Paper ID: 6896

SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advanced Technologies (6)

Author: Dr. Laszlo Bacsardi
Budapest University of Technology and Economics, Hungary, bacsardi@hit.bme.hu

Mr. Mate Galambos
Budapest University of Technology and Economics, Hungary, galambos@mcl.hu
Dr. Sandor Imre
Budapest University of Technology and Economics, Hungary, imre@hit.bme.hu

MODELING AND ANALYZING THE QUANTUM BASED EARTH-SATELLITE AND SATELLITE-SATELLITE COMMUNICATIONS

Abstract

The long distance quantum communication technologies in the future will far exceed the processing capabilities of current silicon-based devices. In current network technology interfaces able to manage together the quantum and classical channel must be implemented.

Free space quantum communication of great distance has been developed and tested successfully. Currently, the quantum cryptographic key generation systems have been realized in metro-area networks, the free space based Quantum Key Distribution (QKD) solutions can achieve megabit-per-sec data rate communication. Long-distance free-space and satellite quantum communication experiments have been demonstrated the feasibility of extending quantum channel from the ground to a satellite, and between satellites in free space. The satellite based single photon links already allow QKD on global scale.

However, for the well-functioning quantum communication we need precise models of quantum channels. In this paper we examined the physical properties of the Earth-space and space-space channels to give some prescriptions about the possible loss and to give some useful ideas about the implementation of such a channel.

Since the current implementation of quantum cryptography protocols is based on photons, we have to know the exact description of the atmosphere's optical properties. In this paper we examined the models based on classical beam weakening. We created a model which describes one photon's (or a few photons') behavior to simulate the communication process over a satellite quantum channel

In the model we examined the properties and performance of recently-use single-photon sources and the loss caused by the gases of the atmosphere. We studied the effects of water droplets, dust and the turbulence of the atmosphere on quantum communication. We dealt with the finite size of the detectors and the beam spreading induced by diffraction and optical turbulences.

We took the modifying effects of the atmosphere into account and we examined the targeting errors which appears when we maintain a satellite communication. Based on our model we could analyze what parameters we need to implement a satellite quantum channel for Earth-satellite and satellite-satellite communication.