Broadband Dual-Polarized Antenna with High Port Isolation and Polarization Purity

Broadband Dual-Polarized Antenna with High Port Isolation and Polarization Purity

G. Wolosinski, V. Fusco
ECIT
Queen's University Belfast
Belfast, UK
g.wolosinski@qub.ac.uk, v.fusco@ecit.qub.ac.uk

P. Rulikowski
Wireless Access Dept.
Alcatel-Lucent Bell Labs
Dublin, Ireland
pawel.rulikowski@alcatel-lucent.com

***Abstract*— This paper presents a novel high symmetry balun which significantly improves the performance of dipole-based dual-polarized antennas. The new balun structure provides enhanced differential capability leading to high performance in terms of port-to-port isolation and far-field cross polarization. An example antenna using this balun is proposed. The simulated results show 53.5% of fractional bandwidth within the band 1.71−2.96 GHz (VSWR<1.5) and port-to-port isolation >59 dB. The radiation characteristic shows around 9 dBi of gain and far-field cross polarization <−48 dBi over the entire bandwidth. The detailed balun functioning and full antenna measurements will be presented during the conference. Performance comparison with similar structures will be also provided.**

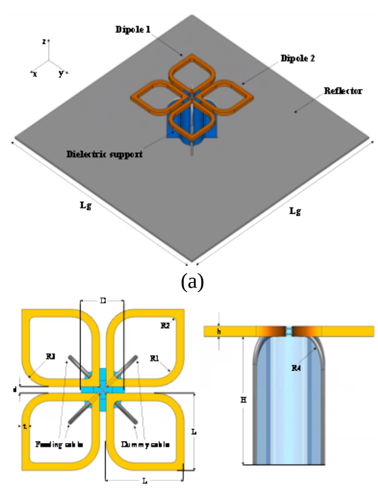
Keywords—Dual-polarized antenna; Port isolation; Cross polarization.

I. INTRODUCTION

In the last few years wireless communication systems require more spectrum resources to satisfy the coexistence of multiple standards within the same base station. For this reason, base station antennas are required to exhibit wide impedance bandwidth and dual polarization feature as well as high port-to-port isolation. Several antenna embodiments have been proposed to address these requirements [1]-[2]. However, albeit with the support of balun structures [3] these antennas find difficulties in achieving very high performance. In this paper a broadband dual-polarized antenna based on a novel balun is presented. The resulting antenna shows extremely high port-to-port isolation and low far-field cross polarization. The antenna operates within the band 1.71−2.96 GHz and it is therefore suitable for base station applications.

II. ANTENNA DESIGN

The proposed antenna is depicted in Fig. 1 and consists of two cross dipoles, a dielectric support, a balun structure, and a metallic reflector. The dipoles are supported by the dielectric support (ε_r=2.1) and fed through the balun which consists of two coaxial feeding cables and two metallic dummy cables with equal cross section. All the cables are connected to the dipoles in the same plane as the dipoles and bent toward the reflector according to four symmetric guides located around the dielectric support (see Fig. 1). In the central feeding section the external part of each cable is connected to the corresponding radiating element while the inner conductor of each feeding cable is attached to the opposite situated dummy cable. The two dipoles are identical to each other apart from their feeding structures which are symmetrically shifted to avoid physical overlap (see Fig. 1c). The feeding cables as well as the dummy ones pass through the reflector by means of four corresponding holes and are shorted to the latter resulting in a quarter-wave balun functioning for each dipole. Such a configuration minimizes the transition effect from a coaxial cable (unbalanced structure) to a dipole antenna (balanced structure) providing a highly balanced feed and therefore highly symmetrical current distribution onto the antenna.



(a)

(b)

(c)

III. SIMULATED RESULTS

The simulated S-parameters of the proposed antenna are reported in Fig. 2. The input impedance fractional bandwidth is 53.5% for S11<−14 dB (VSWR<1.5) with more than 59 dB of port-to-port isolation (S21 value with no sign). The radiation pattern at 2.4 GHz with co and cross-polar components along E and H-plane is shown in Fig. 3. The antenna gain at boresight over the frequency is reported in Fig 4. The co-polar component is maintained between 8.3 and 9.3 dBi while the cross-polar component is kept below −48 dBi within the bandwidth. The extremely low level of the latter as well as the high port-to-port isolation is the direct result of the highly balanced current distribution performed by the balun. In fact, for this antenna configuration, the use of ideal differential feeds instead of the proposed balun would provide values of port-to-port isolation and cross polarization not far from the values obtained by employing the proposed balun, confirming thus the significant differential capability of the latter.

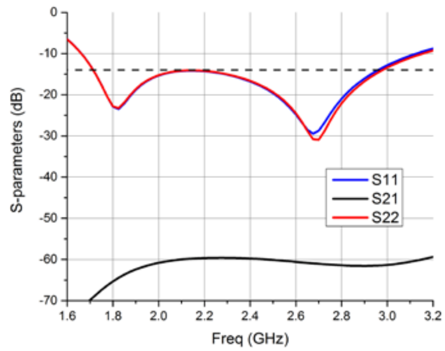


Fig. 2. Simulated S-parameters of the proposed antenna.

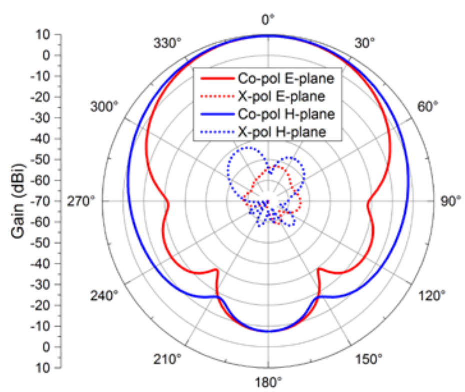


Fig. 3. Simulated radiation pattern at 2.4 GHz.

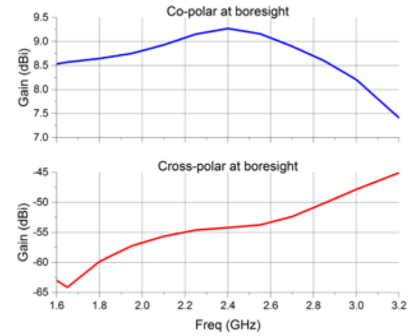


Fig. 4. Simulated co and cross-polar component at boresight.

IV. Conclusion

In this paper a broadband dual-polarized antenna fed through a novel balun is proposed. The high degree of symmetry processed by the feeding structure provides superior antenna performance in terms of port-to-port isolation and polarization purity over a broadband operating range. These features as well as the compact size of the structure make the antenna very suitable for deployment in advanced multi-standard base stations where volume is a premium.

Acknowledgment

This work was supported by Marie Curie European Industrial Doctorate (EID) programme ARTISAN (grant no. 316426).

References

[1] Q. Wu and K. M. Luk, "A broadband dual-polarized magneto-electric dipole antenna with simple feeds," *IEEE Antennas Wireless Propag. Lett.*, vol. 8, pp. 60–63, 2009.

[2] Q. X. Chu, D. L. Wen, Y. Luo, and X. J. Wang, "A broadband ±45° dual-polarized antenna with Y-shaped feeding structure," *IEEE Trans. Antennas Propag.*, vol. 63, no. 2, pp. 483-490, Feb. 2015.

[3] Z. D. Bao, Z. P. Nie, and X. Z. Zong, "A broadband dual-polarization antenna element for wireless communication base station," *2012 IEEE Asia-Pacific Conference Antennas Propag.*, pp. 144-146, Aug. 2012.