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QUBE: FUNDAMENTALLY SECURE DATA WITH THE HELP OF QUANTUM KEY DISTRIBUTION ON CUBESATS

Abstract

With the uprise of worldwide satellite communication networks, data security is a critical issue. This issue is being addressed in the QUBE project, which proposes a CubeSat for quantum cryptography experiments. The satellite and its subsystems are currently being developed and will be used for the downlink of individual photons, or strongly attenuated light pulses, containing encoded quantum information, which can then be employed for the exchange of encryption keys. The launch of the 3U Nanosatellite is planned for early 2020. It will be built using the UNISEC-Europe standard, which has demonstrated to be able to provide a robust structure for increased reliability in CubeSat missions. In addition to state-of-the-art reaction wheels for precision pointing, the satellite will be bringing the OSIRIS optical downlink system from DLR as well as two dedicated payloads for testing components required for quantum key distribution. A sequence of numbers will be created by a miniaturized quantum random number generator (QRNG), which will be used to set the quantum states of the light pulses. These pulses will then be downlinked to the optical ground station (OGS) at DLR in Oberpfaffenhofen, Germany. The ground station is also equipped with the corresponding components for receiving individual quantum states. In addition, the random numbers will be made available via an RF downlink. The photon states received by the optical ground station will then be compared to the previously generated numbers. Due to the underlying quantum mechanics, any attempt of reading the quantum states will alter them, which makes interceptions easily detectable. These quantum key distribution experiments will evaluate whether secure

communication links are possible even on a CubeSat scale. A major challenge for building the proposed CubeSat is the attitude determination and control system that will provide precise pointing. This work will outline detailed mission requirements as well as the chosen subsystems for tackling these challenges in order to achieve a successful mission and prepare for future data security.