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Design of Micro-strip Patch Antenna for Future 5G WCS

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ABSTRACT

This paper delineates a dual-band slotted Micro-strip patch antenna (MPA) with the capacity to work on two different 27.2GHz and 27.6GHz frequency bands. The single band MPA architecture was developed using FR4 substrate for the 27GHZ band, later on the antenna was further improved to slot connectivity on two separate bands, 27.2GHz and 27.6GHz. The antenna resulted in S11 of -17.5dB at 27.2GHz for the single band, while the antenna resulted in S11 of -24.2dB at 27.6GHz for the dual band. At 27.2GHz and 8.2dB at 27.6GHz, the dual band culminated in a reasonable gain of 6.2dB. 5G cell network extension networks expand the broadband network environment and offer energy-efficient services to the health care sector, manufacturing industry and smart city initiatives.

Keywords: Patch Antenna, Gain, Return Loss, Radiation Pattern and 5G

1. Introduction

The spectrum of 5G is not restricted to radio technology; it will also include services for fixed host communications, cloud networks, etc,. From personal contact to social interconnection, 5G forms the basis of digitalization. Digitalization provides incredible possibilities for mobile connectivity, but mobile communication systems suffer from serious difficulties. Through studying the own values and Eigen vectors, the electromagnetic properties of the conductor can be investigated [1]-[3]. It can be noted that TCM has a structured method for designing an antenna relative to conventional antenna design approaches and TCM approach, whereas the previous approach relies largely on practice and trial and error. Multiband frequency operations may be performed by polarized circular antennas. The multiband circular polarized antenna in a

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single antenna will combine different frequency bands and support multiple wireless applications on a single network [4]-[6].

In order to obtain compact scale, less weight, and low cost, the multiband circular antenna may also be used with the micro-strip antenna. Under the feed lines for circular polarization of the patch antenna, Jay et al. introduced defected ground structures (DGSs). Circular polarization of three triangular slots in the ground plane is to utilizing an innovative approach of the gain-enhanced micro-strip antenna [7]-[10]. Likewise, return failure bandwidth in multi-layered antenna improved by 64 percent with the integration of the DGS. Flexible substrates such as polyethylene terephthalate (PET) and polycarbonate have a large tangent loss that results in more degradation of the gain. Flexible for conformal designs than the proposed substrate, but includes additional scaffolding 4G LTE MIMO antenna system consists of two CPW-fed conformal antennas cantered on CRLH that ful fill the class 7G LTE band.

Since they need to work on new band multiband MIMO antennas, the new frequency band must cover certain networking device with increased data rate [11]-[13]. The fifth-generation (5G) networking infrastructure is expected to use milli-meter-wave bands, which have a vast volume of usable space, to address the world wide capacity deficit of today's wireless cellular networks. Several measurements have demonstrated the promise of higher bandwidth orders of magnitude combined with more gain from multi-element antenna arrays through beam forming and spatial multiplexing. As a consequence, it may be an essential move for the realization of 5G wireless cellular networks to build an ideal antenna for the creation of milli-meter-wave beams [14]-[16]. While numerous beam forming techniques exist, so far the most common beam forming technology is the active-phased array. As a consequence, milli-meter-wave phased-array antennas have gained enhanced interest lately.

2. Design of Micro-strip Antenna

The antenna is intended to provide an understanding of emerging developments in research and development and innovative methods in the design and study of reconfigurable and meta-material antennas for 5G wireless applications in Figure. 1.

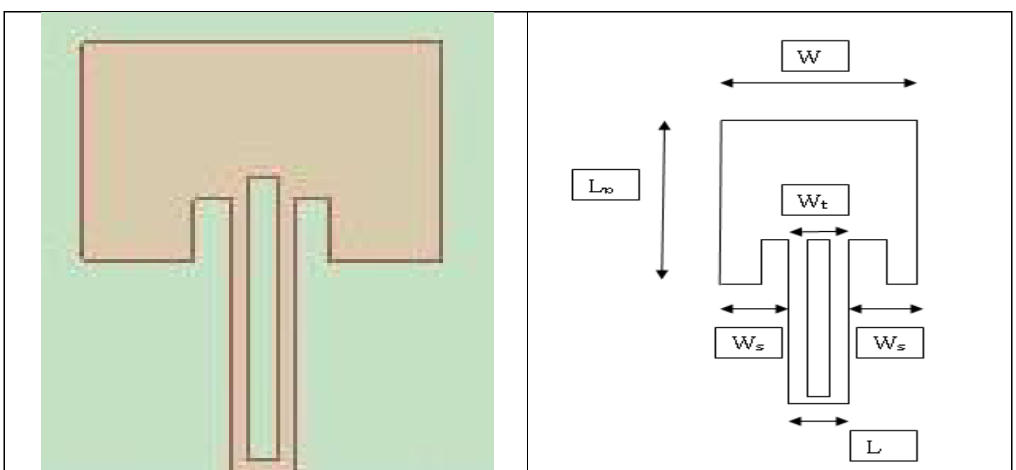

Figure.1. Proposed Structure of Antenna

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The dual-band, reconfigurable and DGS antenna architecture concept and technique has been identified to work on short-range communication and multi-band antennas covering different frequencies in one wireless system that plays an important role in targeting low-profile, tiny and multiple antennas. It offers an analysis of existing research developments and innovative methods utilized in multiband architecture, frequency reconfiguration and DGS antennas. Defected ground construction applied to microwave antenna slots or faults built into the ground plane. Using DGS in antenna architecture contributes to a reduction in scale, gain or increase in bandwidth. DGS opens a door for microwave researchers with a broad range of applications such as miniaturization, multiband efficiency, and bandwidth and gain enhancement, suppression of mutual coupling between two components, suppression of higher harmonics mode, suppression of cross-polarization, formation of notched bands, and achievement of circular polarization. The Table 1 shows dimension of micro-strip patch antenna.

Table 1:- Dimension of Micro-strip Patch Antenna

SL. No.	Parameter	Value (mm)
1	Lp	12
2	Wp	8
3	Ws	4
4	Wt	2
5	L	2

3. Results and Discussions

In this article, for present 4G and potential 5G, a broadband right-hand (RH)/ left-hand (LH) slotted antenna consisting of wireless device implementations in less room is growing the need for multiband MIMO antenna technology. It is not a simple job to build the antenna, but special changes or form configurations should often be introduced or careful optimization is required to achieve the multiband frequency range. The 5G network would focus heavily on MIMO systems because it needs small capacity and lower costs. The length of the new direction is elevated as the current flows through the slot. In order to eliminate the harmonics and thus reduce the scale of the antenna, the DGS structure is used. The antenna device with two ports at 27.2GHz and 27.6GHz is simulated and tested. Over such bandwidths, no surface wave transmission is recognized. A broad frequency range of 1.0683 (27.58-28.649) GHz at 27.2GHz and 1.4306 (37.213-38.643) GHz at 27.6GHz with a gain of 6.2dBi and 8.2dBi was protected by the small mm wave two-element micro-strip antenna in Figure. 2.

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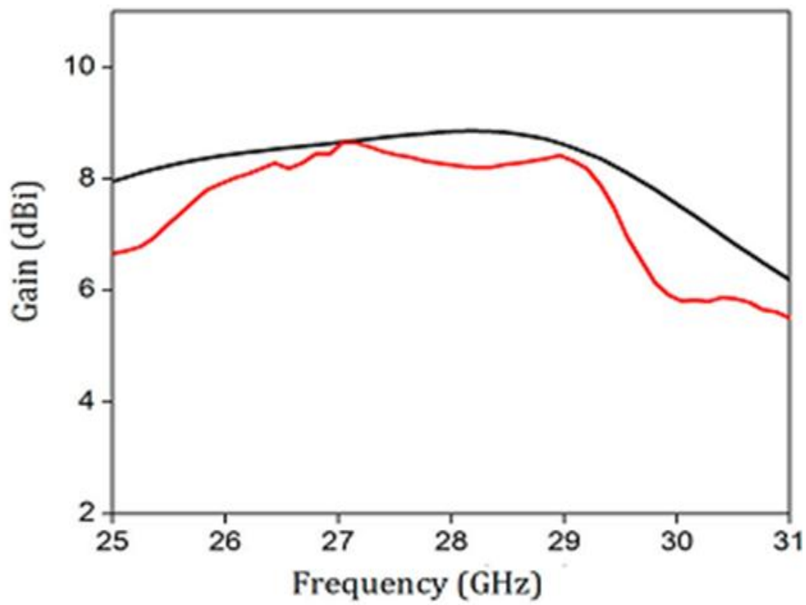

Figure.2. Gain of Micro-strip Patch Antenna

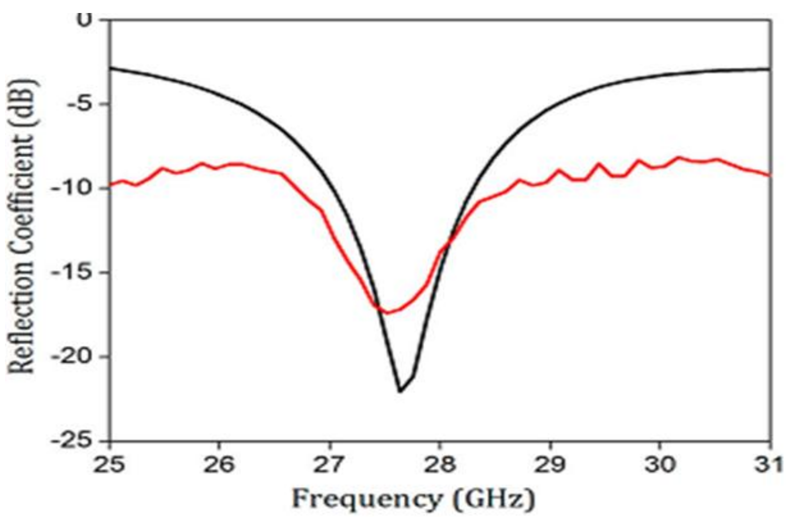

Figure.3. Reflection Coefficient of Micro-strip Patch Antenna

The planned single band MPA resulted in a return loss of -17.5dB and 27.6GHz operating frequency after simulation at 27.2GHz operating frequency, while the engineered single band MPA resulted in a return loss of -24.2dB. Figure.3 shows reflection coefficient of microstrip patch antenna. FR-4 is a composite reinforced with glass and laminated with epoxy. The FR-4 glass epoxy is a flexible material which contains a self-extinguishing fiber glass fabric. This substrate is widely common as an electric insulator with widespread physical strength with nearly very low water absorption. It has a dielectric value of 4.2, respectively, and a failure tangent of 0.008.

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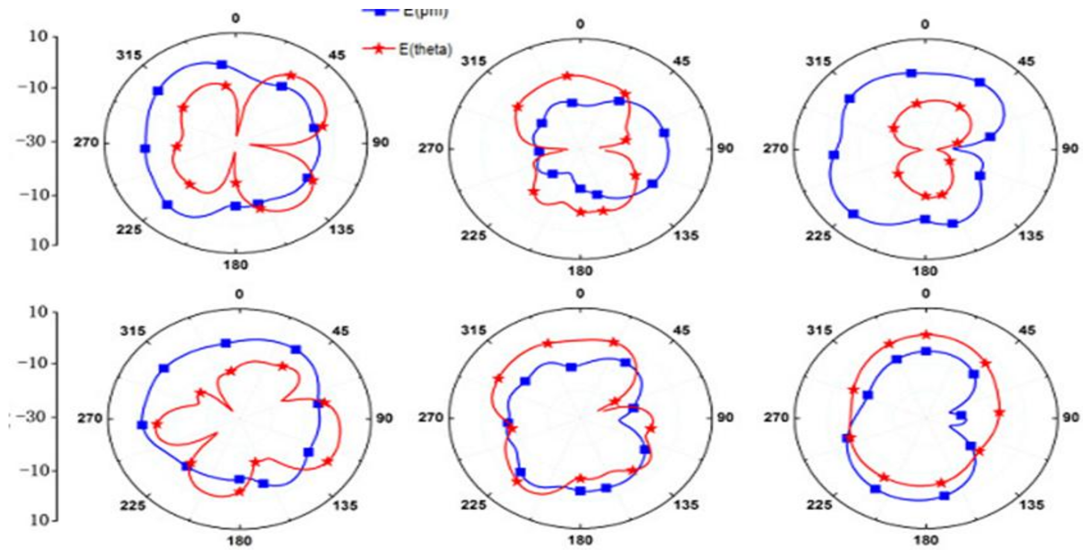

Figure.4. Radiation Pattern of Micro-strip Patch Antenna

The patch's form often raises or reduces the antenna's dimension. Figure.4 illustrates the outline of the antenna patch as the aperture for the antenna through which electromagnetic waves radiate over the edges of the antenna aperture. In reality, to sophisticate the radiation efficiency in which each patch has a different aperture, different dimensional values to maximize the antenna gain, there are different patch forms. Separate feeding mechanisms such as micro-strip line feeding, proximity coupled feeding, coaxial feeding, and aperture coupled feeding control the micro-strip printed antenna. The feeding of the micro-strip line is known to be the simplest to run the antenna among all feeding mechanisms. The simulation effects are addressed in Table 2 in order to examine the dual band micro-strip patch antenna.

Table 2: Simulation Results of Micro-strip Patch Antenna

SL. No.	Frequency (GHz)	Reflection Coefficient (dB)	Gain (dB)
1	27.2	-17.5	6.2
2	27.6	-24.2	8.2

4. Conclusion

The Proposed structure suggested providing a small micro-strip antenna for dual band service. The antenna resulted in S11 of -17.5dB at 27.2GHz for the single band, while the antenna resulted in S11 of -24.2dB at 27.6GHz for the dual band. At 27.2GHz and 8.2dB at 27.6GHz, the dual band culminated in a reasonable gain of 6.2dB. The antenna is shaped by combining four strips, which can provide 685-1012MHz, 1596-2837MHz, and 3288-3613MHz with three wide bandwidths. Normal LTE700/2300/2500, GSM850/900, DCS, PCS, UMTS, 2.4GHz WLAN, and 5G (3300–3600MHz) bands may be shielded. The suggested antenna is ideal for applications for LTE/4G/5G/WLAN operations on cell phones.

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