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IMPROVING RELIABILITY OF REMOTE GROUND SYSTEMS FOR SMALL SATELLITE MISSIONS IN DEVELOPING COUNTRIES

Abstract

In the last years, several non-space developing countries have gained access to space with their first satellite mission. This represents an opportunity but at the same time poses the risk of being an isolated effort that does not guarantee the systematic development of capabilities and the continuity of mission operations. Several programs such as Kyutech's BIRDS project attempt to create capabilities in developing countries that will ignite their own strategies for developing and maintaining their own space programs. In that sense, it is imperative that nations that recently became space nations improve the reliability of their own designed systems. That is the intention of this work. The work of the Costa Rica Institute of Technology as part of the BIRDS network has focused on the development of capabilities for environmental monitoring, via the creation of efficient store-and-forward systems. From this perspective, the design of both the flight segment - composed of CubeSat satellites - and the remote ground system require improvements in performance and cost of the final solution. The purpose of this paper is to present and discuss key learnings in the design of remote ground terminals implemented for the second Costa Rican Cubesat project. This mission consists of a store-and-forward satellite that relays the information collected from a series of ground terminals, which will then be used to study the wetland dynamics in remote locations of Costa Rica. The idea is to show a case study that other developing countries can emulate and that these learnings can be applied to their systems as well. The case study will demonstrate the design of a remote communication system, including its thermal control and pest control systems. Also, the case study dealt with power performance issues due to extreme operating conditions of the wetlands where the remote ground system was installed. Results of the paper include innovative designs of the ground remote terminal casing as well as passive cooling solutions implemented to encompass the operation's environment. These improvements also included optimization of the transmission protocol to

avoid overheating of the radio used to transmit from the remote location to the satellite. The methods described in this paper can be used by other store and forward missions to improve the reliability of their operations. It is also an example of how developing countries can deal with design issues with their own resources to sustain the success of their space programs and initiatives.