Design and Development of Compact Super Wideband Antenna for Various Wireless Applications

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Abstract—A small super wideband compact antenna with different ground slots for different wireless applications is proposed. This paper provides analysis of super wideband antenna at different resonant frequencies for various wireless applications like 3G, 4G, 5G, WLAN, WiFi and radar applications. The antenna design is based on 25mmx25mm dimensions, U shaped and rectangular shaped slots are made in patch and ground. So in simpler terms antenna provides resonating frequencies made with defected ground. The resonating frequencies include 7.4, 13.6, 17.4, 19.5, 23.4, 26.2 and 35.2 GHz. These frequencies are used for different application wireless application as mentioned. Simulated results are provided with better agreement for wideband applications. The antenna provides high BDR (5.1 GHz - 40.2 GHz).

Keywords—Wideband, defected ground, WLAN, U-shaped slots

I. INTRODUCTION

Design and analysis of an antenna has always been a challenging task. The use of wideband antennas for various applications has changed the world, which can transfer data at high rates and with secure transmission. Wideband antennas have been broadly classified mainly into two categories namely ultra wideband and super wideband. The data transmission for various ad-hoc networks was at a very less speed before the introduction of wideband antennas, so the research on ultra wideband and super wideband became a need to cope up with different faster devices. Ultra wideband based devices use frequencies from 3.1 GHz to 10.6 GHz and provide faster data rates for short range distances, but it was not still enough to provide the data rates for long range distances. So the research begun on super wideband antennas which provided high data rates for both long and short range distances, usable frequencies included beyond 10.64 GHz. The super wideband antennas at the start of the research were bigger in size which led to implementation of bigger devices, so again a compact device was needed to be installed for portable sizes.

This project concentrates on main factors i.e. compact size, high data transmissions and multiple applications using a single device and intends to provide good results which are a good agreement. A good device includes all the usable frequencies for different applications which are taken in consideration in this article. Working on a design which can include all applications with good results in comparison to other can lead to good progress in the field of antennas and can have a great effect of sensors too, the design gives better performance, high BDR (5.1 – 40.2) GHz and has a small size as compared to referred models.

II. ANTENNA DESIGN & DESIGN EQUATIONS

The objectives of the proposed design is to analyze super wideband antenna with suitable characteristics including stable radiation pattern and gain in order to achieve these objectives, the design is made quite simple with a defected ground with rectangular slots for achieving the maximum resonating frequencies which are more than seven. After inserting the first slot the first three frequencies are achieved and the last two slots help in achieving the remaining resonant frequencies. Slots are also made in patch too. These U-shaped slots in patch help to smoothly distribute the current and hence minimize the size of patch which results in the increasing impedance bandwidth. Antenna is printed on FR-4 substrate which is

Fig.1 designed model of front and back view
The simulated S11 of the designed antenna is shown in Fig.2. It can be seen that the antenna shows different bands of operation around 5GHz to 40GHz. The operation is made possible by slotting the patch and ground In order to get this The introduction of slots affects the surface current distribution, thereby increasing the current length path.

### III. PARAMATRICAL ANALYSIS

Optimization of different characters of an antenna can be studied through parametrical study. Parametric analysis of the effect of feedwidth is carried how and the graph depicts those results which are analyzed. How the effect is feedwidth on impedance matching varies and the better result for a stable feedwidth can be obtained. This study is carried out by varying feed width (L0) from 2.5 to 3.5mm at a step of 0.5mm. For L0=2.5mm, L0=3.5 mm the desired impedance matching of antenna is not obtained, but when the dimension of the feedwidth is fixed at 3mm good impedance matching is observed across the bands.

### IV. SIMULATED RESULTS

The entire analysis of the antenna is carried out on HFSS v.13.0. The substrate material used for the antenna design is FR-4 with \( \varepsilon_r = 4.4, h = \). Lumped port excitation method is used for excitation. The proposed structure has a volume of 1000mm³. Antenna dimensions are summarized in table1. Simulated results of s11 (Fig.3) are shown for frequencies of 7.4, 13.6, 17.4, 19.5, 23.4, 26.2, 35.2 GHz the reflection coefficient is below -20db. VSWR<2 for these resonating frequencies is shown in Figure3.Both the graphs show agood agreement.
The gain of the proposed structure is presented in Fig. 5. The gain at different resonating frequencies of 7.4, (b) 13.6, (c) 17.4, (d) 19.5, (e) 23.4 (f) 26.2 (g) 35.2 GHz are shown having nearly Omni-directional pattern in H-plane and bi-directional pattern in E-plane, at higher frequencies the distortion is observed in the pattern due to the losses in the patch.
IV CONCLUSION
A compact multiband Antenna is proposed which is suitable for many applications like 3G, 4G, UTMS, WiMAX, WLAN, WiFi and radar. The percentage bandwidth of different operating band is also at a suitable level to meet the bandwidth requirement. The antenna maintains suitable radiation characteristics which is an interesting feature of an antenna. The great advantages of antenna include smaller size and number of operating bands which is five. The size of the antenna is less than the compared models which gives it an edge to use it for mobile applications and to perform different operations under a single device. In general antenna is simple to design with printed on FR-4 substrate that is cost effective and readily available.

REFERENCES

Table 1: Comparison of proposed antenna with previously reported antennas

<table>
<thead>
<tr>
<th>Reference</th>
<th>Dimensions</th>
<th>Fractional BW%</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1]</td>
<td>31mmx45mm</td>
<td>181</td>
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Fig. 5: Gain of the proposed configuration at (a) 7.4, (b) 13.6, (c) 17.4, (d) 19.5, (e) 23.4, (f) 26.2, (g) 35.2GHz.


