EE/ CprE/ SE 491 - sddec23-17

Simulated Design of Quantum Networks

Week 9 Report

April 10 - April 16

Client: Dr. Durga Paudyal

Faculty Advisor: Dr. Durga Paudyal

Team Members:

Benjamin Amick - Network security engineer

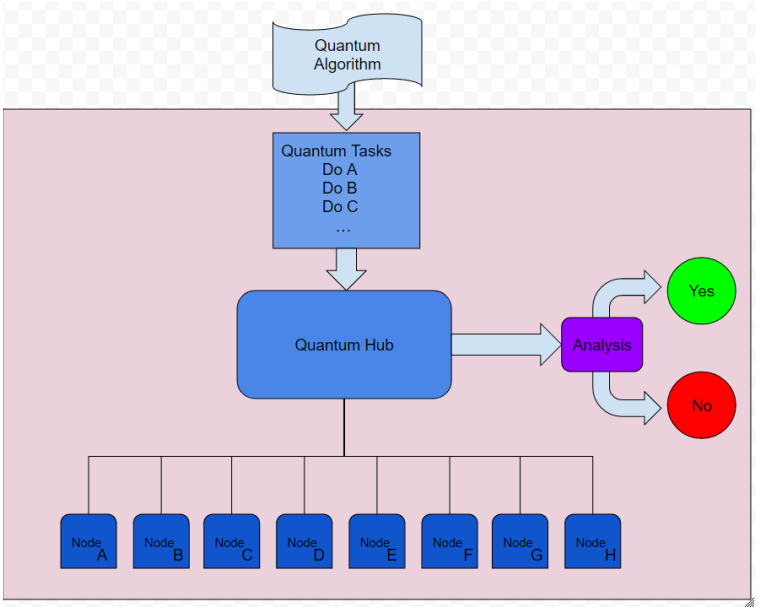
Derrick Wright - System integration engineer

Ohik Kwon- System component designer

Steven Tompary- Network engineer

Past Week Accomplishments

- During this week, we finalize our high-level design diagram and where it could be used as part of our clients' quantum cluster computing. From the diagram below, the pinkish square part is what we will build for next semester. Also we talked about our client's short-term goal. This information will be used when we have to deal with performance issues. For example, if we had to choose either function A or B, then we can consider based on our client's short-term goal.

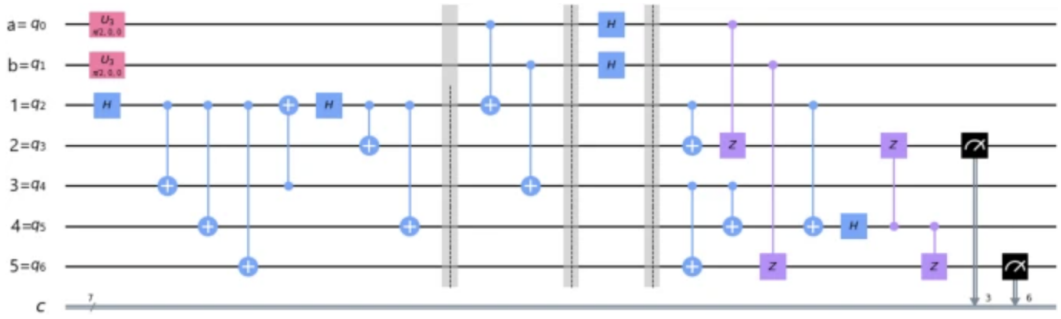


[Figure fixed high-level diagram.]

- **Ben** - Keep evolving pseudocode and draw high level diagram
  - Worked to keep evolving simple pseudo code for our classical network which will distribute jobs to each node.
  - Presented a high-level diagram to the client and made discussion about what additional parts should be implemented.

- **Ohik** - Researched about cluster state.
  - Keep reading quantum information books.
  - Researched about cluster state even not sure about what cluster state it is since cluster state technology is referenced many times in many papers as a key to implement QKD and error correction performance.

- Fund and read paper which use cluster state as 5 quantum bits quantum transportation



A generalized circuit for teleporting arbitrary two-qubit state using five-qubit cluster state.

Quantum transportation using cluster state

- **Steven** - Researched cluster computing
  Researched about classical cluster computing and routers. That's because even if we're building a quantum network for quantum cluster computing, we still need classical channels and a router to run it.

- **Derrick** - Revised Use Case Diagram, Leaning Qiskit
  Since we need to take care of example jobs, Derrick started early to move on to build example jobs for testing. This example job should take quantum information as input data and contain hybrid algorithms.

Resources

Slides we used during a meeting
https://drive.google.com/drive/folders/1ADuFrguqWioXrodApQ-er4v-RZr_0XQW?usp=share_link

Books we are reading

- Quantum Computation and Quantum Information, Michael A. Nielson

Articles we found this week and reading

- Github Qiskit Community Tutorials

- https://journals.aps.org/prl/pdf/10.1103/PhysRevLett.86.5188
- https://www.nature.com/articles/nature11472#MOESM308
- https://www.oeaw.ac.at/fileadmin/Institute/IQOQI-Vienna/PDF/publications-zeilinger/2008_-_Quantum_Computation_and_Quantum_Communication_with_Entangled_Photons.pdf
- Entanglement Swapping in Quantum Switches: Protocol Design and Stability Analysis
- Cluster-state quantum computation - https://doi.org/10.1016/S0034-4877(06)80014-5

Pending Issues

- We need to take care of our example jobs for testing our network since it has to deal with quantum input information and go through quantum wire.
- We need to discuss future plans about senior design for next semester as the end of this semester is approaching.

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Benjamin Amick	Work on pseudo code	5	36
Derrick Wright	Researched Qiskit	5	36
Ohik Kwon	Research quantum information	5	36
Steven Tompary	Work on cluster computing architecture	5	36

Plans for Coming Week

- Share individual research about quantum networks - everyone
- Work collaborate on our final presentation -everyone
- Work collaborate on our design documents -everyone
- Keep studying about quantum information and computation. Also trying to understand cluster state and its applications to our network -Ohik
- Keep evolve pseudo code of our quantum router and keep contact with our clients regarding performance of our router -Ben
- Keep communicating with Ben regarding quantum network cluster computing. And research about cluster computing architecture and scheduler - Steven

- Research regarding sample job for our testing which consider quantum input data- Derrick