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Reconfigurable MIMO Antenna for 5G Communication Applications

G.Sudhakar Reddy, Praveen Kumar Kancherla, Amulya Boyina

Abstract ---The current article presents the design of reconfigurable multiband antenna fed by coplanar waveguide feeding using commercially available pin diodes. Multiple input multiple output structure is proposed to reduce the polarization diversity related issues. The designed antenna operating in the wideband with coverage in 5G band. The proposed model is showing huge bandwidth of almost 10 GHz with peak realized gain of 6.8 dB. Good impedance characteristics in the operating band with Omni directional radiation makes this model suitable for future communication applications.

Keywords—Multiple input multiple output (MIMO), Reconfigurability, polarization diversity, Impedance bandwidth.

I. INTRODUCTION

The headways in remote correspondence frameworks and expanding enthusiasm of the client for best nature of administration, has prodded an earnest need to plan effective RF systems. Scientists have demonstrated LTE (Long term assessment) or 4G innovation as successor to current 3G based correspondence framework. To improve the limit and speeds by using an alternate kind of RF frameworks, 5G technology is coming into existence which is more advantageous than 4G [1]. In July 2016, the FCC has announced modern rules which would fascinate the adoption of the development of 5G wireless networks, The announcement by the FCC provides much needed vision in future research and for the development of millimetre wave 5G technology [2]. As to reduce the shortage of bandwidth globally, 5G technology is expected to use millimetre wave bands [3], which posses required spectrum. Planar antennas have fascinated interest for millimetre wave applications only. So, novel planar antenna, T-Dipole antenna's fed by integrated blain was employed popularly in wireless communication at higher frequencies [4-5].

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Currently reconfigurable antenna dragged much attention because the antenna performance satisfies the user requirements [6-7]. As it provides good directional radiation pattern by changing their electrical attributes such as radiation pattern, frequencies and polarization according to their

behaviour. The reconfigurable attributes of an antenna can reduce the system complexity, noise, avoid interference and can also enhance the security. It has various shapes and sizes but they are mainly classified into four categories [8-9]. Frequency, pattern, polarization and hybrid reconfigurable antenna. The reconfigurable characteristics are obtained by changing the structure to modify the current distributions. To achieve the reconfigurable, features, few electronic components as PIN diodes, varactor diodes, FET&MEMO switches are used [10].

In this paper 5G based model has been designed with both polarisation and frequency reconfigurability, and the designed antenna operates at frequency band ranging from 24-30 GHz.

II. DESIGN OF PROPOSED ANTENNA

The architecture of proposed design is presented in fig 1(a) which is imprinted on AP9121R substrate with relative permittivity of 2.2, with loss tangent 0.0009.

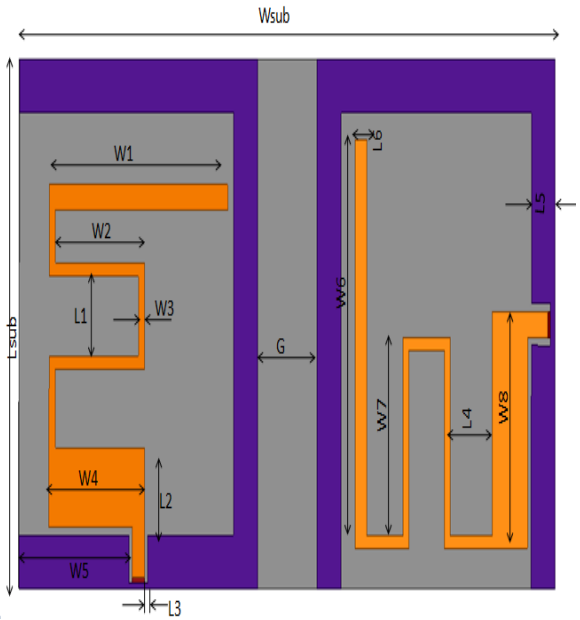

Fig.1 Geometry of proposed Antenna

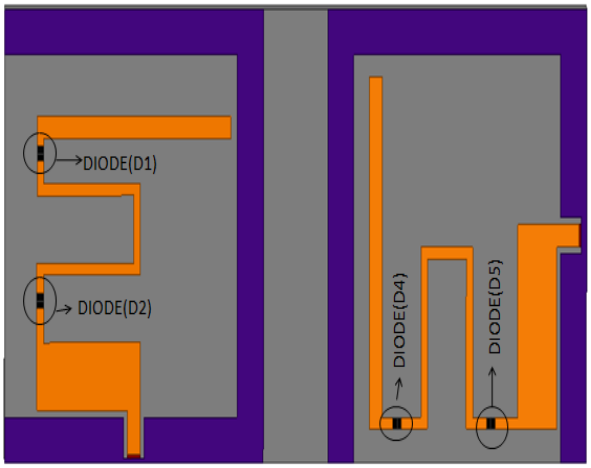

Fig 2. Proposed Antenna with Diodes

The dimensions of designed antenna are 50 x 20 x1.6 mm^3 consisting of two parts with CPW feeding of 50 ohm characteristic impedance matching. FR4 material of stature 1.6 mm was utilised for design of proposed antenna. The patch part of antenna consisting of sigma shaped design, which helped for high range coverage. The C-shaped ground plane is also helped for 5G coverage. The entire representation of (50 x 20 x 1.6) mm proposed antenna is a MIMO antenna structure. One of the important role of reconfigurable antenna is switching operation. Based on this technology, in proposed antenna 4 diodes are placed. That particular 4 Diodes are perform to achieve the 5G coverage (20-30) GHz frequency range. Antenna dimensions are shows in Table 1.

Table 1. Design Parameters of Proposed Structure

PARATEMER	Dimension in mm	PARAMETER	Dimension mm
WS	50	Ls	20
W1	15.5	L1	3
W2	8	L2	3
W3	0.5	L3	0.3
W4	9	L4	3.5
W5	9.2	L5	2
W6	16	L6	1
W7	8.5	G	10

Four Diodes were mounted on the radiating surface of antenna in desired manner. Diodes (R=1.5Kohm, C=0.02pF, H=0.45nH) at OFF condition. At ON condition the RLC values and positioning are change.in the proposed antenna we absorbed frequency shift and pattern shift by using MIMO.

III.RESULTS AND DISCUSSION

Especially the proposed antenna great achievement of 5Gcoverage at resonant frequency of 28GHz. The initially step of proposed antenna working at 28GHz frequency with coverage of 20-30GHz band. They are most important 4 diodes conditions are 1.off off off on off, 2.off off off on, 3.off off on on,4.off off off off. In fig.3 Return loss characteristics of proposed antenna is presented.

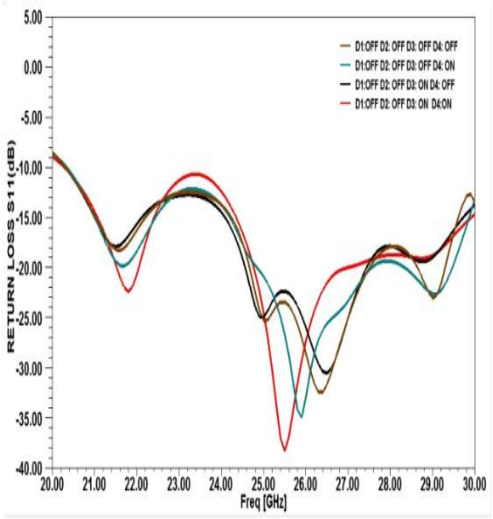

Fig.3 proposed antenna with frequency shift at four different states diodes act.

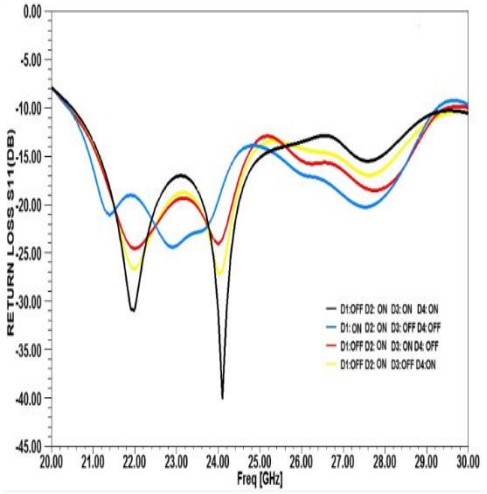

Fig.4 Proposed antenna at another 4 diodes working conditions.

Reflection coefficient represents the frequency shift observation with in 5G Coverage. At Diode off off off off state the coverage band (20-29.9) GHz and frequency is 28GHz.Similarly remaining conditions also give same coverage and different frequency shifts.

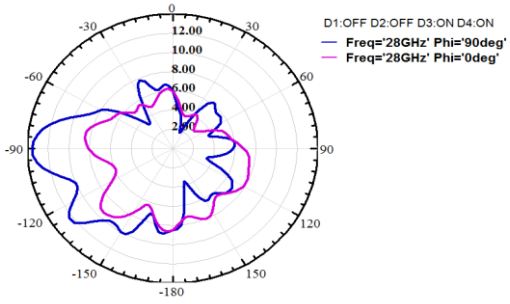

Fig.5 Radiation patter for D1:OFF D2:OFF D3:ON D4:ON

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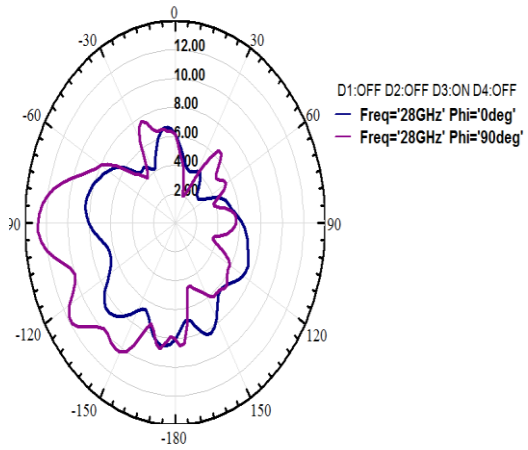
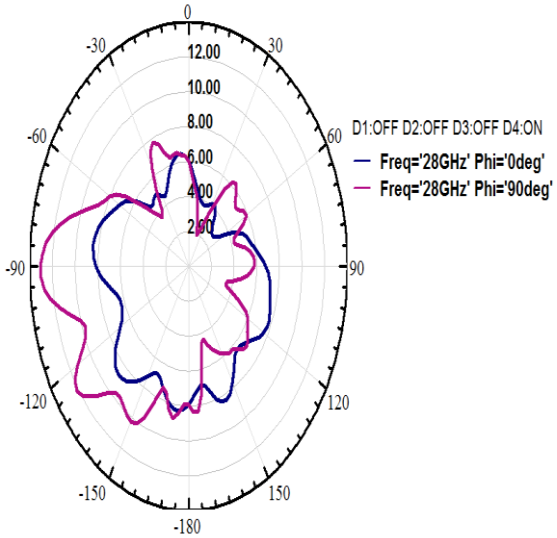
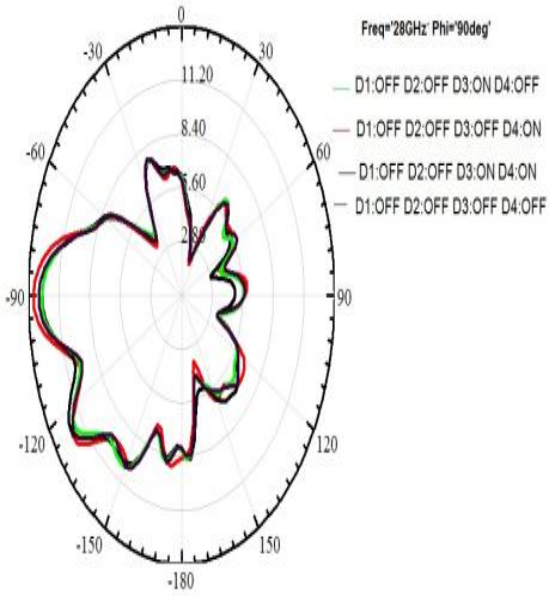


Fig 6. Radiation Pattern with diodes off off on off state.

By using MIMO get high pattern shift of antenna. The radiation pattern of antenna is Omni directional antenna. The switches or diodes are placed on the proposed antenna at different states but the coverage of antenna is same in all conditions of diodes. In the radiation pattern all E-plane orientations are observed with patter shift.





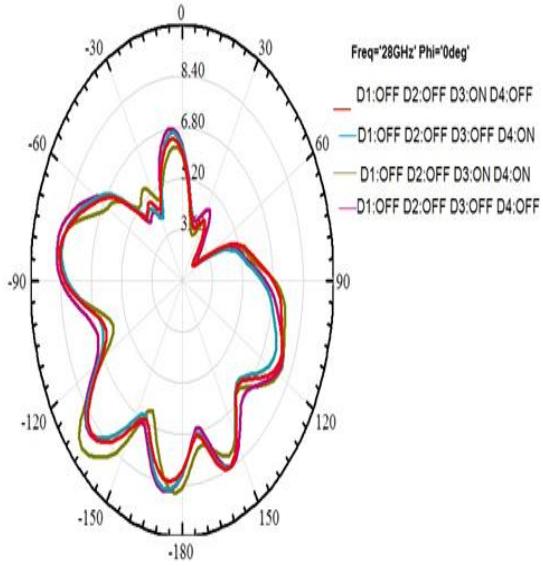


Fig. 6(a), 6(b) and 6(c) E –Plane and H-plane orientation of designed antenna at 28 GHz

The Radiation pattern at resonant frequencies of proposed antenna when all switches are in main 4 conditions are get 28 GHz resonant frequency.

The main four conditions are shows in table form

Table:2 Antenna operation at different diodes

Antenna Operation	Diodes Condition
21-30	OFF OFF OFF OFF
21-30	OFF OFF OFF ON
21-30	OFF OFF ON ON
21-30	OFF OFF OFF OFF

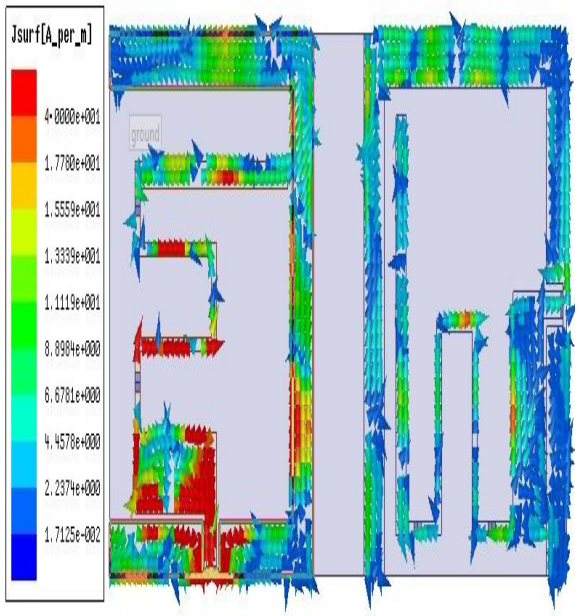


Fig.6 (a) Proposed antenna current distribution at off off off on with 28GHz

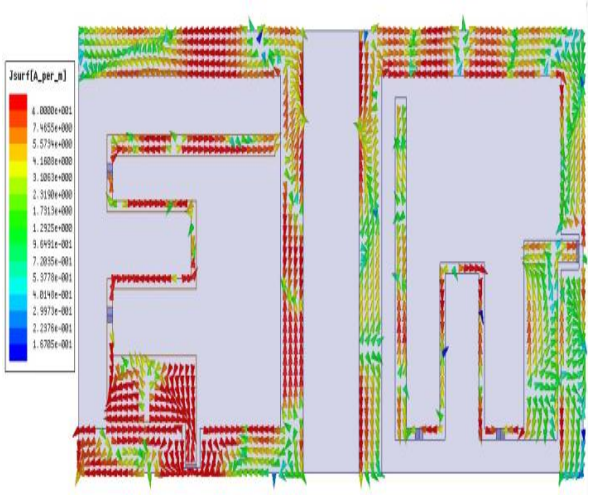


Fig.6(b) Proposed antenna with off off on off at 28GHz

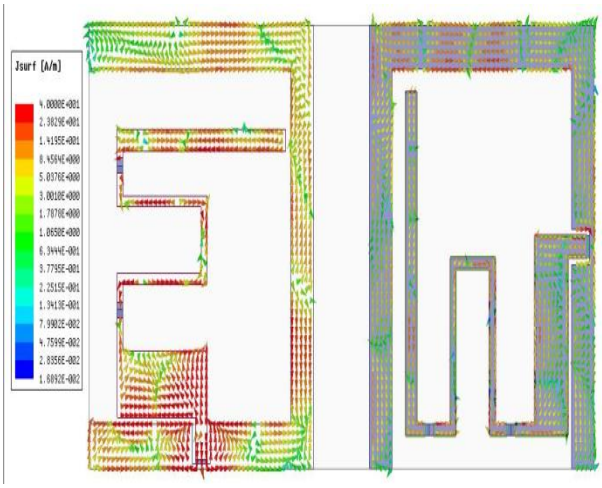


Fig. 6(c) Current distribution at 28GHz with off off on onstste

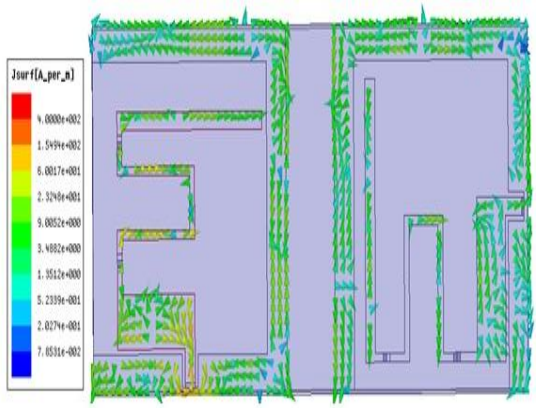


Fig.6(d) current distribution at 28GHz with diodes off off off off

From the current distributions, at fig.6(a) the proposed antenna operating at 28 GHz and 3 diodes at off condition and 1 in on condition the power distribution shows in. From the Fig. 6(b) off off on off state the current distribution displays can observed at same frequency of 5G application. In Fig.6(c) MIMO functioning applying one condition in on state and another one in off state.

The proposed antenna working coverage of 20-30GHz range with resonant frequency of 28GHz it is used in wireless applications. From the current distributions the antenna working is good at off and on conditions of diodes. The reconfigurable technique is apply to achieve the 5G coverage. The Antenna at off state and on state both conditions current distributions are mating so shifting ex: frequency and pattern shifts.

IV.CONCLUSION

In current article, MIMO antenna operating at 5G band is designed with reconfigurable nature. The proposed antenna has impedance bandwidth of 68% with peak gain of 6.8 dB. Omni directional radiation in H-plane with low cross polarization is the attractive feature of the proposed antenna. Bandwidth of more than 10 GHz with compact structure makes it appropriate for high data rate applications.

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