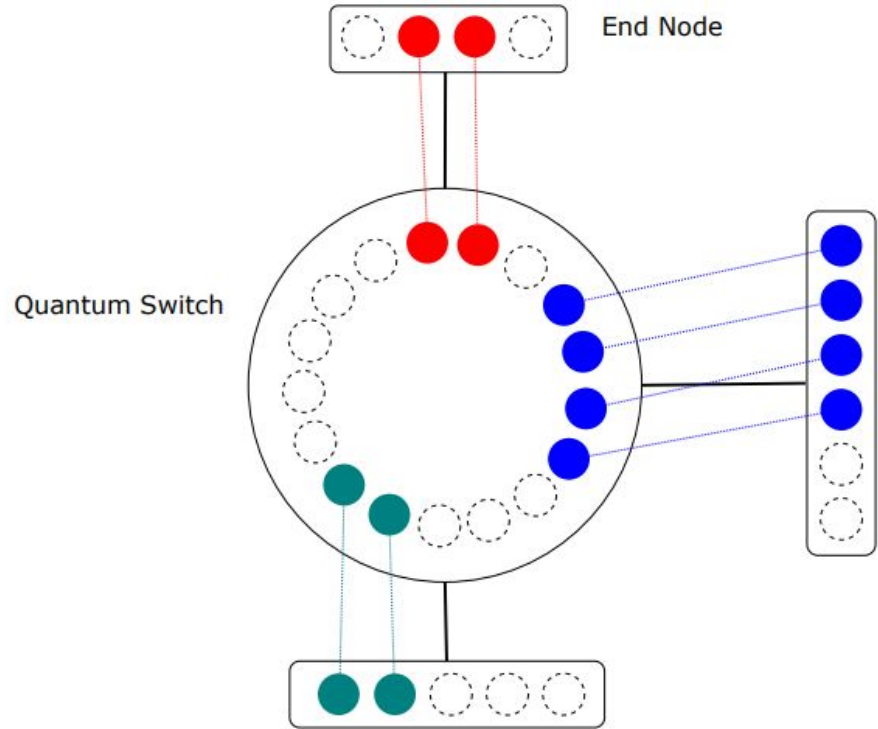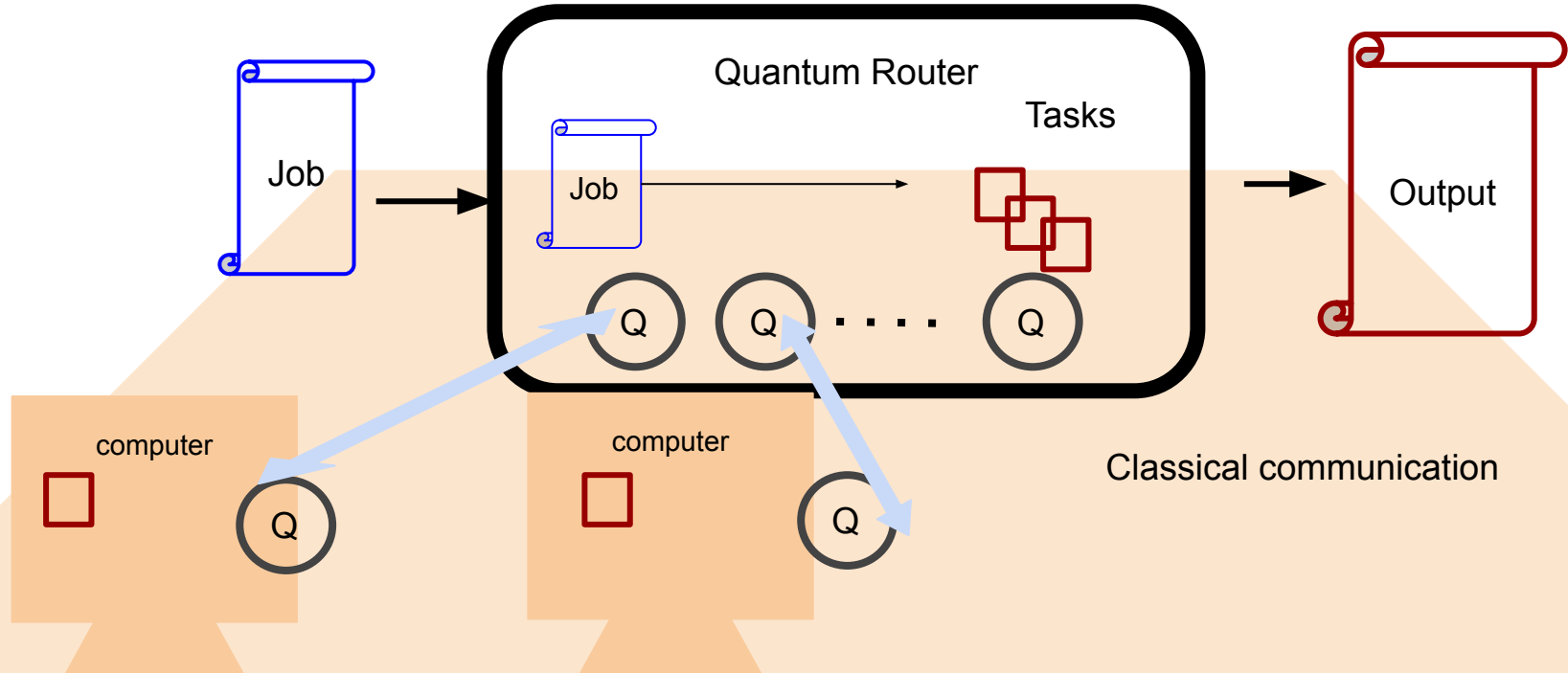# Project Design Plan

Quantum Computing
sddec23-17

Project Summary

- How can we distribute a quantum tasks to smaller nodes?
- How can we route quantum information between quantum nodes?

End Node

Quantum Switch

Design Context -> why they need this?

Design Context

- Clients: Dr. Durga and Dr. Smith
  - Doing intensive **researches** regarding quantum computers.
  - Major interest : **Quantum computation** and **Quantum information theory**
    - **They are making Ion trap to hold Q-bits. They want to research quantum cluster computing.**
- Needs
  - Design a quantum network **simulation** to communicate with quantum cluster computers. These computers will have both classical and quantum components.

Design Context

- They anticipates that quantum computing will be commercialize at least **30 years later.**
- **This project is for initiating their work on quantum cluster computing.**
- It is important to keep in mind that this project is a proof of concept simulation and therefore
  - Has little immediate impact on society / culture
  - Has little impact on the economy
    - Project is completed using free tools
  - Has little impact on the environment
    - Electricity usage to run computers
- Prior work:
  - Our project combines quantum routers and classical clusters to create a state of the art quantum computing cluster. Some other universities have done some exploratory work with this and there do exist some papers.
    - University of Maryland
      - Quantum cluster computing

Design Exploration

No Dependencies	Later Dependencies	Immediate Dependencies
- Giving tasks to node - When tasks are done - I/O device - Logging - Entanglement	- Giving tasks to node - When tasks are done - I/O device - Logging - Entanglement - Error correcting	- Giving tasks to node - When tasks are done - I/O device - Logging - Entanglement - Interrupt handler

Proposed Design - High Intelligence Nodes

- Could route quantum information themselves

- Needed to know where other nodes and information was located

- Easier to implement routing protocols

- Nodes could have more error correction inside them

Proposed Design - Low Intelligence Nodes

- Very Scalable

- Quantum router would need to be in control of all information and keep track

- Node would still need to be able to send and receive quantum information

- Very little troubleshooting on the node side

Design Analysis

- High intelligence nodes would make routing and error handling much easier and more efficient

- Low intelligence nodes would make the quantum operations needed harder to implement but the node itself would be much simpler.

- Because scalability and a large number nodes is important to our clients we decided low intelligence nodes would be better