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LINK ANALYSIS OF A CUBESAT BASED QUANTUM KEY DISTRIBUTION PLATFORM

Abstract

The need for secure communication is becoming more and more important in today's world. Quantum computers threaten to destroy the secure mathematical background of asymmetric encryptions such as RSA. Luckily, quantum communication can solve this problem by replacing the key generation algorithms with a fully secure one. One of the most interesting advances in this area is quantum key distribution (QKD). This technology allows us to establish a perfectly safe encryption, which cannot be compromised. A promising way of worldwide quantum encryption is by using an optical link between a satellite and various ground stations.

The Mobile Communications and Quantum Technologies Laboratory at Budapest University of Technology and Economics is focusing on different research questions of quantum communication including fiber-based quantum key distribution and satellite-based quantum communications.

In this paper, we analyse a configuration in which a quantum communication CubeSat is orbiting at 500 km high sun synchronous orbit (SSO). We use the BB84 quantum key distribution protocol for key sharing between the satellite and multiple ground stations. To analyse a CubeSat platform based system, we performed a thorough analysis of the parameters influencing the communication link. For this purpose, we wrote a flexible and high-performance simulator in C++.

In accordance with the CubeSat platform, we have concluded that the satellite's minimum telescope radius should be close to 0.2 m, limiting us to a 6 Unit or 12 Unit CubeSat platform. In our calculations, we assumed that the optical ground station has a telescope with 0.6 m diameter at least. We investigated the effects of different weather and climate parameters on our communication link. Weather has a serious effect on the transmittance, lowering the transmitted bits by almost 77

By simulating an orbiting satellite, we also made an estimation on the generated key length and the possible uses of this technology. Theorising optimal conditions and that all necessary technology is available, we simulated a span of 1 year of key distribution with 1 satellite and several ground stations. We also simulated a network of hundreds of satellites to demonstrate the capacity and flexibility of the CubeSat-based system.