Dual Band Yagi –Uda Antenna For GPS And MMDS Application

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Abstract*-in this paper a dual band Yagi-Uda antenna for wireless communication application is presented. The two resonant modes are presented for Yagi-Uda antenna is associated with various length and width of the strips in which the lower resonant frequency (1.5GHz) and for the higher resonant frequency (2.6GHz). to analyze the antenna performance a study was governed with the Ansys HFSS software and a pattern was designed, manufactured and tested through this design. Yagi- Uda antenna can achieve directivity (4dBi), return loss (-17dB) for L band (1.5GHz) and (-29dBi) for S band (2.5GHz).This design especially suitable for GPS & MMDS application*

Keywords-Yagi Uda; concave reflector; Microstrip directors; driven dipole; directivity.

I. INTRODUCTION

As present wireless communication systems have refined fastly in these years. As antenna is required for high directivity and good radiation performance because of rising imposition of GPS function for electronic devices such as smartphones ,GPS navigation, the embedded GPS antenna have lots of focus from the academics and industry. The main radiation lobes of a GPS antenna should straight towards the sky [1]-[2] in order to achieve better electromagnetic waves from the satellite. As Yagi-Uda antenna acquire good directivity and also suitable for wireless communication. The purpose of using L band for GPS application is the least expensive and easiest to implement compared to another frequency band such as C band and S band. Yagi-uda antanna specially used for VHF nad UHF application and also used for microwave applications. Yagi-Uda antenna having three element such as concave reflector, folded dipole as a driven element and parasitic element are joined to the boom. These parasitic elements can be two or more than two or three. More directors are used to increase thedirectivity. These parasitic elements pick up power from the driven dipole and re-radiate it. The phase is different when parasitic Re-radiating there signal thereby some signal is boosted in some direction and other signals are dropped down to the other direction. By which this is clear that the amplitude and phase are manipulate in the parasitic element also depends upon their length and spacing between them. Director should vary 0.1λ-0.25λ depending upon design.

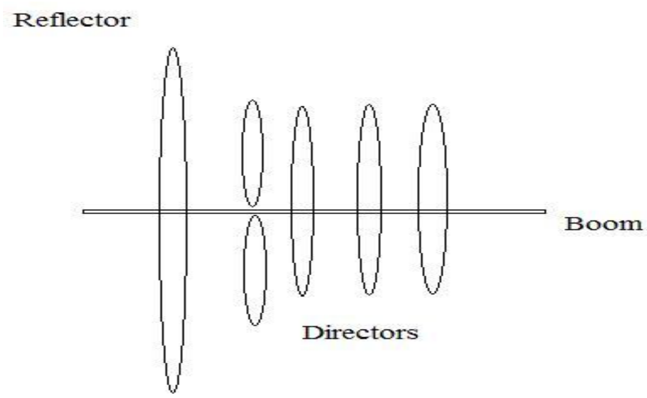

Fig1. Configuration of Yagi Uda antenna

MMDS (multichannel multipoint distribution service) is a telecasting and telecommunication services that conduct in the radio spectrum of UHF portion. This band is existing between 2.1GHz and 2.7GHz. this is also called as wireless cable MMDS was grasp as a spurious for conventional cable television . it also has many application in the telephone , data communication and fax. In MMDS, a medium power transmitter is located with an omnidirectional broadcast antenna at or near the highest topographical point in the intended coverage area. The workable radius can reach up to 70 miles in flat terrain (significantly less in hilly or mountainous areas). Each subscribes is equipped with a small antenna, along with a converter that can be placed next to , or top of a conventional TV set. The MMDS frequency band has room for several dozen analog or digital video channels along with narrow band channel that can be used by subscriber to transmit signals to the network. The narrow band channel was originally intended for use in an educational setting (so called wireless classrooms). The educational app has enjoyed some success but conventional TV viewer prefers satellite TV services, which have more channels. As MMDS network can provide high-speed internet access, telephone/fax and TV together, without the constraints of cable connections.

II. DESIGN CONFIGURATION

To enhance the directivity pattern a Yagi-Uda antenna is most suitable antenna. In ground plane, a reflector surface such as a concave parabolic can also used to enhance the directivity which is helpful to radiate energy in the specify direction . This planar antenna consist a driven dipole, a single director and a concave parabolic reflector. One of the two arm of driven dipole located on the top of the substrate and next one is located to the bottom layer i.e. ground plane. There two capacitor are inserted on the top and bottom layer to modify the balanced condition. The antenna is fabricated on the low cost FR4_epoxy substrate with substrate thickness is 0.8 mm, dielectric constant is 4.4 and loss tangent is 0.02. in this having on part of the director ,driven element and concave reflector to the bottom layer and other arm of director, concave reflector on the substrate with the thickness of 0.8 mm. Two capacitor are used to matching purpose one on the substrate and other one on the bottom layer. As capacitor are used to transfer the power signal from driven element to the director.

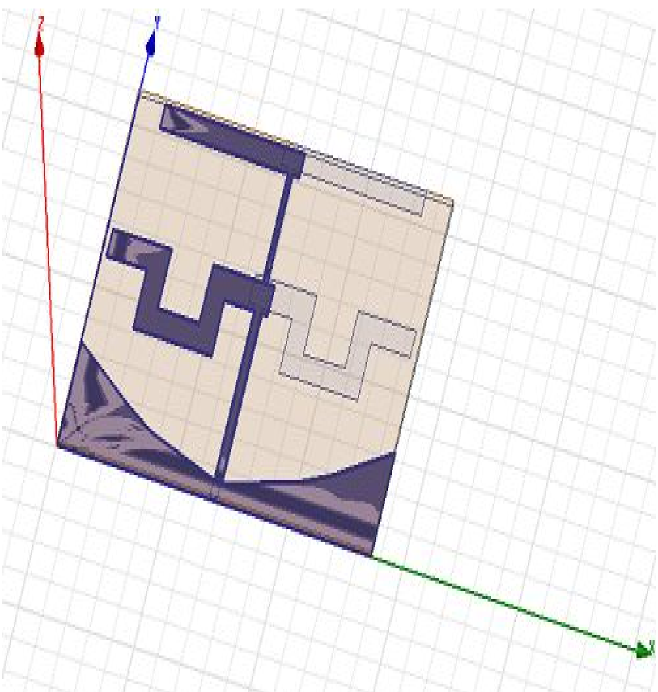

Fig2. Bottom layer view of Yagi-Uda antenna

There are two operating frequency 1.58GHz for GPS application and 2.68GHz for MMDS application. The antenna rectangular in shape is 68mm long (L) and 54.5mm wide (W). This view is designed on the ground plane. (fig2.)There are three part in which highlighted portion of lower one arm is the concave reflector, and middle one is the driven element and last is the director. The capacitor is adjoining with the trace between driven element and director. This is used to achieve high gain and decrease the reflection coefficient. The impedance of each director is capacitive and its current is leading. Similarly the impedance of the reflector is inductive so its current is lagging and the voltage is induced in it.

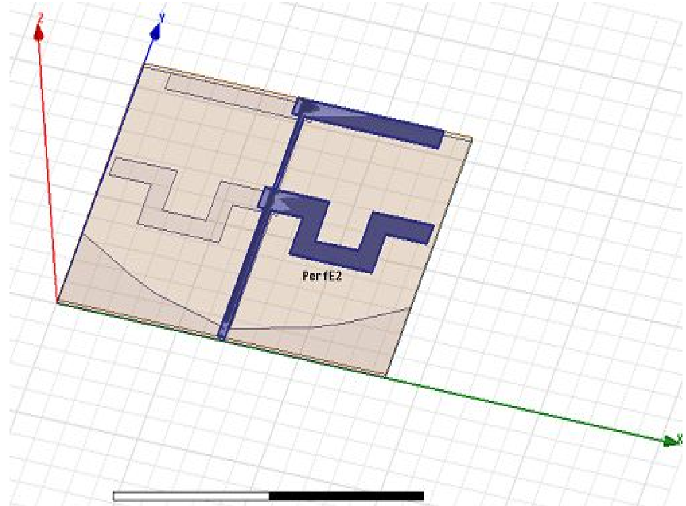

Fig3. Upper layer view of Yagi-Uda antenna

This view is designed on the substrate. The feeding point is given to the trace from the x axis. Middle one is driven dipole and upper one is the director. Although the director is only one it is carefully and innovatively designed to enhance the dragging ability of the radiation pattern. There is no via connected with lower surface and upper surface.

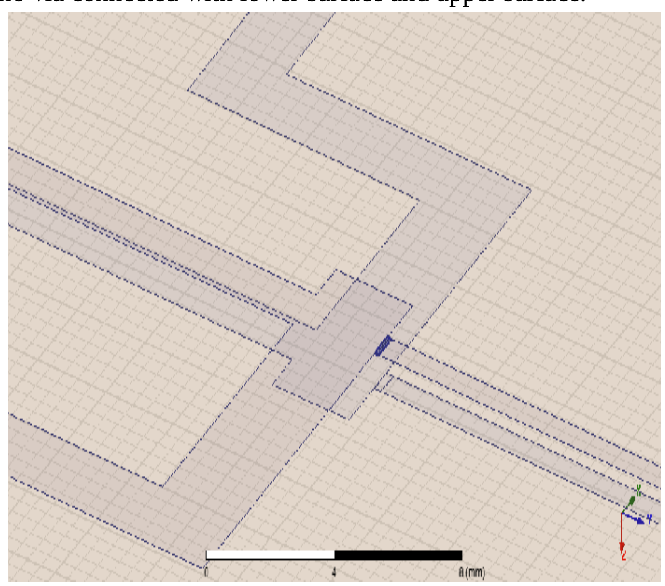

Fig4. Sharp view of capacitor between driven element and director in both layers

Two capacitor on the both layers strip traces are selected to be of the same capacitor value and with same package size of 0402 to enhance the balanced conditions. With capacitor the strip lines working as the matching component on the traces which are used to transfer the power from driven dipole to director. Design frequency at the central frequencies, 1585 and 2680 MHz, of the GNSS band (1559 to 1610.44 MHz) and MMDS band (2500 to 2690MHz).

III. ANALYSIS

TABLE: ANTENNA'S DIMENSIONS

Top –layer director	Length-30.3mm Width-3.7mm	Bottom-layer director	Length-30.3mm Width-3.7mm
Top –layer meandered driven dipole	Length-12.5mm Width-4.0mm	Bottom-layer meandered driven dipole	Length-12.5mm Width- 4.0mm
Top-layer traces	Upper trace width/length - 0.8mm/16.8mm Lower trace width/length-1.5mm/16.8mm	Bottom-layer traces	Upper trace width/length-0.8mm/16.8mm Lower trace width/length-1.5mm/16.8mm
Substrate	Length-68.0mm Width- 54.5mm	Bottom layer reflector	Length-68.0mm Width-16.1mm
Capacitor value	pF- 1.2	Capacitor package	Size-0402

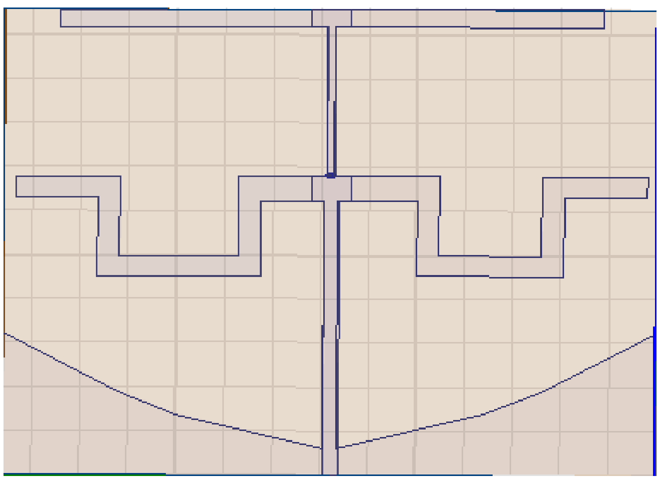

Fig5. Designed Yagi-Uda antenna on HFSS

All dimensions used to design and fabricated of this antenna are listed in table. This antenna is designed by using these dimensions. To reduce the size of the antenna, the shape of the reflector is designed to be concave parabolic while maintaining the same directivity as using a conventional reflector. For minimizing the occupied area the driven dipole is ramble and driven dipole is placed at the center in front of the concave parabolic reflector to achieve the end-fire radiation. The driven dipole and the director becomes reflector and driven dipole for the high band (MMDS) antenna. The length of the two arms of the original director for GPS, or the driven element for MMDS, is designed to be longer than a quarter guided wavelengths at 2680MHz.

IV. SIMULATED RESULTS

The simulated results are found by using 3D full-wave electromagnetic simulator Ansys HFSS.

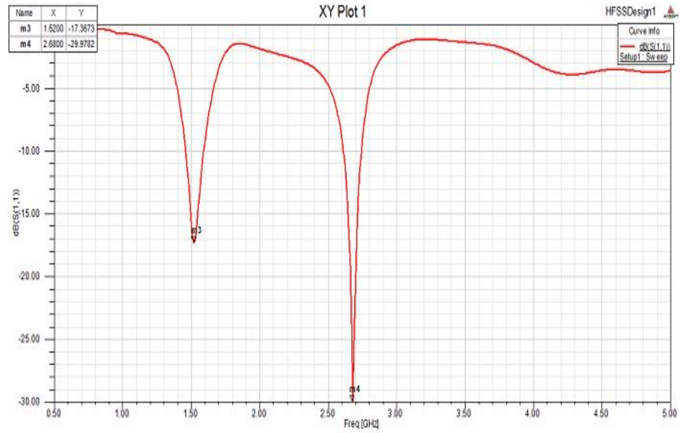

Fig 6. Simulated reflection coefficients (s11)

Simulated reflection coefficient s11 with the capacitor value is -29 dB at 2.6GHz and -17dB at 1.5GHz. Since capacitor used as the matching component at 1.2pF. It is signifying that the variation of s11 with capacitor is more appreciably in high band than in the low band. Therefore matching component mainly used for the high band (MMDS).

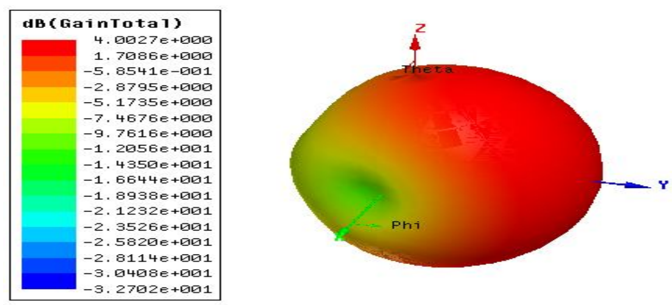

Fig7. Simulated 3D radiation pattern at 1.5GHz frequency

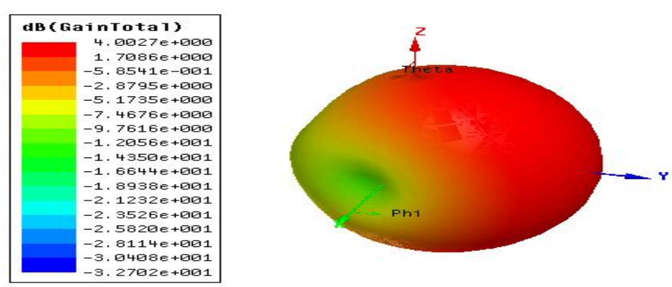

Fig 8. Simulated 3D radiation pattern at 2.6GHz frequency

Simulated gain at both the frequency is 4dBi for 1.5GHz i.e. GPS application and 3dBi for 2.6GHz i.e. MMDS application.

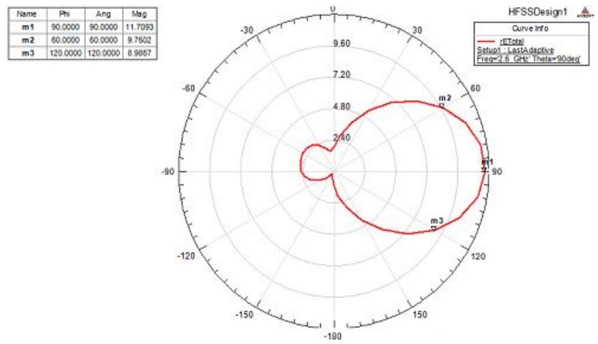

Fig 9. Simulated 2D radiation pattern at 2.6GHz

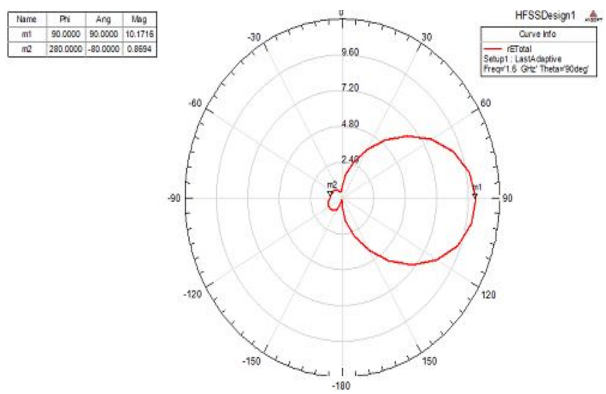

Fig 10. Simulated 2D radiation pattern at 1.5GHz

V. CONCLUSION

A dual band Yagi-Uda antenna is designed on a thin substrate with the help of simulator. The significant result is comes by using capacitor as matching component on traces to connect the driven dipole and directors so there variation is done different capacitor value but the significant result is achieve at 1.2pF.this antenna has manufactured, designed and simulated for good performance on the dual-band operation of GPS and MMDS.

FUTURE WORK

Here the modifications are done by reducing the size of the arms of the driven element by clever transformation like as meander type. Further for higher directivity can be comes by adding more directors and also by changing the shape of the concave parabolic reflector for batter results.

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