Metrology for quantum-secured communications

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Quantum key distribution (QKD) via optical fibre is one of the most commercially-advanced quantum optical technologies. The National Physical Laboratory (NPL) is developing traceable performance metrology for the quantum layer of these technologies, and has established a testbed for characterization of the photonic components in QKD systems.

Characterization at the single-photon level [1] requires that measurements of photon number and detection probability are traceable to the SI primary scale for optical power measurements, which is currently realized in the 0.1 mW regime using cryogenic radiometry. Traceability allows the accuracy of measurements to be compared using a standardized procedure for estimating measurement uncertainty [2]. This enables a worldwide-accepted certification process to be developed.

Previous work focused on prepare-and-measure decoy-state phase-encoded BB84 at 1550 nm over optical fibre. Particular attention was given to characterising the active optical components, such as the attenuated pulsed laser and gated single-photon detectors, because of their importance to the security of a QKD system. Measurements were performed prior to, and in real time during, operation of a QKD system [3,4].

This informed the definition of an ETSI Group Specification document (pre-standard) [5,6]. The document gives specifications and procedures for the characterization of the aforementioned components of QKD systems, an essential service for future vendors and buyers alike.

Our work with the UK Quantum Communications Hub [7] will allow us to characterise QKD components and systems on the UK Quantum Network (UKQN) and promote the use of ETSI QKD standards. This requires us to expand our capabilities to address implementations using free-space visible wavelengths and chip-scale modules, and establish an NPL node on the UKQN.

These efforts will enable QKD systems to be evaluated and standard measures to be defined, thus helping to shape a validation and certification process for the technology. This complements, and is part of, a broader European effort to develop standards and metrological techniques to accelerate the commercial uptake of QKD and other technologies based on single photons [4,8].

The poster will present an overview of these topics.

References

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