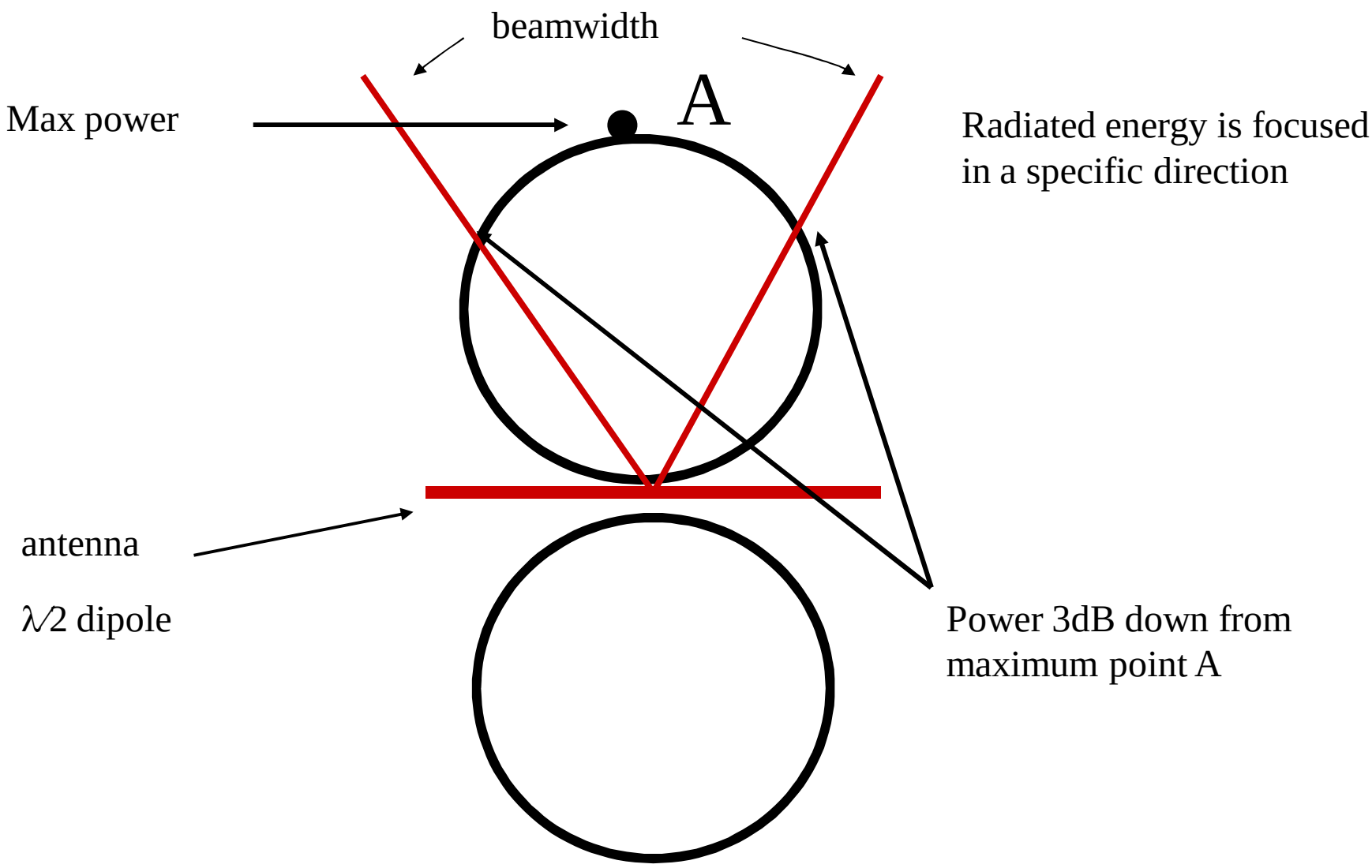
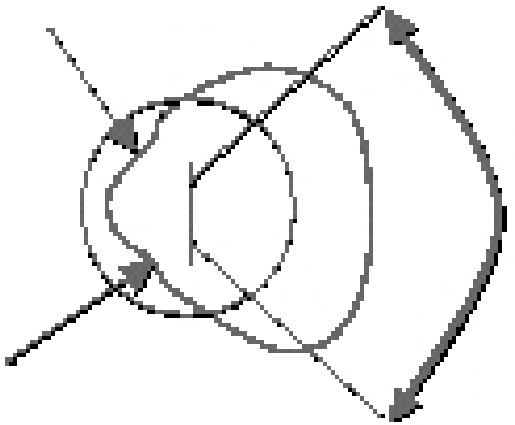
Directional Antenna

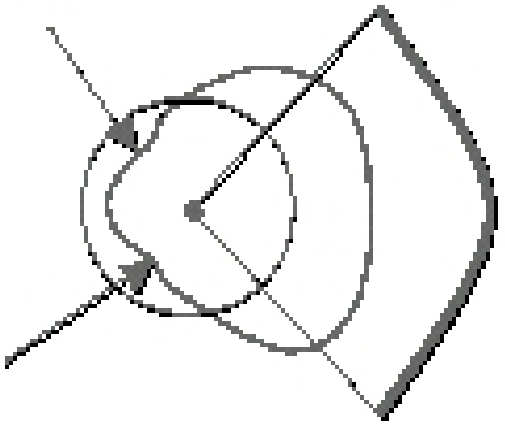


Directional Antennas

- For directional antennas the lobes are pushed in a certain direction, causing the energy to move be condensed in a particular area
- Very little energy is in the back side of a directional antenna



Side View
(Vertical Pattern)



Top View
(Horizontal Pattern)

Antenna Array

- ***Antenna array*** is a group of antennas or antenna elements arranged to provide the desired directional characteristics.
  - Generally any combination of elements can form an array.
  - However, equal elements in a regular geometry are usually used.

Isotropic Radiators(Contd..)

- Then the radiation intensity for this isotropic antenna U_i can be written as:

$$U_i = r^2 S = \frac{P}{4\pi}$$

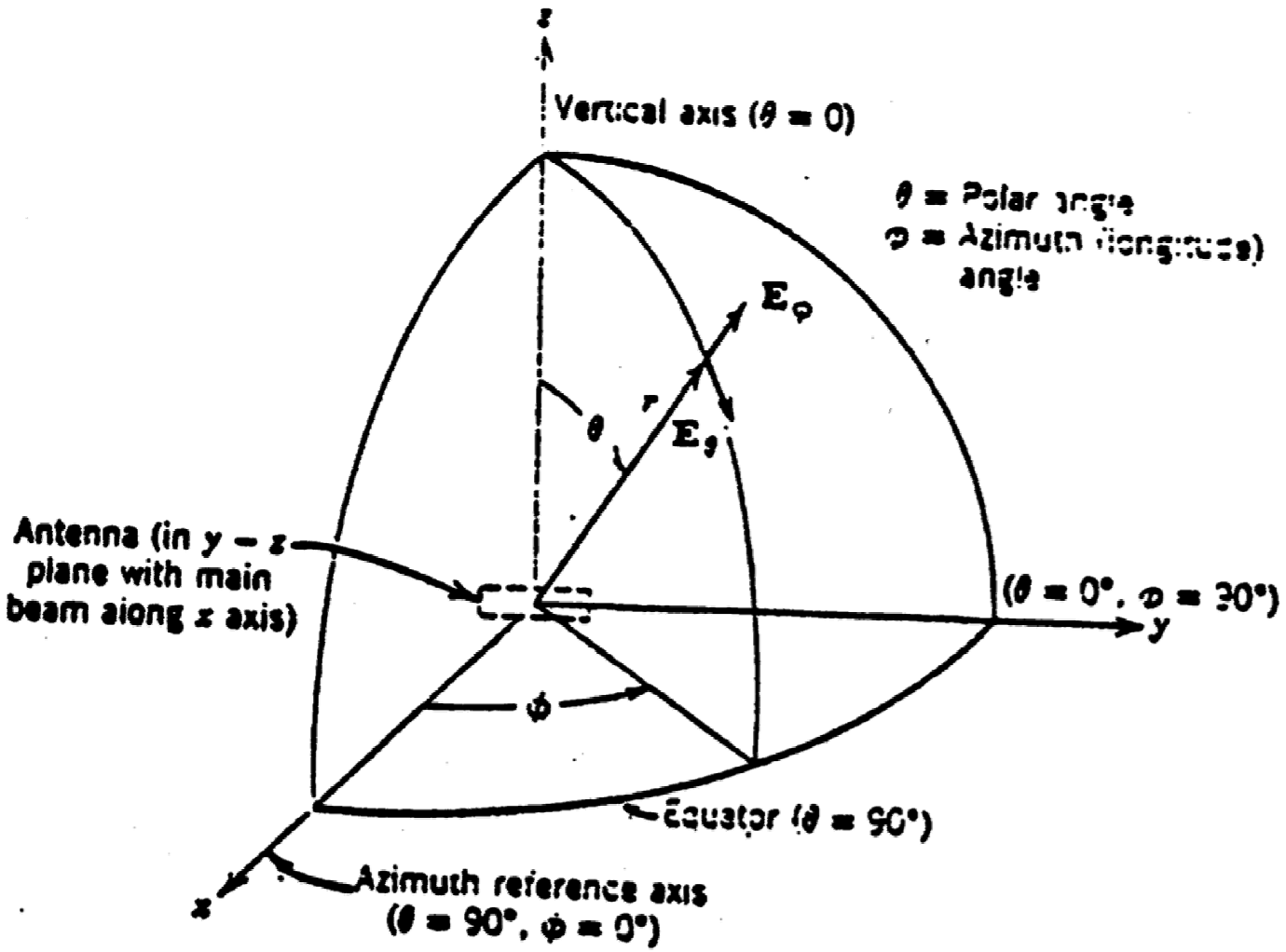
❖ ***NOTE:*** An isotropic antenna is not possible to realize in practice and is useful only for comparison purposes.

Radiation Pattern

Graphical representation of the relative distribution of the radiated power in space is called a radiation pattern.

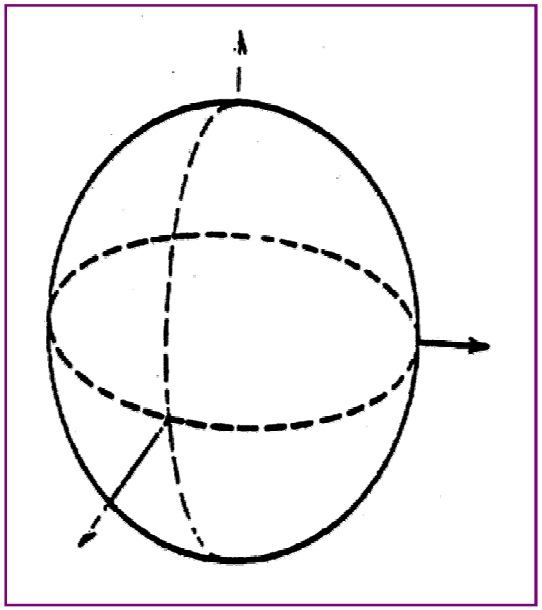
- ✓ is an indication of radiated field strength around the antenna.
- ✓ Power radiated from a $\lambda/2$ dipole occurs at right angles to the antenna with no power emitting from the ends of the antenna.
- ✓ Optimum signal strength occurs at right angles or 180° from opposite the antenna.
- ✓ In most cases, the radiation pattern is determined in the far-field region.
- ✓ Radiation properties include radiation intensity, field strength, phase or polarization

Coordinate System



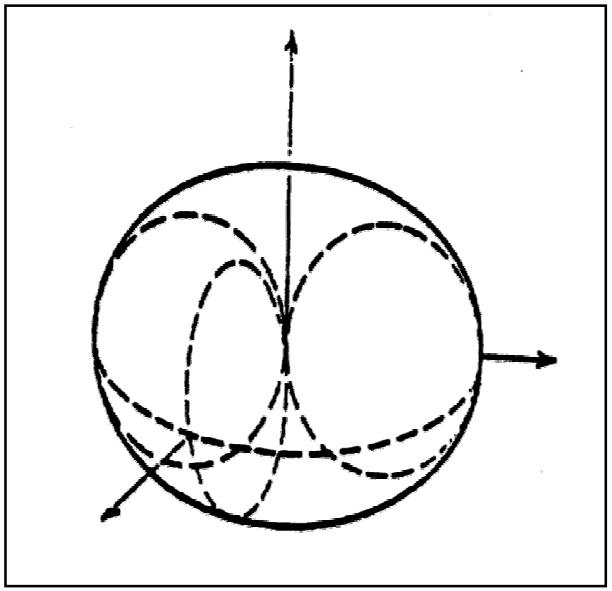
Types of Radiation Patterns

Idealized
Point Radiator



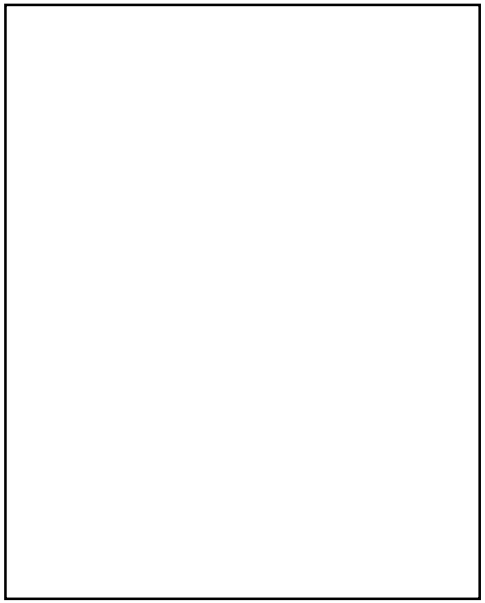
Isotropic

Vertical Dipole



Omnidirectional

Radar Dish



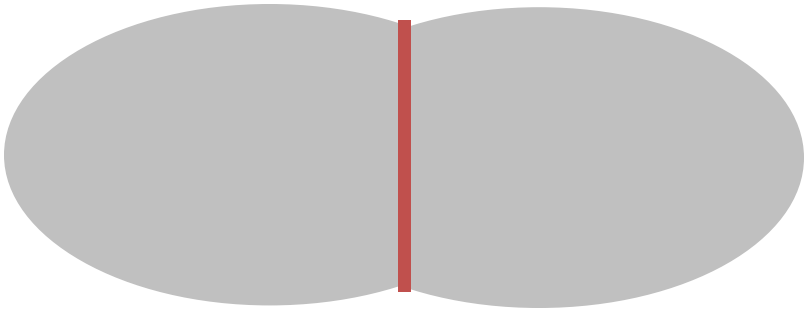
Directional

a) ***Isotropic pattern*** is the pattern of an antenna having equal radiation in all directions. This is an ideal (not physically achievable) concept. However, it is used to define other antenna parameters. It is represented simply by a sphere whose center coincides with the location of the isotropic radiator.

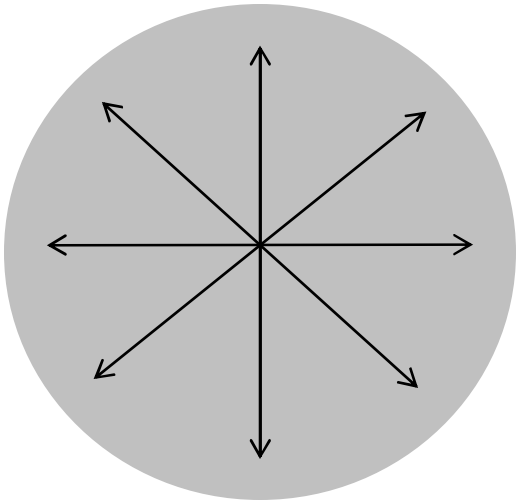
b) ***Directional antenna*** is an antenna, which radiates (receives) much more efficiently in some directions than in others. Usually, this term is applied to antennas whose directivity is much higher than that of a half-wavelength dipole.

c) ***Omnidirectional antenna*** is an antenna, which has a non-directional pattern in a given plane, and a directional pattern in any orthogonal plane (e.g. single-wire antennas).

Omni directional (Dipole) Antennas…



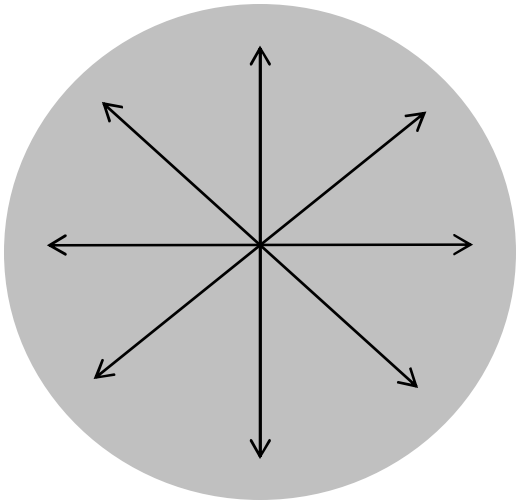
Dipole Side-View



Coverage Area – Top View

Omni directional (Dipole) Antennas…

Coverage Area – High-gain
Side View

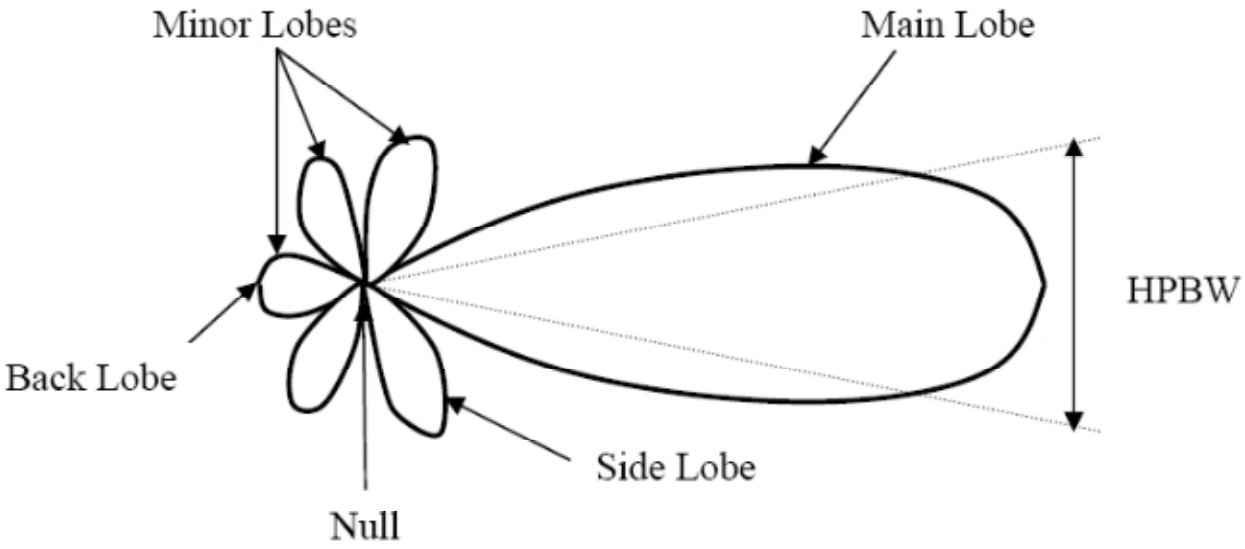


Coverage Area – Top View

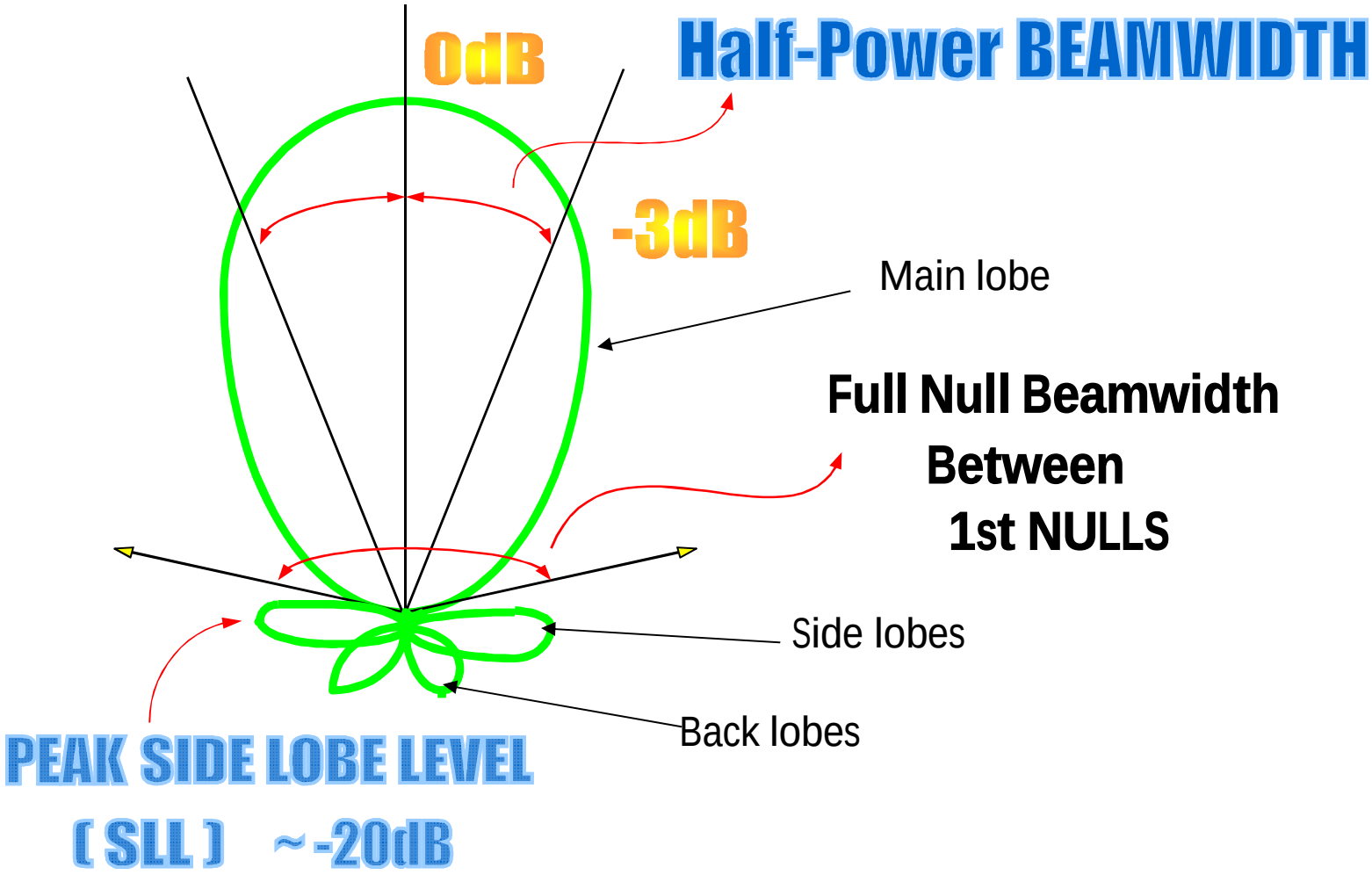
Radiation Pattern(Cond..)

- A more practical type is the directional antenna which radiates more power in some directions and less power in other directions.
- A special case of the directional antenna is the omni directional antenna whose radiation pattern may be constant in one plane (e.g.E-plane) and varies in an orthogonal plane (e.g. H-plane).
- The radiation pattern plot of a generic directional antenna is shown in Fig :

Radiation pattern of a generic directional antenna



Radiation Pattern Lobes



Definitions

- **HPBW:** half power beamwidth (HPBW) can be defined as the angle subtended by the half power points of the main lobe.

- **Main Lobe:** Radiation lobe containing the direction of max. radiation.

- **Minor Lobe**: All the lobes other then the main lobe are called the minor lobes.

✓ These 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).

- **Back Lobe**: This is the minor lobe diametrically opposite the main lobe.

- **Side Lobes**: These are the minor lobes adjacent to the main lobe and are separated by various nulls.

✓ Generally the largest among the minor lobes.

✓ In most wireless systems, minor lobes are undesired. Hence a good antenna design should minimize the minor lobes.