Analysis of Multiband Antenna for WLAN/Wi-Max/IMT Application

Neerat Sharma
Chandigarh Engineering College, Landran, India
Department of Electronics and Communication

ABSTRACT— Inmodern technical world, various type of users and application based on different technologies including local Wi-Fi, Wi-Max gave rise to fast changing and growing communication which in turns gave rise to improvement of Multiband Antenna for better communication. In this paper, we focused on the analysis of the requirement of the various techniques such as Wi-Fi and Wi-Max for designing multiband antenna for better communication and for better experience for users. Therefore increase in Wireless communication system going to be Introduce worldwide the demand for wireless devices to support both old and new standard via single antenna becomes compulsory. The most immediate task for the new multiband antenna is to operate in both the new standard frequency band and the already established frequency bands. This is also a requirement on handheld devices to serve Cellular Bands and the new Multiband Microstrip Antenna that operates in Multi Frequency bands to Major Global Communication frequency bands including Bluetooth, Wireless LAN, and WiMax frequency band has to be designed.

INDEX TERMS— WLAN, WI-Max, Defected Ground Structure, Microstrip Antenna, Cellular Bands

I. INTRODUCTION

The vision of the wireless communication supporting information exchange between people and devices is the communication frontier of the next few decades. Multimedia communication will be a great possibility which can be anywhere from the world. Development of wireless local area networks (WLAN) and WIMAX (Worldwide Interoperability for Microwave Access) participated in the enhanced and optimized resources in the information and communication from last few years. Also, in the today's environment, technology demands antennas which can operate on different wireless bands and should have different features like low cost, minimal weight, low profile antennas that are capable of maintaining high performance over a chromatic spectrum of frequencies. This technological trend has much focused in the design of Microstrip patch antennas. Various types of technical concepts which are helpful in communication are explained below.

1) **WLAN:** Local Area Network which is based on wireless communication which is used to link more than two devices is known as WLAN. Access points are commonly used medium for providing wider connectivity of the devices in WLAN. The various different IEEE standards based on the various parameters like coverage, number of users and cost have been developed and implemented in variants such as 802.11, 802.11a, 802.11b, 802.11g, 802.11n. These standards are very useful in deciding the Ethernet connectivity to different communication mediums.

2) **Wi-Max:** There are many new changes occurred in wireless communication in last decades which enables the communication under wireless standards with high speed data transfer, low distortion and high reliability. One of the most common and effective technology based on wireless is known as Wi-Max which act as high-speed mobile Internet access medium to provide communication in wider scale to various type of devices. Communication including fixed communication and mobile internet communication can be carried by Wi-Max technology. Basic high speed Wi-MAX, nowadays provide fast speed up to 40 Mbit/s which is covered under IEEE 802.16m standard and with emergence of optical mediums, more speed up to 1 Gbit/s can be the possibility. Out of various standards based on IEEE, 802.16 standard act as the core of Wi-MAX technology and usaually with any add on features is said as Fixed Wi-MAX. Other standard based on IEEE such as 802.16d and 802.16e act as mobile mobile Wi-MAX.The mobile and fixed Wi-Max structures have many advantages and disadvantages dependent on the user and application for which these structures have been used. Coverage is one of the major advantages of fixed structures and mobility is the best feature of mobile structure. The explanation of the formal standard is as follow.

- The basic standard, 802.16 is also popular as 802.16d in last few decades, which signals to the working criteria of the standard. Due to the behavior it shown, it is more suitable to see it as Fixed Wi-MAX without carry capabilities of mobile communication.

- 802.16e-2005, often summarize to 802.16e, is an amendment to 802.16-2004. It introduced support for adjustability, among other things and is therefore also known as Mobile Wi-MAX.

- In Modern wireless communication process, antennas based on multiband properties have been playing a very essential part for wireless service requirements. Wireless local area network (WLAN) and Worldwide

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Interoperability for Microwave Access (WiMAX) have been widely applied in mobile devices such as handheld computers and intelligent phones. [3]

II. Objectives

Our proposed work is divided into various phases and we have done analysis on it for following objectives to fulfill.

- To design a square microstrip patch antenna for a multiple frequency with coaxial probe feeding techniques and compare the results and is to find best method for WLAN/WIMAX applications.
- A comparative study, design of a square multiband microstrip patch antenna using coaxial probe feeding techniques for different WLAN (Wireless Local Area Network) and WIMAX (Worldwide Interoperability for Microwave Access) bands.

III. Types of Antenna

Various type of antenna are available in market and some of the most popular antennas are as follows.

1) **Microstrip Path Antenna:** Microstrip patch antennas were first proposed in the 1970s by Howell and Munson[4] and since then a massive amount of research and development efforts have been put into it. This phenomenon has been accelerated due to its advantages over other antennas structures. This seems almost like the perfect antenna, but there is one main drawback, the bandwidth, which typically is from a fraction of a percent to a few percent depending on the substrate dielectric constant and thickness.

2) **Basic Patch Antenna Shapes and Geometries:** In its existing basic shape and form, antenna of microstrip patch contains radiating patch on single side of a dielectric substrate (useful material), and on the other side, it is almost a ground plane as shown in Figure 3.1.

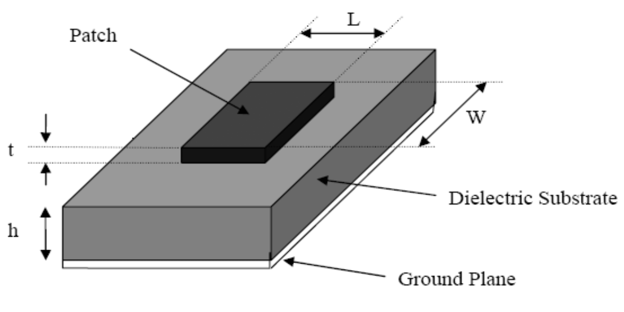

Figure 1: Microstrip patch structure for basic antenna

The patch is generally made of conducting material such as copper or gold and can take any possible shape [6]. The radiating patch and the feed lines are usually the dielectric substrate is etched with photo on it [7].

In order to simplify analysis and performance prediction [3], the patch is generally square, rectangular, circular, triangular [4], and elliptical or some other common shapes as shown in Figure 2 [5]. Rectangular patches are probably the most utilized patch geometry. It has the largest impedance bandwidth compared to other types of geometries, and is the main research interest in this project. Circular and elliptical shapes are slightly smaller than of rectangular patches. Thus it will have smaller bandwidth and gain. This circular geometry patches were difficult to analyze due to its inherent geometry. Triangular patch is even smaller than both rectangular and circular geometries. However, this will produce even lower gain and smaller bandwidth. It will also produce higher cross-polarization due to its unsymmetrical geometry [4]. Dual polarized patch could be generated from these geometries. Circular ring patches has relatively the smallest conductor size, but at the expense of bandwidth and gain [6][8][9]. Furthermore, for this geometry, it will not be easy to excite lower order modes and obtain a good impedance match for resonance. Non-contacting forms of excitation are normally turned to for this shape.

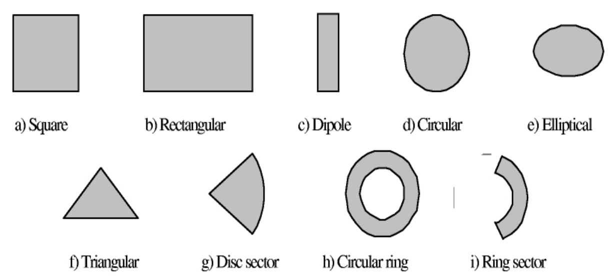

Figure 2: Common shapes of microstrip patch elements.

For a rectangular patch, the length L of the patch is 0.3333 λo< L< 0.5λo, where λo<< is the free-space wavelength. The patch is selected to be very thin such that t<<λo (where t is the patch thickness). The height h of the dielectric substrate is 03333.0≤ h ≤ 0.5λo. The dielectric constant of the substrate is typically in the range $2.2<\epsilon_r<2.2$

Microstrip patch antennas radiate primarily because of the fringing fields between the patch edge and the ground plane. For good antenna performance, a thick dielectric substrate having a low dielectric constant is desirable since this provides better efficiency, larger bandwidth and better radiation [4]. However, such a configuration leads to a larger antenna size.

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IV. Experimentation

The geometry of proposed antenna which is coaxial fed for WLAN/WI-MAX/IMT applications is depicted in figure 5.9. In which the antenna parameter are same as above but there is a change DMS (Defected microstrip Structure) and uses normal ground plane.

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The dimensions of the designed antenna with coaxial feed are same as,

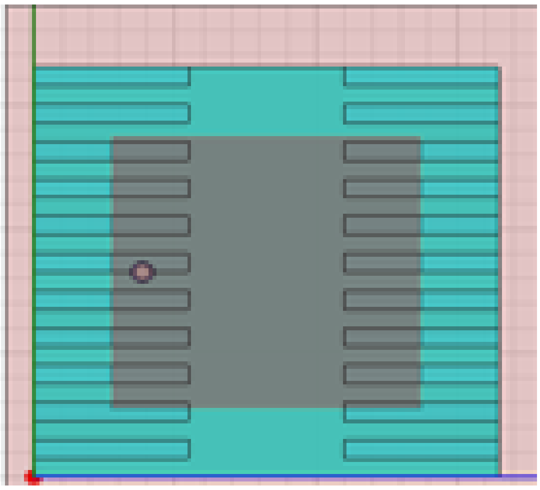

Figure 3: Geometry dimension of proposed antenna with DMS.

The return loss plot for the designed antenna with coaxial feed is shown in figure 4 as below. The 10 dB bandwidth as shown in the table 1.

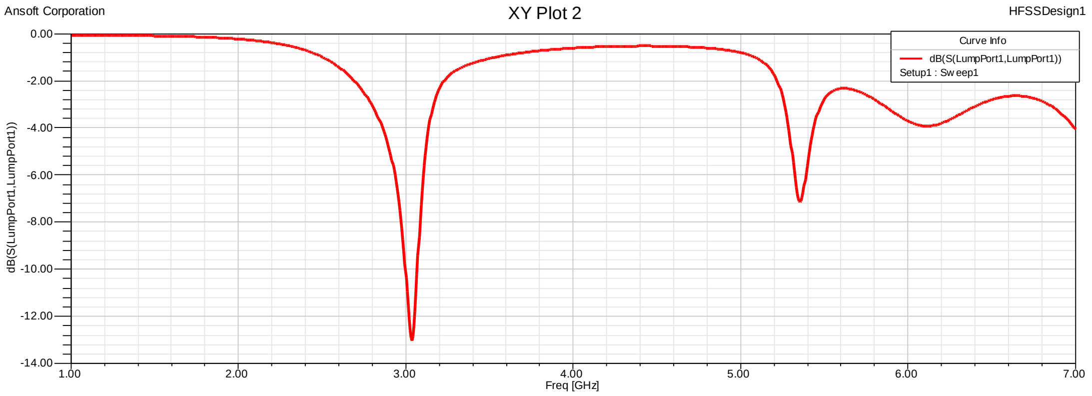

Figure 4: Simulated return loss [S11]

Figure 5 shows the radiation pattern plot for the proposed antenna with using DMS.

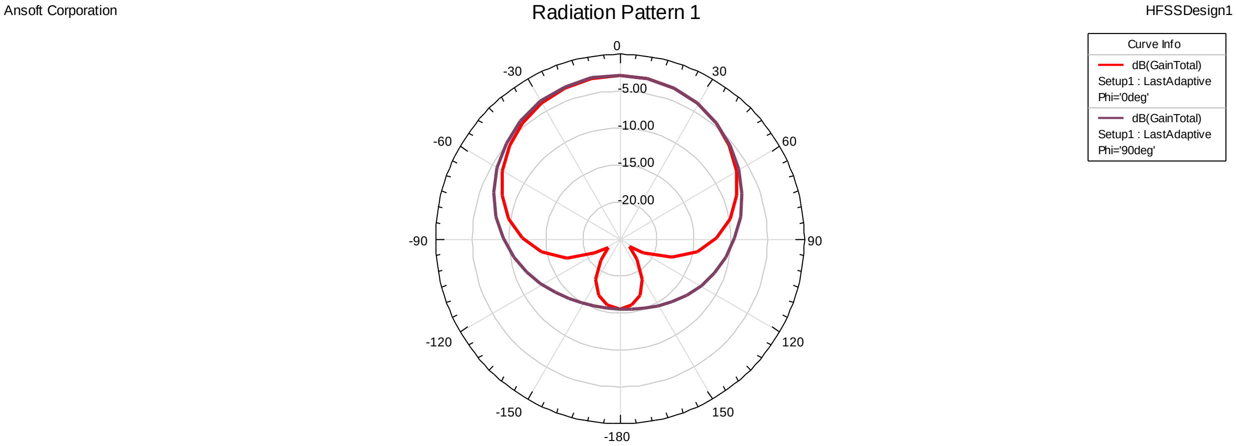

Figure 5: Radiation pattern plot

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The VSWR (voltage standing wave ratio) plot for the design antenna (coaxial feed) with using DMS is shown in figure 6. The value of VSWR is shown in the table 1

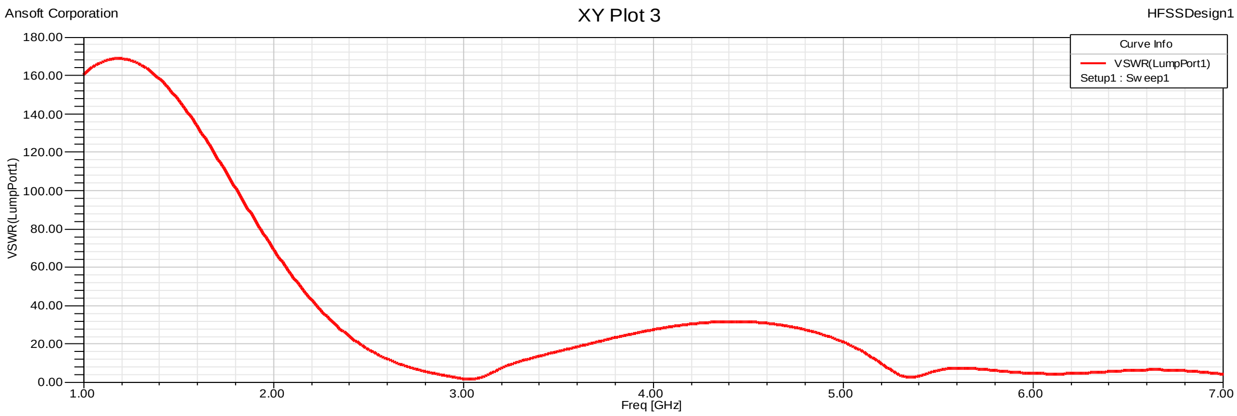

Figure 6: VSWR Plot

SR.NO	FREQUENCY (GHZ)	RETURNLOSS (DB)	BANDWIDTH (GHZ)	VSWR
1	3.0	-12.97	3.00-3.07	1.95

Table 1: Summarized results of the proposed antenna with DMS.

V. CONCLUSION

In this work, We have done some basic analysis about communication of various technologies vaialble for communication and also described the importance of antenna design for the communication process.
This our continuous research for designing antenna design for WLAN, Wi-Fi, Wi-Max technology for making the communication better.

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