Microorbiter LunarSat Mission

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This paper presents an overview of the LunarSat mission operations concept, including timeline, planning and cost aspects.

Since operating a satellite is very cost-intensive, considerations have been taken to lower the operations cost. For example, the ground segment preparation and the operations phase can make up 60% of the life cycle cost. The high cost of this phase is mainly due to is manpower intensive nature (need of large teams to control the spacecraft) which is related to the high amount of software it requires (software development and validation also involves a lot of personnel). In the actual LunarSat Operations Cost to Completion Evaluation, about 62% of the budget would be dedicated to manpower, the other 38% to Facility. The budget for LunarSat Operations will be about 30% (or less) of the total budget of the mission.

Reduction of the operations cost comes along with an increase of the risk of failure. That is why small satellite missions developed in the context of big institutions or agencies, where this “safe philosophy” is still of considerable importance, have to conform to “safe” approaches and testing/validation standards. That is especially the case for the LunarSat mission. Operations cost reducing strategies for the LunarSat mission have been evaluated, including a reduction of redundancy, use of new technologies, re-use of existing hardware, charging figures for universities and other cost saving areas like ground stations (facilities).

Investigations concerning the selection of ground stations have also been conducted on the base of cost as well as availability and ground station characteristics. Different ground stations have been evaluated including the ESA Network, Weilheim, Santiago, Malindi, Evpatoria/Ussuriysk, Bear Lakes/Kalyazin, Surrey, Perth and others. While for the critical phases of the LunarSat mission the ESA Ground Station Network will be used on high priority, it shall be used on low priority for the nominal phases. To fulfill the tracking requirements, one ground station has to be added.

Investigations concerning the mission timeline have also been conducted. The purpose of a timeline is to create a link between Mission Operations on the one hand and the different payloads and subsystems on the other hand. It is a schedule of events and procedures of the spacecraft and ground segment. It displays at a high level the activities of the spacecraft and the ground. In order to fulfill this task, information about mission design, and about the subsystems and payload concerning Mission Operations (modes, requirements, constraints, power, data) are required. Activity planning consists of placing

spacecraft and ground activities on a timeline and assigning planning resources to that activity while satisfying resource constraints plus the mission and maintenance objectives at a most possible degree. It has to ensure the safety and efficiency of the mission. The interaction of activities, resources and constraints defines the effectiveness of the timeline. Various timeline tools for operational scenarios and activity planning exist but no standard tools. A preliminary timeline for the LunarSat mission is presented.