EE/ CprE/ SE 491 - sddec23-17

Simulated Design of Quantum Networks

Week 8 Report

April 3 - April 9

Client: Dr. Durga Paudyal

Faculty Advisor: Dr. Durga Paudyal

Team Members:

Benjamin Amick - Network security engineer

Derrick Wright - System integration engineer

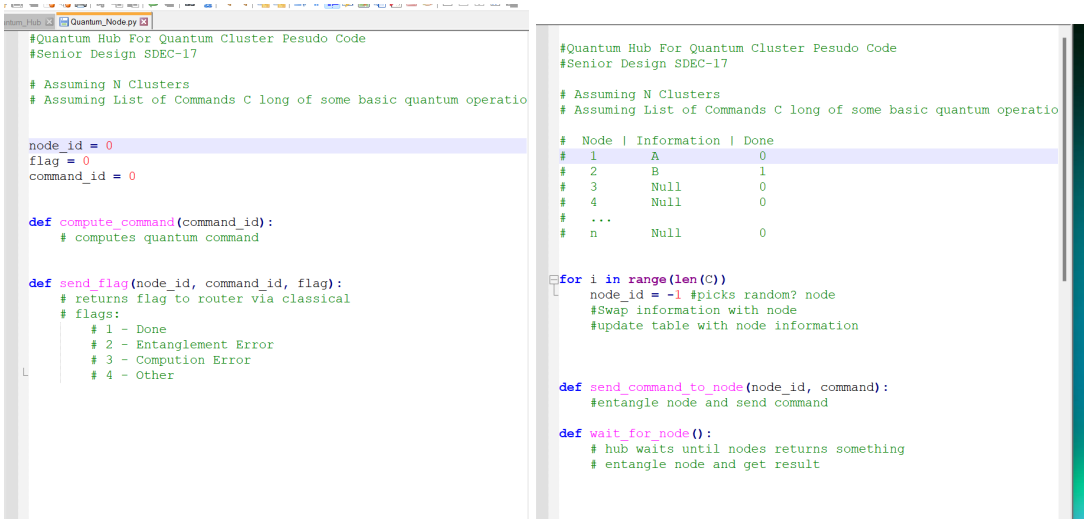
Ohik Kwon- System component designer

Steven Tompary- Network engineer

Past Week Accomplishments

- After we fixed our project, we started to work on each part. Ben made simple pseudo code for our quantum router. Ohik researched quantum communication, quantum teleportation which will be implemented in our network. Ohik is also trying to implement cluster states in our network for implementing advanced features such as error correction and QKD. Derrick has worked to revise use case diagrams and Steven summarized jargons we have used and triggered confusion due to unclear definition of each.

- **Ben** - Built simple router pseudo code
    - Worked to make simple pseudo code for our classical network which will distribute jobs to each node.



```
#Quantum Hub For Quantum Cluster Pesudo Code
#Senior Design SDEC-17

# Assuming N Clusters
# Assuming List of Commands C long of some basic quantum operatio


node_id = 0
flag = 0
command_id = 0


def compute_command(command_id):
    # computes quantum command


def send_flag(node_id, command_id, flag):
    # returns flag to router via classical
    # flags:
        # 1 - Done
        # 2 - Entanglement Error
        # 3 - Compution Error
        # 4 - Other
```

```
#Quantum Hub For Quantum Cluster Pesudo Code
#Senior Design SDEC-17

# Assuming N Clusters
# Assuming List of Commands C long of some basic quantum operatio

#  Node | Information | Done
#   1       A             0
#   2       B             1
#   3       Null          0
#   4       Null          0
#   ...
#   n       Null          0


for i in range(len(C))
    node_id = -1 #picks random? node
    #Swap information with node
    #update table with node information



def send_command_to_node(node_id, command):
    #entangle node and send command

def wait_for_node():
    # hub waits until nodes returns something
    # entangle node and get result
```

Figure : simple pseudo code of our router

- **Ohik** - Researching about Qiskit document, Quantum communication implementation
    - Keep reading quantum information books.
    - Researched about quantum communication and cluster computing.

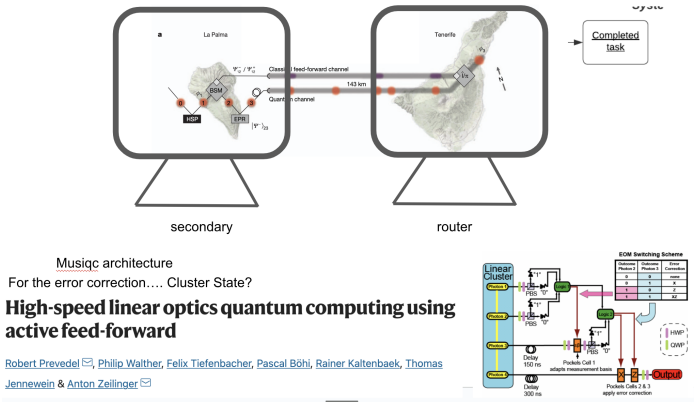


Figure : proposed quantum circuit for quantum communication

- **Steven** - Summarized jargon we're using
  Summarize and make sure about jargons we're using regarding this project since we realized that confusing unclear terminologies trigger misunderstanding with each other.

- **Derrick** - Revised Use Case Diagram
  To get a clear understanding, Derrick revised the use case diagram and shared it with advisors to make sure all of us, including advisors, are on the same page.

Resources

Slides we used during a meeting
https://drive.google.com/drive/folders/12x3zLfx6RXnJv1q1oNlqcTaKOMG6hGrq?usp=sharing

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

Pending Issues

- We need to take time for revision of our 491 class works such as design documents since our project has been changed quite a lot.
- We still need more specification, especially about our dummy jobs for simulation and determination of whether we will assume our nodes are classical or quantum. We will discuss this with our advisor for our next meeting.

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Benjamin Amick	Researched about QKD	5.5	31
Derrick Wright	Researched Quantum Information	5.5	31
Ohik Kwon	Research quantum gates	5.5	31
Steven Tompary	Researched quantum networks	5.5	31

Plans for Coming Week

- Share individual research about quantum networks - everyone
- Keep studying about quantum information and computation. Read papers regarding quantum communication. Learned Qiskit - ohik
- Keep communicating with Steven regarding quantum network cluster computing. And write down Pseudocode for our quantum router which we will make for our quantum network. During this week, he will evolve this. - Ben
- Trying to finish drawing a use case diagram, and trying to revise some design documents. - Derrick
- Research about interrupt handler of classical network for implementing interrupt handler to our quantum network for cluster computing.-Steven