Simulation of Rectangular Microstrip Antennas and the Effect of Variable Frequencies and Performance Analysis

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***Abstract* -The analysis paper is predicated on the study of appropriate Simulation of microstrip antennas for 5G technology for the utilization of telecommunication applications. Mobile users want a lot of options on their mobile phones akin to high knowledge rate, economical telecommunication, and luxury to use varied applications. The antennas' carrying out in terms of reflection coefficient, (VSWR), bandwidth, gain, and efficiency performance are simulated four designs assumed, and compared using Studio Suite Antenna magus (CST, 2021). technology provides very high bandwidth, reduced latency better Quality of Service, this rectangular microstrip patch antenna is used in this Simulation because it is a basic antenna and easy to design, we utilized FR4-Generic substrate material with varying relative permittivity has been designed, the other hand, optimum capacity, and a wide band of spectrum availability furthermore demand to occur for mobile telecommunication. we utilized Simulation of various frequencies 4.8 GHz5.8 GHz, 6.4 GHz and 7.2 GHz. However, these four designs patch antenna dimensions were slightly different from each other.in addition, we analyze the effect of variable frequencies and Performance Analysis, also analysis of various dimensions of an antenna. The impedance ratings were slightly higher, respectively, and gain it was accepted,7.219 dbi,7.233dbi,7.227dbi, and 7.252dbi, also VSWR 1.017, are as well considered which is examine whether the microstrip patch antenna design is appropriate for 5G.**

***Keywords* --Microstrip antenna, rectangular patch antenna, Efficiency, gain,5G**

I. INTRODUCTION

Microstrip patch antennas (MSPA) are becoming more popular in wireless applications due to their low-profile design. built-in antennas in portable wireless devices such as mobile phones and communication antennas on missiles. Because they must be tiny and conformal. One of the challenging issues is to design compact, high-performance, and wideband antennas. In moving toward to fifth-generation (5G) network, many studies have been conducted on (MSPA) that are because of their compactness, cheap and fast manufacturing. The attenuation of the materialistic dimension of an antenna implies a harmonic increase frequency. the main idea of miniaturization is to shift the resonance to lower frequencies to reap an electrically small antenna. the layout of the antenna had visible a vast project due to the speedy development in (WiMAX) and communique structures. Patch antenna designs had demonstrated because the first-class option to be utilized in wireless communique gadgets with many advantages which includes light-weight, planar shape, small size, low profile, and compatibility with microwave integrated circuits (MICs). also, concerning international Interoperability for Microwave access (WiMAX) in this survey, we utilized FR4-Generic substrates materials with varying relative permittivity has been designed in this antenna the substrate thickness it same 1.10 mm and by calculating the area of each antenna, the following became clear sloped down as the frequency increases, the area decreases from 286.99mm2 in frequency 4.8 GHz to 130.57mm2 in frequency 7.2GHz respectively under different frequencies , 4.8 GHz,5.8 GHz 6.4 GHz, and 7.2 GHz. The dimensions of this patch antenna were slightly different from each other. In addition, we analyze the effect of variable frequencies and performance analysis, as well as measurements of various parameters of the antenna design. The impedance ratings were slightly higher, respectively, and the gain, 7.219 dBm, 7.233 dBm, 7.227 dBm, and 7.252 dBm, also VSWR 1.017, 1.074,1.072,1.049 was accepted and checked It grew to become out the microstrip patch antenna layout is appropriate for a 5G network.

II. PROPOSED RECTANGULAR ANTENNA

The goal is to own a high advantage and performance to make sure that the foremost records switches in any wireless communication devices space antenna are the amount one requirement. once birth out any microstrip patch antenna, several improvement ways are used, and twin feed. Wide information measure antennas are applied for a huge type of community frequencies, that are larger and inexperienced for a few distance space implementations. section distinction is simple to maintain the foremost common issue in wireless communication devices is the orientation of receivers and transmitters. Multiband operation and antenna length miniaturization could also be performed by utilizing the noted options of self-similarity and area filling.

The important three layout parameters of the antenna are the ringing recurrence (fr), the relative permittivity of the substrate (Er), and the density of the substrate (h). The ringing recurrence of the antenna needs to be appropriate for the WiMAX. In these four designs, the parameters' different frequencies are 4.8 GHz,5.8 GHz 6.4 GHz, and 7.2 GHz, also substrate (Er) 4.35, substrate (h) 1.10mm, a loss tangent (tanδ) of 0.00013.

Microstrip patches become explained and simulated usage of the present-day model for Studio Suite Antenna magus (CST, 2021). to take a look at the overall achievement parameters of the radiating patch element. The device has been validated to have higher reliability and accuracy to assess the antenna layout parameters which include mirrored image coefficient, efficiency, gain, creativity, radiated power, powerful angle, etc. The width

and duration of the proposed antenna to be operated are different frequencies 4.8GHz.5.8GHz,6.4GHz, and 7.2GHz Here we're taking FR4-Generic dielectric cloth which has a dielectric consistency of (Er) 4.35, and the top of high substrate (h)is taken as 1.15 mm,1.05mm,0.95mm,0.90mm The Operating different Frequency of the antenna is chosen for WIMAX applications.

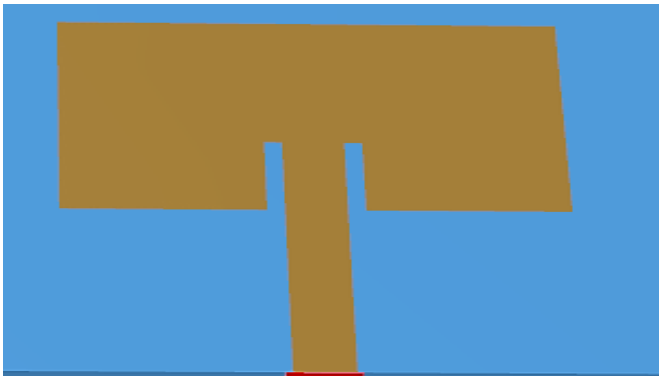

Fig. 1. Shape Rectangular Patch.

TABLE I. ANTENNA DESIGN PARAMETERS

Frequency	substrates material	substrate (h)	patch area W×L	Feed line area WF×LF
4.8 GHz	FR4-Generic	1.15 mm	286.99 mm^2	2.217×17.20 mm
5.8 GHz	FR4-Generic	1.05 mm	198.35 mm^2	2.025×14.23 mm
6.4 GHz	FR4-Generic	0.95 mm	163.26 mm^2	1.832×12.90 mm
7.2 GHz	FR4-Generic	0.90 mm	130.57 mm^2	1.639×11.46 mm

III. SIMULATION OUTCOME

The four antennas layout for the (MSPA) was analyzed and simulated utilizing of the Studio Suite Antenna magus (CST, 2021) To examine the overall performance parameters of the various designed antennas. This device has tested to have higher reliability and accuracy to assess the antenna layout parameters inclusive of mirrored image coefficient, efficiency, gain, directivity, radiated power, powerful angle, etc., The width and period of the proposed antenna to be operated at many frequencies It turned into referred to formerly are located the use of the analytical expression given through the above-referred to equations.

A. Antenna Performance Parameters

Radiation efficiency, which indicates or mensuration the amounts of the losses in the antenna, is definite as the percent or ratio of radiated power (Pr) from the patch antenna to input power (Pi) for the same antenna. The input power (Pi) is converted to radiant power, surface wave energy, and a small fraction dissipated due to dielectric losses and conductors. Another important parameter of an antenna it contains much data that is significant in the design is the bandwidth, in general principle, most of the time, the impedance matching or return loss bandwidth is identified to measure the antenna bandwidth. it is equal to 960 MHz,1.16 GHz, 1.28 GHz, and 1.44 GHz, also expressed by percent %, We also explain some other outputs frequency values at minimum VSWR, Max gains, and Impedance Imaginary As shown in the following table No.2.

TABLE II. ANTENNA PERFORMANCE PARAMETERS

Frequency	4.8 GHz	5.8 GHz	6.4 GHz	7.2 GHz
VSWR	1.017	1.074	1.072	1.049
Frequency value at minimum VSWR	4.748 GHz	5.740 GHz	6.333 GHz	7.116 GHz
BW	960 MHz	1.16 GHz	1.28 GHz	1.44 GHz
BW below 2.0 level	78.73 MHz	108.8 MHz	119.9 MHz	135.4 MHz
Impedance Imaginary	52 Ω	53 Ω	53.6 Ω	54 Ω
Max gain	7.219 dBi	7.233 dBi	7.227 dBi	7.252 dBi
minimum S parameter value	-41.34 dB	-28.92 dB	-29.18 dB	-32.36 dB
Frequency value at minimum S parameter	4.768 GHz	5.760 GHz	6.355 GHz	7.156 GHz
Beamwidth (a above 10.0 dB below peak level) ϕ= 0° & ϕ= 90°	77.77° & 90.18°	77.12° & 90.61°	77.08° & 90.61°	76.11° & 90.44°

B. S Parameters

The S11 defines the energy transmitted from port one to port one itself, for this reason defining the mirrored image withinside the antenna.

For most radiation, the mirrored image has to be as much less feasible to make the antenna extra efficient. The S11 parameter decreased to -20 dB with a value of -41.43 dB on the ringing recurrence of 4.8 GHz, -28.92 dB on the ringing recurrence of 5.8 GHz, -29.18 dB on the ringing recurrence of 6.4 GHz, finally -32.36 dB on the ringing recurrence 7.2 GHz.

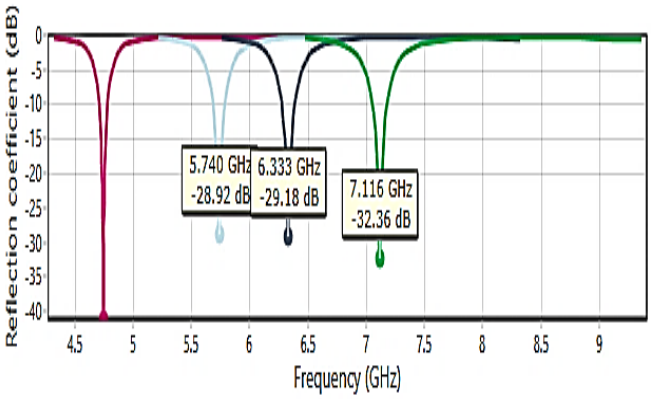

Fig. 2. minimum S parameters(S11)

C. VSWR

Additionally, the excellent significance parameter of an antenna is the reflection coefficient of the antenna inputs. It is definite as the ratio of the reflected current (Ir) or voltage (Vr) to the incident current (Ii) or voltage (Vi), as in S11, where the patch antenna is an analyzer. It is the measure of the impedance of a failure to correspond (mismatch) between the antenna input and the feed source. The unit of measurement of mismatch is usually described in terms of a return loss S11 or voltage standing wave ratio (VSWR), And after comparing the results, it becomes clear that they are all acceptable, with a preference for frequency 4.8 GHz which equals 1.017 as shown in the figures.

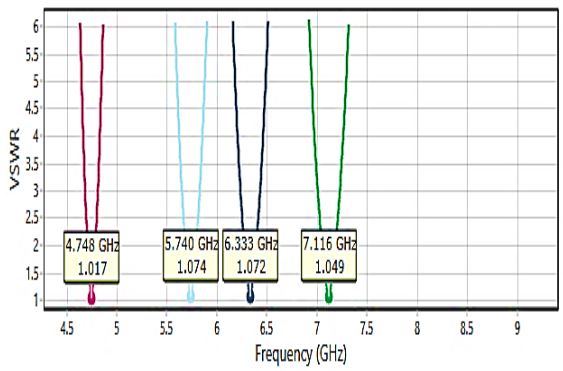

Fig. 3. Voltage Standing Wave Ratio simulation

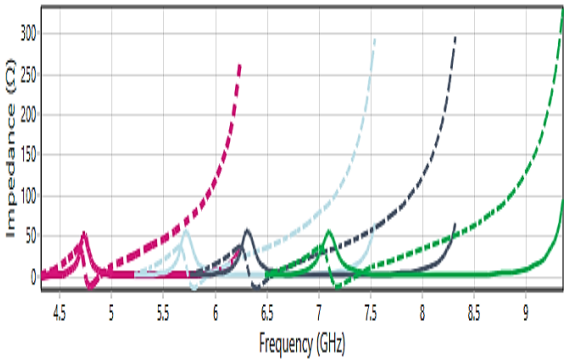

Fig. 4. the average impedance value of data

D. TOTAL GAIN

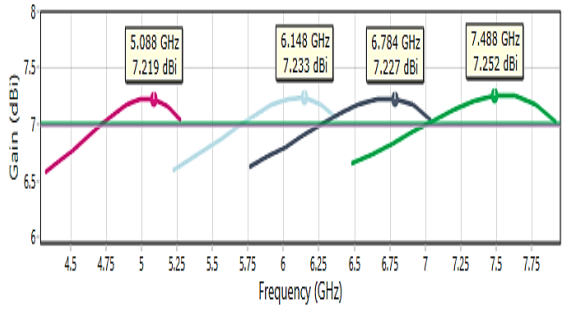

Fig. 5. the average gain value and frequency maximum gain value of data

E. SMITH CHART

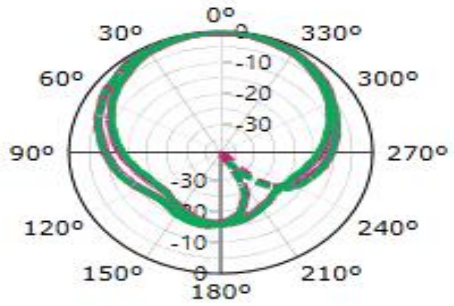

Fig. 6. maximum gain value when $\emptyset = 0^{\circ}$ *and* $\emptyset = 90^{\circ}$

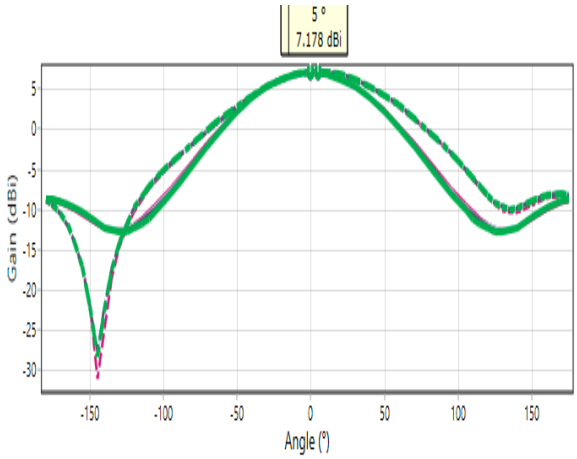

Fig. 7. maximum gain value when $\emptyset = 0^{\circ}$ *and* $\emptyset = 90^{\circ}$

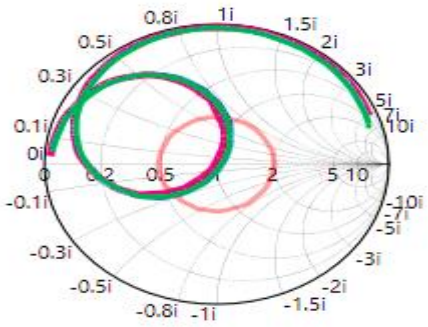

Fig. 8. input impedance smith chart

F. 3D GAIN radiation pattern

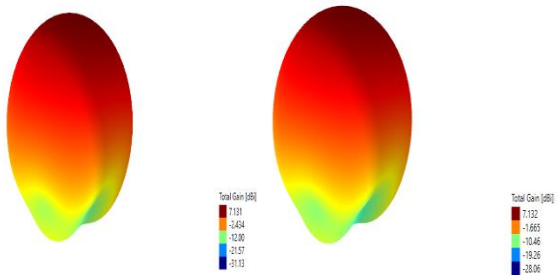

Fig. 9. 3-D radiation pattern of antenna Simulation Results 4.6 GHz, and 5.8 GHz.

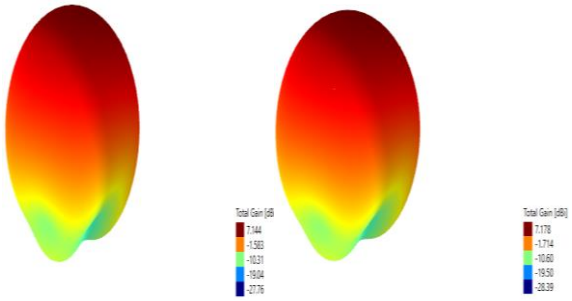

Fig. 10. 3-D radiation pattern of antenna Simulation Results 6.4 GHz and 7.2 GHz.

CONCLUSION

in this study, A rectangular (MSA) has been proposed for 5G packages in reaction to the developing call for cellular data and cellular devices. with designs of four patch antennas with four different frequencies This antenna has a resonance frequency of 4.8 GHz,5.8 GHz, 6.4 GHz, and 7.2 GHz for which VSWR respectively equals 1.017,1.074. 1.072 and 1.049. also, the bandwidth respectively equals 960MHz, 1.16 GHz, 1.28 GHz, and 1.44 GHz (relative operational band 20%), and the average gain value is approximately 7.23 dBi. the data shows that with the diversity of frequency the antennas carry out well.

CONTRUBITION OF THE AUTHORS

The contributions of the authors to the article are equal.

CONFLICT OF INTEREST

There is no conflict of interest between the authors.

STATEMENT OF RESEARCH AND PUBLICATION ETHICS

Research and publication ethics were observed in this study

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