

Superdense Coding

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Recall that a quantum bit can store not more than a single classical bit.

With a little bit of help, one can get around this limitation.

We claim that if Alice and Bob share an EPR pair, then Alice can send two classical bits to Bob by sending a single quantum bit.

The Protocol (1)

Alice and Bob share an entangled pair in the state

$$2^{-1/2} (|00\rangle + |11\rangle) \quad [\text{Alice MSB, Bob LSB}]$$

If Alice want to send two bits, then she applies the following gate:

00	I	$2^{-1/2} (00\rangle + 11\rangle)$
01	X	$2^{-1/2} (01\rangle + 10\rangle)$
10	Z	$2^{-1/2} (00\rangle - 11\rangle)$
11	ZX	$2^{-1/2} (01\rangle - 10\rangle)$

The Protocol (2)

After applying her gate, Alice send her qubit to Bob.

Bob performs a Bell measurement:

