**ROMANIAN JOURNAL OF INFORMATION SCIENCE AND TECHNOLOGY**
Volume **10**, Number 4, 2007, 355–360

# Miniaturized Broadband Microstrip Antennas for HIPERLAN/2 Application

J. S. ROY, M. THOMAS

International Centre for Wireless and Mobile Communication,
Electronics and Communication Engineering Department,
Birla Institute of Technology (Deemed University), Mesra,
Ranchi-835215, INDIA

E-mail: drjsroy@rediffmail.com

**Abstract.** The investigations on U-slot loaded and V-slot loaded proximity coupled microstrip antennas are reported. The performances of two antennas are investigated in frequency band of high performance wireless local area network (HIPERLAN/2) using IE3D software and the computed results are verified by measurement. Results show that the antennas have wide bandwidth and moderate gain and may be used as very small, compact antennas for HIPERLAN/2 communication.

**Keywords:** Microstrip antenna, proximity coupled, broadband, wireless communication.

## 1. Introduction

The need for wireless broadband communications has increased rapidly in recent years demanding quality of service, security, handover, and increased throughput for the wireless local area networks (WLANs). The main aim of next generation wireless communication is high speed networking service for multimedia communication. One of the most important high data rate wireless broadband communication standard is ETSI High Performance Local Area Network type 2 (HIPERLAN/2) which uses the frequency band 5.470 GHz – 5.725 GHz with omnidirectional antenna [1]. The microwave wireless communication systems require compact and broadband antennas. Because of many attractive features, microstrip patch antennas have received considerable attention for wireless communication applications [2–7]. Single layer Microstrip antennas have very narrow bandwidth and it is very difficult to achieve high impedance bandwidth. But using two layer proximity coupled microstrip antennas high bandwidth can be achieved [2, 8–10]. Since radiation pattern of a microstrip antenna has wide beamwidth in one hemisphere, two back-to-back microstrip antennas can be used to produce nearly omnidirectional radiation pattern required for LAN application. In proximity coupled (also known as electromagnetically coupled), the microstrip radiating patch, fabricated on a dielectric substrate, is excited by a microstrip line on another substrate as shown in Fig. 1. Investigations on slot loaded single layer microstrip antennas are reported by many authors but research work on slot loaded proximity coupled microstrip antennas are insufficient [2–4].

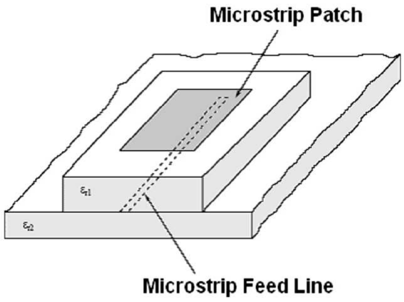


**Fig. 1.** Proximity Coupled Microstrip Antenna.

In this paper, the theoretical and experimental studies on two types of proximity coupled microstrip antennas are reported. Both proximity coupled microstrip antennas were rectangular type, but one antenna was loaded by cutting U-shaped slot on the patch and other was loaded by cutting V-shaped slot on the patch. The geometry of U-slot loaded and V-slot loaded microstrip radiating patches are shown in Fig. 2 and Fig. 3 respectively. Results show that the proposed microstrip patch antennas have very small size, wide bandwidth and moderate gain for the application in HIPERLAN/2.

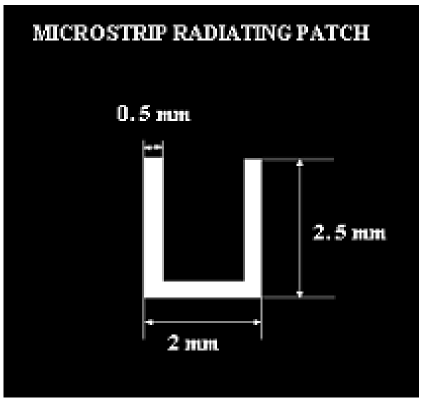


**Fig. 2.** Microstrip Patch with U-slot.

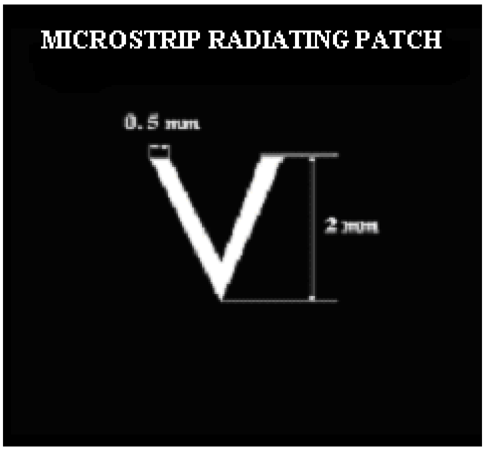


**Fig. 3.** Microstrip Patch with V-slot.

## 2. Computed and Measured Results

The Method of Moment using IE3D software is used for the design of the proximity coupled microstrip antennas. The antennas were fabricated on Glass Epoxy substrate with dielectric constant 4.36, substrate thickness 1.57 mm and measurements were done using Vector Network Analyzer (N5230A, Agilent Technologies). Two microstrip antennas, with U-slot and V-slot on the center of the rectangular patches, were fed by SMA connectors via very small microstrip lines. The microstrip feed lines were placed below the centers of the U-slot and V-slot. The dimension of the U-slot loaded microstrip antenna was 12 mm×5 mm and the dimension of the V-slot loaded microstrip antenna was 12 mm×4 mm. The dimensions of the U-slot and V-slot are shown in Fig. 2 and in Fig. 3. The dimension of the feed line was 5 mm×1 mm These optimum dimensions of the patches, slots and feed line were determined using IE3D computation to obtain required frequency for HIPERLAN/2 and to achieve best impedance matching.

The computed return loss of the U-slot loaded proximity coupled microstrip patch antenna shows that it resonates at 5.56 GHz. The antenna shows linearly polarized broadside radiation pattern and the computed gain at 5.56 GHz is 5.2 dBi. The minimum gain at the frequency band of 5.470 GHz–5.725 GHz is 4 dBi. The computed −10 dB return loss bandwidth of the antenna is 210 MHz. The computed and measured return losses for U-slot loaded proximity coupled microstrip patch antenna are compared in Fig. 4. The computed return loss of the V-slot loaded proximity coupled microstrip patch antenna shows that it resonates at 5.565 GHz. The antenna shows linearly polarized broadside radiation pattern and the computed gain at 5.565 GHz is 5.3 dBi and minimum gain at the frequency band of 5.470 GHz–5.725 GHz is 4.7 dBi. The computed −10 dB return loss bandwidth of the antenna is 200 MHz. The computed and measured return losses for V-slot loaded proximity coupled microstrip patch antenna are compared in Fig. 5. Good agreement between simulated and measured results are achieved. The computed radiation patterns for U-slot loaded and V-slot loaded proximity coupled microstrip antennas are shown in Fig. 6 and Fig. 7 respectively.

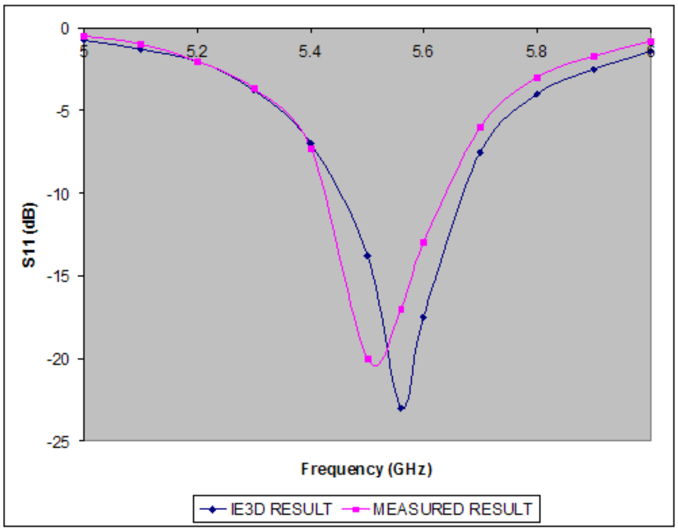


**Fig. 4.** Comparison between simulated and measured return losses for u-slot loaded proximity coupled microstrip antenna.

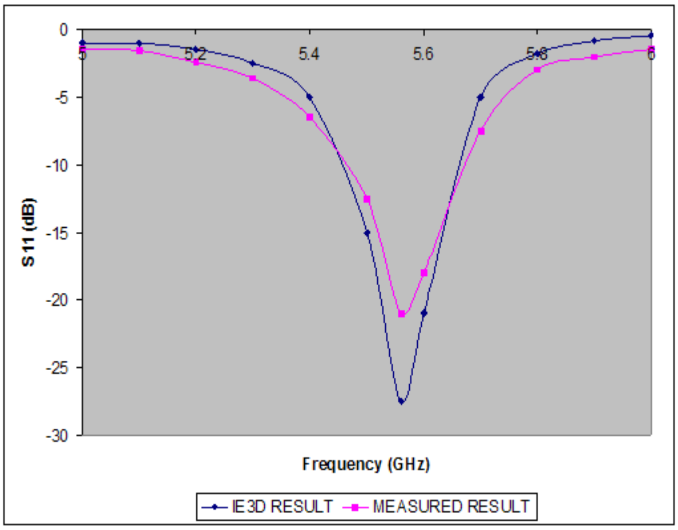


**Fig. 5.** Comparison between simulated and measured return losses for v-slot loaded proximity coupled microstrip antenna.

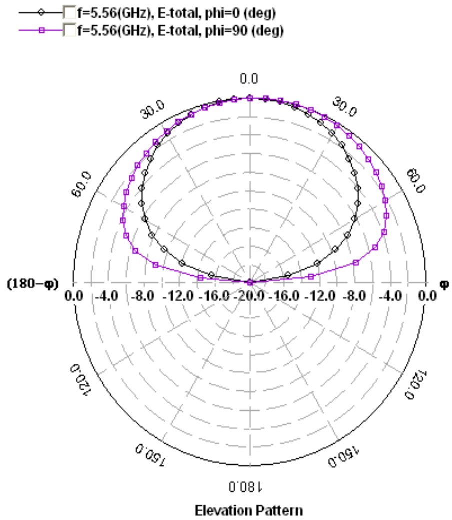


**Fig. 6.** Computed radiation pattern of U-slot loaded proximity coupled microstrip antenna.

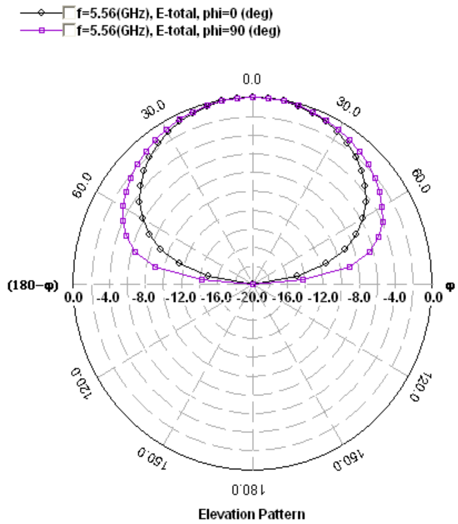


**Fig. 7.** Computed radiation pattern of V-slot loaded proximity coupled microstrip antenna.

## 3. Conclusion

The investigations on very reduced size broadband microstrip antennas for the application in HIPERLAN/2 communication are reported here. The computation using IE3D shows that in order to achieve same characteristics, in the frequency range of HIPERLAN/2, using proximity coupled rectangular microstrip antenna without loading by any slot, the required dimension of patch should be 12 mm×10 mm and for proper impedance matching the dimension of the feed line should be 15 mm×4 mm. Therefore using the proposed U slot loaded and V-slot loaded proximity coupled microstrip antenna the peripheral area of the patch is reduced by 50% in case of U-slot loaded antenna and 58% in case of V slot loaded antenna. Thus these proposed antennas are truly miniaturized broadband antennas.

**Acknowledgements.** Authors like to acknowledge University Grants Commission (UGC) for providing financial assistance during this work.

# References

[1] NEE R. V., PRASAD R., *OFDM for Wireless Multimedia Communications*, Artech House, 2000.

[2] GARG R., BHARTIA P., BAHL I. J., ITTIPIBOON A., *Microstrip Antenna Design Handbook*, Artech House 2001.

[3] WONG K. L., *Compact and Broadband Microstrip Antennas*, Wiley, 2002.

[4] KUMAR G., ROY K. P., *Broadband Microstrip Antennas*, Artech House, Boston, 2003.

[5] ROY J. S., CHATTORAJ N., SWAIN N., *Short Circuited Microstrip Antennas For Multiband Wireless Communications*, Microwave & Optical Technology Letters, vol. **48**, pp. 2372–2375, 2006.

[6] CHEN H.-D., LI J.-N., HUANG Y.-F., *Band-Notched Ultra-Wideband Square Slot Antenna*, Microwave & Optical Technology Letters, vol. **48**, pp. 2427–2429, 2006.

[7] ROY J. S., CHATTORAJ N., SWAIN N., *New Dual-Frequency Microstrip Antennas for Wireless Communication*, Romanian Journal of Information Science and Technology, vol. **10**, no. 1, pp. 113–119, 2007.

[8] POZAR D. M., VODA S. M., *A Rigorous Analysis of a Microstrip Fed Patch Antenna*, IEEE Trans. Antennas & Propagat., vol. **AP-35**, pp. 1343–1350, 1987.

[9] ROY J. S., SHAW S. K., PAUL P., PODDAR D. R., CHOWDHURY S. K., *Some Experimental Investigations on Electromagnetically Coupled Microstrip Antennas on Two Layer Substrates*, Microwave & Optical Technology Letters, vol. **4**, pp. 236–238, 1991.

[10] DUFFY S. M., *An Enhanced Bandwidth Design Technique for Electromagnetically Coupled Microstrip Antennas*, IEEE Trans. Antennas & Propagat., vol. **AP-48**, pp. 161–164, 2000.