AeroCube-7 FCC Mission Statement

The AeroCube-7, also known as the Optical Communications and Sensor Demonstration (AeroCube-OCSD) mission will address two cross-cutting capabilities: a demonstration of small-spacecraft proximity operations and high-speed optical transmission of data.

The flight demonstration will consist of two identical AeroCube-7s that are ejected from a CubeSat deployer. There are three major mission requirements: first, demonstrate an optical downlink of 20-Mbytes over 60-seconds with a bit error rate (BER) of 10-4 or better to a 30-cm diameter telescope from low Earth orbit (LEO). Second, demonstrate angular tracking of an AeroCube within 50-meter range and third, demonstrate angular, range, and range rate tracking of an AeroCube using a commercial, off-the-shelf (COTS) optical ladar.

The AeroCube-7 is a Nano class satellite, weighs approximately 2.3 kg and is 4x4x6 inches in dimension. It will be launched on an Antares OA-8 in November of 2017. The orbit is between 450-500 km circular with 51.6 degree inclination, depending on vehicle performance. DAS 2.0.2 predicts a lifetime of 7.5 years (area-to-mass ratio of 0.008 m^2/kg) and a spacecraft probability of collision with space objects larger than 10 cm in diameter during the orbital lifetime of the spacecraft of 0.000000, well below the 0.001 threshold required (see "**AC7 DAS2.02 Output v1**" Exhibit). DAS 2.0.2 analysis predicts the risk of human casualty for the expected year of uncontrolled reentry and the orbital inclination of less than 1/10000, which also meets the requirement.

Each of the two AeroCube-7 satellites has two radios. The AdvRadio is built by The Aerospace Corporation around a Texas Instruments CC1101 transceiver chip. It operates at a fixed 914.7 MHz frequency (see "**AdvRadio bandwidth**" Exhibit) and outputs 1.3 W. The second radio is also built by The Aerospace Corporation and is called the AeroCube Software Defined Radio (SDRadio). It also operates at a fixed 914.7 MHz frequency (see "**SDRadio bandwidth**" Exhibit) and outputs 1.3 W.

When the AeroCube-7 satellites are ejected, they will power on. However the radios will alternatively turn on in receive mode only. As the satellite flies over a ground station, the station will continuously beacon towards the satellite. When the satellite radio hears the beacon, along with the proper serial number code, it will respond and a link will be established. At that point, the ground station will ask the satellite for information, typically payload data or onboard telemetry. The satellite will respond by downlinking the requested information. When the link is lost due to the satellite passing out of view and the satellite was transmitting, the satellite will try up to 3 seconds to complete the last packet transmitted. The satellite will then revert to a passive receive mode and wait for the next beacon from a ground station.

We would like to use two types of ground stations to communicate with the AeroCube-7 satellite. The first is a 5-meter diameter dish antenna at The Aerospace Corporation in El Segundo, CA. At 914.7 MHz, it has 30 dB gain, 5 deg beamwidth and uses a complementary radio with a 9W amplifier. The second ground station is a portable 2-meter diameter dish. This has 22 dB gain, a 15 deg beamwidth and uses a complementary radio with a 9W amplifier. This portable station would be located in an RF quiet area that improves the ground footprint of the ground station network. A typical satellite pass is 8 minutes long, twice per day - so the system spends a lot of time not in use. The antenna parameters and ground station locations are shown in the exhibit "**FAA sketch and antenna figures**."