KEYSIGHT

Editorial Backgrounder

Building the Foundation for Quantum

Introduction

Quantum is often seen as a disruptive technology creating opportunities to rethink innovation across industries. Yet many questions still arise around the definition of quantum computing, the problems it will solve, and what can be expected from quantum systems. As the end of Moore's Law draws near, quantum technology provides the means to achieve unprecedented computing breakthroughs. The unique properties of superposition and entanglement enable previously unimagined performance in quantum applications like computing, communications, and sensing. As quantum research enters this new phase in physics and mathematics, you can use engineering to build real systems.

Industry & Customer Challenges

1. **Performance:** Ensuring a quantum system's accurate and smooth operation requires a lot of equipment to control, calibrate, and make critical measurements. For example, quantum physicists leverage arbitrary waveform generators (AWG) and digitizers for quantum control and readout. Network analyzers are used to calibrate the cables and fiber optics. Oscilloscopes are essential for measuring signals, power supplies, and many more pieces of equipment.

2. **Scaling:** The complexity of synchronizing multiple control signals rises as the number of qubits increases. Leveraging an open field-programmable gate array (FPGA) architecture, new modular and scalable solutions provide needed flexibility and low latency.

3. **Uptime**: Uptime is a measure of system reliability, expressed as the percentage of time a quantum computer has been working and available. Increasing quantum computational reliability and uptime requires having more error-free qubits that will not fall apart due to noise. To address the reliability challenges of uptime, engineers need to diagnose and resolve issues quickly in order to focus on their scientific breakthroughs and innovations.

Keysight Solutions

Keysight addressed the quantum **performance** issue by introducing the world's first fully digital quantum control system this past summer.

In addition, quantum research customers use these products:

- Modular and AXIe-based (like M819XA) AWGs and Digitizers (M3XXXA series)
- Network Analyzers
- Infiniium and UXR Scopes
- PathWave FPGA
- Labber instrument control, measurement automation, and data storage and organization

Modularity and **scalability** issues are being handled by leveraging an open field-programmable gate array architecture that provides flexibility and low latency while optimizing cost and space. At Keysight, we design and integrate all our products to ensure manufacturing scalability and high performance.

To increase quantum computational reliability and **uptime**, customers can choose from a wide range of support agreements designed to meet their support requirements, with transparent fixed pricing for total peace of mind. Alternatively, users may customize their needs by mixing and matching various support offerings.

Key Features and Customer Benefits

1. **Performance**: Keysight's Quantum Benchmark offers an essential software layer for both makers and users of quantum computers to turbocharge the runtime performance of error-prone quantum computers. True-Q software tools deliver runtime error suppression, error-aware compilation, error diagnostics, and optimization to improve quantum hardware performance dramatically.

The software solves the mission-critical challenge of validating whether quantum hardware will execute a user-supplied algorithm to a user-specified precision, delivering quantum advantages to its users. Quantum Benchmark builds proprietary technology based on years of research by several of the world's leading experts in quantum computing.

2. **Scaling**: Keysight's quantum solutions portfolio includes a scalable, high-performance qubit control system that, when combined with Labber's software, will handle instrument control, signal generation, qubit calibration, and device testing. Together, the commercially scalable solutions ensure that customers will accurately and efficiently implement quantum algorithms on today's emerging quantum platforms.

3. **Uptime**: When you have technical challenges and are working against the clock, you need help now. KeysightCare re-engineers the service experience. Customers receive dedicated, proactive support through a single point of contact for instruments, software, and solutions. The result is faster response times, access to specialized experts, and quicker time to resolution. Additionally, Keysight provides calibration and repair services as well as education and technology refresh services.

Additional Information

Link to press relevant press releases, case studies and/or product areas on Keysight.com.

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Keysight and Singapore’s Quantum Engineering Programme to Accelerate Research, Development and Education in Quantum Technologies

Keysight.com Links:

- Emerging Technology - Quantum
- Keysight University – Quantum