NOTE: I HAVE FILED A SEPARATE STA FOR THE AEROCUBE-3 SATELLITE EXPERIMENT (0018-EX-ST-2008) AND THE PSSC TESTBED SATELLITE EXPERIMENT (0020-EX-ST-2008). I AM ALSO FILING THIS 422 FOR A LONGER PERIOD THAT WOULD ENCOMPASS BOTH EXPERIMENTS. PLEASE DECIDE WHETHER THE STAs OR THE 422 ARE PREFERABLE.

THE RF TECHNICAL DETAILS IN THIS GRANT REQUEST ARE IDENTICAL TO THOSE IN THE GRANT 0802-EX-ST-2006.

PSSC Testbed test and AeroCube-3 test

The purpose of the PSSC Testbed is to conduct research on solar cell degradation due to space radiation. Solar cells from several manufactures are installed onto a nanosatellite for direct comparison. The test occurs for the life of the satellite which is estimated to be less than 6 months. The purpose of the AeroCube-3 is to continue research regarding the space application of MEMS components and related microelectronics technologies. The operation includes a demonstration of principles of the physics of the low-earth-orbit space environment and its effects on MEMS microelectronics. The lifetime of AeroCube-3 can be much longer since it is in a higher orbit.

The PSSC Testbed is a PICOSAT class satellite, weighs less than 7 KG and is a 5 x 5 x 10 inches in dimension (see "design" Exhibit). It is being launched on the Space Shuttle STS-126 scheduled for liftoff on September 2008, but it may slip. The Shuttle will drop off the PSSC Testbed satellite into a 320 km circular at 51 degrees inclination. Orbital analysis predicts re entry in less than 1 year (see "lifetime" Exhibit).

The AeroCube-3 is a PICOSAT class satellite, weighs less than 1 KG and is a 10 cm cube (see "design" Exhibit). It is being launched as part of a 3-Cubesat complement delivered to Orbital Sciences. The launch is on board a Minotaur vehicle from Wallops Island in Virginia, slated for a June 2006 but it may slip. The orbit is 416 Km circular at 41 degrees inclination. Orbital debris analysis is being performed now and will be added as an exhibit in a couple of weeks. AeroCube-2 inflates a drag enhancing balloon that is at least 24 inches in diameter, creating 452 square inches in drag area. This will reduce the lifetime to TBD years (analysis is being done at this time).

Both the PSSC Testbed and the AeroCube-3 satellites have a Freewave Technologies, Inc. FGRM radio inside which outputs 2 Watts. We have fixed the frequency (i.e. not hopping or spread spectrum) at 914.7 MHz (see "bandwidth" Exhibit) so that we can quickly link up with the satellites rather than waiting for the hopping sequence to sync up. (Each radio has its own serial number so only one can be talked to at any given moment). Both the PSSC Testbed and the AeroCube-3 satellites have an omni-directional patch antenna. We have the pattern calculated and tested but use -10dB as the gain for 90% of the sphere area (see "pattern" Exhibit).

When either the PSSC Testbed satellite or the AeroCube-3 satellite is ejected, it will power-on. However the radio will be in receive-mode only. As the satellite flies over a ground station, the station will be continuously beaconing upwards toward 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 whatever information it wants namely state of health log files or images from the cameras. The satellite will respond by down-loading the requested information. When the link is lost due to the satellite passing out of view, and if it was transmitting at the time, it will try 256 times to complete the last packet transmitted. If each packet is 72 bytes long and the radio data rate is 38.4 Kbaud, then it will try for only a couple of seconds before the 256 attempts are exceeded. At that point it will go back into a passive receive mode again, awaiting the next beacon from a ground station with the correct serial number.

We would like to use three ground stations to communicate with the satellites. Each antenna has its benefits and detriments. A typical satellite pass is 5 minutes long, twice per day - so the system spends a lot of time not in use. The largest antenna is the 60' diameter dish in Menlo Park, CA, near Stanford University. It has 41 dB gain, 1.5 deg beam width and would use a 2W Freewave FGRM radio on the feed horn. The second is the 16' dish at The Aerospace Corporation in El Segundo, CA, near LAX airport. It has 30 dB gains, 5 deg beam width and also would use a 2W Freewave FGRM radio on the feed horn. The final ground station is a portable 2-meter diameter dish. This has 22 dB gain, 10 deg beam width and would use a Freewave FGRM radio with the output passed through a 9 W amplifier. This portable station we would like to use somewhere that is RF quiet and also advantageously located for maximum satellite coverage. We are thinking Anchorage Alaska would work well or Irwindale California. The Irwindale site is in the floor of a gravel pit so the power out of the antenna is shielded by the walls of the gravel pit from contaminating the surrounding urban area. See "FAA" Exhibit.

Only the Palo Alto antenna will dip below 30 degrees above the horizon because it is the only one with sufficient gain. It could go as low as 10 degrees off the horizon unless the FCC has an issue however its narrow beam width will prevent it from contaminating urban areas. The other antennas will not go below 30 degrees above the horizon as this would increase the satellite link distance to an unacceptable space loss value for them.