# A Survey on Feeding Techniques of Microstrip Patch Antenna

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*Abstract*— The paper shows how to improve the antenna performance by the analysis of bandwidth enhancement. The sizes and weight of various wireless electronic systems have rapidly reduced due to the development of modern integrated circuit technology. Microstrip patch antennas are increasing in popularity for use in wireless applications due to their low-profile structure, less weight, reasonable cost of production and can be easily integrated with microwave integrated circuits, but it also has some drawbacks. Inferior gain and inadequate bandwidth are the major drawbacks of a patch antenna. Almost all the important wireless applications lie in the band starting from 900 MHz to 5.8 GHz.

***Key words:*** Microstrip Patch Antenna, Feeding techniques, Bandwidth Enhancement

## I. INTRODUCTION

One of the most innovative topics in recent antenna technology is microstrip patch antenna, and increasingly finding applications in wide range of modern microwave systems. Microstrip antenna is not a new, its idea date backs to the 1950s, but no serious attention was paid to the radiator till the 1970s.However since then various evolution started taking place in this area and microstrip antenna became a key component for modern communications; mobile and satellite communications, remote sensing, sensors and also in optical systems. Microstrip antennas are most familiar form of printed antennas, where only a portion of the metallization is responsible for radiation. A microstrip antennas consists a sandwich of two parallel conducting layers divided by a single dielectric substrate. The top portion is termed patch that is responsible for radiation and bottom portion acts as a ground plane. That's why microstrip antenna is also known as patch antenna. Microstrip antennas are the most ordinary types of antennas having wide range of applications due to their various advantages of less weight, low profile, reasonable cost, planar configuration, superior portability and are array suitable with easy fabrication and integration with microwave monolithic integrate circuits (MMICs). In spite of various fascinating quality the microstrip element have an inherent disadvantage of inadequate bandwidth and inferior gain.

Distinct techniques are available to feed microstrip patch antennas. These techniques can be contacting and non-contacting techniques. In the contacting technique, the RF power is fed directly to the radiating patch with the aid of a connecting element like a microstrip line. In the non-contacting technique, power is transferred between the microstrip line and the radiating patch via electromagnetic coupling. There are many feed techniques but microstrip line, coaxial probe, aperture coupling and proximity coupling are normally utilized[1].

## II. MICROSTRIP PATCH ANTENNA

A microstrip patch antenna made of conducting patch of different shape and size on one side of a dielectric substrate while back side have a ground plane moreover patch and ground forms cavity and the fringe of the patch form the sides of the cavity as shown in Figure 1

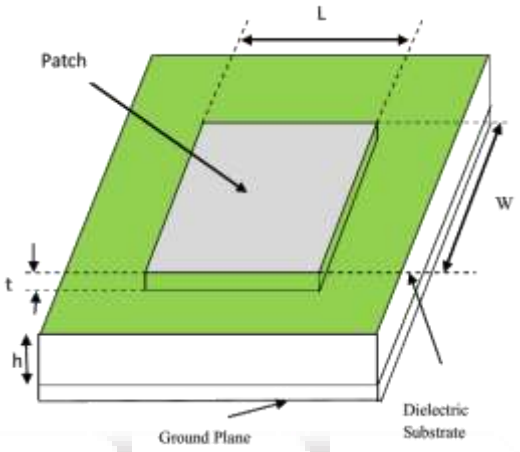


Fig. 1: Microstrip Patch Antenna

The fringe of the patch act approximately as a cavity with perfect electric conductor on the top and the bottom surfaces, and a perfect "magnetic conductor". on the sides. When the antenna is get excited at a definite resonance frequency, a strong electric field generates on the surface of the patch that is essentially z directed and independent of the z coordinate.

Microstrip patch antennas are one of the most widely used types of antennas in the microwave frequency range, and they are often used in the millimeter-wave frequency range. [2], [3], [4].

### *A. Applications*

1) Mobile and satellite communication application
2) Global positioning system applications
3) Radio frequency identification (RFID)
4) Interoperability for microwave access (WiMax)
5) Radar application
6) Reduced size microstrip patch antenna for Bluetooth applications
7) Broadband microstrip S-shaped patch antenna for wireless communication

## III. FEEDING TECHNIQUES

### *A. Coaxial Feed*

For microstrip patch antennas, the coaxial feed is a very familiar technique used for feeding. The inner conductor of the coaxial connector extends through the dielectric and is soldered to the radiating patch, while the outer conductor is connected to the ground plane. The main advantage of this type of feeding is that the feed can be placed at any desired

 

location inside the patch in order to match with its input impedance.

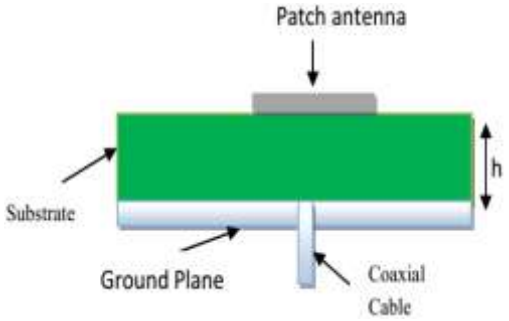


Fig. 2: coaxial feed

However, its major drawback is that it provides narrow bandwidth of 2-5% and is difficult to model since a hole has to be drilled in the substrate and the connector protrudes outside the ground plane, thus not making it completely planar for thick substrates. Also for thicker substrate the increased probe length makes the input impedance more inductive leading to matching problems. For a thick dielectric substrate, which provides broad bandwidth, the microstrip line feed and the coaxial feed suffer from numerous disadvantages. Those substrate which are thicker in dimension can enlarge surface wave and produce a high cross polarized field. [5].The electrical circuit is shown below

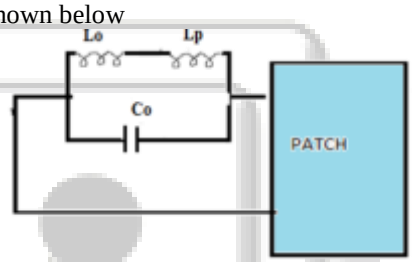


Fig. 3: Circuit

*B. Microstrip Line Feed*

In this feeding technique, a conducting strip is connected directly to the edge of the Microstrip patch. The conducting strip is smaller in width as compared to the patch. The advantage of this feeding is that the feed can be etched on the same substrate to provide a planer structure. However increase the thickness of the dielectric substrate being used surface waves and spurious feed radiation also increases, which hampers the bandwidth 2-5% of the antenna. This feed radiation also leads to undesired cross polarized radiation. This method is advantageous due to its simple planar structure..

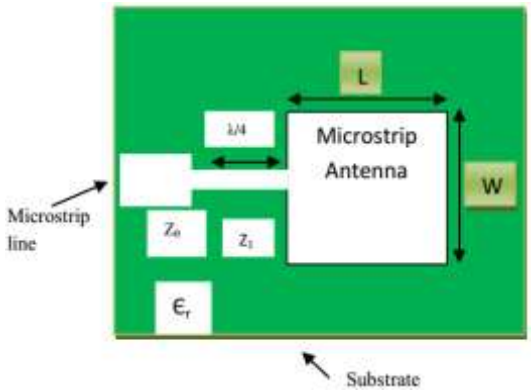


Fig. 4: Microstrip Line Feed

And its electrical circuit is shown below

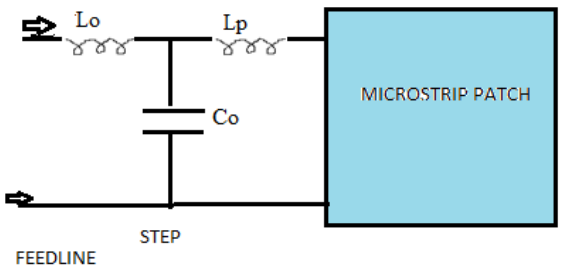


Fig. 5: circuit

*C. Proximity Couple Feed (Electromagnetic Coupling Scheme)*

In this feeding two dielectric substrates are used such that the feed line is between the two substrate and radiating patch is on the top of upper substrate and feed line end under the patch. It is also known as electromagnetic coupled microstrip line .Coupling between the patch and microstrip has capacitive in nature The equivalent circuit diagram of this feed is shown in figure 3. Coupling capacitor is in series with the parallel R-L-C resonant circuit representing the patch. Requirement of this coupling is to match the impedance and tuning of the bandwidth. The open end of the microstrip feed gives stud and stud parameters which help in improving bandwidth.

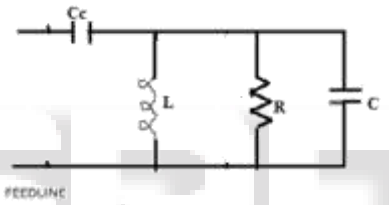


Fig. 6: Circuit

By using this feeding technique 13 % of Bandwidth is achieved (Devan Bhalla et al, 2013). It is effective to use two layers as it increase the bandwidth and reduce spurious radiation, but it is difficult to form right alignment of the patches. Advantages are that it allows planer feeding & less line radiation than microstrip feed.'

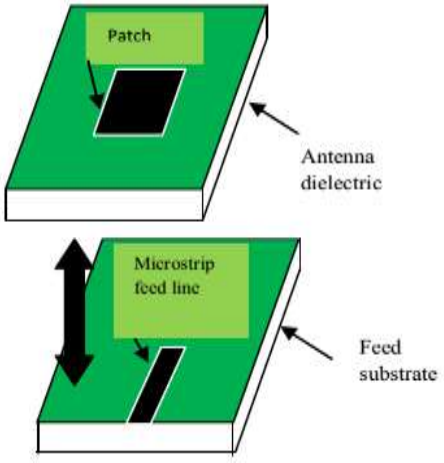


Fig. 7: PCF

*D. Aperture Coupled Feed*

In this type of feed technique the radiating patch and the microstrip feed line are separated by the ground plane. Coupling between the patch and feed line is made through a slot or an aperture in the ground plane (D.M. Porzar *et al*,1987 C.A.Balanis *et al*,2001, Ramesh Garg, *et al*,2001). Variations in the coupling will depend upon the size i.e.

 

length and width of the aperture. To optimize the result for wider bandwidths and better return losses. The coupling aperture is usually centered under the patch leading to lower cross-polarization due to symmetry of the configuration. Since the ground plane separates the patch and the feed line so spurious radiation is minimized. Aperture coupling overcomes the problems related to probe feeds. [7]

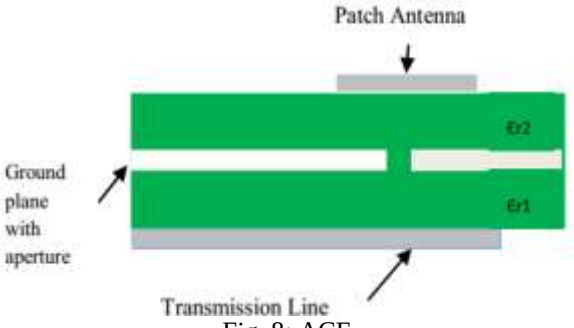


Fig. 8: ACF

Aperture coupled feeding is attractive because of advantages such as no physical contact between the feed and radiator, wider bandwidths of 21%, and better isolation between antennas and the feed network. Furthermore, aperture coupled feeding allows independent optimization of antennas and feed networks by using substrates of different thickness or permittivity.

The coupling slot is nearly centered with respect to the patch where the magnetic field of the patch is maximum. This is done purposely to enhance magnetic coupling between the magnetic field of the patch and equivalent magnetic current near the slot. The electrical circuit is shown below

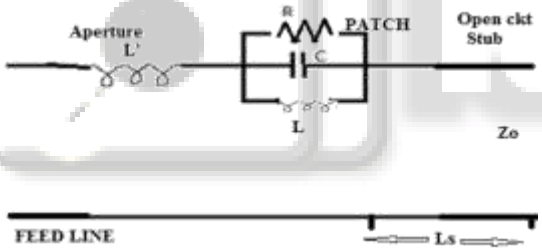


Fig. 9: Circuit

## IV. Conclusion

The technological advancement of the microstrip antenna is increasing day by day. Several investigations are going on to improve the gain and bandwidth of patch antenna. Hence we can conclude from the above survey that the maximum bandwidth can be achieved by aperture coupling and proximity coupling because they provide best impedence matching and radiation efficiency.

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