Study on Performance Analysis of Printed Dipole Antenna with 5G Application

Miss Shazia Sultana [1], Dr. R. S. Meena [2]
M. Tech (Digital Communication) [1], Professor [2]
Rajasthan Technical University, Rajasthan, India [1, 2]

Abstract:
In wireless applications such as local wireless networks (WLANs), flat dipole antennas are a good choice and can be modified for more advanced functionality. In practice, it is usually a dipole antenna that requires a balanced supply. This layer is a distinct line of vertical field micro-strip. In practice, it is usually a dipole antenna that requires a balanced supply. This layer is a distinct line of vertical field micro-strip. However, due to the electric field passing through the gap, the dipole of the wire that extends directly from the length of the dipole arm is a precise rod. In general, the results of several antenna parameters are superior to the printed dipole antennas. Due to dual polarization, the potential, radiated power, and H-type antenna efficiency are superior to other array configurations. Efficiency percentages for different antenna types range from 89 to 95, and the highest observed value in H-type matrices is due to high radial power.

Key Word: local wireless networks (WLANs), H-type antenna, field micro-strip, Radial Power, CST-Software

1. Introduction

In wireless applications, such as a wireless local area network (WLAN), a flat panel dipole antenna will be a good choice and can be modified to achieve a more advanced function. A printed dipole component with a built-in microstrip provides a wide operating bandwidth. It has been described how to determine the length of the electric cable and short circuit open, which provide broadband response. The line transmission line λ / 4 can be equal to a short circuit and can radiate the open end causing the coupling effect and energy loss. Therefore, instead of an open opening, a hole can be designed through the substrate of the bottom layer metal to be a balun through the whole structure. In this article, the printed bipolar antennas are checked and compared with the open-loop micro-balun and balun through a hole. To simulate the full structures of a printed dipole antenna with an integrated micro band balun, the time scale of the 3D risk (FDTD) method was used. As a commercial software, a soft HFSS (High Frequency Structure Simulation) is used based on the FEM method, to perform design simulation and compare with the FDTD method. The bipolar antennas printed at GHz with open terminal and balun were made through a hole on the FR-4 PCB. The numerical results and measured data are compared and discussed for the performance of two different baluns.

2. Literature Survey

MIMO radio systems demonstrate the ability to increase the spectral efficiency of communications in a rich multi-track environment. From the antenna point of view, various array configurations and component types of MIMO connections have been proposed and analyzed. At present, demand for antennas continues to increase in military applications and commercial applications. A standard dipole antenna has a multi-directional radiation pattern, but due to the development of wideband communication, a high bandwidth gain is required for a modern wireless system (Fan et al 2007)

Printed antennas are preferred by a wide operating bandwidth in many wireless applications. In this study, printed bipolar arrays are presented for potential use in wireless communications. Compared with traditional line antennas, printed bipolar antennas have advantages such as flat structure, small size, thin shape, light weight, ease of manufacture, low cost (Li et al 2009). A dual-band antenna was reported on the printed balun (Chen et al. 2004), but the effect of the balun was not clearly explained.

The CPW-fed antenna discussed in Sze et al. (2006), Liu (2004), and Liu (2007) has a simple but larger structure. Two electromagnetic parallel antennas, E print monopole antenna and dual band antenna were designed and analyzed for MIMO applications (Xiong et al 2012, Ali Nezhad & Hassani 2010, Zhou et al 2012).

Antenna MIMO polarized single- interconnect (Su et al., 2012). However, this antenna and have a complex structure and gain antenna has a low efficiency in terms of performance. Since the above-mentioned drawbacks Airbag printed microstrip dipole antenna MIMO system fill. When coupled with an antenna element plurality important milestone. Currently primarily constrained by the current and near -Field coupling generated from the ground caused. Can reduce the associated antenna element (Ding et al., 2007), whether printed dipole antenna geometry by changing it.

3. Antenna Design and Structure

In practice, typically a dipole antenna, which needs to be balanced feeding. This layer is significantly perpendicular field micro-strip line. However, an accurate bar directly from the wire dipoles extending along the length of the dipole arms, since the electric field across the gap. This is an alternative, for example, linear groove or the micro-strip for a serial connection requires a feeding mechanism. Here is a print printed dipole antenna balun (Michailidiset al.2007).

Balun is a device for balancing the unbalanced transmission line. A printed dipole with integrated balun is characterized by broadband performance (Edward & Rees 1987) and has an application of wireless communication (Chuang &Kuo 2003). The design of the printed dipole antenna includes the following calculation.

Step 1: Calculation of effective dielectric constant $\lambda 0 = c/f_r$

c is velocity of light ($3*10^8$m/sec).

f_r = frequency of operation

$\lambda 0$ =operating wavelength (m)

Guide wavelength in dielectric is given by

$$\lambda_d = \frac{\lambda_0}{\sqrt{\varepsilon_r}}$$

ε_r= dielectric constant

λd = Operating Guide wavelength with dielectric (m)

The effective dielectric constant is given as,

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[(1 + 12h/W)^{-1/2} + 0.04(1 - W/h)^2\right]$$

Where, h is the thickness of the substrate, W the width of the strip and ε_r the relative dielectric constant of the substrate used.

Step 2: Calculation of ΔL

$$\Delta L = 0.412 * h\left\{\frac{\varepsilon_r + 0.3}{\varepsilon_r - 0.258}\right\}\left\{\frac{W/h + 0.264}{W/h + 0.813}\right\}$$

L=effective length due to ε_{reff} (m).

Step 3: Calculation of length and width of dipole

$L = \{C/2f_r * \sqrt{\varepsilon_{reff}}\} - 2\Delta L$

W = L/3

L=Length of dipole (m)

W= Width of dipole (m)

The length of the dipole L is the function of strip width W, Substrate parameters H and R and dielectric thickness. The length of the dipole is adjusted to obtain optimum results. Figure 3.1 shows the printed dipole antenna.

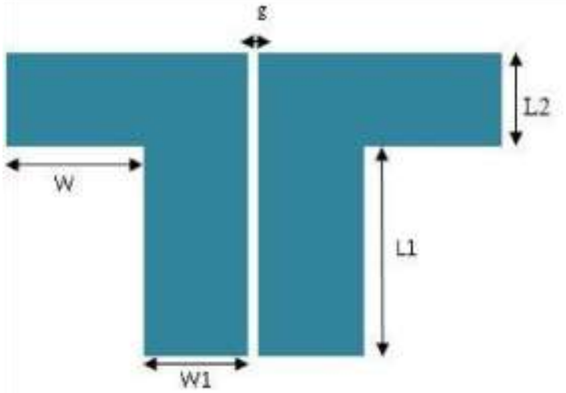


Figure 3.1 Configuration of the printed dipole antenna.

In order to simulate the antenna design, length = 35 mm, width = 55 mm, distance (g) between bipolar arms = 1 mm is considered. The length (L1) and width (W1) of each arm of the printed bipolar structure are 23 mm and 11 mm respectively, the length (L2) of the bipolar arm is 12 mm and the width (W) of the arm is 16 mm. The printed dipole antenna is designed based on the thickness h = 1 mm of FR4 with constant dielectric constant r = 2.65.

The design of the balun is based on Marchand balun (Fan et al 2007) and is essentially a small part of the C - Planar Strip (CPS) line with four stubs. In this design, this heel has been replaced by the actual open circle. The CPS line with ZCPS characteristic resistance rotates the radiating element resistance of closed RL + CPS value to 50 using the following design formula.

$$Z_{L \cdot CPS} = Z_{CPS}\frac{Z_L + jZ_{CPS}\tan(\beta l)}{Z_{CPS} + jZ_L\tan(\beta l)}$$

Suppose if the reactance $X_{L\ CPS}$ is about $jX_0\Omega$, the open micro stripstub (MS1), with characteristic impedance Z_{MS1} and electrical length βl_{MS1}, adds the impedance $Z_{in\ MS,1} = -jZ_{MS1}\cot(\beta l_{MS1})$ to $X_{L\ CPS}$, moving the entire band closer to 50Ω. Subsequently, at the upper frequency band, $Z_{MS\ 2}$ and βl_{MS2} are determined to compensate reactance according to equation

$$Z_{L \cdot CPS} = Z_{CPS}\frac{Z_L + jZ_{CPS}\tan(\beta l)}{Z_{CPS} + jZ_L\tan(\beta l)}$$

A complete balun structure is shown in Figure 3.2. The engineering sizes of the dipole antenna and the balloon are shown in Table 3.1. The designed antenna element is suitable for 5.8 GHz applications. This antenna element can be configured for use in MIMO applications

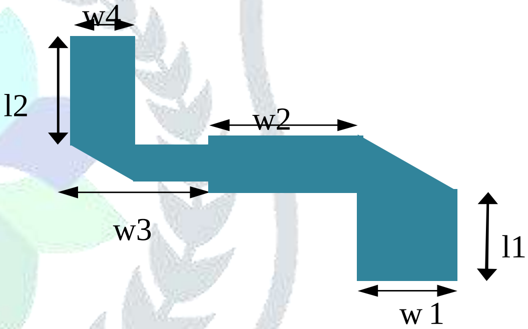


Figure 3.2 Configuration of the balun feed for printed dipole antenna

Table 3.1 Designed geometrical parameters of dipole antenna with balun feed

Dipole arm		Balu N	
Parameter	Value (mm)	Paramete r	Value (mm)
L1	23	l1	7.6
L2	12	l2	7
W1	11	w1	2.8
W2	16	w2	5
G	1	w3	4
Overall dimension	35*55mm2	w4	1.6 mm

Figure 3.3 shows the simulated current distribution of two element array at 5.8 GHz. In each case, the spacing between the array elements is calculated as 25 mm and the mutual coupling between the antennas can be obtained from S_{ij} of

the scattering matrix. Changes in the position, pattern, and polarization of the elements results in different mutual coupling.

In either case, the spacing between the array elements is calculated at 25 mm and mutual coupling between the antennas of Sij is obtained with a scattering matrix. Changes in position, pattern, and polarization result in different interrelationships. The configuration of the antenna array investigated in this work is a parallel, collinear, echelon and H type array antenna for WLAN application. Parallel and echelon configurations have vertically oriented elements and only provide spatial diversity. The H-shaped array is double polarized. Figures 3.4 to 3.7 show the structure of 6 elements, echelon, collinear and H-shaped printed dipole antennas, respectively. These figures show the simulated current distribution at the 5.8 GHz frequency. Red shows a strong current distribution and weak current distribution is shown in blue.

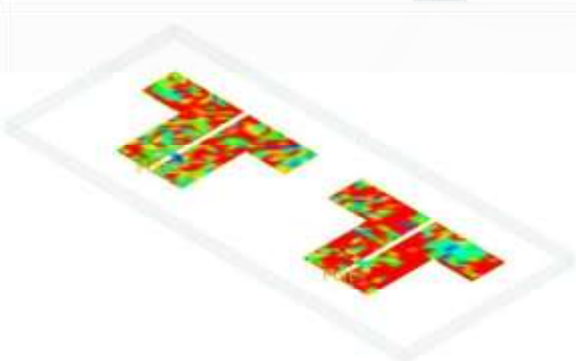


Figure 3.3 Simulated electric current distribution of two element printed dipole antenna

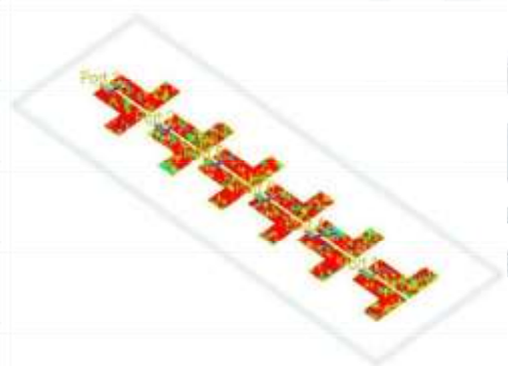


Figure 3.4 Simulated electric current distribution of printed dipole antenna in side by side array configuration at 5.8GHz

Figure 3.5 Simulated electric current distribution of collinear dipole array configuration at 5.8GHz

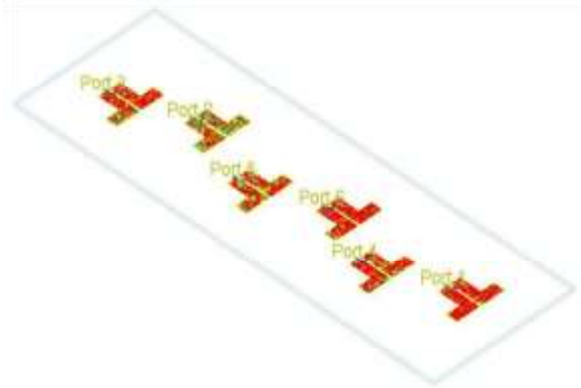


Figure 3.6 Simulated electric current distributions of multiple printed dipole antennas in Echelon configuration at 5.8GHz

Figure 3.7 Simulated electric current distribution of printed dipole antenna in H-shaped configuration

4. Compare Performance Analysis

Using the method of moments Ads (ADS 2011) Simulate using design software. Single printed dipole antenna of Figure .8 -34dB return loss shows the simulated 5.8 GHz. Figure 4.2 6 echelon array elements is less than -25dB return loss shows, 4.1 -5.6GHz frequency range. The number of antenna elements, mutual coupling printed dipole antenna is found to reduce the operating frequency 6GHz to 8GHz.

Downshifting of the operating frequency is reasonable, as neighboring elements of the antenna tend to effectively increase the size of the antenna. The return loss of the H type array antenna is less than -30 dB in the frequency range of 5 to 6 GHz

WLAN utilize the frequency ranges between 5.2 - 5.9 GHz (Gupta et al 2011). The return loss of the proposed antennas are low in this frequency range and hence it can be used for WLAN applications. The return loss of different antenna configurations is given

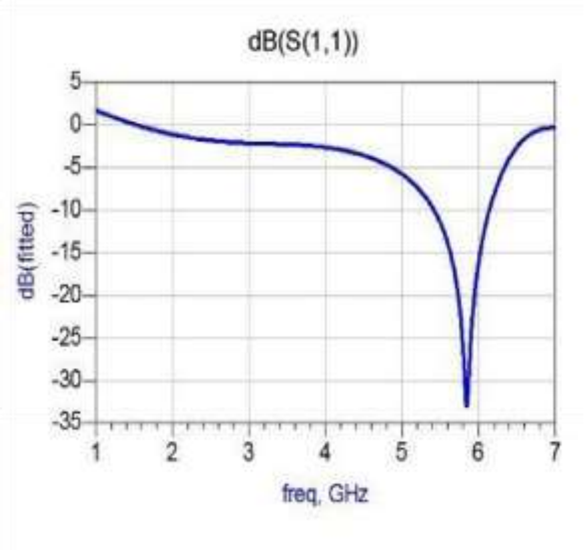


Figure 4.1 Simulated return loss of single printed dipole antenna

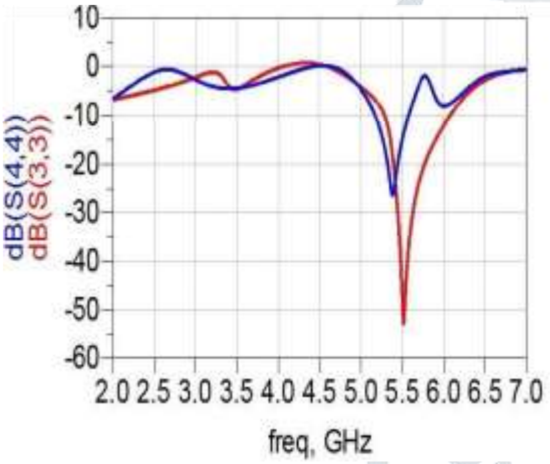


Figure 4.2 Simulated return loss of the 6 element echelon array configuration

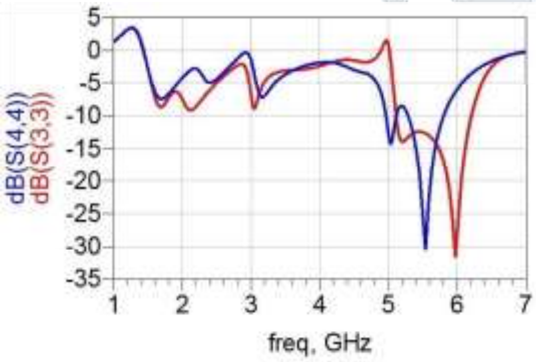


Figure 4.3 Simulated return loss of the H shaped array antenna

Table 4.1 Simulated return loss of different antenna configuration

Antenna configuration	S Parameter value in dB					
	S11	S22	S33	S44	S55	S66
2 element array	-27	-23	Not Applicable			
2*2 array	-15	-11	-14	-18	Not Applicable	
6 element Side by side	-20	-18	-15	-22	-28	-15
6 element Collinear	-24	-26	-24	-19	-20	-22
6 element Echelon	-19	-18	-30	-26	-28	-17
6 element H shaped array	-16	-14	-31	-30	-18	-23

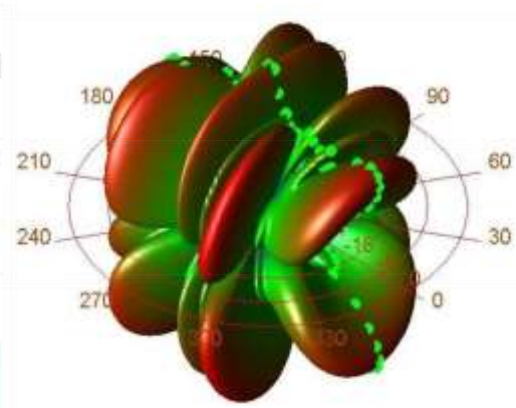


Figure 4.4 Radiation pattern of array of printed dipole antenna

Figure 3.7 shows a diagram of the printed dipole array antenna. The radiation intensity of the antenna is shown in red and provides a multidirectional pattern.

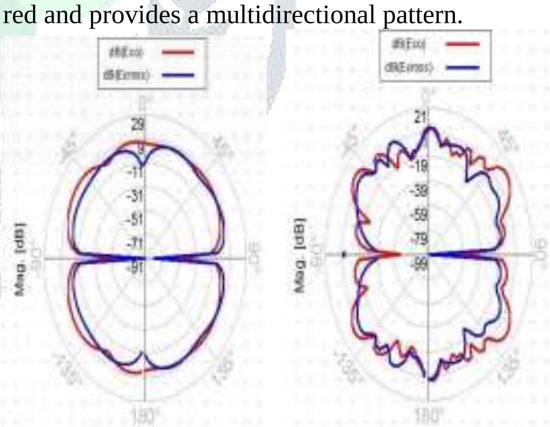


Figure 4.4 Linearly polarized electric field pattern of echelon and Hshaped array antenna

Figure 4.4 shows the polarized polarization E-plane pattern of polarization polarization and polarization polarization of the antenna. It can be seen that the radiation pattern E of polarized polarization and element polarization is in the form of an omnidirectional pattern at 5.8 GHz. Figure 5.13 shows the absolute field radio component in the form of e and H at 5.8 GHz. The radioactive carbon pattern is similar to the pattern of a traditional dipole antenna with the maximum wavelength of eight radiation forms.

Figure 4.5 shows the polarization field pattern of the H array antenna and antenna. The pattern pattern is perfectly oriented at two frequencies, ranging from -10 dB to 10 dB. Table 4.2 shows absolute electric fields of different antenna configurations, linearly polarized electrode patterns.

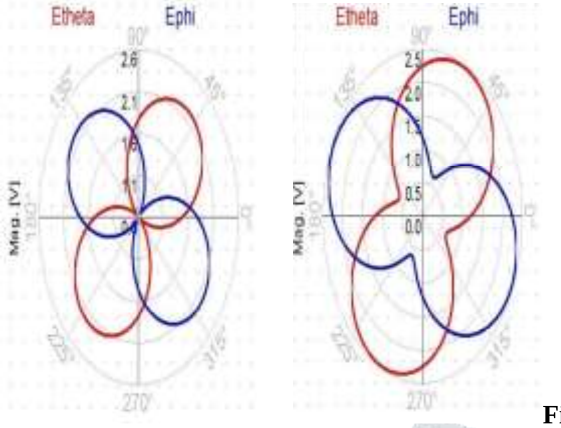


Figure 4.5 Absolute electric field components of Echelon and H-shaped array antenna

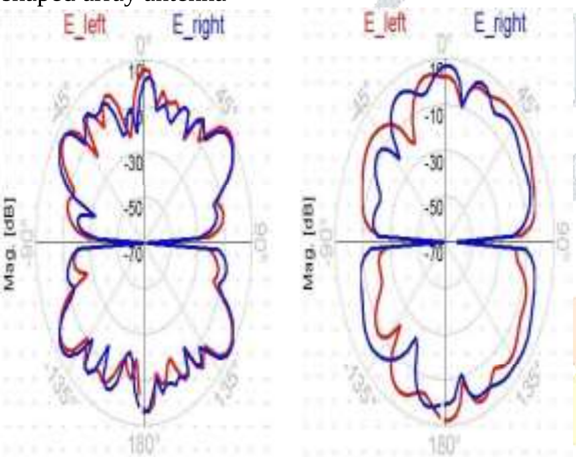


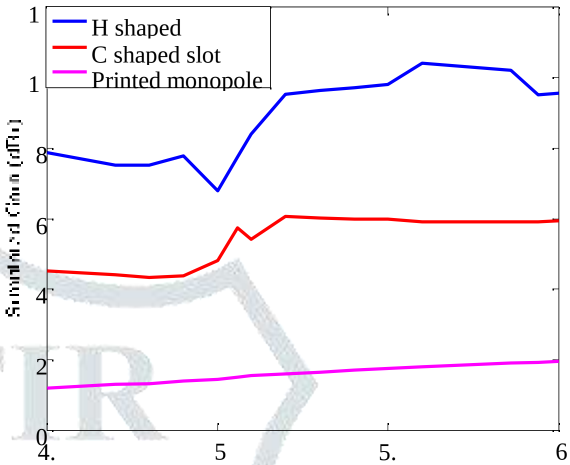
Figure 4.6 Circularly polarized electric field pattern of echelon and H-shaped array antenna

Table 4.2 Antenna parameters of different array configurations

Antenna configuratio n	Absolute Electric Field (dB)	Linearly polarized electr		Circularly polarized	
		Co-polar	Cross-polar	E left	E right
2 element array	0.35 -4.5	-9	-20	-14	-11
6 element Side by side	1.2, 0.792	-4	-24	-2	-3
6 element Echelon	2.1,3.22	8	-40	-10	3
6 element Collinear	2.3,3.62	10	-22	-20	-15
6 element H shaped array	2.5,3.98	-7	-16	-21	-10

Figure 4.7 shows the peak gain of the proposed antenna, existing C shaped slot antenna and printed monopole antenna.

The antenna gain is between 8 dB and 8 - 8 dB at a frequency of 5-5.5 GHz and 10 - 10.5 dB over the frequency range of 6.0 - 5.5 GHz. The gains, possibilities, radiated power, maximum intensity and efficiency of the various antenna configurations are shown in Table 4.3



Frequency in GHz

Figure 4.7 Simulated gain of H shaped and existing antennas

Table 4.3 Simulated results of printed dipole antenna in different configuration

Antenna type	Gain (dBi)	Directivity (dBi)	Radiated power (mW)	Max intensity (mW/ster)	η(%)
Single Printed dipole	3.56	3.57	1.20	1.112	89
2 element array	5.92	5.92	4.38	1.514	94
6 element side by side array	8.82	8.85	24.5	14.8	94
6 element Collinear array	9.56	9.56	27	16.2	94
6 element Echelon array	10.1	10.15	35.6	31	94
H-shaped array	10.4	10.4	45.8	37.8	95

4. Conclusion

In general, the results of multiple antenna parameters are better than printed dipole antennas. Gain, potential, radiated power, and efficiency are superior to other array configurations because of the dual polarization of the H type antenna. Efficiency percentages for the different antenna types ranged from 89 to 95, with the highest observed in H type arrays that could be due to high radiation power.

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