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SOFTWARE-DEFINED COMMUNICATION ON THE NANOSATELLITE MOVE-II

Abstract

In this paper, we will report on the results and lessons learned of the development, test and operation of two software-defined transceivers on the CubeSat mission MOVE-II (Munich Orbital Verification Experiment II). MOVE-II, a single-unit CubeSat, is the second satellite of the CubeSat program MOVE of the Technical University of Munich (TUM). The main goals of the mission are verification of a novel satellite bus for demanding payloads, verification of a novel type of solar cells as well as education of students. The MOVE-II satellite bus features two independent communication systems. The system for telemetry and telecommand of the satellite is a software defined radio (SDR) based full duplex UHF/VHF system. All signal processing and protocol handling is done in a XILINX Spartan 6 FPGA. It has a fixed baud rate and supports different coding and modulation schemes allowing slightly higher data rates at reduced link margin. For high-speed data transfer, the S-Band system provides additional bandwith. It is an SDR based half duplex system supporting the same channel coding and modulation schemes at a significantly higher baud rate. The downlink data rate of this system is 3 MBit/s. MOVE-II uses a novel data link layer protocol called Nanolink. It is specifically tailored for the needs of a CubeSat and features virtual channels and optional ARQ while maintaining it's low overhead. Thus it enables an efficient use of the available bandwidth. The commanding of MOVE-II is done at our facilities with a matched SDR based setup, utilizing a combination of GnuRadio and in-house developed software. All data is directly forwarded to the novel web based operations interface. Thus we can immediately see the received data and perform all necessary monitoring and commanding of MOVE-II from any location. A Linux based on-board computer, deployable solar cells, and an active attitude determination and control system were also developed for the mission. Currently we are performing final tests and a dress rehearsal of the final integration steps and the LEOP phase of MOVE-II. The launch of the satellite is scheduled for a period between end of July to end of August 2018. We will report on the development process of the communication architecture within the resource-constraint environment of a university, but also focus on our extensive test program and the first on-orbit results.