*IOSR Journal of Electronics and Communication Engineering (IOSR-JECE)*
*e-ISSN: 2278-2834,p- ISSN: 2278-8735.*
*PP 44-48*
*www.iosrjournals.org*

# Design of Compact Multiband Antenna for Wwan/Lte Mobile Phone Applications

Chinna Kannan C[1], Balaji B.K[2]
[1]*Department Of Electronics And Communication, Saranathan College Of Engineering, Trichy, India.*
[2]*Department Of Electronics And Communication, Saranathan College Of Engineering, Trichy, India.*

**Abstract:** *The design of compact multiband planar antenna is presented. The structure is a combination of a monopole antenna and a coupled ground plane on a FR4 substrate. The proposed antenna can be used in handheld mobile communicating device which support different wireless applications of 9 different bands with their frequencies of 700MHz, 900MHz, 1.84GHz, 1.9GHz, 2.1GHz, 2.3GHz, 2.4GHz, 2.5GHz and 3.6GHz coming under the bands of different wireless applications as GSM , UMTS, LTE, WIFI , WILAN/WIMAX. The designing and simulation of this antenna is done in ADS software. The proposed antenna achieves higher gain, efficiency and good radiation characteristics over the operating frequency bands are obtained.*

**Keywords:** *Multiband, Wwan/Lte, Wlan/Wimax.*

## I. INTRODUCTION

For the growth of the mobile communication industry, more functions and better service quality are required. For that mobile antenna would be designed to cover the multiple frequency bands with single antenna. The Operating Frequency bands for mobile communication device are Long Term Evolution (LTE), Global System of Mobile Communication (GSM), World Wide Area Network (WWAN), World Local Area Network (WLAN) and Worldwide Interoperability for Microwave Access (WIMAX).

Now a day's different types of multiband antennas are designed which can able to cover more number of operating frequency bands with compact size. In [1, 2] multi-loop –type antenna with a meander structure were utilized to attain compact size and multiband operations. In [3], bendable planar inverted –F antennas were utilized to achieve compact size. Other multiband techniques include using a multi-band antenna structure [4], utilizing a slot antenna structure [5], and loading a parallel resonant circuit in antennas [6].

In this Work, we designed a multiband antenna for communication device which covers LTE700 (704-787 MHz), GSM900 (880-960 MHz), DCS1800 (1710-1880 MHz), PCS1900 (1850-1990 MHz), UMTS (1920-2170 MHz), LTE2300 (2300-2400 MHz), WLAN (2400-2480MHz), LTE2500 (2500-2690 MHz) and WiMAX (3400-3600 MHz) bands are presented.

## II. PROPOSED ANTENNA CONFIGURATION

The geometry and dimensions of the proposed antenna is shown in Figure 1. The antenna was designed on a FR4 glass epoxy substrate with a thickness of 0.8mm, relative permittivity of substrate is 4.4, and a loss tangent of 0.02.The overall FR4 substrate was employed as the system circuit board ($122\times60mm^2$) on which the main antenna was designed on top edge of a mobile phone ($10\times47.5mm^2$).The system ground plane was designed on backside of the FR4 substrate ($112\times60mm^2$). The designed antenna dimensions are reasonable for practical mobile phones applications.

The proposed antenna is composed of a circuit structure directly connected to a feeding contact for a monopole antenna and a coupled ground strip is connected to a shorting contact. The monopole strips are designed to be approximately a quarter-wavelength long at 700, 900, 1800, 1900, 2100, 2300, 2400, 2500 and 3600MHz.

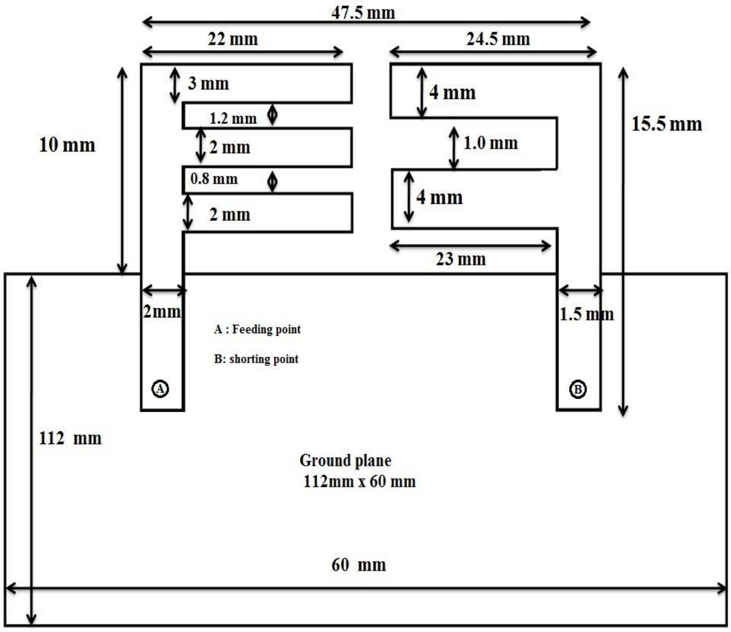
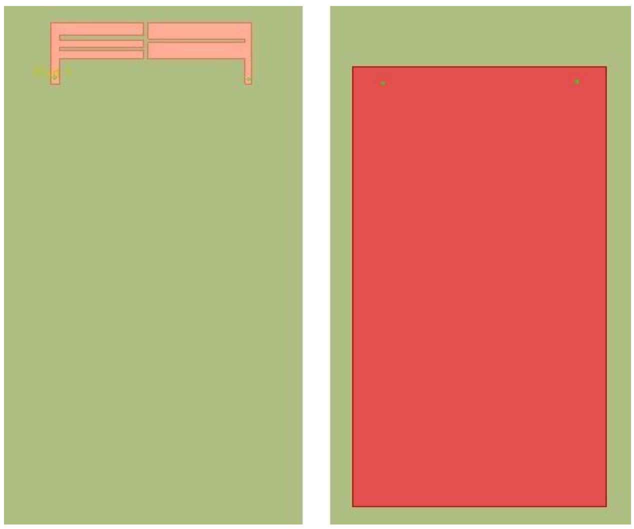



Fig 1. Geometry and dimensions of the proposed antenna.

A coupled ground strip is also added to connect to the right side of the lower bands and to obtain good impedance matching across the operating bands. Then After adjusting the monopole strips in the resonant modes, a low operating band of 704-787 MHz and 840–960 MHz was obtained for LTE700 and GSM900 applications. The high modes of 1800, 2100, 2300, 2400 and 2500 MHz constitute high operating bands of 1760– 2770 GHz for GSM1800, GSM1900, LTE2300, and LTE2500 applications. The Front and Back view of proposed antenna is shown in Figure 2. The coupled ground strip includes comb-shaped dual-parasitic shorted strips. The overall antenna is fed by a 50 Ω coaxial feed connected to the feeding point (point A) of the driven monopole and a coupled ground strip is to be connected to the shorting point (point B) of the system ground planes.



(a) (b)

Fig 2. Front (a) and Back (b) view of proposed antenna

## III. SIMULATED RESULTS

The simulated return losses of the proposed antenna are shown in Figure 3. The simulation was done using Advanced Design System software. The simulated results based on a 3:1 VSWR which as −6 dB return loss cover the following operating bands LTE700 (704-787 MHz),GSM900 (880–960 MHz), GSM1800 (1710–

1880 MHz), GSM1900 (1850–1990 MHz), UMTS 2100 (1920-2170 MHz), LTE2300 (2305–2400 MHz), WLAN (2400-2480MHz), LTE2500 (2500–2690 MHz) and WiMAX (3400-3600 MHz).

Table 1 shows the gain and return loss for appropriate frequencies. In that we obtained the return loss about -6.56 to -20.97db and the gain is about 2.1 to 6.7 dbi for the respected frequency range. The obtained gain is good enough for every frequency band of antenna radiation.

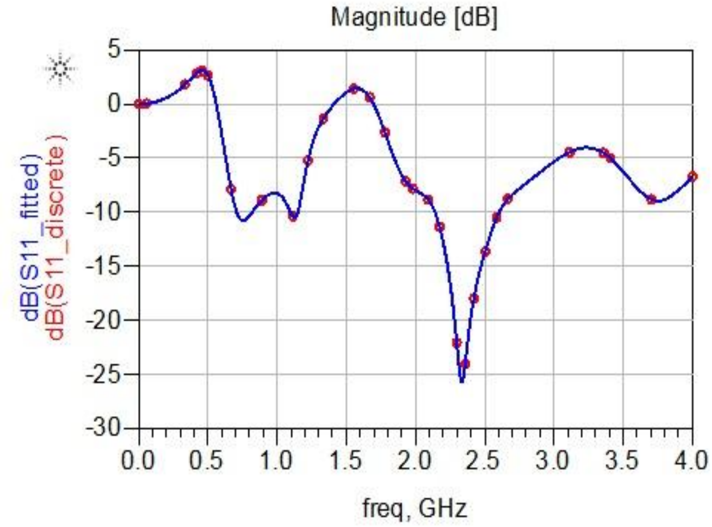



Fig 3. Simulated return losses of the proposed antenna

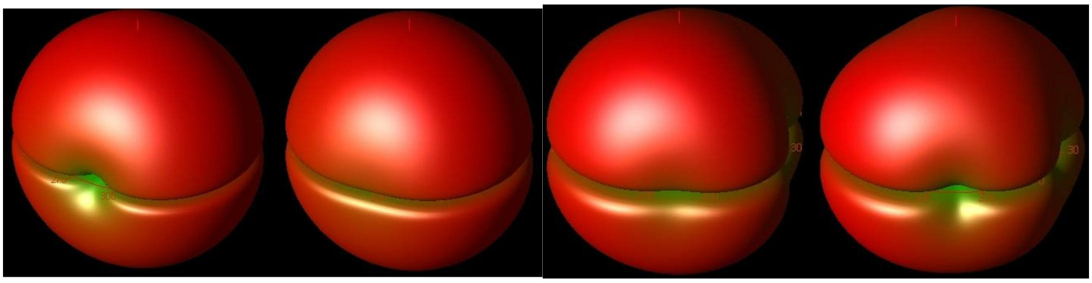

Fig 4. Proposed antenna Gain (dbi) with respect to frequency (GHz)

The radiation efficiency of the proposed antenna for the lower frequency bands 700MHz and 900MHz are about 100% efficiency is obtained. For upper frequency bands 1800 MHz, 1900MHz, 2100 MHz, 2300MHz, 2400MHz, 2500MHz, 3400MHz we obtain 94% to 98 % radiation efficiency. Even though we obtain low return loss of about -6.5 to -20.97 for respective frequency range we get high efficiency for all frequency band of operation. Figure 4 shows the graphical view of gain in dbi with respect to frequency in GHz.

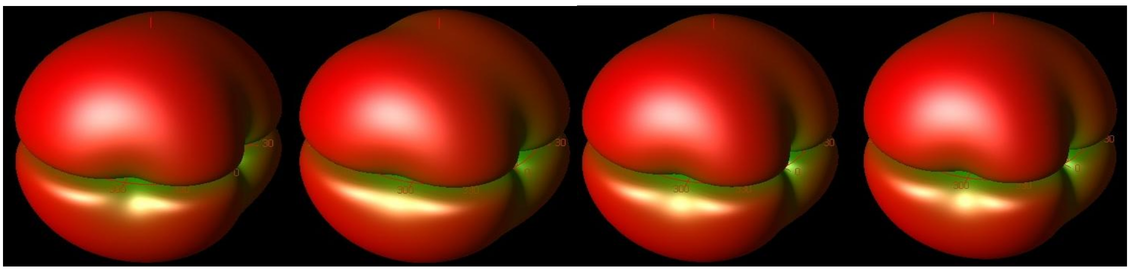
Table 1. Gain and return loss of the respected frequency

| **Frequency Band (MHz)** | **Return Loss (db)** | **Gain (dbi)** |
|---|---|---|
| 700 | -10.26 | 2.1 |
| 900 | -8.67 | 2.8 |
| 1800 | -6.56 | 4.7 |
| 1900 | -9.58 | 4.8 |
| 2100 | -20.97 | 4.3 |
| 2300 | -10.07 | 5.1 |
| 2400 | -8.53 | 5.8 |
| 2500 | -7.15 | 6 |
| 3600 | -8.02 | 6.7 |

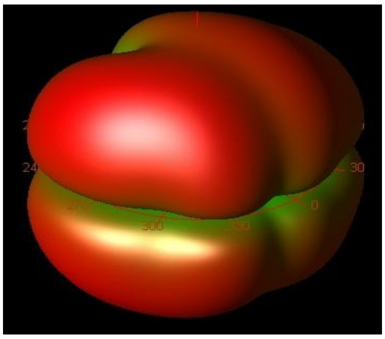
The simulated radiation patterns of the proposed antenna for every frequency band of 700MHz, 900MHz, 1800 MHz, 1900MHz, 2100 MHz, 2300MHz, 2400MHz, 2500MHz, 3400MHz isometric view is shown in Figure 5. It defines the proposed antenna is capable of radiate in all direction with high gain. The obtained results of proposed antenna are acceptable for practical mobile phone applications.



(a) (b) (c) (d)



(e) (f) (g) (h)



(i)

Fig 5. Simulated radiation patterns at (a) 700MHz ,(b) 900MHz, (c) 1800 MHz (d) 1900MHz (e) 2100 MHz (f) 2300MHz (g) 2400MHz (h) 2500MHz (i) 3400MHz

## IV. CONCLUSION

A compact multiband WWAN/LTE planar antenna for mobile phones had been designed and simulated results are verified. A direct-fed monopole antenna and a coupled ground strip were used to realize nine operating bands over 3:1 VSWR on a −6 dB return loss covering the GSM900/1800/1900/UMTS2100/ LTE700/2300/2500 WLAN and WiMAX application bands. The proposed antenna has good radiation characteristics of gain of about 2.1 to 6.7 dbi and efficiency is 94% to 98% for respective frequency band. The total footprint of the proposed antenna is only ~470 $mm^2$, thus, the antenna can be easily integrated into the system circuit board of mobile phones.

## REFERENCES

[1]. Chu, F.H., and Wong, K.L.: 'Internal coupled-fed dual-loop antenna integrated with a USB connector for WWAN/LTE mobile handset', IEEE Trans. Antennas Propag., 2011, 59, pp. 4215–4221

[2]. Chen, W.S., and Jhang, W.C.: 'A planar WWAN/LTE antenna for portable devices', IEEE Antennas Wirel. Propag. Lett., 2013, 12, pp. 19–22

[3]. Hu, C.L., Huang, D.L., Kuo, H.L., Yang, C.F., Liao, C.L., and Lin, S.T.: 'Compact multi branch inverted-F antenna to be embedded in a laptop computer for LTE/WWAN/IMT-E applications', IEEE Antennas Wirel. Propag. Lett., 2010, 9, pp. 838–841

[4]. Lu, J.H., and Guo, J.L.: 'Small-size octa-band monopole antenna in an LTE/WWAN mobile phone', IEEE Antennas Wirel. Propag. Lett. 2014, 13, pp. 548–551

[5]. Wong, K.L., and Lee, L.C.: 'Multiband printed monopole slot antenna for WWAN operation in the laptop computer', IEEE Trans. Antennas Propag., 2009, 57, pp. 324–330

[6]. Ban, Y.L., Chen, J.H., Joshua, S.Y., Li, L.W., and Wu, Y.J.: 'Low-profile printed octa-band LTE/WWAN mobile phone antenna using embedded parallel resonant structure', IEEE Trans. Antennas Propag., 2013, 61,pp. 3889–3894.

[7]. Constatine A. Balanis, Antenna Theory Analysis and Design, A JOHN WILEY &SONS, INC., Publication, Third Edition 2005.