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Study of Multi-band Compact Rectangular Microstrip Patch Antenna for wireless Communication Applications

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ABSTRACT

Nowadays the Internet of Things (IoT) has drastically reformed our engagement with the surrounding world, morphing routine items into smart, interconnected systems. This change owes its realization to advancements in the wireless communication technologies that play an essential role in driving IoT devices. In these technologies, the antenna holds a pivotal position as it forms the connecting link between the wireless gadget and the medium of communication. Exponentially increasing ocean of users connected to the internet, due to the usage of multiple wireless devices by a single user, demands high data rate transfer with low latency rate for development of modern wireless communications. Moreover, the present wireless communication systems suffer from more complex challenges due to the increased demand for compact devices. The antenna with four-port MIMO, where each antenna contains two-element arrays to enhance the gain of the antenna, is proposed. The antenna resonates at 25.5–29.5 GHz with a peak gain of 8.3 dBi. A two-port multiple input, multiple output (MIMO) antenna for dongle applications and smartwatch is presented in with the improvement of return loss and frequency band by the introduction of defected ground structure (DGS). In addition, DGS is also used to optimize the isolation between the units of the MIMO antenna. The Envelop Correlation Coefficient (ECC) is an essential parameter of the MIMO antenna, which can be lowered by using DGS.

Keywords: Wireless Communication, Return Loss, Gain, MIMO antenna.

1. INTRODUCTION

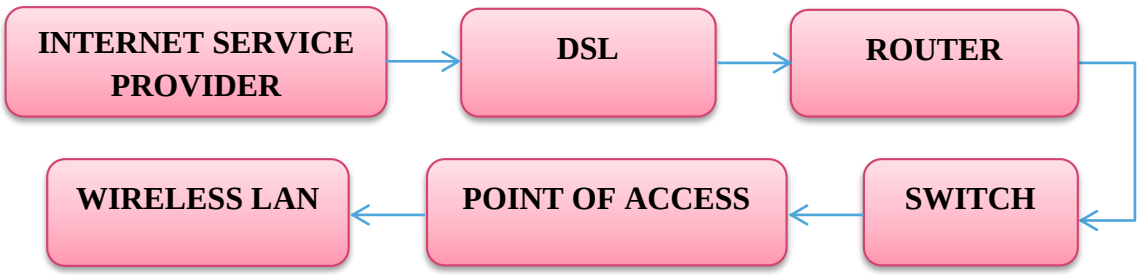
Recently, in high performance applications where size, weight, cost, ease of installation is constraining. Namely an application such as aircraft, spacecraft, and satellite and missile applications requires low profile antennas. The field of wireless communications has been growing since the invention of portable electronic devices as mobile phones some decades ago. The success of the second-generation (2G) cellular communication services leads to the development of wideband third-generation (3G), fourth-generation (4G) and fifth-generation (5G). In many wireless communication applications such as telemetry and communications, aviation,

naval communications, automatic guidance of intelligent weaponry, radar, GPS systems, micro strip antennas are used because of its advantages and also make them popular. This structure of an antenna is simple to manufacture and versatile in nature and also it is proposed to perform functions which include circular polarization as well as dual and triple band operations with wide and small frequency ratios. The primary advantage of this approach is the case of fabrication as the design does not require alignment between multiple layers of metal and dielectrics. The antenna has enough freedom to control the dual design frequencies. It covers the applications such as WCDMA 3G [1]. In the past few years, there has been a huge increase in demand for wireless communication systems that can meet both customer and market needs for higher transfer rates and wider bandwidths [2]. The patch antenna is essential to wireless communication and global positioning systems.

Recent research has led to the creation of many multiband patch antennas (MBPA), which are meant to make it easier for mobile phones to use Wi-Fi and WiMAX. One of the most important technologies in wireless communications is the multiband antenna. Multiple-band polarization antennas (MBPAs) are better than single-band antennas because they can support multiple operations with a single resonator element, are easy to receive, and send signals at multiple frequencies. On literature review multiband antennas can be used for 5G communication. One of them is built so that the resonating frequencies fall between 450 MHz and 6 GHz, and here is how the other one is made. The resonant frequencies of this suggested antenna are 2.4 GHz, 2.8 GHz, 4.1 GHz, 5.5 GHz, 5.9 GHz, 6.6 GHz, 7.9 GHz, and 9.3 GHz. Another multiband antenna works in the millimetre wave band, which goes from 24 GHz to 86 GHz. Its resonance frequencies are 14.601 GHz, 23.3.01 GHz, and 28.9 GHz. In addition to a low VSWR, high gain, and high directivity, the suggested antennas also offer a low return loss. These patch antennas are ideal for use in 5G applications, but they are also acceptable for use in Wi-Fi, WiMAX, Bluetooth, and WLAN applications. Wireless LAN is used for transmission of signals at particular frequencies for pre-requisite ranges. On the other hand, C band is widely exploited for satellite communication between Ground station and satellite for effective up-linking and downlinking of frequencies. Over the past few years, C band's most significant contribution has been demonstrated via VSAT. There are many satellites providing C Band that includes Asia Satellite, INSAT and many more. Very Small Aperture Terminal (VSAT) is a divulgence apparatus used for commercial and personalized purposes. The user requires a vessel that confederates the antenna with the user's application device with the help of a transceiver. The transceiver is accountable for broadcasting and receiving signals to a transducer. The earth station acts as a central node in this chain of events. Each end user is reticulated with the central node via the satellite in a star topology arrangement. The primary lead of S and C band over other frequency assortments is the fact that it is less liable to rain waning and its conforming interference and comprises of cheaper bandwidth Studding in [3,4]. The frequency band at which the antenna is performing can also be utilized for Curative Disaster Management in the healthcare sector. These services can work at real time in operations varying from formation of still images to broadcasting signals over global system for mobile communication. The frequency range where the antenna predominantly resonates can also be utilized for the operations carried out under the communication standard WiMAX studding in [5-7]. WiMAX stands for Worldwide Interoperability for Microwave Access. It is a family of communication principles centred on the IEEE 802.16 set of standards, which provide several physical layer and Media Access Control possibilities. The main principle behind the

WiMAX standard is to create last mile wireless broadband access and connectivity. WiMAX was originally premeditated to deliver 30 to 40 megabit-per-second data rates, but with the recent updates, it has started delivering up to 1Gb/s of data speed.

1.2 Wireless Lan Basic Principals



2. Results and discussion

A microstrip patch antenna is a metallic stripe or patch equestrian on a dielectric layer (substrate) over a ground plane. The microstrip patch antennas can be utilized for the functioning of Aircraft, Satellite, Missiles, Cell phones, Sophisticated electronic devices and many more applications. Multi band antennas have lots of real-world uses, particularly for mobile devices for many applications. These antennas function on several bands or frequencies and can either operate on these different frequencies one at a time or concurrently, depending on the competence of the specific antenna. The principle advantage to multi band antennas is their capacity to afford a durable, steady wireless connection in often challenging to reach localities.

Wireless communication systems require quick, efficient, and dependable two-way data transmission, which is reflected in the design of their antenna subsystem. The antenna plays a vital role in such systems. In today's information-based society, there is a growing demand for antennas that not only have a broad frequency band and are compact and easy to install but also exhibit high radiation efficiency, anti-interference performance, and other desirable characteristics [8,9]. The microstrip patch antenna is a type of directional antenna, meaning it transmits signals in a specific direction [10]. It can be designed to have omnidirectional or directional characteristics, which is beneficial in WLAN applications as it can provide higher gain in specific directions and overcome obstacles that may block signals.

3. Conclusion

The design of a multi-band rectangular patch antenna has been performed by inserting slots and modifying the ground plan parameters. This type of design is also characterised as ultrawide band antenna. This antenna is used to fulfil the need for wireless LAN, broadband, satellite, radar communication and multimedia applications. A brand-new multiband microstrip patch antenna was constructed for usage in wireless communication systems. The suggested antenna is compatible with a broad spectrum of frequencies, ranging from 1 GHz up to 5 GHz. The simulation results showed that the return loss for each resonant frequency is less than-10 dB, and the suggested design satisfies the requirements for return loss, VSWR, and bandwidth. The outcomes of the simulations present a more favourable scenario for wireless communication than before. Based on the results of the simulations, it looks like the antenna could be a great choice for use in wireless communication systems.

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