Paper ID: 71836
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IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advances in Space-based Communication Systems and Services, Part 1 (2)

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QUANTUM KEY DISTRIBUTION FOR SECURE COMMUNICATION BY NANO-SATELLITES

Abstract

Satellite play a key role for quantum key distribution (QKD) over large distances. Currently nano-satellite missions are prepared to demonstrate capabilities for quantum key generation and optical communication link distribution already at a mass level below 10 kg. In this contribution details of the QUBE satellite will be provided, which is now fully assembled and will be launched at end of 2022.

Challenging requirements for placing a QKD payload on a nano-satellite concern accommodation despite limited resources, precision pointing of the optical link and ground based testing facilities. This contribution will summarize details of the satellite design and integration, as well as on-ground testing results.

As satellite bus in QUBE a 3U-CubeSat was employed to appropriately accommodate the QKD payloads. It used the UNISEC-Europe electrical interface standard with a baseplate to plug-in all subsystems and payloads. Minimization of volume, mass, and power budgets for all components were key design principles during all project phases, without sacrificing overall reliability or electrical and structural integrity. One of the major challenges of this mission is the attitude determination and control system, which uses dedicated innovative, miniature, reaction wheels for precision pointing of the satellite. Sealed in a cube of just 2 cm side length, 6 wheels on one board provide a fully redundant 3-axes attitude control system. Two vertically mounted star sensors provide inputs to attitude determination in data fusion with Sun sensors, gyros and magnetometers.

Emphasis was placed on extensive FlatSat testing prior to flight model integration in order to ensure compatibility of all subsystems. Subsequently engineering models were at electrical and mechanical tests also used for hardware-in-the-loop verifications. A distributed operations software provided remote access continuously to engineering models for the tests to all project partners, independent of their office location in Germany. It will be used also as operations software after launch.

The proposed quantum key distribution experiments evaluate suitability of a nano-satellite for QKD, which would open perspectives for future cost-efficient realization of multi-satellite networks for QKD to support global secure communication.