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A COMPREHENSIVE REVIEW ON BANDWIDTH IMPROVEMENT APPROACHES OF MICROSTRIP PATCH ANTENNA (MPA)

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Abstract

The field of wireless communication is developing very rapidly at present. With the development of the field of wireless communication, more compact size devices have been required that can produce more ICs in short space. As a result, antenna designers pay more attention to the microstrip patch antenna for its various advantages, such as compact size, low profile, high reliability, low cost, etc. MPA has demerits, too, for certain advantages. The significant drawback is lower bandwidth. Because of these antenna manufacturers, more attention is given to designing small broadband antenna sizes. In the last decade, literal analysis has been implemented to increase the bandwidth of the MPA. The aim of this paper work is to demonstrate a study on different MPA bandwidth enhancement techniques such as slot technique, air gap technique, multiple radiating element technique, parasitic patch technique, multiple feeding technique, proximity couple technique, and comparative analysis between them.

Keywords: *Broadband, Microstrip Patch Antenna, Wireless Devices, Wireless Communication, 5G systems.*

I. INTRODUCTION

The wireless communication field has grown rapidly in the last decade. Due to the simplicity of producing multiple ICs in smaller spaces, the need for portable wireless devices with broadband facilities has arisen [1]. Wireless devices have also asked that they run in a wide frequency range.

The higher data rate for wireless devices must be shielded by a broadband antenna [2]. The 5G wireless networking system, which works in higher bandwidth ranges, has also been launched today. Antenna manufacturers are paying more attention to designing lightweight broadband antennas because of this.

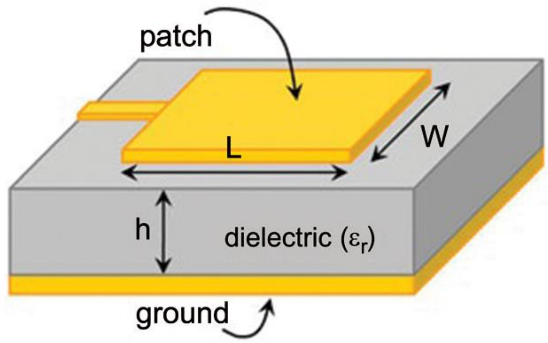

Fig. 1: Illustrates rectangular microstrip patch antenna

A. Bandwidth Enhancement Techniques: -

The major demerits of the MPA are the lower bandwidth activity. Therefore, some bandwidth improvement techniques are being shown to solve this problem. Bandwidth enhancement has achieved up to 182 percent by using these techniques [3].

- **a)** Slot Technique
- **b)** Adding parasitic patch
- **c)** Air gap technique
- **d)** Multiple feeding technique

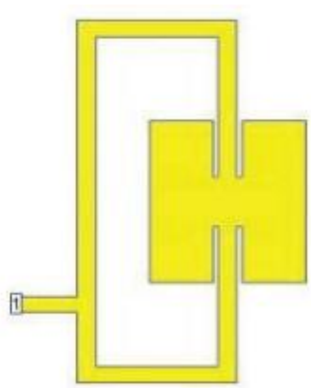

Fig. 2: Illustrates the design of the simple plurality of feeding aerial.

The width W of the microstrip patch antenna is calculated by using the following equation [4].

$$w = \frac{c}{2\, f_r \sqrt{\frac{(\varepsilon_r + 1)}{2}}}$$

Where

f_r denotes the resonant frequency, and

r represents substrate dielectric constant

The effective dielectric constant (ε_{reff}) of antenna is derived by applying the given equations.

$$\varepsilon_{reff} = \frac{(\varepsilon_r + 1)}{2} + \frac{(\varepsilon_r - 1)}{2}\sqrt{\left(1 + 12\frac{h}{W}\right)}$$

Where h denotes the height of the antenna and W denotes the width.

The length of the antenna may be measured by applying the following equation[5].

$$L = \frac{c}{2\, f_r \sqrt{\varepsilon_{reff}}}$$

The antenna length extension is calculated by applying the equation below.

$$\Delta L = 0.412\, h\, \frac{(\varepsilon_{reff} + 0.3)\left(\frac{W}{h} + 0.246\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)}$$

Here W represents the width and h denotes the height.

The real length (L_{eff}) of the antenna can be calculated by using the following formula.

$$L_{eff} = L + 2\Delta L$$

II. LITERATURE REVIEW

Rasin et al. conducted a survey on wideband microstrip patch antenna design techniques. A summary of the design techniques for broadband microstrip patch antennas is provided in this review article. Basically, a microstrip patch antenna is composed on one side of a regular printed circuit board (PCB) substrate with another side grounded by a trace of copper or some other metal of any geometry. Using coaxial, stripline, aperture-coupling or proximity-coupling methods, and this antenna can be fed. The concept of patch antenna slowly attracted the antenna community in 20 years after its birth in early 50's. The patch antennas are very useful because of their; low weight, ability to conform to any geometrical shape, simple integration with HMICs and MMICs, and low cost fabrication. Their biggest downside is their restricted bandwidth, making them inadequate for modern wireless networking technologies [6].

III. DISCUSSION AND CONCLUSION

After evaluating all antennas, the antenna displays less radiation efficiency and directionality characteristics with the growing number of slots on the radiating patch for the slot antenna technique. The antenna shows broadband and elevated directive characteristics for the parasitic patch process. But antenna design takes up more room for the inclusion of parasitic patch, which causes major trouble in designing compact broadband antenna size. These antennas illustrate broadband characteristics in the multiple feeding technique, but the antenna gain is not appropriate for the 5G communication device.

The air gap technique antenna demonstrates a broadband and high-directive antenna that meets the compact size broadband antenna design requirements. In addition, the cellular device gets into the small cell system in the 5G wireless communication system and the 5G communication system is in the high frequency spectrum. Furthermore, with the rise in frequency, path loss is increasing. The antenna must also be more instructions to prevent interference and path loss in the small cell system. So here the problems of less directive and narrow bandwidth can be solved by using the air gap technique antenna. So it is shown after an overall review that the air gap is the best strategy for improving bandwidth in the present situation.

IV. REFERENCES

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