

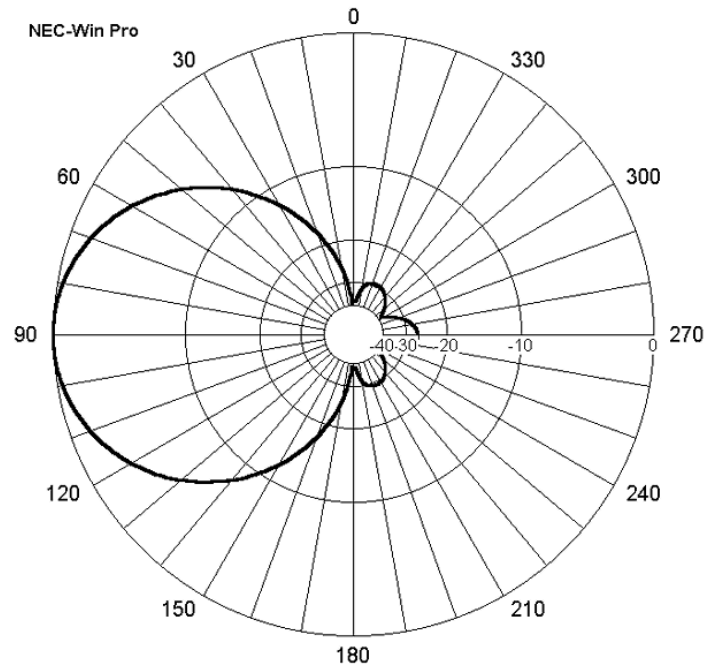
Antenna Types

S.M. Riazul Islam, PhD

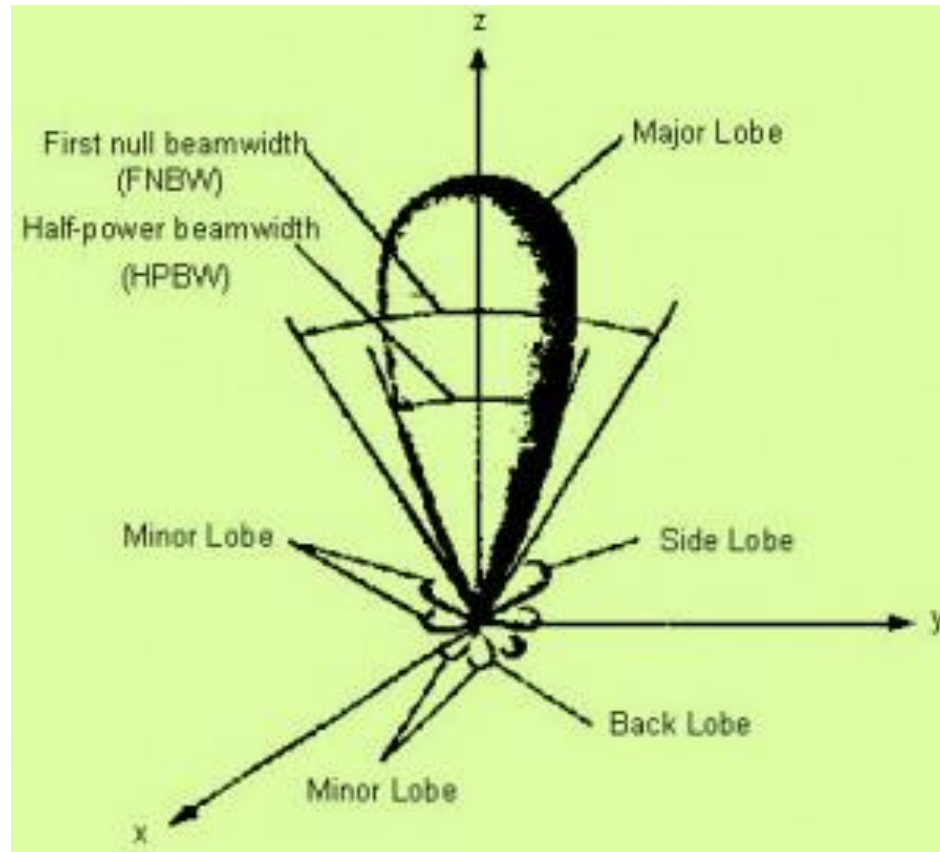
Antenna Types: Parameters

- **Radiation resistance** relates the power supplied to the antenna and the current flowing into the antenna.
- **Antenna pattern** shows a distribution of radiated power as a function of direction in space. The **directivity** and **gain** are related parameters; the directivity measures the antenna's ability to concentrate its power in a given direction and the gain is the ratio of power radiated to input power.
- **Antenna BW** refers to the frequencies available outside the center frequency. For ex, a 10MHz transmitter with 10% bandwidth could send information on frequencies from 9 MHz to 11Mhz.
- **Signal-to-noise ratio** is the relationship between the desired information signal and the noise. It must exceed 1 for any information to be transferred.

$$R_{rad} = \frac{P_{rad}}{I^2}$$

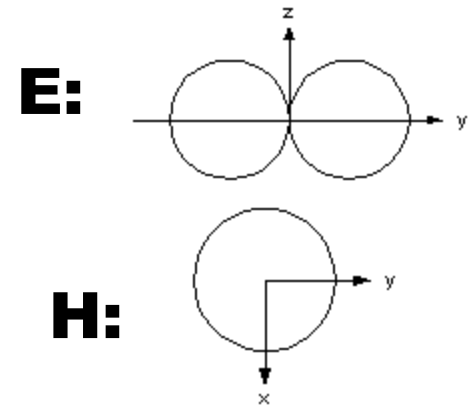
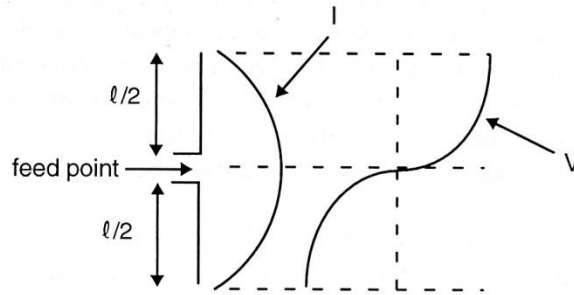
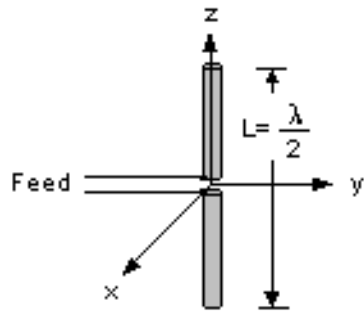


Antenna Types: Radiation Pattern

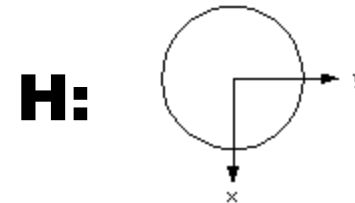
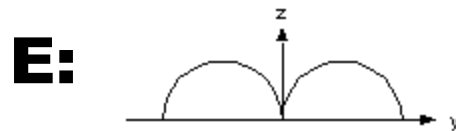
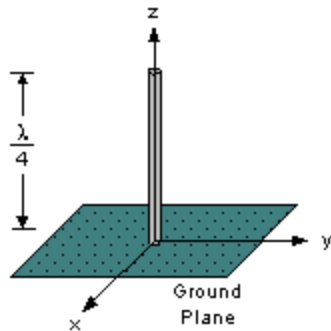


Antenna Types

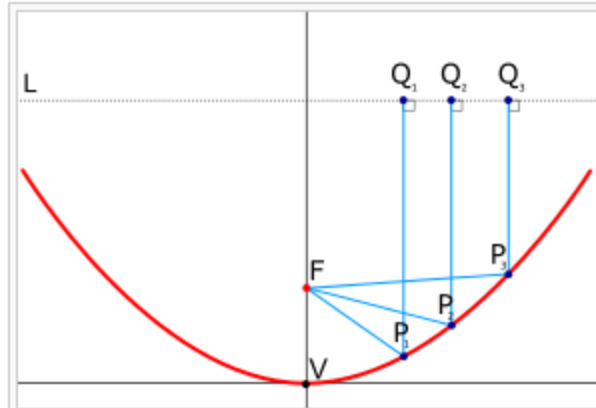
- Half-Wave Dipole



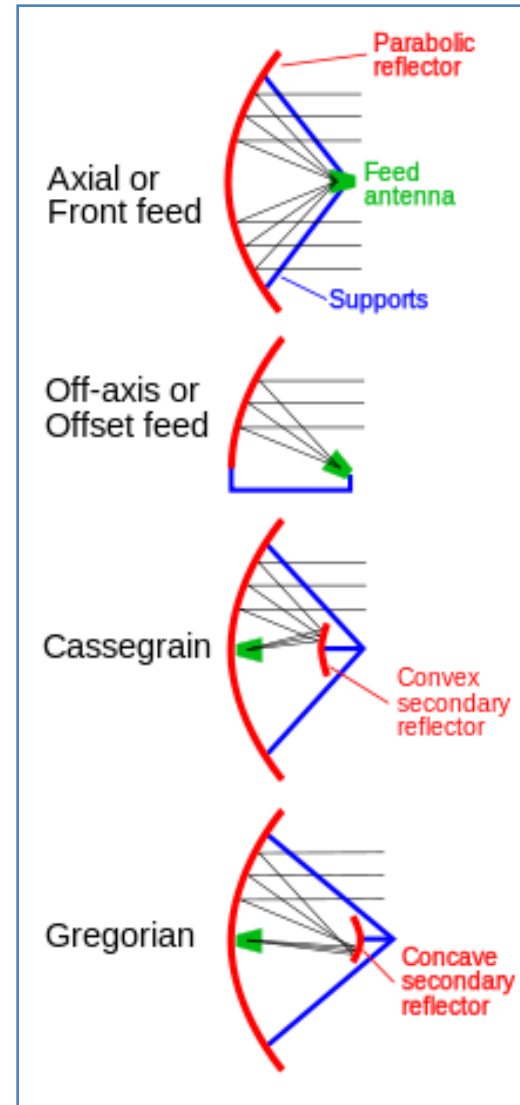
- Half-Wave Monopole



Antenna Types

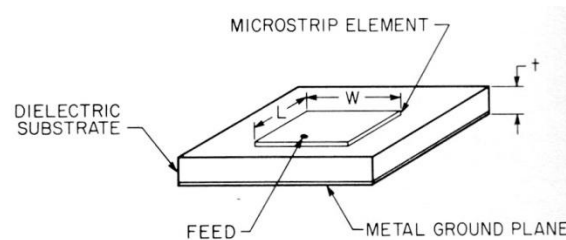
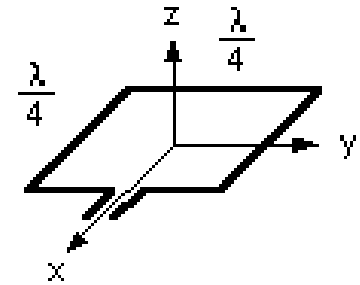
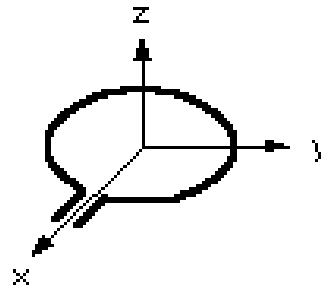


- Parabolic Antenna: uses a parabolic reflector, a curved surface with the cross-sectional shape of a parabola: Parabolic dish, cylindrical, array of feeds.
- Axial/Front Feed, Cassegrain (Convex/Concave) Feed etc



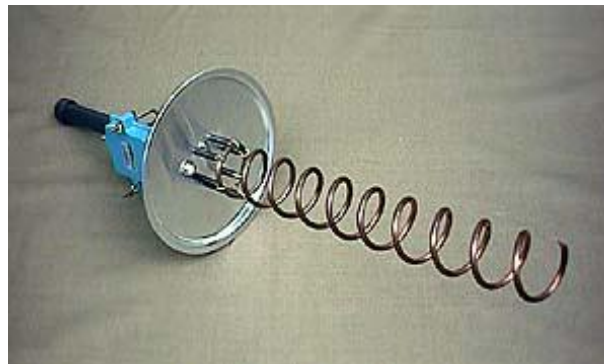
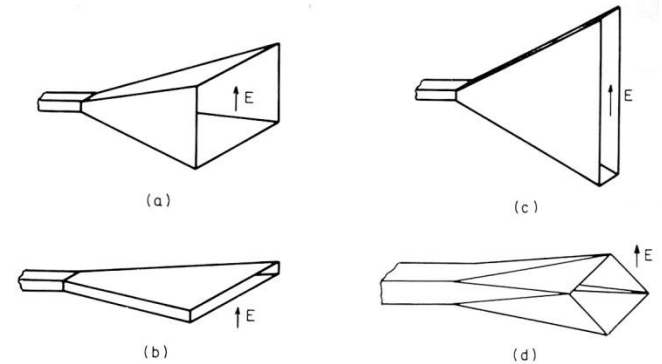
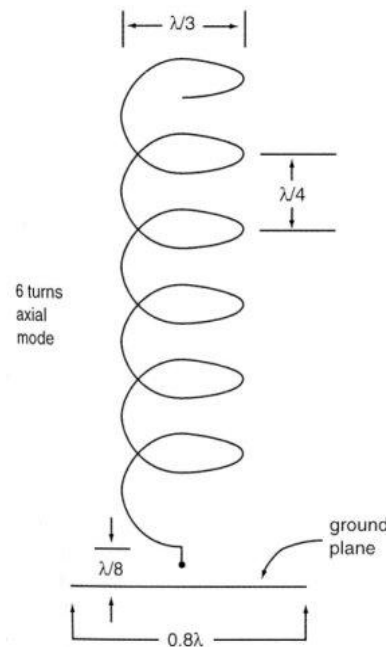
Antenna Types

- Loop antennas are very useful as receivers, especially for low frequencies when dipoles would become very large.
- Microstrip or patch antennas are often manufactured directly on a printed circuit board. The dielectric between the two rectangular conductors is simply the printed-circuit substrate. These antennas are generally built for devices that require small antennas, leading to frequencies usually in the gigahertz.



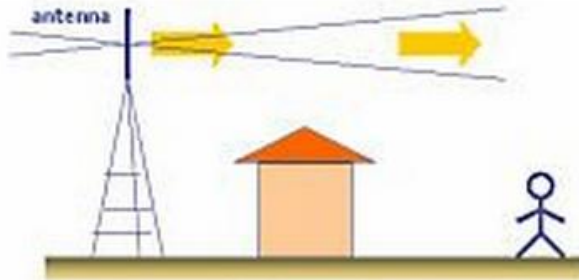
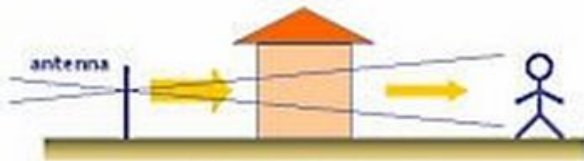
Antenna Types

- Helical antennas are used because they are circularly polarized. They radiate in both the vertical and horizontal directions, unlike the dipole which only radiates normal to its axis.
- Horn antennas are obviously very directional. The shape of the horn determines if the electric or magnetic fields are maximized. The gain is very high in the direction of the horn's axis.



Antenna Types: Sector Antenna

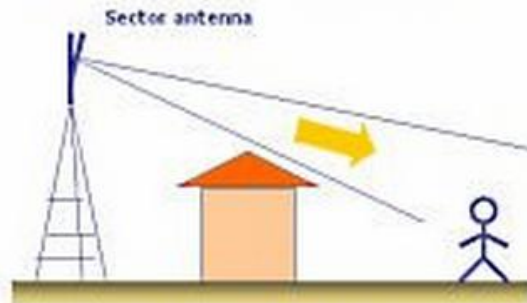
◆ Omni-directional limitations



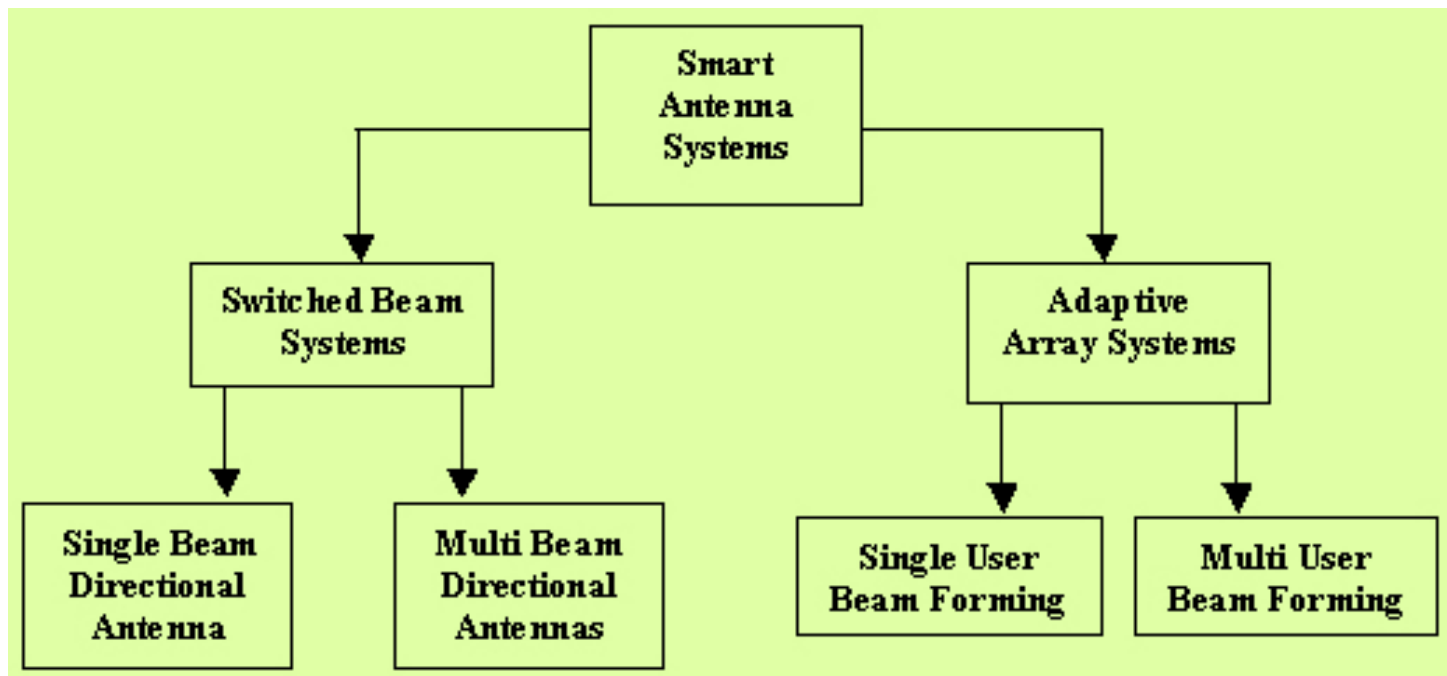
◆ Down-tilt Omni-directional



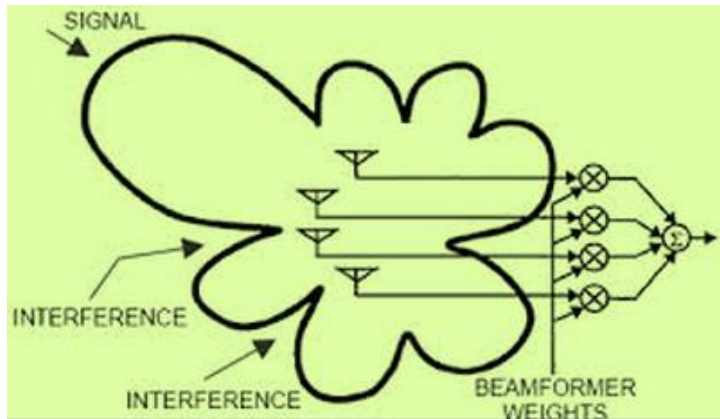
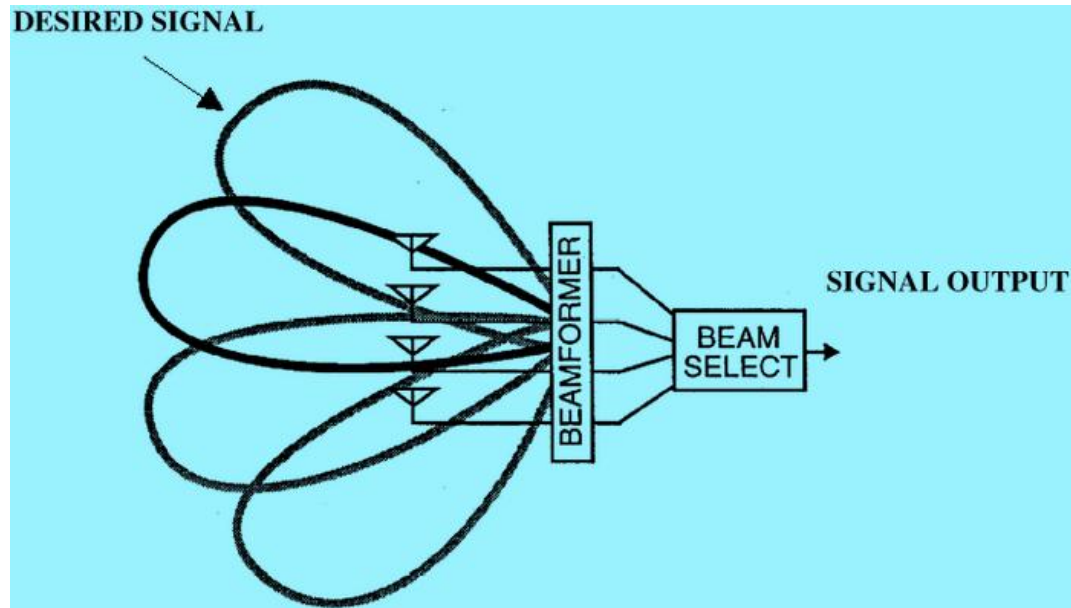
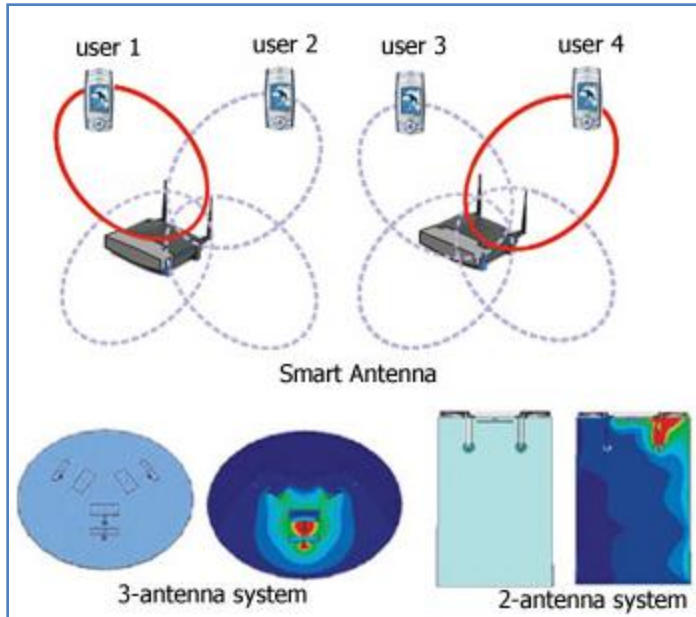
• Sector antenna efficiency



Antenna Types: Smart Antenna



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Antenna Types: Applications

U.S. Navy's ELF system

- Operates at 76 Hz
- 80 miles of wire
- Penetrates to underwater subs
- One-way system



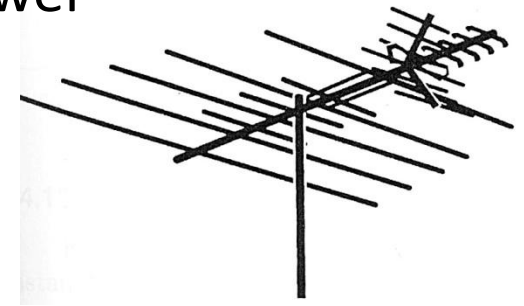
Antenna Types: Applications

- VHF and UHF antennas need to be large enough to achieve the desired frequency and provide a large range of coverage. VHF and UHF covers frequencies from 3 MHz to 3000 MHz and includes television and FM radio broadcasting.



Transmitting Tower

- Yagi array antenna. The array has different size conductors to receive different frequencies. Yagi arrays are highly directional, so they should always be pointed towards the transmitter tower.



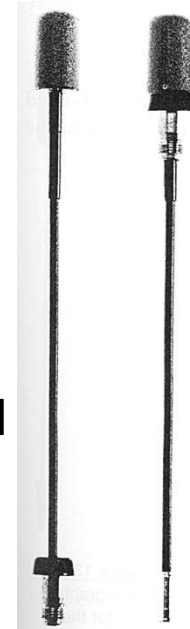
UHF/VHF/FM
Receiving Antenna

Antenna Types: Applications

- Lots of applications in wireless communications. Two common antennas are the quarter wave helical and quarter wave whip antennas.
- The whip, which is the same as a monopole, is the most common antenna for cellular phones, and is typically used in the 400 to 500 MHz range.
- The quarter wave helical antenna is smaller than the whip and has similar performance. Lately it is used in the 800 to 1000 MHz bands.



$\frac{1}{4}$ Wave Helical



$\frac{1}{4}$ Wave 2-in-1



$\frac{1}{4}$ Wave Whip