Scalable Quantum Control: Advancing Fidelity and Integration with Qblox

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Pushing quantum systems beyond their current limitations requires advancements in fidelity, scalability, and the reduction of experimental overhead. Qblox's Cluster system is designed to address these challenges with a fully integrated, time-efficient, ultra-low-noise control stack.

Thanks to its modular architecture, the Qblox Cluster can be configured to support a wide range of qubit platforms, including superconducting qubits, semiconductor spin qubits, and colour centres. For each platform, Qblox provides specialized capabilities that equip researchers to push the frontiers of quantum research and development—ultimately enabling the scalability required for future quantum technologies.

For example, in the case of superconducting qubits, Qblox offers a plug-and-play quantum control solution through its fully integrated control stack. This includes built-in phase-locked loops, system-wide synchronization, and real-time conditional feedback across all channels, enabling seamless and precise operation.

Qblox also delivers unmatched two-qubit gate fidelities, thanks to ultra-accurate, low-noise flux control that ensures consistent high-fidelity performance across both single and repeated gate operations. Additional features like fast, high-fidelity initialization with active reset, 1-ns pulse placement accuracy, and ultra-fast gate execution allow researchers to push the limits of experimental speed and precision in superconducting quantum systems.

For spin qubits, the Qblox quantum control stack empowers researchers to streamline and accelerate their experiments through a highly integrated, future-proof design. It enables a simplified experimental setup with tightly integrated hardware and offers efficient device tune-up via a dedicated spin qubit software library. Researchers can send arbitrarily long pulses with gapless playback and operate on a 1-nanosecond instruction time grid to achieve high gate fidelities. Qblox's ultra-low-noise, ground-loop-free hardware ensures optimal qubit performance—making it a robust solution for advancing semiconductor spin qubit platforms toward scalable, high-precision quantum computation.

For optically addressable qubits, the Qblox quantum control stack supports colour centre qubit tune-ups, the creation of long-distance entanglement, and the development of scalable quantum networks enabled by a fast, highly integrated control system. This includes precise AOM and EOM control, direct microwave driving, high-resolution time-tagging, and a user-friendly software interface that maintains access to low-level functions without abstraction.

We will draw upon the most recent examples and successes of our customers to drive innovation, validate our technology in real-world experiments, and accelerate the path toward scalable, fault-tolerant quantum computing across multiple qubit platforms.

References

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