Exploring expressivity of a PBKAT specification language for entanglement distribution protocols

Quantum networks provide communication services whose capabilities extend beyond classical networks, improving scalability of distributed quantum applications, enabling quantum cryptography and coordination primitives that surpass their classical counterparts in security and performance. Fundamental communication resource in quantum networks are distributed *Bell pairs*—pairs of maximally *entangled qubits* (or quantum states) with each qubit located at a separate node.

The distribution of entangled qubits (Bell pairs) between distant end-nodes will be the main task of the quantum internet. To maximize the rate of Bell pair generation under extremely constrained and error-prone quantum hardware resources, there is a variety of entanglement distribution protocols (e.g., see a recent survey). PBKAT is a high-level language simplifying specification and analysis of such protocols. Importantly, PBKAT abstracts away essentially everything except locations of individual qubits, leaving low-level details such as hardware request for local entanglement generation, memory management, quantum operations and classical signaling to underlying implementations.

The goal of this project is to assess the ability of PBKAT to express existing entanglement distribution protocols from the aforementioned survey, evaluate the performance of the PBKAT tool in terms of computation time and accuracy when analyzing the expressed protocols, and identify and address possible limitations of PBKAT.