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DEMONSTRATION OF SWITCHED CV-QDK NETWORK

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Abstract

A quantum channel is a physical media able to carry quantum signals. Quantum key distribution (QKD) requires direct quantum channels between every pair of prepare and measure modules. This requirement heavily compromises the scalability of networks of directly connected QKD modules. A way to avoid this problem is to introduce switches that can dynamically reconfigure the set of connections. The reconfiguration of a quantum channel implies that the modules using it can adapt to the new channel and peer.

Keywords: QKD, quantum channel, SNR, IP.

Introduction

QKD is a family of protocols that generate a shared secret key between two mutually trusting parties. In the specific case of prepare and measure protocols, these are the transmitter (Alice) and the receiver (Bob). The generated key is information-theoretically secure (ITS), which can be proven using quantum information theory. QKD protocols are superior to state of the art key exchange protocols as the security of the latter is based on computational complexity assumptions, which could be broken as soon as sufficiently powerful computers (quantum or classical) and algorithms are available.

2.CV-QKD prototypes

The demonstrated switched QKD network is based on a 12.5 MHz-bandwidth low-noise and low-complexity CV-QKD system with Gaussian modulation. The CV-QKD systems have an in-band synchronisation, K. Abboud, H.A. Omar, W. Zhuang, Interworking of DSRC and cellular network technologies for V2X communications:

a survey. IEEE Trans. Veh. Techn one dense wavelength division multiplexing (DWDM) channel in the C-band in one direction is needed for the QKD operation. Additionally, a bidirectional, standart internet protocol (IP)-based reconciliation link in required. This link does not rely on a purely-optical point-to-point connection, it can be transported over any existing network infrastructure, e.g., Ethernet. The devices can be configured to transmit with any figure between 0,0004 and 40 protons per symbol on average in the quantum band. This corresponds to a transmit power range of approximately -122 dBm to -72 dBm at a carrier frequency of 193.4 THz. The in-band synchronisation signals are typically 30 dB to 40 dB stronger than the quantum signal. The error correction runs with a single fixed-rate code, which supports a SNR down to -19.5 dB. This is a receiver sensitivity of approximately -105 dBm with 2.5 dB of receiver loss and heterodyne detection. Excess noise powers smaller than 50 dB below the shot noise can be detected (-141 dBm in the signal bandwidth at 193.4 HTz). With trusted detector noise and an inherent system noise as low as 0.15mSNU, the system supports up to 23 dB of channel loss. The inherent system noise is attributed to the eavesdropper. Simulated and measured key rates are depicted in fig.1.

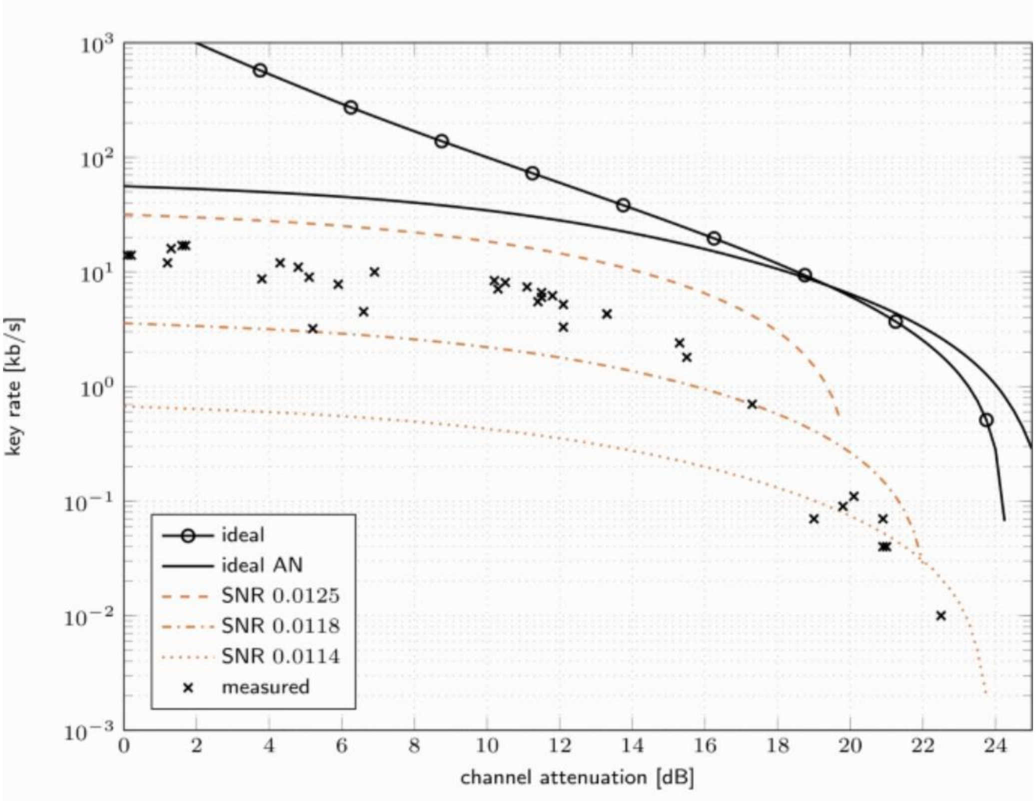

Figure 1.

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