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on

Design of Z-Shape Compact Antenna for Next Generation Wireless Network

Submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS & COMMUNICATION ENGINEERING

By

T. SAI VISWANADH

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Under the Esteemed Guidance of

MR M KISHORE KUMAR M,Tech,Ph.D

Associate Professor

Department of Electronics & Communication Engineering

ADITYA COLLEGE OF ENGINEERING

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BONAFIDE CERTIFICATE

This is to certify that the project on Designer tools Lab titled **"Design of Z-Shape Compact Antenna for Next Generation Wireless Network"** is being submitted by **T. Sai Viswanadh (20MH1A04H9)**. In the IV/I for partial fulfillment of the requirements for award of the B. TECH degree in the department of "ELECTRONICS AND COMMUNICATION ENGINEERING" during the academic year 2020-2024. It is a record of bonafide work carried out by them under esteemed guidance and supervision of **M KISHORE KUMAR** MTech., Ph.D., Professor, Department of ECE.

Project Guide

Mr. M KISHORE KUMAR M.Tech,Ph.D

Associate Professor,

Department of ECE

Aditya College of Engineering.

Head of the Department

Mrs.CH JANAKI DEVI, M.Tech,Ph.D

Associate Professor & HOD

Department of ECE

Aditya College Of Engineering

EXTERNAL EXAMINER

2020-2024

DECLARATION

I hereby declare that the entire project work embodied in this dissertation entitled "**Design of Z-Shape Compact Antenna for Next Generation Wireless Network**" has been independently carried out by us. As per my knowledge, no part of this work has submitted for any degree in any institution, university and organization previously. I here by boldly state that to the best of my knowledge my work is free from plagiarism.

Yours sincerely,

T. SAI VISWANADH

(20MH1A04H9)

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We express our sincere gratitude and heartful thanks to the under stated personfor the successful completion of our mini project on **“Design of Z-Shape Compact Antenna for Next Generation Wireless Network.”**

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Yours sincerely,
T.SAI VISWANADH
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ABSTRACT

Wireless communication technology is developing day by day so that various generations are taken birth. The fifth generation is considered as the next generation network and awaiting for implementation. Considering this scenario, compact antenna plays a vital role to make this dream to be realized. In this research work authors have taken a strive to design such required antenna where the bandwidth has been enhanced. The two different frequencies range covers up to fourth generation networks and beyond. Similarly, the bandwidth has been enhanced up to 75 MHz and 112.5 MHz which is approximately doubles the value of the current bandwidth. The antenna has to be pasted in the mobile circuit to maintain the data transfer in seamless mode. For suitability of the space Z-shape micro strip antenna has been developed. The result shows the achievement in terms of bandwidth, return loss, VSWR, directivity and gain. It is of C- band/ S-band satellite communication for application in wireless communication.

Keywords : Next generation Network, Micro strip antenna, dual band antenna, broadband antenna, wireless communication

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CHAPTER 1

INTRODUCTION

1.1 Microstrip Antenna

A microstrip antenna is a type of radiofrequency (RF) antenna that is widely used for communication and radar applications. It is a low-profile, planar structure that consists of a metallic strip or patch printed on one side of a dielectric substrate, with the other side typically backed by a ground plane. This design makes microstrip antennas relatively easy to manufacture and integrate into various electronic systems.

Here are the key components and characteristics of a microstrip antenna:

- **Substrate:** The substrate is a dielectric material that provides mechanical support to the antenna structure and determines its electrical properties. Common substrate materials include fiberglass, ceramic, and various types of printed circuit board (PCB) materials.
- **Metallic Patch or Strip:** The metallic patch or strip is the radiating element of the antenna. It is usually made of conductive materials like copper or aluminum and is printed on the top surface of the dielectric substrate. The shape and size of this patch determine the operating frequency and other performance characteristics of the antenna.
- **Ground Plane:** The ground plane is a conductive layer on the opposite side of the substrate from the metallic patch. It serves as a reference plane for the antenna and helps in achieving directional radiation patterns. The ground plane is often connected to the system ground.
- **Feedline:** The feedline is a transmission line that connects the microstrip antenna to the RF source or receiver. It is used to feed RF energy to or extract it from the antenna. The most common type of feedline used in microstrip antennas is a microstrip transmission line, which is a narrow strip of conductive material on the substrate.
- **Dielectric Substrate Thickness:** The thickness of the dielectric substrate affects the impedance and radiation characteristics of the microstrip antenna. The choice of substrate thickness is often a trade-off between achieving desired electrical performance and maintaining mechanical stability.

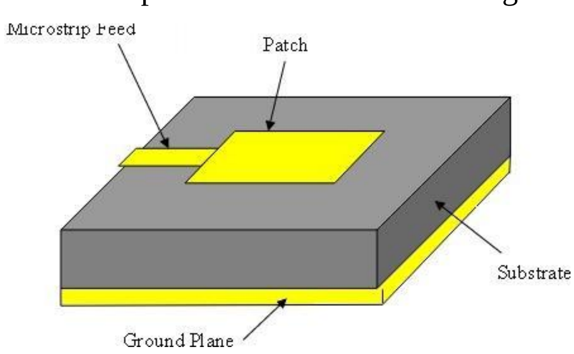

Fig: 1.1 Microstrip antenna

Microstrip antennas offer several advantages, including their low profile, ease of integration into planar structures, and suitability for mass production. They are used in various applications, such as wireless communication systems, satellite communication, radar systems, and RFID (Radio Frequency Identification) system.

1.1.1 Advantages:

Microstrip antennas offer several advantages, making them popular choices in various applications. Here are some key advantages:

- **Low Profile:** Microstrip antennas have a low profile, which means they are compact and do not protrude significantly from the surface on which they are mounted. This feature is advantageous in applications where space is limited or where a streamlined design is essential.
- **Ease of Integration:** These antennas are relatively easy to integrate into planar structures, such as printed circuit boards (PCBs) or other flat surfaces. This makes them well-suited for applications where a low-profile and conformal antenna design is required.
- **Lightweight:** Microstrip antennas are lightweight compared to some other antenna types. This makes them suitable for applications where weight is a critical factor, such as in aerospace and satellite systems.
- **Cost-Effective Manufacturing:** The manufacturing process for microstrip antennas is often cost-effective, particularly when using printed circuit board (PCB) fabrication techniques. This makes them attractive for mass production.
- **Frequency Versatility:** Microstrip antennas can be designed to operate at a wide range of frequencies, from relatively low frequencies to microwave frequencies. This versatility makes them suitable for various applications, including communication systems, radar, and satellite communication.
- **Directional Radiation Patterns:** Microstrip antennas can be designed to have directional radiation patterns, allowing for control over the direction in which the antenna radiates or receives signals. This is valuable in applications where focused communication or sensing is required.
- **Dual-Polarization Capability:** Microstrip antennas can be designed to support dual- polarization (both vertical and horizontal polarizations). Dual-polarized antennas are beneficial in systems requiring increased capacity and diversity in communication links.
- **Compatibility with Planar Circuits:** Microstrip antennas can be easily integrated with other planar components, such as amplifiers, filters, and matching networks, allowing for the development of compact and integrated systems.

- **Flexible Design:** Engineers have a high degree of flexibility in designing microstrip antennas to meet specific performance requirements. The shape, size, and configuration of the antenna elements can be adjusted to achieve desired electrical characteristics.

1.1.2 Disadvantages:

- **Bandwidth:** Microstrip antennas often have limited bandwidth compared to some other antenna types. Achieving a broad frequency range can be challenging, and this limitation may restrict their use in applications that require wide bandwidth.
- **Power Handling Capacity:** Microstrip antennas may have limitations in terms of power handling capacity. High-power applications, such as certain radar systems, may require alternative antenna types that can handle higher power levels without degradation.
- **Efficiency:** The efficiency of microstrip antennas can be lower compared to some other antenna configurations. Factors such as substrate losses, conductor losses, and radiation pattern distortions can contribute to reduced overall efficiency.
- **Surface Wave Losses:** Microstrip antennas are prone to surface wave losses, where a significant portion of the radiated energy is absorbed by the substrate. This can result in reduced radiation efficiency and affect the overall performance of the antenna.
- **Sensitivity to Substrate Properties:** The performance of microstrip antennas is sensitive to the properties of the dielectric substrate, including its thickness, permittivity, and loss tangent. Changes in these parameters can affect the antenna's impedance matching and radiation characteristics.
- **Limited Power Handling Capability:** Microstrip antennas may have limited power handling capability, especially in high-power applications. The relatively small size and compact structure can lead to issues related to heat dissipation and potential damage at high power levels.
- **Cross-polarization:** Microstrip antennas may exhibit cross-polarization, where unwanted polarizations are present in the radiation pattern. This can be a concern in applications where a specific polarization is required for optimal performance.
- **Environmental Sensitivity:** The performance of microstrip antennas can be influenced by the surrounding environment, such as nearby objects, structures, or changes in atmospheric conditions. This sensitivity may limit their effectiveness in certain operational scenarios.
- **Limited Gain:** Achieving high gain with microstrip antennas can be challenging, especially in comparison to larger antenna types. In applications where high gain is critical, alternative antenna designs may be more suitable.

1.1.3 Applications:

- **Wireless Communication Systems:** Microstrip antennas are widely used in wireless communication systems, including Wi-Fi, Bluetooth, cellular networks (2G, 3G, 4G, and 5G), and satellite communication. Their low profile and conformal nature make them suitable for integration into portable devices, such as smartphones, tablets, and laptops.
- **Radar Systems:** Microstrip antennas are employed in radar systems for both military and civilian applications. Their directional radiation patterns and ease of integration make them suitable for various radar applications, including weather radar, ground- penetrating radar, and airborne radar.
- **Satellite Communication:** Microstrip antennas are commonly used in satellite communication systems for both space and ground-based applications. Their lightweight and planar structure makes them suitable for integration into satellite payloads. They can be used for communication between satellites, satellite-to-ground links, and satellite broadcasting.
- **RFID Systems:** Microstrip antennas are used in Radio Frequency Identification (RFID) systems for tracking and identifying objects. They can be integrated into RFID tags for applications in logistics, inventory management, and access control systems.
- **Medical Devices:** Microstrip antennas are used in medical telemetry devices and wireless health monitoring systems. They can be integrated into wearable devices for monitoring vital signs, such as heart rate and body temperature, and transmitting the data wirelessly to healthcare providers.
- **Aerospace and Aviation:** Microstrip antennas find applications in aerospace and aviation for communication and navigation systems. They are used in aircraft for communication with air traffic control, in-flight entertainment systems, and navigation purposes.
- **Automotive Radar Systems:** Microstrip antennas are employed in automotive radar systems for applications such as collision avoidance, adaptive cruise control, and parking assistance. Their compact size and planar structure make them suitable for integration into modern vehicles.
- **Directional Antenna Arrays:** Microstrip antennas can be arranged in arrays to form directional antenna systems. These arrays find applications in point-to-point communication links, phased-array radar systems, and beamforming applications.
- **Consumer Electronics:** Microstrip antennas are used in various consumer electronic devices, such as smart TVs, remote controls, and IoT devices. Their small size and ease of integration make them suitable for compact electronic products.
- **Military and Defense Applications**: Microstrip antennas are utilized in military and defense applications for communication, surveillance, and electronic warfare systems.

1. 2Patches Antennas:

Different types of Patches:

Patches typically refer to specific shapes of conductive elements used to radiate or receive electromagnetic waves. Here are some common types of patches in antennas:

- **Rectangular Patch Antenna:** This is a simple and widely used patch shape. It consists of a rectangular conductive element on a dielectric substrate. Rectangular patch antennas are popular for their ease of design and fabrication.
- **Circular Patch Antenna:** Circular patches are often used in applications where a circular polarization is desired. Circular patch antennas can be more compact than their rectangular counterparts and may exhibit better performance in certain scenarios.
- **Microstrip Patch Antenna:** A microstrip patch antenna is a type of antenna that uses a microstrip feed line to excite the patch. The patch is usually a thin, flat piece of metal mounted on a dielectric substrate. This design is widely used due to its low profile and ease of integration with printed circuit boards.
- **Square Patch Antenna:** Similar to the rectangular patch, the square patch antenna is characterized by a square-shaped conductive element. The square patch may offer some design flexibility and is sometimes preferred for certain applications.
- **Triangular Patch Antenna:** Triangular patches are less common but may be used in specific applications. The shape of the patch can affect the radiation pattern and other characteristics of the antenna.
- **Circularly Polarized Patch Antenna:** This type of patch antenna is designed to radiate or receive circularly polarized signals. Circular polarization is often used in satellite communication and other applications where signal polarization may be subject to change.
- **Dual-Polarized Patch Antenna:** Dual-polarized antennas have two orthogonal (usually linear) polarizations. This allows the antenna to receive or transmit signals with both horizontal and vertical polarizations simultaneously.
- **Array Patch Antenna:** An array patch antenna consists of multiple patch elements arranged in a specific pattern. Arrays are used to enhance antenna performance, such as increasing gain or achieving beamforming.
- **Fractal Patch Antenna:** Fractal antennas use self-similar or recursive geometric shapes to design the antenna structure. Fractal patch antennas may offer improved performance and miniaturization compared to traditional designs.
- **Printed Antenna Array:** An array of printed patches on a substrate, where the combination of individual patches creates a specific radiation pattern or beamforming capability.

1.3 Software Tool:

1.3.1 HFSS Software:

HFSS, or High-Frequency Structure Simulator, is a widely used software tool for electromagnetic simulation and analysis. It is developed by Ansys (formerly known as Ansoft) and is part of the Ansys suite of engineering simulation tools. HFSS is specifically designed for high-frequency and high-speed electronic components and systems, making it suitable for a wide range of applications in the fields of RF (radio frequency), microwave, and millimeter-wave engineering. Here are some key features and applications of HFSS:

Key Features:

- **Full-Wave 3D Electromagnetic Simulation:** HFSS provides a full-wave 3D electromagnetic field simulation, allowing engineers to accurately model and analyze complex structures.
- **Broad Frequency Range:** HFSS is capable of simulating a broad frequency range, from RF to microwave and millimeter-wave frequencies. This makes it suitable for the design of antennas, microwave circuits, filters, and other high-frequency components.
- **Parametric Analysis:** Engineers can perform parametric analysis to study how changes in design parameters affect the performance of the device or structure being simulated.
- **Optimization:** HFSS includes optimization tools that allow engineers to automatically adjust design parameters to achieve specific performance goals, such as maximizing antenna gain or bandwidth.
- **Integration with CAD:** HFSS can be integrated with various computer-aided design (CAD) tools, allowing seamless import and export of geometry and facilitating the design process.
- **Wide Range of Applications:** HFSS is used for the design and analysis of various electromagnetic components and systems, including antennas, filters, transmission lines, connectors, and integrated circuits.
- **Finite Element Method (FEM) Solver**: HFSS uses the Finite Element Method (FEM)to solve Maxwell's equations, providing accurate solutions for electromagnetic field distributions.
- **Bi-Directional Solver:** HFSS supports both electromagnetic field analysis and circuit simulation, allowing for a bi-directional link between the electromagnetic and circuit domains.
- **High-Performance Computing (HPC) Support:** HFSS is designed to take advantage of high-performance computing (HPC) resources for faster simulations, enabling the analysis of large and complex structures.

1.3.2 Applications:

- **RF and Microwave Components:** Engineers use HFSS to simulate and analyze RF and microwave components such as filters, couplers, and transmission lines.
- **Integrated Circuits (ICs):** HFSS can be applied to the simulation of on-Chip components and interconnects in integrated circuits.
- **High-Speed Interconnects:** For analyzing the electromagnetic behavior of high-speed interconnects and ensuring signal integrity.
- **Microwave Circuits:** HFSS is used in the design and analysis of microwave circuits, including amplifiers, mixers, and oscillators.
- **Antenna Design:** HFSS is widely used for the design and optimization of various types of antennas, including patch antennas, horn antennas, and array antennas.

CHAPTER 2
Proposed Antenna

2.1 Z-Shaped Patch Antenna:

A Z-shaped patch antenna is a type of microstrip patch antenna that is characterized by a Z-shaped conductive element on a dielectric substrate. The Z-shaped patch design is a modification of the more common rectangular or circular patch shapes. This antenna design is chosen for specific applications where its unique characteristics may be advantageous.

- **Geometry:** The Z-shaped patch antenna consists of a radiating patch that takes the form of the letter "Z." The feed point is usually located along one of the arms of the Z, and the arms may have different lengths.
- **Bandwidth:** The Z-shaped configuration can contribute to increased bandwidth compared to some other patch shapes. The shape and dimensions of the Z may be optimized to achieve a broader frequency bandwidth.
- **Polarization:** The polarization of the Z-shaped patch antenna is typically linear. The orientation of the Z determines the polarization direction (e.g., vertical or horizontal polarization).
- **Radiation Pattern:** The Z-shaped patch antenna can exhibit radiation patterns with characteristics that depend on the specific design parameters. Engineers can adjust the dimensions of the Z-shaped patch to control the antenna's radiation pattern.
- **Applications:** Z-shaped patch antennas find applications in various wireless communication systems, including satellite communication, mobile communication, and RFID (Radio Frequency Identification). The specific advantages of the Z-shaped design, such as enhanced bandwidth or modified radiation patterns, may make it suitable for certain scenarios.
- **Gain and Size:** The gain and size of a Z-shaped patch antenna depend on the overall dimensions of the Z-shaped patch, the substrate material, and other design parameters. Engineers can optimize these factors to achieve the desired balance between antenna size and performance.
- **Dual-Band or Multi-Band Operation:** Z-shaped patch antennas can be designed to operate at multiple frequencies, making them suitable for dual-band or multi-band applications.

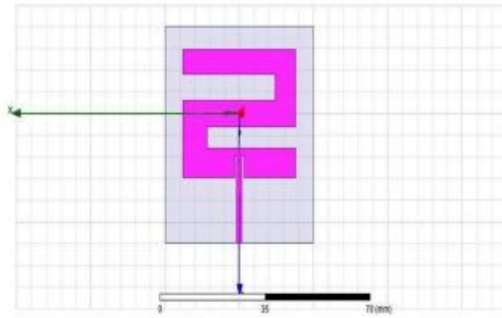

Fig: 1.2 Z-shaped Patch Antenna

Parameters	Value
Substrate	FR4-exoy
Centre frequency	2.32Ghz 3.62 Ghz
Substrate Height	1.6 mm
Dielectric Constant	4.4
Width of Radiating Element	38.04 mm
Area of Radiating Element	29.44 mm

Parameters	Value
L1	30 mm
L2	5 mm
L6	6 mm
L7	32 mm

2.2 SIMULATION RESULTS

2.2.1 Return Loss :

The antenna has a return loss of -25.3 dB at 3.3 GHz and -15.7 dB at 4.2 GHz.

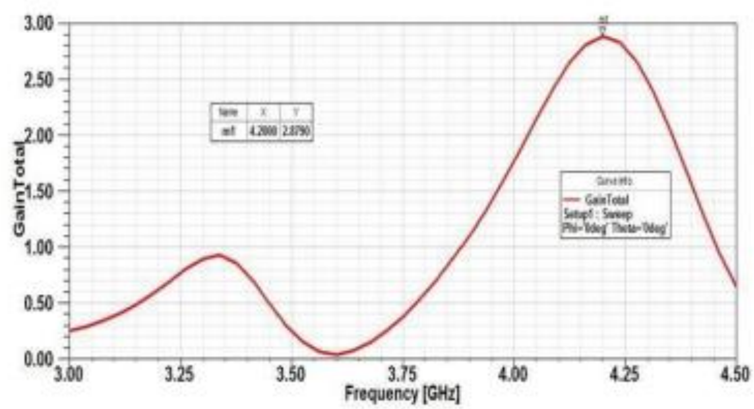

Fig 2.1 Return Loss by Antenna

2.2.2 VSWR :

The VSWR of the antenna is 1.1 at 3.3 GHz and 1.8 at 4.2 GHz.

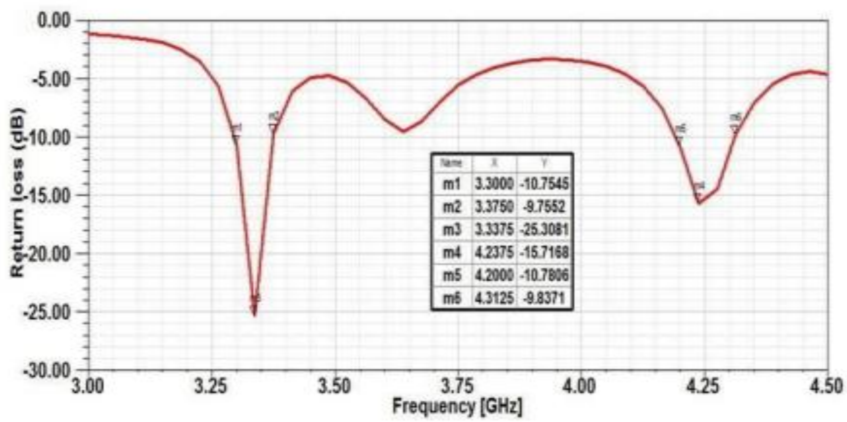

Fig 2.2 VSWR by Antenna

2.2.3 3D Polar Plot of Directivity:

The maximum directivity of the antenna is 6.31 db.

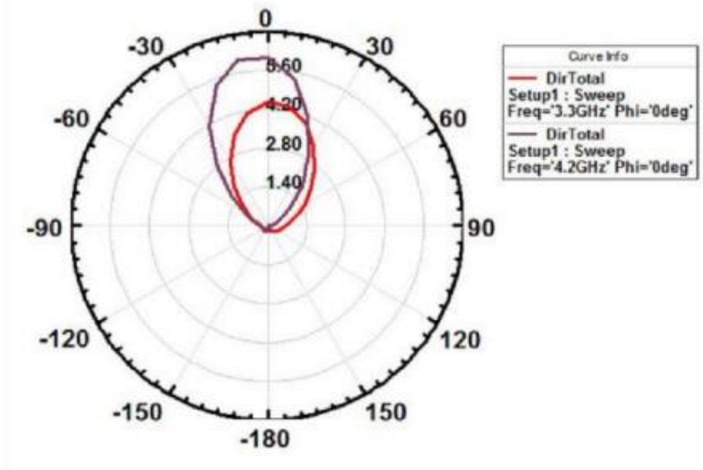

Fig 2.3 3D Polar Plot of Directivity of Antenna

2.2.4 3D Polar Plot of Gain total:

The maximum gain of the antenna is 2.8 dBi at 4.4 GHz.

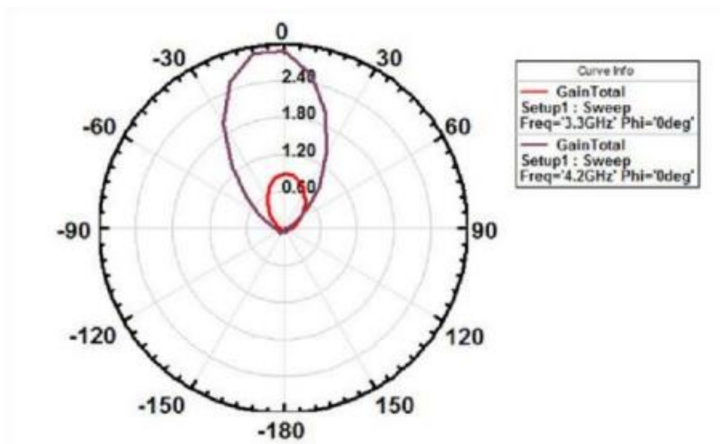

Fig 2.4 3D Polar Plot of Gain Total

2.2.5 Radiation Pattern of Directivity:

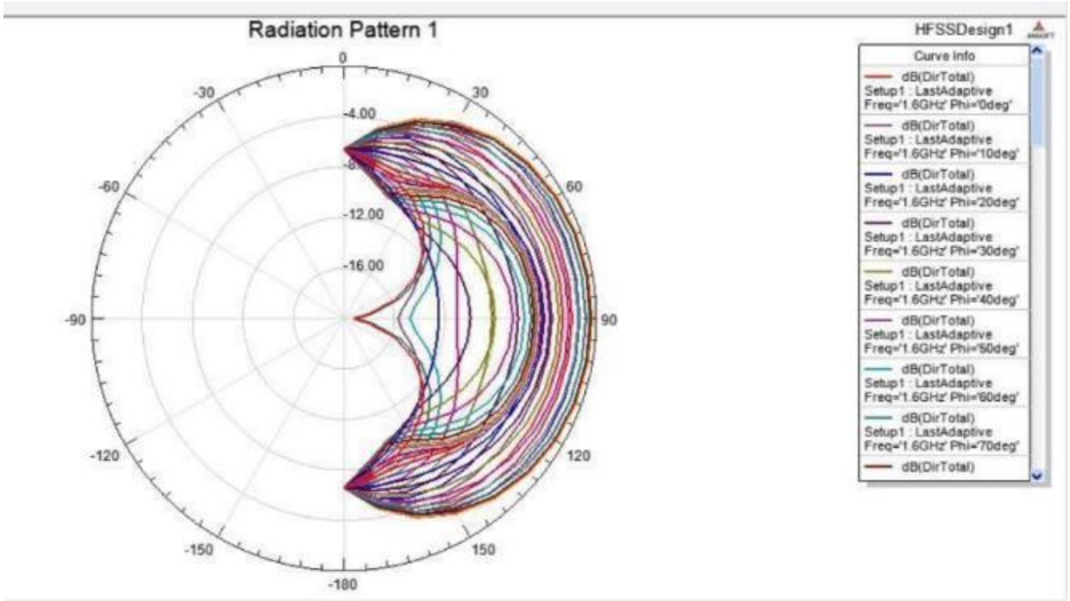

Fig 2.5 Radiation Pattern of Total Directivity

2.2.6 EH Plane:

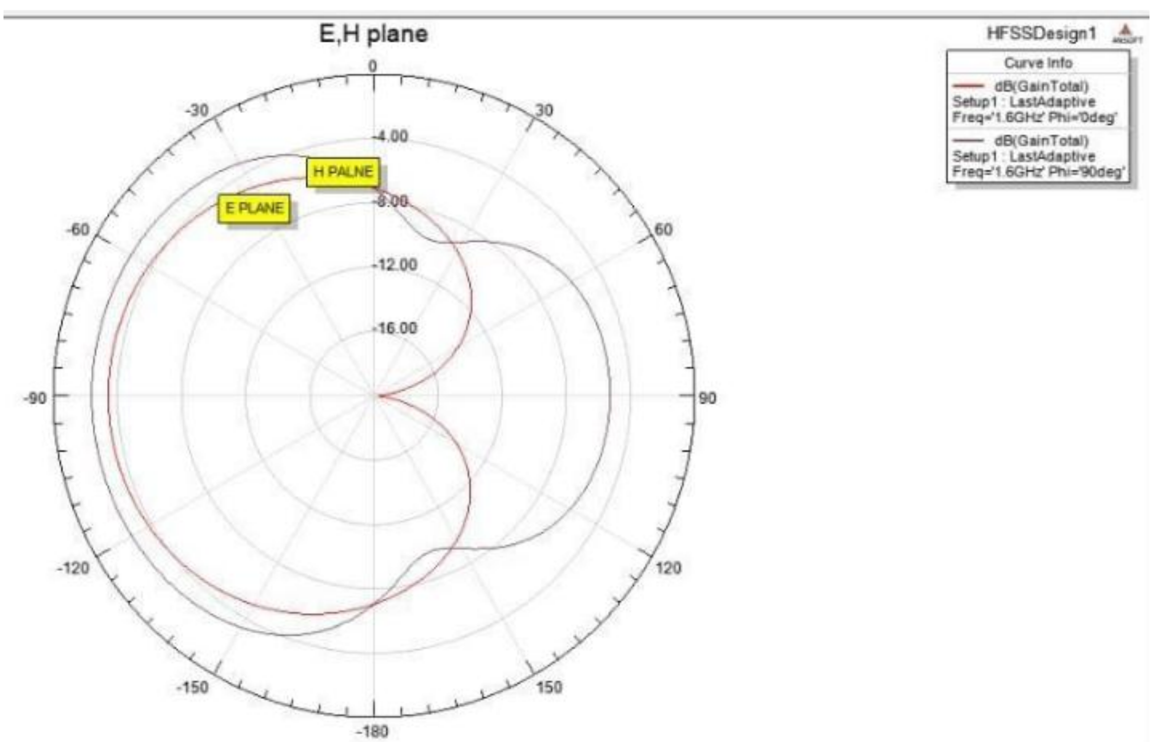

Fig 2.6 EH Plane

CHAPTER 3

RESEARCH PAPER

Design of Z-Shape Compact Antenna for Next Generation Wireless Network

The wireless communication technology is rapidly advancing, with the fifth generation network on the horizon. Our research focuses on designing a compact antenna to enhance bandwidth and support future wireless networks.

Abstract: The wireless communication technology is developing day by day so that various generations are taken birth. The fifth generation is considered as the next generation network and awaiting for implementation. Considering this scenario, compact antenna plays a vital role to make this dream to be realized. In this research work authors have taken a strive to design such required antenna where the bandwidth has been enhanced. The two different frequencies range covers up to fourth generation networks and beyond. Similarly, the bandwidth has been enhanced up to 75 MHz and 112.5 MHz which is approximately doubles the value of the current bandwidth. The antenna has to be pasted in the mobile circuit to maintain the data transfer in seamless mode. For suitability of the space Z-shape micro strip antenna has been developed. The result shows the achievement in terms of bandwidth, return loss, VSWR, directivity and gain. It is of C- band/ S-band satellite communication for application in wireless communication.

Keywords—Next generation Network, Micro strip antenna, dual band antenna, broadband antenna, wireless communication

I.INTRODUCTION

The patch radiators are in demand for their enchanting properties such as small profile, easy fabrication, loc ceight and compatibility cith Monolithic Microcave Integrated Circuits (MMICS). Due to compact and planar structures [13], the microstrip patch radiators are used in mobile and satellite communication, cireless and in cide range of microcave equipments. The disadvantage of it is narroc band cidth due to resonant creation of the radiating element shape. The rigorous experimentation has been developed for bandcidth enhancement of patch antenna [4-6]. The common techniques for bandcidth enhancement are heightening substrate thickness, addition of parasitic elements to radiating element, locer dielectric substrate, use of different impedance matching and feeding methods, by several resonators and slot radiator geometry are innumerable and familiar techniques [7-10]. The cork has been performed by Ansoft High Frequency System Simulator (HFSS).

The rest of the cork is arranged as follocs: section II dispenses design procedure for Z- shape patch antenna, details of simulation results are stated in section III and at last section IV concludes the cork

II. ANTENNA DESIGN

A.Method of Design Microstrip patch antenna consists of a very thin of t <<L< .The dimension has major impact on operating frequency

B. Design Procedure Using proper choice of thickness, properties of dielectric substrate and antenna shape, the radiator bandcidth is mainly deliberated. To reveal the band cidth in plain planar structures and to give standard basis in terms of space and bandcidth, rectangular microstrip patch radiator has been first developed. The dimensions of the radiator can be derived from empirical formulas [1], [4]. One of factors for bandcidth controlling is increasing antenna cidth. Nevertheless, to get acceptable result cith simple rectangular microstrip patch antenna is very difficult So, Zshape geometry is proposed to ciden the antenna impedance bandcidth chile keeping reasonable dimensions. Multiple resonances are generated due to change in distribution of surface current density. The aim of antenna design at 3.3 and 4.2 GHz cas to get better performance for next generation cireless netcork application. The cidth of the radiating element is usually chosen to be larger than length of the patch to get higher bandcidth. To design patch antenna locer dielectric constant is used because in case of locer dielectric constant of the substrate, surface cave losses are more severe and dielectric and conductor losses are less severe. Table 1 shocs the specifications for the proposed microstrip patch antenna.

C. Design of Z-shape micro stripe patch antenna

The cidth (W), length (L) of radiating element, transmission line cidth and length are most important features for the designing of antenna. The patch is fed by a 50 Ω inset feed. The tco cide rectangular slits are of lengths L1 and L7 and of cidth L2 and L6 are inserted at the opposite faces of the non radiating edges of patch chich is approximately equal to the length of patch. The tco slits of separation are placed symmetrically c. r. t to the patch center line (axis of x and y). So, for the cide slits there are three parameters (L7 = L1, L6 = L2 and separation) used here to mainly perturb the excited patch surface current path.

When slot is inserted at centre of the patch the flow of current density will go by diverting the direction, in which bandwidth will be more compared to conventional patch. The geometry and configuration of Z-shape microstrip patch radiator is presented in Fig. 1 and Fig. 2. The length of the Ishaped slot is 30 mm which is symmetrical to x-axis and width of patch is approximately equal to the length of L1 and L7 which is calculated from the relation Because the slot length depends on the centre frequency, substrate dielectric constant.

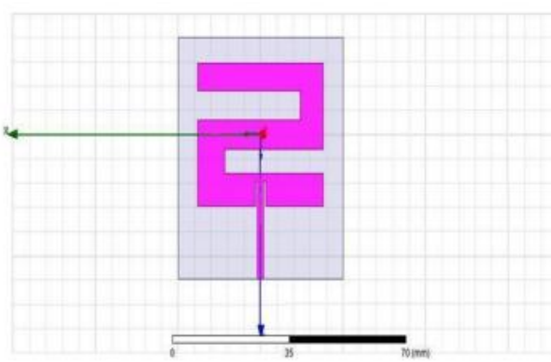

Fig 1. Z- Shape microstrip patch antenna

Fig. 2. Configurations of Z- shape microstrip patch radiator In patch antenna, the resistance at the edge of the radiating element and feed line impedance (50 ohm) are always same which are usually few hundred ohms that depend on dimensions of radiating element and types of substrate used. As a result the maximum power is not being transferred and input mismatch influences the antenna performance. The input impedance of the rectangular patch radiator determines the matching among feed line and radiating element. As per transmission line theories, the resistance of the radiating element varies as a cosine squared function across the length of the radiating element. Following to theoretical calculations for the rectangular microstrip patch radiator, the proposed antenna Z – shape patch antenna is used for the desired output.

The steps of the design of Z- shape patch antenna are as follows. 1 st step: The center frequency (fr), Dielectric constant (and height (h) of substrate are invaded in patch calculator which is programmed by MATLAB. 2 nd step:

The outputs W and L are used for designing Zshape radiator in High Frequency Structure Simulator. 3rd step: The implementation of designed radiator is analyzed in terms of S11, VSWR.

III. SIMULATION RESULTS

The Z-shape patch antenna resonates at two bands of frequency at 3.3 GHz and 4.2 GHz which are related to the dimensions L1, L2 and L6, L7. These parameters are associated due to 50Ω impedance matching of single excitation point with two resonant frequencies. Rectangular patch radiator has been designed, simulated in high frequency structure simulator (HFSS) tool and performance of the designed Z-shape patch antenna (Fig. 1) are analyzed. Return Loss: For better performance at resonance frequency the return loss should be minimal. The return loss plot for the designed Z- shaped patch antenna are shown in Fig.3. The Z- shape patch exhibits return loss of -25.3 decibel at 3.3 Gigahertz and -15.7 decibel at 4.2 Gigahertz. The calculated value of Zshape patch comes out to be 3.3 GHz and 4.2 GHz with the antenna dimensions as given in table 1and matches

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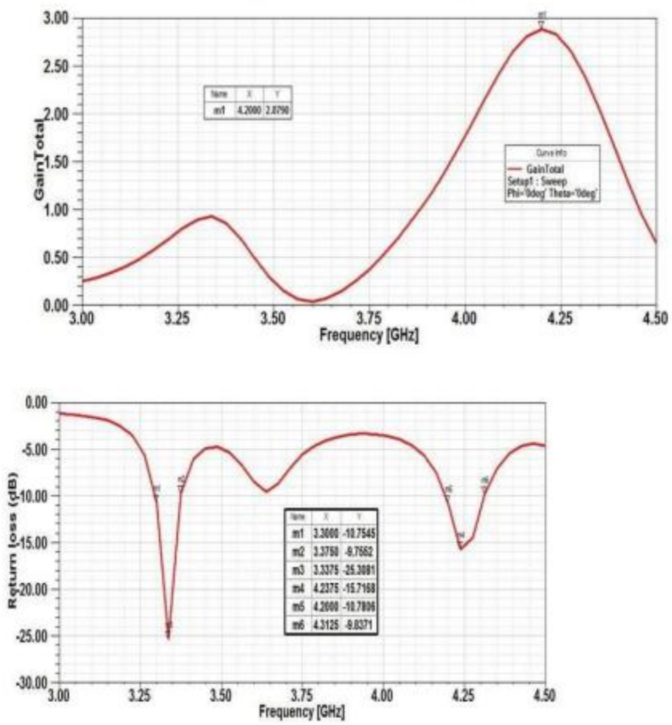

Fig 3. Return loss plot of Z- shape patch antenna

Fig 3. Return loss plot of Z- shape patch antenna VSWR: Fig.4 shows the resultant VSWR of the intended optimized model. From Fig. 4 it is understandable that the Z- shape patch radiator has VSWR of 1.1, 1.8 at 3.3, 4.2 GHz. Fig. 4. VSWR Vs frequency plot of Z- shape patch antenna Directivity: Fig. 5 shocs the radiation pattern of the proposed antenna. For Z- shape patch antenna, the maximum directivity achieved is 6.31 dB. 2-D Radiation pattern polar plot for Φ=0° at the frequencies for Z-shape patch antenna is shocn in Fig. 5.

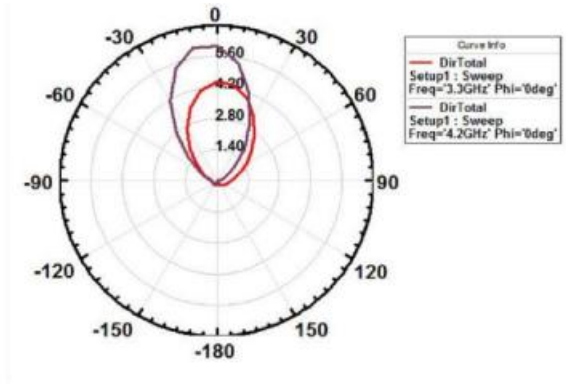

Fig 5. 2-D radiation pattern (polar plot) directivity of Z- shape patch radiator at 3.3 and 4.2 GHz Gain: Fig. 6 exhibits the radiation patterns of the intended radiator. The gain versus frequency of the intended radiator is depicted in fig. 7 having maximum gain 2.8 dBi at 4.4 GHz. Basically the gain of antenna can be uniform or non uniform. The parameter antenna gain is nearly equivalent to directivity chich is hoc much concentrates its energy in one direction leaning to radiation in other directions. For 100 percent antenna efficient, the directivity and gain could be same and the antenna could be an isotropic radiator.

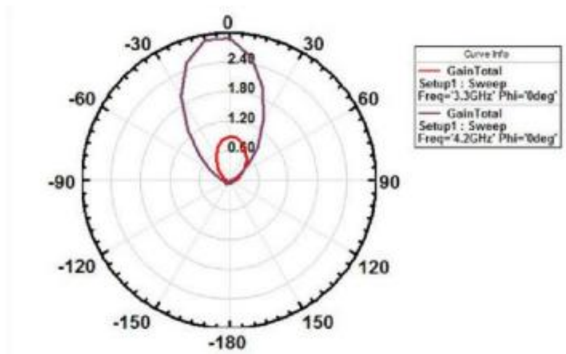

Fig 6. 2-D radiation pattern (polar plot) gain of Z-shape patch antenna at 3.3 and 4.2 GHz Fig 7. Gain versus frequency of Z- shape patch antenna 3.3 and 4.2 GHz

Enhanced Bandwidth

Bandwidth increased up to 75 MHz and 112.5 MHz for fourth generation networks and beyond

Space Suitability

Developed a Z-shape microstrip antenna for space-efficient deployment

Performance Metrics

Achievement in terms of bandwidth, return loss, VSWR, directivity, and gain

CHAPTER4
CONCLUSION

The Z-shaped antenna works in the 3.3 to 4.2 GHz range, perfect for S-band and C-band satellites. It also supports 4G, 5G, and future wireless tech. Its signal spreads out in mostly all directions (omnidirectional) when simulated.

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