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# DESIGN OF 2.45 GHz MICROSTRIP PATCH ARRAY FOR 2x2 MIMO COMMUNICATION SYSTEMS.

**MANISHA.S, SANKEIRTHANA.R, SWETHA.J**
**PSG COLLEGE OF TECHNOLOGYCOIMBATORE**

***ABSTRACT*- MIMO techniques are the most important advancements in recent wireless systems. They are a critical part of important standards such as IEEE 802.20, 802.11 and 4G. The MIMO technology has attracted attention in wireless communications, because it offers significant increase in data throughput and link range without additional bandwidth or increased transmitted power.Primary reason to use multiple antennas is to improve link quality and reliability. This is important especially for worst channel conditions like multipath fading, shadowing, etc.MIMO diversity and MIMO multiplexing modes depending on a variety of factors including the channel environment and signal quality. So the theme of this work is to design a 2x2 MIMO antenna using Advanced Design System 2011. The design is fabricated in a FR4 substrate in order to test the behavior of the communication system for the real time environment.**

## I.INTRODUCTION

All wireless technologies face the challenges of signal fading, multi-path, increasing interference and limited spectrum. MIMO (multiple-input-multiple-output) technology exploits multi-path to provide higher data throughput, and simultaneous increase in range and reliability all without consuming extra radio frequency. It solves two of the toughest problems facing any wireless technology today, speed and range

MIMO is an acronym that stands for Multiple Input Multiple Output. A MIMO system consists of m transmit antennas and n receive antennas. Itis an antenna technology that is used in transmission and receiver equipment for wireless radio communication. There can be various MIMO configurations. For example: a 2x2 MIMO configuration consists of 2 antennas to transmit signals and 2 antennas to receive signals.

MIMO takes advantage of multi path .with multi path, transmitted information bounces off walls, ceilings, and other objects, reaching the receiving antenna multiple times via different angles and at slightly different times. In the past, multi path caused interference and slowed down wireless signals. MIMO technology takes advantage of multi path behavior by using multiple, smart transmitters and receivers with an added spatial dimension, to dramatically increase performance and range.

MIMO involves of space time transmit diversity (STTD), spatial multiplexing (SM) and uplink collaborative MIMO. In space time transmit diversity, the same data is coded and transmitted through different antennas, which effectively doubles the power in the channel. This improves signal to noise ratio (SNR) for cell edge performance. . In uplink collaborative MIMO link, two devices can collaboratively transmit on the same sub-channel which can also double uplink capacity. Spatial multiplexing delivers parallel streams of data to receiver by exploiting multi-path. It can double (2x2 MIMO) or quadruple (4x4 MIMO) capacity and throughput. Spatial multiplexing gives highercapacity when RF conditions are favorable and users are closer to the base transmitting station. As MIMO involves spatial multiplexing, it increases the throughput.

Spatial multiplexing is a multiple antenna technique that increases the data rate as compared to single antenna techniques. Theoretically, spatial multiplexing can increase the capacity of the system as pairs of transmitter and receiver antennas are added to the system. The source data (usually data requested by the user) is split into two or more independent data streams that are transmitted over multiple antennas, called spatial streams. A common configuration is the previously mentioned 2×2 MIMO system. In this case the throughput is theoretically doubled compared to the single antenna configuration. This paper presents a MIMO antenna which is of 2x2 MIMO systems. The MIMO presented here is an H-shaped patch design which proved to have a better directivity and gain when compared to a simple rectangular patch antenna's performance. Also the Band width of the H-shaped antenna has been improved over the rectangular system, by introducing slots appropriately in the design.

## II.ANTENNA DESIGN

The design of the antenna proposed is shown in figure1 and the fabricated antenna is shown in figure 2. The design consists of two antenna elements an H-shaped rectangular patch and a Wilkinson power divider is used to split the input power equally. The antenna is designed to have a resonant frequency of 2.45 Ghz. The two H-shaped rectangular patches are inclined at an angle of 60 degrees to each other to have optimal isolation from each other and better directivity. The antenna is fabricated over an FR-4 substrate of permittivity 4.6 and of thickness 1.6 mm.

Figure1

## III.ANTENNA PERFORMANCE ANALYSIS

The design for the array antenna begins with the design of the patch in ADVANCED DESIGN SYSTEM (ADS) software.

Initially a simple rectangular patch with dimensions as given in the figure 3 is designed on a FR4 substrate whose relative permittivity is 4.6, loss tangent as 0.011 and height of the substrate is taken to be as 1.6mm.A slot type feed line is used to obtain an optimal return loss of 20 dB. This design when simulated using the ADS software ,as then inferred from figure 4 a return loss of -22dB is achieved but the resonant frequency is shifted to 2.5GHz which is a slight deviation from the resonant frequency we are aiming to achieve. Bandwidth of 20MHz is obtained using this design .

Thus, to improve the bandwidth, H-shaped slots are inserted in the design as shown in figure 5.

Two slots on the upper and lower boundary of the patch antenna of height 1.6mm and width 16mm is made.From figure 6 it is evident that the result of such slots is that the bandwidth has increased to 50MHz with a return loss of -25 dB and resonant frequency of 2.45GHz which is the desired frequency.

Thus this optimized design is considered efficient and its radiationpattern is obtained as shown in figure 6 using ADS.

On comparing the simple rectangular patch design and the optimized design, power radiated, directivity and gain is better in optimized design .The data related are as given in the table below.

Also on comparing the simple rectangular patch design and optimized patch design in terms of return loss ,bandwidth and resonant frequency .From table 2 it is evident that the optimized design has better performance than the rectangular patch design.

## IV.CONCLUSION

A microstrip based 2x2 MIMO antenna was taken up for study, its design parameters were calculated and the design was implemented using Advanced Design System (ADS) software, version 2011. The design is inclusive of a power divider and two rectangular patches which are inclined at an angle of $60^o$ with respect to each other. The simulated results show the $S_{11}$ parameter value at 2.45 GHz center frequency to be -22dB. In order to optimize $S_{11}$ value for improved bandwidth, H-shaped patch is implemented. The simulated result for H-shape antenna shows a better performance in return loss (of -34dB) as well as in bandwidth. The bandwidth for the optimized patch is 52MHz, which when compared to the conventional patch (whose bandwidth is 41MHz) shows an increase of 21%. The design was implemented using FR4 substrate and a printed circuit board was fabricated to test the design .The test evidently shows that the H-shaped patch antenna has betterperformance as compared to the rectangular patch design for the considered design frequency of 2.45 GHz.

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