A Dual Band Offset MIMO antenna with WIMAX Applications

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Abstract— In this paper a designed multiple band antenna with partial extended ground (PEG). An offset four element multiband planar MIMO antenna with an omnidirectional radiation pattern is proposed for non-line of sight (NLOS) communication on the low-cost fr-4 dielectric substrate for 4g and future technologies. The patch antenna system was created in 2.48 and 5.6 band operation. The recommended the overall size of the MIMO antenna is 61.9*77.42 mm2. Applied and tested the antenna other result handled the simulations result very well. The measurement gain is 4.2 dB and the separation S12 is 12.14dB. The proposed design covers WLAN/WiMAX bands with gain and radiation efficiency. An ECC level of ≤ 0.01 has been achieved in the whole band.

Keywords: Long Term Evolution (LTE), Offsetting Technique, MIMO Antenna, WiMAX

I. INTRODUCTION

Over the past few years, a remarkable development in indoor and outdoor wireless activities enhances the multiple input multiple output (MIMO) antenna technology [1]. Variety of antenna designs in the market has been innovated with the microstrip patch antennas, due to low cost and planar designs. A single-port antenna is easy to fabricate but unable to achieve the required data rate, spectral efficiency, and capacity for the presently available 4G data and multi-media users. Also, the effects of co-channel and adjacent channel interferences have high level of influence in these antennas. Therefore, multiple input multiple output (MIMO) antenna has been introduced to overcome the drawbacks of single input single output (SISO). The SISO also places impossible bandwidth demands on the gigabit (GB) wireless system. Therefore, gigabit per second (GBPS) wireless links in NLOS communication using SISO are in general not feasible due to signal to noise ratio (SNR) limits, average signal to interference with noise ratio (SINR) limits, high power/ bandwidth requirements, and due to range reduction in practical receivers[2].

The enhanced gain, high spectral efficiency, high data rate, high efficiency, link reliability, and large capacity of the MIMO, make it suitable among the wireless local area network (WLAN), wireless interoperability of microwave access (WiMAX), and long-term evolution (LTE) technologies. The MIMO is at the core of the 4G/5G wireless technologies.

The demand of portability and compactness of the wireless technologies/devices requires special implementation strategies of MIMO antennas in a limited space, which in turn sets the upper limit on maximum achievable performance of antenna design parameters [2]. The effect of proximity effect/mutual coupling degrades radiation efficiency, MIMO gain, and distorts far field radiation patterns. To solve these issues of the close proximity of radiating elements sharing the common ground and/or radiation emission, many of the mutual coupling reduction techniques and diversity techniques are utilized by the antenna designers. These techniques result in better utilization of space and enhance the antenna design parameters.

MIMO with high isolation, compact size, and low volume are the current challenges for all the wireless applications. The performance of multi-element MIMO antenna can be enhanced by placing symmetric antenna elements with polarization diversity technique to achieve wide-lobe radiation patterns and required isolation. The polarization diversity provides the size reduction, link reliability, and maintains port isolations due to the orthogonal arrangement of radiators. The effect of different diversity techniques leads to the performance enhancement of MIMO antennas [2].

II. DESIGN STUDIES

The 1x1 MIMO antennas for wireless applications optimized by the Particle Group. The particle swarm optimization (PSO) used with the mini-max algorithm is set to achieve better design goals for the target of the frequency band, the density is required, and the required antenna parameters [3].

Recommended design behind the proposed radiator element. The minimum benefit reduction required for wireless applications. Low volatile cooling (High port separately Port), is a compact size, high profit and bandwidth. 2.48 And 5.6 GHz with both sides of the half-ground to reduce the interconnecting between the lines. 2.48 And 5.6 GHz with both sides of the half-ground to reduce the interconnecting between the lines. The appropriate criteria have been received to achieve better results are shows [3].

<table>
<thead>
<tr>
<th>Parameter</th>
<th>GW</th>
<th>GL</th>
<th>SL</th>
<th>SW</th>
</tr>
</thead>
<tbody>
<tr>
<td>value</td>
<td>30.95</td>
<td>7.88</td>
<td>38.71</td>
<td>30.95</td>
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</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>FL</th>
<th>FW</th>
<th>PW</th>
<th>PL</th>
</tr>
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<tr>
<td>value</td>
<td>16.6</td>
<td>2.26</td>
<td>12.78</td>
<td>11.97</td>
</tr>
</tbody>
</table>

Table 1: parameters Optimized (mm).

Last sections of many moderns the main responsibilities will be used [4], [5]. This group of changes to systems of different standards, including GSM, 2.4 and 5.6 GHz ISM bands are designed. Some designs are designed for double band programs [5], [6].1*1 Conventional Patch Antennas is 30.95 * 38.71 mm2.
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III. SIMULATION RESULTS

The verification of CST design and performance parameters of proposed MIMO antenna has been done [2]. From the simulation and measurement of $S$ parameters, it has been observed that the return-losses at ports 1 and 2 are equal ($S_{11}$, $S_{22}$), and isolations between ports are also equal ($S_{12}$, $S_{21}$). This is due to the symmetric structure of the presented MIMO. For easy analysis of the presented MIMO antenna, only $S_{11}$ and $S_{12}$ scattering parameters have been considered throughout the article [2]. A result of the proposed antennas simulated - 10 dB ability 2.34-2.68 GHz and 5.51-5.71 GHz frequency band, VSWR <2, and 12.14 dB isolation [3].

![Fig. 1: 1*1 design with and without PEG](image1)

![Fig. 2: S parameters of design without PEG](image2)

![Fig. 3: S parameters of design with PEG](image3)

![Fig. 4: 2*2 MIMO design without PEG](image4)

![Fig. 5: S parameters of 2*2 MIMO design](image5)

![Fig. 6: 2*2 MIMO design with PEG](image6)

![Fig. 7: S parameters of MIMO design](image7)

![Fig. 8: MIMO 2*2 S parameters](image8)
Proposed in the middle of ground and partially limits the effectiveness compared to the fig.9 and fig.11 [3]. Return loss of purpose antenna is -37.22db (lower band) and -33.26db (upper band). Partial ground and full ground effect of 2*2 MIMO antenna shown in fig.9 and fig.11.

Research targeted is a scientific effort to create compact dual-band antennas for next-generation MIMO applications [3]. The proposed technique offsetting is important in designing the MIMO antenna and meeting the MIMO specific need. The proposed research work focuses on the improvement of the antenna parameters. The offsetting technique provides density in size and improves all the degrading aspects of the MIMO antenna parameters [2]. So we use this technology in my antenna design. Because of the strong interconnection between the antenna elements, it is difficult to put multiple antennas together within the substrate while maintaining high separation. Offsetting principle used in feed, as well as patch etc.

Proposed antenna 2x2 MIMO benefits and form of the radial patterns of behavior, the 2D-3D radiation patterns and behavior. Total gain of antenna is 4.2 dB and the radiation of the best overall system efficiency of 93%. Bandwidth of the antenna is defined (2.34-2.68) and (5.51-5.71) [3].

An envelope correlation coefficient (ECC) is evaluated for the uncorrelated channels to observe the channel is good, bad, or good enough. In real propagation world even in line of site communication, finding a truly uncorrelated channel is impossible. Therefore, ECC is used for the measurement of such conditions. Far-field analysis and S parameter approach are considered to find the value of ECC. The effect of mutual coupling between any of the two ports of MIMO can be seen in terms of two scattering parameters $S_{12}$ and $S_{21}$. However, ECC involves all the scattering parameters of the designed MIMO to show their effects on the correlation coefficient ($q$). For the good diversity behavior the value of ECC must be $<0.5$ for mobile applications. The simulated value of ECC is in the range of 0.01 for the proposed MIMO antenna.
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Fig. 14: 3D E-field radiation pattern at 5.6GHz

Fig. 15: Radiation pattern of E-field at 2.48 GHz freq.

Fig. 16: Radiation pattern of E-field at 5.6 GHz freq.

Fig. 17: 3D H-field radiation pattern at 2.48GHz

Fig. 18: 3D H-field radiation pattern at 5.6GHz

Fig. 19: Radiation pattern of H-field at 2.48GHz freq.
The effect of antenna radiation on the conducting plane was observed by finding the surface current density on the conducting plane due to backward radiation. These effects were observed for different separation distances between the antenna and the conducting plane. Each antenna element was excited individually while the others were terminated with matched loads and the surface current density was calculated on the conducting plane. All antenna elements had a similar effect on the conducting plane. Some excited current density on the conducting plane was observed which was below the excited antenna element. This density was 2 A/m when the conducting plane was at a distance of 1 mm from the antenna. The current density decreased significantly as the separation distance between antennas and conducting plane increased [5].

The ECC can be obtained using the far-field characteristics of the radiating element. ECC depend on the efficiency and power distribution of the radiating element. ECC involve all the scattering parameters of the designed MIMO to show their effect on the correlation coefficient [1]. The recommended range antenna VSWR, simulated VSWR current wave 2 at least once. The VSWR value of proposed antenna is 1.062. A simulated radiation efficiency is 93%.

In this work, PEG with micro strip patch antenna have been studied and compared the design characteristic performance. The radiation properties of the proposed antenna have been analyzed with existing design. The gain of the proposed antenna are 4.2 dB. The minimal return loss of the simulated antenna is observed to be −37.22 dB. The Port of offsetting implementation of the diagonal is used for better space utilization. The proposed antenna is acquired the operating

Fig. 20: Radiation pattern of H-field at 5.6GHz freq.

Fig. 21: Current distribution at 2.48GHz frequency

Fig. 22: Current distribution at 5.6 GHz frequency

Fig. 23: VSWR of MIMO system

Fig. 24: Radiation efficiency of MIMO antenna

IV. CONCLUSION
frequency 2.48–5.6 GHz, which act as the peak absorption frequency and unique spectral signature. Hence, the projected microstrip patch antenna suitably employed to the application for detection of explosive and material characterization.

REFERENCES


