SPACE AI Inc.

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From: Doug Young
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Subject: Request for Info - File # 0225-EX-CM-2019
Reference: 50984

Q&E

1. Please provide an EMC analysis for the 450.1-450.15 MHz transmissions
   Can you please precise the kind of analysis that is required.

   We understand the EMC analysis requirement from the point of view of the launcher and or when the satellite will be sharing a cubesat dispenser.
   For our particular case we do not realize a formal EMC analysis as per MIL-STD-461G due the following considerations:
   a) The satellite will be launch completely OFF in a single 2U like-PPOD provided by ISRO. The satellite once liberated by the dispenser will turn ON and initiate a safe timer of 30 minutes, before start operations. So from this point of by the EMC will not be a factor for other spacecraft or the launcher.
   b) From the point of view of internal operation, we have follow the best practices, like the ones suggested in [1] [2] and an extensive testing plan. The satellite is now fully integrated and has been in operation successfully without any problem of interferences between subsystems. The satellite has been in thermal vac operation for more than 48hrs in ON condition without any operational problem.

2. Is there any WiFi or other transmission capability on the satellite aside from the microhard p400 listed in the technical description?

   On the Manufacturer section of the FCC FORM 422 we declared the following devices:
   2 Analog Devices AD9375 chips

[1] http://www.stengel.mycpanel.princeton.edu/MAE342Lecture20.pdf
[2] https://www.nasa.gov/sites/default/files/atoms/files/nasa_csli_cubesat_101_508.pdf

2 Microhard p400 chips

Under the consideration that this are the transmitting components of our subsystems, for both Platform and Payload.

For the Platform

We are using the Microhard p400 chips in two cards. One card will start as a beacon using the allocated frequency for the initial acquisition of the satellite just right after the release from the launcher and as describe on the previous point. Once we get the signal from the beacon we will switch to the second card that is telemetry and command card to operate the satellite. Due the frequency allocation the operation will be in half-duplex mode.

For the Payload

The Analog Devices chips are part of the SDR functionality of the Space AI Communications Card (SAI-CC). This card will be the payload and the only functionality that we will test o this mission will be the capability to transmit on the allocated frequency. The card has WiFi and Bluetooth capabilities mainly oriented for communications inside the satellite, but for this mission these components are going to be in off condition. The main interest for this mission is to test the main operational aspects of the card (computing element, sensors, IMU, etc) plus the analog devices radio. The operation profile will be: The selection of the best pass over the ground station will be programmed based on the TLE information. The ground station will contact the satellite to command to start the testing of the payload. The telemetry radio will be switched off and the SAI-CC card will start operation, once concluded the SAI-CC card will return the command to the onboard computer and this will recover the normal operation of the satellite.

3. Please provide clarification on the following ODAR-related issues:
   3.1. Looking at the figures of the spacecraft in stowed and deployed configurations provided, how did you determine the increase in cross-sectional area from stowed vs deployed?

   The initial assumption was that the largest mean cross-sectional area (CSA) is that of the satellite with the antennas deployed, however the mass and volume on these are so thin and small that will not be able to account as a filling area and for that make a contribution to the cross sectional area. For that, after consultation and review the ODAR has been updated assuming for this calculation we only take the maximum dimensions of the satellite as the largest maximum possible CSA. The

minimum value will be taking in account the nominal solid dimensions, according to the following formula values:

The values used and estimated are:

Mean CSAmax = [2*(10.8x10.8) + 4*(10.8x22.7)]/4 = 303.48 cm2

Mean CSAmin = [2*(10x10) + 4*(10x20)]/4 = 250.0 cm2

3.2. Please provide orbital lifetimes for both the stowed and deployed configurations.
The ODAR document has been updated to reflect this.

3.3. Please indicate the spacecraft material with the highest melting point or provide DAS (or other similar software analysis) outputs indicating survivability of debris.?
The ODAR document has been updated to reflect this.

On summary the following are the changes of the ODAR document:

REVISION AND HISTORY PAGE

PAG.	SEC.	ED	DESCRIPTION
iv		1.0	Revision and history page added
4	2.6	1.0	The value of orbital life time is adjusted
15	6.1	1.0	The cross sectional area value is adjusted
17	7.3	1.0	Information about the orbital decay calculations are complemented. Figure 5 is added
19	8.1	1.0	A table (Table 2) with the materials with the highest melting points
21	11	1.0	References added

4. Please indicate whether mission objectives could be achieved at a lower altitude with shorter orbital lifetime.

   In principle yes is possible to achieve the mission objectives at a lower altitude assuming that we can fulfill the 1 year orbital lifetime. This last aspect is the most relevant factor to us to test the reliability of the systems and for that a minimum time of 1 year has been defined has the minimum.

5. The satellite orbit appears to be identical to or similar to the Starlink orbit. Please indicate what procedures or protocols are in place to address conjunctions with other active objects, including, if applicable, collision avoidance capabilities, telemetry and ranging information, assistance from third party space situational awareness services, and operator-to-operator information sharing and coordination arrangements, etc.
   Can you please provided further guidance on this question.

   As declared on the ODAR on section 2.6 (pag. 4) The SAI-1 will not have any active device for operational manoeuvres; neither have any kind of propellant. The spacecraft will decay naturally from operational orbits within the stated orbital parameters in a natural orbital decay. So the satellite will not have any active collision avoidance capabilities. However we will make available all the necessary information for telemetry and ranging information, assistance from third party space situational awareness services, and operator-to-operator information sharing and coordination arrangements, etc in order to avoid any complications.

   For that we will like guidance over the aspect that if we can contact directly the Starlink Mission Control center in order to provided them with all the necessary information?

   The selection of the orbit for us was a based on the soonest and most cost/effective launch opportunity. We will be aware of this kind of potential conflicts for any future launch opportunity.