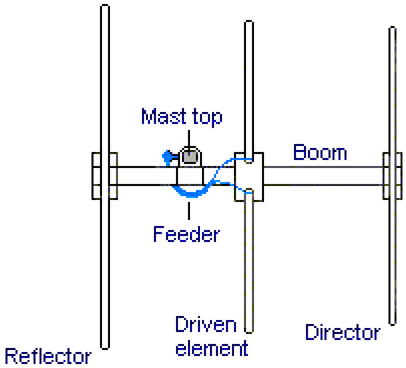
[YAGI-UDA](#)

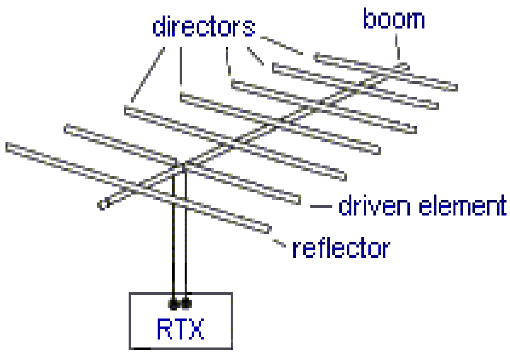
("Parasitic Array", "Yagi" or "Beam")

Among **multielement antennas**, the most familiar is the famous ***'Yagi-Uda',*** named after the two Japanese Engineers, Dr. Hidetsugu **Yagi** & Dr. Shintaro **Uda**, who invented this famous antenna in the 1930s. This very common antenna, whose name is usually shortened to just ***'Yagi',*** or more often simply called a ***'Beam',*** is a version of a ***'Parasitic Array'*** Antenna.

Dr Hidetsugu Yagi presents the Yagi-Uda!



Basic 3-Element Yagi-Uda



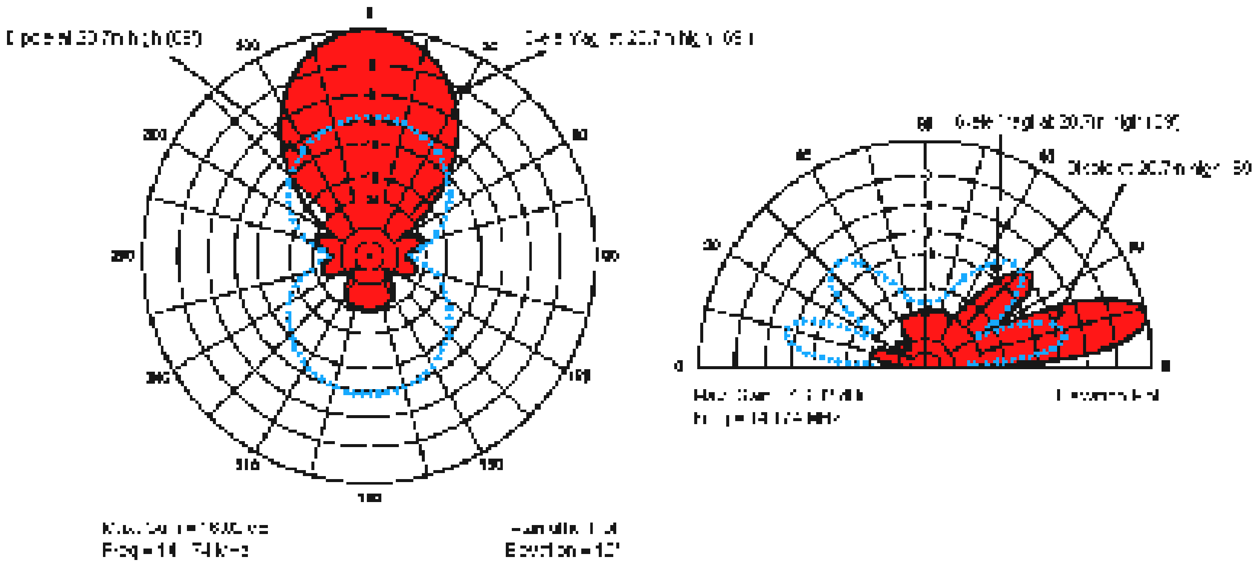
A 7-Element Yagi-Uda

The **Yagi-Uda**, emblem of the classic beam, is a **multielement directive parasitic array**, basically designed from a **'Dipole'** which is the **'Driven Element'**, a **'Parasitic Element'** which is the **'Reflector'**, and additional

'Parasitic Elements' which are the **'Directors'** all of which are usually arranged in the horizontal plane. The gain offered by a simple half-wave dipole mounted horizontally is about 2.14 dBi in free space (theoretically and thus never met in practice). To get more gain and directivity we can combine antenna elements, usually half-wave dipoles, into an array. The 3-element beam above is viewed from above. Cut for the 20m band, the reflector is 35.43 ft (10.8m) long, the driven element 33.14 ft (10.1m) and the director 32.48 ft (9.9m) long. The distance separating each element is ranging from 0.1 - 0.25λ. For 20 meters it is 6.2 ft (1.9m) in this example.

To understand how it works, in its **basic form** this is a simple half-wave dipole on which is added a single rod to form an H, the rod being spaced from the dipole by a small fraction of a wavelength (0.1 - 0.25λ). By making the rod slightly longer than the dipole (driven element), it acts as a reflector, modifying the response pattern to a cardioid (heart-shape) pattern, so it becomes directive.

In practice the pattern is far from perfect and there are always unwanted rear lobes with some additional minor ones, more or less extended depending on its selectivity. Adding a second rod slightly shorter than the dipole on the opposite side of the driven element from the reflector and it is called a director; we reinforce and narrow the main lobe of the radiation pattern. Further directors may be added in front of the first, each slightly shorter (10-12%) that the previous. Each director slightly improves the gain of the antenna array, up to a limit of about 36 elements (1 – Driven, 1 – Reflector, and 34 – Directors)! Beyond which there is no significant signal increase. **Adding parasitic elements reduces the impedance of the driven element, as seen by the feed line, and a folded dipole is frequently used to help to compensate for this**.



Radiation patterns of a 6-element Yagi cut for the 20m band (red) placed 69 ft high compared to a Dipole (Hertz in blue). The Yagi displays a large lobe in only one direction with a substantial gain.

The gain of a Yagi is thus directly dependant on the length of elements and the number of directors. The gain is thus closely related to the antenna's directivity pattern. The angular width of the E-plane main lobe at the half power, or 3 dB points compared to the peak, represents the antenna beamwidth. It is about 60° for a 3-element HF beam and as narrow as 13° for a 6-element Yagi placed 1λ over ground.

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