The 6-meter Breadboard Antenna for the Deep Space Network Array

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Development of very large arrays of small antennas has been proposed as a way to increase the downlink capability of the NASA Deep Space Network (DSN) by two or three orders of magnitude thereby enabling greatly increased science data from currently configured missions or enabling new mission concepts. The current concept is for an array of 3600 x 12-m antennas at each of three longitudes arranged in several large stations at each longitude for weather diversity. The DSN array will utilize radio astronomy sources for phase calibration and will have wide bandwidth correlation processing for this purpose. An $80M development program has been proposed to NASA to develop the technology and prove the performance and cost of a very large DSN array. The program includes a 3-element interferometer to be completed by late 2004. This paper describes the design and development of the low cost 6-meter breadboard antenna to be used as part of the interferometer.

The baseline breadboard antenna is a 6-*meter hydroformed symmetrically shaped dual reflector system utilizing Gregorian optics*. The heritage for this antenna lies in the Allen Telescope Array project plans to build 350 6m antennas specified for use up to 11 GHz. Hydroforming is the process of forming aluminum to a rigid and precise mold by using a fluid or gas under pressure. It has been highly developed for use in production of low-cost reflectors for satellite communications and thousands of antennas in the 1 to 4 meter range have been manufactured. This project improve the rms of the surface to extend the useable frequency range to 38 GHz. The backup structure utilizes 9 equally spaced aluminum struts connecting a center yoke to the rim of the dish. The pedestal consists of a central pipe tucked under the dish with a central bearing for azimuth motion and a jackscrew for elevation control.

Also under consideration, as an alternative design for the hydroformed dishes, is an antenna manufactured from composite materials. Composite materials have proven mechanical and structural properties that are superior to metals, at a reduced weight. The major challenge that this type of structure is the cost. But new manufacturing processes and novel implementations are expected to reduce the cost of manufacturing considerably. Other challenges that need to be resolved include the environmental performance and finding a suitable material to incorporate as the reflective surface.

The feed is a dual frequency horn covering the X (8-9 GHz) and Ka (30-38 GHz) bands. The X-band will be a coaxial waveguide fed corrugated horn and Ka-band will utilize a dielectric rod in the center of the corrugated horn.