Realizing downstream access network using continuous-variable quantum key distribution

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1. Introduction

- Quantum key distribution (QKD) is designed to establish symmetric keys between two legitimate parties. Continuous variable (CV) QKD that uses the coherent states and homodyne detection can only apply the cost-effective telecommunication components [1].
- Access network allows multitude end-users to connect to the nodal network [2].
- For downstream access network, signals are generated from the OLT, and broadcasted to every ONU in the network through passive beamsplitter.

2. CV-QKD downstream access network

- The downstream access network is composed of standard CV-QKD transmitter and receivers, BS is located at the ODN to passively distribute quantum states to each ONU.
- The ODN which is located in the middle of the OLT and ONUs separates the channel into segments.
- Since every ONU gets a copy of the quantum signal, malicious ONU may try to intercept the key between the OLT and the specified ONU.

3. Security analysis

- Standard CV-QKD is designed for point-to-point distribution scenario [3]. Further modification of the security analysis is needed for downstream access network.
- Classical post-processing is conducted with one activated ONU at a time.
- Different channel segments are treated as one channel to reduce the calibration complexity of channel parameters.
- The eavesdropper Eve is considered as being able to control other parties so that the security against other parties in the downstream access network can be obtained.

4. Performance analysis

- We show that quantum key distribution can be implemented in the downstream access network by using continuous-variable quantum key distribution.
- The realization of the downstream access network with our proposed security analysis can maximally maintain the implementation from the standard CV-QKD set-up.
- The security analysis is highly effective and can be conducted without the collaboration of other ONUs.
- Performance analysis shows the feasibility of the downstream access network.

References