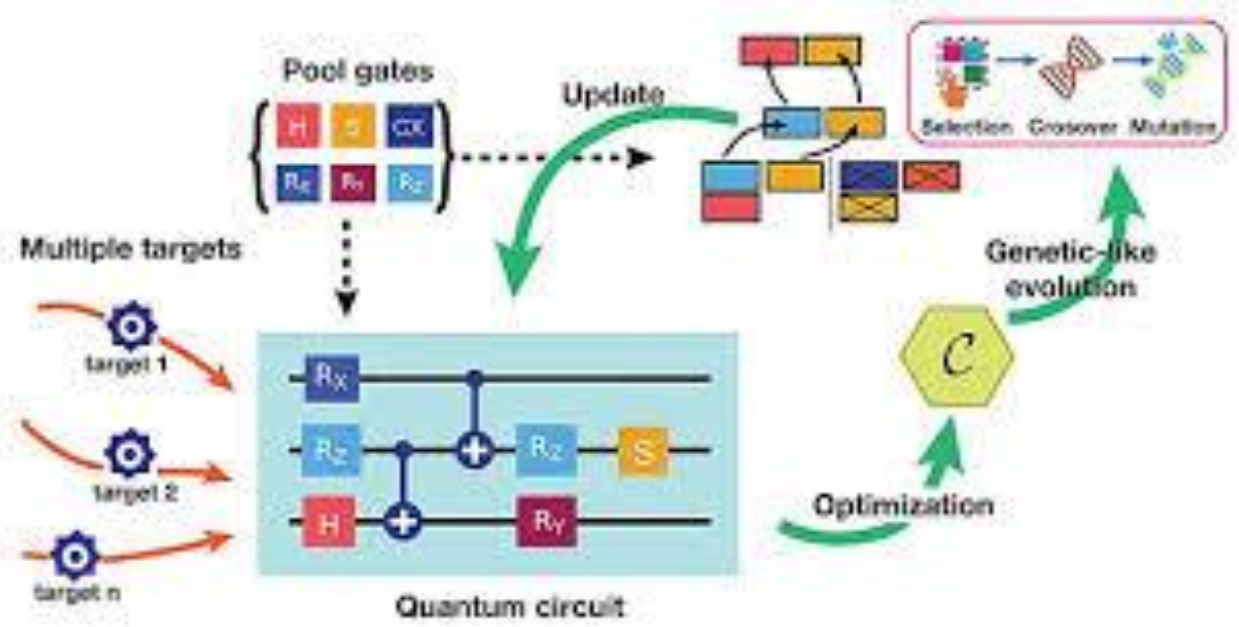
บทที่ 8 SUMMARY & NEXT STEPS



ผู้ช่วยศาสตราจารย์จุฑาวุฒิ จันทรมาลี

หลักสูตรวิทยาศาสตรบัณฑิต สาขาวิชาวิทยาการคอมพิวเตอร์
คณะวิทยาศาสตร์และเทคโนโลยี มหาวิทยาลัยสวนดุสิต

Pre-Session Quiz

1) What are some use-cases for quantum networks?
2) What are some of the special properties of quantum bits (Qubits)?
3) What makes a quantum computer so fast?
4) What is Y2Q? And when do most experts expect it?
5) Can you transmit information faster than light with quantum teleporting?
6) Will quantum networks replace classical networks?
7) What is Cisco researching and developing in Quantum?

Post Session Quiz / Summary

1) What are some use-cases for quantum networks?

Quantum Cryptography

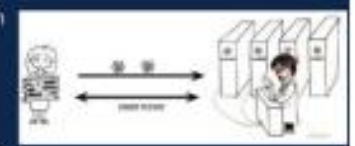
- Quantum networks can be used to securely exchange cryptographic keys, as these are mathematically proven to detect and prevent eavesdropping
- The most well-known method of this application is *Quantum Key Distribution (QKD)*

Distributed Quantum Computing

- Interconnecting geographically-dispersed quantum computers to realize benefits such as:
  - Increased Processing Power
  - Distributed Quantum Computing
  - Specialized Quantum Modules
  - Fault Tolerance
  - Hybrid Quantum-Classical Systems
  - Etc.

Blind Quantum Computing

- A privacy-preserving method in which a client can delegate a computation task to remote quantum computer(s) without disclosing the source data or algorithms
- The results of the computations would likewise be private



Network Clock Synchronization

- A world-wide set of high-precision clocks connected by quantum networks could achieve ultra precise clock signals
- Current accuracy: ≤ 30 ns
- Quantum accuracy: ≤1ps

Distributed Sensing

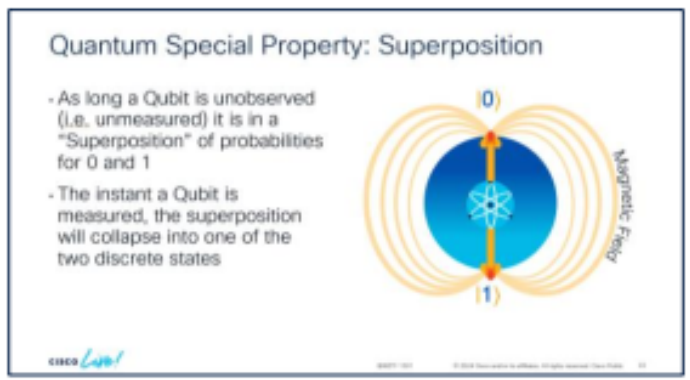
- Signals from distributed sensors can be combined via quantum networks to obtain higher-accuracy measurements than currently possible with classical network interconnections
- E.g. Telescope Array
  - Classical precision: $\propto 1/\sqrt{N}$
  - Quantum precision: $\propto 1/N$

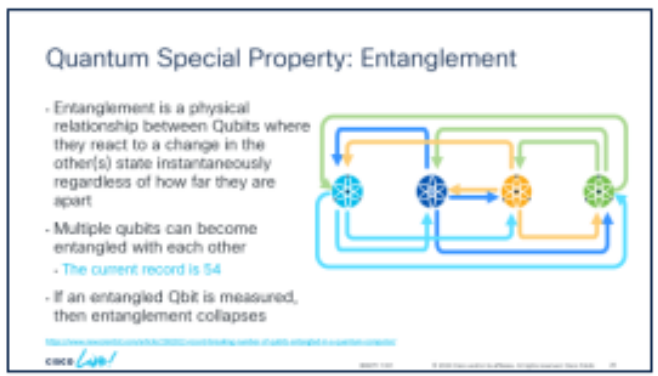
Quantum Money

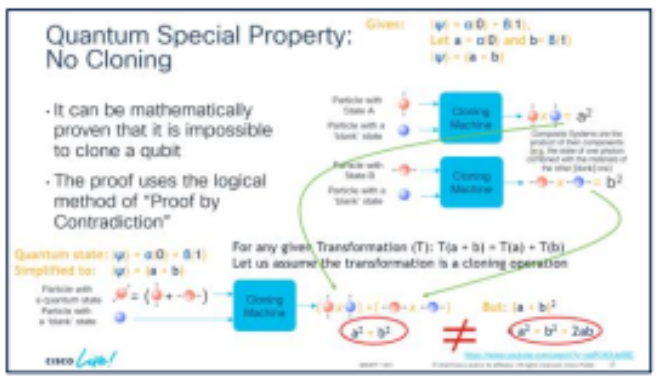
- The main security requirement of money is unforgeability
- A quantum money scheme aims to fulfill by this requirement by exploiting the no-cloning property of the unknown quantum states

Post Session Quiz / Summary

2) What are some of the special properties of quantum bits (Qubits)?

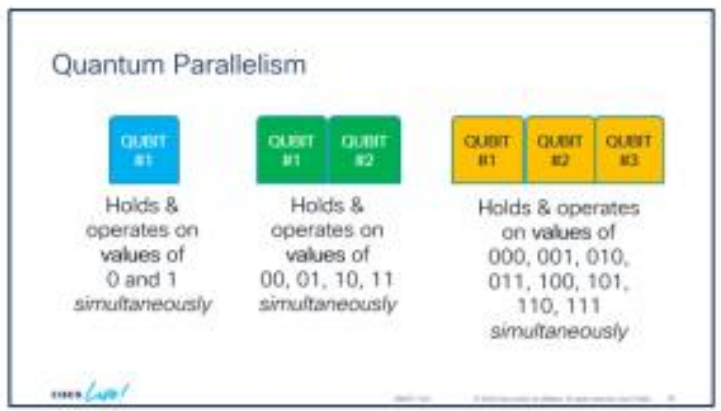


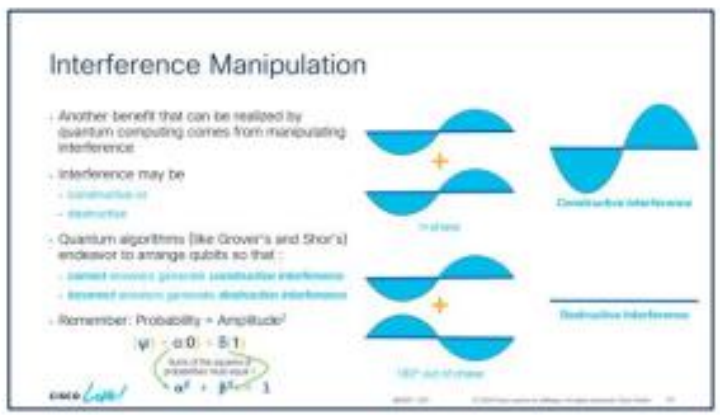




Post Session Quiz / Summary

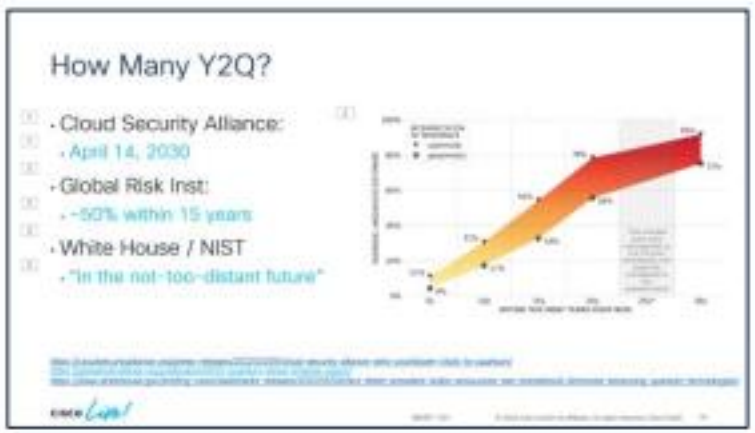
3) What makes a quantum computer so fast?





Post Session Quiz / Summary

4) What is Y2Q? And when do most experts expect it?

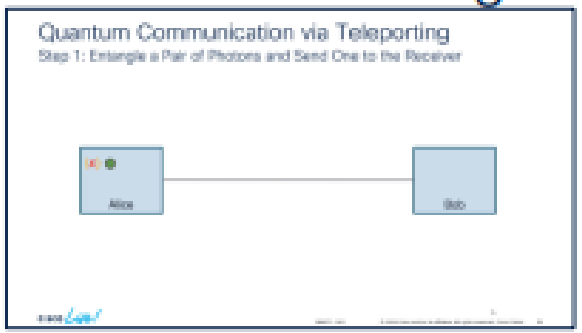


Post Session Quiz / Summary

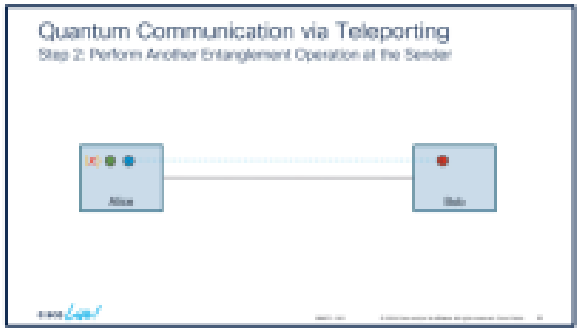
5) Can you transmit information faster than light with quantum teleporting?

Key Takeaway:
Quantum teleportation does NOT enable faster than light communication

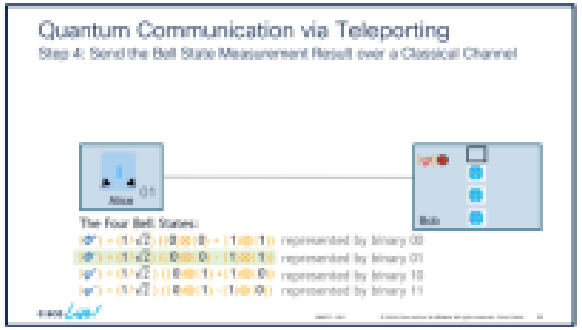
In fact, ***for every bit*** of information sent via ***quantum*** teleportation, ***at least 3 additional bits*** of data must be sent over ***classical*** channels



Equivalent to sending (at least) one bit over a classical channel



Teleporting one of 4 random states does occur faster than light, but (strictly speaking) this not an information transfer on its own merit, since we cannot correctly interpret what has been sent without additional data



(At least) Two more bits of data are sent over a classic channel

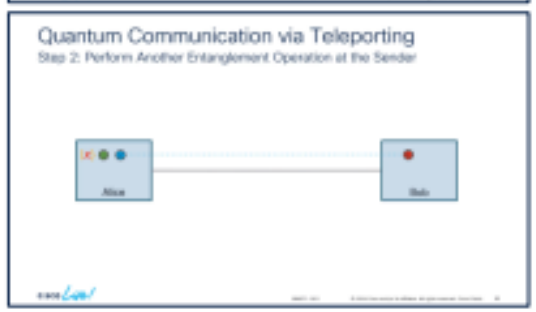
Post Session Quiz / Summary

6) Will quantum networks replace classical networks?

Equivalent to sending (at least) one bit over a **classical channel**

Key Takeaway:
Quantum teleportation does NOT enable faster than light communication

In fact, ***for every bit*** of information sent via ***quantum*** teleportation, ***at least 3 additional bits of data must be sent over classical channels***



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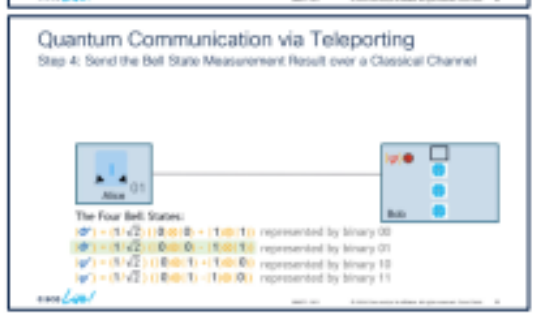
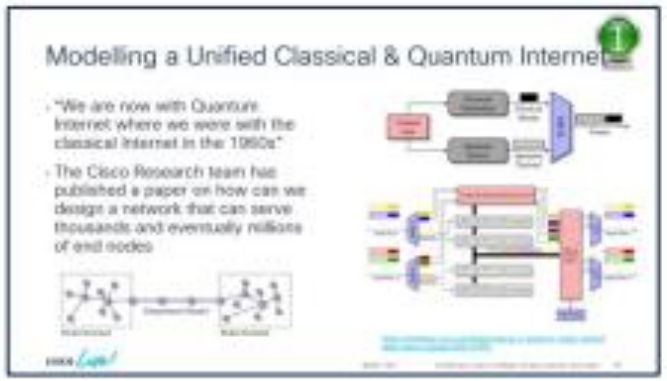
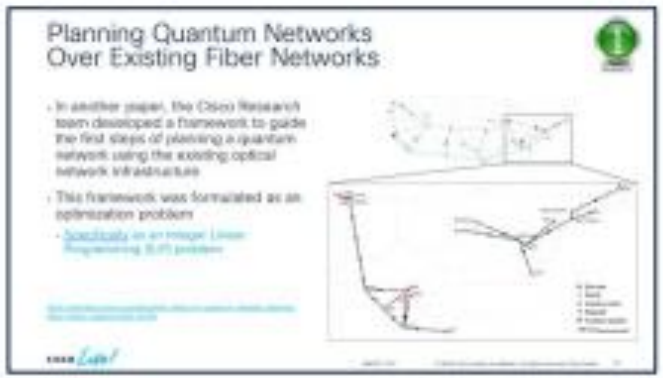


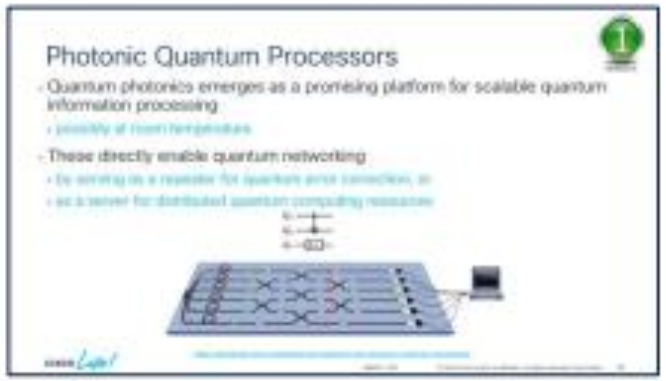
(At least) Two more bits of data are sent over a **classic channel**

Post Session Quiz / Summary

7) What is Cisco researching and developing in Quantum?








QUESTIONS
ANSWERS