SUBSTANTIAL ANTENNA DESIGN FOR HIGH PERFORMANCE COMMUNICATION NETWORKS

Dr. J. Vignesh[1], Dr. E. Gajendran[2], Dr. S.R. Boselin Prabhu[3]
[1]Professor, Department of Computer Science and Engineering,
Sreyas Institute of Engineering and Technology, Hyderabad, India.
[2]Associate Professor, Department of Computer Science and Engineering,
Sree Dattha Group of Institutions, Hyderabad, India.
[3]Associate Professor, Department Electronics and Communication Engineering,
VSB Engineering College, Karur, Tamilnadu, India

Abstract

LTE is the upgrade path for carriers with both GSM/UMTS networks and CDMA2000 networks. The different LTE frequencies and bands used in different countries mean that only multi-band phones are able to use LTE in all countries where it is supported. A new wireless standard long term evolution technologies has been proposed to operate in the 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 gives inefficient and limitation in the coverage area of the system. To avoid strong mutual coupling between closely packed mobile antenna one possible solutions 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 high 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, good efficiency, high impedance bandwidth and satisfactory performance.

Keywords: Long term evolution, meander line and multiple-input–multiple-output.

I. INTRODUCTION

MIMO also represents a new challenge for network operators. Traditional cellular networks generally 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 case scenarios, without line of sight and fast moving mobile users. Multi-user Multiple-Input and Multiple-Output (MUMIMO) systems have became promising in the context of achieving high data rates required for cellular standards after 3rd Generation (3G) of wireless systems. MU-MIMO is supported in 3GPP Long Term Evolution (LTE) [1-7].

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 bandwidth, and allows flexible bandwidth operation of up to 20 MHz. Currently, enhancements are being studied to provide substantial improvements to LTE Release 8, allowing it 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 communications. It supports data rates up to 100 Mbps for high mobility applications and 1 Gbps for low mobility uses. The LTE standard supports both frequency division duplexing (FDD) and time division duplexing (TDD), which are of paired and unpaired spectra, respectively. The LTE frequency band is rather extensive. It starts from 699 MHz(Band 12, FDD) and the highest band goes up to 3800 MHz[8] (Band 43, TDD).

A new LTE protocol named LTE Direct works as an innovative device-to-device technology enabling the discovery of thousands of devices in the proximity of approximately 500 meters. Pioneered by Qualcomm, the company has been leading the standardization of this new technology along with other 3GPP participants. LTE Direct offers several advantages over existing proximity solutions including but not limited to Wi-Fi or Bluetooth. One of the most popular use cases for this technology was developed by a New York City based company called Compass.to. The core feature of proximal discovery among devices included a targeted discount voucher to a nearby device which matched specific interests. The Compass.to use case was featured at global conferences and events such as CES 2015, MWC 2015, and said to be extended to many other scenarios including film festivals, theme parks and sporting events. “You can think of LTE Direct as a sixth sense that is always aware of the environment around you,” said Mahesh Makhijani, technical marketing director at Qualcomm [9-18], at a session on the technology. Additionally, the protocol offers less battery drainage and extended range when compared to other proximity solutions. 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.

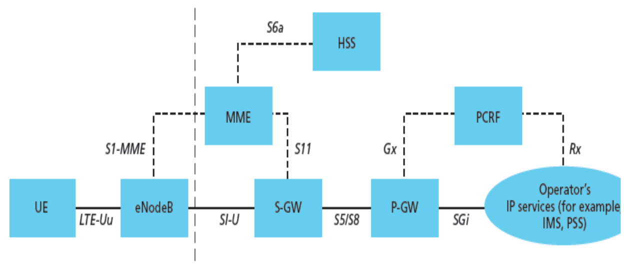

Figure 1: Architecture of LTE

This relaxes the inter-element spacing between antennas due to their smaller size. The LTE specification has to cover much lower frequency bands, such as those in the 700–800 MHz bands (bands 5,6,12,13 and 14 within 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 consists of two meander line antennas that covers the frequency band from 760 MHz to 886 MHz, with a center frequency of about 830 MHz. The isolation is more than 12 dB between the two elements in the operating band. This corresponds to $|\rho| < 0.3$with approximately 85% efficiency, which is a good metric for diversity systems [9]. Isolation enhancement techniques are investigated, and an isolation of more than 15 dB was obtained. The antenna system occupies only 20x10mm2which is half of size of a regular cellular phone terminal.

II. EXISTING ANTENNAS

It is composed of a Circular spiral micro strip radiating structure, which is fabricated 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. In order to have the LTE/WWAN operation, the proposed antenna must be designed with multiple resonant modes. To this end the antenna utilizes 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.

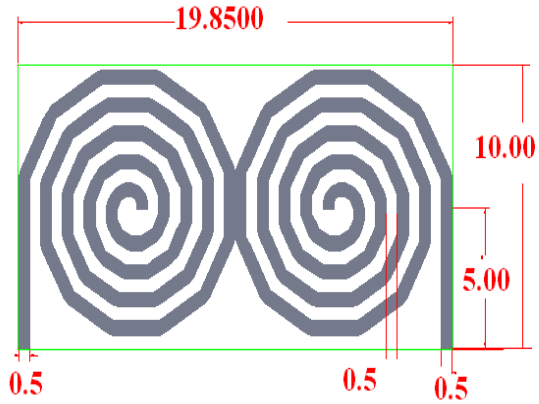

Figure 2: Antenna Structure

In order to evaluate the performance of the proposed antenna, the antenna is simulated through the simulation tool IE3D.

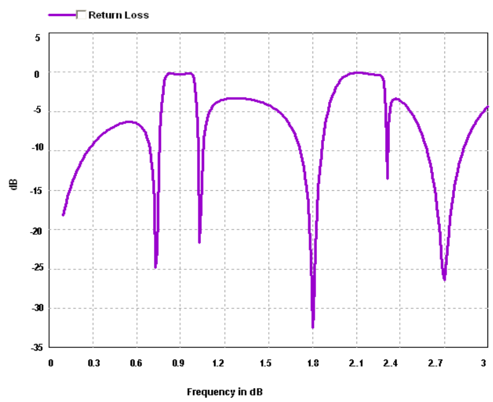

Figure 3: Antenna Characteristics

To analyze the multi band coverage of the antenna, the effects of adjusting the antenna parameter are investigated. The analysis of the antenna for different 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, 1.02 to 1.05 GHz, 1.71 to 1.86 GHz, 2.5 to 2.826 GHz with the resonances of 0.7, 1.032, 1.8, 2.7 respectively.

The VSWR of the antenna, the efficiency of the antenna, and the radiation pattern of the antenna. These parameters will help us understand if the antenna we are designing will be the optimal design for our application. The simulated radiated pattern of the E plane and H plane are obtained at 0.7, 1.032, 1.8, 2.7 GHz. It is noticed that H plane the radiation pattern is Omni directional, and in E plane the radiation pattern is bidirectional. 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. Azimuth and elevation are angles used to define the apparent position of an object in the sky, relative to a specific observation point. The observer is usually (but not necessarily) located on the earth's surface. The azimuth (az) angle is the compass bearing, relative to true (geographic) north, of a point on the horizon directly beneath an observed object.

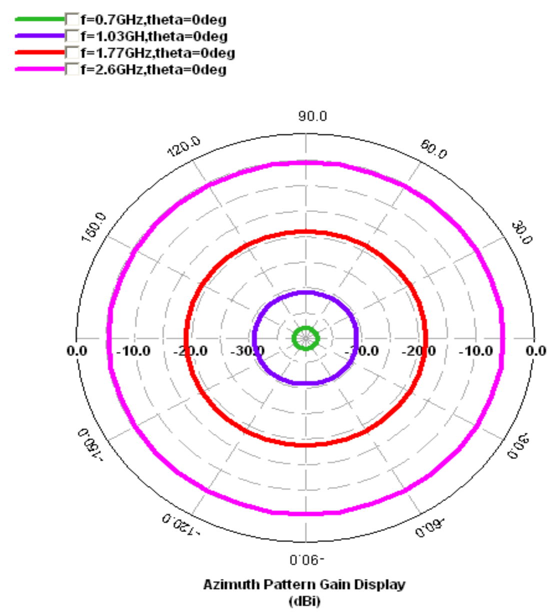

Figure 4: Azimuth Pattern

The horizon is defined as a huge, imaginary circle centered on the observer, equidistant from the zenith (point straight overhead) and the nadir (point exactly opposite the zenith).

As seen from above the observer, compass bearings are measured clockwise in degrees from north. Azimuth angles can thus range from 0 degrees (north) through 90 (east), 180 (south), 270 (west), and up to 360 (north again).The elevation (el) angle, also called the altitude, of an observed object is determined by first finding the compass bearing on the horizon relative to true north, and then measuring the angle between that point and the object, from the reference frame of the observer.

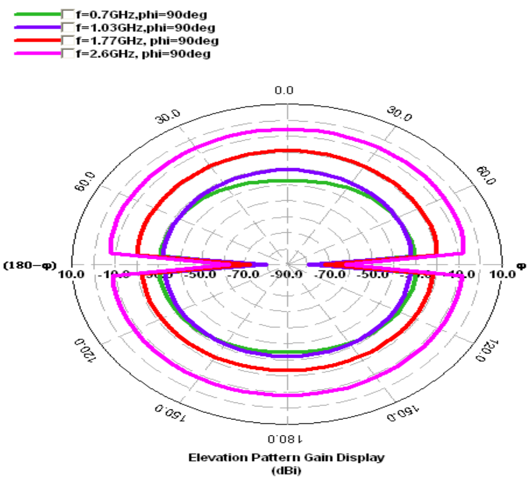

Figure 5: Elevation Pattern

III. CONCLUSION

The requirements were originally set forth by the ITU-R organization in the IMT Advanced specification. However, due to marketing pressures and the significant advancements that WiMAX, Evolved High Speed Packet Access and LTE bring to the original 3G technologies, ITU later decided that LTE together with the aforementioned technologies can be called 4G technologies. The LTE Advanced standard formally satisfies the ITU-R requirements to be considered IMT-Advanced. To differentiate LTE Advanced and WiMAX-Advanced from current 4G technologies, ITU has defined them as "True 4G". 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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