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Zeinab Eskandari, Asghar Keshtkar, Javad Ahmadi-Shokouh

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# A Narrow-Frame Antenna for WWAN/LTE/WiMAX/WLAN Mobile Phones

Zeinab Eskandari<sup>1,\*</sup>, Asghar Keshtkar<sup>1</sup> and Javad Ahmadi-Shokouh<sup>2</sup>

<sup>1</sup> Imam Khomeini International University, Ghazvin, Iran

<sup>2</sup> University of Sistan and Baluchestan, Zahedan, Iran

\*Corresponding author (Email: zeinab.eskandari@hotmail.com)

Zeinab.eskandari@hotmail.com, akeshtkar@gmail.com, shokouh@ece.usb.ac.ir

**Abstract-** In this paper, we present a novel narrow-frame antenna with a size of  $75 \times 8 \times 5.8$  mm<sup>3</sup> for 5.7 inch mobile phones. The antenna mainly consists of a monopole with four branches that are coupled to a two-branch grounded strip. Our antenna is able to cover more bands than other narrow-frame antennas by excitation of several resonant modes. The improved range of the antenna covers the following eleven bands: LTE700, GSM850, GSM900, DCS, PCS, UMTS, LTE2300, LTE2500, LTE3400 (3400-3800MHz)/WiMAX3.5 GHz (3400-3650 MHz), WLAN5.2 GHz (5150-5350 MHz) and WLAN5.8 GHz (5725-5875 MHz). Another advantage of the proposed antenna is that it does not need any lumped element to match the antenna. The working principles of the proposed antenna are thoroughly studied. A prototype of the proposed antenna is fabricated and measured, with the results in good agreement with the simulation results.

**Keywords:** Mobile Antenna, Multiband antenna, Narrow-frame antenna, WWAN/LTE/WiMAX/WLAN antenna.

## I. INTRODUCTION

Recent smartphone designs have much larger touchscreens which requires antennas with less ground clearance [1], [2]. Moreover, there is an increasing demand for multiband antenna to cover LTE, WWAN, WiMAX and WLAN [3]-[5]. However, it is challenging to incorporate multiband antennas covering the aforementioned range of wireless bands in large screen devices with a small non-ground portion [6]-[11]. Previous work, using octa-band antennas with 8 mm or 6 mm of non-ground portion height [7]-[10] were able to cover LTE700 (698-787 MHz), GSM850 (824-894 MHz), GSM900 (880-960 MHz), DCS (1710-1880 MHz), PCS (1850-1990 MHz), UMTS (1920-2170 MHz), LTE2300 (2300-2400 MHz), LTE2500 (2500-2690 MHz) bands. However, higher bands such as WiMAX3.5 (3400-3650 MHz), WLAN5.2 (5150-5350 MHz), WiMAX5.5 (5250-5850 MHz) and WLAN5.8 (5725-5875 MHz) were not covered. In [11], a nano-band antenna with 7 mm non-ground portion height is presented that can cover an additional band of LTE3400 (3400-3800 MHz). To the best of our knowledge, [7]-[11] are all the narrow-frame antennas with non-ground portion height of 8 mm or less that can cover at least eight bands of LTE700, GSM850, GSM900, DCS, PCS, UMTS, LTE2300, and LTE2500, shown in Table I.

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