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# Design of a New Multiband Conical DRA for Wireless Communication Applications

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***Abstract*—This paper aims at designing a new dielectric resonator antenna (DRA) design with CPW feeding. This paper presents a novel DRA designed forwireless applications.In this design a conical DR structure is mounted on a cylindrical DR. The proposed DRA is analyzed by using HFSS software. An ultra-wideband operation has been observed through simulation using HFSS at resonant frequencies of1.096GHz and 5.603GHz. The First band covers entire P, L and S-bands and the other band covers part of the C-band requirements according to IEEE standards. Parametric studies of the antenna are carried out by varying the CPW slot width and DR materials. The Simulated results for wireless application are presented here.***

***Keywords*—Dielectric Resonator Antenna (DRA), Coplanar Wave Guide feed (CPW) feed.**

## I. INTRODUCTION

The increasing use of wireless mobile communication systems demand the antennas for different systems and standards with properties like reduced size, broadband, multiband operation, moderate gain etc. [1]. WiMAX and WLAN are the standard-based technologies enabling the delivery of last mile wireless broadband access. WiMAX refers to interoperable implementations of the IEEE 802.16[1].

The dielectric resonator was first proposed as a radiating element in the early 1980s. Unlike traditional printed microstrip antennas, dielectric resonator antennas (DRAs) offer several advantages, such as small size, low dissipation loss and high radiation efficiency [2]. The dielectric resonatorantenna (DRA) is also simple to fabricate and easy to feed by different coupling mechanisms, such as coaxial probe, microstrip line coupled aperture, slotline, stripline and so on. Moreover, compared with the microstrip antenna, no surface wave losses are suffered because the DRA element is directly placed on the ground plane. However, because of the high dielectric constant and the high Q-factor, it has a limited impedance bandwidth of operation [3].Much work has been done on bandwidth enhancement of DRAs. Stacked DRAs with two different materials offer bandwidths in the range of 35%–66% [2].The radiation efficiency of some modes found to be better than 98%. The dielectric resonator antennas have small sizes. They might be useful in a variety of personal and mobile communication and tactical systems such as radars [4].

The coplanar waveguide (CPW) inductive slot simultaneously acts as an effective radiator and the feeding structure of the DR. DR also works as the dielectric loading of the CPW slot, affects the radiation patterns of the radiating inductive slot, and thus achieves consistent radiation patterns within the working frequency band [5].

Among the different shapes DRA, the conical shaped DRA is used to improve bandwidth. In this paper, the new type DRA is designed for ultra wideband applications by placing a conical DRstructure on cylindrical DR. As a result of which a new type of conical DRA is obtained. The DRA is excited by using CPW feeding.

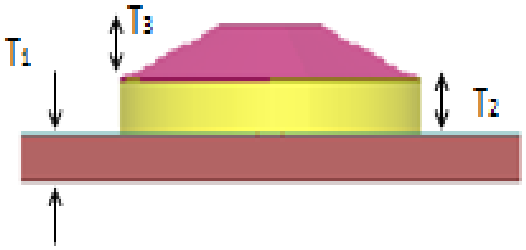
## II. ANTENNA DESIGN

The proposed conical DRA structure is shown in Fig. 1. This antenna consists of a conical DR on cylindrical DR and a center-fed CPW loop which is etched on an FR4_epoxy substrate (Ɛr = 4.4, T = 1.6mm), with LandW denote the length and the width of the substrate respectively.

DR is placed above the slot with an offset L1 from slot to the lower edgeofthe DR.The CPW line is designed with the center metal strip width Wg=2mm and a gap width=0.3mm.The resonating material having a dielectric constant of 2.25(Polyethylene).The conical DR has dimensions R1,R2,T2 and T3 and the dielectric constant Ɛdr=2.25.The center fed CPW slot has dimensions L1,G,Wg,Li and Wi.

**Table 1: Design parameters of proposed antenna**

| Parameter | Value |
|---|---|
| L | 50mm |
| W | 50mm |
| R1 | 15mm |
| R2 | 5mm |
| T1 | 1.6mm |
| T2 | 2mm |
| T3 | 2mm |
| L1 | 20mm |
| G | 0.3mm |
| Wg | 2mm |
| Li | 10mm |
| Wi | 11mm |

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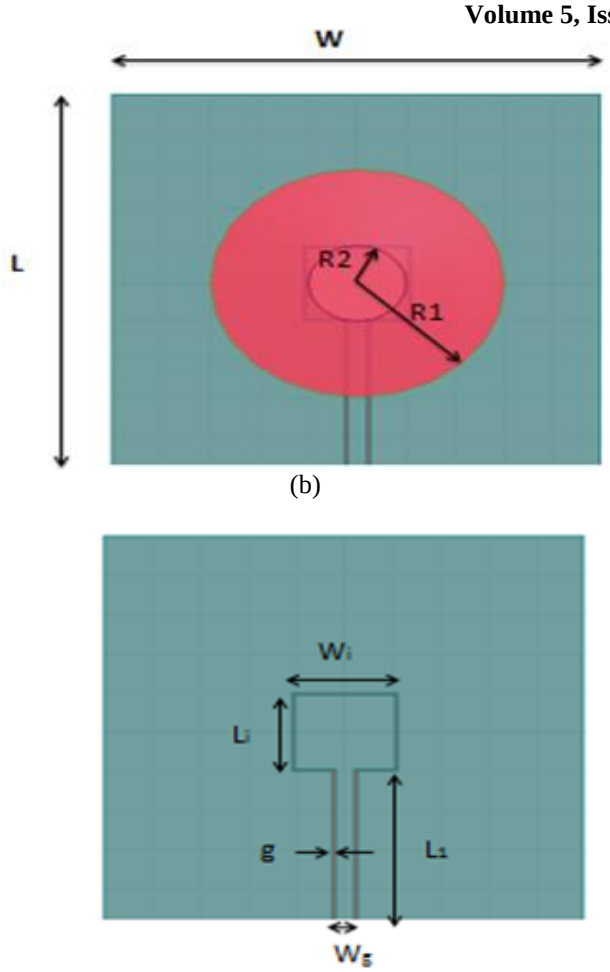


**Fig : (a) Side View**
**(b) Top View**
**(c) Back View of the proposed antenna**

## III. RESULTS AND DISCUSSION

As discussed in the previous section that an ultra wide band can be achieved by modifying the basic shape of the DRA. So the first design step was to modify the width of CPW feed and substrate material of the conical DRA. To achieve optimal performance, a parametric study is performed to investigate the characteristics of the proposed antenna.

The simulated dual band resonance frequencies of DR and slot are at 1.096GHz and 6.102GHz. For the case g = 0.3mm, a wide bandwidth with less S11 is observed. The band width of an antenna is 4.0082GHz in the first band and 1.0879GHz in the second band. This DRA is simulated using HFSS software.

### *A. Parametric Study*

The proposed DRA is analyzed using HFSS. The simulated return loss of a conical DRA plotted against frequency is shown in Fig1 and Fig2 by varying the CPW slot width (g) and DR material respectively. The proposed antenna achieves an impedance bandwidth from 0 to 4.0082GHz covering entire P, L and S-bands and the other band covers part of the C-band requirements according to IEEE standards for g=0.3mm. Based on the information gathered from the parametric study, a prototype antenna forUltra wide band application is designed.

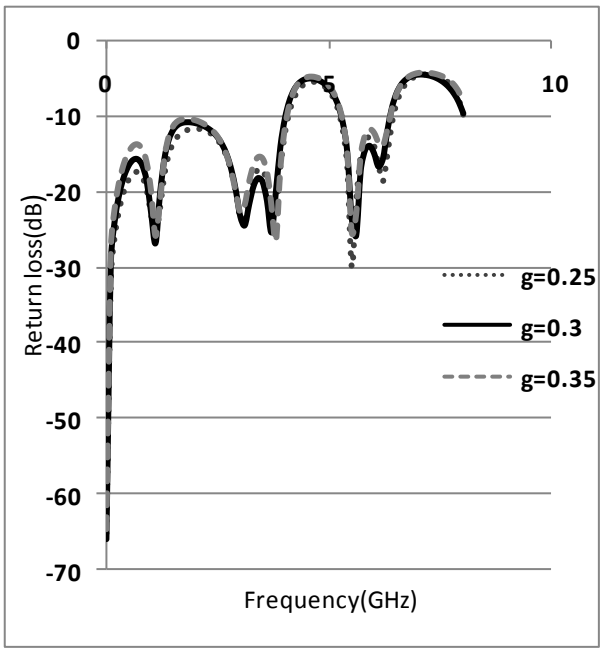


**Fig.1: Plot of Return loss with respect to variations in CPW slot width (g)**

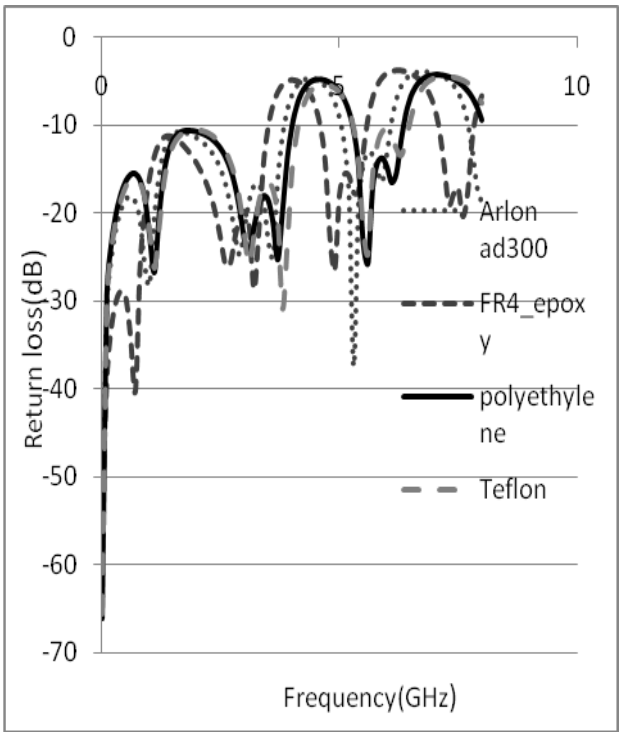


**Fig.2: Plot of Return loss with respect to variations in DR material**

The simulated VSWR of a conical DRA plotted against frequency is shown in Fig3 and Fig4. VSWR lies between 1 to 2 for required bands.

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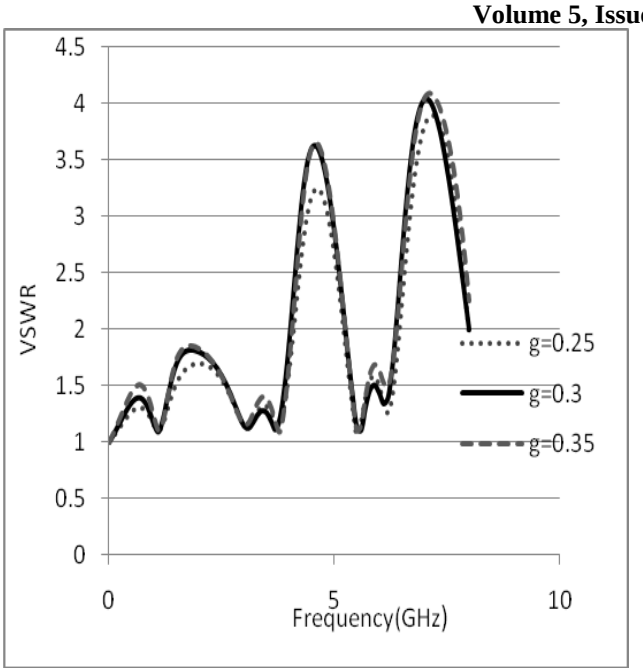


**Fig.3: Plot of VSWR with respect to variations in CPW slot width (g)**

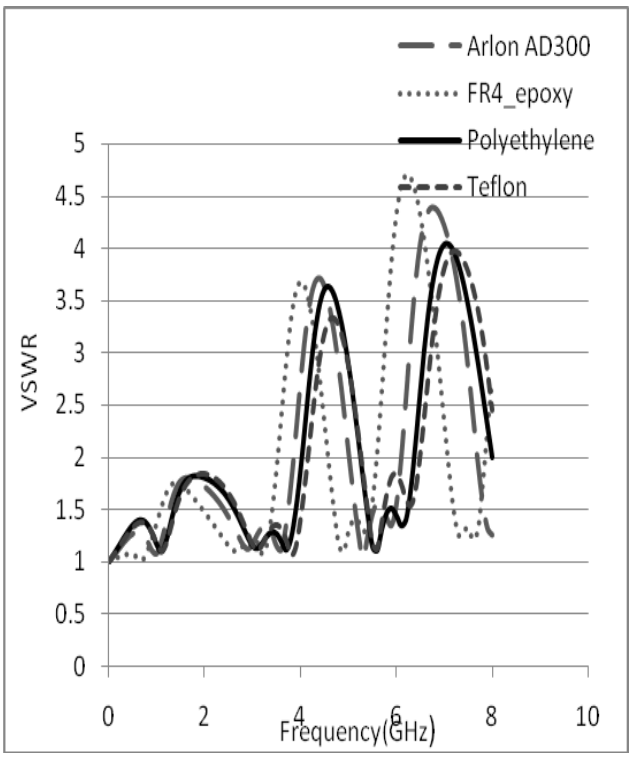


**Fig.4: Plot of VSWR with respect to variations in DR materials**

### *B. Radiation Pattern Characteristics*

The simulated far field radiation patterns of E-Plane and H-Planeof the proposed conical DRA are shown in Fig.3. The radiation pattern is bidirectional in E plane and omnidirectional in H plane for R1=15mm.

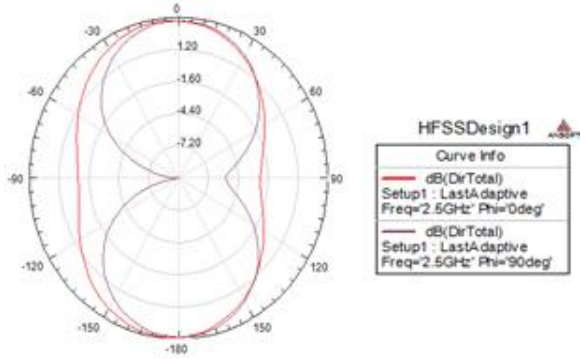


**Fig.5: 2-D Radiation pattern in E-plane and H-plane**

### *C. Gain and Directivity*

The Peak Gain of antenna is 3.38dB. It is observed from Fig6 that the simulated peak directivity is3.91dB

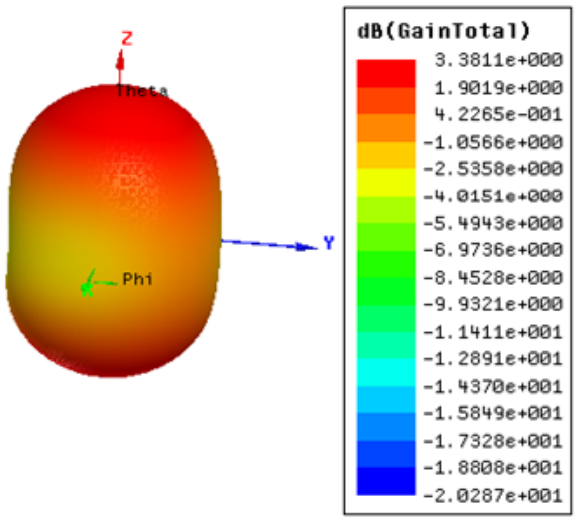


**Fig.6: 3-D polar plot of proposed antenna**

## IV.CONCLUSION

In this paper, a novel antenna design to improve the bandwidth has been proposed. The hybrid structure of the antenna, consisting of a resonating slot and a dielectric resonator, is fed by a coplanar waveguide. The design has been simulated using HFSS. Using parametric study, the optimized dimensions to improve the bandwidth is also observed.We have obtained two independent frequency bands ranging from 0-4.0082GHz and 5.26-6.35GHz. The presented multi-band DRA is suitable for WLAN and WIMAXapplications. The radiation pattern in*E* plane has been studied and is found to be bidirectional while that in H-plane is omnidirectional. The antenna is supposed to produce a gain around 3.38dB. The presented DRA has better features when compared with other DRAs.

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