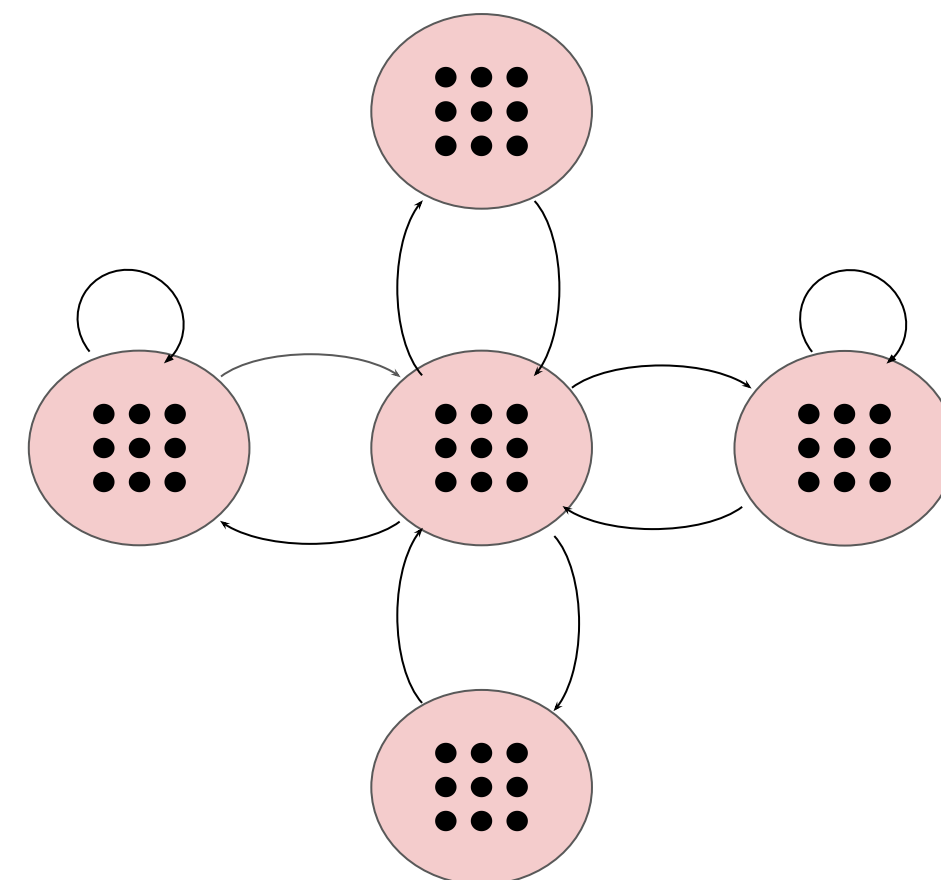


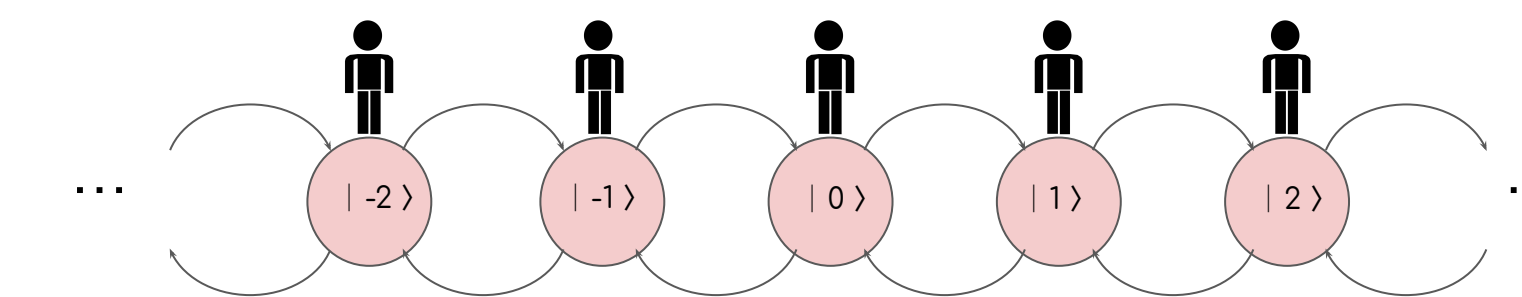
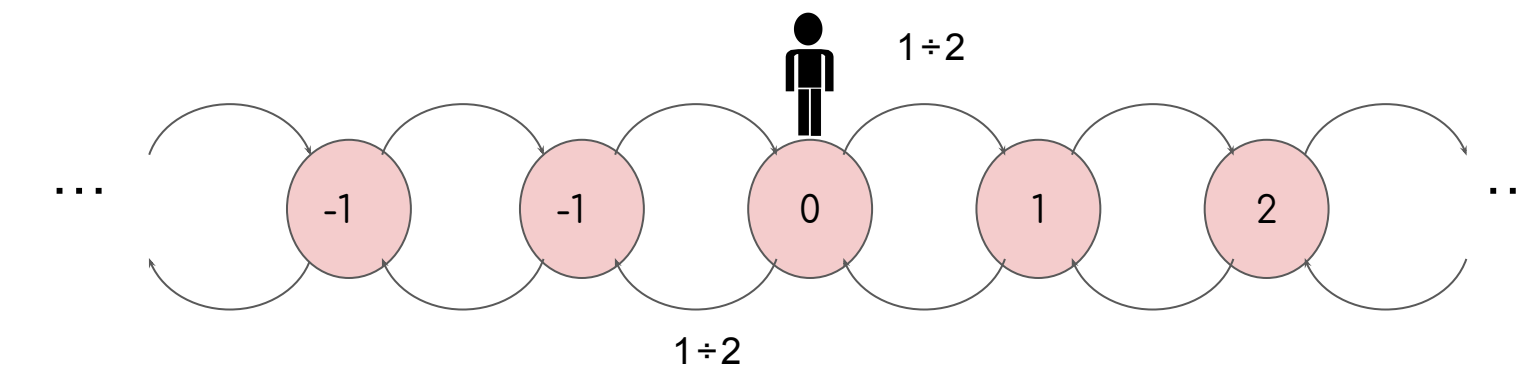
Introduction

- **Goal:** Implement distributed quantum walk control plane
 - Control plane: Part of a network that controls how data is forwarded
 - Quantum Walk: Mathematical tool used in this model
 - Implementation: How to perform the control plane on a real network
- **Contributions:**
 - Perform network quantum algorithms which relies on quantum walks such as Grover's Search
 - Perform distributed quantum computation
 - New model implementation to have new approaches in the field.



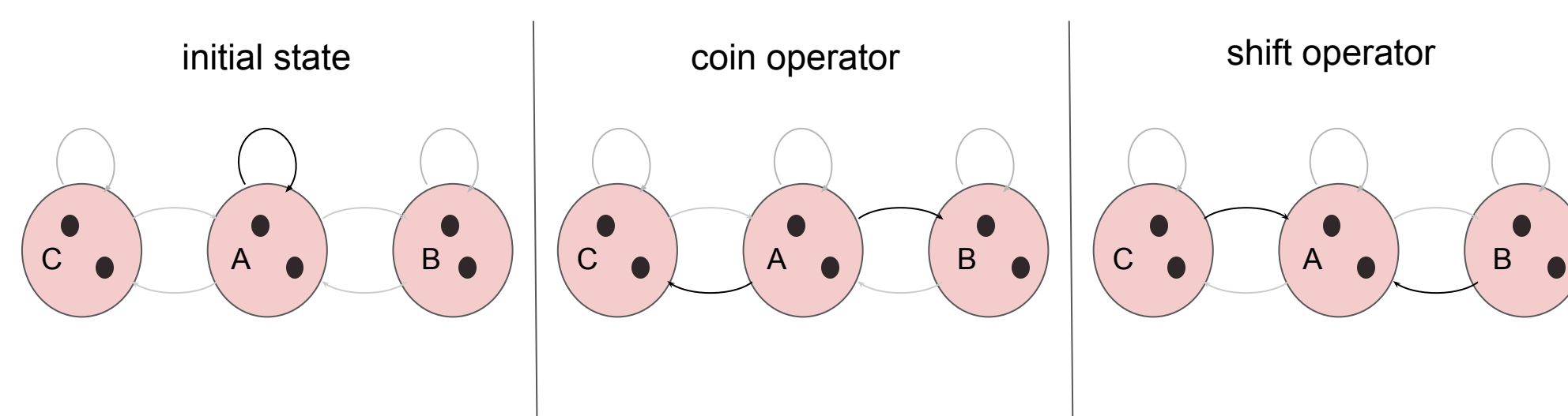
Quantum Walk

- **Random Walk:**
 - Every time step the walker moves from a node to its neighbor
 - You have a probability of going in each possible direction
- **Quantum Walk:**
 - Quantum version of a random walk
 - Propagate among neighbors of a node
 - The state is a vector on a Hilbert space
 - Quantum walks encode edges in a Hilbert space
 - When you measure the system it collapses at a unique position



Quantum Walk Control Plane

- Logical model describes the control plane showing the operations needed to perform the quantum walk mathematically
- Protocol is universal for quantum computing
- Evolution includes a coin and a shift operator
- Use entanglement to make a connection between data qubits and the quantum walk
- Entanglement is a strong correlation between particles where the state of a single particle can not be described alone



Distributed Quantum Walk Implementation

- Local coin operator
- Non-local shift operator
- Quantum gate teleportation:
 - Consume EPR pairs to perform operations between distant nodes
 - EPR pairs are pairs of entangled qubits on a specific state
- Linear approach: linear number of qubits in respect to the number of edges
- Logarithmic approach: logarithmic number of qubits in respect to the number of edges in each node.
- There is a tradeoff between number of encoding qubits and complexity of the shift operation
 - Less encoding qubits → more epr pairs needed for the shift
 - More encoding qubits → less epr pairs needed for the shift

