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QEYSSAT: QUANTUM ENCRYPTION AND SCIENCE ON A SMALL-SATELLITE PLATFORM

Abstract

QEYSSAT is a mission proposed by a team of Government and Academia Users in Canada to demonstrate new applications in quantum cryptography and perform long-distance experiments in conditions where distance, relative speed and gravity effects cannot be simulated on the ground. The mission has completed Phase 0 at CSA and technology developments are on-going to demonstrate the main elements of the payload. The mission objectives are to demonstrate the feasibility of global quantum key distribution (QKD) from ground to a space platform and perform long-distance Bell inequalities measurements to test quantum mechanics in regimes never explored before. Initial system engineering work indicates that the mission objectives can be met with a simple, small-satellite platform carrying a receive-only optical payload. The receive-only configuration selected for QEYSSAT is less performing than options where quantum sources are placed on the satellite, but analyses indicate that mission objectives can be met with this simpler approach. The QEYSSAT payload would use a 40-cm telescope to receive single photons (entangled or weakly modulated) from a ground station to establish quantum keys using a variant of the BB84 QKD protocol. Using more than one station would enable a demonstration of global QKD. Because the power requirements are very low, the overall payload can be fitted without compromises on a 100-kg class microsatellite. The main challenges to enable the missions are the single photon source, the tracking system that must receive individual photons in presence of turbulence in the atmosphere and finally the single-photon detectors and associated electronics that must provide precise time-tagging and synchronization. The paper will present the mission concept, describe the complete system with its dedicated ground segment, present the main system budgets and finally show the results of the prototyping work demonstrating the performance of the acquisition and tracking sub-system.