Ammar Yasser Mohamed

Student at Faculty of Engineering Helwan university

Report1: Antenna Parameters

Introduction

Antennas are a critical component in communication systems, enabling the transmission and reception of electromagnetic waves. This report discusses the fundamental parameters that characterize antenna performance, including: radiation pattern, gain, directivity, bandwidth, impedance, VSWR, polarization, efficiency, radiation resistance, and antenna temperature.

1) Radiation Pattern

Definition: The radiation pattern describes the distribution of power radiated by the antenna as a function of direction in space.

Types:

- **Omnidirectional**: Radiates equally in all directions.
- **Directional**: Radiates more power in specific directions.
- **Beamwidth**: The angular width of the main lobe.

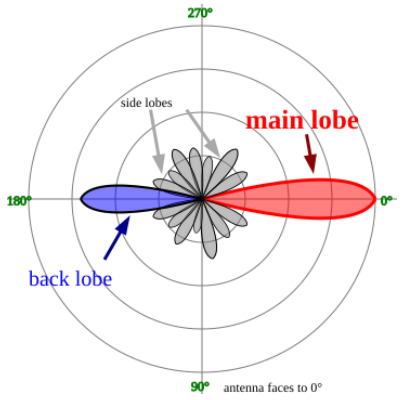

Figure 1: Example of a radiation pattern.

2) Gain

Definition: Gain measures the ability of the antenna to direct radiated power in a specific direction compared to an isotropic source.

Unit: Decibels (dB).

3) Directivity

Definition: Directivity is the ratio of the maximum radiation intensity in a given direction to the average radiation intensity.

Relationship with Gain: *Gain = Directivity* $\times$ *Efficiency*.

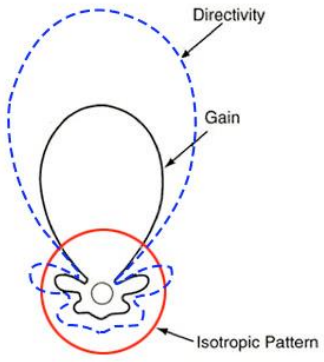

Figure 2: Relationship between gain and Directivity.

4) Bandwidth

Definition: The range of frequencies over which the antenna operates effectively.

Types:

- **Impedance Bandwidth**: Range of frequencies over which the impedance is matched.
- **Frequency Bandwidth**: Range of frequencies over which the antenna performs efficiently.

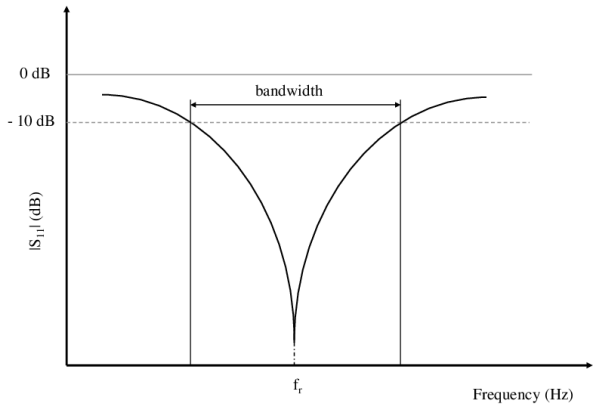

Figure 3: Example of Frequency bandwidth which the antenna performs efficiently

5) Impedance

Definition: The antenna's resistance to the flow of current and voltage, typically given in ohms (Ω).

Importance: Matching antenna impedance with the transmission line and receiver is crucial for maximum power transfer.

6) VSWR (Voltage Standing Wave Ratio)

Definition: VSWR is a measure of impedance matching of the antenna to the transmission line.

Ideal Value: 1:1 (perfect match).

7) Polarization

Definition: Polarization refers to the orientation of the electric field of the radiated wave.

Types:

- **Linear**: Electric field oscillates in a single plane.
- **Circular**: Electric field rotates in a circular manner.
- **Elliptical**: A general form of polarization, which includes linear and circular as special cases.

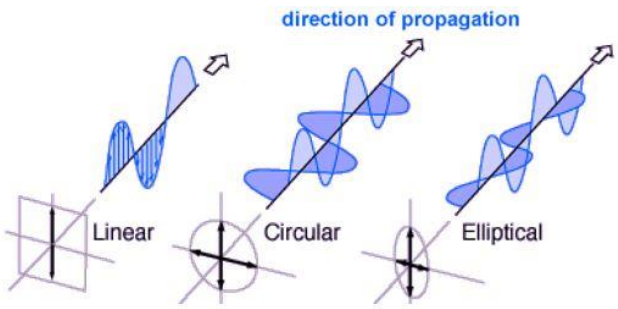

Figure 4: Example of types of polarization

8) Efficiency

Definition: Efficiency is the ratio of the power radiated by the antenna to the total power input to the antenna.

Factors: Material losses, mismatch losses, etc.

9) Radiation Resistance

Definition: Radiation resistance is the part of an antenna's input impedance that represents radiation of energy.

Importance: Higher radiation resistance generally indicates better efficiency.

10) Antenna Temperature

Definition: Antenna temperature is a measure of the noise power output by the antenna in terms of temperature.

Relevance: Important in satellite and radio astronomy applications.

Conclusion

This report has summarized the key parameters that characterize antenna performance. Understanding these parameters is essential for designing and using antennas effectively in various communication systems.