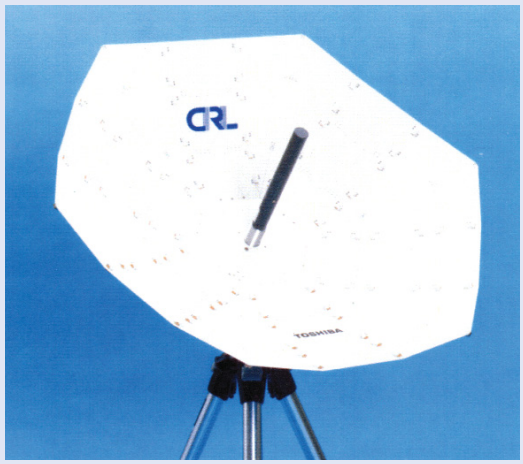
Patent Application Publication No. 2003-37407

Deployable antenna equipment

Invented by: ***IDE Toshiyuki, OGAWA Takaya*, and SHISHIDO Makoto****
(*Toshiba Corporation)



Outline of the invention

This invention consists of a small, lightweight, parabolic antenna that one can easily carry. As shown in Fig.1, the reflector surface of the antenna is divided into several segments (one of which is shown (four segments), in a simplified manner in Fig.1a). The segments are structured permitting further folding in a manner similar to origami (Fig.1b). The divided and folding structure makes this antenna easy to store and carry. Adjacent segments can be connected via magnet joints, for example, permitting convenient assembly of the antenna without requiring tools. Although the reflection surface of a parabolic antenna is generally curved, flat facets are employed in this antenna, which is based on the principle of compact storage via a folding mechanism. This design allows for a simple antenna structure featuring small dimensions in the folded state, enhancing portability and enabling reliable and stable folding and deployment operations.

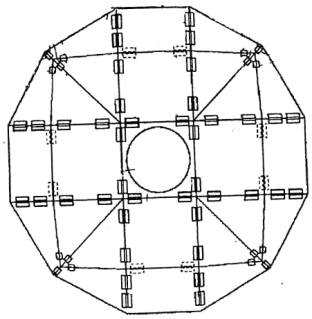


Fig.1 a: View of assembled antenna reflector

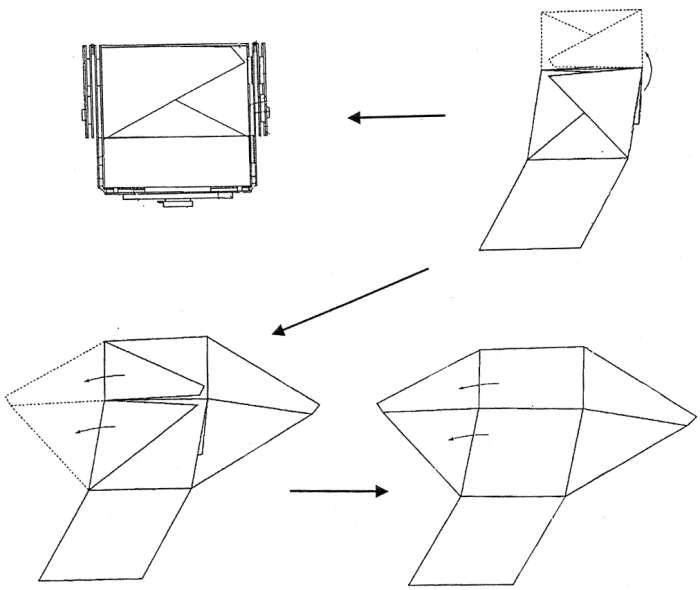


Fig.1 b: View of reflector segments

Manufacturing
Building the prototype

The prototype is designed to operate in the S-band (2.5 GHz), with an aperture diameter of 680 mm, reflector accuracy of 3 mm or less (RMS value), and gain of 20 dBi or greater. A quadrifilar helical structure is used for the feed unit. Measured values include gain of 21.6 dBi, a beam width of 11 degrees, and aperture efficiency of 50%, which agree approximately with the design values and correspond to sufficient performance in practical use. The approximate parabolic reflector surface shape, composed of flat facets, does not result in an abnormal antenna radiation pattern (Fig.2), and satisfactory electrical characteristics have been confirmed. However, further study is necessary relating to the use of this antenna in frequencies other than those in the S-band.

Fig.3 shows the folded antenna. The dimensions of the folded segments are 130 mm × 144 mm × 28 mm, including protrusions. Nearly all components have been reduced to roughly the size of a CD, and the total weight of the reflector is 2.2 kg. Thus the original design aim has been fulfilled: the creation of an antenna that a person can carry and assemble with ease. For reference, Fig.4 shows the antenna in mid-assembly. This antenna has 6 segments, each of which consists of 9 facets.

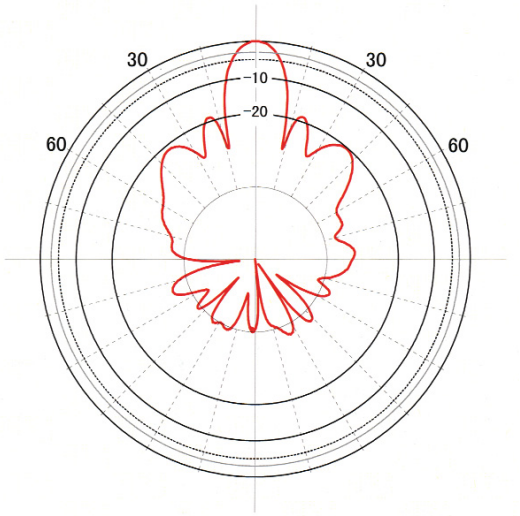


Fig.2: Prototype radiation pattern

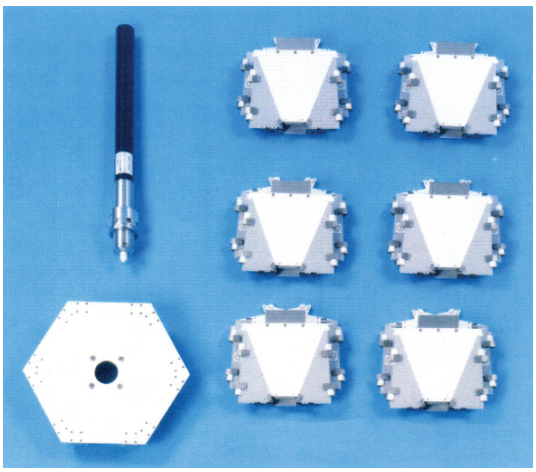


Fig.3: Folded antenna

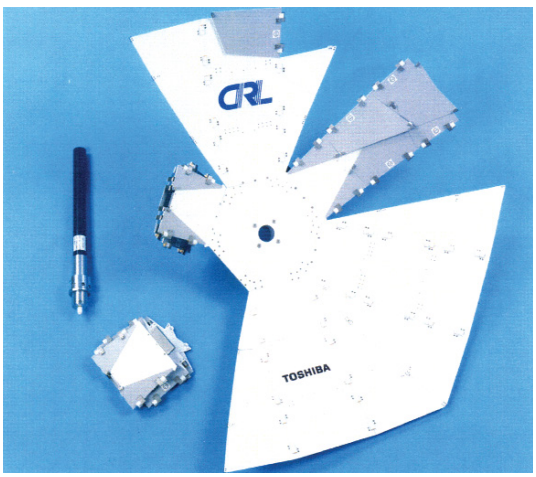


Fig.4: Partially deployed antenna

Future use

This antenna will be used in a variety of satellite communications experiments, including measurement of the antenna patterns of the Engineering Satellite VIII (ETS-VIII) onboard antennas. In addition to these satellite communications experiments, the antenna is highly promising in terms of establishing emergency communications from areas that have experienced natural disasters, such as earthquakes, typhoons, or other disasters.