

Name(s):	<b>Siegfried Janson, Darren Rowen, Todd Rose, Richard Welle</b>
Title(s):	Director, Microsatellite Systems
Company/ Organization Name:	The Aerospace Corporation
Paper Title:	<b>CubeSat Scale Laser Communication</b>
Abstract:	<p>We report on the development of optical space-to-ground communications scaled for application in 1.5U CubeSats.</p> <p>Advances in microelectronics have enabled unprecedented data collection capabilities in spacecraft. A 15-megapixel color imager operating at 30 frames/s can generate over 10 gigabits/s (Gb/s) of raw data. Even operating in a framing mode, with non-overlapping frames, the data rate from a single camera can exceed 40 megabits/s (Mb/s) or 3600 Gb/day, far more than can be downloaded using an S-band downlink at data rates of several Mb/s. Laser communications can potentially provide Gb/s data rates, but have not previously been flown in CubeSats.</p> <p>Space-to-ground optical links from LEO have been demonstrated at data rates in excess of 5-Gbps. However, the high-performance spacecraft terminal, with a mass of 35 kg, a power consumption of 120 W, a ~50-microradian angular beam width, and a gimbaled pointing system, would obviously not fit in a CubeSat. Eliminating the optical gimbal and increasing the angular beam width to several milliradians to allow spacecraft body-pointing of the laser, enables a significantly smaller, lighter optical terminal. This approach takes advantage of the exceptionally low moments of inertia of CubeSats, and their ability to perform rapid slew maneuvers.</p> <p>The NASA-funded Optical Communication and Sensor Demonstration program will demonstrate optical communications using milliradian beam spreads that are compatible with near-term CubeSat pointing capabilities. The baseline mission will use a 10-W modulated fiber laser with a 0.35-degree angular beam width on a 1.5U CubeSat (AeroCube-OCSD) and a 30-cm-diameter telescope to receive optical pulses. We plan on demonstrating at least 50-Mb/s optical downlinks. The spacecraft, which have been delivered and are scheduled for launch in spring 2015, are configured to transmit at up to 500 Mb/s; we intend to attempt downlink at data rates above 50 Mb/s using a larger ground station.</p>