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Comparative Study on Different Feeding Technique of Microstrip Patch Antenna (MPA)

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Abstract: The wireless communication is revaluating rapidly in recent years. So this Paper describes the feeding techniques for various Microstrip Patch Antennas. Even it can provide dual and circular polarizations, wide bandwidth, dual frequency operation, flexibility in feeding line, beam scanning Omni directional patterning. It is having a variety of feeding methods applicable to them. These methods are divided into two Categories i.e. Contacting and Non contacting. Likewise, microstrip patch antenna is having lots of parameters like VSWR, Gain, Bandwidth, Return loss, Directivity using HFSS Software etc. The shape of the microstrip patch also matters to get the different outputs. In this paper, we discuss microstrip patch antenna, its different feeding techniques of the patch.
Keywords: Microstrip Patch Antenna, Feeding Techniques.

I. INTRODUCTION

A Microstrip Patch Antenna consists of a flat "patch" of metal, placed over a dielectric material or "substrate". The dielectric is covered by a metal ground plane on its other side. The ground plane is connected to the supply's ground terminal and acts a return path for the current in the antenna. Ground plane also acts as a reflector for radio waves from the patch. Microstrip Patch Antenna has drawn the attention of researchers over the past work because of their many attractive features. They are widely used in different types of communication system.

The metal patch can be of any continuous shape like rectangular, circular, triangular elliptical etc. Patch antennas became popular because of their low cost, thin and light weight structure. They give sufficient gain, directivity and bandwidth for applications like missile, mobile phones telemetry, GPS and satellite communications. Microstrip Patch Antenna consists of a Conducting rectangular patch of width "W" and "L" on the side of dielectric substrate of thickness "h" and dielectric constant "ε_r". With high permittivity substrate the size of antenna can be reduced up to great extent but these techniques reduce the radiation efficiency of antenna and impedance bandwidth of antenna also reduced. The radiating patch has different shapes such

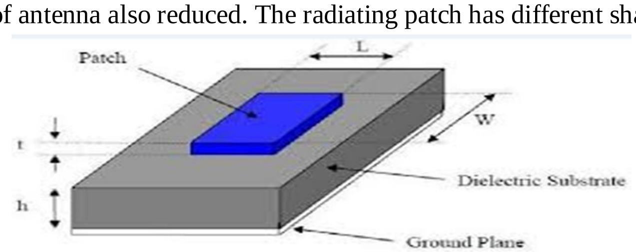

Figure 1: Structure of Microstrip Patch Antenna

The role of feeding is very important in case of efficient operation of antenna to improve the antenna input impedance matching. The various types of feeding techniques are:-

II. FEEDING TECHNIQUES

There are many techniques are used to transmit electromagnetic energy to a microstrip patch antenna. The feeding is very important for the efficient operation of antenna to improve the antenna input impedance matching. The Five feeding techniques used in this paper are microstrip line feeding, Co-axial Feed, Aperture Coupled Feed, Proximity Coupled feeding and Branch Feed.

A. *Microstrip Line Feed*

In this type of feed technique, a conducting strip is connected directly to the edge of the microstrip patch as that shown in figure 2. The conducting strip is smaller in width as compared to the patch and this kind of feed arrangement has the advantages that the feed can be etched on the same substrate to provide a planar structure [3].

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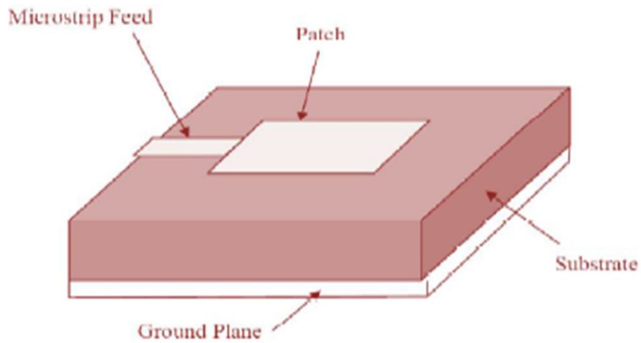

Figure 2: Microstrip Line Feed

When the patch is fed by source, the edge nearer to the source has infinite impedance because of zero current at the open circuit edge and at the middle of the patch; the impedance is zero because of maximum current at the patch centre is shown in figure 3. Hence, a 50 ohms input impedance feed point is selected by moving closer to the patch centre. This feed is easy to fabricate, simple to match by controlling the inset and unnecessary junctions can be avoided by printing the entire circuit in one go.

B. Co-axial Feed

Co-axial feed is a non planar feeding technique in which a co-axial cable is used to feed the patch. The outer conductor of the cable is connected to the ground plane and the inner conductor penetrates through the dielectric making a metal contact with the patch. The advantage with co-axial feed is that the co-axial probe can be placed at any desired location inside the patch metal in order to match with the input impedance, which is not easy with inset feed. Also, the ground plane isolates the spurious radiation from the feed and the radiation from the antenna leading to better radiation performance. The drawback with this feed is that, it is difficult to obtain impedance matching for thicker substrates due to probe inductance and significant probe radiation for thicker substrates. The probe used to couple power to the patch can generate somewhat high cross-polarized fields if electrically thick substrates are used. Co-axial feed has poor polarization purity. The location of probe is defined by the X co-ordinate and the Y co-ordinate. The probe is in direct contact with the antenna and it is located at the point where the antenna input impedance is 50 ohms.

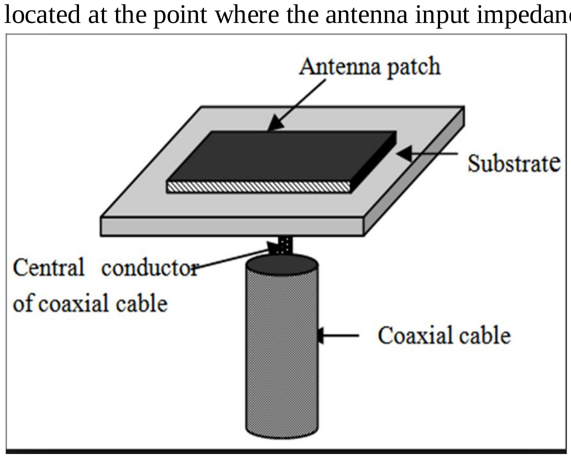

Figure 3: Co-axial feed line

C. Aperture Coupled Feed

In Aperture Coupling two different substrate the radiating patch and microstrip feed line are separated by the ground plane. The energy of microstrip feed line is coupled to the patch through a slot on the ground plane separating two substrates to make a coupling effective. In this coupling technique the top substrate uses a thick low dielectric constant while the bottom substrate is of high dielectric substrate. In the middle, the ground plane isolates the feed from radiation element and minimizes interference of spurious radiation for pattern formation and polarization purity. Aperture coupling feeding facilitate with the advantages of no physical contact between the feed and radiator, wider bandwidths, and better isolation between antennas and the feed network and independent optimization of the feed mechanism and the radiating element.

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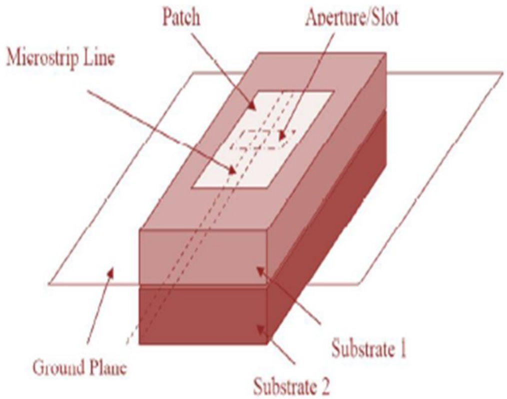

Figure 4: Aperture coupling line feed

D. Proximity Coupled Feed

In proximity feed, the feed line is placed between two dielectric substrates. In edge fed technique it is not possible to choose a 50 ohms feed point since the impedance at the edges will be very high. To overcome this, the feed line is moved to a lower level below the patch. The edge of the feed line is located at a point where the antenna input impedance is 50 ohms. Here the power transfer from the feed to the patch takes place through electromagnetic field coupling. Since the feed line has been moved to a lower level, feed line radiation has been reduced to a great extent and also this technique allows planar feeding [6]. Also, it has an improved bandwidth efficiency compared to the other techniques. The disadvantage with this method is that multilayer fabrication has to be done and it offers poor polarization purity [8].

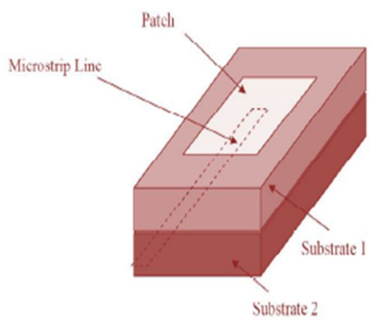

Figure 5: Proximity Coupled line feed

E. Branch Line Feed

In this type of feed technique, a conducting strip is connected directly to the edge of the microstrip patch as shown in figure. The conducting strip is smaller in width as compared to the patch. This kind of feed arrangement has the advantage that the feed can be etched on the same substrate to provide a planar structure. An inset cut can be incorporated into the patch in order to obtain good impedance matching without the need for any additional matching element. This is achieved by properly controlling the inset position or we can cut the slot and etch it from the patch with an appropriate size as shown in figure. Moreover, this technique is used now a days and named branch feed microstrip line feed technique.

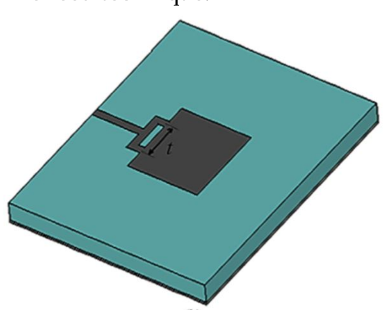

Figure 6: Branch line feed

III. COMPARISON OF DIFFERENT FEEDING TECHNIQUES

Comparisons between different techniques are that the Aperture-coupled feed has more bandwidth but less directivity. Co-axial feed provides high beam-width but less bandwidth. We can observe that the proximity fed antenna has poor radiation performance. Inset feed has the highest directivity. Aperture feed has the lowest reflection loss. Co-axial feed has the highest beam width. Aperture feed has the lowest VSWR value. Comparing the four antennas, we infer that microstrip fed line has better radiation performance of all the antennas. Microstrip line fed antenna has a moderate radiation performance but has the simplest structure making it easier to fabricate.

IV. CONCLUSION

It is analyzed that selecting feeding technique for patch antenna is important because it affects various parameters of antenna i.e. Return loss, VSWR, bandwidth, patch size. The maximum bandwidth can be achieved by aperture coupling; on other hand proximity coupling gives the best impedance matching and radiation efficiency. We can do perfect matching by changing the feed point Coaxial feeding technique. The high return loss can be achieved at resonant frequency by changing the feed point. The microstrip fed micro strip antenna provides the best result because the impedance matching is good in microstrip fed antenna. Overall microstrip line feed gives less return losses, reliable, easy to fabricate, and VSWR is less than 1.5. Bandwidth performance is better in using non-contacting techniques as compared to contacting techniques. The performance properties are analyzed for the optimized dimensions and the proposed antenna works well at the required (5.25-5.85) GHz Wimax frequency band.

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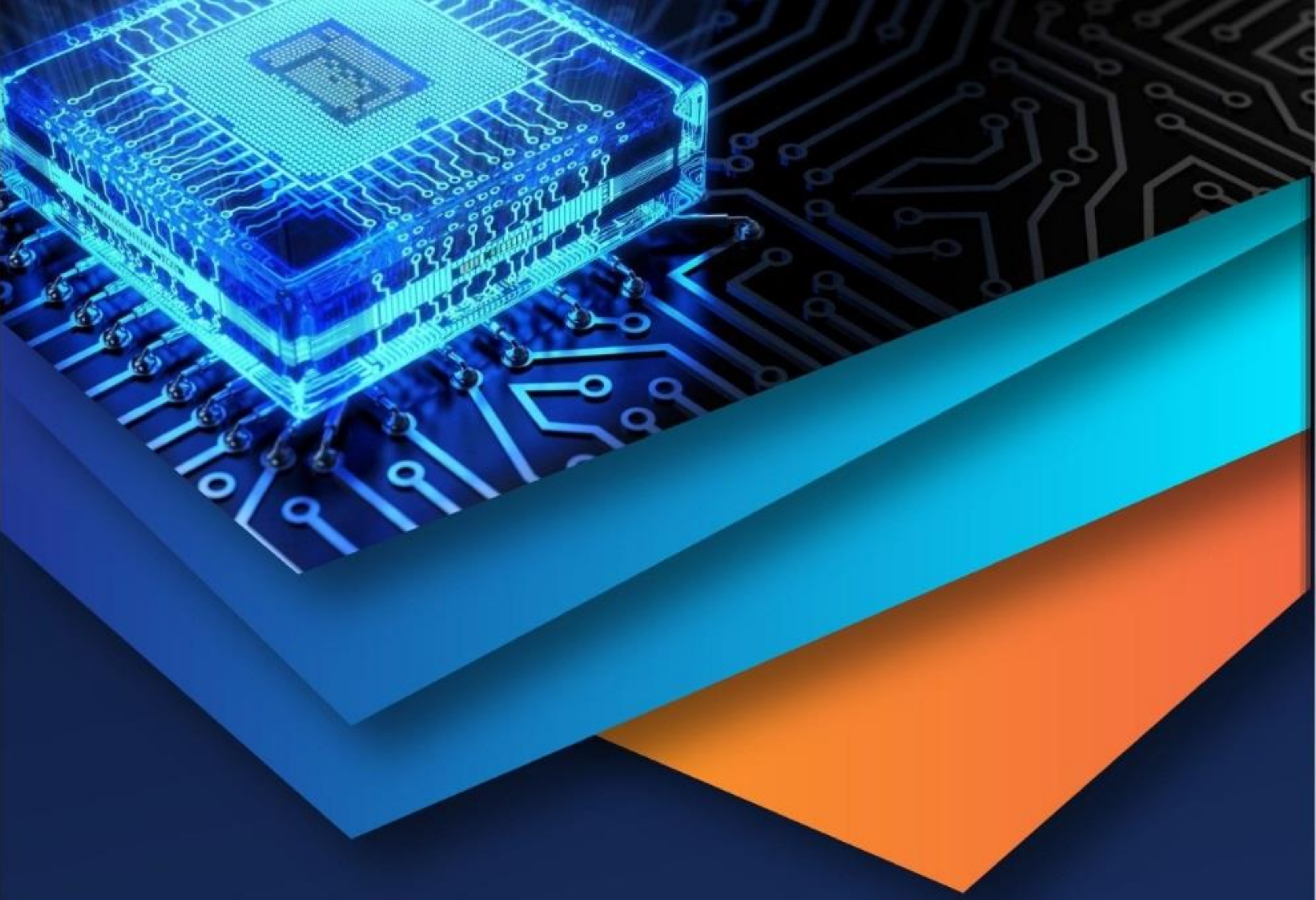

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