

PERFORMANCE METRICS FOR QUANTUM NETWORKING





The size, value, or amount of quantum resources used by a quantum network.

- Quantum Resources: The number of qubits or entangled pairs.
- **Network Size:** The number of nodes, the distance covered by the network, and the number of users.
- **Value:** How much does it cost to operate a quantum network and how much value does it provide.



QUALITY METRICS

How well a quantum network can perform a task.

- **Efficiency:** The probability that a process or protocol proceeds without error.
- **Fidelity:** The "distance" between an ideal quantum process and the actual process.



TIMING METRICS

How fast quantum networking services and protocols can be performed.

- Latency: How long does it take to deliver a service on a quantum network?
- **Timing Precision:** Higher-resolution timing can decrease quantum network performance.
- **Timing Accuracy:** Less timing error improves network performance.



How often quantum networking services and protocols are performed.

- Entanglement Generation Rate: How many entangled pairs can be delivered per second?
- Channel Capacity: How much information can be transmitted per
- second?
- Error Rate: How many errors or losses are expected per second?



High-level metrics for quantum networking services.

- **Network Downtime:** How much time per day is the network unavailable to users?
- **Network Cost:** How much does it cost to operate the network and how much value does it provide?
- **Network Load:** How many users are on the network and how many quantum resources do they require?



The performance of entanglement generation.

- Entanglement Generation Rate: Decreases with loss and quantum repeater latency.
- Entanglement Fidelity: Improves with entanglement purification protocols, but causes the rate to decrease.

There is a tradeoff between quality and entanglement generation rate.



METRICS FOR QUANTUM KEY DISTRIBUTION

The performance of entanglement-based key distribution.

- Quantum Bit Error Rate (QBER): The number of errors per length of sifted key.
- Secret Key Rate: The number of bits of secret key delivered per second.

Smaller QBER means larger key rate.

Larger entanglement generation rate means larger secret key rate.



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