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Dual Polarized Aperture Coupled Stacked Element for Base Station Antenna

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Abstract-The demand towards broad band efficient antennas for base station and mobile wireless applications have increased dramatically over the last few years. Today there is a huge increase in the number of subscribers and demand for equipments that is capable of handling cost-effective network capacity solutions in Spectrum limited markets. Our Paper describes the design of dual polarized antenna element which can be implemented in a base station antenna array using IE3D **Zeland Software**. The Element is based on aperture coupled architecture with stacked patch, maintaining the symmetry needed for dual polarization operation. Most of common antenna elements are linearly polarized with narrow band resonators. Our design has Broad-band and dual-polarized characteristics of traditional aperture coupled architecture. The Bandwidth for Return Loss > 10 dB of the element covers 1710-2170 MHz frequency spectrum. The Isolation between the ports corresponding to the two different polarizations is greater than 32 dB over the bandwidth.

1. INTRODUCTION:

The increased subscriber base and capacity requirement made many operators acquiring license in the higher band frequency spectrum 1710-2170 MHz, In this paper we present an antenna element suited for the high bands 1710-2170 MHz. A base station antenna would have a linear array of such elements positioned along the vertical axis.

II. BASIC ELEMENT DESIGN AND ELECRTICAL OPERATION.

The aim of any antenna element design process is to obtain the physical parameters for the desired performance in IE3D software. The element consists of a two-layer aperture coupled patch structure as shown in figures 1. The two patches are centered over a cross-shaped aperture in a 1mm thick and 250 mm wide Aluminum reflector. The patches are separated by plastic spacer standoff. The cross-shaped aperture is excited by a microstrip feed network etched on a 0.762 mm thick substrate with permittivity 2.55. The feed is divided into two parts, sections of wider microstripline before the aperture.

In the higher band the antenna radiates through the same mechanism as in any aperture coupled element. The aperture couples power for excitation to the vertically polarized channel and the horizontally polarized channel. These two channels are referred to as channel 1 and 2 respectively. The feed consists of a 50 ohms line which divides into two 100 Ohms lines. These two lines excite the aperture in a symmetrical manner. The lines end in open circuit stubs for matching the input impedance to 100 Ohms over the frequency range and a small amount of symmetrical capacitive tuning was applied on both channels. Figure (2) shows the large radiating patch and the top patch radiating into the far-field. The dual polarization operation is provided by the cross-shaped aperture with a feed network. This feed arrangement provides the symmetry necessary for high port-to-port isolation and good polarization purity. Since the feed of both polarization channels are positioned in the same layer it is necessary to have microstrip lines crossing each other at some point. Thus the location of an air bridge is indicated in figure (2). The size and position of the patches are chosen for good performance in lower and upper band of frequency range.

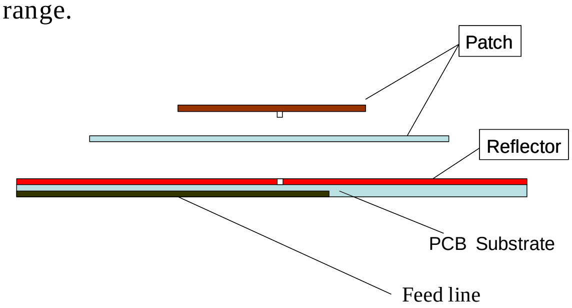

Figure (1) Stacked Patch Element

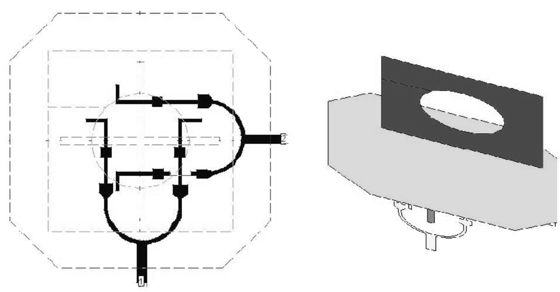

Figure (2) Top & Side View of Stacked Patch Element

III. IE3D SIMULATED RESULTS

IE3D is a full-wave; method-of-moments based electromagnetic simulator solving the current distribution on 3D and multilayer structures of general shape. The S-parameters of the antenna element described above has been simulated in IE3d software. The result is shown in figure (3). The return loss in the entire band 1710-2170MHz is better than 18dB

The port-to-port isolation is greater than 30 dB in entire band as seen from the S21-parameter in figure 3. However in the middle region of the frequency bands of interest, we see two points of resonance where the coupling is much larger. We could conclude that the resonance phenomenon was related to the exact configuration of the feed network. It is our belief that the coupling primarily occurs where the open circuit stubs run parallel to a feed line of the other polarization. In this case we chose the length of the open circuit stubs so that the no resonance would be present in the frequency bands of interest. The radiation pattern plot in figure (5) with phi=0º and pho=90º. The Gain against frequency range plot is as shown in figure (4)

IV. CONCLUTION

We have presented a dual polarized high band antenna element capable of operating in the frequency range of 1710-2170MHz. The radiation properties in both bands are similar and the port-to-port isolation is greater than 30 dB. The bandwidth with respect to return loss is sufficient for the purpose of designing a base station antenna array. Further investigation is necessary regarding coupling phenomenon and array behavior.

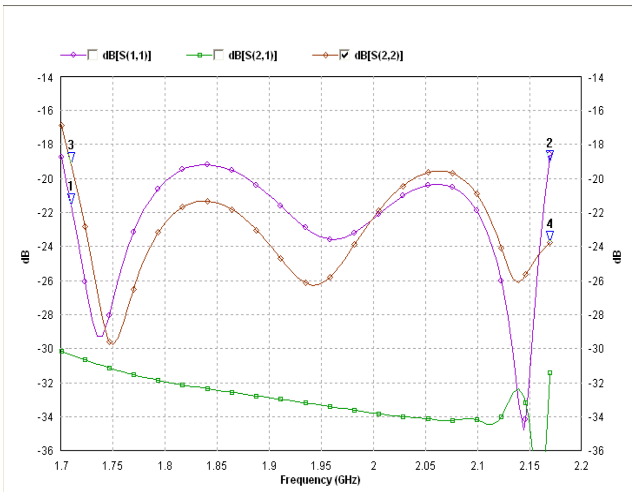

Figure (3) Return loss and Isolation

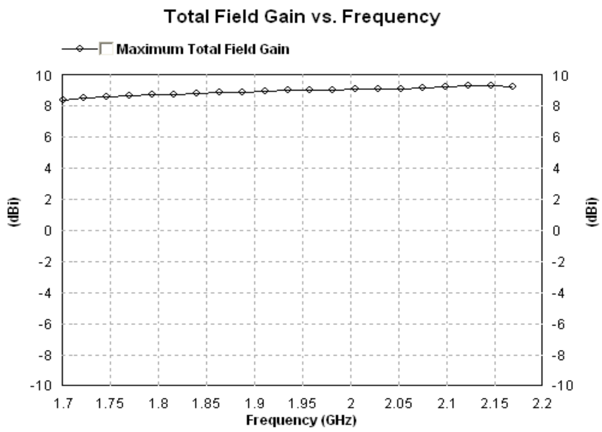

Figure (4) Gain Plot

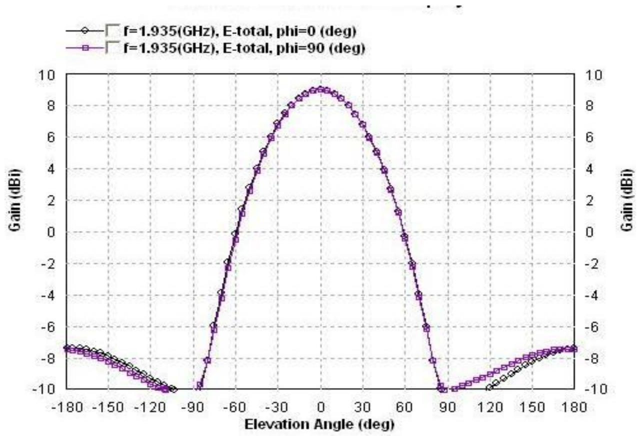

Figure (5) Radiation pattern

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