EE/ CprE/ SE 492 - sddec23-17

Simulated Design of Quantum Networks

Biweekly Status Report

September 18 - September 27

Client: Dr. Durga Paudyal

Faculty Advisor: Dr. Durga Paudyal

Team Members:

Benjamin Amick - Network security engineer

Derrick Wright - System integration engineer

Ohik Kwon- System component designer

Steven Tompary- Network engineer

Past Week Accomplishments

We have begun to build our first iteration. This version includes the creation of both quantum connections and classical connections.

For the classical connection, Ben and Steven created a new internet protocol based on TCP. To do this, we first looked at how many bits were needed for the id, type, and length of the packet. The ID number will be the number which the packet is going to, 000 for the router and 001 through 111 being the nodes. This gives us 7 nodes to work with for our first version. Next, we have our packet type, this determines if the packet is sending (0) or receiving (1) and aids the nodes in knowing if they need to respond. Next is the data length, this is needed because it tells the receiver how long the packet is so that it does not collide with the next packet or cut it off too soon. Here is the packet diagram of what we decided:

ID - 3 bits	Packet type - 1 bit	Data Length - 12 bits
Data 4079 bits		

We will also need the packet to be padded with 0's if the data portion is not filled.

For quantum communication, we kept evolving based on our EPR pair communication system. The most important issue was how we can check the entanglement state for our quantum teleportation. To do this, we found a journal, '*The controlled SWAP gate for determining quantum entanglement.*' We decided to employ this method to verify our EPR pair communication system.

- **Ben** - Worked with Steven to create a new classical protocol to be used by our router and nodes to communicate with each other.
- **Ohik** - Found and studied verification protocol for entanglement state using SWAP gate.
- **Steven** - Worked with Ben to create a new classical protocol to be used by our router and nodes to communicate with each other.

- **Derrick** - Reviewed the Qiskit documentation for the system integration. Made module for 1 quantum bit EPR pair communication.

Resources

Our git repository
https://github.com/Kcops11/SeniorDesignQuantum17

Books we are reading

- Quantum Computation and Quantum Information, Michael A. Nielson

Articles we found this week and reading

- Github Qiskit Community Tutorials
- When Entanglement meets Classical Communications: Quantum Teleportation for the Quantum Internet, IEEE Transactions on Communication, 2020, 10.1109/TCOMM.2020.2978071
- The controlled SWAP test for determining quantum entanglement, Quantum Science and Technology, 2021, *https://doi.org/10.1088/2058-9565/abe458*

Pending Issues

- There are no pending issues for this week since we all agreed on detailed functionalities of our first iteration network.

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Benjamin Amick	Work on cluster computing architecture	5	51
Derrick Wright	Made module for quantum teleportation	5	51

Ohik Kwon	Found systematic way to verify entanglement state	5	51
Steven Tompary	Work on cluster computing architecture	5	51

Plans for Coming Week

- Combine the classical and quantum portions of our project to ensure they integrate successfully.