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DESIGN LPDA OUTDOOR ANTENNA FOR 4G LTE ROUTER TO OVERCOME THE RECEPTION ISSUES FACED BY THE LTE CUSTOMERS

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ABSTRACT

LTE is used mainly in the areas where the copper foot print is not available or if it is not possible to provide the high speed solution using the existing network. Since SLT uses 2600 MHz band for LTE, the cell radius is smaller when it is compared to CDMA (Code Division Multiple Accesses). Further, when the customer base is increased cell gets shrunk and as a result the customer at the edge of the cell will face reception issues due to low signal strength. The main idea behind this research is to develop an antenna to enhance the signal reception at the customer end. For increasing this signal strength, the Log Periodic Dipole Array antenna was designed and prepared for solve this problem. As a result of designing, the antenna gain was performed as 14.39 dB at the 2556MHz. And when the antenna checked in practically the signal was increased than dipole antenna. Hence the requirement was successfully completed by this antenna.

Keywords: Long Term Evaluation (LTE), Log Periodic Dipole Array (LPDA), Gain, Frequency

1. INTRODUCTION

The frequency range of LTE (Log Term Evolution) is used as 2600MHz by Sri Lanka Telecom. The dipole antennas are used such as receiving antenna of 4G LTE routers. However this antenna doesn't work effectively. Hence they required a 4G LTE outdoor antenna to increase signal strength at the customer end[1].

According to this problem, the signal strength of required antenna should be higher than currently using dipole antenna. After comparing properties of the antennas, Log Periodic Dipole Antenna was selected as most suitable antenna for reducing this problem.

The log periodic dipole array (LPDA) antenna is a directional antenna with relative characteristics across its wide frequency range. The LPDA antennas are wideband structures having geometry such that its impedance and radiation characteristics vary period with the logarithm of frequency. They exhibits a relative constant feed-point impedance, simplifying matching to transform line[2].

In this project, 2556MHz Log Periodic Dipole Array antenna was designed and prepared to increase the signal strength at the customer end.

2. EXPERIMENTAL

There are three important parameters while designing a Log Periodic Dipole Array antenna- Scale Factor, Spacing Factor and the apex angle defined by following equations ,

$$\tau = \frac{Ln}{Ln-1} = \frac{Rn}{Rn-1} = \frac{dn}{dn-1} \quad [1]$$

$$\sigma = d_n / 2L_n \quad [2]$$

$$\alpha = \tan^{-1}\left(\frac{1-\tau}{4\sigma}\right) \quad [3]$$

Other important parameters were calculated using following equations,
Length of last element ($L_{(last)}$)

$$L_{(last)} = \frac{C}{2f_1} \quad [4]$$

Operating bandwidth (B),

$$B = \frac{fn}{f1} \quad [5]$$

Where ;

τ = scale factor

σ = space factor

C = velocity of light waves α

= apex angle

The Log Periodic Dipole Array antenna used in this work is designed with τ =0.979,σ =0.187and n =25. The scale factor should be such that its value is always less than one. The apex angle (α) should not be too small or too large, since it affects the bandwidth of the antenna. As the frequency increases the spacing factor decreases. This design methodology is based on the mutual coupling between the array elements [3].

The basic structure was designed using LPCAD35 software and simulation was done by using 4NEC2 software[4].

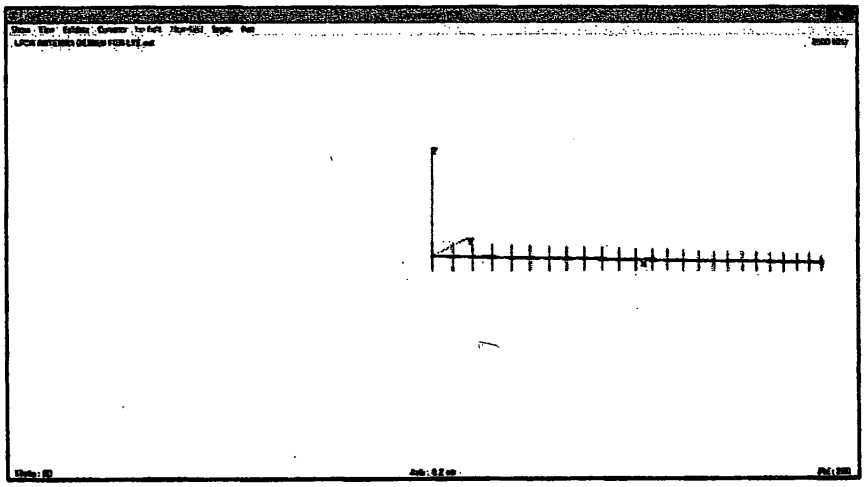

Figure 1: View of the designed antenna using 4NEC2 software

3. Result and discussion

As a results of simulations the radiation pattern was displayed as follows,

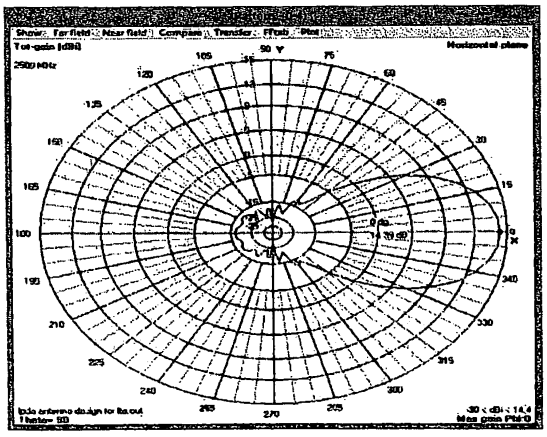

Figure 2: Horizontal radiation

Next the frequency sweep in horizontal, vertical and full can be generated. Then following SWR, reflective coefficient, gain and impedance were displayed as follows,

Table 1: Gain vs Frequency

Frequency (MHz)	Gain (dB)
2300	13.68
2556	14.17
2812	13.07
3068	11.98
3324	11.28
3580	9.02

Table 2: SWR vs Frequency

Frquency (MHz)	SWR (Ω)
2300	2.24
2556	1.44
2812	1.53
3068	1.97
3324	2.55
3580	3.47

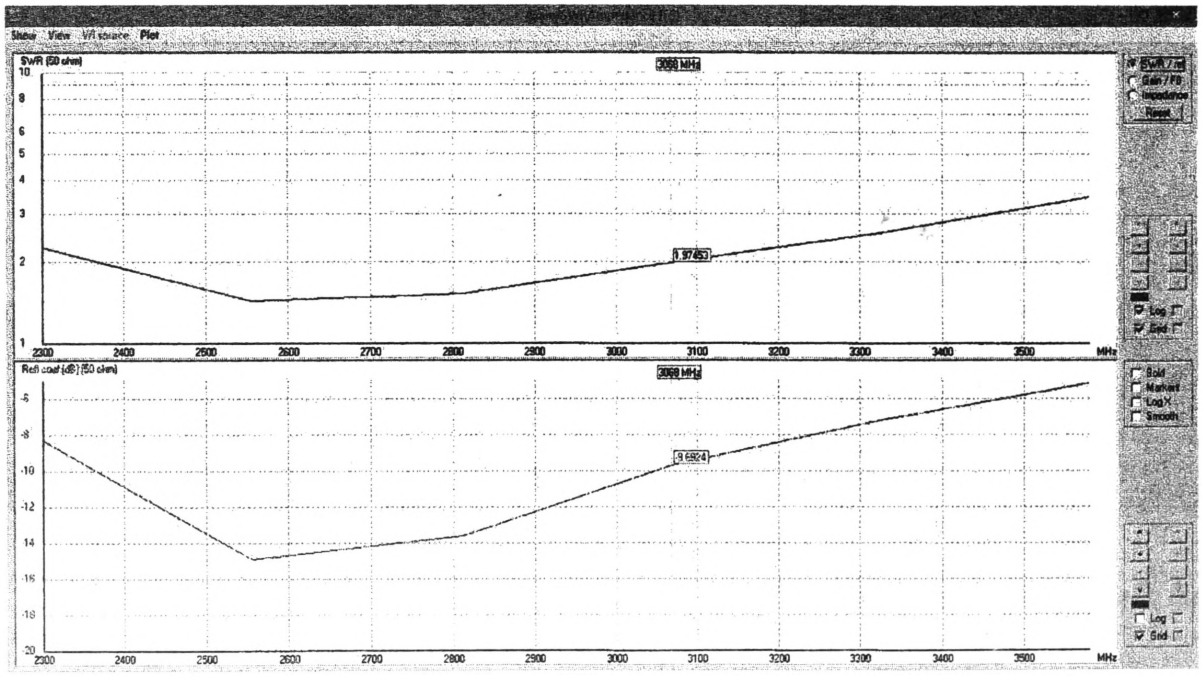

Figure 3 SWR and Reflective coefficient

For successful antenna, the reflective coefficient should be less than (-)10. According to this graph the best performance band width of this antenna is 2400MHz to 3050 MHz.

When testing the antenna in practically the result was as follows,

When connecting dipole antenna

When connecting LPDA antenna

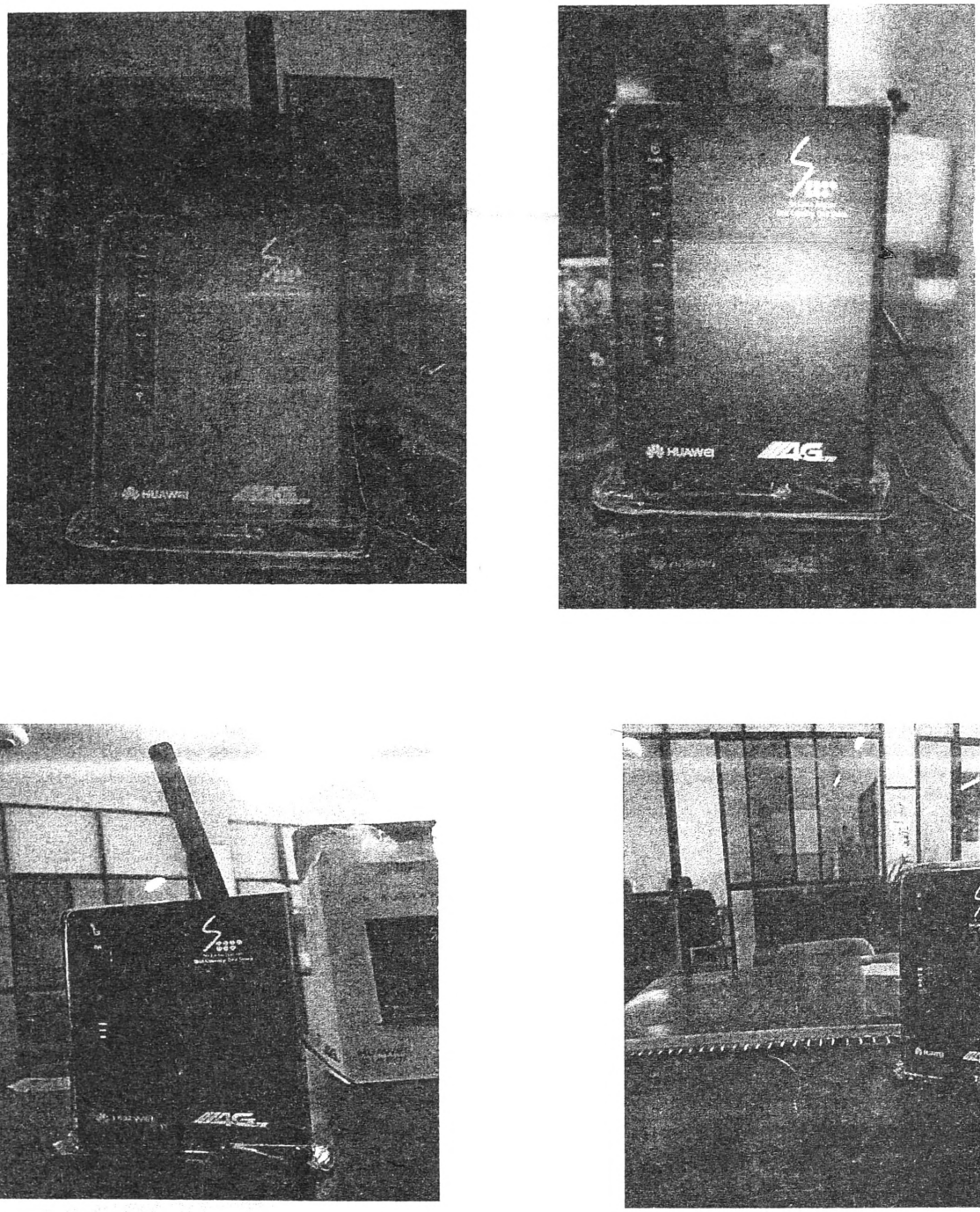

Figure 4: Practical testing of antenna

According above figures, the signal strength of this antenna was greater than the dipole antenna.

4. CONCLUSION

But the research of this project was to develop an antenna to enhance the signal reception at the customer end. The frequency of LTE is around 2600 MHz. For this frequency range, the

LPDA antenna was designed and prepared. As a result of designing, the antenna gain was 14.39 dB at the 2556MHz. hence the signal strength of this antenna was improved than currently use antenna.

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REFERENCES

[1] http://www.changpuak.ch/electronics/lpda.php

[2] Warren L. Stutzman, Gary A. Thiele, *Antenna Theory and Design (Hardcover)* , John Wiley & Sons ,2012

[3] http://www.qrz.ru/schemes/contribute/arrl/chap10.pdf

[4] http://wb0dgf.com/LPCAD.htm