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To: IEEE working group on metrics and benchmarks of quantum computing
From: Scott Glancy
Applied and Computational Mathematics Division
National Institute of Standards and Technology
scott.glancy@nist.gov
https://www.nist.gov/people/scott-glancy
Re: IEEE Framework for Metrics and Benchmarks of Quantum Computing

Here are some comments on the "IEEE Framework for Metrics and Benchmarks of Quantum Computing". I am glad to see that IEEE is working to establish some metrics and benchmarks for quantum computing. It certainly is time that this developing industry will benefit from some reliable tools for evaluating and comparing quantum computing devices, and IEEE is an appropriate body for standardizing such tools. In addition, quantum computing, I also see a need for metrics and benchmarks of quantum communication devices such as quantum key distribution, randomness generation, entanglement distribution, quantum repeaters, and quantum networks. Quantum key distribution and randomness generation devices are already commercially available, and it is difficult to compare the performance (especially security) offered by these devices. However, it may be most effective to develop metrics and benchmarks for quantum communication under a different framework.

To revise the current document, I recommend adding a few quantum computational models:

- Measurement-based quantum computing: A model of quantum computing that is initialized with a large entangled state, and computation proceeds by sequentially measuring the entangled the entangled qubits to realize the desired computation. It is sometimes called "one-way" or "graph-state" quantum computing. [1,2]

- Continuous-variable quantum computing: A model of quantum computing that encodes quantum information in continuous-variable systems such as optical modes or mechanical oscillators. [3,4]

- Quantum sampling: A model of quantum computing that produces random samples from probability distributions from which is it difficult to sample classically. (For example, boson samplers). [5,6]

- Topological quantum computing: A model of quantum computing that uses topological strategies fault-tolerantly process information. [7,8,9]

One might argue that some of these models are also technically strange types of circuit quantum computing. However, they use very different strategies for encoding, processing, or protecting quantum information. In my opinion, their architectures are sufficiently different that they need specialized treatments.

I would also include "Quantum Samplers" as a separate family of devices based on functionality in Table 2:

- Quantum Samplers: A family of quantum devices that are not capable of universal quantum computation but are specialized to randomly sample from probability distributions from which sampling is classically difficult.

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