A HYBRID QUANTUM-CLASSICAL OPTIMIZATION APPROACH OF SD QKD NETWORKS FOR DEPLOYMENT IN MADRID'S QUANTUM NETWORK AND EUROQCI NATIONAL INFRASTRUCTURE USE CASES.

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Amidst the rapid advancements in modern communication networks, the present study focuses on the analysis of quantum network deployments for the distribution of symmetric encryption keys. The optimization problem of Software Defined Quantum Key Distribution (SD-QKD) networks can be formulated in terms of a QUBO (Quadratic Unconstrained Binary Optimization) cost function, aiming to optimally partition a given network's geometry into dedicated and non-dedicated segments (i.e., channels) for QKD protocol processes. The Madrid Quantum Network infrastructure serves here as our reference framework, integrating considerations of network parameters such as attenuation (losses) of its commercial fibre channels, fibre specifications, Polarization Mode Dispersion and stability among others, so as to outline requirements and availability of components and resources for the potential coexistence of classical and quantum signals. These factors allow us to characterize the network and establish a generalizable optimization problem, which is addressed using a simulated Quantum Annealing algorithm on a classical processor. Moreover, the network size in our simulation is left parameterizable, enabling us to further explore the scalability of the use case with a larger number of nodes for prospective network expansions. Considering all the previous, our medium-scale simulation enables us to derive the most effective deployment of QKD systems within the context of the national infrastructure for quantum technologies.