29th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Generic Technologies for Small/Micro Platforms (6A)

Author: Mr. Oliver Ruf
Germany, oliver.ruf@s4-space.com

Mr. Bhardwaj Shastri
Germany, bhardwaj.shastri@telematik-zentrum.de
Mr. Maximilian von Arnim
Zentrum für Telematik, Germany, maximilian.vonarnim@telematik-zentrum.de
Mr. Panagiotis Kremmydas
Zentrum für Telematik, Germany, p.kremmydas@telematik-zentrum.de
Mr. Julian Scharnagl
Zentrum für Telematik, Germany, julian.scharnagl@telematik-zentrum.de
Prof. Klaus Schilling
Zentrum für Telematik, Germany, klaus.schilling@telematik-zentrum.de

LOLASAT – NANO-SATELLITE IN-ORBIT DEMONSTRATION FOR VERY LOW LATENCY COMMUNICATION

Abstract

The satellite communication market is changing rapidly, exploring non-GEO opportunities and concepts. One of the concepts currently pursued is large constellations in low Earth orbit, often targeting a significant reduction in size, power consumption and mass of a satellite, as well as reduced communications latency. For some user applications, such as autonomous driving, emergency support, financial services a low latency is crucial. A latency of less than 10ms would make the perceived quality of a satellite service very similar or even better to the experience of terrestrial broadband communications. Moreover, this would facilitate the integration with 5G networks.

A latency of less than 10 ms could be achieved by Very Low Earth Orbit (VLEO) satellite systems operating at an altitude in the range of 200-300 km. Other important advantages of altitudes are 10dB lower path loss and much smaller beam diameters projected on the ground. System studies have confirmed the potential of this concept and first experience was gained with ESA GOCE mission, which operated for 4 years at a nominal altitude of 260 km. However, there remain many challenges in implementing a VLEO telecommunication system. For example, the impact of aerodynamic disturbances on payload pointing is not fully understood. Furthermore, the environmental effect of atomic oxygen on the spacecraft and its antennas are still not fully characterized.

The LoLaSat mission aims to design, develop, implement, test, and operate a Ka-band communication payload on a 3U+ CubeSat in VLEO to fully characterize the orbital environment and test the functionality, versatility, and performance of a low latency communication link in this orbital range. LoLaSat is unique because of two innovative objectives: 1) The operation of a small satellite platform in the unusual VLEO altitude to reduce the link distance. This allows low latencies and drastically reduces required RF power in order to have small satellites able to provide high data rate services. The low altitude requires active measurement of drag effects and continuous drag-compensation by the propulsion system. Furthermore, gaining operational knowledge of this orbit by characterization of the atmosphere and the radiation environment is linked to this objective. 2) The in-orbit demonstration of a Ka-band telecommunication payload at high data rates up to 100 Mbps, yet low cost and limited power needs.

This paper presents the mission and system design of the LoLaSat Mission, which is currently in the system design phase and has a planned launch in November 2023.