High-Dimensional B92 Protocol

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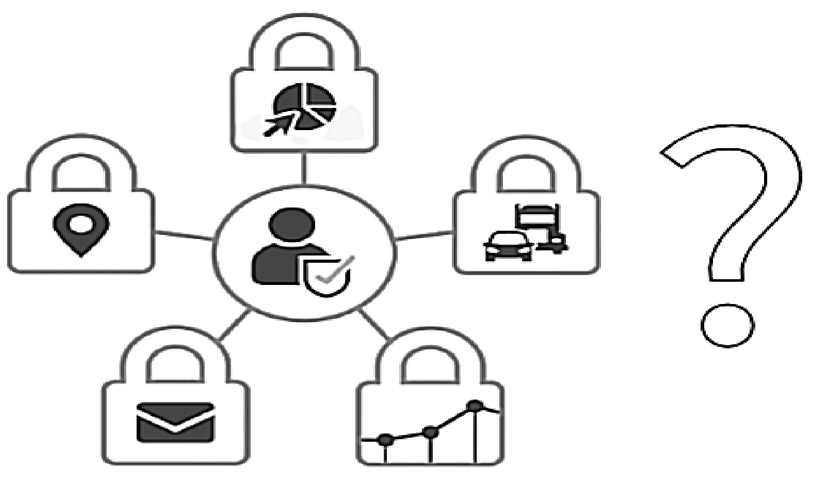
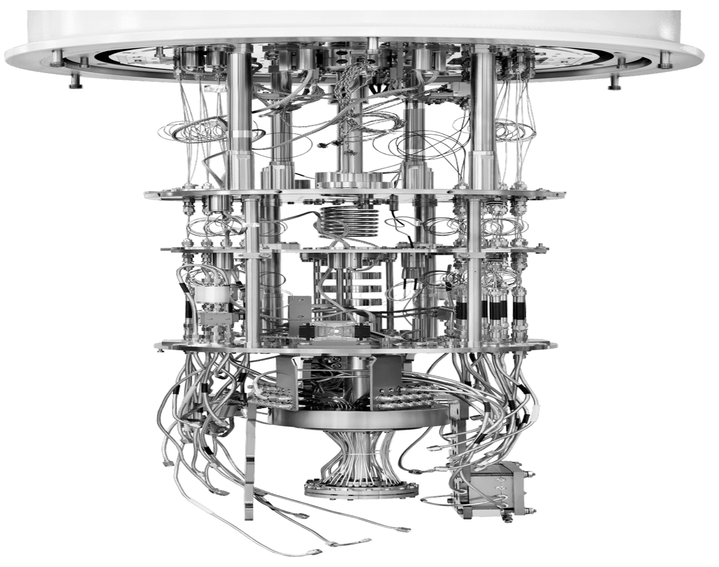
The Situation Now



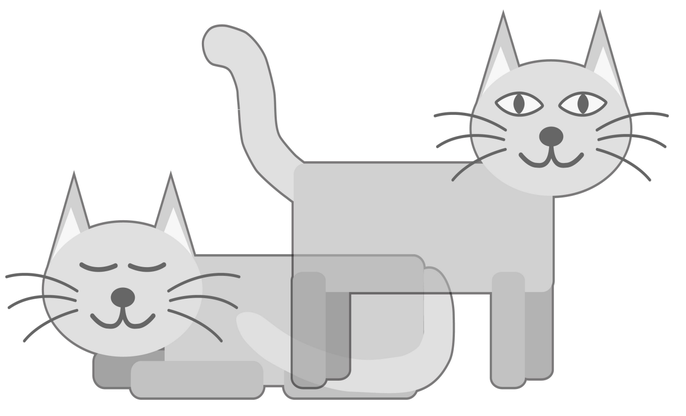
- We think that our messages, password, healthcare data are securely encrypted.
- But this is based on unproven mathematical assumptions.

The Looming Threat



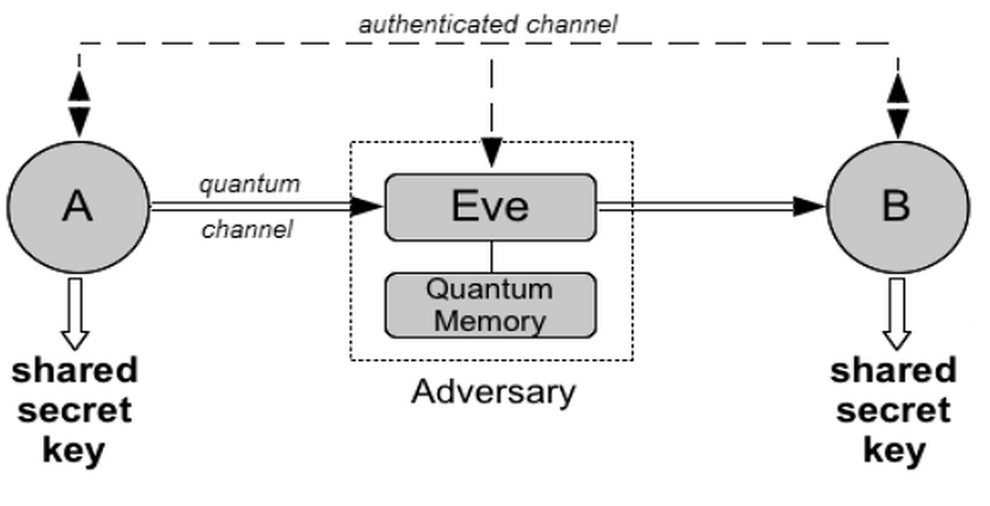
- Quantum Computers can break our modern security infrastructure.
- Much stronger encryption system is needed.

The Solution: Quantum Key Distribution



- Really small particles exhibit quantum mechanical properties like superposition and wave function collapse.
- Quantum key distribution (QKD) exploits these properties to design secret-key generation and distribution protocols.

Sturcture of a QKD protocol



- Alice(A) and Bob(B), prepare, send and measure quantum bits (qubits) through the quantum channel.
- The adversary, Eve, attacks these qubits to gain information.
- A and B can use the classical channel to detect Eve and finalize their key.

B92

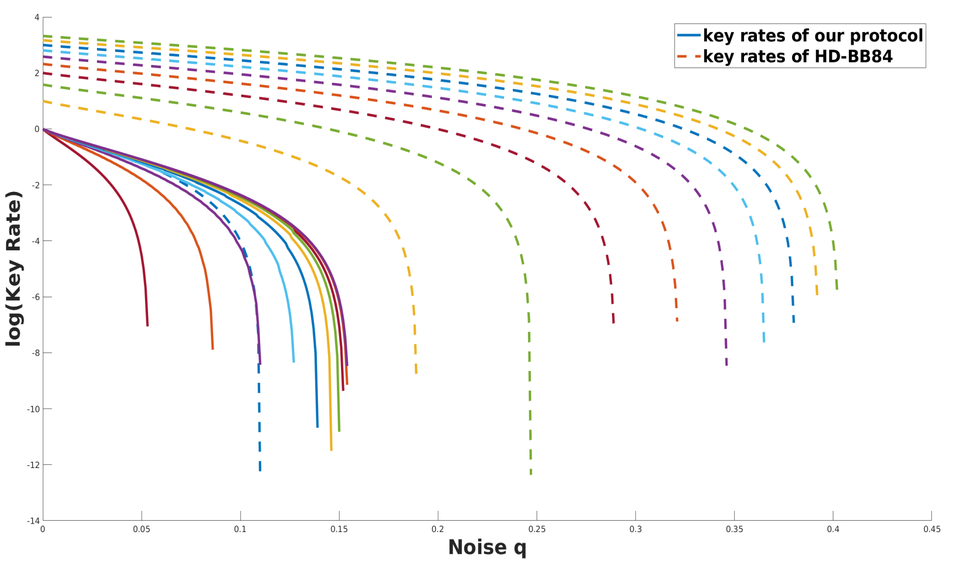
- B92 QKD protocol, one of the simplest and easiest to implement, is quite susceptible to environmental noise.
- I propose a solution to this noise sensitivity.

High-Dimensional B92

$$\begin{pmatrix} a_1 \\ a_2 \end{pmatrix} \quad vs \quad \begin{pmatrix} a_1 \\ a_2 \\ . \\ . \\ a_n \end{pmatrix}$$

- Qubits are described by two complex numbers but high-dimensional systems (qudits) need n.
- Qudits are seeing increasing interest in the community.
- I propose using qudits in a B92-variant to increase noise sensitivity and prove its unconditional security.

Result in Depolarizing Channel



- Depolarizing channel models the 'worst' that can happen to a qudit.
- My result (solid lines) shows *higher noise-tolerance than any other B92 protocol to date*.
- I also compare it with HD-BB84 protocol, which uses twice as much resources.

Result in Amplitude Damping Channel

$\|\phi\rangle = \frac{1}{\sqrt{2}}(\|i\rangle + \|j\rangle)$	key-rate
$\|i\rangle = \|0\rangle, \|j\rangle = \|1\rangle$	.9158
$\|i\rangle = \|0\rangle, \|j\rangle = \|2\rangle$	.5184
$\|i\rangle = \|1\rangle, \|j\rangle = \|3\rangle$	-.2844
$\|i\rangle = \|2\rangle, \|j\rangle = \|3\rangle$	-.4366

- Another very important quantum channel, models spontaneous emission of energy.
- This table shows that in a variant of this channel, choices of basis states affect the protocol's performance.

Contact

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