National Aeronautics and Space Administration

NASAfacts

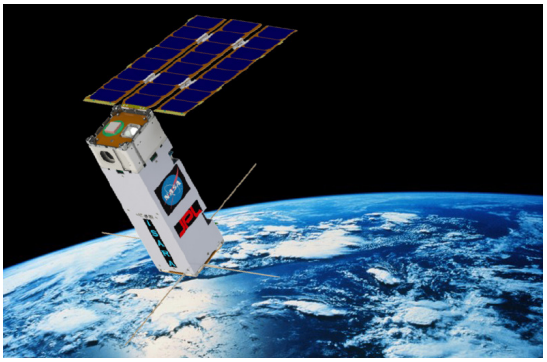
Integrated Solar Array and Reflectarray Antenna for High Bandwidth Cubesats

Increasing Cubesat Downlink Data Rates to 100 Mbps

The Integrated Solar Array and Reflectarray Antenna (ISARA) mission will demonstrate a reflectarray antenna that increases downlink data rates for CubeSats from the existing baseline rate of 9.6 kilobits per second (kbps) to more than 100 megabits per second (Mbps). The ISARA spacecraft is slated for launch no earlier than Dec. 1, 2015.

The reflectarray antenna consists of three panels, electrically tied together through hinges, which have an array of printed, resonant patches on them. The size of the patches are adjusted so that the phase of the reflected feed illumination collimates the radiation much in the same way a parabolic dish reflector would. Unlike a parabolic dish, however, the reflectarray panels are flat which enable them to be folded down against the CubeSat. On the opposite side of the printed reflect array antenna, solar cells have been added. This makes the overall antenna/solar array panel assembly slightly thicker, but the cells are utilizing the “dead space” between the rails that would have otherwise been left empty. This combination of antenna and solar cell makes for a very efficient use of CubeSat volume, leaving plenty of room for an auxiliary payload to also be stored on-board.

The data rate of 100 Mbps—comparable to the combined rate of 20 typical household high-speed Internet connections—would enable the download of a feature length, high-definition movie in five and a half minutes. The key to this technical advance is the reflectarray antenna , which is designed to reflect a narrow radio signal from its surface toward the precise location of a specified receiver. This antenna will be integrated into a deployable solar array panel that is commercially available for a three-unit (3U) CubeSat, measuring approximately 4 inches x 4 inches x 13 inches (10 centimeters x 10 centimeters x 33 centimeters) and weighing approximately 11 pounds (5 kilograms).



Conceptual 3U Cubesat and Solar Array with Integrated Reflectarray Antenna

The ISARA mission will be validated in space during a five-month mission to measure key reflectarray antenna characteristics, which include how much power can actually be obtained over its field of view. The ISARA contains a transmitter and an avionics subsystem that features a high precision attitude control system designed to navigate the CubeSat. Once in orbit, ISARA will deploy its solar array and reflectarray antenna. It then will use its attitude determination and control system to stabilize itself. An ultra high frequency (UHF) communications system will be used to make initial contact with the satellite and perform in-orbit checkout procedures.

During the in-orbit test, ISARA’s reflectarray

antenna will transmit a signal that will be received by a ground station located at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. The spacecraft's location and orientation telemetry data will be analyzed to reconstruct the antenna signal pattern, which will then be compared against preflight ground measurements.

At the end of the validation mission, the reflectarray antenna technology will be available for use on other missions which need high bandwidth telecommunications. The ISARA technology will enable CubeSats and other small satellites to serve as viable platforms for performing missions that were previously only possible on larger and more costly satellites. For a modest increase in mass, volume and cost, the high data rate this technology enables will pave the way for high value science missions and formation flying missions that use distributed CubeSats and small satellites.

The ISARA payload is being developed by JPL and will be demonstrated on a CubeSat developed by The Aerospace Corporation in El Segundo, California. JPL partnered with Pumpkin Inc. in San Francisco, California, to develop the solar array.

ISARA was selected for a flight opportunity as part of the CubeSat Launch Initiative in NASA's Human Exploration and Operations Mission Directorate.

ISARA's spacecraft will be launched and deployed as an auxiliary spacecraft on a rideshare mission arranged by the Launch Services Program at NASA's Kennedy Space Center.

The ISARA mission is funded through NASA's Small Spacecraft Technology Program (SSTP), which is chartered to develop and mature technologies to enhance and expand the capabilities of small spacecraft with a particular focus on communications, propulsion, pointing, power, and autonomous operations. SSTP is one of nine programs within NASA's Space Technology Mission Directorate.

For more information about the SSTP, visit:
http://www.nasa.gov/smallsats

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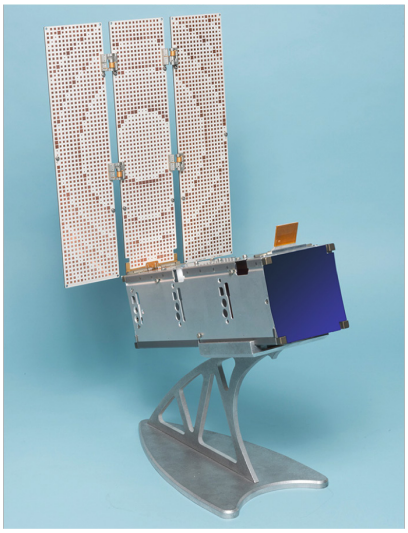
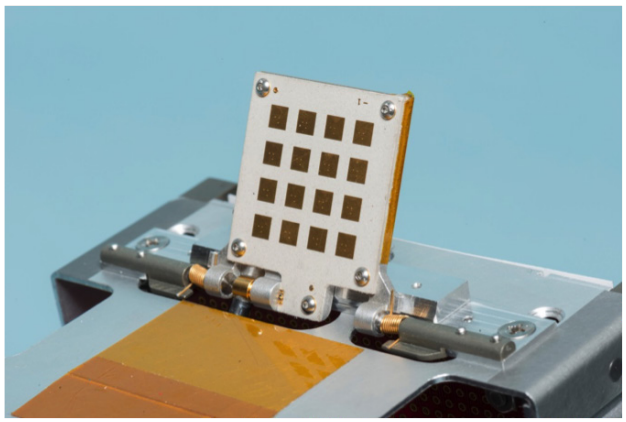


ISARA Reflectarray Antenna



Reflectarray Feed Antenna

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