

Teleport a general qubit state given by following:

$$|\alpha\rangle = a|0\rangle + b|1\rangle$$

This will be ported to some other state. let's say to γ .

We use a third qubit to enable this process. Call it β .

step by step process as per the circuit diagram.

1. Entangle the two states, having the one to be ported.

$$|\beta\gamma\rangle = \frac{|00\rangle + |11\rangle}{\sqrt{2}}$$

The matrix representation for the entangled state can be written as following:

$$|\beta\gamma\rangle = \left[\frac{1}{\sqrt{2}}, 0, 0, \frac{1}{\sqrt{2}} \right]^T$$

At this stage, we can write the combined state of all 3 qubits as a tensor product of $|\alpha\rangle$ & $|\beta\gamma\rangle$

$$|\alpha\rangle \otimes |\beta\gamma\rangle = \begin{bmatrix} a \\ b \end{bmatrix} \otimes \begin{bmatrix} \frac{1}{\sqrt{2}} \\ 0 \\ 0 \\ \frac{1}{\sqrt{2}} \end{bmatrix} = \begin{bmatrix} \frac{a}{\sqrt{2}} \\ 0 \\ 0 \\ \frac{a}{\sqrt{2}} \\ \frac{b}{\sqrt{2}} \\ 0 \\ 0 \\ \frac{b}{\sqrt{2}} \end{bmatrix}$$