EFFECTIVE APERTURE AND RADIATION PATTERN OF ANTENNA

the predicted power available P_o, the polarization of the incoming waves must match the polarization of the antenna, and the load (receiver) must be impedance matched to the antenna's feed point impedance.

Aperture and gain

The directivity of an antenna, its ability to direct radio waves in one direction or receive from a single direction, is measured by a parameter called its gain, which is the ratio of the power received by the antenna to the power that would be received by a hypothetical isotropic antenna, which receives power equally well from all directions.

It can be shown that the aperture of a lossless isotropic antenna, which by definition has unity gain, is:

$$A_{eff} = \frac{\lambda^2}{4\pi}$$

where, λ is the wavelength of the radio waves. So the gain of any antenna is proportional to its aperture:

$$G = \frac{4\pi A_{eff}}{\lambda^2} = \frac{4\pi A_{phys} e_a}{\lambda^2}$$

Radiation pattern

Radiation pattern is one of the important characteristic of an antenna as tells the spatial relative distribution of the electromagnetic wave generated by the antenna. The radiation pattern is a plot of the magnitude of the radiation field as a function of direction (θ,□). The radiation pattern is essentially a 3-D surface.

In the field of antenna design the term radiation pattern (or antenna pattern or far-field pattern) refers to the directional (angular) dependence of the strength of the radio waves from the antenna or other source.

Particularly in the fields of fiber optics, lasers, and integrated optics, the term radiation pattern, or near-field radiation pattern, may also be used as a synonym for the near-field pattern or Fresnel pattern.

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This refers to the positional dependence of the electromagnetic field in the near-field, or Fresnel region of the source. The near-field pattern is most commonly defined over a plane placed in front of the source, or over a cylindrical or spherical surface enclosing it.

The far-field pattern of an antenna may be determined experimentally at an antenna range, or alternatively, the near-field pattern may be found using a near-field scanner, and the radiation pattern deduced from it by computation. The far-field radiation pattern can also be calculated from the antenna shape by computer programs such as NEC. Other software, like HFSS can also compute the near field.

The far field radiation pattern may be represented graphically as a plot of one of a number of related variables, including; the field strength at a constant (large) radius (an amplitude pattern or field pattern), the power per unit solid angle (power pattern) and the directive gain. Very often, only the relative amplitude is plotted, normalized either to the amplitude on the antenna boresight, or to the total radiated power. The plotted quantity may be shown on a linear scale, or in dB. The plot is typically represented as a three dimensional graph (as at right), or as separate graphs in the vertical plane and horizontal plane. This is often known as a polar diagram.

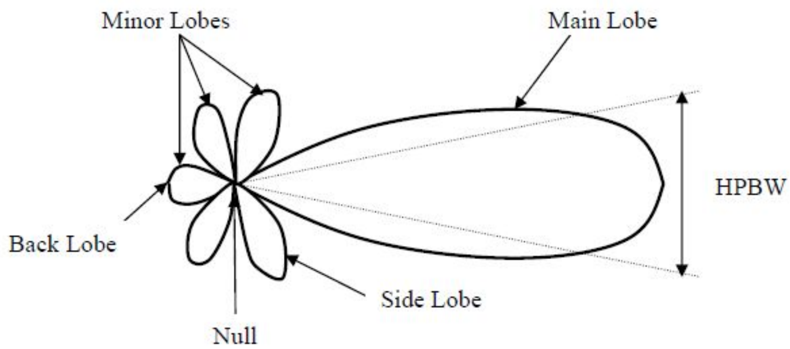

Fig 5 Radiation Pattern

There are various parts of radiation pattern:

1. **HPBW:** The half power beamwidth (HPBW) can be defined as the angle subtended by the half power points of the main lobe.
2. **Main Lobe:** This is the radiation lobe containing the direction of maximum radiation.

3. **Minor Lobe:** All the lobes other then the main lobe are called the minor lobes. These lobes represent the radiation in undesired directions. The level of minor lobes is usually expressed as a ratio of the power density in the lobe in question to that of the major lobe. This ratio is called as the side lobe level (expressed in decibels).
4. **Back Lobe:** This is the minor lobe diametrically opposite the main lobe.
5. **Side Lobes:** These are the minor lobes adjacent to the main lobe and are separated by various nulls. Side lobes are generally the largest among the minor lobes.