Chapter 3
Design and Analysis of Rectangular Microstrip Patch Array Antenna on 28 GHz Band for Future of 5G

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ABSTRACT

The narrow beam widths generally associated with antennas at higher frequencies has led to the study of using advanced multiple-input multiple-output (MIMO) and adaptive beam-forming. These antenna technologies are overcoming some of the challenging propagation characteristics of mm waves and could increase the spectrum efficiency, provide higher data rates, and adequate reasonable coverage for mobile broadband services. With the potential for higher 10+GHz frequencies as well as mm waves deployment, most 5G candidates bands in 20 to 50 GHz. The frequency band of 5G is proposed and demonstrated above 24GHz such as 28GHz to 38GHz. In this chapter, the authors present a design of 28GHz for 4 Elements microstrip patch array antenna for future fifth generation (5G) mobile-phone applications. The designed antenna can be implemented using low cost FR-4 substrates, while maintaining good performance in terms of gain and efficiency. In addition, the simulated results show that the antenna has the S11 response less than -10 dB in the frequency range of 22 to 34 GHz.

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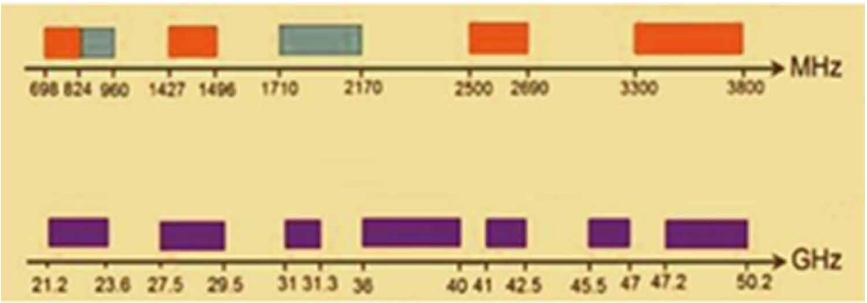
INTRODUCTION

Global system of mobile communication has many developments starting from 1980 (1G) passes by many modifications till 2010 that resulted in 4G. These versions introduce many services including voice, text, and multi-media. 3G & long term evolution (LTE) have the characteristics of transmitting and receiving data with high rate. However, there is an increasing demand on that rate to become higher and higher to reply that requirement. So, we are going forward towards next generation, 5G, which will integrate all different technologies in such a way that the global service will be enhanced. These services include higher mobile data volume per area, huge number of connected devices, longer battery life for low power devices, five times reduce end to end latency and user data rate which is higher 10 to 100 times than the existing one. Fifth generation till now has no unique definition (Andrews, 2014) and it is expected to be in use in 2020. Compared with 4G systems, one of the major differences in 5G cellular systems is the shift to higher frequencies where is easier to obtain wider bandwidths. As illustrated in Figure 1, the centimeter/millimeter wave bands could provide bandwidths several times broader than 3G and 4G frequency bands (Rappaport, 2013). Therefore, the centimeter/millimeter wave bands can support the higher data rates required by applications in the future. In addition, there are different Frequency band candidates that could be potentially used for 5G, and research activities can be found in all of these bands.

However, moving to these centimeter/millimeter wave bands would bring new challenges in the designs of antennas for mobile devices (Rajagopal, 2011). Microstrip patch antennas are quite and an obvious choice for wireless devices such as low cost, lightweight & volume. The microstrip antennas are low profile, simple and very versatile in terms of resonant frequency, polarization, pattern, and impedance. These antennas can be mounted on the surface of high-performance aircraft, spacecraft, satellites, missiles, cars, and even handheld mobile telephones. Without major modification and arrays of these antennas can simply be produced (Balanis, 1997). Microstrip antennas are very versatile and are used, among other things, to synthesize a required pattern that cannot be achieved with a single element. In addition, they are used to scan the beam of an antenna system, increase the directivity, and perform various other functions which would be difficult with any one single element.

The elements can be fed by a single line or by multiple lines in a feed network arrangement, so in this Chapter we used an array to develop the performance of this antenna (Garg, 2000). Several researchers gave a lot of attention to the subject; Legacy antennas cannot be effectively and efficiently used in future

Figure 1. 3G and LTE bands and proposals spectrum for 5G 20-50 GHz



Frequency Bands in MHz used for conventional Mobile.
Frequency Bands in GHz proposed for 5G Mobile system.FL:27500.5,FH:28394.5