Paper ID: 52830
oral

IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Near-Earth and Interplanetary Communications (7)

Author: Prof. Otto Koudelka
Graz University of Technology (TU Graz), Austria

Mr. Andreas Johann Hörmer
Graz University of Technology (TU Graz), Austria
Mr. Reinhard Zeif
Graz University of Technology (TU Graz), Austria
Mr. Gerhard Eigelsreiter
Austria

# A HIGH-PERFORMANCE LOW-COST COMMUNICATIONS SYSTEM FOR SMALL LEO SATELLITES

**Abstract**

In the framework of two nanosatellite projects with European Space Agency a versatile platform consisting of a powerful processor based on a system-on-chip-module with a large field-programmable array (FPGA) and a software-defined radio (SDR) front-end was developed by TU Graz and the SME UniTel. The SDR module covers a frequency range from 300 to 6000 MHz. These two units constitute a flexible transceiver for small LEO satellites, suitable both for LEO-to-ground links, but also for inter-satellite links for LEO constellations. Without extra converters S- and C-band can be accommodated directly. The design was made flexible such that X-, Ku- and Ka-band can be utilised as well by using adapter boards containing the LNAs, SSPAs and frequency converters for these bands. Special care was taken in the PCB layouting to guarantee a very high performance and to minimise EMC effects. UniTel recently developed an add-on module with special hardware encryption. Due to the optimised PCB layouting, the hardware is immune against side attacks. The size of the modules was chosen to comply with the CubeSat form factor. Industrial COTS electronic components are used in the transceiver. With the support of ESA the systems were extensively tested for total dose radiation at the Co60 test facility at ESTEC and for single-event upsets at the Paul-Scherrer Institute. It was verified that it is safe to operate this transceiver system in a LEO environment for at least two years. The paper describes the system design of the processor and radio front-end and gives insight in the hardware design criteria for optimised EMC performance. Furthermore, results of the radiation and RF performance tests are presented. The processor unit will be first flown on the OPS-SAT nanosatellite spacecraft in late 2019. The combined processor/SDR system is planned for utilisation within the PRETTY nanosatellite mission planned for launch in 2021.