SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
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INTER-SATELLITE QUANTUM KEY DISTRIBUTION PATHFINDER MISSION

Abstract

Long-range, ultra-secure digital communications is a capability of significant interest to governments (Civil and Defence) and private sector entities who require the highest levels of communications security. The most promising technology, for this application over long ranges, is Quantum Key Distribution (QKD) where single-use, random encryption keys are generated and shared between two remote parties to encode and decode provably secure messages.

The practical implementation of intercontinental QKD networks using free-space optical communication links will rely on the development of space instrumentation and mission technologies so that spacecraft can act as nodes within the eventual network. The University of New South Wales (UNSW) Canberra Space and the National University of Singapore (NUS), Centre for Quantum Technologies (CQT) are developing an Inter-satellite Quantum Key Distribution Pathfinder mission to perform a proof-of-concept QKD experiment between two free-flying 6U CubeSat spacecraft. The purpose of the mission is to act as a stepping stone to an eventual QKD secure network by developing and validating the performance of the core building block technologies of an operational system.

The concept of operation of the mission is to launch two co-joined 6U spacecraft in a 12U launch configuration; complete the initial commissioning of the platform and payload; separate the spacecraft and establish the baseline quantum link performance between the two spacecraft at close separations; drift the spacecraft apart and re-test the quantum link at increasing distances until losses cause the quantum bit error rate to exceed the maximum acceptable rate. The goal-requirement is to maintain the link over distances in excess of 100 km.

The QKD protocol to be employed on the mission is BBM92 using polarisation entangled photon pairs generated by a Spontaneous Parametric Down-Conversion (SPDC) source developed for space-flight applications by CQT. The core enabling spacecraft technologies developed by UNSW are the fine pointing system, the classical optical system and the classic inter-satellite link.

The results of the Mission Phase A study will be presented along with the development plan for the flight programme.