Quantum Computing:
Report on Quantum Hardware

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1   Abstraction of a Quantum Computer

The quantum hardware chapter of the National Academies Report,
Quantum Computing: Progress and Prospects [1] first discusses a
big-picture view of quantum hardware.

1.1   Quantum Data Plane

This part of the quantum computer is defined as the actual qubits, circuitry
and other hardware built to contain the qubits. Systematic errors occur
between qubits and are slow to change. Thus, system calibration is possible.

1.2   Control & Host Processors

The control processor plane executes the appropriate sequence of quantum
gates. This converts compiled code to running commands.

2   Types of Qubits

Trapped ion qubits were the first type of gate-base qubits. first being
demonstrated in 1995. Laser or microwave sources are commonly used in
this type of quantum computer.
Superconducting qubits are supercooled to very low temperatures to
achieve the desired effects required for quantum computing.

3   Quantum Hardware as of 2018

Gate-base machines have an error rate below below 0.1% for gates involving
single qubits. For the situation involving many qubits, the situation is more
complicated.
Technical challenges exist related to both manufacturing and operation of
large quantum computer. Qubit quality, raw materials for the machines
and controlling the computation process are paramount.

References

[1] GRUMBLING, E., AND HOROWITZ, M., Eds. *Quantum Computing Progress and Prospects.* The National Academies Press, Washington, DC, 2019.