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Design and Development of Microstrip Patch Antennas for WLAN Applications

P. Suresh, J. Venkatagiri and G. Prakasha
Department of Computer Science and Engineering, Sri Venkateshwara College of Engineering, Vidyanagar, 562-157 Bengaluru, Karnataka, India

Abstract: Wireless communication has been developed very rapidly past few decades. While the 4th generation mobile system that supports multimedia services is about to be broadly used through the 1st-3rd generation systems be concentrated on speech, these systems are fully available wherever users are to solve these problems additional base stations and repeaters need to be built again with the decrease of the cell size for covering where the base station signals cannot reach. However, these additional base stations and the repeaters raise the cost of implement and finding the right place is almost infeasible because other base stations and repeaters already occupied the many places. In this regard, the method to serve dual services simultaneously is a key technology to make it possible for everyone to communicate with people anywhere. In terms of size, cost and implementation, the microstrip antenna is a great candidate for the dual service repeater, since the repeaters are usually located in the confined place. But the bandwidth enhancement techniques should be considered to overcome the major drawback of narrow bandwidth. There are several bandwidth enhancement techniques to broaden the impedance bandwidth of the microstrip antenna such as stacked patch, parasitic patch and multiplayer antennas.

Key words: Microstrip antenna, higher order modes, annular ring, circular, triangular and triangular ring, square

INTRODUCTION

Currently the most commonly used WLAN system is the IEEE 802.11b system with a maximum throughput of 11 Mbps using a narrowband system. Keeping on par with the growth of broadband connectivity in the landline sector, the new generation of WLAN systems is designed with a maximum throughput of at least 600 Mbps. Broadband refers to transmission of information using a system that uses a comparatively larger frequency band, resulting in increases data transfer rate or throughput. If the broadband WLAN is to make an entry into the market and have an impact, it is important that the systems are versatile and performs extremely well. The broadband 802.11n system requires them to have a good coverage without failing signal strength. The range of coverage is dependent directly on the antenna performance hence the significance of the broadband antenna. A key requirement of a WLAN system is that it should be low profile where it is almost invisible to the user. For this reason the microstrip patch antennas are the antennas of choice for WLAN use due to their small real estate area and the ability to be designed to blend into the surroundings.

Origin of the proposal: Many antenna designs are already present in the market that will successfully meet the broadband requirement. For example, an omni-directional discone antenna is able to transmit in all direction and perform extremely well over a very large bandwidth. These antennas are usually large metallic cumbersome objects and extremely indiscreet. Aside from the appearance, directivity and security are important features of WLAN systems. The system coverage often needs to be limited to designated areas and since the 802.11x systems use the ISM bands, there are transmitted power limitations to reduce interference. It is important for the system to be highly directive in order to reduce coverage in unwanted areas. Primarily, it is due to possible LAN security breaches in case the LAN's coverage extends outside the property and received by unwanted parties. The outside parties may then gain access to documents and other resources. Besides the security issue, there is also possible interference from neighbouring WLAN systems. There have been documented incidents in congested downtown business districts where earlier WLAN systems perform very poorly due to interference from neighbouring systems. As a result the demand has increased for broadband WLAN antennas that meet all the desired requirements.

The broadband antennas are required to be compact, low-profile, directive with high transmission efficiency and designed to be discreet. Due to these

Corresponding Author: P. Suresh, Department of Computer Science and Engineering, Sri Venkateshwara College of Engineering, Vidyanagar, 562-157 Bengaluru, Karnataka, India

well met requirements coupled with the ease of manufacture and repeatability makes the microstrip patch antennas very well suited for broadband wireless applications.

Definition of the problem: The larger and larger popularity of wireless communication systems induced a demand. In high performance aircraft, spacecraft, satellite and missile applications where size, weight, cost performance, ease of installation and aerodynamic profiles are constraints, low profile antennas may be required. Presently there are many other government and commercial applications, such as mobile radio and wireless communications that are similar specifications. To meet these requirements microstrip antennas can be used. These antennas are low profile, conformable to planar and non-planar surfaces, simple and inexpensive to manufacture using modern printed circuit technology, mechanically robust. When mounted on rigid surfaces, compatible with MMIC designs and when the particular patch shape and mode are selected they are very versatile in terms of resonant frequency, polarization, pattern and impedance. In addition by adding loads between the patch and the ground plane such as pins and varactor diode, adaptive elements with variable resonant frequency, impedance, polarization and pattern can be designed.

Objective: After going through the numerous literatures it is found (Gai *et al*., 2010; Balanis, 1997; Wang *et al*., 2009; Xiao and Feng, 2007; Guo *et al*., 2003), the geometry of the microstrip patch antenna plays an important role, particularly in enhancing the gain and the space occupied by the patch in an array which decides the number of elements that can be printed for a chosen area. Hence, it is necessary to choose an optimum geometry. Convenient geometrical shapes are rectangular, rectangular ring, circular and annular ring, triangular and triangular ring. Other geometries like elliptical etc. are possible but they do not provide any electrical or structural advantages. In addition, the analysis will be difficult because of the co-ordinate system required. Requirements are normally higher gain, omni-directional in horizontal plane, minimum area to occupy in an array and to obtain circular polarization for some application.

The main objective of this proposal is to design and develop microstrip patch antennas of having different circular, rectangular and annular ring shapes and sizes and to analyze the variations in the radiation pattern and polarization for various antenna geometries and dielectric substrates. The antenna characteristics are verified by fabricating arrays and performing rigorous tests on the microstrip antenna in appropriate mode/combination of modes. The final result will be used for optimizing the geometry and design of the microstrip antenna for WLAN applications.

MATERIALS AND METHODS

A microstrip patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side (Chitra *et al*., 2012; Tran and Sharma, 2009). The patch is generally made of conducting material such as copper or gold and can take any possible shape. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. Microstrip antennas received considerable attention starting in the 1970's, although, the idea of a microstrip antenna can be traced to 1953 and a patent in 1955. Often microstrip antennas are referred to as patch antennas. The microstrip antenna is a thin low profile antenna that is easy to mount on existing structures. Since it requires space only for the feed lines behind the ground plane, either linear or circularly polarized antennas can be constructed with gains in the 4-7 dB range. The bandwidths are typically from a fraction of a percent up to a few percent depending on the substrate dielectric constant. Microstrip antennas appear to be ideally suited to applications which require low profile antenna elements or conformal arrays at frequencies from VHF to X-band.

RESULTS AND DISCUSSION

In recent times lot of importance is being given to microstrip devices because of a number of advantages (Kuo and Wong, 2003; Liu, 2007) they have over conventional devices in frequencies above 1 Ghz. A few areas identified are mobile communications, global positioning systems and satellite communications (Wu *et al*., 2005; Ali *et al*., 2017). In many high-performance aircraft, spacecraft, missile and satellite applications where size, weight, cost, performance, ease of installation and aerodynamic profiles are constraints and low profile antennas may be required. Also, there are many other government and commercial applications, such as mobile radio and wireless communications that have similar specifications or example in cars and trucks, having access to satellite telecommunications and global positioning systems, compact antennas, mounted inconspicuously on the vehicle will be required to receive these services together with roadside traffic information data.

Not only are these services likely to be operated at different frequencies but the radiation pattern requirements from the antennas will also be different. Several of the unique characteristics of Microstrip antennas and their advantages are:

- They are very thin and need not extend far above or below the ground plane. Consequently they can be made very rugged
- They are economical to design and construct
- Either linear or circular polarization is possible
- They are easy to mount on existing structures
- Compatible with MMIC designs
- They are very versatile in terms of resonant frequency, polarization, pattern and impedance

CONCLUSION

Antenna gains of 3 dB or more are specified for the telecommunication systems addressed above, depending on the application and in all cases the antennas are to be circularly polarized. Three solutions to the antenna problem can be envisaged.

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REFERENCES

Ali, E.M., N.Z. Yahaya, N. Perumal and M.A. Zakariya, 2017. Design of microstrip patch Antenna at 900 MHz for charging mobile applications. J. Eng. Appl. Sci., 12: 988-993.

Balanis, C.A., 1997. Antenna Theory Analysis and Design. 2nd Edn., John Wiely and Sons Inc., New York, USA., ISBN-13: 978-0471592686, Pages; 960.

Chitra, R.J., B.R. Karthik and V. Nagarajan, 2012. Design of double L-slot microstrip patch antenna for WiMAX and WLAN application. Proceedings of the 2012 International Conference on Computing, Communication and Applications (ICCCA'12), February 22-24, 2012, IEEE, Dindigul, India, ISBN:978-1-4673-0270-8, pp: 1-4.

Gai, S., Y.C. Jiao, Y.B. Yang, C.Y. Li and J.G. Gong, 2010. Design of a novel microstrip-fed dual-band slot antenna for WLAN applications. Prog. Electromagnet. Res. Lett., 13: 75-81.

Guo, Y.X., I. Ang and M.Y.W. Chia, 2003. Compact internal multiband antennas for mobile handsets. IEEE. Antennas Wirel. Propag. Lett., 2: 143-146.

Kuo, Y.L. and K.L. Wong, 2003. Printed double-T monopole antenna for 2.4-5.2 GHz dual-band WLAN operations. IEEE. Trans. Antennas Propag., 51: 2187-2192.

Liu, W.C., 2007. Optimal design of dualband CPW-fed G-shaped monopole antenna for WLAN application. Prog. Electromagnet. Res., 74: 21-38.

Tran, T.Q. and S.K. Sharma, 2009. Performance of single layer multimode microstrip patch antenna with reconfigurable radiation patterns. Proceedings of the 2009 IEEE International Symposium on Antennas and Propagation Society (APSURSI'09), June 1-5, 2009, IEEE, Charleston, South Carolina, ISBN:978-1-4244-3647-7, pp: 1-4.

Wang, E., J. Zheng and Y. Liu, 2009. A novel dual-band patch antenna for WLAN communication. Prog. Electromagnet. Res. C, 6: 93-102.

Wu, J.W., Y.D. Wang, H.M. Hsiao and J.H. Lu, 2005. T-shaped monopole antenna with shorted L-shaped strip-sleeves for WLAN 2.4-5.8-GHz operation. Microwave Opt. Technol. Lett., 46: 65-69.

Xiao, C. and Q. Feng, 2007. A new patch antenna with magnetic substrate for active RFID card. Proceedings of the 2007 International Conference on Wireless Communications, Networking and Mobile Computing (WiCom'07), September 21-25, 2007, IEEE, Shanghai, China, ISBN:978-1-4244-1311-9, pp: 2097-2100.