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Author: Ms. Rebecca Jensen-Clem
Massachusetts Institute of Technology (MIT), United States, jcjc@mit.edu

Ms. Mary Knapp
Massachusetts Institute of Technology (MIT), United States, mknapp@mit.edu
Dr. Alessandra Babuscia
Jet Propulsion Laboratory - California Institute of Technology, United States, alessandra.babuscia@gmail.com
Prof. Sara Seager
Massachusetts Institute of Technology (MIT), United States, seager@mit.edu
Mr. Ivan Sergeev
Massachusetts Institute of Technology (MIT), United States, vsergeev@mit.edu
Mr. Matthew Houston
Massachusetts Institute of Technology (MIT), United States, mhouston@mit.edu

COMMCUBE-1: INCREASED DATA DOWNLINK VOLUME THROUGH THE GLOBALSTAR NETWORK

Abstract

CubeSats are trending toward greater capabilities and higher data volumes. Large data downlink volume will soon become a bottleneck for CubeSat performance. Current missions must build and operate their own ground stations, pay for time on an existing network of ground stations, or rely on the amateur radio community to retrieve their mission data. A better communications solution is needed to enable highly capable CubeSats to make significant contributions to science.

CommCube-1 is a 2U CubeSat which will demonstrate a novel communications architecture for CubeSats. Rather than relying on links to individual ground stations, CommCube-1 will transmit and receive data using a GloablStar two-way data modem and the GlobalStar satellite constellation, acting as a satellite phone customer in low Earth orbit. This approach provides two key advantages: first, continuous coverage at moderate data rates will improve the maximum data volume transmitted per orbit; second, decreased command latency allows for rapid satellite response to commands from the ground. Low command latency will enable highly agile CubeSat constellations for investigation of terrestrial or astronomical transient phenomena. CommCube-1 will demonstrate these key advantages through a series of stepped tests, transmitting data packets of increasing size through the GlobalStar satellite constellation. CommCube-1 will also carry an S-band patch antenna and transceiver for comparison and backup purposes. A small Earth imager will provide meaningful data for communication tests in addition to serving educational outreach goals.

CommCube-1 will tweet status updates and post to Facebook and other social media sites in order to engage the general public in its mission. Members of the public may engage actively with CommCube-1 by participating in competitions related to Earth image data from the spacecraft. Middle school and high school students will use CommCube-1 imaging and telemetry data as a part of their science curriculum to explore topics including electronics, orbital mechanics, measurement error and statistics, data processing and storage, and geography. Younger students (grades 1-6) will learn about satellites and space engineering through CommCube-1 Lego® kits designed by MIT students. CommCube-1 will launch in 2013-2014.

This paper will describe CommCube-1's subsystems with particular focus on the GlobalStar modem payload, the S-band communication system, and the Earth-imaging camera. A link budget for both communications systems will be presented as well as projected coverage and data rates for the GlobalStar link. CommCube-1's on-orbit test plan and educational outreach activities will also be discussed.