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OVERVIEW OF A SPACE BASED QUANTUM KEY DISTRIBUTION NETWORK

Abstract

The quantum satellite communication is based on the need of long distance secret communication. An encryption method is offered by the symmetric key cryptography, which uses the same key for encoding and decoding the messages. The question is how the communication parties exchange the keys used for the symmetric coding since meeting in person might be unfeasible. Several classical algorithms exist for the secret key exchange, but there are quantum approaches as well. The quantum key distribution (QKD) protocols follow the laws of the quantum mechanics. According to these laws, any attempt of eavesdropping the key will disturb the quantum states during the key distribution process, and the presence of an eavesdropper will be revealed.

Using satellite systems, the free-space quantum communication should be able to realize secret key agreement over long distances, and the QKD can be extended to achieve global quantum data protection. In the last years, several studies dealt with laser based space communications, but it is still an unrealized technique in Earth-satellite and satellite-satellite communications.

Our aim is to develop a complex network model which enables the quantum key exchange service in a global scale. With our model based on the behavior of single-photon sources, we are able to model the effect of losses originated from beam spreading and pointing error on the QKD. After the evaluation of the communication channels, we have planned a network by ground stations and satellite orbits.

We developed a simulation platform to model the communication network. Our complex network provides quantum key exchange service between the ground stations using satellites. The model handles communication channels with different kind of optical and transmission errors, different ground stations on the Earth and satellites on different orbits. For the key exchange, different quantum key distribution protocols can be used. We analyzed and evaluated the performance characteristics of such satellite network including bit error rate and waiting time.