Quantum networks in the cloud

Quantum network is defined on a graph, where the nodes have quantum computers and the edges represent the connection. Let us define the following concepts:

1) **Qubit-pairs:** Qubits (nodes) of a quantum network could be entangled using entanglement generation procedure with photons that succeeds with a finite probability $p_{success} = \frac{1}{2} p_c^2 e^{-L/L_{att}}$ where p_c is the coupling strength (between photos and fibre), L is the distance between the nodes and L_{att} is the attenuation length of the optical fiber. We could try to create entangled pairs between m qubits in parallel. in case, none of them succeed, try again (try n_{eg} times) until one pair has been generated. The success probability could be found here

2) **Quantum network:** A quantum network is defined on a graph where each node has certain parameters that could be used to benchmark quantum computers. Suppose, we have different quantum processors connected through a classical network, then what is the most efficient way to create entangled link between any two quantum processors? To answer this question, we define the following cost function for a given path p and find the path that gives the minimum cost

$$C(p) = n_p/R_p; C = min_p(C(p))$$

Where n_p denotes the total number of qubits and R_p is the communication rate for a given path. Please find the code here.

3) **Quantum cloud:** Quantum cloud consists of several quantum networks. Unlike a quantum network, quantum cloud requires quantum error correction and fault-tolerance such that when a node is lost, it is possible to recover the information.

Quantum networks have several potential applications such as quantum neural networks, quantum blockchain and quantum optimisation solvers