ARRAY MIKROSTRIP ANTENNA WITH TRIANGULAR PATCH USING DGS TECHNIQUE FOR MIMO 2X2 AT FREQUENCY OF 15 GHz

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***Abstract*—This paper proposes MIMO antenna for 5G communications. The antenna proposed in this paper is mimo 2x2 antenna using triangular patch. The antenna works at a frequency of 15 GHz. This paper use the DGS method with rhombus shape. The material used is Duroid Roger 5880 with Ɛr = 2,2 and a material of thickness 1,575 mm. Based on the simulation results, this antenna have bandwidth greater than 1 GHz over than frequency 14,5-15,5 GHz, and gain of 9,8 dB with radiation patterns is uni directional.**

***Keywords*—MIMO antenna, triangular patch, DGS method.**

I. INTRODUCTION

Wireless communication is growing more rapidly. Demand for peak data is also getting higher in order to meet the ever increasing needs which are increasingly driving the development of (fifth generation) technology 5G. At the moment developing fifth generation wireless communication (5G), 5G technology is being studied seriously. 5G technology is targeted to be used commercially in 2020. 5G technology is designed to have very low latency, very high peak data speeds, and greater capacity.

Until now, the 5G regulation has not been officially established by the ITU, but telecommunications operators have carried out several experiments in various frequencies, namely 6 GHz - 100 GHz to meet the minimum requirements for 5G technology. One of the 5G technology experiments that has been carried out is by the world telecommunication company, Erricson and NTT Docomo, which conducted trials at a frequency of 15 GHz [1]. At a frequency of 15 GHz the value of attenuation due to the influence of weather tends to be quite high. This is due to the high frequency and the resulting wavelengths are smaller, the signal will be vulnerable to reflection caused by waves propagating through larger objects that give rise to multipath fading [2]. To overcome some of these problems a system called MIMO (Multiple Input, Multiple Output) is needed. In order to meet the needs of the 5G wireless communication, this paper proposes array mikrostrip antenna with triangular patch using DGS technique at frequency of 15 GHz.

II. DESIGN AND CHARACTERISTICS OF THE ANTENNA

Figure 1 and figure 2 explain the form of antenna proposed in this paper. Mikrostrip antenna consist of ground plane layer, substrat, and triangular patch which connected to feed. Antenna design is simulated using material ROGER RT 5880, the material has a value ε_r of which is small and the thickness is quite thick. The thickness of the material affects the bandwidth produced by the antenna. thick material with a small ε_r value produces a wide bandwidth.

Besides that the antenna proposed in this paper is array antenna. Antennas arranged in an array to increase gain. On the ground plane section uses the Defected Ground Structure (DGS) technique with rhombus shape. The shape of the rhombus is a square shape rotated by 90 degrees. The DGS technique can reduce surface waves are undesired, which occur when patches emit radiation, some radiation gets trapped along the surface of the substrate. Surface waves are avoided when designing antennas because they can reduce gain, antenna efficiency and reduce bandwidth [3].

In array antennas, patch that interfere with other patch radiation are avoided because it affect other antenna parameter such as mutual coupling. The defected ground structure can reduce the value of mutual coupling in the antenna array [4].

This paper uses triangular patch because triangular patch have the same radiation characteristics as rectangular patch and square patch with smaller surface area than rectangular patch and square patch .

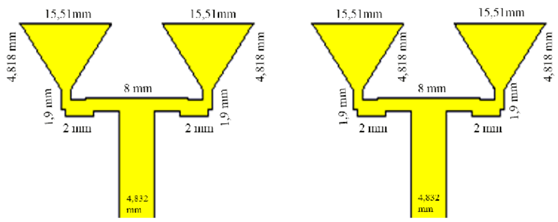

Fig 1. Antenna design front view

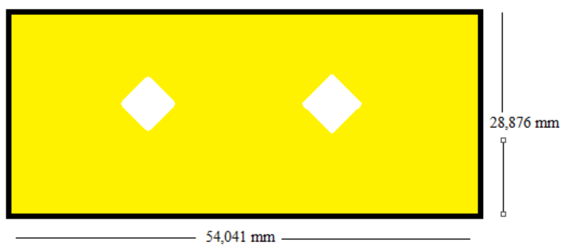

Fig 2. Antenna design ground view

III. RESULT AND DISCUSSION

Figure 3 shows a photo of the 2x2 mimo antenna gain simulation, fig 3 show antenna gain , based on the simulation results the antenna gain is 10,89 dB. From figure 3 , it can be concluded that the radiation pattern from the proposed antenna design is uni directional. Graph of return loss and insertion loss from antenna simulation results can be seen in figure 4 that is -20,039 dB for return loss with bandwidth of 1,449 GHz and -30,737 dB for insertion loss, while image 4 shows blue graph is insertion loss and red graph is return loss graph obtained from the simulation results.

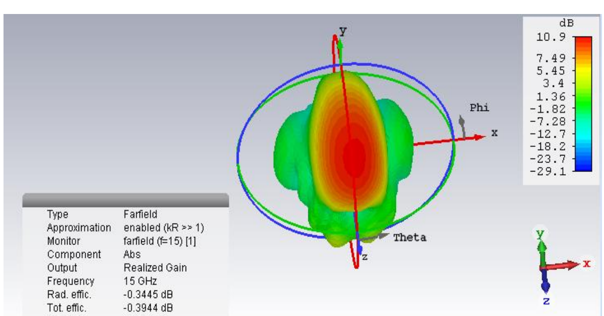

Fig 3. Simulated Antenna Gain.

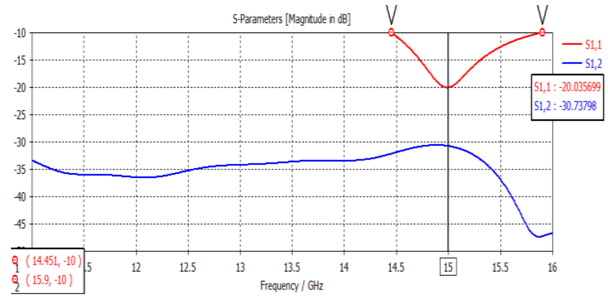

Fig 4. Simulated s-parameters

IV. CONCLUSION

Antenna with triangular patch using defected ground structure (DGS) technique for MIMO 2x2 with bandwidth enhancement is presented . By using triangular patch with defected ground structure (DGS), the ground plane cut in rhombus shape can produce a bandwidth of 1449 MHz at frequency 14,451 GHz - 15,9 GHz with middle frekuency 15 GHz , besides that the rhombus DGS designed on the proposed antenna can reduce the value of mutual coupling. Based on the simulation results the value of mutual coupling obtained is < -30dB. In addition, antennas arranged in array 1x2 and mimo can increase the gain, in this paper array techniques can obtain gain 10,89 dB at frequency of 15 GHz.

REFERENCES

1. K. e. a. Tateishi, “Field Experiments on 5G Radio Access Using 15 GHz Band in Outdoor Small Cell Enviroment,” IEEE PIMRC, vol. 26, pp. 851-855, 2015.
2. K. J. Sinaga, Perancangan dan Realisasi Antena MIMO 4x4 Array Rectangular Patch Dengan U-Slot Untuk Aplikasi 15 GHz, Bandung: Telkom University, 2017.
3. Zulkifli, F.Y., Rahardjo, E. T. and Hartanto, D., “Radiation properties enhancement of triangular patch microstrip antenna array using hexagonal defected ground structure”, Progress in Electromagnetics Research, vol. 5, 101 –109, 2008
4. Guha,D., Biswas, M. and Antar, Y.M.M, “Microstrip patch antenna with defected ground structure for cross polarization suppression”, IEEE Antenna and Wireless Propagation Lett, Vol.4, pp.455 –458, 2005.