Design of a Dual-Band 8x8 MIMO Antenna for 5G Smartphone Applications

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***Abstract*—A Dual-band 8x8 MIMO antenna for the 5G communication services is proposed in this paper. It operates at 3.3-3.7GHz and 4.85-5.08GHz frequency bands. The antenna is printed 0.8-mm-thick FR4 substrate of relative permittivity 4.4 and loss tangent 0.02 and designed to be perpendicular to the edge of the system circuit board. It can be applied to the popular full-screen mobile phone. According to the simulation results, reflection coefficient is less than -6 dB, and the isolation is better than 12 dB over the band-frequency of 3.3-3.7GHz and 4.85-5.08GHz. It meets the needs of the future 5G applications.**

Keywords—MIMO antenna, smartphone, 5G communication, isolation.

I. INTRODUCTION

The study of the 5G smartphone antenna has significant application value for meeting the requirements of the contemporary 5G wireless communication system. As 4G mobile communication systems have evolved, the needs of individuals for mobile communication speed are rapidly rising. To satisfy these demands, through the research and development of the fifth generation (5G) antenna, [1].

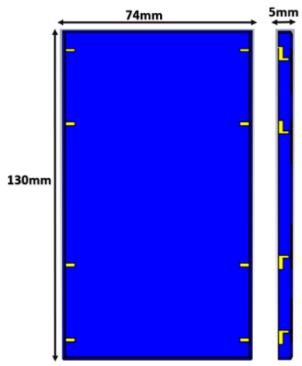
Smartphones are gaining more and more popularity nowadays, due to their wide variety of functions such as communication services, mobile financial services and entertainment. Therefore, the ability to further achieve multiband operation of the smartphone is a hotspot in the wireless communication field. As it has been known that multiple-input multiple-output (MIMO) operation can effectively increase the spectrum efficiency or channel capacity, so applying of MIMO technology in smartphone will ensure the enhancement of its channel capacity, [2-4].

In this paper, an 8x8 MIMO antenna consists of eight elements is proposed. The proposed antenna operates as a dual band antenna. The eight elements are distributed along two side edges of the smartphone, in line with the current trend of full-screen smartphone, meet the requirements of a full screen smartphone antenna design.

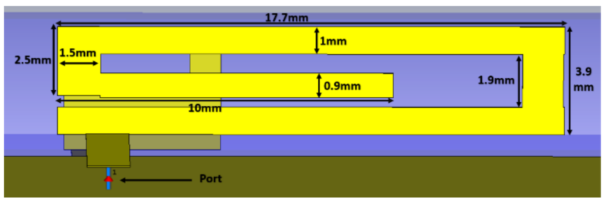
II. DESIGN AND CHARACTERISTICS OF THE ANTENNA

In order to meet the trend of modern ultra-thin smartphones. The antennas are printed on the inner and outer surfaces of the side frame of the smartphone system circuit board. The system circuit board in Fig.1 is selected to have a size of 130mm x 74mm and the height of the edge frame of the mobile phone is only 5mm. The single antenna operates at 3.3-3.7GHz and 4.85-5.08GHz frequency bands.

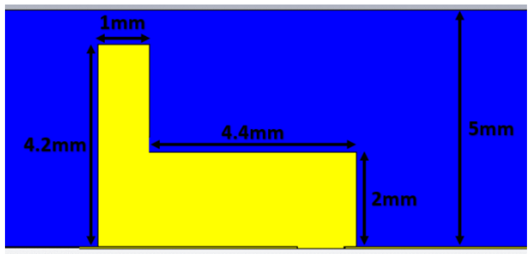
Both the side-edge frame and the system circuit board are fabricated using 0.8-mm-thick FR4 substrate of relative permittivity 4.4 and loss tangent 0.02. The radiation part of the antenna divided into two parts shown in Fig.1, the front radiation part is a bending line monopole, the back of the radiation part is an L-shaped short-circuit stub.



(a)



(b)



(c)

Fig. 1. (a) The proposed 8x8 antenna array structure. (b) The bending line monopole. (c) L-shaped short-circuit stub.

The simulated results are carried out using CST. As seen in Fig.2 the reflection coefficient of the 8x8 MIMO antenna is less than - 6 dB, while the transmission coefficient, Fig.3, it shows -20 dB at 4.9GHz and less than -12dB at 3.3 GHz, which is acceptable for smartphone applications. Fig.4 shows (3:1 VSWR) in the desired frequency range of [3.3-3.7 GHz] and [4.85-5.08GHz]. In Fig.5, the total efficiency of the 8x8 MIMO antenna at [3.3-3.7GHz] is around 65% for (1,2,3,4) antennas and around 50% for (5,6,7,8) antennas, efficiency is around 30% at [4.85-5.08GHz] for all antennas.

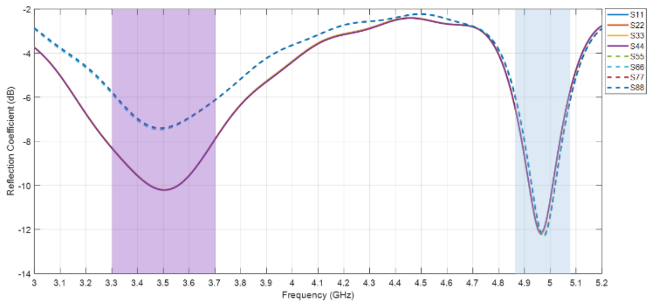


Fig. 2. Simulated Reflection Coefficient.

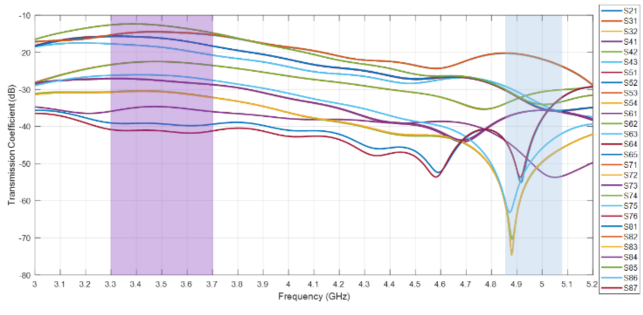


Fig. 3. Simulated Transmission Coefficient.

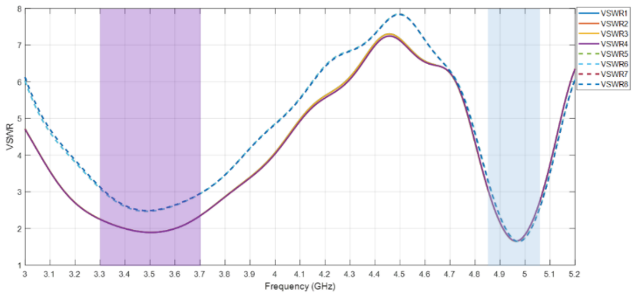


Fig. 4. Simulated VSWR.

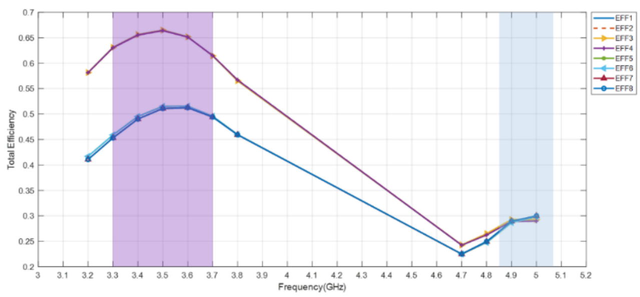


Fig. 5. Simulated Antenna Efficiency.

Antenna efficiency is impacted by the presence of a human hand and head. This is because some of the antenna radiating or receiving power is absorbed due to the electrical properties of the human body. Signal strength may be diminished as a result of human effect on a mobile antenna.

Figure 6 shows smartphone attendant human body. The reflection coefficient in Fig.7 of all antennas is still less than - 6 dB. In contrast, the operational bandwidth [3.3-3.7GHz] changed due to hand model to [3.35-3.75GHz] but [4.85-5.08GHz] band still the same. The isolation of all antennas stays less than -12 dB. Figure 8 shows the total efficiency of the 8x8 MIMO antenna at [3.35-3.75GHz] is around 60% for (1,2,3,4) antennas and around 45% for (5,6,7,8) antennas, efficiency is around 30% at [4.85-5.08GHz] for all antennas.

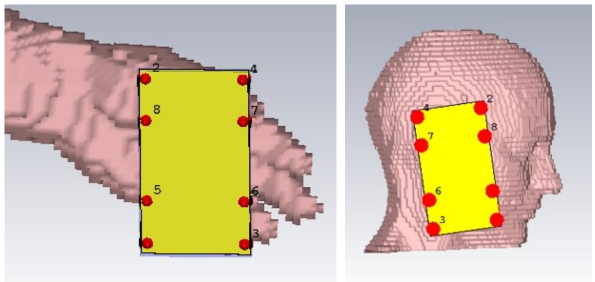


Fig. 6. Smartphone attendant human body

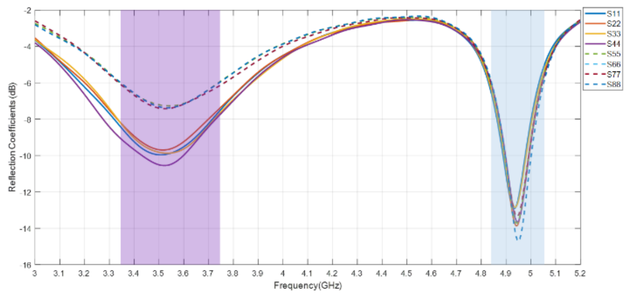


Fig. 7. Reflection Coefficient smartphone attendant human body.

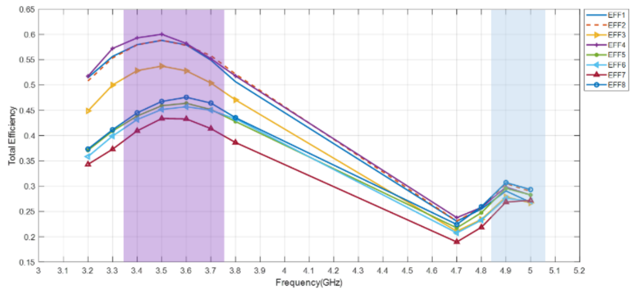


Fig. 9. Antenna Efficiency smartphone attendant human body.

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