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Building the quantum internet

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Abstract

Many organized efforts across the world are racing to realize the "Quantum Internet" – the internet of the future that is upgraded to provide an additional service: that of reliably transmitting qubits between distant users. Just like the internet's classical data communications service, the quantum communications service must reliably support many user groups, and support diverse and dynamic applications – each with its unique requirements on the quality of service for transmission of qubits, e.g., rate, latency, fidelity etc. Supporting long-distance quantum communications at high rates and fidelities will require scalable quantum repeaters and quantum-capable satellites for continental-scale quantum connectivity. In this talk, I will describe the underlying theory of quantum networking and quantum repeaters, allude to a few important applications, and give a glimpse of a large effort underway as part of an NSF-funded 10-year engineering research center called the Center for Quantum Networks (CQN). CQN is a highly interdisciplinary effort with research ranging material-science theory to design high-coherence time quantum memories, quantum memory design and fabrication, building efficient interfaces between matter and photon qubits, cryogenic compatible packaging capabilities, quantum error correction theory to design codes for quantum communication and entanglement distillation, repeater architecture design and analysis, the entire network protocol stack up to the application layer, and finally network control, tomography and management protocols. I will also describe how CQN engages disciplines such as law and policy, social and

behavioral sciences and economics through a research thrust focusing on societal impacts of the quantum internet.