ANTENNA TYPES

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ANTENNA :

The antenna is one of the critical components in any wireless communication system. The word 'antenna' is derived from Latin word 'antemna.' Since the first demonstration of wireless technology by Heinrich Hertz and its first application in practical radio communication by Guglielmo Marconi, the antenna has been a key building block in the construction of every wireless communication system. IEEE defines an antenna as "a part of a transmitting or receiving system that is designed to radiate or receive electromagnetic waves."

CLASSIFICATION

Antennae could be broadly classified as wire antennae, aperture antennae, printed antennae, array antennae, reflector antennae and lens antennae.

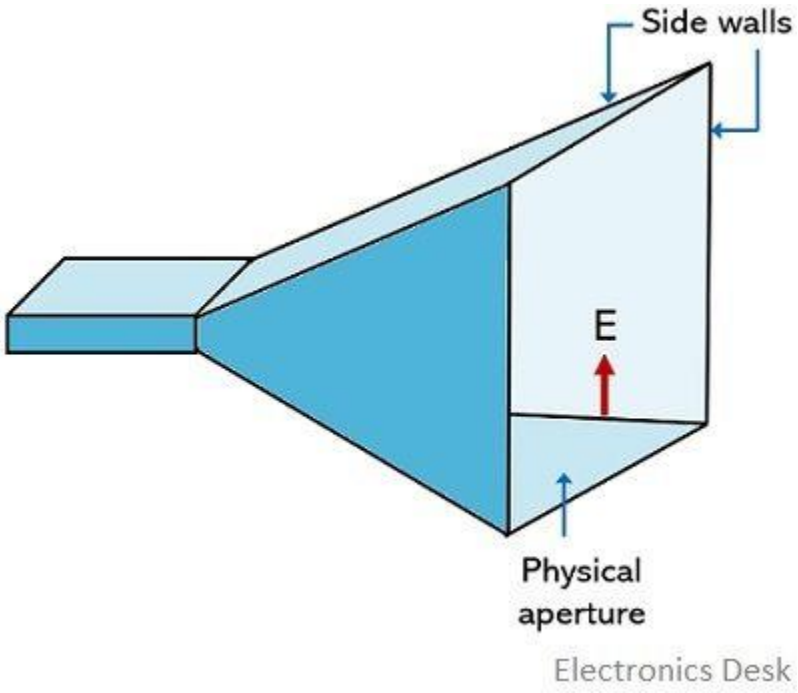
WIRE ANTENNA

This is the basic type of an antenna, widely used on top of the buildings, automobiles, ships and spacecrafts. These antennae are made into different shapes such as a straight wire (dipole), loop and helix.

APERTURE ANTENNA

These antennae are in the form of a slot or aperture in a metal plate and commonly used at higher frequencies (3-30 GHz). Typical examples are slotted waveguide antennae and horn antennae. These antennae are very useful for aircraft and spacecraft applications, because they can be conveniently flush mounted on the surface of the aircraft or spacecraft.

In practice, these antennae are covered with a dielectric material to protect them from hazardous environmental conditions.



PRINTED ANTENNA

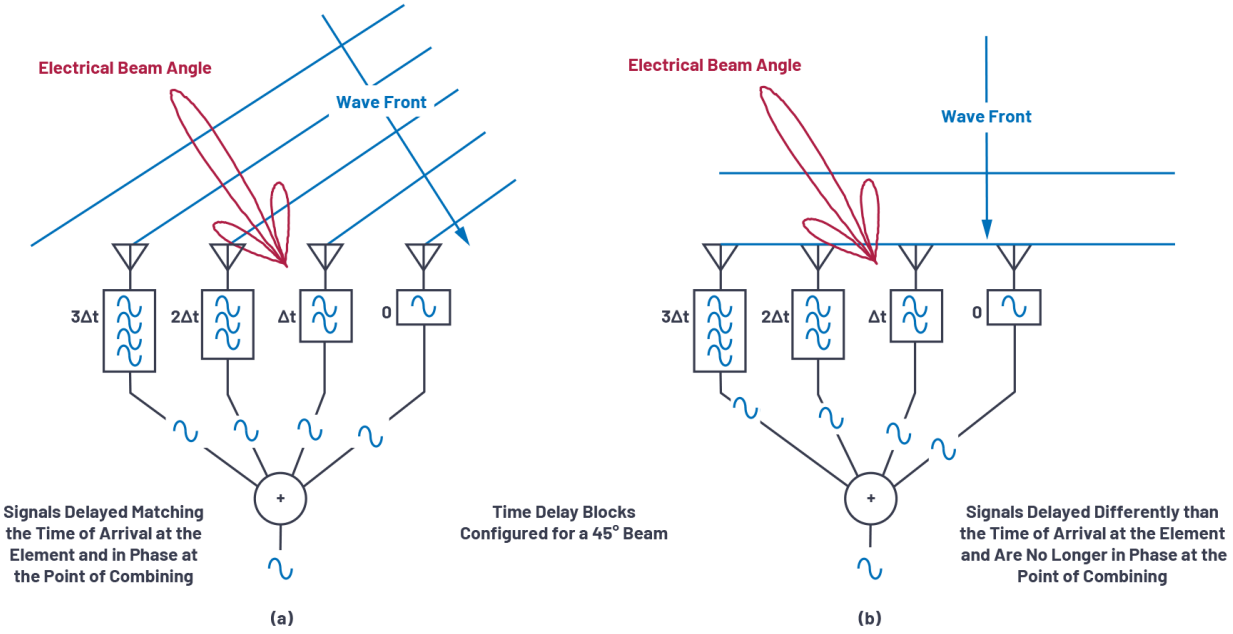
By definition, a printed antenna is one that is fabricated using standard photolithography technique. The most common version of printed antenna is microstrip antenna, which consists of a metallic patch above a ground plane. The shape and size of patch determine the frequency of operation of the antenna and its performance.

These antennae are more popular because of their low cost and ease of fabrication, and easy integration with circuit components. Printed antennae are inexpensive to fabricate using modern printed circuit technology, and are

conformal to planar and non-planar surfaces. These antennae can be easily mounted on the surface of aircrafts, spacecrafts, satellites, missiles and even on handheld mobile devices.

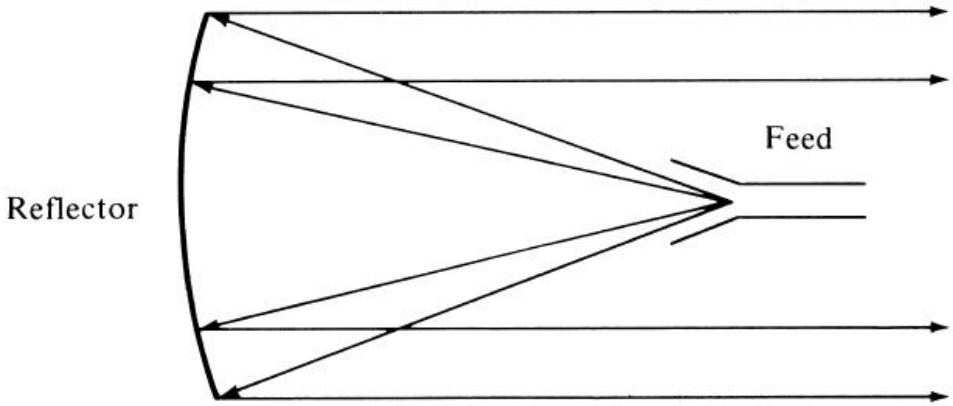
ARRAY ANTENNA

In an array antenna, several radiators separated from each other are geometrically arranged to give desired radiation characteristics that are not possible to achieve with a single independent radiating element. The arrangement of array elements is such that radiation from individual elements adds up to give the maximum radiation in a particular direction or directions, and minimum radiation in other directions. In practice, individual radiators are arranged in linear or planar grid depending on the application.

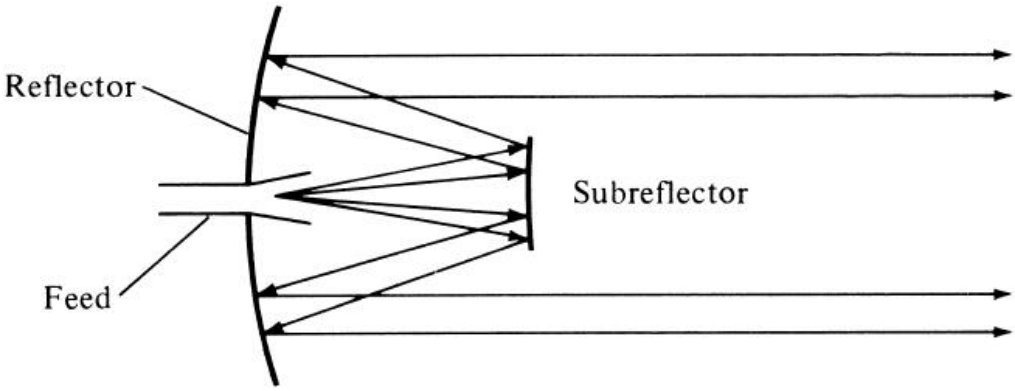


REFLECTOR ANTENNA

These antennae are specifically used in applications requiring communication over long distances, such as outer space exploration and satellite communication. They are built with large diameters in order to achieve the high gain required to transmit or receive signals over very long distances. The reflector antenna usually uses a smaller antenna as the feed.



(a) Parabolic reflector with front feed



(b) Parabolic reflector with Cassegrain feed

LENS ANTENNA

In these antennae, lenses are used to collimate the incident divergent energy to prevent it from spreading in undesired directions. By choosing the appropriate material and setting the geometrical configuration of lenses, they can transform various forms of divergent energy into plane waves. Lens antennae are classified according to the material from which they are constructed or their geometrical shapes.

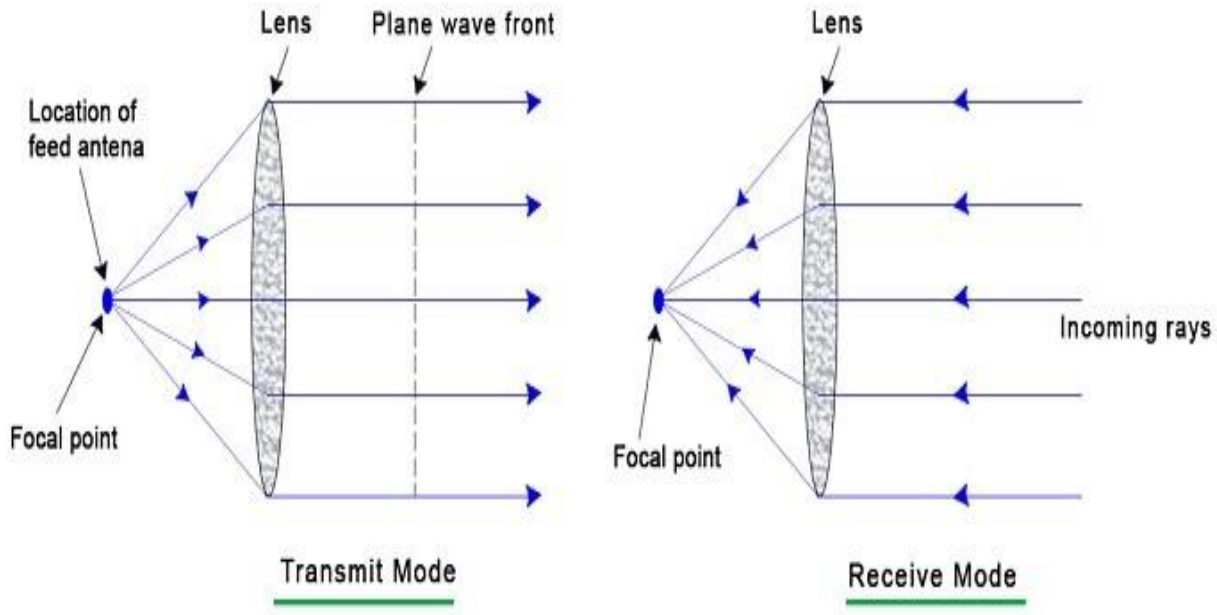


TABLE I

Operating Frequency and Applications of Different Antennae

Antenna type	Frequency of operation	Application area
Wire antenna	300-3000 kHz (MF)	AM broadcasting, maritime radio, coast guard communication, direction finding
	3-30 MHz (HF)	Telephone, telegraph and facsimile, amateur radio, ship-to-coast and ship-to-aircraft communication
Aperture antenna	3-30 GHz (SHF)	Airborne radar, microwave links, satellite communication
Printed antenna	3-30 GHz (SHF)	Airborne radar, microwave links, satellite communication
	30-300 GHz (EHF)	Radar
Array antenna	300-3000 kHz (MF)	AM broadcasting, maritime radio, coast guard communication, direction finding
	3-30 MHz (HF)	Telephone, telegraph and facsimile, amateur radio, ship-to-coast and ship-to-aircraft communication
Reflector antenna	30-300 MHz (VHF)	Television, FM broadcast, air traffic control, police, navigational aids
	300-3000 MHz (UHF)	Television, satellite communication, surveillance radar, navigational aids
Lens antenna	30-300 MHz (VHF)	Television, FM broadcast, air traffic control, police, navigational aids
	300-3000 MHz (UHF)	Television, satellite communication, surveillance radar, navigational aids

Note: MF-medium frequency, HF-high frequency, VHF-very high frequency, UHF-ultra-high frequency, SFH-super-high frequency, EHF-extremely high frequency