have to change based on the parameter changes. So the need for antennas with multiple functions is increased. In order to accomplish current and future demands, antenna parameters such as radiation pattern, operating frequency, polarization are reconfigured.[2] For changing the state various components such as switches, diodes, optical cables and mechanical actuators are used. To access different wireless services such as Bluetooth, Wi-Fi, 3G, GPS and Wimax over several frequency bands, multiradio wireless systems are presently being developed.[1] Multiband antennas which require complex filtering have to access those devices. Frequency Adjustable antennas with multiband potential can be used to eliminate filtering requirements. To reconfigure frequency of antenna several methods used such as PIN diodes, MEMS based design, stepper motors, optical cables and fluidic micro-pumps. Cognitive radio is an adaptive, intelligent network technology that can be configured dynamically. In wireless spectrum available channels are automatically sensed by cognitive radio. It can be evolve as a fully reconfigurable transceiver which dynamically adapts its communication parameters to user and network demands.[9] Dynamic spectrum management offers many advantages to wireless systems, including diversity and channel capacity improvement through wider bandwidths. Network architecture is one of the constraints for an antenna which is designed for cognitive radio. The coveted nature of an antenna which is designed for cognitive radio is omnidirectional coverage and extremely wide bandwidth design. For cognitive radio systems patch antennas has been limited due to their narrow bandwidth. Through novel patch topologies, such as the Eshaped patch, their bandwidth can be extended. Frequency reconfigurability is also employed in E-shaped patch.

II. MULTIBAND RECONFIGURABLE E-SHAPED PATCH ANTENNA CONCEPT

From the literature study of designed antenna starts from broadband microstrip antenna[4], single layer-single patch U slot[5], double U slot antenna[6]. Then the patch antenna with switchable slots came into picture The E-shaped patch antenna has single feed line and single layer.

Slots in the patch provide access to control switches by bias lines but in this design is use only ideal switch case. Due to slots in the patch, the designed antenna has two resonances. A coveted impedance matching is achieved by altering the slot dimensions which strongly controls the resonance modes of patch. The 2 E-Shaped patch antenna design is shown in the figure below. There is 2 antenna design one is for OFF state switch and the other is for ON state.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 10, October 2013

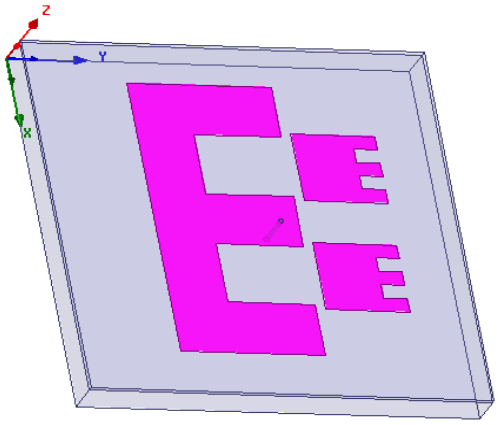

Fig.1.E-Shaped patch antenna when the switch is OFF State

The E-shaped patch antenna is simulated on FR4 substrate and the antenna design has other substrate called foam to increase the bandwidth which is placed between FR4 and ground. The dielectric constant of the substrates used in the design is 4.4 and 1.0 respectively. The size of antenna is 120×100 mm² with 50Ω probe feed.

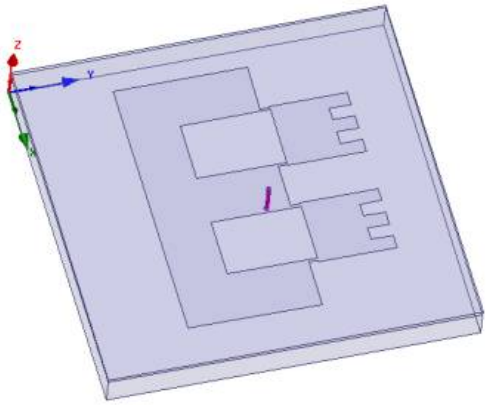

Fig.2. E-Shaped patch antenna when the switch is ON

III. RESULTS AND DISCUSSION

The 2 E-Shaped patch antenna is designed and simulated using HFSS 13.0 electromagnetic simulator. Four main parameters is obtained as simulated results. The parameters are return loss, voltage standing wave ratio, radiation pattern and radiation efficiency. OFF state of the switch is represented by open circuit and ON state is represented by short circuit. A good antenna must have its return loss is less than -10dB and vswr is in the range from 1 to 2.5.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 10, October 2013

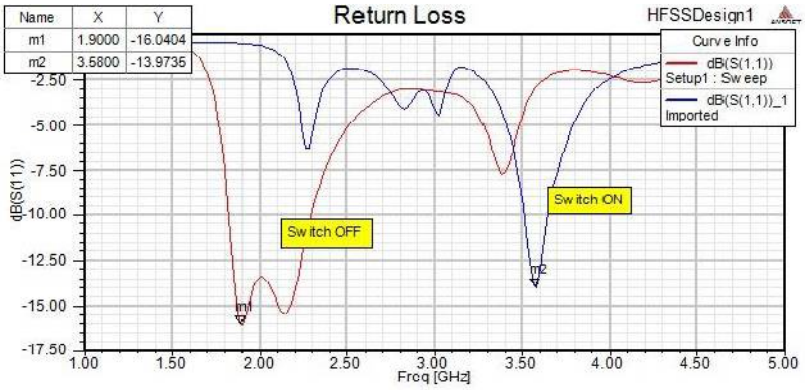

Fig.3. Return loss(S11)

In Fig.3.Shows the return loss (S11) is less than -10 dB. For OFF state of the switch -16dB as the return loss at 1.9 GHz and for ON state of the switch -13 dB at 3.58 GHz.

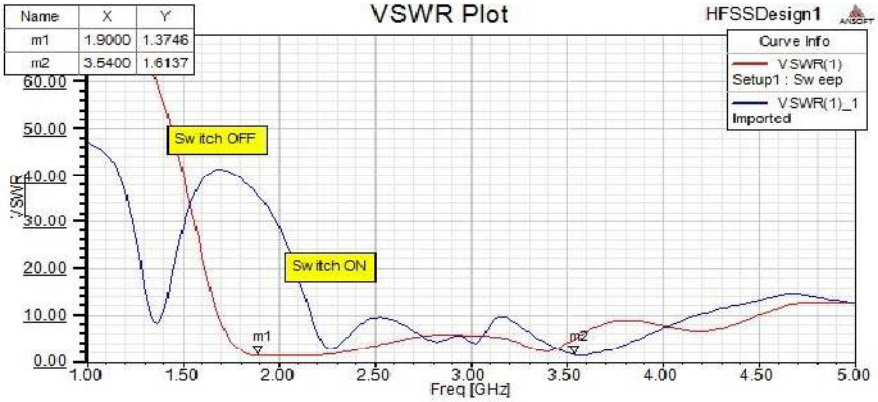

Fig.4.VSWR

Fig.4. Shows the VSWR which states that for the frequencies1.9 GHz and 3.58 GHz is 1.6 and 1.3 respectively.

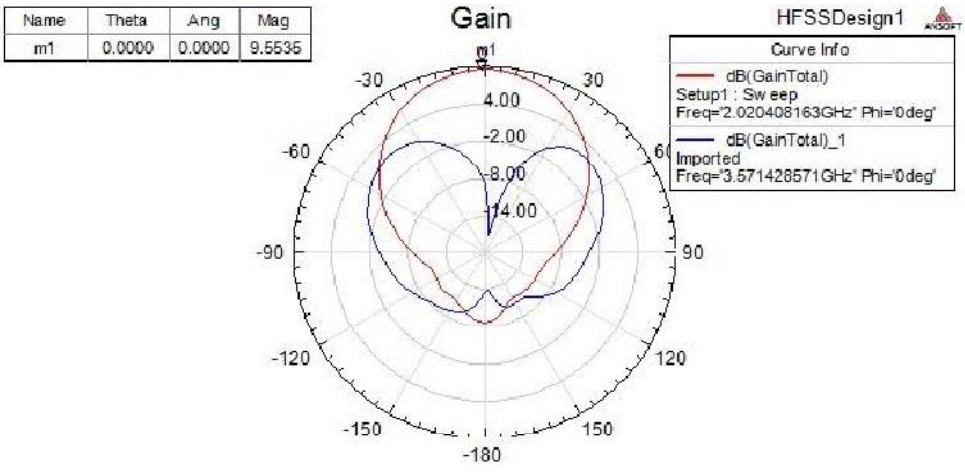

Fig.5.Gain

Fig.5 shows the Gain plot. Total gain is about 9dB obtained at OFF state of the switch and ON state it is about 7dB.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 10, October 2013

Radiation pattern for OFF and ON state is shown in the figure.6 and figure.7 respectively.

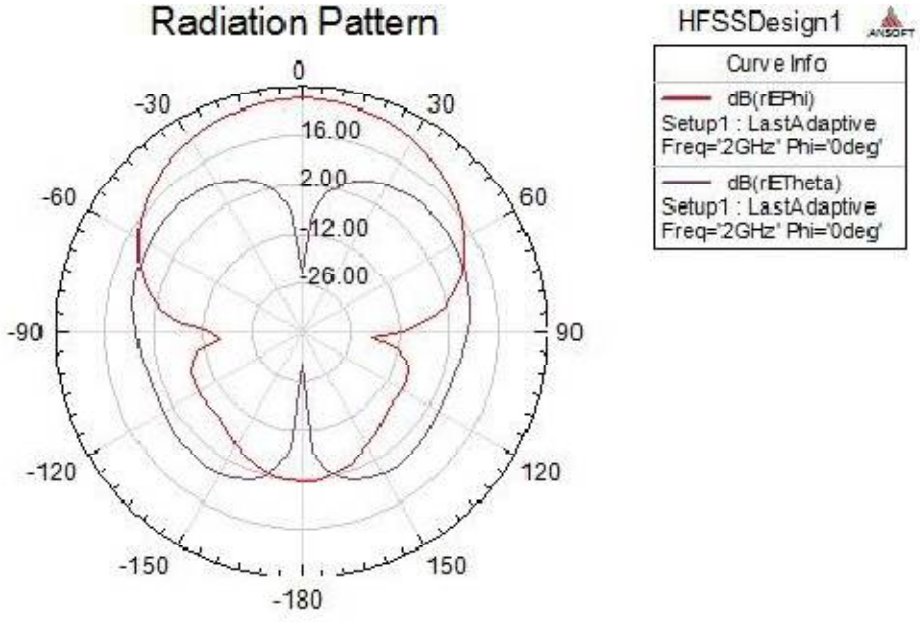

Fig.6 Radiation Pattern when switch is OFF

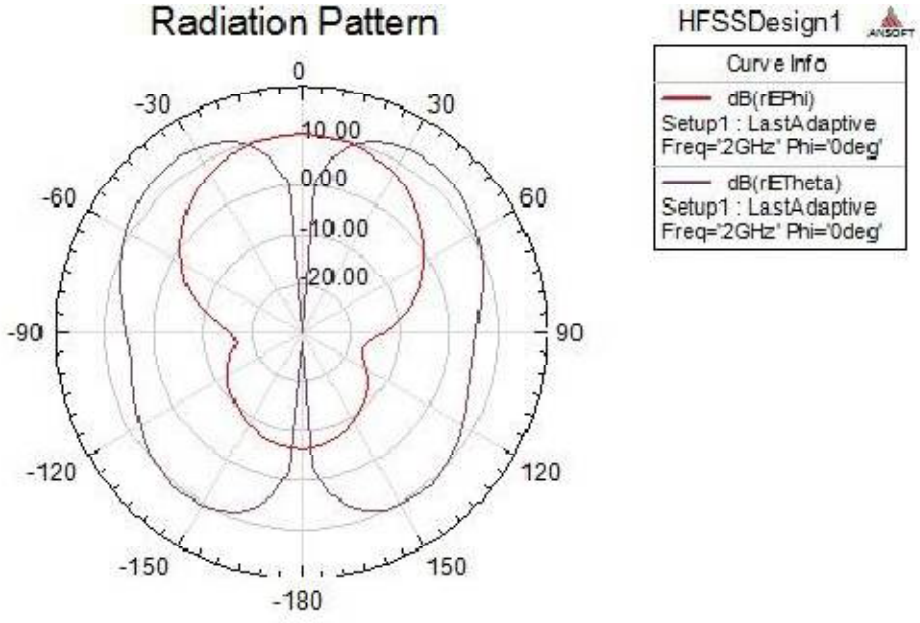

Fig.7.Radiation Pattern when switch is ON

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 2, Issue 10, October 2013

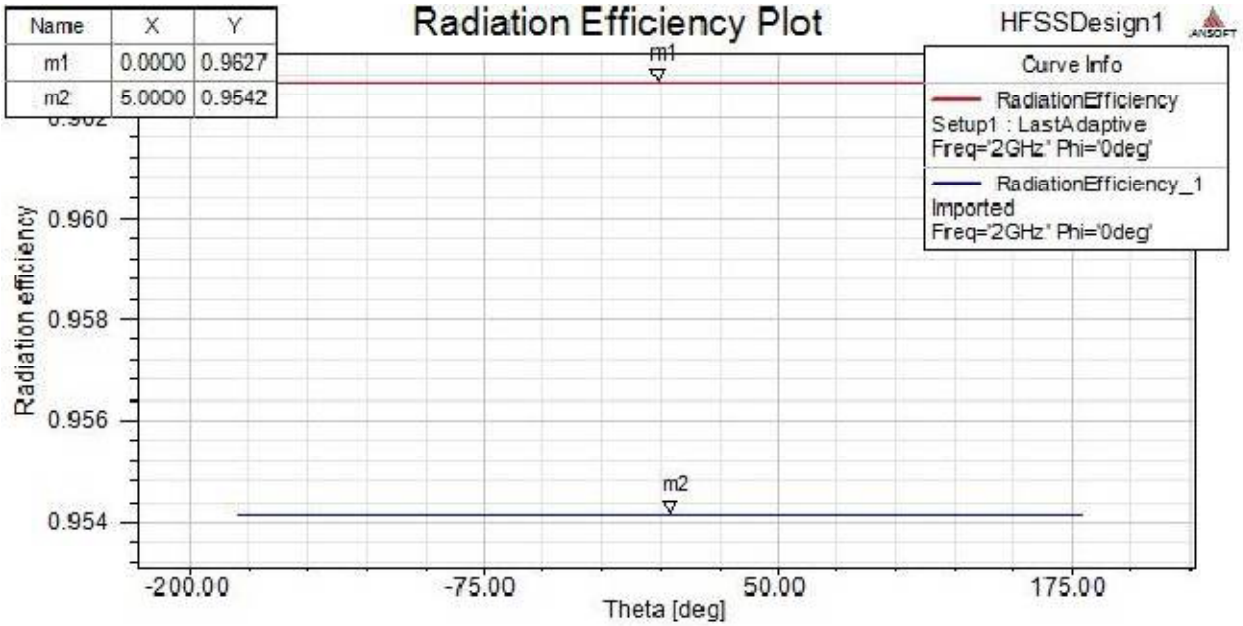

Fig.8.Radiation Efficiency

Finally the radiation efficiency plot is shown in figure.8.For OFF and ON state of the switch, obtained radiation efficiency is 96% and 95% respectively.

IV. CONCLUSION

Unused spectrum in wireless networks can be identified by a new technology called cognitive radio. Adjustable antenna along with a sensing antenna offers a solution for the antenna design challenges in cognitive radio. Proposed Eshaped patch antenna can be used as reconfigurable antenna for cognitive radio.

REFERENCES

[1] Lei Ge, and Kwai-ManLuk "A Band-Reconfigurable Antenna Based on Directed Dipole" IEEE Trans. Antennas Propag., vol.62, no. 1, pp. 64-71, Jan. 2014.
[2] Christos G. Christodoulou, Youssef Tawk, Steven A. Lane, and Scott R. Erwin "Reconfigurable antennas for wireless and space applications" Proceedings of the IEEE vol.100 no.7, pp.2250-2261, July 2012.
[3] Elliott R. Brown "RF-MEMS Switches for Reconfigurable Integrated Circuits" IEEE Transactions on Microwave Theory and Techniques, vol. 46, no. 11,pp 1868-1880 Nov 1998
[4] K. Luk, C. Mak, Y. Chow, and K. Lee, "Broadband microstrip patch antenna," Electron. Lett., vol. 34, pp. 1442–1443, Jul. 1998.
[5] T. Huynh and K.-F. Lee, "Single-layer single-patch wideband microstrip antenna," Electron. Lett, vol. 31, pp. 1310–1312, Aug.1995.
[6] Y.X. Guo, K.M. Luk, K.F. Lee and Y.L. Chow,"Double U slot rectangular patch antenna" Electron.Lett.vol.34.no.19, Sep1988
[7] 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.
[8] H.Rajagopalan,J.M.Kovitz,andY.Rahmat-Samii,"Frequency reconfigurable wideband E-shaped patch antenna: Design, optimization,and measurements," in Proc. IEEE Antennas Propag. Soc. Int. Symp.(APSURSI), Jul. 8–14, 2012, pp. 1–2.
[9] J. Bahl and P. Bhartia, "Microsinp Antennas", Dedham, MA: Artech House, 1982
[10] Y. Tawk and C. G. Christodoulou, "A new reconfigurable antenna design for cognitive radio," IEEE Antennas Wireless Propag. Lett., vol.8, pp. 1378–1381, 2009.
[11] H. Tarboush, S.Khan, R. Nilavalan,H.Al-Raweshidy, and D. Budimir, "Reconfigurable wideband patch antenna for cognitive radio," in Proc. Loughborough Antennas Propag. Conf., Nov. 2009, pp.141–144.
[12] Christos G. Christodoulou, Youssef Tawk, Steven A. Lane, and Scott R. Erwin "Reconfigurable antennas for wireless and space applications" Proceedings of the IEEE vol.100 no.7, pp.2250-2261, July 2012.