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Modified Design of Microstrip Patch Antenna for WiMAX Communication System

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ABSTRACT: *In this thesis, a brand new style for U-shaped Microstrip patch antenna is projected, which may be used for WiMAX communication system. the look of the antenna is completed in simulation software system (CST) Microwave Studio. The U-shaped antenna has been achieved a better gain of eleven.2db compared with 'T' formed, 'L'-shaped and CPW Patch antenna while not slot. Here we are introduce 'U' formed Microstrip patch antenna for WiMAX communication applications. Our projected antenna style uses 4-4.5 giga cycle waveband and it's acting at narrowband. RT/DUROID 5880 material is employed for making the substrate of the microstrip antenna. This changed style of the microstrip patch antenna provides high performance in terms of gain and come loss.*

Keywords: WiMAX, C

INTRODUCTION

Microstrip antenna was projected in early 1970 and it provides a good revolution within the field of antenna style and analysis. Nowadays, microstrip patch antenna has become extremely popular and is wide utilized in numerous varieties of applications. Microstrip antenna provides

numerous options like comfort ability and compatibility. Microstrip patch antennae have several admirable properties like, high performance, high gain, low cost. The well-known feature of the microstrip patch antennae is that they're reliable and strong in nature. Additionally to those properties, it provides a straightforward programme and is easy to know. Its provides very high performance in terms of information measure and gain. The topology used for creating microstrip patch antenna is formed, that is single narrowband patch antenna. The E-shaped microstrip patch antenna is employed for WLAN applications. While, twin band Stacked patch antenna is employed for each WLAN and WIMAX applications. The microstrip patch antenna has become extremely popular in several applications like in WiMAX communication system and mobile applications. This antenna is specifically designed for WiMAX communication systems. WiMAX belongs to IEEE 802.16 family of standards. the total kind of WiMAX is Worldwide ability for Microwave Access, it provides rate of 30-40 Mbps, facultative North American country with practical implementations. Microstrip patch antenna encompasses a straightforward 2 dimensional geometrical structure. The microstrip associatetenna is warranted to an insulated material substrate. Rectangular patch is most typically employed by the microstrip antenna. The fabric, that is employed for the patch is copper.

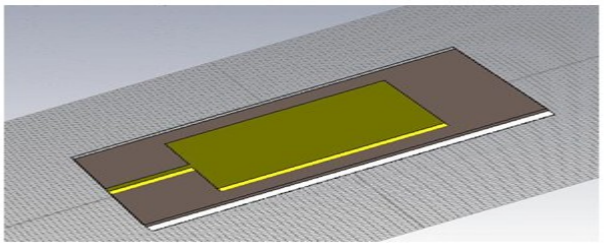


Fig.1: a simple microstrip patch antenna

Satellite communication and Wireless communication has been developed quickly within the past decades. Nowadays world's communication depends on wireless links. Within the preceding few years, the rise of LAN represents one among the most interests within the years; the expansion of LAN drawn one among the most interests within the data and communication ground. Thus, this trend in business and government communication systems has been to make up low value, smallest weight, low profile antennas that area unit skilled of maintaining high performance over an oversized band of frequencies. This sophisticated trend has alert a lot of try into the planning of MPA. MPA area unit similar temperament for WLAN/WiMAX application systems and having some disadvantages, like slim information measure, low gain etc. Broad adornment is that the main drawback, for determination this drawback we tend to projected new structure for devices that need quite one waveband of operate. Dual-band wireless phones have prove to be common recently since they permit exploitation the one phone in 2 networks that have totally different frequencies. Tri-band phones incorporates additionally gained recognition. Motionless, there be at hand quite 3 frequency bands employed in favour of wireless applications. Table 1-1 lists many helpful wireless applications

and their operating frequencies. The systems having multi-band operation need antennas that resonate at the desired frequencies. This solely adds problem to the antenna blueprint drawback.

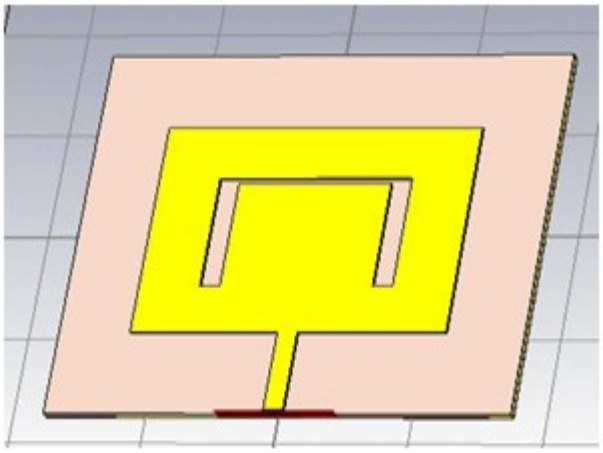
WiMAX technology relies on the IEEE 802.16 commonplace conjointly known as Broadband Wireless Access. The name WiMAX was shaped by the WiMAX atmosphere that was created in Gregorian calendar month 2001 to support conformity and ability of the quality. the talk describes WiMAX as "a standards-based technology sanctionative the discharge of walk wireless broadband access as associate substitute to cable and DSL". there's no standardized world accredited spectrum for WiMAX, although the WiMAX atmosphere has offered 3 accredited spectrum profiles: a pair of.5 GHz (2.5-2.69 GHZ), 3.5 GHz (3.4-3.69 GHZ) and five.5 GHz (5.25-5.85 GHZ). WiMAX offer the information rate upto70 Mbps over fifty kilometre. IEEE 802.16-2004 is usually known as IEEE 802.16d, since that was the unit that developed the quality. it's conjointly oftentimes remarked as "fixed WiMAX" since it's no blockage for quality. It replaced IEEE Standards 802.16-2001, 802.16c-2002, and 802.16a-2003. 802.16e-2005 is associate modification to 802.16-2004 and is usually remarked in shortened type as 802.16e. It introduced blockage for quality, between alternative things and is as a result conjointly referred to as "mobile WiMAX".

LITERATURE SURVEY

In order to start the thesis, the first step is to study the research papers that have been performed previous by other researches. Papers related to this work are chosen and studied. With the help of literature review, it becomes clearer to perform this project. The idea of Micro strip radiators was first projected by Decamps in 1953.A copyright was issued in France in 1955 in the names of Glutton and Bassano. However 20 years conceded before practical antenna ware made up. Development all through 1970's was accelerated by the accessibility of good substrate with low loss tangent and good-looking thermal and mechanical properties, better photolithographic techniques, and improved theoretical models. The first realistic antenna was developed by Howell and Munson. Since then wide research and development on Microstrip antennas designed at exploiting their advantages.

CPW-Fed Microstrip Antenna Analysis

The literature survey for single-band MPA using CPW feed line. This includes the antennas by means of circular, annular, rectangular, and triangular patches. The CPW-fed antennas have been extensively used for wireless communications owing to their many good-looking features such as wide bandwidth, simplest structure of a solitary metallic layer, no soldering points, simple integration with MMICs, etc. Design and Development of CPW-FED Microstrip antenna T,L-slot and U-Shaped for WiMAX Applications. This paper represents the learning of CPW-FED Rectangular antenna without slot for low frequency WiMAX applications. These antennas are resonating at 3.347 GHz and 3.395 GHz and gives mono polar radiation



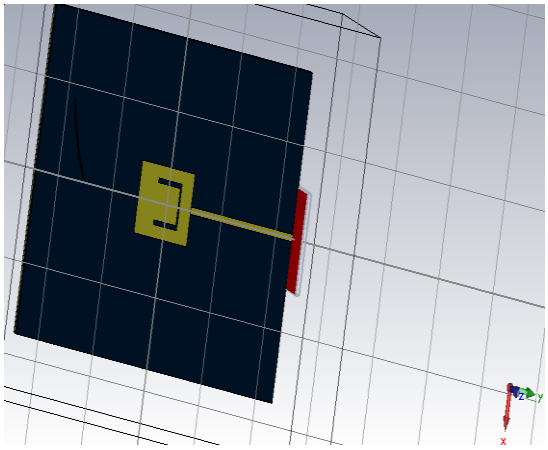
pattern at this frequency. This antenna can be used in low frequencies of 2-11 GHz which is used in WiMAX applications.

Comparative Analysis of CPW-Fed antenna with different slots

A single band CPW-FED antenna for wireless communication is presented. In this paper, direct Microstrip line feed is incorporated. These antennas offers high profile, narrow band, high gain, and compact antenna element compared to Microstrip patch antennas. The comparison of the different CPW slot antennas is shown in the paper and it shows which antenna gives better impedance bandwidth, and it also improves gain, return loss and directivity compared to all the three.

PROPOSED SYSTEM

The goal is meant U-shaped Microstrip patch antenna for WiMAX Communication System. The designed by victimization substrate material RT/DUROID 5880 with permittivity a pair of 2 and stuff tangent loss=0.0009.Various iterations are administrated to calculate the dimension, length and height of the antenna. The Microstrip antenna features a narrowband property that may be a disadvantage of Microstrip patch antenna



and shows magnetism nature, in some cases. There could also be several shapes attainable for creating Microstrip patch antenna like, rectangular, circular, elliptical, square etc. during this paper; we have a tendency to area unit planning an oblong formed patch antenna. This U-shaped rectangular Microstrip patch antenna is functioning at a band of 4-4.5 GHz. the peak of the substrate is calculated as a pair of 4mm, that come backs most return loss bigger than -42dB that improves the gain of the antenna and results high performance. The far-field pattern of Miro strip patch antenna additionally has superb characteristics. Easy U-shaped Microstrip patch antenna was designed for WiMAX communication system with completely different dimensions of height and length. The conclusion comes out that the antenna offers most come back loss of -38 decibel with height of two.4mm. The structural style of the straightforward U-shaped patch antenna is shown within the following figure2.

Fig.2: U-shaped microstrip patch antenna

SIMULATION RESULTS

Return Loss of antenna:

Return loss is a measure of impedance matching between the feed line and the Antenna. The higher the return loss, the higher is the matching between feed line and Antenna.

Return loss is given by

$$RL\ (dB) = -20\log10\ (|\Gamma|)$$

Where Γ is the reflection coefficient.

The frequency vs. return loss graph plotted is called Impedance Bandwidth of the antenna. Bandwidth is taken as the range of frequencies over which the return loss is less than -10 db.

CPW Rectangular patch:

The Impedance Bandwidth of a CPW rectangular patch antenna designed to resonate is shown in figure. The designed antenna resonates at 3.221 GHz and the return loss is -11.575 dB which covers the minimum required value of return loss of -10 dB.

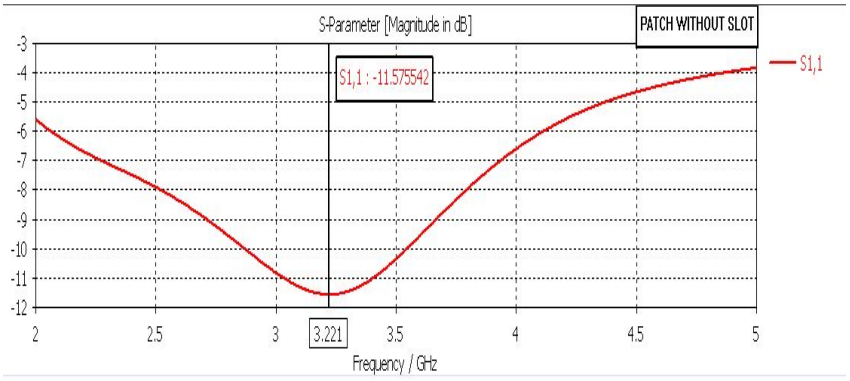


Fig.3: Impedance Bandwidth of a CPW Rectangular patch antenna

CPW L-Slot Rectangular patch:

The Impedance Bandwidth of a CPW rectangular patch antenna designed to resonate is shown in figure. The designed antenna resonates at 3.347 GHz and the return loss is -13.052 dB which covers the minimum required value of return loss of -10 dB.

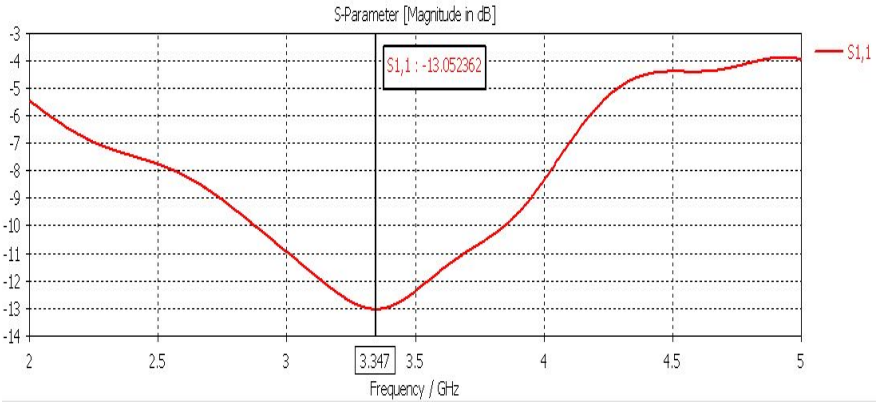


Fig.4: Impedance Bandwidth of a CPW L-Slot Rectangular patch antenna

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CPW t-Slot Rectangular patch:

The Impedance Bandwidth of a CPW rectangular patch antenna designed to resonate is shown in figure The designed antenna resonates at 3.395 GHz and the return loss is -15.198047 dB which covers the minimum required value of return loss of -10 dB.

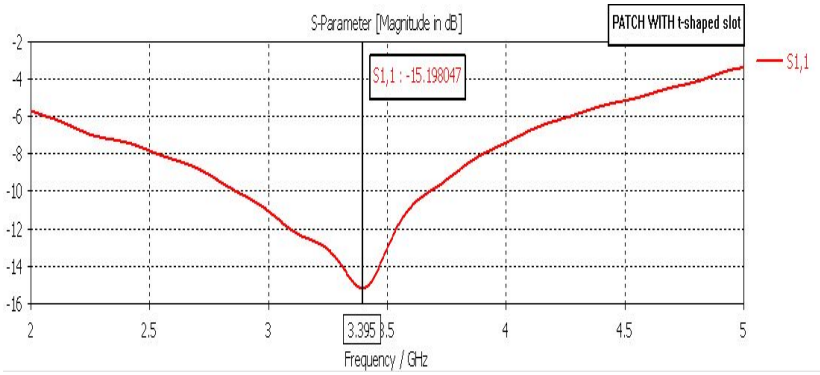

Fig.5: Impedance Bandwidth of a CPW t-Slot Rectangular patch antenna

CPW U-Slot Rectangular patch:

The Impedance Bandwidth of a CPW rectangular patch antenna designed to resonate is shown in figure 6. The designed antenna resonates at 4 GHz to 4.5 GHz and the return loss is -13.052 dB which covers the minimum required value of return loss of -10 dB

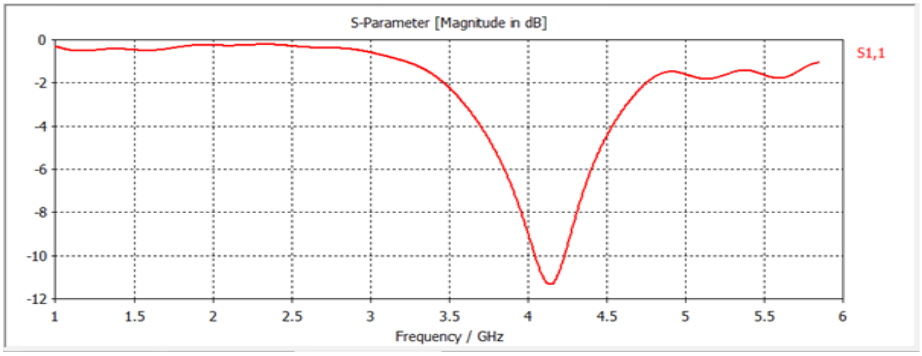

Fig.6: Impedance Bandwidth of a CPW U-Slot Rectangular patch antenna

Voltage Standing Wave Ratio:

The ratio of the maximum voltage to the minimum voltage in a standing wave is known as voltage standing wave ratio. The term, which indicates the impedance mismatch, is VSWR. The higher the Impedance mismatch, the higher will be the value of VSWR. The ideal value of VSWR should be 1:4 for effective radiation. The VSWR for different slots is shown below.

VSWR of CPW Rectangular patch:

Ideally, VSWR must lie in the range of 1-2 which has been achieved for 3.221 GHz frequency, near the operating frequency value. The VSWR ratio at 3.221 GHz frequency is 1:1.716 respectively for CPW patch without slot.

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Fig.7: VSWR of a CPW Rectangular patch antenna

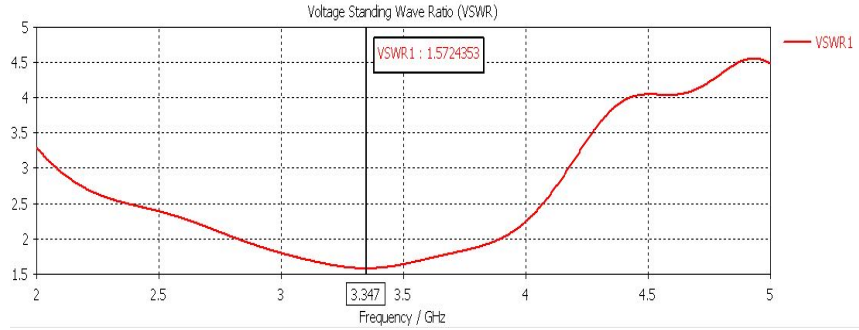

Fig.8: VSWR of a CPW L-Slot Rectangular patch antenna

Fig.9: VSWR of a CPW t-Slot Rectangular patch antenna

VSWR of CPW U-Slot Rectangular patch:

The VSWR ratio at 4 GHz to 4.5GHz frequency is 1:1.420 respectively for CPW U-Slot patch which is shown in figure.

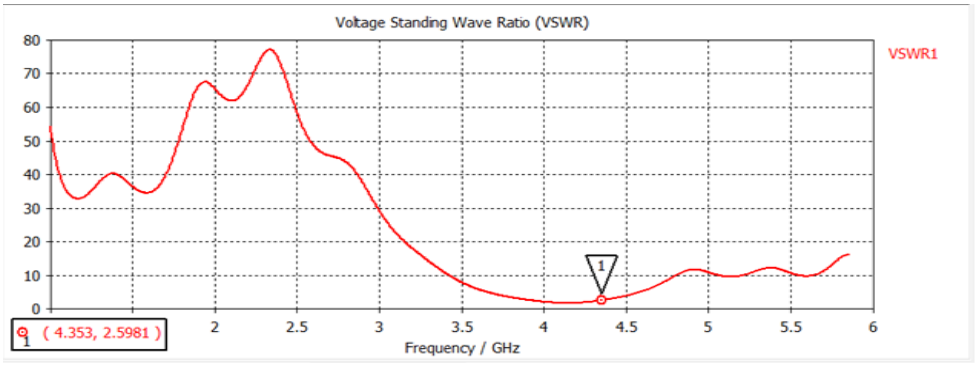

Fig.10: VSWR of a CPW U-Slot Rectangular patch antenna

Directivity of an Antenna:

The ratio of Maximum radiation intensity of the subject antenna to the radiation intensity of an isotropic or reference antenna, radiating the same total power is called the directivity. An Antenna radiates power, but the direction in which it radiates matter much. The antenna, whose performance is being observed, is termed as subject antenna.

$$\text{Directivity} = \frac{Maximum\ \ radiation\ \ intensity\ \ of\ subject\ \ antenna}{Radiation\ \ intensity\ \ of\ an\ isotropic\ \ antenna}$$

Directivity of CPW Rectangular patch:

The radiation pattern showing the directivity (3D view) for the designed antenna has been shown in Figure for 3.221 GHz and polar view in Figure 11. The directivity for 3.221 GHz frequency is 4.25 dBi. The directivity plot represent amount of radiation intensity and it can be represent by red colour.

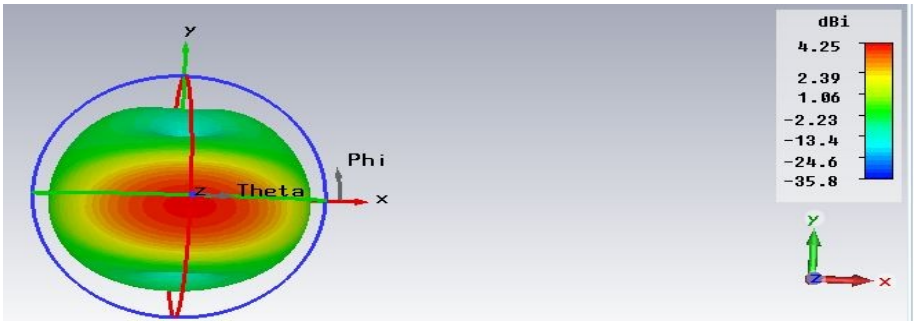

Fig.11: Directivity (3D view)

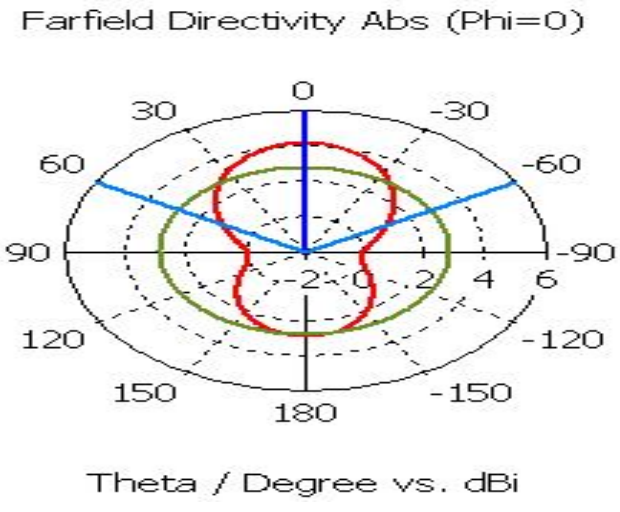

Fig.12: Directivity (Polar plot)

Directivity of CPW L-Slot Rectangular patch:

The radiation pattern showing the directivity (3D view) for the designed antenna has been shown in Figure 13 for 3.347 GHz and polar view in Figure 14. The directivity for 3.347 GHz frequency is 4.11 dBi.

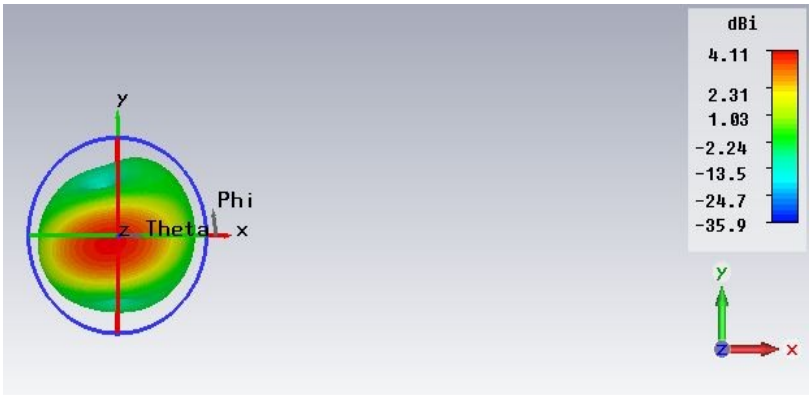

Fig.13: Directivity (3D view)

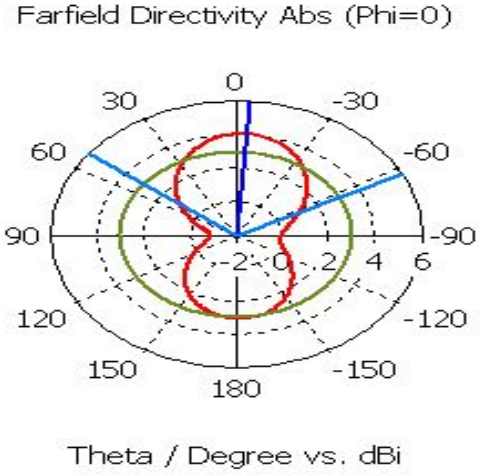

Fig.14: Directivity (Polar plot)

Directivity of CPW t-Slot Rectangular patch:

The radiation pattern showing the directivity (3D view) for the designed antenna has been shown in Figure 15 for 3.395 GHz and polar view in Figure 16. The directivity for 3.395 GHz frequency is 5.02 dBi.

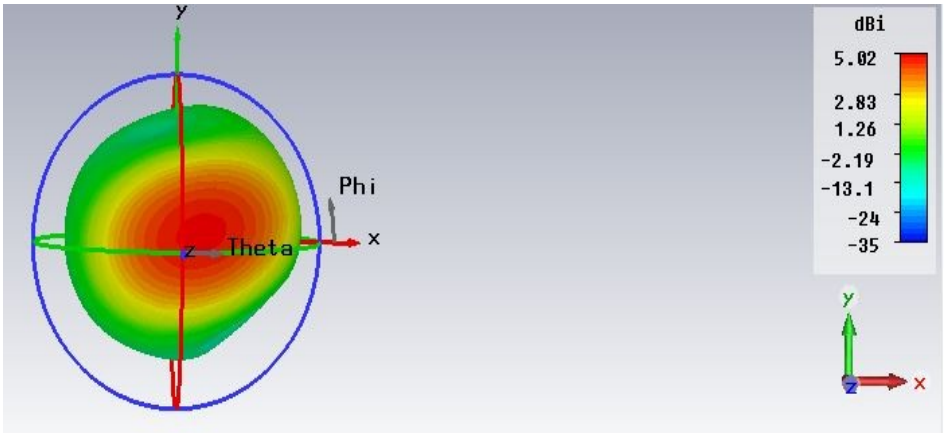

Fig.15: Directivity (3D view)

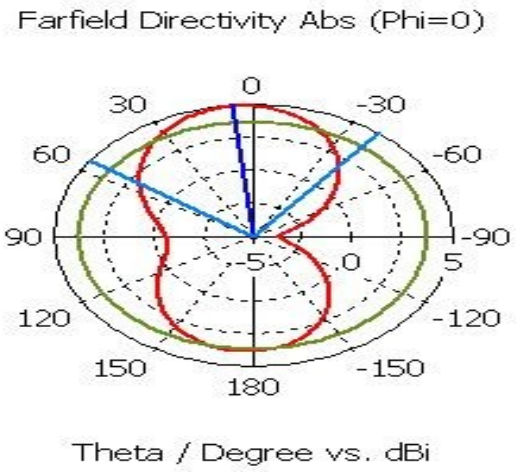

Fig.16: Directivity (Polar plot)

Directivity of CPW t-Slot Rectangular patch:

The radiation pattern showing the directivity (3D view) for the designed antenna has been shown in Figure for 4 to 4.5GHz and polar view in Figure 17. The directivity for 4 to 4.5 GHz frequency is 5.02 dBi.

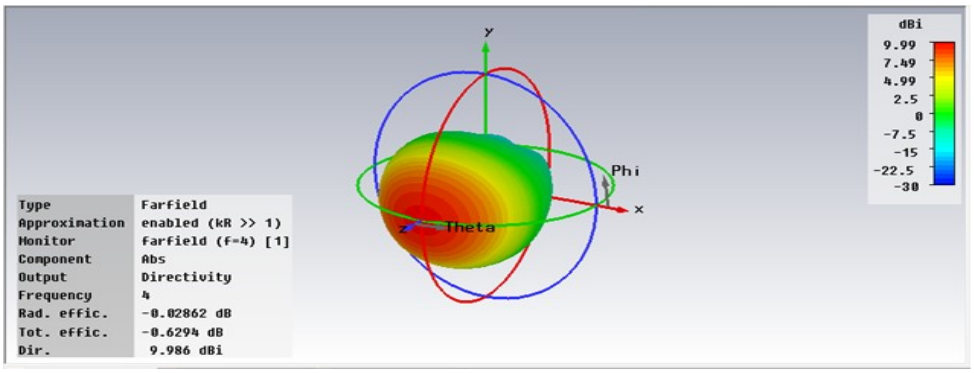

Fig.17: Directivity (3D view)

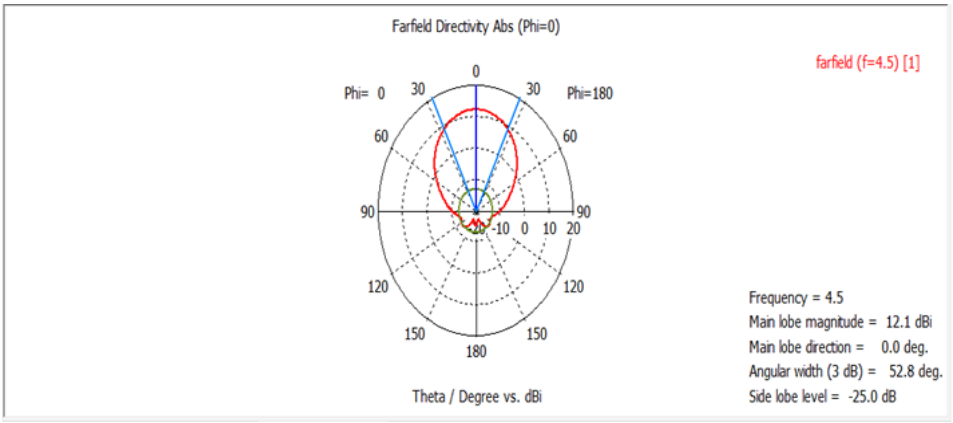

Fig.18: Directivity (Polar Plot)

Performance Comparison:

The comparative analysis of impedance bandwidth and gain for the different slot antennas are tabulated as follows in Table

Shape	S-Parameter	VSWR	Directivity (dBi)	Gain(dB)	Frequency (GHz)
Without Slot	-11.576	1.71	4.25	2.70	3.221
L-Slot	-13.052	1.57	4.11	2.82	3.347
t-Slot	-15.198	1.42	5.02	3.304	3.395
U-Slot	-12.24	1.72	11.14	11.2	4-4.5

CONCLUSION

In this paper, The U-shaped MicroStrip Patch Antenna has been created. The simulation results show that the antenna lined the frequencies from 4GHz to 4.5GHz. Hence, these antennas are applicable for WiMAX applications that's inside the vary of 4-4.5 GHz. The microstrip patch antenna is most generally used antenna style within the WiMAX communication system. During this thesis, we've accrued the performance of the antenna by up sure essential parameters of the antenna like graphical record, gain and come loss. we have a tendency to do some modifications here with dynamical the size of the microstrip patch antenna. This nice performance is achieved by modifying the structure of the patch antenna. The improved style offer US gain of eleven.23dB with most come loss - 12dB that greatly helps to boost the performance of the antenna so it is expeditiously employed in the WiMAX communication system and different applications. Future works are done by increase the thickness of the substrate to boost the information measure of the antenna. Besides, the slotted ground plane methodology can also decrease the standard issue of the small strip patch antenna to boost the information measure of the antenna. It accustomed transmit information up to to50kms.

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