

Planar Triple-band MIMO Dipole Antenna for LTE /WLAN Access Points

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Abstract - A novel triple-band three-port diversity dipole antenna for LTE / WLAN access points is presented. The impedance bandwidths, determined from $RL \geq 10$ dB, can reach about 1763 / 795 MHz (52.4 / 14.1 %) for 2500 / 3500 MHz and 5200 / 5800 MHz operating bands, respectively, which are covering the required bandwidth for LTE /WLAN system. This proposed triple-band MIMO dipole antenna also provides maximum peak antenna gains and efficiencies of 7.5 / 7.8 / 7.5 dBi and 87 / 89 / 88 % across 2500 / 3500 / 5500 MHz bands, respectively, with uni-directional radiation pattern in XY-, XZ- and YZ-plane.

Index Terms —LTE, Dipole antenna, MIMO.

1. Introduction

LTE (Long Term Evolution) system has attracted high attention for broadband access in wireless wide area network (WWAN) environment due to rapid developments in the Fourth Generation (4G) mobile communication technology. To achieve big transmission rate and high quality performance, high-gain operation with multi-beam radiation characteristics becomes demanding in LTE applications. The femtocell access point is in most cases a piece of equipment located in the customer premises. There are different types of diversity antennas including spatial diversity antenna, frequency diversity antenna [2], polarization diversity antenna [1], [3] and pattern diversity antenna [4], [5]. The pattern and polarization diversity techniques are very effective to solve multipath-fading effects in complex environments [2]. Several multi-input / multi-output (MIMO) antenna with pattern and polarization diversities have been proposed in the literature [4]-[7]. However, triple-band dipole antenna with high gain operation for LTE / WLAN applications is very scant in the open literature. Therefore, in this article, a novel triple-band dipole antenna mainly composed of a symmetrical dipole antenna embedded into dual slots is proposed and shown in Fig. 1. By properly adjusting the dimensions of the embedded slots, the operating bandwidths ($RL \geq 10$ dB) can reach about 1763 / 795 MHz (52.4 / 14.1 %), which are enough for LTE 2500 / 3500 MHz and WLAN 5200 / 5800 MHz systems. Also, the proposed MIMO dipole antenna provides maximum peak antenna gains and efficiencies of 7.5 / 7.8 / 7.5 dBi and 87 / 89 / 88 % across 2500 / 3500 / 5500 MHz bands, respectively, with good uni-directional radiation pattern in the azimuthal and elevation planes. Details of the proposed triple-band dipole antenna designs are described, and experimental results for the obtained high-gain performance are presented and discussed.

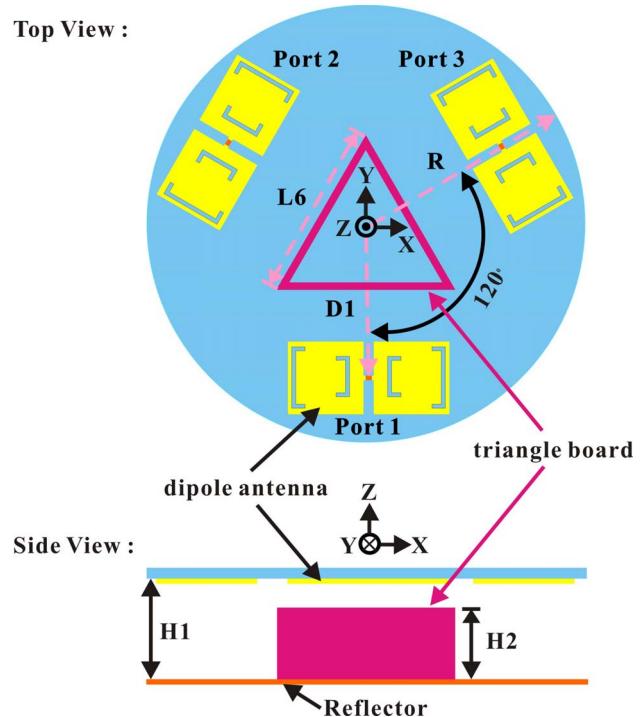


Fig. 1. Geometry of the proposed planar triple-band dipole antenna with high-gain operation.

2. Antenna design and experimental results

Fig. 1 illustrates the geometry of the proposed uni-directional MIMO dipole antenna for LTE 2500 / 3500 and WLAN 5200 / 5800 MHz access points. The proposed triple-band dipole antenna is fed by a 50Ω coaxial cable line and arranged 20 mm above a circular plate with the radius of 60 mm. A triangular reflector with the dimension of $33 \times 18 \text{ mm}^2$ is introduced and arranged in the center of the circular plate. This proposed triple-band antenna is comprised of a symmetrical dipole element with the dimension of $17 \times 16 \text{ mm}^2$. In this study, by introducing a pair of face-to face U-shaped slot, the resonant modes at 2500 / 3500 MHz bands can be easily excited. Then, a pair of smaller back-to-back slot is embedded to excite the 5200 / 5800 MHz band due to the resonant length chosen to be corresponding approximately to one operating wavelength of 5500 MHz band.

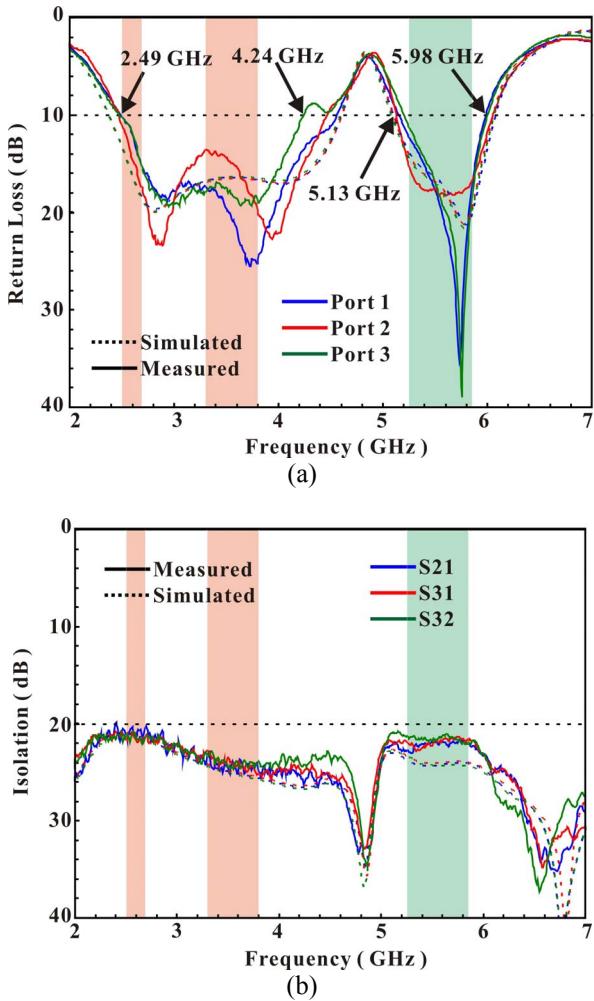


Fig. 2. Simulated and measured return loss and isolation against frequency for three ports of the proposed triple-band dipole antenna.

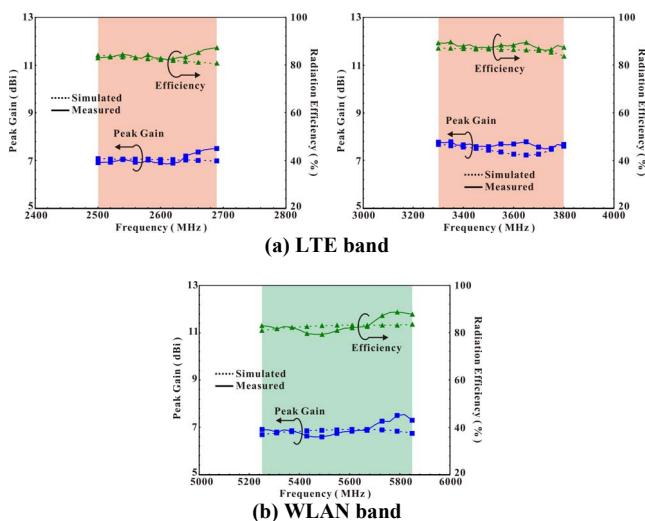


Fig. 3. Simulated and measured peak gains and efficiencies across the operating bands for the proposed triple-band dipole antenna.

To demonstrate the above deduction and guarantee the correctness of simulated results, the electromagnetic simulator HFSS based on the finite element method [8] has been applied for the proposed planar omnidirectional dipole array design. Fig. 2 shows the related simulated and experimental return loss and isolation for the proposed triple-band dipole antenna. From the experimental results, the measured impedance bandwidths ($RL \geq 10$ dB) can reach 1763 / 795 MHz (52.4 / 14.1 %) for LTE 2500 / 3500 MHz and WLAN 5200 / 5800 MHz operating bands, respectively, to provide more impedance bandwidth to meet the specifications of LTE / WLAN system. The 3D radiation patterns of the proposed triple-band dipole antenna are measured in anechoic chamber by using NSI-800F with Agilent PNA N5230A. Fig. 3 shows the simulated and measured peak gains and efficiencies of the triple-band dipole antenna. The maximum measured peak antenna gains and efficiencies are 7.5 / 7.8 / 7.5 dBi and 87 / 89 / 88 % across 2500 / 3500 / 5500 MHz bands, respectively, with uni-directional radiation pattern in XY-, XZ- and YZ-plane.

3. Conclusions

A novel triple-band dipole antenna with high-gain operation for LTE / WLAN access point has been proposed and investigated. It provides relatively wider impedance bandwidth of 1763 / 795 MHz (52.4 / 14.1 %) for LTE 2500 / 3500 MHz and WLAN 5200 / 5800 MHz operating bands, respectively, to meet the specifications of LTE / WLAN system. Also, the proposed triple-band dipole antenna provides maximum peak antenna gains and efficiencies of 7.5 / 7.8 / 7.5 dBi and 87 / 89 / 88 % across 2500 / 3500 / 5500 MHz bands, respectively, with unidirectional radiation pattern in XY-, XZ- and YZ-plane.

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