ISARA FCC Mission Statement

The Integrated Solar Array and Reflectarray Antenna (ISARA) mission will demonstrate a high bandwidth Ka-band antenna for satellite communications in the CubeSat form factor. The primary payload, a reflectarray antenna, is designed to provide up to 100 Mbps data rate with minimal impact to satellite mass, volume, or power. The reflectarray (35 dB of gain at 26 GHz) is integrated to the underside of a 30 cm x 70 cm deployable solar array panel that provides power for Ka-band transmission and nominal mission operations. It is expected that this reflectarray design could become a practical high gain antenna option for 3U (30 cm x 10 cm x 10 cm) and larger CubeSats. The ISARA bus radios (915 Mhz) for command and control of the satellite are the focus of this licensing submission and the 26 GHz transmitter license for the experiment will be requested separately.

The ISARA is a Nano class satellite, weighs approximately 5 kg and is 4x4x12 inches in dimension. It will be launched on a SpaceX Falcon 9 vehicle slated for March 2016. The orbit is 420 km x 720 km with 98 degree inclination. DAS 2.0.2 predicts a lifetime of 9 years (tumbling area-to-mass ratio of 0.006 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 0.000001, well below the 0.001 threshold required (see "**ISARA 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.

The ISARA satellite 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 ISARA satellite is ejected, it 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**."