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CUBESAT-BASED LOW-COST COMMUNICATION NETWORK AND ITS UTILISATION FOR CAPACITY BUILDING IN DEVELOPING COUNTRIES

Abstract

The rise of affordable CubeSat technologies combined with the development of miniaturised high-sensitivity communication systems is opening new opportunities for deployment of low-cost data-gathering satellite constellations. Based on the concept of store and forward (SF) communication, such constellations would provide an easy and affordable solution for enhancing data gathering in remote areas in developing countries having low cellular data penetration. Moreover, SF communication CubeSats are also simple enough for capacity building in countries willing to advance towards a national space program.

Based on these considerations, the Intelligent Space Systems Laboratory (ISSL) of The University of Tokyo initiated the TRICOM program, aimed at developing a 3U SF communication CubeSat with an extremely sensitive receiver, able to receive very weak signals (¡ 20mW) from remote areas in developing countries lacking cellular coverage and electricity, preventing the installation of powerful emitters. It builds upon the Hodoyoshi project, aimed at developing cost-competitive micro-satellites using parts freely available in the Japanese domestic market, and having produced 60kg-class micro-satellites Hodoyoshi 3 and 4, launched in 2014. After losing TRICOM-1 due to a launch failure in January 2017, its successor, TRICOM-1R was placed in orbit by JAXA SS-520-5 sounding rocket on February 3, 2018. Then started a campaign of communication tests with ISSL partners worldwide (in Africa, Southeast Asia and South America) which provided positive results: TRICOM-1R was able to receive data from the ground with an 8mW signal. Having successfully demonstrated functioning of the TRICOM class of satellites, the ISSL initiated the main phase of the TRICOM program: starting capacity building programs in countries having no experience with space technology, establishing a global network of ground sensors and ground receiving stations, and working towards the deployment of a jointly developed and operated global constellation of SF TRICOM CubeSats.

The first capacity building program was started in 2018 with Rwanda and includes the training of local engineers and the development of the first Rwandan satellite, RWASAT-1, a modified version of TRICOM-1R, with the adjunction of a small (1U) 6-band multispectral camera. The partnership with Rwanda is part of larger collaboration with the Smart Africa organisation, regrouping 22 African countries and aiming for the development of a joint constellation of TRICOM satellites.

This paper presents in detail the TRICOM program, the results of the 2018 worldwide test campaign as well as the current and future capacity building programs in our partner developing countries.