1.1 Problem Statement

What problem is your project trying to solve? Use non-technical jargon as much as possible.

Dr. Durga, who is our advisor and client, is very interested in research about quantum computation and information technology. He is currently working with Dr. Smith who also researches quantum computation and information with him. They want to have their own quantum platform such as quantum gates and quantum networks for their research, quantum cluster computing. Having actual quantum networks for cluster computing is demanding since they need working quantum computers. Thus, our group is making a simulation of quantum networks for their research regarding quantum cluster computing.

1.2 Requirements & Constraints

List all requirements for your project . This includes functional requirements (specification), resource requirements, qualitative aesthetics requirements, economic/market requirements, environmental requirements, UI requirements, and any others relevant to your project. When a requirement is also a quantitative constraint, either separate it into a list of constraints, or annotate at the end of requirement as "(constraint)". Other requirements can be a single list or can be broken out into multiple lists based on the category.

Our network has to be considered as a physical aspect of the quantum. When we run our simulation, although we don't use actual quantum bits unless we're purchasing computation resources from IBM, we should consider the nature of quantum such as quantum entanglement restriction (distance etc.) since our client want to have a simulated quantum network for cluster computing which reflects limitations as much as possible. Also, our network has to be available to work as cluster computing, not just for simple communication between different nodes. Although degree of decentralization can be change due to the property of our project, but it has to be working as network for cluster computing.(Functional requirements)

Our network has to be cost efficient. It can't not use many Q bits since that means it will cost a lot when our clients request to run our network on IBM quantum computers. Our clients goal is to save their research funding as much as possible related quantum networks to fabricate actual quantum nodes. (Economic Constraint)

Our network has to have an expandable network protocol since Dr. Durga and Dr. Smith might want to add functions to our prebuilt network protocol (Expandable Requirement)

Our network has to be easy to implement when our researchers have all requirements to run our network such as quantum computers for running simulations to make them available to keep focus on Quantum information research. (User interface Requirement / User skill Constraint)

1.3 Engineering Standards

What Engineering standards are likely to apply to your project? Some standards might be built into your requirements (Use 802.11 ac wifi standard) and many others might fall out of design. For each standard listed, also provide a brief justification.

IEEE 802.3 Ethernet: This standard defines the physical and data linky layers of wired Ethernet networks. These networks are going to be critical to set up as they will be used in conjunction with our quantum network we are creating and provide a good baseline network that we can build off of.

IETF RFC 2544: Methodology for measuring the performance of network devices. This standard from the Internet Engineering Task Force describes standards on how network devices are monitored and how their performance is tracked. Once our network is running, we will need to test the speed and reliability using these standards to ensure that it is a viable option compared to standard internet.

IEEE P7130: Standard for Quantum Computing Definitions. These standards provide standards on how quantum computing framework functions are described and what terminology is used. This is important because if we are to communicate with our advisor, we will need to use the proper terms so that he can understand and implement our design.

IEEE P802.1Q-2021: Bridges and Bridged Networks, Amendment 28: Quantum Key Distribution Protocol. This amendment to IEEE 802..1Q defines the Quantum Key Distribution (QKD) protocol which is used to secure network traffic over a quantum network. This is important because if we want the traffic on our network to be secure therefore we will need to implement QKD.

1.4 Intended Users and Uses

Who benefits from the results of your project? Who cares that it exists? How will they use it? Enumerating as many "use cases" as possible also helps you make sure that your requirements are complete (each use case may give rise to its own set of requirements).

Who may benefit from our project?

- Researchers and academics in the field of quantum computing and quantum networking who are looking for new designs of quantum networks for quantum cluster computing.
- Companies and organizations which are looking to initiate their projects related to quantum cluster computing. Our network would be helpful to initiate their project, or they even use our network for cluster computing.
- The General Public who are interested in the great potential of quantum cluster computing which might save tremendous computational resources if it is conducted via a single quantum computer.

How would they use it?

- Researchers could use our network for initiating to make their own quantum network for cluster computing.
    - Researchers could use our network for cluster computing to run their cluster algorithm to test feasibility of their work.

    - Researchers could use our network for cluster computing to add their quantum key distribution function to test feasibility of their work.
- The General Public interested in quantum computing and cluster computing could download our network and use it for their own study or evolve our network such as any open-source project.