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Planar Printed Quasi-Yagi Antenna for Millimeter Wave Applications- A Review

Syed Dawar Mehdi Rizvi, Kapil Bhushan

M.Tech Student (Microwave Engineering), Dept. of Electronics & Communication Engineering, SRMS CET Bareilly, UP, India

Asst. Professor, Dept. of Electronics and Communication Engineering, SRMS CET Bareilly, UP, India

ABSTRACT: Today is the world of wireless communication. High speed wireless communication is the most desirable and demanding need for the wireless communication needed today. Off course it is evident that for imperative wireless communication the role of an antenna is always important. The need here to consider the millimeter wave band for the consideration is the fact that there is an unprecedented amount of bandwidth present in the 60GHz band which can support multiple Gbps of data transfer speed which is the most appealing feature of this band.

KEYWORDS: Quassi Yagi Uda antenna, millimeter wave applications, 60 Ghz band applications, planar antennas for millimeter bands .

I. INTRODUCTION

An Antenna constitutes the most fundamental part of a wireless communication system. The basic way of defining an antenna it could be called as the interface between the feed guided media and the space as we know that the impedance of the free space is nearly 377ohm where as the the characteristics impedance of the transmission line is 50 ohm so there is definitely a significant impedance mismatch which is responsible for the transmission line’s inability to radiate significantly in the free space. So technically an antenna could also be defined as an interface between the two medias with different impedances that is it acts as an impedance matcher we can correlate this concept with the maximum power theorem of the networks in which it was told there is maximum transfer of power from the source to the load end when the characteristic impedance of the line or circuit is equal to the characteristic impedance of the load circuitry.

There are many types of antennas possible depending upon the needs and the requirement of the system where its application is to be made. Yagi Uda antennas has always been considered due to simplicity in design, high gain, directivity and low cost. It was realized that the conventional Yagi antennas were limited in their applications due to their size, poor bandwidth and poor ability to tune but when this design was implemented in the microwave are on the micro strip basis it attracted so many researchers to optimize the same. The first micro strip fed Yagi Uda Radiator by developed by Sir Huang, since than it has been researched a lot by so many scholars and researchers. Again the Quassi Yagi Uda antenna is popular in its version due to light weight, ease of fabrication, high directivity and easy RF compatibility with microwave ICs.

As we have discussed the merits of the Quassi Yagi Uda antennas it is evident that we should consider the issues which can be considered as the demerits of such antennas. The most considerable issue is that the narrow bandwidth of the Quassi Yagi Uda design which is not there in case of the traditional Yagi Uda antenna.

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II. STUDY

Before Designing a quassi Yagi Antenna It is important for a Designer to study different points about the design as well as the about the applications where it will be implemented. Main points to consider are as follows:

- Features of the Quassi Yagi Antenna
- Behaviour of the design for different band of frequencies.
- Design considerations
- Gain and Bandwidth
- Compatibility to work as an array element also.

III. COMPARISION OF THE TRADITIONAL YAGIUDA WITH THE QUASSI YAGI PLANAR ONE

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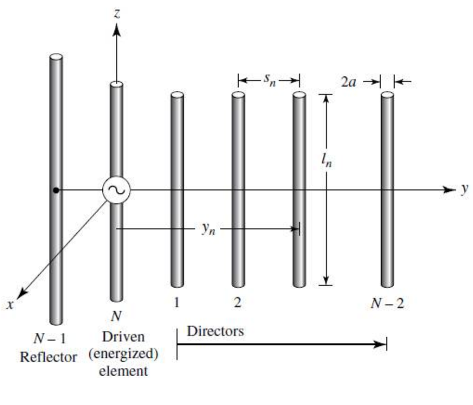
The Classic Yagi Uda Antenna was invented by Shintaro Uda and Hidetsugu Yagi in 1926. It has been used for decades for the Amateur radio, Tv and satellite reception. To achieve the end-fire beam formation, the parasitic elements in the direction of the beam are somewhat smaller in length than the feed element. Typically the driven element is resonant with its length slightly less than λ/2 (usually 0.45–0.49λ) whereas the lengths of the directors should be about 0.4 to 0.45λ. However, the directors are not necessarily of the same length and/or diameter. The separation between the directors is typically 0.3 to 0.4λ, and it is not necessarily uniform for optimum designs. It has Been shown experimentally that for a Yagi-Uda array of 6λ total length the overall gain was independent of director spacing up to about 0.3λ. The length of the reflector is somewhat greater than that of the feed. In addition, the separation between the driven element and the reflector is somewhat smaller than the spacing between the driven element and the nearest director, and it is found to be near optimum at 0.25λ.



Schematics of the classical Yagi Uda Antenna [6]

In 1991John Huang proposed a micro strip fed Quassi-Yagi Uda Antenna for mobile vehicle applications. There are certain basic similarities between the planar and the classical design of the Yagi antenna but there are a lot of difference also hence it is called as Quassi Yagi Design.

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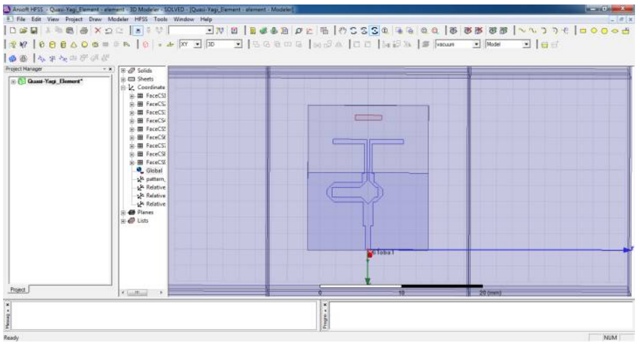

Schematics of the Quassi Yagi element (One Director and truncated Gnd plane)

The Quassi Yagi element contains a driven dipole which is the element which is fed through a differential output where as the design is fed by a single output of a micro strip line and therefore a balun is needed to incorporate the change. The purpose of the balun is to convert the single input into the differential one and also the acts as an impedance matcher between the two sections of the design.

IV. ANALYSIS AND CHARACTERISTICS OF THE QUASSI YAGI ANTENNA

As already discussed while comparing the classical design with the Quassi Yagi Design we noticed that the Quassi Yagi design suffers from poor Bandwidth.
Several methods of improving the bandwidth of the Quassi Yagi antenna has been proposed in the open literature and some of them are discussed below.

So many research paper have explained that Bandwidth of the Quassi Yagi Uda element can be increased by increasing the width of the substrate as or otherwise with the distance between the patch and the ground plane the bandwidth also increases. [9]-[15]

Improvement in the return loss is possible by altering the structure of the balun which increases the input impedance of the design and also maintain the impedance matching due to which the overall return loss decreases but on the other hand it might add to the complexity of the design and bandwidth also decreases so there could be a possibility of a tradeoff between the return loss and the bandwidth of the overall design.

Gain of the Quassi Yagi is less compared to the classical Yagi Uda and there are many methods in the literature for the improvement of the gain.

One such method is increase in the no of directors in the element but that is limited to a certain extent also there is a trade off with the bandwidth of the design.

In some research paper the use of meta materials is described for the gain enhancement of the antenna which will have the limitation that it could be used only for that specified band in which the meta material shows the properties. These artificial materials are made up of many periodic element cells, which can be either resonant cells, such as electric resonators and magnetic resonators or non-resonant cells such as the I-shaped structures . Great interests have been focused on meta-based antennas [4][5]

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V. FUTURE SCOPE

As we noticed that 60 GHz band being the ISM this could be utilized for very high data rate wireless communication.

We know that the previous and exsisting technologies in Wi-Fi were using the frequency 2.45GHz (IEEE802.b/g) and 5 GHz (IEEE802.a) but IEEE has proposed a new standard of the Wi Fi that would be in the 60 GHz band (IEEE802.ad). The WiGig specification allows devices to communicate without wires at multi-gigabit speeds. It enables high performance wireless data, display and audio applications that supplement the capabilities of previous wireless LAN devices.

The formation of the WiGig alliance to promote the **IEEE 802.11ad** protocol was announced in May 2009. The completed version 1.0 WiGig specification was announced in December 2009.In May 2010, WiGig announced the publication of its specification, the opening of its Adopter Program, and the liaison agreement with the Wi-Fi Alliance to cooperate on the expansion of Wi-Fi technologies. In June 2011, WiGig announced the release of its certification-ready version 1.1 specification.

The WiGig specification allows devices to communicate without wires at multi-gigabit speeds. It enables high performance wireless data, display and audio applications that supplement the capabilities of previous wireless LAN devices. WiGig tri-band enabled devices, which operate in the 2.4, 5 and 60 GHz bands, deliver data transfer rates up to 7 Gbit/s, about as fast as an 8-band 802.11ac transmission, and more than 11 times faster than the highest 802.11n rate, while maintaining compatibility with existing Wi-Fi devices. The 60 GHz signal cannot typically penetrate walls but can propagate off reflections from walls, ceilings, floors and objects using beamforming built into the WiGig system. When roaming away from the main room, the protocol can switch to make use of the other lower bands at a much lower rate, both of which can propagate through walls.

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