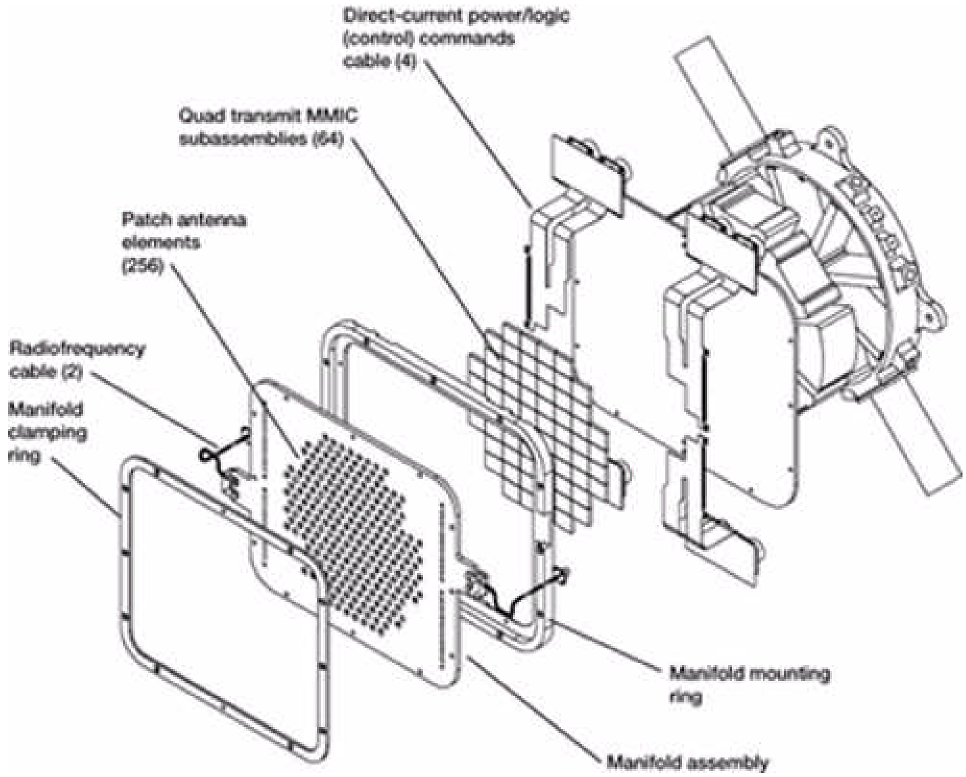
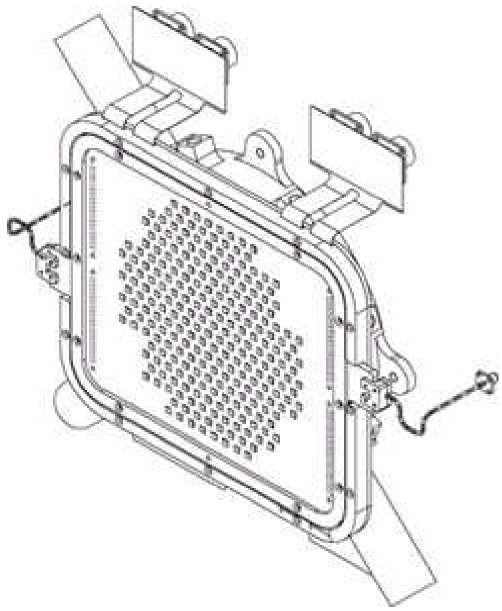
K-Band Phased Array Developed for Low-Earth-Orbit Satellite Communications



K-band phased-array antenna assembly. (Copyright Raytheon TI Systems; used with permission.)

Future rapid deployment of low- and medium-Earth-orbit satellite constellations that will offer various narrow- to wide-band wireless communications services will require phased-array antennas that feature wide-angle and superagile electronic steering of one or more antenna beams. Antennas, which employ monolithic microwave integrated circuits (MMIC), are perfectly suited for this application. Under a cooperative agreement, an MMIC-based, K-band phased-array antenna is being developed with 50/50 cost sharing by the NASA Lewis Research Center and Raytheon Systems Company. The transmitting array, which will operate at 19 gigahertz (GHz), is a state-of-the-art design that features dual, independent, electronically steerable beam operation (±42°), a stand-alone thermal management, and a high-density tile architecture. This array can transmit 622 megabits per second (Mbps) in each beam from Earth orbit to small Earth terminals. The weight of the total array package is expected to be less than 8 lb. The tile integration technology (flip chip MMIC tile) chosen for this project represents a major advancement in phased-array engineering and holds much promise for reducing manufacturing costs.



Assembled K-band phased-array antenna. (Copyright Raytheon TI Systems; used with permission.)

The transmit phased-array antenna has passed the critical design review and is being fabricated, with delivery anticipated in late 1999. Soon after the array is completed, Lewis plans to integrate it into a flight experiment to test its operation in the space environment. The array will be a critical component of the Direct Data Distribution (D^3) flight experiment on a future space shuttle mission, as early as 2001. Incorporation and proper design of significant mechanical, thermal, and control interfaces required for safe and successful operation on a shuttle mission will provide significant leverage for using the antenna in future communications spacecraft. Phased-array antennas that are capable of rapid direct downlinking of large volumes of data from various space platforms, such as the one being developed and described here, are high on the priority list.

For more information, visit Lewis' Communications Technology Division at http://ctd.grc.nasa.gov/.

Lewis contacts: Godfrey Anzic, (216) 433-3570, Godfrey.Anzic@grc.nasa.gov
Authors: Godfrey Anzic
Headquarters program office: OSS
Programs/Projects: Space Communications, D^3