Compact dual-band antenna for wireless access point

G. Augustin, S.V. Shynu, P. Mohanan, C.K. Aanandan and K. Vasudevan

A compact dual-band printed antenna covering the 2.4 GHz (2400–2485 MHz) and 5.2 GHz (5150–5350 MHz) WLAN bands is presented. The experimental analysis shows a 2:1 VSWR bandwidth of up to 32 and 8% for 2.4 and 5.2 GHz, respectively. The measured radiation patterns are nearly omnidirectional, with moderate gain in both the WLAN bands.

Introduction: Wireless local area networks (WLAN) have recorded tremendous growth in recent years. A wireless access point facilitates wireless connection between PCs, laptops, wireless routers and other wireless modules. To meet the miniaturisation and bandwidth requirements of modern wireless communication equipment, the design of a compact, broadband antenna is of prime interest. As per IEEE recommendation, the 2.4 GHz WLAN occupies a spectrum from 2400–2485 MHz whereas the 5.2 GHz Hyperlan occupies 5150–5350 MHz. The present scenario in wireless communication systems indicates a shift of operating frequency from the 2.4 GHz band to the 5.2 GHz band for various reasons. Hence, a single, compact antenna supporting both these WLAN bands is of great significance. Several low-profile antennas offering dual-band operation have been reported [1–4].

In this Letter, we propose a novel dual-band planar antenna suitable for wireless communication systems. Various antenna parameters are optimised using Ansoft HFSS™ v10 to meet the design goals at both frequency bands of interest. The measured performance of the proposed geometry is presented and discussed.

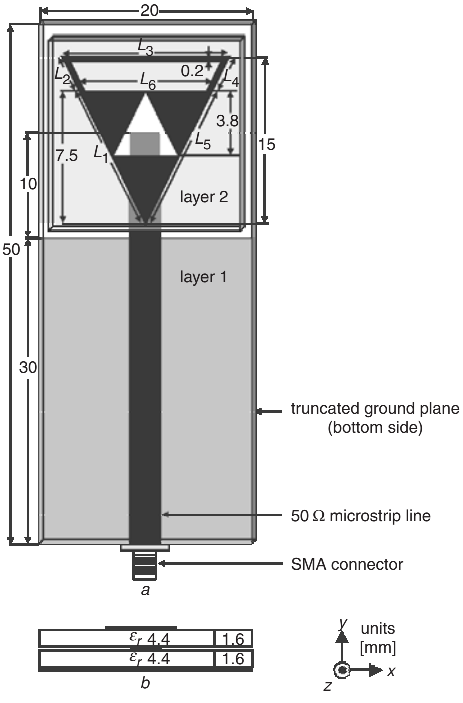

Fig. 1 *Geometry and dimensions of proposed antenna*

a Top view
b Cross-sectional view
Dimensions: $L_1 = 13.5$ mm, $L_2 = 3.5$ mm, $L_3 = 20$ mm, $L_4 = 3.5$ mm, $L_5 = 13.5$ mm, $L_6 = 12$ mm

Antenna design: The proposed geometry comprises a triangular slot loaded patch antenna, on layer 1, excited by the planar strip monopole, as shown in Fig. 1. The dimensions of the patch are optimised for 2.4/5.2 GHz WLAN application, on a substrate of thickness of 1.6 mm and the dielectric constant is ε_r 4.4. The overall size of the antenna, including the feed structure, is 20 × 50 mm. A 50 Ω microstrip line with truncated ground plane etched on layer 2 serves as the feed and radiating monopole. The dual-band performance of the proposed antenna is obtained from the dual resonant structures of different dimensions. In the geometry, the resonant path length $L_1 + L_2 + L_3 + L_4 + L_5$ is set close to λ_g at 2.4 GHz and the slot dimension $L_2 + L_3 + L_4 + L_6$ corresponds to λ_g at 5.2 GHz. The relative position of the feed monopole is optimised using the optimisation tool of HFSS™ v10 to obtain good impedance matching.

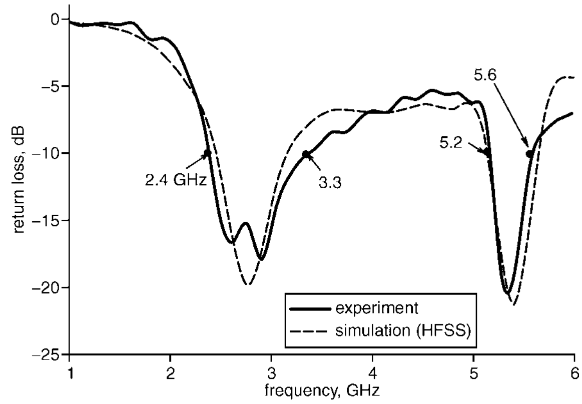

Fig. 2 *Measured and simulated return loss of proposed antenna*

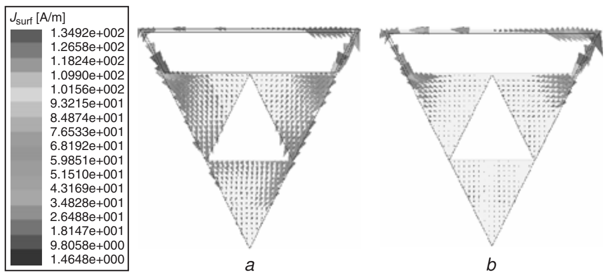

Fig. 3 *Simulated surface current distributions on proposed antenna*

a 2442 MHz
b 5250 MHz

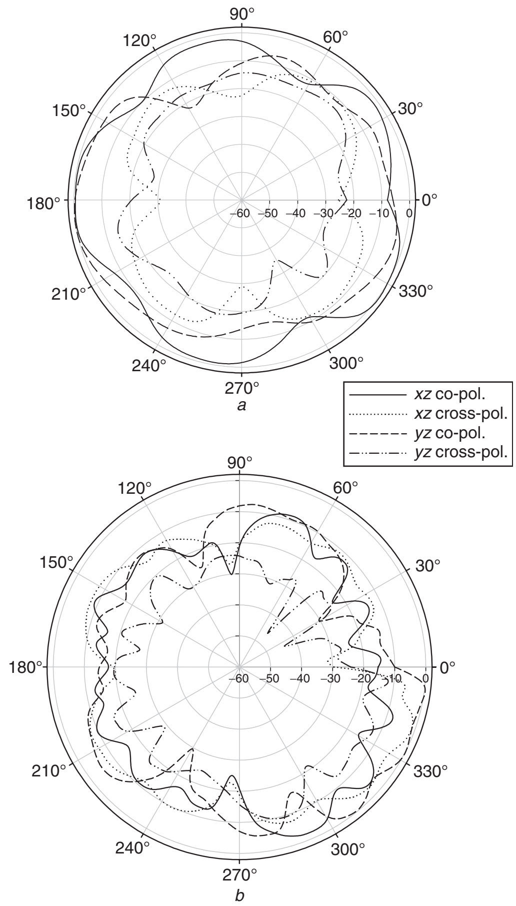

Fig. 4 *Measured radiation patterns of proposed antenna*

a 2442 MHz
b 5250 MHz

Results and discussion: The simulated results obtained using HFSS™ v10 are validated experimentally from measurements using an HP8510C vector network analyser. Measured and simulated return loss characteristics of the proposed antenna are shown in Fig. 2. It can be seen that the lower resonant mode covers the 2.45 GHz WLAN band and the upper resonance covers the 5.2 GHz band. In the lower resonant band, the 2:1 VSWR bandwidth is about 936.625 MHz (2.39–3.32 GHz), which corresponds to 32.8% at the centre frequency of 2.85 GHz. This meets the bandwidth requirement for IEEE 802.11 b/g WLAN applications. In the 5.2 GHz band, the −10 dB return loss bandwidth is about 435.125 MHz (5.17–5.60 GHz) with 8.1 % bandwidth at the centre frequency of 5.38 GHz. Measured return loss behaviour shows reasonably good agreement with simulated results. The simulated surface current distributions for the proposed antenna at 2.4 and 5.2 GHz are presented in Fig. 3. It can be seen that the upper part of the triangular patch contributes to the 2.4 GHz resonance and the slot contributes to 5.2 GHz.

Measured radiation patterns in the orthogonal *x-z*, *y-z* planes are shown in Fig. 4. The measured gain in the two operating bands is shown in Fig. 5. For the lower band, the antenna gain varies from 3.7 to 4.7 dBi. For the upper band, the antenna gain lies between 2.8 and 5.3 dBi.

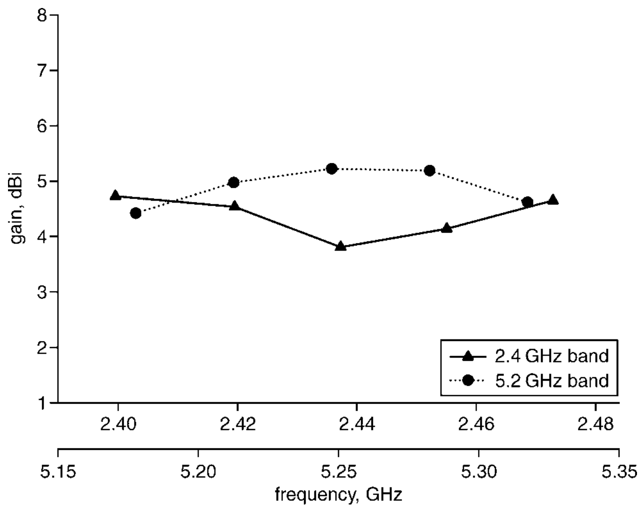

Fig. 5 *Measured gain of proposed antenna*

Conclusions: A compact dual-band monopole excited patch antenna for the wireless access point has been designed, fabricated, tested and simulated. The proposed antenna of dimensions 20 × 50 mm is suitable for integration with the wireless access point. It exhibits two broad 2:1 VSWR bands covering the 2.45 GHz (2386–3323 MHz) and 5.2 GHz (5167–5602 MHz) WLAN bands with good radiation characteristics in the bands.

8 March 2006
Electronics Letters online no: 20060721
doi: 10.1049/el:20060721

G. Augustin, S.V. Shynu, P. Mohanan, C.K. Aanandan and K. Vasudevan (*Center for Research in Electromagnetics and Antennas, Department of Electronics, Cochin University of Science and Technology, Kochi–682022, Kerala, India*)

References

1 Chuang, H.R., and Lin, C.C.: 'A printed UWB triangular monopole antenna', *Microw. J.*, 2006, **49**, (1), pp. 108–120
2 Liu, W.-C., and Hsu, C.-F.: 'Dual-band CPW-fed Y-shaped monopole antenna for PCS/WLAN application', *Electron. Lett.*, 2005, **41**, (18), pp. 390–391
3 Chen, H.-D., and Chen, H.-T.: 'A CPW fed dual frequency monopole antenna', *IEEE Trans. Antennas Propag*, 2004, **52**, (4), pp. 972–982
4 Chen, T.L.: 'Multi-band printed sleeve dipole antenna', *Electron. Lett.*, 2003, **39**, (1), pp. 14–15