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# Types of Microwave Antenna and Its Applications

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**Abstract:** *This paper represents the classification of microwave antenna and its applications. Microwave antenna is a type of antenna which is operated at microwave frequency and they are widely used in many practical applications. A microwave antenna is a major system component that allows a microwave system to transmit and receive data between microwave sites. Microwave have wavelengths ranging from 1 meter to 1 millimeter. Microwaves are mainly used in satellite communication.*

**Keywords: Microwave Antenna, Classification of antenna**

## Introduction

A Microwave Antenna is a physical transmission device used to broadcast microwave transmissions between two or more locations. Mainly used to convert electronic signals to electromagnetic waves.

### A Antenna Definition

According to the IEEE Standard Definition of Terms "an antenna is any device that converts electronic signals to electromagnetic waves (and vice versa) effectively with minimum loss of signals.

### B Radiation Pattern

It is the representation of field strength at a particular distance from antenna at all points in space. It consists of two principle planes namely E-plane (electric field plane) and H-plane (Magnetic field plane).

### C Effective aperture

Antenna aperture is defined as the area of opening of the antenna. Effective aperture is defined as that area through which the Electromagnetic waves are transmitted considering into account the mismatch losses, conductor-dielectric losses and polarization losses.

### D Directivity

It is defined as the ratio of radiation intensity of an antenna in given direction over that of an isotropic antenna. It can also be defined as the ratio of radiation intensity in given direction to the average radiation intensity in all directions.

### E Directive gain of antenna

The gain is also known as the directive gain of antenna. Gain takes into account the efficiency as well as the directional capabilities of the antenna. Gain is the product of efficiency and directivity. An antenna which has larger aperture will have more gain.

### F Antenna beam area

It is denoted by $\Omega_A$. It is the solid angle through which all of the radiated power by an antenna would flow if power maintains its maximum value over $\Omega_A$ and zero elsewhere. It is also defined as the angle subtended by half power point in the main lobe in two principle planes.

### G Antenna lobes

An antenna can neither radiate all of the energy in one particular direction nor can it radiate equally in all directions. Often peaks are formed in the radiated energy. These peaks are called lobes. The direction where maximum energy is radiated contains the major lobe. The lobe just opposite to the major lobe is known as the back lobe. All the remaining lobes in the remaining directions are called as side lobes.

### I. Classification of antenna

Antennas can be classified on the basis of:

1.Frequency

2.Apertures

3.Polarization

4.Radiation

This paper represents detailed classification of antennas based on their frequency.

### Classification of antenna based on frequency

1. VLF antenna

2. LF antenna

3. HF antenna

4.VHF antenna

5.Microwave antenna

An antenna which is operated at microwave frequency is known as the microwave antenna. There are various types of antenna which have numerous applications. The following are the different types of microwave antenna.

1.Micro strip patch antenna

2.Horn antenna

3.Parabolic antenna

4.Plasma antenna

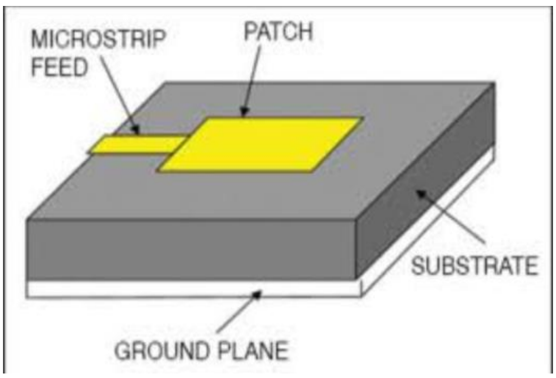
5.MIMO antenna

**Horn antennas**

Horn antennas are a natural evolution of the idea that any antenna represents a region of transition between guided and propagated waves. So generally, horn antennas are connected to the feed at the rear and are flared outwards. The feed is given by the waveguide. Horn antennas are possible in many shapes like rectangular, circular and elliptical. The best patterns of radiation (narrow main lobe and low side lobe) are obtained by making length of the horn large as compared to the aperture width. But the space occupied by antenna should also be taken into consideration. Thus, while designing, there is a tradeoff between size and aperture area.

**Micro strip patch antennas**

The first practical antennas were developed in the 1970's. since then, microstrip antennas have been extensively researched and developed. This is because structure of a microstrip antenna is a radiating metallic patch on a thin grounded dielectric material. These antennas are generally available in rectangular and circular shape. The patch is generally made from conducting materials like copper and gold. These antennas are based on photolithographic technology, that is, the patch as well as the feed lines are photo etched on the dielectric substrate. Microstrip patch antennas have become a part of revolution in the electronics industry due to the developments in large scale integration. These antennas are helpful in eliminating the disadvantages of bulkiness and expensiveness of regular antennas.

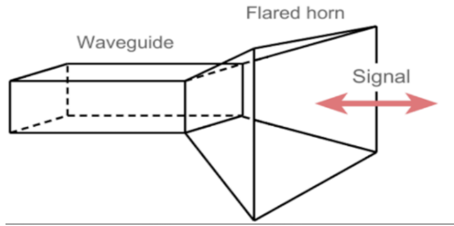


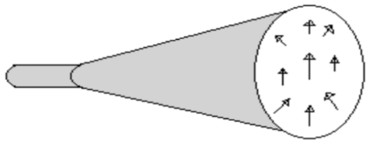

**Applications:**

1.Global positioning satellite

2.Paging

3.Cellular phones



Conical Horn Antenna

**Applications**

1.Used as feed for parabolic antennas in satellite systems.

2.Used for moderate power gain.

1.

**Parabolic antenna**

A parabolic antenna is also known as a reflector. It has a curved surface with cross section of a parabola. It is also known as a dish antenna or parabolic dish. Its basic construction is such that the feed is directed to the vertex of the parabola and the feed itself is placed at the focus, thus giving a very high directivity. As directivity is directly proportional to gain, its gain is also very high. Parabolic reflectors are used for high frequencies. This is because narrow beam widths can be achieved by using a reflector much larger than the wavelength. So, for realizable size of antenna, smaller wavelengths or very high frequencies are preferred. Thus, microwaves are ideal for use in these types of antennas.

**Applications:**

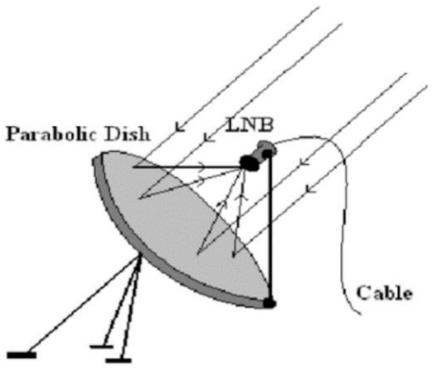
1.Used for high power gains.

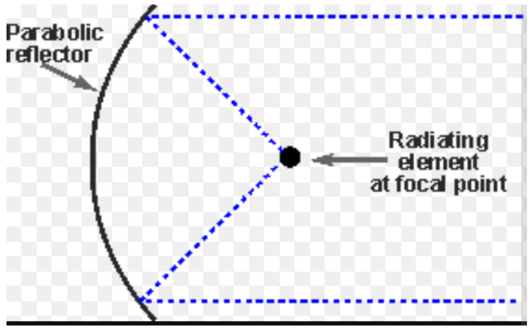
2.Point to point communication.

3.Radio telescopes

4.Television signals

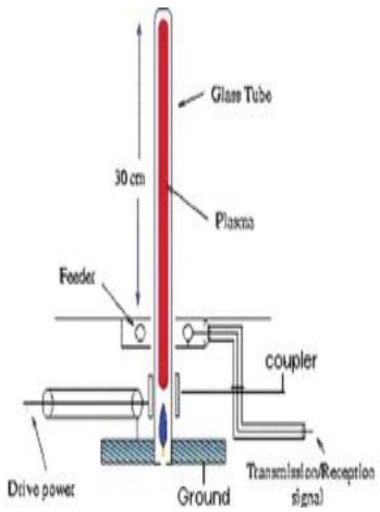
5.Satellite communication.




**Plasma antenna**

A plasma antenna is a column of ionized gas which uses plasma as a medium instead of metal components. The electron behavior of plasma antenna is completely different from that of metal antenna. In the plasma antenna, the functioning concept is altogether different. It is due to ‘electrons in free space’ rather than ‘electrons moving freely.’ One fundamental distinguishing feature of a plasma antenna is that the gas ionizing process can manipulate resistance. When de-ionized, it has infinite resistance and hence it does not react with RF. when ionized, it will have some resistance due to which it will react with EM waves. Plasma can be made to appear and disappear according to the signal frequency applied to the antenna.




**Features and applications:**

1.Reflectors-If EM wave frequency is smaller than plasma frequency the wave is reflected or absorbed, this is used in radar absorbing material.

2.Stacking-Plasma antenna can be stacked onto one another for different frequencies, like the inner antenna can be designed for low frequency and the outer antenna for higher frequencies.

3.High speed digital communication

4. Mobile industry- If the plasma silicon antennae are used in towers, the towers would be able to transmit denser beams and provide more phone support than traditional antennae

**MIMO**

In radio, multiple input and multiple output is the use of multiple antennas at both the transmitter and the receiver end to improve communication performance. The multiple signals arrive at the receivers at different times in different phases, depending on the different paths they take. Some signals will be direct, others via multiple different paths. With this special multiplexing, each signal is unique as defined by the characteristics of the path it takes. The unique signatures produced by each signal over the multiple paths allow the receivers to sort out the individual signals using algorithms implemented by DSP techniques. The same signals from different antennas then can be combined to reinforce one another, improving signal-to-noise ratio and, therefore, the reliability and range.

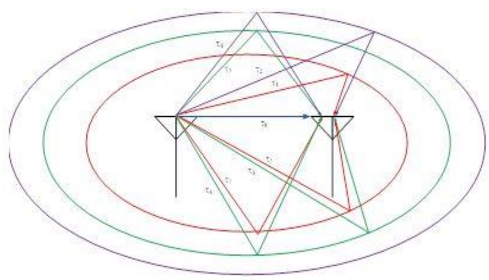


Figure 1: Multipath Channel Model Illustration.

**Features and applications:**

1.WiFi 802.11n communication- for 11n Wi-Fi, the data to be transmitted is scrambled, encoded, and interleaved and then divided up into parallel data streams, each of which modulates a separate transmitter. Multiple antennas then capture the different streams, which have slightly different phases because they have travelled different routes, and combine them back into one.

2.RFID

3.Mesh networks

## Conclusion:

We have discussed the use of microwave antenna as an essential part of wireless communication and furthermore had an overview about the applications for the same, understanding from the scratch the terms and definitions of antenna. The antenna discussed are used in various applications mainly Radar and satellite communication.

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