WIRELESS LOCAL AREA NETWORK (WLAN) ANTENNA DESIGN HAVING COMPACT SIZE WITH IMPROVED GAIN

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Abstract--**In this research, design of dual band antenna for access of WLAN (wireless local area network) over a short range communication is discussed. The designed dual band antenna is expected to cover frequencies bands of 2.4 GHz and 5.2 GHz. The proposed antenna must be able to work for both the frequencies. The characteristics of antenna has been studied and simulated according to required criterion of WLAN.**

The basic design is based on WLAN slot antenna having narrow characteristic over both the WLAN bands. It is designed on FR4 substrate and computer simulation tool HFSS is used for simulation of proposed dual-band antenna. Overall characteristic of any antenna is greatly affected by antenna width, length and spacing between feeding line, thickness of antenna, spacing between antenna and ground plane and permittivity of the related substrate.

The designed antenna has compact planar monopole rectangular radiating element having I-shaped slot, on the same axis on rectangular patch to introduce dual band wireless communication applications. The height of the ground plane is 1.45mm that is designed on other side of the substrate. The resonant behavior of any WLAN antenna depends on the resonant bands that are joined in order to get complete response, these resonant bands are related to different fractional parts of proposed antenna. In order to identify each band of the antenna, current distribution is observed, it can be observed that the higher current distribution will lead to the antenna element resonating at this band. This behavior of antenna can lead to the novel design of antenna, furthermore the WLAN can be achieved though the modification process of various parts, and with the aid of related current distribution to antenna structure. In the design of this antenna, it has been found that ground plane and radiating element are the most effective parameters to achieve this objective. The resulting antenna has been formed to possess reasonable radiation characteristics, antenna gain and dual band response.

All the antennas that are presented in the research, have been modeled using the same FR4 substrate having thickness 1.45mm, and 4.4 relative dielectric constant. These antennas have been fed with a 50Ω microstrip feed line. Simulation tool HFSS has been used for the performance evaluation of different antennas presented in this research. By the application of fractal geometry on the radiating element, it has been observed, that resonance of two band antenna has improved as compared to literature and reasonable coupling of these bands have achieved.

The simulated design must fulfilled all the criterion that has established by federal communication commission (FCC). All the bench marks related to antenna design should be maintained like return loss must be below -10dB, gain should be positive and better than previous work. By proper tuning of Omni-direction radiation pattern, the proposed antenna can also be considered suitable for outdoor communication. Also, HFSS simulation for various parameters show that the proposed antenna is a good choice for dual-band WLAN communication applications for both short or long distances.

I. Introduction

WLAN is wireless band which is used to connect computer systems with communication network wirelessly, the frequency bands 2.4GHz and 5.2GHz can be used in WLAN communication as it is standard of ISM. The WLAN application is becoming more useful with the advent of wireless communication technology. The use of WLAN communication is increasing as more of the communication devices are utilizing this band. WLAN antennas plays vital role in obtaining excellent system performance and also wireless local area networks are becoming popular from the time they start providing connectivity of high data rates, it also provides ease in connectivity of wireless systems. As, IEEE standards in WLAN communication requires a dual band operation in the rage of 2.4 GHz and 5.2 GHz so, there is need of single antenna radiating element that allows the dual-band operation in these bands. A dual band antenna having both the band will be able to meet the requirements of IEEE standard. Microstrip antennas are used on large scale to obtain such system, as these antennas have light weight, simple structure only existing in single plane, compact in size and have low cost characteristics [1-5]. For the duality of WLAN applications, we propose rectangular radiating element having I-shaped slot in our research. These I-shaped slots provide high resonant frequency responses [5- 8]. The proposed design of dual band antenna consists of rectangular radiating element. It also consists of metallic I-shaped slots that are appropriately placed on the radiating element shown in Fig. 1. The proposed antenna provides dual-band operation and also has small dimensions. HFSS simulator has used to analyze the design of proposed antenna The characteristics of simulated antenna are described in detail, in this report which proves to be a suitable candidate for WLANs applications.

Now-a-days various applications and are using wireless services due to the ease of connectivity. More applications are yet to come with smaller size and utilizing dual band of operation. Manufacturers are producing various different types of wireless communication systems due to the high demand of wireless connectivity in short or long range, like walkie talkie, wireless communication in short range, cellular or mobile communication for medium range and satellite communication and global positioning for long range. Every system in these system operates at several frequency bands. Each system requires an antenna to serve user, and that antenna should work on the specified frequency band. In past each system had used one antenna but that is expensive and inefficient in terms of space usage. Variety of systems suggest the need for dual band antenna, and there are different methods to obtain dual band operation with microstrip antennas. In this report we will describe three of them in detail that are used to achieve the dual nature of WLAN antenna's.

The first method consists of single antenna design, most of the times, this design is used to have a dual band microstrip antenna. This method is used in large majority of the researchers as it is simple to design. There are two different types of this method, the first type creates the first resonance band with some element inside the main radiator and the second band is generated with second element present in the same antennas. The only requirement of the second resonating elements is that it has to be in orthogonal dimensions of the same main radiator [9]. A simple rectangle having two non-equal sides can be used as the main radiator. In this type of design, the sides of the rectangle are designed in a specific ratio, this ratio corresponds to the ratio of the frequencies. Larger side of the antenna will radiate at lower frequency and smaller side of the antenna will create larger band. In the rectangular patch it is natural to have two non-equal sides moreover this shape is easy to design in fabrication process. The only limitation of this method is that as the two frequency bands are generated at orthogonal polarizations so there is need of orthogonal polarized antenna at receiving end as well. However, polarization requirement does not press this technique because of wide range of advantages like short-range and low-cost applications.

The second method introduce different techniques in design such as patch loaded with reactive elements, notching elements will create two different bands within a larger band [11]. The bandwidth of the notch can be controlled by the length and width of notching element. Inclusion of varactors and embedded slots [10] along with capacitors will also lead to the dual band operation, pin diode [12- 18], slots or either external slots [6-9]. The resonant mode of the patch can be modified by these reactive loading approaches. So, the radiation of higher mode could be same as the fundamental mode. This shows that single feed can be used for both frequencies on single radiating element, so this design technique is most famous to obtain dual frequency behavior.

The same substrate can have two or more independent radiation elements to obtained dual or multi-band operation [22, 23]. This method supports strong currents and radiation at the resonance as the second. This type of design can lead to MIMO antennas as well. Multi-layer patches or substrates [24] can be used in this type of design. It also uses patches of several shapes. Due to same polarization at the two frequencies and also with dual polarization there is no problem at design of receiving or transmitting antenna. Bandwidth enhancement is possible in Multi-layer structure as each layer is working independent in making a combined radiation. By printing two resonators on the same. substrate double frequency band antenna can be obtained. Their radiation pattern is similar at all operating frequency bands.

Fractal geometry also provides dual band operation [26] is third category which provides the dual band operation. Fractal geometry is like replication of same shape with different size and orientation. The small size will generate higher frequency band and larger size will generate lower frequency band. Similarly, Space-filling property are also used to generate different frequency bands. Fractal geometry is also used in size minimization of antenna. It also improves the reflection coefficient response of dual-band antenna. Many non-harmonic resonances are reported in self-similar [27-28] in the geometry which may leads to have dual-band antennas. Impudence has been improved by fractals on a decreased physical area for the performance of voltage standing wave ratio (VSWR), in comparison to Euclidean geometries of non-fractal. Fractal element antennas can simplify the design of the transmitting and receiving, for many cases in terms of space usage on the surface of substrate. However, the application of fractal geometry to antenna design makes them more complex in structure and the benefits of the different fractal geometries are limited only for the first few iteration levels.

In our research report, the proposed design has been presented a technique in which microstrip radiating element has used on the surface of the substrate for dual band antenna, this technique has been discussed in our previous discussion. On the radiating element, I-shaped slot has been introduced for the dual function also their characteristics like gain and radiation pattern, return loss/S11, of proposed designed antenna. Fig.2 represents that results of proposed antenna design are more suitable for WLANs application.

II. Literature Review

Rapid development in wireless communication technology requires the need for advancement in antenna designs. That is why interest has been developed in microstrip dual-band antenna. In this context, much of the research works have been reported in the literatures. The following is detail study of the literature of the highly relevant research works to the scope related to our report.

In 2006, Behdad and Sarabandi [17] has discussed various techniques in microstrip slot antennas for designing dual-band. The idea behind this research was to investigate microstrip antenna load with slot and a varactor or lumped capacitor by varying the distance along the slot and keeping the location of a capacitor fixed with the slot, the decrease of capacitance. These variations will lead to shift these resonant frequencies of the proposed dual band antenna. This change in resonant frequencies may lead to the tuning of different resonant bands. A ratio change tuning is generated for a dual-band antenna with reasonable frequency, which is good achievement. Frequency ratio in the range of {1.3–1.56} GHz which is electronically tunable, antenna is designed and fabricated having dual-band. Single varactor was used with a capacitance of {0.6–2.5} pF. Simulated design of a compact dual band microstrip slotted antenna was developed and presented in 2008 [18]. The design consists of a slotted circular radiating element with a dielectric substrate. The substrate helps the band matching and lowers the operation of frequency. The developed design explains the detail about the overall size reduction of about 65% compared to an unslotted radiating element along with good radiation pattern, efficiency and gain. The detail study of this simulated and the fabricated design showed that the frequency ratio of the two resonances can be changed from 1.19 - 1.8 making it usable for its applications in the field of wireless communication area.

In 2012 Ali, and Ahmed [30] analyzed and designed a monopole slotted antenna as a device for use in the dual frequency wireless communication applications. The antenna has been fed with {50} Ω transmission line that is microstrip, and the slotted structure was designed at rare of substrate. The measurement results are in good agreement with the simulation results.

In 2011 Salim, and Ali [29] presented the design. of new dual frequency internal planar compact antenna as a suitable candidate for WLAN USB dongle applications. The designed consist of the second iteration of Peano-type space-filling geometry. That geometry has designed on a substrate with 2.43 relative dielectric constant, 0.6mm height and fed with 50Ω microstrip transmission line. Furthermore, proposed designed operates with a dual resonant function with frequency ratio of about {2.35}; resulting in. bandwidths, for reflection coefficient ≤ (-10) dB, covering. the two WLAN band for WLANs application as described by IEEE.

In 2011 panda and Ali [27, 28] simulated the design of an E-shaped compact. planar slotted antenna as a suitable candidate to function. with a dual-frequency operation over the whole WLAN bands of. (2.1- 2.4 and 5.1-5.7) GHz. While the characteristic impedance of 50 Ω microstrip feed line is designed on back of substrate, the E-shaped slot designed has been made at ground plane. To facilitate dual-band operation and also tuning, an extra designed trapezoidal slot on the feeding side has been attached to structure of slot. The ratio of the two resonating frequencies.$fo2/fo1$ can be changed according to desirable range, while do not changing the external geometry of the antenna, making antenna suitable for other dual-band WLANs applications.

The resonating frequencies. of WLAN are only capacity of shape, size and dielectric constants as it were because of its adaptability, WLAN, can be designed with various shapes according to scope prerequisites relying on the applications in the remote/wireless communication businesses. WLAN has been used as a part of microwave circuits from long time for example, filters and oscillators. The Q-factor is. normally somewhere around (50 and 500), it can be high as 10,000. WLAN is generally regarded as energy storing device opposed as a radiator due to these applications [2]. WLANs like UWB Antenna can likewise be energized with various nourishing techniques for example dielectric image waveguide feeding, slots, microstrip lines and feeding probes WLAN is consider as great substitution for microstrip antennas. WLAN has high power control ability and wide impedance bandwidth on grounds because of their numerous profitable and alluring components. In that capacity, these incorporate their adaptability in structure, reduced size and light weight, variety in shapes, basic structures, simple manufacture, extended impedance bandwidth.

Wireless communication invokes developing. fragment of correspondence business in remote area. Accordingly, it had acquired the creative ability of people and consideration of media users and consumers. It has more than two billion clients worldwide Framework of cell have experienced fast development in recent era Surely cellular phones are becoming the instrument of business in developing countries and also taking place of wireline frame works also wireless networks are supplanting wired networks in various homes buildings offices and organization. Due to advancement in wireless technology a lot of new applications are emerging e.g. wireless sensor networks, smart homes and automated highways. It also provides a lot of industrial facilities. Portable PCs and palmtop PCs shows the tremendous development of wireless network. It also gives bright future to wireless systems.

Normally antenna and filters in wireless front end modules are connected with 50Ω reference impedance and they are observed separately. This technique normally limits the performance of whole subsystem of filter antenna, and gives boundary to the designed applications of UWB and WLAN antennas. A technique in which different antennas are connected with each other at common impedances instead of 50Ω is presented for subsystem of WLAN antenna. Additional out of band constraints of an antenna was controlled by very common polynomial optimization methodology [5]. Different antenna filter designs have been proposed recently in which few are planar and non-planar by the use of SIW cavities, horn antenna covered with a frequency selective surface in non-planar antenna structures to produce WLAN module [6].

Another proposed antenna design Improves the antenna gain, impedance bandwidth and also minimizes the size of subsystem by designing the antenna having shared ground plane [7]. For GSM, satellite application and WLANs, Γ-shaped filtering antenna has been proposed. In stop band it gives high suppression and in pass band it gives flat antenna gain [8]. Slots are introduced in any antenna design to get required frequency bandwidth and to reduce antenna size in WLAN antenna module [9]. Multilayer technological approach was used instead of basic conventional cascaded function for designing antenna filter subsystems [10]. Through the replacement of single port of designed filter and resonator by patch antenna, WLAN antenna was obtained [11]. Application of Wi-Fi for dual-band filter antenna subsystem is achieved by integrating a step impendence resonator filter with DRA (dual band hybrid) monopole antenna [12]. In [13] an antenna with improved performance has been proposed in SIW technology which gives ease in selection of required filtering topology. Some works exhibited the utilization of WLANs by utilizing part of a mode [15] - [17] and utilizing creased structures [18] - [19], in this manner accomplishing noteworthy scaling down. Nonetheless, for channel outline these structures lessen the level of opportunity in the configuration and can't helpfully be utilized to accomplish a craved self-assertive topology of a channel. SIW based channel was proposed when contrasted with customary channels with critical reduction in size. The channel is permitted by the use of metamaterials to work underneath the cut-off of its first overwhelming mode [20]. For the era of transmission zero or for semi elliptic capacities this type of structure is not desirable. To abuse several modes inside of cavity distinctive methods can be used. In the waveguide innovation, double band response has achieved by introducing multimodal half breed resonators [21].

For coupled resonator channels, synthesis method can be followed with a specific end goal to understand a wanted sifting capacity. Synthesis technique for microwave coupled resonator channels is surely understood and examined broadly in writing [23] - [24]. In [25] - [27] synthesis methodology for multiband channels is depicted. The work introduced in [28] talked about a union system for channels stacked with complex terminations, therefore representing extra limitations on channel plan technique.

A. Motivation

Some attractive qualities of WLAN antennas makes them extremely encouraging and reasonable at microwave frequencies for WLAN applications. Now-a-days wireless communication turns out to be part of everyday life. To accomplish this, one of the best system is wireless local area network antenna. These antennas have extremely low cost and transmits at millimeter wave frequencies. These antennas also have attractive features like basic manufacturing strategies simple configuration and also gives adaptability in design. The evolution and improvement of WLAN is going to emerge in 4G LTE devices and presented in Fig. 1. In this research, the design methodology for WLAN antenna is presented. Improved efficiency, minimizes the size and parametric analysis of this antenna is also presented in this thesis.

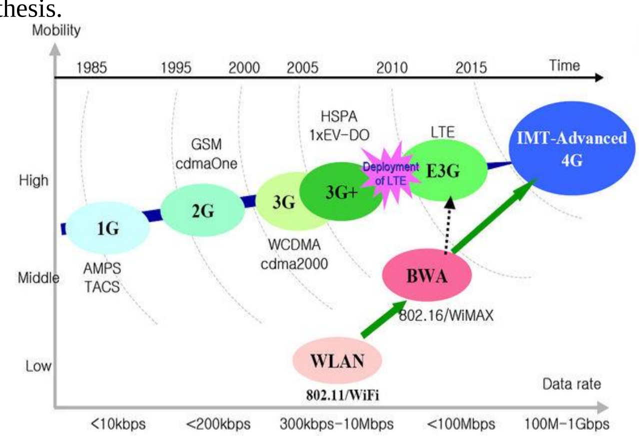


Figure 1 Improvement in communication

III. DESIGN OF DUAL BAND ANTENNA FOR WLAN

A Basic Geometry

Figure 5.1 is representing the Proposed geometry of dual nature antenna, and the description of parameters are listed in Table 1. The proposed antenna is printed on the FR4 substrate with the dimension of x, permittivity and dielectric constant of 4.4. The radiating patch consists of a rectangular shape with a I-shaped slot near the feeding line on the patch that helps in getting the required result that is duality function. The antenna is fed with a 50 Ω characteristics impedance.

On the other side of the substrate a ground plane is designed having width W**,** that is same as the radiating patch and the length is denoted as L_f. The overall volume is 30 x 34 x 1.4 mm^3. The length of the radiating element is used for good impedance matching, and the ground plane helps in minimizing the size of the proposed antenna by helping in good impedance matching. The resonant frequency can be achieved by using mathematical relation of equation 5.1.

$$f = \frac{c}{4L\sqrt{\varepsilon r}}$$

c represents speed of light

L represents resonant. path length of the radiator

εr represents relative dielectric constant.

50 Ω microstrip is required by antenna to feed by using the following equation we can get the width of microstrip feeder.

When. w/h > 1;

$$Z_0 = Z_f \, 2\pi\sqrt{\varepsilon_{eff}} \, \ln(8\frac{h}{w} + \frac{w}{4h})$$

$$\varepsilon_{eff} = \frac{\varepsilon r+1}{2} + \frac{\varepsilon r-1}{2}\left[\left(1 + 12\frac{h}{w}\right)\right]^{-1/2} + 0.04(1 - \frac{w}{h})2]$$

when w/h < 1;

$$Zo = \frac{Zf}{\sqrt{\varepsilon eff}\,(1.393 + \frac{w}{h} + \frac{2}{3}\ln(\frac{w}{h} + 1.444))}$$

$$\varepsilon_{eff} = \frac{\varepsilon r+1}{2} + \frac{\varepsilon r-1}{2}\left[\left(1 + 12\frac{h}{w}\right)\right]^{-1/2}$$

In above equations we have,

Z_f = 376.8 Ω, shows wave impedance of free space

h represents medium plate height

w represents microstrip line width

ε_{eff} represents effective dielectric constant

There are two ways of solving these equations and finding out the appropriate dimensions of antenna. First path is analytical and using the equations as above and finding out the dimensions of antenna. Other method of calculating the dimension is through modern tools like HFSS. HFSS is used as a simulation tool for our design. The effects of different features on WLANs antenna's performances are also discussed. These results are shown in figure 1(b) to figure 4 with simulation. The functional dimensions for proposed dual band antenna are listed in below mentioned Table 1:

Table 1: WLAN antenna dimensions

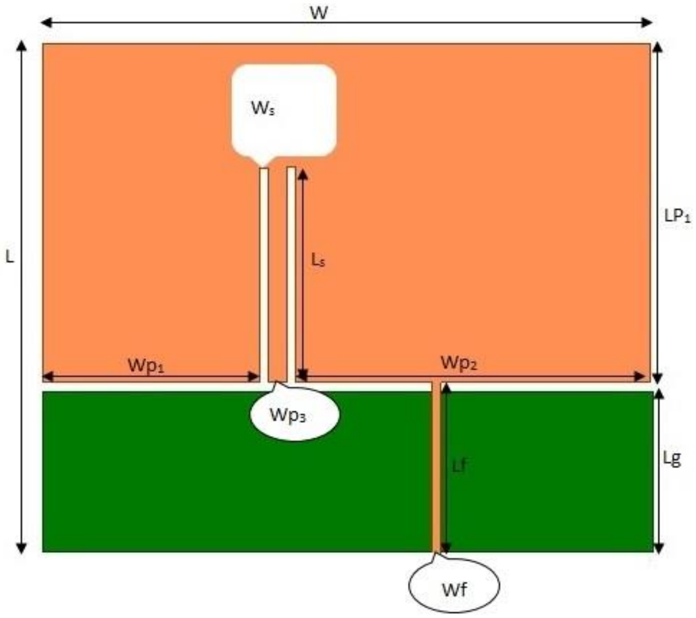
Parameter	Size (mm)	Parameter	Size (mm)
L	30	Wp2	20
W	34	Wp3	2
Lp1	20	L_f	10
Wp1	12	Ls	12
Lg	9.5	$W_s=W_f$	0.5

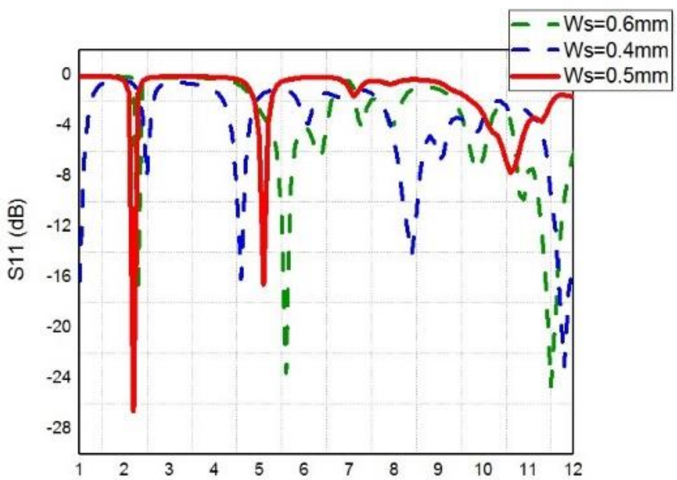
The overall length of the radiating element is indicated by L and the width is denoted by W. The I-shaped slot length and width is denoted as Ls and Ws respectively. Ground has a length denoted by Lg. Whereas L_f, denote the length of feeding line. All other remaining parameters are also shown in the figure 1 (a) whereas their dimensions are shown in the above table 1.

B Result and Discussion

Dual-band rectangular microstrip antenna's results for WLAN has been studied Performance of antenna will be discussed by the effects of various slot styles. A microstrip antenna with rectangular radiating element and a I-shaped slot is designed. The proposed antenna covers two frequency bands of (2.3 - 2.4 GHz) and (5.1 - 5.3) GHz. Antenna gain for most of

Figure 5.1. (a) Proposed antenna indicating dimensions **(b)** Simulate result in form of S11





operating frequencies can be achieved as 4 dB Patch of antenna is a rectangular element whose side length is 25 mm. Appropriate gain of the antenna is ensured by reducing the volume of antenna, Number of parameters are used to measure the whole performance of an antenna. These are discussed one by one in detail along with a different parameter effects on the result.

C Return loss of Antenna

Amount of lost power in the load which does not return back as reflection is indicated by return loss. In the explanation of previous section, reflection of waves leads to the formation of standing waves. This happens when antenna impedance and transmitter does not match So RL is a parameter that is similar to the VSWR, that indicates the perfection of matching between the transmitter and antenna. When the device is inserted in optical fiber or transmission line the return and reflection loss is the reflection of signal power [1]. It is represented in dB as a ratio that is relative to the transmitted signal power. This can be mathematically represented as shown in equation

RL [dB] = 10 log [*Pr/Pi*]

In this equation,

Pi shows power supplied from source
Pr shows reflected power
Also, if incident wave's amplitude is denoted by Vi and Vr reflected wave as Vr. Then, we have the return loss in term of reflection coefficient Γ as described in equation below:

R*l* = *-20log* | Γ |

The shape and dimensions of proposed antenna is shown in figure 1 a) while simulated return loss of the proposed antenna is shown in figure 1 b).

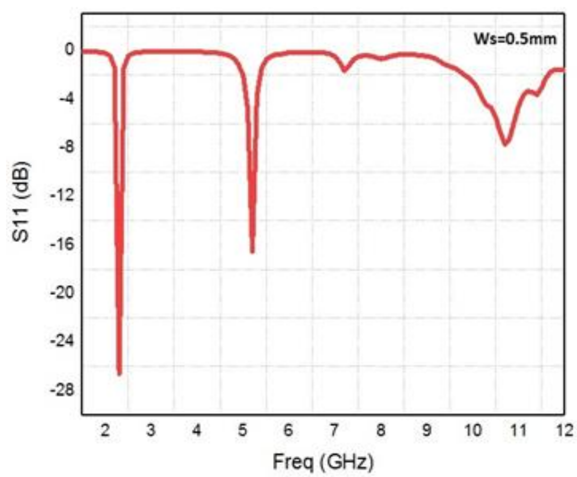


Figure 5.2. Effect of width of slot (Ws) on the result of S11

Whereas reflection Coefficient (Γ) can be calculated from equation:

Γ=Vr/Vi

The return loss of an antenna should be less than $-10\ dB$, to radiate efficiently. Return loss changes of S11 with Ws are given below in Fig. 2.

In the figure Ws mainly effects the bandwidth and the resonant point at high band. when Ws increases, the resonant frequency of 2.4 GHz band moves towards left So, the matching situation becomes worse when the resonant frequency at high frequency decreases.

Ls is representing the Length of the I-shaped slot on the radiating element. Figure 3 is representing varying results of S11 parameter with Ls, Ls will affect antenna matching but it will not affect the resonant frequency of two frequency bands. The matching situation becomes poor with the increase in Ls. So, the antenna bandwidth is also decreased.

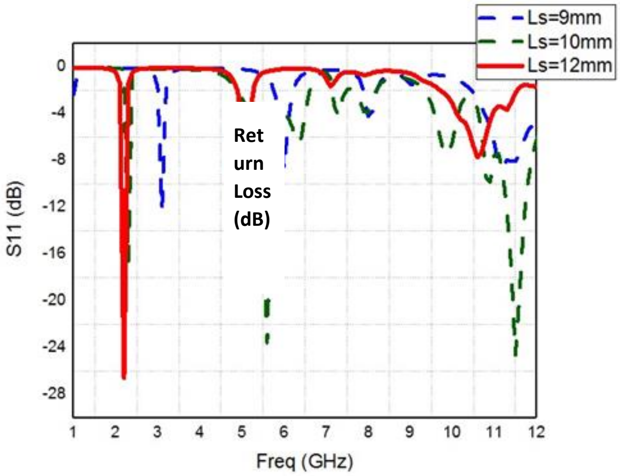


Figure 3. Effect of length of slot (Ls) on S11

W_f is the horizontal part of the feeding element, and the S11 is changing with W_f as given in Figure 4. As W_f increases the resonant. frequency of. 2.4 GHz band decreases with the increase of W_f the resonant frequency of the high frequency band does not change. The high frequency band's bandwidth is decreased with the increase in W_f.

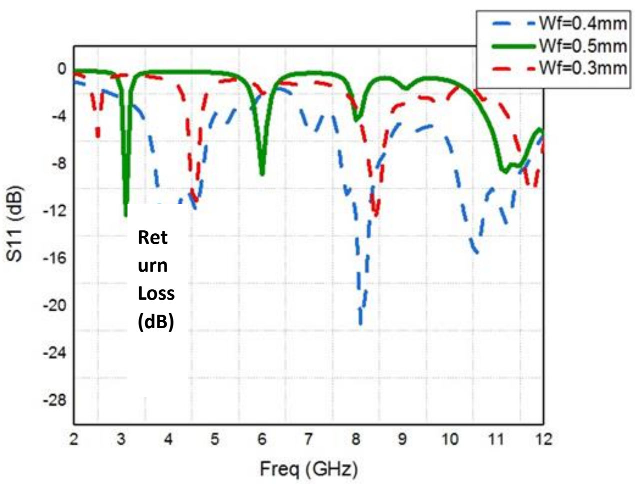


Figure 4. Effect of width of feeding line on reflection coefficient

D Radiation Pattern

The antenna radiation is graphical representation of radiation pattern of antenna in three dimension. Radiation pattern tells us about the intensity of radiation from antenna, it shows pattern of radiated antenna's power per unit solid angle [3]. The power is distributed over a sphere of radius (r) when the total power radiated by the isotropic antenna is P So, power density Sin any direction at this distance is shown in equation:

S=$P/4\pi r2$

Also, the radiation intensity isotropic antenna Ui is given in equation:

Ui=$P/4\pi$

For performance comparison of practical antennas, Isotropic antennas may be used as reference but in practice these antennas are not realizable. Radiation pattern of any antenna tells about beam width of antenna, its side lobes and antenna resolution Antenna's radiation pattern is presented through E plane and considered as electric field intensity vector, H plane pattern can be considering as magnetic field intensity vector.

Through computer simulations radiation pattern of proposed antenna has been evaluated. To feed antenna no feeding cable is required in simulation. The simulated gain radiation patterns of the antenna at frequency of (2.4 ,5.2) GHz are given in Fig. 5 (a), (b) respectively. The circular shape represents the H-plane and the dipole like shape represent E-plane respectively in these figures. In our research other port is terminated with a 50- load when port 1 or 2 is excited. The proposed antenna has omnidirectional radiation patterns at this frequency in the H-plane (i.e. in the x-y and x-planes). That is usual for monopole antennas in E-plane the radiation pattern do not have null and are not of dumb bell shaped So, from typical monopole antennas these are different. These are different due to same shape ground which makes distribution of current different from typical planar dual band monopole antenna.

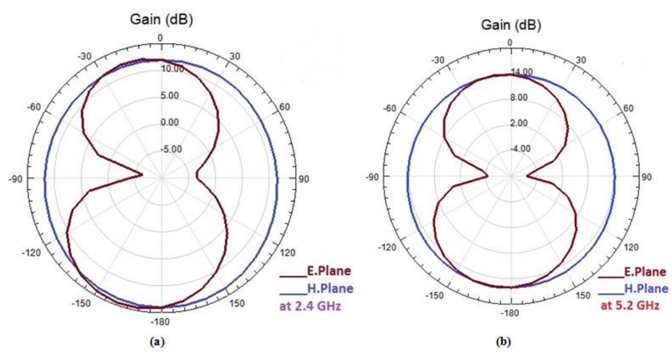


Figure 5. Radiation pattern at double frequencies **(a)** 2.4 GHz **(b)** 5.2 GHz

E Current Distribution

The physical characteristics of guided wave to radiated wave on slowly increasing geometry of the radiating element curvature was analyzed. Which gives the result in the form of radiating patch of simulated surface current distribution of the first design as shown in figure 6 (a), (b) at frequencies of (2.4, 5.2) GHz respectively. The surface current distributions are more powerful almost to the nearer edges of radiating element specially at the feeding edges. On contrary to this distributions of low currents are found on other parts. More impact occurs on the electrical features of antenna when distribution of current paths on gradual curvatures are disturbed or changed.

That is reason we state earlier that these edges are used for impedance matching. It also concludes our last observation that antenna's performance is critically dependent on the width of the ground plane W and it is not very sensitive to the length of the. ground plane L, as explained in previous discussion.

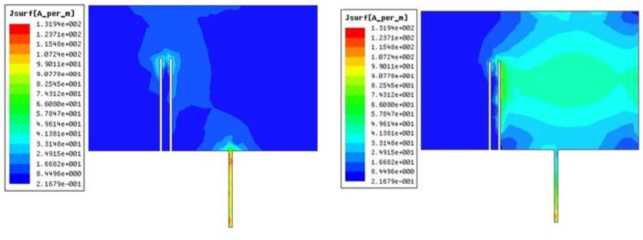


Figure. 6. Current concentration at **(a)** 2.4 GHz**(b)** 5.2 GHz

F Gain of the Proposed dual band antenna

At the peak of main beam gain of the antenna is the ratio of maximum radiation intensity to the radiation intensity in the same direction Isotropic radiator would produce this that have the same input power. Isotropic antenna is considered to have a gain of unity. We can calculate the antenna gain by using the relation given in equation:

$$G(\theta, \emptyset) = \frac{p(\theta, \emptyset)}{\frac{Wt}{4\pi}}$$

Where, $(\theta, \emptyset)$ represents power radiated per unit solid angle in the direction $(\theta, \emptyset)$

Wt represents total radiated power

In case of dual band microstrip antennas research have been conducted to obtain better gain. Often most of the antenna has poor radiation, efficiency and also have poor gain. So, during simulation the gain was observed with the whole supported UWB bandwidth (3.1 to 10.6 GHz) and results are as shown in Fig. 7. Observation shows that the proposed dual band antenna has a better gain. But there is variation from. 4 dBi at 3.1 GHz to 7.5 dBi at 5.5 GHz. The average gain of antenna is 4.4 dBi. Also observation shows that antenna has better radiation efficiency, but with variation from 42% at 3.3 GHz to 84% at 5.5 GHz. The average radiation efficiency is 67%. Table 2 shows the comparison of the proposed antenna with the existing few antennas. This comparison w.r.t return loss, maximum gain shows the dominancy of proposed antenna over the conventional designs.

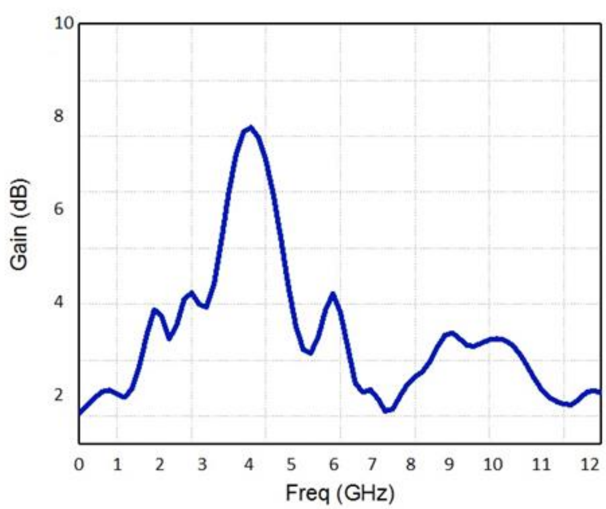


Figure 7. Proposed dual band antenna gain

Table 2: Comparison with existing antennas in terms of Return loss for both WLAN bands, and maximum gain

Work	Return loss 2.4GHz (dB)	Return loss 5.2GHz (dB)	Maximum Gain (dB)
[2]	-18	-14.3	5.7
[3]	-19.5	-16.8	6.3
[17]	-22.3	-12.3	4.4
[28]	-24.7	-10.6	5.2
This work	-26	-16	7

IV. Conclusion

In In our research report we have discussed and designed, a dual frequency antenna according to the requirement of WLAN. It helps in multi frequency communication. Our antenna covers and operate in two frequency bands i.e. 2.3GHz -2.4GHz and 5.1GHz -5.3GHz in addition volume of this antenna is only 16 x 29 x 1.6 $mm^3$and gain of antenna is greater than 4dB. The report describes the design of antenna That fulfills two bands i.e. IEEE 802.11b and IEEE 802.11a with the help of simulation of proposed antenna's characteristics. Proposed antenna has broadband characteristics in terms of VSWR, return loss, radiation pattern etc. Also seen in gain pattern, that consider maximum gain is about 10dBi ±. This shows possibility to develop as an outdoor purpose on top of indoor access point antenna. This is possible by turning in omnidirectional radiation pattern. The designed antenna has compact size (20mm by 50mm). It is designed as rectangular radiating element having two I-shaped slot by using these two slots, the impedance bandwidth of proposed antenna effectively covers both WLAN bands. According to above discussion there are some concluding points:

1. The current concentration analysis on the. surface of the simulated dual frequency WLAN antenna at different resonant frequencies throughout the WLAN resonance contributes as an effective factor in the modifying processes to achieve the purpose of extracting the dual band behavior response from WLAN one.

2. The proposed dual band WLAN antenna structure consider as a full structure. Wherever it is compared to that of dual or multi band antenna, so the modification processes on the WLAN antenna structure denote to remove any parts responsible. on higher or unwanted resonance frequencies. This will give some control on the path of electric current on. the modified structure and also will concentrate the current on the regions responsible on the desired resonance frequencies.

V. References

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