DESIGN OF DUAL-BAND MICROSTRIP PATCH ANTENNA FOR 5G APPLICATIONS

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Keywords:

Microstrip Patch antenna, dual band, 5G.

Introduction:

The rapid evolution of wireless communication systems has led to the emergence of 5G technology, which offers significantly higher data rates, ultra-low latency, and enhanced connectivity compared to previous generations. To support these advanced features, efficient and compact antenna designs are essential, particularly for operation in dual, triple and multiple frequency bands. Microstrip patch antennas have gained considerable attention due to their low profile, light weight, ease of fabrication, and compatibility with integrated circuits. These antennas are widely used in modern wireless devices, including smartphones, IoT systems, and base stations. However, conventional single-band antennas are not sufficient to meet the requirements of 5G systems. To address this challenge, dual-band microstrip patch antennas are designed to operate at two distinct frequencies, enabling support for multiple communication standards within a single antenna structure. This reduces system complexity, size, and cost while improving overall performance. In the context of 5G, dual-band antennas are particularly useful for covering sub-6 GHz frequency bands such as n78(3.3 GHz & 3.8GHz), n77(3.3 GHz & 4.2GHz) and n41(2.5GHz & 2.69GHz).

Objectives:

1. To design a dual-band microstrip patch antenna.
2. To achieve operation in sub-6 GHz 5G bands.
3. To improve bandwidth and gain.
4. To ensure good return loss and radiation pattern.
5. Validate on Vector Network Analyzer after fabrication.

Methodology:

The project aims at obtaining two resonant frequencies from the rectangular microstrip patch antenna. The rectangular microstrip patch antenna uses FR4 substrate due to its inexpensive cost and easy availability. It has a dielectric constant of 4.4, a height of 1.6 mm is selected and a loss tangent of 0.02, fed by means of a quarter wave matching transformer. Length of the patch antenna is, Lp = 18.3 mm. Width of the patch antenna is Wp=21.3 mm.

Quarterwave transformer's length is Lt=7.5mm while width Wt = 1.2mm. Additionally, the feed length (Lf) of microstrip line is 7.5 mm, and the feed width (Wf) is 3.16 mm. Normally a single rectangular patch antenna gives single resonance based on the Length of the patch antenna when centre feed.

Here we take the advantage of width and change the centre fed to offset fed and obtain the two resonances resulting in dual band. The figure 1 shows the offset feed rectangular microstrip patch antenna. From the centre a offset of 6mm is chosen for obtaining the dual bands.

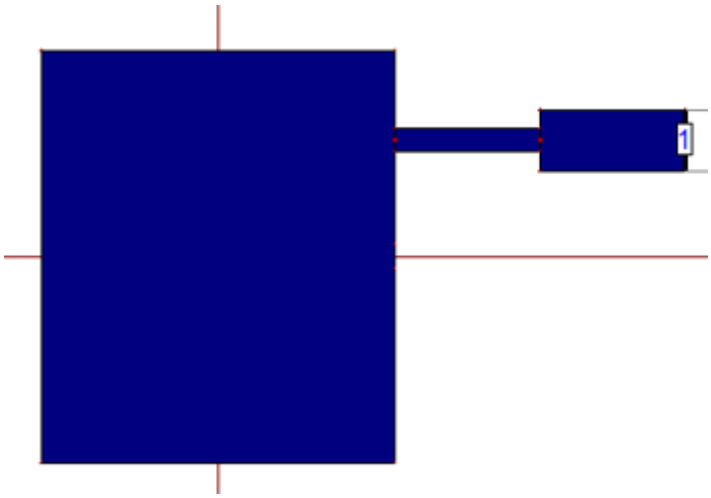

Figure 1: Geometry of the patch antenna

Result and Conclusion:

The proposed antenna is simulated using mentor graphics 3DEM software. Figure 2 shows the return loss characteristics of the antenna, resonates at 3.3GHz with return loss of -11.05 dB providing a bandwidth of 31 MHz. Further, it also resonates at 3.8 GHz with return loss of -14.6dB providing bandwidth of 103 MHz.

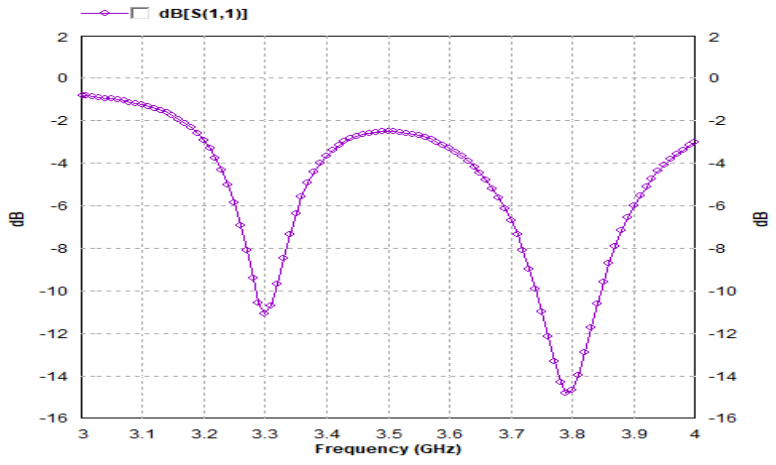

Figure 2: Return Loss Characteristics of the proposed antenna

Figure 3 shows the gain of the antenna. At 3.3GHz the gain is found to be 1.93dBi and at 3.8GHz the gain is found to be 2.2dBi.

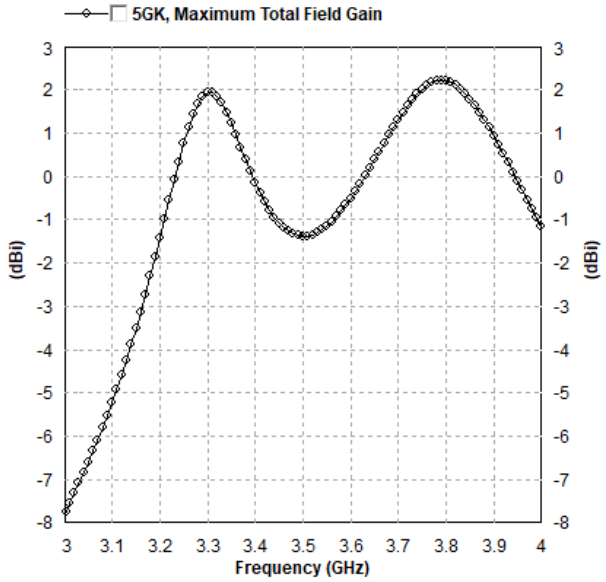

Figure 3: Gain Versus Frequency Plot of the proposed antenna

In conclusion, a simple and impactful technique to obtain a dual band antenna is given and can be extended for any dual band patch antenna design irrespective of their frequency of separation.

References:

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Future Scope:

The future scope of this project includes

1. Fabrication of the patch antenna and validation
2. Realising different Dual band Pairs
3. Increase the gain and efficiency of the antenna using different substrates.