CIRCULAR ANTENNA FOR WIRELESS COMMUNICATION

[1]V.Sumitha, [2]A.Sangeetha, [3]P.Priya, [4]N.Porchelvi
[1]sumithajanani@gmail.com, [2]srijaajay303@gmail.com, [3]ruthriyas@gmail.com, [4]Jeeva.selvi@gmail.com

Abstract: A new wireless standard long term evolution (LTE) technologies has been proposed to operate under the range of 700 MHz spectrum, due to lower operating frequencies of LTE system compared with existing Wi-Fi and cellular standards. The antenna should be small in size electrically to cover higher operating frequency. This provides inefficient and limitation in the coverage area of the system. To avoid strong mutual coupling between the two closely packed mobile antennas, one possible solution would be the orthogonally proposed MIMO antenna. Usually most of the antennas for a wireless application designed by using PIFA or micro strip antenna due to the advantages of small size, low cost, low profile and higher bandwidth. In this project, a suitable antenna for the new wireless system (LTE) operate in the frequency range of 2.4 to 2.5GHz with compact size, very good efficiency, high impedance bandwidth and also provides satisfactory performance. The size of the proposed antenna is 20x10mm.

Keywords: Long term evolution, meander line antenna, multiple-input–multiple-output (MIMO).

1. INTRODUCTION

MIMO stands for Multiple-Input Multiple-Output. MIMO systems use more than one transmit antenna (Tx) to send a signal on the same frequency to more than one receive antenna (Rx). Since MIMO has been deployed for years in WLAN networks, it is a relatively new feature in commercial wireless networks. MIMO technology is a graded characteristic feature of next-generation LTE networks, and it is a major piece of LTE‟s promise to significantly boost data rates and overall system capacity. MIMO represents a new challenge for network operators. Traditional cellular networks provide the best service under line-of-sight conditions .MIMO is currently use in WLAN (Wireless Local Area Networks) and is being considered as a candidate to be used for wider range wireless networks. Multiple antennas, both at the base station and at the mobile equipment, together with a sophisticated signal processing can improve drastically the performance of the wireless link, even under the worst cases, without the line of sight and fast moving mobile users.

Multi-user Multiple-Input and Multiple-Output (MUMIMO) systems have become promising in the context of achieving high data rates required for cellular standards after 3rd Generation (3G) of wireless systems. MU-MIMO is assisted in 3GPP Long Term Evolution (LTE).Release 8 provides high peak data rates of 300 Mb/s on the downlink and 75 Mb/s on the uplink for a 20 MHz presently, enhancements are providing substantial improvements to Long Term Evaluation Release 8, allows to meet or exceed International Mobile Telecommunications- Advanced (IMT-A) requirements. The long term evolution (LTE) release 10, which is also referred as LTE-Advanced in 2012. The “4G” standard aims to provide a greater bandwidth for mobile communication, which supports the data rates up to 100 Mbps for high mobility applications and 1 Gbps for low mobility uses. The LTE standard support both the frequency division duplexing (FDD) and the time division duplexing (TDD), which are paired and unpaired spectra. The LTE frequency band is rather extensive. It begins from 699 MHz (Band 12, FDD) and the highest band will go upto 3800 MHz (Band 43, TDD).Most of the MIMO antenna systems proposed in [3-6], among a large list that appears in literature cover frequency bands higher than 2 GHz. This relaxes the inter-element spacing between antennas due to their small in size. The LTE specification covers much lower frequency bands, such as those in the 700–800 MHz bands (bands 5,6,12,13 and 14 within the range of frequency division duplexing (FDD) mode of operation). In this work we present the design and fabrication of a compact dual element MIMO antenna system that operates in the 800 MHz band of the LTE specification. It contains two meander line antennas that covers the frequency band from 760.0 MHz to 886.0 MHz, with a center frequency of about 830.0 MHz The isolation is more than 12 dB between the two elements in the operating band which corresponds to $|\rho| < 0.3$ with approximately 85% of efficiency, which is a good metric for diversity

system[9]. Isolation enhancement techniques are investigated, and an isolation of more than 15 dB was obtained. The antenna system covers an area of only 20x10mm2 which is half of size of a regular cellular phone terminal. Section II describes the modeling of dual element MIMO antenna system. Section III presents and compares the simulation and measurement results and Section IV concludes the communication.

Antenna design:

The basic geometry of the diversity antenna is illustrated as a close-up view in Fig. 1

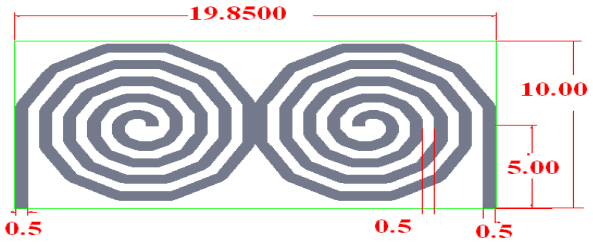

Figure 1: Geometry of the diversity antenna

It is composed of a Circular spiral microstrip radiating structure, which is constructed on a 0.4-mm-thick FR4 substrate with dielectric constant "r = 4:4. The antenna is fed by a 50 ohm coaxial cable and has a compact size of 20x10mm2, so that it can be used inside a mobile handset device as an internal antenna. As shown in figure2.In order to have the LTE/WWAN operation, the proposed antenna must be designed with multiple resonant modes. To this end, the antenna makes use of the strip to generate 700MHz, 800MHz, 2300 MHz, 2500 MHz frequency band. 700MHz denotes the lower frequency band and 2500 MHz denotes the higher frequency band.

Table1: Antenna parameter

Total Length	20mm
Total Width	10mm
Strip Width	0.5m
Turns	54
Segments	12

2. Simulated results and discussion:

In order to evaluate the performance of the proposed antenna, the antenna is simulated by using EM simulation software IE3D. We are going to analyse the multi-band coverage of the antenna shown in figure 2.

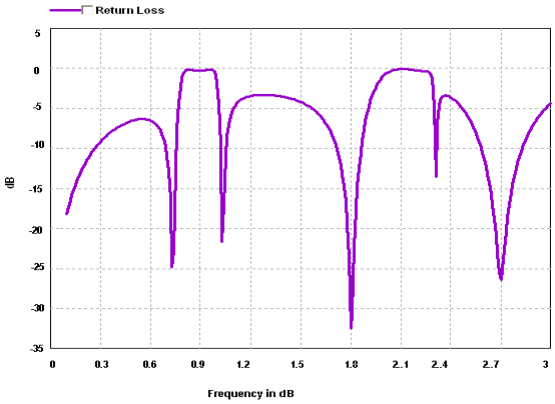

Figure 2: Multi-band coverage of the antenna

To analyze the multi band coverage of the antenna, the effects of altering the antenna parameter is considered. To test the antenna various parameters has been carried out by varying one parameter and keeping other parameter constant. The designed values of the antenna are optimized with IE3D tool. The optimization was performed for the best impedance bandwidth. The simulated return loss,,s11" of the proposed antenna is shown in figure, which clearly indicates that the impedance bandwidth of multi band antenna are 0.69 to 0.756 GHz, 1.022 to 1.052 GHz, 1.710 to 1.860 GHz, 2.50 to 2.826 GHz with the resonances of 0.7, 1.032, 1.8, 2.7 respectively. In Fig2 we had four main parameters that are bandwidth of the antenna, efficiency of the antenna, VSWR of the antenna and radiation pattern of the antenna are to be satisfied. These parameters help to a design suitable antenna for our applications.

3. Radiation pattern:

The simulated radiated pattern of the E plane and H plane are obtained at 0.7, 1.032, 1.8, 2.7 GHz. It can be noted that the radiation pattern is Omni directional in H plane and bidirectional in E plane. The radiation pattern had to be spread evenly 360 degrees around the antenna. The reason for this is because since the location of the transmitter is not fixed. The Azimuth

angle and the elevation angle for proposed antenna is shown in fig3.

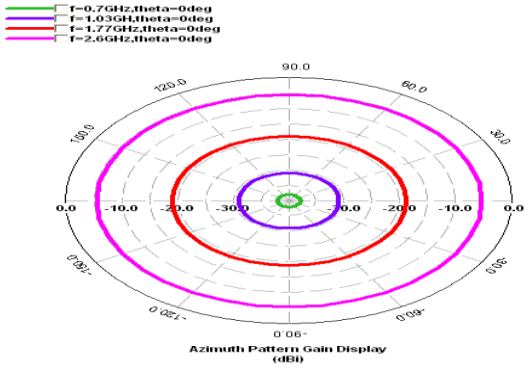

Figure 3 Azimuth

Azimuth and elevation are angles used to define the apparent position of an object in the sky, relative to a observer. The observer is usually (but not necessarily) located on the earth's surface. The azimuth angle is the compass, relative to the (geographic) north, of a point on the horizon directly underneath to an observed object. The horizon is termed as a large and imaginary circle focused on the observer, equidistant from the zenith (point straight overhead) and the nadir (point exactly opposite the zenith).

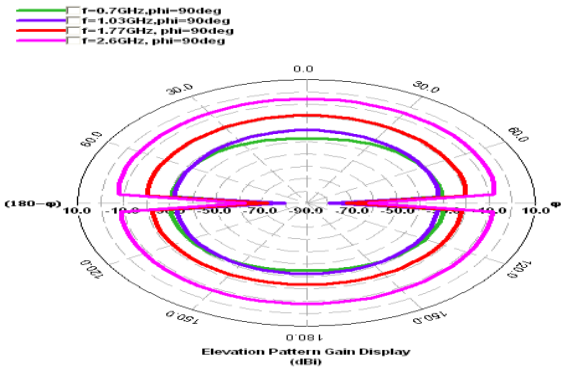

Figure 4: Zenith

As seen from above the observer, compass bearings measurements are done clockwise in degrees from north. Azimuth angles varies from 0 degrees (north) and goes through 90 degrees (east), 180 degrees (south), 270 degrees (west), and up to 360 degrees (north again).The elevation (el) angle is known as the altitude. It can be determined by first finding the compass bearing on the horizon relative to the true north, and then measuring the angle between that point and the objects, from the reference frame of the observer. The Elevation angle ranges from 0 (on the horizon) up to 90 degrees (at the zenith). At, sometimes the range of the elevation coordinate may be extended downward from the horizon to -90 degrees (the nadir). This will be helpful when the observer is located at some distance above the surface, as like in an aircraft.

4. Measured output:

From the measured results, is understood that the proposed antenna structure shows that it is similar to the simulated results. Since the size is small, even small variations in the fabricated results discrepancy in the measured results. The SMA connector losses may be varied by using the variation for the frequency shifted.

- **Results for two ports :**

The two ports have connected with the network analyzer.

Figure5: Insertion Loss

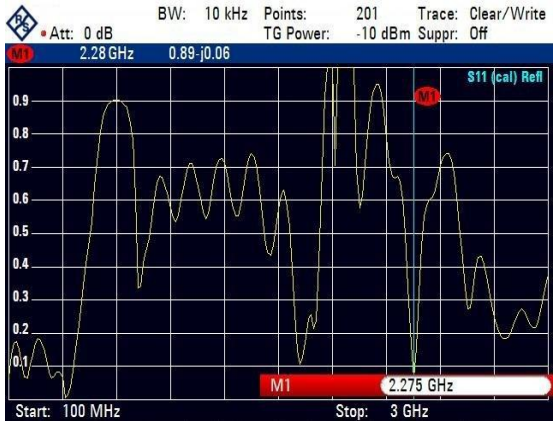

Figure 6: Return Loss

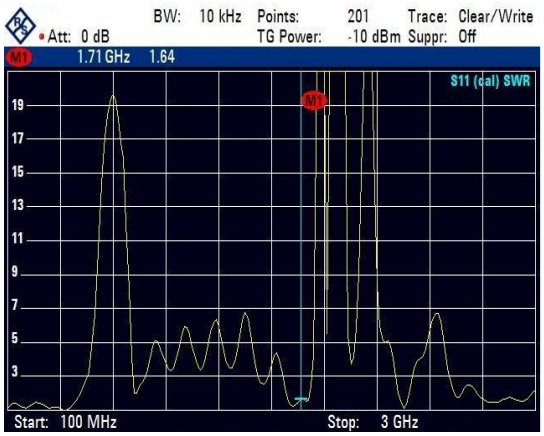

Figure 7: Reflection Coefficient

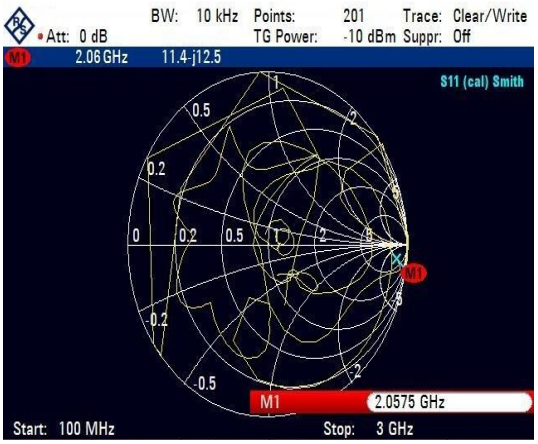

Figure 8: VSWR

Figure 9: Smith Chart

- Results for one port :

  In the two ports, one port has been connected with the network analyser and the other port has connected with the 50 ohm matching impedance.

4. CONCLUSION

An antenna is designed to cover the LTE antenna frequencies such as 0.69 to 0.756 GHz, 1.02 to 1.05GHz, 2.5 to 2.826 GHz and also DCS antenna frequency such as 1.71 to 1.86 GHz. The size of the proposed antenna has been reduced up to 80 percent when compared with the base paper size of an antenna. The size of the proposed antenna is (20 mm x 10 mm).

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