Progress In Electromagnetics Research Letters, Vol. 91, 145–152, 2020

Low Cost Substrate Based Compact Antennas for 4G/5G Side-Edge Panel Smartphone Applications

Issmat S. Masoodi, Insha Ishteyaq, Khalid Muzaffar*, and Muhammad I. Magray

Abstract—The integrated design of 4G LTE and mmWave 5G antennas based on a low cost substrate is proposed for mobile terminals. The 4G LTE antenna is designed along with the millimeter wave 5G antenna element, and this integrated module is mounted orthogonally to cater for smartphone applications. The 4G LTE module consists of two orthogonally placed compact asymmetric coplanar strip (ACS) fed antennas which caters to LTE1900, LTE2300, and LTE2500 bands. ACS-fed antennas operate from 1.8 to 2.7 GHz with a reasonable gain ranging between 1.5 and 2.9 dBi. The mmWave 5G antenna module comprises two compact Vivaldi antennas with wideband operational bandwidth ranging from 23 to 39 GHz. Each mmWave 5G antenna attains 1-dB gain bandwidth of 47.6% indicating high radiation bandwidth across the operating frequency band. Orthogonal pattern diversity is achieved for the usage of smartphone in both portrait and landscape modes. The whole antenna architecture is accommodated to the panel of height 6 mm inside a fabricated three dimensional mobile phone case. Simulated and measured results are presented with technical justification.

1. INTRODUCTION

Communication engineers and hardware specialists across academia and industry believe that the future cellular communication systems would need to cater to high data rates which in turn translates to higher carrier frequencies than the existing ones [1]. The now famous testing campaign led by Prof. Rappaport is a testimony to the feasibility of millimeter wave frequencies, as carrier frequency for cellular communication system. The primary issue with using carrier frequencies beyond 20 GHz is the inherent free space path loss [2], which could be mitigated using high gain antennas on both the mobile device and access point or base station as demonstrated in [1]. It is well known that technology transition would happen in a sequential manner which provokes hardware engineers to design and deploy transceiver radio systems which are backward compatible as well. In other words, future millimeter wave 5G hardware would coexist with the older 4G radios. Hence, co-design of 4G and 5G antennas is the theme of this paper. The antenna to be integrated in a mobile device has several requirements such as electrically compact and low specific absorption rate for 4G antennas. But the antennas operational at 28 GHz must have high gain with low physical footprint. Even though several articles on co-design of 4G and 5G have been published [3–7], the edge panel integration for future mobile phones would not be feasible for these reported designs. Hence, a highly compact 4G LTE Multiple-Input Multiple-Output (MIMO) antenna integrated with a wideband high gain millimeter wave 5G MIMO antenna is proposed with detailed simulated and measured results.

2. LOW COST SUBSTRATE BASED 4G LTE AND MMWAVE 5G MIMO ANTENNA DESIGNS

The proposed antenna architecture consists of integrated 4G LTE and mmWave 5G antennas designed on a 20-mil thick polycarbonate substrate having dielectric constant (ε_r) of 2.9 and loss tangent of

Received 10 April 2020, Accepted 27 May 2020, Scheduled 8 June 2020

* Corresponding author: Khalid Muzaffar (khalid.muzaffar@islamicuniversity.edu.in).

The authors are with the Department of Electronics and Communication Engineering, Islamic University of Science & Technology, Awantipora, J&K, India.