Performance Comparison Of Triangle Antenna of 60 GHz for 5G Wireless Communication Network

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Abstract-In this paper microstrip triangle with slot antenna for 5G wireless communication network are proposed. The microstip triangle antenna is design and operating 60 GHz milimeter-wave frequency band and it's suitable for 5G wireless communication. The substrates are chosen in the design, which are RogerRT5880 with copper thickness 0.035 mm to analyze their effect toward milimeter-wave performance on the designed. The designed and analysis is performed by using CST Microwave Studio.The lowest return loss of the antenna is -24.75dB which is triangle with slot and the maximum gain obtained is 6.82 db at the 59.68GHz for this antenna. The antenna is considering the gain, return loss and size, the microstrip antenna can be a suitable candidate for the 5G wireless application for short range high speed communication.

1. Introduction

The current status of the 5G technology for wireless systems is very much in recent development stages.5G technology for wireless system will probably start to come to awareness around 2020 with deployment following on afterwards. The wireless communication is development of target microstrip antenna is a thrilling research interest nowadays and many techniques have been proposed to improve their performance. The 4G wireless communication systems have already been initiated in some of the countries and are going to be in other soon. However, the problem and challenges of spectrum scarcity and power consumption still persist even with the presence of 4G systems [1]. Therefore the need for 5G wireless system came in order to solve the issues and the requirement of high data rate and mobility to solve the challenges the research on 5th generation wireless system is going on the expected to be accomplished by 2020[1].

Most of the technologies to be used for 5G will commence to come in the systems used for 4G and then as the new 5G cellular system starts to formulate in a more concrete manner, they will incorporated into the new 5G cellular system[5]. The main issues with 5G technology is that there is such a extremely wide variation in the requirement, superfast downloads to small data requirements for IoT than any one system will not capable to meet these needs. Accordingly a layer approach is likely to be adopted. As well say, 5G is not just a mobile technology, it is ubiquitous access to high & low data rate services. Through the second half 2014, 5G technology include all sort of advance features which will make it most powerful and in huge demand in near future. Nevertheless, the several between 4G and 5G techniques from a user point of view is increased data rate and less power usage with better coverage. 5G system may take the wireless signals to a higher frequency range of 30 to 300 gigahertz (GHz) and will reduce the wavelength from centimeter to millimeter[2]. One of the challenges is the technology may face is attenuation of line of sight communication is not possible between transmitter and receiver. Proposed antenna could provide the communication for future 5G network application which has a faster data rate. Furthermore millimeter wave bands could relieve congestion and reduce demand for spectrum in frequency bands below 5 GHz. Microstrip antennas for wireless system application in operates 60GHz is proposed which has a faster data rate and high gain. The gain is enhanced by inserting the slot into the patch and the most optimized results are discussed in the following sections.

2. Antenna and Design Geometry

Based on the several parameter studies, the geometry of the triangle antenna for 60 GHz band are proposed is shown in the figure 2. The proposed antenna is compare between of a triangle patch antenna without slot and triangle antenna slot inside the patch.

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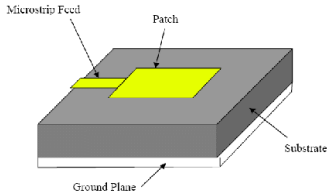

Figure 1:

Figure 1 : Basic microstip patch antenna

To compute the resonant frequency of an equilateral triangle patch, at the lowest-order resonant frequency f_r, the side length a, can be given by (1) and placed at the distance of h mm (substrate thickness) away from the ground plane. The chosen substrate material is 0.127mm thick RogerRT5880 dielectric board with a dielectric constant of 2.2 and loss tangent 0.0009. The printed circuit board (PCB) material has some advantage such as low dielectric torelance and loss, stable electric property against frequency and thus it is better choice for high frequency operation.

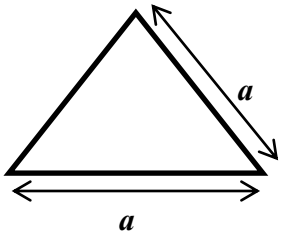

Figure 2 : Theoretical design parameter for triangle antenna.

$$a = \frac{2c}{3f_r\sqrt{\varepsilon_r}} \quad (1)$$

$$C = 3 \times 10^8 \quad (2)$$

Based on the formula above, theoritically calculated both side (a) of top radiating patch for 60 GHz resonance are found to be 2 mm and 0.5 mm, respectively. However, the dimension have been adjusted and optimized to meet requrement of the resonant frequency and other characteristics. The design paramaters are obtained from several parametric studies and suitable patch and slot size are selected for a high gain, wideband 60 GHz antenna.

Table 1 : Initial Design Paremeter

Parameter	Value
Thickness (h)	0.127 mm
Dielectric constant (ε_r)	2.20
Loss tangent	0.0009
Patch Size (a_1 x a_2)	2.02 x 2.2 mm^2
Ground Plane (W_g x L_g)	3.6 x 4.3 mm^2
Total Antenna Profile	3.6 x 4.3 x 0.127 mm^2
Substrate	Roger RT5880

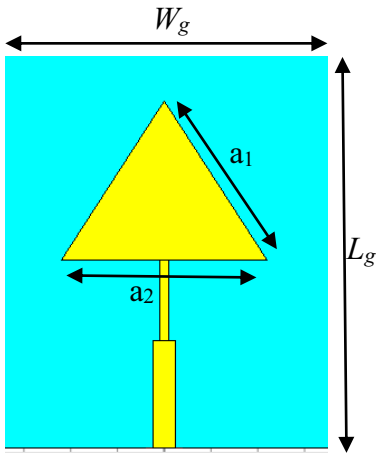

Figure 3 : Geometry and dimension of proposed antenna.

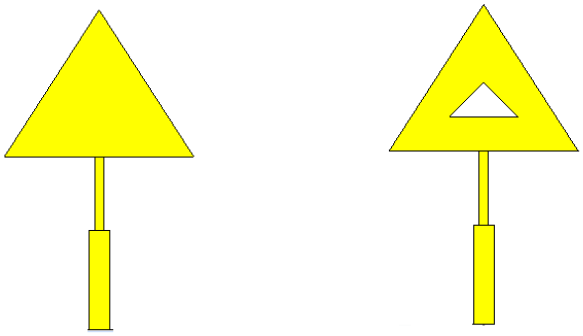

Figure 4 : Proposed design of triangle antenna without slot and with slot

3. Simulation and Result

The simulation of the proposed antenna is performed using Computer Simulation Technology (CST) Microwave Studio commercial software program. The simulated results of the reflection coefficients $|S_{11}|$ for the proposed milimeter-wave antenna are illustrated in Fig. 4. It is apparent that the proposed antenna can cover millimeter-wave bands of 60 GHz for $|S_{11}|$ less than -10. The simulated maximum realized gain of the proposed antenna . A stable gain for triangle without slot antenna with a value 4.55 dB in the frequency at 61.75 GHz and with return loss -14.76dB is observed and gain at 6.82 db for triangle antenna with slot frequency at 59.68 GHz with -24.75 db return loss, Simulated results demonstrate that the antenna is characterized by omnidirectional patterns.

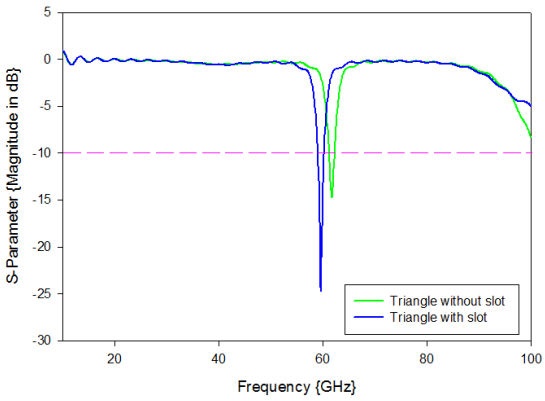

Figure 5 : Comparison of reflection coefficient S_{11} versus frequency between triangle without slot and with slot .

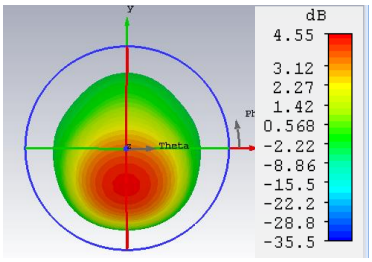

Figure 6(a) : Simulation radiation pattern plot for triangle without slot

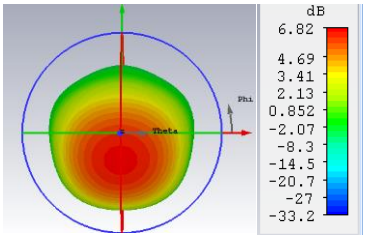

Figure 6(b) : Simulation radiation pattern plot for triangle with slot

4. Conclusion

In this paper, the triangle antenna for wireless application at 60 GHz is proposed. The antenna configuration is designed and analyzed by using the CST Studio Suite 2016 based on the finite element method. Several parametric studies have been performed to obtain a better combination of design parameters. From the anaylsis, its can be concluded that the insert the slot at the antenna can influence the return loss, gain and frequency. The triangle with slot antenna has a good result of return loss ,S_{11} compare to triangle without antenna. As we can see, the result of simulation antenna are achieved for the 5G wireless communication

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