International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622
International Conference on Industry Automation and Computing (ICIAC- 12th and 13th April 2014)

RESEARCH ARTICLE OPEN ACCESS

Design of a Printed Monopole 'F-shaped' Antenna

Reema Dhumal*, Sachin Khade**
*(Department of Electronics and Telecommunication Engg., YCCE, Nagpur
Email: reemadhumal1@gmail.com)
** (Department of Electronics and Telecommunication Engg., YCCE, Nagpur,
Email: sac_mob@rediffmail.com)

ABSTRACT
A novel printed multiband monopole antenna is proposed for next generation mobile communication system. A simple 'F-shaped' monopole antenna with one of its arms meandered, resonates in DCS1800, PCS1900, WLAN (2.4GHZ) and WiMAX (5.6GHz). The use of an 'L-shaped' parasitic element facilitates bandwidth enhancement in the WiMAX band. Meandering is used to obtain resonance in lower bands of the frequency spectrum.
Keywords - Printed monopole antenna, multiband, wireless applications, parasitic element

I. Introduction

Antennas are the backbone of modern wireless communication system. With the ever increasing demand of bandwidth and Quality of Service (QoS), there is a need to design antennas with advanced and specific operational features, so as to fulfill the imposed technical requirements. Hence, more and more new technologies are evolving in the area of advanced mobilized antenna design.

A simple type of antenna called 'microstrip patch antenna' is being preferred over other antennas owing to its numerous benefits. The advantages of a microstrip patch antenna which make it appropriate for use in many wireless applications, are that it is low profile and lightweight, easy to integrate with accompanying electronics, made conformal to the host surface, easy to mass produce using printed-circuit technology, easier to integrate with other MIC's on the same substrate, low fabrication cost, allows linear polarization as well as circular polarization, can be made compact for use in personal mobile communication, allows dual- and triple-frequency operations [1].

A microstrip patch antenna, in its simplest form has a radiating patch on one side, ground plane to the opposite side and dielectric substance sandwiched in between the radiating patch and the ground plane. The fringing field between the periphery of the patch and the ground plane cause the radiations [2].

In this paper, we propose the design of a microstrip patch antenna that can be used at four different frequency bands- DCS1800, PCS1900, WLAN (2.4GHz) and WiMAX (5.6GHz). Antennas which can transmit/receive satisfactorily in more than one frequency band are called 'multi-band antennas'. They may be used for dual-band, tri-band, quad-band or penta-band applications [3]. In [4], the effect of varying the plate width and microstip feed line width on the impedance is studied.

II. Antenna Design

Fig. 1 shows the design of the proposed antenna and fig. 2 shows the ground plane design for the antenna. The antenna is designed on a FR-4 substrate with dielectric constant = 4.4 and loss tangent of 0.025. The antenna has a monopole 'F-shaped' meandered patch on a printed circuit board (PCB) with a volume of $20 \times 40 \times 1.58$ mm^3. One arm of the 'F-shaped' monopole antenna has been meandered. Meandering the shape of a patch helps in achieving resonance in lower frequency bands; since as the length of the patch increases, the λ increases, consequently we get to achieve lower fundamental frequencies. Also, meandering a patch makes the design appear compact [5].

An 'L-shaped' parasitic element is used to improve bandwidth at the desired frequency. The parasitic element concentrates current around itself along with the main patch. So, by using a parasitic element,

placed close to the main radiating patch, we achieve bandwidth enhancement [6].

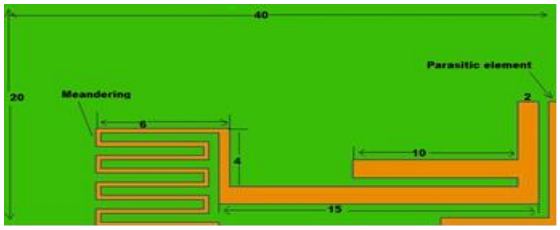

Fig. 1: designed F-shaped Patch

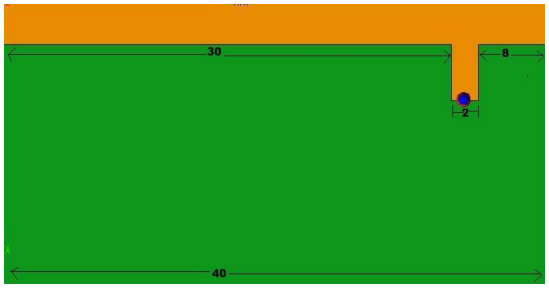

Fig. 2: ground plane of the designed antenna

III. Simulation Result

The proposed antenna is studied and designed using a 'Method of Moment' based electromagnetic simulator 'CADFEKO'. A plot of return loss characteristics (S11) is shown in fig. 3. It is clear from the simulated results shown in fig. 3, that the antennas have the operational bands in DCS1800, PCS1900, WLAN (2.4GHz) and WiMAX (5.6GHZ). It is also observed from fig. 3 that, without the use of parasitic element, the bandwidth of DCS1800 band is 200MHz, WLAN is 250MHz, and WiMAX band is 650MHz. The use of parasitic element improves the bandwidth of DCS1800 band to 300MHz, WLAN band to 320MHz, and WiMAX band to 1.3GHz.

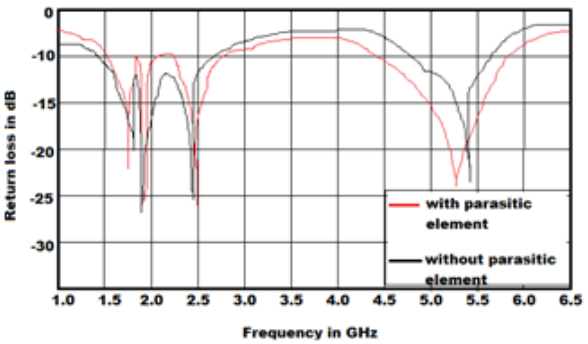

Fig. 3: simulated S-parameters, with and without parasitic element.

The gain of the antenna at various frequencies is shown in table below and its total gain of 4.2 dB is shown in figure 4.

Freq.(GHz)	1.8	1.9	2.4	5.6
Gain (dB)	2	2.8	3.2	3.9

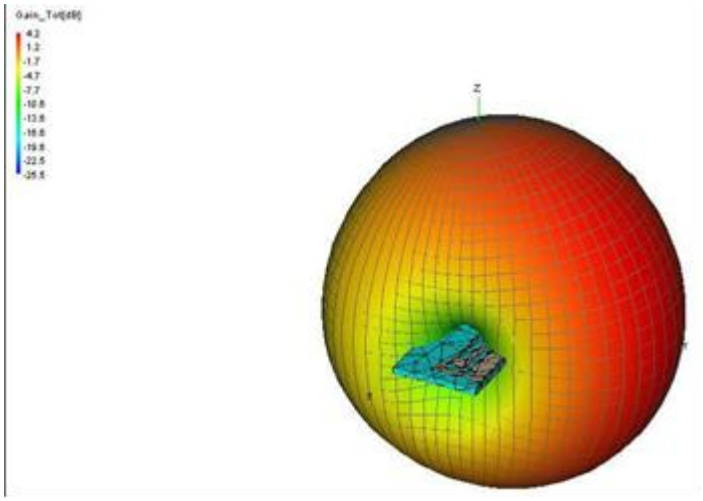

Fig 4: total gain of the proposed antenna in dB

IV. Conclusion

A printed multiband antenna for wireless applications is proposed in this paper. The antenna can be used for operation in the mobile terminals including DCS1800, PCS1900, 2.4GHz WLAN and 5.6GHz WiMAX systems. The bandwidth achieved for WLAN is 320MHz and for WiMAX, it is 1.3GHz. Meandering shifts the resonant frequencies to lower frequency bands and made the antenna design compact. Use of parasitic element made the system broadband. The total gain of the antenna is 4.2dB.

REFERENCES

[1] Girish Kumar and K.P Ray, *Broadband microstrip antennas* (Artech House, 2002)
[2] Stutzman and Gary A. Thiele, *Antenna theory and design* (John Wiley & Sons, 1998, 2nd edition)
[3] C. A Balanis, *Antenna theory*: *analysis and design* (John Wiley & Sons, 1996, 2nd edition)
[4] M.John and M.J Amman, Optimization of impedance bandwidth for the printed rectangular monopole Antenna, *Micow and Opt.Tech. vol. 47, no.2*, 2005, pp. 153-154
[5] Jalil Agha Rashed Mohassel, *Meander antennas*, doctoral diss., University of Michigan, 1982
[6] Gupta and Garg, *Microstrip lines and slotlines* (Artech House, 1979)