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SoC-based flexible architecture for Quantum Communications and Quantum Random Number Generation

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We present a Zynq-7000 system that exploits the full SoC capabilities of both FPGA and CPUs to implement Quantum Key Distribution (QKD) and Quantum Random Number Generation (QRNG) systems. The system can both receive (top->down, Config1) or transmit (down->top, Config2) a data streaming from and to an external source via a TCP. It exploits interrupts, BRAM and bare-metal applications to reach the maximum speed of the gigabit connection. The system can generate the electronic signals to control a quantum apparatus (Config1) and can also readout the signals, via a custom TDC with 28 ps jitter or via external ADCs, from the apparatus (Config2). Config1 can be used for a QKD transmitter while Config2 can be used as a QKD-Receiver or as (discrete and continuous variable) QRNG. The results are presented in two manuscripts (10.1109/TQE.2022.3143997, 10.48550/arXiv.2406.01293). The system was successfully tested and used over the years in several quantum experiments.

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