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RECONFIGURABLE ANTENNA FOR COGNITIVE RADIO: A LITERATURE SURVEY

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Abstract **–** Cognitive Radio technology is suggested to realize a flexible and efficient usage of the frequency spectrum due to the advancement in technology. In this paper we have presented a review of recent advancements in spectrum sensing using Cognitive radio technology with the use of reconfigurability. Multi antennas have been discussed with their advantage of sensing environment.

Keywords **-** *Cognitive Radio, Reconfiguration antenna, Spectrum sensing.*

1. INTRODUCTION

In recent years, the researchers are very interested more on the efficient use of spectrum to resolve the issue of network congestion and suppression of interference and noise at the receiver front end. The growing popularity of wireless communicationdemands the wide bandwidth operation, improved spectral efficiency and high data rate applications.Reconfigurability is a prominent feature of modern radio frequency (RF) systems for wireless and satellite communications. It is on demand in corporations smart, cognitive and frequency agile RF devices which can both sense the surrounding RF environment and communicate simultaneously in a congested wireless environment. Cognitive radio (CR) is a new class of radio that is able to sense the environment over a wide spectrum that detects the unused spectrum and use the spectrum for transmission with minimum interference problem.

Cognitive radio is the capability and reconfigurability both. The cognitive capability of a cognitive radio enables interaction with its environment in real time to determine the suitable communication parameters and adapt the radio environment dynamically. A CR monitors the available bands on the spectrum and detects the spectrum holes by capturing their information. It estimates the properties of these bands which were detected in spectrum sensing and then the data rate, the bandwidth, and the mode of transmission, the fitted spectrum bands are chosen according to the user demands and spectrum properties. Cognitive radio CR is an a enhanced to Software-Defined Radio (SDR) that its automatically detects the surrounding RF, catalysts and smartly accommodates its operating parameters to the infrastructure of network according to meet user demand.

A reconfigurable antenna is capable of modifying dynamically its frequency and radiation pattern in a controlled and reversible manner. In mobile and satellite communications, reconfigurable antennas are useful to support a large number of standards to eliminate strong interference signal and to cope with the changing environmental condition.There are basically many approaches for achieving antenna reconfigurability in terms of frequency agility, radiation, and polarization. Reconfigurable antennas can be implemented through varactor diodes, RF-MEMS, PIN diodes, Photoconductive

switching elements and altering the structure of antenna.

2. RECONFIGURABLE ANTENNA FOR COGNITIVE RADIO

The author proposed a design for frequency reconfiguration which is composed of a radiating element in the form of an inverted U, fed by a microstrip line on its upper side. The antenna is based on FR4-epoxy substrate with a dielectric constant of 4.3, thickness of 1.6 mm, and loss tangent of 0.0018.

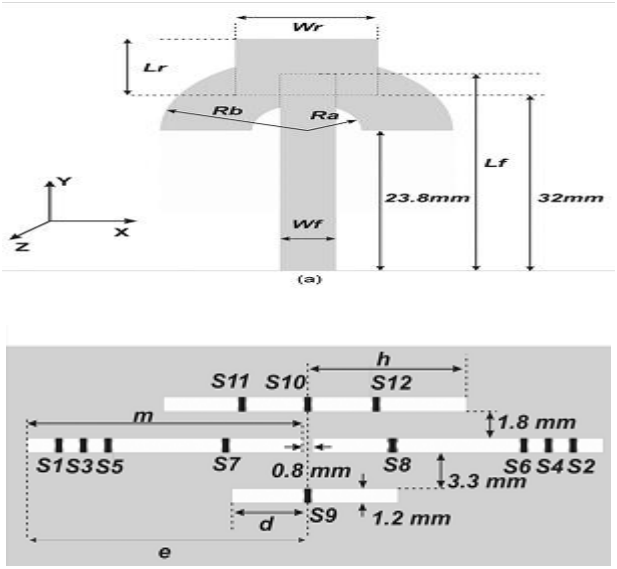

Figure 1 :The reconfigurable antenna for cognitive radio [13

To bias the PIN diodes 0.4-mm-width slots are introduced in the ground plane to separate the two ports of the switches and be able to have a voltage difference between them. For a dc separation and ensure an RF continuity of the ground plane, 100-pF surface-mount RF capacitors are used to bridge the slots, which provide almost a short circuit at the operating frequencies.

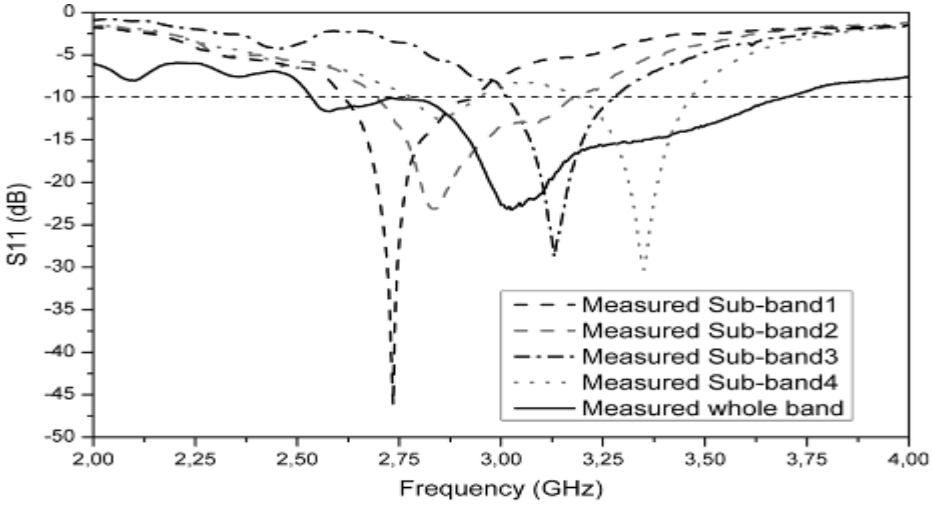

Figure 2: Simulated and Measured Return Loss of reconfigurable antenna for cognitive radio [17]

In order to operate the antenna in one of four sub-bands, six switches S1– S6 working by pairs have been integrated to the middle slots in order to control their electrical length and in the wideband mode and cover the whole wide band, six other switches S7–S12 are used to deactivate the effect of the four slots by disrupting them.

Fig 2 shows the return loss of the antenna which is able for channel sensing in cognitive radio system. In the figure frequency shifts are observed insub-band curves 1–3, but in a lesser degree in sub-band 4. Thefrequency shift is the minimum at sub-band 4, and it increasesas we move toward sub-band 1. These shiftsare due to the fact that the parasitic capacitance in the OFF stateof the PIN diodes provided by the constructor is smaller than that in the real ones. In sub-band 3, only the parasitic capacitance of S5 and S6 affect the antennas (since S3 and S4 are turned ON), which generates a small shift. In sub-band 2, S1 and S2 are turned ON, and the parasitic capacitance of S3 to S6 affects the antenna response, which creates a higher shift than in the case of sub-bands 3 and 4.Finally, in sub-band 1, all switches are in the OFF state, and all of their parasitic capacitances intervene, which create the highest frequency shift. The antenna can be operated either in a wideband mode or in one of four sub-bands, which allows using it for sensing the wide band and then choosing the most suitable among the four sub-bands to operate in.

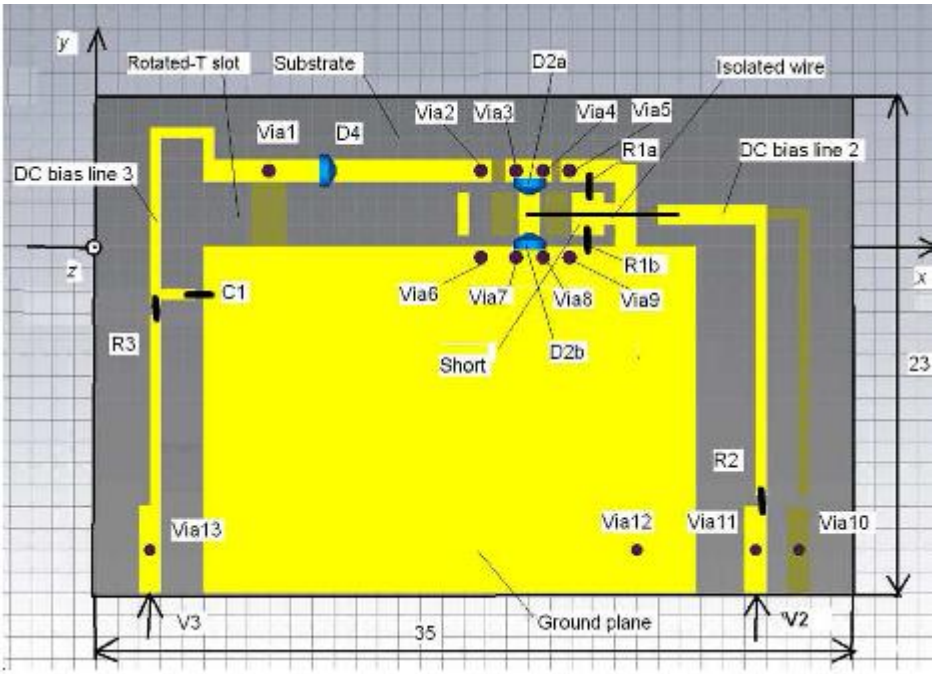

Fig 3: Reconfigurable antenna design for cognitive radio [18]

The antenna is printed on both sides of a TACONIC TLY-0-0310 dielectric substrate with relative permittivity and thickness of 0.8 mm, and its area is 2.3x3.5 cm. The slot has a rotated-T shape, having a horizontal segment and a vertical segment which is formed by a gap between the ground plane and a section of a dc bias line that is RF shorted to the ground plane through a dc blocking capacitor C1= 6pF. The width of the horizontal segment of the slot is 3.5 mm, while the width of its vertical segment is 2 mm.

The author proposed another antenna for cognitive radio in which the slot has a rotated-T shape with both horizontal and vertical segments. The vertical segment of the slot improves the omnidirectionality of the antenna in the horizontal plane when the series PIN diode was switched to OFF state.

The antenna uses pairs of PIN diodes which providing switching operation at eight adjacent frequency sub-bands in the frequency range of 6–10.6 GHz.

The three switchable shorts consist of pair of surface mount PIN diodes (D1a–D1b, D2a–D2b, and D3a–D3b, respectively) that are connected back-to-back by means of a solder pad, which allows for lateral adjustment inthe position of the 0 Ω PIN diode pair. These switchable shorts are mounted on both sides of the substrate across the slot in a staggered manner. Specifically, the switchable shorts with the pairs D1a–D1b and D3a–D3b are mounted on the back side of the substrate, while the switchable is mounted on the front side of the substrate. The PIN diodes D1a and D1b are connected anode to anode, while PIN diodes D3a and D3b are connected cathode to cathode. In this way, one dc voltage source can control both pairs. When it is positive, the pair D1a–D1b is in ON state whiles the pair D3a–D3b is in OFF state. On the other hand, when it is negative, the pair D3a–D3b is in ON state while the pair D1a–D1b is in OFF state. Finally, when it is zero, both pairs are in OFF state. The feeding method is microstrip line, which was printed on the back side of the substrate and connected to the metal arm bordering the slot from above through via 1.

CONCLUSION

In this paper, we have reviewed antenna requirements for Cognitive radio by using the reconfigurable antennas. The reconfigurable antenna can be achieved through the PIN diodes with multiple ways of arrangements.

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