

The Quantum Teleportation Protocol

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Problem Statement

- **Alice** has one special unit of information that she wants to send to **Bob**.
- It is in a box **S** – So she can't look at it.
- The minute one opens the box, the info dissipates and is gone!
- All she can use to communicate with **Bob** is a phone line.

What can she do?

Luckily... A Secret From The Past!

- She remembers a previous pact with **Bob**:
 - To share each one of the two ends of a “secret” connection...
 - ... That noone else has access to.
- The ends of that connection consist of Boxes **A** and **B**
 - Similar to Box **S**.

So, what she does is...

... Another Connection.

- She connects Box **S** to her end – Box **A**
 - In a way similar to the way the first connection was created...
 - ... With a slight twist...
 - Simply to maintain the effectiveness of both connections – for her purpose.

How does the message gets through though?

The Measurement.

- Now, She looks inside both Boxes **S** and **A**
- And records what she sees.
- Somehow, this propagates the information from Box **S** to Box **B**
- BUT... The information becomes encoded.

Not to worry however...

The Recovery.

- Luckily again, **Bob** can recover the original information
- But only IF he knows what **Alice** saw.
- So, He awaits for a phone call from her.
- She eventually calls
 - and communicates her results to him...
- ... And now, **Bob** has the original information in his box

And everyone is happy! =D

What Just Happened.

- Box == **Quantum state**
 - Characterized by a **superposition** of states;
 - Meaning: It is in all possible states at once!
- Connection == **Quantum Entanglement**
 - Measurements on one end of an entangled state affect the outcome on the other end.
 - ==> Measurements have a global effect.
- Both ends of the connection – Boxes **A** and **B**
== a special pair of entangled states
 - Known as the **EPR pair** (Einstein, Podolsky, Rosen)

The Teleportation Protocol

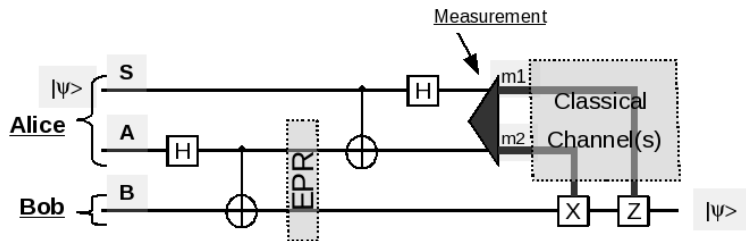


Figure: The Teleportation Protocol

Bob recovers the unit of information $|\psi\rangle$
by applying a $\sigma_x = X$ if $m_2 = 1$,
and then a $\sigma_z = Z$ if $m_1 = 1$.