Dual Band MIMO Microstrip Patch Antenna for WLAN and WiMAX Applications

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Abstract: The present Wireless communication systems such as 3G, Bluetooth and 4G technologies require larger data transfer rates with high speed and accuracy. The Multiple Input Multiple Output (MIMO) technology is one of the advanced wireless communication systems, which is very much capable to accomplish the demands of the present and emerging communication systems like Wi-Fi, 3G and 4G etc. Patch antennas which are low cost, low in weight, planar or conformal layout, easier to fabricate, and able to be integrated with electronic or signal processing circuitry show good compatible with MIMO systems. Patch antennas can be designed in any desired shape like ring, circular, triangular etc. Flexibility in patch antenna design makes it preferable for many modern wireless communication applications. The placement of multiple antennas in small region in a MIMO system cause mutual coupling. In this study, the physical aspects of the mutual coupling between two identical patch antennas investigated. Long Term Evolution (LTE) is a wireless broadband technology, which is designed to support roaming Internet access via cell phones and handheld devices. As LTE offers significant improvements over older cellular communication standards, for instance a 4G (fourth generation) technology along with WiMAX.

In the proposed system, I have analysed dual band micro strip patch antenna and their use in MIMO communication systems. Modified Rectangular insert feed patches have demonstrated a great capability of miniaturization due to its geometrical shape. Etching some slots in the patches changes the antenna frequency response so that dual band designs are easily conceived. Several configurations are analysed using the HFSS simulation software and a 2.4 GHz & 3.8GHz two-port antenna is fabricated on a FR-4 substrate. Simulation results and some graphics are also included.

1.INTRODUCTION

A successful method for enhancing unwavering quality and expanding channel limit is to utilize Multi-Element reception apparatuses, for example, Multiple-Input Multiple-Output (MIMO) radio wire frameworks. MIMO innovation has pulled in consideration in remote correspondences because it offers critical increments in information throughput and connection go without additional data transfer capacity or transmit control. MIMO receiving wires make utilization of different radio wires at both the transmitter and beneficiary to abuse the spatial direct for limit in-wrinkle. It is one of a few types of savvy radio wire innovation.

The fast increment of remote correspondence guidelines has prompted the improvement of multiband reception apparatuses for multimode handset terminals. Accordingly, the ideal coordination of smaller multiport radio wires in PDAs has given reception apparatus building another test. The plan of very much coordinated gathered reception apparatuses on the same PCB may is by all accounts a down to earth errand yet enhancing their disconnection remains the more noteworthy test, particularly at frequencies where the telephone case and its environment add to the radiation system. In addition, regardless of whether a multimode radio front-end module as of now shows an adequate segregation between its yields, diminishing the reception apparatus' shared coupling remains completely important to guarantee that less power is lost in alternate radiators.

Close radio wire component separating definitely prompts shared coupling. By and large talking, this coupling implies that present initiated on one reception apparatus creates a voltage at the terminals of close-by components.

2.LITERATURE REVIEW

1. *A Review on MIMO Antennas Employing Diversity Techniques*

Arny Adila Salwa Ali and Sharlene Thiagarajah: Multiple-input-multiple-output (MIMO) technology is a generic term used to describe techniques proposed to improve capacity, bandwidth efficiency or data rates for the next generation wireless communication systems. MIMO systems integrate multiple antenna elements with adaptive signal processing to provide smart array processing, diversity combining or spatial multiplexing capability. The performance of a MIMO system depends on the correlation properties of its multipath signal. Low correlation between multipath signals is desired to improve channel capacity. This is achieved by exploiting antenna elements that can provide diversity via its spatial configuration, polarization potential or radiation pattern characteristics. This paper shall provide a review of the various MIMO antenna designs that focuses on spatial, polarization and pattern diversity, and its impact on performance. Issues on size, cost and implementation complexity will also be highlighted.

Y.J. Sung: A novel technique for designing a tunable dual-band microstrip patch antenna is proposed. Dual-band operation is easily achieved by loading a microstrip patch antenna with one varactor diode placed on a small gap between a square patch and a parasitic strip. It is observed from the measured result that the proposed antenna shows a wide tuning range at the two resonant frequencies.

Md. Fokhrul Islam,M. A. Mohd. Ali,B. Y. Majlis and N. Misran: There is an increasing demand for newer microwave and millimeter-wave systems to meet the emerging telecommunication challenges with respect to size, performance and cost. Microstrip antennas offer the advantages of thin profile, light weight, low cost, ease of fabrication and compatibility with integrated circuitry. This paper presents a coaxilly-fed single-layer compact microstrip patch antenna for achieving dual-polarized radiation suitable for applications in the IEEE Radar Band C and X. Simultaneous use of both frequencies should dramatically improve data collection and knowledge of the targets in an airborne synthetic aperture radar system. The designed antenna consists of three rectangular patches which are overlapped along their diagonals. The design and simulation of the antenna were performed using 3D full wave electromagnetic simulator IE3D. The antenna with a bandwidth of VSWR<2 reaches 154MHz (f_0=6.83GHz) and 209MHz (f_0=9.73GHz) was designed and simulated successfully.

Bing Bai,Jungang Miao and Fengqin Lee: This paper presents a stacked dual-band circularly polarized microstrip patch antenna for GPS receivers. The dual-band operation is obtained by stacking two layers of microstrip antennas working at two discrete frequencies. Each of them is fed by dual probes. The technique of redundant via hole is proposed in order to feed the upper layer patch through the lower layer antenna. A prototype of the antenna was realized and the measured results are presented. Keywords: Circularly polarization, stacked microstrip antenna, dual-band, dual probes feed, redundant via polo.

G. Kumar and K. P. Ray: The proprietary HSpice models for the SiGe BiCMOS technology provide excellent agreement with these measured results over the entire temperature range from -50 to 150°C. Fig. 3 shows the difference between the simulated and measured values of the bandgap reference output, expressed as an error percentage of VBGX, against temperature at V,, = 2.5 and 4.0V. An error of < 1% is observed, using a value of 2.2 for the Spice bipolar transistor model parameter XTI, which controls the deviation from linearity of the transistor's V,, against temperature characteristic. Table 1 summarises the performance of the BGR at V,, = 2.5V

Hossein Eskandari, Mohammad Naghi Azarmanesh: In this paper, four printed wide-slot antenna fed by a microstrip line with a polygonal slot for bandwidth enhancement is proposed and experimentally studied. One of these antennas is fabricated and measured. Impedance, radiation and gaincharacteristics of this antenna are presented and discussed. From experimental results, the measured impedance bandwidth, defined by 10-dB return loss, can reach an operating bandwidth of 4.03 GHz at operating from approximately 1.87 to 5.90 GHz.

Zhi Ning Chen, Terence S. P. See, and Xianming Qing: A small printed antenna is described with a reduced ground-plane effect for ultrawideband (UWB) applications. The radiator and ground plane of the antenna are etched onto a piece of printed circuit board (PCB) with an overall size of 25mmtimes25 mmtimes1.5 mm. A notch is cut from the radiator while a strip is asymmetrically attached to the radiator. The simulation and measurement show that the miniaturized antenna achieves a broad operating bandwidth of 2.9-11.6 GHz for a 10-dB return loss. In particular, the ground-plane effect on impedance performance is greatly reduced by cutting the notch from the radiator because the electric currents on the ground plane are significantly suppressed at the lower edge operating frequencies. The antenna features three-dimensional omni-directional radiation with high radiation efficiency of 79%-95% across the UWB bandwidth. In addition, a parametric study of the geometric and electric parameters of the proposed antenna will be able to provide antenna engineers with more design information

N.P.Agrawall, G.Kumar and K.P.Ray: The circular disc monopole (CDM) antenna has been reported to yield wide-impedance bandwidth. Experiments have been carried out on a CDM that has twice the diameter of the reported disc with similar results. New configurations are proposed such as elliptical (with different ellipticity ratios), square, rectangular, and hexagonal disc monopole antennas. A simple formula is proposed to predict the frequency corresponding to the lower edge of the bandwidth for each of these configurations. The elliptical disc monopole (EDM) with ellipticity ratio of 1.1 yields the maximum bandwidth from 1.21 GHz to more than 13 GHz for voltage standing wave ratio (VSWR)<2.

Chao-Ming Wu : A novel and simple wideband dual-frequency design of a coplanar waveguide (CPW)-fed triangular planar monopole antenna is proposed. By the proper choice of the flare angle for the triangular patch and the gap distance for the CPW feeding structure, an additional resonant mode and wide impedance matching can be realized. Both theoretical and experimental results of bandwidths and radiation characteristics for prototypes of the proposed antenna have been presented and discussed. The measured -10dB impedance bandwidth at the lower band (1.71 GHz) is about 240 MHz and that at the upper band (5.62 GHz) reaches about 2 GHz, which cover the DCS1800 and the IEEE 802.11a 5.2/5.8 GHz WLAN standards, respectively. Good monopole-like radiation patterns with antenna gains of 2.3–3.6 dBi and 3.9–5.6 dBi over the lower and upper bands, respectively, have also been obtained

3.ANTENNA GEOMETRY

In this section, Fig.2 Geometry of Dual Band MIMO microstrip patch antenna is shown in detail with its overall Dimensions in mm.First a rectangular patch is designed and then Y-shape is implemented in this square patch with a ground plane.

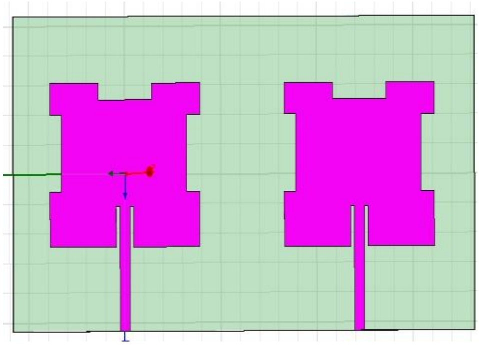

Fig.2:- Proposed two-element MIMO antenna

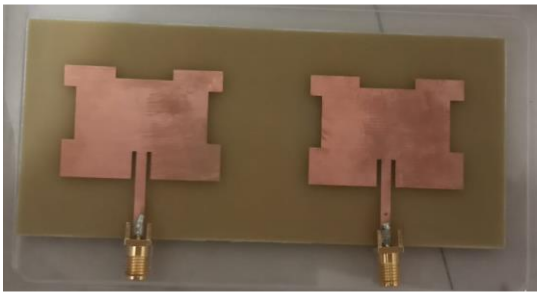

Fig.3:- Photo of Fabricated MIMO Patch Antenna

Dual Band MIMO microstrip patch antenna is designed using FR4 material. A microstrip line feed technique is used here to provide a planar structure. The Dual Band MIMO Microstrip patch is fabricated using lithography technology, a photograph of a fabricated patch antenna is shown in Fig.3. It is tested on Vector Network Analyzer.

4.RESULTS AND DISCUSSIONS

The proposed antenna is simulated using HFSS Software. From Fig.4 a return loss of -19.52 dB at a resonant frequency 2.4GHz has been observed also return loss of -26.52 dB has been observed at resonant frequency 3.8GHz. The Negative sign here indicates that the reflection coefficient of this antenna comes out to be very low.

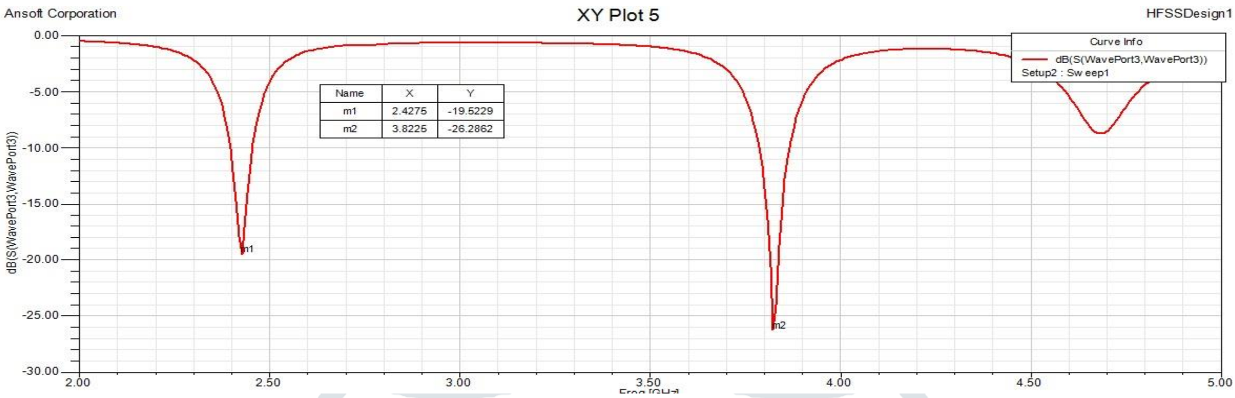

Fig.4:- Return Loss vs Frequency for Designed Antenna

VSWR for resonating frequency of 2.4GHz is 1.053 and VSWR for resonating frequency 3.8GHz is 1.212 which is shown in Fig.5.

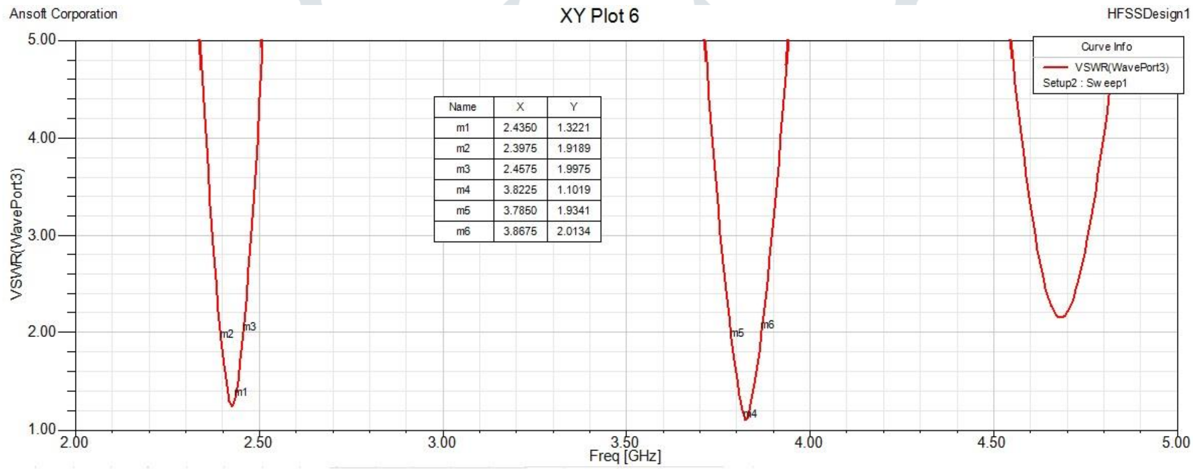

Fig.5 VSWR vs Frequency for Designed Antenna

The radiation pattern for antenna for 2.4GHz and 3.8GHz is as shown in Fig.6 & Fig.7 respectively.

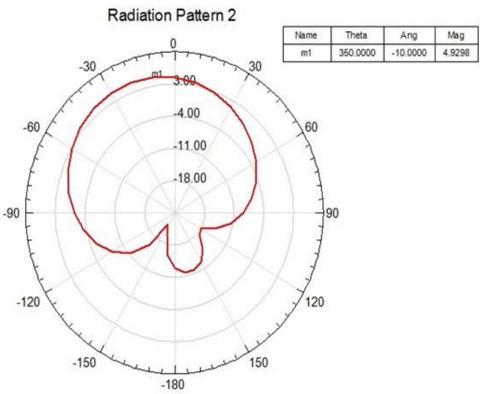

Fig.6:-2D Radiation pattern for 2.4 & 3.8GHz

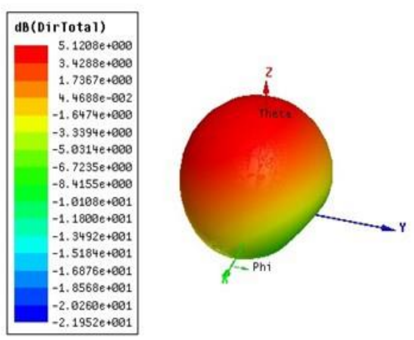

Fig.7:-3D Radiation Pattern for 2.4 & 3.8 GHz

Fig. 7.3 shows the presence of other antennas and the height of the deployment can weigh heavily on the actual antenna selection.the red color shows of above patch antenna gives directional pattern

Designed antenna is tested on vector network analyzer. Fig8. Shows the Return Loss vs. Frequency curve for Dual Band MIMO microstrip patch antenna while testing on Vector Network Analyzer.

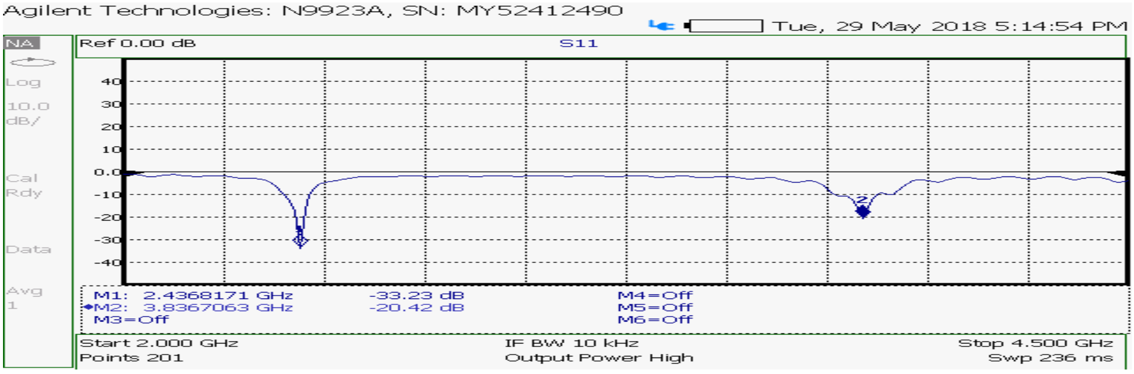

Fig.8:- Return Loss Vs Frequency for Fabricated Antenna

TABLE.1: COMPARISON BETWEEN SIMULATED RESULTS AND MEASURED RESULTS OF PATCH ANTENNA

Sr. No.	MIMO Results	Freq (GHz) S11	S11 (dB)	VSWR	S21 (dB)	BW	Impedance (ohms)
1.	Simulated 2x1 MIMO	2.42	-17.77	1.35	-27.64	65	51.8
		3.80	-25.64	1.11	-19.76	85	
3.	Measured 2x1 MIMO	2.43	-33.26	1.05	-23.71	66	48.2
		3.83	-20.42	1.21	-20.93	84	

Simulated results and measured results match each other thus the antenna is validated and can be used for WLAN and WiMAX Applications.

5.CONCLUSION

In the proposed framework another setup of the opened fix recieving wire has been presented. A straightforward a minimized twofold Rectangular opened fix radio wire for MIMO remote applications is exhibited. This MIMO radio wire exhibit reverberates at 2.45 GHz and 3.80 GHz with an enhanced pick up and with shared coupling of - 27.5 dB and - 20 dB at the thunderous recurrence separately.A few decoupling strategies have been accounted for in papers, the vast majority of which recommend rolling out improvements to the reception apparatus structure, for example, an expansion of the separating between them. The proposed framework is tied in with adding an opened to edge of fix to the reception apparatus to get double band execution A rectangular fix opened shape MIMO fix radio wire has been exhibited in this undertaking. Reproductions and aftereffects of the rectangular fix opened have been given a helpful outline to a recieving wire working at the recurrence of 2.4GHz for WLAN applications and WiMAX applications for 3.8GHz.

6.References

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