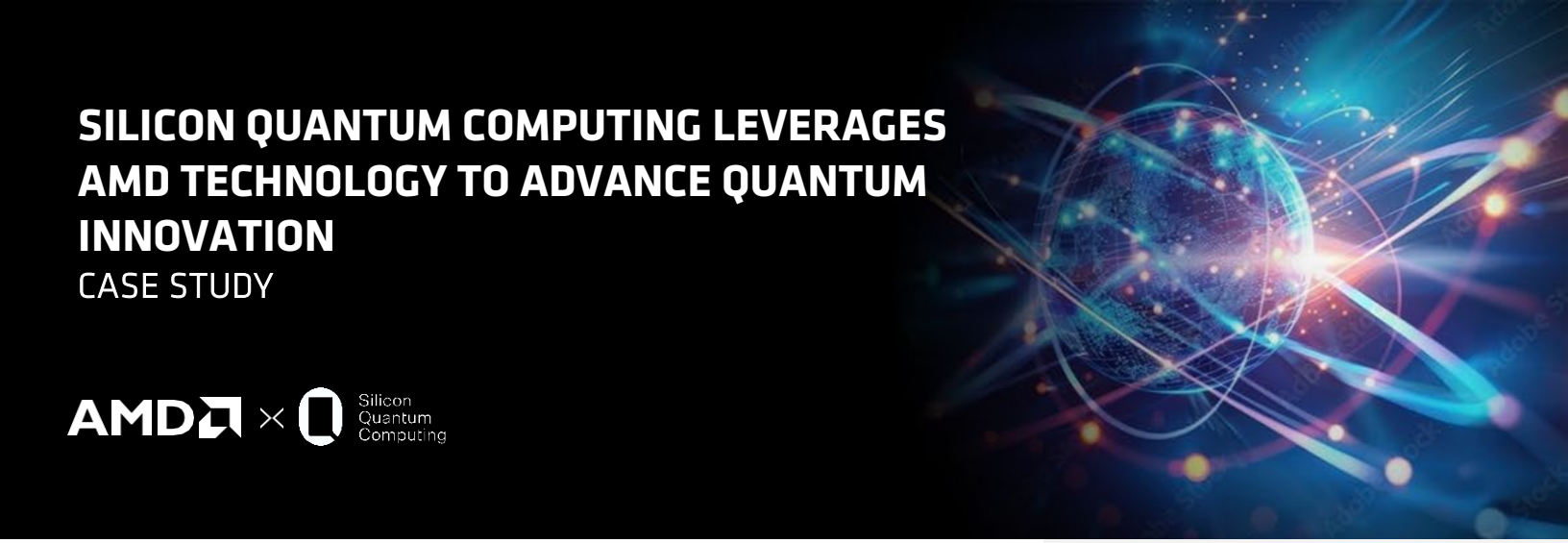
SILICON QUANTUM COMPUTING LEVERAGES AMD TECHNOLOGY TO ADVANCE QUANTUM INNOVATION

CASE STUDY



EXECUTIVE SUMMARY

Silicon Quantum Computing (SQC), headquartered in Sydney, Australia, is taking on the next big challenge in quantum computing by harnessing atomic-level precision in processor engineering. Drawing on a strong relationship with AMD, SQC has developed advanced hardware and software platforms for quantum computing.

The company's approach leverages the AMD Zynq™ UltraScale+™ RFSoC to facilitate rapid design iteration, robust deployment, and seamless integration between quantum and classical compute resources. Additionally, AMD Ryzen™ Threadripper™ processor-powered clusters handle SQC's simulation, modeling, and software preparation, extending the AMD stack from qubit control to high-throughput development workflows. SQC is focused on industries like telecommunications, finance, energy, and defense, and the company forecasts first deliveries of commercial-scale quantum computers by 2033.

"Delivering a commercial-scale quantum computer requires the world's most cutting-edge hardware and relationships with hardware providers. We are proud to be using AMD products, and we are on this journey together," said Michelle Simmons, Founder and CEO of SQC.

INTRODUCTION

SQC is a deep-tech spinout from the Australian University System and has rapidly evolved into a premier quantum technology company, supported by AU$180 million in funding. The company employs more than 100 people, including 85 engineers.

The company's core technological advantage lies in its ability to control and position individual phosphorus atoms within isotopically pure silicon with 0.13-nanometer accuracy. This atomic-level precision and attention to materials science enables SQC to deliver highly effective quantum computing systems. These innovations and capabilities have led to the development and delivery of application-specific quantum systems: "Watermelon" and "Quantum Twins," which help global enterprises take advantage of quantum machine learning and advanced molecular simulation today.

TECHNICAL CHALLENGES

At the heart of SQC's mission is the requirement for perfection in process and materials. The company orchestrates the placement and control of individual atoms within pure silicon wafers to engineer qubits, demanding high levels of engineering and material purity. Achieving and maintaining this precision and purity is central to SQC's strategy, as impurity and imperfections can introduce noise into processors.

INDUSTRY

Quantum Computing

AT A GLANCE

- SQC is driving atomic-level silicon processor manufacturing, achieving feature sizes with 0.13 nanometer precision
- AMD adaptive SoCs drive reliable, high-performance quantum solutions
- Quantum, classical, and AI systems will complement each other
- Fast hardware and firmware iteration is vital to stay ahead in a rapidly evolving field
- Strong industry collaborations, like AMD x SQC, accelerate innovation and deployment

CHALLENGES

Challenges include improving system quality as quantity increases and supporting a wide range of customers.

SOLUTION

AMD Zynq™ UltraScale+™ RFSoC and AMD Ryzen™ Threadripper™ processors, enable precise qubit control and readout.

RESULTS

With the help of AMD technology, SQC is setting new benchmarks in quantum computing through its mastery of atomic-precision engineering and comprehensive integration of hardware and software

AMD TECHNOLOGY

AMD Zynq™ UltraScale+™ RFSoC; AMD Ryzen™ Threadripper™ processors

Moreover, integrating quantum processors with classical compute resources for real-time system management, error detection, and correction introduces a layer of complexity seldom encountered in traditional computing. SQC's engineers must also contend with the relentless pace of quantum hardware advancement, designing and refining chip architectures and firmware at breakneck speed. Additionally, the company is challenged to ensure the versatility of its solutions to meet the diverse demands of sectors such as telecom, finance, energy, and government.

"We have our own manufacturing facility, allowing us to design and deliver new chips weekly. That's a huge advantage over competitors and is essential for agility as we build our commercial muscle and prepare for broad scale adoption of quantum computing," Simmons said.

SOLUTION

SQC's solution is defined by a deep integration of hardware and software, centered around a custom-developed FPGA platform built on AMD Zynq UltraScale+ RFSoC technology. This platform is tailored for precise qubit control and readout, ensuring that SQC can fully leverage the specific advantages of its silicon-based qubit architecture. By developing its own adaptive systems, SQC retains the flexibility to adapt and optimize its hardware for evolving quantum requirements.

The engineering team's expertise extends to the creation of a comprehensive in-house software stack, including custom components within the FPGA for real-time waveform generation, sequencer cores, and specialized compilers that translate high-level instructions into precise quantum operations. Programming languages such as Python, as well as multiple lower-level languages, are used to drive these processes, ensuring a continuous feedback loop between software innovation and hardware deployment. SQC's "turnkey" quantum systems, which can be deployed in customer data centers or via cloud from the company's Sydney headquarters, provide immediate access to quantum resources for enterprise customers across industries from mining to aerospace.

IMPLEMENTATION STRATEGY

SQC fabricates and tests hundreds of chip designs annually. Every week, new firmware and hardware updates are introduced, leveraging the reliability and robustness of the platform to ensure that innovation is never bottlenecked by deployment issues.

This rapid iteration cycle is further accelerated by the use of AMD Ryzen™ Threadripper™ processor-powered clusters, which handle the compute-intensive tasks of simulation, modeling, and software preparation. The result is a seamless pipeline,from atomic-scale fabrication to firmware deployment and customer delivery, with SQC retaining end-to-end oversight and the flexibility to respond instantly to new discoveries or requirements.

> **"**The flexibility of the AMD platform is unmatched. It was the obvious choice for our needs, balancing analog and digital capabilities seamlessly**." Alan Mujumdar, Lead of Hardware Team at SQC**

"By controlling every aspect—down to the analog pulses for qubit control—we maximize reliability and performance. The AMD platform lets us get instructions to the qubits at the speed quantum computing demands," Ramon Buckland, head of software, said.

Stage	Key Activities	Role of AMD Tech
Design & Simulation	Atomistic modelling ensures theoretical robustness before fabrication begins.	AMD Threadripper clusters provide the high-performance compute resources for complex simulations.
Fabrication	Atomic-scale manufacturing and strict quality control within SQC's own facility, yielding qubits with purity and precision.	AMD Zynq UltraScale+ RFSoC devices manage nanometer-precision placement and signal readout.
Integration & Testing	Firmware development, orchestration of qubit control, and rigorous benchmarking to ensure performance consistency and system reliability.	The AMD RFSoC platform orchestrates real-time quantum operations.
Deployment	Delivery of quantum systems to diverse sectors on-prem or via cloud.	Turnkey quantum solutions powered by AMD ensure fast deployment and seamless operation.

RESULTS AND IMPACT

The impact of SQC's technology is already being seen across multiple industries:

- In telecommunications, SQC quantum systems are being used to assess network health and predict outages, enhancing both reliability and customer satisfaction.
- Financial services organizations leverage SQC's hardware to sharpen anti-money laundering analysis and identify illicit accounts before they can be exploited.
- Energy utilities are integrating quantum devices to improve load balancing and anticipate demand peaks, supporting net zero targets and efficient infrastructure usage.

- Governmental sectors, meanwhile, see quantum computing as a strategic "offset technology," conferring critical advantages in security and computational capacity.

SQC's machine learning systems have delivered fast model training time, allowing businesses and datacenter operators to realize faster AI deployment and increased ROI on AI investments.

The reliability and performance of AMD platforms have proven essential. "When you receive a product from AMD, you deploy firmware and it works flawlessly," Buckland said.

"Our customers are the biggest enterprises in the world, with extensive R&D budgets and a clear focus on frontier technologies," Simmons added. "Quantum, classical, and AI systems work alongside one another. Heterogeneous computing is the future."

NEXT STEPS

Continued collaboration with AMD will be important as SQC explores next-generation adaptive compute platforms and hones the integration between quantum and classical orchestration.

"Today, we're scratching the surface of what quantum can do for technology and society. Commercial-scale quantum computing is just around the corner and I'm excited for what the future brings beyond that point," Simmons concluded.

CALL TO ACTION

To learn how AMD can help support your quantum computing needs, please visit www.amd.com/en/solutions/quantum-computing.html.

ABOUT SILICON QUANTUM COMPUTING

Silicon Quantum Computing (SQC) is at the forefront of global efforts to deliver a commercial-scale quantum system in 2033. Backed by 25 years of technological leadership, SQC holds a singular advantage: exclusive capability to manufacture silicon chips with atomic precision – enabling quantum machine learning chips and quantum computing systems with world-leading algorithmic fidelity. With in-house QPU manufacturing, SQC iterates new chips weekly while delivering quantum machine learning and simulation systems to customers today. Founded in 2017, the company is headquartered in Sydney, Australia. For more information, visit www.sqc.com.au.

ABOUT AMD

For more than 50 years AMD has driven innovation in high-performance computing, graphics, and visualization technologies. Billions of people, leading Fortune 500 businesses, and cutting-edge scientific research institutions around the world rely on AMD technology daily to improve how they live, work and play. AMD employees are focused on building leadership high-performance and adaptive products that push the boundaries of what is possible. For more information about how AMD is enabling today and inspiring tomorrow, visit the AMD (NASDAQ: AMD) website, blog, LinkedIn, and X pages.