Software-defined Classical Metadata Control Channel for Quantum Network Applications

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Quantum communication offers new methods to securely transmit and receive messages by exploiting quantum mechanical principles. However, extending these applications beyond point-to-point settings requires robust quantum networking protocols that integrate with conventional messaging. Coordinated interactions between the classical and quantum channels are critical to build a multi-node quantum network to support quantum network applications like super dense coding, teleportation and quantum key distribution (QKD). Encoding of new network abstractions and hybrid network interfaces are equally important in creating quantum networks. In this poster, we present a new OpenFlow-based programmable network abstraction and a unified communication framework for designing applications within a quantum network. Due to its device agnostic programmability and unified forwarding, security enforcement policy, and full compliance of programmable network principles, OpenFlow will provide a flexible architecture for design and development of new network interfaces in support of quantum network applications. Centralized control plane intelligence will make it easy to securely distribute metadata needed to establish quantum key distribution. Our approach leverages advances in software-defined networking to enable control over the switching and encoding of quantum network traffic. An externalized distributed control plane will deploy programmable network intelligence to manage network in order to support the quantum applications. We verify these networking protocols using numerical simulations and then validate the system with experimental quantum optical hardware.

References:

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