Different Antenna array Patterns and their effect on Wireless MIM©gopalax O Communication System

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***Abstract* - Different antenna arrays are used at transmitter and receiver in MIMO communication system. The different multipath causes the interference at the receiver which impacts on the efficiency and also increases the channel estimation error of the MIMO system. Here I have studied over different antenna arrays and their radiation patterns with individual gains and efficiency and also a Proposal for best array antenna design has been done using an mm wave antenna which gives high efficiency.**

***Index terms* - antenna arrays, gain, MIMO efficiency, MIMO capacity**

I. INTRODUCTION

Generally different antenna arrays are used in MIMO system where it is possible to measure angle of arrival (AOA) ,angle of departure(AOD) , path difference and time delay at the receiver . And based on the different radiation pattern efficiency of the MIMO system will change .and the best efficient MIMO system will have less interference at the receiver. Here different antenna arrays of linear and rectangular radiation patterns along with their gain and beam width has been discussed, which gives different value of angle of array and also the direction of main lobe of antenna array. The high efficiency also increases the MIMO system capacity. As capacity depend upon the signal to noise ratio (SNR). Capacity depends upon the surrounding environment also , as at the receiver there will be always a chance that signal may get superimpose to each other and which causes the interference , and this interference increases the channel estimation error and makes the MIMO channel more complex . it has also explained about capacity measurements under fading environments[1],which I have explained here. The more number of fading multipath that will make a time delay in the system at the receiver. When the number of multiple delayed fading paths is large and/or the differential delay between paths is small,[1,2] which is usually true for wideband systems in practice. But compare to continuous time model discrete time model is more accurate and highly efficient.

II. DESIGN PATTERN AND GEOMETRY

The microstrip antenna is attractive due to its plannar profile, easy integration and low cost. But generally the microstrip antenna has 1-3 % band width which cannot be implemented at high frequencies.[3] Here I have designed a broadband microstrip patch antenna with high efficiency and bandwidth.

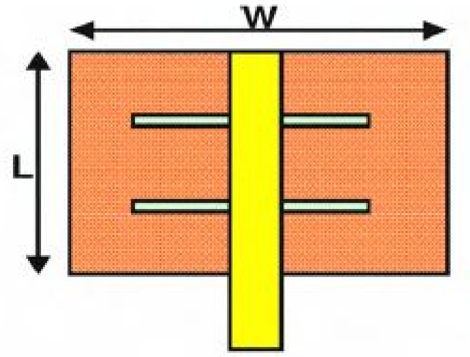

Fig 1: proposed mm wave antenna patch

The microstrip antenna is LxW (1.85x1.7mm) with two slots on the ground and fed by a microstrip line (w=300um). Two slots are spaced 0.25mm above and 0.5mm below the center of the patch on the ground plane.

III. PROPOSED VARIATIONS

As the antenna arrays will be used both at the transmitter and receiver, the power receiver at the receiver will be more unpredictable under multipath fading environments .the system efficiency depends upon the number of elements in the antenna array and also the space within then .as the AOA puts a impact on the receiver, the signals received at the receiver over different multipath will try to superimpose over a dominant signal and which causes interference. So a best antenna array has to be used to have high beam width and SNR values. If the SNR value increases then the capacity of the MIMO system will increase,[1,2] which can further multiple the number of users in the channel.

$$C=x+\log(1+\log(1+SNR))$$

Where x is an asymptotic parameter

In multiuser systems that are interference limited, the SNR is limited by the number of users that are sharing the channel.[5] In multiuser systems, where the users are kept orthogonal in time, frequency, or code, the achievable values of SNR are generally much larger.

But even in point-to-point links there are a number of factors that limit SNR such as antenna effective noise temperature, receiver noise figure, quantization noise, etc.[3] In practice, it is difficult to achieve values of SNR much larger than 30 dB.

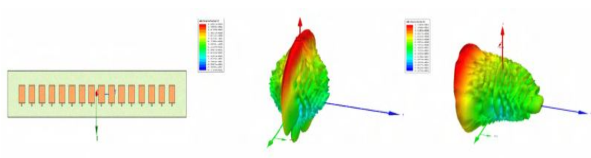

Fig 2: A linear 1*16 mm wave antenna array

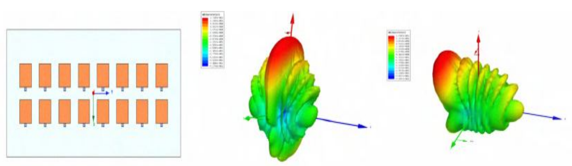

Fig 3: A rectangular 2*8 mm wave antenna array

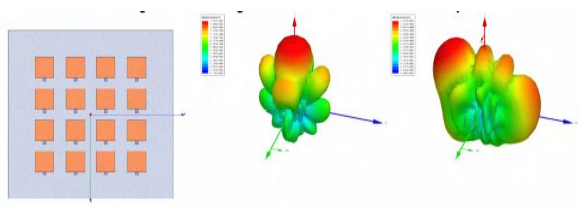

Fig 4: A square 4*4 mm wave antenna array

III. ANTENNA RESULTS

Table 1: When the scan angle is 0 degree

Array	Peak gain	Beam width
1*16	19.56dBi	5°
2*8	18.27dBi	12°
4*4	18.12dBi	21 °

Table 2: When the scan angle is 45 degree

Array	Peak gain	Beam width
1*16	17.88dBi	8°
2*8	17.02dBi	14.7°
4*4	16.4dBi	28°

The variations in array gain, beam width for various Scanning angle and different antenna array architectures has mentioned. Linear array has higher array gain, narrow beam width and lower side lobe level to provide better interference Immunization. As beam scans from broadside with scanning angle at 0° to larger scan angles, the antenna shows gain degradation, beam width broadening and SLL reduction.

Based on the high gain broadband microstrip antenna design a 16 element based antenna array is designed with 0.56Ao element for linear lxl6, Rectangular 2x8 and square 4x4 array architectures. Antenna array performance also varies with frequency.

So it says that antenna element' mutual coupling changes with Frequency, antenna element spacing, antenna architecture, and scanning angles.

IV. RADIATION PATTERN

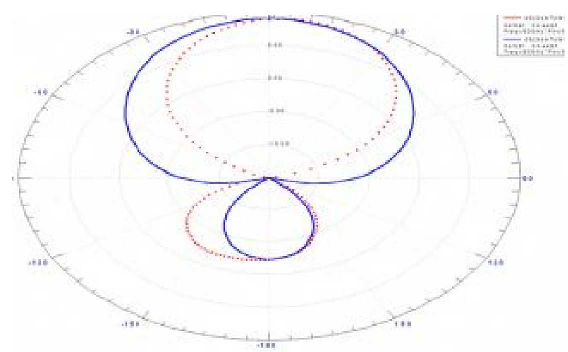

Figure 5: Radiation pattern of the proposed antenna design

Shows that it is a broad beam radiation pattern along the broad bandwidth.

Blue is H plane

Red is E Plane

H plane radiation pattern has broad beam width then E plane.

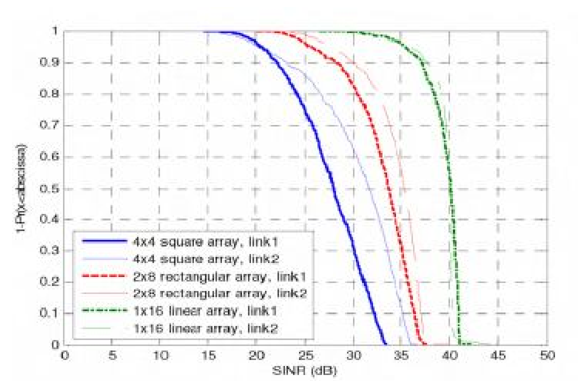

Figure 6: Comparing the signal to noise ratio in different antenna array patterns.

Capacity increased as number of elements in the array was increased. Compared to the baseline case (SISO system), which by Shannon's classical formula scales as one more bits/cycle for each 3 dB increase in SNR, remarkably with MIMO, the scaling is almost like n more bits/cycle for each 3 dB increase in SNR.[4,5] But the inter-element spacing was kept fixed. Increasing number of element consequently resulted in increased antenna aperture and also in increased antenna size. The channel characteristic has to be defined to the MIMO system, such as channel bandwidth and scattering coefficients. The uncertainty in power received due to superimpose of the signal at the receiver increases the error rate and delay time, which makes an effect on system efficiency .so the error rate has to be decreased with the SNR values

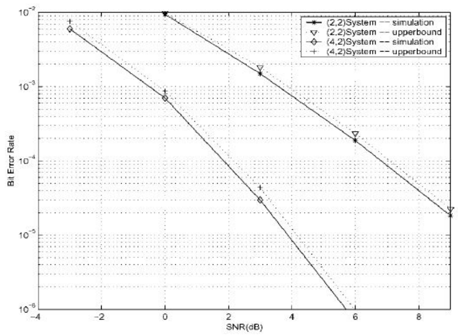

Figure 7: SNR Vs BER (bit error rate)

Generally in fast fading (Rayleigh fading) multiple numbers of local multipaths generated will make interference at the receiver, although the received signals from different transmitters will follow different paths to reach receiver but they try to superimpose over a dominant signal and makes interference Using a linear antenna array in the MIMO receiver will give high values of SNR and beam width.

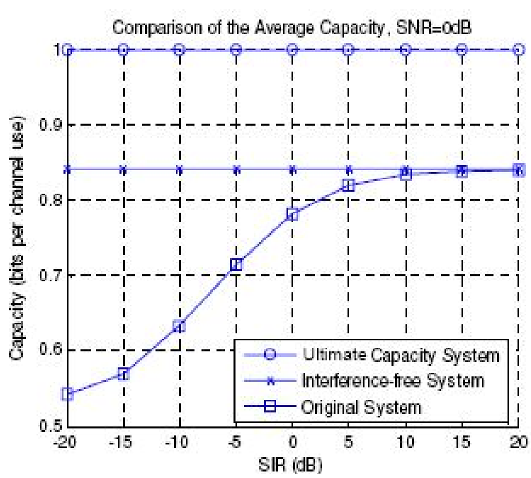

Figure 8 : real time variance of capacity and SNR with different systems

V. CONCLUSION

MIMO uses different array patterns at both transmitter and receiver, and the design that has been done here gives the broad beam radiation pattern performance across a broad bandwidth and with Peak gain of 9.1dB was achieved .Which further increases the Directivity. So the linear array pattern achieves high SNR values for capacity enhancement.

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