Microstrip Grid Array Antenna for 5G Applications

P. Sai Sameera, M. Usha

***Abstract:** A Compact microstrip grid array antenna is designed for 5G applications. A microstrip grid array antenna is designed because it provides more gain than regular microstrip patch antenna. The geometric of the proposed grid array antenna is 26 ×26 mm^2 in length and width of the antenna. Rogers Duroid 5880 with ε_r=2.2 and loss tangent tan δ =0.0009 is used as substrate and height of the substrate is 0.381mm.The proposed antenna has a reflection coefficient, s11 of -32.0369 dB and Gain of 12.858dBi at 28 GHz. As the proposed antenna has higher gain it can be used for 5G applications.*

***Keywords:** Microstrip Antenna, Microstrip Grid Array Antenna, Milli-Meter Wave Band, 5G.*

I. INTRODUCTION

In the recent years there has been an exponential raise in the number of internet users which lead to increase in the demand for mobile data connections and higher data rates for different ongoing and upcoming applications. Due to increase in the number of user the existing communications spectrum (3 KHz-6GHz) has became congested causing slower connection and more dropped connections but users want even more data for their smart devices [1]. In order to meet the demands in the next generation wireless communication network, signals are going to be transmitted in a whole new swath of spectrum, one that's never been used for mobile service before, i.e. spectrum above 6Ghz. Using High frequency millimetre wave band, ranging from 6-300Ghz for providing communication is the main essence of 5G. Even a small fraction of available millimetre wave spectrum can support hundreds of times of more data rate and capacity over the current cellular spectrum [2,3].

The grid array antenna was first proposed by Kraus in 1964 and it is first implemented by Conti in 1981.It has all the benefits of usual patch array antenna such as compact size, easy fabrication, comfortable structure, light weight, low cost and have additional benefits i.e., microstrip grid array antenna has higher gain, higher appature efficiency and lower cross-polarisation level. Microstrip grid array antennas consist of several small rectangular cells called grids, The long side of this grid acts as guiding line or transmission line and the short side of the grid acts as the radiating elements this is because, the current on each long side of grid is out-of phase so that both currents cancel each other and the currents on each short side are in-phase so they act as radiators.

The details of the proposed antenna are presented in section 2, section 3 presents the results of the antenna and final conclusion is in section 4.

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P. Sai Sameera, M.Tech Student, Acharya Nagarjuna University College of Engineering and Technology, Guntur (A.P.), India. E-mail: pulimisameera@gmail.com

M. Usha, Assistant Professor, Acharya Nagarjuna University College of Engineering and Technology, Guntur (A.P.), India.

II. MICROSTRIP GRID ARRAY ANTENNA OPERATING AT 28GHZ

The fig 2 shows the proposed microstrip grid array antenna at 28 GHz. The geometries of the antenna are 26mm×26mm×0.381mm in length, width and height of the antenna. The number of grid cells in the antenna controls the directivity of the antenna, this microstrip grid array antenna consists of 9 grid cells, 14 short sides and have 14 radiating elements.

The length and width of each grid cell depends on the resonant frequency and substrate material. The long side, l of each rectangular grid should be approximately equal to guided wavelength,

$$l = \lambda_g = \frac{\lambda_0}{\sqrt{\varepsilon_{eff}}} = \frac{10.71}{\sqrt{1.83}} = 7.9mm$$

and the short side length, s should be approximately equal to half of the guided wavelength,

$$s = \lambda_g/2 = \frac{l}{2} = \frac{7.9}{2} = 3.95mm$$

[4, 5]. In this antenna the length of the long side $\boldsymbol{l}$ **=8 mm (≈ 7.9mm),** and the length of the short side $\boldsymbol{s}$ **=4mm (≈ 3.95mm)**. The width of the long side, w_l and short side, w_s of the grid cell can be chosen for better transmission and desired amplitude taper on the array respectively. For the proposed Antenna width of the long side, w_l is taken as **1mm** and width of the short side, w_s is taken as **1.25mm** [6, 7, 8]. A single grid cell is shown in fig 1

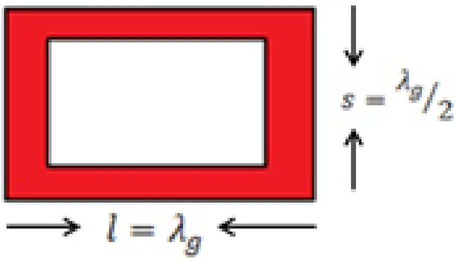

Fig. 1 Rectangular Grid Cell

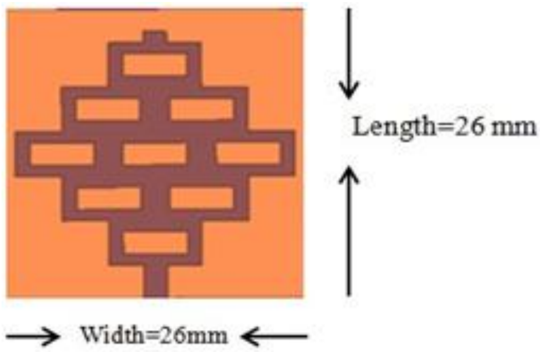

Fig. 2 Proposed Antenna

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III. RESULTS

Fig 3 shows the simulated S_{11} of the antenna. Minimum reflection loss occurs at 28 GHz and it is -32dB. The Proposed Antenna has a bandwidth of 1 GB. Fig 4 shows the gain of antenna, maximum gain of this antenna is 12.858 dB. The proposed antenna has better Gain and S_{11} values at 28GHz than those in ref [6]. Simulated total gain is shown in fig 5.The proposed antenna has a total gain of 19.312.

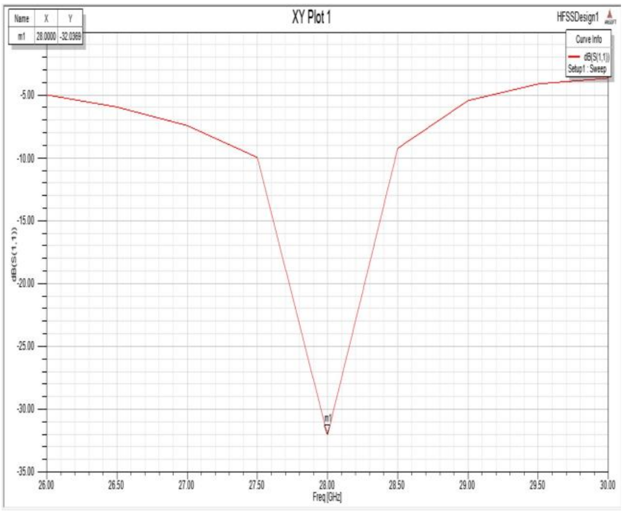

Fig. 3 The Simulated $|s_{11}|$ of The Proposed Grid Array Antenna

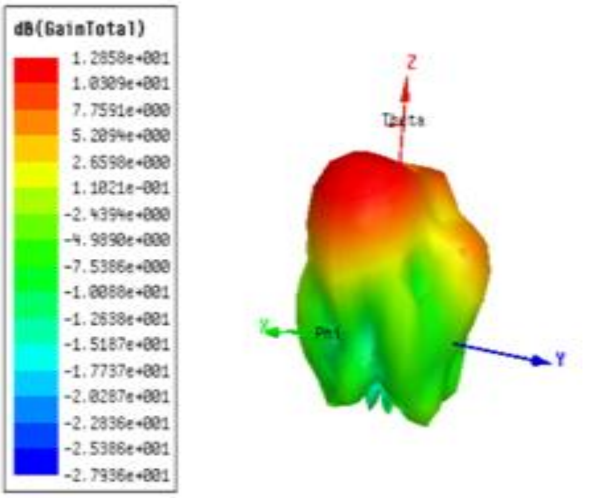

Fig. 4 The Simulated Gain in dBi of The Proposed Grid Array Antenna

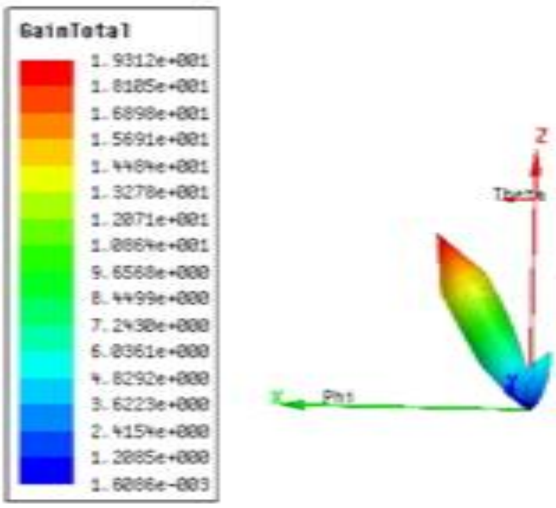

Fig.5 Total Gain of The Proposed Grid Array Antenna

IV. CONCLUTION

A compact, low cost, simple microstrip grid array antenna with operating frequency as 28 GHz is designed and presented in this paper. The gain and Reflection co efficient of the proposed antenna is 12.858 dBi and -32.0369 dB respectively. The proposed antenna has more gain reflection coefficient than other microstrip antennas operating at 28Ghz [6]. This antenna has good gain, Reflection coefficient at 28 GHz and has operating frequency in millimetre wave range this antenna can be used in 5_{th} Generation wireless systems (5G).

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